Journal Article

Wheat production under saline irrigation practices: role of soil conditioners [1999]

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This paper deals with the wheat response to 4 levels of saline irrigation treatments and with the presence of a soil conditioner "Barbary-Plante G2 at 4 different proportions. The plant development was greater with the increase in the proportion of BP but was slowed with the concentration of the saline water. This was also reflected in the final yield where the highest Barbary-Plante Ratio produced a yield three times greater than the control treatment where no soil conditioner was present and irrigation was done using the fresh water.

SALINE WATER USE IN AGRICULTURE

Literature Search

September 2004

OVERVIEW / REVIEW LITERATURE

TI: The role of biosaline agriculture in managing freshwater shortages and improving water security.
AU: Mohammad-Al-Attar; Scanes-CG (ed.); Miranowski-JA
SO: Perspectives-in-world-food-and-agriculture-2004. 2004, 271-282; 16 ref.
PB: Iowa State Press; Ames; USA
LA: English
AB: The Near East is one of the driest areas of the world, being poorly endowed with freshwater resources. The establishment of the International Center for Biosaline Agriculture, which aims to promote the use of saline water in productive sustainable agriculture in its member countries and elsewhere, in the Near East is presented. The role of biosaline agriculture in managing freshwater shortages is discussed.PT: Book-chapter
IB: 0-8138-2021-9
AN: 20043077576

TI: The use of saline water in agriculture in the Near East and North Africa Region: present and future.
AU: Abou-Hadid-AF
SO: Journal-of-Crop-Production. 2003, 7: 1-2, 299-323; 20 ref.
LA: English
AB: Salinity is a major problem that negatively impacts agricultural activities in many regions in the world, and especially the Near East and North Africa region. Generally, salinity problems increase with increasing salt concentration in irrigation water. Crop growth reduction due to salinity is generally related to the osmotic potential of the root-zone soil solution. This will lead to certain phenological changes and substantial reduction in productivity. Salinity also affects the soil physical properties. Sewage treated waste water is an alternative water source for irrigation. Using such waste water will provide a new water resource to expand agricultural activities as well as reduce the environmental pollution. Each country in the region has a unique system of rules and regulations to protect the quality of water resources. Important aspects that should be taken into account when using waste water for irrigation are discussed, including some information on the different irrigation systems used in the region, and the factors leading to success of using saline water for economic crop production. Information on the use of saline water or marginal saline soils for wheat production and improvement of irrigation systems, including old land irrigation systems, under Egyptian conditions is also presented. The regional experiences and the future prospects of using saline water for crop production that vary greatly among countries in the Near East and North Africa region are summarized. This article also presents information on special cultivation methods, such as protected agriculture and soilless culture that can help in alleviating the salinity effects. Finally, the article includes some examples on the inherited knowledge for saline agriculture that conveys the grower's experience in the Near East and North Africa region where several living examples for unique and sustainable cultivation system are still in operation. One of the most impressive cultivation techniques for bio-saline crop management in Egypt is the Edkawy production system.

TI: Prospects-for-saline-agriculture. 2002, xvii + 460 pp.; many ref.
AU: Ahmad-R; Malik-KA; Ahmad-R (ed.); Malik-KA
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: This book contains 47 papers discussing some practical approaches (e.g. biotechnology) for saline agriculture and afforestation, and describes examples of cultivating salt tolerant/halophytic plants (viz., wheat, rice, millet, halophytes and mangroves) for commercial interest on salt-affected land or with highly salinized water in Australia, Central Asia, Egypt, Pakistan and Russia. The possibilities of arid/saline agriculture and afforestation in the United Arab Emirates are also discussed.

TI: Irrigation management under water scarcity.
AU: Pereira-LS; Oweis-T; Zairi-A
SO: Agricultural-Water-Management. 2002, 57: 3, 175-206; many ref.
LA: English
AB: The use of water for agricultural production in water scarcity regions requires innovative and sustainable research, and an appropriate transfer of technologies. This paper discusses some of these aspects, mainly relative

to on-farm irrigation management including the use of treated waste water and saline waters. First, the paper proposes some concepts relative to water scarcity, concerning aridity, drought, desertification and water shortage, as well as policies to cope with these water stressed regimes. Conceptual approaches on irrigation performances, water use and water savings are reviewed in a wide perspective. This is followed by a discussion of supply management to cope with water scarcity, giving particular attention to the use of waste water and low-quality waters, including the respective impacts on health and the environment as water scarcity is requiring that waters of inferior quality be increasingly used for irrigation. The paper then focuses on demand management, starting with aspects relating to the improvement of irrigation methods and the respective performances, mainly the distribution uniformity as a fundamental tool to reduce the demand for water at the farm level, and to control the negative environmental impacts of over-irrigation, including salt stressed areas. Discussions are supported by recent research results. The suitability of irrigation methods for using treated waste waters and saline waters is analysed. Supplemental irrigation and deficit irrigation strategies are also discussed, including limitations on the applicability of related practices. The paper also identifies the need to adopt emerging technologies for water management as well as to develop appropriate methodologies for the analysis of social, economic, and environmental benefits of improved irrigation management.

TI: Saline irrigation assessment and management for sustainable use.
AU: Hamdy-A; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 3-69.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: The paper is focused on issues related to management, environment and health that should be addressed when reusing poor quality waters. Crop-water-yield relations are discussed with particular relation to salinity impact. The exact effects of salinity, toxicity of certain ions, and nutritional imbalance are not explicitly accounted for in crop-water production functions. There is a need for more investigation on how plants respond to the temporal and spatial variation in water and salinity stress in order to obtain more realistic crop water production functions. Guidelines on the suitability of saline water for irrigation are discussed that account for the varying sensitivity of plants at different growth stages to the salinity of water. The factors considered include: plant tolerance, irrigation system, irrigation frequency, soil type, soil physical condition, tillage and seed bed preparation. Blending different salinity waters is a questionable practice. Examples on the reuse of drainage water in a cyclic management strategy for field crops and agroforestry are explained. The results in terms of environmental protection are encouraging. New, improved techniques to assess health risks associated with trace contaminants, microbiological quality, fate of microbiological, chemical and organic contaminants are necessary to improve safety standards.

TI: Sustainable use of salt tolerant plants.
OT: Nachhaltige Nutzung salztoleranter Pflanzen.
AU: Huchzermeyer-B; Heins-T; Kamphues-J (ed.); Flachowsky-G
SO: Animal nutrition - resources and future developments. Workshop on Sustainable Animal Production, 15-16 June 2000, EXPO 2000, Hannover, Germany. Landbauforschung-Volkenrode,-Sonderheft. 2001, No. 223, 391-397; 10 ref.
LA: German
LS: English
AB: The development of mankind has reached the point that new resources need to be trapped in order to fill our basic needs for food, feed and freshwater. It is foreseeable that freshwater resources will become limited, and that currently used agricultural irrigation systems will steadily increase soil salinity in the near future. To date, 30% of the farmland under irrigation cannot be used any more for efficient crop framing due to salt contamination. It is one goal of the scientific community, therefore, to develop sustainable production systems to supply animal and men with food and drinking water. The EU-Concerted-Action, "Sustainable Use of Halophytes" has the objectives to (i) demonstrate the feasibility of brackish water or even seawater irrigated ecosystems for landscape management, agriculture, horticulture, greenification of housing areas, wasteland and roadsides, roof

greenification and sand dune stabilization; (ii) inform potential users as well as the general public through seminars, congresses, exhibits in fairs, and by building demonstration sites at different locations in the Mediterranean and subtropical dry regions; (iii) perform physiological, biochemical and molecular genetically experiments with potential cash crop halophytes in order to identify relevant parameters and to provide data for future breeding projects. This contribution aims at providing early information with respect to the use of halophytes and their by-products as fodder for the animal production in arid areas.
PT: Journal-article; Conference-paper

TI: Use of marginal water: management and practices.
AU: Tekinel-O; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 71-105; 79 ref.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: The paper gives an overview of the use of marginal water resources for agriculture and suggests that precision farming components should be used for monitoring the outcomes. Further saline and wastewater resources are used for irrigation, and special care should be taken since they can have various negative effects on the soil, groundwater, environment and human health. To minimize these effects, various management techniques have been successfully developed. It is important to monitor use of marginal water resources, so that their effects on soil, groundwater, environment and health can be determined. New technologies such as geographic management systems, global positioning system and remote sensing are valuable improvements for monitoring.

TI: Towards sustainable use of deserts.
AU: Farshad-A; Erian-WF; Zarei-Abarghuei-SH; Shrestha-DP
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002.
2002, 683; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033090

TI: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999.
SO: 1999, 480 pp.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: Papers presented at the above conference deal with a wide range of topics on irrigation management under saline conditions including: the use of saline irrigation water; socioeconomic aspects of irrigation management; plant response to salinity;and the management of saline soils.

TI: Use of low quality water for irrigation: major challenges.
AU: Hamdy-A; Hamdy-A (ed.); Leith-H (ed.); Todorovic-M (ed.); Moschenko-M
SO: Halophyte uses in different climates. II. Halophyte crop development: Pilot studies. Proceedings of the 3rd seminar of the EU Concerted Action Group IC 18CT 96-0055 Florence, Italy, 20 July 1998. 1999, 1-18; Progress in Biometeorology, Volume 14; 3 pp. of ref.
PB: Backhuys Publishers; Leiden; Netherlands
LA: English
AB: The future of irrigated agriculture poses the need to develop irrigation strategies using poorer quality water to fulfil the food and fibre production gap, in order to ensure long-term sustainability in irrigated agriculture. Recent technologies developed focusing on the proper management and practicability approaches on the use of saline water for irrigation are reviewed, highlighting the strategies that facilitate the use of poor quality irrigation

waters, while, at the same time, minimizing the adverse impacts on soil productivity, crop production and the environment. There is usually no single way to practise and manage poor quality water for irrigation without long-term consequences to crop, soil and environment. Many different approaches and practices may be integrated and combined into a satisfactory control system. The proposed strategies for the use of poor quality water, although being too simplistic from the perspectives of economics, the management capabilities of farmers and the limitation of infrastructure which delivers irrigation water, are important to foster irrigation sustainability and limit environmental impacts. Without a comprehensive and long-term strategy adaptable to the prevailing economic, climatic, social, as well as edaphic and hydrogeological conditions, it is not considered possible to meet the future challenges of irrigated agriculture using poor quality water.

TI: Irrigating crops with seawater.
AU: Glenn-EP; Brown-JJ; O'-Leary-JW
SO: Scientific-American. 1998, 279: 2, 56-61.
LA: English
AB: This article discusses the potential of seawater as a source of irrigation water in countries where demands on existing water supplies will be exceeded. Seawater agriculture is defined as growing salt-tolerant crops on land using water pumped from the ocean for irrigation. The system works well in the sandy soils of desert areas. Research into identifying suitable crop species has focused either on breeding salt tolerance into conventional crops or the domestication of wild salt-tolerant plants: halophytes. Trials of test species showed yields as varying among these species, with some equalling the biomass production of lucerne irrigated with freshwater. The more productive species were Salicornia, Suaeda and Atriplex (family: Chenopodiaceae). Other high producers were Distichlis (salt grass -Poaceae), and Batis (Batidaceae). Goats and sheep fed a diet where hay was replaced with Salicornia, Suaeda and Atriplex gained as much weight as when hay was used. The animals meat was unaffected by the halophyte rich diet. The feed conversion ratio was 10% lower than that of animals eating a traditional diet. Salicornia bigelovii was shown to be a promising species as it colonizes through prolific production of seed composed of 30% oil (similar to safflower oil), 35% protein, and less than 3% salt. However, the presence of saponins restricted the use of seed-meal, remaining after oil extraction, to levels similar to a protein supplement in livestock feed. Seed yields could exceed yields of soyabeans etc. grown using conventional irrigation. Greater volumes of seawater irrigation are required by these plants as compared to volumes of freshwater used in with conventional crops. Seawater agriculture is discussed in terms of economics of harvesting the crops and also in terms of sustainability of such systems.
PT: Journal-article

TI: Use of poor quality water for irrigation.
AU: Vaishnava-VG; Shelke-DK; Salokhe-VM (ed.); Jianxia-Z
SO: Proceedings of the International Agricultural Engineering Conference, Bangkok, Thailand, December 7-10, 1998. 1998, 826-835.
PB: Asian Institute of Technology; Bangkok; Thailand
LA: English

TI: Irrigation with saline water: benefits and environmental impact.
AU: Beltran-JM; Olalla-Manas-FM-de-S (ed.); Fabeiro-C
SO: Special Issue: The use of water in sustainable agriculture. Selected papers presented at a workshop in Albacete, Spain, 2-4 June 1997. Agricultural-Water-Management. 1999, 40: 2-3, 183-194; 13 ref.
LA: English
AB: Guidelines for a preliminary evaluation of the suitability of water for irrigation are described and the key factors for salinity control in lands irrigated with saline water presented. Options to improve the quality of the drainage water, strategies for the reuse of this water and alternatives for disposal of the outflow are analysed in an effort to obtain sustainable agriculture and maintain the quality of the water resources in the river basin.

TI: The use of saline/brackish water for irrigation: possibilities and constraints.
AU: Ragab-R; Ragab-R (ed.); Pearce-G

SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 12-41; 49 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: The paper considers the issues relating to management, environment and health, that need to be addressed when reusing poor quality waters. It argues that the exact effect of salinity, toxicity of certain ions and nutritional imbalance are not explicitly accounted for in the crop water production functions. It calls for more investigation on how plants respond to temporal and spatial variations in water and salinity stress so that more realistic crop water production functions are available.

TI: Use of saline and brackish waters for irrigation: implications and role in increasing food production, conserving water, sustaining irrigation and controlling soil and water degradation.
AU: Rhoades-JD; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 261-304; 128 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Present-day irrigation management practices have resulted in substantial degradation to the worlds irrigated land and associated water resources by salinization and waterlogging. A holistic management approach is described, which includes the interception, isolation and reuse of saline drainage water for irrigation. This is described in the paper in terms of increasing crop production, conserving water, minimizing drainage and controlling soil and water degradation. Various alternative strategies of reuse are discussed. The potential loss of consumable water in the "blending" strategy is highlighted.

TI: Use and management of saline water for irrigation towards sustainable development.
AU: Hamdy-A; Pereira-LS (ed.); Feddes-RA (ed.); Gilley-JR (ed.); Lesaffre-B
SO: Sustainability of irrigated agriculture. Proceedings of the NATO Advanced Research Workshop, Vimeiro, Portugal, 21-26 March, 1994. 1996, 359-372; 53 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The quantity of good quality water supplies available to agriculture is decreasing, thus requiring the use of marginal quality waters. The options and main guidelines for the sustainable utilization of low quality water, particularly saline water, are discussed. Factors to be considered in assessing the suitability of water for irrigation are cropping system, prevention of salt accumulation in the soil, and the use of advanced irrigation and drainage technology. Management practice for irrigation using saline water must prevent excessive salt and sodicity building up. There are three general management strategies: controlling salinity within permissible levels; changing conditions to improve crop response; and changing management to maintain yields at the field level when salinity causes damage at the plant level. Irrigation practices which are important in the management of saline water are discussed: irrigation scheduling; leaching scheduling; and management of multi-source irrigation water of different qualities.
PT: Conference-paper

TI: Using water of marginal quality for crop production: major issues.
AU: Shalhevet-J
SO: Agricultural-Water-Management. 1994, 25: 3, 233-269; 86 ref.
LA: English
AB: The use of saline water for irrigation is reviewed. Most data concerning the effects of soil salinity on crop yield were obtained by adding salt uniformly to established crops. Most crops are more sensitive to the effects of salinity during the seedling stage. Mean salinity in the root zone provides the best estimate of effective salinity when salts are non-uniformly distributed. Differences in salt tolerance occur between varieties of fruit trees, but

differences among field and garden crops are uncommon and usually small. Crop water use efficiencies are not influenced by soil salinity. Soil fertility has no bearing on salt-tolerance. Plant response to N and K fertilizer is unaffected by saline conditions, but excessive P applications may be toxic at high salinity levels. Drip irrigation gives the best results when saline water is used, as sprinkler irrigation can cause leaf burn. Soil hydraulic conductivities are greatly reduced by high sodium adsorption ratios. Leaching salt from the soil is essential for the use of saline water for irrigation.
PT: Journal-article

TI: Agriculture in dry lands: principles and practice
AU: Arnon,-I.
SO: Developments-in-Agricultural-and-Managed-Forest-Ecology (Netherlands).
1992, no. 26, 991 p., figs, photos, tables; bibliography (vp.); indexes
LA: English
AB: An up-to-date, comprehensive and yet concise, review of present knowledge on agriculture of the world's drylands is provided. Described are (1) the environment and natural resources of dry areas; (2) the reaction of crops to moisture stress; (3) land use and farming systems; (4) soil fertility and crop management, methods of irrigation, effects of salinity on crops, irrigating with brackishwater and seawater and quality criteria of irrigation water, including evolution of tillage methods and crop sequences and associations; and (5) crop protection measures, including weed and insect control, and plant diseases in arid environments.

TI: Saline agriculture: salt-tolerant plants for developing countries
AD: Board on Science and Technology for International Development (BOSTID), National Research Council, Washington, D.C., USA
SO: Washington, D.C. (USA), National Academy Press, 1990, 150 p., figs, photos, tables; bibliography (vp.)
LA: English
AB: Some of the experiences and opportunities in the agricultural use of saline water, seawater and salinized farmland are reported. The maximum amount and kind of salt that can be tolerated by halophytes and other salt-tolerant plants varies among species and even varieties of species and growth stages. This report examines a large number of plants (food crops, fuel plants, forage crops and plants that produce other useful products) that may be suitable for economic production, including Kochia spp., samphire (Halosarcia spp.), mesquite, Acacia spp., saltbush (Atriplex spp.), blue bush (Maireana spp), Tamarix spp. An extensive list of recent papers that contain additional information as well as a list of researchers currently working on these plants are included.

TI: Biosalinity in action: bioproduction with saline water
AU: Pasternak,-D. (ed.); San-Pietro,-A. (ed.)
AD: Institutes for Applied Research, Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel
SO: Plant-and-Soil (Netherlands).
1985, v. 89(1-3) 386 p., figs, photos, tables; bibliography (vp.); summaries (En)
LA: English
AB: This volume contains proceedings of the 3rd workshop on biosaline research held in Israel, in 1984. It is divided into 5 sections. The 1st presents the current state of knowledge on the mechanisms of salt tolerance in algae and terrestrial plants. The 2nd provides up-to-date information on production and utilization of algae as sources of both foods and valuable chemicals. The 3rd deals with crop production by irrigation with brackish water (water containing 500-5000 ppm dissolved salts). The 4th presents research currently being pursued at 2 centres in the U.S. and 1 in Israel, on irrigation of halophytic with sea water. Intensive production of fish with seawater is the subject of the 5th section.

TI: Seawater irrigation successful
AU: Kini,-D.; Rahman,-H.
AD: Faculty of Agriculture, University of Riyadh, Riyadh, Saudi Arabia
SO: Saudi-Business (Saudi Arabia).
1983, v. 6(47) p. 22-25, 27, 29-30; Mar, photos, (some in colour), table
LA: English

AB: Various aspects of using salt-water, including irrigation techniques in agricultural production are discussed. Preliminary research results showed the possibility of using saline water with a concentration of up to 16 000 ppm with only some reduction in both growth and yield of plants. Moreover, both irrigation method and technique of water application greatly influenced plant tolerance to high salinity. Collections comprising 6061 wheat, 1412 barley and 144 millet varieties, collected from 30 different countries, were kept in a germplasm bank. Out of these, 5% of wheat and barley varieties were identified as tolerant of 16 000 ppm salt as compared with normal varieties tolerating only a maximum of 4500 ppm salt. Future research activities are discussed.

TI: Production of food plants in areas supplied with highly saline water: problems and prospects.
AU: Somers-GF; Mussell-H (ed.); Staples-RC (ed.)
SO: Stress-Physiology-in-crop-plants. 1979, 107-125; 85 ref.
PB: John Wiley & Sons.; New York; USA
LA: English
AB: Research on growing crops (wheat, rice, sorghum, barley, maize, cotton, mung bean, Pennisetum typhoides, Rhodes grass, safflower) in saline conditions and the use of halophytes as crops and fodder sources is reviewed. Potential halophytes include Spartina alterniflora, S. patens and Distichlis spicata for fodder and Atriplex patula, Chenopodium album and Kosteletzkya virginica for human consumption.
PT: Miscellaneous

GENERAL & MISCELLANEOUS ISSUES IN SALINE AGRICULTURE

TI: Improving crop salt tolerance.
AU: Flowers-TJ; White-PJ (ed.); Broadley-MR
SO: Genetics of plant mineral nutrition. Society of Experimental Biology Annual Meeting, Southampton, UK, 31 March to 4 April 2003. Journal-of-Experimental-Botany. 2004, 55: 396, 307-319; many ref.
LA: English
AB: Salinity is an ever-present threat to crop yields, especially in countries where irrigation is an essential aid to agriculture. Although the tolerance of saline conditions by plants is variable, crop species are generally intolerant of one-third of the concentration of salts found in seawater. Attempts to improve the salt tolerance of crops through conventional breeding programmes have met with very limited success, due to the complexity of the trait: salt tolerance is complex genetically and physiologically. Tolerance often shows the characteristics of a multigenic trait, with quantitative trait loci (QTLs) associated with tolerance identified in barley, citrus, rice, and tomato and with ion transport under saline conditions in barley, citrus and rice. Physiologically salt tolerance is also complex, with halophytes and less tolerant plants showing a wide range of adaptations. Attempts to enhance tolerance have involved conventional breeding programmes, the use of in vitro selection, pooling physiological traits, interspecific hybridization, using halophytes as alternative crops, the use of marker-aided selection, and the use of transgenic plants. It is surprising that, in spite of the complexity of salt tolerance, there are commonly claims in the literature that the transfer of a single or a few genes can increase the tolerance of plants to saline conditions. Evaluation of such claims reveals that, of the 68 papers produced between 1993 and early 2003, only 19 report quantitative estimates of plant growth. Of these, four papers contain quantitative data on the response of transformants and wild-type of six species without and with salinity applied in an appropriate manner. About half of all the papers report data on experiments conducted under conditions where there is little or no transpiration: such experiments may provide insights into components of tolerance, but are not grounds for claims of enhanced tolerance at the whole plant level. Whether enhanced tolerance, where properly established, is due to the chance alteration of a factor that is limiting in a complex chain or an effect on signalling remains to be elucidated. After ten years of research using transgenic plants to alter salt tolerance, the value of this approach has yet to be established in the field.
PT: Journal-article; Conference-paper

TI: Saline irrigation: assessment and management techniques.
AU: Hamdy-A; Choukr-Allah-R (ed.); Malcolm-CV (ed.); Hamdy-A
SO: Halophytes-and-biosaline-agriculture. 1995, 147-179; 85 ref.
PB: Marcel Dekker Inc.; New York; USA

LA: English
AB: The use of saline water as irrigation water was discussed in relation to the degradation of irrigated lands; assessing the suitability of saline water in irrigation; improvement of water quality for irrigation; use of good and poor quality water in various mixtures; methods of water application; saline agriculture management practices; irrigation practices and management; leaching management for salinity control; drainage for salinity control; and crop management.
PT: Miscellaneous

TI: Influence of saline water irrigation on microorganisms content in the soil.
AU: Wronkowska-H; Karczmarczyk-S; Rumasz-E
SO: Folia-Universitatis-Agriculturae-Stetinensis,-Agricultura. 1999, No. 73, 213-216; 9 ref.
LA: English
LS: Polish
AB: The effect of two years of saline water irrigation of celery and beetroot on the microorganisms in a sandy soil was studied. No negative effects on the number of soil fungi, actinomycetes or bacteria were observed. Halophyte- and halo-tolerant bacteria were 23% more numerous in soil watered with saline water than in non-watered or tap water irrigated soil.

TI: Long term effect of using saline water on soil salinity and sodicity.
AU: Feizi-M; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 89-95; 9 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: The effects of irrigation with water quality of 2, 5 and 8 dS/m on the ECc and ESP of the soil were studied on wheat and sugarbeet crops, with four replications, over 5 years. The results showed that as irrigation water salinity (ECi) increased, the soil salinity (ECc) and exchangeable sodium percentage (ESP) also increased. The ECc of 0-60 cm soil depth was 6.9 dS/m after 5 years irrigation with ECi=1.8 dS/m water. The ECe for water 4.9 and 8.2 dS/m was 8.2 and 10.6 dS/m respectively. ESP reached 21, 24 and 33.5 respectively.

TI: Strategies to minimize adverse environmental impacts of saline water use in agriculture.
AU: Kandiah-A; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 305-315; 18 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Most research is directed toward mitigating farm-level impacts, but inputs and outputs at the farm-level could affect neighbouring lands, other water users and the ecology of the receiving waters. This implies that both environmental and economic impacts of saline water use will have to be evaluated at all levels (i.e. on-farm, off-farm (downstream) and basin levels) before introducing saline water use in irrigation projects. In this paper, a brief discussion on the environmental effects of saline water use and measures to mitigate such effects at the three levels, are presented. Controlled reuse of saline drainage water, where appropriate, is environmentally sound; but in practice inappropriate uses have resulted in serious agricultural and environmental problems. An integrated approach is needed that utilises: (i) sustainable saline irrigation, (ii) reduction of saline sources by efficient water use at farm-level, (iii) reduction of drainage volume (by capture and reuse), (iv) removal of specific toxins (e.g. selenium), and (v) safe disposal of final, unusable volume.

TI: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003.
AU: Pardossi-A (ed.); Serra-G (ed.); Tognoni-F

SO: Acta-Horticulturae. 2003, No.609, 502 pp.
LA: English
AB: These proceedings contain 77 papers presented at the conference on crop response to salinity. Subjects covered include: salt tolerance in roses; effect of salinity on strawberry growth, photosynthesis, ionic contents and yield; effect of electrical conductivity levels of nutrient solution on growth, gas exchange and yield; managing greenhouse-grown peppers in a saline environment; vegetable production in greenhouse using brackish water; effect of potassium nutrition on the yield and quality of tomato plants grown with nutrient film technique under sodium chloride saline conditions; water and nutrient use efficiency of soilless culture; effect of different soilless culture systems on production and quality of melons grown under protected cultivation; and seed germination and stand establishment of vegetable crops in different substrates.

TI: Microeconomics of irrigation with saline water.
AU: Kan-I; Schwabe-KA; Knapp-KC
SO: Journal-of-Agricultural-and-Resource-Economics. 2002, 27: 1, 16-39; 44 ref.
LA: English
AB: Water management and reuse at the field level are analysed under saline, limited drainage conditions. A function relating crop yield and deep percolation flows to applied water and salinity concentration is developed. This function fits simulated data well and is tractable for theoretical and empirical analysis of irrigation economics. With a single irrigation source, irrigation water for cotton and tomatoes at first increases and then decreases with salt concentration. Drain-water reuse is found to be an efficient strategy in events of high surface-water prices and costly solutions to drainage-related environmental problems. However, blending freshwater and drainage appears plausible only under surface water scarcity.

TI: A simple method for determining the suitability of brackish groundwaters for irrigation.
AU: Younger-P; Casey-V
SO: Waterlines. 2003, 22: 2, 11-13.
LA: English
AB: The two most important water quality parameters for irrigation are specific electrical conductance (conductivity) and sodium adsorption ratio (SAR). The high cost of SAR determination means that many irrigation schemes are developed without proper steps being taken to determine the salinity and sodium hazards at a given site. Thus, this paper presents a simple and low-cost alternative technique to determine conductivity and SAR at frequent intervals. The accuracy and flexibility of the new method were tested in Jericho district on the West Bank of the Jordan rift valley in Palestine. A tabulated list of the portable equipment for low-cost SAR determination is given. The empirical determination of sodium concentration and the features of the SAR card are discussed. The low -cost method showed accurate results for groundwaters with low to medium conductivities (up to 3000micronS/cm). This method can be widely applied to areas where there is a need to constantly monitor irrigation water quality to
avert soil damage.

TI: Recycling of saline drainage water - simulation study on alternate use with fresh surface water.
AU: Kumar-S; Jhorar-RK
SO: Role of drainage and challenges in 21st century. Vol. III. Proceedings of the Eighth ICID International Drainage Workshop, New Delhi, India, 31 January-4 February 2000. 2000, 301-316; 21 ref.
PB: International Commission on Irrigation and Drainage; New Delhi; India
LA: English
AB: An appropriate strategy for using saline water on a sustainable basis has been developed using an analysis of the expected salt and water balance. Physically based computer models are being increasingly used for simulating the water and salt balance dynamically. An agro-hydrological model was validated for local conditions. Experimental trials on tile drain systems at 2.7 m depth and 24 m spacings were conducted. Simulations were carried out for a 10 year period. Various water management response indicators were used to interpret the impact of both the medium (initial 4 years experimental) and long-term (next 10 years simulated) conjunctive use of such saline waters on soil environment and crop production.
PT: Conference-paper

TI: Phytotoxic effects of salinity, imazethapyr, and chlorimuron on selected weed species.
AU: Papiernik-SK; Grieve-CM; Yates-SR; Lesch-SM
SO: Weed-Science. 2003, 51: 4, 610-617; 36 ref.
LA: English
AB: Greenhouse experiments were conducted to determine the effect of salinity, imazethapyr, and chlorimuron on weed growth. Five species, barnyardgrass, common cocklebur, ivyleaf morningglory, common purslane, and yellow nutsedge, were grown in potting soil and irrigated with nonsaline (EC _2 dS m-1) or sulfate-dominated saline (EC _7 dS m-1) nutrient solution. Plants were treated after emergence with imazethapyr (Pursuit formulation) at 70 g ae ha-1 or chlorimuron ethyl (Classic formulation) at 8.8 g ai ha-1. Results indicated that irrigation with saline water had no overall effect on the growth or survival of most tested weed species. Growth of yellow nutsedge (maximum height and stem diameter) was reduced for plants irrigated with saline water. Observed growth and survival trends in saline and nonsaline treatments were consistent with information on the herbicide label. Complete control of common purslane was not achieved by either chlorimuron or imazethapyr. Growth and survival of ivyleaf morningglory and yellow nutsedge were greater when plants were treated with imazethapyr than when treated with chlorimuron, whereas for barnyardgrass, growth and survival were significantly greater when plants were treated with chlorimuron. Both herbicides affected common cocklebur growth and survival in a similar way. For all tested species, most surviving plants were not vigorous and would not be highly competitive with crop plants. The results of these experiments suggest that weed control information mentioned on the labels for these herbicide formulations will not require modification for moderately saline soils.

TI: Sodicity and water quality effects on slaking of aggregates from semi-arid soils.
AU: Levy-GJ; Mamedov-AI; Goldstein-D
SO: Soil-Science. 2003, 168: 8, 552-562; 46 ref.
LA: English
AB: Aggregate slaking is one of the main mechanisms responsible for the breakdown of aggregates. Exchangeable sodium percentage (ESP) and electrolyte concentration (C) of the soil solution play a significant role in determining soil physical properties and the response of soil clays to dispersion and swelling. However, studies of sodicity and C effects on aggregate stability have yielded inconsistent results. Our objective was to evaluate the effects of sodicity and C on aggregate slaking in soils with different clay contents. Using the high-energy-moisture-characteristics (HEMC) method, we studied aggregate slaking in 56 samples of Israeli topsoils varying in clay content (80-675 g kg-1) and ESP levels (0-30). In this method, accurately controlled wetting of the aggregates (i.e., the driving force for slaking) was the only force exerted on the aggregates. Aggregates (0.5-1.0 mm) were placed in a funnel equipped with a fritted disk and, using a peristaltic pump, were wetted either fast (100 mm h-1) or slowly (2 mm h-1). Two salinity levels were studied: dionized water (DW, C=0.04 mmolc L-1) and saline water (SW, C=20 mmolc L-1). Thereafter, the aggregates were subjected to stepwise increases in matric potential up to 5.0 J kg-1 to obtain a moisture retention curve that served as the base for calculation of aggregate susceptibility to slaking. The latter was expressed in terms of stability ratio (SR). The SR of low ESP soils increased from 0.298 to 0.751 and from 0.508 to 0.799 for DW and SW, respectively, with the increase in soil clay content from 11.3 to 67.4%. Increase in ESP decreased SR (i.e., enhanced aggregate slaking), whereas use of SW increased SR compared with DW. A triple interaction among ESP, C, and clay content (P=0.001) in their effect on aggregate slaking suggested that the combined effects of these variables on slaking were complex. Our results suggested that: (i) in soils having inherently low aggregate stability (clay < 25%) use of SW was effective in decreasing aggregate slaking at ESP_5, and (ii) for inherently stable soils (clay > 35%), aggregate slaking decreased upon use of SW only when ESP > 15.

TI: A decision support system as a tool to optimal water management in soilless cultures under saline conditions.
AU: Ferentinos-KP; Anastasiou-A; Pasgianos-GD; Arvanitis-KG; Sigrimis-N; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 289-296; 5 ref.
LA: English

AB: An important factor for the optimal operation of commercial hydroponic systems is the appropriate management of the available water sources, especially under saline conditions. In this paper, the main properties of a decision support system for the optimal water management of hydroponics are presented. The system consists of two parts: off-line and on-line. The on-line system, still under development, implements best management based on real present conditions. The off-line part takes as inputs weather, greenhouse equipment, crop production and salinity tolerance data and water sources available, including their cost, and then establishes the optimal water management. The estimated output is used by the grower to make his decisions about required investments. The grower can replay various scenarios until he reaches a decision about the water sources to implement for his own targets. The outputs are also fed into the on-line system as a guide to real-time optimal predictive management of water and nutrients supply to the crop.

TI: Salt accumulation and distribution in a greenhouse soil as affected by salinity of irrigation water and leaching management.
OT: Acumulo e distribuicao de sais no solo em um ambiente protegido em funcao da salinidade da agua de irrigacao e manejo da lixiviacao.
AU: Blanco-FF; Folegatti-MV
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 2002, 6: 3, 414-419; 23 ref.
LA: Portuguese
LS: English
AB: The effects of irrigation water salinity, leaching fraction and its frequency of application on soil salinization were studied. Three water salinities (S1=1.54, S2=3.10 and S3=5.20 dS m-1) and two irrigation water depths associated with their application frequencies (W1=1.00 ETc; W2F1=1.25 ETc in all irrigations and W2F2=1.25 ETc when the irrigation water depth of W1 reached 100 mm where ETc is the crop evapotranspiration), were applied during the growing period of a grafted-cucumber crop in a greenhouse. The experimental design consisted of randomized blocks of 3 x 3 factorial scheme with 3 replications. Soil salinity at 0.1, 0.3 and 0.5 m depths increased linearly with salinity levels of water and the leaching fraction did not have any effect regardless of its management. Salt concentration was higher near the soil surface and between the adjacent drippers.

TI: Quality of irrigation waters and toxic ions.
AU: Gupta-IC
SO: Current-Agriculture. 2002, 26: 1-2, 1-13; 49 ref.
LA: English
AB: The quality of irrigation waters has been evaluated conventionally on the basis of salinity, sodium, alkalinity and toxic elements. Boron, lithium and fluorine, some of the toxic elements tending to occur more so in saline waters, in critical concentrations, have received more attention. Boron could occur in soils and waters upto 10.0 mg litre-1 but only 1% waters contained more than 5.0 mg litre-1. Due to adsorption of boron in clay particles, the waters containing 10.0 mg litre-1 could be used successfully in heavy textured soils whereas this limit reduced to 5.0 mg litre-1 in coarse textured soils. The suppressive effect of boron is more accentuated in high salinity conditions. Boron can be leached out from saline soils and could be detoxicated with the use of gypsum in sodic soils. Lithium occurred in concentration of 2 mg litre-1 in saline groundwaters. Whereas seedling growth of tolerant crops like wheat and barley was not affected up to 20.0 mg litre-1, sensitive gram seedlings were affected at 5.0 mg litre-1. Roots were affected more adversely than shoots. Fluoride occurred generally upto 30.0 mg litre-1 but only 5 per cent waters contained higher than 10.0 mg litre-1. Boron is the most toxic and fluoride the least. The tolerance limits of boron, lithium and fluoride could be considered as 5, 10 and 20 mg litre-1, respectively, for tolerant crops in semiarid zones. The recommended maximum concentrations of other micro toxicants as suggested by NAAS (1972) are also listed.

TI: Simultaneous use of newly adopted simple sensors for continuous measurements of soil moisture and salinity.
AU: Konukcu-F; Istanbulluoglu-A; Kocaman-I
SO: Australian-Journal-of-Soil-Research. 2003, 41: 2, 309-321; 25 ref.
LA: English
AB: Methods available to measure salinity and moisture content in arid and semi-arid regions are limited because of the high salinities and very wide range of water contents (i.e. from saturation near the water table to air dry in

the evaporation front). This paper is focused on the instrumentation employed in monitoring salt and moisture profiles in a column study which has wide applicability in salinity research. Experiments were conducted in a specially designed evaporation chamber which provided high evaporative demand as experienced in arid and semi-arid regions. Intensively instrumented soil columns with a constant shallow saline water table were used. Moisture content was measured by thermal conductivity and salinity by 4-electrode probe. In each case, instruments were manufactured specifically for the purpose in order to provide the desired degree of spatial resolution. Two soil types, sandy loam and clay loam, were used. Results indicated that thermal-conductivity probes measured water content over a wide range from saturation to 0.16 m3/m3 for clay loam and to 0.09 m3/m3 for sandy loam soil with great sensitivity (R2 > 0.95) and were unaffected by salt accumulation. The 4-electrode probes provided reliable measurements (R2 > 0.95) of the salinity of the soil solution for the range relevant to agricultural application. However, the accuracy of the probe decreased with the decreases in the water content after permanent wilting point.

TI: Evaluation of a model for irrigation management under saline conditions: I. Effects on plant growth.
AU: Feng-GL; Meiri-A; Letey-J
SO: Soil-Science-Society-of-America-Journal. 2003, 67: 1, 71-76; 17 ref.
LA: English
AB: Sustained irrigation agriculture is critical for food and fiber production to support the growing human population. Increasing salinity is a significant factor in many irrigated lands. Knowledge on the proper time and amount of water of various salinities to be applied for optimum yield of a given crop is important. Because of the numerous variables, computer simulation models would be valuable to partially replace expensive field experiments. Simulated relative yields of corn from the ENVIRO-GRO model were compared with experimentally measured yields which had irrigation water electrical conductivities (ECs) of 1.7, 4.0, 5.0, 8.0, and 10.2 dS m-1 and average irrigation intervals of 3.5-, 7-, 14-, and 21-d treatments. The simulations were run for 5 yr although the field experiment was conducted only 1 yr. The simulated root-weighted average matric and osmotic heads prior to irrigation were evaluated during the year. Depending on treatment, yields were depressed because of either osmotic or matric effects or a combination of the two. The agreement between simulated and measured yields was good for all treatments indicating that the model appropriately accounted for both osmotic and matric effects. On the basis of these results, the ENVIRO-GRO model can be used with confidence in simulating the consequences of irrigation management options under saline conditions. The simulated yields were lower the second and subsequent years compared with the first year, emphasizing the fact that results from 1-yr experiments cannot be used reliably for long-term predictions because the results are highly dependent on the soil conditions at the beginning of the growing season.

TI: Evaluation of a model for irrigation management under saline conditions: II. Salt distribution and rooting pattern effects.
AU: Feng-GL; Meiri-A; Letey-J
SO: Soil-Science-Society-of-America-Journal. 2003, 67: 1, 77-80; 6 ref.
LA: English
AB: Increasing salinity is a significant factor affecting the future agricultural productivity in semiarid irrigated regions of the world. Computer simulation models, which can be used to evaluate the consequences of differing management strategies on crop yield and salt distribution in the soil profile, would be valuable. Simulated results from models must be compared with measured results from field experiments to establish their validity. The simulated salt distribution from the ENVIRO-GRO model were compared with measured distribution at the end of the growing season from an experiment that had treatment variables of irrigation water electrical conductivity (EC) of _1.7, 4.0, 5.0, 8.0, and 10.2 dS m-1 and average irrigation intervals of 3.5, 7, 14, and 21 d. Root distribution is an input variable to the model. Therefore, a second objective of the study was to test the sensitivity of the model results to the root distribution. In general, the agreement between measured and simulated salt distributions were better for the longer than for the shorter irrigation intervals. For the shorter irrigation intervals, the measured salt concentration near the soil surface was greater than was simulated. This result is explained by the fact that the model does not separate the transpiration (T) from the evaporation (E) component of evapotranspiration (ET), and assumes that all water is lost by T. The E:T ratio would be expected to increase as the irrigation frequency increases, and E would carry salts to the soil surface. Except for nonsaline conditions with frequent irrigation, the simulated yields were increased by having a deeper root distribution. The effect of a deep

root system was greater for the longer irrigation interval when the water storage capacity within the root zone becomes more important.

TI: Relationships between yield and irrigation with low-quality water: a system approach
AU: Sadeh,-A.; Ravina,-I.
AD: Holon Academic Inst. of Technology, Department of Management of Technology, 52 Golomb St, Holon 58102, Israel
SO: Agricultural-Systems (UK).
2000, v. 64(2) p. 99-113; May, figs, 24 ref.; summary (En)
LA: English
AB: With the increasing usage of brackish water in agriculture there is a need to quantify the water quantity and quality relationship during irrigation of crops. A model based on a system approach was developed, where the responses of plants to water and salinity stress are expressed in a structural system of equations. The model was applied to field crops in the Israeli Negev, in 3 case studies, using existing linear and non-linear relationships between yield and irrigation and between yield and salinity. Model coefficients were estimated from experimental data. Model results were consistent with actual yield of maize and cotton in the single season cases. Simulation of wheat growing in the winter with supplemental irrigation with brackish water for 13 years showed interesting results of accumulation of soil salinity and reduction of yield. The model can be easily applied to other crops and growing areas. It can be used for analysis of long-term soil salinization processes. Abstract Elsevier Science Journal.

TI: Soil salinization and sodication from alternate irrigations with saline-sodic water and simulated rain.
AU: Buckland-GD; Bennett-DR; Mikalson-DE; Jong-E-de; Chang-C; de-Jong-E
SO: Canadian-Journal-of-Soil-Science. 2002, 82: 3, 297-309; 40 ref.
LA: English
LS: French
AB: A greenhouse study was conducted on large, semi-disturbed soil cores excavated from the vicinity of Verdigris Lake in southern Alberta, Canada to assess the suitability of different saline-sodic waters for irrigation. Soil salinization and sodication, surface soil physical properties, and yield of five soft white spring wheat crops (Triticum aestivum, var. AC Reed) were examined under alternate applications of simulated rain with saline-sodic irrigation waters ranging from "safe" to "potentially hazardous" for irrigation. Increased salinity and sodicity of irrigation waters alternated with simulated rain resulted in increased salinity and sodicity in the upper 0.60 to 0.90 m of the soil. Salt accumulation in the root zone decreased as the leaching fraction increased. Aggregate stability and infiltration properties of the soil were generally adversely affected by the more saline and sodic irrigation waters. Infiltration properties were significantly greater with irrigation water (IW) than with distilled water (DW). The soil infiltration rate at 2 h, with DW as the infiltrating water, was the most sensitive soil physical property for assessment of irrigation water suitability. The infiltration test after five crop cycles gave a better indication of the effects of excess sodicity of irrigation water on soil structural stability than the aggregate stability test. The cumulative effects of long-term supplemental irrigation with saline-sodic waters on soil chemical and physical properties need to be considered when assessing irrigation water suitability. Irrigation waters with electrical conductivity (EC) less than or equal to 1 dS m-1 and a sodium adsorption ratio (SAR) less than or equal to 5 did not result in deterioration of soil physical properties and were considered "safe" for supplemental irrigation of the Masinasin soil. Alternate applications of irrigation and distilled water should be used to evaluate soil infiltration rates and the structural stability of soils to which saline-sodic waters are to be applied.

TI: The safe use of saline water.
AU: Prakash-NB
SO: African-Farming-and-Food-Processing. 2002, No.31, 19-20.
LA: English
AB: This paper outlines the water salinity factors affecting crop quality. Data on the relative salt index for fertilizers are tabulated. Management practices for the safe use of saline water for irrigation are presented.

TI: Salt sensitivity of crops at different growth stages.
AU: Garg-BK; Gupta-IC

SO: Current-Agriculture. 2001, 25: 1-2, 1-12; many ref.
LA: English
AB: Information about the salt tolerance of crops at different stages of growth is rather limited. The available data on cereals, millets, legumes, field crops, oil seeds and vegetables generally indicate that the early seedling stage is most sensitive for most crops. However, some of the crop species at germination are not as tolerant as at later stages of growth. Sugarbeet, barley and cotton for instance are among the most salt tolerant crops but each is relatively sensitive either during germination or early seedling growth. On the other hand pea gram and beans are not as sensitive during germination as during later stages of growth. It is generally agreed that after the seedling stage most plants become increasingly tolerant as growth proceeds through the vegetative, reproductive and grain filling stages where rice may be an exception. The effect of duration of salinization may be more significant than salt sensitivity during a critical stage of growth. The information on the salt sensitivity of crops at different stages is important for management of saline waters. Different crops could be irrigated with saline waters during the tolerant stages without significant reduction in yields. Genetic variation for salt tolerance at specific growth stages needs to be exploited for gainful crop production under salinity stress.

TI: Humic substances to reduce salt effect on plant germination and growth.
AU: Masciandaro-G; Ceccanti-B; Ronchi-V; Benedicto-S; Howard-L
SO: Communications-in-Soil-Science-and-Plant-Analysis. 2002, 33: 3-4, 365-378; 30 ref.
LA: English
AB: Soluble humic substances and saline solutions (NaCl solution or compost water extract) were tested in laboratory experiments of fertigation. The saline solutions were used at two levels of electrical conductivity (EC) (0.5 and 4 mS cm-1); humic substances (HS) were solubilized in distilled water at two concentrations as humic carbon (HC) (30 and 60 mg litre-1). A mixture of NaCl solution with an EC of 4 mS cm-1 and humic substances at 60 mg litre-1 as HC was also used to evaluate if HS can reduce the effect of NaCl on Lepidium sativum germination and maize growth. Germination tests carried out without soil, showed that the best treatment was with HS. Growth tests, using an English soil sown with maize cv. Botanis, presented the best result when the mixture of saline solution-humic substances was used; while the worst plant performance was obtained with NaCl solution alone. In addition, the treatments with NaCl solution alone caused, in the treated soil, a high release of C and N in soluble forms which could cause environmental pollution problems. Finally, a stimulation of soil metabolic potential occurred using HS at low concentration as HC.

TI: Prewetting rate and sodicity effects on soil permeability and surface sealing.
AU: Shainberg-I; Levy-GJ; Mamedov-AI; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 21-28; 18 ref.
LA: English
AB: Irrigation with saline water may introduce sodium into the exchange complex of soils. Exchangeable sodium deteriorates soils' structure and permeability. The susceptibility of soils to sodicity depends on (1) soil permanent properties (such as texture and mineralogy) and (2) time dependent variables such as cultivation (and time since cultivation), irrigation methods and wetting rates. Whereas the effect of inherent soil properties on soil response to sodicity has been studied extensively, the effect of management on the response of soils to sodicity has received little attention. The objective of this presentation is to demonstrate the effect of prewetting rate (PWR) on the permeability and surface sealing of soils. Six Mediterranean soils, ranging in their clay content between 90 and 680 g kg-1 and their exchangeable sodium percentage (ESP) level between 0.9 and 10.2 were studied. Air-dried soil samples were packed in columns (permeability studies) or trays (sealing studies) and were prewetted from below with three PWRs (2, 4-8, 50-60 mm h-1). Thereafter the soils were either leached or rained upon with distilled water. The effect of ESP and PWR depended on soil texture. In soils with low clay content (9%), the effect of PWR on soil permeability was negligible, whereas the effect of ESP was significant. The permeability of the soils with > 9% clay increased with a decrease in PWR, and the effect increased with increase in clay content. High PWR caused aggregate slaking, lower permeability, more sealing and higher susceptibility to sodicity. In the clay soils PWR had a predominant effect on permeability and runoff, while the effect of ESP on these properties was small. It is concluded that no-till conditions and irrigation with slow application rates maintain stable aggregates and decrease the susceptibility of soils to sodicity and seal formation.

TI: Salinity control in the absence of a drainage system under semi-arid environments.
AU: Ben-Mechlia-N; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 175-181; 8 ref.
LA: English
AB: In many semi-arid regions large irrigation schemes have been developed on fertile plains without provision of drainage networks. The reasons are usually due to a lack of good quality waters and/or high investment costs. Under these environments, characterized by an alternation of wet and dry seasons, adoption of restrictive irrigation practices can help control or, at least, slow down the salinization process of the irrigated lands. Rainfall must have a major role in water supply to the crop and to wash salts below the root zone. Experimental findings show that olive yields planted on loamy sands under 200 mm rainfall are the same (4.3-4.5 T/ha), when irrigation amounts vary between 450-950mm/year. Orange production remains almost unchanged when supply with saline waters increases from 300 to 650 mm/year under 450mm rainfall regime. Sandy soil seems to reach a state of equilibrium after few years of irrigation with saline waters. With loamy soils precipitation higher than 500 mm seems to be effective in salt leaching. When rainfall is important, strategies based on restrictive supply could be used to control salinity in the dry regions. Practices based on supplemental irrigation (SI) and restricted deficit irrigation (RDI) have the potential to reduce the amount of total salts added to the soil while improving crop productivity. An alternative to large scale irrigation projects, where salinization risks are high, is the construction of small reservoirs to collect runoff waters and the development of small irrigation schemes on sloping areas where occasional flash floods could be diverted to wash out the little amounts of accumulated salts.

TI: Use of soil conditioners under saline irrigation: effect of wheat.
AU: Hamdy-A; Sfeir-P; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 339-348; 15 ref.
LA: English
AB: This experiment is one of the primary trials to investigate the use of soil conditioner as a management tool for irrigation with saline water. The trial was conducted to elucidate the impact of using "Barbary Plant G2" soil conditioner in different ratios (control, 10, 20 and 30 g l-1 soil) along with 4 levels of saline irrigation (0.9, 3, 6 and 9 dS m-1) on the wheat plant growing parameters as well as its yield. The obtained results showed that the soil conditioner strongly interferes with plant normal development, yielding better in terms of quantity and quality. The presence of the conditioner improves the development of both the root and vegetative part giving wheat plants of more or less equal shoot/root ratio. This was reflected in the final yield, particularly under irrigation with waters of relatively high salt concentration (9 dS m-1) where grain production was nearly three times greater than that recorded in the absence of the soil conditioner and irrigation practised with freshwater (0.9 dS m-1). Under saline irrigation practices, mixing the soil with the BP polymer resulted in a notable increase in the grain yield; yet, such improvement was not achieved with the accumulated salts in the soil. The mechanisms through which these polymers do act are not very well clarified. Their secure handling would call for further studies, including more peculiar parameters that could specifically illustrate the polymer mechanisms of action. A better understanding of such polymetric compounds will facilitate the use of waters of marginal quality and will further open the way to new agriculture intensification with safer, more economic and higher productive expectations.

TI: Influence of salinity on microbial respiration and enzyme activity of soils.
AU: Okur-N; Cengel-M; Gocmez-S; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 189-194; 15 ref.
LA: English
AB: Detrimental effects of salts on microbial activity may be due to the toxicity of specific ions, elevation of osmotic pressure or the increase in alkalinity which may restrict the availability of water or influence cellular

physiology and metabolic pathways. In this study, the effects of irrigation with saline water (S0=0.65, S1=2.0, S2=3.5, S3=5.0 and S4=6.5 dS m-1) and fertilization with potassium (K0, K1=100 and K2=200 g tree-1) on the microbiological characteristics of an alluvial soil were studied. The experiment was established in 1994 to determine the effects of salinity on yield and quality of Satsuma mandarin budded on Poncirus trifoliata and to test the interaction of fertilizer K with salinity. Soil samples were taken on September 1999 and analysed for their soil respiration and the activities of phosphatase and beta-Glucosidase. The increase in soil salinity had a negative effect on soil's microbiological activity. Soil microbial respiration and the two enzyme activities were inhibited even at low salinity levels, but the addition of potassium decreased the toxic effects. In the Ko parcel, the reductions in soil respiration, phosphatase and beta-Glucosidase were 70%, 61.5% and 61%, respectively, when the salinity of the irrigation water was increased from 0.65 to 6.5 dS m-1. The reductions for the same indices were lesser at K1 (58%, 52% and 53%) and K2 parcels (54%, 47% and 51%), respectively.

TI: An algorithm for re-use of saline groundwater for irrigation.
OT: Tuzlu taban suyunun sulamalarda tekrar kullanimi icin bir hesaplama yontemi.
AU: Kara-T; Apan-M
SO: Ondokuz-Mayis-Universitesi,-Ziraat-Fakultesi-Dergisi. 2000, 15: 3, 62-67; 11 ref.
LA: Turkish
LS: English
PT: Journal-article

TI: Gypsum: an economical amendment for amelioration of saline-sodic waters and soils, and for improving crop yields.
AU: Ghafoor-A; Gill-MA; Hassan-A; Murtaza-G; Qadir-M
SO: National workshop on agricultural use of gypsum in Pakistan, Islamabad, Pakistan, 9-10 April 2001. International-Journal-of-Agriculture-and-Biology. 2001, 3: 3, 266-275; many ref.
LA: English
AB: This paper highlights the economical feasibility of using acids, acid formers and gypsum-like amendments for brackish water treatment. The different characteristics of irrigation water and the effects of these inorganic amendments on different soil physico-chemical characteristics of soil are discussed.

TI: Modelling the effects of saline water irrigation on crop growth.
AU: Castrignano-A; Katerji-N; Hamdy-A; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 171-199; 27 ref.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: CERES-Maize, a crop-specific model for dynamic simulation of crop growth and development, was used for predicting crop response to various combinations of irrigation water quality, soil profile and meteorological conditions. Linear regression between mean simulated and measured data from a set-up of 30 drainage lysimeters showed that the model performed well for final grain yield, though it tended to underestimate above-ground biomass and maximum leaf area index. The largest over-estimations of evapotranspiration were found in the early growing season immediately after each irrigation event. However, the prediction of seasonal evapotranspiration was generally reasonably good.

TI: Irrigation experimental designs.
AU: Beltrao-J; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 209-228.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English

AB: Spatially variable experimental designs for sprinkle and trickle irrigation experiments (including pestigation, fertigation, wastewater reuse, plant-water relations, use of saline water) offer a convenient economical approach for developing crop production functions. They enable a wide range of irrigation rates to be evaluated in a small area. Studies using randomized blocks and continuous irrigation experiments enabled their relative efficiencies to be compared and showed that these systems can be used for developing alternative designs for irrigation plots.

TI: Salinity and sodicity influences on infiltration during surge flow irrigation.
AU: Heydari-N; Gupta-AD; Loof-R
SO: Irrigation-Science. 2001, 20: 4, 165-173; 34 ref.
LA: English
AB: The interactive influences of water quality and surge-flow irrigation (intermittent application of water) on infiltration into a bare loam soil, packed into a long metal flume, were measured with a laboratory recirculating infiltrometer devised for the experiments. Cumulative infiltration and final infiltration rates were measured over three irrigation episodes using synthetic waters of different qualities. Four water-quality combinations of low and high salinity levels (i.e., electrical conductivity, EC=1.5 and 7.5 dS/m) and low and high degree of sodicity (i.e., sodium adsorption ratio in the range of 5-10 and 25-35 mmol1/2l-1/2) were tested. Results showed that surge-flow cumulative infiltration of low saline waters -- especially during the first irrigation episode -- was lower than the corresponding continuous-flow cumulative infiltration. Conversely, it was higher for high saline and high saline-sodic waters. Effects of the water-quality treatments on final infiltration rate were similar to and in agreement with the effects on cumulative infiltration. However, the range of the final infiltration rates among surge-flow treatments was larger than with the continuous-flow treatments. Overall, infiltration was higher with surge-flow application of high saline and high saline-sodic waters than with the continuous-flow treatment. The observed contrasting results for the surge effect with the low saline, high saline, and high saline-sodic water-quality treatments were attributed to soil consolidation, formation of a depositional seal layer, and the different levels of irrigation water salinity and sodicity. It was concluded that the 'surge effect' phenomena (reduction in soil infiltration caused by surge flow) under brackish (saline, sodic, and saline-sodic) water application was not pronounced and had adverse effects, in comparison to the low saline-sodic water application. Consequently, from theory, practical application of surge-flow irrigation under these circumstances, from viewpoints of infiltration reduction and irrigation efficiency improvements, is questionable.

TI: A quick test to assess salinity tolerance of plants.
AU: Cutore-L; La-Loggia-F; Sardo-V; Loggia-F-La; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 143-149; 3 ref.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: A method for the quick appraisal of salinity tolerance of plants was tested in experiments conducted in 25-litre plastic containers (equipped with drainage) on the following plants:- Chamaerops humilis, Typha angustifolia and Phragmites communis. The plants were planted and irrigated over a three month period with increasing saltwater proportions to assess their salinity tolerance. The tests involved measuring the amounts of water and salts applied and leached, and determining the overall salt balance. Typha and Phragmites survived only to a concentration of 10% seawater. Chamaerops easily tolerated 25% sea water and just survived at 50%.

TI: Managing subsurface drip irrigation in the presence of shallow ground water.
AU: Ayars-JE; Schoneman-RA; Dale-F; Meso-B; Shouse-P
SO: Agricultural-Water-Management. 2001, 47: 3, 243-264; 12 ref.
LA: English
AB: Subsurface drip irrigation (SDI) was compared with furrow irrigation system during 1991-93 in California, USA, in the presence of shallow saline groundwater. We evaluated five types of drip irrigation tubing installed at a depth of 0.4 m with lateral spacings of 1.6 and 2 m on 2.4 ha plots of both cotton and tomato. Approximately 40% of the cotton water requirement and 10% of the tomato water requirement were obtained from shallow (< 2 m) saline (5 dS/m) groundwater. Yields of the drip-irrigated cotton (Gossypium hirsutum) improved during the 3-

year study, while that of the furrow-irrigated cotton remained constant. Tomato yields were greater under drip than under furrow in both the years in which tomatoes were grown. Salt accumulation in the soil profile was managed through rainfall and pre-plant irrigation. Both drip tape and hard hose drip tubing are suitable for use in our subsurface drip system. Maximum shallow groundwater use for cotton was obtained when the crop was irrigated only after a leaf water potential of -1.4 MPa was reached. Drip irrigation was controlled automatically with a maximum application frequency of twice daily. Furrow irrigation was controlled by the calendar. Results demonstrate that an SDI system can be operated in the presence of shallow groundwater to induce crop water use from shallow groundwater and reduce the total applied water.

TI: An integrated modelling approach for irrigation water management using saline and non-saline water: the SALTMED model.
AU: Ragab-R
SO: 6th-International-Micro-irrigation-Congress-Micro-2000,-Cape-Town,-South-Africa,-22-27-October-2000. 2000, 1-11; 5 ref.
PB: International Commission on Irrigation and Drainage (ICID); Rome; Italy
LA: English
AB: The SALTMED model was developed for planning water management schedules for irrigated crops that integrate water, plant, soil and field management. The Richards equation and the Convection-Dispersion Equation are used respectively to describe water and solute movements. The daily potential and actual evapotranspiration were calculated using the Penman-Monteith equation. The model runs for a variety of irrigation systems, crops, soils and water salinity levels. The daily model output (graphs and data files) includes yield, potential and actual water uptake, salinity, soil matric potential and soil moisture profiles, crop water requirements, leaching requirements, plant growth parameters, potential and actual evapotranspiration, bare soil evaporation and plant transpiration.

TI: Timing of salinity stress affects rice growth and yield components.
AU: Zeng-LingHe; Shannon-MC; Lesch-SM; Zeng-LH
SO: Agricultural-Water-Management. 2001, 48: 3, 191-206; 23 ref.
LA: English
AB: Differential sensitivity during growth stages is one of the major issues in the management of saline water for irrigation. This study was designed to analyse the effects of salinity on plant growth and yield components of rice by composing 20-day periods of salinization at different growth stages. Plants were grown in sand tanks in a greenhouse and irrigated with nutrient solutions. Treatments were three levels of salinity with electrical conductivities at 1.8, 3.2 and 4.6 dS m-1 and five timing treatments. Plants were salinized on the day of seeding, 1-leaf, 3-leaf, panicle initiation (PI), and booting stages, respectively, and stress was relieved after 20 days in each timing treatment. Salinity-induced reductions in shoot dry weights of plants harvested before PI were significant, but there were no significant differences among timing treatments. Reduction in shoot dry weight of plants harvested at seed maturity was significant only when plants were salinized for a 20-day duration before booting, but not after booting. Reduction in tiller number per plant was significant only when plants were salinized for a 20-day duration before PI. The reductions in spikelets per panicle and seed weight per panicle were most pronounced when plants were stressed between the 3-leaf and PI stages or between PI and booting stages and minor when stressed at the other stages. A 20-day period between 3-leaf and PI stages was most sensitive to salinity in terms of seed yield. These results indicate that the differential sensitivity at growth stages can be clearly shown when stages are well defined in the timing treatments and the stress is quantified at growth stages based on the same duration of salinization. The interaction between cultivar and timing treatment was not significant. Uniform management options can be developed for irrigation using saline water for the cultivars with similar genetic backgrounds.

TI: Autotrophic denitrification of high-salinity wastewater using elemental sulfur: batch tests.
AU: Koenig-A; Liu-LingHua; Liu-LH
SO: Water-Environment-Research. 2004, 76: 1, 37-46; 26 ref.
LA: English
AB: The feasibility of autotrophic denitrification of a high-salinity wastewater using sulfur-oxidizing autotrophic denitrificants was studied. These autotrophic bacteria oxidize elemental sulfur to sulfate while reducing nitrate to

elemental nitrogen gas, thereby eliminating the need for the addition of organic carbon compounds. A series of bench-scale batch tests was performed with synthetic and actual flue gas desulfurization (FGD) wastewater to examine the effects of various environmental and operational factors such as temperature, pH, high salinity, and potentially toxic substances on the rate of autotrophic denitrification using elemental sulfur. Specific denitrification rates of 6 to 8 mg nitrate-nitrogen (NO3--N)/g volatile suspended solids (VSS).h were obtained. The highest denitrification rates were found between pH 7.0 and 8.0 and a temperature of 30degreesC. The denitrification rate started to decrease above an osmotic pressure of 19 atm (approximately 70% of seawater), independent of the type of salt ions, and amounted to approximately 70% activity at the concentration of seawater. Polyphosphate or pyrophosphate could be used as the source of phosphorus instead of orthophosphate because the latter caused immediate calcium phosphate precipitation in the FGD wastewater. Inhibiting factors attributed to inorganic or organic compounds originating from coal combustion were discussed.PT: Journal-article
AN: 20043045715

TI: Removal of high NO3- concentrations in saline water through autotrophic denitrification by the bacterium Thiobacillus denitrificans strain MP.
AU: Gu-JD; Qiu-W; Koenig-A; Fan-Y; Choi-E (ed.); Yun-Z
SO: 6th IWA Specialty Symposium on Strong Nitrogenous and Agro-Wastewater, Seoul, Korea Republic, 11-13 June 2003. Water-Science-and-Technology. 2004, 49: 5-6, 105-112; 20 ref.
LA: English
AB: Autotrophic denitrification by Thiobacillus denitrificans MP isolated from mangrove was investigated in both a sulphur-limestone column reactor and a fermenter. More than 97.5% of the nitrate (NO3-) in the 250 mg NO3--N/L strong influent was removed after 14.3 hours in the column reactor. Influent NO3- was completely depleted in the lower part of the column as the hydraulic retention time increased and a slight pH drop was also observed along the reactor column due to the exhaustion of the buffering ability of the limestone. Trace amounts of oxygen present in the lower part of the reactor column resulted in the accumulation of nitrite and subsequent inhibition of further denitrification. The species composition of the bacterial community in the higher parts of the reactor column was morphologically more diverse than in the lower part. Denitrification by T. denitrificans MP reached an optimal level when the dissolved oxygen was maintained between 1.5-2% of saturation level in the automated fermenter. The stoichiometric ratios of DELTASO42- produced/DELTANO3- -N removed were 6.81 and 9.32 in the reactor column and fermenter, respectively. This study suggests that efficient removal of high NO3- concentrations in water or wastewater can be achieved using autotrophic bacteria immobilized on surfaces of sulphur granules in the column system.
PT: Journal-article; Conference-paper
AN: 20043078012

TI: Effect of salinity on Cd and Zn availability.
AU: Khoshgoftarmenesh-AH; Jaafari-B; Shariatmadari-H
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002. 2002, 2008; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033438

TI: Evaluation of management practices for use of low quality water for irrigation: model simulations.
AU: Suarez-DL
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002. 2002, 1096; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033538

TI: Brackish water and SAR [sodium adsorption ratio] effect on the soil.

AU: Cucci-G; Caro-de-A; Tarantino-E
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002. 2002, 629; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033542

TI: Increasing water supply by mixing of fresh and saline ground waters.
AU: Sen-ZeKai; Saud-AA; Abdusselam-Altunkaynak; Ozger-M; Sen-ZK
SO: Journal-of-the-American-Water-Resources-Association. 2003, 39: 5, 1209-1215; 7 ref.
LA: English
AB: The quality of groundwater in any aquifer takes its final form due to natural mixture of waters, which may originate from different sources. Water quality varies from one aquifer to another and even within the same aquifer itself. Different groundwater quality is obtained from wells and is mixed in a common reservoir prior to any consumption. This artificial mixing enables an increase in available groundwater of a desired quality for agricultural or residential purposes. The question remains as to what proportions of water from different wells should be mixed together to achieve a desired water quality for this artificial mixture. Two sets of laboratory experiments were carried out, namely, the addition of saline water to a fixed volume of fresh water. After each addition, the mixture volume and the electric conductivity value of the artificially mixed water were recorded. The experiments were carried out under the same laboratory temperature of 20degreesC. A standard curve was developed first experimentally and then confirmed theoretically. This curve is useful in determining either the volume or discharge ratio from two wells to achieve a predetermined electrical conductivity value of the artificial mixture. The application of the curve is given for two wells within the Quaternary deposits in the western part of the Kingdom of Saudi Arabia.
PT: Journal-article
AN: 20033206123

TI: Effect of frequency of sodic and saline-sodic irrigations and gypsum on the buildup of sodium in soil and crop yields.
AU: Bajwa-MS; Josan-AS; Choudhary-OP
SO: Irrigation-Science. 1993, 14: 1, 21-26; 18 ref.
LA: English
AB: The effect of 3 frequencies of irrigation with sodic (high residual alkalinity) and saline-sodic (high residual alkalinity and high NaCl concentration) waters with or without gypsum application on soil properties and crop yields were investigated under a millet [Pennisetum glaucum] (fodder)-wheat-maize (fodder) rotation in a field experiment carried out for 6 years (1986-1992) on a well drained sandy loam Typic Ustochrept soil in Ludhiana, Punjab. Irrespective of the irrigation intervals, sustained use of sodic and saline-sodic waters increased pH, electrical conductivity and exchangeable sodium percentage (ESP) of the soil and significantly decreased crop yields. Application of gypsum decreased ESP and significantly improved crop yields. The beneficial effect of gypsum was lower under saline-sodic irrigation. There were no significant beneficial effects of increasing the frequency of sodic and saline-sodic irrigation, both with and without applied gypsum, on the yields of wheat and millet crops grown during winter and monsoon seasons, respectively. Decrease in irrigation interval significantly improved yields of maize grown during the hot dry summer period. Frequency of irrigation did not appreciably alter the effectiveness of applied gypsum in wheat and millet, but in maize, the gypsum treatment was more effective under more frequent irrigation.
PT: Journal-article

TI: Handbook of plant and crop stress.
AU: Pessarakli-M
SO: 1994, xiv + 697 pp.; ref. at ends of chapters, Books in Soils, Plants, and the Environment.
PB: Marcel Dekker, Inc.; New York; USA
LA: English

AB: This multiauthor handbook is a comprehensive survey of the effects of plant and crop stress. It has 33 chapters organized into 8 parts: soil salinity and sodicity problems; plants, crops, and stressful conditions (mainly salinity); plant and crop response to salt, water, and other environmental stress conditions (including salinity, nutrient uptake in stressful conditions, and water stress); molecular biology and microbiological aspects of plant responses under salt, water, and other environmental stress conditions (discussing control of cell elongation, genome size, osmoregulation, and plant growth regulators); empirical investigations of specific plants and crops grown under saline, drought, and other environmental stress conditions (mentioning Phaseolus vulgaris, Medicago sativa, maize, soyabeans, forage legumes, Atriplex species for fodder, and Juncus and Kochia species for fibre and fodder); future promise for plants and crops for cultivation under stressful conditions (discussing salt tolerant crops, particularly Chenopodiaceae and pigeonpeas); irrigating crops with low-quality water (saline water and sewage effluent); and beneficial aspects of stress on plants.
PT: Book

TI: Saline agriculture under desert conditions.
AU: Ahmad-R; Abdullah-ZN
SO: Advances-in-Desert-and-Arid-Land-Technology-and-Development. 1979, 1: 593-618; 7 fig., 7 tab.; 29 ref.
PB: Harwood Academic Publishers.; Chur; Switzerland
LA: English
AB: Plants were raised from seeds on desert sand and irrigated with different dilutions of chemically amended sea water. Another lot of seedlings was preconditioned for salt tolerance by irrigating with gradually increasing concentrations of chemically amended sea water reaching up to the maximum permissible limit determined through the above mentioned experiments. These seedlings were later transplanted in drum pots filled with sand having a basal outlet for drainage. They were irrigated with the same concentration of amended sea water which they were receiving before transplantation. Plants such as wheat, taramera, maize, cotton, sugarcane and sugar beet were grown to maturity on sandy soil using various concentrations of sea water for irrigation. Plants showed luxuriant growth up to certain levels of salinity, while at higher concentrations reproductive growth was more adversely affected than vegetative growth. This technique was found quite useful for saline agriculture where vegetative parts are used as fodder or for human consumption. However, the reduction in reproductive growth may still be within compromisable limits in some other plants.
PT: Journal-article

TI: Simulating physical processes and economic behavior in saline, irrigated agriculture: model development.
AU: Lefkoff-LJ; Gorelick-SM
SO: Water-Resources-Research. 1990, 26: 7, 1359-1369; BLDSC; 60 ref.
LA: English
AB: A model of an irrigated, saline stream-aquifer system is constructed to simulate economic, agronomic, and hydrological processes. The model is applied to a section of the Arkansas Valley in southeastern Colorado and is used to examine the effect of crop-mixing strategies on long-term profits. Mixing in excess of crop rotation requirements provides an index of farmers' willingness to exchange some profit for a reduction in the risk of short-term loss. The model contains three components. The economic component simulates water use decisions that maximize annual profit for each farm. The hydrological component simulates salt transport by employing regression equations that predict changes in groundwater salinity as a function of hydrologic conditions and water use decisions. The agronomic component approximates changes in maize and lucerne production in response to the depth and salinity of irrigation applications. Results from the entire economic-hydrological-agronomic model are consistent with the few historical observations available for the site.
PT: Journal-article

TI: Salinity-heavy metal interactions in four salt-tolerant plant species.
AU: Zurayk-RA; Khoury-NF; Talhouk-SN; Baalbaki-RZ
SO: Journal-of-Plant-Nutrition. 2001, 24: 11, 1773-1786; 29 ref.
LA: English
AB: The concurrent effect of NaCl salinity and heavy metals (cadmium (Cd), chromium (Cr) and nickel (Ni)) on growth, sodium (Na), and heavy metal accumulation was assessed in four salt tolerant plant species. These were:

barley (Hordeum vulgare), purslane (Portulaca oleracea), Inula crithmoides, and Plantago coronopus, all of which have documented potential for use in saline agriculture. Plants were grown in perlite and irrigated with salinized and non-salinized nutrient solutions (9 dS m-1 and 18 dS m-1) containing 2 ppm Cd, 4 ppm Cr, 10 ppm Ni, and a non-metal control. Salinity, Cd, and Ni caused a significant decrease in the dry biomass accumulation of Portulaca oleracea, but had no effects on other plant species. Sodium accumulation was highest in Plantago coronopus and I. crithmoides, indicating pronounced halophytic properties. The presence of heavy metals reduced Na accumulation in H. vulgare and Portulaca oleracea, but had no effect on Plantago coronopus and I. crithmoides, indicating that the Na-heavy metal interaction is plant-specific. Metal accumulation in the four plant species was generally enhanced by the 9 dS m-1 treatment, but not by the 18 dS m-1 treatment. This could indicate the presence of an ionic exclusion mechanism operating at high salinity levels that would operate indiscriminately on Na as well as on Cd, Cr, and Ni.
PT: Journal-article

TI: Engineering perspective in saline agriculture.
AU: Abdul-Razzaq; Razzaq-A
SO: AMA,-Agricultural-Mechanization-in-Asia,-Africa-and-Latin-America. 1999, 30: 2, 35-37; 6 ref.
LA: English
AB: This study examines various ways and means of using salt-affected soils to the best of their viable and sustainable economic capacity for both field and horticultural crop growth. The basic objective is to improve soil water availability for crop growth in view of the quality of the soil and the irrigation water, and the water requirements of the crop. Under saline conditions with poor canal water supply, the following management practices are recommended and discussed: crop selection; land preparation; irrigation management and practices; sowing; weeding; fertilization; amendments; harvesting; and cultivation.
PT: Journal-article

TI: Saline agriculture. Salt-tolerant plants for developing countries.
CA: USA, Board on Science and Technology for International Development.
SO: 1990, 143 pp.; ref. at ends of chapters. A BOSTID Report.
PB: National Academy Press; Washington, DC; USA
LA: English
AB: This book constitutes a report of a panel on the Board on Science and Technology for International Development, of the National Research Council of the USA. Salt-tolerant plants for use as food, fuel, fodder, and fibre and other products are considered. The 1st chapter relating to food is subdivided into sections on grains and oilseeds, tubers and foliage, leaf protein, fruits and traditional crops. The 2nd chapter on fuel considers fuelwood trees and shrubs and the use of salt-tolerant species for liquid and gaseous fuels. The chapter on fodder discusses salt-tolerant grasses, shrubs and trees. The final chapter on fibre and other products considers salt-tolerant species for essential oils, gums, oils and resins, pulp and fibre, bioactive derivatives, and landscape and ornamental use. A list of research contacts is included at the end of each chapter.

TI: Irrigation with brackish water under desert conditions. 6. Automated systems to produce a range of salt concentrations in irrigation water for experimental plots
AU: Pasternak,-D.; Azoulai,-A.; Danon,-A.; Levi,-S.; Malach,-Y.-de; Shalav,-G.
AD: Rudolph and Rhoda Boyko Inst. for Agriculture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).
1986, v. 12(1-2) p. 137-147; Oct, figs, photos, 6 ref.; summary (En)
LA: English
AB: Three fully automated systems, developed recently in the Negev desert (Israel) to enable the carrying out of both small- and large-scale field trials on irrigation with brackish and saline water, are described. The mixing junction supplies relatively large quantities of water with a predetermined, constant salt concentration. The brine injection system was developed to produce a range of salt solutions for field studies of salinity when the major water source is of a low and constant salinity level. The mixing manifold was developed to dilute an abundant source of water with a high and constant salinity level with fresh water, to obtain a range of salt concentrations in the irrigation water. From authors' summary.

TI: Use of saline drainage water for irrigation.
AU: Rhoades-JD; Skaggs-RW (ed.); Schilfgaarde-J-van
SO: Agricultural-drainage. 1999, 615-657; 4 pp. of ref.
PB: American Society of Agronomy; Madison; USA
LA: English
AB: The following topics are discussed: salinity characteristics of drainage waters; assessment of saline waters suitability for irrigation; feasibility of using saline drainage waters for irrigation; management principles for the use of saline drainage waters for crop production and for quality protection.
PT: Book-chapter

TI: Sustainable use of saline drainage water for irrigation in semi-arid regions.
AU: Sharma-DP; Singh-KN; Kumbhare-PS
SO: Role of drainage and challenges in 21st century. Vol. III. Proceedings of the Eighth ICID International Drainage Workshop, New Delhi, India, 31 January-4 February 2000. 2000, 215-225; 17 ref.
PB: International Commission on Irrigation and Drainage; New Delhi; India
LA: English
AB: Subsurface drainage has proved successful in the rehabilitation and conservation of waterlogged saline soils in the irrigated arid and semi-arid zones of India. Options to mitigate the environmental threat posed by disposal of saline effluents from subsurface drainage include blended use of drainage water for irrigation and cyclic use. Issues relating to potential reuse of low quality drainage waters along with management practices are addressed. Saline drainage water of up to 9-10 dS/m can successfully be utilized for the irrigation of the winter crops either directly, or in conjunction with good quality water, without significant yield reduction or soil degradation. Effects of factors influencing the long-term sustainable use of saline drainage waters are presented, such as soil dispersion, crusting and reduced infiltration capacity. Site-specific management practices need to be developed for water quality, soil, crop and climatic conditions. Use, even partial use, of saline drainage water in post-reclamation work, will both augment water supply and minimize effluent disposal requirements.

TI: Seed soaking presowing in vitamins versus the adverse effects of NaCl salinity on photosynthesis and some related activities of maize and sunflower plants.
AU: Ahmed-Hamad-AM; Monsaly-HM; Garab-G
SO: Photosynthesis: mechanisms and effects. Volume IV. Proceedings of the XIth International Congress on Photosynthesis, Budapest, Hungary, 17-22 August, 1998. 1998, 2617-2620; 25 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Seeds of sunflowers and maize were pretreated by soaking for 6 h in 50 p.p.m. solutions of ascorbic acid, thiamin or pyridoxine and then sown in pots in a clay/sand mixture irrigated with saline solutions to give 50, 100, 150 or 200 mM salinity levels. Control treatments used untreated seeds and/or no saline water. Growth and photosynthesis decreased and respiration increased as salinity increased but the biosynthesis of photosynthetic pigments was unaffected. The seed treatments promoted growth and photosynthesis and partially or completely alleviated the effects of salinity probably by increasing the efficiency of water uptake and utilization and by protecting the photosynthetic pigments and photosynthetic apparatus.

TI: Irrigation with brackish water under desert conditions. 3. Methods for achieving good germination under sprinkler irrigation with brackish water
AU: Pasternak,-D.; Malach,-Y.-de; Borovic,-I.; Twersky,-M.
AD: Rudolph and Rhoda Boyko Inst. for Agriculture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).
1985, v. 10(4) p. 335-341; Dec, tables, 9 ref.; summary (En)
LA: English
AB: A field trial was conducted to test the effect of 3 sprinkler irrigation methods on the germination of tomato seedlings and on soil salinity. The 3 irrigation treatments were: (1) fresh conventional, pre-irrigation and daily light application from sowing to full seedling emergence with fresh water; (2) brackish conventional (BC), pre-irrigation and daily light application from sowing to full seedling emergence with brackish water and (3) brackish special (BS), no pre-irrigation, heavy application of brackish water from sowing to full seedling emergence. Five

cultural practices were also applied (flat sowing; shallow-furrow sowing; flat sowing + a 1-cm woodchip mulch; flat sowing + plastic mulch or flat sowing + daily application of KNO3). In case of flat sowing BS resulted in an effective leaching of salt from the upper 5 cm soil layer and in a 5-fold increase in number of germinated seedlings as compared with BC. When brackish water was used seedling germination was better for the shallow furrow and woodchip mulch treatments when compared with flat sowing; in case of BC plastic mulch also increased germination compared with flat sowing.

TI: Influence of soil sample conditioning in the evaluation of soil structure stability as affected by irrigation with saline water.
AU: Tedeschi-A
SO: Italian-Journal-of-Agronomy. 1999, 3: 2, 117-122; 10 ref.
LA: English
LS: Italian
AB: The sensitivity of a modified soil structure stability test was evaluated. Two methodologies used to estimate an index of soil structure stability were tested on samples from salinized soils from a three-year experiment in southern Italy whose plots had been irrigated with artificially salinized water (addition of NaCl). The spatial location of the treatments was the same throughout the years, causing salt accumulation in the soil. The two methods differed only by the presence or absence of a pre-treatment of the sample. In one case (WSI) the samples were air-dried and pre-wetted by capillarity before being shaken in water (Malquori and Cecconi method); in the other (WSDI) the air-dried sample was directly shaken in water without pre-wetting. The WSDI method demonstrated better sensitivity to the disaggregation and dispersion of the water action, enhancing the resolution capacity of the test. The ESP (exchangeable sodium percentage) and ECe (electrical conductivity) values, observed after one and three years of saline irrigation, showed a progressive soil salinization related to the salt quantity delivered with the irrigation water. The modification of the standard method for determining the soil structure stability, consisting of the elimination of sample pre-wetting, permitted a better sensitivity of the test to the different levels of salinity treatments under trial.

TI: Regional drainwater management: source control, agroforestry, and evaporation ponds.
AU: Posnikoff-JF; Knapp-KC
SO: Journal-of-Agricultural-and-Resource-Economics. 1996, 21: 2, 277-293; 29 ref.
LA: English
AB: Source control is one way to address salinity and drainage problems in irrigated agriculture, and reuse of drainage flows on salt-tolerant crops or trees in agroforestry production is another. A regional model of agricultural production with drainwater reuse and disposal is developed. Deep percolation flows are controlled through choice of crop areas, irrigation systems, and applied-water quantities. Crop drainwater may be reused in agroforestry production, and residual emissions are disposed of in an evaporation pond. A significant role for both source control and reuse is found. Sensitivity to various cost and revenue parameters is also analysed.
PT: Journal-article

The use of saline waters for crop production.
Rhoades, J. D. et al.
Rome: FAO, 1992 Online resource. URL: http://www.fao.org/docrep/T0667E/T0667E00.htm
The book analyses current status of saline water use in irigation and examines water, soil and crop management techniques relating to the use of saline water for crop production. The book shows that there is good potential for safe use of saline waterfor crop production. It recommends integrated management of water of different qualities at the levels of farm, irrigation system and drainage basin.

TI: Hydrologic aspects of saline water table management in regional shallow aquifers.
AU: Grismer-ME; Gates-TK; Dinar-A (ed.); Zilberman-D
SO: The-economics-and-management-of-water-and-drainage-in-agriculture. 1991, 51-70; 17 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Hydrological factors associated with irrigation and drainage in regions with saline shallow groundwater are considered. Soil water flow processes and the importance of regional analysis are described. Results of a

simulation model which accounts for major processes governing shallow water table behaviour in salinity-affected regions are discussed. The model is used to analyse the effects of irrigation-drainage management on water table depth, salinity, crop yield, and net economic returns to the grower over a 20-year planning period. Stochastic elements associated with soil hydraulic properties and irrigation applications have been incorporated into this model. These additions to the model indicate the importance of parameter uncertainty and enable results to be interpreted with the notions of stability and risk.

TI: Economic aspects of irrigation with saline water.
AU: Yaron-D; Nobe-KC (ed.); Sampath-RK
SO: Irrigation management in developing countries: current issues and approaches. Proceedings of an invited seminar series sponsored by the International School for Agricultural and Resource Development. 1986, 217-263; app., tab., Studies in Water Policy and Management No. 8, Distributors in UK, Wildwood Distribution Services, Aldershot, UK, OQEH; 45 ref.
PB: Westview Press, for International School for Agricultural and Resource Development; Boulder, Colorado, USA; London; UK
LA: English
AB: The chapter reviews the economic dimensions of irrigation with water of varying salinity levels, with emphasis on on-farm irrigation problems. The farm-region interactions are dealt with only briefly. The paper commences with a short review of the underlying physical water-soil-crop yields relationships and of the source of information regarding them. In the next section, empirical estimates of farms' income losses under selected situations are reviewed. The next section discusses the alternatives open to farms to reduce salinity-induced losses and the agro-economic models designed to evaluate them. Several aspects of farm-region interactions are then reviewed, and the final section points to some hopeful frontier-changing innovations currently under study, which, if successfully developed, may drastically change the frame of reference for salinity problems in agriculture.

BRASSICAS

TI: Comparative performance of different Canola varieties under various salinity regimes.
AU: Humaira-Gul; Rafiq-Ahmad; Shoaib-Ismail; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 251-260; 9 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The effect of salinity on germination, vegetative growth and reproductive yield of 12 rape cultivars (Canola-I, Canola-II, Canola-III, Abasin-95, Ganyou-5, Ganyou-2, Oscar, Shiralee, Dunkled, Westar, Rainbow and Hyola-42) was investigated. Seeds were germinated in test tubes placed on filter paper strips soaked in different NaCl concentrations (0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2 and 1.4%). Canola-III, Ganyou-5, Oscar, Dunkled, Westar and Rainbow showed higher germination in all the treatments compared to other cultivars. To study the growth performance under saline conditions, 8 cultivars were selected on the basis of their tolerance to salinity at the stage of germination, i.e. Canola-III, Dunkled, Oscar, Ganyou-5, Ganyou-2, Rainbow, Abasin-95 and Westar. The seeds were grown in pots filled with sandy soil and irrigated with different sea salt concentrations (0, 0.2, 0.4, 0.6 and 0.8%). Plant height and leaf number decreased with increase in salinity levels. Gradual reduction was observed in pod number with increase in salinity levels. Seed yield per plant was also reduced by salinity treatment in terms of both seed number and weight. Slight reduction was noticed up to 0.6% treatment, but comparatively greater reduction was observed at 0.8% concentration.
PT: Book-chapter

TI: Irrigation method affects selenium accumulation in forage Brassica species.
AU: Suarez-DL; Grieve-CM; Poss-JA
SO: Journal-of-Plant-Nutrition. 2003, 26: 1, 191-201; 25 ref.
LA: English
AB: A greenhouse study was conducted in sand cultures to compare the effects of saline irrigation waters applied by two different methods, flooding and above-canopy sprinkling, on selenium (Se) accumulation by the forage brassicas, kale (Brassica oleracea, cv. 'Premier') and turnip (B. rapa, cv. 'Forage Star'). The composition of the

irrigation water was designed to simulate saline (7 dS m-1) drainage effluent commonly encountered in the San Joaquin Valley of California, USA and being evaluated for reuse by irrigation of salt tolerant crops. The experimental design was a randomized complete block with two irrigation methods, two plant species (kale and turnip), four Se concentrations (0.25, 0.50, 1.0, and 2.0 mg L-1 Se-SeO42-), and three replications. Kale was generally a more efficient Se accumulator than turnip. Shoot Se concentrations in kale and turnip increased with increasing Se in the irrigation waters regardless of irrigation method. Selenium was readily taken up by the leaves of the sprinkled plants to give shoot-Se concentrations that were two- to three-fold higher than in plants of the same cultivar grown under flood irrigation. Both kale and turnip can accumulate Se to concentrations that would be toxic to animals if exclusively fed this material. These Se-enriched forages may be useful as an additive to Se-deficient fodders in order to meet the nutritional requirements of livestock. The potential for phytoremediation of Se contaminated soils or waters is greatly enhanced by sprinkler irrigation via the mechanism of foliar absorption of Se. This enhanced uptake is especially important in the presence of elevated sulfate concentrations, which normally reduce Se uptake by plants.

TI: Water relations, photosynthesis and nitrogen metabolism of Indian mustard (Brassica juncea Czern & Coss) grown under salt and water stress.
AU: Burman-U; Garg-BK; Kathju-S
SO: Journal-of-Plant-Biology. 2003, 30: 1, 55-60; 21 ref.
LA: English
AB: Indian mustard cv. B10-902 plants irrigated with water of varying salinity (0, 4, 8 and 12 dS m-1) were subjected to water stress at vegetative (40 DAS) and flowering (60 DAS) stages by withholding irrigation. There was detrimental effect due to both salinity and drought on plant water status, net photosynthesis, leaf metabolite levels and nitrate reductase activity at both the growth stages. However, plants irrigated with saline water (up to 8 dS m-1) when subjected to drought maintained higher plant water potential and relative water content and displayed higher photosynthetic rates, total chlorophyll, starch, soluble protein as well as higher nitrate reductase activity compared to those irrigated with normal water and subsequently droughted. The beneficial effects of salinity on plants under water stress have been attributed to decreased rate of water use because of reduced leaf area leading to slow development of water stress besides prior osmotic adjustment in salinized plants. Furthermore, saline water-irrigated plants when subjected to drought also produced significantly higher seed yield and dry matter production than non-salinized droughted plants. However, salinity-induced gain under drought conditions was limited up to 8 dS m-1 EC. These results indicate that although irrigation of mustard with saline water inhibits plant growth, it also inhibits water loss and allows a greater degree of osmotic adjustment so that plants are able to continue grow longer.

TI: Irrigation of broccoli and canola with boron- and selenium-laden effluent.
AU: Banuelos-GS
SO: Journal-of-Environmental-Quality. 2002, 31: 6, 1802-1808; 43 ref.
LA: English
AB: Selenium (Se), boron (B), and salinity contamination of agricultural drainage water is potentially hazardous for water reuse strategies in central California, USA. To demonstrate the feasibility of using plants to extract Se from drainage water, Se accumulation was determined in rape (Brassica napus [B. napus var. oleifera]) and broccoli (B. oleracea [B. oleracea var. italica]) irrigated with drainage effluent in the San Joaquin Valley, California. In the 2-year field study (1998-99), both crops were irrigated with a typical drainage water containing Se (150 µg litre-1), B (5 mg litre-1), and a sulfate dominated salinity (EC of 7 dS m-1). Total dry matter yields were at least 11 t ha-1 for both rape and broccoli, and plant tissue Se concentrations did not exceed 7 mg kg-1 DM for either crop. Based on the amount of soluble Se applied to crops with drainage water and the estimated amount of soluble Se remaining in soil to a depth of 90 cm at harvest, both rape and broccoli accumulated at least 40% of the estimated soluble Se lost from the soil for both years. Applied Se not accounted for in plant tissue or as soluble Se in the soil was presumably lost by biological volatilization. This study suggests that irrigating two high value crops such as rape and broccoli with Se-laden effluent helps manage Se-laden effluent requiring treatment, and also produces economically viable Se-enriched crops. Future research should focus on managing residual salt and B in the soil for sustaining long time water reuse strategies.

TI: Salt tolerance potential in different Brassica species, growth studies.

AU: Ashraf-MY; Wahed-RA; Bhatti-AS; Baig-A; Aslam-Z; Hamdy-A (ed.); Leith-H (ed.); Todorovic-M (ed.); Moschenko-M
SO: Halophyte uses in different climates. II. Halophyte crop development: pilot studies. Proceedings of the 3rd seminar of the EU Concerted Action Group IC 18CT 96-0055 Florence, Italy, 20 July 1998. 1999, 119-125; Progress in Biometeorology Vol. 14; 10 ref.
PB: Backhuys Publishers; Leiden; Netherlands
LA: English
AB: Salt tolerance potential of twelve cultivars from Brassica napus, B. carinata, B. compestris, B. juncea and Raphanus raphanistrum was assessed in a field experiment conducted at the Biosaline Research Station-II, Pacca Anna, Pakistan. Experiment consisted of four treatments with four replications. Cultivars Sheiaralle (B. napus), Peela Raya (B. carinata) and RL-18 (B. juncea) produced significantly greater yield and yield parameters and were more salt tolerant than the other cultivars. Growth and yield were reduced with the severity of salinity in all cultivars.

TI: Ionic accumulation of seed and stage sensitivity in Brassica spp. under saline irrigation.
AU: Kuhad-MS; Pratibha-Singh; Nandwal-AS; Narender-Singh; Singh-P; Singh-N; Faroda-AS (ed.); Joshi-NL (ed.); Kathju-S (ed.); Amal-Kar
SO: Recent advances in management of arid ecosystem. Proceedings of a symposium held in India, March 1997. 1999, 277-282; 11 ref.
PB: Arid Zone Research Association of India; Jodhpur; India
LA: English
AB: Accumulation of minerals in seeds of Brassica juncea cv. Kranti and Brassica carinata cv. HC-2 plants grown in pots with different levels of salinity (2, 5, 9, 6, 14.2 and 18.1 dS/m) applied at sowing, stem elongation, branching and siliqua initiation was estimated at physiological maturity. With saline water application, Na+, K+, Ca2+, Cl- and SO42- contents increased significantly in seeds of both species with increasing salinity level, but Mg2- content exhibited a marked decline. Accumulations of K+ and SO42- were considerably greater than the other ions. Even with Cl--dominated salinity, SO42- concentration in seeds was 8-12 times higher than the Cl- content. Salinity level of 9.6 dS/m proved to be the critical value. Saline water application from seedling to maturity stage was equally detrimental to both species. Salinity commencing at the siliqua initiation stage of cv. Kranti, and stem elongation and branching stages of cv. HC-2, resulted in seed yield reductions of less than 50% over controls.

CAPSICUM

TI: Salinity tolerance of pepper grown under protected conditions.
OT: Tolerancia do pimentao a salinidade sob condicoes de cultivo protegido.
AU: Medeiros-JF-de; Cruciani-DE; Folegatti-MV; Miranda-NO; de-Medeiros-JF
SO: Engenharia-Agricola. 2002, 22: 2, 200-210; 21 ref.
LA: Portuguese
LS: English
AB: This study investigates the salinity tolerance of pepper (Capsicum annuum) grown under different irrigation water salinity levels (1.29, 2.54 and 4.45 dS m-1) and amount of water (100, 115 and 130% of actual evapotranspiration). The linear effect was negative for pepper yield and positive for soil salinity with increasing irrigation water salinity. The salt tolerance of pepper (1.81 dS m-1) at initial yield decrease, and 16.0% as the yield decrease per dS m-1 increase beyond salinity threshold.

TI: Physiological and biochemical mechanisms leading to blossom-end rot in greenhouse-grown peppers, irrigated with saline solution.
AU: Aktas-H; Karni-L; Aloni-B; Bar-Tal-A; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 81-84; 12 ref.
LA: English

AB: Blossom-end rot (BER) is a fruit physiological disorder that occurs under salinity stress and is known to be associated with impairment of calcium translocation to the fruit tip. In the present study, we investigated the possibility that oxidative stress is part of the causative mechanism of BER in pepper (Capsicum annuum). Pepper plants of two cultivars (Selica and 107, insensitive and sensitive to BER, respectively) were grown in a greenhouse and irrigated with nutrient solution made up with either desalinated water (control; electrical conductivity (EC) 1.9 dS/m), or saline water (EC 3.7-7.0 dS/m). Irrigation was applied by a circulation system. BER symptoms were observed in 107 throughout the experiment, while in Selica, the amount of BER was minimal. BER occurrence was significantly increased under salinity in the sensitive but not in the insensitive cultivar. The fruit calcium concentration in both sensitive and resistant cultivars was not changed by salinity. The oxidative stress-related enzymatic activities in the fruits were dependent on the fruit developmental stage. Under salinity, oxygen radical and hydrogen peroxide production, and NAD(P)H oxidase activity were all enhanced at the most sensitive developmental stage. In contrast, the antioxidative activities of superoxide dismutase and catalase were not affected by salinity. The results suggest that generation and scavenging of oxygen free radicals may be part of the mechanism that leads to the appearance of BER symptoms in pepper fruits under saline conditions. We suggest that measures to alleviate oxidative stress in greenhouses would reduce the risks of BER in peppers.

TI: Managing of circulated nutrient solutions with saline water for pepper cultivation.
AU: Cohen-S; Offenbach-R; Suriano-S; Aloni-B; Karni-L; Bar-Tal-A; Keinan-M; Maduel-A; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 349-354; 12 ref.
LA: English
AB: The objective of this programme is to optimize the greenhouse production of peppers (Capsicum annuum) by the use of circulating nutrient solution with local and desalinized water. To determine the effect of circulating untreated local water on pepper yield and to monitor the changes in the water salinity and mineral composition, two salinity levels in the source water were tested, 1.9 and 3.7 dS m-1, and the corresponding upper critical points for water replacement were set at 3.0 and 5.5 dS m-1, respectively. Under high-salinity treatment, water reduced the fruit yield significantly by 8.5%. This was less than the effect expected on the basis of literature, and there was no influence on fruit physiological disorders. No effect on plant transpiration was detected. As the salinity of the solution increased, the Cl concentrations in all plant organs increased significantly, while nitrate concentrations decreased. The influence of the treatments on other mineral concentrations in plant organs was smaller and in most cases insignificant. The amounts of water that were displaced during 237 days of cultivation, to meet the critical set points for the low- and high-salinity treatments were 232 and 648 litres m-2 (22 and 46% of the applied water), respectively. The salinity of the solution in the treatments irrigated with untreated water increased rapidly in spring and summer mainly because of increases in Cl, SO4, Na and Ca. Our future investigation will be focused on different mixtures of desalinized and untreated saline water, with different critical values of the salinity set point, for economic optimization of water resources management.

TI: Physiological responses of pepper to salinity and drought.
AU: Pascale-S-de; Ruggiero-C; Barbieri-G; Maggio-A; de-Pascale-S
SO: Journal-of-the-American-Society-for-Horticultural-Science. 2003, 128: 1, 48-54; many ref.
LA: English
AB: Production of vegetable crops can be limited by saline irrigation water. The variability of crop salt tolerance under different environmental conditions requires species-specific and environment-specific field evaluations of salt tolerance. Data on field performances of vegetable crops grown on soils that have been irrigated with saline water for many years are lacking. In this study we analyzed the long-term effect of irrigation with saline water on soil properties and on responses of field-grown pepper (Capsicum annuum L.) plants in these soils. Yield, gas exchanges, water relations, and solute accumulation were measured in plants grown under three different irrigation treatments: a nonsalinized control (ECw=0.5 dS.m-1) and two concentrations of commercial sea salt, corresponding to ECw of 4.4 and 8.5 dS.m-1, respectively. In addition, a nonwatered drought stress treatment was included. Irrigation water with an EC of 4.4 dS.m-1 resulted in 46% reduction in plant dry weight (leaves plus stem) and 25% reduction in marketable yield. Increasing the electrical conductivity of the irrigation water to 8.5 dS.m-1 caused a 34% reduction in plant dry weight and a 58% reduction in marketable yield. Leaf and root

cellular turgor and net CO2 assimilation rates of leaves in salt-stressed plants decreased along with a reduction in leaf area and dry matter accumulation. High concentrations of Na+ and Cl- in the irrigation water did not significantly alter the level of K+ in leaves and fruit. In contrast, drought stressed plants had higher concentrations of leaf K+ compared to well watered control plants. These results indicate that Na+ and K+ may play similar roles in maintaining cellular turgor under salinity and drought stress, respectively. The regulation of ion loading to the shoots was most likely functionally associated with physiological modifications of the root/shoot ratio that was substantially smaller in salinized vs. drought stressed plants. From an agronomic perspective, irrigation with moderately saline water (4.4 dS.m-1) it is recommendable, compared to no irrigation, to obtain an acceptable marketable yield in the specific environment considered.

TI: Best management practices for reducing nitrogen pollution under irrigated sweet pepper with treated wastewater.
AU: Mojtahid-A; Lamiri-M; Choukr-Allah-R; Hamdy-A; El-Omari-H; Ragab-R (ed.); Pearce-G (ed.); Kim-JC (ed.); Nairizi-S (ed.); Hamdy-A
SO: 52nd IEC Meeting of the International Commission on Irrigation and Drainage, Seoul, Korea Republic, 19-20 September 2001. 52nd-IEC-Meeting-of-the-International-Commission-on-Irrigation-and-Drainage.-International-Workshop-on-Wastewater-Reuse-Management,-Seoul,-Korea,-19-20-September,-2001. 2001, 55-62; 6 ref.
PB: Korean National Committee on Irrigation and Drainage (KCID); Gyonggi-do; Korea Republic
LA: English
AB: Proper water management is needed for irrigation with treated wastewater to optimize nitrogen application and reduce the risk of groundwater nitrate pollution. An experiment was conducted on sandy soil at Ben Sergao using pepper (Dragon variety) as an indicator to investigate two irrigation regimes 100% and 120% ETM and two water resources: treated wastewater and saline artesian water supplied with fertilizers. There were two modes of water application:- (1) irrigation using both water sources, and (2) irrigation alternating with both water sources. The study showed that the chemical composition of the irrigation water source needs to be fully considered in order to avoid long-term environmental risks. The use of saline artesian water showed a long-term risk of soil salinization. Irrigation using treated wastewater risks nitrate contamination of groundwater. The results clearly demonstrate that irrigation through alternation is highly recommended as a proper irrigation practice and management approach. The approach better conserves the environment, by reducing the nitrogen load of the groundwater, and effectively reducing the salt concentration in both soils and groundwater.

TI: Use of Bacillus subtilis as biocontrol agent. IV. Salt-stress tolerance induction by Bacillus subtilis FZB24 seed treatment in tropical vegetable field crops, and its mode of action.
AU: Bochow-H; El-Sayed-SF; Junge-H; Stavropoulou-A; Schmiedeknecht-G
SO: Zeitschrift-fur-Pflanzenkrankheiten-und-Pflanzenschutz. 2001, 108: 1, 21-30; 10 ref.
LA: English
LS: German
AB: The rhizobacterium B. subtilis FZB24 registered as biological control agent was field tested as a promoter for salt-tolerance in two cultivars of eggplant (Black Beauty and Long Purple) and pepper (Capsicum annuum cultivars California Wonder and Hungarian Wax) in saline soil in the Sinai region (Egypt) under the condition of irrigation with ground saline water. The use of B. subtilis for root bacterization was realized by watering the seedlings with bacterial spore-(preparation-)suspension, titer 108 spores/ml. Starting from 8 weeks after transplanting and for 4 weeks, fruit yield (kg/m2), number of fruits/plant, average fruit fresh weight, dry weight percentage and fruit size were evaluated. Compared with the unsaline-irrigated control, the yield was reduced in both vegetable crops in all used cultivars, due to irrigating the plants with saline groundwater to more than 90%. By using B. subtilis FZB24 in the plots irrigated with saline groundwater, the yield increased up to 550% in eggplants, and up to 430% in the pepper cultivars, compared with unbacterized plants. Also in the other plant growth parameters, significant promotions could be found in the bacterized plants in the saline plots. So, the bacterization caused 50 and 25% reduction in salinity effect on the yield of eggplants and pepper, respectively, and consequently resulted in a remarkable salt-stress tolerance induction, which varied its degree according to the plant species used. To have insight on the mode of actions of the salt stress tolerance-inducing effect of B. subtilis FZB24, model experiments have been conducted with auxin precursors and IAA in tomato seedlings under controlled, axenic conditions and under salt-stress conditions similar to the field experiment. Up to now, it has

been hypothesized for the mode of action of B. subtilis FZB24, which acts as plant growth and health promoter, and stress tolerance inducer, that the given bacterial production of auxin and auxin precursors during root colonization induces a push in the plant auxin synthesis with changing regulation of the appropriate mechanisms. In the model experiments, the pretreatment of seedlings with millimolar amounts of auxin precursors, tryptophan, indole-3-pyruvic acid or indole-3-acetic aldehyde, 75% growth reduction in untreated seedlings under salt stress could be compensated completely after 1 week. That was not observed to the same degree after preapplication of auxin (IAA). So, the presented model experiment could support the hypothesis of salt-stress tolerance induction in B. subtilis FZB24-treated plants. The results are discussed from the aspect of a general anti-stress effect of B. subtilis FZB24.

TI: Effects of irrigating pepper (Capsicum annuum L.) plants with saline water on plant growth, water use efficiency, and marketable yield.
AU: Pascale-S-de; Ruggiero-C; Barbieri-G; de-Pascale-S; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 687-695; 12 ref.
LA: English
AB: The effects of drip irrigation with saline water at five different concentrations (0, 0.125, 0.25, 0.5 and 1% NaCl) and three different irrigation levels (100, 75 and 50%, of Class A Pan evaporation between irrigations) on plant growth, gas exchanges and yield were investigated in field-grown pepper plants (Capsicum annuum cv. Laser). Both salinity and water stress limited plant gas exchanges and reduced growth, and increased the concentrations of Na+ and Cl- ions in the plant's vegetative and reproductive tissues. However, the effects of salinity stress were mostly apparent at higher salinity levels (0.5 and 1% NaCl), regardless of irrigation levels. For example, salt effects on net assimilation rates were greater than on plant transpiration rate, which resulted in lower water use efficiencies in plants irrigated with water containing high concentrations of salt (_0.5% NaCl). Furthermore, yield (quantified as individual fruit weights and number of fruit per plant) was only significantly reduced by salinity stress when concentrations were greater than 0.25% NaCl and soil electrical conductivities were less than 4 dS m-1 in the root zone. Limited amounts of saline irrigation water can be used for growing peppers for commercial production, even when less than optimal levels of water are applied.

TI: Use of brackish water in raising chillies in red soil
AU: Sundaravadivel,-K.; Muthusamy,-P.; Krishnasamy,-R.; Ramamoorthy,-S.; Periasamy,-M.
AD: Tamil Nadu Agricultural Univ., Agricultural Research Station, Kovilpatty 627701, Tamil Nadu, India
SO: Madras-Agricultural-Journal (India).
1996, v. 83(1) p. 37-39; Jan, tables, 3 ref.; summary (En)
LA: English
AB: The effect of brackish water on the yield of chillies was studied on a red soil in Tamil Nadu, India. Gypsum was applied to the surface of the soil during May and June for effective desalinization of the soils irrigated with high EC (electrical conductivity) waters. Cultivation in raised bed and gypsum addition to irrigation water significantly influenced the dry pod yield of chillies. Gypsum applied to irrigation water gave better results than when applied to the soil. A high chlorine content increased the EC in irrigation water, but did not affect the physical soil properties. Soil fertility and nutrient uptake were almost unaffected with the use of brackish water and addition of amendments to the soil and water.

TI: Sodium transport and distribution in sweet pepper during and after salt stress.
AU: Blom-Zandstra-M; Sonneveld-C (ed.); Berhoyen-MNJ
SO: Proceedings of the XXV International Horticultural Congress. Part 1. Culture techniques with special emphasis on environmental implications, nutrient management, Brussels, Belgium, 2-7 August, 1998. Acta-Horticulturae. 2000, No. 511, 205-211; 13 ref.

LA: English
AB: Na distribution and its transport-profile in Capsicum cv. Mazurka were investigated in plants grown in a nutrient solution containing 10 mM NaCl before and following transfer to Na-free nutrient solution. Capsicum plants tolerated Na stress very well. Na was efficiently kept out of the photosynthetic apparatus. Na was accumulated in root cells and in the pith cells of the stem, mostly in the basal part. Almost no Na was transported

to leaves or fruits. Na concentration of the xylem sap showed a concentration gradient decreasing towards the top of the plant. A split root experiment, in which a pulse labelling with radioactive Na was carried out, showed the involvement of phloem transport. During the salt stress period, Na was recirculated between phloem and xylem. Apparently, pith cells, the intermediates between the xylem and phloem veins, play a decisive role in the (re)circulation of Na through the plant. After transferring the plants to a sodium-free solution a fast release of Na occurred. A model for a general transport mechanism is presented. The consequences of Na release into the nutrient solution after a refreshment will be calculated for the situation in greenhouses.

TI: Effect of saline water irrigation at fruit maturity stage on transpiration rate and growth in sweet pepper (Capsicum annuum).
AU: Hirota-O; Villavicencio-E; Chikushi-J; Takeuchi-S; Nakano-Y
SO: Journal-of-the-Faculty-of-Agriculture,-Kyushu-University. 1999, 44: 1-2, 39-47; 11 ref.
LA: English
AB: The effect of saline water irrigation on growth of Capsicum was investigated for plants grown in pots containing sand. Plants with maturing fruits were irrigated every 3 days with 500 ml of saline water (saline content (or electrical conductivity) of 0.69% (6.95 mS/cm), 0.55 (5.68), 0.41 (4.42), 0.28 (3.12), or control (0.1)). Growth analyses were carried out after 22 days of treatment. Relative growth rate decreased with increasing salinity and was related to retardation of net assimilation rate (NAR). Leaf area ratio did not decrease with increasing salinity. Leaf expansion rate was inhibited by salinity. Salinity did not influence the growth balance between leaves and the other organs. Retardation of NAR was related to obstruction of stomatal conductance and transpiration.

TI: Impact of saline water by pitcher method on chillies production - a study.
AU: Vikram-Chauhan; Singhania-RA; Singh-AK; Ashok-Kumar; Chauhan-V; Kumar-A
SO: Indian-Journal-of-Agricultural-Research. 1999, 33: 1, 62-66; 7 ref.
LA: English
AB: This trial was conducted in Jobner (Rajasthan) in 1989 using the chilli [Capsicum] cultivar Pusa Jwala irrigated by the pitcher method (which has relatively low evaporation and leaching losses compared with other methods, and also uses less water). The lateral and vertical movement of moisture and soluble salts in the soil profile was monitored and the method was concluded to be very effective for chillies. It was also recommended that when using saline water, salt-resistant and shallow rooted crop such as chillies could be grown near the pitcher for effective utilization of saline and high residual sodium carbonate (RSC) water in sandy loam soil of arid and semiarid regions.

FRUITS AND FRUIT TREES

TI: Influence of the volume and salinity of irrigation water on winter melon (Cucumis melo inodorus Naud) grown under plastic tunnel.
AU: Incalcaterra-G; Curatolo-G; Iapichino-G; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 423-427; 10 ref.
LA: English
AB: The use of saline water has depressive effects on many crops and therefore it can be a major problem in those area of the Mediterranean region were vegetables are extensively grown and shortage of good quality water is very common. Plug type transplants of the Sicilian winter melon landrace 'Cartucciaro' were set in polyethylene tunnels at Trapani in the western coast of Sicily, Italy. Three volumes of irrigation water (20, 30, 40 litres per plant) at four salinity levels (control, 2, 4 and 6 per mil NaCl) were compared. Water was provided by a single application 50 days after transplanting. The vegetative parameters at 60 and 70 days after transplanting were slightly influenced by the treatments tested. At 80 days after transplanting, plant length was positively affected by increasing the amount of irrigation water, but was significantly reduced as salinity increased. Plants irrigated with 40 litres of saline water recorded higher early and total yields, and fruits of better quality than those irrigated with lower volumes of good quality water.

TI: Growth ability of mango cultivars irrigated with saline water.
AU: Morsy-MH; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 475-482; 21 ref.
LA: English
AB: Young mango plants of cultivars Alphonso, Taimour, Ewaise, Hindy Bisinnara and Zebda were irrigated with saline water at 0, 15, 30 or 45 mM NaCl to evaluate their growth ability under different salinity conditions. Nutrient solution salinity severely affected plant growth of all mango cultivars especially at its highest concentration (45 mM). Water salinity caused a significant reduction in stem thickness, number of leaves per plant and average leaf area. Root and shoot dry weight was decreased with increasing salinity in all cultivars, while root:shoot ratio was not affected. Negative salinity effects on the growth of all mango cultivars appeared at 30 mM or higher. Some of tested growth parameters of Alphonso were obviously affected with the least concentration (15 mM) of salinity, while salt symptoms occurred later (45 mM) with Zebda. Leaf chlorophylls a and b were measured three times during the season. Their degradation rate occurred rapidly with Alphonso, moderately with Taimour, Ewaise and Hindy Bisinnara, and slowly with Zebda. Based on the results, Zebda mangoes are the most tolerant to salinity, while Alphonso mangoes are the most sensitive.

TI: Germination of seeds and initial growth of passion fruit plants irrigated with saline water in different volumes of substrate.
OT: Germinacao de sementes e crescimento inicial de maracujazeiros irrigados com agua salina em diferentes volumes de substrato.
AU: Cavalcante-LF; Santos-JB-dos; Santos-CJO; Feitosa-Filho-JC; Lima-EM-de; Cavalcante-IHL; de-Lima-EM
SO: Revista-Brasileira-de-Fruticultura. 2002, 24: 3, 748-751; 15 ref.
LA: Portuguese
LS: English
AB: The effects of saline water and substrate volume were studied on germination of seeds of passion fruit (Passiflora edulis f. flavicarpa) yellow and purple cultivars. Saline water was used at 0.5, 1.0, 2.0, 3.0, 4.5 and 6.0 dS/m electric conductivity with substrate volumes of 0.34 and 1.41 litres. Saline water inhibited germination and the initial growth of passion fruit plants. The effects of salinity were greater on growth, in terms of height, stem diameter, leaf area and biomass, than on germination.

TI: Characterization of yellow passion fruit irrigated with saline water.
OT: Caracterizacao dos frutos de maracuja amarelo irrigados com agua salina.
AU: Costa-JRM; Lima-CA-de-A; Lima-EDP-de-A; Cavalcante-LF; Oliveira-FKD-de; de-A-Lima-EDP; de-Oliveira-FKD
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 2000, 5: 1, 143-146; 16 ref.
LA: Portuguese
LS: English
AB: Passiflora edulis plants were irrigated with saline water (10 or 5 litres) in a field experiment conducted in Santa Cruz, Rio Grande do Norte, Brazil. Planting pits were coated, uncoated or treated with side coatings (1, 2, 3 and 4 lateral sides). Water salinity higher than 3.0 dS/m did not show any effect on the external and internal quality of fruits. An increase in the water volume resulted in larger mean fruit weight.

TI: Short term effects of saline irrigation on evapotranspiration from lysimeter-grown citrus trees.
AU: Yang-ShengLi; Yano-T; Aydin-M; Kitamura-Y; Takeuchi-S; Yang-SL
SO: Agricultural-Water-Management. 2002, 56: 2, 131-141; 17 ref.
LA: English
AB: Eight-year-old Murcott orange trees grown in greenhouse lysimeters filled with sandy soil were subjected to irrigation with saline water to investigate the influence of salinity on daily evapotranspiration (ET). The study was conducted in Japan from 1 August to 15 September 2000. The study duration was divided into three periods of about 2 weeks each. In period I, all lysimeters planted with a tree were irrigated with 60 mm of non-saline water at the water content of 70% of field capacity (FC). Salinity treatments for period II started on 14 August. The treatments during period II were as follows: Lysimeter 1 (L1) had 32 mm non-saline water with an electrical conductivity (ECI) of 1.0 dS/m applied. At the same time Lysimeter 2 (L2) had 32 mm of saline water with an

ECI of 8.6 dS/m applied when the water content decreased to 70% of FC. Lysimeter 3 (L3) had 16 mm saline water (ECI=8.6 dS/m) applied at 85% of FC. The irrigation amounts during period II were equal to those corresponding to 1.2 times of water required to reach FC. Treatments in period III were the same as in period I. Daily ET was similar for all weighing lysimeters during period I. The average relative ET for L2 and L3 with respect to L1 (L2/L1 and L3/L1) were similar during this period, with a mean value of 0.99. During period II, ET from L1 was consistently higher than that from L2 and L3. In addition, L3 with a higher irrigation frequency because of irrigation at higher soil water content resulted in higher ET than L2. The average relative ET of period II was 0.71 and 0.88 for both L2 and L3. During the last half of period III, reductions occurred in the ET differences between the saline treatments (L2 and L3) and non-saline control (L1). Evaporation rates from soil did not exceed 0.7 mm per day. Transpiration rates from L1, L2 and L3 during period II varied between 6.3 and 3.1 mm per day, 4.5 and 2.2 mm per day, and 5.8 and 3.0 mm per day, respectively. The results reflected a tangible difference of water extraction by roots from individual soil layers. Maximum water uptake by these trees was observed at layer of 30-60 cm. Nevertheless, no clear differences in water extraction pattern between trees were observed. Approximately, 95% of drainage occurred during the first 2 days following irrigation. The electrical conductivity of soil water (ECS) and the electrical conductivity of drainage water (ECD) for the saline water treatments (L2 and L3), compared to the control (L1) were significantly different during period II. ECS values were 2-5 times higher in saline treatments compared to the control treatment. After irrigating trees with saline water, ECS increased from 5 to 14 and 16 dS/m in L2 and L3, respectively. Similarly, in both saline treatments, ECD values were greatly increased after irrigation. During period III, ECD values increased from 5 to 8 dS/m in L2, and from 3 to 11 dS/m in L3. By contrast, ECS declined from 14 to 5 dS/m in L2, and from 16 to 3 dS/m in L3 over the same period.

TI: Muskmelon production in soilless culture under saline irrigation practices and soil conditioner application.
AU: Hamdy-A; Ahmed-FT; Choukr-Allah-R; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 321-330; 13 ref.
LA: English
AB: The present work investigates soilless inert substrates and the use of saline water with 6.4 dS m-1 and of the soil conditioner, Barbary Plant G2, on water consumption, growing parameters, yield quality and quantity of muskmelon (Cucumis melo). The results point out the high potentiality of using saline water successfully for irrigation of muskmelon under soilless conditions. In average, the muskmelon water consumption was about 5066 m3 ha-1. The average yield of three successive harvests was around 65-89 t ha-1. The obtained yield, biomass and water use efficiency along with the results of plant growth parameters indicated that both sand and perlite are more appropriate than pozzolan for growing muskmelon in soilless conditions. The beneficial effect of the soil conditioner on the improvement of both plant growth parameters and yield are highly related to the physical characteristics of the inert substrate. The poorer are the physical properties of the substrate, the more evident is the role of the soil conditioner and vice-versa.

TI: Optimisation of the use of saline irrigation water for apricot trees.
AU: Volschenk-T; De-Villiers-J; Villiers-J-de
SO: 6th-International-Micro-irrigation-Congress-Micro-2000,-Cape-Town,-South-Africa,-22-27-October-2000. 2000, 1-10; 7 ref.
PB: International Commission on Irrigation and Drainage (ICID); Rome; Italy
LA: English
AB: Approximately 47% of apricot tree plantings in South Africa are located near Montagu and Barrydale in the Little Karoo region. Below average production in this area is due to deteriorating water quality in the Breede River and to increasingly saline groundwater from boreholes. The objective of this project was to establish whether international water guidelines for apricot are applicable under local conditions, and to provide appropriate guidelines for improving the management of saline water, increasing production and net farm incomes, and decreasing return flows to the river system. A drainage lysimeter was used to evaluate the effect of saline irrigation on apricot trees(Prunus armeniaca cultivar Palsteyn) over a period of four years in the Western Cape. Salinity levels included a control (municipal water) and target levels of 0.7, 1.0, 2.0, 3.0, 4.0 dS/m. Leaf

area duration decreased with increasing irrigation water salinity. Leaf water potential, leaf osmotic potential and relative water content of leaves decreased significantly with increased irrigation water salinity. The reduced canopy area in the higher salinity irrigation water treatments intercepted less light and led to reductions in water consumption, tree trunk growth and final fruit size. Irrigation water salinity levels of 1.0 dS/m (or higher) with a 0.1 leaching fraction led to soil water concentrations that exceeded the locally determined threshold salinity value of 3.0 dS/m for potential growth and yield decrement. Growers were therefore advised not to use irrigation water with salinity in excess of 0.71 dS/m for the irrigation of the Palsteyn apricot on Marianna rootstock (if a leaching fraction of 0.1 is applied).

TI: Rootstock/scion responses to variable salinity in irrigation water.
AU: Machacha-D; Pavel-EW; Laker-MC
SO: 6th-International-Micro-irrigation-Congress-Micro-2000,-Cape-Town,-South-Africa,-22-27-October-2000. 2000, 1-6; 10 ref.
PB: International Commission on Irrigation and Drainage (ICID); Rome; Italy
LA: English
AB: Saline borehole water (4-26 mM/l) has been used for irrigation during summer in some regions of Botswana. Pot experiments were conducted under field conditions to determine the likely effects. Stem water potential (covered leaves) and stomatal conductance were measured of two rootstocks (Rough Lemon and Swingle) using the cultivar 'Late Valencia' as scion. Trees were irrigated (with saline water) when the soil matric potential reached 30Kpa. The measurements indicated that the Rough Lemon rootstock was more salt-tolerant than Swingle. No significant differences in stomatal conductance were observed. Na and Cl concentrations of plant organs and soils showed that the rootstock stem of Rough Lemon accumulated significantly higher levels of chloride and sodium than the Swingle rootstock stem. These higher accumulations indicate that the rootstock prevented salts from being accumulated in the leaves, which would likely lead to reduced photosynthetic rates.

TI: The response of orchard citrus trees on different rootstocks to irrigation with saline water, evaluated by trickle linear gradient.
AU: Levy-Y; Lifshitz-J; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 629-640; 24 ref.
LA: English
AB: A salinity field experiment was constructed, using the salinity trickle linear gradient (TLG) method in five linear increments of salinity. In 1998 the average of the Cl- gradient was from 234 to 636 mg L-1. Grapefruit (Citrus paradisi) trees, grafted on eight rootstocks under two fertilization regimes, were evaluated in a complete factorial field experiment (80 combinations). Preliminary results changed the salinity tolerance ranking of the studied rootstocks, particularly sour orange (C. aurantium) and volkameriana (C. volkameriana). Significant interactions were found among the effects of rootstock, salinity and nutrition. These include: effects on tree development, leaf and fruit mineral contents, and fruit quality. The results confirm, under orchard conditions, that altering the nutritional regimes can reduce the chloride uptake of susceptible rootstocks, such as Troyer citrange (C. sinensis x Poncirus trifoliata).

TI: Cabbage yield response to salinity of trickle irrigation water.
AU: Beltrao-J; Faria-J; Miguel-G; Chaves-P; Trindade-D; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 641-645; 9 ref.
LA: English
AB: The objective of this work was to study the effect of saline water on the yield of cabbage (Brassica oleracea var. capitata) under two plant population density treatments (2 and 4 plants for each dripping point), applying an experimental design known as double emitter source (DES). A saline water gradient was created, shown by an electrical conductivity from 0.89 up to 10.98 dS m-1. Experiments were carried out in the Campus of Gambelas, University of Algarve, Faro, south Portugal. The results showed that for lower water salinity levels (from 1 up to 3 dS m-1), cabbage yield decreased about 40% at the higher plant population density. However, at the lower plant density, cabbage yield decreased only about 20%. Yield decreased almost linearly with the increase of salinity; however, between 1 and 6 dS m-1, yield reduction was higher, as well as from 9.6 up to 11 dS m-1. It was also

shown that the salinity threshold value was lower than 2 dS m-1. Regression lines had r2 values not lower than 0.80.

TI: Banana production irrigated with treated effluent in the Canary Islands.
AU: Palacios-MP; Haman-DZ; Del-Nero-E; Pardo-A; Pavon-N
SO: Transactions-of-the-ASAE. 2000, 43: 2, 309-314; 23 ref.
LA: English
AB: Bananas cv. Giant Cavendish were grown for 2 years under 4 different microirrigation (drip) water quality treatments. The treatments consisted of fresh groundwater (FW), fresh groundwater (70%) mixed with secondary effluent (30%) (FW+SE), desalinized secondary effluent (70%) mixed with secondary effluent (30%) (DSE+SE), and desalinized secondary effluent (DSE). The experimental design was a Randomized Complete Block (RCB) design with 3 replications and 4 treatments. The production was under greenhouse conditions, typical for Gran Canaria, Canary Islands. Plants were grown following typical water and fertilizer application used by the best growers on the Island. Productivity of banana plants, estimated as mean bunch weight, was significantly affected by water quality. Plants irrigated exclusively with desalinated secondary effluent showed significantly lower yield than those irrigated using fresh water. Desalinized secondary effluent had most of the salts removed; however, this treatment had the highest levels of sodium adsorption ratio. There was no significant difference in yield in the 2 higher salinity treatments and the 30% addition of secondary effluent did not negatively impact plant growth or banana yield as compared with the FW treatment.

TI: Vineyard soil degradation following irrigation with saline groundwater for twenty years.
AU: Clark-L; Fitzpatrick-R; McCarthy-M; Murray-R; Chittleborough-D
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002.
2002, 1469; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033436

TI: Melon productive behavior in relation to water salinity and irrigation frequency.
OT: Comportamento produtivo do meloeiro em relacao a salinidade e frequencia de irrigacao.
AU: Barros-AD-de; Sousa-A-de-P; Medeiros-JF-de; de-P-Sousa-A; de-Barros-AD; de-Medeiros-JF
SO: IRRIGA. 2003, 8: 1, 44-50; 12 ref.
LA: Portuguese
LS: English
AB: A study was conducted in loamy sandy soils in Rio Grande do Norte, Brazil, to determine the effect of different water salinity levels in terms of electrical conductivity (1.1, 2.5 and 4.5 dS/m) and 2 irrigation frequencies (1 and 2 days) on honeydew melon (cv. Orange Flesh) and cantaloupe melon (cv. Trusty) production. Melon production was still economically feasible at irrigation water salinity levels of 1.1 dS/m up to 2.5 dS/m. The cv. Orange Flesh seemed to be more sensitive to the salt effects than cv. Trusty in all parameters studied. The cv. Trusty was observed to be more tolerant to the deleterious effect of salinity, indicated by the decrease in productivity only at the 4.5 dS/m salinity level.

TI: Growth of yellow melon cultivars irrigated with saline water.
OT: Crescimento de cultivares de melao amarelo irrigadas com agua salina.
AU: Alencar-RD; Porto-Filho-F-de-Q; Medeiros-JF-de; Holanda-JS-de; Porto-VCN; Ferreira-Neto-M; de-Q-Porto-Filho-F; de-Medeiros-JF; de-Holanda-JS
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 2003, 7: 2, 221-226; 17 ref.
LA: Portuguese
LS: English

AB: The effects of five irrigation water salinity levels (N: 1.51, 2.79, 3.93, 5.15 and 7.22 dS/m), on the initial development of two yellow melon cultivars (Gold mine and AF646) were studied in a field experiment conducted in the State of Rio Grande do Norte, Brazil from 4 November to 12 December 1998. Plastic pots with 9-litre capacity filled with alfisol soil (horizon Ap1) were used. Shoot dry matter, leaf area, mean soil salinity and final soil salinity were evaluated using variance and regression analysis. Salinity tolerance was similar for Gold mine and AF646, with a loss of 6.8% in the shoot dry matter for every unit increase in the electrical conductivity of irrigation water. A similar behaviour was observed for leaf area. Irrigation water salinity induced linear effects on mean soil salinity and quadratic effects on final soil salinity.PT: Journal-article
AN: 20033209508

TI: Effect of drip irrigation with saline water on water use efficiency and quality of watermelons.
AU: Lei-TingWu; Xiao-Juan; Li-GuangYong; Mao-JianHua; Wang-JianPing; Liu-ZhiZhong; Zhang-JianGuo; Lei-TW; Xiao-J; Li-GY; Mao-JH; Wang-JP; Liu-ZZ; Zhang
-JG
SO: Water-Resources-Management. 2003, 17: 6, 395-408; 14 ref.
LA: English
AB: High ground water salinity, high water table and secondary soil salinization are dominant in the Hetao Region, China. For the purposes of eliminating secondary salinity and enhancing water use efficiency, drip irrigation of watermelons with saline water was conducted in order to reduce ground water level and soil salinization. Saline groundwater, ranging in salinity from 3.3 dS m-1 in the early season to 6.3 dS m-1 at the harvest time was used. Four irrigation treatments (control, 30, 60, and 90% of evaporation from Chinese Evaporation Pan) were used in the experiments. The control treatment was not irrigated through out the season, as is the local practice. The yield of watermelons was increased and the quality improved under drip irrigation, as compared with control, with the highest increases in both yield and quality in the 60% treatment. The water use efficiency as determined by lysimeter measurements for different treatments had the same trend. The water-product efficiency in the four treatments were 39.2, 30.7, 21.45, and 14.3 kg m-3, respectively. Salts accumulated in the topsoil layer close to the emitter in the 30% treatment. Most salts were leached out of the root zone in the 60 and 90% treatments. The results suggested that drip irrigation of watermelon with saline water was feasible.PT: Journal-article
AN: 20033215939

TI: Effect of saline conditions on nutritional status and fruit quality of satsuma mandarin cv. Owari.
AU: Hepaksoy-S; Aksoy-U; Can-HZ; Okur-B; Kilic-CC; Anac-D; Anac-S; Anac-D (ed.); Martin-Prevel-P
SO: Improved crop quality by nutrient management. 1999, 121-125; 13 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: In Buyukalan-Gumuldur,Turkey, 12 satsuma orchards were sampled in 1996 and 1997 to determine the effect of irrigation water salinity on fruit quality and tree nutritional status. There is a problem with groundwater salinization in this area due to seawater intrusion. As fruit quality parameters, average fruit weight, total soluble solids (TSS), titratable acidity (as % citric acid) and CI content of the fruit juice and crude fibre of the pulp were analysed. In addition, sugar composition was determined by gas chromatography. Sodium, potassium, calcium and chloride contents were analysed in leaves and irrigation water. Water samples were taken towards the end of the irrigation period. Leaf samples were taken during the fruit ripening period (end of October). Data are tabulated.

TI: Potassium and leaf water relations under saline conditions.
AU: Anac-A; Aksoy-U; Anac-S; Hepaksoy-S; Can-Z; Ul-MA; Dorsan-F; Okur-B; Kilic-C; Johnston-AE
SO: Essential role of potassium in diverse cropping systems. Workshop C organized by the International Potash Institute at the 16th World Congress of Soil Science, Montpellier, France, 20-26 August 1998. 1999, 47-56; 11 ref.
PB: International Potash Institute (IPI); Basel; Switzerland
LA: English
AB: In field experiments with satsuma mandarins (var. Owari) fertigated with 3 rates of K and irrigated with different levels of saline water, application of 100 g K/tree increased net CO2 assimilation, decreased relative

turgidity, leaf K values and stomatal density. It is concluded that long term valuation of the effects of K and salinity will provide valuable information on leaf gas exchange properties.
PT: Conference-paper

TI: Salinity duration and concentration affect fruit yield and quality, and growth and mineral composition of melon plants grown in perlite.
AU: Amor-FM-del; Martinez-V; Cerda-A; del-Amor-FM
SO: HortScience. 1999, 34: 7, 1234-1237; 18 ref.
LA: English
AB: The shortage of good quality water in semiarid zones necessitates the use of saline water for irrigation. In order to simulate the usage of brackish irrigation water in greenhouse melon (cv. Galia) culture in perlite, plants were supplied with nutrient solutions containing 0 (control), 20, 40 and 60 mM NaCl applied at 4 different times. Treatments were applied during early vegetative growth (14 days after transplanting (DAT)), beginning of flowering (37 DAT), beginning of fruit set (56 DAT), and beginning of fruit ripening (71 DAT). All vegetative and fruit yield parameters were significantly reduced when salinization was started 14 DAT. This inhibitory effect of salinity was progressively lessened when salinity was imposed at later dates. This suggests that the response of melons to salinity depends on the duration of exposure to saline water. Salinity treatments increased fruit reducing sugars, acidity, and total soluble solids. Fruit yield reduction at each salinization time was correlated with salinity levels, but there was some evidence of a nutrient imbalance, since leaf concentrations of N-NO3, and especially K, were low at higher salinities. These results indicate that brackish waters can be used for growing melon with minimum yield losses if concentration and duration of exposure are carefully monitored.

TI: The response of several Citrus genotypes to high-salinity irrigation water.
AU: Levy-Y; Lifshitz-J; Malach-Y-de; David-Y; de-Malach-Y
SO: HortScience. 1999, 34: 5, 878-881; 33 ref.
LA: English
AB: The effect of irrigation with saline water on 6 citrus genotypes was evaluated in a short-term field experiment at the Ramat haNegev Desert Agro-Research Centre. Salinity levels ranged from 2.0 to 6.4 dS.m-1. Salt-tolerant Citrus species and Citrus X Poncirus hybrids were tested for their possible use as rootstocks for commercial citrus cultivars irrigated with brackish water. All tested genotypes survived the highest salinities. At all salinity levels, the best chloride excluder was Cleopatra mandarin (Citrus reshni), and the worst was sour orange (C. aurantium). Gou Tou Cheng (C. aurantium hybrid) and Rangpur (C. limonia) X Troyer citrange (C. sinensis X Poncirus trifoliata) RT803 were promising genotypes for further evaluation as rootstocks tolerant to high salinities.

TI: Saline water improves grapevine quality.
AU: Lavie-D
SO: International-Water-and-Irrigation-Review. 1999, 19: 3, 14-15.
LA: English
AB: Research was conducted into the use of saline groundwater for the irrigation of grapevines in the Negev Desert and the Ramat Hanegev area, Israel. It was shown that wine produced from these regions were of equal quality to normally irrigated vines, and in some cases, of superior quality.

TI: Effect of three sodium salts on vegetative growth and mineral composition of stone fruit rootstock seedlings.
AU: El-Azab-EM; El-Kobbia-AM; El-Khayat-HM
SO: Alexandria-Journal-of-Agricultural-Research. 1998, 43: 3, 219-229; 19 ref.
LA: English
LS: Arabic
AB: In greenhouse experiments, bitter almond (Prunus amygdalus [Prunus dulcis]), Balady apricot (P. armeniaca) and Balady and Nemaguard peach (both P. persica) rootstock seedlings were irrigated during 1990 and 1991 with solutions of NaCl, Na2CO3 or Na2SO4 (each at 1500 ppm). Seedlings irrigated with NaCl, Na2CO3 or Na2SO4 had significantly lower growth rates than those irrigated with tap water (control). Of the Na salt treatments, seedling growth was lowest in the NaCl treatment, and highest in the Na2SO4 treatment. Bitter

almonds achieved the highest growth rates, while Balady apricot and Balady peach seedlings were the slowest growing. Leaf and root Na contents increased significantly in seedlings irrigated with the three Na salts, especially in those given NaCl. The highest leaf Na and Cl contents were found in Balady peach, while the lowest were in Bitter almond rootstock seedlings. Leaf and root P and K contents were reduced by irrigation with NaCl solution, but not by irrigation with the other Na salts. In both seasons, the NaCl treatment caused a noticeable reduction in leaf Mg content. The same negative response was observed to Na2CO3 in 1990 and to Na2SO4 in 1991. However, root Mg content was higher when seedlings were irrigated with saline water, irrespective of the salt.

TI: Irrigation of grapevines with saline water at different growth stages. 1. Effects on soil, vegetative growth, and yield.
AU: Stevens-RM; Harvey-G; Partington-DL; Coombe-BG
SO: Australian-Journal-of-Agricultural-Research. 1999, 50: 3, 343-355; 40 ref.
LA: English
AB: Mature field-grown grapevines (cv. Colombard on Ramsey rootstock) grown in a semi-arid climate (South Australia) were irrigated with saline water during any one of 4 growth stages within the season: pre-flowering, during berry development, during berry ripening, and postharvest. At other times, plots were irrigated with river water (EC 0.5 dS/m) as was the control throughout the season. Saline water (EC 3.5 dS/m) with a high sodium absorption ratio was produced by addition of sodium chloride. Soil cation exchange capacity was 14 cmolc/kg, and at the end of the trial, the soil exchangeable sodium percentage in the control was 6%, in the treatment salinized pre-flowering 13%, during berry development 20%, during berry ripening 20%, and postharvest 19%. Treatments were applied for 6 consecutive seasons. Vines were highly productive, with the average yield in the control equal to 62 t/ha of grapes. Saline irrigation caused significant, but small, declines in yield in 3 seasons, in pruning weights in 2 seasons, and in berry weights in 4 seasons. Effects on growth, once established, often persisted unchanged through one or more subsequent seasons of saline irrigation. The growth stage shown to be most sensitive to saline irrigation was berry development; saline irrigation during berry development reduced the yield by 7% and during berry ripening by 3%, and pre-flowering it reduced the berry weight by 1%, during berry development by 6%, and during berry ripening by 4%. The amounts of irrigation applied in each of the 4 growth stages were not equal, and hence, treatments did not receive equal additions of salt. Normalizing data to remove this effect showed that the rate of yield decline per unit dS/m increase in the seasonal average salinity during berry development, 7%/dS m, was 3-fold greater than the 2%/dS m during berry ripening.

Response of muskmelon plants (Cucumis melo, L.) to irrigation with saline water.
AU: Amor-FM-del; Carvajal-M; Martinez-V; Cerda-A; del-Amor-FM; Marcelis-LFM
SO: Second International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation, Wageningen, Netherlands, 25-28 August 1997. Acta-Horticulturae. 1998, No. 456, 263-268; 11 ref.
LA: English
AB: Adult greenhouse melon plants were irrigated with saline water for 3 different periods. Irrigation with saline water reduced leaf area, plant height, total number of nodes, distance between nodes, stem diameter of the top of the plant, fruit weight and number of fruits/plant, compared with controls. Fruits from treated plants had higher total soluble solids, acidity and glucose contents than fruits from control plants. The decrease in fruit yield observed after salt treatment could be compensated for by the increase in quality, depending on the time of salinity application.

TI: Effect of water salinity on Thielaviopsis paradoxa and growth of date palm seedlings.
AU: Al-Rokibah-AA; Abdalla-MY; El-Fakharani-YM
SO: Journal-of-King-Saud-University,-Agricultural-Sciences. 1998, 10: 1, 55-63; 12 ref.
LA: English
LS: Arabic
AB: T. paradoxa [Ceratocystis paradoxa], the causal agent of black scorch, was isolated from rotted roots and leaves rachis tissues obtained from date palm trees showing characteristic disease symptoms in Saudi Arabia. Results of artificial inoculation of P. dactylifera seedlings of 10 different cultivars (Helwa, Kuereia, Maktoomy, Nabat Aly, Om-Khashab, Roshody, Rothan, Sabaka, Shagra ans Sukkary) revealed that Nabtat Aly and Om-

Khashab were more susceptible than the other tested cultivars. Increased water salinity (12.9 ds/m) reduced growth of date seedlings as expressed by length or fresh weight of the seedlings. Growth and sporulation of C. paradoxa decreased as the conductivity levels in the solid agar media increased. However, fungal growth was not dramatically inhibited even at the highest conductivity level tested (30.9 ds/m). Increasing the salinity levels (1.4 (tap water), 6.9, 12.9, 18.4, 26.5 ds/m) of the water used for irrigation of 6-month-old seedlings, tended to increase the infection rate of inoculated seedlings compared with the control. It is concluded that fluctuations in water salinity levels along with varietal resistances may contribute to the sporadic occurrence of C. paradoxa in the field.

BEET

TI: Effect of ground water depth and irrigation with saline water on sugar beet. II: Chemical constituents.
AU: Shehata-MM
SO: Egyptian-Journal-of-Agricultural-Research. 1999, 77: 4, 1675-1686; 22 ref.
LA: English
LS: Arabic
AB: The effects of salt concentration in irrigation water (tap water, 2000 and 4000 ppm) and groundwater table depth (40, 70 and 100 cm from the surface) with respect to their interaction on chemical composition of sugarbeet cv. Despres Poly N were studied at a site in Egypt. The results indicated that lowering the groundwater table to 100 cm depth significantly increased total soluble solids, sucrose percentage, and potassium concentration in root as well as chlorophyll A and potassium concentration in leaves. Sodium concentration of roots and leaves was contrary to this trend. Increasing the salt concentration in irrigation water up to 4000 ppm significantly increased total soluble solids in root juice, free proline concentration in leaves and sodium concentration for both leaves and roots. Sucrose percentage, chlorophyll B and carotenoids were not affected by irrigation with saline water up to 4000 ppm. Interaction effect of groundwater depth and irrigation with saline water had no significant effect on any studied constituent of sugarbeet.

TI: Response of root yield and quality of sugar beet (Beta vulgaris L.) to irrigation with saline water and foliar potassium fertilization.
AU: Mekki-BB; El-Gazzar-MM
SO: Annals-of-Agricultural-Science-Cairo. 1999, 44: 1, 213-225; 24 ref.
LA: English
LS: Arabic
AB: In greenhouse pot experiments, sugarbeet cv. Klein Wanzleben was irrigated with water with salinity levels of 0, 2500, 5000 or 7500 ppm chloride salts and given foliar applications of 0 or 3.5% K. A moderate salt concentration (2500 ppm) gave the highest fresh root yield, root diameter and whole plant dry weight. A high salt concentration (7500 ppm) caused an increase in sucrose and TSS [total soluble sugars] percentages, while juice purity was reduced. Sugar yield (g/plant) was also reduced by a high salt concentration, though the highest sugar yield (80.39 g/plant) was obtained with 2500 ppm salinity. K application generally had no signficant effects.

TI: Influence of saline water irrigation on the yield and some physiological processes of red beet.
AU: Rumasz-E; Koszanski-Z; Biczak-R; Rychter-P
SO: Folia-Universitatis-Agriculturae-Stetinensis,-Agricultura. 2002, No.90, 207-212; 12 ref.
LA: English
LS: Polish
AB: The effects of saline water as irrigation on beetroot cv. Czerwona Kula were determined in a field experiment conducted in Poland during 1998-99. The yield of beetroot decreased with increasing salinity, although saline water increased the root dry matter content of the crop. Saline water also increased the total nitrogen, phosphorus, potassium and sodium content of the crop. Supplemental irrigation enhanced carbon dioxide accumulation and transpiration of beetroot leaves, as well as photosynthesis although to a lesser extent.

TI: Using free proline concentration as an indicator for identifying sugar beet varieties relatively tolerant to salinity.
AU: Shehata-MM; El-Ammari-TS; Taha-NEM
SO: Egyptian-Journal-of-Agricultural-Research. 2000, 78: 2, 733-744; 27 ref.
LA: English
LS: Arabic
AB: Nine potted sugarbeet cultivars (the multigerm cultivars Ras poly, Oscar poly, Monte Bianco, Vede poly, Top, Gazelle and Delitzsch poly, and monogerm cultivars Eva and Delamon) were irrigated with 260, 2260, 4260 and 6260 mgm/litre saline water 4 weeks after sowing or when the plants were at the 2-leaf stage to determine the effects of different levels of salinity on proline and sucrose content, juice root purity percentage, fresh weight and sugar yield of sugar beet. Sucrose content did not significantly differ at 4260 and 6260 mgm/litre salinity although it decreased by 1.5 and 1.97%. TSS increased by 1.4% under 4260 mgm/litre salinity and by 3.4% under 6260 mgm/litre salinity. Root and sugar yield, in terms of fresh root weight and sugar yield per plant, decreased with increasing salt concentrations while proline content increased, except in Gazelle and Delitzsch whose proline content was not affected by saline treatment. Monte Bianco, Delamon, Vede and Top were moderately tolerant to salt stress; there were no significant differences in their proline concentrations under 4260 and 6260 mgm/litre salinity levels. A high positive correlation was detected between salinity level and proline content in moderate and very tolerant sugarbeet cultivars.

TI: Physiological response of some sugar beet (Beta vulgaris L.) varieties to irrigation with different levels of chloride salinization.
AU: Kandil-SA; Abo-El-Kheir-MSA; Abou-Ellil-AA; El-Kheir-MSA-Abo
SO: Bulletin-of-the-National-Research-Centre-Cairo. 2001, 26: 1, 79-92; 32 ref.
LA: English
LS: Arabic
AB: The effect of two levels of chloride salinity (3000 and 6000 ppm) in irrigation water and tap water, as control, on certain growth characters, yield and root quality, as well as some physiological aspects of three sugarbeet varieties (Pleno, Aramis and Kawe mira) were studied. Results showed that root yield, root length and diameter, top height, dry weights of top and root, as well as the total dry weight of whole sugarbeet were significantly decreased by increasing the level of chloride salinization in irrigation water up to 6000 ppm. Percentage of sucrose and total soluble solids (TSS) of sugarbeet roots was significantly increased by increasing the concentration of chloride salinity in irrigation water up to 6000 ppm. Root quality and sugar yield/plant were significantly affected by varieties. Pleno variety has the highest sucrose percentage (50.02 g), against 46.36 g and 39.16 g for Aramis and Kawe mira, respectively. Root juice of Aramis variety significantly recorded the lowest values in TSS percentage and consequently the highest one in juice purity than the other two varieties (84.64% against 81.73 and 74.46% for Pleno and Kawe mira, respectively). By 90 days after sowing, Pleno variety leaves contained higher concentrations of chlorophyll a, total chlorophyll (a+b) and carotenoids than those of Aramis or Kawe mira varieties. Chlorophyll a:chlorphyll b ratio exhibited the same tendency. Cell sap concentration, osmotic pressure and proline content in sugarbeet leaves increased with increasing the level of chloride salinity up to 6000 ppm as compared to the tap water-irrigated plants.

TI: Tolerance of some sugar beet varieties to irrigations with saline water in sandy soils.
AU: El-Hawary-MA; Mokadem-SA
SO: Assiut-Journal-of-Agricultural-Sciences. 1999, 30: 1, 1-11; 15 ref.
LA: English
LS: Arabic
AB: In field trials in 1996-98, sugarbeet cv. Oscar poly, MG 561 and Prisma grown in sandy soil were irrigated with tap water or saline water with 3000, 6000 or 9000 ppm NaCl. Increasing salinity beyond 3000 ppm decreased relative water content, K/Na ratio in root, fresh root weight and root and sugar yields, but increased percentage sugar. Cv. Oscar poly had the greatest root and sugar yields and showed the greatest salt tolerance.
PT: Journal-article

TI: Saline water can be reused to irrigate sugarbeets, but sugar may be low.
AU: Kaffka-S; Dong-DaXue; Peterson-G; Dong-DX

SO: California-Agriculture. 1999, 53: 1, 11-15; 5 ref.
LA: English
AB: In a field study in California, sugarbeet cv. SSNB7 was irrigated with high quality water from the Central Valley Project, or with saline water (ECw 6.7 dS/m) from a nearby well. Water quality did not affect overall water use, plant density or clean root yield, but use of saline water decreased percentage sugar and hence sugar yield. This decrease was associated with the higher N levels in saline water. It is suggested that if well water has a high N concentration, it should be used as early in the growing season as possible, followed by the use of better quality water to allow the crop to deplete soil N 6 weeks before harvest. N applied in water should be accounted for when determining fertilizer rates.

TOMATO

TI: Effect of salt stress on water relations and antioxidant activity in tomato.
AU: Pascale-S-de; Angelino-G; Graziani-G; Maggio-A; de-Pascale-S; Bieche-B (ed.); Branthome-X
SO: Proceedings of the Eighth International ISHS Symposium on the Processing Tomato, Istanbul, Turkey, 8-10 June, 2002. Acta-Horticulturae. 2003, No.613, 39-46; 22 ref.
LA: English
AB: We investigated the effects of saline irrigation on water status, antioxidant content and mineral composition of tomato (Lycopersicon esculentum) fruits. Increasing the electrical conductivity of the irrigation water from 0.5 ds/m (non-salinized control) to 15.7 dS/m reduced both leaf and root water potentials. Leaf osmotic adjustment was linearly related to the salinity of the irrigation water. Total carotenoids and lycopene concentrations gradually increased until 4.4-dS/m and decreased at higher salinity levels. The increase in plant carotenoids and lycopene contents obtained upon mild saline irrigation was comparable to that obtained via genetic engineering. A moderate salt stress also improved the levels of other desirable components for the processed tomatoes industry (i.e. TSS, nitrates content, acidity). Overall these data indicate that it is possible to improve carotenoids and ascorbic acid contents and antioxidant activity of tomato, with an acceptable yield reduction (10%), by irrigating with saline water containing sea salt up to 4.4-dS/m (0.25% w/v). Adopting targeted agronomic techniques to enhance the nutritional value of tomato fruits is an environment-compatible strategy that may be considered alternative and/or complementary to other approaches. However, an appropriate irrigation scheduling is needed to contain potential hazards of soil salinization associated to long-term irrigation with saline water.

TI: Yield and fruit quality of tomato grown in greenhouse with saline irrigation water.
AU: Restuccia-G; Marchese-M; Mauromicale-G; Restuccia-A; Battaglia-M; Malfa-G-la (ed.); Lipari-V (ed.); Noto-G (ed.); Leonardi-C
SO: Proceedings of the Sixth International Symposium on Protected Cultivation in Mild Winter Climate: Product and Process Innovation, Ragusa-Sicilia, Italy, 5-8 March, 2002. Acta-Horticulturae. 2003, No.614(Vol 2), 699-704; 5 ref.
LA: English
AB: A study was conducted to analyse the influence of irrigation water regime and water salinity on yield and fruit quality of a tomato crop (Marmande Raf) growing in an unheated plastic greenhouse. Two salinity levels of irrigation water (electrical conductivity (EC)=1.6 and 6.0 dS m-1, respectively) and two irrigation regimes (100% of maximum evapotranspiration (ETM) and 100% ETM plus leaching requirements (Lr)) were studied. The total yield accumulated over the harvest periods was significantly higher for 1.6 dS m-1 than 6.0 dS m-1 and for 100% ETM+Lr than 100% ETM. Nevertheless, when plants were irrigated with both high saline concentration of water and high water supply (100% ETM+Lr), crop yield was similar to that observed on plants grown under low salinity (1.6 dS m-1) and 100% ETM but without considering Lr requirements. Fruit quality (dry matter content, reducing sugar concentration, titratable acidity and firmness) was improved with greater salinity, but was unaffected by water irrigation regime with the exception of dry matter. These results suggest that using an irrigation regime equivalent to 100% ETM+Lr reduces the negative influence induced by high salinity of the irrigation water on yield, while maintaining the beneficial effect on fruit quality.

TI: Irrigation with brackish water under desert conditions. 10. Irrigation management of tomatoes (Lycopersicon esculentum Mills) on desert sand dunes

AU: Pasternak,-D.; Malach,-Y.-de
AD: Ben Gurion Univ. of the Negev, Institutes for Applied Research, PO Box 1025, Beersheva 84110, Israel
SO: Agricultural-Water-Management (Netherlands).
1995, v. 28(2) p. 121-132; Sep, figs, tables, 12 ref.; summary (En)
LA: English
AB: Optimal conditions for irrigation of tomatoes planted on a sandy soil were studied in Israel, during 1986-1989. Plants were drip-irrigated with brackish water (BW) and freshwater (FW). The effect of irrigation frequency was determined. Yields in the FW and the BW treatments were similarly affected by 1 or 2 irigations/day. Irrigation every 2 and 3 days reduced yield in the 2 water quality treatments. On average, yields of BW-irrigated plants were about 44% of yields from FW plants. The effect of 3 planting dates on yields of FW- and BW-irrigated tomatoes was also investigated. The FW yields were similar for the first 2 planting dates but reduced at the third planting date. The BW yields were reduced with each subsequent planting date. Relative yield of BW-irrigated plants was 59%, 43% and 30% for the first, second and third planting date, respectively. The detrimental effect of BW on tomato yield was completely overcome through the use of pulse irrigation. Pulse irrigation markedly reduced midday rhizospheric salt concentration compared with that of plants which were irrigated once a day. Irrigation with BW resulted in lower leaf water potential, higher crop stress index but had little effect on leaf-carbohydrate content. Salinity had no effect on Cl concentration in leaves but doubled the concentration of Na. It had little effect on leaf-Ca content but reduced the levels of K and P. From authors' summary

TI: Irrigation with brackish water under desert conditions. 5. Nitrogen requirement of tomatoes (Lycopersicon esculentum Mill.) during germination under drip irrigation
AU: Pasternak,-D.; Zohar,-Y.; Malach,-Y.-de; Borovic,-I.; Twersky,-M.
AD: Rudolph and Rhoda Boyko Inst. for Agriculture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).
1986, v. 11(3-4) p. 313-318; Sep, tables, 9 ref.; summmary (En)
LA: English
AB: In an experiment in the Negev Desert (Israel), the daily application of brackish water by drip irrigation during the germination of tomatoes resulted in efficient leaching of the major nutrient ions from the area immediately under the emitters. A 2-week delay in the application of N to the germinating seedlings resulted in severe retardation of their growth and in delayed flowering, regardless of the salt concentration in the irrigation water. The results indicate that, in the desert, when brackish water is used to germinate tomato seedlings with a drip system in a sandy-loam soil, N should be applied daily with the irrigation water, starting on the 1st day of irrigation. Authors' summary.

TI: Irrigation with brackish water under desert conditions. 7. Effect of time of application of brackish water on production of processing tomatoes (Lycopersicon esculentum Mill.)
AU: Pasternak,-D.; Malach,-Y.-de; Borovic,-I.
AD: Rudolph and Rhoda Boyko Inst. for Agriculture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).
1986, v. 12(1-2) p. 149-158; Oct, figs, tables, 17 ref.; summary (En)
LA: English
AB: Processing tomatoes were irrigated from the outset with water having electrical conductivities of 1.2 (control), 4.5 and 7.5 dS/m, or were irrigated from the outset with 1.2 dS/m water and then transferred at the 4 or 11-leaf stage to irrigation with 4.5 or 7.5 dS/m water. The total yield of fruit in the control was 13.6 kg per 10 m2 and the marketable yield 12.1 kg per 10m2. When tomatoes were irrigated from the outset with saline water with an electrical conductivity of 7.5 dS/m, the total yield was reduced by 60% relative to the control. However, when salinme water irrigation started at the appearance of the fourth or the eleventh leaf, a water salinity of 7.5 dS/m reduced the yield by only about 30%. Salinity increased the acidity, electrical conductivity, and total dissolved solids of tomato fruit as well as the Na and Cl concentrations in leaves, while the leaf K content did not change. From authors' summary.

TI: Water and leaching requirements of industrial tomatoes irrigated with brackish water
AU: Vinten,-A.; Shalhevet,-J.; Meiri,-A.; Peretz,-J.

AD: Department of Environmental Physiology, Agricultural Research Organization, Bet Dagan, Israel
SO: Irrigation-Science (Germany F.R.).
1986, v. 7(1) p. 13-25; Apr, figs, tables, 12 ref.; summary (En)
LA: English
AB: In field trials, tomato cv. M 82 grown in a sandy loam soil was drip irrigated with 7 water quantities ranging from 30 to 120% of the assumed crop water requirements. Salt concentrations of irrigation water (ECdni) were: (1) S0, national water carrier, ECdni = 1.1 dS/m; (2) S1, well water, ECdni = 5.9 dS/m and (3) S2 artificially salinized well water (Na and CaCl2, 2:1 weight ratio), ECdni=8.1 dS/m. The maximum yield of vine-ripe fruit, 11.3 kg/mup3, was obtained with S0; water requirement was 420 mm. S2 caused a 43% reduction in maximum yield under conditions of nonlimiting water supply. Water requirement was 290 mm, of which 60 mm was estimated to be required for leaching. Water balance calculations showed that even when deficient amounts of water were applied there was considerable deep seepage. Equations used for the estimation of water balance and leaching requirements of the crop are presented and discussed.

TI: Application of diluted sea water to soilless culture of tomato (Lycopersicon esculentum Mill.): effects on plant growth, yield, fruit quality and antioxidant capacity.
AU: D'-Amico-ML; Izzo-R; Tognoni-F; Pardossi-A; Navari-Izzo-F
SO: Journal-of-Food,-Agriculture-and-Environment. 2003, 1: 2, 112-116; 23 ref.
LA: English
AB: The aim of the present research was to evaluate the effects of sea water irrigation on the antioxidant properties and qualitative characteristics of tomato grown in a heated greenhouse. The berries of plants grown with 0, 10 and 20% of sea water, corresponding to conductivity values of 3, 8 and 14 mS/cm, respectively, were harvested at two growth stages, green and red-ripe. Increasing water salinity reduced crop water consumption, plant growth, fruit and crop yield, but increased fruit quality. Titratable acidity, osmotic pressure and concentrations of sodium, sugars and organic acids increased upon irrigation with saline water, whereas K content increased only at 14 mS/cm EC. The antioxidant capability was evaluated by the analysis of reduced/oxidised ratios of the major antioxidants: the reduced pool of ascorbate suggested a favourable response of tomato fruits, and the determinant role of glutathione (GSH) on the behaviour of total GSH content was pointed out. Finally, the trend of ascorbate peroxidase [L-ascorbate peroxidase] activity testified the increased requirement of active oxygen species scavenging under salinization.

TI: Split root system for the use of saline water in hydroponic tomato production.
AU: Tabatabaie-SJ; Gregory-PJ; Ho-L; Hadley-P; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 307-312; 21 ref.
LA: English
AB: Tomato (Lycopersicon esculentum cv. DRK) plants were grown with split root system to determine the effect of an unequal distribution of salinity in the root zone on yield and blossom-end rot (BER). The roots of the plants were divided into two portions and each portion was irrigated with nutrient solutions differing in EC levels achieved by adding Na or all nutrients proportionally. The maximum yield was achieved in treatments with unequal EC when one portion of the roots received only water and the lowest in the high EC treatments. The reduced yield in the high EC treatment was due to the incidence of BER and reduced fruit size. In treatments with unequal salt distribution, the main source of water was from that portion of the root system in the least saline zone. The Na concentration in the leaves and fruits was reduced significantly where one portion of the root system was supplied with water. Solutions with high EC supplied to both sides of the root system significantly increased the incidence of BER, but when only water or a solution with low EC was supplied to one side, BER was reduced by 70%. Ca concentration in the distal end of the fruits was significantly higher in the treatments where one portion of the root system received water. It is concluded that high salinity had positive effects on yield and quality provided that one portion of the root system is placed in low EC or water only.

TI: The growth, yield and quality of greenhouse tomatoes in relation to salinity applied at different stages of plant growth.
AU: Olympios-CM; Karapanos-IC; Lionoudakis-K; Apidianakis-I; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F

SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 313-320; 13 ref.
LA: English
AB: Four levels of salinity in the irrigation water (1.7 (control), 3.7, 5.7 and 8.7 dS/m) were applied to tomato plants at various growth stages and for different time duration. Treatment A was irrigated with the four different concentrations for the last 75% of the duration of the experiment, treatment B for the last 50%, treatment C for the first 50%, and treatment D for the whole experimental period, which was 79 days. Salinity negatively affected the plant size and total fruit weight: the higher the concentration, the lower the growth and yield. Compared with the control, there was a 20.3, 30.2 and 49.0% reduction in the yield and 2.9, 12.2 and 20.1% in the height of plants for 3.7, 5.7 and 8.7 dS/m, respectively. In contrast, fruit number was significantly reduced only at 8.7 dS/m. The average fruit weight was reduced at the highest salinity especially when applied at an early growth stage. When the salinity stress was applied during the entire growing period, the negative results were higher, with increasing reduction in yield occurring with the increase in salt concentration. When good quality water was applied at the beginning of growth, followed later by salinity, the negative effect on plant height, shoot fresh and dry weights, leaf area, yield, average fruit weight and the percentage of fruits with blossom-end rot was less severe. In contrast, when saline water was applied at the early stages of growth, followed by good quality water, the effect on plant parameters (total yield, average weight of fruits and blossom-end rot) was more severe. The longer the duration of saline application was, the more severe was the reduction in leaf area than the control. Increased salinity (various concentrations) increased soluble solids, Na, K, Cl contents of the fruits, irrespective of the time of application.

TI: Effect of potassium nutrition on yield and quality of tomato plants grown with nutrient film technique under sodium chloride saline conditions.
AU: Economakis-C; Daskalaki-A; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 337-339; 8 ref.
LA: English
AB: Tomato plants were grown over a 9-month period (from November until July) under unheated glasshouse conditions in an nutrient film technique system. The plant density was 2.7 plants/m2. The examined factors were N:K ratio and addition of sodium chloride (NaCl). Two N:K ratios (1:1,5 and 1:3) were applied with and without addition of NaCl (600 ppm). Target electrical conductivity and pH of the nutrient solution in all the treatments were 4.8 mS/cm and 6.0, respectively. The total yield, number of fruits produced, fruit firmness and total soluble solids were measured. The NaCl saline solution resulted in decreased yield. Higher yield and fruit firmness were recorded with increased K concentration in the NaCl saline nutrient solution, suggesting that an increased potassium concentration could alleviate the detrimental effects of NaCl when saline water is used.

TI: Effect of salinity on tomato crops.
OT: Effetto della salinita sulla coltura del pomodoro.
AU: Tarantino-E; Monteleone-M; Disciglio-G; Rotonda-P-la; la-Rotonda-P
SO: Informatore-Agrario. 2002, 58: 7, 53-58.
LA: Italian
AB: Increased salinity of the water in some areas affects tomato plants differently at different stages of the crop cycle. Problems of germination can be avoided by sowing tomatoes indoors and transplanting strong seedlings. Literature concerning the effect of salinity on vegetative growth and fruit yields is discussed. The effect on the quality of the fruit varies: negative effects include reduced keeping quality and increases in rejects and cases of apical rot. On the other hand, salinity improves the colour and also the flavour due to increased sugar and acid content. Industrial tomatoes may benefit from saline irrigation in the later stages of ripening but steps must be taken to prevent progressive salinization of the soil.

TI: Vegetative growth, nutritional status and yield of tomato plants growing under salinity conditions and different NO3-:NH4+ ratios.
AU: Flores-P; Amor-Saavedra-FM-del; Carvajal-M; Navarro-JM; Cerda-A; Martinez-V; del-Amor-Saavedra-FM; Fernandez-JA (ed.); Martinez-PF (ed.); Castilla-N

SO: Proceedings of the Fifth International Symposium on Protected Cultivation in Mild Winter Climates: Current Trends for Sustainable Technologies, Cartagena-Almeria, Spain, 7-11 March, 2000. Vol. 1. Acta-Horticulturae. 2001, No.559, 359-364; 17 ref.
LA: English
AB: The effect of salinity and NO3-:NH4+ ratio on vegetative growth, mineral composition and yield of tomato plants was studied in a greenhouse culture experiment. Seedlings of tomato (Lycopersicon esculentum Mill. cv. Daniela) were transferred to 120-litre tanks containing aerated modified Hoagland solution. Treatments consisted of three NO3-:NH4+ ratios (14:0, 12:2 and 10:4) combined with three salinity levels (0, 30 and 60 mM NaCl). There were four replicates of each treatment except for the 12:2 ratio, which had eight (for each salinity level), of which four were changed to the 14:0 ratio, 60 days after transplanting, when 3rd truss had set. Salinity had a negative effect on shoot growth. Ammonium reduced leaf and root fresh weight by about 21% and 24% respectively. The detrimental effect of ammonium on shoot growth was higher for the low than for the high salinity level. Salinity decreased leaf NO3- concentration (around 60%) and increased leaf Na+ and Cl- concentration. The presence of ammonium until the end of the experiment increased leaf Na+ and Cl- concentration under the salinity treatments. Total-N concentration in plant was higher in treatments with ammonium. Salinity reduced total fruit yield regardless of the NO3-:NH4+ ratio. The increase of NH4+ concentration in the nutrient solution decreased tomato yield. In conclusion, vegetative growth and yield of tomato are impaired in the presence of ammonium in the nutrient solution when plants are irrigated with saline waters.

TI: Effect of irrigation water salinity on yield and fruit quality of tomato.
AU: Malash-N; Ghaibeh-A; Abdelkarim-G; Yeo-A; Flowers-T; Ragab-R; Cuartero-J; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 423-434; 17 ref.
LA: English
AB: A field experiment was conducted in the middle area of the Nile Delta, Egypt, to study the effect of different salinities of irrigation water (0.55, 4 or 6 dS m-1) on yield, yield components and fruit quality of 27 tomato genotypes. The results showed that salinity at 4 and 6 dS m-1 decreased total yield, marketable yield, number of fruits and average fruit weight in all genotypes studied. Cultivars "La Laguna" followed by "RETBA" (both known to be salt tolerant) showed the least reduction in yield under salinity treatments. Cultivars "Floradade" and "Edkawy" and hybrid "Baraka" also showed low yield reductions. This implies that such genotypes were relatively salt tolerant. It was also observed that the reduction in yield in the salt tolerant genotypes, was mainly due to the reduction in fruit weight rather than fruit number. Cultivar "Super Strain B" showed the highest reduction in yield. Hybrids "Early Rock", "Shiva (95558)", "Confidence" and "HZ 8704" as well as cultivar "Pacmour", showed severe yield reduction under salinity conditions particularly at 6 dS m-1. This suggests that these genotypes were salt sensitive. However, irrigation with saline water up to 6 dS m-1 increased fruit total soluble solids (TSS), vitamin C, and dry matter contents in all genotypes. Fruit acidity was also enhanced by salinity although 4 dS m-1 level gave the most acid fruits. Salinity had no significant effect on fruit firmness and storage ability.

TI: Micronutrient foliar application increases salt tolerance of tomato seedlings.
AU: El-Fouly-MM; Moubarak-ZM; Salama-ZA; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 467-474; 26 ref.
LA: English
AB: Salinity either of soil or of irrigation water causes disturbances in plant growth and nutrient balance. Previous work indicates that applying nutrients as foliar application increases tolerance to salinity in cereals and leguminous plants. A pot experiment was carried out to study the effect of micronutrient foliar application on salt tolerance of tomato. Seeds were sown in Miticherlich pots filled with sandy loamy soil. One month after germination, seedlings were sprayed with Micronutrient mixture (Wuxal 1.5 ml l-1) containing Fe, Mn and Zn. Three days later, seedlings were irrigated with saline water containing different NaCl concentrations. Two weeks later and just at start of flowering samples were taken for measuring growth patterns, nutrient and sodium

contents in the different organs. Salinity adversely affected growth as (dry weight) and nutrient uptake. Spraying micronutrients could restore the negative effect of salinity on dry weight. Effect of salinity on nutrient uptake could also be partially counteracted by spraying micronutrients.

TI: Agronomic and physiological aspects of salinity stress on a field-grown tomato crop.
AU: Delfine-S; Alvino-A; Villani-MC; Santarelli-G; Loreto-F; Centritto-M; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 647-654; 3 ref.
LA: English
AB: Horticultural plants in the Mediterranean ambient are often exposed to salt stress which causes limitation of stomatal and mesophyll CO2 conductance and reduces CO2 concentration in the leaf. Field-grown tomato plants (Lycopersicon esculentum cv. Pachino) were grown in Rome in 1998 in salt stress conditions by drip irrigating plant rows with water containing 1% (weight/volume) of commercial salt. Irrigation was given daily to restore the evapotranspirated losses. A replication was shaded with a white net to reduce by about 30% the incident solar radiation. Shading reduced the transpiration rate and, consequently, decreased the leaf and fruit sodium uptake in salt-treated plants. Because of the low salt uptake, leaf photosynthesis, stomatal and mesophyll conductance and Rubisco [ribulose-bisphosphate carboxylase] activity of shaded and salt-treated leaves was higher than in the non-shaded and salt-stressed leaves but still lower than in shaded or non-shaded controls. Shading may allow the use of water with moderate salt concentrations to irrigate tomato crops with limited and generally negligible consequences on plant physiology.

TI: Water salinity and influence of SAR on yield and quality parameters in tomato.
AU: Cucci-G; Cantore-V; Boari-F; Caro-A-de; de-Caro-A; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 663-670; 11 ref.
LA: English
AB: Yield generally decreases if a threshold salinity level is exceeded. Further economic damage results from the subsequent fruit deterioration in quality (increase in fibre content, size reduction, shorter storing period). However, salinity can induce some qualitative improvements such as better colour and taste, increased soluble solids and reduced sugars. Research was carried out in Southern Italy to study the effects of four salinity levels of irrigation water (0.5, 4, 8 and 12 dS m-1), two sodium absorption ratio (SAR) values (2 and 10) and two leaching fractions (LF = 15 and 30%) on yield and quality in tomato for fresh consumption (cv. Tombolino), grown on two different soils (clay loam and sandy clay loam). Higher water salinity reduced yield and size of fruits, but had positive effects on sugar, dry matter and fruit cracks. The different SAR applied did not induce any substantial effect on yield quantitative parameters whereas it affected significantly the fruit dry matter and the refractometric index. Tombolino cultivar was more salt-tolerant compared to reported salinity tolerance for tomato in the literature.
PT: Journal-article; Conference-paper

TI: Performance of subsurface drip irrigation of processing tomatoes under saline, shallow groundwater.
AU: Hanson-BR; May-DM; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 671-677; 1 ref.
LA: English
AB: Processing tomato was grown in San Joaquin Valley, California, with drip irrigation in the presence of shallow, saline groundwater to determine the amount of shallow groundwater that can be used by plants without reducing yield. This experiment consisted of applying irrigation water at amounts of 90, 75, 60, 45, and 30% of the maximum potential evapotranspiration. Results showed no statistical differences in crop yield between these treatments at two locations. These results indicate that processing tomato can use substantial amounts of saline groundwater without reducing yield. However, a third location where no shallow groundwater exists showed significant yield reductions with decreasing applied water.

TI: Effect of planting depth on growth and productivity of tomatoes using drip irrigation with semi saline water.

AU: Almasoum-AA; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 773-778; 10 ref.
LA: English
AB: Root growth, development and architecture are important aspects of seedling growth. Stresses that reduce root growth may affect plant growth by reducing the volume and extent of soil exploration. Supply of water and nutrients to the shoot may be reduced if root growth is subjected to stress. In order to study the contribution of root depth on tomato growth, productivity and fruit characteristics using drip irrigation, an experiment was carried out under field conditions in the United Arab Emirates. Tomato (Lycopersicon esculentum) cultivars 'Petopride' and 'Luxor' were grown during 1996/1997 using drip irrigation (ECw 2.5 dcm-1). Three transplant depths were used according to morphological positions on the plant: the first depth was to the root ball, the second was to the cotyledon leaves and the third was to the first true leaves. Results revealed that deeper planting (first true leaves) outperformed other depths in earliness of flowering by two days, in addition to significant increase of marketable fruits for both cultivars. Early yield of cv. Petopride, harvested after 53 days from transplanting, gave 2.6 ton/ha for first true leaves followed by 2.2 and 2.1 ton/ha for cotyledon leaves and root ball, respectively. Similar trends were found for Luxor, which gave 1.0, 0.9 and 0.6 ton/ha fruit yield for the three methods, respectively. Fruit volume had a similar trend. Other parameters such as TSS, acid and fruit diameter did not show a significant change. The effect of planting depth was diminished with successive harvests.

TI: Tomato plant-water uptake and plant-water relationships under saline growth conditions.
AU: Romero-Aranda-R; Soria-T; Cuartero-J
SO: Plant-Science. 2001, 160: 2, 265-272; 33 ref.
LA: English
AB: Growth and water uptake both decrease when tomato plants are irrigated with saline water. To determine the relative contribution of physiological traits to these decreases, plant fresh and dry weight, leaf area, leaf water (psiw) and osmotic (psiPI) potentials, gas exchange parameters, stomatal density, leaf chlorophyll and Na content were investigated in the tomato (Lycopersicon esculentum) cultivars, Daniela and Moneymaker. Plants were grown in a greenhouse in sand culture, and irrigated with a complete nutrient solution supplied with 0 (control), 35 and 70 mM NaCl over a period of 2 months. Salinity reduced plant dry weight, height and number of leaves even at 35 mM NaCl. Leaf psiw and psiPI decreased with salinity but leaf turgor pressures were significantly higher in salinised than in control plants which suggests that bulk tissue turgor did not limit growth under the saline conditions tested. Increasing salinity in the irrigation solution led to both morphological changes (reduction of plant leaf area and stomatal density) and physiological changes (reduction of stomatal conductance, transpiration, and net CO2 assimilation (ACO2)). Plant water uptake, measured as the difference between volume of nutrient solution supplied and drainage collected, was closely related to transpiration, stomatal conductance, and stomatal density. Chlorophyll content per unit of leaf area increased with salinity. Reduction of net ACO2 with salinity was explained in higher degree by stomatal conductance and stomatal density than by Na accumulation in the leaves. Although plant water uptake was similar for the two cultivars, Daniela transported, per unit of water uptake, more Na to the leaves than did Moneymaker. However, Daniela reduced leaf area less than did Moneymaker. Water use efficiency, calculated either as the ratio between total plant dry matter and total plant water uptake, or as the ratio between net ACO2 and transpiration, did not change under our saline growth conditions. The contribution of the observed salt-responses to reduction in shoot water loss, plant water uptake and salt loading, while keeping water use efficiency, is discussed in relation to salt tolerance. Because some of these salt-responses take a long time to develop, growing seedlings in seedbeds with saline media could be of interest to better tolerate further salty conditions in the field or greenhouse.

TI: Ion uptake and distribution in tomato plants grown in sand and irrigated with brackish water.
AU: Grava-A; Matan-E; Yehezkel-C; Abitan-A; Samuel-D; Plaut-Z; Bar-Tal-A (ed.); Plaut-Z
SO: Proceedings of the World Congress on Soilless Culture: agriculture in the coming millennium, Ma'ale Hachamisha, Israel, 14-18 May 2000. Acta-Horticulturae. 2001, No.554, 121-130; 21 ref.
LA: English
AB: Tomatoes were grown in sand in PVC-covered greenhouses between September and May for several consecutive years. Plants were fertigated using either saline or fresh (non-saline) water. The total EC of the fresh water was 2.0-2.3 dS/m and that of the saline water was 7.0-8.0 dS/m (including standard nutrient solution).

Experiments were conducted during four years to determine the effect of salt concentration and composition, timing and length of period of plant exposure to salinity on plant development, fruit yield and quality. The present report is focused on the three-dimensional distribution of salts and water tension in the root zone and on ion uptake and distribution between fruits and vegetative organs throughout the season. The findings reveal that Ca concentration in the leaves was approximately 30-fold higher than that in the fruits, while the concentrations of Cl and of Na were only 3- to 4-fold higher in leaves than in fruits. The concentration of Cl in both fruits and leaves was approximately 8-10 times higher than that of Na. The concentration of Cl in leaves tended to decrease throughout the season, while that of Na was nearly unchanged. The concentration of K in fruits and leaves was the same and changed only slightly throughout the season.

TI: NaCl pre-treatment at the seedling stage enhances fruit yield of tomato plants irrigated with salt water.
AU: Cayuela-E; Estan-MT; Parra-M; Caro-M; Bolarin-MC
SO: Plant-and-Soil. 2001, 230: 2, 231-238; 20 ref.
LA: English
AB: Although salt-adaptation seems to be a widespread property of plants, the adaptive response has been rarely differentiated to the tolerance response. We report on the adaptive response of tomato plants to growing under saline conditions following a 15-day pre-treatment with a lower NaCl concentration (half) than that used during the plant growth. After 20 days of salt treatment (100 mM NaCl), the biomass of the adapted plants increased significantly with respect to that of the unadapted plants when the pre-treatment was applied to five leaf seedlings, but not at the two leaf stage. The long-term adaptive response was determined in two tomato genotypes with different tolerance to moderate salt levels. At 70 mM NaCl, the adapted-plants of the more salt-sensitive genotype produced up to 29% more fruit yield than did the unadapted plants. However, no positive effect was observed in the long-term in the adapted-plants of the more salt-tolerant genotype, which suggests that the stress level necessary to trigger the adaptive response is related to the tolerance degree of genotype. The physiological response of the plants showing a positive response to the adaptation was also modified in the long-term. Thus, K+ concentrations increased in the young leaves of the adapted plants, with respect to unadapted plants, and moreover these differences increased with the salinization period. These results indicate that the changes in growth and physiological responses induced by NaCl pre-treatment at the seedling stage are maintained throughout the plant life cycle.

TI: Irrigation with saline water improves carotenoids content and antioxidant activity of tomato.
AU: Pascale-S-de; Maggio-A; Fogliano-V; Ambrosino-P; Ritieni-A; de-Pascale-S
SO: Journal-of-Horticultural-Science-and-Biotechnology. 2001, 76: 4, 447-453; 53 ref.
LA: English
AB: The combined effect of increasing concentrations of NaCl in the irrigation water and fertilization with different nitrogen sources (ammonium sulfate, calcium nitrate and urea) on the chemical composition of tomato (Lycopersicon esculentum cv. H601) fruit was investigated in Italy during 1999. Increasing water salinity from 0.5 dS m-1 (non-salinized control) to 15.7 dS m-1 resulted in both reduced fruit size and fruit water content, whereas it caused an increase in soluble solids, carbohydrates, sodium and chloride concentrations. Titratable acidity increased upon irrigation with saline water, whereas the fruit redness significantly decreased. In addition, salinity reduced P, K+, Mg2+ and NO3- fruit concentrations. Total carotenoids and lycopene concentrations expressed on both fresh and dry weight basis gradually increased from the non-salinized control to the 4.4 dS m-1 treatment (approximately 0.25% NaCl w/v) and they decreased at electrical conductivities of the irrigation water higher than 4.4 dS m-1. These data show that it is possible to improve carotenoid content and antioxidative activity of tomato, with an acceptable yield reduction, by irrigating with saline water containing NaCl up to 0.25% (w/v).

TI: Comparative response to salinity between salt sensitive and salt tolerant tomato cultivars.
AU: El-Masry-TA; Hassan-MM
SO: Egyptian-Journal-of-Horticulture. 2001, 28: 1, 79-89; 24 ref.
LA: English
LS: Arabic

AB: The effect of saline irrigation water (from Karoun lake water, Egypt) on plant survival, growth and elemental concentrations in tomato salt-sensitive (Castlerock) and salt-tolerant (Edkawi) cultivars was studied under greenhouse conditions. The tomatoes were grown on nutrient solutions treated with 0.50, 3, 6, 9, 12 and 15 dS/m saline water. The cultivar and irrigation water salinity level interactions sigificantly affected crop yield. The observed threshold values were 2.2 and 1.5 dS/m for Edkawi and Castlerock, respectively. An increase in the salinity of the irrigation water above the threshold values decreased crop yield by 3.2 and 4.3%, respectively, for Edkawi and Castlerock. The threshold for plant survival for Edkawi and Castlerock was 6 and 2.9 days, respectively, wherein above the threshold values, plant survival decreased by 1.2 and 1.7%. An increase in soil salinity increased Cl and Na content in the leaf tissue of both cultivars while K and K:Na ratio decreased as soil salinity increased. Higher accumulation of Na and Cl and lower K and K:Na ratio in the leaf tissue were observed in Edkawi whereas the opposite response was observed in Castlerock.

TI: Physiological response of tomato from induced sodium chloride stress.
AU: Beyenne-GT; Hunter-A; Tanino-KK (ed.); Arora-R (ed.); Graves-B (ed.); Griffith-M (ed.); Gusta-LV (ed.); Junttila-O (ed.); Palta-J (ed.); Wisniewski-M
SO: Environmental stress and horticulture crops, a proceedings of the XXVI International Horticultural Congress, Toronto, Canada, 11-17 August, 2002. Act-Horticulturae. 2003, No.618, 291-298; 18 ref.
LA: English
AB: The effects of saline water on tomato (cv. Marglobe) fruit quality parameters such as acidity, soluble solids and salinity were studied. Treatments comprised: sodium chloride (NaCl) solution (at 0, 8.55, 17.11 and 25.66 mM, equivalent to EC concentrations of 0, 1, 2 and 3 mS/cm) at the sixth -true-leaf stage and at the subsequent irrigations at 15-day intervals. Plants were either further treated with NaCl solutions of 0, 34.22, 42.77 and 51.33 mM or (0, 4, 5 and 6 mS/cm, respectively) and/or maintained at their original treatment levels for a further 15 days from the date of the first application. The control plants recorded higher yields than NaCl-treated plants. The lowest yields were obtained from plants treated with high NaCl levels, especially those secondarily treated at levels higher than 25.66 mM. The yield reduction was directly proportional to the NaCl concentration. Overall, NaCl level influenced the fruit size. Plants grown under high NaCl levels, yielded small fruits, while those grown under low NaCl levels yielded larger fruits. Non -marketable fruit percentage and electrical conductivity increased with increasing NaCl concentration. The titratable citric acid value was highest (0.69%) in plants initially treated with 2 mS NaCl/cm and subsequently with 6 mS NaCl/cm, and lowest (0.44%) in plants grown in salt-free medium. Similar trends were observed for titratable malic acid values, although were of higher magnitude. The soluble solids percentage of the puree increased with increasing salinity.PT: Journal-article; Conference-paper
IB: 90-6605-439-5
AN: 20043048903

TI: Tomato irrigated with sea water: antioxidant capacity and quality.
OT: Capacita' antiossidanti e qualita' del pomodoro irrigato con acqua marina.
AU: D'-Amico-ML; Izzo-R; Tognoni-F; Pardossi-A; Navari-Izzo-F; Nardi-S (ed.); Albuzio-A (ed.); Bottacin-A (ed.); Carden-DE (ed.); Concheri-G (ed.); Ferretti -M (ed.); Ghisi-R (ed.); Malagoli-M (ed.); Masi-A
SO: Atti-del-XX-Convegno-Nazionale-della-Societa-Italiana-di-Chimica-Agraria, -Padova,-Italy-24-27-Settembre-2002. 2002, 223-230; 16 ref.
PB: Universita degli Studi di Padova, Dipartimento di Biotecnologie Agrarie; Legnaro; Italy
LA: Italian
LS: English
AB: Results are presented of an experiment conducted to determine the effects of sea water irrigation on the antioxidant properties and qualitative characteristics of tomato.PT: Book-chapter; Conference-paper
IB: 88-900459-3-0
AN: 20033178836

TI: Effect of two irrigation rates on yield, incidence of blossom-end rot, mineral content and free amino acid levels in tomato cultivated under drip irrigation using saline water.
AU: Franco-JA; Perez-Saura-PJ; Fernandez-JA; Parra-M; Garcia-AL

SO: Journal-of-Horticultural-Science-and-Biotechnology. 1999, 74: 4, 430-435; 16 ref.
LA: English
AB: An experiment in Murcia in SE Spain investigated the effects of 2 rates of irrigation, one of which reflected a substantial degree of water stress, on the mineral content, free amino acid levels and incidence of blossom-end rot (BER) in tomato (Lycopersicon esculentum cv. Durinta). The plants were grown in the open with drip irrigation using saline water from a well (mean ECw 5.2 dS m-1). The yield per plant was higher and fewer fruits were affected by BER at the higher irrigation rate. The fruits of the first and fifth truss, and the leaves immediately above, were analysed for their macronutrient, micronutrient and free amino acid content. There were no significant effects on macronutrient content in leaves and fruits: only the fruit N concentration was significantly increased in the water stressed plants. The Ca concentration in the stylar portion of mature fruits, which is related to the incidence of BER, was not significantly affected by irrigation rate. As regards micronutrients, only the Fe (in leaves and fruits of the first truss), Cu (in leaves of the first truss), Zn (in leaves and fruits of the first truss, and leaves of the fifth truss) and Mn (in leaves of the first truss) concentrations differed significantly. The total free amino acid leaf content was similar in both irrigation treatments. However, the total free amino acid content of fruits, significantly those of the first truss, was higher in the less irrigated treatment. The concentrations of aspartic acid (only from the first truss), glutamic acid, proline and alanine were higher in the fruits of the less irrigated plants, while the gamma-aminobutyric acid and phenylalanine (only from the fifth truss) concentrations were higher in fruits at the higher irrigation rate.

TI: Response of tomato plants to saline water as affected by carbon dioxide supplementation. I. Growth, yield and fruit quality.
AU: Li-JH; Sagi-M; Gale-J; Volokita-M; Novoplansky-A
SO: Journal-of-Horticultural-Science-and-Biotechnology. 1999, 74: 2, 232-237; 22 ref.
LA: English
AB: Potted tomato plants (cv. F144) in growth chambers were irrigated with low concentrations of mixed salts; the highest salinity level (EC 7 dS/m) simulated conditions used to produce quality tomatoes in the Negev highlands. CO2 enrichment (to 1200 µmol/mol, given during the day) increased plant growth in the early stages of development. However, later growth enhancement was maintained only when CO2 enrichment was combined with salt stress. In the absence of CO2 supplementation, overall growth decreased with salinity. However, under elevated CO2 concentrations total plant dry biomass was not reduced by salt stress. CO2 enrichment of plants grown with 7 dS/m salt increased total fresh fruit yields by 48% and maintained fruit quality in terms of total soluble salts, glucose and acidity. Fruit ripening was about 10 days earlier under CO2 enrichment, regardless of salinity treatment. It is suggested that combined use of brackish water and CO2 supplementation may enable the production of high-quality fruits without incurring the usual loss in yields associated with salt treatment.

TI: Tomato and salinity.
AU: Cuartero-J; Fernandez-Munoz-R
SO: Scientia-Horticulturae. 1999, 78: 1-4, 83-125; 9 pp of ref.
LA: English
AB: The effects of salinity on tomato plant growth and fruit production, the cultural techniques which can be applied to alleviate the deleterious effects of salt, and the possibilities of breeding salt-tolerant tomatoes are reviewed. Salinity reduces tomato seed germination and lengthens the time needed for germination to such an extent that the establishment of a competitive crop by direct sowing would be difficult in soils where the electrical conductivity (EC) of a saturated extract was equal to or above 8 dS/m. Priming seeds primed with 1 M NaCl for 36 h seems advisable to establish a crop by direct sowing in saline soils, and seedling conditioning, either by exposure to moderately saline water exposure or by withholding watering until seedlings wilt for 20-24 h, can be recommended for crops that are to be established by transplanting. Yields are reduced when plants are grown with a nutrient solution of 2.5 dS/m or higher and above 3.0 dS/m an increase of 1 dS/m results in a yield reduction of about 9-10%. At low EC, yield reduction is caused mainly by reduction in the average fruit weight, whilst the declining number of fruits explains the main portion of yield reduction at high EC. Since the smaller the fruit, the less important the reduction in fruit weight caused by salt, small size tomatoes are recommended to be grown at moderate salinity. Short cycle crops, in which only 4-6 trusses are harvested, are also recommended - especially since upper inflorescences are particularly sensitive to salt. Root growth, which slows when salinity reaches 4-6 dS/m appears to be less affected by salt than shoot growth. Salinity raises Na+ concentration in roots and leaves

of tomato plants. A higher Na+ concentration in the leaves lowers the osmotic potential and promotes water uptake, but it is the ability to regulate Na+ in older leaves while maintaining a low Na+ concentration in young leaves which seems to be related to salinity tolerance. Ca2+ and K+ concentrations in roots of salinized tomato plants change little under salinity whilst they are greatly reduced in leaves; those plants taking up more Ca2+ and K+ from the salinized medium will have lower Na+/K+ and Na+/Ca2+ ratios and an equilibrium of nutrients more similar to the non-salinized plants. Increasing Ca2+ and K+ concentrations in the nutrient solution is, consequently, advisable. Root NO-3 concentration is maintained for longer periods after salinization or under higher salinity levels than leaf NO-3 concentration. Salinity enhances tomato fruit taste by increasing both sugars and acids, fruit shelf life and firmness are unchanged or slightly lowered, but the incidence of blossom end rot is much higher. Breeding of tomato cultivars tolerant of moderate salinity will only occur after pyramiding in a single genotype several characteristics such as greater root volume, higher efficiency in water absorption and dry matter formation per unit of water absorbed, higher selectivity in absorption of nutrients, and higher capability to accumulate toxic ions in vacuoles and old leaves.

TI: Salt tolerance of tomato cultivars as affected by irrigation time.
AU: Shannon-MC; Dalton-FN; El-Sayed-SF; Lieth-H (ed.); Al-Masoom-AA
SO: Towards the rational use of high salinity tolerant plants. Volume 2. Agriculture and forestry under marginal soil water conditions. Proceedings of the ASWAS conference, 8-15 December 1990, Al Ain, United Arab Emirates. 1993, 185-192; 12 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The study was conducted to determine the importance of root-shoot ratio and irrigation timing on the growth and yield of tomato (Lycopersicon esculentum) grown in sandy soil using dilutions of seawater. Tomato cultivars VF36 and Globonnie were grown in the greenhouse and irrigated with 0, 17 and 33% seawater at either 04.00 h or 10.00 h. Cultivars differed significantly in their salt tolerance. Under saline conditions, irrigation at 04.00 h increased total soluble solids in fruits, days from sowing to fruit set, and ion accumulation in shoots. Plant fresh weight, dry weight, height, cluster number, fruit weight and yield per plant were higher when irrigation treatments were applied at 10.00 h rather than predawn.
PT: Conference-paper

FORAGE AND FODDER CROPS

TI: Demonstration of Biosaline Agriculture for fodder production.
AU: Rafiq-Ahmad; Shoaib-Ismail; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 415-422; 16 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Methods for Biosaline Agriculture are briefly discussed for undertaking fodder cultivation at salt affected soils and sandy desert using highly saline water for irrigation. The technique has been demonstrated for growing salt tolerant grasses (Sporobolus arabicus, Leptochloa fusca [Diplachne fusca] and Panicum turgidum) and halophytic fodder bushes (Atriplex nummularia, A. amnicola and A. cinerea) under following conditions: (i) Drum pot culture using different dilutions of sea water for irrigation; (ii) Field experiments performed at coastal sandy belt in Pakistan using highly saline underground water for irrigation; and (iii) Field trials undertaken at inland highly saline silty-clay loam.

TI: Growth promotion of the seawater-irrigated oilseed halophyte Salicornia bigelovii inoculated with mangrove rhizosphere bacteria and halotolerant Azospirillum spp.
AU: Bashan-Y; Moreno-M; Troyo-E
SO: Biology-and-Fertility-of-Soils. 2000, 32: 4, 265-272; 36 ref.
LA: English
AB: Inoculation of the oilseed halophyte Salicornia bigelovii with eight species of halotolerant bacteria, grown in seawater-irrigated pots under environmental conditions native to the plant's habitat, resulted in significant plant growth promotion by the end of the growing season, 8-11 months later. Statistical analysis demonstrated that

inoculation with Azospirillum halopraeferens, a mixture of two Azospirillum brasilense strains, a mixture of Vibrio aestuarianus and Vibrio proteolyticus, or a mixture of Bacillus licheniformis and Phyllobacterium sp. significantly increased plant height and dry weight at the end of the season. Some of the bacterial strains also increased the number of side branches and the size of the spikes. The bacteria did not affect the number of seeds or their weight. Inoculation with the mangrove cyanobacterium Microcoleus chthonoplastes had no effect on plant foliage variables. At the end of the growing season, the N and protein content of the plant foliage was significantly reduced by bacterial inoculation; however, the N and protein content of seeds significantly increased. The P content in foliage increased significantly in plants treated with all the bacteria except M. chthonoplastes, whereas the total lipid content of foliage increased significantly only when plants were inoculated with a mixture of A. brasilense strains or with M. chthonoplastes. In three inoculation treatments palmitic acid in seeds significantly increased and linoleic acid significantly decreased. This study demonstrates the feasibility of using bacteria to promote the growth of halotolerant plants cultivated for forage and seed production in proposed seawater-irrigated agriculture.
PT: Journal-article

TI: Halophytes and biosaline agriculture.
AU: Choukr-Allah-R (ed.); Malcolm-CV (ed.); Hamdy-A
SO: 1995, xii + 400 pp.; ref. at ends of papers.
PB: Marcel Dekker Inc.; New York; USA
LA: English
AB: The current state of knowledge on the utilization of halophytes is reviewed. The potential of halophytes in the development and rehabilitation of arid and semiarid areas is described in the introductory chapter. In the subsequent sections the biology and ecophysiology of halophytes is covered in 4 chapters, the agronomy of halophytes for forages in 3 chapters and irrigation studies using saline and sea water in 4 chapters. In the 4th section studies carried out in Iran, Australia, USA, Tunisia, Israel and Pakistan are described and in the final chapter the economic and environmental aspects of the sustainable use of halophytic forages are covered. Some of the papers were presented at the Workshop on Halophyte Utilization in Agriculture held in Agadir, Morocco in Sep. 1993. The book is aimed at landholders and extension workers involved in the reclamation and rehabilitation of salt-affected areas.
PT: Book

TI: Seawater irrigation of halophytes for animal feed.
AU: Glenn-E; Hicks-N; Riley-J; Swingle-S; Choukr-Allah-R (ed.); Malcolm-CV (ed.); Hamdy-A
SO: Halophytes-and-biosaline-agriculture. 1995, 221-236; 13 ref.
PB: Marcel Dekker Inc.; New York; USA
LA: English
AB: The use of sea water directly to irrigate halophyte crops was described. Guidelines were given on the evaluation of the feasibility of different methods using sea water to produce animal feed under the headings: site selection and soil preparation; irrigation requirements using sea water; sea water source; flooding plots with sea water from buried pipes using pumps or tide centre pivot irrigation and drip irrigation; and the utilization of these sea water halophytes as animal feed. Lambs fed Salicornia bigelovii straw or meal had similar liveweight gains (0.23-0.27 kg/d) and DM intakes to lambs fed on Cynodon dactylon hay + cottonseed meal. Batis maritima, Atriplex linearis, S. bigelovii, Suaeda esteroa and Sesuvium portulacastrum were studied.
PT: Miscellaneous

TI: Root growth and yield of differing alfalfa rooting populations under increasing salinity and zero leaching.
AU: Vaughan-LV; MacAdam-JW; Smith-SE; Dudley-LM
SO: Crop-Science. 2002, 42: 6, 2064-2071; 36 ref.
LA: English
AB: Accumulation of salinity in the root zone can be detrimental to sustained crop production. Irrigation, even with moderately saline water, pushes accumulated salts deeper into the root zone, allowing roots to proliferate in regions of relatively low salinity. Two alfalfa (Medicago sativa L.) subpopulations with low- and high-fibrous rooting characteristics, MnPL-9-LF and MnPL-9-HF, were used to test the effectiveness of increased rooting on

yield when plants were irrigated with saline water but without leaching. Treatments were three levels of heterogeneous root zone salinity predicted by the SOWACH model to represent 10, 20, and 30 yr of irrigation with saline water. Plants were grown for five successive harvests in 10-cm-diam., 130-cm-deep cylinders. The treatments were constructed with NaCl and gypsum. As soil became depleted to 50% extractable water, irrigation water with an electrical conductivity (EC) of 2.8 dS m-1 was applied. By the fifth harvest, soil solution EC from the top to the bottom of the profile ranged from 3 to 12 dS m-1 for the control and from 3 to 23 dS m-1 for the highest salinity treatment. Root production of the high-fibrous root type was stimulated more at low and medium salinity than that of the low-fibrous root type. Across salinity treatments, final root length density (cm root length per cm3 soil volume) was 24% higher for the high-fibrous root type, and herbage yield of the high-fibrous root type was 14% higher than that of the low-fibrous root type. Differential rooting was greatest in the upper half of the root zone. High fibrous rooting in alfalfa is a trait with potential usefulness as a salinity stress avoidance mechanism.

TI: The effect of saline irrigation on lucerne production: shoot and root growth, ion relations and flowering incidence in six cultivars grown in northern Victoria, Australia.
AU: Rogers-ME
SO: Irrigation-Science. 2001, 20: 2, 55-64; 23 ref.
LA: English
AB: The effect of saline irrigation (0.1-7.6 dS m-1) on the growth of six cultivars of lucerne (Aurora, CUF101, Trifecta, Validor, WL Southern Special and Sirosal-also known as Alfanafa) was assessed over four irrigation seasons at Tatura, Victoria, Australia. Measurements made in the study included shoot dry matter production, shoot ion concentrations, flowering incidence, root distribution and soil salinity and sodicity levels. After four seasons, soil ECe levels increased to 4.2 dS m-1 at the beginning of the irrigation season and continued to increase to around 6 dS m-1 at the end of the season for the highest salinity irrigation treatment (7.6 dS m-1). The soils in the two most saline irrigation treatments also became sodic (SAR1:5 > 3) by the third and fourth seasons. By the second season, cultivars differed significantly in salt tolerance as defined by the rate of decline in dry matter production. The cultivars CUF 101 and Validor were consistently the most salt-tolerant cultivars, although cv. Southern Special produced the greatest amount of dry matter over all salinity treatments. Root densities at depths from 0 to 60 cm were greater under saline (2.5 and 7.6 dS m-1) than under non-saline conditions (0.1 dS m-1). Flower production was increased by salinity. It was concluded that, despite the presence of intraspecific variation for salt tolerance, it is detrimental to irrigate lucerne with water at electrical conductivities greater than 2.5 dS m-1 on a red-brown earth in southern Australia.

TI: Effect of water salinity on the mineral nutrition of three varieties of perennial lucerne (Medicago sativa).
OT: Effet de la salinite des eaux d'irrigation sur la nutrition minerale chez trois varietes de luzerne perenne (Medicago sativa).
AU: Mezni-M; Ali-Albouchi; Bizid-E; Hamza-M
SO: Agronomie. 2002, 22: 3, 283-291; 36 ref.
LA: French
LS: English
AB: The impact of irrigation water's salt stress was studied at the level of mineral nutrition of lucerne local cultivar Gabes in comparison with two introduced cultivars, Hunterfield and Hyb.555. The study was conducted in a greenhouse for 120 days (3 cycles of regrowth). Four NaCl concentrations were applied: 0, 2.5, 5 and 10 g litre-1. The mineral nutrition showed an antagonism between Na+/K+ which was more pronounced for the two introduced varieties. The dry matter biomass accumulated more Na+ and Cl- ions from cut to cut and with higher intensity for Hunterfield and Hyb.555 compared to the local variety Gabes. The Na+ and Cl- contents were more significant in stems than in leaves for the Gabes cultivar. However, the two introduced cultivars had more Na+ and Cl- in leaves than in stems. Such a situation allows the local variety to attenuate the toxic effects of the sodium and chloride ions.

TI: Response of alfalfa genotypes to saline water irrigation.
AU: Anand-A; Baig-MJ; Mandal-PK
SO: Biologia-Plantarum. 2000, 43: 3, 455-457; 10 ref.

LA: English
AB: The influence of saline water (4, 8, 12 dS/m) irrigation on gas exchange and growth response of lucerne seedlings, genotypes Anand-2, T-9 and IL-112, was studied in pot experiments. Gas exchange measurements were made on fully expanded leaves 15 days after the first cut (with the first cut being made 75 days after sowing). T-9 and IL-112 showed a significant increase in net photosynthetic rate (PN) at low salinity (4 dS/m) compared to the control whereas Anand-2 maintained an unaltered PN. Reduction in PN at higher salinities was primarily due to reduction of stomatal conductance. There was a greater reduction in transpiration rate as compared to PN rate, which resulted in an increase in water use efficiency (WUE) in all genotypes. High WUE may serve as one of the strategies of the plant to withstand saline environments. However, the slight increase in WUE in Anand-2 could not help in maintaining its growth. An increase in Na+ concentration in comparison to K+ concentration in Anand-2 may also contribute to the inhibition of growth.

TI: Growth and photosynthetic characteristics of lucerne (Medicago sativa L.) genotypes as influenced by salinity of irrigation water.
AU: Anjali-Anand; Baig-MJ; Anuradha-M; Mandal-PK; Anand-A
SO: Indian-Journal-of-Plant-Physiology. 2001, 6: 2, 158-161; 15 ref.
LA: English
AB: Lucerne cv. RL 88, T 9 and Anand 2 were irrigated with four levels of saline water (0.8, 4.0, 8.0, 12.0 dS/m) and the effects on growth and photosynthetic efficiency were examined. Leaf photosynthesis rate (Pn) was maintained in Anand 2, but declined in RL 88 at higher salinity levels. T 9 showed an increase in Pn at 4 dS/m. The reduction in Pn at higher salinity levels was the result of increased stomatal resistance and thereby low intercellular CO2 concentration. RL 88 and Anand 2 maintained the herbage yield with increasing levels of salinity. In T9, however, the herbage yield decreased by 57% at 12 dS/m compared to the control.
PT: Journal-article

TI: Effect of secondary salinization of photosynthesis in fodder oat (Avena sativa L.) genotypes.
AU: Chatrath-A; Mandal-PK; Anuradha-M
SO: Journal-of-Agronomy-and-Crop-Science. 2000, 184: 1, 13-16; 14 ref.
LA: English
LS: German
AB: In a pot experiment, the effect of secondary salinization on photosynthesis was studied in fodder oat genotypes Kent, JHO-829, JHO-881, UPO-94 and OS-6 at the flower initiation stage. With an increase in the electrical conductivity (EC) of irrigation water, the net photosynthesis rate (PN) and the transpiration rate (E) of all the genotypes decreased. The intercellular CO2 concentration (Ci) increased in all genotypes at 10 dS m-1. Stomatal resistance (Rs) had a strong negative correlation with PN and E. The increase in Ci together with the increase in the Rs shows that at higher EC non-stomatal factors also start contributing to the limitation of photosynthesis. It is suggested that secondary salinization effects are strongly under stomatal control at lower saline water irrigation levels, but at higher levels non-stomatal factors may come into play.
PT: Journal-article

TI: Growth of three forage species in saline conditions.
AU: Banuelos-GS; Beuselinck-PR
SO: Arid-Land-Research-and-Management. 2003, 17: 1, 13-22; 28 ref.
LA: English
AB: Extensive areas of salt deposits are rendering agricultural soils in arid regions unsuitable for arable cropping. Identifying native plant species to grow in salt-affected soils or to grow with saline water may sustain productivity of salt affected lands. The objective of this greenhouse study was to compare biomass production and ion accumulation (i.e., Ca2+, Mg2+, Na+, and Cl-) in potential salt tolerant forage species grown under simulated saline conditions found near La Junta region in southeast Colorado, USA. Seed-derived plants of tall fescue (Festuca arundinacea), narrowleafed birdsfoot trefoil (Lotus glaber), and broadleafed birdsfoot trefoil (Lotus corniculatus) were grown in pots filled with soil collected from nonsaline and saline areas near La Junta. Pots were irrigated with one of three qualities of water differing in EC: 0.13, 0.27, and 0.64 S m-1. For all treatments, F. arundinacea produced almost twice as much dry matter (DM) as L. glaber and L. corniculatus. Soil/water quality treatments appeared to have minimal effect on the DM yield of all species in 319 d, although DM yield

appeared to be stimulated in L. glaber by either saline water or when grown in saline soil. Herbage Ca2+ concentrations in all plants were higher when grown in nonsaline soil and decreased as water quality decreased. Herbage Mg2+ concentrations were not affected by soil or water quality treatments. In contrast, herbage Na+ and Cl- concentrations increased in all three species grown in either saline soils or irrigated with saline water. Soil EC increased at harvest for all plant species irrigated with saline water in both saline and nonsaline soils. Based on the growth responses observed for the three forage species under saline conditions, they all appear to be capable of growing in the salt-affected conditions of the La Junta region. Salt management practices will eventually be necessary to sustain productivity.

TI: Irrigating perennial pasture with saline water: effects on soil chemistry, pasture production and composition.
AU: Rogers-ME
SO: Sodicity issues in agricultural industries - current research and future directions. Papers from the International Sodicity Conference, Tatura, Victoria, Australia, 28 February-1 March 2000. Australian-Journal-of-Experimental-Agriculture. 2002, 42: 3, 265-272; 17 ref.
LA: English
AB: In response to a local survey that revealed that many farmers in the Goulburn Valley region of Victoria, Australia, did not adhere to recommendations for safely applying saline irrigation water to perennial pasture, an experiment was conducted at Tatura. Six irrigation water quality treatments, which differed in the timing of the application of saline water, were applied to perennial pasture plots over 4 irrigation seasons. Measurements made included soil electrical conductivity (EC)1:5, soil sodium adsorption ratio (SAR)1:5, soil exchangeable sodium percentage (ESP), pasture dry matter production and composition, dry matter digestibility, tissue ion concentrations and mineral ash content. After 4 seasons, in which the winter rainfall for each season was significantly lower than the long-term average, soil sodicity and salinity levels appeared to reach steady values. Plots irrigated with non-saline water (0.1 dS/m, treatment 1) performed the best in terms of lower soil salinity and sodicity levels and higher dry matter production and pasture quality levels. However, for most of these measurements and for most seasons, there were no significant differences between the control plots and those irrigated with water at 1.2 dS/m (treatment 2). Soil EC1:5 and SAR1:5 levels were highest, and dry matter production and dry matter digestibility levels the lowest (particularly for the clover component), in plots irrigated with water at 2.4 dS/m throughout the season (treatment 6). There were no significant differences in soil characteristics or biomass production between the remaining 3 treatments (treatments 3, 4 and 5) or between treatment 2. These treatments had the same amount of salt applied throughout the season but differed in the pattern of salt application -- whether it occurred at the beginning or end of the season, or was alternated with fresh water throughout the season. This study confirmed that in the long term, there is a reduction in the yield of perennial pastures when saline irrigation water at levels greater than 0.8-1.2 dS/m is used on the red-brown earths of the Shepparton Irrigation Region. However, the soil and pasture were more sensitive to the total amount of salt applied rather than to the pattern of salt application throughout the season. It is concluded that farmers should monitor the salinity levels of their irrigation water to avoid a build up of Na+ and Cl- in the soil profile and consequent long-term reductions in herbage production and quality.

TI: Experiences on Vetiver grass salinity tolerance.
AU: Belligno-A; La-Loggia-F; Sambuco-F; Sardo-V; Loggia-F-La; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 161-169; 5 ref.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: Vetiver grass was grown in 20-litre microlysimeters with drip irrigation water containing seawater concentrations of 0%, 20%, 40%, 60% and leaching fractions of 40% and 120%. Initial results indicated that: (1) plants are able to survive irrigation with 60% seawater concentration (with NaCl contents up to 3.4 % in the leachate); (2) fresh and dry weight in aerial biomass production was influenced by 40% and 60% seawater concentrations, but not in the roots; (3) biomass production increased in 0% and 20% seawater treatments compared to 40% to 60%; and (4) increased leaching fractions increased biomass production.

PT: Book-chapter; Conference-paper

TI: Growth and yield response of paper sorghum to irrigation with saline water.
OT: Effetto della salinita sull'accrescimento e sulla risposta produttiva del sorgo da carta.
AU: Rivelli-AR; Lovelli-S; Nardiello-I; Perniola-M; Gherbin-P
SO: Rivista-di-Agronomia. 2002, 36: 4, 333-338; 11 ref.
LA: Italian
LS: English
AB: An experiment was conducted during 1997 and 1998 in Metaponto (MT), Italy, to evaluate the growth and yield response of paper sorghum (Sorghum bicolor x S. dochna) to irrigation with saline water (EC 0.9, 5, 5 plus leaching requirement, and 10 dS/m). A significant increase in soil salt concentration (ECe) was measured at the end of the growing cycle. Winter rain and the application of leaching requirement were not sufficient for soil reclamation. A significant decrease in yield was observed due to saline stress. In 1997, the total epigeous dry matter decreased from 3900 g/m2 in the control to 2450 g/m2 of the most saline treatment. In 1998, sorghum sown in the same spot as the previous year produced lower yield than in 1997 due to higher salt accumulation in the soil. The soil threshold limit for salinity was 3.5 dS/m, where for each unitary decrease of soil ECe a relative yield decrease of 9.4% was measured. Paper sorghum can be classified between moderately tolerant and moderately sensitive crops.PT: Journal-article
AN: 20043058678

TI: Effects of salt treatments on the production and chemical composition of salt wort (Salicornia herbacea L.), rhodesgrass and alfalfa.
AU: Shimizu-K
SO: Japanese-Journal-of-Tropical-Agriculture. 2000, 44: 1, 61-67; 12 ref.
LA: English
LS: Japanese
AB: The possibility of using salt wort (Salicornia herbacea) in a saline environment as a forage crop was examined compared to rhodesgrass and alfalfa. Rhodesgrass (Chloris gayana cv. Natsuwakaba), alfalfa (Medicago sativa cv. Katanbora) and salt wort plants were irrigated with saline water at various NaCl concentrations (alfalfa: 500, 1000 and 3000, rhodesgrass: 500, 1000, 3000, 10thin000 and 30thin000 ppm, salt wort: 1000, 3000 and 30thin000 ppm) during the growing season to analyse the chemical composition, nutrient absorption and TDN (total digestible nutrients) content of plants. Salt wort showed higher percentages of crude protein and minerals compared to alfalfa and rhodesgrass. The shoot growth of alfalfa under 3000 ppm NaCl irrigation was markedly inhibited, resulting in the death of most of the plants. The dry weight of rhodesgrass shoots decreased at harvest, in the high NaCl concentration treatment, while salt wort showed a higher salt tolerance, compared to that of alfalfa and rhodesgrass. Therefore it is concluded that salt wort is an important plant for use as a forage crop in areas where the cultivation of forage crops is difficult due to the influence of salt.
PT: Journal-article

TI: Reuse of highly saline aquaculture effluent to irrigate a potential forage halophyte, Suaeda esteroa.
AU: Brown-JJ; Glenn-EP
SO: Aquacultural-Engineering. 1999, 20: 2, 91-111; 36 ref.
LA: English
AB: The feasibility of reusing saline aquaculture effluent to produce a salt-tolerant shrub (Suaeda esteroa) with potential as a forage crop was investigated. Plants were grown in sandy loam soil, in drainage lysimeters to determine forage yield, water use and capacity for nitrogen and phosphorus uptake when irrigated with highly saline (31 ppt NaCl) effluent from a tilapia culture system. Water was applied to soil three times per week at five rates, ranging in volume from 50 to 250% of the pan evaporation rate. Plant biomass increased significantly with increasing irrigation volume ($P<0.05$). Due to higher plant growth, water consumption also increased with increasing irrigation volume ($P<0.05$). Nitrate concentrations in water draining from the lysimeters decreased during the experiment and decreased with increasing irrigation volume ($P<0.05$). Toward the end of the experiment, concentrations of nitrate in the leachate in the high volume treatments were below the mean limits set by the US Environmental Protection Agency for effluent discharge. Phosphorus concentrations in the leachate

water increased during the experiment and increased with increasing irrigation volume (P<0.05). It is concluded that using high salinity aquaculture wastewater to irrigate halophyte crops can be a viable strategy for disposal of effluent, especially where phosphorus is not a limiting nutrient.
PT: Journal-article

TI: Influence of salinity in irrigation water on forage sorghum and soil chemical properties.
AU: Clark-DR; Green-CJ; Allen-VG; Brown-CP
SO: Journal-of-Plant-Nutrition. 1999, 22: 12, 1905-1920; 29 ref.
LA: English
AB: Two greenhouse experiments were conducted to investigate effects of saline water treatments on soil chemical properties and forage sorghum cv. Dekalb FS-5. Treatments for the first experiment consisted of a nonsaline control or 500 ml of a solution with an electrical conductivity (EC) of 10 dS m-1 applied once. In the second experiment, treatments were salinity levels of 1.7, 3.5, 5.2, 8.5, and 12.2 dS m-1, applied in non-nitrogenous Hoagland's solution as the sole source of irrigation. Both experiments were replicated four times in pots containing 7 kg of air-dried Amarillo fine sandy loam soil. Sorghum survivability and plant height were measured. In the second experiment, water use by sorghum was also measured. Plants were harvested and analysed after 7 weeks. After harvest, soil salinity, pH, and in the second experiment, extractable soil elements were determined. Soil salinity increased, while soil pH decreased, with the salinity treatments. Extracted soil Ca, Mg, Na, K, Mn, and Cd increased while S, Fe, and Cu decreased, and Al and Zn exhibited no change with increasing salinity. Sorghum aerial plant and root production decreased with increasing salinity. Plant Ca, Sr, Mn, and Cd levels increased with increasing salinity. In contrast, sorghum K, P, and S levels declined with increasing salinity.
PT: Journal-article

TI: Aster tripolium: a winter forage: introduction for salt-affected soils.
AU: Aslam-Z; Bhatti-AS; Mujtabe-M; Hamdy-A (ed.); Leith-H (ed.); Todorovic-M (ed.); Moschenko-M
SO: Halophyte uses in different climates. II. Halophyte crop development: Pilot studies. Proceedings of the 3rd seminar of the EU Concerted Action Group IC 18CT 96-0055 Florence, Italy, 20 July 1998. 1999, 95-103; Progress in Biometeorology, Volume 14; 20 ref.
PB: Backhuys Publishers; Leiden; Netherlands
LA: English
AB: Aster tripolium, a winter forage, had a high degree of salt tolerance in hydroponic and field studies. A 50% reduction in yield took place at an electrical conductivity (EC) of 31.7 dS/m. Salinity and oxygen deficiency in combination had little effect on the growth of A. tripolium. In general A. tripolium had a high inbuilt capacity for salt accumulation. However, with the increase in root-zone salinity, the salt concentration in the shoot increased and was about 30% at 56 dS/m. Despite such a high internal salt concentration, there was a negligible effect on the uptake of total nitrogen by the plants. The contents of Zn, Cu, Mn and Fe were above dietary requirements at all salinity levels. Being both salt- and waterlogging-tolerant, A. tripolium has the potential to cover the winter gap for forage on salt-affected soils in Pakistan and elsewhere. In suitable areas near the sea coast it could be grown with seawater irrigation.

TI: Water use, productivity and forage quality of the halophyte Atriplex nummularia grown on saline waste water in a desert environment.
AU: Glenn-E; Tanner-R; Miyamoto-S; Fitzsimmons-K; Boyer-J
SO: Journal-of-Arid-Environments. 1998, 38: 1, 45-62; 29 ref.
LA: English
AB: A. nummularia grown at Tempe, Arizona in outdoor drainage lysimeters was irrigated with mildly saline (1149 mg/litre total dissolved solids (TDS) storm runoff collected in a pond) or brackish (4100 mg/litre TDS blowdown water from cooling towers) waste water from an electric power plant. Enough water was applied weekly to replace evapotranspiration losses. Soil solution salinity in the rooting depth profile ranged from 300 to 1000 mol m-3 NaCl when irrigated with blowdown water and from 40 to 90 mol m-3 NaCl when irrigated with pond water, but plant growth was not affected by water source. A. nummularia had higher productivity, water use efficiency and total water use than conventional forage crops grown in Arizona drainage districts, and the

nutritive value of plant tissues was acceptable for use as a ruminant forage. The species displays characteristics making it suitable for using for recycling saline water.
PT: Journal-article

TI: Response of nitrogen under different levels of salinity and boron in irrigation water on fodder yield and protein content of bajra.
AU: Kumar-R; Singh-KK; Chhipa-BR
SO: Crop-Research-Hisar. 1997, 13: 3, 547-551; 9 ref.
LA: English
AB: A study was conducted to determine the effects of irrigation water (differing in salt concentration (4.8 to 12 dS/m) and boron level (2 to 10 p.p.m.)) and nitrogen levels (60, 90 and 120 kg/ha) on fodder yield and protein content of bajra (Pennisetum glaucum). The fresh and dry fodder yield of bajra in both of 2 cuttings (60 and 105 days after sowing) decreased with increasing level of salt and boron concentration of irrigation water and increased with increasing level of nitrogen application. The considerable reduction in fresh and dry fodder yield in both the cuttings was observed at EC levels above 8 dS/m and boron levels above 4.0 p.p.m. The optimum dose of nitrogen was found to be 120 kg/ha. Protein content of both the cuttings increased significantly with increasing level of EC and nitrogen, while the boron levels did not affect protein content significantly.
PT: Journal-article

TI: Purslane (Portulaca oleracea L.): a halophytic crop for drainage water reuse systems.
AU: Grieve-CM; Suarez-DL
SO: Plant-and-Soil. 1997, 192: 2, 277-283; 31 ref.
LA: English
AB: In greenhouse trials, Portulaca oleracea plants (a source of livestock fodder and a vegetable crop for human consumption) were irrigated with water at 3 salinity levels (ECi of 2.1, 15.2 or 28.5 dS m-1), and 0 or 2.3 mg Se litre-1, to assess the suitability of this crop for drainage water reuse systems. In the initial cuts, when plants were cut at ground level, shoot dry matter was reduced by 15-30% at 15.2 dS m-1 and by 80-90% at 28.5 dS m-1. Regrowth after cutting above the first node was vigorous and biomass from plants irrigated with 15.2 dS m-1 water was nearly double that from the 2 dS m-1 treatment. Se had a stimulatory effect on plant growth in some treatments but results were not consistent. No visual symptoms of Se toxicity were observed. It was concluded that P. oleracea is a good candidate for inclusion in saline drainage water reuse systems.
PT: Journal-article

TI: Effect of irrigation with saline water on root distribution and forage yield by different root types of alfalfa (Medicago sativa) under different soil salinity conditions with zero leaching.
AU: El-Nahrawy-MAZ
SO: The genus Medicago in the Mediteranean region: current situation and prospects in research. Proceedings of the meeting of the Mediterranean Working Group on Medicago of the FAO-CIHEAM Inter-Regional Research and Development Network on Pastures and Fodder Crops, Hammamet, Tunisia, 19-22 October 1995. Cahiers-Options-Mediterraneennes. 1996, 18: 119-125; 17 ref.
LA: English
AB: The importance of root characteristics of different cultivars of lucerne (M. sativa) in salt tolerance was investigated by growing 2 cultivars (MN4311 and MN4661) in cylindrical plastic growth containers with transparent viewing planes. During a period of about 4 months, plants were harvested 5 times, and root depth was monitored and root length measured. Both herbage yield and root length showed highly significant differences under the 4 salinity levels that were used. Salinity had detrimental effects on forage yield, especially in the first 2 harvests. Interactions between cultivar and salinity levels were significant and non-significant for herbage yield and root length, respectively. MN4311, which produces higher amounts of secondary roots, exhibited higher herbage yield for all salinity treatments and harvests than MN4661. Highly significant differences were detected for both salinity and cultivar effects for all harvests with respect to herbage yield and root length, although differences due to interaction effects were only significant for the first and third harvests. There is therefore a possibility for breeding lucerne with salinity tolerance by modifying root morphology.
PT: Conference-paper; Journal-article

TI: Inula crithmoides: a candidate plant for saline agriculture.
AU: Zurayk-RA; Baalbaki-R
SO: Arid-Soil-Research-and-Rehabilitation. 1996, 10: 3, 213-223; 25 ref.
LA: English
AB: Inula crithmoides, a common halophyte from the coast of Lebanon, was evaluated for use in saline agriculture. The plant is traditionally consumed in Lebanon and the roots are claimed to have medicinal properties as a tonic. Inula crithmoides offshoots were collected from the wild and propagated in a controlled environment. Germination and rooting tests under various salinity regimes ranging from 0.5 to 80 dS/m (NaCl) demonstrated a severe restriction of germination above 20 dS/m and indicated that vegetative propagation is probably the main reproduction strategy in saline environments. The growth of potted plants grown under 5 levels of salinity for a period of 87 days was only affected by salinity exceeding 20 dS/m. Yield of plants irrigated with 40 dS/m saline water was nearly half that of the no-salt control. Mean yield value for plants grown at 20 dS/m reached 18.3 g dry weight (DW) per plant. At this salinity, crude protein content averaged 12.7% mg/kg, and shoot iodine contents ranged between 0.8 and 1.4 mg/kg DW, making I. crithmoides a good-quality fodder, and an iodine-rich vegetable. This species also exhibited ionic relations typical of halophytes, with shoot K/Na ranging between 0.1 and 0.4, indicating that it can substitute Na for K. It is concluded that Inula crithmoides can be a good candidate for use in saline agriculture, provided a selection process is initiated to identify high yielding varieties.
PT: Journal-article

TI: Screening of mesquite (Prosopis spp.) for biomasss production at barren sandy areas using highly saline water for irrigation.
AU: Rafiq-Ahmad; Shoaib-Ismail; Moinuddin-M; Tarana-Shaheen; Ahmad-R; Ismail-S; Shaheen-T
SO: Pakistan-Journal-of-Botany. 1994, 26: 2, 265-282; 22 ref.
LA: English
AB: Seeds of 9 accessions of 3 local species and one exotic species were screened on filter paper with saline water. The local P. juliflora and P. glandulosa showed better germination than P. cineraria and the exotic species under non-saline and saline conditions. When growth of 3 local and 2 exotic species was studied in pots irrigated with sea water diluted to various concentrations, P. juliflora from Brazil grew at the highest concentration and showed the least biomass reduction. Seeds of 20 accessions of 8 exotic and 12 local species were sown in the field and irrigated with saline water. Accessions of the local P. juliflora (D. I. Khan) and P. glandulosa (Sujawal) and several exotic accessions (P. alba accession 0016 and 2 South American species) showed better growth in plant height and stem diameter than the rest. The importance of mesquite for fodder, wood for fuel and timber, and checking movement of sand dunes to control desertification is examined.
PT: Journal-article

TI: Response of thirteen alfalfa cultivars to sodium chloride concentrations in irrigation water under greenhouse conditions.
AU: Ahmed-MH; Mohamed-NA
SO: Annals-of-Agricultural-Science,-Moshtohor. 1994, 32: 4, 1759-1779; 16 ref.
LA: English
LS: Arabic
AB: In a pot experiment, 13 Medicago sativa cultivars were irrigated with water containing 1000, 2000 or 3000 p.p.m. NaCl, or with tap water. Saline water decreased growth in all cultivars, but there were significant cultivar X NaCl concentration interactions for some parameters. Cultivars were classified as salt tolerant, moderately tolerant or salt sensitive.
PT: Journal-article

TI: Forage halophytes in the Mediterranean basin.
AU: Houerou-HN-le; Le-Houerou-HN; Choukr-Allah-R (ed.); Malcolm-CV (ed.); Hamdy-A
SO: Halophytes-and-biosaline-agriculture. 1995, 115-136; 52 ref.
PB: Marcel Dekker Inc.; New York; USA
LA: English
AB: It was shown that out of 700 Mediterranean halophyte species, 27.5% were from the Chenopodiaceae, 15% from the Poaceae, 6% from the Asteraceae and 5% from the Caryophyllaceae, Fabaceae and Zygophyllaceae;

70% were perennial and 30% annual or biennial. The most common tree species was Tamarix, the most common shrubs Salicornia, Salsola, Suaeda and Atriplex, the most common perennials Aeluropus, Sporobolus, Puccinellia and the most common annual species Hordeum maritimum, Lepturus cylindricus, Frankenia and Melilotus. The halophytic vegetation was described and aspects of the palatability (ratio of feed intake:fodder on offer) and preference; primary productivity (aboveground biomass of Atriplex halimus was 10-15 t DM/ha and annual productivity 2-5 t DM/ha); grazing and nutritive value (digestible DM 40-70%, digestible OM 50% and CP content 10-12%); and cultivation (Atriplex nummularia, A. semibaccata and Myoporum insulare grown in Australia and A. canescens and A. lentiformis in the USA) were discussed. Many salt tolerant fodder species used in land reclamation with or without irrigation using saline water (Festuca arundinacea, Sporobolus, Trifolium fragiferum, Lotus corniculatus, Lolium rigidum, Hordeum vulgare, Melilotus alba, M. italica and Medicago spp.) gave DM yields of 5-20 and 2-10 t/ha, respectively.

TI: Leaf, stolon and root growth of white clover (Trifolium repens L.) in response to irrigation with saline water.
AU: Rogers-ME; Noble-CL; Nicolas-ME; Halloran-GM
SO: Irrigation-Science. 1994, 15: 4, 183-194; 30 ref.
LA: English
AB: The effect of irrigation with water at 2.6 and 5.2 dS/m salinity on the growth of pure swards of 6 T. repens cultivars was examined over 3 irrigation seasons at Tatura. After 2 irrigation seasons, soil EC levels increased to 6 dS/m at 0-60 cm depth in the higher salinity treatment resulting in highly significant reductions in shoot DM production, flowering densities and petiole and stolon densities and increased shoot Cl and Na concentrations and reduced leaf water potentials and canopy photosynthetic efficiency rates especially at high temperatures. In contrast, root growth increased at shallow depths (0-15 cm) under both saline irrigation treatments. Cultivars differed in salt tolerance, with cv. Haifa and Irrigation exhibiting smaller reductions in herbage yield and petiole densities during one irrigation season and lower concentrations of Na and Cl in the shoots compared with cv. Aran, Kopu, Pitau and Tamar. In addition, canopy photosynthetic efficiency rates in plots irrigated with water at 5.2 dS/m were higher in Haifa than in Tamar. The salt tolerance ranking obtained for the 6 cultivars was in broad agreement with earlier greenhouse studies.
PT: Journal-article

TI: Overview of problems and prospects for utilizing halophytes as a resource for livestock and for rehabilitation of degraded lands.
AU: Squires-VR; Squires-VR (ed.); Ayoub-AT
SO: Halophytes as a resource for livestock and for rehabilitation of degraded lands. Proceedings of the international workshop on halophytes for reclamation of saline wastelands and as a resource for livestock problems and prospects, Nairobi, Kenya, 22-27 November 1992. 1994, 1-6; 35 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The role and potential of halophytes for land reclamation, as irrigated crops using saline water, as livestock feed, as medicinal plants, as fuelwoods, as shade and shelter and for sequestration of carbon dioxide are reviewed.
PT: Conference-paper

TI: Utilization of halophytic plants for fodder production with brackish water in subtropic deserts.
AU: Miyamoto-S; Glenn-EP; Singh-NT; Squires-VR (ed.); Ayoub-AT
SO: Halophytes as a resource for livestock and for rehabilitation of degraded lands. Proceedings of the International Workshop on Halophytes for reclamation of saline wastelands and as a resource for livestock problems and prospects, Nairobi, Kenya, 22-27 November 1992. 1994, 43-75; 5 pp. of ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Among the major natural resources of arid and semiarid deserts, brackish water (containing dissolved salts of 5 to 20 g/litre) is considered to be currently the least explored resource, primarily because the salinity is too high to produce conventional crops. Production of halophytic plants (which include halophytes and salt tolerant nonhalophytes) by irrigation may enable the utilization of brackish water to supplement fodder needs. The salt

tolerance characteristics of halophytic plants, the characterization of water and soils for irrigated production, and various potential system options for irrigated production are examined. Salt tolerance of most halophytic plants at germination is not usually higher than that of conventional crops, therefore careful management is required for establishment. Many halophytic plants show optimum growth at soil solution salinity of 20-25 g/litre, and 25-50% growth reductions at 30-40 g/litre, even though they can survive soil solution salinity as high as 60-90 g. Forage yields and quality of some halophytic plants are comparable with conventional forage crops. However, excessive uptake of salts and, in some instances, toxic substances such as Se and Mo may reduce nutritive values unless the halophytes are blended with conventional fodder. Under ordinary leaching fractions (>0.25), irrigated production of halophytic fodder is optimum at irrigation water salinity of <10 g/litre (13-15 dS/m), and is reduced substantially when salinity of irrigation water approaches 20 g/litre. Salinity of drainage water can easily reach the seawater level of salinity (35 g/litre) or even higher. The quantity of salts that must be leached for sustainable production is about 100 tons/ha annually. Halophytic plants can be raised in conventional single culture systems using sprinklers or surface irrigation, especially salinity of water is too high for conventional crops (typically above 5 g/litre). Multiple crop culture using strip planting of halophytic crops between conventional forage crops or irrigated silvipastoral systems could also be used, especially for reducing drainage water handling. Halophytic plants grown in strips with limited irrigation may utilize saline water from the shallow water table, and can remove dissolved salts at a rate of 5-10 t/ha annually. The possibility of biofiltration of toxic trace elements from drainage water requires further studies. Future prospects for halophytic fodder production may depend to a large extent upon the success of ongoing selection programs, enhanced breeding efforts, a considerable amount of agrotechnical evaluation, including the aspects of biofiltration and production systems, and improved understanding of the role of halophytes in saline water and soil management.
PT: Conference-paper

TI: Utilization of high salinity tolerant plants and saline water by desert animals.
AU: Gihad-EA; Lieth-H (ed.); Al-Masoom-AA
SO: Towards the rational use of high salinity tolerant plants. Volume 1: Deliberations about high salinity tolerant plants and ecosystems. Proceedings of the first ASWAS conference December 8-15, 1990, Al Ain, United Arab Emirates. 1993, 443-447; 18 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The main source of drinking water for animals in semi-arid areas contains comparatively high concentrations of salts with sodium chloride as the main constituent. Under these conditions, an important fodder is saltbush (Atriplex spp.) which contains up to 10% sodium chloride. When sheep drank water containing 1.0% NaCl they suffered no ill effects, 1.5% was detrimental to some and 2% was detrimental to all sheep. The general reaction of sheep to increasing salt concentration was to increase the volume of drinking water. At high intakes of salt, feed intake was erratic and decreased by about 20 to 30%. There was an adverse effect on animal health and rumen microorganisms, leading to decreased digestion. Urinary nitrogen increased and nitrogen retention decreased with high salt intake. Primary results of feeding Atriplex halimus as a sole feed to camels, sheep and goats showed an increase in water intake and a decrease in feed intake compared with clover hay. Camels, sheep and goats (in descending order) were able to tolerate saltbush fodder. This review concludes that concentrated supplementary feeds should be offered to livestock given Atriplex together with a reliable water source to maintain a balanced nutritional state.
PT: Miscellaneous

TI: Halophyte crops for direct salt water irrigation.
AU: Glenn-EP; Watson-MC; Lieth-H (ed.); Al-Masoom-AA
SO: Towards the rational use of high salinity tolerant plants. Vol. 1. Deliberations about high salinity tolerant plants and ecosystems. Proceedings of the first ASWAS conference, December 8-15, 1990, Al Ain, United Arab Emirates. 1993, 379-385; Tasks for Vegetation Science 27; 45 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Halophytes have been evaluated as potential crops for direct seawater or brackish water irrigation. Large-scale halophyte farms could conceivably be developed in three areas: in coastal deserts using seawater for irrigation, in inland salt deserts using saline underground or surface water for irrigation, and in existing arid-zone deserts using brackish drainage water for irrigation. Coastal desert areas suitable for seawater irrigation of

halophytes are listed. The usable area for halophyte culture was _ 1.3 million km2, comparable to the area of conventional irrigation in the world. The yield-potential of halophytes using seawater irrigation is reviewed. Halophytes grown on seawater in multi-year field trials in a coastal desert environment showed levels of biomass and seed production comparable to conventional crops. Useful products from halophyte crops included animal fodder, grains and oilseeds. The use of halophytes was hindered by the need to modify or adapt present agronomic practices.
PT: Conference-paper

TI: The potential of halophytes in the development and rehabilitation of arid and semi-arid zones.
AU: Choukr-Allah-R; Choukr-Allah-R (ed.); Malcolm-CV (ed.); Hamdy-A
SO: Halophytes-and-biosaline-agriculture. 1995, 3-13; 39 ref.
PB: Marcel Dekker Inc.; New York; USA
LA: English
AB: The possible uses of halophytes (for fodder, fuel and ornamental and landscape trees), the species that may be suitable for economic production in saline environments and the need to develop proper agronomic conditions in order to maximize the productivity of halophyte species by the genetic improvement of their characteristics are described. Species mentioned included Atriplex spp., Paspalum vaginatum, P. dilatatum, Maireana brevifolia, Prosopis tamarugo, P. chilensis and Distichlis spicata grown for fodder, Atriplex and mangrove trees for fuel crops, Maireana sedifolia, Limonium, Eucalyptus occidentalis and E. sargentii for ornamental purposes and landscape trees.
PT: Book-chapter

TI: Effect of secondary salinization of photosynthesis in fodder oat (Avena sativa L.) genotypes.
AU: Chatrath-A; Mandal-PK; Anuradha-M
SO: Journal-of-Agronomy-and-Crop-Science. 2000, 184: 1, 13-16; 14 ref.
LA: English
LS: German
AB: In a pot experiment, the effect of secondary salinization on photosynthesis was studied in fodder oat genotypes Kent, JHO-829, JHO-881, UPO-94 and OS-6 at the flower initiation stage. With an increase in the electrical conductivity (EC) of irrigation water, the net photosynthesis rate (PN) and the transpiration rate (E) of all the genotypes decreased. The intercellular CO2 concentration (Ci) increased in all genotypes at 10 dS m-1. Stomatal resistance (Rs) had a strong negative correlation with PN and E. The increase in Ci together with the increase in the Rs shows that at higher EC non-stomatal factors also start contributing to the limitation of photosynthesis. It is suggested that secondary salinization effects are strongly under stomatal control at lower saline water irrigation levels, but at higher levels non-stomatal factors may come into play.
PT: Journal-article

TI: Effects of salt treatments on the production and chemical composition of salt wort (Salicornia herbacea L.), rhodesgrass and alfalfa.
AU: Shimizu-K
SO: Japanese-Journal-of-Tropical-Agriculture. 2000, 44: 1, 61-67; 12 ref.
LA: English
LS: Japanese
AB: The possibility of using salt wort (Salicornia herbacea) in a saline environment as a forage crop was examined compared to rhodesgrass and alfalfa. Rhodesgrass (Chloris gayana cv. Natsuwakaba), alfalfa (Medicago sativa cv. Katanbora) and salt wort plants were irrigated with saline water at various NaCl concentrations (alfalfa: 500, 1000 and 3000, rhodesgrass: 500, 1000, 3000, 10thin000 and 30thin000 ppm, salt wort: 1000, 3000 and 30thin000 ppm) during the growing season to analyse the chemical composition, nutrient absorption and TDN (total digestible nutrients) content of plants. Salt wort showed higher percentages of crude protein and minerals compared to alfalfa and rhodesgrass. The shoot growth of alfalfa under 3000 ppm NaCl irrigation was markedly inhibited, resulting in the death of most of the plants. The dry weight of rhodesgrass shoots decreased at harvest, in the high NaCl concentration treatment, while salt wort showed a higher salt tolerance, compared to that of alfalfa and rhodesgrass. Therefore it is concluded that salt wort is an important plant for use as a forage crop in areas where the cultivation of forage crops is difficult due to the influence of salt.

PT: Journal-article

TI: Reuse of highly saline aquaculture effluent to irrigate a potential forage halophyte, Suaeda esteroa.
AU: Brown-JJ; Glenn-EP
SO: Aquacultural-Engineering. 1999, 20: 2, 91-111; 36 ref.
LA: English
AB: The feasibility of reusing saline aquaculture effluent to produce a salt-tolerant shrub (Suaeda esteroa) with potential as a forage crop was investigated. Plants were grown in sandy loam soil, in drainage lysimeters to determine forage yield, water use and capacity for nitrogen and phosphorus uptake when irrigated with highly saline (31 ppt NaCl) effluent from a tilapia culture system. Water was applied to soil three times per week at five rates, ranging in volume from 50 to 250% of the pan evaporation rate. Plant biomass increased significantly with increasing irrigation volume ($P<0.05$). Due to higher plant growth, water consumption also increased with increasing irrigation volume ($P<0.05$). Nitrate concentrations in water draining from the lysimeters decreased during the experiment and decreased with increasing irrigation volume ($P<0.05$). Toward the end of the experiment, concentrations of nitrate in the leachate in the high volume treatments were below the mean limits set by the US Environmental Protection Agency for effluent discharge. Phosphorus concentrations in the leachate water increased during the experiment and increased with increasing irrigation volume ($P<0.05$). It is concluded that using high salinity aquaculture wastewater to irrigate halophyte crops can be a viable strategy for disposal of effluent, especially where phosphorus is not a limiting nutrient.

TI: Productivity of forage grass under saline water.
AU: Singhania-RA; Bhati-DS; Singh-GD; Sharma-HS; Yadav-BL; Kameria-PR; Vyas-KK; Somani-LL
SO: Range-Management-and-Agroforestry. 1997, 18: 1, 31-34; 8 ref.
LA: English
AB: Para grass (Brachiaria mutica), guttan panic (Panicum maximum), blue panic (P. antidotale), Rhodes grass (Chloris gayana) and sewan grass (Lasiurus sindicus [L. scindicus]) were grown at Jobner, Rajasthan with the best available water (EC 2 dS/m) or saline water (EC 12 dS/m) from 1986/87 to 1989/90. Averaged over 4 years, Rhodes grass gave the highest green forage yield (41.5 t/ha) followed by blue panic (33.1 t/ha). There was little effect of salinity of water on grass yield. The pH of soil under guttan panic was the lowest, while pH and EC were highest under Rhodes grass and blue panic. Addition of saline water increased the EC of soil from 0.44 to 0.62 while it decreased soil pH.

TI: Evaluation of Atriplex lentiformis (Torr.) S. Wats. and Atriplex nummularia Lindl. as irrigated forage crops
AU: Watson,-M.C.; O'Leary,-J.W.; Glenn,-E.P.
AD: Environmental Research Lab., University of Arizona, Tucson, Arizona, USA
SO: Journal-of-Arid-Environments (UK).
1987, v. 13(3) p. 293-303; Nov, figs, tables, 16 ref.; summary (En)
LA: English
AB: Atriplex shrubs have been recognized for their high productivity, tolerance to saline sodic soils and production of quality forage material. In Arizona, USA, a study was carried out to evaluate Atriplex lentiformis and Atriplex nummularia as agronomic forage crops when irrigated with brackish water. Plants were clipped to a height of 15-20 cm and the subsequent regrowth was determined over a 5-month period during the establishment year. Yields and nutritive quality of each species varied with the harvest date and treatment and with the phenological stage at the time of harvest. The highest biomass yields of A. lentiformis and A. nummularia were estimated to be 14.7 and 12.3 t/ha, respectively. Total yields produced from the sum of the 2 clipped and subsequent regrowth harvests, were less than the highest biomass yields obtained in each species. In all biomass and first clipped treatments, ash and protein contents decreased and neutral-detergent and acid-detergent fibre levels increased from first to last harvest dates. Ca and P declined over the season in most harvest treatments. It is concluded that the cultivation of these species as irrigated crops provides a valuable source of forage.

TI: Developing the seawater agriculture concept.
AU: Pasternak-D; DAnon-A; Aronson-JA; Benjamin-RW
SO: Plant-and-Soil. 1985, 89: 1-3, 337-348; 1 fig., 7 tab.; 13 ref.

LA: English
AB: The experimental work being carried out at Ben-Gurion University of the Negev on the development of seawater agriculture based on salt-resistant halophytes is described. 120 plant species have been tested since 1982. Of these, 26 have performed at least as well under irrigation with 100% seawater as under irrigation with 15% seawater. The outstanding introductions were Atriplex lentiformis, A. barclayana, A. atacamensis, A. undulata and an Atriplex species from Camarones in Argentina. Atriplex nummularia was irrigated with 100%, 75% or 15% seawater. The corresponding annual yields of dry matter were 1.53, 2.12 and 2.89 kg m-2. The ash content was very high, from 25 to 40% of the dry weight, depending on the treatment and season. The crude protein content was 15-21%. A first large scale feeding trial was carried out to test the value of A. nummularia as a protein supplement for sheep grazing on wheat aftermaths. The daily intake of dry matter was 400 g per head, which was effective only with the daily addition of 400 g corn meal per head. The low feed intake is the main limiting factor in the development of seawater-irrigated fodder.
PT: Journal-article

TI: Using highly saline irrigation water for a fodder barley crop.
AU: Hussain-Z
SO: Journal-of-Agricultural-Science,-UK. 1981, 96: 3, 515-520; 17 ref.
LA: English
AB: In field trials during 2 growing seasons, saline irrigation waters with an electrical conductivity (EC) of 2.5, 4.0, 6.0 and 8.0 mmho/cm were used to irrigate barley. DM yields decreased from 2.79, 2.49 and 1.85 t/ha with normal water (2.5 mmho) to 2.45, 1.90 and 1.39 t with 8 mmho water in 1977 and in 1st and 2nd cuts in 1978, resp. CP yields also decreased by 10-27% with increase in salinity. It was concluded that in general more highly saline water leads to a considerable increase in soil salinity even over a short period of growth, and close control of soil salinity through leaching is required. Saline water with an EC of 4.0 mmho/cm may be utilized without excessively high yield reductions if the soil salinity is well maintained. Saline waters with an EC of 6.0 and 8.0 mmho/cm may lead to yield reduction, and they require careful management to control soil salinity build-up.
PT: Journal-article

TREE CROPS (NOT FRUIT OR FODDER)

TI: Farm forestry options for saline environments.
AU: Marcar-N; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 261-268; 30 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Farm forestry can contribute substantially to managing the rise of saline groundwater and productively using saline land. The capacity of trees to survive and grow on saline land is influenced by the species and provenance used, site factors such as seasonal waterlogging, and appropriate management techniques that limit root-zone salt accumulation. Groundwater use is enhanced when water tables are not too saline (electrical conductivity (EC) < 10 dS/m) and not too deep (< 4-5 m). There are good prospects to enhance tree growth on saline land through exploitation of genetic variation within species, such as Eucalyptus camaldulensis (river red gum), by producing improved seed and also through inter-specific hybrids. Examples of outcomes from research into genotype evaluation and tree water use under saline conditions in Australia and Pakistan are provided. For example, whilst commercial tree species such as E. globulus (southern blue gum) and E. grandis (flooded gum) are slightly salt-tolerant, species such as E. occidentalis (swamp yate) and Acacia nilotica (babul) are highly tolerant. Prior to large-scale implementation of farm forestry in saline environments, a better understanding is required of spatial and temporal impacts of tree plantings on groundwater movements.

TI: Growth and chemical composition of pistachio affected by salinities and depths of water table
AU: Sepaskhah,-A.R.; Karimi-Goghary,-S.
AD: Shiraz Univ., Department of Irrigation, Shiraz 897653, Iran
SO: Communications-in-Soil-Science-and-Plant-Analysis (USA).
2003, v. 34(3-4) p. 343-355, figs, tables, 15 ref.; summary (En)

LA: English
AB: The effects of saline (13 dS/m) and non-saline (0.5 dS/m) shallow water-table depths of 30, 60, 90, and 120 cm under irrigated and non-irrigated conditions on growth and chemical composition of pistachio cv. Badami-Zarandi were studied in a greenhouse experiment. It was found that appropriate growth of pistachio occurs at water-table depths of 60 cm or more under irrigated conditions. Only at this depth, the difference in plant growth between irrigated and non-irrigated conditions was significant. Pistachio is grown around the central desert of Iran under adverse conditions such as shallow saline water-tables. From authors' summary.

TI: Effect of salt stress on Rhizobium and growth of Acacia ampliceps.
AU: Roomi-DH; Rafiq-Ahmad; Ismail-S; Ghaffar-A; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 297-308; 18 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: This study was conducted to investigate the salt tolerance of 4 Rhizobium strains (TAL 569, TAL 1388, TAL 1881 and CB 3156) of Acacia species in vitro at different levels of salinity, and determine the effect of soil salinity on the growth of Acacia ampliceps. An increase in rhizobial population was observed in all the strains at 5 dS/m, which gradually decreased at higher levels of salinity though the number of colonies remained higher compared with the control. Rhizobium strain TAL 1881 showed comparatively better growth even at a higher salinity level (electrical conductivity=20 dS/m). A. ampliceps seedlings inoculated with the different strains of Rhizobium and irrigated with saline water (5-15 dS/m) showed marked increases in height and biomass compared with the control (uninoculated). Increasing salinity levels decreased the number, size and weight of the nodules per plant. Among the four strains studied, TAL 1881 produced the greatest plant biomass both under the non-saline and saline conditions. A. ampliceps inoculated with the strain TAL 569 showed the highest protein content (113%). Salinity significantly increased the concentration of Na+ in the leaves of A. ampliceps.

TI: Growth and chemical composition of pistachio affected by salinities and depths of water table.
AU: Sepaskhah-AR; Karimi-Goghary-S
SO: Communications-in-Soil-Science-and-Plant-Analysis. 2003, 34: 3-4, 343-355; 15 ref.
LA: English
AB: Pistachio may be grown around the central desert of I.R. Iran with adverse conditions such as shallow saline water tables, which limit its growth and production. The effects of saline (13 dS m-1) and non-saline (0.5 dS m-1) shallow water table depths of 30, 60, 90, and 120 cm under irrigated and not irrigated conditions on growth and chemical composition of a local pistachio cultivar (Badami-Zarandi) were studied in a greenhouse experiment. The soil was a loamy sand collected from 0-20 cm of soil surface. The results indicated that appropriate growth of pistachio may occur at water table depth of 60 cm under irrigated condition. Only at this depth, the difference in plant growth between irrigated and not irrigated conditions were significant, and low plant growth was obtained at not irrigated condition. At saline water table (13 dS m-1) and not irrigated condition water table depth should be kept below 60 cm for normal pistachio production.

TI: Epidemiology of Verticillium dahliae on olive (cv. Picual) and its effect on yield under saline conditions.
AU: Levin-AG; Lavee-S; Tsror-L
SO: Plant-Pathology. 2003, 52: 2, 212-218; 28 ref.
LA: English
AB: The epidemiology of Verticillium dahliae and its effect on yield was studied for 3 years in three plots of olive cv. Picual, planted in soil previously cropped with highly susceptible V. dahliae host plants and irrigated with saline water. Disease incidence increased 2.2-, 2.6- and 1.5-fold in plots 3A, 9A and 9C, respectively, within 39, 25 and 15 months of the first record taken. The highest severities were recorded in spring 2001 (4.0, 5.3 and 5.4 on a scale of 2-10, respectively). Disease incidence and severity increased during winter-spring and decreased during summer. Seasonal changes were also observed in the isolation of V. dahliae; the highest isolation rates in diseased trees were in winter (34%) and spring (45%), and the lowest were in autumn and summer (19-20%). Verticillium dahliae was isolated on an average of 27, 28 and 19% from the bottom, middle and top of the tree canopy, respectively, and was isolated from trees with and without symptoms. The fruit yield from diseased trees was reduced by an average of 75% in comparison with symptomless trees in plot 3A each year. A similar yield

reduction (89%) was recorded in plot 9A in 2000. The severe expression of the disease and its effect on yield in the present study could be due to the fact that the orchard was planted in infested soil, and that saline irrigation probably exacerbates the problem.

TI: Performance of 31 tree species and soil conditions in a plantation established with saline irrigation.
AU: Tomar-OS; Minhas-PS; Sharma-VK; Singh-YP; Gupta-RK
SO: Forest-Ecology-and-Management. 2003, 177: 1-3, 333-346; 22 ref.
LA: English
AB: Establishing salt tolerant tree plantations utilising the saline ground waters may provide for an economic use of abandoned arid lands but issues related to long-term sustainability of such plantations are unknown. Thus a field trial with 31 tree species was conducted over 9 years (1991-2000) on a calcareous soil in a semi-arid part (annual rainfall about 350 mm) of northwest India (Hisar, Haryana). Tree saplings were planted at the sill of furrows and irrigated with saline water (EC 8.5-10.0 dS/m) for initial 3 years (4-6 times/year) and there after, plantations were irrigated once during the winter only. Measurements were made on tree growth, water use and biomass production. Ranking in order of survival, growth and biomass yield showed that preferred choice for tree species in order of persistence and performance should be: Tamarix articulata, Acacia nilotica, Prosopis juliflora, Eucalyptus tereticornis, Acacia tortilis, and Cassia siamea. Water use efficiency in these tree species ranged between 21 and 99 kg/cm of water. The other species can be A. tortilis (hybrid), Melia azedarach and Acacia farnesiana. Tree species like Acacia auriculiformis, Albizia lebbeck, Bauhinia variegata, Cassia glauca, Syzygium cumini, Crescentia alata, Samanea saman, and Terminalia arjuna showed satisfactory early growth and survival when these were supplied with supplemental saline irrigation but proved to be sensitive after the cessation of irrigation, thus emphasising the need for long-term evaluation trials. Cassia javanica and C. alata were observed to be very sensitive to frost whereas Casuarina equisetifolia could not survive drought due to the prevailing arid conditions at the site. Salt storage in soil profile increased substantially during irrigation period (5.6-10.4 dS/m) but the added salts got distributed in soil profile as a consequence of seasonal concentration of rainfall during monsoons and some episodic events of rainfall during the following years. The soil was enriched with organic carbon (> 0.4% in upper 30 cm) under the promising tree species. Total ionic composition of leaves ranged between 2.8 and 6.8%. Thus, rehabilitation of arid soils with the above recommended tree species using the available saline waters, would not only render these abandoned soils to be productive but would also ensure conservation and improvement in environment for long range ecological security on these lands.

TI: Desert climates, poor water and olives.
AU: El-Kholy-M
SO: WANATCA-Yearbook. 2002, 26: 43-53.
LA: English
AB: This paper discusses the achievements made through field-applied techniques and practices on the use of olive trees in sustainable development and soil conservation in low rainfall and even full desert regions through the use of poor natural resources such as infertile sandy soil and saline water. This paper was written as an Egyptian field model for Mediterranean developing countries as part of an international course on Land and Water Use for Sustainable Olive Growing. The detailed findings will be very useful for olive industry in Australia's more arid regions and many of the issues discussed will benefit growers with fully-irrigated groves in any location.

TI: Assessing tolerance to irrigation water salinity in five woody plants.
AU: Germana-C; Cutore-L; Sardo-V; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 151-159; 3 ref.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: Experiments were conducted to assess salinity tolerance of olive, pomegranate, alemow [Citrus macrophylla], terebinthus [Pistacia terebinthus] and nicotiana. One-year old plants were grown in 20-litre containers and were drip irrigated daily with freshwater blended with seawater in the ratios of 0, 20, 40 and 60%

seawater. Every treatment was replicated three times. Results demonstrated that water transpired by plants decreased with increasing salinity. In terms of the absolute growth of the trunk section, the best results were obtained with pomegranates irrigated with 20% seawater. However in relative terms terebinthi plants showed a better tolerance to 20% and 40% seawater. Nicotiana was found to be highly sensitive to high salinities.

TI: Salt tolerance of tea tree (Melaleuca alternifolia).
AU: Lowe-R; Murtagh-J; Morris-S
SO: Australian-Forestry. 2000, 63: 4, 252-256; 14 ref.
LA: English
AB: Glasshouse trials were established to determine the effect of saline water applied as bottom irrigation to the biomass and oil production of tea tree (Melaleuca altemifolia). Seedlings and their coppice regrowth showed a distinctly different response to salt treatments. Seedlings demonstrated a high tolerance to saline conditions. Leaf production was unaffected below 20 dS/m while oil concentration and oil quality were unaffected to the maximum treatment level of 40 dS/m at which point a majority of trees died. Following treatment removal, trees were harvested and sodium levels in the leaves were measured. After harvest, however, tree health declined rapidly in line with salt treatment. All trees that were in treatments above 5 dS/m died following initial harvest and trees from all treatments above 1 dS/m continued to demonstrate reduced coppicing ability two years after treatment removal.

TI: Performance of Acacia nilotica in different agroforestry systems, grown in saline water.
AU: Solanki-GS; Chauhan-CPS; Singh-RB
SO: Indian-Journal-of-Forestry. 1999, 22: 4, 295-298; 13 ref.
LA: English
AB: Three multipurpose tree species (MPTs, Acacia nilotica, Zizyphus jujuba [Ziziphus mauritiana], Pithecellobium dulce) were planted as 6-month-old saplings at 4X2 m spacing in August 1991 in combination with sorghum/oats [Avena sativa] on a rotational basis in an agrosilvicultural system, or with grasses (Napier [Pennisetum purpureum]/Cenchrus or blue panic [Panicum antidotale]/Para [Brachiaria mutica]) in a silvopastoral system, and alone, on semiarid to subtropical riverine land with sandy loam soil, in Mathura, Uttar Pradesh, India. These model systems were irrigated with saline water obtained from tubewells of different salinity (low, Ece 5.69 ds/m, and high 13.17 ds/m), and with medium salinity water (9.47 ds/m) obtained by mixing the 2 water sources. Tree height and DBH (diameter at breast height) were measured at 17, 29 and 41 months old; the chemical composition of top feed from the trees was also recorded. Actual tree growth data, along with data on the chemical composition of top feed, are only given for A. nilotica; no crop data are given. The growth of A. nilotica was not significantly affected by irrigation water salinity although variations in growth were significant at the 1% level in the different agroforestry systems, with growth best in the agrosilvicultural system; growth was better than that reported previously in another study (as was growth of the other MPT species). The nutritive value of top feed of A. nilotica was better than that from results reported elsewhere in various situations in India, and was not affected by the different saline irrigation treatments.
PT: Journal-article

TI: Clonal variability in photosynthetic and growth characteristics of Populus deltoides under saline irrigation.
AU: Singh-M; Jain-M; Pant-RC
SO: Photosynthetica. 1999, 36: 4, 605-609; 28 ref.
LA: English
AB: Fifty-day-old poplar (Populus deltoides) clones raised from cuttings were irrigated with 50-200 mM NaCl. NaCl at 100 and 200 mM significantly reduced net photosynthetic rate, chlorophyll and carotenoid contents, leaf area, dry matter accumulation, and harvest index (HI) in all tested poplar clones (Bahar, S7C15, and WSL22). Clone S7C15 was more tolerant to salinity than the other clones.

TI: Effect of saline water irrigation on growth and chemical composition of (Casuarina equisetifolia L.) seedlings.
AU: El-Bagoury-H; Hossni-YA; El-Tantawy-A; Shehata-M; Asmaael-R
SO: Egyptian-Journal-of-Horticulture. 1999, 26: 1, 47-57; 21 ref.

LA: English
LS: Arabic
AB: Six-month-old C. equisetifolia seedlings were grown in plastic pots of 25 cm diameter and irrigated with tap water for one month, then irrigated with 5000, 10 000, 15 000 or 20 000 ppm saline water (NaCl and CaCl2 at a ratio of 1:1). Studies in the growing seasons of 1995 and 1996 showed that irrigation with 5000 ppm saline water significantly increased plant height, stem diameter, and fresh and dry weight of stems, branchlets and roots, compared with controls treated with tap water, while 20 000 ppm reduced all the vegetative growth parameters. All salinity treatments reduced branchlet contents of chlorophyll a and b, compared with controls, but increased the contents of carotenoids, carbohydrates, Na and Ca.
PT: Journal-article

TI: Effect of seawater and seaweed salt on coconut gray leaf spot disease
AU: Alonzo,-J.C.; Palomar,-M.K.
AD: Department of Crop Protection, Visayas State College of Agriculture, Baybay, Leyte, Philippines
SO: Philippine-Journal-of-Coconut-Studies (Philippines).
1980, v. 5(2) p. 27-31; Dec, graphs, table, 2 ref.; summary (En)
LA: English
AB: Seawater and seaweed salt could minimize the severity of coconut gray leaf spot. The effects of either treatment on the development of the disease were more or less similar. Generally, there was a continuous reduction in the number of lesions and in its development from the fourth week until the fourth month of counting when coconut seedlings were supplied with increasing rates of salt materials (seawater and seaweed salt). It was observed that seedlings fertilized with 100 g seaweed salt exhibited the least number of leaf spots among the treatments. Statistically, it did not vary significantly with the number of lesions manifested by the plants fertilized with 800-1000 ml seawater and 60-80 g seaweed salt. Under similar conditions of the experiment, 800 ml seawater and 60-80 g seaweed salt are the optimum levels of each kind of salt materials that could reduce the number of leaf spots produced by Pestalozzia palmarum. Authors' summary.

COTTON

TI: Comparative growth performance of five cotton (Gossypium hirsutum L.) genotypes against different levels of salinity.
AU: Saqib-M; Akhtar-J; Shahid-Pervaiz; Qureshi-RH; Aslam-M
SO: Pakistan-Journal-of-Agricultural-Sciences. 2002, 39: 2, 69-75; 27 ref.
LA: English
AB: This study reports relative salt tolerance of five cotton genotypes (FH-930, FVH-53, NIAB-228, MNH-228, MNH-554) grown in solution culture. There were four treatments viz. control, saline-I (NaCl at 75 mol m-3), saline-II (NaCl at 150 mol m-3), saline-III (NaCl at 225 mol m-3) with five replications in a completely randomized statistical arrangement. Rising levels of salinity significantly reduced the shoot and root growth of all the cotton genotypes. The maximum reduction was observed in treatment having NaCl at 225 mol m-3. The genotypes, however, differed among themselves under all the stress treatments and the overall ranking order of genotypes shows the best performance in case of FH-930 while MNH-554 may be regarded as the most sensitive one.
PT: Journal-article

TI: Quality and suitability of irrigation water for cotton crop.
AU: Aly-Ragab-M; Abdel-Ghany-MB; Abdel-Gawad-ST
SO: 1st Asian Regional Conference of ICID, Seoul, Korea Republic, 16-21 September 2001. 1st-Asian-Regional-Conference,-Seoul,-Korea,-16-21-September,-2001. 2001, C01; 7 ref.
PB: Korean National Committee on Irrigation and Drainage (KCID); Gyonggi-do; Korea Republic
LA: English
AB: This investigation evaluated the effect of saline irrigation water on the cotton growth parameters and its yield production in the absence of water table. The experiment studied the two principal approaches to the use of saline water in irrigation when good quality water is available, these being:- (1) mixing or (2) alternate

substitution of saline water with fresh water at certain ratios. Greenhouse studies were carried out with cotton Giza 57 for seven months. The results showed that the alternate irrigation treatment to be recommended is substitution with minimum fresh water, i.e. 30% only of the total volume was applied. No variation in growth parameters was observed, compared to the other treatments (where substitution with fresh water was carried at higher ratios).

TI: Effect of irrigation with saline water on cotton plants of Giza 83 cultivar.
AU: Saeed-MA
SO: Egyptian-Journal-of-Agricultural-Research. 2000, 78: 5, 2029-2045; 26 ref.
LA: English
LS: Arabic
AB: Two pot experiments were carried out to study the effect of irrigation with different levels of saline water on cotton plant and some chemical properties of soil in 1996 and 1997 seasons. Irrigation with saline water decreased significantly root length, plant height, number of fruiting branches, total number of flowers, total number of bolls, number of open bolls, boll setting % and boll opening % at both seasons. Boll weight, seed index, lint percentage and seed cotton yield per plant were also significantly decreased with saline water irrigation in both seasons. Micronaire value was significantly decreased with increasing salinity of irrigation water, while fibre strength was not significantly affected in the two seasons. Saline water irrigation increased chlorophyll (a), chlorophyll (b), total chlorophyll and carotenoids concentrations in cotton leaves. Reducing, non-reducing and total soluble sugars concentrations were increased. Concentrations of N, P and K in cotton leaves were generally decreased with increasing of salt concentrations in irrigation water, while oil and protein percentages in cotton seed were decreased significantly in both seasons. Irrigation cotton plants with water of different salinity levels increased soil E.C. value, sodium, bicarbonate and chloride concentrations and decreased calcium, magnesium, potassium and sulfate concentrations. Salinity effect was more pronounced at 6000 ppm level in irrigation water and much lower at 2000 ppm level for almost all characters studied.

CEREAL CROPS (MAIZE, RICE, MILLET, WHEAT, BARLEY)

TI: Effect of seawater on photosynthesis and dry matter accumulation in developing rice grains.
AU: Sultana-N; Ikeda-T; Kashem-MA
SO: Photosynthetica. 2002, 40: 1, 115-119; 27 ref.
LA: English
AB: To understand the physiology of rice under seawater salinity, potted rice plants were irrigated with different concentrations of Japan seawater (electrical conductivity 0.9, 5.7, 11.5, or 21.5 mS cm-1) from 10 d after transplanting (DAT) to 35 DAT, and from 75 to 100 DAT. Seawater salinity decreased the net photosynthetic rate, stomatal conductance, intercellular CO2 concentration, transpiration rate, leaf water and osmotic potentials, and relative water content, and increased leaf temperature. The contents of chlorophylls, carotenoids, and total sugars significantly decreased in the leaves but content of non-reducing sugars decreased only slightly. With increasing salinity the Na+ concentration increased, while Ca2+, Mn2+, and K+ concentrations decreased. Salinity decreased the contents of sugars and proteins, dry mass, and rate of dry matter accumulation in developing grains.
PT: Journal-article

TI: Irrigation with brackish water under desert conditions. 11. Salt tolerance in sweet-corn cultivars
AU: Pasternak,-D.; Sagih,-M.; Malach,-Y.-de; Keren,-Y.; Shaffer,-A.
AD: Ben Gurion Univ. of the Negev, Institutes for Applied Research, PO Box 1025, Beer Sheva 84110, Israel
SO: Agricultural-Water-Management (Netherlands).
1995, v. 28(4) p. 325-334; 1 Dec, fig, tables, 25 ref.; summary (En)
LA: English
AB: The salt tolerance of 14 sweetcorn cultivars differing in days for silking and days for grain filling was evaluated under field conditions in the Negev, Israel. Plants were drip irrigated with fresh (ECi=1.2 dS/m) and brackish (ECi=6.2 dS/m) water. Brackish water irrigation started 20 days after planting following the application

of 100 mm of freshwater. There were large intraspecific variations in absolute yield and in salt tolerance (expressed as the ratio of brackish water yield to freshwater yield). The cultivar N.K. Rogers 2572 had, under saline conditions, both the highest absolute ear yield (18.1 kg/10 m2) and the highest relative ear yield (82%). Salinity affected all major yield parameters (number of ears per unit area, number of kernels per ear and kernel weight). Ear number was more affected than other parameters. The results indicate that early-flowering cultivars are, under the irrigation regime employed in the trial, more salt tolerant than late-flowering cultivars. Salinity had an inconsistent effect on kernel quality parameters. In some cultivars it increased soluble carbohydrates and sucrose content, whereas in others these parameters were reduced. Authors' summary.

TI: Effect of salt and water stress on corn yield production.
AU: Emdad-MR; Fardad-H
SO: Iranian-Journal-of-Agricultural-Sciences. 2000, 31: 3, 641-654; 24 ref.
LA: Persian
LS: English
AB: A greenhouse experiment was conducted to investigate the effect of salinity and water stress on the growth and yield of maize hybrid 704 in plastic containers. Irrigation water was applied with different levels of NaCl (EC 2, 4, 6 and 8 dS/m) to study the effect of salinity. Water stress was induced by subjecting the crops to varying degrees of depletion of soil water consumption (30, 50, 70 and 90%) at constant time intervals of 4, 6, 9 and 14 days. Both stresses were induced from the fourth leaf stage until harvest. Both salinity and water stress reduced the leaf area, dry matter weight, and plant height of maize hybrid 704. However, saline water treatments reduced the crop yield more effectively than the water regime treatments. Salinity of 4, 6 and 8 dS/m reduced the yield by approximately 17, 34 and 49%, respectively, compared with the control treatment (0.5 dS/m). In addition, increasing water stress reduced the crop yield by approximately 31%. The highest crop yields were obtained with 30 and 50% depletion of soil water and salinity of 0.5 and 2 dS/m.

TI: The effects of saline water and soil tillage on the salt and water regimes in a sloping cornfield using a moving irrigation system.
AU: Assouline-S; Ben-Hur-M; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 203-209; 10 ref.
LA: English
AB: Moving irrigation systems in soils with low infiltrability generate high amounts of runoff. Therefore, tillage practices are applied to increase the surface storage capacity of the field and improve the distribution uniformity of the water. When saline water is used, sprinkling over the canopy might be harmful to the growth, and a direct application of the water to the soil surface might be advantageous. In this study, the interaction between tillage practices and water application methods are compared in terms of yields and soil water and salt content distribution with depth in a cornfield irrigated with saline water. Also, the effect of slope is considered. The treatments are: (i) control, where the soil surface is not treated; (ii) microbasins (pits) constructed on the soil surface between the rows; (iii) dykes erected across the furrows every two rows. The control and microbasins treatments are irrigated with a moving sprinkler system while water is applied directly to the soil surface in the dykes treatment. The lowest yield is obtained in the control plots. Compared to it, the yields increase by 41% and 17% in the microbasins and the dike treatments, respectively. In terms of water and salt contents, a slope effect is observed in the control plots, the values down slope being the highest at all depths. No slope effect is obtained in the two tillage practices. The water and salt content distributions with depth are weighted using the water extraction distribution of corn grown in the Northern Negev. The weighted water contents are practically similar for the two tillage practices and are higher than for the control. The weighted salt contents are the highest for the dykes and practically similar for the microbasins and the control. The combined effect of the water and the salt contents explains the differences in terms of yields.

TI: Effects of saline water irrigation under different bed shapes and soil textures on the growth of maize and salt accumulation in the beds.
AU: Sokei-Y; Wasano-K; Yamashita-K; Nose-A
SO: Japanese-Journal-of-Crop-Science. 2001, 70: 3, 352-358; 16 ref.

LA: Japanese
LS: English
AB: The effects of furrow irrigation with saline water (EC= 8 dSm-1) on the emergence and growth of maize under various bed shapes (flat-top and sloping) and soil texture (sandy loam, clay loam and LiC) were investigated in a greenhouse. Emergence rates in flat-top beds were lower than those in sloping beds, especially those with sandy loam soil. Although plant height in flat-top beds was shorter than in sloping beds, the plant height with LiC largely increased after 21 days. The dry weight followed the same trend. The soil moisture content was lowest (5-15%) in sandy loam soil for both beds. ECe in flat-top beds after sowing was greater (10-15 dSm-1), especially in sandy loam soil. The salt distribution in beds showed the highest salinity at the peak or in areas surrounding the peak of sloping beds, and in the surface and shoulder of flat-top beds. The early seedling growth of maize was closely related with the salt distribution in beds. These results provide useful information to elucidate the relation between salt accumulation and early seedling growth.

TI: Irrigation with brackish water under desert conditions. 2. Physiological and yield response of maize (Zea mays) to continuous irrigation with brackish water and to alternating brackish-fresh-brackish water irrigation
AU: Pasternak,-D.; Malach,-Y.-de; Borovic,-I
AD: Rudolph and Rhoda Boyko Inst. for Agrigulture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).
1985, v. 10(1) p. 47-60; May, figs, tables, 17 ref.; summary (En)
LA: English
AB: The physiological behaviour and yield response of maize under irrigation with saline water was studied in the laboratory and in the field. In the laboratory, the germination rate decreased only when the electrical conductivity (EC) of the substrate solution became more than 15.6 dS/m. The seedlings adapted their osmotic potential to the osmotic potential of the substrate. It may be an explanation for the resistance to salinity during germination. In the field, 2 maize cvs. (a field maize and a sweet maize) were irrigated alternately with saline (ll days from sowing), fresh (2l days from emergence), and saline (from day 33 to harvest) water and compared with maize irrigated with saline water continuously throughout the season. There was no osmotic adjustment by the leaf sheats in response to salinity, which may be related to a reduction in yield. Irrigation with alternatively saline, fresh and saline water did not reduce yield significantly, even when the highest level of salinity was used (ECdni = 10.5 dS/m). The osmotic potential of the leaf sheats decreased with plant age, which may be an explanation for the higher resitance to salinity at late growth stages.

TI: Growth and yield of rice as affected by saline water treatment at different growth stages.
AU: Lee-ChungKuen; Yoon-YoungHwan; Shin-JinCheol; Lee-ByunWoo; Kim-ChungKon; Lee-CK; Yoon-YH; Shin-JC; Lee-BW; Kim-CK
SO: Korean-Journal-of-Crop-Science. 2002, 47: 6, 402-408; 12 ref.
LA: Korean
LS: English
AB: Rice cv. Janganbyeo was cultivated in Korea Republic during 1999-2000 by irrigating the saline waters of high salinity (3.0%) and medium salinity (1.5%) for 4 days, and low salinity (0.5%) for 30 days at the tillering, early meiosis and heading stages. Leaf injury due to salinity was most severe at the tillering stage in 1999, and at the heading stage in 2000. Heading date was delayed by 1-5 days by treatment of saline waters only at the tillering stage. Culm length and panicle length were most severely shortened by treatment at the early meiosis stage. Yield and yield components, except for panicle number, were decreased most by the high salinity treatment regardless of the growth stage. In particular, ripening ratio and grain weight, among the yield components, were decreased most conspicuously by the saline water treatment regardless of the salinity and growth stage. In terms of grain weight, grain-filling rate and duration, there was no remarked difference among the concentrations and treatment durations of saline water at the tillering stage. However, among the concentrations and treatment durations of saline water at the early meiosis stage, their reductions were highest when treated with high salinity for 4 days and followed by low salinity for 30 days. Their reductions were very severe only when treated with high salinity for 4 days at heading stage.

TI: Influence of soil amendments on certain soil properties and yield of rice in coastal saline water irrigated soil.
AU: Mahendran-PP; Balasubramaniam-P; Senthilkumar-PS
SO: Research-on-Crops. 2002, 3: 1, 44-47; 6 ref.
LA: English
AB: Experiments were conducted in a sodic soil during 1994-95 and 1995-96 with the rice variety ADT 36 irrigated with sea water untruded well water. Among the different soil amendments, application of farmyard manure with 100% gypsum requirement significantly reduced soil pH, ESP and increased the grain yield of rice cultivar ADT 36.

TI: Use and management of poor quality waters for the rice-wheat based production system.
AU: Minhas-PS; Bajwa-MS
SO: Journal-of-Crop-Production. 2001, 4: 1, 273-306; many ref.
LA: English
AB: This paper discusses some of the aspects of the rice-wheat cropping system and also reports on the possible options to sustain rice-wheat yields under conditions where poor quality waters have to be used.

TI: Effect of water salinity in sprinkler irrigation on yield of different wheat cultivars.
AU: Mahlooji-M; Akbari-M
SO: Seed-and-Plant. 2001, 17: 2, Pe172-Pe182, 16-17; 13 ref.
LA: Persian
LS: English
AB: A study was conducted to determine the effect of water salinity in sprinkler irrigation on the yield of wheat cultivars Mahdavi, Cross Sorkhtokhm, Ghods and Niknezhad using different mixtures of saline and fresh water during the 1998-99 growing season at the Roodasht Agricultural Research Station in Isfahan, Iran. Salinity treatments comprised: 5, 7, 9 and 11 dS/m. Grain yield obtained upon treatment with 11 dS/m decreased by 50%, compared with that obtained upon treatment with 5 dS/m. The cultivar did not significantly affect the grain yield, although Mahdavi and Niknezhad had the highest and the lowest grain yields, respectively. The mean dry weight and physiological maturity stages were significantly different. Mahdavi and Niknezhad produced the highest and lowest dry weights, respectively. Mahdavi and Ghods had the highest and the lowest 1000-grain weight, respectively. The mean Na+ and K+ ion concentrations were significantly different in the flag leaves at flowering (GS=65). Mahdavi had the highest K+ and lowest Na+ concentrations in its flag leaves.

TI: Yield and yield attributes of wheat (Triticum aestivum L.) as influenced by conjunctive use of saline water with surface water on saline black soils.
AU: Rao-GG; Nayak-AK; Chinchmalatpure-AR
SO: Journal-of-the-Indian-Society-of-Soil-Science. 2003, 51: 1, 86-88; 6 ref.
LA: English

TI: Phosphorus uptake and distribution responses of two wheat cultivars to salinity stress.
AU: Poustini-K; Aboutalebian-MA
SO: Iranian-Journal-of-Agricultural-Sciences. 2001, 32: 3, 599-606; 20 ref.
LA: Persian
LS: English
AB: The responses of wheat cultivars to salinity stress regarding phosphorus (P) uptake and distribution were evaluated in a greenhouse experiment. Salinity treatments comprised of three levels of saline water used for watering: solutions of zero (S0), 2.5 (S1) and 5.0 g NaCl/litre (S2), equivalent to zero tap water, 43.0 and 85.5 mM NaCl, respectively. Application of treatments commenced at 25 days after sowing. Phosphorus content of plant organs in five different growth stages, were determined using molybdovanadate colorimetric method. P uptake decreased and its distribution pattern changed with increase in salinity. Increase in salinity increased the accumulation rate of P in leaves and the P redistribution percentage in the main stem and tillers, but decreased the P accumulation rate in the main stem and tillers, and the P redistribution percentage in leaves. In the susceptible Inia-66 cultivar, the rate of P uptake (P content in shoots) reached its maximum at maturity, with a considerable reduction in uptake as the salinity increased. In the salt-resistant Tabasi cultivar, P uptake by shoots increased up

to the maturity stage, reaching a maximum that was 40, 68 and 90% higher than Inia-77 at S0, S1 and S2 levels, respectively. Although the rate of redistribution in Inia-66 was higher and increased with salinity, this process was more efficient in Tabasi because of the higher P accumulation in main stem and tillers. The uptake and distribution of this macroelement could be considered as a parameter closely related to salinity resistance in wheat.

TI: Use and management of poor quality waters for the rice-wheat based production system.
AU: Minhas-PS; Bajwa-MS
SO: Journal-of-Crop-Production. 2001, 4: 1, 273-306; many ref.
LA: English
AB: This paper discusses some of the aspects of the rice-wheat cropping system and also reports on the possible options to sustain rice-wheat yields under conditions where poor quality waters have to be used.

TI: Wheat production under saline irrigation practices: the role of soil conditioners.
AU: Sfeir-P; Hamdy-A; Hamdy-A
SO: Special session on non-conventional water resources practices and management and Annual Meeting UWRM Sub-Network Partners. Special-Session-on-Non-conventional-Water-Resources-Practices-and-Management-and-Annual-Meeting-UWRM-Sub-Network-Partners,-IAV-HASSAN-II,-Rabat,-Morocco,-28-October,-1999. 2000, 119-141; 15 ref.
PB: Mediterranean Agronomic Institute; Bari; Italy
LA: English
AB: The use of lower quality non-conventional water resources has proven to be very complex, and requires adequate handling to protect soil productive capacities from adverse effects. Use of soil conditioning is one of the physical, hydraulic, biological or chemical management practices that can be used. The paper describes tests on the impact of using the soil conditioner 'Barbary-Plante G2' (BP) in 4 different ratios (control, 10, 20, and 30 g/litre of soil) along with 4 levels of saline irrigation (electrical conductivity of 0.9, 3, 6 and 9 dS/m) on wheat (Triticum durum) production. Plant development was greater with increased BP, but slowed with higher concentrations of saline water. The tests showed that the highest BP ratio (30 g/litre of soil) combined with the highest concentration of saline water (9 dS/m) produced 14 t/ha of grains - three times higher than treatments without the conditioner and irrigated with fresh water.

TI: Effect of alternation techniques of irrigation on the yield of wheat.
AU: Abdel-Naby-MM; El-Sayed-AM; Abdel-Gawad-ST; Abdel-Gawad-SM
SO: 6th-International-Micro-irrigation-Congress-Micro-2000,-Cape-Town,-South-Africa,-22-27-October-2000. 2000, 1-10; 11 ref.
PB: International Commission on Irrigation and Drainage (ICID); Rome; Italy
LA: English
AB: Studies of the response of wheat to irrigation with water of different salt concentrations and on different soil textures lead to the development of leaching and alternation strategies that would reduce the negative impacts. The greenhouse experiments were carried out on two types of soil - clayey soil and sandy clay loam. Wheat (Tritium durum L. cv Appio) was cultivated as an indicator plant. In both soils, permanent saline irrigation practices generally resulted in gradual yield losses corresponding to gradual increments in the salt content of irrigation waters. The alternation technique under the clay soil was effective in reducing the damage in yield grain production. In the case of sandy clay loam, the beneficial role of the alternation technique was more noticeable under highly saline irrigation.

TI: Screening pearl millet germplasm for tolerance to soil salinity.
AU: Krishnamurthy-L; Rai-KN; Hash-CT; Serraj-R
SO: International-Sorghum-and-Millets-Newsletter. 2003, publ. 2004, 44: 155-157;
6 ref.
LA: English
AB: Greenhouse-grown pearl millet (Pennisetum glaucum) entries (comprising popular varieties, hybrids and progenies) were irrigated either with deionized water (control) or saline solution (250 mM NaCl solution) and sampled at 18, 25, 32 and 39 days after sowing (DAS). Genotypes in saline water-irrigated pots emerged in 6-9

DAS, while those in the control pots emerged within 3-4 DAS. Differences among genotypes and genotype x salinity interactions existed at all sampling times for both absolute and relative weights. Cluster analysis based on the absolute and relative biomass for four growth stages indicated 4 major groups with a similarity coefficient of 40%. Eight entries with a skewed performance at one or two stages were excluded and grouped separately. The pots where one or two plants emerged were harvested at the fourth, or third and fourth sampling times, and the sparse population in these pots permitted them to grow with more vigour and less competition. Although these ranked the least at earlier stages, their later performance was high. Remaining genotypes were grouped into highly sensitive, sensitive, tolerant and highly tolerant and highly tolerant entries based on the group means of the total biomass and relative biomass in all sampling periods. Almost all entries that emerged poorly under saline water irrigation were classified as highly sensitive. At least one highly tolerant progeny and one sensitive or highly sensitive progeny were identified from most of the populations.PT: Journal-article
AN: 20043053249

TI: Minerals in barley grains as affected by benzyl adenine and salinity from diluted seawater.
AU: Saleh-AL; Hussein-MM; El-Faham-SY; Abo-El-Kier-MS; El-Kader-AAA; El-Kier-MSA
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002. 2002, 2090; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper

TI: Response to saline water at various growth stages in relation to growth and ionic composition of husked and huskless barley.
AU: Gill-KS
SO: Applied-Biological-Research. 2000, 2: 1-2, 21-25; 10 ref.
LA: English
AB: Pot experiments were conducted on husked (Ratna) and huskless (IB-65) barley to study the stage sensitivity to saline irrigation (1.9, 6.5, 9.6, 13.7 and 16.5 dS/m) and its effect on plant growth and ionic distribution. During the germination stage, dry matter accumulation in roots, stem and leaves decreased with increased salinity level. Ratna accumulated more dry weight especially in leaves and accumulated less Na in leaves and root than IB-65 during tillering stage. At the flowering stage, Ratna accumulated higher dry weight of leaves and ears and more Na in root and stem and less in leaves than IB-65. Potassium content was less affected in almost all plant parts for both varieties. During the grain filling stage, dry weight accumulation did not differ significantly for root and stem, though leaf weight decreased slightly but ear weight significantly decreased. Ratna was more tolerant to salinity than IB-65 and early stages were more sensitive than later advanced stages wherein water of very poor quality up to 16 dS/m could be used without much reduction in dry weight.

TI: Influence of salinity stress and cycocel on chlorophyll content and yield attributes of barley (Hordeum vulgare L.).
AU: Bagdi-DL; Afria-BS; Naagar-KC
SO: Agricultural-Science-Digest. 2003, 23: 2, 98-100; 14 ref.
LA: English
AB: The effect of 5 levels of saline irrigation water (0, 4, 8, 12, and 16 dSm-1 EC) and 4 levels of presoaking seed treatment (0, 500, 1000 and 1500 mg Cycocel [chlormequat]/litre) for 5 h on barley cv. BL-2 was investigated in a greenhouse pot experiment. The quality (chlorophyll and protein contents), and seed, straw and biological yields of barley decreased significantly with increased in water salinity, especially at levels above EC 8 dSm-1. Presoaking of each seed in Cycocel progressively increased the quality and yields of barley, the increases being maximum at 1500 mg/litre.PT: Journal-article
AN: 20043058413

TI: Effects of saline irrigation water and Zn application on soil Cd solubility and Cd concentration in wheat.
AU: Khoshgoftarmanesh-AH; Shariatmadari-H; Karimian-N
SO: Journal-of-Science-and-Technology-of-Agriculture-and-Natural-Resources.

2004, 7: 4, 53-60; 22 ref.
LA: Persian
LS: English
AB: A factorial experiment with 2 levels of Zn (0 and 1.5 mg Zn/kg), 5 salinity levels of irrigation water (0, 60, 120 and 180 mM NaCl, and 120 mM NaNO3) in 3 replications, was conducted. Wheat (Triticum aestivum cv. Roshan) was sown in pots. After plant harvesting, Zn and Cd concentrations were determined in the shoot. Activities of the metal species in the soil solution were predicted using the computer program MINTEQA2. Treating the soil with NaCl-salinized water increased total concentration of CdTAU as well as Cd2+, CdCl2 and CdCl+ species; whereas, NaNO3 treatment had no significant effect on CdTAU. Shoot Cd concentrations were positively related to CdTAU and soil solution Cl- but negatively related to ZnTAU. Application of Zn-fertilizer decreased Cd and increased Zn concentrations in shoot. The results indicated that Cl- has an effective role in increasing the mobility of soil Cd and its uptake by plant.
PT: Journal-article
AN: 20043085008

TI: Classification of different wheat genotypes in salt tolerance categories on the basis of biomass production.
AU: Javaid-Akhtar; Tanveer-ul-Haq; Armghan-Shahzad; Anwar-ul-Haq-M; Ibrahim-M; Ashraf-N
SO: International-Journal-of-Agriculture-and-Biology. 2003, 5: 3, 322-325; 18 ref.
LA: English
AB: A hydroponics study was conducted in 2000-01 in Pakistan to investigate the salt tolerance of 20 wheat genotypes under salinity levels of control, 100 and 200 mol/m3. Seven-day-old seedlings were transplanted in thermopole sheets with holes floating on 1/2 strength Hoagland's solution (200 litres) and analysed after 20 days. Classification criteria was made according to the salt tolerance of the genotypes based on biomass accumulation. Salt tolerant genotypes included 8244, 8730, 8659, B2-57 and B2-5711. Moderately salt tolerant genotypes were 8602-1, B4-5711, 8784, 8670, 8706-1 and 8638. The sensitive genotypes were 8699, 8757, B4-92, B2-5713, 8290, 5038, 8750, 8284 and B2-5734.
PT: Journal-article

TI: Tolerance potential of wheat cv. LU-26S to high salinity and waterlogging interaction.
AU: Tanveer-Ul-Haq; Khalid-Mahmood; Armghan-Shahzad; Javaid-Akhtar
SO: International-Journal-of-Agriculture-and-Biology. 2003, 5: 2, 162-165; 28 ref.
LA: English
AB: The effects of salinity (1.2 and 15.0 dS m-1 sodium chloride) and aeration (for 0, 1, 4, 8, 12 or 24 h per day) on the performance of hydroponically grown wheat (cv. LU-26S) plants were studied. As the sodium chloride level was increased from 1.2 to 15.0 dS m-1, the average shoot length (from 41.3 to 26.8 cm) and fresh shoot weight (from 33.8 to 14.3 g) decreased, whereas the number of tillers per plant (from 6.9 to 7.2), and chloride (from 20.4 to 201.5 mol m-3), sodium (from 3.7 to 50.1 mol m-3), potassium (from 1.92 to 21.1 mol m-3), calcium (from 13.11 to 17.65 mol m-3) and magnesium (from 7.8 to 11.6 mol m-3) concentrations in the leaf sap increased. Under saline and non-saline conditions, aeration for 24 h per day resulted in the highest mean shoot length (36.4 cm), fresh shoot weight (31.6 g), magnesium content (15.0 mol m-3) and calcium content (25.2 mol m-3), whereas aeration for 8 h resulted in the highest number of tillers per plant (7.9) and chloride (133.3 mol m-3) content. Sodium concentration was not affected by aeration under non-saline conditions; however, under saline conditions, aeration for 8 h gave the highest sodium content (31.95 mol m-3).

TI: Effect of salinity on growth and solute accumulation in two wheat lines differing in salt tolerance.
AU: Saneoka-H; Shiota-K; Halil-Kurban; Chaudhary-MI; Premachandra-GS; Fujita-K
SO: Soil-Science-and-Plant-Nutrition. 1999, 45: 4, 873-880; 28 ref.
LA: English
AB: The wheat line, Saline Agriculture Research Center line 1 (SARC), was selected in a salinity tolerance improvement programme in Faisalabad, Pakistan. This study compared SARC with Pothowar, a common wheat cultivar grown in the same region, in order to study the mechanism of salinity tolerance in the SARC line. Two wheat lines were planted in pots and were subjected to salt stress by daily application of a 200 mM NaCl solution for 30 d during the vegetative growth stage. Dry weight of plant parts, leaf area, leaf water status, and solute

concentrations in the cell sap of the leaf tissues were determined at 13 and 30 d after initiation of the stress treatment. Decrease in the plant dry weight and leaf area due to salt stress was more pronounced in Pothowar than in SARC, indicating that SARC was more tolerant to salinity. SARC maintained a higher turgor at low leaf water potentials and showed a higher capacity of osmotic adjustment compared to Pothowar. Major osmotica that increased by salinity in order to maintain a lower osmotic potential in the two lines were Na+, Cl-, K+, and glycinebetaine. Increase in the concentrations of Na+, Cl-, and glycinebetaine was much higher in SARC than in Pothowar. These results suggested that the SARC line had a physiological mechanism that conferred a higher salinity tolerance.
PT: Journal-article

TI: Germination and seedling growth characteristics of some cultivated and wild selections of wheat cultured in sea water
AU: Ahmed,-S.U.
AD: Department of Botany and Microbiology, Kuwait Univ., Kuwait, Kuwait
SO: Journal-of-Arid-Environments (UK).
1985, v. 8(2) p. 133-139; Mar, figs, tables, 23 ref.; summary (En)
LA: English
AB: Three cultivars and 2 wild selections of wheat were cultured in 11 dilutions of sea water for 21 days in an attempt to ascertain if wheat could be cultivated in Kuwait. The percentage of seed germination and 6 seedling growth characteristics were studied. The 2 wild selections germinated in 100% sea water, whereas the 3 cultivars failed to germinate in dilutions of 60% and above. An inverse relationship was noted between percentage germination, and the seedling growth characteristics studied. Increased salinity delayed germination and subsequent rate of growth and development. Since all the cultivars tested germinated and grew in sea water dilutions up to 50% (19 750 ppm), it is proposed that wheat may be cultivated in Kuwait using the brackish water available. The two wild selections were found to be resistant to high salinity.

TI: Effect of NaCl salinity on photosynthesis and dry matter accumulation in developing rice grains.
AU: Sultana-N; Ikeda-T; Itoh-R
SO: Environmental-and-Experimental-Botany. 1999, 42: 3, 211-220; 36 ref.
LA: English
AB: The effect of salinity on rice at the reproductive phase was investigated. From flag leaf to dough stage, rice plants grown in pots were irrigated twice a week with saline water (0, 25, 50, 100, and 200 mM NaCl) at a volume of 1.5 times that of the soil. Photosynthesis and leaf biochemical constituents were measured at flowering (15 days after treatment establishment, DATE) and milking stage (25 DATE). Samples for grain dry matter and biochemical analysis were collected at milking (25 DATE) and dough (37 DATE) stages. Reduction in photosynthesis in the salinized plants depended not only on a reduction of available CO2 by stomatal closure, but also on the cumulative effects of leaf water and osmotic potential, stomatal conductance, transpiration rate, relative leaf water content, and biochemical constituents such as photosynthetic pigments, soluble carbohydrates, and protein. The cumulative effects resulted in low concentrations of assimilates in the leaves. These low concentrations and poor translocation of assimilates from the source reduced grain dry matter. Grain growth was less sensitive to salinity at the milking stage. This suggests that the plant is able to escape stress when the duration of salinity is short.

TI: Growth, yield and N, P, K & Na contents of paddy (Oryza sativa L.) under saline water irrigation.
AU: Mohiuddin-ASM; Ahmed-IU; Faiz-B; Islam-KR
SO: International-Journal-of-Tropical-Agriculture. 1998, 16: 1-4, 25-32; 18 ref.
LA: English
AB: The results of a pot experiment with rice cv. BR-10 showed that the panicle initiation stage was the most sensitive to saline water irrigation, followed by the maximum tillering stage. The effect was more pronounced when irrigation with saline water was initiated at an early growth stage. The continuous application of saline water reduced growth, grain and straw yields and N, P, K and Na contents of both grain and straw irrespective of the salinity levels (8 or 16 dS/m). During later growth stages, rice was rather more tolerant to saline irrigation.

TI: Effect of salinity, sodicity and Ca/B ratios of irrigation waters on soil properties and yield of barley grown on loamy sand soil.
AU: Madan-Lal; Mani-Ram; Jakhar-SR; Lal-M; Ram-M
SO: Annals-of-Agri-Bio-Research. 1999, 4: 1, 33-35; 6 ref.
LA: English
AB: In a pot experiment on loamy sand soil, barley was irrigated with water at Ca/B ratios of 100-800, and at EC 6.0 or 12 ds m-1 and SAR of 25 or 50. ECe, SAR, ESP and boron content of soil increased while barley grain and straw yield decreased with an increase in SAR and EC of irrigation water. The pH of soil decreased significantly with an increase in salt concentration of irrigation water but increased with increase in SAR of water. Grain and straw yields increased up to a Ca/B ratio of 600 in irrigation water, but decreased at higher levels.

TI: Fertilizer management studies in wheat grown hydroponically under saline conditions.
AU: Malik-MA; Shah-SH
SO: Pakistan-Journal-of-Agricultural-Sciences. 1997, 34: 1-4, 82-85; 14 ref.
LA: English
AB: A hydroponics culture study was conducted over two years to investigate the performance of two wheat varieties (LU-26s and Pak-81) grown under varying salinities(ECe 0, 7.5 and 15 dSm-1) and different fertilizers schedules (Control, N, NP and NPK). A standard rate of 100, 75 and 60 kg ha-1 of N, P and K, respectively was used. The average of two years' results showed that LU-26s performed better for all salinities than Pak-81 and produced significantly higher number of tillers/plant, 100-grain weight and grain yield/plant. Of the different fertilizer regimes, combined application of the three macro elements (NPK) increased tillering and delayed earing with well developed spikes and heavier seeds, resulting in higher grain yield.

TI: A modified version of CERES-Maize model for predicting crop response to salinity stress.
AU: Castrignano-A; Katerji-N; Karam-F; Mastrorilli-M; Hamdy-A
SO: Ecological-Modelling. 1998, 111: 2-3, 107-120; 24 ref.
LA: English
AB: A new saline stress index was developed for CERES-Maize, a computer model of maize growth and development, in order to simulate crop response to irrigation with saline water in Mediterranean conditions. Changes from the original model consisted in modifying the estimation of the stress coefficient, which was defined as a function of predawn leaf water potential. The study was carried out at the Mediterranean Agronomic Institute of Bari using a set-up of 30 drainage lysimeters. Linear regression between mean simulated and measured data showed that the model performed well for final grain yield though it tended to underestimate (_ 8%) above-ground biomass and maximum leaf area index (LAI). The largest evapotranspiration over-estimations were found early in the growing season immediately after each irrigation event. However, the prediction of seasonal evapotranspiration was generally reasonably good.

TI: Salinity stress and its counteraction by the growth regulator "Brassinolide" in wheat plants (Triticum aestivum L. cultivar Giza 157).
AU: Hathout-TA
SO: Egyptian-Journal-of-Physiological-Sciences. 1996, 20: 1-2, 127-152; 64 ref.
LA: English
LS: Arabic
AB: Salinity above 800 ppm NaCl reduced height, fresh and dry weight and number of leaves per plant of wheat cv. Giza 157. Carbohydrate, nitrogen, minerals and hormonal contents and yield decreased with increasing salinity levels from 1600 to 3200 ppm NaCl, but at a salinity level of 800 ppm NaCl there were significant increases in these criteria. The salinized plants accumulated soluble carbohydrate, among which free soluble sugars showed a remarkably high level, as well as soluble amino acids, particularly proline. Certain minerals accumulated, especially Ca2+ and K+, together with the soluble sugars, amino acids and proline for osmoregulation. Proline seemed to have additional functions other than osmoregulation because of its poor ability to resist the toxic effects of salinity. Spraying the salinized plants with 0.05 ppm brassinolide counteracted the toxic effects of salinity by increasing IAA and decreasing ABA levels and contents, thus causing further increases in auxin levels responsible for higher rates of tillering concomitant with increases in the accumulation of the

metabolites that counteracted the salinity effect alone. This led to higher growth, metabolism and yield. It is recommended to apply an 800 ppm NaCl salinity level using wheat cv. Giza 157 growing under normal nutritional practice where there is obligatory use of saline irrigation. Under these conditions grain yield/plant was increased by 12% when the plants were sprayed with brassinolide and by 3% without.

TI: Salt tolerance of kenaf.
AU: Francois,-L.E.; Donovan,-T.J.; Maas,-E.V.
SO: Advances in new crops : proceedings of the First National Symposium NEW CROPS, Research, Development, Economics, Indianapolis, Indiana, Oct 23-26, 1988 edited by Jules Janick, J.E. Simon. Portland, Or. (USA). Timber Press. 1990. p. 300-302.
LA: En (English)

MISCELLANEOUS CROPS

TI: Paclobutrazol as aid to reducing the effects of salt stress in Rhamnus alaternus seedlings.
AU: BAnon-S; Ochoa-J; Martinez-JA; Fernandez-JA; Franco-JA; Sanchez-Blanco-MJ; Alarcon-JJ; Morales-MA; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 263-268; 19 ref.
LA: English
AB: R. alaternus seedlings were irrigated with 0, 70 mM and 140 mM salt water in greenhouse conditions to study the effect of the drench application of 30 mg paclobutrazol (PBZ) on the salt stress response. Overall, PBZ and salinity reduced growth and development in a cumulative way, producing plants that were too small, especially at the highest saline concentration. PBZ-treated plants showed less marginal and tip necrosis, defoliation and mortality than nontreated, especially in 140 mM-treated plants. PBZ increased the relative chlorophyll content in leaves in both saline and nonsaline conditions. Salinity significantly reduced stomatal conductance in plants not treated with PBZ. PBZ increased stomatal conductance from 37.2 to 72.3 mmol m-2 s-1 in the 70-mM salt treatment, and from 47.8 to 68.0 in the 140-mM salt treatment. Salinity reduced both the relative water content and water potential, but maintained turgor potential in PBZ-treated and nontreated plants as a consequence of osmotic adjustment. Although the degree of osmotic adjustment was very similar, the osmotically active compounds accumulated in each type of treatment (PBZ-treated and nontreated plants) are probably different. In both saline treatments, the salt content of the leaching water increased when plants were treated with PBZ. These findings suggest that PBZ reduced saline stress symptoms and mortality in stressed plants by promoting organic solutes synthesis and by reducing the availability of saline ions in the medium (greater leaching action).

TI: Effect of water salinity on seed germination of Ocimum basilicum L., Eruca sativa L. and Petroselinum hortense Hoffm.
AU: Miceli-A; Moncada-A; D'-Anna-F; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 365-370; 5 ref.
LA: English
AB: Laboratory experiments were conducted to study the effects of salt concentrations (0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0 and 10.0 mS/cm established by sodium chloride) on basil (Ocimum basilicum), rocket (Eruca sativa [E. vesicaria]) and parsley (Petroselinum hortense [P. crispum]) germination. Salinity did not significantly reduce germination percentages of basil and rocket. The germination percentage of basil was > 80% and that of rocket was > 90%. However, parsley was particularly sensitive to water with high electrical conductivity (EC) levels. In parsley, as the salinity increased, the germination percentage decreased. The use of brackish water for this species was not good for nursery activities as it determined germination reductions and extended the mean germination time. The mean germination time was more directly influenced by water salinity. However, the mean germination time did not increase markedly using water with high EC.

TI: First results on yield and quality response of basil (Ocimum basilicum L.) grown in a floating system.

AU: Miceli-A; Moncada-A; Vetrano-F; D'-Anna-F; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 377-381; 4 ref.
LA: English
AB: A greenhouse experiment was conducted to evaluate the effect of plant density and water EC on the yield and quality of basil grown using the floating system. The growing set-up consisted of benches containing the nutrient solution and the floating boards. Two nutrient solutions with different electrical conductivity (2.8 and 3.8 mS cm-1) were compared. Both solutions had the same nutrient composition and the differences in EC were obtained using water with different salinity (ECw 0.8 and 1.6 mS cm-1). For each nutrient solution, three plant densities were adopted: 226, 373 and 593 plants m-2. Five days before harvest, one-half of the floating boards were supplied exclusively with water instead of nutrient solution to evaluate the effect of this treatment on leaf nitrate content. As a result, the floating system appears to be suitable for growing basil. Water salinity did not affect its production. The yield increased as plant density increased. The water treatment before harvest, resulted in a higher yield and lower nitrate concentration.

TI: Influence of salinity and irrigation method on zucchini plants grown in closed-soilless system.
AU: Colla-G; Rouphael-Y; Saccardo-F; Rea-E; Pierandrei-F; Salerno-A; Pardossi-A (ed.); Serra-G (ed.); Tognoni-F
SO: Proceedings of the international symposium on managing greenhouse crops in saline environment, Pisa, Italy, 9-12 July, 2003. Acta-Horticulturae. 2003, No.609, 429-433; 6 ref.
LA: English
AB: Zucchini (Cucurbita pepo cv. Afrodite) plants were grown in a closed soilless system from 28 March to 6 June 2002 under greenhouse conditions at the Experimental Farm of Tuscia University to evaluate the impact of two irrigation methods (drip- and sub-irrigation) and two saline waters (1 and 34 mM NaCl) on their growth, yield and water use efficiency. Electrical conductivity of the substrate increased by increasing the salt concentration of the nutrient solution and by changing from drip to sub-irrigation method. The irrigation method did not influence the marketable yield at 1 mM NaCl (average 2.27 kg/plant), while at 34 mM NaCl, plants grown with sub-irrigation method recorded lower yield than those grown with drip irrigation system (0.42 vs. 0.95 kg/plant). Dry weight of fruits, leaves, stems and flowers showed a similar trend due to the lack of significant differences among treatments on dry matter of plant tissues (leaves, stems, flowers and fruits). The maximum water use efficiency was observed with drip irrigation at 34 mM NaCl and with sub-irrigation at 1 mM NaCl.

TI: Free amino acids and glycine betaine in leaf osmoregulation of spinach responding to increasing salt stress.
AU: Martino-C-di; Delfine-S; Pizzuto-R; Loreto-F; Fuggi-A; di-Martino-C
SO: New-Phytologist. 2003, 158: 3, 455-463; 29 ref.
LA: English
AB: The aim of the paper was to determine nitrogen compounds contributing to leaf cell osmoregulation of spinach (Spinacia oleracea) submitted to increasing salt stress. Sodium, free amino acids and glycine betaine contents were determined in the last fully expanded leaf of plants stressed by daily irrigation with saline water (0.17 M NaCl). After 20 d of treatment, when Na+ content was c. 55 µmol g-1 f. wt above the control, and the reduction of stomatal conductance lowered photosynthesis to c. 60% of the control, the free amino acids of the leaves, especially glycine and serine, strongly increased. Proline and glycine betaine also increased significantly. After 27 d of treatment, when the Na+ content was c. 100 µmol g-1 f. wt above the control and photosynthesis was 33% of the control, the free amino acid content, especially glycine and serine, declined. Glycine betaine, but not proline, increased further. Glycine betaine comprised c. 15% of the overall nitrogen osmolytes at mild salt-stress, but represented 55% of the total, when the stress became more severe. The increase of glycine betaine balanced the decline in free amino acids, mainly replacing glycine and serine (the precursors of glycine betaine) in the osmotic adjustment of the cells. Photorespiration, which increased during salt stress, was also suggested to have a role in supplying metabolites to produce compatible osmolytes.

TI: Irrigating landscape bedding plants and cut flowers with recycled nursery runoff and constructed wetland treated water.

AU: Arnold-MA; Lesikar-BJ; McDonald-GV; Bryan-DL; Gross-A
SO: Journal-of-Environmental-Horticulture. 2003, 21: 2, 89-98; 18 ref.
LA: English
AB: Direct nursery runoff (runoff), wetland treated recycled nursery runoff (recycled), and a municipal water source (tap) with and without elevated salt (NaCl targeted injection to 3.0 dS/m) levels were tested as potential drip irrigation sources for production of in-ground cut flower crops and landscape bedding plants. Two species of cut flowers, sunflower (Helianthus annuus cv. Mammoth) and gladiolus (Gladiolus hortulanus cv. Tout A Toi), and two bedding plants, vinca (Catharanthus roseus cv. Pacifica Red) and zinnia (Zinnia elegans cv. Lilliput Mixed Colors), were established in trial beds irrigated with four water treatments during the 2001 summer. A second experiment was conducted from November 2001 to May 2002 to investigate the growth and flowering responses of two cut flower crop species, larkspur (Consolida ambigua) and paperwhite narcissus (Narcissus tazetta cv. Galilea) and two bedding plants, snapdragons (Antirrhinum majus cv. Montego Mix) and pansies (Viola wittrockiana cv. Crown Mix). Marketable crops of sunflower, paperwhite narcissus, and larkspur were produced with all four water treatments. Direct nursery runoff, recycled wetland treated water, and NaCl-spiked water that were high in soluble salts during the heat of summer reduced the yield and inflorescence diameter with sunflowers, but only slightly reduced inflorescence quality and had no effect on yield of paperwhite narcissus. These three treatments also affected stand density, but not yield of cut larkspur inflorescences in the cool season. Irrigation with NaCl-spiked water reduced the flower counts on pansies and growth indices on pansies and snapdragons over much of the growing season, but reduced snapdragon flowering only in the spring. Vinca was unaffected by the irrigation treatments. The survival and flowering of zinnia were reduced or delayed by irrigation with recycled or NaCl-spiked water.

TI: Growth, water relations, and ion content of field-grown celery [Apium graveolens L. var. dulce (Mill.) Pers.] under saline irrigation.
AU: Pascale-S-de; Maggio-A; Ruggiero-C; Barbieri-G; de-Pascale-S
SO: Journal-of-the-American-Society-for-Horticultural-Science. 2003, 128: 1, 136-143; 38 ref.
LA: English
AB: We irrigated field-grown celery (Apium graveolens L. var. dulce [Mill.] Pers. 'Tall Utah') with four concentrations of saline water, NSC (nonstressed control), SW1, SW2, and SW3, corresponding to EC of 0.5, 4.4, 8.5, and 15.7 dS.m-1, respectively, plus a nonirrigated control (NIC) and investigated the effects of the treatments on water relations, yield and ion content. In addition, we compared simultaneously plant response to both salt and drought stress by using a modified version of the threshold-slope model. Increasing salinity of the irrigation water reduced fresh and dry weights of the shoots, but increased the dry matter percentage in shoots. The marketable yield was moderately affected by salinity (25% reduction at EC 8.5 dS.m-1). In contrast, a severe water stress dramatically decreased the marketable yield from 23 t.ha-1 (average of the irrigated treatments) to < 7 t.ha-1 (nonirrigated control). Na+ and Cl- concentrations increased in salinized plants whereas nitrogen content, K+, Ca2+, and Mg2+ concentrations decreased upon salinization. Midday leaf water potentials (PSIt) decreased from -1.48 MPa (0.5 dS.m-1) to -2.05 MPa (15.7 dS.m-1) and -2.17 MPa (nonirrigated control), though the reduction in leaf cellular turgor was less severe. The maintenance of high leaf cellular turgor was positively correlated to a decrease in osmotic potential and to an increased bulk modulus of elasticity. These results indicate that it is possible to irrigate celery with saline water (up to 8.5 dS.m-1) with acceptable losses in marketable yield and confirmed that in the field, this species has the ability to efficiently regulate water and ion homeostasis. In the absence of irrigation, celery plants were unable to cope with the drought stress experienced, although this was comparable, in terms of soil water potential, to the one caused by saline irrigation.

TI: Growth and water relations of sun-cured tobacco irrigated with saline water.
AU: Angelino-G; Ascione-S; Ruggiero-C
SO: Beitrage-zur-Tabakforschung-International. 2003, 20: 6, 394-401; 37 ref.
LA: English
LS: German
AB: We have investigated the effects of saline irrigation on growth and water relations of two sun-cured tobacco genotypes, Xp102 and Px107, which belong to the Xanthia and Perustitza tobacco ecotypes, respectively. We compared three commercial sea salt concentrations of the irrigation water (0.25%, 0.5%, and 1% w/v) plus a non-salinized control, corresponding to an electrical conductivity (ECw) of 4.4, 8.5, 15.7 and 0.5 dS m-1 and osmotic

potentials of -0.22, -0.35, -0.73 and -0.02 MPa, respectively. The ECsoil increased with the salinity of the irrigation water. At high salinity (1%), the soil where Px107 plants were grown showed a significantly higher salinity compared to the soil of Xp102. For both genotypes, the soil water content increased with increasing salinity and during the growth season. Increasing salinity progressively reduced the leaf turgor pressure and enhanced the cellular osmotic adjustment. The latter was more pronounced in Px107 compared to Xp102 (0.36 vs. 0.20 MPa). At higher salinity (0.5% and 1%), both genotypes showed reduced leaf surface area, dry matter accumulation, water use, net assimilation rate (NAR) and crop growth rate (CGR). Px107 roots were more sensitive than shoots to salinity 3% reduction per dS m-1 and compared to Xp102 roots, which showed a reduced development only at 1% salinity. Assessment of plant salt tolerance according to the Maas and Hoffman model revealed a slope of 1-2% for both genotypes, indicating that these tobaccos are relatively more salt tolerant compared to other species.

TI: Germination and seedling development of lettuce in relation to water salinity.
OT: Germinacao e formacao de mudas de alface em diferentes niveis de salinidade de agua.
AU: Viana-SBA; Fernandes-PD; Gheyi-HR
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 2001, 5: 2, 259-264; 33 ref.
LA: Portuguese
LS: English
AB: An experiment was carried out with lettuce cv. Elba, with the objective of studying the effects of 6 levels of electrical conductivity of the irrigation water (ECw) varying from 0.3 to 3.8 dS m-1 on the vigour and development of lettuce seedlings. The irrigation water of the desired ECws was prepared maintaining an Na:Ca:Mg ratio of 7:2:1. All the variables studied were affected by salinity during germination and in the seedling stage, however, an ECw of 3.8 dS m-1, provided on average 90% germination, 61% vigour and seedlings with 50% growth, permitting lettuce to be classified as moderately tolerant to salinity during germination and moderately sensitive in the seedling phase.

TI: Endive and saline stress: effects on production, nitrates and macro-elements.
OT: Indivia e stress salino: effetti su produzione, nitrati e macroelementi.
AU: Giustiniani-L; Graifenberg-A; Botrini-L; Curadi-M; Pellegrini-G
SO: Colture-Protette. 2002, 31: 10, 79-84; 24 ref.
LA: Italian
LS: English
AB: In a greenhouse trial in Pisa, Italy, endive cultivars Melie, Samoa, Ascolana and Grower Giant showed yield reductions of 46% (Samoa) to 23% (Grower Giant) when irrigated with a sodic saline solution. NO3 concentration was reduced by an average 80% but in the outer leaves only, Grower Giant showing the greatest reduction (86%). Na and Cl concentrations were higher than other elements in all 4 cultivars. Na concentration was highest in the inner leaves (131% increase) and Cl concentration in the outer leaves. Sodic saline irrigation reduced N, P and K in all the plant tissues, except, in the case of K, in the roots. Ca and Mg concentrations were not significantly affected.

TI: Influence of saline irrigation on growth, ion accumulation and partitioning, and leaf gas exchange of carrot (Daucus carota L.).
AU: Gibberd-MR; Turner-NC; Storey-R
SO: Annals-of-Botany. 2002, 90: 6, 715-724; 29 ref.
LA: English
AB: Ion accumulation in root tissues (periderm, xylem and phloem tissues) and in leaves of different ages was assessed for carrot plants grown in the field (in Western Australia, in 1997/98) with a low level of salinity (5.8 mM Na+ and 7.5 mM Cl-) and in a glasshouse with salinity ranging from 1 to 80 mM. At low levels of salinity (1-7.5 mM), in both the field and glasshouse, carrot leaves accumulated high concentrations of Cl- (140-200 mM); these appear to be the result of a high affinity for Cl- uptake and a low retention of Cl- in the root system. However, Cl- uptake is under tight control, with an 80-fold increase in external salinity resulting in only a 1.5-fold change in the Cl- concentration of the shoot and no increase in the Cl- concentration of the root xylem tissue. In contrast to Cl-, shoot Na+ concentrations were comparatively low (30-40 mM) but increased by seven-fold when salinity was increased by 80-fold. Growth over the 56-day-treatment period in the glasshouse was insensitive to

salinity less than 20 mM, but at higher concentrations the yield of carrot tap roots declined by 7% for each 10 mM increase in salinity. At low levels of salinity the accumulation of high concentrations of Cl- (150 mM) in carrot laminae did not appear to limit leaf gas exchange. However, photosynthesis and stomatal conductance were reduced by 38 and 53%, respectively, for plants grown at a salinity of 80 mM compared with those grown at 1 mM. Salinity-induced reductions in both the internal CO2 partial pressure (pi) and carbon isotope discrimination (DELTA) were small (2.5 Pa and 1.4 per mil, respectively, at 80 mM) indicating that the reduction in photosynthesis was only marginally influenced by CO2 supply. At a salinity of 80 mM the photosynthetic capacity was reduced, with a 30% reduction in the CO2-saturated rate of photosynthesis (Amax) and a 40% reduction in both the apparent rate of RuBP-carboxylase-limited CO2 fixation (Vcmax) and the electron transport rate limiting RuBP regeneration (Jmax). This study has shown that carrot growth and leaf gas exchange are insensitive to the high leaf Cl- concentrations that occur at low levels (1-7 mM) of salinity. However, growth is limited at salinity levels above 20 mM and leaf gas exchange is limited at salinity levels above 8 mM.

TI: Response of two leafy vegetables grown at high salinity to supplementary potassium and phosphorus during different growth stages.
AU: Kaya-C; Higgs-D; Sakar-E
SO: Journal-of-Plant-Nutrition. 2002, 25: 12, 2663-2676; 29 ref.
LA: English
AB: An outdoor pot experiment was carried out in sand culture to investigate the response of spinach (Spinacia oleracea) cv. Matador and lettuce (Lactuca sativa) cv. Paris Island grown at high salinity to supplementary phosphorus (P) and potassium (K). Plants were tested during a period from germination to vegetative growth stage. Treatments in germination stage were (1) tap water alone (TW); (2) TW plus 60 mM NaCl (TW+S); and (3) TW+S plus supplementary 1 mM KH2PO4 and 2 mM K2SO4 in tap water (TW+S+PK). Treatments initiated for seedling and vegetative growth stages were (1) complete nutrient solution (C); (2) C plus 60 mM NaCl (C+S); and (3) C+S plus supplementary 1 mM KH2PO4 and 2 mM K2SO4 in nutrient solution (C+S+PK). High salinity in tap water delayed germination and reduced the final germination percentages for both species compared to the control values. High salinity also decreased root elongation compared to the control while the TW+S+PK treatment was similar to the control for both species. Seedling growth, vegetative growth, total chlorophyll and water usage were significantly reduced in both species by high salinity and membrane permeability increased relative to control values. Supplementary K and P (C+S+PK treatment) produced fresh weight, chlorophyll concentrations, water usage and membrane permeability values similar to or slightly lower than the controls. Spinach growth parameters appeared to be less affected than those of lettuce by salinity. Sodium (Na) concentration in plant tissues increased for both species, especially in lettuce, in the elevated NaCl treatment and leaf P and K was lowered compared to the control values. Supplementary P and K produced leaf and root Na levels that were much higher than control values but significantly lower than in the saline treatment in most cases. These results suggest that supplementary P and K can reduce the adverse effects of high salinity on plant growth and physiological development in these leafy vegetables.

TI: Interactive effects of saline water irrigation and nitrogen fertilization on growth and metabolism of isabgol (Plantago ovata Forsk).
AU: Uday-Burman; Garg-BK; Kathju-S; Burman-U
SO: Journal-of-Plant-Biology. 2002, 29: 3, 249-255; 26 ref.
LA: English
AB: The effect of nitrogen application (0 and 30 kg ha-1) was studied on isabgol (P. ovata) plants irrigated with waters of varying levels of salinity (0, 4, 8, 12 and 16 dS m-1). The composition of irrigation water was similar to that of local ground waters. Although increasing salinity progressively decreased seed yield and shoot dry matter, the magnitude of detrimental effects was less in N-supplied plants compared to the control plants at all salinity levels. N application led to significant increase in the concentrations of nitrogen and potassium and a decrease in sodium concentration in the shoot tissue resulting in more favourable K:Na ratio in N-supplied plants than the control plants under varying salinity levels. This possibly induced a better metabolic efficiency in N-supplied plants in terms of higher levels of total chlorophyll, starch, soluble protein, free amino acids and nitrate reductase activity both at vegetative and flowering stages, despite salinity stress. The results indicate the importance of nitrogen fertilizer application in alleviating the salinity effects on isabgol plants grown in soils of poor fertility.

TI: Effect of saline water and fertility levels on nutrient composition of Isabgol (Plantago ovata Forsk.).
AU: Laxman-Singh; Pal-B; Singh-L
SO: Crop-Research-Hisar. 2002, 24: 3, 528-531; 11 ref.
LA: English
AB: The effects of saline water irrigation and fertility rates on the Ca, Mg and Na composition of P. ovata cv. GI-2 were determined in a field experiment conducted in Agra, Uttar Pradesh, India during the rabi season of two consecutive years. Treatments comprised irrigation at EC 2.4 and 12 dS/m, and application of 50 kg N/ha+25 kg P/ha (F1) in combination with 20 kg Zn/ha (F2), 25 kg K/ha (F3) or 20 kg Zn/ha+25 kg K/ha (F4). Irrigation at EC 2.4 dS/m resulted in higher Ca and Mg, and lower Na concentrations in the grain and straw of P. ovata compared with irrigation at EC 12 dS/m. All the fertilizer treatments resulted in higher Ca and Mg, and lower Na concentration in the crop compared to the control, with F4 resulting in the highest Ca and Mg concentrations in both grain and straw. Among the fertilizer treatments, F1 resulted in the highest straw and grain Na concentration. The interaction effects of irrigation and fertilizer treatments on the Na composition of P. ovata were significant, with irrigation at EC 12 dS/m enhancing the Na composition and fertilizer application reducing the Na composition of the crop.

TI: Influence of irrigation water of various salinity on the yield of onion and cabbage.
OT: Wplyw nawadniania woda o roznym zasoleniu na plonowanie cebuli i kapusty.
AU: Rumasz-RE; Koszanski-Z; Biczak-R
SO: Inzynieria-Rolnicza. 2001, 5: 13, 423-427; 5 ref.
LA: Polish
LS: English
AB: The field experiment was carried out in 1998-99 on a sandy soil of a good-rye-complex. The influence of water of various salinity on the yield of onion and cabbage was tested. The highest onion yield was obtained when the plants had been watered with tap water, whereas cabbage yielded best when diluted saline water had been used. The yield increases were: onion by 24.7% cabbage by 30.5%. Productivity of 1 mm water depended both on the plant species and water salinity.

TI: Effect of different water salinity levels on growth, nodulation, and N2-fixation by dhaincha and on growth of sunflower using a 15N-tracer technique.
AU: Fawaz-Kurdali; Farid-Al-Ain
SO: Journal-of-Plant-Nutrition. 2002, 25: 11, 2483-2498; 29 ref.
LA: English
AB: The effect of different salinity levels of irrigation water (ECw range 1.1-33 dS/m) on the nodulation, dry matter production and N2 fixation by dhaincha (Sesbania aculeata) was investigated in a pot experiment. The same effect on the growth of sunflower (Helianthus annuus) cv. G-342, which was also utilized as a reference crop for measuring N2-fixation by the legume crop using the (15N)isotope dilution method, was also investigated. Irrigation with water having ECw of more than 4.03 dS/m reduced plant growth, and the reduction was more pronounced in S. aculeata than in H. annuus. High levels of water salinity caused more inhibition in shoot than in root growth of both plant species. The indigenous rhizobial strains could form nodules on S. aculeata grown under different salinity levels of irrigated water, except for those irrigated with high level of groundwater salinity (ECw 33 dS/m) where nodulation and N2 fixation were completely inhibited. However, %N2 fixation was significantly enhanced by a moderate salinity level (ECw of 4.03 dS/m) in irrigated water, whereas small effects were obtained with higher water salinity levels (up to 12.3 dS/m). The results indicated that S. aculeata and H. annuus grown in saline soils can be irrigated either with saline water up to 8.03 dS/m and 12.3 dS/m, respectively, or with gradually increased levels of salinity for both of them.

TI: Effect of boronated saline-sodic water on herb and oil yield of palmarosa (Cymbopogon martinii) and soil characteristics.
AU: Sharma-YK; Pal-B
SO: Journal-of-the-Indian-Society-of-Soil-Science. 2001, 49: 2, 383-386; 11 ref.

TI: Growth of faba bean irrigated with saline drainage water.
AU: Banuelos-GS; Zayed-A; Mackey-B

SO: Journal-of-Plant-Nutrition. 2002, 25: 5, 1101-1114; 37 ref.
LA: English
AB: There is an increasing trend in utilizing poor quality waters for irrigated agriculture due to growing municipal and environmental demands for good quality water. Suitability of poor quality water as a supplemental source for irrigation depends on the level of salinity and solute concentration in the water and the selected crop. This greenhouse study assessed the tolerance of faba beans (Vicia faba L.) to irrigation with saline drainage effluent that contains boron (B) and selenium (Se). Plants were grown in a Panoche clay loam (fine-loamy, mixed, calcareous, thermic typic Torriorthents) and irrigated with poor quality drainage effluent typical in part of the westside of California's San Joaquin Valley. The chloride/sulfate saline effluent had an electrical conductivity (EC) of 10 dS m-1, a range of B concentrations from 10 to 30 mg L-1, and one level of Se as selenate at 250 µg L-1. After 150 days of growth at full bloom, plants were harvested and plant accumulation of B, Se, and chloride (Cl-) was evaluated on their effects on dry matter (DM). Dry matter production and nodulation in faba bean were significantly affected by salinity level of 10 dS m-1 and slightly affected by B levels 20 mg L-1 or less in the treatments. Leaf tissue accumulated the greatest concentrations of Cl- (up to 8%) from the saline treatments and the greatest concentration of B (up to 1500 mg kg-1 DM) and Se (up to 3.5 mg kg-1 DM) from the non-saline treatments containing a range of B in solution. This study suggests that faba bean may be suitable for irrigation with drainage effluent high in B concentrations but low in salinity.

TI: Effect of sodium chloride salinity on seedling emergence in chickpea.
AU: Esechie-HA; Al-Saidi-A; Al-Khanjari-S
SO: Journal-of-Agronomy-and-Crop-Science. 2002, 188: 3, 155-160; 19 ref.
LA: English
LS: German
AB: Although laboratory (Petri dish) germination as an estimate of seed viability is a standard practice, it may not give an accurate prediction of seedling emergence in the field, especially when saline irrigation water is used. Experiments were conducted to investigate seedling emergence in two chickpea cultivars (ILC 482 and Barka local) in response to varied salinity levels and sowing depths. Seeds were sown in potted soil at a depth of 2, 4 or 6 cm. The salinity treatments were 4.6, 8.4 and 12.2 dS m-1. Tap water (0.8 dS m-1) served as the control. Depth of sowing had a significant effect on seedling emergence. Seeds sown 6 cm deep showed the lowest seedling emergence. Similarly, salinity had an adverse effect on seedling emergence. The lowest seedling emergence percentages were obtained at the highest salinity treatment (12.2 dS m-1). The interaction between salinity treatment and seeding depth was significant. Hypocotyl injury was implicated as a possible cause of poor seedling emergence in chickpea under saline water irrigation and was less severe when pre-germinated seeds were used. ILC 482 appeared to be more tolerant to salinity than Barka local, suggesting that breeding programmes involving regional exchange of germplasm may be helpful.

TI: Responses of cumin to salt stress.
AU: Garg-BK; Uday-Burman; Kathju-S; Burman-U
SO: Indian-Journal-of-Plant-Physiology. 2002, 7: 1, 70-74; 26 ref.
LA: English
AB: Cumin (Cuminum cyminum), a primary seed spice traditionally grown on marginal lands with low fertility is often irrigated with poor quality ground waters. A pot trial was conducted to study the effect on plant performance, nutrient uptake and leaf metabolism at 0, 4, 8, 12 and 16 dS m-1 levels of saline irrigation water. Salinity levels at and above 8 dS m-1 significantly reduced seed yield, nutrient uptake and levels of most of the leaf metabolites such as total chlorophyll, starch and soluble protein. Nitrate reductase activity, however, was most sensitive to salt stress. The detrimental effects of increasing salinity on plant water status and metabolism were generally more pronounced at the flowering than at the vegetative stage. Salinity induced high accumulation of sodium and changes in K:Na ratio seem to cause derangement in growth and metabolism of cumin plants.

TI: Lentil (Lens culinaris Med.) sensitivity to salinity through the water use efficiency.
AU: Hamdy-A; Katerji-N; Mastrorilli-M; Ameen-A; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 311-319; 13 ref.

LA: English
AB: The present work was carried on lentil for classifying six new varieties with respect to their salt tolerance degree. Lentil crops were grown in small lysimeters placed in greenhouse and irrigated with saline waters of different concentrations, 0.9 dS m-1 (fresh water, used as a control), 3, 6 and 9 dS m-1. Grain water use efficiency (WUEg) is the agronomic criterion used for ranking the six varieties, it represents the ratio of dry grain lentil to the water consumed by evapotranspiration. For the six studied variety we observed that leaf area, productivity in dry matter in yield, and water consumptive use changed with the salt concentrations. The WUEg obtained as the average of the 4 salinity levels, indicated the ILL5845 variety as the most tolerant one, since it attains the highest WUEg value (1.20 g/kg). The varieties ILL5883, ILL6796, ILL5582 and ILL4400 ranged between moderately and weakly tolerant, since their average WUEg value was 0.89 g/kg. The ILL8006 variety was the one with the lowest WUEg value (0.67 g/kg); moreover its productivity was the lowest both under saline and no saline soil conditions; therefore, because of its poor agronomic performance, it is not recommended under irrigation with saline water.

TI: Salinity tolerance in elytrigia (Agropyron elongatum).
AU: Belligno-A; Loggia-F-la; Sambuco-F; Sardo-V; Brancato-R; la-Loggia-F; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 349-351; 2 ref.
LA: English
AB: An experiment was conducted to assess salinity tolerance of elytrigia. Six months old tussocks were transplanted in 20-litres microlysimeters and daily drip irrigated with the following sea water concentrations: 0; 20; 40; and 60% through the three summer months. Treatments included three different leaching fractions, in three replications. Fresh water had an electrical conductivity of 0.83 dS m-1 and seawater a conductivity of 54.3 dS m-1. The main results referred to fresh and dry matter, ashes and organic matter, nutrients, microelements and proteins in roots and leaves. While all the plants survived even the highest sea water concentration, fresh, dry and organic matter were significantly decreased by saline concentration: dry matter production ranged from 21.7 to 13.1 g/plant in roots and from 106.2 to 59.7 g/plant in the aerial part. Na content was considerably increased and K decreased by salinity content, whereas P, N, total proteins, Ca and Mg were practically unaffected both in roots and leaves. Also microelement (Fe, Zn, Cu, Mn) uptake was not appreciably affected by seawater percentage. Opposite to that, organic components responded very remarkably to salinity, thus evidencing their osmoregulating function; the consistent response of proline confirms its possible use as a saline stress

TI: Combined effects of salts and nitrogen on the yield function of lettuce.
AU: Beltrao-J; Jesus-SB; Panagopoulos-T; Trindade-D; Miguel-MG; Neves-MA; Ben-Asher-J; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 363-368; 11 ref.
LA: English
AB: The objective of this work is to study the combined effects of saline water and nitrogen on the yield function of Summer lettuce (Longifolia Lam., cv. Nevada), under an experimental design known as triple emitter source TES. Three trickle laterals were connected together in order to form a triple joint lateral. Two of them and their emitters were connected to two tanks of stock solutions. One tank contained a solution of NaCl and the other of NH4NO3. The third lateral contained only fresh water, where electrical conductivity was 0.9 dS m-1. The emitters on the three coupled lines had different discharges, varying their concentrations, but the accumulative discharges for each dripping point were constant. Maximal concentrations of NaCl and NH4NO3 were, respectively, 7 and 2 g L-1, being the maximal accumulative amounts of NaCl and NH4NO3 per plant, respectively 120 g plant-1 (S1=10 g plant-1; S2=50 g plant-1; S3=75 g plant-1; S4=100 g plant-1) and 40 NH4NO3 g plant-1. Effects on yields were analysed through three options: (1) Increased salinity (S); (2) Sum of added salt and nitrogen (N+S); (3) Nitrogen/Salts ratio (N/S). It was concluded the main several aspects: (1) Until a maximal accumulative NH4NO3 amount of 15 g plant-1, there was always a N-S combination effects; on the other hand, beyond this value, osmotic pressure, rather than N-S combination is affecting the yield; (2) Maximal yield was obtained at 50 g of accumulative NaCl and 19 g of accumulative NO3NH4 g plant-1; beyond these values, osmotic pressure rather than N-S combination is affecting the yield, due to the lower N/S ratio.

TI: Effect of late salinization of chia (Salvia hispanica), stock (Matthiola tricuspidata) and evening primrose (Oenothera biennis) on their oil content and quality.
AU: Heuer-B; Yaniv-Z; Israela-Ravina
SO: Industrial-Crops-and-Products. 2002, 15: 2, 163-167; 22 ref.
LA: English
AB: Linoleic acid and alpha-linolenic acid are the main essential polyunsaturated fatty acids that are required in the human diet. The omega-3 essential fatty acids, found in fish and some plants' seed oil, are linked to a lowered risk of heart disease. In arid and semiarid regions, where water availability is a major limitation in crop production, alternative water resources, such as saline water and treated sewage effluent, are utilized. Oilseed plants, rich in essential polyunsaturated fatty acids, may be considered a highly economic substitute for common field crops irrigated with fresh water. The purpose of the present study was to determine the influence of irrigation with saline water on the oil yield and quality of Salvia, Matthiola and Oenothera plants. We found that salinity affected the oil content and composition of each plant differently. Salinity decreased the oil yield of Salvia plants, increased it in Oenothera and had no effect on Matthiola. Changes were also found in the oils' composition, which may have clinical implications.

TI: Growth and chemical composition of Thuja orientalis L. seedlings as affected by saline irrigation water, soil moisture content and soil type.
AU: El-Sallami-IH; Makary-BS
SO: Assiut-Journal-of-Agricultural-Sciences. 2001, 32: 3, 61-86; 50 ref.
LA: English
LS: Arabic
AB: The combined effect of saline irrigation (saline at 0, 2000, 4000 and 8000 ppm), soil moisture (80 and 120% of field capacity), and soil type (clay loam or sandy soil) on growth and chemical composition of T. orientalis was evaluated in the field (Assiut, Egypt), during the 1999 and 2000 seasons. Saline water at 2000 and 4000 ppm had no significant effect on most growth parameters. Salinity at 8000 ppm resulted in significant decreases in growth parameters. All salinity levels decreased leaf contents of N K, Mg and chlorophyll (chlorophyll a and b, and carotenoids). Sodium, Ca and total phenolic compound content increased with increasing salinity levels. P and total carbohydrate contents were not affected by salinity. Soil moisture at 120% of field capacity (high) decreased the damage caused by salinity, improved vegetative and root growth, and increased leaf contents of N, P and K. High soil moisture decreased Na, Ca and Mg contents. Low soil moisture (80% of field capacity) increased the concentrations of Na, Ca, Mg, pigment, total carbohydrates and phenolic compounds. Clay loam soil caused higher vegetative root growth, absorption of N, P, K and Mg, and carbohydrate and chlorophyll synthesis, compared to sandy soil. The combination of 2000 or 4000 ppm salinity level under high soil moisture in clay loam soil resulted in satisfactory growth response to salt stress. Seedlings tolerated low salt levels at high soil moisture content.

TI: Yield improvement in zucchini under salt stress: determining micronutrient balance.
AU: Villora-G; Moreno-DA; Pulgar-G; Romero-L
SO: Scientia-Horticulturae. 2000, 86: 3, 175-183; 26 ref.
LA: English
AB: Zucchini plants (Cucurbita pepo var. moschata) grown in pots under greenhouse conditions were supplied with different amounts of NaCl (0, 20, 40, and 80 mM). The foliar concentrations of Cl, Fe, Mn and Zn increased in response to rising NaCl levels. The Cu concentrations in leaves were highest in the 0 mM NaCl treatment. In fruits, concentrations of Cl, total Fe and extractable Mn increased with higher levels of NaCl. Fruit yield was increased only by NaCl at 80 mM. Length and fresh weight of fruits tended to increase with increasing NaCl rate, and fruit dry weight proved greatest at 80 mM. The activities of catalase and ascorbic acid oxidase assayed in fruits showed an inverse relationship with the salt concentrations applied. In this context, it is useful to determine the effect of NaCl on the micronutrient concentration, given that the improvement of crop watered with saline water enhances the micronutrient profile. Thus, at 80 mM, NaCl treatment improved the micronutrient levels in the shoot, and significantly increased the micronutrient density in the edible part of this crop.

TI: Pre treatments of gladiolus cormels to produce commercial yield: I-effects of GA3, seawater and magnetic system on the growth and corms production.
AU: Khattab-M; El-Torky-MG; Mostafa-MM; Reda-MSD
SO: Alexandria-Journal-of-Agricultural-Research. 2000, 45: 3, 181-199; 27 ref.
LA: English
LS: Arabic
AB: In a pot experiment conducted during 1997 and 1998 in Alexandria, Egypt, Gladiolus cv. Sancerre cormels were presoaked for 24 h in gibberellic acid solutions at 0 or 100 ppm. A month after planting, plants were irrigated with diluted seawater at different concentrations (0, 5, 10, 15 or 20%). Each treatment was irrigated with non-magnetically or magnetically treated water. Generally, plant height, number of leaves, leaf area, leaf dry weight, corm volume, circumference and dry weight and number of cormels/plant were significantly reduced by saline treatments. Both GA3 and magnetized seawater increased most of these characteristics. Using 5% magnetically treated seawater increased the values for plant height and corm volume and circumference than the control. Using GA3 combined with the 5% magnetized seawater level increased leaves and corm dry weights, compared with the control. Total chlorophyll (a + b) and K+ contents in leaves were significantly reduced by increasing salinity but, increased by using GA3 or the magnetic system; the opposite trend was observed with regard to the Na+ contents in leaves.
PT: Journal-article

TI: Pre treatments of gladiolus cormels to produce commercial yield: II-effect of re-planting the produced corms on the vegeyative growth, flowering and corms production.
AU: Khattab-M; El-Torky-MG; Mostafa-MM; Reda-MSD
SO: Alexandria-Journal-of-Agricultural-Research. 2000, 45: 3, 201-219; 23 ref.
LA: English
LS: Arabic
AB: Young gladiolus (cv. Sancerre) cormels require a season of vegetative growth before flowering can be induced. The cormels were presoaked for 24 h in GA3 at 0 or 100 ppm, then the plants were irrigated with different concentrations of magnetized or non-magnetized diluted seawater (0, 5, 10, 15 or 20%). Flowering behaviour and final corm yields raised from replanting of corms produced from the treated plants were investigated during 1998 and 1999 in Alexandria, Egypt. The residual effect of seawater, GA3 and the magnetic system influenced corm size and carbohydrate content, reduced and nonreduced sugars, K and Na in corms that consequently affected the flowering and corm yield produced from replanting of these corms.

TI: Yield and quality of carrot as affected by soil salinity from long-term irrigation with saline water.
AU: Pascale-S-de; Barbieri-G; de-Pascale-S; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 621-628; 19 ref.
LA: English
AB: In 1995 and 1996, the effects of residual soil salinity on yield and some aspects of yield quality were studied in carrot (Daucus carota) grown during irrigation-free seasons on a field which had undergone the same irrigation treatments with saline water (0, 0.125, 0.25, 0.5 and 1% of commercial NaCl) since 1988. Within the range of electrical conductivity of the saturated-soil extract (ECe) between 1.9 dS m-1 (treatment 0%) and 4.2 dS m-1 (treatment 1%) the marketable yield decreased by about 65% and the marketable root number m-2 by 57%. The N concentration was increased from 2.53 to 3.32 g 100 g-1 dry matter (leaf) and from 1.28 to 1.47 (root) with increased soil salinity. Na and Cl concentrations of leaf and root were doubled in plants grown on soil with the highest salinity. Root characteristics and mineral composition of leaves and roots were significantly affected in plants grown on salt-affected plots with a different partitioning of ions in plant tissues. The response of salt tolerance was evaluated by using the Maas and Hoffman "threshold slope" model. The threshold value was 2.0 dS m-1 and yield was reduced at the rate of 28% per unit increase in soil salinity. The rate of yield reduction was higher than those reported in literature for sensitive crops, due to the greater effects of soil physical and chemical conditions altered by long term irrigation with saline water: the soil of 1% treatment assumed typical characteristics of alkaline-saline soil.

TI: Growth, leaf ion concentration, stomatal behaviour and photosynthesis of bean (Phaseolus vulgaris L.) irrigated with saline water.
AU: Lovelli-S; Rivelli-AR; Nardiello-I; Perniola-M; Tarantino-E; Ferreira-MI (ed.); Jones-HG
SO: Third International Symposium on Irrigation of Horticultural Crops, Estoril (Lisbon), Portugal, 28 June-2 July, 1999. Acta-Horticulturae. 2000, No. 537 (Vol.2), 679-686; 7 ref.
LA: English
AB: The aim of this study was to determine the effects of soil salinity on plant growth, gas exchange, and leaf nutrients of a salt sensitive species, green shelled bean (Phaseolus vulgaris cv. Lingua di fuoco). Plants were grown in pots under greenhouse conditions and irrigated with water containing one of three salinity levels: 0.39 (tap water control), 10 or 20 dS m-1; salinity levels were adjusted by adding CaCl2 to the irrigation water. Leaf area development, stomatal conductance, transpiration, photosynthesis, leaf ion concentrations, and plant dry weight were measured. Salinity stress severely reduced plant growth and leaf area development in bean, and increased leaf senescence. Plants exposed to salinity stress had higher concentrations of Ca2+, and lower concentrations of K+, in new leaf tissue than unstressed plants. Photosynthesis was also reduced in salt stressed plants, and this reduction was due to limitations on stomatal conductance.

TI: Physiological and agronomic responses of beans to irrigation with saline water.
OT: Risposta fisiologica ed agronomica del fagiolino da industria all'irrigazione con acque saline.
AU: Pascale-S-de; Ruggiero-C; Barbieri-G; de-Pascale-S
SO: Rivista-di-Agronomia. 1999, 33: 2, 79-89; 29 ref.
LA: Italian
LS: English
AB: In a field trial in 1995 on a soil which had received saline irrigation for 7 years, beans (Phaseolus vulgaris) were irrigated with water containing 0, 0.25, 0.5 or 1% NaCl. Soil and water salinity levels of 1% NaCl prevented germination and early seedling development. In the 0.5% treatment overall water potential showed a more pronounced decrease in the leaves than in the roots. The decrease in osmotic potential was not as great and therefore leaf turgor was reduced by 50% and root turgor by 32% compared with the control. Leaf osmotic potential was correlated with leaf Cl content. Leaf and root growth rates were closely correlated with their respective turgor potentials. In response to increasing salinity, aboveground dry matter decreased from 23 to 8 g/plant and root dry matter from 13 to 10 g/plant, leaf area from 22 to 7 dm2/plant, and stomatal density from 379 to 190 stomata/mm2, while specific leaf weight increased from 5.4 to 6 mg DM/cm2 and succulence from 23 to 32 mg H2O/cm2 of leaf area. Pod yield decreased from 1.18 to 0.13 kg/m2.

TI: Evapotranspiration and crop coefficient of cucumber in greenhouse.
AU: Blanco-FF; Folegatti-MV
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 2003, 7: 2, 285-291;
37 ref.
LA: English
LS: Portuguese
AB: The evapotranspiration (ETc) and crop coefficient (Kc) of cucumber in a greenhouse were determined during the winter-spring season in Piracicaba, Sao Paulo, Brazil. The cucumbers were irrigated with water of three different levels of salinity: S1=1.5, S2=3.1 and S3=5.2 dS m-1. The electrical conductivity of S1 was obtained only by addition of fertilizers, as fertigation was used, and the S2 and S3 levels in addition to fertilizers received magnesium sulfate, calcium chloride and sodium chloride. Cucumber cv. Hokushin seedlings were grafted on squash, transplanted on beds in double rows and directed vertically with a single stem. Irrigation was performed when the soil matric potential reached -30 kPa, which was determined by the mean matric potential at 0.15 and 0.30 m depths, and the depth of irrigation was calculated from a reduced-evaporation pan. A randomized block design was adopted with three replications. ETc and Kc were found to reduce linearly by the salinity of the irrigation water with reduction in ETc of 4.6% for unit increase of salinity. Due to the reduced evapotranspiration in saline treatments, deep percolation was increased by saline water and corresponded to 4, 7 and 17% of the total applied water in S1, S2 and S3, respectively. Measured Kc values for S1 were very close to the estimated values; thus the combined use of tensiometers and evaporation pan was found to be adequate for irrigation management in greenhouse.PT: Journal-article
AN: 20033209519

TI: Germination, growth and ion regulation in saline-water-irrigated Sporobolus arabicus Boiss.
AU: Khan-D; Ahmad-R
SO: Hamdard-Medicus. 2002, 45: 4, 76-88; 42 ref.
LA: English
AB: The effects of saline water (10-30% sea water dilution) irrigation on germination, growth and ion regulation in Sporobolus arabicus were investigated. The caryopses of S. arabicus did not germinate on the first day of incubation in any salinity treatment, but there was a significant reduction in final germination only in 20 and 30% sea water. Seasonal variation in harvested-biomass indicated that control plants as well as those irrigated with 10% sea water showed some tendency of higher biomass production during January and February. The analysis of variance for all the component sources of variation showed that only the harvest had highly significant effects on the growth of Sporobolus. Salinity affected biomass but at a very low level of significance. The amount of biomass clipped in a year decreased with the increase of salinity and at 30% sea water concentration, the biomass was approximately 24% less than that of the control. No significant differences occurred in germinability among the caryopses obtained from control and treated plants. The moisture level of leaves declined significantly at 20 and 30% sea water. Protein content decreased and proline and sugar levels increased at high salinity. The increase in Na concentration with the increase of salts in the irrigation medium was associated with decrease in K and Ca in roots as well as the leaves. Mg exhibited no significant variation. The salt excretion through leaves increased with salinity. All major cations and anions were excreted, but Na and Cl predominantly. With respect to intracellular cationic accumulation S. arabicus appeared to be a sodiophilic plant.
PT: Journal-article
AN: 20043001777

TI: Sugarcane response to saline irrigation water.
AU: Lingle-SE; Wiedenfeld-RP; Irvine-JE
SO: Journal-of-Plant-Nutrition. 2000, 23: 4, 469-486; 21 ref.
LA: English
AB: Salinity of irrigation water reduces yield and juice quality in sugarcane, but cultivars vary in the degree of reduction. Genotypes which accumulate more potassium (K+) may be more resistant to salinity than genotypes that accumulate less K+. The effect of irrigation water salinity on yield and juice quality was examined in a cultivar with high conductivity, high K+ juice (cv. NCo310), and a cultivar with low conductivity, low-K+ juice (TCP 87-3388). Plants were grown in lysimeters containing 793 L of soil and irrigated with water of 0.01, 1.25, 2.93, or 4.70 dS m-1. Quality and component analyses were conducted on the juice of single stalks subdivided by length, and the juice from whole stalks. The two cultivars responded similarly to increased salinity, although juice of NCo310 had a higher mineral concentration, especially K+ and Cl. Yield and most quality components were not significantly reduced by 1.25 dS m-1 water. The 2.93 and 4.70 dS m-1 treatments reduced stalk height and weight but not stalk numbers. The reduction in stalk height was due to decreases in number of internodes per stalk and mean internode length. Increasing salinity reduced total soluble solids and sucrose in juice, but increased Na+, K+, Mg+2, Ca+2 and Cl-. Within a stalk, sucrose increased from top to bottom, while K+ decreased. Sodium concentrations were sharply higher in the lowest section, especially in plants irrigated with saline water. Chloride concentration was approximately equal in all sections. An increase in K+ accumulation did not appear to increase the salt tolerance of NCo310.
PT: Journal-article

TI: Response of clusterbean to saline and sodic waters under different soils.
AU: Pathan-ARK; Chhipa-BR; Lal-P; Vyas-KK
SO: Annals-of-Agricultural-Research. 2000, 21: 1, 42-47; 6 ref.
LA: English
AB: In a greenhouse pot trial, clusterbeans (Cyamopsis tetragonoloba) cv. Durgapura were grown on loamy sand, loam or clay soil, and were irrigated with water with EC of 2, 4 or 6 dS/m and SAR of 10, 20, 30, 40 or 50. Plant height, seed index, seed and straw yields, and contents of P and K in seeds and straw decreased with increasing salinity and sodicity, while the content of N and Na increased. Results were best with clay, followed by loam, then loamy sand.
PT: Journal-article

TI: NaCl effects on celery (Apium graveolens L.) grown in NFT.
AU: Pardossi-A; Bagnoli-G; Malorgio-F; Campiotti-CA; Tognoni-F
SO: Scientia-Horticulturae. 1999, 81: 3, 229-242; 19 ref.
LA: English
AB: The effects of NaCl salinity and foliar application of calcium nitrate on the biomass production, water relations and mineral uptake were investigated in celery cv. Istar plants grown by the nutrient film technique (NFT) under greenhouse conditions during winter. Plants were supplied with nutrient solutions containing different concentrations of NaCl for a final electrical conductivity (EC) of 2.0, 6.0 and 10.0 mS cm-1. Increasing salinity had little or no influence on plant growth, water relations, and the tissue concentration of macronutrients, but it enhanced the uptake of Na and Cl, which accumulated markedly in the mature leaves and to a much lesser extent in the actively growing leaves. Salinization also improved the crop quality by reducing the accumulation of nitrate-nitrogen and the incidence of blackheart in young leaves. Blackheart was completely prevented by foliar application of calcium nitrate. Celery grown in NFT exhibited substantial tolerance of NaCl salinity and, therefore, it could be used to exploit saline water in soilless culture. These findings also suggest that proper management of the salt concentration of the nutrient solution can be used to improve the quality of celery with little effect on yield.

TI: Influence of saline water irrigation on celery yield.
AU: Rumasz-E; Koszanski-Z; Wronkowska-H
SO: Folia-Universitatis-Agriculturae-Stetinensis,-Agricultura. 1999, No. 73, 207-211; 12 ref.
LA: English
LS: Polish
AB: In a microplot experiment, root celery [celeriac] was irrigated with simulated sea water, tap water or diluted sea water (1:1). Controls were not irrigated. Irrigation increased root yield by an average of 38%. Diluted sea water was the most effective increasing yields by 52% compared with 35% for tap water and 25% for sea water.

TI: Effect of salinity management on soil properties and cucumber yield under greenhouse conditions.
AU: Tubail-KM
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 75-82; 15 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: Experiments on saline irrigation management methods were conducted on drip irrigated cucumber (Hybrid extram.) grown in 20 litre pots of sandy loam soil using saline water (EC 3.2 dS/m). The experiment was conducted in a greenhouse with completely randomised block design, using four treatments: (i) fresh water; (ii) two freshwater irrigations followed by saline water; (iii) one freshwater irrigation followed by two with saline water; (iv) saline water only. Relative yield was reduced by 5.8% and 15.3% in the 3rd and 4th treatments respectively. Analysis of leaves and fruit showed a significant increase in Na but decrease in K concentrations with the increase in applied amounts of saline water. Na:Ca ratio was increased with higher salinity in the irrigation water. The soil analysis showed a significant increase in EC, SAR, and sodium and chloride concentrations with the increased use of saline water.

TI: The effect of saline irrigation water on sunflower production: assessment of leaching fraction for the control of root zone salinity.
AU: Karam-F
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 98-107; 10 ref.
PB: Jordan Univ. Sci. & Technol.; Jordan
LA: English
AB: The effects of saline irrigation water on soil salinity and sunflower (Helianthus annus) seed yield were determined in an experiment comprising clay and loam lysimeters irrigated with waters of three different salinities. In spite of a leaching fraction of 20% on both types of soil, soil salinity showed a slight increase during the growing season. Under these conditions, the results suggested a leaching fraction of 30% during the peak

water consumption period, reduced the impacts of saline irrigation on both soil and plant. Yield and evapotranspiration were highly affected by salinity-induced water stress or soil texture. Seed yield on clay was almost 30% lower than on loam. Water use efficiency of sunflower obtained in this experiment corresponds with values reported in the literature and was not affected by soil texture and salinity.

TI: Yield, earliness and fruit quality of pepino clones and their hybrids in the autumn-winter cycle.
AU: Prohens-J; Ruiz-JJ; Nuez-F
SO: Journal-of-the-Science-of-Food-and-Agriculture. 1999, 79: 2, 340-346; 25 ref.
LA: English
AB: Two consecutive pepino [Solanum muricatum] crops, consisting of 2 hybrids and their 4 parents, were grown in a greenhouse during autumn/winter 1994-95 and 1995-96. Plants were irrigated with water at 2 salinity levels (electrical conductivities of 3 or 8 dS/m), and full-sized fruits were sprayed with ethephon at 0 or 500 mg/litre. Salinity reduced crop yield and fruit size, but this effect was less pronounced in the hybrids, which showed heterosis for yield characters. Yield and fruit size of hybrids irrigated with saline water were greater than those of the parents irrigated with non-saline water. Salinity and ethephon application improved earliness; in most clones the combination of salinity and ethephon shortened the growing cycle by 1 month. Salinity improved fruit quality by increasing the fruit dry matter (DM) and soluble solids content (SSC) of all clones. Ethephon application did not markedly affect fruit quality, except for parental clone 9-1, in which ethephon-treated fruits had lower SSC and TA. Salinity improved the aroma and flavour of fruits of 2 of the hybrids.

TI: Options for using low-quality water for vegetable crops.
AU: Shannon-MC; Grieve-CM
SO: Proceedings of the colloquium 'Water management and water relations of horticultural crops' held at the 94th ASHS Annual Conference, Salt Lake City, Utah, USA, 24 July, 1997. HortScience. 2000, 35: 6, 1058-1062; 23 ref.
LA: English
AB: Salinity problems which develop in irrigated agriculture, salt tolerance of fruits and vegetables, cyclic reuse of saline water are examined. A series of experiments were conducted during 1996 and 1997 to determine the potential for growing leafy vegetables using relatively saline irrigation water. Nine species of leafy vegetable were grown in sand tanks outdoorsand irrigated with water of electrical conductivity 3, 7, 11, 15, 19 or 23 dS/m. Crop yields were less affected by saline water if was applied later in the season. In most cases vegetables grown at high salinity were darker green which would enhance their marketability. Irrigation with saline water high in sulfates seemed to enhance the flavour of leafy cruciferous vegetables.

TI: Physiological responses of peanut grown under saline conditions as affected by spraying with Vapor Gard and MnSO4 under gypsum application.
AU: El-Zeiny-HA; Saad-AOM; Thalooth-AT; Garab-G
SO: Photosynthesis: mechanisms and effects. Volume IV. Proceedings of the XIth International Congress on Photosynthesis, Budapest, Hungary, 17-22 August, 1998. 1998, 2633-2636; 17 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Groundnut cv. Giza 4 seeds inoculated with Rhizobium sp. were sown in pots of sandy soil irrigated with saline water and given basal fertilizers with or without application at 5 and 8 weeks of the equivalent of 500 kg gypsum/feddan. Pots given gypsum were sprayed or not sprayed with an aqueous solution of 1.5% Vapor Gard with or without 0.1% MnSO4 at 5 and 9 weeks. Gypsum application significantly increased plant height and leaf area, chlorophyll a, total chlorophyll, cell sap concentration, free proline concentration and osmotic pressure. Growth parameters and total chlorophyll content were increased by Vapor Gard or Mn, but Vapor Gard gave best results. Chlorophyll a, total chlorophyll and carotenoids were highest with gypsum + Mn. [1 feddan = 0.42 ha].

TI: Irrigation with brackish water under desert conditions 1. Problems and solutions in production of onions (Allium cepa L.)
AU: Pasternak,-D.; Malach,-Y.-de; Borovic,-I.
AD: Rudolph and Rhoda Boyko Inst. for Agriculture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).

1984, v. 9(3) p. 225-235; Nov, figs, tables, 11 ref.; summary (En)
LA: English
AB: Field trials showed that brackish water (electrical conductivity ECi 4.4 dS/m) reduced yield of onions. Yield was reduced by 60 and 30% under sprinkler and drip irrigation, respectively. Under drip irrigation, seedling death occurred during the 1st 40 days following field emergence. Yield reduction was completely prevented by germinating and establishing the field with fresh water (ECi 1.2 dS/m) irrigation before changing to brackish water irrigation 45 days after sowing. With the sprinkler irrigation, onion yield with brackish water irrigation could be increased by either increasing sowing density or by alternating brackish and fresh water irrigation.

TI: Irrigation with brackish water under desert conditions. 8. Further studies on onion (Allium cepa L.) production with brackish water
AU: Malach,-Y.-de; Pasternak,-D.; Mendlinger,-S.; Borovic,-I.; El-Salam,-N.A.
AD: Ramat Negev Regional Council Agricultural Station, Halutsa, Israel
SO: Agricultural-Water-Management (Netherlands).
1989, v. 16(3) p. 201-215; Sep, figs, tables, 18 ref.; summary (En)
LA: English
AB: The interactions between the effects of salinity and temperature on the germination of onion seeds, the effect of stage of salinization on onion yield, varietal differences in salt tolerance, and the effect of salinity on water and ion relationships of the plants were studied in Israel. A strong interaction was found between the effects of salinity and temperature on onion germination. At 12degC onion seeds germinated fully in vitro with water having an electrical conductivity (EC) of up to 30 dS/m. At 30degC germination was almost completely arrested at an EC of 20 dS/m. Lower temperatures and higher salinity levels reduced the germination rate. In the field, continuous drip irrigation (EC of 1.2, 4.0, 6.0 and 8.0 dS/m) resulted in severe die-off seedlings in the salinized plots during the first 90 days of growth and, consequently, in severely reduced yields of bulbs. Much of this effect could be averted by delaying salinization until the 2nd-leaf stage and even more by waiting until the 4th-leaf stage. Nine onion cultivars were subjected to the same salinity treatments. No differences were found in the relative responses of the cultivars to salinity. Authors' summary.

TI: Irrigation with brackish water under desert conditions. 4. Salt tolerance studies with lettuce (Lactuca sativa L.)
AU: Pasternak,-D.; Malach,-Y.-de; Borovic,-I.; Shram,-M.; Aviram,-C.
AD: Rudolph and Rhoda Boyko Inst. for Agriculture and Applied Biology
SO: Agricultural-Water-Management (Netherlands).
1986, v. 11(3-4) p. 303-311; Sep, figs, tables, 13 ref.; summmary (En)
LA: English
AB: In a field trial in the Negev Desert (Israel) 3 Romaine lettuce cvs. and 7 iceberg lettuce cvs. were drip irrigated from day 20 after planting with water of 4 levels of salinity (electrical conductivity of 1.2, 3.5, 8.2 and 10.5 dS/m). The Romaine lettuce cvs. were far more tolerant to salinity than the iceberg cvs. There were no specific salt-tolerant cvs. within either of the 2 groups. The slope of the linear regression of relative yield vs. salinity was - 5.6 for the iceberg lettuce cvs., which is half the value reported elsewhere for lettuce. Iceberg lettuce appears to be more sensitive to salinity at later than at early growth stages. There was no apparent osmotic adaptation of lettuce to salinity. The osmotic potential of the leaves decreased to - 1.3 MPa about a month after planting and then gradually increased to - 0.6 MPa. Authors' summary.

LIVESTOCK MANAGEMENT

TI: Effect of drinking saline water and feed shortage on adaptive responses of sheep and camels.
AU: Assad-F; El-Sherif-MMA
SO: Small-Ruminant-Research. 2002, 45: 3, 279-290; 35 ref.
LA: English
AB: This study investigated the effect of saline load and inadequate feed intake on some of the adaptive physiological responses in female sheep and camels, raised under semiarid conditions. The experiment comprised 5 consecutive periods, P1-P5, of 40 days each, during which levels of both energy and protein were gradually

decreased by increasing the roughage portion in the diet. Sheep and camels were divided into 3 groups according to the type of drinking water, namely, a fresh water (F) group (280 parts per million total dissolved salts; ppm TDS), low saline (LS) group (7650 ppm TDS), and high saline (HS) group (13535 ppm TDS). Saline water was obtained by diluting seawater with tap water. In sheep, live body weights (BWs) decreased significantly ($p < 0.01$) with decreasing nutrient intake, with average final loss equal to 8.4%. Plasma glucose decreased with decreasing protein intake, but as energy intake increased the effect of protein shortage disappeared. Plasma glucose levels in sheep decreased from a level of 3.51 mmol/l in the F group to 2.89 mmol/l in the HS group. Concentrations of liver enzymes aspartate aminotransaminase (AST) and alanine aminotransaminase (ALT) in sheep increased in plasma in relation to saline load especially at low nutritional level. The activity of the acetylcholinesterase enzyme (AChE) in its 3 sites (blood, red blood cells, and plasma) was depressed significantly by both saline load and decreased feed intake. At the P2 period, salinity depressed acetylcholine in its 3 sites to 60-67% in the HS group as compared to the control. The depression during the P5 period reached 41-54%. Extracellular fluids (ECFs), interstitial fluids (ISF), plasma volume (PV), and blood volume (BV) in the ewes decreased ($p < 0.05$) by increasing salinity concentration. Decreasing feed intake lowered ECF, ISF, and BV from the P2 period. In camels, live BWs decreased insignificantly by decreasing feed intake with a final BW loss of 1.9%. Plasma glucose unaffected by salinity. Protein deficiencies had no effect on plasma AST of camels, but both salinity and low level of nutrient intake affected the concentration of enzyme ALT. Nutrient shortages and saline load affected activity of AChE at the P4 and P5 periods. The inhibition of the enzyme activity during P5 due to high salinity treatment reached 91% in blood, 63% in RBCs, and 50% in plasma as compared to the control group. Body fluid compartments of camels unaffected by salinity, only by reduced feed intake. The results indicated better tolerance of camels than sheep to both saline load and feed shortage.

TI: Influence of inclusion of salicornia biomass in diets for rams on digestion and mineral balance.
AU: Abouheif-MA; Al-Saiady-M; Kraidees-M; Eldin-AT; Metwally-H
SO: Asian-Australasian-Journal-of-Animal-Sciences. 2000, 13: 7, 967-973; 23 ref.
LA: English
AB: A metabolism trial was conducted with 28 Najdi rams allocated into seven dietary groups to evaluate the effect of dietary inclusion of Salicornia bigelovii biomass on nutrient digestibility, ruminal fluid metabolites and nitrogen and mineral balances. Either the stems (ST) or spikes (SP) of this seawater-irrigated halophyte were incorporated into complete diets at rates of 0, 10, 20 and 30%, replacing equal amounts of rhodes grass hay in a ground mixed control diet. Digestibility of DM, OM, EE, NFE and faecal and urinary nitrogen were not affected by increased level of ST in the diet. As level of ST increased from 0 to 20% in the diets, CP digestibility and nitrogen retention approached their maximum ($p<0.01$), whereas CF digestibility reached its minimum ($p<0.01$). On the other hand, except for EE, digestion of all nutrients and nitrogen retention were linearly depressed ($p<0.01$) as SP increased in the diets from 10 to 30%. Concentration of ammonia-N, total VFA and pH values in the rumen fluid were lower ($p<0.01$) with the ST or SP diets than with the control diet. Increasing level of ST or SP in the diet was associated with an increase ($p<0.01$) in the proportion of acetate and a decline ($p<0.01$) in molar percentage of propionate in ruminal fluid. Sodium absorption increased ($p<0.01$) with increased ST and SP in the diets up to 10 and 20%, respectively, followed by constant absorption values up to 30%. When the level of ST in the diet gradually increased to 30%, a concomitant increase ($p<0.01$) in Ca and P absorption were obvious; whereas, increased level of SP in the diets from 0 to 30% resulted in noticeable ($p<0.01$) depression in Ca and P apparent absorption.
PT: Journal-article

TI: Effect of saline water on some biochemical parameters in sheep.
AU: Fawzia-A; Nassar-AM; Hussein-N; Sohair-MA
SO: Desert-Institute-Bulletin,-Egypt. 1995, 47: 2, 241-252; 20 ref.
LA: English
LS: Arabic
AB: Eighteen adult Barki X Merino rams were distributed into three equal groups, that were given drinking water containing 0, 0.7 and 1.3% sodium chloride. Blood samples were collected monthly for 5 months and glucose, acetylecholinesterase enzyme activity (AChE) in whole blood, red blood cell and plasma, serum glutamic oxalacetate (SGOT or AST) and glutamic pyruvic transaminase, (SGPT or ALT) activities, and plasma creatinine were determined. The results showed a tendency for a slow decline in blood glucose level with increasing salinity,

and a highly significant inhibition of AChE activity in blood, red blood cells and plasma of rams that consumed saline water. An increase in plasma SGOT and SGPT activities in rams receiving the saline water. A highly significant increase in plasma creatinine was also reported in saline treated rams. It was concluded that rams had the ability to withstand and adapt to saline water by changing selected biochemicals in their blood and liver function in addition to kidney function, without affecting animal health status and physiological process of adaptation. In conclusion, sodium chloride added at 1.390 (w/v) in drinking water has no harmful effect on rams.

TI: Major plasma cations and aldosterone concentration of sheep and goats as affected by some environmental conditions.
AU: Ashmawy-NA; Ibrahim-SA
SO: Veterinary-Medical-Journal-Giza. 1999, 47: 2, 213-223; 25 ref.
LA: English
AB: Adaptation of sheep and goats to semi-arid conditions was studied. Blood samples were collected from 5 adult Ossimi ewes and 5 Zaraibi goats at weekly intervals for 8 weeks during winter (December to January), summer (July to August) and spring (March to April). Response to severe heat stress was recorded in August. Water was not available during direct exposure to solar radiation between 12.00 and 15.00 h. The effects of salt in drinking water (13.0 g/litre) and to water deprivation for 48 h were also examined. The mean Na+ concentration tended to decline gradually in both sheep and goats from 351.5 and 370.2 mg/100 ml in winter to 211.5 and 207.0 mg/100 ml in spring and to 125.9 and 122.6 mg/100 ml in spring, respectively. Plasma Na+ concentrations in sheep and goats exposed to stress were higher (561.7 and 578.6 mg/100 ml) than those in animals that were provided saline water (430.1 and 448.6 mg/100 ml) and in animals deprived of water (465.7 and 505.7 mg/100 ml), respectively. Plasma potassium concentration showed opposite trend, the higher values were recorded during summer (19.2 and 19.1 mg/100 ml) and lower values during spring (13.8 and 13.9 mg/100 ml) in both sheep and goats, respectively. Goats had higher concentration of Na+ and lower concentration of K+ than sheep during periods of water deprivation (WD) and water salinity (WS). However, during heat stress, goats had higher concentrations of Na+ and K+ than sheep. Aldosterone concentration varied between seasons in both sheep and goats, the higher values were recorded during summer season. During heat stress, plasma aldosterone in goats was double that of sheep, while opposite trend to heat stress was observed during WD and WS.

TI: Addition of ascorbic acid to relieve the adverse effects of using underground and saline water on egg quality and some physiological parameters.
AU: El-Fiky-AA
SO: Egyptian-Poultry-Science-Journal. 1998, 18: 1, 81-101; 25 ref.
LA: English
LS: Arabic
AB: Seventy-two Norfa pullets, 20 weeks of age, were divided into 6 groups and subjected to 6 drinking water treatments: municipal town water (MTW), MTW plus ascorbic acid (AA) 1 g/litre, MTW plus NaCl 2 g/litre, MTW plus ascorbic acid 1 g + NaCl 2 g/litre, underground water (UGW) and UGW plus ascorbic acid 1 g/litre. Egg quality, egg shell quality, egg fertility, embryonic mortality and hatchability were studied and physiological properties of semen of cocks subjected to the same 6 treatments were also investigated. Supplementation with ascorbic acid increased feed intake and decreased water intake in the case of town water. Ascorbic acid in saline and underground water decreased feed and water intake. Addition of NaCl to MTW substantially decreased body weight at sexual maturity, weight of first 5 eggs and egg production during the first 3 months of laying. It also slightly delayed age at sexual maturity but ascorbic acid supplementation resulted in a slightly younger age and heavier weight at sexual maturity. Underground water also had deleterious effects on body weight at sexual maturity and on the average weight of the first 5 eggs, but addition of ascorbic acid relieved these effects. NaCl and ascorbic acid, alone or in combination had adverse effects on egg fertility. Semen volume, sperm concentration, motility and live sperm percentage were also adversely affected by water salinity and ascorbic acid supplementation. Egg weight and yolk indices, and Haugh units were not significantly affected by treatments; however, ascorbic acid and MTW slightly increased Haugh units. Addition of NaCl to MTW decreased egg shell weight, shell weight/unit surface area, egg shell volume and breaking strength. Ascorbic acid addition had the opposite effect in this respect, except in the case of egg shell volume, which was not affected. Underground water decreased shell thickness and breaking strength and ascorbic acid supplementation improved the latter only. Ascorbic acid supplementation reduced the number of pores/cm2 and increased egg weight loss especially in the

second week of incubation. NaCl supplementation decreased egg fertility, while underground water increased embryonic mortality. Embryonic mortality was highest with underground water treatment (38.7%) which occurred mainly at stage II and in pipped eggs. Ascorbic acid supplementation improved survival when added to UGW. Hatching weight was slightly affected by the treatments.

TI: The effect of dietary inclusion of halophyte Salicornia bigelovii Torr on growth performance and carcass characteristics of lambs.
AU: Kraidees-MS; Abouheif-MA; Al-Saiady-MY; Tag-Eldin-A; Metwally-H
SO: Animal-Feed-Science-and-Technology. 1998, 76: 1-2, 149-159; 25 ref.
LA: English
AB: Sixty-three Najdi ram lambs (22.8 kg) were used to evaluate the effect of dietary inclusion of S. bigelovii byproducts on growth performance, carcass characteristics and mineral and water intake. Dry stems or spikes of this seawater-irrigated halophyte were incorporated into isonitrogenous diets at rates of 100, 200 or 300 g/kg, replacing equal amounts of rhodes grass hay (Chloris gayana) in a ground, mixed control diet containing roughage 400 g/kg. Lambs were randomly allocated to 7 dietary groups of 9 lambs each, and fed individually for 100 days ad libitum. Feeding Salicornia stems up to 300 g/kg, or spikes at 100 g/kg, did not affect DM intake, compared with the control; however, the inclusion of spikes at levels above 100 g/kg decreased DM intake. Feeding stems at 100 and 200 g/kg improved average daily gain ($P<0.05$) by 10.6 and 4.8%, respectively, compared with the control. Daily Na intake increased ($P<0.01$) with increasing levels of Salicornia in the diet. This, in turn, linearly increased ($P<0.01$) daily water intake by 20.5, 31.3 and 34.6% in lambs fed on stems at 100, 200 or 300 g/kg, respectively. Corresponding increases in spike-fed lambs were 33.3, 39.6 and 47.5%, respectively, compared with the control. Graded levels of Salicornia stems or spikes had no effect on empty body weight and dressing percentage, but linearly increased ($P<0.01$) the percentage of kidneys and heart weights. Warm carcass weight decreased linearly ($P<0.05$) with increasing levels of spikes.
PT: Journal-article

MIDDLE EAST, NORTH AFRICA, AND PERSIA (IRAN)

General & miscellaneous issues related to saline agriculture

TI: Use of saline drainage water for irrigation, reclamation and cultivation of new land areas in Sinai Peninsula.
AU: El-Saidi-MT; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 57-67; 8 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: This paper contains discussions on: (1) the current water resource status in Egypt; (2) the strategies for the optimum utilization of available water resources; (3) the irrigation water supply in North Sinai; and (4) the measures to control salinity in saline drainage water-irrigated soil. Two development projects in Egypt, the North Sinai Development Project and the Tushka Project, are described, and their results are given.

TI: UNESCO's work for the protection of arid zones with particular emphasis to sabkhat.
AU: Clusener-Godt-M; Barth-HJ (ed.); Boer-B
SO: Sabkha-ecosystems.-Volume-1:-The-Arabian-Peninsula-and-adjacent-countries. 2002, 347-352; 4 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: This paper discusses three of UNESCO's numerous programmes for the protection of arid zones, particularly the sabkhat (saline desert flats devoid of vegetation) in the Arabian Peninsula. The first programme is the Man and the Biosphere Programme which deals mainly with the terrestrial and coastal resources management, terrestrial and coastal ecology. This programme aims to harmonize the relationship between human beings and nature through conservation and sustainable development. The second is the Project on Integrated Biodiversity Strategies for Islands and Coastal Areas which deals mainly with the protection of coastal areas and the

protection, rational use and development of their living resources. The third project is the halophytic plants for sustainable development of coastal and salt-affected areas in Morocco which aims to investigate Moroccan and acclimated halophytic plant species in order to estimate their potential as economically useful plants under saline irrigation.

TI: Effect of agriculture drainwater reuse on soil, Nile Delta, Egypt.
AU: Amer-KM; Hussien-TM
SO: Food-production,-poverty-alleviation-and-environmental-challenges-as-influenced-by-limited-water-resources-and-population-growth.-Volume-1A.-18th-International-Congress-on-Irrigation-and-Drainage,-Montreal,-Canada,-2002. 2002, 14; 6 ref.
PB: International Commission on Irrigation and Drainage (ICID); New Delhi; India
LA: English
AB: A study was carried out from 1993 to 1999 to evaluate reuse of drainage water for irrigation in the Nile Delta, Egypt, and to alleviate its negative impacts such as salt accumulation in profiles. The soil salinity study has been carried out in three different locations in the delta, and showed that soil salinity build-up and ionic levels were not constant - in some areas there was a clear link between the salinity of applied water and soil build-up. (Nubaria, with its light permeable soil was a good example). In areas with heavier, less permeable soils and shallow water tables (such as Hamoul) the links were less clear (due to the applied water salinity not being the main factor that controlled soil salinity). The study has shown that drainwater reuse does not necessarily lead to increased salinity build-up. The Hamoul drainwater area had lower soil salinity and ionic levels than the respective mixed and fresh water areas. This was attributed to: good natural drainage at the study area, the application of additional irrigation water for leaching, and good management. Strategies to minimize soil salinity levels and achieve sustainable agriculture development include:- (i) controlling soil salinity, in light soils with deep water table, by the quality and quantity of applied water, (ii) in heavy soils with shallow water table (where the situation is much more complicated by salt contribution coming from both the applied water and the saline water table), the use of a good sub-surface drainage system to prevent upward flow of saline water table to the root zone and also to collect the leached salts through soil profile and into the drains.

TI: Conservation, management and sustainable use of a saline water in the Segdoud Oasis (Southern Tunisia).
AU: Askri-B; Bouhlila-R; Olivier-JJ
SO: Food-production,-poverty-alleviation-and-environmental-challenges-as-influenced-by-limited-water-resources-and-population-growth.-Volume-1A.-18th-International-Congress-on-Irrigation-and-Drainage,-Montreal,-Canada,-2002. 2002, 15; 12 ref.
PB: International Commission on Irrigation and Drainage (ICID); New Delhi; India
LA: English
AB: Water flow studies on a 1.5 ha irrigated plot in the Segdoud Oasis (Southern Tunisia), quantified the processes affecting surface drainage and groundwater levels and causing salinisation of soil and water. The distributed mode MAPIRA model was used to simulate the flow process (including infiltration, percolation, capillary rise, artificial drainage, underground flow and evapotranspiration). The model was calibrated against the observed piezometric levels and drain flow data. Results showed that the model simulations were generally consistent with the observed data, however some difference occurred due to uncertainties in the estimation of the irrigation water quantity. Flow processes in each block of the plot were quantified. The study showed how they affected the quality and quantity of soil moisture. Salt accumulation in the soil was attributed to deficiencies in the drainage system.

TI: Assessment of soil and irrigation water salinity in El Rowad & Tarek Ibn Ziad Egyptian pilot areas using geostatistics.
AU: Elgammal-EE; Ramadan-FM; Madramootoo-CA
SO: Feature-Session-F-21-ICID-Young-Professionals-Forum.-18th-International-Congress-on-Irrigation-and-Drainage,-Montreal,-Canada,-2002. 2002, 17; 4 ref.
LA: English
AB: Geostatistical assessment of soil salinity was used to generate accurate soil salinity maps for two pilot areas in Egypt's South El Husseinia plain. The approach was also used to assess the salinity of irrigation water salinity

and to guide the sampling period. Adjustment of the geometric model for geostatistical interpolation, required for accurate salinity maps, was carried out by changing separation distance range of the selected data, lag distance interval and the type of the geometric model. The El Rowad Pilot area had acceptably correlated EM38 measurements from which accurate salinity maps could be derived. However the Tarek Ibn Ziad Pilot area had high soil salinity variability due to some areas still being in the early stage of reclamation.

TI: IMAGE: a physically-based one dimensional irrigation management model for soil salinity control.
AU: Al-Ajmi-A; Nortcliff-S; Simmonds-LP
SO: Soil-Use-and-Management. 2002, 18: 3, 184-190; 7 ref.
LA: English
AB: This paper describes a study of 37 farms in the Batinah region of Oman where fodder crops and date palms are grown using saline irrigation water. Soil water salinities (epsilons) range from 2 to 50 dS m-1. Soil water salinity depends on irrigation water quality and management factors such as the amount and frequency of irrigation and the area of the irrigation basin relative to the vegetation canopy. An irrigation management model for soil salinity control IMAGE has been developed, based on the salt balance of the profile assuming that the epsilons is in equilibrium with the irrigation water. The input parameters required to run the model include the annual water application, irrigation interval, soil textural class, potential evaporation, the ratio of crop canopy to irrigation basin area and the salinity of irrigation water. Verification of the model using rather uncertain data from a survey of the farms showed that this simple approach predicted epsilons to within 2.5 dS m-1 in 82% of cases. The model showed that epsilons was highly sensitive to the size of irrigation basin and the amount and scheduling of irrigation, and so provides a tool for optimizing salinity management.

TI: Drainage and salinization in Central Tunisia -- the limits of agricultural production.
OT: Assechement et salinisation en Tunisie centrale -- les limites de la production agricole.
AU: Lillvik-A; Nilsson-M
SO: Minor-Field-Studies -International-Office,-Swedish-University-of-Agricultural-Sciences. 2002, No.190, 70 pp.; 43 ref.
PB: Sveriges Lantbruksuniversitet (Swedish University of Agricultural Sciences) International Office; Uppsala; Sweden
LA: French
AB: Processes causing scarcity of drinking water and poor food production in the Sidi Bouzid area, Central Tunisia, are attributed to the overexploitation of groundwater in areas where the groundwater level is decreasing by 0.4 m/year. More than half of the sampled soils are saline because of irrigation with saline water. Although canal irrigation increased salinization in clay soils, drip and sprinkler irrigation increased salinization in all soil types. It is suggested that the overexploitation of groundwater for irrigation use increases salinization and further reduces the meagre prosperity of the local population.

TI: Oasis crop production constraints and sustainable development strategies.
OT: Contraintes de la production oasienne et strategies pour un developpement durable. Cas des oasis de Nefzaoua (Sud tunisien).
AU: Kadri-A; Ranst-E-van; van-Ranst-E
SO: Secheresse. 2002, 13: 1, 5-12; 15 ref.
LA: French
LS: English
AB: The development of irrigated agriculture in southern Tunisia is closely linked with the availability of water - often at great depth - and the construction of water delivery systems around urban oasis centres located on hilltops. One of the main problems encountered in these ecosystems is that available water supplies are not always sufficient to meet downslope cropland expansion needs. The use of saline irrigation water has led to serious soil degradation in lower slope areas and lowlands as a results of rising water table. A modern interdisciplinary and ecological research strategy encompassing a broad range of system components, including socioeconomic aspects of human involvement in these ecosystems, is required to enable an accurate assessment of waterlogging and salinity problems in these irrigated lands. Some strategies for improving and sustaining the agricultural productivity of irrigated oasis cropland are proposed.

TI: Field studies of crop response to water and salt stress.
AU: Shani-U; Dudley-LM
SO: Soil-Science-Society-of-America-Journal. 2001, 65: 5, 1522-1528; 35 ref.
LA: English
AB: Studies of crop response to water and salt stress vary either salinity with a high leaching fraction or irrigation in the absence of salinity to isolate and quantify the effects of the two types of stress. Under deficit irrigation with saline water, a water conserving practice, the crop experiences simultaneous matric and osmotic stress, and it is not known if experiments designed to isolate stress effects may be used to predict crop response to simultaneous stresses. Thus, a study was conducted wherein yields were determined under varying levels of salinity and irrigation. Maize (Zea mays L.) and melon (Cucumis melo L.) were grown at the Arava Research and Development Farm in Yotvata, Israel, and alfalfa (Medicago sativa L.) at the Utah Power & Light Research Farm in Huntington, UT. Maize and melon plots were drip irrigated at six ratios of potential evapotranspiration ranging from 0.2 to 1.7 in combination with four salinity levels. Alfalfa was irrigated with water of 0.2 and 4.0 dS m-1 from a line-source sprinkler. For all three crops, the salinity treatments consisted of a control treatment with a salinity level less than published salt-tolerance thresholds. Interactive effects of salinity and water stress were not observed in these field experiments. At low irrigation levels (_70% of potential evaporation), yields were unaffected by the salinity level. At the higher irrigation levels, the salinity level caused significant differences in yield. Yield data were fit to piecewise linear models that emphaized the limiting nature of the effects of salt and water stress.

TI: Water scarcity and salinisation in Central Tunisia -- limits for agricultural production.
AU: Lillvik-A; Nilsson-M
SO: Minor-Field-Studies -International-Office,-Swedish-University-of-Agricultural-Sciences. 2001, No.178, 72 pp.; 43 ref.
PB: Sveriges Lantbruksuniversitet (Swedish University of Agricultural Sciences) International Office; Uppsala; Sweden
LA: English
AB: This report concerns problems related to water scarcity and food production in a dry area in central Tunisia (Sidi Bouzid). We studied if, and why, the farmers over-utilize their natural resources, e.g. soils and groundwater. The objective was to study the salt content in the groundwater and salinity in the soils (Calcic Xerosols). We were able to compare our results with results from earlier studies in the area, conducted by students from the Department of Earth Sciences at Goteborg University, in order to see how the salts in the soils and groundwater have developed over a twelve-year period. Further, we investigated the presence and development of salt around the area by collecting and analysing 66 soil samples from 0-20 cm and 20-40 cm depth, and 30 groundwater samples from wells during our 9 weeks of fieldwork (September-November 2000). Our objective has also been to study groundwater level fluctuations, and the factors that control the fluctuations within the research area. For this reason, we used available statistics to study groundwater level fluctuations. The location of the places where samples were collected was determined with a GPS and mapped in a database-produced GIS map of the research area. Farmers at the estates where samples were collected were interviewed in semi-structured interviews in order to find out the difficulties with farming in the area, and the farmer's perception of the problems and future risks. The answers to our questions are supposed to give us an understanding of the sustainability in food production. The results indicate that the farmers think that there are obvious problems that restrict their yield and farming. The greatest disadvantages, according to the farmers, are the lack of rain and too little organic content in the soil. Changes in the natural physical conditions have forced some of the farmers to quit growing watermelons. However, the reason to stop growing tomatoes depends on the low price offered by the local canning industry. The government has implemented various measures over the years that have resulted in a number of radical changes of the farmer's strategies. The strategies have changed from livestock-keeping nomads to settled farmers. Later, the strategies changed from winter-grown cereals and olive production to irrigated vegetables grown during summer. Statistical material reveals that the groundwater level is declining steadily in the area. Variations in the precipitation are large and a relationship with the fluctuations in groundwater levels can be seen. Nevertheless, in spite of high precipitation in some years, the groundwater levels still decline, possibly due to over-exploitation of the groundwater. The electrical conductivity in the groundwater varies between > 1 < 9 mmho/cm, and the average value is 3.6 mmho/cm, which exceeds the limit for soil salinization. The results imply that saline groundwater is used for irrigation in the area. There is a high risk associated with the use of saline groundwater

for irrigation because it can lead to salinization of the soil. The salt in the irrigation water will accumulate on the soil surface when the water evaporates in the warm climate. We found that 30 out of 64 soil samples were saline (> 4 mmho/cm). The electrical conductivity in the soil varied between > 0.5 > 14 mmho/cm, with an average value in the area of 4.25 mmho/cm, which exceeds the limit for saline soils. None of the analysed soil samples were sodificated. Time series reveal that the salt content in the water has a negligible variation, but the soil samples showed signs of ongoing salt accumulation. The conductivity in soils and groundwater varied with the topography and geomorphology in the landscape. The salt content was generally higher in low-lying areas and the salt content was generally lower in higher elevations. The electrical conductivity was also generally higher in clay soils than in sandy soils. Fields irrigated with groundwater during the summer period became more saline over time. Drip irrigation and sprinkler irrigation on clay soils generally resulted in very high levels of salt in the soil. The conclusion of our results suggests that there is no sustainability of food production in the area today.

TI: Saline drainage water, irrigation frequency and crop species effects on some physical properties of soils.
AU: Al-Nabulsi-YA
SO: Journal-of-Agronomy-and-Crop-Science. 2001, 186: 1, 15-20; 18 ref.
LA: English
LS: German
AB: The effects of water quality, irrigation frequency and crop species on some soil physical properties were evaluated during 1992-93 in Al-Hassa, Saudi Arabia. The experiment had a split-split-plot design, with three irrigation water qualities (normal water, drainage water and a 1:1 mixture of freshwater and drainage water) as the main treatments, two irrigation frequencies (at 7- and 14-day intervals) as the subtreatments and two crops (barley cv. Gusto and lucerne cv. Higazi) as the sub-subtreatments. The soil infiltration rate was highest in the barley plot receiving freshwater irrigation at weekly intervals. The lowest soil infiltration rate was found in lucerne plots receiving saline irrigation water at 14-day intervals. Bulk density and proportions of micropores (pore radius, r < 1.4 μm) were higher and the proportion of macropores (r > 14.4 μm) was lower in barley than in lucerne. Saline irrigation caused the greatest decrease in total porosity. The soil infiltration rate was higher with more frequent irrigation, and was highest in lucerne plots receiving freshwater irrigation. The decrease in soil bulk density and infiltration rate was greater with saline drainage water, irrespective of the crop grown and the irrigation frequency.

TI: Policy recommendations to maintain and enhance agricultural productivity in the Nile river delta.
AU: Wichelns-D
SO: International-Journal-of-Water-Resources-Development. 2000, 16: 4, 661-675; Many ref.
LA: English
AB: Agricultural productivity has declined in some portions of the Nile River Delta, due to the sustained reuse of saline drainage water in some areas and the over-application of irrigation water in others. Recent changes in agricultural policies and the Government of Egypt's land reclamation plans have increased the demand for Nile River water in Egypt. Efforts to supply the land reclamation projects will reduce the volume of Nile River water available to farmers in the Delta, where soil and water quality may be degraded further unless current policies regarding irrigation and drainage are modified. This paper examines the economic dimensions of farm-level decisions in respect of cropping patterns and irrigation water volumes, to identify policies that will maintain and enhance productivity in the Nile Delta. Recommendations include volumetric water pricing, where feasible, and crop-specific land assessments elsewhere. Successful policy efforts would enable the Ministry of Public Works and Water Resources to achieve its water supply and drainage goals more effectively, and to improve the quality of irrigation water delivered in the Delta.

TI: Study on desertification of irrigated arable lands in Egypt. II- Salinization .
AU: Gad-A; Abdel-Samie-AG
SO: Egyptian-Journal-of-Soil-Science. 2000, 40: 3, 373-384; 11 ref.
LA: English
LS: Arabic
AB: This paper discusses desertification processes on the Egyptian arable lands, focusing on salinization. The study is based on recently collected accurate data on volumes and salinities of drainage waters and official data on available irrigation waters. Studying the change in soil salinity between years 1986 and 1988 revealed, in general,

improvements in areas characterized by drainage water salinity of 750 to 2000 g/m3. However, areas whose drainage water salinities ranged from 2000 to > 3000 g/m3 recorded an increase. Salt balance data were calculated in four separate pilot areas with a total area of 150000 feddans. Deposition of salts was associated with low volumes of applied irrigation waters. Calculating the salt balance on the national level revealed a removal of 13.3 million tonnes of salts in 1990, from an irrigated area of 7.2 million feddans. Future prospects for the year 2017 were analysed in view of the plans to increase the cultivated area by 3.4 million feddans. The estimated salt balance in the year 2017 indicates an addition of 62.2 million tons of salt every year to the irrigated soils, not including salts which are added through other sources such as chemical fertilizers and manure. These figures stress the necessity of a tight control on water use for irrigation combined with adoption of modern irrigation and efficient drainage systems. An ultimate necessity in face of such a situation is to breed and grow high salt-tolerant crops. [1 feddan=0.42 ha].

TI: Application of magnetic technologies in desert agriculture. II- Effect of magnetic treatments of irrigation water on salt distribution in olive and citrus fields and induced changes of ionic balance in soil and plant.
AU: Hilal-MH; Hilal-MM
SO: Egyptian-Journal-of-Soil-Science. 2000, 40: 3, 423-435; 8 ref.
LA: English
LS: Arabic
AB: The magnetizing of saline irrigation water through a proper magnetic field has been introduced as an effective means for soil desalinization. Magnetic field decreases the hydration of salt ions and colloids, leading to better salt solubility and accelerated coagulation and salt crystallization. The mode of magnetic treatment implies a certain influence on the structure of water and soil solution. Besides, the required magnetic field strength depends on salt type and concentration. In the current work, the effectiveness of magnetizing water of different salinity on salt accumulation in soil, on soil alkalinity, ionic balance and ion uptake by plant, was evaluated in a series of pot and field experiments (Ismailia, Egypt). Sandy loam soil pots, irrigated with normal highly saline water of an E.C. [electrical conductivity] value of 8.2 mmohs/cm continues to retain salts compared to pots irrigated with magnetized saline water. Moreover, moisture loss by evaporation was lower with magnetized water. In an olive farm irrigated with moderately saline water through a drip system of irrigation, analysis of different soil layers before and after magnetism were conducted. Magnetized water was shown to have 3 main effects: (1) increasing the leaching of excess soluble salts, (2) lowering soil alkalinity, (3) dissolving slightly soluble salts such as carbonates, phosphates and sulfates. Such effects were also demonstrated in a citrus orchard where the solubility and uptake of Ca2+, Mg2+ and SO4 were accelerated while Na+ uptake was reduced to one half by magnetized water. However the degree of effectiveness of magnetized water on soil salinity and ionic balance in soil solution and citrus leaves depended greatly on the travelling distance of magnetized water along the drip irrigation lines. The effect of magnetized water in the orchard is maximum at a distance of 350 m and diminished at a travelling distance exceeding 750 m from the magnetron.

TI: Biosaline Agriculture Centre: main features and facilities.
AU: Hariri-AS
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 463-464.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: The Biosaline Agriculture Centre is a new, applied, agricultural research institution specializing in the utilization of saline, brackish and sea waters for agriculture and rehabilitation that is currently being developed in Dubai. The objective of the project is to develop sustainable management systems to irrigate crops and useful plants with saline water, and to provide a resource of salt-tolerant plants for development in arid, semi-arid and salt-affected areas.
PT: Conference-paper

TI: (Agricultural production using brackish water)
OT: La production de recoltes au moyen de l'exploitation des eaux Saumatres
AU: Lahlou,-A.

AD: l'Organisation islamique pour l'Education, les Sciences et la Culture (ISESCO), Rabat, Morocco
SO: 1999, 112 p., figs, photos, tables, 30 ref.
LA: French
AB: The technologies involved in using brackish water for agricultural production are reviewed. Subjects include: (1) distribution of salinity in the world; (2) aspects of salinity in Morocco; (3) sources of brackish water, such as groundwater, rivers and coastal water; (4) the measurement of salinity; (5) water quality for irrigation; (6) interpretation of measurement results of water with low conductivity rates; (7) the effects of salts on soils; (8) the analysis of salt tolerance in crops; (9) salt tolerance of cereals, tomato and lucerne; (10) leaching; (11) drainage; and (12) desalinization methods, including distillation, electrolysis, reverse osmosis, freezing, demineralization, and a chemical method involving the use of methane gas.
AV: KIT(N01-94)

TI: Irrigation water management for agricultural development in Kuwait.
AU: Abdal-M; Albaho-M; Suleiman-M
SO: Irrigation under conditions of water scarcity. Vol 1C. 17th ICID International Congress on Irrigation and Drainage, Granada, Spain, 13-17 September 1999. 1999, 325 - 329.
PB: International Commission on Irrigation and Drainage; New Delhi; India
LA: English
AB: Water resources for agricultural development in the arid conditions of Kuwait are very limited and the quality of the irrigation water is deteriorating due to continuous over-pumping. Resources for irrigation water are limited to brackish underground water, treated sewage water and expensive desalinated seawater. Field drainage is not common, and lands under crop production are being severely affected by salt accumulation. The improvements that are needed are identified by the paper as intensive deployment of advanced irrigation technology and training in equipment maintenance. The paper discusses the environmental problems and obstacles to crop production. Emphasis should be given to irrigation water management that will improve crop production and efficient water application. The paper identifies that large amounts of water are wasted in crop production and more efficient management, resulting from the introduction of technology, needs to be introduced. These include trickle irrigation, soil conditioners and appropriate training.

TI: The promise and peril of soil and water resources of Jordan.
AU: Abu-Sharar-TM
SO: Dirasat.-Agricultural-Sciences. 1999, 26: 2, 179-197; 16 ref.
LA: English
LS: Arabic
AB: Jordan has a serious shortage of good quality water for domestic and agricultural consumption. Jordanian soils have the additional problems of salinity, sodicity, poor structural stability, surface crust, soil erosion, subsurface layer compaction, and accumulation of heavy metals and pesticide residues. To alleviate the water shortage poor quality water produced from Khirbit Es-Samra Treatment Plant is mixed with fresh runoff water collected in King Talal Reservoir. The water mixture is characterized by elevated pH and HCO3 concentration which, causes precipitation of soluble Ca as CaCO3, especially, when using the water in drip irrigation. Runoff water from Amman - Zerqa metropolitan area is contaminated with Pb as shown by the relatively high Pb concentration. Average Pb concentration may reach 29 and 31 μg/litre in surface and bottom waters, respectively. Because of the water shortages, excessive pumping of groundwater from Dhuleil Aquifer over 30 years has resulted in high water salinity. The Cl salts represent _ 80% of the total soluble salts. The crust formation on surface soil enhances soil erosion which increases suspended fine clay in runoff water. These crusts cause a rapid drop in water infiltration rate and soil hydraulic conductivity. This paper reviews the extent of these problems and proposes strategies for sustainable management of Jordan's soil and water resources.

TI: Use of marginal quality waters for irrigation.
AU: Oster-JD
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 1-16; 46 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English

AB: This review focuses on aspects of water management that are important when dealing with the use of poor quality water for irrigation. These comprise: (i) selection of appropriately salt tolerant crops and control of water quality through leaching; (ii) maintenance of soil physical properties to assure soil tilth and adequate soil permeability to meet crop water and leaching requirements; (iii) improved water management and adoption of advanced irrigation technology where relevant. A fourth aspect, disposal of saline drainage water, is beyond the scope of the paper. Details are given on research and technologies that facilitate the use of poor quality water.

TI: Crop response to irrigation with low quality water.
AU: Abdelgawad-G; Ghaibah-A; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 59-71; 22 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: The response was investigated of crop growth and yield to different salinity levels of irrigation water obtained through blending irrigation water with drainage water, and through the use of saline groundwater. The studies were conducted in North-east Syria, Tunisia and Libya. Yield function related to the salinity of irrigation water (ECiw) were obtained using non-linear programming. Threshold data obtained were comparable to ECe values tabulated by FAO, but not comparable to Eciw tabulated by FAO. Soil solution samples obtained by vacuum lysimeters inserted at different soil depths in the root zone were concentrations correlated to salinity of irrigation water 0, 15 and 30% leaching fractions.

TI: Marginal water potential in irrigation in the Southern Jordan Valley.
AU: Eisheh-IA
SO: Irrigation management and saline conditions, Proceedings of Regional symposium, Irbid, JUST, Jordan, June 1999. 1999, 405-412; 8 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: Marginal quality water resources are to be utilised in the development of the 'Sustainable Use of Marginal Quality Water in the Southern Jordan Valley' Project. The area is already partially cropped and irrigated by wells of different qualities. The project envisages 3 ha farm units using salt-tolerant crops, wheat/barley (80%) and palm trees (20%), that will be appropriate for soil management.

TI: Use of well water in Helewat Desert Region, Ramadi, for agriculture.
AU: Yasein-MF; Al-Bayati-AH; Abed-AA
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 108-118; 25 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: A study was conducted in the Helewat Desert Region, Iraq, to study the variation in chemical properties of local groundwaters and to determine how their use for agriculture affected soil chemical properties and characteristics of wheat crops (variety Maxiback). The concentration of bicarbonate in the water was >2 meq/litre and the chloride concentration more than 27.5 meq/litre. The use of these waters caused salt accumulation (average electrical conductivity increased from 6.9 to 13.3 dS/m, and sodium adsorption ratio from 4.6 to 11.1 meq/litre). Wheat productivity decreased from 3.4 t/ha in the first season to 2.7 t/ha in the second. The paper recommends: (i) that these waters should not be directly used for irrigation; (ii) that a leaching component should be included in irrigation applications; (iii) that root crops should be used to help avoid surface crusting; and (iv) salt-resistant crops should be selected.

TI: Ion pairs in saline water and the possibility of its uses in irrigation.
AU: Abed-MA
SO: Irrigation management and saline conditions. Proceedings of Regional symposium, JUST, Irbid, Jordan, June 1999. 1999, 221-225; 9 ref.

PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: The ionic composition of saline water taken from two sources in Iraq was determined. The water was of medium salinity level and was suitable for use in irrigation - with no infiltration problem or negative effects on crops.

TI: Integration of marginal water resources into a strategy for irrigation water supply in the Jordan Valley.
AU: Kuck-AJ
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 331-344; 20 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: The paper describes the background the present situation and the reasons for the current gap between irrigation water supply and demand in the Jordan Valley, and elaborates on possible irrigation supplies. The Brackish Water Project (BWP) was set up to initiate and coordinate activities related to a sustainable application of marginal water resources for irrigated agriculture. The project monitors fresh, saline and treated waste water resources in the central and southern Jordan Valley, and is investigating optimal irrigation practices, adequate crops /cropping patterns and leaching / drainage requirements. This includes appropriate supply management, organisational requirements and institutional aspects are further topics of investigation.

TI: Brackish water as a source for irrigation: behaviour and management of salt-affected reservoirs (Iran).
AU: Shiati-K; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 72-82; 7 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Due to the torrential regime of rivers in Iran, reservoirs are needed to provide storage space for irrigation supplies. In reservoirs on brackish and saline rivers, the temporal variation of salt content can partially be alleviated and water quality controlled, at least in part, by stratification phenomena in reservoirs. The paper shows how appropriate management can improve the quality of the water to be withdrawn and, at the same time, minimize the risk of salinity build-up in the reservoir. A dynamic reservoir simulation model is used to carry out such studies. Two real cases with various extent of salinity were examined. The results show how the brackish River Ajichai, with average monthly salinity varying between 1630-12 180 mg/litres, could supply water with salinity of 2340-2710 mg/litres for irrigation purposes on the 40 ha Tabriz Plain.

TI: An integrated approach for soil, crop, irrigation and drainage management when using saline water for irrigation in the Mediterranean Region;- the SALTMED Project.
AU: Ragab-R; Yeo-AR; Ghaibeh-A; Abdelgawad-G; Flowers-T; Malash-N; Abdul-Karim-J; Cuartero-J
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 119-138; 27 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: The ongoing SALTMED Project for the Mediterranean Region is addressing the use of alternative water resources such as brackish water (groundwater), seawater, desalination of saline water, etc., by adopting an integrated management approach for irrigation, drainage and leaching. Since salinity impact on soil and the environment is a long term process, long-term experiments are needed. A model is being developed to predict the long-term effect of using saline water on soil and the environment, on crop yield, on soil water, and on soil salinity profiles under different strategies of water management (blending and alternate use of fresh and saline waters). Water and leaching requirements are being developed in parallel with the field and greenhouse

experiments. The paper highlights the project objectives, the integrated management approach being adopted, different water application strategies the modelling approach and the expected outputs.

TI: Proper management needed for better and safe utilization of saline water for irrigation in Palestine.
AU: Sbeih-MY; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 178-192; 9 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Water is used extensively in irrigated agriculture in Palestine, Israel, where 30% of the cultivated land is irrigated in the Gaza Strip. Irrigated agriculture is a source of income, but water quality is deteriorating especially in Gaza and Jordan Valley due to: (i) salinization in Gaza Strip due to sea intrusion; (ii) over-pumping in Gaza Strip and Jordan Valley, especially due to extensive irrigation use; (iii) low rainfall in the Jordan Valley and Gaza Strip; (iv) excessive use of pesticides; (v) pollution due to the inflow of raw waste water. Although the concentration of total dissolved solids reaches 3000 ppm in the Jordan Valley and 5000 ppm in the groundwater of Gaza, the water is still used for irrigation - due to shortage of water. However, the salinity is increasing with time. This is important because the Jordan Valley produces more than 59% of the vegetables produced in the West Bank, and 100% of the bananas produced in Palestine. Improved water management is needed to achieve efficient utilization of saline water. However, no plans have yet been contemplated for the proper management of saline water used in irrigation.

TI: Water resources in Yemen and their degradation: the risk for an extensive desertification
AU: Thirugnanasambanthar,-S.; Romano,-P.; Angelakis,-A.N.
AD: FAO, Sana'a, Yemen
SO: Desertification-Control-Bulletin (UNEP).
1998, no. 32, p. 51-61, figs, tables, 22 ref.; summary (En)
LA: English
AB: The current situation of water resources exploitation and degradation in Yemen is reviewed and the threat of further degradation is discussed. The surface water resources in the 4 main drainage basins, the Red Sea basin, the Gulf of Aden basin, the Arabian Sea basin and the Rub Al Khali basin, are described. About 90% of the groundwater is utilized in agriculture. Rural migration to the urban centres has put great pressure on the water supply systems of the cities. Over the past 2 decades, groundwater extraction has increased rapidly, which has led to heavy depletion of aquifers, particularly those in the Northern Governorates. It is argued that the main strategy should focus on water conservation and a search for alternative sources of water. Attempts are being made to conserve water in the irrigation sector. An important alternative source is urban wastewater which, if treated properly, could be used for irrigated agriculture and other purposes. In Yemen, and in many other arid and semi-arid regions, wastewater could be considered: (1) a reliable source of water; (2) a low-cost source of water; (3) a means to protect coastal aquifers against seawater intrusion and general coastal pollution; and (4) a basis for improved public policy in the matter of natural resources and conservation.

TI: Saline water irrigation of horticultural crops on desert sand dunes.
AU: Bustan-A; Cohen-S; Sagi-M; Golan-R; DeMalach-Y; Pasternak-D; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 193-200; 17 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Saline water irrigation has been practised in the Negev desert highlands of Israel for 25 years, but with the advent of drip irrigation, large areas of sand dunes can now be developed. In considering the benefits of saline water irrigation of desert dunes, sandy soils achieve good water drainage and salt leaching, but have low water retention. Drip and surface irrigation methods are compared in desert conditions. A frequent irrigation regime,

several times a day (called 'pulse irrigation'), was found to overcome much of the reduction in yields which often occur in sandy soils irrigated with saline water. Recent results in the cultivation of tomato (Lycopersicon esculentum), melon (Cucumis melo), and potato (Solanum tuberosum), irrigated with saline water on desert dunes are described, demonstrate the advantage of frequent irrigation. The reduction in yields of tomatoes and melon under saline conditions was due to a decline in fruit size. However, this was commercially compensated by the improvement in fruit quality. Pulse irrigation was specifically effective for processing tomatoes and melons growing during summer, but had no effect on yields of potatoes, which were grown during cooler seasons.

TI: An assessment of soil degradation process by secondary salinization in North section of Yazd-Ardekan Basin, Iran.
AU: Meshkat-MA; Abedi-MJ; Tavassoli-A
SO: Journal-of-Agricultural-Sciences -Islamic-Azad-University. 1998-1999, 4: 15-16, 51-61, 110-111.
LA: Persian
LS: English
PT: Journal-article

TI: Effect of some management practices on the salinity regime of soil under irrigation with diluted sea-water.
AU: Afifi-MY; Ahmed-AT; Atyia-NM
SO: Desert-Institute-Bulletin,-Egypt. 1996, publ. 1999, 46: 2, 341-351; 10 ref.
LA: English
LS: Arabic
AB: The influence of the application methods of diluted sea water and soil conditioners on soil salinity in Salhyia, a non-calcareous sandy soil and a Maryout calcareous sandy clay loam soil was studied in Egypt. Saline water application included continuous irrigation with water at 3000 ppm, (i.e. water supply dilution) and alternating either one or two successive irrigations with diluted sea-water having 6000 ppm and one irrigation using fresh water (i.e. soil dilution). The applied soil conditioners were peatmoss and bituminous emulsion. The results indicate that frequent alternation of saline and fresh water at a ratio of 1:1 caused considerable attenuation of salinity build-up, especially in sandy soils. Nevertheless, in the relatively fine-textured calcareous soils, e.g. Maryout soil, no such effect was found. In the sandy soil peatmoss was more effective in reducing soil salinity than bituminous emulsion when using low salt concentration water, whereas the reverse was true under high water salinity. In contrast, applying such conditioners to the calcareous soil aggravated soil salinity. The SAR (sodium adsorption ratio) of the soil solution and hence the potential sodicity hazard was high, indicating that the use of diluted sea-water for irrigation appears to be limited, except in case of adopting practices able to counteract soil sodification.

TI: Effect of some management practices on salinity regime of soils under irrigation with diluted sea-water.
AU: Afifi-MY; Ahmed-AT; Atyia-NM
SO: Egyptian-Journal-of-Soil-Science. 1998, 38: 1-4, 413-423; 10 ref.
LA: English
LS: Arabic
AB: The influence of the application of diluted sea water and soil conditioners on salinity in a non-calcareous sandy soil and a calcareous sandy clay loam soil was investigated in a greenhouse experiment. Saline water application included continuous irrigation with water having 3000 ppm, (i.e. water supply dilution) and alternating either one or two successive irrigations with diluted sea-water having 6000 ppm and one irrigation using fresh water (i.e. soil dilution). The soil conditioners were peatmoss and bituminous emulsion. The results indicated that frequent alternation of saline and fresh water at a 1:1 ratio caused considerable attenuation of salinity, especially in sandy soils. Nevertheless, in the relatively fine-textured calcareous soils, such an effect was not observed. In the sandy soil peatmoss was more effective in reducing soil salinity than bituminous emulsion when using a low salt concentration water, whereas the reverse was true under the conditions of high water salinity. In contrast, applying such conditioners to the calcareous soil aggravated soil salinity. The sodium absorption ratio of the soil solution and hence the potential sodicity hazard was high, indicating that the use of

diluted sea-water for irrigation appears to be limited, except in cases of adopting practices able to counteract soil sodication.

TI: Use of saline water for irrigation in Saudi Arabia.
AU: Al-Jaloud-AA; Hamdy-A (ed.); Lieth-H (ed.); Todorovic-M (ed.); Moschenko-M
SO: Halophyte uses in different climates. II. Halophyte crop development: Pilot studies. Proceedings of the 3rd seminar of the EU Concerted Action Group IC 18CT 96-0055 Florence, Italy, 20 July 1998. 1999, 105-117; Progress in Biometeorology, Volume 14; 33 ref.
PB: Backhuys Publishers; Leiden; Netherlands
LA: English
AB: Research has shown that Prosopis juliflora tolerated soil salinity (ECc) of up to 38.3 dS/m with irrigation water salinity of 13.5 dS/m. Casuarina equisetifolia tolerated up to 27.6 dS/m with irrigation water salinity of 6.6 dS/m and Eucalyptus camaldulensis tolerated up to 15.2 dS/m with irrigation water salinity of 2.12 dS/m for proper establishment provided 15% excess water is applied for leaching to control soil salinity. The survival period of P. juliflora ranged between 13 and 16 weeks under different water salinities in sandy, loam and sandy clay soils. Similarly, an experiment on faba bean [Vicia faba] showed that the effect of normal irrigation water and a 1:1 mixture of drainage and normal irrigation water on plant growth was not significantly different. The adoption of proper management practices such as leaching requirements, adequate drainage, improved irrigation methods, crop selection, adoption of suitable planting techniques and fertilizer application are important for proper management of saline irrigation to achieve higher water use efficiency.

TI: Design of solar still for sea water desalination.
AU: Abd-El-Salam-MFM
SO: Proceedings, Seventh Conference of Agricultural Development Research, Cairo, Egypt, 15-17 December 1998. Volume 3. Annals-of-Agricultural-Science-Cairo. 1998, Special Issue, Volume 3, 613-643; 16 ref.
LA: English
LS: Arabic
AB: A simple solar still was designed for water desalination under Egyptian weather conditions to provide drinking water for farm animals and water for soilless culture. Average global solar radiation received on a horizontal surface was 7.5-8.5 and 4.5-5.5 kWh/m2/day through the summer and winter seasons, respectively. The basin-type still was manufactured using locally available materials such as woods, 0.3 mm plastic film (black, white), plastic wire, plastic tanks and muslin (black, white). Four different still cover surface angles of 30, 45, 60 and 75° (triangle roof) were designed to cover 4 basins (60X80 cm), and 4 different water depths, 2, 3, 4, and 5 cm, were tested inside the still. The longitudinal axis of the still was directed from north to south to receive the highest amount of solar radiation. The still was placed different surfaces to determine the optimum performance for energy conservation. Results indicated that the maximum basin water temperatures were 55, 58 and 58°C in June, July, and August 1997, respectively, and 39°C in January 1998. A thermometer was designed to simultaneously determine the temperature inside the still and the ambient temperature, using a thermistor as a temperature transducer. The distilled water quantity and overall daily efficiency in the winter were 1.33 litres/m2/day and 38%. The still produced an average of 2.89 litres of distilled water per day, with an overall daily efficiency of 38% for a sea water depth of 3 cm in the basin, on a sandy surface, using a black muslin (to absorb the sea water and increase the sea water diffusion surface area), with roof angle 45X60°. Although, output per unit area is moderate, it is cheap, simple in design, requires low maintenance, and the cost of distilled water from the still was 4.33 LE/m3. The still can be constructed on the roof of buildings where saline water is available.

TI: Seawater irrigation studies in the United Arab Emirates - an introduction to the Al Ain Conference.
AU: Lieth-H; Lieth-A; Lieth-H (ed.); Al-Masoom-AA
SO: Towards the rational use of high salinity tolerant plants. Vol. 1. Deliberations about high salinity tolerant plants and ecosystems. Proceedings of the first ASWAS conference, December 8-15, 1990, Al Ain, United Arab Emirates. 1993, 1-10; Tasks for Vegetation Science 27; 15 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: A conference on the development of harvestable ecosystems using water above seawater strength salinity for irrigation was held at the University of the United Arab Emirates in Al Ain to enlist the help of scientists to give

advice for the newly started trial plantations of many salt tolerant species. The scientific, engineering, socioeconomic and physiological problems with using saline water for agriculture and forestry are listed. Trial plantations were started in 1989 near the coast of Abu Dhabi in Mussafah and later moved to Nahshallah and then to other sites along the coastline. Among the most successful species for seawater irrigation were Conocarpus spp. Laguncularia spp. and Spartina alterniflora cv. Nahshallah.

TI: Reversing the flow: water and nutrients from the sea to the land.
AU: Hodges-CN; Thompson-TL; Riley-JJ; Glenn-EP
SO: Ambio. 1993, 22: 7, 483-490; 30 ref.
LA: English
AB: The problems associated with increased levels of carbon dioxide in the atmosphere and decreasing carbon levels in the world's soils are examined. One method of increasing the flow of carbon from the atmosphere into the soil is seawater-based agriculture where seawater and nutrients from the sea are brought onto the land for aquatic animal production and halophyte farms. In Saudi Arabia there are plans for a new integrated rural and urban community based on seawater which will remove more carbon from the atmosphere than it will add as a result of its combined use of fossil and biofuels.
PT: Journal-article

TI: (Water and soil resources evaluation for the experimental site of the alluvial fan of Atar wadi (Djibouti))
OT: Evaluation des ressources en eau et terre du site experimental du cone de dejection de l'oued Atar
AU: Mohamed,-J.; Bray,-L.; Mohamed,-A.; Abdourahman,-G.; Zotskina,-E.
SO: Sciences-et-Environnement (Djibouti).
1993, no. 8, p. 23-26, 12 ref.; summaries (En, Fr)
LA: French
AB: Multi-disciplinary studies were conducted to determine the water and soil resources of the alluvial fan of Atar wadi, Djibouti. Water resources are limited, and salinity, sodicity and alkalinity affect most of the soils. Areas suitable for conventional irrigated agriculture are limited. The alluvium aquifer has hydraulic links with the basalt aquifer which provides fresh water to the town of Djibouti on one side and with seawater on the other side. New settlements of irrigated farms may raise the level of the saline-fresh water interface and therefore increase the salinity of fresh water for Djibouti. Propositions are made for a national plan to increase agricultural production by improving productivity of the existing farms. Planting of halophytes is proposed for regenerating the vegetation and improving saline areas of the zone.

TI: Using mineralized underground water for growing farm crops in desert conditions.
AU: Penkov-M; Mondeshka-M
SO: 17th ICID European Regional Conference on Irrigation and Drainage, Varna, Bulgaria, 16-22 May, 1994. Volume 3: measures for mitigation of non-beneficial ecological effects of irrigation. 1994, 285-293.
PB: International Commission on Irrigation and Drainage (ICID); New Delhi; India
LA: English
LS: French
AB: On Abdaly Island, Kuwait, vegetables are grown in greenhouses under irrigation using purified water. In order to expand production and reduce costs, open-air cultivation of a number of crops was tested using saline groundwater (salt content 5-6 g/litre). Promising results were obtained on these desert soils with lucerne (Medicago sativa), onions and beet. The study focused particularly on soil salinization processes and the preservation of ecological balance.

TI: The ecological background, deterioration and reclamation of desert dune sand
AU: Tsoar,-H.
AD: Department of Geography, Ben Gurion Univ. of the Negev, Beersheva, Israel
SO: Agriculture,-Ecosystems-and-Environment (Netherlands).
1990, v. 33(2), special issue, p. 147-170; Dec, figs, photos, table; bibliography (61 ref.); summary (En)
LA: English

AB: The physical properties of desert dune sand are reviewed as part of its ecological characteristics. Sandy soils are known for their superiority to other finer soils in deserts. For this reason, sand dunes in arid lands are covered, as a natural process, by vegetation. The drawback of sand is its mobility: erosion of sand, not lack of moisture, is the major limiting factor for vegetation on dunes. The destruction of vegetation by overgrazing and by being collected for firewood and building material is a relatively quick process. This stimulates sand movement and increases deterioration through positive feedback. Whilst deterioration processes are swift, natural reclamation processes are slow. One way of increasing the productivity of dune sand is by the use of sophisticated methods of agriculture. Unlike sand in humid areas, sand in deserts offers many advantages for agriculture: it is the only soil that endures irrigation with brackish water, and its thermal retention forces crops to ripen quickly. The problem of low and unreliable rainfall in arid lands can be turned to advantage by the use of the drip irrigation method, which allows a rational and economic use of fertilizers without the risk of leaching by subsequent rain. Author's summary.

TI: Irrigation of field crops with saline and sodic water.
AU: Saden-D
SO: Water-and-Irrigation-Review. 1992, 12: 4, 4-6.
LA: English
AB: Regional sources of saline and sodic groundwater in the western Negev, Israel are used for agricultural irrigation. The yield of crops is different from that found in areas irrigated with non-saline water. The soils of the saline management (SM) area are mainly loessial serozems. The principal summer crops are cotton and industrial tomatoes. Attempts to produce groundnuts with brackish water have failed. The production of sweetcorn is low but the yield of fodder maize is similar to crops irrigated with non-saline water. In winter, wheat is grown for grain and silage. Sorghum and sunflower irrigated with saline water have been grown. Soil permeability is maintained by spreading gypsum on the land surface before winter. The accepted methods of irrigation are trickle or sprinkler irrigation. In a survey of ten farms growing Acala cotton from 1983-1990 using trickle irrigation average yields from SM fields were higher than from non-saline management fields. A regression model predicted that the difference in yields will become smaller after 10 or 15 years of salt management. The factors affecting the success of crops grown in the Negev are discussed.

TI: Sulphur and irrigation management for salinity control in desert soils.
AU: Hilal-MH; Korkor-SA; Lieth-H (ed.); Al-Masoom-AA
SO: Towards the rational use of high salinity tolerant plants. Vol. 1. Deliberations about high salinity tolerant plants and ecosystems. Proceedings of the first ASWAS conference, December 8-15, 1990, Al Ain, United Arab Emirates. 1993, 479-483; Tasks for Vegetation Science 27; 8 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The potential role of sulfur in controlling the salt balance and salt accumulation in the root zone was investigated in field experiments in Egypt. The effects of sulfur applications to a light calcareous soil in Sinai under flooding irrigation with saline underground water, a saline calcareous soil under drip irrigation where the soluble salts exceeded 60 mmhos/cm in the topsoil, and a sandy soil of moderate salinity content near Ismaelia were investigated. In the calcareous soil irrigated with saline water sulfur application reduced salt accumulation in the root zone. The yields of barley, wheat, fodder beet, fodder beans, and maize increased following sulfur application. On the sandy soil irrigation scheduling and sulfur application increased yields of cucumbers. In the highly saline soil laying dripper lines between rows in the bottom of furrows increased the yields of onions.
PT: Conference-paper

TI: Sulphur application and irrigation management for salinity control in desert soils and their impact on crop yield.
AU: Hilal-M; Korkor-SA; Hilal-MH (ed.)
SO: Proceedings Middle East Sulphur Symposium 12-16 February 1990, Cairo, Egypt. 1992, 339-349; 8 ref.
PB: The Sulphur Institute; Washington; USA
LA: English
AB: This paper discusses the potential role of sulfur application to soils and proper irrigation scheduling as promising means of salinity control. In a calcareous soil at Ras Sidr (South Sinai, Egypt) irrigated with saline

water, 4500 ppm salt accumulation in the root zone was greatly reduced by sulfur application. In a barley field the total salt content in topsoil of sulfur non treated plots reached 61 mmhos., whereas in sulfur treated plots salinity did not exceed 23 mmhos by the end of the growing season. Salinity control was associated with 115% increase in yield. Similar effect persisted on the yield of wheat, fodder beets and maize are also discussed. The residual sulfur effect persisted for more than 6 growing seasons in calcareous and alkaline clay soils. Long term deeper irrigation has maintained better salt and moisture distribution around plants and significantly increased yield of cucumber and onion as compared to light daily irrigation.
PT: Conference-paper

TI: Development of new arid zone crops for the Negev Desert of Israel
AU: Pasternak,-D.; Aronson,-J.A.; Ben-Dov,-J.; Forti,-M.; Mendlinger,-S.; Nerd,-A.; Sitton,-D.
AD: Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel
SO: Journal-of-Arid-Environments (UK).
1986, v. 11(1) p. 37-59; Jul, tables, 36 ref.; summary (En)
LA: English
AB: The progress achieved in 8 major introduction and development projects carried out in the Negev Desert in Israel is reviewed. They include perennial fodder plants for dryland pasture improvement, selection and cultivation of halophytes with seawater irrigation, industrial crops (jojoba, buffalo gourd, evening primrose, senna), drought and salinity resistant ornamentals and new ornamentals for export (cut flowers, cut branches and potted plants). Several projects such as jojoba and several ornamentals have reached the stage of commercial exploitation. On the basis of obtained results, 4 additional projects were started: introduction and development of lesser known subtropical fruits and nuts, guayule, multi-purpose tropical legumes for arid and semi-arid regions and Aloe spp. for medicinal and cosmetic uses.

TI: Development of new arid zone crops for the Negev desert of Israel
AU: Pasternak,-D.; Aronson,-J.A.; Ben-Dov,-J.; Forti,-M.; Medlinger,-S.; Nerd,-A.; Sitton,-D.
AD: Rudolph and Rhoda Boyko Inst. for Agricultural and Applied Biology
SO: Applied-Research-Institute,-Ben-Gurion-University-of-the-Negev (Israel).
1984, no. 63, 46 p., tables, 36 ref.; summary (En)
LA: English
AB: This report reviews progress achieved in 8 projects on the introduction and development of new crops for the arid and semi-arid regions of Israel. They include perennial fodder plants for improvement of dryland pasture, selection and cultivation of halophytes with seawater irrigation, industrial crops (jojoba, buffalo gourd, evening primrose, senna), drought- and salinity- resistant ornamentals, and new ornamental products for export (cut flowers, cut branches, and potted plants). Several of these projects, like those on jojoba and several ornamentals, have reached the stage of commercial exploitation of the results. Authors' summary.

TI: The reclamation of a desert by the combination of ancient and modern water systems
AU: Issar,-A.
AD: J. Blaustein Inst. for Desert Research, Ben-Gurion Univ. of the Negev, Sede Boqer, Israel
SO: Outlook-on-Agriculture (UK).
1981, v. 10(8) p. 393-396, photos, tables, 7 ref.; summary (En)
LA: English
AB: A well-developed system of harvesting the scanty rainfall of the Negev desert in runoff channels enabled farmers 1500 years ago to grow crops of grain and fruit, and produce oil and wine. Restoration of some of these early systems has shown that the principles hold good today and may be applicable in arid and semi-arid areas of other countries, particularly if they are used in combination with modern techniques such as drip irrigation and the use of brackish water. Author's summary.

Fruits and fruit trees

TI: Adaptation of five columnar cactus species to various conditions in the Negev desert of Israel

AU: Nerd,-A.; Raveh,-E.; Mizrahi,-Y.
AD: Applied Research Institutes, Ben Gurion Univ. of the Negev, Beersheva, Israel
SO: Economic-Botany (USA).
1993, v. 47(3) p. 304-311; Jul, figs, photos, tables, 20 ref.; summaries (En, Es)
LA: English
AB: Five species of columnar cacti were examined with the aim of introducing new orchard fruit crops to the Negev desert of Israel. The species comprised Stenocereus gummosus, Stenocereus griseus, Stenocereus thurberi and Pachycereus pringlei, all found in semi-arid regions of Mexico, and Cereus peruvianus, which is grown in subtropical regions. Young seedlings were planted at 4 sites in the Negev. The sites differed in climatic conditions and water quality. Growth data, expressed as total stem length and stem biomass, were obtained after 5 to 6 years in the orchards. Cereus peruvianus grew best at the site with moderate temperatures and good quality water, whereas the other species also did well under more extreme conditions of high temperatures and brackish water. Growth of all species was retarded at the site having water with the highest NaCl content. In the sixth year, a severe drop in temperature at one of the sites caused extensive injury to C. peruvianus and S. griseus plants, raising doubts as to the suitability of that site for their cultivation. At this stage, C. peruvianus is the most promising candidate for domestication. Its growth rate was much higher than that of the other species, yield was precocious and fruit of good quality. At all sites the Cl concentration in C. peruvianus was much lower than that in the other species, indicating that the exclusion of Cl from the stems was not correlated to salt tolerance. From authors' summary.

TI: Introduction of marula, an unexploited fruit tree from southern Africa, to the Israeli Negev.
AU: Nerd-A; Mizrahi-Y
SO: Papers from a memorial meeting for Alexandra Poljakoff-Mayber, Jerusalem, Israel, 2 February 2000. Israel-Journal-of-Plant-Sciences. 2000, 48: 3, 217-222; 10 ref.
LA: English
AB: Marula (Sclerocarya birrea subsp. caffra) is a medium-sized tree native to southern Africa producing edible plum-sized drupes utilized by rural people. Marula was examined by us with the aim of introducing new orchard crops to the Israeli Negev Desert. Young seedlings grown from seeds obtained from Botswana were planted in 1985-86 in four different locations in the Negev: Besor -- moderate temperatures and good quality water (electrical conductivity, EC=1 dS m-1); Ramat Negev Experimental Station -- low winter temperatures (lowest, -7°C) and two water qualities, good and brackish (EC=3.5-4 dS m-1); Qetura and Neot Hakikar -- both warm sites, with summer temperatures that may rise to 46°C, and brackish water with similar EC (3.5-4 dS m-1), but with a higher concentration of Na+ and Cl- at Neot Hakikar. Growth was faster and yields were higher at Qetura and lagged behind at the other sites, especially at Ramat Negev, where frost events severely damaged the young trees. Results from a new plot established nearby at Kibbutz Revivim indicate that under certain growth conditions marula can also succeed in the Ramat Negev region. The trees differed in their flowering time, which ranged over 3-4 months (spring-early summer). Marula fruits abscise at the green stage, abscission time being related to the flowering time. Fruits collected immediately after abscission ripened after 14-17 days of storage at 20°C. During ripening the fruits turned yellow, firmness and acidity significantly decreased, and soluble sugars and soluble solids concentrations increased slightly. A surge of ethylene occurred toward the end of the ripening stage. Individual trees varied in fruit weight and the proportion of various fruit components. The main limitations to fresh consumption were the low content of flesh, presence of fibres in the flesh, and the thick peel. It was concluded that marula may be used as an industrial fruit crop in the arid regions of Israel where high summer temperatures and the brackish irrigation water restrict the cultivation of most common fruit trees.

TI: Effect of water salinity and irrigation technology on yield and quality of pears.
AU: Oron-G; DeMalach-Y; Gillerman-L; David-I; Lurie-S
SO: Biosystems-Engineering. 2002, 81: 2, 237-247; 23 ref.
LA: English
AB: The scarcity of fresh water in arid regions makes saline water a valuable alternative water source for irrigation. Saline water has an agricultural potential but it is necessary to develop special management procedures to obtain maximum yield and high product quality. Field experiments, which were carried out in a pear orchard near Beer-Sheva, Israel, demonstrate that the choice of irrigation method is very important for saline water irrigation. It was shown that by using saline water through subsurface drip irrigation (SDI) reasonable yields can

be obtained. Moisture distribution under SDI is better adjusted to the root pattern in order to counteract osmotic effects of the soil salinity in comparison to conventional drip irrigation. Saline water use, particularly through SDI, tends to increase sugar content and acidity of the fruits simultaneously, along with decreasing fouling phases.

TI: Influence of different water quantities and qualities on lemon trees and soil salt distribution at the Jordan Valley.
AU: Abu-Awwad-AM
SO: Agricultural-Water-Management. 2002, 52: 1, 53-71; 19 ref.
LA: English
AB: The influences of water quantity and quality on young lemon trees (Citrus limon) were studied at the University of Jordan Research Station at the Jordan Valley for 5 years (1996-2000). Five water levels and three water qualities were imposed via trickle irrigation system on clay loam soil. The primary effect of excess salinity is that it renders less water available to plants although some is still present in the root zone. Lemon trees water requirements should be modified year by year since planting according to the percentage shaded area, and this will lead into substantial water saving. Both evaporation from class A pan and the percentage shaded area can be used to give a satisfactory estimate of the lemon trees water requirement at the different growth stages. The highest lemon fruit yield was at irrigation water depth equal to evaporation depth from class A pan when corrected for tree canopy percentage area. Increasing irrigation water salinity 3.7 times increased average crop root zone salinity by about 3.8-4.1 times. The high salt concentration at the soil surface is due to high evaporation rate from wetted areas and the nature of soil water distribution associated with drip irrigation system. Then, the salt concentration decreased until the second depth, thereafter, salt concentration followed the bulb shape of the wetted soil volume under trickle irrigation. Irrigation water salinity is very important factor that should be managed with limited (deficit) irrigation. But increasing amount of applied saline water could result in a negative effect on crop yield and environment such as increasing average crop root zone salinity, nutrient leaching, water logging, increasing the drainage water load of salinity which might pollute ground water and other water sources.

TI: Effects of salinity and indole acetic acid on growth and mineral content of date palm seedlings.
AU: Aljuburi-HJ; Al-Masry-HH
SO: Fruits-Paris. 2000, 55: 5, 315-323; 24 ref.
LA: English
LS: Spanish, French
AB: Salinity in irrigation water is a serious problem for agriculture in the Arabian Gulf States. Irrigation with saline water depresses growth and productivity of date palm trees. An experiment was conducted at the United Arab Emirates University, in Al-Ain, to study the effect of saline water on growth properties and mineral contents of date palm (cv. Lulu) seedlings. Effects of salt alone (16 or 26 g/litre) or in combination with IAA (150 or 200 mg/litre) added to the irrigation water were studied. After the treatment application, growth characteristics and leaf, stem and root mineral concentrations were measured. The salinity in the irrigation water reduced the leaf number per seedling, increased the leaf and stem dry matter percentage, and the Na concentration in leaves, stems and roots. There was no consistent effect of salts or IAA added to the irrigation water on N, P, K, Mn, Zn and Fe concentrations of leaves, stems and roots. The Na concentration gradually decreased from roots to leaves for most treatments. Compared to saline water used alone, irrigation of date palm seedlings with water supplemented with IAA + salts reduced the adverse effects of salinity by reducing Na accumulation in leaves and stems of Lulu seedlings.

Tree crops (not fruit or fodder)

TI: Effect of irrigation with different levels of seawater and fertilization on growth and mineral content of some timber tree seedlings.
AU: El-Baha-AM; El-Settawy-AA; Kandeel-EE; Mohamed-NH
SO: Alexandria-Journal-of-Agricultural-Research. 2003, 48: 1, 183-197; 29 ref.
LA: English

LS: Arabic
AB: Two experiments were carried out from 1998 to 1999 in the greenhouse at the nursery of the Experimental Station of the Forestry and Wood Technology Department, Faculty of Agriculture Alexandria University, Egypt, to investigate the effect of sea water as a source of irrigation mixed with tap-water at five levels (0% sea water as control, 20, 40, 60, and 80%), and three levels of NPK fertilization: i.e. control, (100- 25- 25 kg N, P2O5, K2O)/feddan, and (150- 25- 25 kg N, P2O5, K2O)/feddan; on survival percentage, height growth, total dry weight and mineral content of the leaves of three timber trees of the most common fast growing species in Egypt: Acacia saligna, Casuarina cunninghamiana and Eucalyptus camaldulensis. Under salinity and fertilizer application levels, C. cunninghamiana seedlings were superior in survival percentage followed by A. saligna, however, E. camaldulensis seedlings were highly susceptible. The 20% sea water in irrigation water did not affect the survival percentage of C. cunninghamiana, however, the three species did not tolerate the 60 and 80% sea water. Application of NPK and with increasing the level of nitrogen led to increase, survival percentage of the three species. Height growth and total dry weight of the seedlings were decreased with increasing salinity levels; while they were increased with application of the fertilizer. The interaction between salinity and fertilizer application levels significantly affected vegetative growth of the seedlings. Generally, the height growth and total dry weight of the seedlings grown under NPK fertilizer application and salinity treatments were better than those grown under salinity only. These results revealed the necessity of NPK fertilizer application to reduce the negative effect of salinity on vegetative growth. The leaves of A. saligna seedlings contained the highest percentages of N, P, K, Ca and Mg, while, E. camaldulensis seedlings contained the highest percentages of Na and Cl. Increasing salinity level significantly decreased N, P, K content in the leaves, while increased their content of Ca, Mg, Na and Cl. With increasing fertilizer application level, the contents of the leaves of the species of all minerals were increased except for Na. The most promising species under saline conditions were C. cunninghamiana and A. saligna with application of NPK fertilizer application for reducing the injurious consequences of salinity on plants.

TI: Growth and oil production of argan in the Negev desert of Israel
AU: Nerd,-A.; Eteshola,-E.; Borowy,-N.; Mizrahi,-Y.
AD: Applied Research Inst., Ben Gurion Univ. of the Negev, Beersheva, Israel
SO: Industrial-Crops-and-Products (Netherlands).
1994, v. 2(2) p. 89-95; Feb, figs, tables, 18 ref.; summary (En)
LA: English
AB: Argan (Argania spinosa) is a wild tree native to southwestern Morocco. It bears a plum-sized fruit with 1-3 kernels rich in oil. The oil is highly prized as an edible and cooking oil by the local people. The possibility of domesticating the species was studied in Israel. Seedlings were planted in the Negev desert at Qetura with a high summer temperature and brackish water, and at Ramat Negev with a low winter temperature and good-quality water. Average tree height in the seventh year was 4.0 m at Qetura and 4.6 m at Ramat Negev. Best yielders produced dry fruits between 20 and 25 kg/tree at both sites in the sixth and seventh years, and average orchard yield was 3-4-times lower as a result of high variation between the trees. Kernels comprised 6.5% of fruit weight and contained 55% of oil. In the seventh year, oil yield was 0.6 kg/tree at Qetura and 50% lower at Ramat Negev. The higher oil yield at Qetura is related to higher average fruit yields, higher kernel weights and higher oil content of the kernels. Characteristics of the fruits and fatty acid composition of the argan oil and the chemical composition and quality characteristics of the defatted argan kernel meal are presented. Fruit components, such as the pericarp (45% of fruit weight), and the defatted meal (3.5% of fruit weight) can be used as animal feeds. The meal is characterized by a high protein content (46%) and a high in vitro digestibility (96%). Authors' summary.

TI: Effect of irrigation intervals and salt concentrations on the growth and chemical composition of Asclepias curassavica L.
AU: Hussein-MMM; Haggag-AA
SO: Annals-of-Agricultural-Science-Cairo. 2003, 48: 1, 307-327; 45 ref.
LA: English
LS: Arabic
AB: A. curassavica seedlings were irrigated every 3, 6, 9 or 12 days with tap water or saline water at 1500, 3000, 4500, 6000, 7500 ppm in a field experiment conducted in Cairo, Egypt during 2000-02. Prolonging the irrigation intervals up to 9 or 12 days reduced the survival percentage and the vegetative growth parameters of the crop. Saline water at 4500-7500 ppm reduced most of the vegetative growth parameters measured. No significant

reduction was detected for most of the studied growth characteristics when the plants were irrigated every 3 days with saline water at 1500 ppm, or every 6 days using tap water. Prolonging the irrigation intervals and/or raising the salt concentration reduced the total chlorophyll content and increased the proline content in the crop. Carbohydrate content increased gradually by prolonging the irrigation intervals. Na, Cl and Ca content decreased steadily with prolonged irrigation intervals.

TI: Epidemiology and effects of Verticillium wilt on yield of olive trees (cvs. Barnea and Souri) irrigated with saline water in Israel.
AU: Levin-AG; Lavee-S; Tsror-L
SO: Phytoparasitica. 2003, 31: 4, 333-343; 23 ref.
LA: English
AB: The epidemiology of Verticillium dahliae on olive trees (cultivars Barnea and Souri) irrigated with saline water was studied over a period of 3 years (1999, 2000 and 2001). Disease incidence in Barnea increased from 18.9 to 40.5% in the first year, while disease severity decreased from 4.2 to 2.4 (on a scale of 2-10). In the first month after pruning of diseased branches (June 1999), disease incidence was 26.9% and it increased to 60.6% by May 2000. No changes in disease severity were observed from this time until the end of the study. In Souri, disease incidence doubled during the 3 years of the study (from 22.1 to 44.8%), and disease severity increased from 2.4 to 2.9. The disease significantly reduced the Barnea yield in 1999 and 2000 (48.3 and 12.0%, respectively). In Souri, yield was measured only in 2001, where a reduction of 66.8% was observed. V. dahliae was isolated from both diseased and symptomless trees. A significant decrease in the isolation rate of V. dahliae from diseased Barnea trees occurred between the first year (47.9%) and the third year (5.3%); positive isolations were obtained in all seasons, without differences between seasons. In Souri, the fungus was isolated in significantly higher rates during the winter and spring (55 and 50%, respectively). Our findings strongly support the assumption that natural recovery occurs in Barnea 4-5 years after planting, but not in Souri.

TI: Successfully irrigating olive trees using salt-water.
AU: Wiesmann-Z; Malach-Y-de; David-Y; de-Malach-Y
SO: International-Water-and-Irrigation. 2002, 22: 1, 18-21.
LA: English
AB: This paper investigates the effects of irrigation with salt water on the development and yield of the olive trees (Barnea and Picual varieties) in the Negev region (Israel) and the quantity and quality of oil produced. The trees were tested as to their reaction to irrigation by salt water at two levels of salinity: 4.2 and 7.5 ds/m, which began immediately after planting. This irrigation treatment was directly compared to similar trees that were irrigated with sweet water (1.2 ds/m). Irrigation treatment using salt water at a medium level (4.2 ds/m) and at the higher level (7.2 ds/m) impeded the development of the olive tree in relation to similar varieties irrigated using sweet water. Olive trees irrigated with salt water at the two levels began to yield fruit one year after the trees irrigated with sweet water. The effect of salt water irrigation on olive oil production indicates that there was little discernable difference between the yields arrived at by using high salinity irrigation water and sweet water (15.7% oil). The average yield from olive trees irrigated using water with medium levels of salinity was found to be higher (16.3% oil). Very high levels of Vitamin E were found in olive produced from trees of the Picual variety irrigated with water containing medium salinity levels.

TI: Agriculture development and afforestation in arid lands: a case study in the United Arab Emirates.
AU: Yokota-H
SO: Report-of-the-Tokai-Branch-of-the-Crop-Science-Society-of-Japan. 1998, No. 126, 25-28; 8 ref.
LA: Japanese
AB: The process of revegetation (including afforestation) in the United Arab Emirates is described. Irrigation is necessary for the establishment of trees and other vegetation, and the use of saline water for irrigation is discussed.

Forage and fodder (incl. halophytes)

TI: Effect of potassium and nitrogen fertilizers on the growth and biomass of some halophytes grown under high levels of salinity.
AU: Noaman-MN
SO: Journal-of-Agronomy. 2004, 3: 1, 25-30; 22 ref.
LA: English
AB: A field experiment was conducted at the Nahshala Farm, about 50 km from Al -Ain UAE during 2001-2002 growing seasons, using five halophyte species: Spartina spp., Distichlis palmeri, Paspalum vaginatum, Juncus roemerianus and Batis maritima, under six levels of N and K fertilizer combinations irrigated with saline water of 20 g/L, to determine the optimum rate of potassium and nitrogen under such high salinity stress and to study the response (growth and biomass production) of such halophytes to different levels of K and N as anti -salinity nutrients. The differences between fertilizer treatments for different halophyte species regarding plant height were not significant at the initial stage of growth and thereafter the differences became apparent at the third stage. Halophytic plants, which have evolved in saline environment, responded differently in terms of biomass and yield production to increasing N and K fertilizer. In general, their biomass and yield production significantly increased as the fertilizer increased with no exception. The K:N ratio for each species behaved differently under different levels of N and K fertilizer.PT: Journal-article
AN: 20043065095

TI: Desert forages of the Arabian Peninsula -- the sustainable use of salt affected soils through conservation and evaluation.
AU: Peacock-JM; Ferguson-ME; Al-Hadrami-G; Saleh-A; McCann-IR; Dakheel-A; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 43-56; 25 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The native plant biodiversity of the Arabian Peninsula, which comprises over 3500 species, is being rapidly depleted. The primary cause is overgrazing, particularly by the large population of ruminants (24 million and growing steadily). Increasing amounts of supplementary feed in the form of lucerne and Rhodes grass (Chloris gayana) is being produced to accommodate the shortfall from the rangeland. These species, introduced to the region, consume huge volumes of sweet water, mainly applied through irrigation from groundwater. The combined effects have meant that groundwater levels have fallen dramatically, the potential productivity of the land has fallen, salt levels have increased and in some cases, the land has had to be abandoned. The National Agricultural Research Systems of the Arabian Peninsula, working with the International Center for Agricultural Research in the Dry Areas, have taken steps to address the resulting degradation and increased salinity levels. This paper systematically describes a holistic approach that was begun in 1997 to address these problems. It started with the collection of indigenous knowledge and interviews with local bedouin farmers in the United Arab Emirates (UAE); continued through a series of training programmes for human resource development, germplasm collection missions in the UAE, the Sultanate of Oman and the Republic of Yemen, including salt-affected areas; the development of herbaria, databases and one large genebank in the Republic of Yemen as well as a working collection in the UAE. Seeds of selected species have been multiplied and evaluations for water use efficiency and nutritive value are underway. Initial data shows that not only do the desert forages use less water than the introduced forages, but also their nutritive value is as good. In addition, research is underway to identify other forages that are more tolerant to salinity, research sites have been identified in the Sultanate of Oman, the UAE University and the new Biosaline Agricultural Center in Dubai. Collaborative research at the UAE University in Al-Ain on screening for salt tolerance of a perennial forage (Sporobolus spp.), perennial shrubs (Atriplex spp.) and two annual forages (Hordeum vulgare and Pennisetum glaucum) is also briefly described. This research will not only benefit the Arabian Peninsula countries, but also all countries that are likely to face the increasing impacts of global warming, desertification, drought and, in particular, salinity, in the 21st century.
PT: Book-chapter

TI: Use of seawater irrigation for halophyte plantation on the Arabian Peninsula.
AU: Wakabayashi-H; Gintzburger-G (ed.); Bounejmate-M (ed.); Nefzaoui-A
SO: Fodder-shrub-development-in-arid-and-semi-arid-zones.-Volume-2.-Proceedings-of-the-Workshop-on-Native-and-Exotic-Fodder-Shrubs-in-Arid-and-Semi-arid-Zones,-27-October-2-November-1996,-Hammamet,-Tunisia. 2000, 617-626; 12 ref.

PB: International Center for Agricultural Research in the Dry Areas (ICARDA); Aleppo; Syria
LA: English
AB: CO2 emissions, caused by desertification, including deforestation of the tropical rain forests, account for about 13% of the global warming problem. Nevertheless, reforestation is limited: only 10% of the area cut each year is reclaimed. Halophytes, which are very useful as fodder, food, biomass, fuel, etc., represent one of the possible solutions to this situation. Planting halophytes is proposed as a way to establish vegetation along the periphery of the Rub Al Khali desert in the Arabian Peninsula. Irrigation systems were designed for massive plantation along the coastline of the United Arab Emirates and the piedmont area of the Al Jabal Al Akadar facing the Rub Al Khali desert. The five species suggested as most suitable are Batis maritima, Atriplex canescens, Salicornia bigelovii, Suaeda estora [S. esteroa] and Sesuvieum verusocum [Sesuvium verrucosum]. Three areas for halophyte plantation using seawater irrigation were considered: the coast of the UAE (Concept A), the inland border (concept B), and the piedmont area (Concept C). Wider discussion and critical examination are still needed.

TI: Sabkhat and halophytes in the Horn of Africa (Djibouti, Eritrea, Ethiopia, Somalia, Sudan).
AU: Boer-B; Barth-HJ; Omyma-Osman; Barth-HJ (ed.); Boer-B
SO: Sabkha-ecosystems.-Volume-1:-The-Arabian-Peninsula-and-adjacent-countries. 2002, 147-159; many ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Literature dealing exclusively with aspects of halophytes, saline deserts, and saline water agro-ecosystems in the Horn of Africa region (Djibouti, Eritrea, Ethiopia, Somalia and Sudan) is limited. This review is the first attempt to summarize the information available on the halophyte flora, and the sabkha resources of the region. We try to provide useful and realistic recommendations on the next steps toward the sustainable development of the region's environmental geo-biological resources.

TI: Sustainable development of mangroves for coastal sabkha environments in Abu Dhabi, UAE.
AU: Soyza-AG-de; Vistro-NB; Boer-B; de-Soyza-AG; Barth-HJ (ed.); Boer-B
SO: Sabkha-ecosystems.-Volume-1:-The-Arabian-Peninsula-and-adjacent-countries. 2002, 341-346; 4 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: With an increasing demand for freshwater, and with freshwater resources becoming increasingly limited throughout the world, there is an urgent need to identify plant species that can grow with saline water. Mangroves, many of which can grow in the coastal inter-tidal areas and tolerate seawater concentrations of salts, have been identified as a group of plant species with high potential for expanded introduction to many areas of Abu Dhabi Emirate's coastal environment. With this in mind, we have initiated projects to identify potential areas for expanding mangrove ecosystems. Projects include development of planting techniques, research on effects of various environmental factors on mangrove survival and growth, and the potential for introducing non-native species of mangroves. We are particularly interested in increasing mangrove (and other halophyte) cover in coastal areas including sabkhat (3550 km2 of the Emirate's coastline) and the diversity of mangroves and associated plant and animal species along these coastal areas. Although these development activities have a high priority, the overriding priority remains that all developments must be sustainable and they must not have deleterious effects on existing ecosystems.

TI: Halophytes and soil salinity in Qatar.
AU: Abulfatih-HA; Abdel-Bari-EM; Alsubaey-A; Ibrahim-YM
SO: Qatar-University-Science-Journal. 2002, 22: 119-135; 31 ref.
LA: English
LS: Arabic
AB: Saline soils cover approximately 6% of the land in Qatar. Halophytes are common along the coastal areas and inland salt flats and wetlands, where saline water is available in their natural habitats permanently or periodically. The prevailing plants are mostly perennials including dwarf succulent shrubs (Anabasis setifera, Arthrocnemum glaucum, Atriplex leucodada, Cornulaca aucheri, Halocnemum strobilaceum, Halopeplis perfoliata, Heliotropium bacciferum, Limonium axillare, Salicornia europaea, Salsola baryosma, S. cyclophylla, S. marina, Seidlitzia rosmarinus, Suaeda aegyptiaca, S. vermiculata and Zygophyllum qatarense), followed by

tussock forming grasses (Aeluropus lagopoides and Sporobolus spicatus), sedges (Cyperus conglomeratus and Sporobolus arabicus), reeds (Phragmites australis), annuals (Cressa cretica, Frankenia pulvurulenta and Zygophyllum simplex), and shrubs and trees (Avicennia marina, Phoenix dactylifera and Tamarix ramosissima). There are seven common halophytic communities found in Qatar, which include, the inland wetland halophytes, the inland salt flat halophytes, the coastal mangrove halophytes, the coastal low marsh halophytes, the coastal high marsh halophytes, the coastal sandy shore halophytes, and the coastal sandy-rocky shore halophytes.

TI: Effects of irrigation water salinity and leaching fraction on the growth of six halophyte species.
AU: Noaman-MN; El-Haddad-ES
SO: Journal-of-Agricultural-Science. 2000, 135: 3, 279-285; 21 ref.
LA: English
AB: A pot experiment was carried out at Nahshala Farm, about 50 km from Al-Ain, UAE, during the 1998/99 growing seasons, using six halophytes: Spartina sp., Distichlis palmeri, Paspalum vaginatum, Juncus roemerianus, Salicornia bigelovii and Batis maritima, under two levels of leaching fraction, 0.25 and 0.50 and three levels of irrigation salinity, 10, 20 and 40 g/l. The objectives of the experiment were two-fold: (1) to find out the optimum and threshold of saline water irrigation to keep salinity level down as much as possible in the soil using the leaching fraction technique; and (2) to study the response (growth and biomass production) of some halophytes to different levels of salinity. The experiment was conducted in triplicate with a split-plot design arranged in a randomized complete block. Results indicate that these halophyte species can be grown productively at a leaching fraction between 0.25 and 0.50 when salinity of the irrigation water is less than 20 g/l. At higher salinities, Salicornia bigelovii can grow and yield satisfactorily under these conditions, while the other species may require more frequent irrigation at higher leaching fractions. Some of these tested halophytes may be able to revegetate the salt-affected lands and be a potential source of forage in these harsh habitats. This study supports the idea of seawater agriculture by demonstrating the possibility of using some high salt-tolerant halophytes at relatively higher leaching fraction in order to maintain satisfactory yield production of such halophytes.

TI: Utilization of Acacia saligna as livestock fodder in arid and semi-arid areas in Egypt.
AU: El-Shaer-HM; Sulas-L
SO: Legumes for Mediterranean forage crops, pastures and alternative uses. Proceedings of the 10th meeting of the Mediterranean Sub-Network of the FAO-CIHEAM Inter-Regional Cooperative Research and Development Network on Pastures and Fodder Crops, Sassari, Italy, 4-9 April 2000. Cahiers-Options-Mediterraneennes. 2000, 45: 213-217; 13 ref.
LA: English
LS: French
AB: Rehabilitation of the native rangelands and/or cultivation of salt-drought tolerant shrubs could be one of the best approaches to reduce grazing pressure and increase carrying capacity since shrubs provide alternative feed resources. Acacia saligna shrubs are one of the most important introduced shrubs which suit the environmental conditions of the northern coast of Egypt. This article highlights the potential of A. saligna as livestock fodders in arid and semi-arid areas in Egypt. Approximately one million A. saligna seedlings were transplanted along the Egyptian Mediterranean coast through a national program for improving the native rangelands. The maximum yields of fresh matter, dry matter and other nutrients were attained in spring. Fresh A. saligna shrubs provided a diet that was scarcely able to maintain liveweight although the crude protein content was acceptable (about 12.5%). Several trials were conducted to improve the utilization of A. saligna by air-drying or ensiling with Atriplex nummularia and 10% molasses or 20% poultry waste. When A. saligna was processed as a silage, palatability, intake and nutrient utilization were increased compared with the fresh or air-dried A. saligna. Improving intake, nutrient utilization and reducing the concentrations of antifeedants in A. saligna

TI: The performance of Opuntia ficus-indica seedlings that resulted from different number of joint mature cladodes at two planting dates.
AU: Nasr-Y; Jamjoum-K; Nefzaoui-A (ed.); Inglese-P
SO: Proceedings of the Fourth International Congress on Cactus Pear and Cochineal, Hammamet, Tunisia, 22-28 October, 2000. Acta-Horticulturae. 2002, No.581, 159-167; 8 ref.
LA: English

AB: In Jordan, due to the limitation of the feed resource as a result of rangeland degradation, there is a growing concern on cactus pear, which produces satisfactory fruits and fodder under the prevailing conditions. Thus, the best method for establishing the Opuntia ficus-indica seedlings in the open field was studied. This study was carried out to test the best range of the joint cladodes (1-7 joint cladodes) that should be used to produce the highest vegetative and productive yield at two planting dates that are popular for cactus plantations in Jordan (autumn and spring). During the growing season of 1998/1999, two fields (each) of one hectare respectively (1 ha during the first planting date (October 1998) and 1 ha during the second planting date (March 1999)) were planted by various numbers of the joint cladodes (from 1-7) using spaces of 4 m between-the-rows and 3 m within-the-row. The planted cladodes were distributed within three replicates at each planting date using RCBD experimental design. As growth of the new seedlings started in the first growing season (FGS), flowers were removed to enhance the vegetative growth. During the hot dry summer, the seedlings were supplementary irrigated by saline water (5 litre/plant/week). Data collection sheets and a database were designed to collect the reading of the fodder and fruit yield for every plant in the field. The plants perform well especially those planted during the first planting date and the results showed that the performance of cactus plants during the first growing season improved by increasing the number of the planted joint cladodes from 1 to 7. The same trend related to fruit number per plant and cladode production was obtained during the second growing season except some negative effect in the plants that resulted from 7 joint cladodes and planted during the FPD.
PT: Journal-article; Conference-paper

TI: Irrigation with brackish water under desert conditions. 9. The salt tolerance of six forage crops
AU: Pasternak,-D.; Nerd,-A.; Malach,-Y.-de
AD: Institute for Applied Research, Ben Gurion Univ. of the Negev, Beersheva, Israel
SO: Agricultural-Water-Management (Netherlands).
1993, v. 24(4) p. 321-334; Dec, figs, 26 ref.; summary (En)
LA: English
AB: The response of 6 forage crops to salinity was investigated in the field in Israel, during 1990-91. The crops were Rhodes grass (Chloris gayana), Bermuda grass, Kallar grass (Leptochloa fusca), salt (spike) grass (Distichlis spicata), seashore paspalum (Paspalum vaginatum), and alfalfa. The electrical conductivity (EC) of the irrigation water (ECi) was 1.2-9.5 dS/m, and the mean seasonal EC of the saturated soil paste (ECe) was 3-14 dS/m. The salt tolerance of the 6 forage species was found to be: salt grass > Bermuda grass > seashore paspalum > Rhodes grass > Kallar grass = alfalfa. In the first season, dry matter yields of salt grass, Bermuda grass and seashore paspalum were not affected by a soil ECe of 14 dS/m. In the second season, only the yield of salt grass was unaffected. Rhodes grass had, in the second season, exceptionally high annual yields (5.0 kg/m2) with fresh water irrigation. There was no consistency in the effect of salinity on crude protein, fibre and ash contents among the 6 forage grasses. When brackish water supply was limited, dry matter yield of salt grass was double the yield of the other species, indicating an advantage of this species under non-irrigated rangeland conditions. This work shows that brackish water with an ECi of >/= 10 dS/m may be used for irrigation of certain forage crops without any yield reduction. From authors' summary.

TI: Evaluation of the water requirement of sorghum (S. vulgaris [Sorghum bicolor] L.) in saline soils of Yazd - Ardakan Plain.
AU: Zehtabian-G; Mirvakili-SA
SO: BIABAN. 2001, 6: 1, 125-136; 18 ref.
LA: Persian
LS: English
AB: A study was conducted to determine the water requirement of two sorghum varieties, Speedo feed and Nothro feed, in the Yazd-Ardakan area, Iran. Evaporative pan indexes (EPI) factors (0.4 and 0.6) were studied as the main factor and irrigation intervals (II) (5, 9 days) and two varieties of sorghum were considered as subfactors. Water salinity in the area was 2358 µm hos/cm and the soils were saline. The water efficiency was 40% and the plant index for sorghum was 0.3-1.1. Parameters like flowering percentage, number of leaf and tillering, diameter of stem, leaf area and yield were recorded in two harvests. Results showed that EPI did not significantly affect the yield, while irrigation intervals of 9 days reduced the yield significantly. Total yield was 19.2 t/ha and 14.5 t/ha at 5 and 9 day irrigation intervals, respectively. Nothro feed variety yielded 18.98 t/ha and Speedo feed 14.75 t/ha. Nothro feed variety showed the best result with 5-day irrigation intervals, at both 0.4 and

0.6 EPI, while Speedo feed variety showed the best result at a 5-day irrigation interval and at 0.6 EPI. Considering economical use of water in the area and total yield (t/ha), 5-day irrigation intervals at 0.4 EPI was found suitable for the area.

TI: Growing halophytes in Egypt for forage production and desertification contol.
AU: Ashour-N; Arafat-SM; El-Haleem-AA; Serag-M; Mandour-S; Mekki-B
SO: Bulletin-of-the-National-Research-Centre-Cairo. 1999, 24: 3, 349-360; 15 ref.
LA: English
LS: Arabic
AB: Field trials were carried out in sandy soil at the Sea Coast of Suez Gulf to evaluate the productivity of some local and exotic halophytic plants irrigated with diluted seawater (12.5, 25.0, 37.5 and 50.0% seawater). The tested halophytic plants were Diplachne fusca (local), Spartina patens, Sporobolus virginicus (Smyrna-smooth) and S. virginicus (Dixe-coarse) (exotic). The fresh and dry matter yield of most of the tested plants tended to increase by increasing the proportion of sea water in irrigation water from 12.5 to 25%. Further increase in salinity level of irrigation water caused a decrease in the biomass production in various degrees according to plant type. All the tested plants can tolerate cutting 3-4 times per year and are capable of recovering and maintaining a productive stand. The dry matter yield ranged between 2.7-16.0 tonsthinacre-1thinyear-1 according to plant type. Diplachne fusca, Spartina patens, and Sporobolus virginicus were promising for feeding goats and sheep in a desert area by saline irrigation water. Diplachne fusca as a forage crop was grown successfully in highly salt-affected soil (electrical conductivity 17 dSthinm-1) at the south coast of Qaroun Lake, Fayoum Governorate. It was concluded that some halophytes may be used to combat desertification in arid and semi-arid regions through depleting soil salts and also as salt-tolerant forage crops.
PT: Journal-article

TI: Potential of Atriplex species as fodder shrubs under the arid conditions of Egypt.
AU: El-Shaer-HM; Kandil-HM; Hamdy-A (ed.); Lieth-H (ed.); Todorovic-M (ed.); Moschenko-M
SO: Halophyte uses in different climates. II. Halophyte crop development: Pilot studies. Proceedings of the 3rd seminar of the EU Concerted Action Group IC 18CT 96-0055 Florence, Italy, 20 July 1998. 1999, 87-94; Progress in Biometeorology, Volume 14; 26 ref.
PB: Backhuys Publishers; Leiden; Netherlands
LA: English
AB: Irrigated agricultural land represents only 5% of Egypt's surface area but it is where >90% of the human population is accommodated. The use of salt-affected wastelands and saline water to produce non-conventional crops is of particular importance. Halophytes such as Atriplex spp. if used to supply animal fodder would be of wide application. There are four native Atriplex species: A. halimus, A. farinosa, A. leucolada and A. vesicaria. The non-native species are A. nummularia, A. canescens, A. semibaccata and A. glauca. These shrubs differ in their palatability, chemical composition and nutritive values. Most of Atriplex species are rich in crude protein but need to be supplemented with soluble carbohydrate resources. The main constraints that limit the intake and utilization of Atriplex spp. are high salt and fibre contents but low in energy value. The utilization of Atriplex spp. as fodder can be improved by various pre-treatments to enhance their palatability and nutritional value. Ensiling Atriplex shrubs with other feed ingredients (fodder crops or agricultural wastes) is considered the most efficient processing method. Therefore, the feed gap in Egypt can be satisfactorily filled using saltbushes as fresh and conserved fodder on a year-round basis.

TI: Potential of Atriplex species as fodder shrubs under the arid conditions of Egypt.
AU: El-Shaer-HM; Kandil-HM; Hamdy-A (ed.); Lieth-H (ed.); Todorovic-M (ed.); Moschenko-M
SO: Halophyte uses in different climates. II. Halophyte crop development: Pilot studies. Proceedings of the 3rd seminar of the EU Concerted Action Group IC 18CT 96-0055 Florence, Italy, 20 July 1998. 1999, 87-94; Progress in Biometeorology, Volume 14; 26 ref.
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wide application. There are four native Atriplex species: A. halimus, A. farinosa, A. leucolada and A. vesicaria. The non-native species are A. nummularia, A. canescens, A. semibaccata and A. glauca. These shrubs differ in their palatability, chemical composition and nutritive values. Most of Atriplex species are rich in crude protein but need to be supplemented with soluble carbohydrate resources. The main constraints that limit the intake and utilization of Atriplex spp. are high salt and fibre contents but low in energy value. The utilization of Atriplex spp. as fodder can be improved by various pre-treatments to enhance their palatability and nutritional value. Ensiling Atriplex shrubs with other feed ingredients (fodder crops or agricultural wastes) is considered the most efficient processing method. Therefore, the feed gap in Egypt can be satisfactorily filled using saltbushes as fresh and conserved fodder on a year-round basis.
PT: Conference-paper

TI: Effect of saline sprinkler irrigation on alfalfa yield and soil chemical properties.
AU: Feizi-M; Rezaei-M; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 96-105; 10 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Studies were conducted on the effect of sprinkler irrigation with saline water on silty clay loam soils on the Zayandehroud River plain near Isfahan, Iran. Experiments investigated the effects on lucerne yield, and determined the salinity threshold values by applying four water qualities of 2.1, 3.2, 4.4, and 5.4 dS/m in a randomized blocks (four replicates). The results show that water quality treatments up to 4 dS/m containing 20 meq/litre Cl and 30 meq/litre Na, did not cause any leaf burn, and may be recommended for sprinkler irrigation. The greatest leaf burn and Cl, B, Na contents were observed in the lucerne during the hottest and driest summer months. Increasing irrigation water salinity from 2.1 to 5.4 dS/m decreased the lucerne's hay yield by 11%.

TI: Forage production from three grass species under saline irrigation in Egypt.
AU: Ashour-NI; Serag-MS; El-Haleem-AKA; Mekki-BB
SO: Journal-of-Arid-Environments. 1997, 37: 2, 299-307; 23 ref.
LA: English
AB: The growth of halophytic forage plants (Leptochloa fusca [Diplachne fusca], Spartina patens, Sporobolus virginicus (cv. Smyrna) and S. virginicus (cv. Dixe)) in coastal salt-affected desert lands, Egypt, using diluted seawater for irrigation, was investigated and compared with Medicago sativa. Field trials were conducted over 3 years from February 1993 to January 1996 at the Saline Agricultural Experimental Station of the National Research Centre on the Suez Gulf Coast. Four concentrations, 12.5, 25, 37.5 and 50% of seawater were used for irrigation. Each plot was irrigated weekly in the autumn and winter, and twice weekly in the spring and summer. Four harvests were made at 2- or 3-month intervals. Plant dry weight, water content, and succulence, and average protein, fat, fibre, soluble carbohydrates and ash were determined. Fresh and dry weights of the plants, except Medicago sativa, increased with concentration of seawater between 12.5 and 25%. Further increase in salinity generally decreased fresh and dry weights, except in S. virginicus cv. Dixe in which plant weight increased up to 37.5% seawater. Increasing salinity in the irrigation water generally decreased plant fibre content, but left fat and soluble carbohydrate contents unaffected. S. virginicus (Dixe) produced the highest fresh and dry yields, and S. virginicus (Smyrna) the lowest. However, S. virginicus (Dixe) was the least palatable, and M. sativa the most. All plants tolerated diluted seawater irrigation up to 50%. At 25 and 37.5% seawater S. virginicus (Dixe) produced the highest biomass. It is concluded that L. fusca, Spartina patens and Sporobolus virginicus (Smyrna) may be able to provide a source of forage in the desert lands of Egypt using saline water for irrigation.
PT: Journal-article

TI: Ecophysiology of halophytes and their traditional use in the Arab world.
AU: Batanouny-KH; Choukr-Allah-R (ed.); Malcolm-CV (ed.); Hamdy-A
SO: Halophytes-and-biosaline-agriculture. 1995, 73-94; 49 ref.
PB: Marcel Dekker Inc.; New York; USA
LA: English

AB: Saline areas (coastal, great depressions and oases, erosion pavements with gypsum deposits, inland saline depressions, downstream of wadis, around springs and water points, and manmade) and halophytes in the Arab region, the ecophysiology of halophytes, and their traditional uses are described. Halophytic plants were used as range plants, fuel (Tamarix), windbreaks (Tamarix aphylla, Ziziphus), tanning (Rhizophora mucronata), cleaning (Seidlitzia rosmarinus), clothes and utensils (Hammada elegans) and medicine (Typha domingensis for wounds and Zygophyllum for scabies in camels). A list of common halophytes found in this region, considerations to be taken into account when using them and problems confronting their use were given.

TI: Inula crithmoides: a candidate plant for saline agriculture.
AU: Zurayk-RA; Baalbaki-R
SO: Arid-Soil-Research-and-Rehabilitation. 1996, 10: 3, 213-223; 25 ref.
LA: English
AB: Inula crithmoides, a common halophyte from the coast of Lebanon, was evaluated for use in saline agriculture. The plant is traditionally consumed in Lebanon and the roots are claimed to have medicinal properties as a tonic. Inula crithmoides offshoots were collected from the wild and propagated in a controlled environment. Germination and rooting tests under various salinity regimes ranging from 0.5 to 80 dS/m (NaCl) demonstrated a severe restriction of germination above 20 dS/m and indicated that vegetative propagation is probably the main reproduction strategy in saline environments. The growth of potted plants grown under 5 levels of salinity for a period of 87 days was only affected by salinity exceeding 20 dS/m. Yield of plants irrigated with 40 dS/m saline water was nearly half that of the no-salt control. Mean yield value for plants grown at 20 dS/m reached 18.3 g dry weight (DW) per plant. At this salinity, crude protein content averaged 12.7% mg/kg, and shoot iodine contents ranged between 0.8 and 1.4 mg/kg DW, making I. crithmoides a good-quality fodder, and an iodine-rich vegetable. This species also exhibited ionic relations typical of halophytes, with shoot K/Na ranging between 0.1 and 0.4, indicating that it can substitute Na for K. It is concluded that Inula crithmoides can be a good candidate for use in saline agriculture, provided a selection process is initiated to identify high yielding varieties.
PT: Journal-article

TI: The potential economic use of halophytes for agricultural development of southern Morocco.
AU: Choukr-Allah-R; Jones-GW; Kenny-L; Squires-VR (ed.); Ayoub-AT
SO: Halophytes as a resource for livestock and for rehabilitation of degraded lands. Proceedings of the international workshop on halophytes for reclamation of saline wastelands and as a resource for livestock problems and prospects, Nairobi, Kenya, 22-27 November 1992. 1994, 259-261; 3 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: Salinity has substantial adverse social and economic effects in Morocco causing deteriorating agricultural productivity in many irrigated areas. A bio saline approach to the establishment of forage in arid rangelands in S. Morocco using saline irrigation water was investigated. A collaborative project involving the UK and Morocco aims to select halophytic species adapted to local conditions and to determine the optimal methods for their establishment and their suitability as forage. The introduction, development and use of halophytes as fodder and as trees for afforestation is described. Trials are also under way on the introduction of ornamental plants to be irrigated with saline water.
PT: Conference-paper

TI: Fodder production with saline water: project report, January 1982-December 1989
AU: Pasternak,-D.
AD: Applied Research Institutes, Ben Gurion Univ. of the Negev, Beersheva, Israel
SO: BGUN-ARI-Institutes-for-Applied-Research,-Ben-Gurion-University-of-the-Negev (Israel).
1990, no. 35, 181 p.; Dec, figs, tables; bibliography (vp.); summary (En)
LA: English
AB: The possibility of producing fodder with highly saline water was investigated over a period of 7 years near Ashqelon, Israel. Some 140 halophytes were introduced and irrigated with 100% and 15% seawater. About 80 species were grown successfully with 100% seawater during a period of 4-5 years; the highest productivity was exhibited by species belonging to the Atriplex genus. A. lentiformis is most suitable for firewood production in saline environments, A. undulata and Atriplex sp. ("camarones") provide excellent ground cover suitable for

grazing, A. nummularia is a heavy producer with a high leaf N content, and A. barclayana is highly palatable. The intake of seawater-irrigated A. nummularia fed to sheep was very low, and lambs ate about 0.6 kg dry matter/day of A. nummularia and A. barclayana. The animals were able to dispose of excess salts through both faeces and urine. However, Atriplex species proved to be unsuitable as a sole dietary component. Mean apparent digestibility of A. barclayana was found to be 59%. The effect of consumption of A. barclayana and sodium chloride on energy metabolism in sheep was investigated. Atriplex is a poor feed source and has a nutritional value equivalent to that of straw. Although Atriplex is salt tolerant, it is of limited usefulness as a fodder crop. In addition, a data base of salt tolerant plants of the world (HALOPH), containing >1560 species, is presented, as well as a bibliography of 351 references cited in the HALOPH data base.

Miscellaneous crops

TI: Phytochemical screening of Salvia officinalis and Thymus vulgaris irrigated with different levels of saline water.
AU: El-Sakka-MA; Tubail-KM
SO: Alexandria-Journal-of-Agricultural-Research. 2003, 48: 1, 159-165; 11 ref.
LA: English
LS: Arabic
AB: Sage (Salvia officinalis) and thyme (Thymus vulgaris) were a sacred ceremonial herb of the Romans. It was associated with immortality and was thought to increase mental capacity in ancient times. The two plants were grown on loamy soil beds each of 10 m2 area. The experiment was conducted in a greenhouse with completely randomized design using 3 treatments for each plant (fresh water, EC=1.04 dS/m; saline water, EC=7.3 dS/m; and 50% saline water). No agrochemicals were added through the growth season (Organic agriculture). Soil and plant samples were collected for analysis. Soil analysis showed a significant increase in Na, Cl, K concentrations as well as in electrical conductivity and SAR values with increased of applied saline water. Photochemical and spectral analysis showed the increasing of sterols and volatile oils in sage and saponins in thyme as the amount of saline water increased. No significant differences in the other tested substances between the different treatments.PT: Journal-article

TI: Biochemical studies on Rosmarinus officinalis L. plant tolerance to salinity under compost levels.
AU: Mona-YK
SO: Annals-of-Agricultural-Science-Cairo. 2002, 47: 3, 893-909; 37 ref.
LA: English
LS: Arabic
AB: A pot experiment was conducted in the field in Giza, Egypt, during the 1998/99 and 1999/2000 growing seasons to study the effect of commercial sea salt (NaCl) at 0, 2000, 4000 and 8000 ppm and compost application at 0, 0.7 kg/pot (7.0 tonnes/fed) and 1.0 kg/pot (10.0 tonnes/fed) on the growth, chemical composition, oil content, yield and yield components of rosemary (R. officinalis). The results showed that increasing salinity levels reduced all growth, traits (plant height, number of branches per plant, herbage fresh and dry weights and photosynthetic pigments), sugars content, oil% and yield, as well as K% and K:Na ratio, except at 2000 ppm level. Free proline content, Na and Cl% showed an opposite trend. The compost treatment reduced the harmful effects of saline stress. Application of compost at 1.0 kg/pot (10.0 tonnes/fed) to the soil is, therefore, recommended to reduce the deleterious effects of irrigation with saline water.

TI: Effect of biofertilizer, salinity and magnetic technique on the growth of some annual plants.
AU: Mostafa-MM
SO: Alexandria-Journal-of-Agricultural-Research. 2002, 47: 2, 151-162; 22 ref.
LA: English
LS: Arabic
AB: The effects of biofertilizer (Azotobacter chroococcum and A. vinelandii) and irrigation with magnetically salinized water (0.6, 3.8, 7 and 10.2 dS/m) on the growth of Calendula officinalis cv. Muraji and D. ecklonis [Osteospermum ecklonis] were determined in a field experiment conducted in Egypt during 1998-2000. The

biofertilizers increased the leaf area of C. officinalis and plant height and inflorescence diameter of D. ecklonis but delayed its flowering time. Magnetic saline water irrigation enhanced plant height and flower diameter of both species and increased the leaf area and dry weight of Muraji. Na and Na:K ratio in the leaves of both species and Na:Ca ratio of Muraji decreased, whereas the N content in the leaves of D. ecklonis increased. Biofertilizers, combined with lower levels of saline water (0.6-3.8 dS/m) enhanced the N content in the leaves of Muraji and the height and dry matter content of D. ecklonis flowers.

TI: Effectiveness of indol-3-butyric acid on the propagation of some ornamental shrubs cuttings under salinity conditions.
AU: Mostafa-MM
SO: Alexandria-Journal-of-Agricultural-Research. 2002, 47: 1, 107-117; 24 ref.
LA: English
LS: Arabic
AB: The present investigation was carried out during 1999 and 2000 at Alexandria Research Branch, Alexandria, Egypt to study the effect of IBA (0.0, 1250, 2500, and 5000 ppm) and salinized irrigation water [ECs=0.6 (tap water), 1.4 and 4.2 dS m-1] on rooting and postpropagation of acalypha (Acalypha wilkesiana), poinsettia (Euphorbia pulcherrima) and lantana (Lantana camara). Generally, irrigation the cuttings with salinized water reduced almost all the measured data progressively with increasing the rate of salinity. The preplanting dipping of the used cuttings in IBA solutions modified and alleviated most of the harmful effects of saline stress, especially under the lower levels of salinity. Whereas, the addition of IBA at 1250-5000 ppm combined with the lower levels of salinity (not more than 1.4 dS m-1) enhanced root characteristics (rooting % and roots length and dry weight) and vegetative parameters (leaf number, area, and dry weight). Besides, it increased N% and reduced Na% and the ratios of Na/K and Na/Ca in the produced leaves on different cuttings. Roots seemed to be less sensitive to saline stress than leaves, whereas the highest ratios of roots/leaves and shoots were resulted from applying salinity at 4.2 dS m-1 combined with IBA at 2500, 1250 or 0.0 ppm for acalypha, poinsettia and lantana, respectively. The percentage of relative water content (RWC%) was reduced by applying salinity at 4.2 dS m-1 by 32.5, 18.3 and 19.7% under the control treatment for the previous mentioned plants, respectively. While applying IBA enhanced RWC% somewhat for the used plants, except for lantana. The limits of Na/K were 0.3:0.4, 0.3:0.6 and 0.3:0.6, while those of Na/Ca were 0.2:0.3, 0.2:0.6 and 0.2:0.4 for acalypha, poinsettia, and lantana, respectively.

TI: Optimization of nitrogen use for the production of chrysanthemum crop irrigated with treated wastewater.
AU: Benhoummane-B; Choukr-Allah-R; Hamdy-A; El-Omari-H; Ragab-R (ed.); Pearce-G (ed.); Kim-JC (ed.); Nairizi-S (ed.); Hamdy-A
SO: 52nd IEC Meeting of the International Commission on Irrigation and Drainage, Seoul, Korea Republic, 19-20 September 2001. 52nd-IEC-Meeting-of-the-International-Commission-on-Irrigation-and-Drainage.-International-Workshop-on-Wastewater-Reuse-Management,-Seoul,-Korea,-19-20-September,-2001. 2001, 119-126; 9 ref.
PB: Korean National Committee on Irrigation and Drainage (KCID); Gyonggi-do; Korea Republic
LA: English
AB: The aim of this study was to optimise nitrogen status under irrigation with waters of different nitrogen concentrations:- (i) treated wastewater (infiltration-percolation), (ii) artesian well saline water supplied with fertilizer nutrient, and (iii) alternation of both water sources. Chrysanthemum coronarium was used as an indicator plant. The experiment included two irrigation regimes (- 100% and 120% ETM) and was conducted in the greenhouse on sandy soils, at Ben Sergao, experimental station, Morocco. Irrigation with treated wastewater was shown to result in better plant growing parameters, and its flower production compared well with the other two irrigation sources. However, this was not the case with respect to the nitrogen status. The initial nitrate concentration in the water source is the dominant factor in pollution of the water-table as well as the nitrogen content of the crop. The highest nitrate concentration in the water-table was found under irrigation with treated wastewater (and was nearly 100% higher than with the alternation irrigation technique). Irrigation with fertilizer in the artesian water gave the lowest water-table pollution. The study showed that there is a real risk of nitrate contamination of groundwater when treated wastewater is used (on sandy soils) as a single source for irrigation. The risk can be reduced by optimizing N-use and minimizing groundwater pollution. This can be done by

alternating irrigation supply between treated wastewater and other water sources that are lower in N-content (such as fresh and/or saline water).

TI: Guar crop performance under different levels of salinity.
AU: Aboushal-AA
SO: Alexandria-Journal-of-Agricultural-Research. 2000, 45: 2, 39-56; 26 ref.
LA: English
LS: Arabic
PT: Journal-article

TI: Effect of growth regulators on germination and growth of Lolium multiflorum Lam. at different levels of salinity.
AU: El-Din-NMN
SO: Desert-Institute-Bulletin,-Egypt. 1998, publ. 2000, 48: 2, 453-474; 29 ref.
LA: English
LS: Arabic
AB: Germination of Lolium multiflorum seeds under irrigation with saline water at concentrations of 2000, 4000 and 6000 ppm. and presoaking in indolacetic acid (IAA) (10 and 20 ppm.) and gibberellic acid (GA3) (100 and 300 ppm) in addition to fresh water (control) were studied. Germination reached 100% after 7 days from the presoaked grains in IAA (10 ppm) and after 5 days from the presoaked grains in GA3 (300 ppm). The plant seeds exhibited a progressive reduction in germination percentage with increasing salinity levels. Soaking the seeds in IAA (10 ppm) increased peak thickness, peak length, root thickness and number of seminal roots, while it decreased the cap and root length of the apex. GA3 (300 ppm) was the most effective growth regulator for increasing L. multiflorum plant height, fresh and dry weight and no. of tillers/plant followed by GA3 (100 ppm), IAA (10 ppm) and lastly IAA (20 ppm) compared with control, (fresh water irrigation). A pot experiment using saline irrigation water at 2000 and 4000 ppm showed that the growth regulators have ameliorated the retarding action of salinity and improved growth and yield. The percentages of total nitrogen, protein, carbohydrates, sodium and potassium contents tended to increase with increased GA3 or IAA concentrations.
PT: Journal-article

TI: Physiological behaviour of two chickpea Tunisian varieties irrigated with saline nutrient solution.
AU: Sleimi-N; Lachaal-M; Andelly-C; Soltani-A; Hajji-M; Horst-WJ (ed.); Schenk-MK (ed.); Burkert-A (ed.); Claassen-N (ed.); Flessa-H (ed.); Frommer-WB (ed.); Goldbach-H (ed.); Olfs-HW (ed.); Romheld-V et-al
SO: Plant-nutrition:-food-security-and-sustainability-of-agro-ecosystems-through-basic-and-applied-research.-Fourteenth-International-Plant-Nutrition-Colloquium,-Hannover,-Germany. 2001, 408-409; 8 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: The response of salt tolerant (Amdoun 1) and sensitive (Chetoui) chickpea cultivars to saline water irrigation was studied. At the flowering stage (25 days after salt treatment), plant growth was decreased by 9% in Amdoun 1. The leaf growth was stimulated (108% of the control) in this cultivar; however, a reduction for this parameter was observed in Chetoui. The seed weight of Amdoun 1 was 8-fold higher than that of Chetoui when grown in 36 mM NaCl. The presence of salt did not significantly vary the K concentration for both cultivars. Na+ was markedly retained in the roots of Amdoun 1 and in the stems of Chetoui. NaCl increased Na+ concentration without altering its distribution among various organs. Leaves, however, were devoid of this cation. NaCl (36 mM) did not significantly affect the absorption and transport of Mg2+. In Amdoun 1, the selectivity of K+/Na+ transport (28.2) and accumulation (28.0) was superior to the selectivity of absorption (18.3). In Chetoui, the selectivity of transport (16.7) was lowest.

TI: The economics of greenhouse vegetables using different water qualities in Saudi Arabia.
AU: Al-Abdulkader-AM; Al-Jaloud-AA
SO: Arab-Gulf-Journal-of-Scientific-Research. 1999, 17: 3, 412-422; 12 ref.
LA: Arabic
LS: English

AB: Investing in greenhouses is an important agricultural investment in Saudi Arabia. Such greenhouse production of vegetables is associated with higher yields and reduced water use, compared with traditional open field agriculture. The main objective of this study was to determine the net economic return of greenhouse cucumbers and tomatoes irrigated with water of different qualities (salinity in the range 800-1400 ppm). Results indicated that good economic returns were generated following irrigation with saline water.

TI: Effect of bacterial inoculation, P and organic fertilization on microbiological properties, growth and production of fenugreek plant under saline calcareous soil conditions.
AU: El-Ghany-BFA; Salem-MO; El-Sibaie-MAF
SO: Desert-Institute-Bulletin,-Egypt. 1997, publ. 1999, 47: 1, 1-13; 17 ref.
LA: English
LS: Arabic
AB: A field experiment was conducted at Ras-Sudr experimental station, Egypt to evaluate the effect of biofertilization (Rhizobium leguminosarum), sheep dung, two levels of P-fertilization (15 and 30 kg P2O5/f. [1 feddan=0.42 ha]) on microbiological changes and the yield of fenugreek in saline calcareous soil (52% CaCO3) irrigated with saline groundwater (6400 ppm). The results indicated that bacterial population, aerobic cellulose decomposers, fungi, actinomycetes and asymbiotic nitrogen fixers, (Azotobacter and Azospirillum) increased with increasing rate of P application, using sheep dung and biofertilization. Fenugreek production increased by 237% over the control.

TI: Effect of natural soil conditioners and irrigation conditions on some chemical properties of sandy soils of Inshas and cucumber yield.
AU: Aziz-MA; Sallam-MFA; El-Gendy-AM; El-Moniem-MA
SO: Egyptian-Journal-of-Soil-Science. 1998, 38: 1-4, 377-411; 23 ref.
LA: English
LS: Arabic
AB: The effect of soil conditioning, irrigation water salinity, irrigation interval and systems on some chemical properties of sandy soils of Inshas, Egypt, and on cucumber production and water use efficiency (WUE) were studied. The conditioners were tafla [24% clay, 43% silt, and 32% fine sand], farmyard manure and their mixture, incorporated into the surface soil layer (0-15 cm) at the rate of 5% (weight/weight) before cultivation of cucumber. The irrigation water salinities were 350 (tap water), 2000 and 4000 ppm. Irrigation intervals every second day and every third day were used under surface and drip irrigation systems. The different soil chemical properties, cucumber yield and WUE were determined after two successive growth seasons (1991-1992). The results indicated that soil conditioning markedly increased the amount of total soluble salts, especially in the treatments of saline irrigation water, regardless of the other treatments. This increase took vertical and horizontal directions under drip irrigation conditions and a vertical one only under furrow irrigation conditions. The increase in soil salinity in the conditioned treatments followed the order: tafla > organic manure > mixture. Low soil salinity was found with irrigation after one day (F1) as compared with that after two days (F2) under both systems of irrigation. Furrow irrigation plots contained higher values of ECe [electrical conductivity] than drip ones. The use of drip irrigation system controlled the salinity increment in the root zone. The all conditioning treatments contained more soluble cations and anions as compared with untreated soil. Sodium and chloride ions had the higher values, while the lowest ones were for magnesium and potassium. The use of saline irrigation water increased the mounts of soluble calcium, sodium and chloride. The effect of irrigation water salinity on soluble ions, especially under the conditions of longer irrigation interval (F2), followed the order: Na+ > Ca2+ > Mg2+> K+ and Cl- > HCO3- > SO4-2. The use of furrow irrigation was more effective in increasing the values of Ece and soluble ions. The maximum yield of cucumber was obtained in the plots treated with mixture (tafla and manure), low irrigation water salinity (tap water), and F1 under drip irrigation system. The interaction among the studied factors on the cucumber yield was highly significant. The higher WUE of cucumber was obtained in the treatment received both conditioners, irrigated with low saline irrigation water (tap water) for F2 under drip irrigation system. Drip irrigation was the best method for water management, high cucumber yield, water conservation and water use efficiency.

TI: Uptake of Cd and Ni by spinach, Spinacea oleracea (L.) from polluted soil under field conditions as affected by salt water irrigation.

AU: Helal-M; Baibagyshew-E; Saber-S
SO: Agronomie. 1998, 18: 7, 443-448; 32 ref.
LA: English
LS: French
AB: The effect of salt water irrigation on the uptake of Cd and Ni by spinach from a polluted soil under field conditions was studied at the Nahda project site, in the northwest of Egypt. Microplots were irrigated either with water or with salt solution (0.8 g litre-1) for 9 weeks. Subsequently, the plants were harvested for root evaluation and chemical analysis. Salt water irrigation stimulated root development and enhanced the extractability of Cd and Ni from soil as well as their uptake by spinach. Possibly related interactions are discussed. The results suggest that the risk of leaching of heavy metals into surface waters and their transfer to the food chain in salt-affected areas may be much greater than so far assumed.

TI: The use of the sea coastal areas in Abu Dhabi as a growing medium for vegetables
AU: Alafifi,-M.A.
AD: Arid Lands Research Centre, Abu Dhabi, United Arab Emirates
SO: IWOSC-Proceedings (Netherlands).
Wageningen (Netherlands), International Working Group on Soilless Culture, 1977, no. 4, p. 377-382, summaries (En, Es)
LA: English
AB: This paper deals with the growing of horticultural crops in the desert coastal areas of Abu Dhabi protected against airborne salt by greenhouses, cooled evaporatively by sea water. A trickle irrigation system is applied using nutrients dissolved in desalted seawater and coastal sand as substrate. A specific problem is the formation of "rocks" due to the precipitation of calciumphosphate. Preliminary studies to solve this problem with tomato as test plant are discussed.

TI: Use of sea-water dilutions for irrigation in sand dunes in the northern coasts in Libya.
AU: Abaza-M; Ghoneim-MF; Zwaik-A
SO: Libyan-Journal-of-Agriculture. 1974, 3: 7-18; 24 ref.
LA: English
AB: Alfalfa, barley, beet, flax, safflower and wheat were grown in lysimeters, pots and nursery plots on a highly calcareous sandy soil from the coast at Tajora, and irrigated with sea water diluted with 0 to 90% fresh water. The threshold salinity levels for growth were 10% seawater for flax and safflower, 30% for alfalfa, beet and wheat, and 50% for barley. Beet growth was greater with 10% seawater than with fresh water. Samples of beet plants were analysed for Na, K, P, Ca and Mg concentrations; uptake of each element was nearly independent of the concentration in the irrigation water.
PT: Journal-article

TI: Evaluation of quality and yield in commercial Egyptian cotton varieties in North Sinai.
AU: El-Aziz-MAA; Belal-AH; El-Feky-TA
SO: Egyptian-Journal-of-Agricultural-Research. 1998, 76: 1, 231-245; 19 ref.
LA: English
LS: Arabic
AB: Field experiments were conducted the during the 1995 and 1996 growing seasons in El-Arish, North Sinai, Egypt, to evaluate eight Egyptian commercial cotton (Gossypium barbadense) cultivars, Giza 45, Giza 70, Giza 77, Dandara, Giza 75, Giza 80, Giza 83 and Giza 85, under drip irrigation using slightly saline water (3480-4160 ppm). Earliness was found in Dandara, Giza 80 and Giza 83 over the two growing seasons. Yield and its components were highest in Giza 80 and Giza 83. The total cotton seed yield was the highest in Giza 83 and Giza 80 with mean values of 11.55 and 11.31 Kent/fed., respectively. For fibre properties, Giza 45 showed the highest fibre strength, whereas, micronaire reading (fibre fineness and maturity) was highest in Giza 75, Giza 80, Giza 83 and Giza 85. The highest value of reflectance was recorded from Giza 85. Giza 83 and Dandara had the highest degree of yellowness, and the highest wax % and sugar %, respectively. The data suggested that the most suitable cultivars for the North Sinai condition were Giza 80 and Giza 83.

TI: Effect of saline water on yield response of cotton under sprinkle and furrow irrigation systems.

AU: Sohrabi-TM; Kyani-AR; Pazira-A
SO: Iranian-Journal-of-Agricultural-Sciences. 1998, 29: 3, 543-553; 5 ref.
LA: Persian
LS: English
AB: In a field experiment in Iran, cotton was irrigated by sprinkler or furrow systems with water having salinity levels of 0.36, 2.13, 3.97 or 7.8 dS/m. In The plots sprinkle-irrigated with water of salinity levels of 3.97 and 7.8 dS/m, cotton yield was decreased by about 25 and 36%, respectively, compared with the control (0.36 dS/m). In the furrow-irrigated plots, irrigation with salinity level of 7.8 dS/m decreased the cotton yield 19% compared with the control (0.36 dS/m).

Cereal crops (Maize, rice, wheat, barley, sorghum)

TI: Hydrous and photosynthetic adaptations of common and durum wheat to saline stress.
OT: Adaptations hydrique et photosynthetique du ble dur et du ble tendre au stress salin.
AU: Alem-C; Labhilili-M; Brahmi-K; Jlibene-M; Nasrallah-N; Filali-Maltouf-A
SO: Comptes-Rendus-Biologies. 2002, 325: 11, 1097-1109; 40 ref.
LA: French
LS: English
AB: Seven varieties of bread wheat (Triticum aestivum) and seven varieties of durum wheat (T. durum) were cultivated at three different sites in the area of Errachidia (southeastern Morocco). These sites differed by the degree of salinity of the irrigation water (EC < 0.74, 7 and 14 mS/cm at Errachidia, Dwira and Ain El Atti, respectively). Results on the impact of the reduction of growth on physiological parameters such as photosynthesis, transpiration, foliar water content, and grain yield of the cultivars are presented. The findings showed that the reduction in leaf area is the principal strategy that makes it possible to attenuate the effects of the reduction in the availability of water under saline stress. Bread wheat, which limits the reduction in the leaf area, at the risk of causing problems associated with water stress, seems better able to preserve its photosynthetic potentialities and grain productivity than durum wheat.

TI: Effect of calcium accumulation on the membrane integrity in the barley varieties under salt stress.
OT: Effet de la teneur en calcium sur la stabilite membranaire chez des varietes d'orge soumises au stress salin.
AU: Alem-C; Alaoui-MM; Amri-A; Maltouf-FA
SO: Al-Awamia. 2001, No.104, 9-22; 26 ref.
LA: French
LS: Arabic, English
AB: Irrigation with saline water leads to the decrease in the calcium uptake by the plant. Salt stress causes the perturbation in the structure and function of the plasma membrane. This study was conducted to determine the variations in the membrane stability of Moroccan barley cultivars (Aglou, Arig 8, Asni, Laannoceur, Merzaga 077 and Rabat 071) under salt stress (NaCl and CaCl2), in relation to their ability to accumulate calcium. Results showed that the membrane stability changed with the type of salt stress and the plant parts studied (roots or shoots).

TI: Effects of water quality and nitrogen on yield, yield components and water use efficiency of barley.
AU: Nagaz-K; Mechlia-NB; Horst-WJ (ed.); Schenk-MK (ed.); Burkert-A (ed.); Claassen-N (ed.); Flessa-H (ed.); Frommer-WB (ed.); Goldbach-H (ed.); Olfs-HW (ed.); Romheld-V et-al
SO: Plant-nutrition:-food-security-and-sustainability-of-agro-ecosystems-through-basic-and-applied-research.-Fourteenth-International-Plant-Nutrition-Colloquium,-Hannover,-Germany. 2001, 396-397; 5 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands
LA: English
AB: A field study was carried out in Tunisia [date not given] on sandy soil to determine the effects of water quality and nitrogen on yield and water use efficiency of barley (Hordeum vulgare cv. Ardhaoui). Two irrigation water qualities were used: canal water (3.4 dS/m) and saline water (11.7 dS/m). N was applied at the rate of 0, 60, 120 and 180 kg/ha. Results showed that barley grain yield was significantly decreased with the use of saline water. The reduction in grain yield was mainly attributed to the reduction in the number of spikes per m2, number

of grains per spike and grain weight. The water use efficiency (WUE) decreased significantly with increasing irrigation water salinity. Crop yield, yield components and WUE increased with an increase in nitrogen rates. The rate of 180 kg N/ha was seen to give good yield and high WUE for barley in arid regions of Tunisia.

TI: Nitrogen and water quality effects on yield and water use efficiency of barley (Hordeum vulgare L. cv. Ardhaoui) in the arid climate of southern Tunisia.
AU: Nagaz-K; Ben-Mechlia-N
SO: Agricoltura-Mediterranea. 2000, 130: 1, 11-17; 21 ref.
LA: English
AB: In a field study in 1997/98 on sandy soil at Ben Gardane, Tunisia, barley cv. Ardhaoui was irrigated with canal water (3.4 dS/m) or saline water (11.7 dS/m), and was given 0, 60, 120 or 180 kg N/ha. Grain yield was decreased by irrigation with saline water, mainly due to reduction in the number of spikes/m2, number of grains/spike and 1000-grain weight. Water use efficiency (WUE) decreased significantly with increasing irrigation water salinity. Crop yield, yield component values and WUE increased with increasing N rate.

TI: Leaf K/Na ratio predicts salinity induced yield loss in irrigated rice.
AU: Asch-F; Dingkuhn-M; Dorffling-K; Miezan-K
SO: Euphytica. 2000, 113: 2, 109-118; 39 ref.
LA: English
AB: Salinity is a major constraint to irrigated rice production, particularly in semi-arid and arid climates. Irrigated rice is a well suited crop to controlling and even decreasing soil salinity, but rice is a salt-susceptible crop and yield losses due to salinity can be substantial. The objective of this study was to develop a highly predictive screening tool for the vegetative growth stage of rice to estimate salinity-induced yield losses. Twenty-one rice genotypes were grown over seven seasons in a field trials in Ndiaye, Senegal, between 1991 and 1995, and were subjected to irrigation with moderately saline water (3.5 mS cm-1 electrical conductivity) or irrigation with fresh water. Potassium/sodium ratios of the youngest three leaves (K/NaLeaves) were determined by flame photometry at the late vegetative stage. Grain yield was determined at maturity. All cultivars showed strong log-linear correlations between K/NaLeaves and grain yield, but intercept and slope of those correlations differed between seasons for a given genotype and between genotypes. The K/NaLeaves under salinity was related to grain yield under salinity relative to freshwater controls. There was a highly significant correlation ($p<0.001$) between K/NaLeaves and salinity-induced grain yield reduction: the most susceptible cultivars had lowest K/NaLeaves and the strongest yield reductions. Although there were major differences in the effects of salinity on crops in both the hot dry season (HDS) and the wet season, the correlation was equally significant across cropping seasons. The earliest possible time to establish the relationship between K/NaLeaves under salinity and grain yield reduction due to salinity was investigated in an additional trial in the HDS 1998. About 60 days after sowing, salinity-induced yield loss could be predicted through K/NaLeaves with a high degree of confidence ($p<0.01$). A screening system for salinity resistance of rice, particularly in arid and semi-arid climates, is proposed based on the correlation between K/NaLeaves under salinity and salinity-induced yield losses.

TI: Effect of some soil amendments on the quantity and some chemical properties of wheat yield under irrigation with saline water conditions.
AU: Shabana-MK; Wassif-MM; Saad-SM; Ashour-IA
SO: Desert-Institute-Bulletin,-Egypt. 1998, publ. 1999, 48: 1, 197-207; 16 ref.
LA: English
LS: Arabic
AB: The effect was studied of adding sulphur, organic manure and bituminous emulsion on wheat yield as well as the grains components of N, P, K, protein, ash and carbohydrates under irrigation with saline water containing 4494 ppm salts. Two field experiments were conducted on calcareous soil in the Ras Sudr area of South Sinai, Egypt, during 1989-1990 and 1990-1991 seasons. Data indicated a significant increase in both grain and straw yield of wheat in the two seasons compared with the control treatment. The highest yield was obtained by adding the three amendments together where the average of the two seasons reached 2.48 ton/fed. [1 feddan=0.42 ha] and 2.97 ton/fed for grain and straw respectively. The application of such amendments led to a significant increase in total uptake of N, P and K as well as the percentages of protein, total ash and carbohydrates in grains. The

obtained values varied according to the kind of amendments and in most cases the combined treatment of the three amendments was the best.
PT: Journal-article

TI: Response of some cereal crops to pre-sowing hardening treatments under saline conditions.
AU: Saad-FF; Shaban-SA; Said-A
SO: Assiut-Journal-of-Agricultural-Sciences. 1999, 30: 1, 43-57; 17 ref.
LA: English
LS: Arabic
AB: Two field experiments were carried out at Wadi Sudr Experimental Station, South Sinai, during 1994/95 and 1995/96 to study the effect of four pre-sowing seed-hardening treatments on wheat cv. Sakha 92, barley cv. Giza 123 and triticale cv. Secale 3, on calcareous soil and irrigated with saline water (well water 6400 ppm). Dry seeds (control) were compared with soaking in tap water, 0.01% ZnSO4 or 0.25% CaCl2. Grain yield in both years was higher in barley than in wheat or triticale. Seed soaking in ZnSO4 was the most effective treatment, followed by soaking in CaCl2. Barley was the least responsive species to seed treatments (14-16% response to ZnSO4), while the response to ZnSO4 in triticale reached 69.4% in 1995/96.
PT: Journal-article

TI: Influence of irrigation with saline water on wheat yield, yield components and nutrient uptake.
AU: Abou-Khadrah-SH; Abdel-Hafez-SA; Sorour-FA; El-Bably-AZ
SO: Irrigation management and saline conditions. Proceedings of Regional Symposium, JUST, Irbid, Jordan, June 1999. 1999, 87-97; 21 ref.
PB: Jordan: Univ. Sci. & Technol.; Jordan
LA: English
AB: A pot experiment was carried out in northern Egypt to investigate the influence of irrigation with saline water on growth, yield components and nutrient uptake of wheat cultivars (Sakha8, Sakha69 and Sakha61). Five salinity levels were imposed on the clayey soil by irrigation with water salinised with NaCl and CaCl2. Irrigation water ECS were 0.4, 2.0, 4.0, 6.0 and 8.0 dS/mat SAR 8. Continuous salinity in the water during the growing season significantly reduced plant height, flag leaf area, total dry matter accumulation, number of spikes per pot, number of grains per spike, weight of grains per spike, 1000 grain weight, grain yield and straw yield. Moreover, it decreased total NPK uptake. Sakha8 cultivar was significantly superior to Sakha69 and Sakha61 in total dry matter accumulation, number of spikes per pot, number of grains per spike and total nitrogen uptake. Sakha61 significantly exceeded in flag leaf area, weight of grains per spike and 10000 grain weight as well as total P uptake. Sakha69 was significantly taller.

TI: Response of maize cultivars to plant distribution under different salinity conditions at Siwa Oasis.
AU: Hassan-KH
SO: Annals-of-Agricultural-Science-Cairo. 1999, 44: 1, 189-199; 25 ref.
LA: English
LS: Arabic
AB: In field experiments in 1995-96 at El-Dakrour and Khemisa in the Siwa Oasis, Egypt, maize cv. S.C. 103, T.W.C. 310, D.C. 204 and Giza 2 were sown on 1 or both sloping sides of furrows, with furrow irrigation with brackish water at salinity levels of 1750 and 4300 ppm. High salinity significantly decreased plant height, grain yield and most yield attributes in both plant distribution systems. However, the differences in most yield components between plant distribution systems were more pronounced at low salinity, and were not significant at high salinity.

Aquifers

TI: Effect of groundwater pumping on seawater intrusion in coastal aquifers.
AU: Sherif-MM; Singh-VP; Al-Oufi-HS

SO: International Conference on Soil and Groundwater Contamination and Clean-up in Arid Countries, Muscat, Oman, 20-23 January 2003. Sultan-Qaboos-University-Journal-for-Scientific-Research -Agricultural-Sciences. 2002, 7: 2, 61-67; 10 ref.
LA: English
LS: Arabic
AB: Many aquifers around the globe are located in coastal areas and are thus subjected to the seawater intrusion phenomenon. The growth of population in coastal areas and the conjugate increase in human, agricultural, and industrial activities have imposed an increasing demand for freshwater. This increase in water demand is often covered by extensive pumping of fresh groundwater, causing subsequent lowering of the water table (or piezometric head) and upsetting the dynamic balance between freshwater and saline water bodies. The classical result of such a development is seawater intrusion. This paper presents a review for the seawater intrusion phenomenon in coastal aquifers. The effect of pumping activities on the seawater intrusion in the Nile Delta aquifer of Egypt was investigated. It is concluded that any additional pumping should be located in the middle Delta and avoided in the eastern and western sides of the Delta.

TI: Groundwater utilization and management in the State of Kuwait.
AU: Al-Ruwaih-F; Mohammad-Shehata; Al-Awadi-E
SO: Water-International. 2000, 25: 3, 378-389; 10 ref.
LA: English
AB: The main brackish groundwater resources in the State of Kuwait are the groundwater located in the Kuwait Group and the Dammam limestone aquifers. Most of the groundwater used in the State of Kuwait is for irrigation, some part of it is used for domestic purposes and for small scale industries. Since rainfall is seasonal and is less than the annual evaporation, the recharge from rainfall is negligible. Water levels in both the aquifers are highly affected by the pumping rate from each well. The groundwater is extracted heavily resulting in decline of water levels and the deterioration of groundwater quality though there is underflow from Saudi Arabia. Improvement of the groundwater management is essential for maintaining long-term productivity of the aquifers in the State of Kuwait.

TI: Upconing and saline water intrusion and the need for water conservation in the lower part of Wadi Fatimah, western Saudi Arabia.
AU: Mohammed-Amin-Sharaf; Mohammed-Tahir-Hussein; Al-Bassam-AM
SO: International-Journal-of-Water-Resources-Development. 2001, 17: 2, 211-226; 11 ref.
LA: English
AB: Shallow aquifers were exploited in western Saudi Arabia a long time ago in history. In the last five decades, and under the conditions of an increasing supply of water, many new wells were drilled at relatively deeper intervals than the hand-dug wells of the time. In the downstream part of Wadi Fatimah, and over time, more saline water has been brought up in a number of wells. Overexploitation of groundwater for industrial and agricultural purposes has led to the appearance of two phenomena responsible for the salinization--upconing and saline water intrusion. Upconing occurs in separate pockets while saline water encroachment affects the lower part of Wadi Fatimah and the area towards the Red Sea coast. This article deals with the identification and delineation of areas by each of the two phenomena. The methodologies used in this work are mainly hydrogeological and hydrochemical. Resistivity surveys helped in delineating the fresh water-saline water interface. Methods to control upconing and saline water intrusion are suggested to safeguard the aquifer from further contamination. Effective conservation measures are recommended for the protection of groundwater resources in Wadi Fatimah.

TI: Modeling and analysis of seawater intrusion in the coastal aquifer of Eastern Cap-Bon, Tunisia.
AU: Paniconi-C; Khlaifi-I; Lecca-G; Giacomelli-A; Tarhouni-J
SO: Transport-in-Porous-Media. 2001, 43: 1, 3-28; 27 ref.
LA: English
AB: A numerical model that treats density-dependent variably saturated flow and miscible salt transport was used to investigate the occurrence of seawater intrusion in the Korba aquifer of the eastern coast of Cap-Bon in northern Tunisia. We examined the interplay between pumping regimes and recharge scenarios and its effect on the saline water distribution. More localized simulations were used to examine, in vertical cross sections, the effects of well location and soil type and the role of the vadose zone in possible remediation actions. The

exploratory simulations suggest interactions between the unsaturated zone and the saltwater-freshwater interface with possible implications for groundwater exploitation from shallow unconfined coastal aquifers, involving in one case feedback between seawater intrusion and the high pressure head gradients around the pumping-induced drawdown cone and, in another case, threshold-like interface displacement for tight soils such as clays. The data processing steps undertaken in this GIS and modelling study were described in some detail, and a critical assessment is given of the data availability and of the requirements for successful monitoring and modelling of seawater intrusion risks in heavily exploited coastal aquifers such as those found in the semi-arid regions of the Mediterranean basin. It is shown how, with the aid of GIS, reasonably reliable information can be assembled from maps, surveys, and other sources of geospatial and hydrogeological data, an approach that is necessary in the many regions of the world with acute water resource problems but with limited means for undertaking systematic data acquisition and environmental monitoring actions. The need for more concerted monitoring of relevant parameters and processes and of closer coordination between monitoring and modelling is stressed. An idea of the extent of over-exploitation of the Korba aquifer is obtained by examining the pumping and rainfall/infiltration data, and the simulation results support groundwater pumping as the mechanism for and seawater intrusion as the origin of the salt contamination observed in the soils and subsurface waters of the Korba plain.
PT: Journal-article

TI: Groundwater vulnerability and the reuse of water, with reference to Saudi Arabia.
AU: Lloyd-JW
SO: International-Journal-of-Water-Resources-Development. 2001, 17: 2, 179-184; 20 ref.
LA: English
AB: The abstraction of groundwater in Saudi Arabia, irrespective of quality, is a mining operation so that increasing emphasis will need to be placed on desalinization and the recycling of sewage and industrial waste waters. Aspects of the reuse of such waters are discussed with respect to aquifer protection and aquifer value as a storage medium. This includes the direct application of effluents to land and the introduction of recycled water to aquifers.

TI: Integrated hydrochemical method of water quality assessment for irrigation in arid areas: application to the Jilh aquifer, Saudi Arabia.
AU: Al-Bassam-AM; Al-Rumikhani-YA
SO: Journal-of-African-Earth-Sciences. 2003, 36: 4, 345-356; 14 ref.
LA: English
AB: Water samples from 72 wells tapping the Jilh aquifer were collected and analysed for 10 different water quality parameters. Using these data, a regional irrigation water quality was assessed using three techniques: (i) United States Department of Agriculture method (USDA), (ii) Food and Agriculture Organization (FAO) guidelines for water quality assessment, and (iii) Water-Types approach. The USDA method revealed that the aquifer water salinity, as represented by electrical conductivity, ECw, ranges from high salinity (C3: ECw > 0.75-2.25 dS/m) to a very high salinity (C4: ECw > 2.25 dS/m). The sodium adsorption ratio (SAR) varied from low (S1) to very high (S4) sodicity. Therefore, the water of the Jilh aquifer is dominantly of the C4-S2 class representing 56% of the total wells followed by C4-S1, C4-S3, C3-S1 and C4-S4 classes at 19%, 14%, 8%, and 3% of the wells respectively. The FAO system indicated moderate to severe restriction on the use for irrigation and slight to moderate ion toxicities for Na+, Cl-, B+, NO3- and HCO3-. It is clear that, both USDA and FAO systems condemn the Jilh groundwater as hazardous for irrigation due to its high salt content, unless certain measures for salinity control are undertaken. The dominant salt constituents in the water are Mg-Cl2, Na-Cl and Ca-Cl2 as per the Water-Types method. However, due to the complexity in classifying the aquifer groundwater for irrigation, a simplified approach acknowledging three class groups (I-suitable water, II-conditionally suitable water and III-unsuitable water) adopted from the three methods, is suggested in this paper. The simplified approach combines C-S classes of the USDA method among these three groups according to the lowest ratings. The salinity of the FAO method has been split arbitrarily into slight and moderate subclasses with values of 0.7-2.25 and > 2.25 dS/m, respectively; to match with the C3-class of the USDA system. The Water-Types were classified assuming that Ca-Cl2 is the least hazardous salt, followed by Mg-Cl2 and Na-Cl. Using this integrated hydrochemical method, the majority of the wells (92%) contain unsuitable water for irrigation (Group III) while the remaining wells (8%) are in Group II with water considered conditionally suitable for irrigation.PT: Journal-article

AN: 20043037597

TI: Hydrogeochemical characteristics of processes in the Temara aquifer in northwestern Morocco.
AU: Pulido-Bosch-A; Tahiri-A; Vallejos-A
SO: Water,-Air,-and-Soil-Pollution. 1999, 114: 3-4, 323-337; 14 ref.
LA: English
AB: The physicochemical characteristics of the groundwater of the Temara aquifer were studied by means of piezometric mapping and determination of the ionic composition of the groundwater. In general, the agricultural activity is intense in the area, with water being pumped from numerous wells. Two aquifer formations can be distinguished which, over a wide area, are separated by layers of low permeability. The increased salinity at some points of the coastal zone is probably linked to the combined action of the washing out of Miocene marls, dissolution of carbonate rocks, agricultural pollution and seawater intrusion.
PT: Journal-article

TI: Seawater intrusion in coastal aquifers: guidelines for study, monitoring and control
AD: FAO, Land and Water Development Div., Viale delle Terme di Caracalla, 00100 Rome, Italy
SO: Water-Reports (FAO).
1997, no. 11, 162 p., figs; bibliography (p. 137-150)
LA: English
AB: The problem of seawater intrusion (SI) into coastal aquifers, and measures, both legal and technical, to be taken with the view to studying, monitoring, preventing and controlling SI are described. By the year 2000 more than 66% of the population of developing countries will live in the vicinity of the sea, giving rise to excessive pressure on groundwater, resulting in SI and related deterioration of the water quality. Subjects discussed include: (1) methods for monitoring SI; (2) the use of mathematical SI models; (3) data requirements for groundwater models; (4) the effects of sea level rise; (5) karstic coastal aquifers; (6) legal measures, including water resources planning and regulation; (7) hydraulic and physical measures, including artificial recharge; and (8) SI problems in several countries in the Near East, including Cyprus, Egypt, Lebanon, Syria, Tunisia and Turkey. It is emphasized that enforcement is the key to the ultimate success of regulatory restrictions on groundwater pumping. Technical recommendations, recommendations for improved water resources planning, and recommendations for future action are given.

TI: Promising areas for water development in Northern Somalia.
AU: Faillace-C
SO: Rivista-di-Agricoltura-Subtropicale-e-Tropicale. 1996, publ. 1997, 90: 3, 325-352; 14 ref.
LA: English
LS: Italian
AB: Eight areas were identified for the development of surface and groundwater resources in Northern Somalia using technologies appropriate to local conditions. A shallow, thin aquifer extends along the coastal belt and it could be exploited by infiltration galleries, hand-dug wells, drainage ditches and other structures suitable to tap only the top part of the aquifer to avoid salt water intrusion. The numerous thermal springs and fresh-water springs (_500), are little exploited as they are not captured by spring boxes and piped where water is needed. The underground flow of the numerous temporary river courses filled with sand is only partially tapped by some rudimentary holes dug by the shepherds; conditions are also favourable for the construction of underground dams across many of these temporary river courses. The stored water could be used also for the irrigation of narrow riverine belts. The crystalline basement is highly fractured in certain areas and offers good prospects to find limited amounts of water to be tapped by shallow wells. The limestone and sandstone rocks outcropping in large areas have good conditions for groundwater storage to be exploited by deep wells. The alluvial deposits of the numerous valleys incising the mountain areas have good groundwater conditions which could be exploited by shallow wells. Geological and morphological conditions in the mountain areas are favourable for the construction of small dams. The eight selected areas cover _50% of Northern Somalia. The remaining area was considered unfavourable for future development projects using groundwater due to the high salinity of the aquifer or to its depth. In this very large area, it will be necessary to consider the collection of rain water and runoff water to be stored in appropriate reservoirs and used mainly for animal watering.
PT: Journal-article

TI: Agricultural prospects and water resources in Libya
AU: El-Asswad,-R.M.
AD: Alfateh Univ., Department of Soil and Water, Tripoli, Libya
SO: Ambio (Sweden).
1995, v. 24(6) p. 324-327; Sep, figs, tables, 13 ref.; summary (En)
LA: English
AB: Agriculture in Libya is mainly dependent on underlying aquifers for its water requirements. In some regions of the country, which represent the best agricultural land, the groundwater withdrawn exceeds natural aquifer replenishment by more than 500%, causing a significant annual decline in groundwater levels and seawater intrusion into the coastal aquifers. A number of water management measures are presented. These measures include water transfer, reduction of irrigated areas, desalinization of seawater and complementary measures. Without an extensive programme for managing the country's finite water resources, future generations will face serious water resource problems.

AUSTRALIA

TI: Groundwater irrigation and phosphogypsum application: their influence on soil properties and pasture production in northern Victoria.
AU: Burrow-DP; Surapaneni-A
SO: Australian-Journal-of-Experimental-Agriculture. 2004, 44: 2, 193-205; 33 ref.
LA: English
AB: Saline-sodic irrigation water (ECiw=0.1, 0.8, 2.5, 4.5, 7.5 dS/m, SARiw=3, 5, 11, 17, 29 (mmolc/litre)0.5) was applied to lucerne plots over 1991-95 followed by further irrigation (ECiw=0.1, 0.8, 4.5 dS/m, SARiw=3, 5, 17 (mmolc/litre)0.5) of perennial pasture in 1997-99 with and without added phosphogypsum (PG=0, 5 tonnes/ha; May 1998). The later irrigation treatments and PG did not decrease exchangeable sodium percentage (ESP) in the B horizon nor alter bulk soil physical properties. Microaggregate stability to wetting decreased with increasing residual sodicity and decreasing soil electrolyte concentration. The stability of topsoil aggregates was explained by higher organic carbon content while subsoil aggregate instability was related to higher clay content and higher ESP. Pasture yield decreased by 2 tonnes/ha with an associated increase in soil ESP from 9 to 15%. Pasture yield was highest for ECiw=0.8 dS/m and this treatment marginally increased N uptake in leaves. Higher yields for this treatment could not be readily explained by soil physico -chemical measurements.PT: Journal-article
AN: 20043070577

TI: Salt, water, and groundwater management models to determine sustainable cropping patterns in shallow saline groundwater regions of Australia.
AU: Khan-S; Xevi-E; Meyer-WS
SO: Journal-of-Crop-Production. 2003, 7: 1-2, 325-340; 28 ref.
LA: English
AB: This article describes models which can consider the interactions between plants, soils, water, irrigation practices, crop yields, and economics under shallow, saline groundwater conditions. Personal computing capability has now made it possible to develop a range of interactive modelling tools based on existing and new biophysical concepts. In view of the large number of available models, it is not possible to cover all modelling efforts in a single article. Hence, the discussion in this article is limited to farm and irrigation area scale salt, water, and groundwater management models. It provides an introduction to the SWAGMAN suite of models that have been used in Australia to determine sustainable cropping patterns under shallow, saline water table conditions. Salient features and applications of a detailed process based model (SWAGMAN Destiny), a lumped hydrologic economic model (SWAGMAN Farm) and a distributed biophysical model (SWAGSIM) are provided.

TI: Potential impact of saline irrigation water on the grape industry in the Murray Darling Basin. Final report to the Grape Wine Research and Development Corporation.
AU: Alexander-F; Heaney-A
SO: ABARE-EReport. 2003, No.03.6, iv + 50 pp.; many ref.

PB: Australian Bureau of Agricultural and Resource Economics; Canberra; Australia
LA: English
AB: In response to the salinity problem, the Commonwealth and state governments have agreed to design and implement a National Action Plan to deliver improved salinity and water quality outcomes. A feature of the plan is likely to be investment in defensive or remedial actions where high value assets, such as irrigated crop production in Murray Darling Basin (Australia), are threatened by salinity or deteriorating water quality. The salinity and land use simulation analysis (SALSA) model developed at Australian Bureau of Agricultural and Resource Economics was used to simulate the impact of rising stream salinity on grape yield and producer returns in the basin over a 50-year period. This model combines the simulation and optimization techniques to represent the relationship between surface and groundwater processes and the relationship between these processes and dryland and instream salinity. The impact in soil and water resources on agricultural productivity was simulated by the model. Results from the model showed that grape yields, and thus producer returns, were only marginally affected by rising stream salinity. These results illustrated that stream salinity and increases in salt concentration were generally larger the further along the river system, reflecting higher underlying groundwater salinities. Salt concentrations, and thus grape yield losses, are projected to be highest in the Victorian Mallee and South Australian Riverland horticultural regions where grape production is a major irrigated activity. At the end of the 50-year period, yield losses are negligible in the Goulbourn Valley and the New South Wales Murray catchment, while rising to almost 3% at Lock 2-Morgan. The monthly salinity is likely to be higher in months when vines are most susceptible to damage, which suggests that salt impacts are likely to be greater than those estimated. Grape growers can take steps on farm to reduce the effects of salinity during application of saline irrigation by improving the efficiency of their irrigation system, minimizing salt build up within the root zone and reducing the toxic salt build up within the plant. A range of measures can also be undertaken elsewhere in the basin both on- and off-farm to reduce the salinity of surface water by reducing accessions to saline groundwater systems. Subsurface drains in irrigation areas and groundwater pumping can also reduce accession to groundwater aquifers and high water tables. Appendices provide SALSA model documentation and the people contacted during the completion of the project.

TI: Impact on soil hydraulic properties resulting from irrigating saline-sodic soils with low salinity water.
AU: Bethune-MG; Batey-TJ
SO: Sodicity issues in agricultural industries - current research and future directions. Papers from the International Sodicity Conference, Tatura, Victoria, Australia, 28 February-1 March 2000. Australian-Journal-of-Experimental-Agriculture. 2002, 42: 3, 273-279; 11 ref.
LA: English
AB: Irrigation-induced salinity is a serious problem facing irrigated areas in the Murray-Darling Basin of Australia. Groundwater pumping with farm reuse for irrigation is a key strategy for controlling salinity in these irrigation areas. However, the reuse of highly saline-sodic groundwater for irrigation leads to accumulation of sodium in the soil profile and can result in sodic soils. Leaching of saline-sodic soils by winter rainfall and low salinity irrigation waters are 2 management scenarios likely to exacerbate sodicity problems. Characteristic to sodic soils is poor soil structure and potentially reduced soil permeability. Two indicators of soil permeability are infiltration rate and hydraulic conductivity. A replicated plot experiment was conducted to examine the long-term impact of irrigation with saline-sodic water on soil permeability. High levels of soil sodicity (ESP up to 45%) resulted from 10 years of saline irrigation. Over this period, leaching by winter rainfall did not result in long-term impacts on soil hydraulic properties. Measured soil hydraulic properties increased linearly with the salinity of the applied irrigation water. Leaching by irrigating with low salinity water for 13 months decreased soil salinity and sodicity in the topsoil. The resulting reduction in steady-state infiltration indicates soil structural decline of the topsoil. This trial shows that groundwater reuse on pasture will result in high sodium levels in the soil. Sodicity-related soil structural problems are unlikely to develop where there is consistent groundwater irrigation of pasture. However, structural decline of these soils is likely following the cessation of groundwater reuse.

TI: Effects of irrigation water salinity and sodicity on infiltration and lucerne growth over a shallow watertable.
AU: Slavich-PG; Petterson-GH; Griffin-D

SO: Sodicity issues in agricultural industries - current research and future directions. Papers from the International Sodicity Conference, Tatura, Victoria, Australia, 28 February-1 March 2000. Australian-Journal-of-Experimental-Agriculture. 2002, 42: 3, 281-290; 16 ref.
LA: English
AB: Irrigation using saline sodic groundwater is a major strategy to manage salinization from shallow watertables in the irrigation areas of southeast Australia. There is concern that this strategy will increase soil sodicity and induce a decline in soil physical properties that affect infiltration. Laboratory experiments have shown that the saturated hydraulic conductivity of soils may decrease when a saline-sodic soil is leached with low salinity water. This paper evaluates the field significance of these concerns to irrigation water management practices. The effects of changing the irrigation water source from saline-sodic groundwater to low salinity channel water on the infiltration properties of a hardsetting red-brown earth and the yield of lucerne (Medicago sativa) were evaluated over a 3-year period. Four dilution strategies to use high-salinity (EC 6 dS/m) and high-sodicity [SAR 16 (mmol/L)0.5] groundwater were compared. They were: (i) irrigation with groundwater in the spring then channel water for remainder of the summer irrigation season; (ii) irrigation with channel water in spring then groundwater for the rest of season; (iii) irrigation with diluted groundwater EC 3 dS/m for whole season; and (iv) alternative irrigations with groundwater EC 6 dS/m and channel water throughout the season. The control treatment was irrigated with low-salinity (EC 0.15 dS/m) channel water all season. The treatments were applied for 2 summer irrigation seasons then channel water was applied to all plots for another season. The site was underlain by a shallow watertable at 1.0 m. The final steady infiltration rate of each plot was measured each irrigation using capacitance water level loggers. This value was used as an index of soil structural stability to the water quality treatments. The results show all groundwater treatments caused the soil to increase in salinity from ECe(0-0.15 m) 0.6-0.9 dS/m to 3.8-7.3 dS/m and sodicity from SARe(0-0.15 m) 1.7-2.1 to 14.2-16.8 after 2 years of application. The steady infiltration rate was not affected by treatment during this period. In the third year when all plots were irrigated with channel water there was a small decrease in the steady infiltration rate during irrigation in the alternating groundwater treatment. The steady infiltration rates of the experimental soil were relatively low, varying from 4.9 to 7.0 mm/h for different water quality treatments. The most likely explanation of the small treatment effect is that infiltration in this soil is dominated by water entry via surface cracks. Soil analysis indicated that sufficient electrolyte was maintained in the matrix of the surface soil to prevent significant swelling and clay dispersion, even after many irrigations of channel water were applied. Water balance estimates and changes in profile salinity indicated that the lucerne used significant quantities of water directly from the watertable, concentrating salt within the capillary fringe above the watertable to a maximum of 36 dS/m. A larger proportion of the water requirement appeared to be taken up directly from the watertable where saline irrigation water was also applied. This led to rapid profile salinization and sodification from a combination of upward flux from the watertable and salt applied in the irrigation water.

TI: Genetic variation among and within provenances and families of Eucalyptus grandis W. Hill and E. globulus Labill. subsp. globulus seedlings in response to salinity and waterlogging.
AU: Marcar-NE; Crawford-DF; Saunders-A; Matheson-AC; Arnold-RA
SO: Forest-Ecology-and-Management. 2002, 162: 2-3, 231-249; 32 ref.
LA: English
AB: The economics of tree growing on salt-affected land or with saline water irrigation will be considerably improved if sources of more salt-tolerant seed of commercial tree species can be identified and deployed. This paper deals with three experiments to evaluate variation in salt and waterlogging tolerance among and within provenances and families of Eucalyptus grandis W. Hill (flooded gum) and E. globulus Labill. subsp. globulus (Tasmanian blue gum), both commercially important timber species in southern Australia, but with an overall low to moderate tolerance to salt and combined salt and waterlogging. In experiments 1 (five families of E. grandis from each of seven provenances) and 2 (four families of E. globulus from each of six provenances), four treatments -- control (C), salt (S; 75 and 150 mol m-3), waterlogging (W) and combined salt and waterlogging (SW) -- were applied in factorial combinations to 14-week-old (E. grandis) and 10-week-old (E. globulus) seedlings in sand-filled pots. In experiment 3, the above treatments were applied to 9-week-old (E. globulus; four families) and 12-week-old (E. grandis; four families) seedlings cultured as above, but in this case, salt concentrations were incrementally increased from 150 to 450 mol m-3, and a larger number of seedlings used than for the previous experiments. In all experiments, the salt mix comprised NaCl, MgSO4, MgCl2 and CaCl2

with molar elemental ratios of 12:2:1 of Na:Mg:Ca and 8:1 of Cl:SO4. For both species in experiments 1 and 2, height and shoot dry weight was reduced much more by combined salt and waterlogging than by either treatment alone. Shoot dry weights for S, W and SW treatments were reduced by 49, 77 and 80%, respectively, for E. grandis and by 28, 70 and 73%, respectively, for E. globulus. Large differences in growth were found among families within provenances and among provenances, irrespective of treatment. Although there were marked differences in growth among provenances and families-within-provenances in response to salt, waterlogging and combined salt and waterlogging, these differences were non-significant when ln-transformed data were analysed, except among E. globulus provenances in response to waterlogging ($p < 0.05$). Estimates of narrow-sense heritability (h2) for shoot dry weight in the presence and absence of salt and waterlogging ranged from 0.35 to 0.92. Family differences were found for leaf Cl and Mg concentrations in relation to applied salt. Marked variation in seedling health and height growth was found between individual seedlings within families of both species in experiment 3. Prospects for improving tolerance to salt and combined salt and waterlogging are discussed.

Using saline water for irrigation.
Online publication URL: http://www.agric.nsw.gov.au/reader/10898. New South Wales Dept. of Primary Industries. December 2001
Salinity has long been recognised as a problem in many parts of Australia, and many irrigators have to consider using marginal quality water. If to use saline water for irrigation a clear understanding of how salinity affects a crop is required. Salinity levels have to be constantly monitored to ensure that they stay within the acceptable range, and lower-than- average yields has to be accepted. This discussion tells how salts affect plants, what levels of salinity are acceptable, and some management options for saline irrigation water.

TI: Management of salinity and sodicity in a land FILTER system, for treating saline wastewater on a saline sodic soil.
AU: Jayawardane-NS; Biswas-TK; Blackwell-J; Cook-FJ
SO: Australian-Journal-of-Soil-Research. 2001, 39: 6, 1247-1258; 19 ref.
LA: English
AB: The Filtration and Irrigated cropping for Land Treatment and Effluent Reuse (FILTER) technique was developed to provide a sustainable system for treatment of saline sewage effluent on naturally occurring saline and/or sodic soils. Potentially, it can also be used to ameliorate soils that are salinized by inappropriate application of saline effluent on soils with impeded drainage. The FILTER technique involves using the nutrient-rich effluent for irrigated cropping combined with removal of excess water from the root zone through a subsurface drainage system, during wet weather and winter periods when evapotranspiration demand is low. This paper describes the changes in salinity and sodicity in FILTER plots used for land application of saline sewage effluent on a heavy clay soil (red brown earth; Typic Chromexert) with restricted drainage, at the Griffith City Council sewage works site in New South Wales, Australia. The field experiments consist of trials conducted on four 1-ha plots, over an 18-month period. The pre-FILTER soil chemical characteristics and their changes with FILTER operations were measured. In addition, the volumes and the chemical properties of the effluent applied and subsurface drainage water passing through the soil were monitored. These data are used to explain the salinity and sodicity changes within the FILTER soils, and their potential effects on soil stability. Management options to minimize salinity and sodicity to provide a sustainable system are suggested.

TI: Survival, growth and water use of a range of tree species irrigated with saline drainage water.
AU: Stevens-RM; Sweeney-SM; Meissner-AP; Frahn-WA; Davies-G
SO: Australian-Forestry. 1999, 62: 1, 97-105; 30 ref.
LA: English
AB: Irrigation tests were carried out with 36 species and provenances of mainly Australian native trees (16 Eucalyptus spp., 3 Acacia spp., 3 Casuarina spp., Salix matsudana, Grevillea robusta, Robinia pseudoacacia) using saline drainage water (EC 2 dS/m and boron 2.4 mg/litre, from irrigated horticultural plantings) in a trial sited at Loxton, in semiarid southeastern South Australia. Twelve months after planting, the survival rates amongst species were similar with a site mean of 96%. Three years after planting, the tallest trees were E. gomphocephala and the provenances/clones of E. occidentalis and E. camaldulensis, with heights ranging from 5.3 to 6.7 m; these trees also had the greatest girth, with basal areas (measured at 0.3 m above ground level)

ranging from 16 to 24 m2/ha. The basal area and height of E. camaldulensis was highly variable ranging from 1 m2/ha and 2.1 m for the CML42 clone, to 16 m2/ha and 6.2 m for the Alcoa clone 20. Provenance also had a significant effect on the values of these parameters in E. occidentalis. In the third year, water use rates were determined for 12 of the better growing species. Over the summer, the mean daily water use rates ranged from 49 litres/tree for the Alcoa clone 20 of E. camaldulensis, to 12 litres/tree for E. kondininensis. The Alcoa clone 20 of E. camaldulensis had the higher daily rate of water use per unit area of sapwood, 4.7 kl/m2. The hourly rates of water use per unit area of sapwood rose with increasing vapour pressure deficit up to a value of about 17 hPa and then remained constant as VPD rose to 55 hPa. Variation amongst tree species in the relationships between hourly rates of water use per unit area of sapwood and VPD was highly significant.

TI: Trees for saline environments.
AU: Marcar-N; Arnold-R; Benyon-R
SO: Selected papers from the 1999 Biennial PURSL [National Program for the Productive Use and Rehabilitation of Saline Land] Conference held at Naracoorte in South Australia. Natural-Resource-Management. 2000, June: Special Issue, 14-18; 15 ref.
LA: English
AB: The paper is presented in the context of the problem of dryland and irrigation salinity in southern Australia. Tree growth on saline land is influenced by species and provenances used, site factors (e.g. seasonal waterlogging) and appropriate management which limits root-zone salt accumulation. While commercial species such as Eucalyptus globulus and E. grandis are slightly salt-tolerant, species such as E. occidentalis are highly tolerant. Groundwater use is enhanced when water tables are not too saline (EC<10 dS/m) and not too deep (<4-5 m). There are good prospects to enhance tree growth on saline land through exploitation of genetic variation within species such as E. camaldulensis by producing improved seed, and also through inter-species hybrids.

TI: Commercial forest plantations on saline lands.
AU: Lambert-M; Turner-J
SO: 2000, xviii + 198 pp.; 18 pp. of ref.
PB: CSIRO Publishing; Collingwood; Australia
LA: English
AB: This book reviews published literature on the subject of the establishment of commercial tree crops or plantations on saline land. It provides a synthesis of scientific research and evaluation of field trials in Australia, and is aimed at land scientists, foresters, managers and policy-makers. The book originated from literature searches made as part of activities undertaken by Xylonova, a multidisciplinary research and development programme established to bring together the technology, skills and expertise of Australian forest research organizations to develop hybrid eucalypt (Eucalyptus spp.) species tolerant of salinity and pollution, together with forest management practices which maximize the commercial potential of timber plantations. The book is not intended for use as a manual, but provides the principles that should be considered in establishing and managing plantations under saline site conditions. There are ten chapters: (1) Salt in the environment - both dryland salinity and secondary salinity associated with irrigation are covered, processes relating to soil salinity are described, and a classification of soil salinity presented; (2) Tree crop physiology - includes aspects of salt tolerance in natural environments, plant growth in sodic soils, plant uptake mechanisms, and salt accumulation in plantations; (3) Screening trials for salt tolerance - species selection, laboratory assessments, field trials, comparing results, evaluation of salt in plant tissues, salt tolerance and waterlogging; (4) Species selection and productivity - measuring productivity, genetic selection and breeding programmes, application of biotechnology to the improvement of trees, propagation systems; (5) Products, quality and marketing - plantation development, economic considerations, developing projects; (6) Effects on environmental benefits - effects on groundwater utilization and hydrology, case studies (Kyabram plantation, Victoria, Hotham Valley and Stene's Farm, both in Western Australia), plantation influences on soils, water and salinity, nutrient and salt removals in tree biomass; (7) Effluent irrigation applications - the relation between effluent application in plantations and soil salinity, including an analysis of seven case studies from various regions of Australia; (8) Plantation management in saline environments - the establishment and silviculture of commercial tree plantations, other land uses; (9) Assessment and monitoring of plantation health and environmental values; and (10) Carbon accumulation in forest plantations - potential carbon trading, measuring carbon accumulation in forest plantations. There is a glossary and an index, as well as an extensive bibliography.

TI: Sustainable effluent-irrigated plantations: an Australian guideline.
AU: Myers-BJ; Bond-WJ; Benyon-RG; Falkiner-RA; Polglase-PJ; Smith-CJ; Snow-VO; Theiveyanathan-S
SO: 1999, vii + 286 pp.; refs at end of each chapter, 1 disk.
PB: CSIRO Forestry and Forest Products; Canberra; Australia
LA: English
AB: This guideline contains 17 chapters in four parts, entitled: (A) introduction; (B) planning and designing a plantation; (C) establishing and managing a plantation; and (D) reference section. Part B includes chapters on effluent characteristics; site and species selection; effluent loading rates; impacts on ground and surface water; irrigation system design; and economic evaluation of effluent reuse options. Part C has chapters on establishing, growing and harvesting a productive plantation; irrigation scheduling; and monitoring. Part D contains three models for effluent-irrigated plantations: a water balance model for their design, an irrigation scheduling model, and an economic evaluation model. Also included are chapters on nitrogen dynamics in effluent-irrigated plantations; approvals, licences and regulations; a bibliography of Australian plantations irrigated with effluent or saline water; and a glossary of terms and list of abbreviations.
PT: Book

TI: Sodium and potassium uptake of rice panicles as affected by salinity and season in relation to yield and yield components.
AU: Asch-F; Dingkuhn-M; Wittstock-C; Doerffling-K
SO: Plant-and-Soil. 1999, 207: 2, 133-145; 30 ref.
LA: English
AB: Sodium and potassium uptake of panicles was studied for eight rice cultivars in field trials under irrigation with saline and fresh water in the hot dry season (HDS) and the wet season (WS) of 1994 at WARDA in Ndiaye, Senegal. Sodium and potassium content was determined at four different stages of panicle development and related to salt treatment effects on yield, yield components and panicle transpiration. Yield and yield components were strongly affected by salinity, the effects being stronger in the HDS than in the WS. The cultivars differed in the amount of salt taken up by the panicle. Tolerant cultivars had lower panicle sodium content at all panicle development stages than susceptible ones. Panicle potassium concentration decreased with panicle development under both treatments in all cultivars, but to a lesser extent in salt treated susceptible cultivars. Grain weight reduction in the early panicle development stages (PDS) and spikelet sterility increase in the later PDS were highly correlated ($P<0.01$) with an increase in panicle sodium concentration in both seasons, whereas reduction in spikelet number was not. The magnitude of salt-induced yield loss could not be explained by increases in sodium uptake to the panicle alone. It is argued that the amount of sodium taken up by the panicle may be determined by two different factors. One factor (before flowering) being the overall control mechanism of sodium uptake through root properties and the subsequent distribution of sodium in the vegetative plant, whereas the other (from flowering onwards) is probably linked to panicle transpiration.

TI: Water use of grazed salt bush plantations with saline water table.
AU: Slavich-PG; Smith-KS; Tyerman-SD; Walker-GR; Thorburn-P
SO: Special Issue: interactions between plants and shallow, saline water tables: implications for the management of salinity in Australian agriculture. Agricultural-Water-Management. 1999, 39: 2-3, 169-185; 15 ref.
LA: English
AB: Old man saltbush (Atriplex nummularia) has been widely planted on salt affected land in south-east Australia to provide a vegetative cover which can be used as a fodder reserve. Such plantations are also perceived as having the capacity to use saline groundwater and hence affect the extent of shallow water tables. This paper examines the water use characteristics of saltbush plantations which are regularly grazed and established above shallow water tables (1-2 m). Soil chloride, water content, soil water and sap isotope composition (delta2H), leaf water potential, stomatal conductance, sap flow and climatic conditions were monitored during dry summer and moist winter conditions at two plantations in southern NSW. The results showed that the transpiration rate of old man saltbush was low (less than 0.3 mm/day) throughout the monitoring period. The low transpiration rates were associated with a low leaf area index (0.35), low stomatal conductances and low xylem water potentials. At most times of the year the plants used shallow water sources derived mainly from rainfall. However, up to half the transpiration at the driest time of year (March) was derived from groundwater. Although saltbush can establish

and grow slowly on highly saline land its capacity to transpire saline ground water is small relative to recharge from irrigation and rainfall. Hence, saltbush plantations are likely to have a negligible hydrological impact.
PT: Journal-article

TI: Growth and ground water uptake responses of lucerne to changes in groundwater levels and salinity: lysimeter, isotope and modelling studies.
AU: Zhang-L; Dawes-WR; Slavich-PG; Meyer-WS; Thorburn-PJ; Smith-DJ; Walker-GR; Thorburn-P
SO: Special Issue: interactions between plants and shallow, saline water tables: implications for the management of salinity in Australian agriculture. Agricultural-Water-Management. 1999, 39: 2-3, 265-282; 29 ref.
LA: English
AB: Shallow saline water tables underline large areas of the Riverine Plains of the Murray Basin of southern Australia. It is believed that deep-rooted perennial plants in these areas are able to reduce recharge and use shallow groundwater, thus controlling groundwater levels. Results from WAVES simulations of plant growth, evapotranspiration, groundwater uptake, salt accumulation, and the impacts on lucerne (Medicago sativa) growth were compared against measurements made in lysimeters at Griffith, NSW, Australia. With minimal calibration, WAVES was able to reproduce both the daily and seasonal variation in evapotranspiration, upward flux from the groundwater table, plant growth in terms of leaf area development, soil water profiles, soil water salinity, and root water extraction patterns. There was a decline of 36% in transpiration, 42% in leaf area growth, and 67% in upward flux after the salinity of the water table increased from 0.1 to 16 dS/m. Although the upward flux of water was large, lucerne used little of it (< 20%), preferring 'fresher' rainfall and irrigation water near the surface.

NORTH AMERICA / CALIFORNIA / SAN JOAQUIN VALLEY

TI: Field crop production in areas with saline soils and shallow saline groundwater in the San Joaquin Valley of California.
AU: Ayars-JE
SO: Journal-of-Crop-Production. 2003, 7: 1-2, 353-386; 20 ref.
LA: English
AB: Salinity in soil and water is irrevocably associated with irrigated agriculture throughout the world and as a result requires that salt management becomes an integral part of the production system. With careful water management, it is possible to sustain irrigated agriculture in areas with saline soil and saline groundwater with and without subsurface drainage. The results from two field projects conducted in an area with saline soils and saline groundwater in California, USA demonstrated the type of irrigation systems and management needed to sustain production of moderately salt tolerant and tolerant crops. During the first study at Murrieta farms, yields of cotton and sugarbeet were maintained using both saline and non-saline water for irrigation when pre-plant irrigation and rainfall were adequate to maintain soil salinity at a tolerable level. *Wheat* production was reduced in areas that used saline water for irrigation. Use of saline water containing toxic elements such as boron for irrigation poses a threat to the sustainability of the system. The second study evaluated the management of furrow and subsurface drip irrigation in the presence of shallow saline groundwater. Careful management of the furrow system during pre-plant irrigation and the first irrigation of the growing season was required to prevent waterlogging. It was possible to manage the subsurface drip system to induce significant crop water use from shallow groundwater. Rainfall and pre-plant irrigation were adequate at this site to manage soil salinity.

TI: Use and reuse of saline-sodic waters for irrigation of crops.
AU: Grattan-SR; Oster-JD
SO: Journal-of-Crop-Production. 2003, 7: 1-2, 131-162; many ref.
LA: English
AB: Saline-sodic water is used to irrigate crops where supplies of good-quality water are scarce or in areas affected by high, saline water tables. This review covers the basic irrigation principles, practices, and limitations of irrigation with saline and saline-sodic water. The focus of this review is on studies that have been conducted in the San Joaquin Valley (SJV) of California, USA, because of our personal experiences and extensive number of studies conducted in this area. Particular emphasis is directed towards the control of soil salinization, the adverse effects on soil physical properties, and on the search for potential crops that are suitable for saline systems. Trace

elements such as B, Se, and Mo may also influence the feasibility of using saline-sodic water for irrigation should these constituents be present. This review addresses these elements and discusses how these constituents may or may not affect the overall feasibility of using saline water for irrigation.

TI: Reuse of saline-sodic drainage water for irrigation in California: evaluation of potential forages.
AU: Grattan-S; Grieve-C; Poss-J; Robinson-P; Suarez-D; Benes-S
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002. 2002, 110; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033431

TI: Effects of drainage salinity evolution on irrigation management.
AU: Kan-I
SO: Water-Resources-Research. 2003, 39: 12, 1377; 32 ref.
LA: English
AB: A soil physics theory of solute movement through a drained saturated zone underlying agricultural land is introduced into a long-term economic analysis of farm-level irrigation management; this is an alternative to the immediate, homogeneous blending assumption employed in previous studies as a base for calculating changes in drainage salinity over time. Using data from California, the effect of drainage salinity evolution is analysed through a year-by-year profit optimization under the requirement of on-farm drainage disposal. Paths of optimal land allocation among crop production with fresh surface water, saline drainage reuse and evaporation ponds appear to depend on the relative profitability of the first two; that of reuse is affected by the trend of drainage salinity. Tile spacing and environmental regulations associated with evaporation ponds affect the timing of evaporation pond construction. The system converges into a solution involving both drainage-disposal activities; this solution includes an outlet for salts and is therefore sustainable. Following this strategy, the system is asymptotically approaching a steady state that possesses both hydrological and salt balances. Economic implications associated with land retirement programs in California are discussed.

TI: Drainage water reuse.
AU: Oster-JD; Grattan-SR
SO: Irrigation-and-Drainage-Systems. 2002, 16: 4, 297-310; many ref.
LA: English
AB: Saline-sodic ($4 < EC[dS/m] < 30$; $10 < SAR < 40$) drainage water can be used to irrigate crops that are moderately sensitive, moderately tolerant and tolerant to salinity. However, in order to be sustainable, particular attention is required towards crop selection, control of soil salination, and crop and soil management to maintain soil permeability to water and air. Potential negative impacts of B, Mo and Se on crop yields, forage quality and wildlife also must be taken into account and, if necessary, mitigated. The focus of this paper is the California experience, along the Westside San Joaquin Valley (WSJV), related to these concerns.

TI: Vegetative approach for improving the quality of water produced from soils in the westside of central California.
AU: Banuelos-GS; Sharmarsakar-S; Cone-D; Stuhr-G; Baker-AJM (ed.); van-der-Lelie-D (ed.); Vangronsveld-J (ed.); Zhao-FJ
SO: Advances in phytoremediation. 6th International Conference on the Biogeochemistry of Trace Elements (ICOBTE), University of Guelph, Canada, 1-2 August 2001. Plant-and-Soil. 2003, 249: 1, 229-236; 27 ref.
LA: English
AB: Water reuse is a proposed strategy for utilizing or disposing of poor quality drainage water produced in the westside of central California. This 2-year field study evaluated the ability of two potential forage species to tolerate irrigation with water high in salinity, boron (B), and selenium (Se). The species used were: Sporobulus airoides var. salado (alkali sacaton) and Medicago sativa var. salado (alfalfa). After first year establishment with good quality water (< 1 dS m-1), the two species were furrow-irrigated with drainage effluent that had an average

composition of sulfate-dominated salinity ((electrical conductivity (EC) of 6.2 dS m-1)) B (5 mg l-1), and Se (0.245 mg l-1). Both crops were clipped monthly from June to October of each year. Total dry matter yields averaged between 11 and 12 mg ha-1 for both crops irrigated with effluent for two growing seasons. Plant concentrations of Se ranged from a low of 1.3 mg kg-1 in alkali sacaton to a high of 2.5 mg kg-1 in alfalfa, while B concentrations ranged from a low of 60 mg kg-1 in alkali sacaton to a high of 170 mg kg-1 in alfalfa. Chemical composition of the soil changed as follows from preplant to post-irrigation after two seasons with drainage effluent: EC from 2.78 to 6.5 dS m-1, extractable B from 1.9 to 5.6 mg l-1, and no change in extractable Se at 0.012 mg l-1 between 0 and 45 cm. Between 45 and 90 cm, EC values increased from 4.95 to 6.79 dS m-1, extractable B from 2.5 to 4.8 mg l-1, and no change in extractable Se at 0.016 mg l-1. Increased salinity and extractable B levels in the soil indicate that management of soil salinity and B will be necessary over time to sustain long term reuse with poor quality water.

TI: Model describes sustainable long-term recycling of saline agricultural drainage water.
AU: Letey-J; Birkle-DE; Jury-WA; Kan-I
SO: California-Agriculture. 2003, 57: 1, 24-27; 4 ref.
LA: English
AB: This paper presents a model that describes a farming system for irrigating a salt-tolerant crop with high-salinity drainage water from a salt-sensitive crop as applied to San Joaquin Valley, California, USA. The farming system would include the collection of subsurface drainage water from the salt-sensitive crop, which would then be combined with good, low-salinity water for an average electrical conductivity of 5 dS/m; irrigation of the salt-tolerant crop(s) (cotton, in this case) for several cycles; and final disposal of the drainage water in an evaporation pond. The irrigation management practices, and the long-term sustainability of the system is discussed.

TI: Salinity and irrigation method affect mineral ion relations of soybean.
AU: Grieve-CM; Wang-D; Shannon-MC
SO: Journal-of-Plant-Nutrition. 2003, 26: 4, 901-913; 22 ref.
LA: English
AB: Soyabean (Glycine max) is moderately salt tolerant, but the method of irrigation used for crop production under saline conditions may influence the uptake and distribution of potentially toxic salts. This field study was conducted in California, USA, to determine the effects of application of saline waters by drip and above-canopy sprinkler irrigation, on the ion relations of soyabean cv. Manokin. Salinity was imposed by adding NaCl and CaCl2 (1:1 by weight) to nonsaline irrigation waters. Saline treatments with electrical conductivity (ECi) of 4 dS/m were compared with nonsaline controls (ECi=0.5 dS/m). Ion concentrations in leaves, stems, roots and when present, pods, were determined at the vegetative, flowering, podding and grain filling stage of the crop. Both Na+ and Cl- were excluded from the Manokin leaves and stems when plants were drip-irrigated and the uptake of these ions occurred solely via the root pathway. However, when saline water was applied by sprinkling, the ions entered the leaves by both foliar absorption and root uptake, and their concentrations in the leaves were about 9-fold higher than in those under saline drip irrigation. Regardless of treatment, leaf-K was highest during the vegetative stage, then decreased with plant age as K+ was mobilized to meet nutrient demands of the developing reproductive structures.

TI: Response of safflower (Carthamus tinctorius L.) to saline soils and irrigation: I. Consumptive water use.
AU: Bassil-ES; Kaffka-SR
SO: Agricultural-Water-Management. 2002, 54: 1, 67-80; 28 ref.
LA: English
AB: Salt-tolerant crops can be grown with saline water from tile drains and shallow wells as a practical strategy to manage salts and sustain agricultural production in the San Joaquin Valley (SJV) of California, USA. Safflower (Carthamus tinctorius) was grown in previously salinized plots that varied in average electrical conductivity (ECe) from 1.8 to 7.2 dS m-1 (0-2.7 m depth) and irrigated with either high quality (ECi < 1 dS m-1) or saline (ECi=6.7 dS m-1) water. One response of safflower to increasing root zone salinity was decreased water use and root growth. Plants in less saline plots recovered more water on average (515 mm) and at a greater depth than in more salinized plots (435 mm). With greater effective salinity, drainage increased with equivalent water application rates. Seed yield was not correlated with consumptive water use over the range of 400-580 mm. Total

biomass and plant height at harvest were proportional to water use over the same range. Safflower tolerated greater levels of salinity than previously reported. Low temperatures and higher than average relative humidity in spring likely moderated the water use of safflower grown under saline conditions.

TI: Potential for utilizing blended drainage water for irrigating west side, San Joaquin Valley pistachios.
AU: Ferguson-L; Sanden-B; Grattan-S; Reyes-HC; Wilson-C; Cross-E; Ak-BE
SO: XI GREMPA Seminar on pistachios and almonds. Proceedings of the XI GREMPA Seminar organized by the University of Harran with the collaboration of the FAO-CIHEAM Inter-Regional Cooperative Research and Development Network on Nuts, Sanliurfa, Turkey, 1-4 September 1999. Cahiers-Options-Mediterraneennes. 2001, 56: 155-167; 2 ref.
LA: English
LS: French
AB: Pistachios grown on the west side sometimes experience insufficient irrigation during years of drought. Saline drainage water from other crops is a potential supplemental water source for saline tolerant crops in drought years as well as an inexpensive alternative during non-drought years. However, before the pistachio industry starts using previously unacceptable irrigation water the salt tolerance of California's commercial pistachio rootstocks needs assessment. Our results through 1999 demonstrate that six sequential seasons of irrigation with 8 dS/m water produced no significant effect on marketable yield of trees grown on the four major commercial California pistachio rootstocks. Two sequential seasons of irrigation water with 12 dS/m significantly decreased yield as follows. In 1997, trees grown on UCB-1 rootstocks had a 19% decrease in marketable yield and trees on Atlantica rootstocks had a 14% decrease, trees on PGI and PGII rootstocks had no decrease in yield. In 1998, trees grown on UCB-1 rootstocks had a 49% decrease in marketable yield, trees on Atlantica rootstocks had a 19% decrease, trees on PGII an 18% decrease, and trees on PGI a 14% decrease in marketable yield. In 1999, yields dropped sharply as a result of alternate bearing, making yield comparisons useless.

TI: Salt distribution and plant uptake under drip and sprinkler irrigation with saline water.
AU: Wang-D; Shannon-MC
SO: National-irrigation-symposium.-Proceedings-of-the-4th-Decennial-Symposium,-Phoenix,-Arizona,-USA,-November-14-16,-2000. 2000, 612-617; 7 ref.
PB: American Society of Agricultural Engineers; St Joseph; USA
LA: English
AB: Spatial and temporal distributions of soil salinity are dynamic functions of irrigation methods and plant water extraction. Differences in irrigation methods can also affect plant salt uptake during irrigation with brackish saline water. This study determined the characteristics of salt distributions under drip and sprinkler irrigation regimes and correlated these distributions and irrigation methods with salt concentrations in soyabean plants. Results showed that more salt accumulated in the soil profile in the drip than in the sprinkler irrigation plot. Under salinity treatment, higher concentrations of Na+ were found in roots than in leaves or stems, and significantly higher concentrations of Ca2+ were found in plant leaves than in the stems or roots. Higher concentrations of Cl- were found in leaves and stems in sprinkler than drip irrigation plots, indicating strong foliar uptake of Cl-. For irrigation with saline water, drip irrigation may be more suitable for salt sensitive plant species susceptible to foliar salt damage. Sprinkler irrigation can be used for more salt tolerant plants and can create more leaching, leaving less residual salt in the soil profile at the end of the growing season.

TI: Behavior and distribution of salts under irrigated agriculture in the middle of Baja California, Mexico.
AU: Endo-T; Yamamoto-S; Honna-T; Takashima-M; Iimura-K; Lopez-R; Benson-M
SO: Japanese-Journal-of-Soil-Science-and-Plant-Nutrition. 2000, 71: 1, 18-26; 21 ref.
LA: Japanese
LS: English
AB: Various properties of uncultivated and cultivated soils were investigated in the title area to clarify the behaviour and distribution in the profile of salts by irrigation at three sites. The first site (Guerrero Negro) was managed under trickle irrigation for either one or four years. Although some spots in the area contained 3 dSthinm-1 in ECe (electrical conductivity of saturated extract) that was caused by CaSO4, the average ECe was 1 dSthinm-1. No evidence of a tendency for the accumulation of sodium in the profile was observed because of the sandy texture. Soil pH was above 8.5 due to changes in salt compositions as the result of irrigation. The second

site (Vizcaino) was managed using furrow irrigation for a decade. The irrigated soil had some accumulation of sodium salt on the surface. This has been ascribed to the poor quality of the irrigation water. Although irrigation water with a high salt concentration was applied, there was a stable crop yield for a decade. This may have been possible because of the sandy soil texture through which salts were easily leached to lower layers. The third site (Jesus Maria) was managed using furrow irrigation for eleven years. The soil had mainly sodium salt accumulation on the surface (>10 dSthinm-1 ECe value). It sustained stable crop production for eleven years. These findings indicate that irrigation water quantities should be supplied in amounts and qualities just enough to meet crop requirements without exacerbating salt accumulation.
PT: Journal-article

TI: Long-term reuse of drainage waters of varying salinities for crop irrigation in a cotton-safflower rotation system in the San Joaquin Valley of California - a nine year study: I. Cotton (Gossypium hirsutum L.).
AU: Goyal-SS; Sharma-SK; Rains-DW; Lauchli-A
SO: Special issue: Water use in crop production. Journal-of-Crop-Production. 1999, 2: 2, 181-213; 44 ref.
LA: English
AB: Use of saline drainage water for crop irrigation was evaluated in the San Joaquin Valley, California, as a means of decreasing its volume. Results of a nine-year crop rotation (cotton-cotton-safflower, X3) in which only the cotton was irrigated with drainage water of 400, 1500, 3000, 4500, 6000, and 9000 ppm total dissolved salts are presented. The different salinity levels of irrigation waters were achieved by mixing non-saline canal water (400 ppm) and saline drainage water. Cotton lint yields were not affected by increased salinity level of the irrigation water for the first two years. Detrimental effects became evident in the third cotton crop with increasing severity in later years. In the fifth year of cotton (seventh year of the study), lint yields were adversely affected by waters of salinity greater than 3000 ppm. However, fibre quality remained unaffected at all levels of irrigation water salinity. The reductions in lint yield appeared to be a function of time and the salinity level of applied water. Shoot height and biomass were reduced by the irrigation water salinity before lint yields. Stand establishment appeared to be the most sensitive to salinity and was perhaps the main reason for yield reduction. Increase in irrigation water salinity increased Na+ content of leaf blades and petioles and decreased K+/Na+ ratio of leaf blades and petioles. It is concluded that irrigation waters of up to 3000 ppm salinity may be used for four years without any yield reductions, as long as some leaching occurs through preplant irrigations with low salinity water. Data on crop growth and development and ionic content collected over the nine year period are presented.

TI: Saline-sodic drainage water - a resource for forage production ?
AU: Oster-JD; Kaffka-SR; Shannon-MC; Grattan-SR
SO: Irrigation under conditions of water scarcity. Vol 1F. 17th ICID International Congress on Irrigation and Drainage, Granada, Spain, 13-17 September 1999. 1999, 195-207; 23 ref.
PB: New Delhi: International Commission on Irrigation and Drainage; India
LA: English
AB: Saline-sodic drainage water (EC> 4 dS/m; SAR > 4 (mmol/l)0.5) can potentially be used for production of salt-tolerant forage along the land-locked west-side of the San Joaquin Valley, California. Forage crops are currently in short supply and sequential reuse of drainage water, for such forage production, could reduce the volume of drainage water that needs to be dealt with. This could mean that the area required for evaporation ponds could be reduced by at least one order of magnitude. Crucial management issues include: (i) salt-tolerant characteristics of potential forage crops; (ii) effects of saline-sodic drainage waters and soil texture on soil physical characteristics such as soil tilth and leaching requirements; (iii) crop rotation / water quality impacts on forage produce; (iv) off-site impacts on crop disease and wild-life; and (v) familiarity by growers with the crops.

TI: Potential suitability of the halophyte Salicornia bigelovii as the final crop in a drainage water reuse sequence.
AU: Grattan-SR; Benes-SE; Peters-DW; Mitchell-JP
SO: Irrigation under conditions of water scarcity. Vol 1G. 17th ICID International Congress on Irrigation and Drainage, Granada, Spain, 13-17 September 1999. 1999, 107-120; 11 ref.
PB: New Delhi: International Commission on Irrigation and Drainage; India
LA: English

AB: A drainage water concept was proposed for the San Joaquin Valley of California, USA where saline drainage-water was used sequentially to irrigate progressively more salt-tolerant crops. Halophytes are the final crop in the sequence, prior to disposal. Salicornia bigelovii has emerged as a promising halophyte. Field and greenhouse studies have shown that this native coastal plant can grow and thrive in the desiccating conditions of the valley when irrigated with Na-sulfate drainage water (29 dS/m and >25 mg/l B). The plant can maintain relatively high evapotranspiration rates comparable to reference ET0 showing that it can be effective at reducing drainwater volumes. The seeds of S. bigelovii produce oil high in polyunsaturated fat comparable to soyabean and young stems can be eaten as a supplement to salads. Thus the plant has excellent potential for reducing drainage volumes, and thereby decreasing the area needed for environmentally sensitive evaporation ponds. Results to date from a 3 year greenhouse study have shown that S. bigelovii grows well over the range of salinity treatments (10 - 45 dS/m) regardless of whether they were irrigated with hypersaline drainage water or seawater. At higher salinity levels, plants performed better in the seawater treatment than in the drainage water treatments. Salicornia grew well in a field in the western part of the San Joaquin Valley when irrigated with 29 dS/m drainage water containing high levels of B and Se. Cumulative ET rates from field-grown salicornia exceeded ET0.

TI: Effect of saline irrigation water composition on selenium accumulation by wheat.
AU: Grieve-CM; Suarez-DL; Shannon-MC
SO: Journal-of-Plant-Nutrition. 1999, 22: 9, 1443-1450; 17 ref.
LA: English
AB: A study was conducted to determine the effects of irrigation water composition and salinity level on Se accumulation in leaves and grain of spring wheat (Triticum aestivum cv. Yecora Rojo). Plants were grown in greenhouse sand cultures and irrigated with complete nutrient solution. Salinity treatments were initiated 4 days after sowing by irrigating the seedlings with either chloride-dominated waters or with waters containing both chloride and sulfate salts. Compositions of the mixed salt waters were designed to simulate saline drainage waters commonly present in the San Joaquin Valley of California. The experimental design was a randomized complete block with two salinity types (Cl- or mixed salts), eight salinity levels (osmotic potentials=0.07, 0.16, 0.21, 0.30, 0.36, 0.44, 0.52, and 0.63 MPa), and three replications. Four weeks after sowing, Se (1 mg litre-1 as sodium selenate) was added to all irrigation waters. In the chloride system, the molar ratio of SO42-:SeO42- was approximately 110 across all salinity levels, whereas in the mixed salt system, the SO42-SeO42- ratio in solution increased from about 300 to 4700 as salinity increased. Selenium concentration was determined in fully-expanded flag leaf blades and grain. Salinity type, and to a lesser extent, salinity affected Se accumulation. In the Cl-- system, wheat accumulated Se to levels that may be potentially harmful to livestock and humans, e.g., blade-Se ranged from 435 to 295 mg kg-1 dry wt; grain-Se ranged from 81 to 54 mg kg-1 dry wt. Under the saline conditions of the mixed salt system, the inhibition of selenium uptake by sulfate reduced both blade- and grain-Se to levels that would minimize the health risk to consumers.

TI: Growth, water use and salt uptake of four halophytes irrigated with highly saline water
AU: Miyamoto,-S.; Glenn,-E.P.; Olsen,-M.W.
AD: Texas A and M Univ., Agricultural Research Center, 1380 A and M Circle, El Paso, Texas 79927, USA
SO: Journal-of-Arid-Environments (UK). 1996, v. 32(2) p. 141-159; Feb, figs, tables, 24 ref.; summary (En)
LA: English
AB: Halophytes have been considered potential crops for irrigated production with brackish water or seawater. This study was conducted to obtain quantitative information on salt tolerance, water use and salt uptake responses of 4 halophytes: Atriplex nummularia, Distichlis palmeri, Batis maritima, and Suaeda esteroa. Outdoor lysimeter experiments were conducted during the summer of 1991 and again during the spring of 1992 in the subtropic coastal desert of Sonora, Mexico. The plants were grown at an average leaching fraction of approx. 0.3 with diluted or concentrated seawater having salinity levels of 1.2, 10, 20, 40, and 60 g/l. Results indicate that these halophyte species can be grown productively at a leaching fraction of 0.3 or less when salinity of the irrigation water is less than 10 g/l. At higher salinities, frequent irrigation at higher leaching fractions may be required for these species. Authors' summary.

TI: The effect of environmental conditions on the growth and development of the oilseed halophyte Salicornia bigelovii Torr. in arid Baja California Sur, Mexico
AU: Troyo-D,-E.; Ortega-R,-A.; Maya,-Y.; Leon,-J.L.

AD: Centro de Investigaciones Biologicas de Baja California Sur, La Paz, Mexico
SO: Journal-of-Arid-Environments (UK).
1994, v. 28(3) p. 207-213; Nov, figs, tables, 24 ref.; summary (En)
LA: English
AB: The growth and development of a natural population of the annual halophyte Salicornia bigelovii as affected by environmental factors were analysed in Baja, California Sur, Mexico. The seeds of Salicornia bigelovii have potential as an alternative source of oil and flour, and thus the plant has potential as a seawater-irrigated oilseed crop. Four transects were traced in a coastal salt marsh, from which samples of soil and plants for laboratory analysis were taken, starting at the lowest seashore tide line. Edaphic and environmental factors as well as biomass, plant density, size, and dry matter were analysed through multivariate statistical methods. Growth was positively correlated with soil organic matter, and negatively correlated with the percentage of sand as a component of texture and with the Na balance (sodium adsorption ratio) in the soil saturated paste. Authors' summary.

TI: Fourwing saltbush seedling survival using saline irrigation
AU: Aldon,-E.F.; Doria,-J.R.C.
AD: Rocky Mountain Forest and Range Experiment Station, Albuquerque, New Mexico, USA
SO: Arid-Soil-Research-and-Rehabilitation (USA).
1993, v. 7(3) p. 243-251; Jul, fig, photo, tables, 12 ref.; summary (En)
LA: English
AB: Fourwing saltbush (Atriplex canescens) is an important species in arid and semi-arid plant communities. It is palatable, drought resistant, and provides good soil protection and forage for livestock and wildlife. In many areas of the world, lands once used for growing crops are now without vegetation because of declining water tables, brackish groundwater, saline soil conditions, or combinations of these. Fourwing saltbush can grow in such areas and improve site productivity and stability. The survival and establishment of 2 different ages of seedlings were tested in Mexico in 1989, using 17 different saline supplemental irrigation schedules. Large seedlings (18.5 cm at start) survived all watering regimes, which included 8 weeks of 100% seawater irrigation. They grew to a height that ranged between 24.9 and 37.6 cm, depending on the concentrations and frequency of saline water irrigations. Small seedlings (5.2 cm at start) had significantly lower survival at all concentrations of irrigation water. Small plant height ranged from 10.9 to 27.6 cm after 8 weeks of irrigation, depending on treatment salinity. Dry weights of tops and roots after 8 weeks for both size seedlings followed similar trends. Authors' summary.

TI: Chemical effects of saline irrigation water on a San Joaquin Valley soil: I. Column studies.
AU: Thellier-C; Sposito-G; Holtzclaw-KM
SO: Journal-of-Environmental-Quality. 1990, 19: 1, 50-55; 26 ref.
LA: English
AB: A glasshouse soil column experiment was performed to characterize salinity and sodicity developed from water of differing compositions applied to a representative soil from the San Joaquin Valley of California. The soil column experiment was designed to simulate physicochemical conditions in a field experiment conducted in the western San Joaquin Valley, where an Entisol above a shallow, saline aquifer was irrigated with waters of varying quality. Columns 0.46 m long containing the Entisol were leached with, California Aqueduct water, (EC = 0.72 dS m-1, SAR = 4 molc 1/2-3/2) or with saline 'well water' (EC = 8 ds m-1, SAR = 13 molc 1/2m-3/2) for periods up to 1 yr. When a simulated 'aquifer' was 0.43 m below the soil surface, leaching with aqueduct water produced a positive downward gradient of soluble salt concentrations and exchangeable Na, whereas leaching with well water produced a dramatic increase of sodicity at the soil surface and a zone of soluble bivalent cation accumulation about 0.2 m below. These effects reflected the combined influence of the applied water quality and evaporative capillary rise from the saline 'aquifer.' After the simulated 'aquifer' was withdrawn, soil saturation extracts indicated equilibrium with the applied water after 0.5 to 1 yr, the rate being greater under leaching with aqueduct water. The saturation extract and drainage effluent for the soil receiving aqueduct water became more dilute, producing calcite dissolution and increasing exchangeable Ca, with a consequent decline in sodicity. The soil receiving well water showed an increase in exchangeable Na at the expense of exchangeable Ca, with little or no change in exchangeable K and Mg. At the completion of the experiment, the soil irrigated with well water had become more saline and sodic but, since EC was sufficiently high as compared to SAR no major permeability

problems with the soil were expected. Therefore, from the results of this study, the reuse of saline drainage water would appear to be suitable for agricultural purposes provided that salt-tolerant crops were grown.
PT: Journal-article

TI: Management of water use in agriculture
AU: Tanji,-K.K. (ed.); Yaron,-B. (ed.)
AD: Department of Land, Air and Water Resources, University of California, Davis, California, USA
SO: Advanced-Series-in-Agricultural-Sciences (Germany).
Berlin (Germany), Springer Verlag, 1994, v. 22, 339 p., figs, photos, tables; bibliography (vp.)
LA: English
AB: An overview is presented of the issues and problems of water management in agriculture, with special reference to the situation in the USA. The following subjects are reviewed: (1) global water resources and agricultural water use, including water quality considerations for crops and animal production; (2) irrigation systems, drainage and shallow groundwater management, runoff irrigation, and efficient methods of water use in rainfed agriculture; (3) use and treatment of problem waters, including irrigation with saline waters and treated sewage effluents, as well as treatment and disposal of unusable drainage waters; and (4) the economics of non-uniform water infiltration, irrigation under drought conditions, and management and policy issues in irrigation of agricultural crops.

TI: Recycling drainage water in San Joaquin Valley, California.
AU: Oron-G
SO: Journal-of-Irrigation-and-Drainage-Engineering. 1993, 119: 2, 265-285; 33 ref.
LA: English
AB: A conceptual framework for on-farm recycling of the saline wastewater is proposed as a means to diminish environmental damage and to reuse water efficiently. The decision-making support model is based on data collected in the San Joaquin Valley, California, and is intended to predict the water flow rates of the various system components towards reuse. The model assumes that agricultural practices of surface water application will not change soon, and that drains have been installed in the fields. The case study shows that the cost of on-farm reuse of saline wastewater is in the range of $0.07-$0.26 per m3.
PT: Journal-article

TI: Agroforestry systems for on farm drain water management.
AU: Jorgensen-GS; Solomon-KH; Cervinka-V
SO: Drainage and water table control: Proceedings of the Sixth International Drainage Symposium 13-15 December 1992 Nashville, Tennessee. 1992, 484-490; 7 ref.
PB: American Society of Agricultural Engineers (ASAE); St Joseph; USA
LA: English
AB: The agroforestry concept for management of saline water drained from irrigated or waterlogged soils, and land with rising water tables, is to irrigate salt-tolerant trees and other crops with agricultural (cropland) drainage water in order to concentrate the salts and reduce the volume of drainage water which must ultimately be treated or disposed of. At an agroforestry demonstration site near Mendota, California, water with an electrical conductivity averaging 10 dS/m was applied to Eucalyptus camaldulensis and other salt tolerant trees. Water not consumed by evapotranspiration and percolating below the root zone was recaptured by a tile drain system. The concentrated water was applied to Atriplex canescens and other halophytes that can utilize poor quality water and further reduce the drain water volume. Drain water collected from these fields was placed in above-ground evaporation tanks, where the salts and other chemical constituents can be removed from the farming system. The economic contribution of agroforestry to the farm depends on the value of the biomass produced for the local marketplace, and on the avoided costs of even larger evaporation ponds and treatment facilities that would otherwise be necessary.

TI: Productivity and irrigation requirements of halophytes grown with seawater in the Sonoran Desert
AU: Glenn,-E.P.; O'Leary,-J.W.
AD: Environmental Research Lab., University of Arizona, Tucson, Arizona, USA
SO: Journal-of-Arid-Environments (UK).

1985, v. 9(1) p. 81-91; Jul, figs, tables, 19 ref.; summary (En)
LA: English
AB: Irrigation requirements and above-ground yields of halophytes (Atriplex, Salicornia, Distichlis, Cressa and Batis species) grown on seawater were estimated in the Sonoran desert at Puerto Penasco, Sonora, Mexico and Tucson, Arizona, USA. Sprinkler and flood methods of irrigation were compared at Tucson. The most productive halophytes yielded the equivalent of 10 - 17 t/ha of biomass and 0.6 - 2.6 t/ha of protein, which compares favourably with a conventional biomass crop such as lucerne grown on fresh water, which yields 5 - 10 t/ha of dry matter and 0.5 - 3.0 t/ha of protein in the USA. Minimum effective water application was 18m/year (5 cm once daily) when seawater was flooded on porous sand. The sprinkler method produced over 1000 g dry weight/m2 of Salicornia bigelovii with only 2.4 m of brackish water, which is comparable with water use for lucerne in desert irrigation districts.

CHINA / MONGOLIA / CENTRAL ASIA

TI: The movement of water and salt in sandy land after irrigated with saline water.
AU: Huang-Qiang; Li-ShengXiu; Song-YuDong; Huang-Q; Li-SX; Song-YD
SO: Acta-Pedologica-Sinica. 2003, 40: 4, 547-553; 8 ref.
LA: Chinese
LS: English
AB: A field experiment was conducted to study water and salt movement in soil in the centre of the Takelamakan desert (China) after irrigation by saline groundwater. A series of data about soil water potential, soil water content and electrical conductivity (EC) value of soil solution at different depths along the soil profile were obtained at different times after stopping irrigation. Twenty-four hours after irrigation, 8.85% of the amount of irrigation water were contained in the soil layer of 0-150 cm. Seventy-two hours after irrigation, 3.4% of the amount of irrigation water were contained in layer of 0-150 cm, and the average soil water content in this soil layer was 5.3%. After this time, soil water content in this layer reduced slowly. During the time from stopping irrigation to seventh day after stopping irrigation in autumn, the daily evaporation water amount was between 2-6 mm. Two hours after irrigation, soil water contained in the layer of 0-20 cm moved upward to the surface of ground, while 72-144 h after irrigation, the upward region of soil water extended to the depth of 90 cm underground. When irrigated with saline water with an EC value of 6.3 mS cm-1, the EC value of the soil solution reduced obviously in the upper part of the layer and was almost the same as that of before irrigation in the lower part of the layer. Twenty-four hours after irrigation, the amount of salt contained in the soil solution in 0-150 cm layer was less than that of before irrigation, while 144 h after irrigation, it was only 53.46% of that of before irrigation. After stopping irrigation, the daily amount of salt accumulated on the ground surface with an area of 100 cm x 100 cm was 13-35 g in autumn.

TI: Research progress on irrigation with lightly salted water.
AU: Wang-WeiGuang; Wang-XiuGui; Shen-RongKai; Yang-ShuQing; Hu-WenMing; Wang-WG; Wang-XG; Shen-RK; Yang-SQ; Hu-WM
SO: Water-Saving-Irrigation. 2003, No.2, 9-11; 14 ref.
LA: Chinese
LS: English
AB: Underground lightly salted [brackish] water resources are relatively abundant in China and using them efficiently could be an important method to resolve the water resource crisis. Research data from domestic and overseas studies on light salt water irrigation (LSWI) are summarized, including the adaptability and technology of LSWI, and the environmental impact. Current problems in LSWI are discussed, including comprehensive LSWI technology for combining regional characteristics, effects of large-scale LSWI on equalization factors of regional water resources, and safety of LSWI.

TI: Study on salinity situation of seashore saline soil under seawater irrigation.
AU: Zhao-GengMao; Liu-ZhaoPu; Chen-MingDa; Deng-LiQun; Wu-JiaMei; Zhao-GM; Liu-ZP; Chen-MD; Deng-LQ; Wu-JM
SO: Scientia-Agricultura-Sinica. 2003, 36: 6, 676-680; 10 ref.

LA: Chinese
LS: English
AB: Fifteen undisturbed soil columns were studied in Jiangsu, China during summer to investigate the salinity condition of seashore saline soil under sea water irrigation. Results showed that salt movement and distribution at 0-40 cm depth of seashore saline soil were very active, but salt at 40-120 cm depth was relatively stable. Salt peak was not observed in on-irrigating treatments through the summer, and was in more stable situation of desalinization. A low salt was observed with the presence of temperature and evaporation. Salt movements and distribution in sea water irrigating treatments were very different from that in non-irrigating treatments. A very high salt peak was occurred at 0-5 cm depth and a low salt peak at 5-40 cm depth. However, no salt peak was observed below 40 cm depth of the columns. The higher concentration of the sea water and the longer time of intensive evaporation, the more salt in topsoil was cumulated. Sodium ion was rapidly absorbed by the soil glue through Ca2+, Mg2+ exchange, thus Na2+ was very stable in bulk. On the other hand, Ca2+ and Mg2+ were apt to leach out from the bulk. The action of Cl- was active, and it was cumulated under high evaporation and leached by the rainfall and sea water irrigation. HCO3- was not very vulnerable with the changes in the outer condition. In addition, optimum sea water concentration used to irrigate saline soil could not make the soil cumulate soluble salt.

TI: Experimental study on soil water erosion under surge irrigation and use of PAM in Hetao Irrigation Region, Inner Mongolia.
AU: Yuan-PuJin; Huang-XingFa; Lei-TingWu; Zhang-JianGuo; Zhan-WeiHua; Wang-JianPing; Liu-ZhiZhong; Yao-ChunMei; Yuan-PJ; Huang-XF; Lei-TW; Zhang-JG; Zhan-WH; Wang-JP; Liu-ZZ; Yao-CM
SO: Journal-of-China-Agricultural-University. 2002, 7: 2, 36-40; 9 ref.
LA: Chinese
LS: English
AB: A study on the effects of surge irrigation, polyacrylamide polymer (PAM) and irrigation with saline groundwater on soil water erosion was carried out in Hetao Irrigation District, Inner Mongolia. Results showed that irrigation methods had less influence on soil water erosion. On the other hand, PAM had great effect on soil water erosion. The sediment content in the treatment with omega(PAM)=10 x 10-6 was 14.57% of that under treatment without PAM in continuous irrigation. While under surge irrigation, that was 0.91% of the amount in no PAM treatment. Soil water erosion in irrigation field can be mostly prevented by applying PAM with concentration as low as 10 x 10-6. When PAM concentration reaches as high as 20 x 10-6, there will be almost no sediment in the flow of irrigation water in furrows.

TI: Effect of marginal water irrigation on soil salinity, sodicity and crop yield.
AU: Li-FaHu; Benhur-M; Keren-R; Li-FH
SO: Transactions-of-the-Chinese-Society-of-Agricultural-Engineering. 2003, 19: 1, 63-66; 8 ref.
LA: Chinese
LS: English
AB: Irrigation with marginal water for an extended period of time could result in potential secondary soil salinization and sodification. The influence of marginal water irrigation on the dynamic balance of soil salinity and sodicity, as well as crop yield under shallow groundwater table, was investigated. This experiment was conducted in a subsurface-drained plot in China with silt clay soil where forage maize (Zea mays) had been planted. The lateral movement of saline and sodic groundwater and its evaporation resulted in a significant difference in salt and sodicity distribution between the northern and southern parts of the experimental plot. Under the experimental conditions, salt in the 0- to 1.2-m soil increased by an average of 7.5% and sodicity by 19.6% during the maize growth season. Plant yield and height were inversely correlated with soil salinity. Among the grain yield, dry matter weight and plant height, the grain yield was most negatively affected by soil salinity. Therefore, utilizing rainfall in winter to leach soil salt is necessary to maintain sustainable irrigation agriculture in this region.

TI: The utilization of highly saline water in planting and vegetable growing in desert hinterland.
AU: Pan-BoRong; Gu-FengXue; Pan-BR; Gu-FX; Ahmad-R (ed.); Malik-KA
SO: Prospects-for-saline-agriculture. 2002, 269-276; 3 ref.
PB: Kluwer Academic Publishers; Dordrecht; Netherlands

LA: English
AB: A study was conducted to determine the feasibility of using highly saline water in planting and vegetable growing in a desert hinterland in the Taklimakan Desert, Xinjiang, China. Results indicate that utilization of highly saline water in planting and vegetable growing in desert hinterlands is quite feasible. Although salts in the soil were culminated, the content of soil nutrient and particulate matter was increased. The population of soil microorganisms and enzyme activity were also increased.

TI: Use of saline water for irrigation of halophytes, forages production and raw materials for medicine in arid regions of Russia and Central Asia.
AU: Shamsutdinov-Z; Buravtsev-VN; Shamsutdinov-NZ
SO: Food-production,-poverty-alleviation-and-environmental-challenges-as-influenced-by-limited-water-resources-and-population-growth.-Volume-1A.-18th-International-Congress-on-Irrigation-and-Drainage,-Montreal,-Canada,-2002. 2002, 17; 10 ref.
PB: International Commission on Irrigation and Drainage (ICID); New Delhi; India
LA: English
AB: Experiments were conducted on the irrigation of potential fodder crops and medicinal halophytes in the arid territories of Russia and Central Asia using saline groundwaters (0.9 dS/m), Caspian sea water and saline drainage water (0.6 dS/m). The crops tested were the halophytes Kochia scoparia, Suaeda arcuata, Climacoptera lanata, Aeluropus littoralis, Agropyron elongatum [Elymus elongatus], etc. Fodder halophytes were found to give yields of 12-18 t/ha for dry fodder mass and 1.5-3.0 t/ha for seeds when irrigated by saline water. Similarly perennial medicinal halophytes Glycyrrhiza glabra and Glycyrrhiza uralensis- yielded about 8-12 t/ha dry root mass. Salt extraction halophytes (Salicornia europaea, Suaeda accuminata, Bassia hyssopifolia, Climacoptera lanata) gave yields of 16-20 t/ha dry phytomass, and with 36-50% salt content. This last group could be used in combination with soil surface protection - by shading and reduction of physical evaporation - to lead to soil desalinization.
TI: Effect of brackish water on soil environment in saline area of Quzhou of Hebei Province.
AU: Qiao-YuHui; Yu-ZhenRong; Qiao-YH; Yu-ZR
SO: Transactions-of-the-Chinese-Society-of-Agricultural-Engineering. 2003, 19: 2, 75-79,; 7 ref.
LA: Chinese
LS: English
AB: Irrigation experiments with brackish and fresh water in the fields of Quzhou saline area, Hebei Province, China, were conducted to investigate the water consumption, its composition and the environmental effects on the soil. Extremely high amount of water resulted to an insufficient use of soil water which is an important part of crop water consumption. Irrigation with brackish water increased the soil salt content, and at the end of wheat growing season, the conductivity of soil solution will be up to 10 mS/cm. Appropriate measurements should be taken to avoid the negative effects on the crops. If the brackish water can be used sparingly, it can be used as a substitute for fresh water resources.

TI: Experimental investigation into effects of drip irrigation with saline groundwater on water use efficiency and quality of honeydew melons in Hetao Region, Inner Mongolia.
AU: Lei-TingWu; Xiao-Juan; Wang-JianPing; Liu-ZhiZhong; Li-GuangYong; Zhang-JianGuo; Mao-JianHua; Lei-TW; Xiao-J; Wang-JP; Liu-ZZ; Li-GY; Zhang-JG; Mao-JH
SO: Transactions-of-the-Chinese-Society-of-Agricultural-Engineering. 2003, 19: 2, 80-84, VI; 8 ref.
LA: Chinese
LS: English
AB: A study on the suitability of honeydew melons drip-irrigated with saline groundwater was conducted in Changsheng Experimental Station in Hetao Region, Nei Menggu (China), where secondary soil salinity has been a problem for a long time. Saline groundwater, ranging from 3.3 dS/m in the early season to 6.3 dS/m at the harvest, was used as the source of the drip irrigation system. Four irrigation treatments were used for the experiments, namely 30, 60 and 90% of evaporation and control. The control was not irrigated throughout the season as is the local practice. Zero, 1, 2 and 3 laterals of equal flow rate were used in the drip system for applying water to control, 30, 60 and 90% treatment, respectively, at the same period of time and same frequency. Results showed that the yield of honeydew melons increased and the quality of those under treatments of drip irrigation improved, as compared with those under control, with highest increased in yield under 60% treatment. The water use efficiency as determined by lysimeter measurements for different treatments had the same trend.

The water production efficiencies of the four treatments were 25.0, 20.5, 18.0 and 11.37 kg/m3, respectively. The pattern of soil salinity for three drip treatments was similar. Salts accumulated at the top layer of soil (0-10 cm) adjacent to the emitter. However, it seemed that a higher amount of salts were leached beyond the root zone under the treatments with 60 and 90% of evaporation, which suggested the feasibility of drip-irrigating honeydew melons grown in the saline soils with saline water.

TI: Field study on saline water irrigation systems for high-yielding winter wheat.
AU: Zhang-YongBo; Shi-Hong; Zhang-YB; Shi-H
SO: Transactions-of-the-Chinese-Society-of-Agricultural-Engineering. 2000, 16: 1, 44-48; 4 ref.
LA: Chinese
LS: English
AB: Results of a field experiment with winter wheat in the Huqu irrigation area of Yuncheng Basin, China, showed that the acceptable rate of saline water irrigation varied with mineralization rate.

TI: Effects of irrigation with light saline water on growth of winter wheat and soil environment in salinized regions.
AU: Qiao-YuHui; Yu-ZhenRong; Zhang-YinSuo; Xin-JingFeng; Driessen-PM; Qiao-YH; Yu-ZR; Zhang-YS; Xin-JF
SO: Soils-and-Fertilizers-Beijing. 1999, No. 4, 11-14; 8 ref.
LA: Chinese
AB: An experiment was carried out in 1997-98 in Quzhou County, Hebei Province, China, to study the effects of irrigation with slightly saline water on the growth of winter wheat and the soil environment in salinized regions. The salt content of the irrigation water was 0.84 g/litre and 3.2 g/litre. The soil was moderately fertile, containing 1.02% organic matter, 0.077% total nitrogen, and 50 mg/kg of alkalizable nitrogen. The results showed that irrigation with saline water had some inhibitory effects on growth of winter wheat. Dry matter accumulation of the above-ground part was only 75% of that with fresh water irrigation. However, it had little effect on the final economic yield. It was concluded that shallow ground slightly saline water can be used in moderation for irrigation, although it increased the content of salt in the surface layer. The long-term effect of saline water irrigation on the soil needs further study.

TI: The utilization of saline water and brackish water for irrigation in the coastal reclamation area of Jiangsu Province.
AU: Wang-JA; Pan-CB; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 254-260.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Utilising saline water and brackish water for irrigation in China's Jiangsu Coastal reclamation area has extended the irrigation area, improved agricultural production, extended the irrigation system, and successfully prevented the soil from salinizing. The paper concludes that: (i) brackish water up to 1-2 gm/litre is suitable for irrigation use in China; (ii) irrigation with saline water (_4 gm/litre) can quickly protect rice seedlings from drought; (iii) salinities greater than 10 gm/litre cannot be used unless diluted; (iv) irrigation with water more saline than 3 gm/litre should be limited, and in such cases water efficiency measures should be introduced; and (v) there is a need for scientific management rules to determine suitable water qualities for the range of principal irrigation applications.

SOUTH ASIA / INDIA / PAKISTAN/ BANGLADESH / SRI LANKA

General

TI: **Use-of-saline-water-in-agriculture:-a-study-of-arid-and-semi-arid-zones-of-India**. 2003, Ed.3, vii + 302 pp.; many ref.
AU: Gupta-IC; Gupta-SK; Gupta-IC (ed.); Gupta-SK
PB: Scientific Publishers (India); Jodhpur; India
LA: English
AB: This 3rd edition of a book first published in 1979 is a compilation of available information and technologies on the use of saline water in agriculture. It contains 7 chapters, including: (1) the origin and nature of irrigation waters; (2) the quality of irrigation waters -- criteria and indicators; (3) the quality of groundwaters in the arid and semiarid zones of India; (4) the effects of saline water irrigation on soil properties; (5) crop tolerance to saline conditions; (6) management practices; and (7) alternative uses and disposal of saline water.

TI: Managing saline and alkaline water for higher productivity.
AU: Tyagi-NK; Kijne-JW (ed.); Barker-R (ed.); Molden-D
SO: Water-productivity-in-agriculture:-limits-and-opportunities-for-improvement. 2003, 69-87; 26 ref.
PB: CABI Publishing; Wallingford; UK
LA: English
AB: Two major approaches to improving and sustaining high agricultural productivity in a saline environment involve: (i) modifying the environment to suit the available plants; and (ii) modifying the plants to suit the existing environment. They could be used separately or together to make possible the productive utilization of poor-quality water without compromising the sustainability of the production resource at different management levels. This chapter discusses the issues arising from the use of these approaches as related to the use of marginal-quality water, at both field and irrigation system levels. The results are reviewed of field studies in India encompassing areas with low to moderate monsoonal rainfall (400-600 mm), underlain by saline/alkaline water and supplemented with deficit canal-water supplies, sufficient only to meet 40-50% of irrigation requirements. Analysis of the results indicates that there are good possibilities of achieving reasonably high water productivity on a sustainable basis by appropriate technological interventions. Some important interventions that have been identified include in situ conservation of rainwater in precisely levelled fields; blending saline/alkaline and fresh water to keep the resultant salinity below threshold or to achieve its amelioration; and, if residual sodium carbonate cannot be brought down to acceptable levels, dilution-blending or cyclic application and scheduling irrigation with salty water at less salt-sensitive stages. In high water table areas, provision of subsurface drainage facilitates the use of higher-salinity water, reducing the overall irrigation requirement. At higher levels of irrigation systems, it was found that water productivity in saline environments can be improved by a number of measures. These include reallocation of water to higher-value crops with a limited irrigation requirement, spatial reallocation and transfer of water-adopting polices that favour development of water markets and reducing mineralizing of fresh water by minimizing application and conveyance losses that find a path to saline aquifers. In spite of the technological advances that mitigate salinity damage and the likely economic advantages, there is always a need to exercise caution while practising irrigation with salty water for maintaining sustained productivity.

TI: Water productivity under saline conditions.
AU: Kijne-JW; Kijne-JW (ed.); Barker-R (ed.); Molden-D
SO: Water-productivity-in-agriculture:-limits-and-opportunities-for-improvement. 2003, 89-102; 39 ref.
PB: CABI Publishing; Wallingford; UK
LA: English
AB: The opportunity for increasing water productivity under saline conditions is contingent on the determination and accurate implementation of the leaching requirement needed to prevent unnecessary percolation below the root zone. The leaching fraction of the applied irrigation water percolates through the root zone to maintain soil salinity at an acceptable level. Crop water use (evapotranspiration) and leaching requirement (LR) together constitute the beneficial depletion of the water resource. Evapotranspiration and leaching are linked through the yield-water-production function. The more the crop growth is affected by salinity, the lower the evapotranspiration and the higher the leaching fraction of the applied irrigation water. Crops differ in their tolerance for salinity. Under controlled conditions, crops have salinity threshold values below which crop yields are not affected. However, evidence is presented that under field conditions (Pakistan), where plants were subjected to periodic and simultaneous water and salt stress and to non-uniform water application, yields are

lowered by salt concentrations below the assumed threshold values. In addition, rather than having one specific seasonal crop salt tolerance (threshold value), crops react differently depending on the timing of the imposed salinity stress. Irrigation water that is consumed by evapotranspiration leaves the remaining water more concentrated with salts. The leaching requirement increases with the salinity of the water supply and the sensitivity of the crop for salinity. This chapter illustrates how uncertainty about LR, resulting in part from uncertainty about yield-salinity relations, imposes constraints on the possible improvement of water productivity under saline conditions. The chapter points out implications for the successful production of crops with a mixture of saline water and good-quality irrigation water (e.g. conjunctive use of groundwater and canal water).

TI: Effect of saline drainage effluent on soil health and crop yield.
AU: Kahlown-MA; Muhammad-Azam
SO: Agricultural-Water-Management. 2003, 62: 2, 127-138; 17 ref.
LA: English
AB: Field trials were conducted in arid area of Pakistan with wheat-cotton rotation to evaluate the potential use of brackish drainage effluent for soil reclamation and crop production. The original drainage effluent was diluted with canal water before application. The treatments included: simple leaching with marginal water (electrical conductivity (EC) 1.25 dS m-1) without growing crop; irrigation with saline water (EC 2.25 dS m-1) alone; irrigation with saline water and green manure; and irrigation with saline water and farmyard manure. The changes in infiltration rate, soil salinity and sodicity along with crop yield were recorded. Maximum improvement of 88.9% was recorded in infiltration rate with green and farmyard manure application. In case of soil salinity and sodicity, the highest decrease of 2.8 and 41.3% was recorded with farmyard manure and an increase of 39.2 and 14.9% with simple leaching at 0-15 cm depth. At other three sampling depths, all treatments significantly increased EC of soil. Whereas sodium absorption ratio increased only at the lowest depth (60-90 cm) under all treatments. The application of farmyard manure produced the highest wheat and cotton yield with an average of 1925 and 1485 kg ha-1, respectively. The overall results showed that the application of farmyard manure was comparatively more effective than other treatments in overcoming the adverse effects of irrigation with poor quality water. However, the use of farmyard manure with drainage effluent is recommended under acute shortage of irrigation water.

TI: Farmers' knowledge of soils and the sustainability of agriculture in a saline water ecosystem in Southwestern Bangladesh.
AU: Ali-AMS
SO: Geoderma. 2003, 111: 3-4, 333-353; 41 ref.
LA: English
AB: Small holder farmers throughout Bangladesh operate in small but diverse ecosystems and possess a deep intimate knowledge of local soils. They have developed soil management strategies that helped them to attain a high degree of sustainability. In this study, a group of small holder farmers from a village in the saline water ecosystem in southwestern Bangladesh were interviewed to explore the depth of their knowledge of soils. Data collected from a parallel scientific study done in the same village revealed that the village farmers possessed considerable knowledge of local soils, their classification, and management problems. Farmers' typology of soils differed from their scientific classification because of the diversity in objectives and approaches to study the village soils. Despite their lack of knowledge of the soil genesis and morphology and soil chemistry, farmers qualitatively identified major typology, properties, and constraints of topsoil, and have developed strategies through generation-long practical on-farm experiments that helped them to maintain a sustainable agricultural system in the village. Farmers' knowledge of soils is, therefore, a vast resource that should be tapped and incorporated in the national scientific database and utilized in formulating future agricultural development policies.

TI: Efficient use of saline drainage effluent with high frequency drip irrigation.
AU: Singh-P; Sanwal-S
SO: Improved-irrigation-technologies-and-methods:-Research,-development-and -testing.-Proceedings-ICID-International-workshop,-Montpellier,-France,-14-19 -September-2003. 2003, 1-7; 6 ref.
PB: International Commission on Irrigation and Drainage (ICID); New Delhi; India

LA: English
AB: This study tested the suitability of high frequency drip irrigation using saline/sodic drainage effluent as the irrigation water supply, and compared the results with traditional methods of surface irrigation. This approach is of interest in areas of India where there are problems of waterlogging and soil salinity, and where drainage effluent is to be used for irrigation (since there is no drainage outlet), such as the canal command area in the central and south -western part of Haryana, India. The quality and the quantity of the drainage effluent vary over the year. Saline/sodic drainage effluent may not be used with the traditional methods of irrigation for crop production on a long-term basis. High frequency drip irrigation was found to give better results with saline/sodic water, compared to other methods of irrigation. This can be attributed to its frequent water application and specialized salt and water distribution in the crop root zone. Field experiments were conducted for tomato (Cultivar: Selection-7) using drip irrigation and traditional surface irrigation (rectangular check basin). The drip irrigation was done at four irrigation frequencies:- (i) twice a day, (ii) once a day, (iii) alternate days, (iv) after two days. The surface irrigation was done as per the recommended practice in the region. The depths of irrigation for both treatments were 25%, 50%, 75% and 100% of the maximum crop water requirement. The irrigations were done with (i) saline/sodic drainage effluent, (ii) good quality canal water and saline drainage effluent (treated to neutralise sodicity). The highest crop yield of 22.05 t/ha was obtained for good quality canal water with daily drip irrigation with 10.7cm seasonal depth of water application (25% irrigation). The highest crop yield for surface irrigation was 19.82 t/ha for good quality canal water with 82.7cm depth of water application.PT: Book-chapter; Conference-paper
AN: 20043023132

TI: Rising water table of saline and sodic ground water in Haryana and management strategies -- a review.
AU: Goel-AC; Vijay-Kumar; Kumar-V
SO: Agricultural-Reviews. 2003, 24: 2, 116-122; 15 ref.
LA: English
AB: The development and execution of canal system in central and south western parts of Haryana brought a large area under irrigation and helped in the introduction of heavy irrigation duty crops. Though the crop production has increased tremendously yet the nonexploitation of the saline ground water and application of heavy irrigation have led to the rising of the water table in central and south-Western part of Haryana, India. The increase in canal irrigation area from 0.99 to 1.4 million ha in this region has largely contributed to this problem and more than 5 per cent area in this zone is under critical zone (0-3 m). The water table has continuously been rising at an average annual rate of 10 to 30 cm for the last twenty five years. The main emphasis in developing the surface irrigation potential and neglecting the drainage of the saline and sodic ground water of the above mentioned zone of the state has created waterlogging condition and soil salinization. Poor water management practices have also aggravated the situation. The serious problem of the rising water table can be tackled by adopting the improved water management practices, introduction of drip irrigation system, bringing more and more area under sprinkler irrigation, using of brackish ground water in conjunction with canal water. Introduction of horizontal drainage i.e. tile drainage system, vertical drainage and reuse of drainage water and farm forestry can be the possible measures to reduce the problem of rising water table.PT: Journal-article

TI: Spectral reflectance characteristics of Na-carbonate irrigated arid secondary sodic soils.
AU: Joshi-DC; Toth-T; Sari-D
SO: Arid-Land-Research-and-Management. 2002, 16: 2, 161-176; 25 ref.
LA: English
AB: In the arid region of Rajasthan, India, saline groundwater containing elevated residual Na-carbonate (RSC) is frequently used for raising winter crops. Relationships between spectral reflectance characteristics of RSC water irrigated sodic soils under differential management with their physicochemical and crust characteristics have been investigated. Studies have been carried out at four sites irrigated with saline/high RSC water (EC 4.0 to 10.1 dS m-1, Na adsorption ratio (SAR) 21.8-45, adjusted SAR 45.8-98.1 and RSC nil to 19 mmolc L-1) for more than 10 years. Some of the parcels have received gypsum for amelioration and have received differential management. The spectral values were higher at Site 2 (32.3-42.1%) followed by Site 1 (18.2-23.2%), and Site 3 and Site 4 (11.1-20.5%). Higher reflectance values were obtained at 800 and 1000 nm wavelengths, followed by 460 nm, and the lowest at 620 nm. At Site 1 and Site 2 low penetration values (0.05-4.24 kg cm-2) were

associated with higher soil water content. At Site 3 and Site 4 large penetration resistance (29.06-46 kg cm-2) was attributed to low water content. The multiple regression analysis involving eight soil parameters could predict spectral reflectance to the extent of 99.7% of total variance. The spectral reflectance shows a negative relationship with soil water status, and positive relationships with soil salinity and pH value. For the remote sensing of soil salinity and sodicity in the area, the fallow season of May and June is suggested.

TI: Poor quality irrigation water and secondary salinization in semi-arid region of Rajasthan.
AU: Singh-J; Shanwal-AV; Verma-SL
SO: Annals-of-Agri-Bio-Research. 2000, 5: 2, 127-130; 10 ref.
LA: English
AB: One hundred and sixteen soil samples (58 each from irrigated and unirrigated soils) and 58 irrigation water samples were collected from 58 sites of semi-arid region (Jhunjhunu) of Rajasthan and analysed for electrical conductivity and pH. The water samples were further analysed for soluble cations and anions, and SAR, adj. SAR, RSC and pHc were also calculated. From salinity and alkalinity index of irrigated and unirrigated soils, it was observed that soils were within the permissible limit of salinity and sodicity. However, irrigated soils showed slightly higher EC and pH than unirrigated due to continuous irrigation with saline-sodic water. Inspite of this process, the secondary salinization was not so high. This was mainly due to light textured soils of the tract. The effect of poor quality irrigation water on soil salinity and alkalinity was evident from the regression analysis. The EC of irrigation water had significant positive correlation (r=0.885) with EC of irrigated soils. The pH of irrigated soil had significant positive correlation with RSC (r=0.472) and SAR (r=0.529) of irrigation water.
PT: Journal-article

TI: Managing marginal quality waters in agriculture: the Indian experience.
AU: Tyagi-NK
SO: Irrigation under conditions of water scarcity. Vol 1G. 17th ICID International Congress on Irrigation and Drainage, Granada, Spain, 13-17 September 1999. 1999, 1-15; 18 ref.
PB: New Delhi: International Commission on Irrigation and Drainage; India
LA: English
AB: This review of issues concerning low quality waters in India discusses opportunities to mitigate the looming water crisis. It presents technologies for safe use of marginal quality waters. Best management practices have to be evolved for site-specific water quality, soil crop and climatic conditions. Based on the objective assessment available information, research priorities for refinement of the existing technologies and issues that need attention are identified as: (i) expansion of national water quality monitoring network, (ii) better understanding of solute transport process on the root zone, (iii) use of micro-irrigation application techniques to ease the constraints imposed by water quality, (iv) studies aimed at harnessing the synergy of crop salt tolerance and hydraulic technology, (v) low cost technologies for treatment of wastewaters, (vi) policies for promotion of the use of marginal quality water.

TI: Sustainable agriculture in saline black soils of semi-arid areas in Gujarat.
AU: Girdhar-IK; Faroda-AS (ed.); Joshi-NL (ed.); Kathju-S (ed.); Amal-Kar
SO: Recent advances in management of arid ecosystem. Proceedings of a symposium held in India, March 1997. 1999, 235-240; 8 ref.
PB: Arid Zone Research Association of India; Jodhpur; India
LA: English
AB: Effects of poor quality waters having different EC [electrical conductivity], SAR [sodium adsorption ratio] and RSC [residual sodium carbonate] levels on soil properties and yields of sorghum and wheat were evaluated in saline black soils under rain-out shelter conditions in Gujarat. Application of low saline waters in saline soil helped leach salt to lower depths. Further, with the leaching of salts, SAR of the soil solution was reduced. ESP and SAR increased with soil depth in all the water quality treatments. The fodder yield of sorghum and grain yield of wheat remained unaffected by the salinity of irrigation waters at different SAR and RSC levels throughout the experimental period from 1990/91 to 1995/96. Though there was salinity and sodicity build up in the soil, specifically at lower depths, as a result of saline water irrigation, the yield of these crops was not significantly affected. Salvadora persica grew successfully on saline black soils up to 65 dS/m.
PT: Conference-paper

TI: Prospects for saline agriculture in Pakistan.
AU: Shah-AH; Sufi-AB; Bhutta-MN; Patto-PM
SO: Role of drainage and challenges in 21st century. Vol. IV. Proceedings of the Eighth ICID International Drainage Workshop, New Delhi, India, 31 January-4 February 2000. 2000, 61-78.
PB: International Commission on Irrigation and Drainage; New Delhi; India
LA: English
AB: The main factors responsible for the low economic efficiency of the present irrigation system of Pakistan include inadequate drainage, excessive water losses, outdated land and water management practices, fragmented land holding, and above all waterlogging and salinity. Salinization of agricultural land is leading to the necessity for the development of alternate methodologies for agricultural production. One promising idea involves utilization/revegetation of salt-affected and waterlogged lands through growing crops, trees, grasses and saltbush tolerant to both salt and waterlogging. Bio-saline technology has recently been tried in the field in Pakistan involving participative development with the farmers.
PT: Conference-paper

TI: Saline agriculture for irrigated land in Pakistan: a handbook.
AU: Qureshi-RH; Barrett-Lennard-EG
SO: 1998, 142 pp.; 10 ref.
PB: Australian Centre for International Agricultural Research (ACIAR); Canberra; Australia
LA: English
AB: This handbook aimed at extension officers and farmers dealing with saline agricultural practices for irrigated land in the title area, contains 8 chapters entitled: introduction; Pakistan and its salinity problem; three approaches for managing saline, sodic and waterlogged soils; classification, sampling and analysis of salt affected soils and water; salt and waterlogging: effect on plants; crops and grasses for salt-affected land; trees for salt-affected land; saltbushes for highly salt affected land; building farming systems- integrating the elements.
PT: Book

TI: Embarking on the second green revolution for sustainable agriculture in India: a judicious mix of traditional wisdom and modern knowledge in ecological farming.
AU: Sinha-RK
SO: Journal-of-Agricultural-and-Environmental-Ethics. 1997, 10: 2, 183-197; 15 ref.
LA: English
AB: The Green Revolution in India which was heralded in the 1960s was a mixed blessing. Ambitious use of agrochemicals boosted food production but also destroyed the agricultural ecosystem. Of late, Indian farmers and agricultural scientists have realized this and are anxious to find alternatives (perhaps a non-chemical agriculture) and have even revived their age-old traditional techniques of natural farming. Scientists are working to find economically cheaper and ecologically safer alternatives to agrochemicals. Blue-Green Algae Biofertilizers, Earthworm Vermicomposts (Vermiculture), biological control of pests and herbal biopesticides are showing promise. Saline agriculture and sewage farming are also being promoted in India to augment food production in the face of water scarcity. There is a move to search for alternative foods, which are more nutritious, cheaper and have shorter harvest cycles. Farm and food policy in India has to change its outlook before there can be a second green revolution.
PT: Journal-article

TI: Economic assessment of selected resource management practices for efficient use of saline-sodic water in arid and semiarid subtropical India.
AU: Mahander-Singh; Singh-M
SO: Palawija-News. 1998, 15: 3, 8-13.
LA: English
AB: The impact is assessed of four techniques (land levelling, bunding, gypsum application and sprinkler irrigation) on the performance of pearl millet-wheat and pearl millet-mustard cropping systems under irrigation with saline and alkaline waters in Karanpur village, Mathura district, Uttar Pradesh, India. The four techniques are assessed in terms of their effect on yield, monetary returns, and sustainability of natural resources. It is noted that

in spite of the higher benefits from the improved technologies, these technologies have not been widely adopted due to economic, social, institutional, infrastructural and technical constraints. Recommendations are made for consideration by the government, farmers and researchers to make the use of saline/alkaline waters in crop production more efficient and to ensure the sustainability of crop yields, farmers' income and the environment.
PT: Journal-article

TI: Experiences with use of saline drainage effluents for crop production in India: country report.
AU: Tyagi-NK; Sharma-DP; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 127-138; 23 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: A number of pilot projects have been implemented to demonstrate the efficacy of sub-surface drainage in controlling waterlogging in the irrigated arid zones of India. Also field studies were undertaken to develop technology for reuse of saline drainage effluents in the post reclamation phase. Results of these studies, which involved application of drainage effluents in combination with fresh water at various crop growth stages and in different application modes, have shown promising results. The recommendations that emerged from these studies have shown that, due to effective leaching during the monsoon rainfall, saline waters can be used that exceed the normal recommendations. Trials on conjunctive use of drainage effluents and fresh water, carried out at many locations, have demonstrated the benefit of avoiding the use of saline water at the initial stages. The cyclic mode of water application was more effective, also, the use of saline drainage effluents in the post reclamation phase augments the water supply as well as minimizing drainage water disposal requirements.

TI: Production potential and economics of different cropping sequences under brackish water irrigation.
AU: Harbir-Singh; Singh-KP; Sharma-HC; Kairon-MS; Tej-Singh; Malik-DS; Singh-H; Singh-T
SO: Indian-Journal-of-Agronomy. 1986, 31: 4, 362-366; 2 ref.
LA: English
AB: The production potential and economic feasibility of 20 cropping sequences involving 5 crops in the kharif [monsoon] season and 4 crops in the rabi [winter] season were investigated under saline water irrigation conditions in 1979-83. Soyabeans and Bengal gram [Cicer arietinum] were the crops least tolerant of salt stress. Bajra [Pennisetum americanum] was the most tolerant crop. Mung beans were also tolerant of salt stress. Bajra as a rainfed crop followed by wheat, mustard [Brassica juncea] or barley in the winter season formed the best cropping sequences under saline water irrigation conditions.
PT: Journal-article

Forage and fodder crops

TI: Yield responses of winter (rabi) forage crops to irrigation with saline drainage water.
AU: Yadav-RK; Kumar-A; Lal-D; Batra-L
SO: Experimental-Agriculture. 2004, 40: 1, 65-75; 14 ref.
LA: English
AB: A field experiment in an alluvial sandy loam saline soil was conducted during the winter (rabi) season from 1997-98 to 1999-2000 at the Central Institute for Research on Buffaloes, Hisar, Haryana, India, to study the effect of saline drainage water (EC=3.6-7.4) on five (rabi) forage crops: oat (Avena sativa), rye grass (Lolium rigidum), senji (Indian clover) (Melilotus indica) berseem (Egyptian clover) (Trifolium alexandrinum) and shaftal (Persian clover) (Trifolium resupinatum). All the crops were established using canal water as pre-sowing irrigation and the various irrigation strategies were imposed subsequently. Irrigation with canal water resulted in a 115% increase in forage yield compared with the saline drainage water. The results suggested that alternate irrigation with saline drainage water increased the yields of all the forage crops compared with using saline drainage water only. Further, alternate irrigation, starting with canal water, was superior to alternate irrigation starting with saline

drainage water because less salt was added in total. Oat produced the largest green-forage yield (32.3 t ha-1) in the first year while rye grass gave its maximum in the second (34.6 t ha-1) and third years (37.0 t ha-1). Persian clover performed better than did Egyptian clover in all the three years. Interaction between species and irrigation treatments was significant. In comparison with canal irrigation water, there was a 36%, 42%, 54%, 68%, and 85% yield reduction in rye grass, oat, Persian clover, Egyptian clover and senji, respectively when only saline drainage water was used for irrigation reflecting their relative tolerances of salinity. Yields declined linearly for all crops with increases in the quantity of salt applied.

TI: Response of nine forage grasses to saline irrigation and its schedules in a semi-arid climate of north-west India.
AU: Tomar-OS; Minhas-PS; Sharma-VK; Gupta-RK
SO: Journal-of-Arid-Environments. 2003, 55: 3, 533-544; 16 ref.
LA: English
AB: Traditionally, the degraded lands in arid and semi-arid regions are left for pastures but their forage productivity is low, unstable and unremunerative. Often this results in acute shortages of fodder during the post-monsoon period that can perhaps be partly overcome if the limited saline ground-water resources are effectively utilized to supplement water supplies. Thus, a field experiment was conducted during 1993-1997 on a calcareous soil in a semi-arid part of north-west India (average rainfall 350 mm/annum) to evaluate the suitability of forage grasses to saline irrigation (ECiw 8.5-10.0 dS/m) and optimize its schedule. Grass species included in this experiment were Brachiaria mutica Stapf. Cenchrus setigerus Vahl. Chloris gayana Kunth, Cymbopogon flexuosus, Cynodon dactylon Pers. Echinochloa colonum Link. Panicum antidotale Retz., P. coloratum Linn., P. laevifolium Hack., P. maximum Jacq. (Local wild), P. maximum Jacq. (Cultivated) and P. virgatum. Species those were identified to be the most promising included Panicum laevifolium and P. maximum (both local wild and cultivated) with an annual forage production of 3.43-4.23 Mg/ha. The overall reduction in forage yield with saline irrigation equalled 29 per cent when compared with canal water (ECiw 0.4 dS/m). Scheduling saline irrigation based on climatological approach, i.e. when the ratio of depth of irrigation water (Diw) and cumulative open pan evaporation (CPE) equalled 0.4, was observed to be optimal whereas increased salt accumulation nullified the benefits of enhanced water supplies (Diw/CPE=0.8). Two of the definite advantages of irrigated forages were about three-four-fold increase in productivity as compared with natural/seeded pastures and extension of production period to those of conventional shortages, i.e. during summer months (April-June) when the most nomad populations are forced to migrate to traditionally irrigated areas. Thus, it was concluded that saline water use strategies for rehabilitating arid lands with above grass species would not only render these degraded lands be more productive but also ensure conservation and improvement for long-range ecological security of these lands.PT: Journal-article
AN: 20043042362

TI: Effect of saline water irrigation on the performance of grasses under Bhal condition.
AU: Maliwal-GL; Das-A; Patel-KH; Jakasaniya-MS; Patel-PT
SO: Forage-Research. 1998, 24: 2, 61-66; 18 ref.
LA: English
AB: Studies were conducted for three years to evaluate the comparative performance of different grasses under waterlogged conditions during monsoon at Bhal, Gujarat, India. Paragrass [Brachiaria mutica], Gatton panic (Panicum maximum), Karnal grass (Leptochloa fusca [Diplachne fusca]) and marvel grass (Dichanthium annulatum) survived, while the others died. A further study was conducted for five years on the green fodder yield of four grasses using saline water irrigation. The green fodder yield of all grasses increased with increase in salt concentration of irrigation water compared with pond water. The effect of saline water irrigation on green fodder was not significant. All the grasses gave equivalent fresh weight yields but marvel grass gave the most consistent yields across years. Persistence was higher (80%) in marvel grass at the end of experiment, while Karnal grass died after two years of saline water irrigation. The protein content decreased with increase in salt concentration in all the species. The fibre content was lowest in Gatton panic followed by marvel grass. The salt concentration of soil increased with increase in salts of irrigation water at cutting but decreased to the initial level after the monsoon each year.
PT: Journal-article

TI: Response of selected tropical grasses to irrigation with brackish water
AU: Sangakkara,-U.R.
AD: Department of Crop Science, University of Peradeniya, Peradeniya, Sri Lanka
SO: Pertanika-Journal-of-Tropical-Agricultural-Science (Malaysia).
1994, v. 17(1) p. 21-26; Apr, fig, tables, 10 ref.; summaries (En, Malay)
LA: English
AB: Agricultural development programmes in the dry zone of Sri Lanka envisage the establishment of suitable fodder crops for livestock under irrigation programmes using brackish underground water. The responses of 3 popular tropical grasses and natural species to irrigation with brackish water having ECs ranging from 0.5-6.0 mS/cm, were evaluated when established in a sandy soil. Growth of all 3 species was affected by the increasing EC of irrigation water. Brachiaria mutica was affected to the greatest extent. Yields of Paspalum dilatatum were reduced to a lesser extent, and Panicum maximum produced the highest yield and provided a significant quantity of fodder in all treatments. The introduced species outyielded the natural species with the exception of B. mutica at the higher EC levels. The practical significance of the results in terms of possible uses of these species in growing grasses under irrigation in the sandy tracts for herbage production in the dry season is discussed. From author's summary.

TI: Responses of some arid zone grasses to brackish water
AU: Ashraf,-M.; Yasmin,-N.
AD: Bahauddin Zakariya Univ., Institute of Pure and Applied Biology, Multan, Pakistan
SO: Tropenlandwirt (Germany).
1997, v. 98(1) p. 3-12; Apr, figs, tables, 19 ref.; summaries (De, En)
LA: English
AB: The degree of salinity tolerance of 3 forage grass species of deserts in Pakistan, Cenchrus pennisetiformis, Panicum turgidum and Pennisetum divisum, was compared with that of 2 species with known salinity tolerance: Puccinellia distans and Leptochloa fusca. The plants were subjected to 4 6-week salinity treatments of 2.4 (control) to 24 dS/m. Shoot biomass production in L. fusca and P. distans was not affected by salinity and they had significantly greater shoot fresh and dry matter than the other species. The worst affected was P. divisum, the remaining 2 were intermediate in biomass production. It was found that L. fusca accumulated relatively greater concentrations of Na, Cl, K and Ca in the shoot than the other species, whereas C. pennisetiformis absorbed relatively greater amounts of Na and Ca. Intermediate Na and Cl accumulation in the shoots was seen in P. turgidum, but it was highest in the accumulation of Na, Cl and K in the roots. The poorest species in biomass production, P. divisum, contained relatively moderate amounts of Na in the shoots, but it had high K and Cl following different treatments. In conclusion, C. pennisetiformis and P. turgidum are intermediate in salt tolerance, whereas P. divisum is sensitive in relation to L. fusca and P. distans.

Tree crops

TI: Performance of several tree species on a saline site in Southern Pakistan.
AU: Marcar-NE; Ansari-R; Khanzada-AN; Khan-MA; Crawford-DF
SO: Journal-of-Tropical-Forest-Science. 2003, 15: 3, 457-468; 29 ref.
LA: English
LS: Malay
AB: Fast-growing, salt-tolerant trees and shrubs can productively use salt-affected land and contribute to its reclamation. We report on survival and growth of several tree species on a highly saline (mean ECe(0-60 cm) 21 dS m-1) site underlain by shallow saline water table, near Hyderabad, Pakistan. At 21 months after planting, four types of responses were found to salinity with Acacia ampliceps (seedlot 15769) the least tolerant and Casuarina equisetifolia the most tolerant. Amongst the acacias, A. maconochieana and A. stenophylla (15736) were more tolerant than A. ampliceps and A. nilotica. Significant differences were found among provenances of A. ampliceps, A. stenophylla and C. glauca. A. victoriae, C. obesa and Eucalyptus camaldulensis had poor survival. A. auriculiformis, A. salicina, E. occidentalis, Cassia sturtii and Azadirachta indica died within one week of planting. Floodwaters covered the site for about two months following heavy monsoon rains from approximately

21 months, resulting in high mortality for most species. Acacia nilotica, A. stenophylla, C. glauca and C. obesa survived well, whilst other species had either poor or no survival. Surviving trees of A. stenophylla, A. nilotica, Atriplex lentiformis and E. microtheca continued to grow reasonably following flooding, whilst surviving trees of other species grew slowly.

TI: Tolerance of Acacia nilotica to fluorine enriched saline irrigation water at early growth stages.
AU: Jadoun-BS; Kalyan-Singh; Jha-MN; Singh-K
SO: Indian-Forester. 2000, 126: 7, 756-765; 13 ref.
LA: English
LS: Hindi
AB: A field trial with Acacia nilotica was conducted in polythene lined micro-plots at Valipura in Uttar Pradesh (India) to determine the tolerance of the species to fluorine enriched saline irrigation water at early growth stages (seedlings were 3 months old at the start of the experiment), using varying qualities of artificially prepared saline water (2.5, 5, 7.5, 10, 20 ppm fluorine maintained at EC 4 and 8 dS/m) for irrigation on sandy loam soil (coarse-loamy mixed hyperthermic Ustorthent). The saline water was applied alternately with canal water at 3-month intervals over 15 months. The best available canal water (EC 0.2 dS/m, with fluorine traces) was used as control. Reductions in seedling growth were observed even at low fluorine levels, but was significantly greater at and above 20 ppm. There was a 50% reduction in biomass yield as limits of tolerance was observed at about 20 and 18 ppm fluorine levels in saline water of 4 and 8 dS/m, respectively. Uptake of fluorine by plants increased progressively with increase in fluorine levels. Subsequently the uptake of Na+ increased but that of phosphorus and Ca2+ decreased. Nitrogen, K+ and Mg2+ uptake did not show any particular trend.

TI: Suitable agroforestry systems for coastal saline regions: case study.
AU: Dagar-JC; Tomar-OS
SO: Range-Management-and-Agroforestry. 1998, 19: 2, 165-172; 7 ref.
PB: Range Management Society of India, Indian Grassland and Fodder Research Institute; Jhansi; India
LA: English
AB: An extensive survey was carried out of agroforestry systems used in the coastal regions of India, and important systems adapted to different conditions identified. Suitable practices either already being used or feasible for 5 types of areas are described. The areas are: land impregnated with high salinity due to inundation by sea water; acid sulfate soils; land with saline waterlogged soils but not inundated by sea water; land with low salinity but having a shallow water table with saline water beneath good quality water; and waterlogged and saline soils caused by seepage in canal command areas. The paper also includes details of the climatic characteristics and soil properties at selected coastal stations.
PT: Journal-article

TI: Effect of saline water irrigation on establishment and growth of tree species on sand dunes of Haryana.
AU: Jagan-Nath; Jhorar-BS; Mor-RP; Batra-ML; Dhillon-RS; Nath-J; Faroda-AS (ed.); Joshi-NL (ed.); Kathju-S (ed.); Amal-Kar
SO: Recent advances in management of arid ecosystem. Proceedings of a symposium held in India, March 1997. 1999, 465-468; 5 ref.
PB: Arid Zone Research Association of India; Jodhpur; India
LA: English
AB: The salinity tolerance of Azadirachta indica, Dalbergia sissoo, Acacia nilotica and Prosopis cineraria was assessed to stabilise sand dunes of Haryana. About 9- to 12-month-old seedlings of these tree species were planted in 1993 in pits of 60X60 cm size, which were filled with field soil, pond silt and farm-yard manure in the ratio of 2:1:1. With increase in the salinity level, even up to 250 dS m-1, all trees were able to grow satisfactorily. However, the growth was positive only upto EC of 100 dS m-1. In post-rainy season the soil profile was free of salts upto 100 cm depth in 1994; later on the salinity increased with increase in depth, as well as salinity level of water.

TI: Suitable agroforestry systems for coastal saline regions: case study.
AU: Dagar-JC; Tomar-OS
SO: Range-Management-and-Agroforestry. 1998, 19: 2, 165-172; 7 ref.

PB: Range Management Society of India, Indian Grassland and Fodder Research Institute; Jhansi; India
LA: English
AB: An extensive survey was carried out of agroforestry systems used in the coastal regions of India, and important systems adapted to different conditions identified. Suitable practices either already being used or feasible for 5 types of areas are described. The areas are: land impregnated with high salinity due to inundation by sea water; acid sulfate soils; land with saline waterlogged soils but not inundated by sea water; land with low salinity but having a shallow water table with saline water beneath good quality water; and waterlogged and saline soils caused by seepage in canal command areas. The paper also includes details of the climatic characteristics and soil properties at selected coastal stations.

Miscellaneous crops

TI: Performance of gram (Cicer arietinum) and Indian mustard (Brassica juncea) as inter-row crops with wheat (Triticum aestivum) under different moisture and salinity levels.
AU: Agrawal-PB; Sinha-AK; Yadav-BR
SO: Indian-Journal-of-Agricultural-Sciences. 2003, 73: 3, 129-133; 20 ref.
LA: English
AB: A field experiment was conducted during the winter (rabi) seasons of 1994/95 and 1995/96 on silty loam soil (Inceptisol), in New Delhi, India to study the response of different wheat (Triticum aestivum)-based intercropping systems, i.e. wheat+Indian mustard (Brassica juncea) and wheat+gram (Cicer arietinum), to varying moisture regimes (CPE 0.4 and 0.8) and irrigation water salinity levels (0.4, 6 and 12 dS/m). The growth and yield (4.489 t/ha) of wheat increased with increasing frequency of irrigation water when its salt level was EC 6 dS/m. However, a decreasing trend in growth and yield was observed with further increase in the salinity (EC 12 dS/m) of irrigation water. The growth and yield (0.018 t/ha) of gram significantly decreased with increasing frequency and salinity of irrigation water. However, the yield (0.873 t/ha) of Indian mustard significantly increased with increasing irrigation frequency even with saline water of EC 12 dS/m. Indian mustard was found to be tolerant of both salt and moisture stress, while gram was very sensitive to salt stress. Water-use efficiency increased at both salinity levels but the increase was greater (9.92%) at lower salinity level. The water-use efficiency decreased with increasing moisture regimes. It was lowest (121.06 kg ha-1 cm-1) in wheat+Indian mustard intercropping.

TI: Effect of mixing of saline and canal water on yield of groundnut and wheat.
AU: Yogesh-Sharma; Tiwari-C; Verma-BL; Singhania-RA; Sharma-Y
SO: Crop-Research-Hisar. 2003, 26: 2, 249-253; 5 ref.
LA: English
AB: An experiment conducted in Bikaner, Rajasthan, India, during 1999-2002 on saline and BAW mixed irrigation indicated that the salinity of mixed water had significant effect on groundnut pod yield. The maximum average pod yield (42.22 q/ha) was observed with canal water, while 34.03 q/ha pod yield was obtained with BAW (ECiw 2.5 dS/m). Approximately 18.3, 51.1, 59.7 and 79.3% reduction in groundnut pod yield was observed at ECiw 3.75, 5.0, 6.25 and 7.5 dS/m, respectively, compared to BAW. Similarly, kernel weight per plant and number of kernels per plant reduced as the EC of the mixed water increased from 2.5 to 7.5 dS/m. For wheat, the maximum grain yield (36.04 q/ha) was recorded with canal water. There was a reduction of 12.5, 22.9, 35.5 and 46.7% in wheat grain yield at ECiw 3.75, 5.0, 6.25 and 7.5 dS/m, respectively, compared to BAW. Plant height, ear length and number of tillers per plant were maximum with canal water. There were reductions in these parameters when the salinity of mixed water increased. The EC2 of soil also increased from 0.16 to 1.26 dS/m with an increase in the salinity of irrigation water after three years' rotation of experimentation, whereas there was little increase in pH2.

TI: Interactive effects of irrigation water salinity and soil fertility on salinity and sodicity build-up in soil and yield and cation composition of palmarosa (Cymbopogon martinii) and lemongrass (Cymbopogon flexuosus).
AU: Arun-Prasad; Anwar-M; Patra-DD; Singh-DV; Prasad-A
SO: Journal-of-the-Indian-Society-of-Soil-Science. 2001, 49: 1, 178-187; 15 ref.

LA: English
AB: The experiment was conducted during 1991-93 in an open-bottomed reinforced concrete cemented cylindrical barrel embedded in the field in Lucknow, Uttar Pradesh, India. The sustained use of saline water increased the pH, ECe, and SARe of irrigated soils irrespective of the crop species and soil fertility. The herb and oil yield of palmarosa significantly decreased at high salinity while that of lemongrass consistently decreased with increase in salinity. Increasing soil fertility increased the herb and oil yield of palmarosa but had no effect on lemongrass. The concentration of Na in the shoot tissue of palmarosa and lemongrass increased with increase in salinity. Palmarosa had lower concentration of Na and higher capacity to maintain their K and Ca concentrations in the shoot tissues at high salinity than lemongrass. A high accumulation of Na and low concentration of K and Ca in shoot tissues was in accordance with the drastic herb yield reduction in lemongrass under increased salinity stress.

TI: Influence of saline water under different fertility levels on yield and nutrients uptake by blonde psyllium.
AU: Laxman-Singh; Pal-B; Singh-L
SO: Research-on-Crops. 2002, 3: 3, 551-556; 18 ref.
LA: English
AB: A field experiment was conducted during two consecutive rabi seasons [year not given] in Agra, Uttar Pradesh, India, to assess the effects of saline water and fertilizer levels on the yield and nutrient uptake of blonde psyllium (Plantago ovata). The saline water treatments were ECiw 12 and 24 dS m-1, while the fertilizer treatments comprised the control (F1), 50 kg N + 25 kg P2O5/ha (F2), 50 kg N + 25 kg P2O5 + 25 kg K2O/ha (F3), 50 kg N + 25 kg P2O5 + 20 kg ZnSO4/ha (F4), 50 kg N + 25 kg P2O5 + 25 kg K2O + 20 kg ZnSO4/ha (F5). Saline water at ECiw 12 dS m-1 significantly reduced the yield, uptake of Na, Ca and Mg by the seed, and uptake of Ca and Mg by the straw. This treatment, however, significantly increased the Na uptake by the straw compared with the control. F3 and F5 significantly increased the uptake of Ca, Mg and Na by both seed and straw compared with F2 and F4. The combined effect of saline water and fertilizer treatments showed that saline water at ECiw 12 dS m-1 reduced the yield and seed uptake of Ca, Mg and Na at all fertilizer levels. F3 and F5, however, significantly enhanced the seed and husk yields and the seed uptake of Ca, Mg and Na compared with F2 and F4 at both levels of salinity. The percentage of increase over F1 was 57.49, 57.20, 67.33 and 101.71% for seed yield and 57.38, 81.82, 68.18 and 103.41% for husk yield in F2, F3, F4 and F5, respectively. F5 with saline water at 12 dS m-1 recorded the highest seed and husk yields and seed uptake of Ca, Mg and Na.

TI: Conjunctive use of saline ground water and surface water in Indian Mustard on salt-affected black soils.
AU: Nayak-AK; Rao-GG; Chinchmalatpure-AR
SO: Journal-of-the-Indian-Society-of-Soil-Science. 2001, 49: 2, 328-331; 4 ref.
LA: English
AB: Field experiments on the conjunctive use of saline groundwater and surface water in cyclic mode and mixing mode were conducted with Indian Mustard (Brassica juncea) on salt-affected black soils of Gujarat, India, during 1997-98 and 1998-99. The results on the experiments on cyclic and mixing mode indicate that application of three irrigations with waters of electrical conductivity (EC) 4 dS m-1 resulted in the drastic reduction in the yield over control in the saline black soils. However, application of two saline irrigations and one irrigation of best available water (BAW) in rotation increased the yield significantly over three saline irrigations. The flowering and pod formation were the critical stages with reference to saline water irrigation. Again application of one saline irrigation at branching stage with two BAW gave yields at par with that of three irrigations with BAW. Application of saline water reduced net soil salinity and alkalinity of saline black soils with mustard crop under high groundwater table situation as compared to fallow land.

TI: Effect of saline water through drip irrigation system on yield and quality of tomato.
AU: Kadam-JR; Patel-KB
SO: Journal-of-Maharashtra-Agricultural-Universities. 2001, 26: 1, 8-9; 7 ref.
LA: English
AB: Results of a field experiment conducted in Rahuri, Maharashtra, India, during rabi 1996-97 to determine the effect of saline water through drip irrigation system on yield and quality of tomato are presented. It was shown

that the yield of tomato decreased with increased in saline water level, the reduction ranged from 3.13 to 24.00%. Similarly, acidity and total soluble solid and lycopene contents increased with increased in saline water level. However, the pH of fruit juice decreased with increased water salinity.

TI: Effect of salinity on the germination of Sonneratia apetala Buch.-Ham.
AU: Hoque-AKF; Alam-MR; Kabir-ME; Islam-MS
SO: Bangladesh-Journal-of-Forest-Science. 1999, 28: 1, 32-37; 20 ref.
LA: English
LS: Bengali
AB: The effect of salinity on the germination of Sonneratia apetala was studied in Bangladesh. The best germination success was observed in the 0-5 ppt salinity range with the highest value (98.67%) at the 0 ppt (fresh water) level. Germination success decreased significantly with the increasing level of salinity. Increasing salinity also remarkably delayed the germination. Satisfactory germination success was observed when salt treated seeds were sown in fresh water condition. This indicates that salt has only a reversible inhibitory effect on germination. The rate of recovery from the inhibitory effect of salt was not found to be sensitive to the level of salinity, and did not exhibit any definite relationship with the length of exposure of seed to the saline condition.

TI: Performance of winter annual flowering species as affected by different modes of saline and canal water irrigation.
AU: Tomar-OS; Minhas-PS
SO: Indian-Journal-of-Horticulture. 2002, 59: 2, 201-206; 6 ref.
LA: English
AB: A field experiment was conducted in 1997-99 in Hisar, Haryana, India to investigate the performance of winter ornamental flowers (Antirrhinum, Calendula, candytuft, Chrysanthemum, Dahlia, marigold [Tagetes], Marticaria, ornamental mustard [?Sinapis alba] and sweet william [Dianthus barbatus]) under saline irrigation (at electrical conductivity (EC) of 4-5 dS/m). Based on tolerance, monitored in terms of survival and growth, yield of cut flowers, longevity of flowering and, ultimately, the economic vale of produce, it was concluded that the preferred choice should be chrysanthemum followed by calendula and german chamomile. No adverse effect of saline irrigation was noticed on the growth of ornamental mustard. Species like Antirrhinum, candytuft, Dahlia, marigold, stock and sweet William showed poor performance under saline irrigation. Performance of these species also improved considerably when the transplanted seedlings were established with better quality water, and later on saline water.

TI: Effect of saline water and fertility levels on the yield, potassium and zinc content and uptake by blonde psyllium (Plantago ovata Forsk.).
AU: Laxman-Singh; Pal-B; Singh-L
SO: Crop-Research-Hisar. 2001, 22: 2, 210-216; 19 ref.
LA: English
AB: A field experiment was conducted for two consecutive years [date not given] during the rabi season at a Research Farm in Bichpuri, Agra, Uttar Pradesh, India to evaluate the interaction effect of saline water (ECiw 2.4 dS/m and control) and fertility levels (control, F1; 50 kg N+25 kg P2O5/ha, F2; F2+25 kg K2O/ha, F3; F2+20 kg ZnSO4, F4; and F3+20 kg ZnSO4/ha, F5) on the yield, and potassium and zinc uptake of blonde psyllium cv. Gujarat Isabgul-2. Application of ECiw 12 dS/m water significantly decreased the grain and husk yield, and uptake of potassium and zinc. The grain:husk ratios at 12 dS/m were 2.97:1, 2.96:1, 2.93:1, 2.93:1 and 2.92:1 for fertility treatments F1, F2, F3, F4 and F5, respectively, compared to ECiw 2.4 dS/m. Whereas fertility treatments F2, F3 and F5 significantly enhanced the content and uptake of potassium and zinc compared to F1. The interaction effect results also indicated that application of ECiw 12 dS/m water significantly reduced the zinc content in grain and straw compared to ECiw 2.4 dS/m. Fertility treatments F2, F3 and F5, however, enhanced potassium and zinc uptake by blonde psyllium at both the levels of salinity. Fertility treatment F5, comprising 50 kg N+25 kg P2O5+25 kg K2O+20 kg ZnSO4/ha proved significantly superior at 12 dS/m than other fertility treatments for yield and uptake of potassium and zinc. The superiority of the fertility treatments may be arranged as F5 > F3 > F4 > F2 > control for grain, husk yields and nutrients uptake.

TI: Conjunctive use of fresh and salty water in cotton and wheat in South West Punjab.

AU: Singh-CJ; Aujla-MS; Saini-KS; Buttar-GS; Brar-JS
SO: 17th-World-Congress-of-Soil-Science,-Bangkok,-Thailand,-14-20-August-2002.
2002, 1237; available at http:-www.sfst.org-.
PB: Soil and Fertilizer Society of Thailand; Bangkok; Thailand
LA: English
PT: Book-chapter; Conference-paper
AN: 20033033539

TI: Effect of S, Zn and Mo on groundnut (Arachis hypogaea L.) grown with saline water irrigation in coastal saline soil of West Bengal.
AU: Bhattacharya-B; Chakraborty-A; Bandyopadhyay-S; Samanta-D
SO: Indian-Agriculturist. 1997, 41: 2, 145-153; 14 ref.
LA: English
AB: In a field study in 1996 and 1997, a combined application of 20 kg S, 10 kg Zn and 3.0 kg Mo/ha increased groundnut plant height by 28% and the dry matter by 117%. Nodulation was improved by all 3 nutrients. Pod yield was generally increased by each fertilizer, with the highest yields given by joint application. Yield component data are tabulated.

TI: Effect of seawater on Salvadora persica Linn.
AU: Joshi,-A.J.; Kumar,-M.K.
AD: Department of Life Sciences, Bhavnagar Univ., Bhavnagar, Gujarat, India
SO: Annals-of-Arid-Zone (India).
1993, v. 32(3) p. 167-170; Sep, fig, tables, 15 ref.; summary (En)
LA: English
AB: In Gujarat, India, 29% of Salvadora persica seeds germinated in pure seawater (56 dS/m), although maximum germination was recorded in distilled water. In isotonic solutions of 12 atm., maximum germination was observed in NaCl followed by mannitol and Na2SO4. Reduction of about 6% in soluble proteins in various parts of 21-day-old seedlings grown in 24 dS/m seawater was observed. Salinity induced an increase in accumulation of glutamic acid, glysine, isoleucine, leucine, methionine, phenylalanine, proline, serine, threonine and valine in different parts, whereas a reverse effect was noted for arginine, alanine, aspartic acid and asparagine. Accumulation of total, reducing and major sugars in the roots, hypocotyls and cotyledons of the seedlings was adversely affected under salinity stress. Increased uptake of cations and Cl was observed in seedlings grown in seawater. From authors' summary.

Cereal crops

TI: Influence of saline water irrigation and varying soil moisture regimes on soil properties, crop water use and yield of wheat inter-crops.
AU: Agrawal-PB; Sinha-AK; Yadav-BR
SO: Journal-of-the-Indian-Society-of-Soil-Science. 2002, 50: 3, 287-293; 18 ref.
LA: English
AB: Field experiments were conducted during the rabi seasons of 1994-95 and 1995-96 on silty loam soil (Inceptisol) at the experimental farm of the Indian Agricultural Research Institute, New Delhi to ascertain the effect of varying soil moisture regimes (IW/CPE=0.4 and 0.8) and irrigation water salinity levels (EC 0, 6, 12 dS m-1) on physico-chemical characteristics of irrigated soil under different wheat crop combinations (sole wheat, wheat + chickpea and wheat + mustard). Bulk density of soil marginally decreased but saturated hydraulic conductivity increased substantially with an increase in salinity of irrigation water. Trend of variation in magnitude of these properties was more conspicuous with advancement of crop growth under all cropping systems. However, moisture retained at 0.3, 1, 5 and 15 bar tensions was not influenced significantly either by saline water or by crop combinations. Increase in salt was observed due to an increase in salinity of irrigation water and frequency of irrigation was maximum in the surface layer and under wheat + chickpea cropping system. Actual evapotranspiration (ETa) increased with an increase in moisture regimes and slightly with EC 6 dS m-1

but decreased substantially with EC 12 dS m-1. Water use was greater under wheat + mustard cropping system followed by wheat + chickpea and sole wheat. Maximum ETa rate was observed during the spike development stage. The ratio of ETa/ET0 was higher during the vegetative and the spike development stages. Water use efficiency (WUE) increased at both salinity levels but it was higher at lower salinity level. The WUE decreased with an increase in moisture regimes. It was lowest in wheat + mustard intercropping.

TI: Effect of varying proportion of saline and best available water on yield and yield attributing characters of wheat in black clay soil.
AU: Raghuwanshi-SRS; Dubey-DD; Tiwari-SC
SO: Crop-Research-Hisar. 2000, 19: 1, 40-43; 8 ref.
LA: English
AB: A field experiment was initiated in 1991-92 at Indore, Madhya Pradesh, to compare irrigation with different water qualities for wheat production. Either the best available water was used, or water with EC 4 or 6 dS m-1 and SAR 10 was applied, or different combinations of good and saline water. Grain yield was highest (5.03 t/ha) when irrigated with well water, and lowest (3.67 t) when irrigated with the most saline (EC 6 dS m-1) water. Mixing saline with tubewell water in a 1:2 ratio gave yields of 4.84 and 4.67 t/ha using 4 and 6 dS m-1 saline water, respectively. Saline water increased Ca and K content of grain and straw.
PT: Journal-article

TI: Effect of irrigation with saline and mixed with best available water on soil properties and yield of wheat in smectitic clay soil.
AU: Raghuwanshi-SRS; Dubey-DD; Tiwari-SC
SO: Crop-Research-Hisar. 2000, 19: 1, 44-47; 6 ref.
LA: English
AB: A field experiment was initiated in 1991-92 at Indore, Madhya Pradesh, to compare irrigation with different water qualities for wheat production. Either the best available water was used, or water with EC 4 or 6 dS m-1 and SAR 10 was applied, or different combinations of good and saline water. Yield data and soil properties for 1996-97 are presented. The grain and straw yield of wheat decreased with the increase in ECiw. An increase in ECiw from 4 to 6 increased the electrical conductivity of saturation extract (ECe), water soluble cations and anions, SAR and ESP. The ESP increased beyond the critical level of 15 after five years (1996-97) of saline water irrigation to wheat. The ECe, water soluble cations and anions, SAR and ESP of the soil also increased with increasing SARiw (resultant SAR of irrigation water). Major changes were seen in 0-45 cm soil layers. The results suggested that waters having SAR below 10 and ECiw of 4 or 6 dS m-1 may be safely utilized for irrigating wheat after mixing them with tubewell water in a 1:2 ratio.

TI: Studies on the effect of saline water irrigation on germination and biometric characteristics of wheat crop in semi-arid Malwa region of Madhya Pradesh.
AU: Raghuwanshi-SRS; Dubey-DD; Tomar-AS
SO: Crop-Research-Hisar. 2001, 22: 3, 319-321; 4 ref.
LA: English
AB: A field study was conducted in Indore, Madhya Pradesh, India to determine the effect of different combinations of saline waters and best available tubewell water (BATW) on germination rate and biometric characteristics of wheat cv. WH-147. The saline irrigation waters were prepared by mixing NaCl, Na2SO4, CaCl2, MgCl2 and KCl (Ca:Mg::6:1, Cl:SO4::4:1) with the BATW to make the waters of EC 4 and 6 with sodium absorption ratio of 10. The highest germination rate of 94.25% and greatest plant height of 80.50 cm were observed with BATW, whereas the number of tillers decreased significantly with increase in ECe level of irrigation water.

TI: The effects of soil amendments on seedling establishment of pearl millet genotypes in summer under condition of saline water irrigation.
AU: Khafi-HR; Mehta-AC; Pethani-KV; Buhecha-KV
SO: Crop-Research-Hisar. 2001, 22: 3, 345-349; 4 ref.
LA: English

AB: A field experiment was carried out on medium clayey soil of Jamnagar (Gujarat, India), during the summer seasons of 1996, 1998 and 1999 to study the effects of soil amendments on seedling establishment of pearl millet genotypes, i.e. J-2296 (male), 81A (female) and GHB-235 (hybrid), under saline water irrigation. The treatments included 3 irrigation intervals of 5, 10 and 15 days and 5 different ameliorating techniques, i.e. farmyard manure, ash, top sowing, control and murram. Irrigation interval of 15 days produced the highest final plant count (14.06) and the lowest reduction in plant count (41.97%). The highest final plant count per metre row length (17.77) was observed with application of farmyard manure with lowest reduction of 41.35%. The hybrid genotype produced higher plant count of 13.37 per metre row length as well as lower reduction of 45.36% compared to male and female genotypes.

TI: Effect of water salinity on nutrient composition and their uptake by Isabgol (Plantago ovata Forsk.).
AU: Laxman-Singh; Pal-B; Johri-SN; Singh-L
SO: Current-Agriculture. 2000, 24: 1-2, 115-117; 12 ref.
LA: English
AB: A field experiment was carried out for two years continuously in winter season at Agra, Uttar Pradesh, India, to evaluate the performance of Isabgol (Plantago ovata) in salt-stressed conditions. Six types of saline water with electrical conductivity of 2.4 (control), 4, 8, 12, 16 and 20 dS m-1 were used. The salinity increased the N and Na content, whereas contents of P, K, Ca and Mg significantly decreased in grain and straw over control. The uptake values of N, P, K, Ca, Mg by grain and straw reduced significantly. However, the uptake of Na by grain also reduced with increasing levels of water salinity.

TI: A study on economics of phosphorus application for wheat grown with poor quality irrigation water.
AU: Lal-R; Lal-P
SO: Bhartiya-Krishi-Anusandhan-Patrika. 1993, 8: 3-4, 179-184; 5 ref.
LA: Hindi
LS: English
AB: Wheat cv. Kalyansona was grown on loamy sand in a field experiment in 1980-82 and irrigated with sodic saline water (EC 8 dS/m, SAR 26). In these conditions, applying 45 rather than 30 kg P2O5/ha gave better economic returns.
PT: Journal-article

TI: Econometric consideration for reuse of drainage effluent in wheat production
AU: Agnihotri,-A.K.; Kumbhare,-P.S.; Rao,-K.V.G.K.; Sharma,-D.P.
AD: RHRS-Seobagh, Neoli, Himachal Pradesh, India
SO: Agricultural-Water-Management (Netherlands).
1992, v. 22(3) p. 249-270; Nov, figs, tables, 18 ref.; summary (En)
LA: English
AB: In Haryana, India, a study was made, during 1989-90, of the long-term yield responses of wheat to irrigation water salinity and quantity in addition to the method of irrigating the wheat crop. An econometric framework was also developed to assess the mixing of saline drainage water with good quality canal water to irrigate the wheat. By subsidizing the price of saline drainage water, it may be possible to enhance the fairly good substitution of canal water by drainage water, which will ultimately result in a favourable shift in crop income and a substantial saving of precious canal water. From authors' summary.

ITALY / SPAIN/ GREECE/ TURKEY

TI: Corn yield response to saline irrigation water applied with a trickle system.
AU: Yazar-A; Gencel-B; Sezen-MS
SO: Journal-of-Food,-Agriculture-and-Environment. 2003, 1: 2, 198-202; 12 ref.
LA: English
AB: A field experiment was carried out in 2001 to evaluate the maize yield, yield loss and water use efficiency in relation to the salt concentration level of irrigation water applied with trickle system in the Mediterranean Region of Turkey. Saline irrigation water with ECw of 3.0, 6.0, 9.0, and 12.0 dS/m along with canal water of 0.5 dS/m

was used. In addition, three treatments were included by applying 10% leaching fraction to 0.5, 6.0, and 12.0 dS/m treatments after flowering. There was no significant difference in maize grain yields among the treatments as indicated by the variance analysis. The highest yield, averaging 8875 kg ha-1, was obtained from the treatment plots irrigated with canal water. Generally, profile salt concentration increased with increasing salinity of irrigation water. Higher salt concentration on the top layer was due to higher evaporation rate from the wetted surface. The general salt distribution profile at saline irrigation water treatments followed the typical water distribution under trickle irrigation (bulb shape) with maximum ECe at the soil surface. Applying a leaching fraction of 10% after flowering did not affect the salt distribution profile significantly in the treatments. There were no significant differences in dry matter production levels, water use efficiency, irrigation water use efficiency, 1000-grain weight, and harvest index among the salinity treatments. Saline irrigation water can be used for irrigating maize crop when applied with trickle system.

TI: Some remarks on the use of brackish water for irrigation.
OT: Considerations sur l'emploi des eaux saumatres pour l'irrigation.
AU: Cavazza-L
SO: New-Medit. 2003, 2: 4, 41-45; 8 ref.
LA: French
LS: English
AB: Climatic changes are expected to increase difficulties for the agriculture of the Mediterranean region. This encourages the use of saline waters for irrigation. The following cases can be considered: (a) water salinized by sea water intrusion (saline wedge at river mouth and karstic aquifers); (b) water from saline-soil watershed; (c) drainage water; (d) fossil water. Each of these cases has its own characteristics and offers possibilities of intervention. A general solution is often offered by the possibility of mixing waters having different salinities. After some approximation and for a given crop eight different cases can be outlined with different results. The effect of brackish water irrigation on the quality of the produce shall be taken also into account. Long term consequence of the use of saline waters on soil traits may have a great importance according to the soil type. Considerations are given on the use of non-renewable resources.

TI: Determination of salt tolerance of stock (Matthiola tricuspidata) as a potential oil crop.
AU: Demiral-MA
SO: Turkish-Journal-of-Agriculture-and-Forestry. 2003, 27: 4, 229-235; 14 ref.
LA: English
LS: Turkish
AB: To investigate the salt tolerance of stock (M. tricuspidata), a control and 4 different concentrations of NaCl + CaCl2 were applied to plants grown under greenhouse conditions. Na, Cl and electrical conductivity (EC) analyses were conducted in soil, plant and leached samples. Yield, plant growth parameters and plant dry matter were also determined. All plants survived until the end of the experiments. Treatments affected the ion content and EC of leached and soil samples significantly. Increasing salinity conditions increased translocation of Na and Cl in plants. Flower numbers, seed pod numbers, and dry matter content of shoot and leaf were affected significantly. The second treatment, 2.0 dS m-1, gave the highest seed pod number. However, treatments increased the plant dry matter up to 6.0 dS m-1 in the shoot, and up to 8.0 dS m-1 in the leaf. The results suggest that irrigation of stock with saline water is feasible.

TI: Effects of irrigation water with different salt concentrations and SAR values on soil salinisation and sodification.
AU: Cucci-G; Rubino-P; Caliandro-A
SO: Italian-Journal-of-Agronomy. 2003, 7: 1, 41-48; 14 ref.
LA: English
LS: Italian
AB: Background. Most soils irrigated with brackish water are subject to salinization or alkalization, which cause a reduction in soil fertility and the formation of saline-alkaline soils in the medium or long term. To further contribute to the knowledge on these topics, a study was undertaken in Italy on the salinization and sodification of soils irrigated by waters with different salt concentrations and sodic levels, within a collaborative research project dealing with the effect of irrigation with saline-sodic waters on the chemical, hydrological, mechanical and

agronomic aspects, under laboratory and field conditions. Methods. Two types of clay loam soils were tested for two consecutive years. They were packed in cylindrical pots and placed under a shed, and bean (1999) and capsicum (2000) were grown in succession. Both crops were irrigated with nine types of water obtained by mixing NaCl and CaCl2, from the factorial combination of three salt concentrations (0.001-0.01-0.1 M in the first year and 0.01-0.032-0.1 M in the second) with three SAR values (5-15-45). Both crops were irrigated whenever the bulk of soil in the pot had lost 30% of the available moisture by evapotranspiration, monitored by weighing the pots. Watering volumes corresponded to the volume required to restore field capacity to the entire soil profile plus the compared leaching requirement (10-20%). Throughout the cycles of both crops, drainage water was collected and analysed. At the end of the irrigation season in both years, soil samples were taken from the 0.30 m top layer of each pot and tested for electrical conductivity, pH, soluble Na-K-Ca-Mg on the saturation extract, plus exchangeable cations and exchangeable sodium percentage (ESP). Results. The amount of drainage water differed from the applied leaching requirement (LR). The amounts of leached solutes varied as a function of the amount of drainage water and its salt concentration. The percentages of leached solutes, as compared to those applied, decreased considerably as the irrigation water salinity increased. Salt build-up in the soil increased proportionately with the salt concentration of the irrigation water, while it varied slightly with LR and soil type. As a result of the balance between applied and leached solutes, at the end of the irrigation season of both years, the ECe values of the top soil layer (0.30 m) were 1 and 2.2 dS m-1 and 13.9 and 19.5 dS m-1, against a value of 0.71 dS m-1 observed prior to the research, using the lowest and highest water salinity, respectively. The exchangeable sodium percentages increased gradually, while those of Ca decreased gradually as the salinity and SAR of irrigation water increased; exchangeable potassium percentages did not vary considerably as a function of irrigation water quality. The exchangeable magnesium percentages increased proportionately with the SAR of irrigation water. Conclusions. The leaching requirement efficiency decreased considerably as irrigation water salinity increased. The results obtained show that in areas where the long term average yearly rainfall is not below 450-500 mm, winter rainfall could be more effective than LR to leach the solutes applied with brackish water, decreasing the seasonal irrigation volumes and amounts of applied solutes. A progressive sodification was observed in the top soil layer, as the salinity and SAR of the irrigation water increased.

TI: Effect of irrigation with sodic-saline water on some mechanical properties of soil.
OT: Effetto dell'irrigazione con acque salino-sodiche su alcune caratteristiche meccaniche del suolo.
AU: Fabbri-A; Guarnieri-A; Marcheselli-L
SO: Rivista-di-Ingegneria-Agraria. 2003, 34: 1, 11-16; 24 ref.
LA: Italian
LS: English
AB: This study investigated the influence of NaCl and CaCl2 concentration, and of the sodicity index of four Italian clay soils (Argese, Cardone, Carpi and Ozzano), on their physical-mechanical characteristics. The soils were treated with salt solutions at concentrations (0.001-0.1 M), and the sodicity indexes were 5-15-45 classical sodium adsorption ratio. The Atterberg limits (LL and LP), penetration resistance as cone-index (CI), and monoaxial compression resistance under unconfined conditions were determined. The measured values of the Atterberg limits showed that significant effects of the salinity/sodicity variations on the Ozzano soil, wherein LL decreases for increasing salinity and sodicity, while LP decreases. Based on CI, differences among the various treatments were not significant, besides those obvious, due to differences between soils or moisture. A highly significant influence of the treatment of the samples on the compression resistance, measured on cylindrical samples submitted to monoaxial compression in unconfined conditions, was observed.

TI: Ameliorative effect of calcium nitrate on cucumber and melon plants drip irrigated with saline water.
AU: Kaya-C; Higgs-D; Kirnak-H; Tas-I
SO: Journal-of-Plant-Nutrition. 2003, 26: 8, 1665-1681; 30 ref.
LA: English
AB: Cucumber (Cucumis sativus cv. Orlando) and melon (Cucumis melo cv. Ananas) were field grown to investigate the effects of supplementary calcium nitrate applied to irrigation water on plant growth and fruit yield of salt stressed and unstressed cucumber and melon plants in Turkey during 2001. Treatments were (1) control: normal irrigation water (C); (2) normal irrigation water plus supplementary 5 mM Ca(NO3)2 added to the irrigation water (C + CaN); (3) salt treatment: C plus 60 mM NaCl added irrigation water (C + S); and (4) supplementary Ca(NO3)2: C + S plus supplementary 5 mM Ca(NO3)2 added to the irrigation water (C + S +

CaN). Plants irrigated with water containing high NaCl produced less dry matter, fruit yield, and chlorophyll than the control treatments of both species. Supplementing irrigation water with Ca(NO3)2 resulted in increases in dry matter, fruit yield, and chlorophyll concentrations over plants irrigated with saline water. Membrane permeability increased with C + S treatment for both species. Supplementary Ca(NO3)2 restored membrane permeability. Sodium (Na) concentration in plant tissues increased in leaves and roots in the elevated NaCl treatment. Concentrations of Ca and N in leaves were decreased in the high salt treatment and fully restored by supplementary Ca(NO3)2. These results clearly show that supplementary Ca(NO3)2 can partly mitigate the adverse effects of saline water on both fruit yield and whole plant biomass in melon and cucumber plants.

TI: Irrigation with saline water in the reclaimed marsh soils of south-west Spain: impact on soil properties and cotton and sugar beet crops.
AU: Moreno-F; Cabrera-F; Fernandez-Boy-E; Giron-IF; Fernandez-JE; Bellido-B
SO: Agricultural-Water-Management. 2001, 48: 2, 133-150; 15 ref.
LA: English
AB: The drained and irrigated marshes in south-west Spain are formed on soils of alluvial origin from the ancient Guadalquivir river estuary. The most important characteristics of these soils are the high clay content (_70%), high salinity, and a shallow, extremely saline, water table. The reclaimed area near Lebrija, called Sector B-XII (_15000 ha), has been under cultivation since 1978. For some years, however, water supply for irrigation is limited due to drought periods. The effects of irrigation with highly and moderately saline waters on soil properties and on growth and yield of cotton and sugarbeet crops were evaluated during 1997 and 1998 in a farm plot of 12.5 ha (250 x 500 m) in which a drainage system had been installed, consisting of cylindrical ceramic sections (0.3 m long) forming pipes 250 m long, buried at a depth of 1 m and spaced at intervals of 10 m. These drains discharge into a collecting channel perpendicular to the drains. Two subplots of 0.5 ha (20 m x 250 m) each were selected. In 1997, cotton was growing in both subplots, and irrigation was applied by furrows. One subplot (A) was irrigated with fresh water (0.9 dS m-1) during the whole season, while in the other subplot (B) one of the irrigations (at flowering stage) was with water of high salinity (22.7 dS m-1). During 1998 both subplots were cropped with sugarbeet. Subplot A was irrigated with fresh water (1.7 dS m-1) during the whole season, while in subplot B two of the irrigations were with moderately saline water (5.9-7.0 dS m-1). Several measurement sites were established in each subplot. Water content profile, tensiometric profile, water table level, drainage water flow, soil salinity, and crop development and yield were monitored. The results showed that after the irrigation with high saline water (subplot B) in 1997 (cotton), the soil salinity increased. This increase was more noticeable in the top layer (0-0.3 m depth). In contrast, for the same dates, the soil of subplot A showed no changes. After five irrigations with fresh water, the salinity of the soil in the subplot B reached values similar to those before the application of saline water. In 1998 (sugarbeet), the application of moderately saline water in subplot B also increased soil salinity, but this increase was lower than in 1997. The irrigation with high saline water affected cotton crop development, with cotton growth reduced in comparison with that in the subplot irrigated only with fresh water. Despite this negative effect on crop development, the crop yield was the same as in the subplot A. Sugarbeet development did not show differences between subplots, but yield was higher in subplot B than in subplot A.

TI: Irrigation with brackish water: effects on soil strength of a fine-textured soil.
AU: Ventrella-D; Castrignano-A; Maiorana-M; Losavio-N; Vonella-AV; Fornaro-F; Pagliai-M (ed.); Jones-R
SO: Sustainable land management - environmental protection. A soil physical approach. International Conference, Florence, Italy, 2-7 July 2001. Advances-in-Geoecology. 2002, No.35, 279-290; 12 ref.
LA: English
AB: The penetrometer is the most widely used instrument for assessing in situ soil strength that is one of most important factors affecting root growth and consequently crop productivity. During a two-year period (1999-2000), soil penetration resistance was measured with a cone penetrometer in order to evaluate the effects of saline water irrigations on soil strength. This study was carried out in Southern Italy, in a coastal area of Basilicata region. The soil is classified as a Typic Epiaquert, similar to those formed on silty-clay and clay lagoon sediments that are present over large portions of the alluvial basin between the Basento and Bradano rivers. The penetration resistance (cone index) was measured to a depth of 52.5 cm at 3.5-cm intervals on three adjacent plots submitted, since 1998, to different crop irrigation treatments: fresh (F: 1 dS m-1), saline (S: 4 dS m-1) and fresh/saline water (FS). We carried out three surveys in the first year of maize cultivation and two surveys in the following year of

sugar beet cultivation. Each survey consisted of 54 penetrometer measurements on a 1.5 m by 2 m grid. In order to treat the spatio-temporal variability of soil impedance, a multi-variate approach is applied, where the set of T sampled times is treated as a realization of T inter-correlated random functions. The estimation of the property of interest involved fitting an anisotropic linear model of coregionalization to the T(T+1)/2 simple and cross-variograms consisting of two parts: an isotropic model on the horizontal plane and another one in the direction perpendicular to the surface. The variography showed a high temporal correlation between the soil strength measured at different times, which proved that the soil profile structure was conservative. For each survey, a three-dimensional map was produced interpolating the data by cokriging. The visual comparison between such maps revealed a temporal variability but the soil structure, along the vertical profile, was not significantly altered by the effects due to saline irrigations.

TI: Irrigation of cotton and wheat with drainage water in the Mediterranean Region of Turkey.
AU: Yazar-A; Yarpuzlu-A; Sezen-SM; Aksoy-U (ed.); Anac-D (ed.); Anac-S (ed.); Beltrao-J (ed.); Ben-Asher-J (ed.); Cuartero-J (ed.); Flowers-TJ (ed.); Hepaksoy-S
SO: Proceedings of the International Symposium on Techniques to Control Salination for Horticultural Productivity, Antalya, Turkey, 7-10 November 2000. Acta-Horticulturae. 2002, No.573, 331-338; 8 ref.
LA: English
AB: Reuse of drainage water for crop production is a common practice in downstream section of the Lower Seyhan Irrigation Project area in the Mediterranean region of Turkey. Therefore, effective salinity control measures must be implemented for sustainable irrigated agriculture, which requires safe use of saline, low quality irrigation and drainage waters for crop production. A five-year study was conducted in the Lower Seyhan Irrigation Scheme from 1991 to 1996 in order to evaluate the response of cotton and wheat grown on a clay soil in a sequence to drainage water applications with different leaching fractions as well as salinity build-up in the soil profile during each growing season in Tarsus. Effect of winter rainfall on salt balance of the soil profile was investigated. In addition, water quality changes occurred in drainage canal were evaluated throughout the study period.

TI: The effect of alternating different water qualities on accumulation and leaching of solutes in a Mediterranean cracking soil.
AU: Crescimanno-G; Provenzano-G; Booltink-HWG
SO: Hydrological-Processes. 2002, 16: 3, 717-730; 32 ref.
LA: English
AB: The relevance of bypass flow on water flow, solute or pesticide transport is becoming increasingly recognized. Recent investigations proved that soil salinization may be influenced by bypass flow, i.e. the rapid transport of water and solutes via macropores and/or shrinkage cracks to subsoil and groundwater. This paper explores the role of bypass flow in the process of accumulation and leaching of solutes, as well as of sodium, in a Mediterranean (Sicily, Italy) cracking soil irrigated with saline/sodic waters. The results of bypass flow experiments performed on undisturbed soil cores showed that leaching of solutes occurred in concomitance with bypass fluxes when a low salinity solution was alternated with a high salinity solution. Exchange of solutes between the incoming solution and the soil matrix occurred during the bypass flow events at the contact surfaces (cracks walls) between the solution and the soil matrix and where cracks terminated in the soil samples. Concomitant exchanges of sodium were indicated by measurements performed in the effluent solution during the bypass flow measurements. The amount of sodium released from the soil during the bypass flow events, as well as that of the soluble salts leached from the soil, were found to depend on the degree of soil cracking. These results indicate that: (1) in management of irrigation in cracking soils, under the occurrence of bypass fluxes, alternating a low salinity/sodicity water with a high salinity/sodicity solution can be effective for preventing salinization and sodification; and (2) greater efficiency of removal of sodium/soluble salts can be obtained if application of the leaching solution is performed when the soil is at a considerable degree of cracking.

TI: Simulation studies of long-term saline water use: model validation and evaluation of schedules.
AU: Tedeschi-A; Menenti-M
SO: Agricultural-Water-Management. 2002, 54: 2, 123-157; many ref.
LA: English

AB: In the Mediterranean environment characterized by hot, dry summers, a hydrologically oriented field experiment on vegetable crops was carried out between 1988 and 1993 at a site near Naples, Italy. The objective of the experiment was to study the impact of saline water on crop yield and soil properties. The research was carried out on a clay loam soil classified as Haplustolls. Irrigation water was applied at concentrations: 0, 1.25, 2.5, 5, 10 g l-1 of NaCl and at three irrigation intervals of 2, 5 and 10 days. The increasing concentrations were obtained by adding NaCl to fresh water. The irrigation treatments (i.e. solute concentration and irrigation intervals) were repeated consistently over the same plots throughout the experiment. Irrigation schedules alternating sodic and fresh water were evaluated using a numerical simulation model (SWAP) and taking into account the impact of sodic water on soil physical properties. Measurements done during the field trials were used to calibrate and validate the numerical simulation model and to illustrate the consequences on salt and water balance of the irrigation schedules considered in the study. The electrical conductivity of the saturated extracted of soil paste (ECe), the structure stability index and the infiltration rate indicated observable changes in soil physical properties between the irrigation treatments 0 and 1% over the duration of the experiment. Over the years there is clear evidence that no significant change in ECe was observed in the plots irrigated with fresh water (0% T2 and T10). On the other hand, ECe increased linearly with time for the treatments irrigated with saline water (1% T2 and T10). Degradation of soil structure was evident in the observed infiltration rate: < 1 mm h-1 in the treatment 1% versus > 10 mm h-1 in the treatment 0%. Changes in soil hydrological properties were evaluated by determining the h(theta) and K(h) relationships of undisturbed soil cores for four irrigation treatments and using the van Genuchten parametric model of these relationships. For the 2- and 10-day irrigation frequencies, the h(theta) curve of the 1% treatment had lower values of theta than the 0% treatment at the same pressure head in the range 2.0-3.0 pF. Significant differences were observed between the mean values (for each treatment) of most of van Genuchten's parameters, particularly between the (0% 2 day) and (1% 2 day) treatments. Prior to the evaluation of irrigation schedules the SWAP model was calibrated and validated against the data available in the 1993 (aubergine crop). Irrigation schedules were compared on the basis of a performance indicator (Sc), which measures the relative change in the amount of adsorbed and dissolved salt over an entire irrigation season.

TI: Spatial and temporal changes of soil salinity in a cotton field irrigated with low-quality water.
AU: Cetin,-Mahmut [Author]; Kirda,-Cevat [Author,-Reprint-Author]
SO: Journal-of-Hydrology-(Amsterdam). 2003; 272(1-4): 238-249
PY: 2003
LA: English
AB: Reuse of upland drainage waters has become an acceptable and common practice among many farmers who have no access to good-quality irrigation water, and suffer long periods of droughts in arid and semi-arid regions. This study was carried out in a farmer's cotton field of 0.27 ha, located in the Eastern Mediterranean Coastal Region of Turkey, at 2.1 m mean sea level. The area presently lacking irrigation water has a typical Mediterranean climate with dry and hot summers, and cool and rainy winters. The farmers in the area use low-quality irrigation water, diverted from drainage channels, carrying irrigation return flows of upland fields. The objective of the work was to assess what effect the existing practice of irrigation can have on soil salinity using both conventional statistics and geostatistical techniques. Eighty one soil samples were collected from 0 to 30 cm depth in 1999 and 2000 along five parallel transects established in North/South direction of the experimental field. Two samplings were done each year, before and after irrigation seasons, in early June and late September, respectively. Simple-mean ECe-comparison tests of the data revealed that soil salinity had decreased from 4.8 to 3.0 dS m-1 under farmer's irrigation practice over the two irrigation seasons. There was always a decreasing trend in soil salinity from the beginning until completion of the irrigation seasons, in both years 1999 and 2000. Kriged contour maps, drawn based on spatial variance structure of the data, revealed that saline areas (ECegtoreq4 dS m-1) of the field decreased from 51 to 20%, confirming the trend demonstrated with conventional statistics. The results, although limited only to 2 years work, suggest that the risk of increasing soil salinity is nearly nil would farmers cultivate and irrigate downstream low lands where irrigation schemes can not reach, rather than using these areas only for rain-fed farming.
UD: 20031221

TI: Nitrate content in cardoon grown under NaCl stress.
OT: Contenuto in nitrati e salinita da cloruro di sodio nel cardo.
AU: Giustiniani-L; Graifenberg-A; Botrini-L; Temperini-O; Granchi-G

SO: Colture-Protette. 1999, 28: 8, 39-42; 21 ref.
LA: Italian
LS: English
AB: The effects of saline irrigation water on nitrate accumulation in cardoon (Cynara cardunculus) grown in soil-filled benches were investigated during autumn and winter in Pisa (central Italy). The experiment was conducted in an unheated plastic greenhouse to avoid leaching. Four cardoon cultivars (Gigante di Romagna, Gigante di Lucca, Bianco gigante inerme a foglia intera, Bianco avorio gigante a foglia frastagliata), were irrigated with water of low electrical conductivity (0.5 dS/m) and low Cl content (75 mg/litre) or the same water amended with NaCl (4 g/litre) with 6.2 dS/m electrical conductivity. Marketable yield, fresh weight of the whole plant, NO3 and Cl concentration in the edible part, petioles of external and internal leaves, and roots were evaluated. An average 16% reduction in marketable yield was observed in plants grown under the more saline conditions. The average NO3 concentration in the marketable yield of control plants was 2413 mg/kg fresh weight, while an average 37% reduction in NO3 concentration was shown in plants grown under saline conditions. It is suggested that there is marked antagonism between NO3 and Cl- ions.

TI: Irrigation of olives in a lysimetric tank using saline water.
OT: Irrigazione con acque saline dell'olivo in vasca lisimetrica.
AU: Dettori-S; Filigheddu-MR; Ibba-M; Virdis-F
SO: Rivista-di-Frutticoltura-e-di-Ortofloricoltura. 1999, 61: 7-8, 73-77; 19 ref.
LA: Italian
AB: In an experiment in Sardinia, Italy, 10-year old pot-grown olive trees, cv. Olia Manna, were irrigated with water of 0.3% salinity (A) and 0.9% salinity (B) or with local well water (C), which is becoming increasingly saline in recent years. Some of the pots were placed in 9 m3 lysimeters, from which the drainage water was analysed. Treatments A and B led to modification of the cation exchange capacity of the soil, due to substitution of 30-60% of Ca, depending on the saline concentration; potassium and magnesium were also removed. All 3 cations were found in the water draining from the lysimeters as was surplus sodium. The olive trees, though tolerant, reacted with slowed trunk and mesocarp growth and reduced oil yield, though the glucide content of the fruit seemed to be enhanced. Repeated saline irrigation could impair yields due to a build-up of soil salinity.

TI: Use of saline waters for irrigation: Cyprus case.
AU: Papadopoulos-I; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 42-50; 23 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: Due to limitations on available water resources, Cyprus faces a serious challenge to sustain present levels of agricultural production while coping with less, and lower quality, water. Effective water use and on farm management of saline waters are important aspects in addressing problems of salinity, water scarcity and practising intensive agriculture on environmentally sound grounds. This paper provides information on salinity, saline waters and cultural practices adopted and used with improved irrigation technology in Cyprus. A particular problem is secondary soil salinization due to irrigation. Proposed practical solutions include: fertigation, treatment of municipal waste waters, use of acid fertilizers, introduction of regulations on the use of waste water for irrigation.

TI: Optimal management of a coastal aquifer in southern Turkey.
AU: Hallaji-K; Yazicigil-H
SO: Journal-of-Water-Resources-Planning-and-Management. 1996, 122: 4, 233-244; 22 ref.
LA: English
AB: Seven groundwater management models were developed to determine the optimal planning and operating policies of a costal aquifer in southern Turkey threatened by saltwater intrusion. Steady-state and transient finite-element simulation models, representing the response of the system, were linked to linear and quadratic optimization models using response functions. Optimal pumpage policies were determined for 93 wells under

three management objectives that maximized agricultural water withdrawal and minimized drawdowns and pumping costs, subject to constraints related to the systems response equations, demand requirements, drawdown limitation in saltwater intrusion control locations and pumping wells, and discharge bounds. Results are shown in the form of trade-off curves relating optimal pumpage rates and pumping costs to basin wide drawdowns and saltwater containment. Modeling results indicated that significant increases in total aquifer yield were possible with controlled drawdowns so that infringement of saltwater was prevented. Optimal pumping schedules differed, depending on the type of objective function used. The best policy appeared to be the one in which the excess water pumped from the most productive wells was transported overland to meet local demand at less productive wells.
PT: Journal-article

SUB-SAHARAN AFRICA

TI: Use of saline groundwater for community-based irrigation in dryland areas of Southern Africa.
AU: Lovell-CJ; Murata-M; Batchelor-CH; Chilton-PJ; Ragab-R (ed.); Pearce-G
SO: The use of saline and brackish water for irrigation. Implications for the management of irrigation, drainage and crops. Proceedings of the International Workshop at the Tenth ICID Afro-Asian Regional Conference on Irrigation and Drainage, Denpasas, Bali, Indonesia, 19-26 July, 1998. 1998, 106-115; 19 ref.
PB: Indonesian National Committee on Irrigation and Drainage (INACID), Directorate General of Water Resources Development, Ministry of Public Works; Jakarta; Indonesia
LA: English
AB: For many people in communally-managed dryland areas of sub-Saharan Africa, the groundwater stored in crystalline basement aquifers is the only source of water for long periods of the year. In these areas, 'productive water points' have been designed and implemented to provide surplus water for activities such as small scale irrigation. One factor that may hinder widespread replication is the occurrence of saline and brackish groundwater. Results are presented on groundwater quality recorded in dry areas of Zimbabwe, on the use of collector wells to abstract shallow groundwater for irrigation in areas where groundwater salinity generally increases with depth, and on developments of low-cost irrigation techniques such as sub-surface clay pipes and low-head drip which can improve water use efficiency of small-scale irrigation using moderately saline groundwater. Sub-surface techniques are preferred from a water efficiency point-of-view, and this is also the case for the use of saline waters - for which the salinity build-up notices was not acceptable.

TI: Seawater-based agriculture: possibilities of Salicornia cultivation in Africa's coastal village communities.
AU: Israel-A; Mshigeni-KE
SO: Discovery-and-Innovation. 1997, 9: 1-2, 1-3; 8 ref.
LA: English
AB: The possibility of using the halophyte Salicornia spp. in cultivation of the coastal belt of Africa, as an oilseed and forage crop, is discussed.
PT: Journal-article

SOUTH AMERICA

TI: Greening of arid cities by residual water reuse: a multidisciplinary project in Northern Chile.
AU: Caceres-Villanueva-L; Delatorre-J; Riva-F-de-la; Monardes-V; de-la-Riva-F
SO: Ambio. 2003, 32: 4, 264-268; 18 ref.
LA: English
AB: This paper describes a project in northern Chile aimed to promote the development of appropriate green areas and gardens for arid regions under prevalent conditions of shortage of water and high salt content in soil and water. Field studies were conducted to test the suitability of selected salt-tolerant native and introduced plants for ornamental use, e.g., Nolana sp. and Calandrinia sp. Plant growth, water and soil quality, marine spray, climate, waste water treatment and irrigation operating problems were the subject of specific studies and discussion.

TI: Growth in banana cultivars under different salinity levels of irrigation water.
OT: Crescimento de bananeiras sob diferentes niveis de salinidade da agua de irrigacao.
AU: Carmo-GA-do; Medeiros-JF-de; Tavares-JC; Gheyi-HR; Souza-AM-de; Palacio-EA-de-Q; de-Q-Palacio-EA; do-Carmo-GA; de-Medeiros-JF; de-Souza-AM
SO: Revista-Brasileira-de-Fruticultura. 2003, 25: 3, 513-518; 10 ref.
LA: Portuguese
LS: English
AB: The effects of different salt levels (0.55, 1.70, 2.85, and 4.00 dS/m) in irrigation water applied daily or once every 2 days on vegetative growth of banana cultivars Pacovan and Marmelo were evaluated in Brazil. The increase in water salinity decreased plant height, number of leaves, leaf area up to 240 days after planting, with values stabilizing after the rainy period.

TI: Simulation of the economic feasibility of fodder shrub plantations as a supplement for goat production in the north-eastern plain of Mendoza, Argentina.
AU: Guevara-JC; Silva-Colomer-JH; Estevez-OR; Paez-JA
SO: Journal-of-Arid-Environments. 2003, 53: 1, 85-98; 37 ref.
LA: English
AB: The economic feasibility of Atriplex nummularia Lindl. and spineless cactus (Opuntia spp.) plantations for supplementing goats in the north-eastern plain of Mendoza (mean annual rainfall=175 mm) during the fall-winter period was examined by a simulation model. It was run with 50-200 goats and annual rainfall probability (p; 10-90% probability of occurrence). Cactus production was estimated from a rain-use efficiency factor of 12.5 kg DM ha-1 year-1 mm-1 and the annual rainfall probabilities in the area. Saltbush production (1.88 t DM ha-1 year-1) was assumed not to be affected by annual rainfall thanks to the presence of a, 5-10 m deep, moderately saline water table (3.5-5.0 dSm-1). A decrease in goat mortality and an additional number of kids per goat were considered as annual benefits derived from supplementing the goat diet. The establishment cost (US$ ha-1) ranged from 812 (50 goats; p0.1) to 317 (200 goats; p0.9) for cacti plantations and from 691 (50 goats) to 378 (200 goats) for saltbush plantations, amounts that not all stockmen could afford. The cost of metallic fence installation was the main item of establishment cost for both shrubs. The nutrient costs for shrub production were lower than those for lucerne hay, the conventional feed used by stockmen. A decrease in doe mortality from 10% to 2% and an increase in annual kid crop ranges from 0.17 to 0.32 would economically justify shrub plantations for stockmen having more than 50 goats at annual rainfall probabilities from p0.1 to p0.8. Limitations of the modelling effort and the feasibility of using the model in other areas of the world were stated.
PT: Journal-article

TI: Application of saline water in the development and physiological behavior of the coconut.
OT: Aplicacao de agua salina no desenvolvimento e comportamento fisiologico do coqueiro.
AU: Silva-Junior-CD-da; Passos-EEM; Gheyi-HR; da-Silva-Junior-CD
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 2002, 6: 1, 39-44; 27 ref.
LA: Portuguese
LS: English
AB: This study evaluates the effect of drought and application of water of different levels of salinity on the development of a 5-year-old "Brazilian Tall" coconut (Cocos nucifera) cultivated under field conditions. The experiment was conducted at the Itaporanga Experimental Station in the State of Sergipe located in Northeast of Brazil. The experimental design consisted of randomized blocks (4) with 4 treatments and each repetition constituted of 12 plants. The applied treatments were: T0 -- not irrigated; T1 -- application of 40 litre per plant of fresh water at intervals of 3 days; T2 and T3 -- application of saline water containing 7.5 and 15.0 g litre-1 of total salts. The following variables were analysed: number of living leaves, number of dead leaves, the percentage survival of plants at the end of the experiment, the leaf water potential and the stomatal conductance. The analysis of the data showed that the treatments T0 and T3 affected significantly the number of living leaves, but the variable stomatal conductance in the dry period was affected by all the treatments, which points out the inadequacy of the amount of water applied. At the end of the experiment, the survival percentage was of 83% for T1, 81% for T2, 79% for T3 and 58% for T0. The results permit to conclude that water containing up to 15 g litre-1 salts during dry season is essential to avoid the loss of young plants.

TI: Effect of irrigation water salinity and its mode of application on garlic growth and production.
OT: Efeito da salinidade e modo de aplicacao da agua de irrigacao no crescimento e producao de alho.
AU: Amorim-JR-de-A; Fernandes-PD; Gheyi-HR; Azevedo-NC-de; de-A-Amorim JR.; de-Azevedo-NC
SO: Pesquisa-Agropecuaria-Brasileira. 2002, 37: 2, 167-176; 25 ref.
LA: Portuguese
LS: English
AB: In Paraiba State, Brazil, garlic is usually irrigated by sprinkler system using water with varying salt concentrations that may cause damage to plants. The present study was carried out under greenhouse conditions testing five levels of water salinity varying from 0.6 to 3.0 dS m-1 and two modes of water application, wetting or not of the plant leaves. The growth and development of plants of cv. Cabaceiras were evaluated at 30, 60, 90 and 120 days after planting (DAP). Garlic plants were relatively tolerant to salinity at the bulb formation stage and initial growth up to 30 days. During the final stage (90-120 DAP), wetting of the leaves affected the growth of aerial parts and the number of garlic cloves. The salinity levels started affecting aerial parts during the period 30-60 DAP while the bulb was affected only between 60-90 DAP. The most sensitive phase of bulb growth to salinity was the last 30 days of the crop cycle. The bulb ratio cannot be utilized as a characteristic for evaluation of salinity tolerance in garlic.

TI: Growth and nitrogen fixation of Leucaena leucocephala and Mimosa caesalpiniaefolia in a saline soil of the Brazilian semi-arid region as affected by sulphur, gypsum and saline water.
AU: Stamford-NP; Araujo-Filho-JT; Silva-AJN
SO: Tropical-Grasslands. 2000, 34: 1, 1-6; 22 ref.
LA: English
AB: A greenhouse experiment was conducted to evaluate the effects of applying elemental sulfur inoculated with Thiobacillus (T. thiooxidans and T. ferrooxidans, sulfur oxidizing bacteria) or gypsum, on dry matter production and nitrogen fixation by seedlings of Leucaena leucocephala and Mimosa caesalpiniaefolia [M. caesalpiniifolia] inoculated with 2 appropriate strains each of Bradyrhizobium and grown in a soil with high sodium content and irrigated with saline water. An alluvial solodic medium texture soil, representative of the semiarid region of Pernambuco, Brazil, was used. The treatments consisted of the addition of elemental sulfur at two levels (0.3 or 0.6 t/ha), and gypsum at two levels (0.6 or 1.2 t/ha); both these treatments lead to leaching of sodium from the soil (but by different mechanisms) and possible amelioration of excess salinity/alkalinity. Plants were irrigated with saline water (containing NaHCO3, NaCl, MgCl2, CaCl2, KCl) at three levels of electrical conductivity (0.2, 6.1 and 8.2 dS/m at 25°C), in a factorial combination. There was a treatment with no sulfur or gypsum applied. The results showed that elemental sulfur inoculated with Thiobacillus decreased soil pH and increased Al toxicity which harmed the growth of L. leucocephala, and that M. caesalpiniifolia was more susceptible than L. leucocephala to salinity promoted by the saline irrigation water.

TI: Quality of the water for irrigation in different aquifers in area of sediments in the Rio Grande do Norte State, Brazil.
OT: Qualidade fisico-quimica da agua para irrigacao em diferentes aquiferos na area sedimentar do estado do rio grande do norte.
AU: Oliveira-M-de; Eluterio-Maia-C
SO: Revista-Brasileira-de-Engenharia-Agricola-e-Ambiental. 1998, 2: 1, 17-21; 17 ref.
LA: Portuguese
LS: English
AB: More than 600 water samples from different aquifers in a semi-arid region of northeastern Brazil were studied to assess the water quality of water used for irrigation. The analyses were conducted using a database from the Laboratory of Analysis of Water and Soil Fertility of the Department of Soils and Geology at Escola Superior de Agricultura de Mos. A large number of water samples were saline or had high amounts of sodium in relation to the bivalent cations Ca and Mg. Saline and sodic water was most frequently found in tubular wells.