# ENVIRONMENTAL IMPACT OF TRADITIONAL NPK, UREA & DAP FERTILIZERS VS HRF BP G3 Evolution

HYDRO RETENTIVE FERTILIZER
Barbary Plante EVOLUTION

## CONSEQUENCES
## &
## SOLUTIONS

# ENVIRONMENTAL IMPACT OF FERTILIZERS USED IN AGRICULTURE

Conventional nitrogen, phosphorus, and potassium-based fertilizers, such as UREA, NPK, and DAP, have significant environmental impacts with respect to water pollution and greenhouse gas emissions.

# WATER POLLUTION

Water pollution from traditional fertilizers in agriculture is a major environmental problem in many parts of the world.

Traditional fertilizers, such as chemical fertilizers based on nitrogen, phosphorus, and potassium, are widely used to increase agricultural production by providing plants with the nutrients they need to grow.

However, their overuse or incorrect use can lead to adverse consequences for aquatic ecosystems and water quality.

# WATER POLLUTION

## Nitrates in groundwater

Nitrogen-containing fertilizers, such as urea and nitrogen compounds in NPK fertilizers, can be converted to nitrates in the soil. Nitrates are soluble in water and can travel quickly to groundwater, contaminating drinking water supplies. High nitrate levels in water can have adverse effects on human health and aquatic ecosystems

# WATER POLLUTION

## Washing

When fertilizers are applied to fields, some of the nutrients are not taken up by the plants and can be washed away by rainfall or irrigation, a process called leaching. Nutrients such as nitrates and phosphates can end up in streams, lakes, and groundwater, contributing to water pollution.

# WATER POLLUTION

**Eutrophication**

Excess phosphorus from the use of phosphate fertilizers such as DAP can lead to eutrophication of water bodies. Eutrophication occurs when nutrient levels (mainly phosphorus and nitrogen) in the water increase excessively, which promotes the growth of algae and aquatic plants. This can disturb the ecological balance of aquatic ecosystems and lead to the death of fish and other aquatic organisms.

# WATER POLLUTION

## Impact on biodiversity

Water pollution from fertilizers can also affect the biodiversity of aquatic ecosystems by altering the living conditions of native species and promoting invasive species

# GREENHOUSE GAS EMISSIONS (GHGS)

**Carbon dioxide ($CO_2$) emissions related to fertilizer production**

The manufacture of chemical fertilizers often requires energy-intensive industrial processes, which can lead to $CO_2$ emissions. In addition, the transportation and distribution of fertilizers also adds $CO_2$ emissions to their life cycle.

# GREENHOUSE GAS EMISSIONS (GHGS)

## Nitrous oxide ($N_2O$) emissions

The application of nitrogen fertilizers, such as urea and nitrogen compounds from NPK and DAP fertilizers, can result in the release of nitrous oxide ($N_2O$), a potent GHG. $N_2O$ is a greenhouse gas that has a much higher global warming potential than carbon dioxide ($CO_2$). $N_2O$ emissions contribute to climate change.

# GREENHOUSE GAS EMISSIONS (GHGS)

## Production of nitrous oxide ($N_2O$)

The production of nitrous oxide ($N_2O$) in soil is mainly the result of the activity of specific bacteria during the denitrification process. Denitrification is a microbiological process that occurs under anaerobic conditions (i.e., in the absence of oxygen). Denitrification bacteria convert nitrates ($NO_3$) or nitrites ($NO_2$) in the soil into nitrogen gas ($N_2$) or nitrous oxide ($N_2O$).

# GREENHOUSE GAS EMISSIONS (GHGS)

## Production of nitrous oxide (N2O)

Bacteria involved in denitrification typically include heterotrophic bacteria that use nitrates or nitrites as electron acceptors for their metabolism. Some of these denitrifying bacteria include genera such as Pseudomonas, Paracoccus, and several others.

# GREENHOUSE GAS EMISSIONS (GHGS)

## **Production of nitrous oxide (N2O)**

Fungi are not usually directly responsible for denitrification, but they can have an indirect impact on the process by affecting soil conditions, including oxygen availability and the decomposition of organic matter.

# GREENHOUSE GAS EMISSIONS (GHGS)

## GHG Comparison

To compare the effects of greenhouse gases (GHGs) in carbon dioxide (CO2) equivalents, the global warming potential (GWP) over a specific period of time is used.

# GREENHOUSE GAS EMISSIONS (GHGS)

## Nitrous oxide ($N_2O$) emission measurement

GWP is a measure that expresses the climate impact of a GHG in relation to $CO_2$ over a given period. Generally, 20-year, 100-year and 500-year periods are used to estimate GHG GWPs.

# GWP of nitrous oxide & methane in $CO_2$ equivalent

## 20-year Global Warming Potential (GWP)

- Methane ($CH_4$) : About **84** to **87** times more potent than $CO_2$
- Nitrous oxide ($N_2O$): About **298** to **310** times more potent than $CO_2$

## 100-year Global Warming Potential (GWP)

- Methane ($CH_4$) : About **28** to **36** times more potent than $CO_2$
- Nitrous oxide ($N_2O$): About **116** to **120** times more potent than $CO_2$

## 500-year Global Warming Potential (GWP)

- Methane ($CH_4$) : About **7** to **9** times more potent than $CO_2$.
- Nitrous oxide ($N_2O$): About **26** to **28** times more potent than $CO_2$

# CANADA
# FERTILIZER APPLICATION GHGS

In December 2020, the Trudeau government announced that it would set a national target to reduce greenhouse gas (GHG) emissions from fertilizer application by 30% below 2020 levels by 2030.

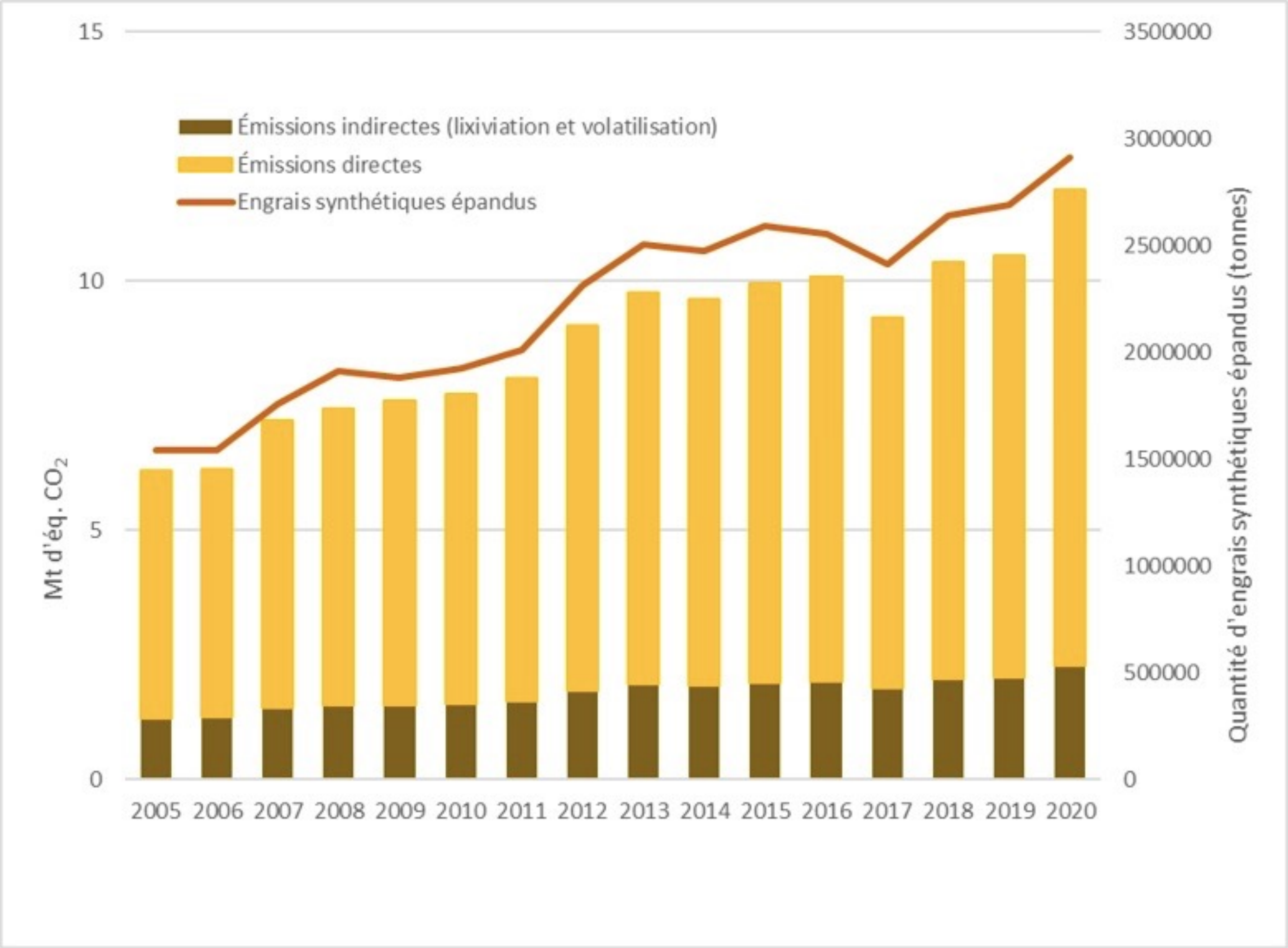
Based on 2019 data, emissions from synthetic fertilizers used by farms accounted for approximately 13 million tonnes of CO2 equivalent per year, or 1.7% of Canada's total emissions for that year.

Reducing this amount by 30% would reduce national emissions by 0.5%. Under the government's net-zero climate policy, no source of emissions, no matter how small, is exempt from measures to reduce and eventually eliminate emissions.

# CANADA
# FERTILIZER APPLICATION
# GHGES

Figure 1.

Direct and indirect emissions from the application of synthetic nitrogen fertilizers, 2005 to 2020 (NIR, 2022).



# CANADA
# FERTILIZER APPLICATION GHGS

Fertilizers are an essential input for Canada's agricultural crops. However, the use of nitrogen (N) fertilizers results in emissions of nitrous oxide (N2O), a potent greenhouse gas with a global warming potential of 265 to 298 times greater than that of carbon dioxide (CO2) over a 100-year period.

In 2020, the agriculture sector accounted for 75% of national N2O emissions, up from 45% in 1990 and 56% in 2005. Since 2005, nitrogen fertilizer use has increased by 89%, and N2O emissions associated with nitrogen fertilizer use have increased by 92%. In 2020, direct and indirect emissions associated with the use of synthetic fertilizers amounted to 11.82 megatonnes of carbon dioxide equivalent per year (Mt CO2 eq). CO2/1 year) (National Inventory Report, 2022).

The application of a 30% reduction, which translates to 3.5 Mt CO2 eq. CO2/year, helps to curb further increases in emissions by 2030 in order to reach the target.

# CANADA
# FERTILIZER APPLICATION GHGS

On average, for one hectare of maize or potato crops, the use of nitrogen fertilizers such as urea (N46) can result in $N_2O$ emissions in the range of **1 to 2 kilograms of $CO_2$ equivalent per hectare per year** (kg $CO_2$eq/ha/year) or more.

These numbers can vary widely depending on specific farming practices, fertilizer management, soil conditions, and climate.

# CANADA
# FERTILIZER APPLICATION GHGS

In conclusion, **CANADA** has developed a Strategic Framework for Sustainable Agriculture, which includes measures to encourage more efficient use of fertilizers and reduce agricultural emissions. The country has also set up financing programs to support farmers who adopt sustainable farming practices.

# USA
## FERTILIZER APPLICATION GHGS

Similarly, the U.S. has several programs and initiatives in place to encourage sustainable agricultural practices and reduce agricultural emissions. For example, the Conservation Stewardship Program provides financial incentives to farmers who implement nutrient management practices to reduce nitrogen losses from fertilizers.

https://www.nrcs.usda.gov/programs-initiatives/csp-conservation-stewardship-program

# EUROPE
## FERTILIZER APPLICATION GHGS

As a result, the EU has adopted a series of agricultural and environmental policies aimed at reducing agricultural emissions, including emissions from the use of fertilisers. The EU's Common Agricultural Policy (CAP) promotes sustainable farming practices and environmental protection measures.

# WHAT SOLUTIONS ARE AVAILABLE?
# TO REDUCE ENVIRONMENTAL IMPACT FERTILIZERS

To reduce the environmental impact of traditional fertilizers in agriculture, it is essential to adopt sustainable practices.

This includes precise fertilization management, use of slow-release fertilizers, use of organic fertilizers, crop rotation, effective irrigation management, creation of vegetated buffers along waterways, farmer education, technological innovation, regulation and incentives, and ongoing research to develop environmentally friendly solutions.

By combining these measures, it is possible to minimize water, air and soil pollution while maintaining agricultural productivity.

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# OUR SOLUTION

## HYDRO RETENTIVE FERTILIZER BARBARY PLANTE G3 EVOLUTION

A WIDELY USED & VALIDATED TECHNOLOGICAL INNOVATION

FOR SUSTAINABLE AND RESPONSIBLE DEVELOPMENT

# HYDRO RETENTIVE FERTILIZER BARBARY PLANTE G3 Evolution

Barbary Plante's third-generation hydro retentive fertilizer capsule (BP G3 ) are characterized by the use of a 100% biodegradable super-absorbent polymer that coats NPK, Urea or DAP fertilizers and trace elements, presented in the form of a green capsule.

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# HYDRO RETENTIVE FERTILIZER BARBARY PLANTE G3 Evolution

**Several capsules by BP G3 Evolution**

**One capsule of BP G3 Evolution**

## COMPOSITION

**80% Hydrophilic Gel**
which creates a reservoir of moisture that attracts the roots of seeds and plants, thus promoting optimal hydration.

**20% fertilizer and trace element**
**(Urea N46, i.e. NPK 20.20.20 or DAP 18/46)**
Highly nutritious providing the essential elements to boost plant growth, development and productivity.

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# HYDRO RETENTIVE FERTILIZER BARBARY PLANTE G3 Evolution

**They are recommended for the following crops:**

Alfalfa, almonds, avocados, apples, orange, lemon, olive, pomegranate, mango, palm, barley, all beans, broccoli, cabbage, cauliflower, carrots, celery, citrus, soybeans, corn, cotton, grapes, lawns, lettuce, melons, nectarines, tea, coffee, rice, pears, peaches, peanuts, sorghum, sugar cane, beets, strawberries, tomatoes, grass, turnips, nuts, watermelons, wheat and all other crops.

# HYDRO RETENTIVE FERTILIZER BARBARY PLANTE G3 Evolution

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**They are recommended for all of the following soil types:**

Sandy, silty, clayey, limestone, peaty, alluvial, volcanic, podzolic, rocky, arid, desert, saline and all other types of soils.

# HYDRO RETENTIVE FERTILIZER BARBARY PLANTE G3 Evolution

## The main advantages

- Reduced watering by up to 50%
- Improved yields in quantity by 150% to 200% and quality than with the use of conventional fertilizers
- Reduction of cultivation cycles
- Reduces fertilizer consumption
- Slow release of water and nutrients
- Neutralization of the harmful effects of salts allowing the desalination of brackish water
- Improvement of arid, sandy and saline soils

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# COST-BENEFIT ANALYSIS

## HYDRO RETENTIVE FERTILIZER

## BARBARY PLANTE G3 Evolution vs CONVENTIONALFERTILIZERS

This economic analysis examines the costs and benefits of using conventional fertilizers compared to the use of super-absorbent hydrogels, as well as the use of BP G3 fertilizer retainers, either for individual use or in combination with conventional fertilizers. The data presented in the tables are from recent economic studies conducted in Canada but may be adapted based on economic data specific to other countries or updated to reflect more recent values.

**COST-BENEFIT ANALYSIS**

CONVENTIONAL FERTILIZERS

Data

Canada

| GRANDES CULTURES CANADA | FERTILISANTS UREA | | FERTILISANTS NPK | | FERTILISANTS DAP | |
|---|---|---|---|---|---|---|
| TYPE | N46 | | 20.20.20 | | 18/46 | |
| COMPOSITION | Azote (N) 46% | | Azote (N) 20%<br>Phosphore (P) 20%<br>Potassium (K) 20% | | Azote (N) 18%<br>Phosphore (P2O5) 46% | |
| **ENGRAIS** | **COUTS D'ACQUISITION** | | | | | |
| PRIX $ CAD/TM FOB | **$573** | | **$718** | | **$790** | |
| **COUTS** | **COUTS D'EXPLOITATION** | | | | | |
| En tonne/hectare | 0,325 à 0,435 | | 0,375 à 0,500 | | 0,100 à 0,150 | |
| Réel | 0,380 | **$218** | 0,437 | **$314** | 0,125 | **$99** |
| **EAU** | | | | | | |
| De 300 à 800 mm/cycle | **550** | 100% | 450 | 100% | 650 | 100% |
| De 250 à 950 $/hectare | **600** | $ | **500** | $ | **700** | $ |
| **RENDEMENT tonne/hectare** | | | | | | |
| De 20 à 50 tonne/hectare | 45 | 100% | 35 | 100% | 48 | 100% |
| Prix de vente/tonne | **317** | $ | **317** | $ | **317** | $ |
| total vente/hectare | **14 265** | **$** | **11 095** | **$** | **15 216** | $ |
| **CYCLE PRODUCTION jour** | | | | | | |
| de 80 à 120 jours | 100 | 100% | 100 | 100% | 100 | 100% |
| **SOURCES** | **IMPACT ENVIRONNEMENTAL** | | | | | |
| **GAZ A EFFET DE SERRE (GES)*** | N2O | GES | NO2 | GES | N2O | GES |
| Pertes d'azote associées à l'épandage | Facteur Emission | 100% | Facteur Emission | 100% | Facteur Emission | 100% |
| kg N20 par tonne d'azote par an | FE N2O_N | 20 | FE N2O_N | 20 | FE N2O_N | 20 |
| **POLLUTION SOL/ EAU** | NITRATES | 100% | NITRATES | 100% | NITRATES | 100% |
| **AVANTAGES INCONVENIENTS** | **IMPACT ENVIRONNEMENTAL ELEVE - TAXE CARBONE** | | | | | |

*Sources : https://www.environnement.gouv.qc.ca/changements/ges/guide-quantification/guide-quantification-ges.pdf

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# ENVIRONMENTAL IMPACT
## HYDRO RETENTIVE FERTILIZERS
## BARBARY PLANTE G3 Evolution

**LES HYDRO RETENTIVE FERTILIZERS BP G3**

**A Complete Solution for Environmental Preservation**

The hydro retentive fertilizer BP G3 are proving to be valuable allies in the fight against drought, desertification, erosion and soil degradation. They also contribute significantly to the elimination of water pollution and the reduction of nitrate infiltration. In addition, their use prevents greenhouse gas emissions associated with nitrogen and reduces CO2 emissions generated by the production, transportation and distribution of conventional fertilizers.

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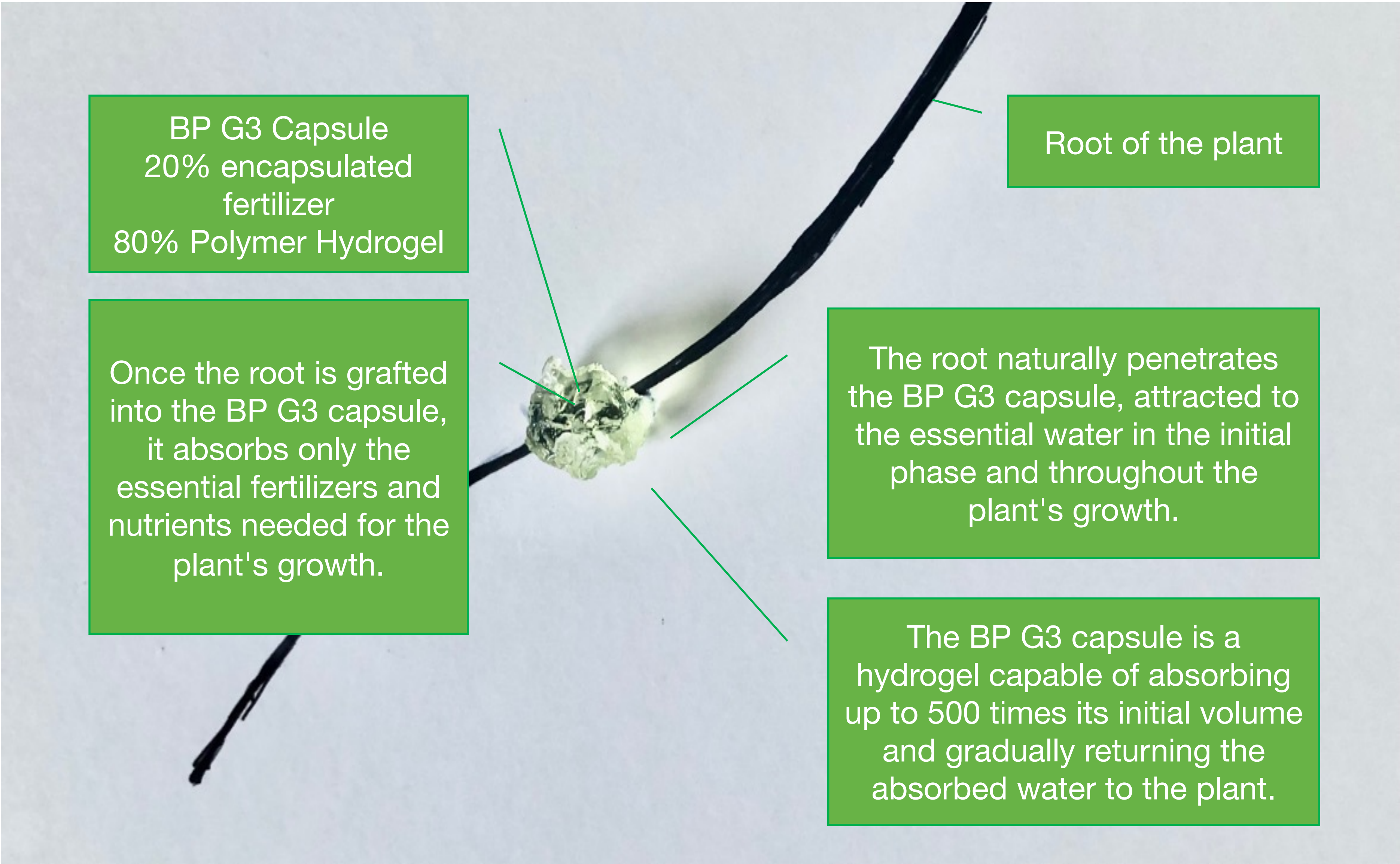
**THE MECHANISM FROM OPERATION**

**A UNIQUE DESIGN FOR SMART, SUSTAINABLE AND RESPONSIBLE AGRICULTURE**

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# ENVIRONMENTAL IMPACT
# HYDRO RETENTIVE FERTILIZERS
# BARBARY PLANTE G3 Evolution

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**MITIGATE THE EFFECTS OF DROUGHT**

With an exceptional water absorption capacity, hydro retentive fertilizer BP G3 act as available water reservoirs, thus significantly reducing the consequences of drought while being able to reduce watering requirements by up to 50%.

# ENVIRONMENTAL IMPACT
## HYDRO RETENTIVE FERTILIZERS
## BARBARY PLANTE G3 Evolution

**COMBATING DESERTIFICATION**

Hydro retentive fertilizer BP G3, with their water-holding capacity, reduced watering requirements, and ability to contain fertilizers and nutrients essential for tree and plant growth, play an essential role in the fight against desertification by promoting the creation of green barriers.

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# ENVIRONMENTAL IMPACT
# HYDRO RETENTIVE FERTILIZERS
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**PREVENT SOIL EROSION AND DEGRADATION**

Hydro retentive fertilizer BP G3 contain ammonia fertilizers such as urea or DAP that are encapsulated in the hydrogel, thus avoiding any negative impact on the soil structure. Due to their confinement, they are not in direct contact with the soil, which prevents soil acidification and degradation of soil aggregates. This preservation of the quality of the soil strengthens its resistance to wind and water erosion.

# ENVIRONMENTAL IMPACT
# HYDRO RETENTIVE FERTILIZERS
# BARBARY PLANTE G3 Evolution

## FIGHT AGAINST WATER POLLUTION

Encapsulating fertilizers in hydro retentive fertilizer BP G3 has multiple significant environmental benefits. By preventing the leaching of fertilizers (NPK, urea or DAP), it contributes to significantly reducing eutrophication of aquatic ecosystems.

In addition, BP G3 fertilizer hydrogels offer an effective solution to improve the distribution of nutrients to plants while reducing losses to the environment, thus contributing to the prevention of water pollution.

# ENVIRONMENTAL IMPACT
## HYDRO RETENTIVE FERTILIZERS
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**PREVENT NITRATE INFILTRATION**

Thanks to their use on agricultural land, even in the presence of nitrate-rich fertilizers such as nitrogen fertilizers, which are encapsulated, hydro retentive fertilizer BP G3 effectively prevent nitrate leaching through rainfall or watering, thus preventing their penetration into the soil. This measure helps protect groundwater, which is crucial for the supply of drinking water.

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# ENVIRONMENTAL IMPACT
# HYDRO RETENTIVE FERTILIZERS
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**PREVENT THE EFFECTS OF GREENHOUSE GASES**

Agriculture plays a significant role in greenhouse gas (GHG) emissions, particularly nitrous oxide (N2O). However, hydro retentive fertilizer BP G3 contribute significantly to the reduction of nitrous oxide (N2O) emissions due to their design, where nitrogen fertilizers are encapsulated, thus preventing any reaction with the soil bacteria responsible for the production of N2O. This preventive action substantially reduces the impact of GHGs in the agricultural context.

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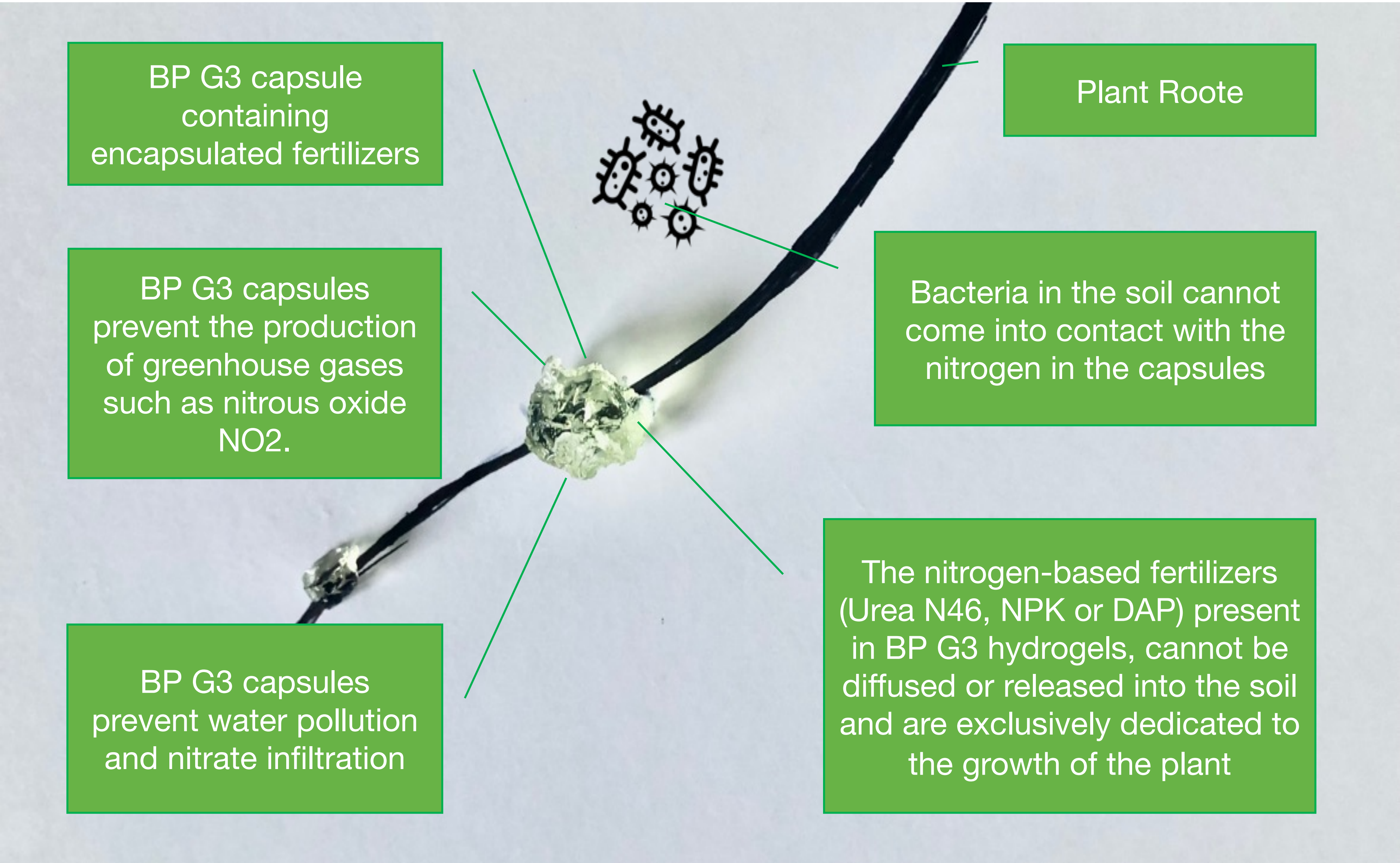
## HOW THE HYDRO RETENTIVE FERTILIZERS BP G3 PREVENT THE IMPACT ENVIRONMENTAL RELATED FERTILIZERS CONVENTIONAL UREA N46 NPK DAP



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## Why does the use of fertilizers trapped in hydro retentive fertilizers BP G3 reduce GHG production and water pollution?

When traditional fertilizers are applied to the soil, they come into direct contact with the bacteria present in the soil, which in reaction generates N2O emissions.

The use of nitrogen-based BP G3 hydrogel, such as N46 urea, avoids any direct contact of the fertilizer trapped in the capsules with the soil surrounding the plant roots.

This encapsulation inhibits the free interaction of nitrogen with soil bacteria, thus preventing the emission of N2O or the diffusion of fertilizers into the soil.

The fertilizer contained in BP G3 hydrogel is only available for root development and plant growth.

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# ENVIRONMENTAL IMPACT
## HYDRO RETENTIVE FERTILIZERS
## BARBARY PLANTE G3 Evolution

**REDUCE $CO_2$ RELATED TO THEIR PRODUCTION, TRANSPORT AND DISTRIBUTION**

The use of hydro retentive fertilizer BP G3 containing traditional chemical fertilizers offers the opportunity to significantly reduce fertilizer consumption by a minimum of 30%. This is accompanied by a proportional reduction in $CO_2$ emissions.
In addition, it helps to mitigate the carbon footprint associated with their entire life cycle, especially with regard to their transmission and distribution.