TYMIRIUM® technology and Regenerative Agriculture

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TYMIRIUM® technology and Regenerative Agriculture:

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Rethinking Agriculture

The global food supply is in the hands of agricultural production, which is facing unprecedented challenges in the 21st century. The past century saw remarkable increases in crop productivity that alleviated hunger and limited land conversion, but this production model depleted the Earth's soil and its biodiversity and contributed to climate change. We now confront a new, challenging reality shaped by unpredictable weather patterns, resource scarcity, and a population that surpassed 8 billion in 2022.

At Syngenta, we recognize that farmers are on the front line of these challenges, striving to feed the world while grappling with extreme weather, pest pressures, and crop failures. **As the global population approaches 9.7 billion by 2050, we must reimagine food production to not only meet growing demand but also reduce environmental impact and safeguard natural resources.**

We believe that agriculture can be both a solution to food security and a powerful force for environmental regeneration. Building on a commitment that traces back to more than a decade ago, Syngenta Group has established four sustainability priorities[1] to address these interconnected challenges, each with clear targets set:

Higher yields, lower impact. Accelerate crop productivity of the agricultural sector while reducing the impact on the planet through more sustainable technologies.

Regenerate Soil and Nature Enable the adoption of regenerative agriculture practices to help farmers improve productivity, soil health, biodiversity and climate improving rural prosperity, and ensuring sustainable operations.

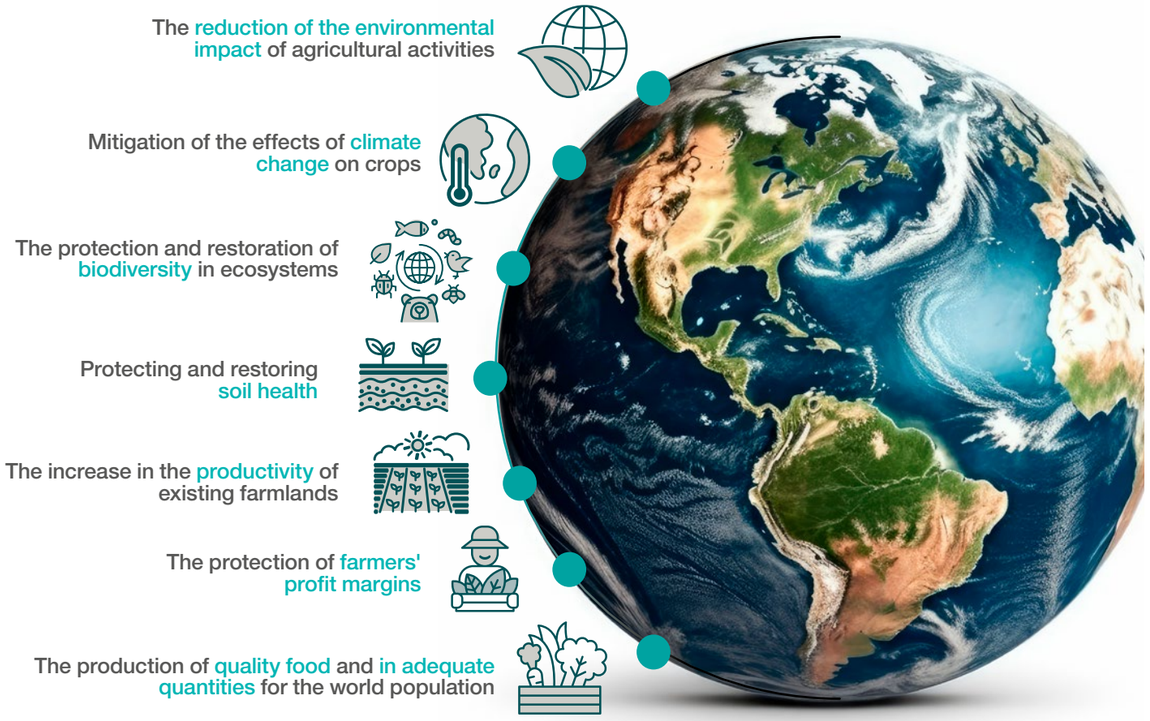
Improve Rural Prosperity. Improve the prosperity of low-income and under-served farmers by improving their access to inputs, knowledge, finance and markets.

Sustainable Operations Reduce the environmental impact of our operations and supply chain, strengthen our diverse and inclusive culture and ensure the health and safety of our people.

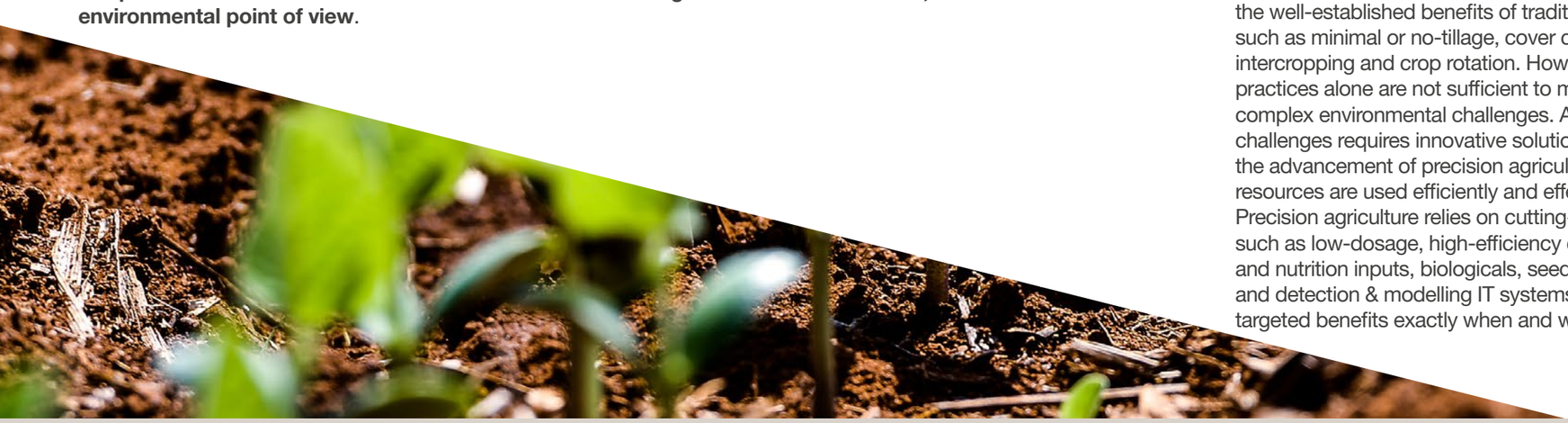
By embedding these priorities in the core of our strategy, our operations, and our mindset, we mean to help transform agriculture into a regenerative force that not only feeds the world but also improves it.

What is **Regenerative Agriculture**?

Regenerative agriculture is an outcome-based food production system that nurtures and restores soil health, protects the climate, water resources and biodiversity, and enhances farms' productivity and profitability[2]. Some of its benefits are:

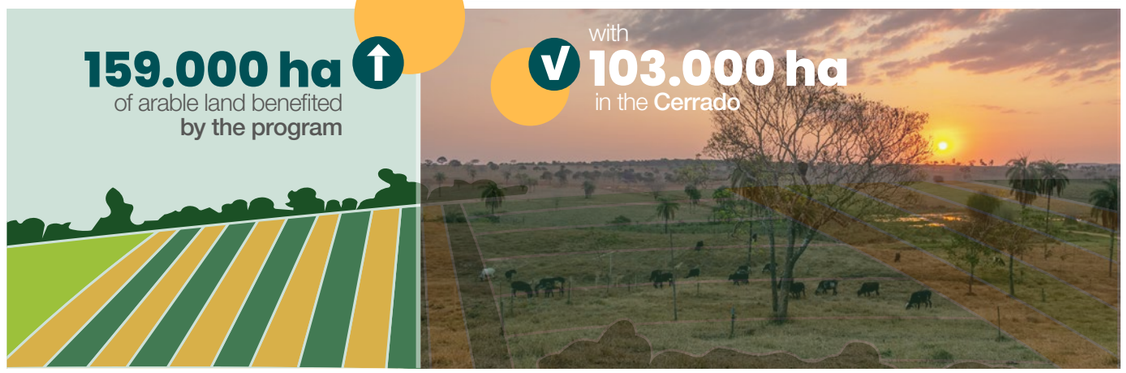


This strategy supports the UN-SDG Objective n.2 in its promotion of a "sustainable agriculture", with the idea that **only by safeguarding the well-being of the environment and of the crops themselves it is possible to obtain results that are sustainable in the long term from an economic, social and environmental point of view**.



Our commitment to Regenerative Agriculture: **the REVERTE® Project**

The REVERTE® program, developed by Syngenta and The Nature Conservancy (TNC), aims to support farmers, through agronomic techniques and long-term financing provided by Itaú BBA bank, to transform degraded areas into productive ones. The idea is to demonstrate the economic viability of recovering land instead of opening new ones for planting. Thus, it contributes to the preservation of native vegetation and the advancement of regenerative agriculture, initially targeting the Brazilian Cerrado with its 18 million hectares of degraded land and important opportunities to conserve native habitat. TNC collaborated with Syngenta in the inception of REVERTE® and is part of it in the Cerrado only. Regenerative agriculture techniques such as direct planting, cover crop management, crop rotation, precision agriculture, and crop and livestock integration were implemented to support the enhancement of soil biodiversity so that it regains its potential productivity.



Enabling **Regenerative Agriculture** through innovation

Regenerative agriculture represents a transformative approach to food production, aiming to restore ecosystems while addressing the demands of a growing population. This transformation builds on the well-established benefits of traditional practices such as minimal or no-tillage, cover cropping, intercropping and crop rotation. However, these practices alone are not sufficient to meet today's complex environmental challenges. Addressing these challenges requires innovative solutions that drive the advancement of precision agriculture, where resources are used efficiently and effectively.
Precision agriculture relies on cutting-edge solutions such as low-dosage, high-efficiency crop protection and nutrition inputs, biologicals, seed treatments, and detection & modelling IT systems, which provide targeted benefits exactly when and where they are needed. For instance, modern crop protection products are formulated to tackle specific challenges with minimal doses, reducing environmental impact. Biologicals harness natural molecules and organisms to enhance plant health and soil quality, boosting productivity while conserving resources. Similarly, seed treatments apply precise doses directly to the seed, improving germination, early crop establishment, and yield potential.
By tailoring applications to the unique needs of crops, fields, or even individual plants, these innovations not only enhance productivity but also uphold the principles of regenerative farming. They minimize resource use, reduce environmental footprints, and foster resilient farming systems, creating a positive model that benefits both farmers and the planet.

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TYMIRIUM® technology for Regenerative Agriculture

TYMIRIUM® technology protects crops from soil-borne threats such as plant parasitic nematodes and difficult to control fungi like Fusarium, while preserving[3] beneficial soil organisms, aligning closely with regenerative agriculture principles. By promoting healthier root systems, TYMIRIUM® technology enhances plant resilience, improves water and nutrient efficiency, and increases productivity on existing farmlands. Its low-dosage, targeted approach reduces potential environmental impact while maintaining soil biodiversity. Available as both soil and seed treatments, TYMIRIUM® technology promotes seed germination and young plant establishment even in challenging seedbeds, supporting no-tillage regimens. This innovative technology balances environmental and profitability benefits for farmers, contributing to yield improvement and a lower carbon footprint per unit of production.

Plant-parasitic nematodes as a **global threat to agricultural productivity**

The challenge of managing both soil pests and soil-borne diseases lies fundamentally in their non-visible nature. Nematode infestations often remain undetected until they have already caused significant damage, while soil-borne fungal diseases typically become evident only after symptoms manifest, and, by the moment this happens, crop yields are irreparably compromised. This represents a critical threat to global agricultural productivity, as well as important sustainability aspects such as land use and resource efficiency.
In particular, plant-parasitic nematodes are estimated to cause a 12% reduction in crop yields annually, equivalent to $157 billion in economic losses worldwide – losses that outnumber those caused by insect pests.[4]

The challenges posed by nematodes are multifaceted. By attacking the roots and feeding on them, not only they damage the plant directly, but also create entry points for fungal infections such as *Fusarium*, further undermining crop productivity. Moreover, the damage they inflict often mimics symptoms of abiotic stresses, nutrient deficiencies, or overlaps with those caused by other pathogens, leading to frequent misdiagnoses and underestimation of their impact.
Addressing these issues is essential to limiting the damage of nematode infestation to agricultural productivity and, as a potential consequence, food security. And innovative solutions that can support farmers in embracing regenerative practices are a key element to do that effectively with a reduced impact on the environment.

TYMIRIUM® technology: Making the invisible, visible.

In addition to protecting plant roots from the invisible threats of nematodes and soil-borne diseases, TYMIRIUM® technology promotes healthier, denser and deeper root systems, that can support the crops to better access soil nutrients and water. Its versatility allows for application as both a soil treatment and a seed treatment, offering additional sustainability benefits through targeted, efficient crop protection.

TYMIRIUM® technology is an innovative solution in the realm of crop protection, functioning as both a nematicide and fungicide for seed and soil applications. This technology offers effective performances against a wide range of plant parasitic nematodes and soil-borne diseases, with particular efficacy against Fusarium species and early foliar diseases.

TYMIRIUM® technology acts by inhibiting fundamental biochemical processes at the basis of the cellular respiration of target organisms. Due to its selective activity against the designated targets, it maintains compatibility with other crucial soil organisms such as earthworms, soil mites, and arbuscular mycorrhizal fungi - symbiotic fungi that form beneficial associations with plant roots. This has been confirmed through studies in our soil health research center in Stein, including an extensive microbiome analysis across various soils and crops. The results of these studies[3] showed a preservation of the biodiversity of bacterial and fungal communities associated with the use of TYMIRIUM® technology, compared to untreated controls.

The core of the activity of TYMIRIUM® technology lies in protecting plant roots, which serve as the foundation for overall plant health and productivity. By safeguarding the root system under biotic stress, the technology enables plants to develop better above soil vs. untreated. and, as a consequence, increase their photosynthetic activity.

Among the benefits of maintaining strong photosynthetic activity, according to scientific consensus[5], is a greater production of root exudates. These exudates contain carbohydrates[6], proteins, secondary metabolites, and other useful molecules that, in turn, nourish soil microbes. This creates a virtuous cycle where plant health and soil health are mutually reinforcing, supporting a healthy soil ecosystem.

Furthermore, TYMIRIUM® technology has the potential to improve plant resilience against weather stresses by promoting a healthier and more extensive root system (see “On the Field” section). Plants treated with this technology have the potential for better water use efficiency and nutrient uptake, especially under conditions of nematode or Fusarium infestation[7]. This enhanced resilience is becoming particularly valuable in the face of climate change and increasingly unpredictable weather patterns. All these aspects make TYMIRIUM® technology an ideal solution that supports sustainable production and economic advantages for farmers: improved crop health, yield stability, and good return on investment.

TYMIRIUM® technology is available as both a soil-applied solution and a seed treatment, offering versatile application methods. The soil application allows for highly effective protection at lower dosages than lead benchmarks.The seed treatment builds on these benefits while also supporting early plant establishment, an approach that is particularly valuable in no-tillage regimens where seeds face more challenging growing conditions. This practice is key in regenerative agriculture as it preserves soil structure by minimizing disturbance.

Climate benefits: supporting a low carbon footprint on farm through yield increase

Agriculture has an environmental impact that we cannot neglect. the Intergovernmental Panel on Climate Change has estimated that the sector of agriculture, forestry and land use is responsible for between 13% and 21% of global greenhouse gas emissions, either directly or indirectly.
As part of its commitment to sustainability represented by the 4 Sustainability Priorities launched in 2024, Syngenta aims at enabling a lower carbon footprint production by means of a “Higher yields, lower impact” strategy. This entails accelerating productivity of the agricultural sector while reducing the impact on the planet through innovative, low-carbon products or technologies.
Solutions like TYMIRIUM® technology, that are able to protect major crops from threats and secure yield with low impact on the environment, are key to this objective. Thanks to its yield increase benefits, as well as the reduced use rate, our estimates have shown that the use of TYMIRIUM® technology has the potential to reduce the carbon footprint on farm per unit of production, compared to widely used benchmark products.

Trials on soybean & sugar cane in Brazil comparing the performance of TYMIRIUM® technology with local benchmark products showed:*

Soybean Vs local Benchmarks**

As a further benefit of **yield increase, TYMIRIUM® technology has potential to avoid up to**

9% CO_2eq

emissions on farm per ton of soybean grains produced

Sugar cane Vs local Benchmarks***

(limited data set, more assessments ongoing)

As a further benefit of **yield increase, TYMIRIUM® technology has potential to avoid up to**

16% CO_2eq

emissions on farm per ton of sugarcane produced

** Data obtained by modeling via Cool Farm Tool app, by Cool Farm Alliance.
** Lead benchmark represents 20% of market share in 2023.
*** Lead chemical and biological benchmark.

By giving farmers, the freedom to maximize their yields without having to compromise on sustainability, TYMIRIUM® technology represents a major step forward in the space of Regenerative Agriculture, thanks to these important features:

It facilitates young plant establishment in no till regimens
By enhancing plant vigor & photosynthetic activity under biotic stresses, TYMIRIUM® technology has the potential to increase in plant exudates that have a beneficial effect on soil microbiome and soil health.

It is compatible with biodiversity
The use of TYMIRIUM® technology, either as in-furrow or as seed treatment solutions, affects only the target pest, leaving beneficial organisms unharmed.

It contributes to low carbon footprint per ton of crop
Thanks to yield increase effects, this technology helps lower carbon emissions on farm per ton of crop, compared to available alternatives.

It enhances crop resilience to climate change
Thanks to a healthy and extensive root system, plants treated with TYMIRIUM® technology has potential to better water use efficiency and nutrient uptake capabilities, that help them tackle climate-induced stress conditions.

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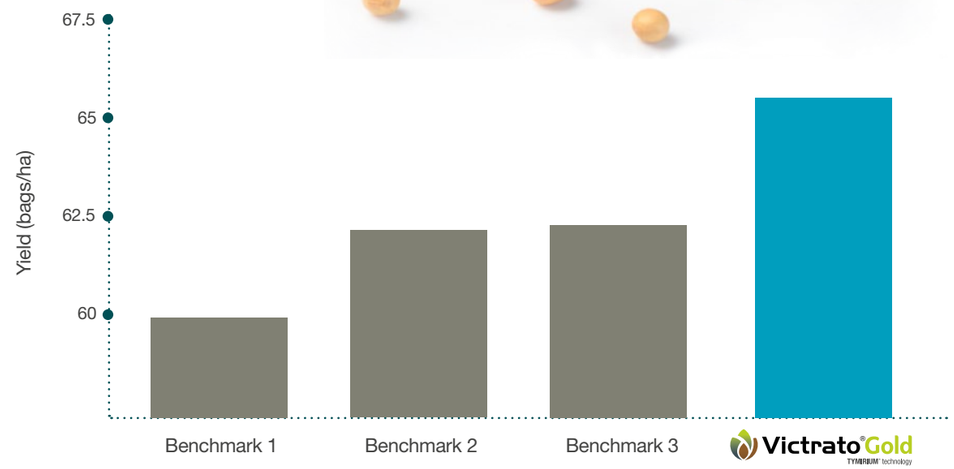
On the field

TYMIRIUM® technology combines sustainability achievements with practical benefits for growers, like consistent results in yield increase and soil health.

Soybean trials

Country: Brazil

Season 22/23 and 23/24 (513 trials), seed treatment application



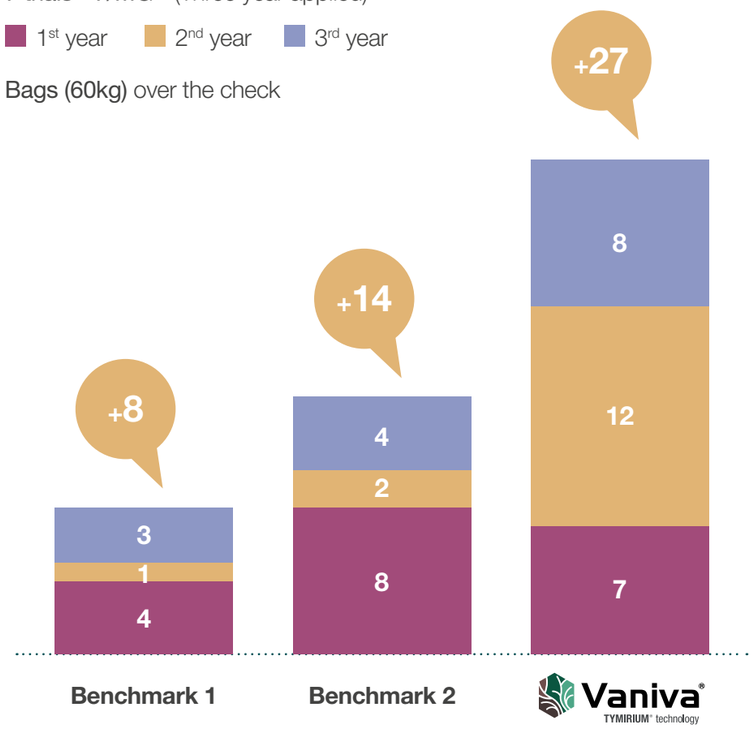
Coffee trials

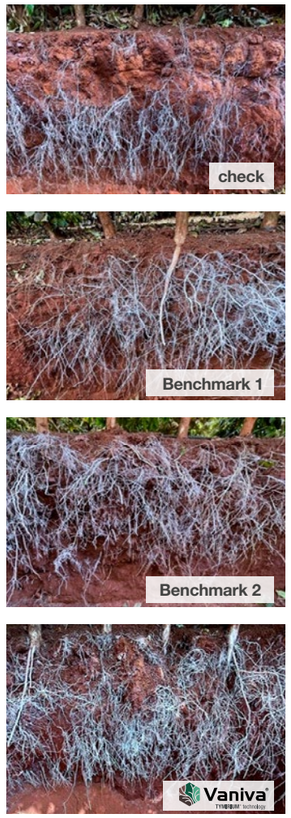
Country: Brazil *Season 20/21to 22/23, 3 Year soil application*

Yield (bags/ha) | Processed coffee beans
7 trials - 7/MG - (Three year applied)

1st year 2nd year 3rd year

Bags (60kg) over the check

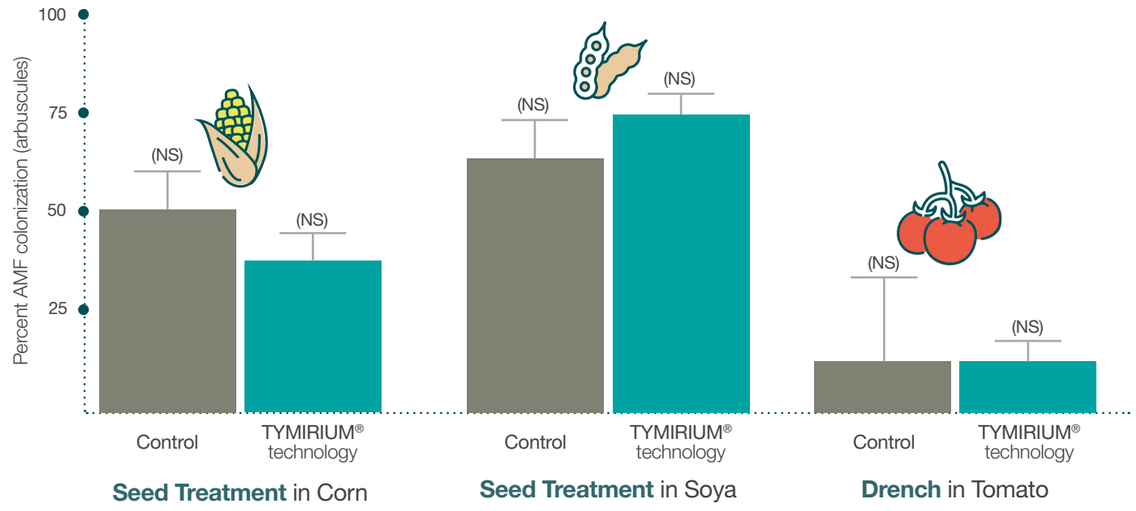




Compatibility of **TYMIRIUM®** technology with Arbuscular Mycorrhizae Fungi (AMF)

The Arbuscular Mycorrhizae Fungi (AMF) symbiosis is one key asset to the design of sustainable agroecosystems, essential to improve nutrient use efficiency, and with important positive effects on soil health and crop resilience.
Our tests demonstrated that TYMIRIUM® technology is fully compatible with the presence of AMF, across different crops and application methods. The graph below shows that the impact of this technology on AMF colonization is minimal, with both positive and negative variations that have no statistical (NS) relevance.

The use of **TYMIRIUM®** technology is fully compatible with AMF



Seed Treatment in Corn

Seed Treatment in Soya

Drench in Tomato

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[7] De Souza Marques et al., “Leaf physiology and histopathology of the interaction between the opportunistic phytopathogen Fusarium equiseti and Gossypium hirsutum plants”, European Journal of Plant Pathology, Volume 168, 2024.

For other information:

https://tymiriumtechnology.syngentadigitalapps.com/en

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