SOIL PREBIOTICS: HARNESSING BIOSTIMULANTS TO IMPROVE SOIL MICROBIAL HEALTH

INTRODUCTION

In recent years, there has been a shift towards sustainable agricultural practices as a response to the environmental impact of traditional synthetic fertilizers and pesticides. Consumers are becoming more conscious of the need for better alternatives. Additionally, extreme weather events are increasing, posing significant challenges to crop production and resilience. Farmers are also facing input accessibility challenges, making it more difficult to obtain traditional agricultural inputs. Consequently, policy shifts towards sustainable agriculture values are on the rise. One of the new sustainable approaches in agriculture is the use of biostimulants, which stimulate natural processes to improve nutrient uptake, nutrient use efficiency, and abiotic stress tolerance, as well as crop quality and yields. Biostimulants are typically applied to seeds, plants, or the rhizosphere, supporting plant health in various ways. (Li et al., 2022).[1]

ENHANCING SOIL MICROBIAL HEALTH AND PLANT GROWTH THROUGH SOIL PREBIOTICS

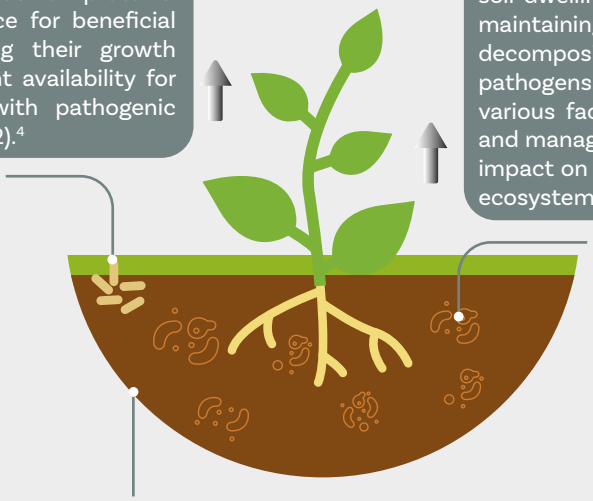
Soil prebiotics, which emerged as a promising tool in sustainable agriculture, are compounds that feed and promote the growth of beneficial microorganisms already present in the plant microbiome. As a biostimulant, soil prebiotics improve soil microbiota and directly influence plant physiology, creating a more resilient and productive environment for plants (Frąc et al., 2022).[2]

Studies have shown that applying certain prebiotics to the soil can increase the population of beneficial bacteria and fungi, which in turn helps to suppress soil-dwelling pathogens and promote healthier root development (Mendes et al., 2013).[3] Therefore, our scientific team is constantly working on extensive knowledge of growth factors for microorganism development. With our expertise, we are at the forefront of the development of new agricultural products that are both sustainable and effective.

OPTIMIZING PLANT AND SOIL HEALTH: THE ROLE OF PREBIOTICS

Soil prebiotics are organic compounds that are used to stimulate and activate microorganisms present in the soil, thereby promoting the growth of beneficial microorganisms. These prebiotics can be complex sugars, polysaccharides, amino acids or proteins. They act by providing a food source for beneficial microorganisms and by stimulating their growth and activity, which improves nutrient availability for plants and reduces competition with pathogenic microorganisms (Revolutionized, 2022).[4]

Soil microbiome refers to the diverse community of microorganisms (including bacteria, fungi, archaea, viruses and protozoa), that live in the soil and interact with each other and with the environment. These soil-dwelling organisms play important roles in maintaining soil health and fertility, by cycling nutrients, decomposing organic matter, and suppressing plant pathogens. The soil microbiome is influenced by various factors, including soil type, climate, land use and management practices, and can have a significant impact on plant growth and productivity, as well as on ecosystem functions and services (Ray et al., 2020).[6]



The plant microbiome encompasses a variety of microbial communities found on the external surfaces and within the internal tissues of the host plant. The primary components of the plant microbiome include the rhizosphere, endosphere and phyllosphere. Additionally, the soil microbiome serves as a significant source for the plant microbiome (Dastogeer et al., 2020).[5]

SOIL PREBIOTIC – CASE STUDY (*PSEUDOMONAS FLUORENSCENS* GROUP)

Pseudomonas fluorescens is a gram-negative bacterium found in agricultural soils. It promotes plant growth and acts as a biocontrol agent by producing antibiotics and other bioactive compounds. It's also used in biopesticides (Akhtar & Siddiqui, 2010). [7]

A plant research trial was conducted to evaluate the efficacy of **SOLULYS® 048 plant protein extract** applied as raw material for a soil prebiotic biostimulant on greenhouse grown tomato transplants.

Roquette product **SOLULYS® 048 plant protein extract** induced significantly higher densities of *Pseudomonas fluorescens* group populations on multiple sampling dates compared to the untreated control (fig. 1).

The **three concentrations of SOLULYS® 048** applied as soil treatments **induced higher *Pseudomonas fluorescens* group densities** at 4 and 15 days after the treatment application (tab. 1)

Pseudomonas fluorescens group populations also **maintained greater densities with SOLULYS® 048** treatments compared to the untreated control and industry reference (fig. 1).

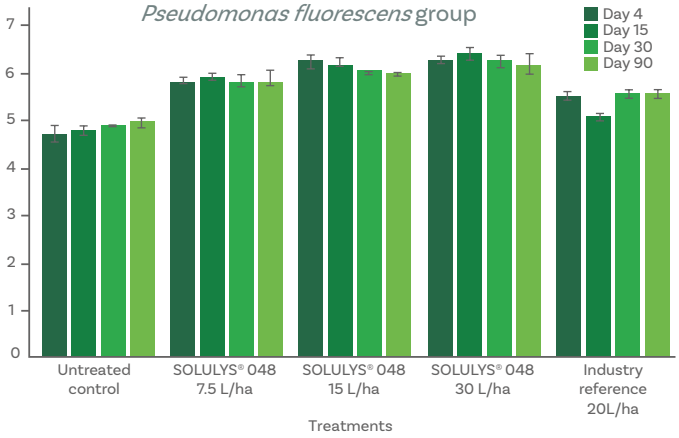


Figure 1: Density of *Pseudomonas fluorescens* group populations over time assessed using culture plating method in tomato soil after soil treatment applications.

Treatments	Day 4	Day 15	Day 30	Day 90
Untreated control	B[i*]	B	B	B
SOLULYS® 048 7.5L/ha	A	A	A	A
SOLULYS® 048 15L/ha	A	A	A	A
SOLULYS® 048 30L/ha	A	A	A	A
Industry reference 20L/ha	A	A	A	A

Table 1: Statistical analysis of *Pseudomonas fluorescens* group.

* i Means that share the same letter within column (Day) are not significantly different from the untreated control at P ≤ 0.05 with the Dunnett's Test.

SUPPORT FOR PLANT DEVELOPMENT

In addition to soil microbial improvement, **SOLULYS® 048** applied as raw material for a soil prebiotic biostimulant also ***improved the plant height, leaf area, leaf number and dry biomass of aerial and roots.***

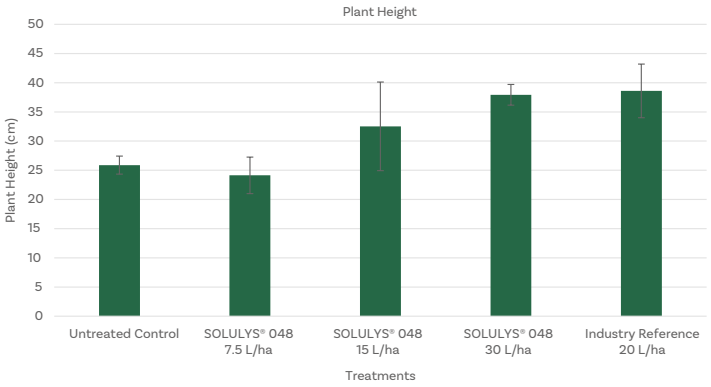


Figure 2: Effects of treatment rates on shoot and root dry biomass from plants harvested at the end of trial. Conditions sharing the same letter(s) are not significantly different according to Tukey's HSD P < 0.05.

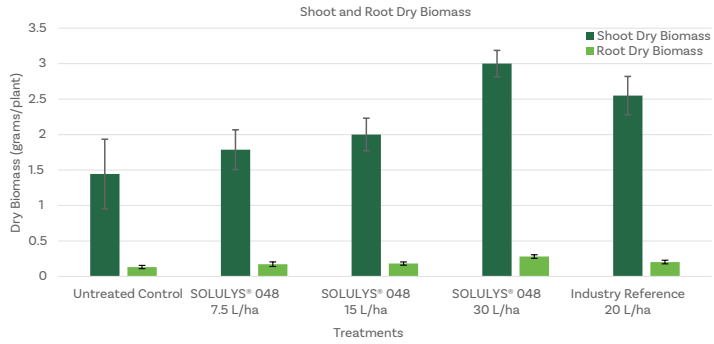


Figure 3: Effects of treatment rates on plant height at the end of trial. Conditions sharing the same letter are not significantly different according to Tukey's HSD P < 0.05.

Differences in efficacy were related to the product concentration **with 30 L/ha SOLULYS® 048 plant protein extract having significantly higher plant growth development than lower SOLULYS® 048 concentrations and the untreated control**, showing its ability to promote plant growth.

Overall, **Roquette has made significant strides to support customers in developing biostimulant formulations** to be able to feed key agriculture microbial populations and promote plant growth. By utilizing plant-based protein extracts as growth factors, our technical team of scientists can develop optimal solutions to support customers' unique needs. Roquette's goal is to establish a technical understanding of our customers' products and support their manufacturing processes or formulation requirements, ultimately providing high-value technical solutions.

1. Li, J., Van Gerrewey, T., & Geelen, D. (2022). A Meta-Analysis of Biostimulant Yield Effectiveness in Field Trials. Frontiers In Plant Science, 13. https://doi.org/10.3389/fpls.2022.836702
2. Frąc, M., Hannula, E. S., Bełka, M., Salles, J. F., & Jedryczka, M. (2022). Soil mycobiome in sustainable agriculture. Frontiers In Microbiology, 13. https://doi.org/10.3389/fmicb.2022.1033824
3. Mendes, R., Garbeva, P., & Raaijmakers, J. M. (2013). The rhizosphere microbiome: significance of plant beneficial, plant pathogenic, and human pathogenic microorganisms. FEMS Microbiology Reviews, 37(5), 634-663. https://doi.org/10.1111/1574-6976.12028
4. Revolutionized, E. G. (2022). Probiotics & Prebiotics: An Overview Of Soil Biologicals - Growing Produce. Growing Produce. https://www.growingproduce.com/sponsor/biome-makers/probiotics-prebiotics-an-overview-of-soil-biologicals/
5. Dastogeer, K. M., Tumpa, F. H., Sultana, A., Akter, M. A., & Chakraborty, A. (2020). Plant microbiome–an account of the factors that shape community composition and diversity. Current Plant Biology, 23, 100161. https://doi.org/10.1016/j.cpb.2020.100161
6. Ray, P., Lakshmanan, V., Labbé, J. L., & Craven, K. D. (2020). Microbe to microbiome : A paradigm shift in the application of microorganisms for sustainable agriculture. Frontiers in Microbiology, 11. https://doi.org/10.3389/fmicb.2020.622926
7. Akhtar, M. S., & Siddiqui, Z. A. (2010). Role of Plant Growth Promoting Rhizobacteria in Biocontrol of Plant Diseases and Sustainable Agriculture. In Microbiology Monographs (p. 157-195). https://doi.org/10.1007/978-3-642-13612-2_7

IND_PLANT-CARE-BIOSTIMULATION_TFS-34.1e/09-2024

ROQUETTE
Offering the best of nature™
www.roquette.com
PUBLIC