How plants 'farm' beneficial bacteria in Serenade®

Tim O'Grady, Business Development Manager, Bayer

Scientists at Rutgers University have proven how a range of crops harness the beneficial bacteria contained in Serenade® SOIL ACTIV to benefit their nutrition, growth, and resilience. This world first research is being led by Dr. James White, a professor in the Department of Plant Biology at Rutgers University, New Jersey. His research shows how plants 'farm' the bacteria to extract and absorb their nutrients, which has significant implications for the future approach to crop nutrition.

The new discovery of rhizophagy or 'root eating', is the process of how plants use microbes to extract their nutrients. This process starts when actively growing roots release exudates, such as sugars, which attracts beneficial bacteria to the root tips. Dr. White has proven that the beneficial bacteria in Serenade SOIL ACTIV soil ameliorant (*Bacillus amyloliquefaciens* strain QST 713) are absorbed into the root cells where the plant can remove nutrients contained inside their walls. The bacteria are then replicated and ejected back into the soil where they continue the cycle to source nutrients, matched to the crop demand.

Certain soil nutrients are favored in the rhizophagy cycle, despite the fact all nutrients are supplied. These often include manganese, iron and magnesium which are critical to forming chlorophyll and maximising photosynthesis, plus calcium and boron, which are critical for building cell strength. Replicated studies conducted by Rutgers show substantial increases in manganese (+27%), calcium (+15%) and boron (+18%) in soybeans, following the application of Serenade SOIL ACTIV.

The rhizophagy process is also critical for building resilient crops, as described in "Teaming with bacteria" by Jeff Lowenfels. Jeff suggests dealing with rhizophagy is like training the plant to deal with other stresses. Dr. White explains that 'plants which work to extract nutrients oxidatively through rhizophagy, become hardier than plants solely reliant on nutrition from synthetic NPK fertilizers'. Also, rhizophagy builds stronger plants as the nutrient form is optimal for utilisation by the plant.

Rutgers University has demonstrated the rhizophagy cycle with Serenade SOIL ACTIV on avocado, macadamia, almond, hazelnut, tomato, lettuce, carrot, onion and cabbage crops. It's important to understand that each strain of bacteria have vastly different capabilities to supply nutrients in rhizophagy. QST 713 is a 'pioneer' strain that was selected for its robustness and ability to form symbiotic associations with a range of crops. Initial research at Rutgers has shown this extends to forming positive association with other beneficial fungi, such as trichoderma and mycorrhizae.

So, what does this all mean for agriculture? Fundamentally, it changes our understanding of how plants source nutrients in a healthy soil and highlights the importance of soil biology. According to Dr. White, this knowledge opens the door to developing a new approach to agriculture based on microbes, that is not only better for agriculture, but also for human health.

Rutgers University: Evidence of rhizophagy in vegetable crops

Tomato seedlings treated with Serenade SOIL ACTIV showed longer roots, longer root hairs containing the beneficial bacteria and had higher antioxidants (purple pigments) formation resulting from the rhizophagy cycle.

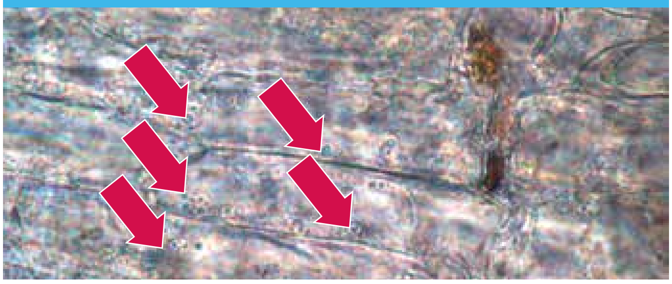
Untreated control

Serenade SOIL ACTIV

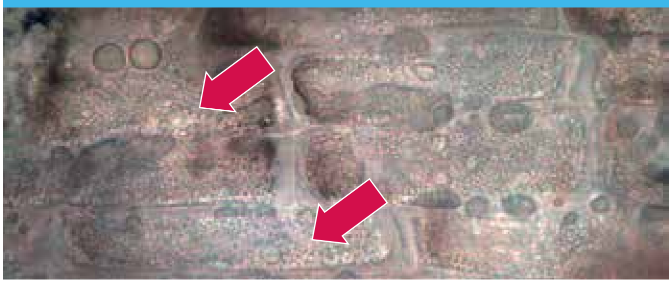
Rutgers University: Evidence of rhizophagy in various tree crops

The beneficial bacteria contained in Serenade SOIL ACTIV inside the root cells of avocado (top left), macadamia (top right), and on the root hairs of almonds (bottom left) active in the rhizophagy cycle. The bacteria are shown to be forming a symbiotic association with mycorrhizae fungi in hazelnut (bottom right).

Avocado



Macadamia



Almonds

Hazelnut

This article includes information from new research that is part of ongoing collaboration between Bayer and Rutgers University to explore the mechanisms by which the QST 713 strain of Bacillus amyloliquefaciens is able to successfully and reliably harvest soil resources in symbiosis with agricultural crops.