SERENADE® prime

Guide for soil use in avocados.

Introduction to Serenade® Prime

Serenade Prime contains *Bacillus amyloliquefaciens*, a bacteria that forms a symbiotic relationship with the avocado roots. The roots provide the food (exudate) for the bacteria and in return, they unlock access to soil nutrients and other resources to improve nutrient uptake, potentially leading to improved fruit quality and size at harvest.

KEY BENEFITS:

- IMPROVE NUTRIENT UPTAKE
- IMPROVE FRUIT SIZE AND QUALITY
- CONVENIENT APPLICATION VIA IRRIGATION
- GREATER ROOT MASS

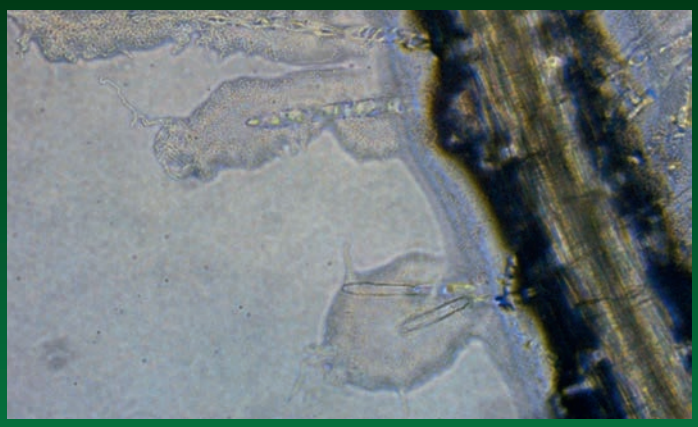


Figure 1. Serenade Prime builds a beneficial film around the root tips.

Root Colonisation

Serenade® Prime is a suspension of the dormant spores of the QST 713 strain of *Bacillus amyloliquefaciens*. The spores rapidly colonise new root surfaces during periods of active root growth. The trigger for colonisation is the release of exudates from roots. The bacterium use exudates to build a dense film around the roots, which acts both to modify soil resources to make them more available to the plant and as a bridge between roots and the soil to improve nutrient uptake (Figure 1).

Nutrient Uptake

After colonisation with Serenade Prime, soil immobile nutrients such as zinc, iron and phosphorus can be changed to plant-available forms. For instance, when iron is not in a plant-available form, the QST 713 bacteria can release bacillibactin, which is an iron-chelating compound. Colonisation also results in the release of organic acids, which mobilises 'fixed' phosphorus to assist rapid root development. Releases of enzymes also break down organic material to plant-available forms, which are more easily taken up by plant roots.

Greenhouse Results: Avocado, California 2018

Serenade Prime improved nutrient uptake and provided significant improvement to early shoot and root growth on avocado var. *Zutano* transplants (Figures 2 and 3). It was applied as a soil drench at transplanting and DNA analysis (qPCR) showed successful colonisation across all treated plants with QST 713 strain bacteria up to 3 months after application (Figure 4).

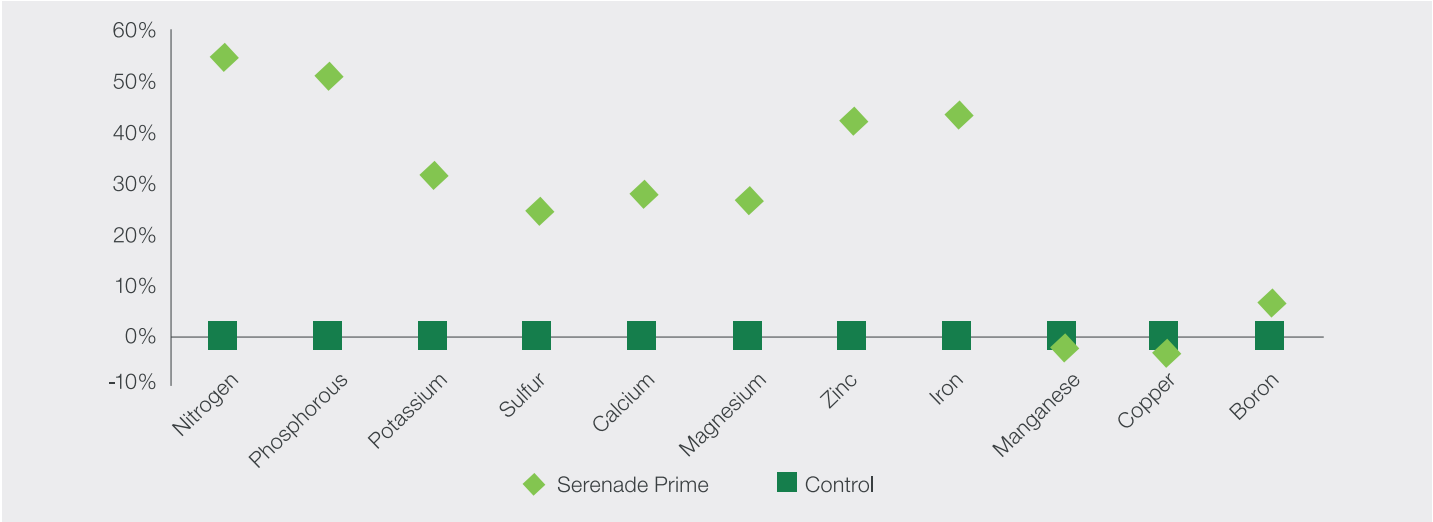


Figure 2. Total plant nutrient uptake: % change compared to control

This greater root mass, in turn, may assist uptake of immobile micronutrients, like zinc and iron, which are only obtained from soil in very close proximity to the root surface. It's also important in forming new root tips where uptake of calcium and boron occurs.

Figure 3. Root and shoot growth: % change compared to control

Figure 4a. Shoot growth at 3 months after transplanting control *left*, Serenade Prime *right*.

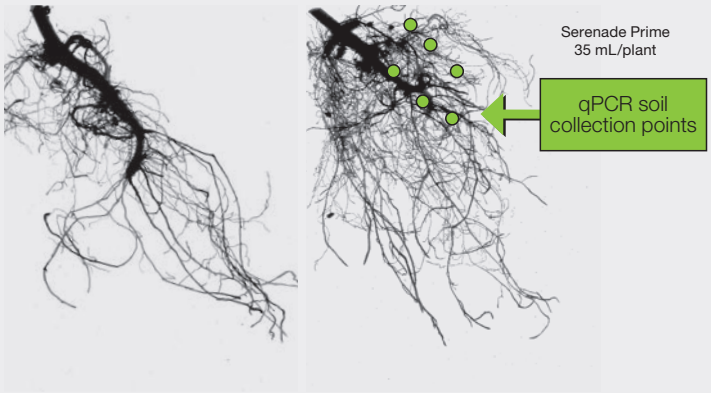


Figure 4b. Root growth 3 months after transplanting control *left*, Serenade Prime *right*.

Field Results: Avocado, Bundaberg district 2015-18

Serenade Prime treated Hass var. avocado trees showed an increase in first grade pack-out by **17% (2.05 t/ha)** and fruit size (Figures 5 and 6). This 3.6 hectare trial compared Serenade Prime to the grower standard where the entire block was harvested and commercially packed over three seasons. Serenade Prime was applied at 35 mL/tree at the start of the root flush periods in spring and autumn from 2015-2018.

Figure 5. Pack-out (t/ha) of Hass var. avocados by quality grade over 3 years. Bundaberg district (2015-18)

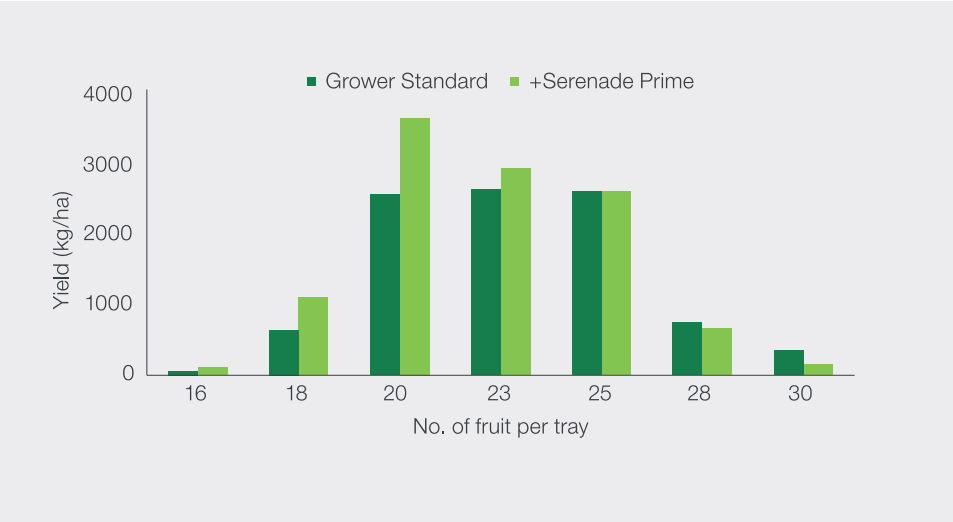


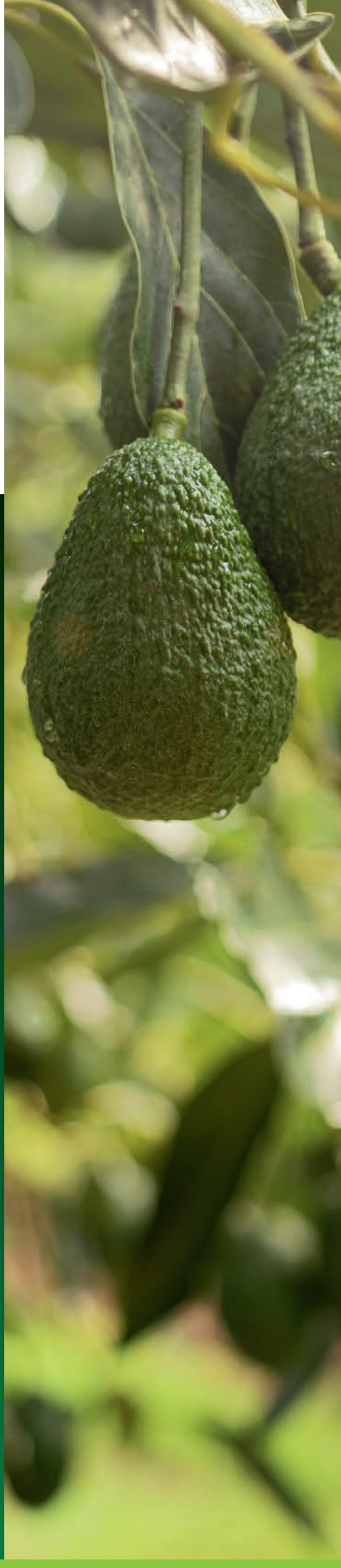
Figure 6. Pack-out (kg/ha) of Hass var. avocados (first grade) by size categorisation. Bundaberg district (2015-18)

Root Flush Application & Rate

Serenade Prime should be applied at the start of the root growth cycle during spring and autumn. Accelerated root exudation at this time allows the opportunity for the beneficial bacteria to rapidly colonise and dominate the rhizosphere. Pre-emptively colonising young feeder roots provide the opportunity to build a supply of plant-available nutrients in the rhizosphere ahead of critical periods of nutrient demand.

On established trees, Serenade Prime should be applied at 35 mL/tree, or a maximum of 10 L/ha under higher density orchards. On newly planted trees, apply at 10 mL/tree. Serenade Prime is highly compatible and can be applied through the irrigation system at the same time as commonly used fertilisers, phosphorous acid or organic amendments, without compromising the ability to colonise roots.

Figure 7. Apply at the start of each major root flush cycle



* Please refer to the Serenade Prime product label for the Restraints associated with the use of Serenade Prime. Always refer to the product label before use.

Bayer CropScience Pty Ltd, ABN 87 000 226 022, Level 1, 8 Redfern Road, Hawthorn East, Victoria 3123.
Technical Enquiries 1800 804 479. crop.bayer.com.au