

Users' guide for Serenade® Prime



Building a biological interface between the soil environment and plant root systems using beneficial bacteria

Serenade® Prime is a product based on the beneficial bacteria *Bacillus subtilis* strain QST713, specifically selected for its superior performance in cropping systems. In each container of Serenade Prime there is a guaranteed quantity of viable spores of the bacteria *Bacillus subtilis* strain QST713 as well as a complex mixture of plant-supportive biochemicals which the bacteria produces. These types of beneficial bacteria live on plant root surfaces and in the soil around the plant root system in a zone called the rhizosphere. In the rhizosphere, plants and bacteria can develop a mutually beneficial relationship under suitable conditions. When the interactions between the bacteria, the plants and the soil are balanced, both the plants and the bacterial populations in this zone function at a higher level as a result. When plants and beneficial bacteria are functioning in harmony in the rhizosphere, resources required for growth such as nutrients and water become more available through the mutually beneficial plant/bacteria relationship.

It is important to understand that it is only as a result of these interactions within the rhizosphere that the benefit to plants becomes available. The *Bacillus subtilis* organism does not directly provide improved plant growth - it is only when there is an active interface between the soil, plant roots, bacteria and some of the exudate biochemicals from the roots that the benefits of higher functioning plants/crops become accessible.

In annual/short-cycle crops, Serenade Prime is designed to be used early in the crop as an inoculating agent to build the soil/root/microbe inter-relationships in the rhizosphere to a highly activated state from the early stage of crop growth. In perennial crops, Serenade Prime is designed to reinvigorate the soil/root/microbe inter-relationships in the rhizosphere at critical times of plant/root growth.

Serenade Prime at a glance

Active organism	<i>Bacillus subtilis</i> strain QST713
Formulation	A liquid biological mix comprising viable spores and associated biochemicals produced by <i>Bacillus subtilis</i> QST713
Application target	Apply to the soil to provide an inoculating dose of beneficial bacteria to the root zone of each plant.
Application method	Plant hole drench methods, in-furrow bands sprays, trickle and micro-sprinkler irrigation injections.
Application placement	Apply the Serenade Prime mix as close as possible to the existing plant roots.
Irrigation	For several days after application, care should be taken not to wash the bacterial spores out of the root zone. Therefore if irrigation is required within this timeframe close attention should be paid to meeting the immediate water needs of the plants without excessive movement of water or soil from the root zone.
Timing	First application at or about planting/transplanting. In some crops, repeat applications are required to "top-up" the beneficial effect on new roots in the crop.
Rate	5 – 7 L/ha or 35-70 mL/tree (Do not exceed 10 L/ha in high density plantings of tree crops).
Additional "food source"	Additional nutrient "starters" for the microbes are NOT required.
Speed of colonisation	Colonisation of root systems can occur in as little as a few hours under suitable conditions, but is generally completed within 2 - 3 days.
Possible benefits	A more biologically active rhizosphere resulting in: increased breakdown of organic matter in soils, increased seedling vigour and resilience, increased nutrient availability, more productive plants.
UV stability	<i>Bacillus subtilis</i> in spore form is generally considered stable to ultraviolet light breakdown. Further protection of the spores is achieved by correct placement below the soil surface in the root zone.
Compatibility	Serenade Prime is compatible with many commonly used insecticide, fertilizers, adjuvants and surfactants but has not been fully tested with all of these. Untested mixtures should be checked on a small area before using on a large scale. Bayer cannot be held responsible for the performance of other manufacturers' products in mixtures.
Withholding period	Not required when used as directed.



SERENADE[®] prime



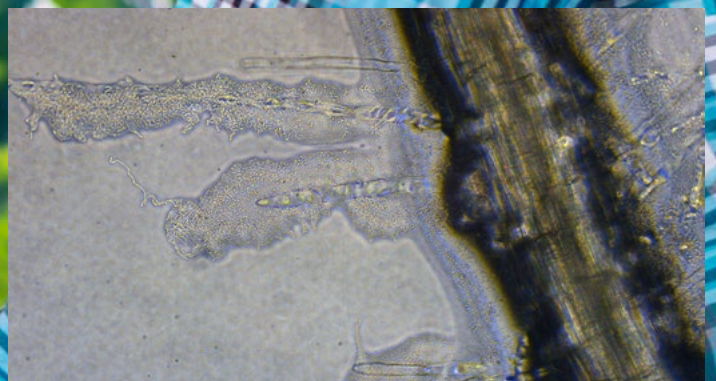
APPLICATION

Key factors influencing success of application are RATE, PLACEMENT, TIMING and WATER FLUX after application.

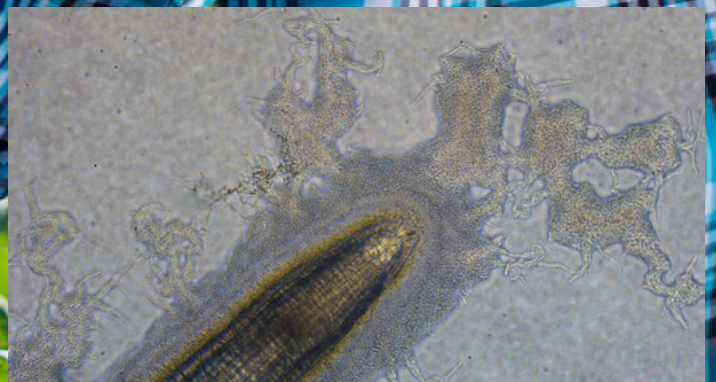
Rate	Regardless of method, aim for total application in the range 5 – 7 L/ha or 35-70 mL/tree (Do not exceed 10 L/ha in high density plantings of tree crops). In annual/short-cycle crops this can equate to plant-hole drench rates up to 0.5 mL/plant depending on crop spacing.
Placement	Do not apply outside root zone. If microbes do not sense the biochemical root exudates which are the signal for root colonisation, then they will not be attracted to root structures and successful colonisation will not occur.
Timing	Serenade Prime benefits plants when new root tissue is colonised very early after initial growth. Consequently it is best used to prime plants for EARLY GROWTH. In annual/short-cycle crops, the first application at planting/transplanting is the most important. In perennial crops, application to coincide with the production of new root flushes is most effective.
Water Flux	Very thorough root colonisation can occur within 2-3 days if application placement has been optimum. To maximize colonization success, adjust watering to reduce soil flow through and therefore movement of spores away from the root zone.

NUTRIENT UPTAKE CAPABILITIES

Inoculating the soil-root interface with beneficial bacteria can enable better access to nutrients from the surrounding soil. Applying Serenade Prime from the start of the crop allows *Bacillus subtilis* to prime the young plants for efficient utilisation of key nutrients early in crop establishment. The microbial “biofilm” around fine roots and root hairs is integral to the complex uptake reactions between the root tissue and the physical nutrient molecules in the soil.



Bacillus subtilis cells colonising around root hairs.



Film of *Bacillus subtilis* cells firmly attached around root tip.

ROOT COLONISATION

Serenade Prime *Bacillus subtilis* QST713 becomes integrated within the plant root systems, mostly as a thin organic film comprised of polysaccharide gums and gels layered around the surfaces of the root structures, particularly the small fine roots and root hairs. After application, *Bacillus subtilis* spores become activated and are rapidly attracted towards roots. The mechanism by which this occurs is complicated and involves rapid colonisation of plant root surfaces by the bacteria. There are chemical signals exuded from the plant roots which trigger this colonisation. What results is a dense protective layer around the roots which is comprised of microbes and the biochemicals which they produce.