



Serenade[®]

Biological Fungicide

Enhancing Crop Protection

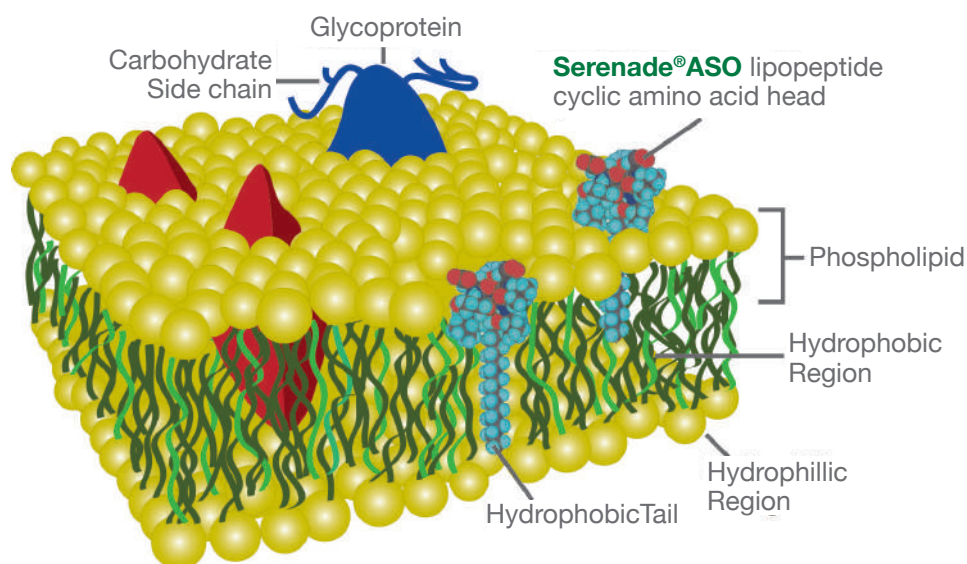


Serenade[®]ASO biological fungicide can be used against foliar diseases in tomatoes & grapes. Based on the beneficial bacterium *Bacillus amyloliquefaciens* strain QST 713. **Serenade[®]ASO** fungicide delivers disease prevention with high levels of environmental safety, human safety and safety to non-targets including bees when used as directed.

Mode of Action



Serenade[®]ASO is a contact fungicide produced using fermentation. During the manufacturing process, the beneficial bacteria in **Serenade[®]ASO** produce a range of anti-fungal secondary compounds known as lipopeptides. These lipopeptides disrupt the cell membrane of the pathogen, resulting in a physical breakdown of the pathogen cell on contact. This is a unique mode of action, distinct from single-site active fungicides, recognized by the Fungicide Resistance Action Committee (FRAC) as Code 44. This mode of action is especially important when **Serenade[®]ASO** is used alongside a complimentary fungicide programme. Because **Serenade[®]ASO** causes membrane disruption it allows the second fungicide better access to the pathogen. Lipopeptides are stable to heat, pH, UV and other fungicides, making **Serenade[®]ASO** an ideal component in fungal disease control alternation and tank-mix programs. Lipopeptides are contact active, rather than systemic.



Fluid Mosaic Membrane Model

Antibacterial compounds difficidin and macrolactin produced by **Serenade[®]ASO** has efficacy against bacterial speck on tomato *Pseudomonas syringae*. Some of these compounds compete for an enzyme needed by pathogenic bacteria to build their cell walls. This is a contact mode of action.

Serenade[®]ASO has been demonstrated to induce systemic resistance responses in treated plants. This means **Serenade[®]ASO** primes plants to defend themselves against pathogens, in addition to the contact control described above. The induced response results in bacterial disease reduction and in other measurable effects such as:

- + Increased resistance to abiotic stress
- + Increased peroxidase activity
- + Priming of the salicylic acid pathway
- + Priming of the gibberellic acid pathway

Introduction



Serenade[®]ASO can be used when other crop protection tools don't fit due to its short pre-harvest interval. **Serenade[®]ASO** helps growers comply with re-entry intervals, manage worker safety requirements and meet food chain specifications.

Key Benefits



- + Unique biological mode of action, providing resistance management tool
- + Maximum Residue Level (MRL) exemption – treated crops can be sold around the world
- + Pre-Harvest Interval (PHI): 0 days, low Re-Entry Interval (REI): 4 hours
- + Integrated Pest Management (IPM) compatible with wide safety margins to bees, other pollinators and beneficials
- + Easily integrated into grower practices, tank-mix compatible with crop protection as recommended on the label

Grapes	Suppression of Botrytis
Tomatoes	Bacterial Speck (<i>Pseudomonas syringae</i>)

All formulations of **Serenade[®]ASO** fungicide are approved for use in organic production.

Serenade[®]ASO fungicide makes an excellent tank-mix partner for improved efficacy, resistance management and management of residue. **Serenade[®]ASO** has been shown to be compatible with **Antracol[®]**, **Belt[®]**, **Bulldock[®]**, **Folicur[®]** and **Infinito[®]**.

Mode of Action



Soil Applications of Serenade[®]ASO Fungicide

When applied as a soil drench as on tomatoes, **Serenade[®]ASO biological fungicide is an excellent root colonizer**, forming a protective physical barrier against soil diseases. As roots grow, the barrier created by **Serenade[®]ASO** grows, resulting in extended periods of root protection.

The beneficial bacteria in **Serenade[®]ASO** form a mutualistic relationship with the plant in the root zone. The roots produce exudate which **Serenade[®]ASO** relies on as a food source. **Serenade[®]ASO**, in exchange, produces plant growth promoting compounds like auxins to speed the plant's early season growth.

Serenade[®]ASO can improve nutrient solubilization in soil, allowing plants to access nutrients like iron, phosphate and potassium more efficiently. **Serenade[®]ASO** also produces the enzymes endoglucanase and endoxylane which breakdown organic material in the soil to forms more easily taken up by plant roots. As a result, crops treated with **Serenade[®]ASO** in the soil can show improved plant quality and higher yields.

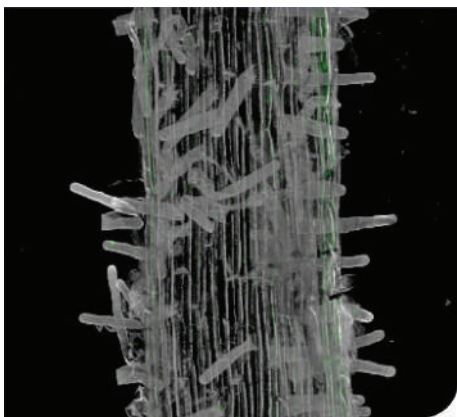


Roots colonized by Serenade[®]ASO have more lateral roots, more dense roots and longer root hairs. This means Serenade[®]ASO-treated plants have increased root surface area for improved:

- + phosphorus uptake
- + availability of other nutrients
- + water absorption
- + anchorage

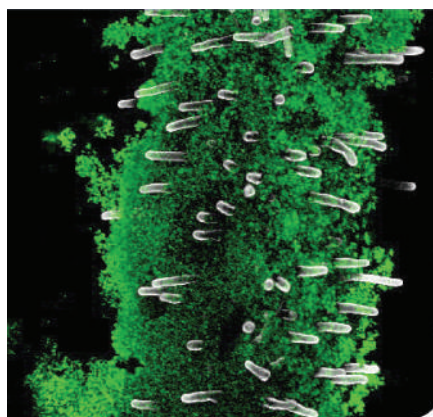
Untreated

Untreated root stand “naked” to potential attack by soil diseases.



Serenade[®]ASO Treated

Serenade[®]ASO builds a dense barrier around the root, including the tip, and grows with the plant as the plant grows.





Safety Profile

Serenade®ASO biological fungicide is based on a unique *Bacillus amyloliquifaciens* strain QST 713.

Bacillus amyloliquifaciens is a bacteria found in air, sea and on land. They are ubiquitous in nature and have long been used in crop protection, animal health and selected human health, as well as industrial enzymes. The patented strain in **Serenade®ASO** has been well characterized through genome mapping and tested in thousands of field trials.

Serenade®ASO Safety Data – Human Health

- + Non-infectious to mammals
- + Little or no skin and eye irritation potential
- + As sensitization to microorganisms can occur, a dust filtering mask may be recommended (see local requirements)
- + Not mutagenic or clastogenic.
- + Not a reproductive or developmental toxicant
- + Not a neurotoxin or an immunotoxin

Serenade®ASO has a very favorable eco-toxicological profile when used as directed

- + Not hazardous to aquatic and terrestrial species (no aquatic classification is required)
- + Not hazardous to native animal populations or birds
- + Low acute toxicity to mammals
- + Supportive to soil microflora
- + No unacceptable impact on beneficial arthropods and bees, even following repeated applications

Crop Safety

No phytotoxicity has been observed with **Serenade®ASO** products when used according to label instructions.

IPM Compatibility

Serenade®ASO products can be used as solo products but work best in Integrated Pest Management programs (IPM) alongside other crop protection products (conventional crop protection and biologicals). Repeated applications are recommended, depending on crop, disease pressure and local practice. For maximum effectiveness, **Serenade®ASO** should always be applied prior to or in the early stages of disease development. Periods of high disease pressure should be avoided.

Resistance Management

Serenade®ASO products have multiple modes of action and are useful in resistance management programs. There are no reports of resistance development against **Serenade®ASO**. It does not show cross-resistance to any existing chemical fungicide.

Residues

Serenade®ASO biological fungicide is non-toxic and exempt from MRL by US-EPA and other regulators around the world. Growers can use **Serenade®ASO** in Integrated Crop Solutions to manage residues while controlling disease late in the production season.

Integrated Spray Programmes



Please refer to the product labels for complete recommendations.

Table Grape Spray Programme

Bud break	2 - 5 cm Shoot Length	10 - 15 cm Shoot Length	25 - 30 cm Shoot Length	Pre-flower	Full flower	Pea berry stage	14 days post pea berry	Veraison	14 days post veraison	Pre-harvest
	PROSPER	FLINT MAX	PROSPER	PROSPER	FLOWER POWER	SERENADE				
			PR•FILER	PR•FILER	TEL DOR		TEL DOR	TEL DOR	TEL DOR	
			decis	MOVENTO	Luna PRIVILEGE					
						FLINT MAX				
								PR•FILER		

Tomato Spray Programme

SERENADE		SERENADE	
	Transplant		
	Confidor	Antracol	All growth stages
	VELUM PRIME 400 SC	Folicur	All growth stages not more than 5 times
	decis FORTE	INFINITO	All growth stages not more than 6 times
	BULLDOCK	BELT	All growth stages not more than 4 times
		SIVANTO	All growth stages not more than 4 times

Antracol® Reg.No. L2065 (Act No. 36 of 1947). Antracol® contains Propineb (Caution). Belt® Reg. No. L8860 (Act No. 36 of 1947). Belt® contains Flubendiamide (Caution). Bulldock® Reg. No. L7612 (Act No. 36 of 1947). Bulldock® contains Beta-cyfluthrin (Harmful). Confidor® Reg. No. L7240 (Act No. 36 of 1947). Confidor® contains Imidacloprid (Harmful). Decis® Forte Reg. No. L6563 (Act No. 36 of 1947). Decis® Forte contains Deltamethrin (Harmful). Flint® Max Reg. No. L8827 (Act No. 36 of 1947). Flint® Max contains Tebuconazole and Trifloxystrobin (Caution). Folicur® Reg. No. L3857 (Act No. 36 of 1947). Folicur® contains Tebuconazole (Caution). Infinito® Reg. No. L8470 (Act No. 36 of 1947). Infinito® contains Fluopicolide and Propamocarb-HCl (Caution). Luna® Privilege Reg. No. L8997 (Act No. 36 of 1947). Luna® Privilege contains Fluopyram (Caution). Movento® Reg. No. L8559 (Act No. 36 of 1947). Movento® contains Spirotetramat (Caution). Profiler® Reg. No. L8596 (Act No. 36 of 1947). Profiler® contains Fluopicolide and Fosetyl-AI (Caution). Prosper® Reg. No. L6252 (Act No. 36 of 1947). Prosper® contains Spiroxamine (Harmful). Serenade® Reg. No. L8544 (Act No. 36 of 1947). Serenade® contains Bacillus amyloliquefaciens (Caution). Sivanto® Prime 200 SL Reg. No. L10776 (Act No. 36 of 1947). Sivanto® Prime 200 SL contains Flupyradifurone (Butenolide) (Caution). Teldor® contains Phenhexamid. Teldor® Reg.No. L6250 (Act No. 36 of 1947). Velum® Prime Reg. No. L9565 (Act No. 36 of 1947). Velum® Prime contains Fluopyram, (Caution). Antracol®, Belt®, Bulldock®, Confidor®, Decis® Forte, Folicur®, Infinito®, Luna® Privilege, Movento®, Profiler®, Prosper®, Serenade®, Sivanto® Prime 200SL, Teldor® and Velum® Prime are registered trademarks of Bayer AG, Germany. Use strictly according to instructions on label.

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