



TECHNICAL NOTES FOR SERENADE[®] ASO

These notes are designed to support the main product manual insert on SERENADE ASO and give advice on how to obtain the best possible disease control.

WHAT IS SERENADE ASO?

SERENADE ASO is an innovative and highly effective broad spectrum contact bio-fungicide, with several modes of action for a wide spectrum of control with little potential for resistance. Based on the proprietary active ingredient, *Bacillus subtilis* QST 713 is formulated in a "grower-friendly" way. It is approved in the UK as a professional pesticide for the reduction of fruit damage on protected strawberries caused by grey mould (*Botrytis cinerea*).

WHAT DOES ASO MEAN?

ASO means Aqueous Suspension Organic.

WHY USE SERENADE ASO?

SERENADE ASO has proven efficacy. Use it as a fungicide alone or as part of a programme of sprays:

- To control disease.
- To eliminate or reduce chemical fungicide use.
- To eliminate or reduce chemical fungicide residues.
- To extend shelf life without chemical fungicide residues.
- To reduce the risk of fungicide resistance developing.

- To minimise the possibility of environmental problems from use of chemical fungicides.
- To reduce the risk for the operators.
- To use in IPM programmes.
- To improve the efficacy of chemical fungicides in tank mix or as part of a programme of sprays.
- To improve yields - Serenade or Serenade programmes are often the highest yield/quality in the trials, even under little or no disease pressure.

WHAT DISEASES DOES SERENADE ASO CONTROL?

SERENADE ASO is approved for the reduction of fruit damage caused by grey mould (*Botrytis cinerea*).

SERENADE ASO also has activity against a wide range of other diseases. Globally, activity is recorded against: *Alternaria*, powdery mildew (*Leveillula*, *Erisiphe*, *Uncinula necator*), bacterial leaf spot (*Xanthomonas*), downy mildew (*Bremia lactucae*), scab (*Venturia*), fire blight (*Erwinia*), *Monolinia*, *Sclerotinia*, *Pseudomonas*, bacterial wilt (*Ralstonia*), canker, and *Colletotrichum*. However there is no approval for control of these diseases in the UK.

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ALWAYS READ THE LABEL: USE PESTICIDES SAFELY

SERENADE ASO is not approved or recommended as a drench, although work is underway with other formulations for this use in the future.

HISTORY AND DEVELOPMENT

The active ingredient is a naturally occurring rod shaped gram positive aerobic motile bacterium - *Bacillus subtilis* (strain QST713). The bacterium was discovered in 1995-6 as part of a screen from a peach orchard in California. The product contains no genetically modified organisms.

The patented strain of bacteria was submitted for approval in the European Community and attained Annex I (91/414) status in February 2007. Serenade was first launched as a bio-fungicide in USA in 2000. In 2008 Serenade was registered and sold in about 30 countries. SERENADE ASO was approved in November 2008 for sale in the United Kingdom as a plant protection agent.

SERENADE ASO is the first biological fungicide for foliar application to be approved in the United Kingdom.

HOW DOES SERENADE WORK?

SERENADE ASO has multiple modes of action:

1. Broad anti-fungal activity.
 - Lipopeptides kill fungal cells.
 - They are highly stable, resistant to elevated temperature and pH extremes.
 - Synergistic activity of 3 different classes of lipopeptides.
2. Stimulates the plants own defence mechanisms.
 - Elicits plant responses - ISR (Induced Systemic Resistance).
3. Colonises the leaf and out-competes pathogens.

IS RESISTANCE LIKELY?

Because of the multiple modes of action it is unlikely that plant pathogens will be able to develop tolerance to Serenade.

HOW BEST TO APPLY IT?

SERENADE ASO should be applied for maximum coverage of plant surfaces. As much of the activity is non-systemic it needs to be applied

thoroughly. It needs to be re-applied to both protect new growth and maintain coverage on the older leaves.

Water Volume:

The label states use sufficient water for good crop cover and at least 400 litres per hectare. Greater volumes of water can be used, but always use 10 ltr of product / ha and adjust the water volume to suit the crop, ensuring good coverage with no run-off. The range of water volumes used within Serenade markets are not recognized as impediments to product performance.

Spray Quality:

Serenade is a contact fungicide and so accurate coverage of all part of the plant subject to disease attack is required. The recommended nozzles are the Cone or the Twin Jet.

Use of foggers or ULV:

There is limited experience on this and although low volume application has been used on some crops the important factor is to ensure good coverage of the plant.

Additional Wetters:

SERENADE ASO can be applied with a non-ionic or silicon surfactant (such as Silwet L-77) on waxy leaved crops or under conditions of very low humidity, but use is not normally required or recommended.

WHEN TO USE IT?

SERENADE ASO is best applied preventatively before the disease is established. This is especially important to allow the ISR mode of action to develop. Under heavy disease pressure, apply SERENADE ASO in rotation or as a tank mix with other fungicides.

SPRAY INTERVAL?

A spray interval of 7 days is recommended.

RESISTANCE MANAGEMENT?

SERENADE ASO can be an important tool for growers in areas where resistance to conventional products has developed, and it will help to prevent the development of resistant pathogens when it is rotated or it is used in tank mix in a

control programme with other registered fungicides.

TANK MIXING

SERENADE ASO has been found to be synergistic with other fungicides. This means that the combined effect is greater than additive effects. This may mean reduced amounts of fungicide are required. It may increase efficacy of other fungicides against fungal pathogens resistant to them.

Chemical tank mix compatibility:

SERENADE ASO has been found to be physically compatible with many chemical pesticides including the following products used on strawberry crops:

Fungicides:

azoxystrobin,
boscalid + pyraclostrobin,
chlorothalonil,
cyprodinil,
iprodione,
myclobutanil,
potassium bicarbonate,
sulphur.

Do not tank mix with fosetyl aluminium as this can cause precipitation of the spores.

Insecticides:

abamectin,
Bacillus thuringiensis (DiPel DF),
spinosad.

Adjuvants:

Activator 90,
Silwet L-77.

Foliar feeds:

There are no known compatibility issues with foliar feeds.

ARE THERE ANY ISSUES WITH WATER HARDNESS?

The pH of water used for spraying should be between 4.5 and 8.5, avoid water with very high levels of salts.

AS THIS IS A BIOLOGICAL PRODUCT ARE THERE ANY TEMPERATURE LIMITS?

The activity is robust over a wide temperature range from 5°C upwards, with activity below this level being reduced. During formulation the spores and metabolites survive temperatures of 100°C.

ARE THERE ANY VISIBLE SPRAY DEPOSITS?

SERENADE ASO has been formulated as a liquid to minimise visible spray deposits.

BIOLOGICAL CONTROL COMPATIBILITY?

SERENADE ASO is compatible with a wide range of macro-biological control organisms and none have been found to be harmed by SERENADE ASO. Specific trials have been conducted with *Aphidius*, *Orius*, *Phytoseiulus* and *Amblyseius swirskii* and for all Serenade has been classified as harmless (IOBC 1). There is also no effect on the pollination behaviour of bees.

There is limited evidence that *Verticillium lecanii* (Vertalec and Mycotal) are harmed by SERENADE ASO and use is not recommended as a tank mix, although rotational use (2-3 days) should be acceptable.

IS SERENADE ASO USABLE IN ORGANIC SYSTEMS?

SERENADE ASO should be usable in organic systems - subject to authorisation from the certification body. Serenade ASO has IMO accreditation which is recognised by most organic bodies.

WHAT IS THE SHELF LIFE?

Unopened packs have a shelf life of 2 years at ambient temperatures.

ARE THERE ANY FOOD SAFETY ISSUES WITH APPLYING BACTERIA ON FOOD CROPS?

B. subtilis is already present in human environments in concentrations that are not influenced

by the amounts added for crop protection using SERENADE ASO. In addition, *B. subtilis* is considered to be a safe organism that does not cause infection or disease. Replacement of current fungicides that have confirmed human and environmental toxicities with SERENADE ASO would be a strategy for reducing risk for agricultural producers.

How can differentiation be made between *B. subtilis* and other bacteria?

Several procedures to recognize *Bacillus subtilis* from other bacteria are available. It is also possible to recognize *B. subtilis* QST713 strain from other *B. subtilis* strains. Ask for more details if required.

SERENADE ASO is a suspension concentrate containing 13.96g/l *Bacillus subtilis* strain QST 713 (a minimum of 1.042×10^{12} cfu/l)

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Bacillus subtilis strain QST713 is patented.
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