

Messenger® STS

Technical Bulletin



Product Name:	Messenger®STS
Formulation:	Wettable dry granule
Active Ingredient:	3% harpin protein
Other ingredients:	Food-grade products and other low-risk ingredients
Application Method:	Foliar spray

Product Overview

Messenger® STS, classified by EDEN BIOSCIENCE® as a plant health regulator, is an improved formulation of Messenger, the first product of an entirely new class of crop production technology. Messenger STS offers growers a highly effective and environmentally sound tool to improve yields and regulate overall plant health. *HarpinEA*, the active ingredient in Messenger STS, is one of a family of proteins produced in nature by certain bacterial plant pathogens. The discovery of harpin was published in Science in 1992, and formed the basis for the harpin protein technology platform developed by EDEN BIOSCIENCE. Harpin proteins activate plant reactions after binding to the plant's early warning receptors. The receptors send a signal (or message) throughout the plant, initiating a sequence of physiological and biochemical reactions that activate plant growth and stress-defense pathways. The result is a healthier, more productive crop. These early warning receptors have been found in a wide range of plants and this explains the biological activity of Messenger STS across many different crops. Based on its beneficial properties and favorable safety profile, Messenger was granted the **U.S. EPA Presidential Green Chemistry Award** in 2001. The primary benefits to growers who use Messenger STS can include improved yield, enhanced fruit quality and extended shelf life.

Broad Spectrum Crop Uses

Messenger STS has been extensively tested on many crops in field and greenhouse trials in major growing areas throughout the world. The product has activity across a broad spectrum of crops, including:

Vegetables

Field crops

Fruit trees and vines

Specialty crops

Turf and ornamentals

Crop recommendations are specific to crop groups since timing of application and duration of effects depends on crop physiology and growth stage.

The Chemistry of Messenger STS

Harpin, the active ingredient in Messenger STS, is a protein derived from — and chemically identical to — the naturally occurring protein produced by bacteria commonly found in the environment. Harpin is an acidic, heat-stable, glycine-rich, extracellular protein with a molecular weight of about 40 kilodaltons. The protein consists of 403 amino acid residues with no cysteine. Messenger STS contains the same active ingredient as the original Messenger. Improvements in the formulation and production process make Messenger STS more stable and user friendly:

- Chlorinated water may be used without pre-treatment, except at the highest dilutions (> 150 GPA);
- Mixed material may be used longer – up to 8 hours; and
- Opened packets may be resealed and reused for up to three weeks.

Messenger STS for Growth and Stress Defense

The harpin protein in Messenger STS activates natural plant biochemical pathways that stimulate certain growth and stress-defense responses. Messenger STS treatments activate growth mechanisms that result in improved plant vigor, increased plant stamina, and healthier plants which in turn reinforce the plant's ability to generate growth and stress-defense responses. This reinforcing circle of plant health results in improved yields and crop quality.

Messenger STS activates Cell Growth and Plant Development

Using modern DNA microarray technology EDEN BIOSCIENCE has verified that many plant growth related genes are activated in plants treated with Messenger STS when compared to untreated control plants. Activated genes that are considered vital in cell growth and plant development, can be classified as follows: cell wall expansion and modification related genes, cell elongation genes, protein and sugar transport genes, reproductive and development related genes including genes involved in flower initiation, fruit set and size

Growth Responses Derive from Improved Photosynthesis and Nutrient Uptake

In greenhouse experiments and field trials conducted by EDEN BIOSCIENCE®, Cornell University and other research organizations, Messenger STS significantly increased photosynthesis and nutrient uptake in plants. These increases are indicative of increased production of energy and more available nutrients, which are important for plant growth, development and fruiting. These are attributes that ultimately express value to growers by increasing yield (size and number of fruit), and fruit quality.

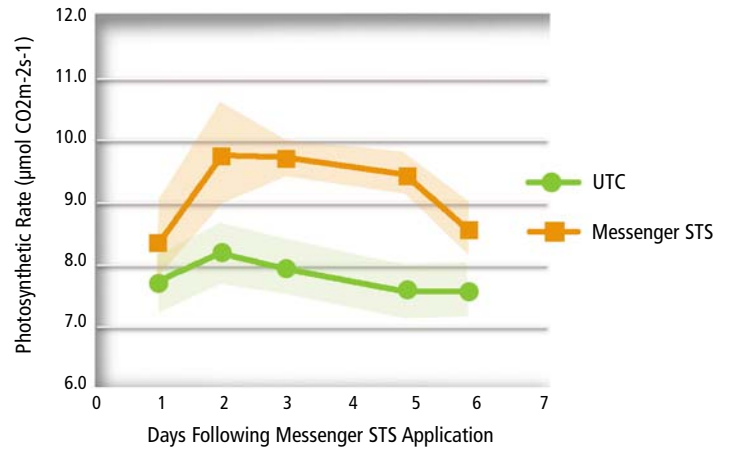


The discovery of harpin was published in the journal *Science* in 1992. The identification of the first proteinaceous hypersensitive response elicitor, harpin, was regarded as a significant discovery that merited publication in this top scientific journal.

Messenger STS Treatment of Tomato Plants

Results in Increased CO₂ Fixation. Three week old Marglobe tomato plants were sprayed with Messenger STS. Untreated controls (UTC) were kept separate during the application. Photosynthesis was measured with the Li-Cor LI 6400 over a period of 5 days after application. Photosynthetic rates were increased 19.8% after 1 day and 25.4% after 4 days when compared to the untreated control.

Similar results were observed in strawberry, table grapes and asparagus.



Stress-Defense Responses to Diseases and Soil-Borne Pests

Messenger STS treatments activate multiple stress tolerance and defense pathways within the plant thereby increasing the plant's natural ability to defend itself against certain viral, bacterial and fungal plant diseases, some of which have only poor chemical controls. The amount of enhanced disease suppression is related to the type, severity and duration of the disease. The stress-defense response also contributes to improved plant health. Healthier, plants treated with Messenger STS have also demonstrated better "tolerance" to nematodes in greenhouse and field trials.

Extended Shelf-life

Pre-harvest applications of Messenger STS have demonstrated benefits that last well past harvest. Post-harvest research on crops treated with Messenger STS has shown that Messenger STS can reduce the incidence as well as the severity of certain diseases such as *Penicillium* in citrus, and *Botrytis* and *Powdery Mildew* in strawberries. Extended post-harvest health is a result of the growth and stress-defense responses to Messenger STS.



Post harvest research conducted by Dr Glenn Wright, University of Arizona, demonstrates Messenger's ability to extend post harvest fruit quality. The trees were treated with Messenger 9.0 oz. per acre 7 days prior to harvest. These photos were taken from Dr. Wright's research 6 weeks after harvest.

Worker Safety

Messenger STS exhibits virtually no acute toxicity to mammals by any route of exposure and is classified as a Toxicity Category IV product (EPA's lowest hazard rating) with the EPA signal word "Caution." Messenger STS can be mixed and applied safely with minimal protective clothing and qualifies for the EPA-minimum 4-hour restricted entry interval requirement for field workers. *HarpinEA*, the active ingredient in Messenger STS, is exempt from the requirement of a tolerance on all food crops.

Acute Toxicity Test Results (MessengerSTS)

Acute Oral LD50 (Rat)	>5,000 mg/kg
Acute Dermal LD50 (Rat)	>6,000 mg/kg
Acute Inhalation LC50 (Rat)	>2 mg/L
Skin Irritation (Rabbit)	Nonirritating
Eye Irritation (Rabbit)	Nonirritating

Environmental Fate

Messenger STS is non-persistent and does not accumulate in the environment. After application, the material degrades rapidly by natural sunlight and by microorganisms in the soil and on plants. At normal use rates, harpin protein is not detectable on plants or in the soil. Messenger STS poses no threat to ground water or surface-water contamination.

Environmental Safety

Messenger STS is EPA-classified as practically nontoxic to all species tested: birds, honeybees, fish and aquatic invertebrates.

Messenger STS exhibited no phytotoxicity to plants in seedling germination and emergence studies. No phytotoxicity has been observed in field trials with plants treated with Messenger STS. No restrictive use labeling is necessary to protect non-target organisms and sensitive habitats.

Test Organism Test Results (MessengerSTS)

Bobwhite Quail (Dietary)	LC50>100,000 ppm
Bobwhite Quail (Acute Oral)	LD50>4,000 mg/kg
Honeybee	LD50>1,258 ug/bee
Plants	No Phytotoxicity
Rainbow Trout	LC50>3,720 mg/L
Daphnia magna	EC50>1,173 mg/L
Algae	EC50>182 mg/L

Summary

Messenger STS holds tremendous promise for boosting agricultural production worldwide. It is a protein-based, biodegradable plant health regulator that stimulates the plant's innate ability to protect itself and regulate its own health, allowing for maximum increased plant growth and reproduction. Crops treated with Messenger STS are healthier, have increased stamina, and are better able to defend against outside stresses. In addition, Messenger STS activates certain growth mechanisms that increase plant vigor and contribute to overall plant health. This reinforcing circle of plant health leads to improved yields, fruit quality and extended shelflife.

Use Advisories

- Do not use Messenger STS in water or tank mixes with pH below 5 or above 10, or with strong oxidizing agents.
- Once Messenger STS has been mixed with water, use within 8 hours.
- Reseal opened packages to minimize exposure to air and moisture. Use opened packages within three weeks.
- Messenger STS is rainfast within 30 minutes or once the spray residue has dried.

References

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