

Strawberry Crop Recommendation

By Evergreen Growers Supply, LLC

OVERVIEW

People have eaten strawberries for hundreds of years and today they remain one of the most popular fruits around the world. Strawberries are grown throughout the temperate Northern Hemisphere from coastal fields in Florida to glasshouses in Finland. No matter where they are grown, it's not just people who enjoy strawberries, but unfortunately so do many pests like aphids, spider mites, and thrips. Growers must maintain a high level of control of these pests if they want to protect their crop. Some insects physically attack the fruit while others leave a lasting impact on plant vigor. Control of insect pests on strawberries has been very successful in recent years primarily due to the use of fresh, aggressive beneficial insects. These biological controls are capable of acting preventatively as generalist mites, feeding on multiple prey and pollen.

OUTDOOR STRAWBERRY CROP PESTS

STRAWBERRY ROOT WEEVIL (*Otiorhynchus ovatus*)

Many pest mites that target strawberries have the ability to live through the winter months. The strawberry root weevil, for instance, is capable of overwintering. These pest mites can be controlled and eliminated by applying *Stratiolaelaps scimitus*. Growers should increase the application rate in areas with a history of spider mite or root weevil infestation. *Stratiolaelaps* can be applied at any time, although it is best to do it when the field is first planted out. This beneficial insect will also overwinter and provide continuous control for many years. We can consult about application rates and timing according to your pest pressure and budget.

SPIDER MITES

Spider mite control can be achieved by introducing *Amblyseius fallacis* ("fallacis") in the early spring, after the last frost. The general recommendation is to apply fallacis at a rate of 10,000 per acre. If a second introduction is necessary, growers should plan to apply it during the late season. Fallacis is most affective after picking has stopped. This insect overwinters and returns in increasing numbers each year until the crop is pulled out of the ground. Fallacis can be very economical for growers because usually only one application is needed. By the second year of

production, root weevil and spider mite problems should be minimized or eliminated due to the persistence of *Stratiolaelaps* and fallacis.

One weakness of all generalist mite predators, including fallacis, is that they cannot tolerate webbing. If the weather turns hot and dry, there is a rapid increase in the potential for a runaway spider mite infestation. Major problems should be controlled immediately by using *Phytoseiulus persimilis* ("persimilis"). Be sure to fully contain the outbreak site by making sure the site is treated in a large enough radius. Persimilis is a tropical mite and will only feed on pest mites. It will not keep working after the pest mites have been eliminated or after a significant frost. They are only capable of surviving winters in mild, coastal climates. Fallacis and persimilis work extremely well together, often balancing each other at a 1 to 1 ratio. Fallacis is also very resistant to organophosphate insecticides and miticides, so it will persist even in an aggressively sprayed crop.

Stethorus punctillum is a small black beetle that thrives in a low humidity environment. If growers are unable to manage the climate effectively and the spider mite conditions are extreme, *Stethorus* could save the crop. It should be applied at a rate of 0.1 per square foot in extreme cases, or in moderate cases, at a rate of 0.01 per square foot.



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These beetles find spider mites by smell and quickly move to new infestations, leaving behind their eggs and larvae to finish the job. One advantage of *Stethorus* is that that can fly plant to plant. They are sensitive to insecticides/miticides.

Another option to help prevent these pests is Met52 EC. This contact bioinsecticide utilizes a pathogenic fungus in an emulsifiable oil for the effective control of spider mites, thrips and more. For best results, Met52 should be applied in early stages of population development. Met52 product efficacy is impacted by coverage and the application frequency is influenced by the environment, the manner of application (foliar or drench), and the population of the target pest.

PFR 97 Microbial Insecticide can also be used to combat spider mites. Preferal™ is a naturally-occurring fungus that infects both foliage and soil dwelling insects such as spider mites, whiteflies, aphids, thrips, and other pests. The best results can be obtained by using PFR 97 in an Integrated Pest Management Program, which includes scouting, monitoring (e.g. yellow sticky cards) and early detection and correct identification of target insects. Monitoring of pest pressure is critical to the effective use of PFR 97. Efficacy results from germination and growth of the beneficial fungus over several days, so applications should start before pest numbers have reached crisis levels. PFR 97 is most effective when application is initiated just before or at the first signs that target pests are present.

****Please read product labels carefully before using. Please use caution and always use products according to safety and legal guidelines.***

WHITEFLY

Whiteflies are not a common pest for outdoor strawberries, but they can become a problem in some situations. Field releases of the predatory beetle *Delphastus catalinae* can be very successful at treating a whitefly problem. *Delphastus* will stay in a crop as long as whiteflies are present. The larvae and the adults are all aggressive predators preferring eggs, but are capable of feeding on all life stages including the adult whitefly. Being aware

of nearby vegetation that may be a host of whitefly may help in anticipating waves of attack, and could be an excellent point of biological control.

APHIDS

Aphids are very attracted to strawberries and are documented virus carriers. Though aphids can be difficult to manage, we recommend resisting the use of chemical spray programs. These products do not ensure eradication and have been known to kill and repel native beneficial insects. This can actually make the elimination of pests more difficult. Preventatively releasing *Aphidoletes aphidimyza* can be a good way to keep aphids from becoming a problem.

Aphid hot spots should be treated with a direct application of *Aphidoletes*. Preventative releases of 2,000 to 3,000 per acre, per week should be enough to successfully locate all aphid clusters. *Aphidoletes* are excellent flyers and have a highly tuned ability to find an aphid by the scent of its honeydew. Releases should be made at dusk, after the thermal winds have died down or before the evening thermal winds have started, depending on the local conditions. *Aphidoletes* will cycle within the crop and overwinter in any climate. Their effectiveness dramatically decreased in the fall when the larvae are beginning to diapause.

When aphid populations are high, *Aphidius colemani* (or *Aphidius matricariae* if the issue is green peach aphid) work well alongside *Aphidoletes*. *Aphidius* species are a group of native parasitic wasps frequently found parasitizing aphids in greenhouses and outdoor crops. Adults are very small dark-colored wasps that do not sting. The larvae develop entirely inside the host aphid, which eventually become rigid mummies when the larvae pupate. *Aphidius* is an outstanding searcher, and can locate new aphid colonies even when aphid populations are low.

THRIPS

Thrips are tiny, slender insects capable of limited flight and cause damage similar to that of spider mites. Thrips will come and go as they please in an outdoor strawberry crop. The presence of *Stratiolaelaps* in the soil will prevent soil pupating thrips from maturing. *Stratiolaelaps* will feed directly



on the pupating thrips by swarming it. The presence of fallacis in the crop will help control the first and second instar of the thrips to some extent if it is not overwhelmed by spider mites.

The predatory mite *Amblyseius cucumeris* (“cucumeris”) is the best biological control to combat thrips. These mites attack the first and second instar larvae. If enough cucumeris are present they are extremely effective. Cucumeris sense the thrips emerging from the leaf, wait for them to stick their heads out, and then bite them off.

Other options for thrips control are Met52 or *Steinernema feltiae*. For help controlling thrips populations either the Granular or EC formulation of Met52 is suitable (see previous section on spider mites for more information about this product.) *Steinernema feltiae* is a beneficial nematode product that helps provide biological control of western flower thrips. Beneficial nematodes (*Steinernema feltiae*) are microscopic worms that attack and kill targeted insects without affecting any other organisms. Within the infected insect, the beneficial nematodes continually reproduce and then spread out for long-term control. When applied to the soil, *Steinernema feltiae* will provide prolonged protection against pest re-infestation. It should be applied at a rate of 50 million per 1,000 square feet.

INDOOR PRODUCTION

FUNGUS GNATS

When producing strawberries indoors, the risk of a fungus gnat infestation goes up. When the plants are being set out, apply *Stratiolaelaps* as evenly as possible. These general predator mites will go after fungus gnats in the soil. We can discuss rates with you based on your current situation.

Within 10 days, of applying *Stratiolaelaps*, consider implementing *Steinernema feltiae*. This beneficial nematode product can be very successfully in providing biological control of fungus gnats. The nematodes will help control any fungus gnats that may be getting started and will feed the *Stratiolaelaps*, allowing them to disperse and reproduce.

SPIDER MITES

To prevent and treat pest problems effectively, it's critical to work in a clean greenhouse. Pest problems from previous years will not disappear without management and effort. If a greenhouse has a history of spider mites, it's more than likely that they will return. Before introducing the strawberry plants into the greenhouse, apply *Stratiolaelaps* to the interface between the floor and the posts and walls, as this is where the spider mites may be hibernating. About 15 to 25 ml at each post and a similar concentration along the walls will help control the return of the mites.

Growers should also start using monitoring and banker plants during this setting out stage. For spider mites, we recommend using bush beans. ‘Strike’ and ‘Provider’ are the two best varieties. Before the strawberries are planted, the beans will attract many pests that were missed in the initial clean up. During the production phase, the bush bean seeds should be planted at the base of every support pole. They will show spider mite damage very quickly and hold the emerging spider mites back from the strawberry crop. The infested bean plants can then be carefully removed and replaced. They could even be used as banking plants by applying persimilis.

At first flower, apply fallacis at a rate of 5 per plant. The fallacis will establish on the plant with pollen and will control any spider mites that move onto plants. The fallacis will also help control whiteflies thrips by eating their eggs and larvae.

If there is no history of spider mites in the house, fallacis and persimilis could be enough to control the pests. If growers find that they have an established spider mite issue, *Galendromus occidentalis* (“occidentalis”) could be another option. This beneficial insect feeds primarily on spider mite nymphs and adults, but not eggs. Occidentalis is a very versatile predatory mite and tolerates high temperatures and low humidity well. This biological control is recommended for greenhouses with a relative humidity of 40% or less. It is native to California and has been used to control spider mites, two spotted mites, russet mites, and others. Adults eat 1 to 3 pest adults or up to 6 pest eggs per day. Apply occidentalis upon



arrival, at a rate of 2 to 3 per square foot, bi-weekly, 1-2 applications. Occidentalis needs at least 11 hours of daylight.

Mesosiulus longipes (“longipes”) is similar to persimilis, but can tolerate lower humidity. The optimum conditions for. These predators require higher humidity as the temperature increases. Longipes are most effective in warm greenhouses or interiorscapes with artificial lighting. Release longipes at a rate of 3 per square foot, once a week, 1 to 2 times.

Another predatory mite that works best when used preventatively against spider mites is *Neoseiulus californicus* (“californicus”). Growers will see best results when californicus can build up before the spider mite populations are able to establish themselves. Californicus is tolerant of various temperatures and low humidity, but works best under warm to hot conditions. It tolerates higher temperatures and lower humidity than persimilis. When pest populations are low, californicus will feed on pollen which keeps predatory populations around the crop. While some predators will actively seek out new prey in the absence of food, most will stay on the crop and wait for the arrival of new pests.

Amblyseius andersoni (“andersoni”) is another predatory mite that can be used to control spider mites and a range of other mite pests. For best results, growers should apply andersoni when pest mite numbers are low. The predatory mites will then be able to feed on small colonies of mites and prevent them from growing and causing major damage.

APHIDS

To prevent aphids on an indoor strawberry crop, growers should use *Aphidoletes*. We recommend releasing 0.2 to 0.5 *Aphidoletes* per 10 square feet, per week. The essential steps toward prevention include weekly releases, separate “hot spot” treatments, and a neutral release point. The best time for release is at the end of the day. If the circulating fans cannot be turned off on the night of release, make sure to release the *Aphidoletes* downwind of the fans so they aren’t sucked into the fans.

WHITEFLY

A few days before the plants arrive, place any clean plant (even a house plant) in the greenhouse to see if any whiteflies have survived. If any whiteflies are attracted to the plant, use a small, handheld vacuum to remove the pest on a daily basis. Freeze the vacuum overnight before dumping the dead whiteflies.

Persistent problems with whiteflies can be managed with *Encarsia*. A general application rate is 2 per 10 square feet, per week. Consider adding monitoring eggplants into the house. High numbers of whitefly adults can be stripped out of the house by vacuuming the eggplants daily.

In the same family as *Encarsia*, *Eretmocerus eremicus* can also be used to control a whitefly problem for indoor strawberry production. *Eretmocerus* originates in the desert regions of Arizona and California and is able to tolerate higher temperatures than *Encarsia*, but can be used together to control silverleaf and greenhouse whiteflies. *Eretmocerus* controls whiteflies by parasitizing whitefly larvae.

THRIPS


While it is likely a few thrips will enter the greenhouse during indoor strawberry production, using the right biological controls will keep them from being a problem. The presence of *Stratiolaelaps* in the soil will prevent soil pupating thrips from maturing. The presence of fallacis in the crop will help control the first and second instar of the thrips to some extent, if it is not overwhelmed by spider mites.

Cucumeris is the best biological control to combat thrips and should be very effective for both the indoor or outdoor strawberry crop. (see the previous section on thrips for more information)

CYCLAMEN MITES

In recent years, indoor strawberry producers have been reporting more issues with cyclamen mites. These pests are almost exclusively found on indoor crops. Unfortunately, symptoms from these mites don’t usually show up until after plants have matured. For that reason, the number one defense against them is prevention.





Fallacis should be used to prevent cyclamen mites from establishing populations within the crop. As soon as true leaves are present, apply fallacis at a rate of 2 mites per square foot. If there is a history of cyclamen mites, immediately double the rate of fallacis.

While cucumeris is typically used to control thrips, it can also be used as a preventative measure against the immature stage of cyclamen mites. Californicus is a general mite predator that can also be used preventatively against these mites.

If growers find that they have an established cyclamen mite issue the general predatory mite occidentalis is a good option. Occidentalis is a very versatile and will primarily target the mites as adults.

Ambyseius swirskii (“swirskii”) are a good option for warmer growing areas as swirskii become inactive when temperatures drop below 59°F. The mites feed by piercing small arthropod prey or grains of pollen with their mouthparts, and draining the contents.

Met52 EC and PFR 97 Microbial Insecticide can also be used to combat cyclamen mites (see the previous section on spider mites for more information about these products).

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