

Cucumber Crop Recommendation

By Applied Bio-nomics Ltd.

OVERVIEW:

Few crops are as attractive to pests as Cucumber. Fortunately, most of the beneficial insects are also fond of Cucumber. From a biological control point of view, the major issues are: continuous cropping (possibly carrying over pests), high-wire (hard to monitor and close to high energy lights), high frequency of traffic (increases likelihood of pest movement), high susceptibility to thrips attack, lack of pollen and high frequency of fungicide application. As always, the movement of people in the greenhouse is a major form of dispersal of the crawling pests, such as spider mites. Whenever possible, restrict the movement of people in known hot spots. Enter the hot spots last and then directly leave. Coveralls should be frozen overnight or washed each day, especially for the people that worked in a known infested area.

PRIOR TO PLANTING OUT

Thoroughly clean the growing area, including walls, floors, posts, wires, etc, with soap or bleach. Whitefly and aphids will persist in cool greenhouses for well over 1 month without any plant material available, but they will be killed with a thorough cleanup.

Before placing the plants in the house, place some “test” plants in the middle of the house and in areas that had a history of pests. The best “test” plant we have seen is the Bush Bean. The Bush Bean is extremely attractive to spider mites, whitefly and thrips. They can easily be grown in a small pot, and are ready to go within 5 days from planting, once the first true leaves are out. This plant will either confirm that you did a good clean-up, or it will show you that you have to effectively clean-up again. If you don’t have time to do a better clean-up, at least you are now aware of the pest load and can establish an appropriate level of beneficials right at the start.

If the house has a history of spider mites, they will be hiding in the ground around the posts and the walls. An introduction of *Stratiolaelaps scimitus* (250 mites per 10 square feet) at each post and along the walls will help kill the over-wintering spider mites.

Discuss with the propagator the presence of pests. Ensure that your plants are clean because of good pest management practices and not because of a chemical

insecticide. If an insecticide is used, get all of the details such as rate and date, as well as method of application.

AT PLANTING OUT

Apply *Stratiolaelaps* at a rate of 50 to 100 per 10 square feet. Lower rates can be used on new rockwool or other substrates, but care must be taken to ensure that the *Stratiolaelaps* is thoroughly mixed. It can be diluted with sawdust or vermiculite but it is difficult to maintain an even distribution immediately after the mixing. Skipping plants can work in clean houses, as the *Stratiolaelaps* will disperse themselves quite well.

Apply *Encarsia* at a rate of 0.5 per 10 square feet if no whitefly is detected. When there is 1-2 whitefly per yellow card per week, increase rate to 1 per 10 square feet. See below: Whitefly Strategy Overview.

AT FIRST FLOWER (WEEK 2-8)

Apply “20 to 1” *P. persimilis* at a rate of 1 leaf per plant. This should be done over a number of weeks. The “20 to 1” *P. persimilis* is harvested from our rearing system at an earlier date so that the ratio of spider mites to persimilis is 20 to 1. We have found that this ratio is ideal for establishing a stable balance of predators and prey. On applications in Holland, we have had numerous years where this single application has been effective for the entire year. See below: Spider Mite Strategy Overview.

Apply *Aphidoletes aphidimyza* at a rate of 1000 per acre per week. The release points must be neutral, away from



any known aphids. Any aphid hot spots should be treated with a direct application of *Aphidoletes* or *Aphidius matricariae* (if green peach aphid) at a rate of 1 *Aphidoletes* to 10 aphids. See below: Aphid Strategy Overview.

If whitefly are present at any level, apply *Delphastus catalinae* at a rate of 0.25 per 10 square feet. Any count over 2 whitefly per week is a serious infestation and should be countered by increasing the rates to 4 per 10 square feet for *Encarsia*. See below: Whitefly Strategy Overview.

EARLY SEASON

Watch for the return of the spider mites. *P. persimilis* tend to move in an upward pattern once they have cleaned up the leaf they were placed on. As a result, care should be taken when placing out the predators. Predatory mites should be placed directly at the major point of infestation and above and surrounding the site on High Wire Systems. Spider mites below your application site have a high likelihood of escape unless you spread out your attack. Always treat the surrounding plants that don't have any apparent damage, at least 2 deep, because these plants usually already have some spider mites on them. Failure to contain the site will have you chasing spider mites for the entire season and spending a lot of money. See below: Spider Mite Strategy Overview.

Prevention of thrips attack is multi-pronged. A. *cucumeris* should be applied to each plant over a period of 5 weeks. This can be accomplished by either applying a slow-release packet on every 5th plant each week, or by sprinkling bulk *cucumeris* over the entire area at a rate of 50 to 250 mites per 10 square feet, depending on the thrips pressure. The presence of *Stratiolaelaps* in the root zone will help prevent soil-pupating thrips such as western flower thrips (WFT) from cycling in the house. Once thrips are detected, *cucumeris* should be reapplied every 2 to 3 weeks at a rate of 200 to 500 per 10 square feet. Blue or yellow sticky cards are effective at stripping the adults out of the house if they are laced with vanilla or almond extract. Place a cotton ball on the cards to hold the vanilla and/or almond. Sticky cards need to be placed at the same level as the flowers to maximize capture.

Whitefly must never be given a chance to increase. A count of over 2 whitefly per week on the yellow sticky

cards should be reacted to immediately. Rates of *Encarsia* should go up to 6 per 10 square feet per week and *Delphastus* should be introduced at a minimum of 0.1 per 10 square feet every two weeks, until the counts are brought back in line. Once the leaves become sticky with honeydew, the parasitoids movement becomes impaired. *Delphastus* releases should be increased up to .5 per 10 square feet if control is at stake. The use of eggplant, strategically located along the aisles at a rate of 4 to 6 per 2 acres, will help draw the whitefly out of the crop. The eggplant is preferred by the whitefly and can be used to trap, which can be a very effective banker system. High levels of whitefly on the eggplant should be vacuumed off, taking care to freeze the vacuum bag to kill the whitefly. A daily vacuuming of the eggplant can strip a significant number of whitefly adults out of the crop. *Cucumeris*, *Delphastus* and *Encarsia* should be introduced to the eggplant, as it will become a nursery for the beneficials. The presence of the thrips predators in the crop will also help with whitefly control, as they will feed on whitefly eggs and larvae. *Aphidoletes* also feed on whitefly larvae when they are starving for aphids. See below: Whitefly Strategy Overview.

Watch for aphids entering the house. Rates of the preventative release should increase to 1500 per acre per week, as the crop is now much larger. Hot spots should be directly attacked with releases of adult *Aphidoletes*, but control of the melon aphid will only occur by prevention, as the melon aphid reproduces and disperses faster than the biocontrols can handle. For major infestations, rates of 3000 per acre per week should be neutrally released until the numbers are back in manageable levels. In order to achieve quick recovery, the ratio of *Aphidoletes* to aphids must be in the order of 1 to 100. This could require extremely large numbers of *Aphidoletes* for a quick cure or a longer time frame for recovery. All species of aphids are controlled by *Aphidoletes*. *Aphidius matricariae* will easily control and cycle with green peach aphid. Because of the intra-guild predation of *Aphidoletes* eggs by *A. swirski*, we do not recommend it if the melon aphid is considered a significant pest.

MAIN SEASON

Spider mites should be surrounded by *P. persimilis*. The treated area should be the hot spot and then two more unaffected plants, as the spider mites are probably on these unaffected plants. The *persimilis* should be placed high on the treated plants as they will be forced to



disperse throughout the entire plant. A ratio of 1 *Persimilis* to 100 spider mites will achieve control in 2 weeks. A typical attack on a single plant hot spot would be 1000 *Persimilis* on the affected plant, 500 *Persimilis* on the immediate adjacent plants, and 200 *Persimilis* on all of the plants within the treatment circle. The hot spot should be flagged and traffic should be diverted. As the humidity drops in the house, the volunteering *Feltiella* will disappear. Hot spots will flare up more frequently due to the decline in the flying predators. *Stethorus punctillum* should be released at a rate of 0.1 per 10 square feet every 2 weeks. The *Stethorus* are not intimidated by low humidity and high temperatures, and will easily be seen feeding on the dome of the plants. See below: Spider Mite Strategy Overview.

Whitefly should be under control based on the preventative releases. Any weekly count of over 2 whitefly per card should immediately be responded to by doubling the rate of *Encarsia*. *Delphastus* will remove very large numbers of whitefly eggs and can be used to reduce outbreaks. If Bemisia are present, *Delphastus* should be released every two weeks at a rate of 0.1 to 1 per 10 square feet, depending on level of infestation. In extremely hot situations (over 86° F), whitefly adults will only live for a few days (instead of months) and will not lay eggs. See below: Whitefly Strategy Overview.

Aphid control should shift entirely to *Aphidoletes*, as *Aphidius* will now be infested with hyperparasites. Any aphid banking system should be converted to *Aphidoletes* by introducing it directly onto the bankers. Please note that we do not recommend any Aphid Banking System. See below: Aphid Strategy Overview.

LATE SEASON

This is the most important time of the year for spider mites. What you do at this time will determine how bad the next year will be. Every effort should be made to eliminate all of the spider mites before the beginning of September. Once the day-length begins to noticeably decrease and the evening temperatures drop, the spider mites begin diapausing. In a diapause state, spider mites are more resistant to chemicals and are not as attractive to the beneficials. If chemicals should be used, it would be at this time.

If the whitefly is not in good control, it will begin to run away in the fall. Adding trap eggplants will help if the plants are vacuumed daily. Adding parasites beyond 6

per 10 square feet will have very little effect, as there are just too many whitefly and the stickiness of the honeydew will begin to impair the movement of all of the parasitoids. *Delphastus* will continue to work at very high whitefly densities but their impact will not be quickly seen, as they will graze on the eggs and the adult whitefly will live on for months.

Aphids must be in good control going into the fall as the *Aphidoletes* will stop cycling due to diapause. Preventative releases will still work, as they are not being asked to cycle. *Aphidius* can work very well in the fall, especially if they were not used in the summer, reducing the pressure of the hyperparasites. Turning on walkway lights, or adding a string of LED lights will help *Aphidoletes* overcome the winter diapause.

SPIDER MITE STRATEGY OVERVIEW

Cleanup is essential. Physical spraying and *Stratiolaelaps* will have extremely high returns on investment. Cleanup must occur before the fall weather becomes apparent. Once spider mites begin developing the “red phase”, they will become unattractive to the predatory mites and more resistant to the chemical sprays.

Spider mites love cucumbers. The fast growing plants help displace the wandering spider mites away from their predators. Frequent animal traffic assists in the dispersal. Whenever possible, have the staff avoid the known hot spots until the end of a shift. The coveralls of every worker should be washed or frozen every night in order to minimize dispersal of the spider mites.

Fans should be carefully directed so that they achieve the desired effect but don't blow directly onto the plants. Increased air movement lowers the humidity at the leaf surface, chasing away the predators. The result is that the spider mites will enjoy a predator free area that will lead to plant death and an out of control hot spot.

P. persimilis is still the main beneficial. The leaf product will work about twice as fast and with half the inoculum compared to the product in a granular carrier. Our growers have found that releasing the *Persimilis* above the infestation will improve the arrest of spread, as it will disperse better on the plant. During hot weather, the *Persimilis* will avoid the exposed tops of the plants in order to prevent themselves from drying out. *Stethorus* will quickly move into the exposed tops of the



plants and feed on a tremendous number of spider mites, but must be applied before the plants are damaged, as the damage is permanent and will reduce the humidity so that the *persimilis* will still avoid the area after it has moved down into the canopy. Therefore, prevention and preventative control is the key to spider mite management. The “20 to 1” introductions early in the year are very effective in preventing run-away infestations.

WHITEFLY STRATEGY OVERVIEW

Whitefly is an insidious pest. Low numbers can give the grower a false sense of security. The longevity and fecundity of the whitefly can lead to overwhelming situations very quickly. The only sure way to control whitefly is to start clean and prevent any significant buildup.

Weekly releases of preventative *Encarsia* must be considered similar to an insurance policy. *Encarsia* will reduce the weekly cost by allowing you to use very low rates (as low as 0.5 per 10 square feet). Fresh *Encarsia* live longer, fly farther, and are actually smarter than refrigerated *Encarsia*. All of Applied’s *Encarsia* are held above 52° F and are never refrigerated. *Encarsia* is guaranteed to be no older than 48 hours from harvest.

Using eggplant as a trap/banker can be very effective, although in our experience, *Encarsia*, starting clean, will be all you need. Whitefly has a very advanced sense of smell and will move onto the eggplant in a very profound way.

If bemsia have established, parasitoids are at a disadvantage because they are all reared on greenhouse whitefly and parasitoids always work best on their established host. All parasitoids will adapt to bemsia and will all host feed aggressively. The use of *Delphastus* will have a major impact on bemsia, and, if started early, will eliminate the bemsia before they move on to the greenhouse whitefly. Bemsia are much harder to monitor because they don’t evenly distribute themselves the way greenhouse whitefly does.

THRIPS STRATEGY OVERVIEW

The fact that cucumbers do not produce pollen is a major reason why thrips are a major pest. The “slow-release” bag was created specifically for the cucumber so that *cucumeris* could continuously be generated and move out onto the plant. The *cucumeris*, however, can only

feed on the early instar thrips. The eggs of the thrips are injected into the plant tissue, making them unavailable to predators. For many thrips, pupation is away from the plant, further impairing the predator’s ability to gain the upper hand. Adult thrips are rapid movers and capable of flight. Therefore, *cucumeris* needs help. *Stratiolaelaps* at the pupating site will help prevent the thrips from successfully cycling in the house. *Orius* are aggressive predators and will feed on all mobile stages of thrips as well as loopers, aphids, and whitefly; but are expensive and will leave the house if conditions are not to their liking.

Major inflows of thrips occur when they are disturbed from their outside habitat. Develop a communication with local farmers so that you are aware when they are about to harvest or mow their crop of alfalfa or hay. Unfortunately, they usually only mow on a sunny day, which means the wind will be up and the vents will be open, but reducing the opening gap and duration can have a significant reduction in the number of thrips that will move into the house.

The use of blue sticky cards help track the arrival of thrips because only thrips like blue, to a significant level. The incorporation of vanilla or almond extract to the traps will increase the trapping of the adults and can have a control effect.

Plants such as fennel or sunflower will give the thrips a sweeter alternative to cucumber flowers and will concentrate the *Orius* with the thrips. They will also attract local *Orius* species from outside, into the house.

APHID STRATEGY OVERVIEW

In recent years, the range and species of pest aphids has dramatically increased. Regular, low releases of *Aphidoletes* will prevent the establishment of all species of aphids. A rate of 1000 per acre per week will protect the crop from aphids.

