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2016 Crop Recommendations
Herbs/Perennials/Bedding Plants

Overview:

Biological control of pests in Herb and Perennial crops requires a change in thinking for the grower as well as the supplier of the products. The old concept of maintaining a balance of pests and predators/parasitoids does not work in a crop where any insect or mite found on the plants is a negative.

At Applied Bio-nomics we have found that fresh beneficial insects and mites perform better and faster. We have, as a result, eliminated the storage of all of our products. These "fresh" products fly farther, live longer, lay more eggs, and are actually smarter than the stored product available elsewhere. The result is that "fresh" beneficials are capable of prevention of pests at low, regular introductions.

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 over-night or washed each day, especially for the people that worked in a known infested area.

In a mono-culture, such as a Sweet Pepper house, it is easy to introduce a monitoring/trap/banker plant, such as Eggplant or Bush Bean that is universally, more attractive to the pests than the main crop. With Bedding Plant, Herbs and Perennials, you will find that certain plants and even cultivars will become the target of certain pests and sometimes, only at certain times of the season. That being said, Eggplants and Beans still perform well and will help with most crops and at most times of the seasons. By keeping a diary, of when and where pests show up, you will be able to target your releases and time them more accurately.

In the past few years, we have focused on using Bush Beans as first, Monitoring Plants, then becoming Trapping Plants and ultimately, Banking Plants. Bush Beans are cheap, fast growing and extremely attractive to Spider Mites, Thrips and Whitefly.

Prior to Planting Out:

The house should be thoroughly cleaned. Walls, floors, posts, wires etc should be washed with soap or another suitable cleaning product. 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.

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*, formerly known as *Hypoaspis miles* (25 mites per square foot, more if high levels of spider mites were present) at each post and along the walls will help kill the overwintering spider mites.

At least one week before a house is filled with plants, one or more bean plants should be placed in the house. Within 24 hours you will see how effective your clean-up actually was. Thrips, whitefly and spider mite will find the bean plant irresistible. The plant should be either carefully removed, if it is over-whelmed with pests, or inoculated with the appropriate biological control if just a low level is detected.

At Planting Out:

Because fungus gnats can have a significant impact on the rate of growth of your plants, it is essential that they are controlled immediately. Apply *Stratiolaelaps scimitus* or *Gaeolaelaps*

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gillespiei, if allowed (subsequently referring to both as *Ss*) at a rate of 250 mites per square meter. Skipping plants can work in clean houses, as the *Ss* will disperse themselves quite well. Within one week apply nematodes at the recommended rate if growing wet, or if the media supports Fungus Gnats. This application will have two effects; first, they will kill some of the fungus gnats and second, they will act as a food source for the *Ss*, which will help them disperse into the entire crop and establish. If there is a very high count of fungus gnats you should consider altering the soil mix slightly, as even subtle variations in the soil mix will have significant impact on whether or not the fungus gnats will explode in population. Raw potato slices (or frozen French Fries) should be used to monitor the relative numbers and stages of the fungus gnat larvae. Try placing a slice of potato on the soil surface for a known time (usually overnight). The fungus gnat larvae are attracted to the potato and, when lifted, will give you a relative count. Repeated monitoring for the same duration of exposure will give you an indication whether the problem is getting better or worse. If the soil is loose, *Atheta coriaria*, the Rove beetle should also be applied at 0.1 to 1.0 per square meter, just once.

Apply *Encarsia* ***Max*** at a rate of 0.25 per square meter if no whitefly is detected. At one to two whitefly per yellow card per week increase rate to 1 per square meter. See below; Whitefly Strategy Overview.

Strategically placed Bean plants can have a dramatic effect on the management of Spider Mite. The Bean plants should be placed amongst any crop that is susceptible at a rate of 1 plant per 10 square meters, and in areas that have a history of Spider mite, as well as any obvious areas such as near heating pipes, perimeter walls, walkways etc. The Beans will not only provide an "early warning system" showing damage only 1 or 2 days into infestation, but they can also pull Spider Mite away from your crop.

Early Season:

Spider mites should be watched carefully, as the damage is permanent. Preventative releases of *Neoseiulus fallacis* in the granular carrier should be made as soon as the first true leaves appear, at a rate of 2 mites per square meter on susceptible plants. The beans will attract the spider mites and show damage very quickly, which will help with monitoring. Once spider mites are present, apply *P. persimilis* to the beans at an approximate ratio of 1 to 100. The bush beans will become bankers, releasing persimilis up, onto the tables for as long as the spider mites survive. In most cases, this will be a long time, as the spider mites come out of hibernation over a very long period of time. Bean leaves that display a ratio of 1 to 10 (*persimilis* to spider mites) can be used to treat remote infestations.

Whitefly must never be given a chance to increase. A count of over 2 whiteflys per week on the yellow sticky cards should be reacted to immediately. Rates of *Encarsia* ***Max*** should go up to 2 per square meter per week and *Delphastus catalinae* should be introduced at a minimum of 100 per hectare 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 5,000 per hectare if control is at stake. The use of Eggplant or Bush beans, strategically located along the aisles at a rate of 4 to 6 per hectare, will help draw the whitefly out of the crop. High levels of whitefly on the trap plants should be vacuumed off, taking care to freeze the vacuum bag to kill the whitefly. A daily vacuuming of the trap plants can strip a significant number of whitefly adults out of the crop. *Aphidoletes* also feeds on whitefly larvae when they are starving for aphids. See below; Whitefly Strategy Overview.

With the occurrence of the Foxglove Aphid, ornamentals are now very vulnerable to serious economic damage. *Aphidoletes aphidimyza* is a very effective predator and preventer of the Foxglove if the Green Peach Aphid is controlled. *Aa* prefers the Green Peach aphid. If high levels of Green Peach are present, the Foxglove may be given a head start that will cause economic damage. Therefore, the objective is to thoroughly manage the Green Peach population at all times,

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forcing the *Aa* to go looking for the Foxglove. This is easily managed by weekly introductions of *Aa* at a rate of 6,000 per hectare. It is essential that the *Aa* be released from a neutral point (away from known Aphid hot spots), so, the simplest strategy is to release them from the same spot every week. If the average temperature is below 15 C, *Aa* must be supplemented with light. Even very dim light is all that is needed, as they tend to be active at dusk. A string of Christmas LED lights works well, or even just the walkway lights, left on. We are experimenting on directed light at hot spots. A simple clamp style of LED is showing considerable promise. In Canada, the Brown Lacewing, *Micromus variegatus*, is showing excellent promise as an early season aphid control, especially for the Foxglove Aphid. *Micromus* has the rare ability to cycle at temperatures down to 4 degrees C, making it an early season tool.

Thrips can be managed very well using flowering yellow Marigolds. The variety "Hero" was selected by Margaret Skinner and Michael Brownbridge in their research at the U of Vermont. You will find that for many crops, the Trapping Marigold will virtually eliminate Thrip pressure. The Marigolds should have *Ss* in the soil and *Nc* on the foliage. If Thrip pressure is extreme, the plants can be treated with Beauvaria. Yellow and Blue sticky traps are also very effective, provided that they are no higher than ½ an inch above the crop. In fact, we have found that the trapping of thrips increases as you approach the floor, so try your blue cards under the benches, keeping in mind that all of the trapping on the cards is visual, so, the cards must always be illuminated or facing South to reflect the sun. Thrips don't soar. Trapping on the cards can be greatly increased by sticking a cotton ball on them to hold a drop or two of Vanilla and/or Almond Extract. Plants that have Thrips on them should be treated by applying 100 to 500 *N. cucumeris* per square meter. The *Ss*, already in the soil will help to prevent the Thrips from cycling in the house. If the thrips are overwhelming, try filling a white pan with 1 inch of soapy water and add enough vanilla, or almond extract, or peppermint oil to make it attractive. The thrips will go to it, and sink, because of the soap.

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. Bean plants can be moved into the hot spots to dilute the attack and possibly pulling the pest. The *persimilis* should be placed low on the treated plants as they instinctively move upwards. A ratio of 1 *persimilis* to 100 spider mites will achieve control in 2 weeks. The hot spot should be flagged and traffic should be diverted. *Stethorus punctillum* should be released at a rate of 500 per hectare every 2 weeks. The *Stethorus* are not intimidated by low humidity and high temperature, making them very effective in hanging baskets. 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 catalinae* 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 1000 to 3000 per hectare, depending on level of infestation. In extremely hot situations (over 30 Celsius) 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 subjected to hyper-parasites. Any aphid banking system should be converted to *Aphidoletes* by introducing *Aphidoletes* directly onto the bankers. **Please note that we do not recommend any Aphid Banking System,** as they act as false targets and distract the searching of the *Aa*. See below; Aphid Strategy Overview.

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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 the whitefly is not in good control, it will begin to runaway in the fall. Adding trap ~~Egg~~plants will help if the plants are vacuumed daily. Adding parasites beyond 6 per square meter 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. Addition of supplemental lighting, such as leaving the walkway lights on, or stringing LED lights can have a very positive impact on *Aa* performance. Preventative releases will still work, as they are not being asked to cycle.

Spider Mite Strategy Overview:

Cleanup is essential. *Ss* will all have an extremely high return 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.

Beans. Try them. You will be amazed.

Frequent animal traffic assists in the dispersal of spider mites. 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 inoculums compared to the product in a granular carrier. 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.

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* ***Max*** will reduce the weekly cost by allowing you to use very low rates (as low as 0.25 per meter square). *Encarsia* ***Max*** live longer, fly farther, and are actually smarter than refrigerated *Encarsia*. All of Applied's *Encarsia* are held above 11 degrees Celcius and are never refrigerated. *Encarsia* ***Max*** is guaranteed to be no older than 48 hours from harvest.

Using Eggplant or bush beans as a trap/banker can be very effective, although, in our experience, *Encarsia* ***Max***, starting clean, will be all you need. Whitefly have a very advance sense of smell and will move onto the Eggplant in a very profound way.

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If *Bemisia* 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 *Bemisia* and will all host feed aggressively. The use of *Delphastus* will have a major impact on *Bemisia*, and, if started early, will eliminate the *Bemisia* before they move on to the Greenhouse whitefly. *Bemisia* are much harder to monitor because they don't evenly distribute themselves the way Greenhouse whitefly does.

Thrip Strategy Overview:

Prevention of thrips is impossible. They can penetrate any screen and will always get in. Monitoring is essential to determine when they first arrive. Yellow or blue sticky traps are preferable over waiting to see damage on the crop. The Bean plants will also help identifying when Thrips first arrive. Once thrips arrive, your response must be immediate and overwhelming. *N.cucumeris* should be applied at a rate of at least 10 mites per plant. They can be shaken out onto the crop from the bulk tube, scattered over the crop by using a hand spreader, puffed out over the crop by pouring the bulk product into a rose duster (the bran will stay behind) or blasted over the crop using a modified and governed Echo backpack leaf blower. The *cucumeris*, however, can only feed on the early instar thrips. The eggs of the thrip are injected into the plant tissue, making them unavailable to predators. For many thrips, pupation is away from the plant, further impairing the predators' ability to gain the upper hand. Adult thrips are rapid movers and capable of flight. Therefore *cucumeris* needs help. *Ss* at the pupating site will help prevent the thrip 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 helps track the arrival of thrips because only thrips like blue, to a significant level. The incorporation of vanilla to the traps will increase the trapping of the adults and can have a control effect.

The Marigold system can be extremely effective. It is a cheap and easy system that can have significant benefits for you. You should have a tray of Yellow Hero's being seeded every month.

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 3000 per hectare per week will protect most crops from aphids. Aphid hot spots must also be treated by direct release of *Aphidoletes.*

Some crops, like ornamental Pepper, are extremely attractive to aphids and should be monitored much more closely and maintained with at least double the regular rate of release of Aphidoletes, if any aphids are present.

Micromus variegatus is extremely effective in early season crops, when temperatures can get very low in your houses.

It should be noted that the presence of ants will greatly reduce or even destroy any attempts at the Biological Control of aphids. Ants farm aphids. The stand guard over them, removing or destroying predators and parasites. If the action gets too hot, they pick up their favorite aphids and move them to new pastures.

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