Pest discussion; Spider Mites 2013

I chose spider mites as my first pest discussion because they are, for the most part, the most common, most damaging and most broadly based pest. The two spotted spider mite is a significant pest in greenhouse vegetables, greenhouse flowers, cut flowers, cane fruits, orchards, plantscapes, bedding plants, and the list goes on and on.

For many years, we have been publishing and updating our crop recommendations and, after all of those years, I have decided that I have been largely repeating myself. The strategies for dealing with spider mites are quite similar throughout our customer base. So, this is an attempt to generalize and hopefully simplify our approach to managing spider mites.

Starting this discussion is like the "chicken and the egg". Where does the pest start?

Based on our experience, and for this discussion, the best place and time to start is in the middle of the summer. In general, what you are experiencing in the middle of the summer will be what you will experience at the same place and time the following summer. Robin Rosetta, in Oregon, did an experiment to see when spider mites in outdoor nurseries began their diapause, their over-wintering behaviour. To be safe, Robin started her survey in early August in the Willamette valley. To her surprise she found that in early August a significant number of spider mites had already begun their diapause. We know that in many greenhouses spider mites returning from diapause can easily be seen well into July**.** So, the first point of this discussion is that, at any given time, there will always be some spider mites that are not going to be around for anything that you may want to do to them. There will always be some survivors.

That being said, most of them are available and vulnerable during the summer months. This is when you need to effectively deal with them. If you can effectively deal with them during the summer, you will find that next summer they will be significantly reduced.

When we inherit a new customer with spider mites, the first year can be very challenging. Because damage caused by spider mites is permanent in ornamental crops, we are usually coming in behind a failed chemical strategy. If we know this in advance, we usually decline the opportunity. That is not how life really works, so we usually approach the endeavour by pointing out that this is not the ideal way to start the program. The residual effects of a failed chemical program extend far beyond the actual chemical residues. Repeated miticide applications stress the plants. The more that is sprayed, the higher the level of stress. Spider mites love plant stress. The other thing that goes without saying, but always needs to be said, is that miticides don't do a very good job of killing, or even controlling, spider mites, but they wreck beneficial predatory mites. The other huge problem with miticides is that their residual effects and, even more importantly, their sub-lethal effects can impair a biological program for up to 6 months.

So, our first step in the summer, trying to get a foothold on a runaway spider mite problem, is physical. We recommend overhead watering in nursery yards, on greenhouse beds, and even in cut flowers if it is possible. The water does three things. First, it reduces the stress on the plants. Plants love rain and, in a hot dry summer, they really respond to the foliar soothing and hydration of a good rain. Second, the foliar rinsing removes some of the residual chemicals and the associated spreaders and stickers that can cause significant stress, largely because these are usually detergents. Spend a day jogging in underwear with detergent residue to test this theory on yourself. And third, the water really screws up the spider mites. Spider mites hate rain and fog and mist. We actually control our rearing system during the summer by deciding how much we will mist our production bean plants. If we want more spider mites we reduce the misting. If the spider mites are threatening to kill our plants before we can harvest, we increase the misting. When nurseries switched from overhead watering to drip irrigation, they not only reduced wasted water, they enhanced the conditions for spider mites.

The next step in the initial battle is to develop a containment strategy. Spider mites spread mainly by animals. We are animals. Your dog is an animal. The nighttime deer are animals. Spider mites get picked up and deposited as we wander through the site. When you have a "hot spot", identify it. Put up a flag or surround it with cones. If you have to go into the "hot spot" do it last thing in the day, and then leave directly. Wear a removable outer garment that you can drop into a freezer or blast yourself off with an air blast or water hose. If you can get your dog to stay away, that will also help, as hair is a perfect mite brush.

The next step we take is to offer the Spider Mites a sacrifice. Bush beans are very effective in attracting spider mites away from your plants. For some plants, such as Tomato, beans are so much more attractive that the spider mites will actually leave the Tomato for the beans. We like to push bush beans into the soil of spider mite affected plants. You will be hearing a lot more about bush beans in this discussion. When the spider mites move on to the beans, you will have to make a decision about how you are going the handle the beans. If the movement on to the beans is slow because the beans are only a little bit more attractive than your plants or the spider mite pressure is low, you can apply predatory mites such as persimilis to turn the beans into banker plants which will generate large numbers of fresh and balanced predators onto your plants. If, on the other hand, the beans become covered in spider mites, you can carefully remove this botanical "sponge" and destroy it carefully, along with the thousands of spider mites, and push in another bean seed. The seeds sprout in a couple of days and the bean is attractive as soon as the first true leaf shows.

Then we attempt to establish the predatory mite, *persimilis*, and/or the predatory beetle, *Stethorus*. These are extremely effective predators capable of managing the high densities and the associated webbing that the spider mites create as a defensive strategy. The only challenge we face at this stage is the residual chemicals. Persimilis, if it isn't impaired by chemicals, works 100% of the time and doesn't stop until it has eaten every spider mite in the release zone. No exception. If you have used *persimilis* in the past and it didn't work, assuming that you received persimilis that was still viable and capable of laying eggs, it was because of the chemicals. *Stethorus* is almost as impressive, but, as it can fly, it will move to higher spider mite densities if it can smell a more productive infestation. Like all Ladybeetles, it

is a grazer, seldom eliminating the pest, so some prey will be available for its offspring. In most crops, Stethorus "grazes" the spider mites down to levels below economic thresholds or even detection.

As the spider mite pressure drops in the fall due to over-wintering behaviour, higher relative humidity, and plant dormancy, our focus switches to their over-wintering sites. At this time, care should be taken to make sure that you actually can see the difference between a diapausing spider mite and a persimilis. To the untrained eye, they can look very similar. In general, diapausing spider mites tend to be "redder" while *persimilis* usually is "oranger". But, on different plants, the colour difference alone is not enough to go by. A hand lens and a good pair of eyes are needed, or a microscope of some type may be needed. The shape of spider mites is more "tube" like, compared to *persimilis* which has the classic "pear" shape of many predatory mites. The most definitive method is still based on the name. The two spotted spider mite always has two spots, one on each side.

In field situations, this is the key time to establish the preventative predatory mite, *Amblyseius fallacis*. In the originals trials that we conducted on field strawberries, we found that the fall application provided the best inoculation. This is because the *fallacis* can get a couple of generations in, then over-winter with the spider mites, returning with the spider mites in the spring, at exactly the right time. The typical field release rate is 10,000 per acre or 2 per square meter.

Where do spider mites go during diapause? In greenhouses that don't drop below freezing, check under your pots, lift a few boards. You will often find them congregating as a red mass on the bottoms of your pots. In colder situations or outdoors they move down into the soil structure, deep enough to avoid lethal temperatures. In structures, they frequently move down the plumbing or heating lines or structural posts. All of these present a break in your contiguous floor. In outdoor nurseries or forests, or mint fields, they just move down the roots to a safe level.

This is actually a very good time to deal with spider mites. And not just the 2 spotted spider mite, as most pest mites employ similar over-wintering strategies. Even eriophiyd mites, such as Russet mites, instinctively move to ground during winter. We use the soil mite *Stratiolaelaps scimitus* (Ss) to treat areas that were the site of spider mite problems during the previous season. This is when we prefer to start with new customers, when we can go into a situation that was a serious problem and, with very little effort and expense, significantly reduce the returning spider mite pressure in the coming year. In some greenhouses, we have been able to ascertain that a 75% reduction in the anticipated spider mites can be achieved. This technique is usually just used once, as the Ss establish and remain in the structure for years to come and the large food population of spider mites is eliminated anyway. Typically we use about 4 liters of Ss per acre, placing a teaspoon to tablespoon sized pile of product at the base of each post, any plumbing or pipes penetrating the ground, and along the perimeter walls. Higher levels should be used where the spider mites were bad. It really is as simple as that.

In outdoor fields we don't want to do anything that will reduce the *fallacis* establishment, so we don't normally recommend Ss unless we are also dealing with Root Weevils or other pests that are more

important for that crop than the spider mites. That being said, fallacis and Ss do actually co-exist well in a field environment, managing all of the pests they were applied for.

The beginning of the new growing season shows us how well our strategies have worked. The key component at this time is the bush bean. We urge our customers to start growing bush beans about 2 weeks before they start up their houses. A bush bean placed in an empty house will show you how well your cleanup went. When I say cleanup, I mean the effective removal of the old plant material. This includes weeds. But, I am not in favour of any chemical cleanup for the sake of arthropod pests. Yes, you may need chemicals to remove any spores of fungal pathogens, but if you think that any chemical is going to kill spider mites, or thrips, or any other pest capable of going to ground, you are mistaken. Let the Ss do their job in the soil under your floor. Bush beans show spider mite damage within 3 hours. You get an immediate report card. In addition, bush beans are extremely attractive to whitefly, thrips, and leaf miners, so if you aren't getting bush beans in before your main crop, you are making things hard on yourself. I have seen 1 bean plant per acre work in this situation, but I would recommend about 1 bean for every 3000 square feet (300 square meters). In year 1 with us, make sure that you have multiple beans where you had a history of spider mites. Put one bean at every post and heating pipe interface and a bean every 10 meter on the perimeter wall. Just like the beans used in the summer, you will have to use your judgement to determine how you are going to deal with them. If they are overwhelmed, remove and replace them, using them like a "sponge". If they start clean, we have done a great job with our winter clean-up.

When propagating plants that are prone to spider mites, *fallacis* should be applied as early as practical. With clean cuttings or seed starts, you can delay until the plants have grown into their normal structure, after misting propagation or covered propagation. If you are using cuttings from stock plants that have a history of spider mites, apply *fallacis* as soon as the wet phase is completed. In year 2 with us your stock plants will also be clean, so some strategic delay in application can occur. *Fallacis* should always be present on these plants before you normally expect spider mites or as soon as the "guardian" beans detect the presence of spider mites.

The release rates of *fallacis* range from 2 to 20 mites per square meter, depending on the plant varieties and their propagation techniques (see *Crop Recommendations*). On plants that will be mowed or pruned, use the low rate, but re-apply after every trimming. *Fallacis* is a unique mite in that once it is established on a plant, it will stay with the plant indefinitely. We have been working with *fallacis* for over 18 years now and our original inoculations are still established and actively protecting the plants to this day. Arborvitae, boxwood, mint, cane berries, and even bamboo, are all showing continuous control and we can still recover *fallacis* from these plants. Another interesting trait of *fallacis* is that it is the only mite I am aware of that will actually leave a plant, go to ground, and relocate on another plant. All of the other predatory mites that I am aware of will only move from plant to plant by foliar contact, or mechanical means. This means that you can be very sloppy applying *fallacis* and still end up with an even distribution.

We sell fallacis in two forms; on bean leaves with some spider mites, or in vermiculite with some pollen. Both forms work equally well. The bean system is slightly more expensive to cover harvesting expenses,

but is typically over-packed by at least the difference in the price. Both provide even applications. The bean leaves allow easier placement in vertical crops, such as bamboo and pepper, while the vermiculite allows for easier broadcasting. For clean propagation, the bean product will provide a slight "pest in first" ability, which will help with establishment.

In our spider mite management system, after prevention with fallacis, we deal with hot spots and subsequent attacks with persimilis or Stethorus. Persimilis is faster acting, cheaper, and will tolerate webbing, so it is the obvious choice for rapid knockdown. On fast growing, vertical crops such as high wire cucumbers, persimilis should be placed at the top of the infestation, providing clean new growth. In slower, non-climbing crops, persimilis should be placed evenly in the plant, knowing that their normal searching behaviour is upwards. Monitoring of persimilis is very easy as they move to the top ridge of a leaf when the spider mites have been eliminated. Persimilis are not capable of remaining in a crop without spider mites as they cannot feed on wind-blown pollen or reproduce eating other pest eggs, such a whitefly eggs. Because of this, we will never recommend a "blanket" treatment of persimilis unless you actually have a "blanket" of spider mites.

We sell persimilis in two forms; on bean leaves with spider mites, or in vermiculite with honey. Unlike fallacis, we only recommend persimilis on bean leaves. This is because the vermiculite product, from us and just about everybody else, is collected by starving them and taking advantage of their tendency to search upwards, forcing them into a collecting jar hung above the plants. Unfortunately, in mites, starvation also triggers sexual cannibalism, where the females consume the smaller males as a first stage survival mechanism. This leads to a significant sex ratio shift in all of the vermiculite style products. Because persimilis works by reproducing faster than spider mites, the sex ratio shift is a serious impairment creating a lag period of 7 to 10 days for control, compared to the bean leaf product which is shipped with spider mites to prevent starvation. I have never seen a situation where the spider mites, which are shipped with the persimilis on the beans, have ever caused damage.

This completes our cycle. A well-managed spider mite program will realize a significant reduction in plant loss or production loss while at the same time reducing your pest management cost.

For other pest mites, use this discussion as a starting point, but be aware that there is a mite out there somewhere that is waiting to jump on your plants, no matter what the situation is. Broad mites, for example, are usually seen in wet situations. So, if you are aggressively misting your plants to control the two spotted spider mite, if Broad mites are present, you may get a Broad mite infestation. Diagnosing Broad mite and other eryophiad mites, such as Cyclamen mite or Russet mite can be difficult. Because these mites are so small, normal observation usually doesn't pick them up until economic plant damage is seen. If you have a history of eryophiad mites, make sure that you establish *fallacis* in the crop at least one month before you traditionally see them. Frequently, *fallacis* has a multiyear effect, as they eliminate these mites and linger with them throughout diapause.

There are a lot of other predatory mites available commercially, but we are convinced that *persimilis*, *fallacis,* and the beetle *Stethorus*, are all that you will need. We have produced many other predatory mites in the past and have dropped them for various reasons, but the most important reason is their

compatibility with other Beneficials. We were the first company to produce *californicus*, about 26 years ago, but we dropped it because it interferes with persimilis and was not capable of over-wintering in the fields we were working with. We stopped working with *degenerans*, which is more of a thrip predator, because it interferes with *Aphidoletes*. It should be noted that *swirskii*, the hot climate thrip predator, excludes the use of *Aphidoletes* for the same reason. We dropped the midge *Feltiella* after only a few years, not because of interference, but because it just doesn't eat enough spider mites to make a difference. Growers like *Feltiella* because they like the idea that it can fly and is easy to scout, as it pupates on the leaves. Because our main customers are ornamental now, the idea of leaf pupation is very negative because they can be seen on the plant. But *Feltiella* was dropped because they do not perform in low humidity, which is when you need a spider mite predator, and they don't eat enough. In our *persimilis* rearing system, during the winter, we get *Feltiella* volunteering. Some of the *persimilis* trays that we sell can have over 1,000 *Feltiella* in them. But, when we graph our weekly *persimilis* production, it doesn't matter how many *Feltiella* are present. We see no significant change. This means that they don't eat enough spider mites to compete, at a detectable level, against *persimilis*.

For your specific crop, please refer to our "Crop Recommendation" section.