Empire State Fruit and Vegetable Expo - 2016
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Title of session: Berry

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Title of talk: Strategies to control arthropod pests in high tunnels

Summary: Arthropod pest management concerns for berry crops under high tunnel production are not radically different than they are outside for the most part. The key to a successful arthropod management strategy in high tunnels or outside is awareness of what is going on in the planting (e.g good monitoring coupled with a knowledge base of the most likely pests) and the availability of integrated control options including cultural practices, biological control and chemical control tailored to the high tunnel production system. Although pest concerns for high tunnels and open field plantings are similar, some pests tend to be more problematic in high tunnels compared the field while others are less problematic. For example, Japanese beetles tend to shy away from high tunnels. On the other hand, two-spotted spider mites tend to be much more of a consistent problem in high tunnels. The abiotic environment of high tunnels relative to the field situation (seasonal patterns for temperature, relative humidity and lack of natural precipitation) will influence pest phenology and population dynamics and pesticide residues. In this presentation, I will focus on the arthropod pests that may be problematic for berry crops under high tunnel production, covering pest identification, monitoring, and control methods. These include mites (two spotted spider mite, cyclamen mite), thrips, tarnished plant bug, root weevils and spotted wing drosophila.

Two spotted spider mites can become very abundant on berry plants (strawberry, raspberry) grown in tunnels and greenhouses, reaching upwards of 100 mites per leaf and causing serious leaf feeding damage and reduced photosynthesis. These tiny, spider-like arthropods, use piercing mouthparts to remove cell liquids thereby creating characteristic white stippling. Biological control using insectary-reared predatory mites is a good option for high tunnel environments. Here are some take-home messages I will cover for two spotted spider mite.

1. Short generation time means populations can build up quickly.
2. Monitor regularly, paying attention to damage symptoms and presence on underside of leaves. Approximate economic threshold around 25% of leaves infested.
3. Consider releasing predatory mites, purchased from insectaries, for biological control of spider mites.
4. *Amblyseius fallacis* has been effective against spider mites in tunnels.
5. Start release of predatory mites early in the infestation cycle. May require back to back releases.
6. Acramite, Savey and Zeal are effective miticides that are relatively easy on predatory mites.

Cyclamen mites are even smaller than spider mites and are specifically problematic for strawberries. Typically they have been more of a problem in older plantings of June-bearing cultivars, although new plantings are sometimes infested in their first year. Cyclamen mites feed on new, unfolded leaves in the crown of the plant resulting in stunted, crinkled and malformed leaves as they expand. Leaves look roughened and off-colored. In heavy infestations, the leaves are severely stunted and mites can move to flowers resulting in fruit that is small, dry, and distorted. Some take-home points for cyclamen mite include:

1. Since the mites are so small, monitor for symptoms of cyclamen mites.
2. If infestation isolated to a few plants, consider rogueing.
3. Release of predatory mites (*Neoseiulus cucumeris, Amblyseius fallacis*), if applied early in the infestation, may provide control.
4. Miticide options are limited in NY (see Portal). Need to apply with adequate water to insure excellent coverage.

Flower Thrips are an infrequent pest of berry crops (strawberries and raspberries) in the field but often become quite abundant in greenhouse situations and can be problematic in high tunnels as well. The western flower thrips is often the main culprit in greenhouses and high tunnels, but other species can occur. Thrips (immature stages and adults) will feed on young leaf tissue but their primary impact is on fruit. Densities can become quite high in flowers and the feeding damage to reproductive tissue causes fruit to be bronzed, hard and seedy. Thresholds have not been well established for NY conditions, but over 5 per flower is reason for concern. Some take-home messages for thrips management include:

1. Monitor for adult and immature thrips in open flowers. Prior to flowering, monitor with sticky traps.
2. Weeds around or inside the tunnel can acerbate problems with thrips.
3. Release of predatory mites (*Neoseiulus cucumeris*), if applied early in the infestation, may provide control.
4. Chemical control options are limited. Spintor (spinosad) is labeled for use in strawberry and can be effective but be aware of resistance problems. Delegate (spinetoram) includes thrips on caneberry label for suppression (recommends using adjuvant).

Tarnished plant bug (TPB) is familiar to most berry growers, especially strawberry growers where damage to fruit is obvious. TPB can be a problem in tunnel production. Adult TPB overwinter in waste areas, hedge rows, etc. in the leaf litter and become active in the spring, feeding on weed species. Populations are generally low in the spring and then build during the season as they go through 2 to 3 generations. Hence, problems with TPB increase during the season such later season strawberries and raspberries are particularly vulnerable. Both adults and immatures (nymphs) feed on young, developing fruit tissue and cause mishappend fruit at harvest. The best way to monitor for TPB is to sample inflorescences for nymphs with a economic threshold of 0.5 nymphs per

inflorescence or 3 out 15 infested inflorescences in strawberries and 10-20% infested canes for raspberries. TPB feeds on many different plant species so keeping weeds in check in the tunnel and around the tunnel may help. There are several different chemical control options available. Some take-home points:

1. Begin monitoring for TPB nymphs at bloom and continue to harvest. Economic thresholds are fairly low.
2. Keep weeds under control in and around tunnel as best as possible.
3. TPB is attacked by several different predators and parasitoids, but none are available for purchase commercially.
4. The higher relative humidity found in tunnels may increase efficacy of fungal entompathogens (e.g *Beauveria bassiana*) compared to the field, but this has not been tested.

Root weevils can be a serious problem in strawberry and raspberry growing outdoors involving several different species including the black vine root weevil and the strawberry root weevil. Under tunnel production, black vine root weevil (BVRW) is probably the most important weevil pest, partly due to its ability to feed on a number of plant species that might be grown in the same tunnels with berries or in adjacent tunnels. Although adult root weevils feed on above ground foliage, causing characteristic leaf notching, it's the larvae feeding on roots that cause the economic injury. After emergence adults feed on leaf tissue for a period of time (4 to 5 weeks in the field) before mating and starting to lay eggs. This pre egg-laying period will be shorter under the warmer tunnel environment. Root weevils overwinter as larvae with adults emerging from June through July. Economic thresholds for root weevils has not been well worked out for strawberry and raspberry plants and likely varies based on plant health, soil conditions, etc. Some take-home points:

1. Adults are most active at night and therefore difficult to monitor.
2. Rather, monitor for characteristic adult feeding damage (leaf notching) to assess presence of root weevils and timing of adult emergence.
3. Most chemical control options (e.g. bifenthrin, thamethoxam [Actara]) target the adult root weevil during the pre egg-laying period.
4. Entomopathogenic nematodes have been effective in controlling root weevil larvae in field plantings. Need more work for tunnel environments.

Spotted wing drosophila (SWD) has been discussed at length at the Empire State Fruit and Vegetable Expo and many other venues over the past several years since its arrival in NY in 2011. It is a major pest of mid and late-season berry crops (especially fall raspberries, summer/fall harvests of day-neutral strawberries, and later maturing blueberry cultivars). SWD infests fruit outdoors and in high tunnels. Because of the low tolerance of fruit infestation, chemical control is the main management tool used to combat SWD, although cultural practices such as frequent harvests and good sanitation can be beneficial. Also, there has been some work with covering the high tunnel with exclusion netting to prevent colonization by SWD. This technique has shown some promise, but also has significant challenges that need to be worked out. Monitoring for

the presence of adult SWD with traps placed in and around the tunnel may assist in timing insecticide applications for mid-season berry crops (summer raspberry in particular) which in some years may complete harvest before SWD becomes established in the area. Some take-home points for SWD:

1. SWD can be a serious problem in high tunnels for susceptible berry crops (e.g. raspberries, blackberries, day-neutral strawberries).
2. Frequent harvests and good sanitation are important cultural practices to help reduce SWD infestations.
3. For susceptible, later-season berry crops, insecticides will likely be necessary to produce marketable fruit.
4. Horticultural practices to create a more open vegetative structure may promote good insecticide coverage on fruit.
5. Monitoring for adult SWD in mid-season may help with deciding when to initiate chemical control.
6. Monitoring for infested fruit can help detect problems with management tactics.