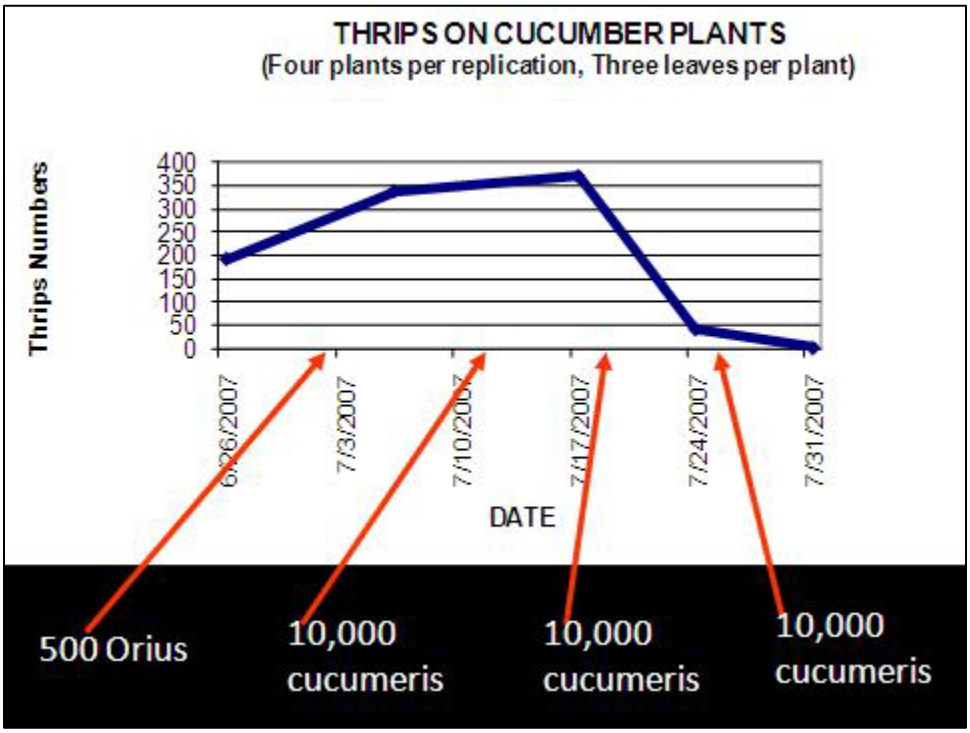
2007

CASE STUDY 1.
Location: Penn Yan, NY; **Crop:** High Tunnel Cucumbers; **Problematic Pest:** Thrips; **Biological Control Used:** *Amblyseuis cucumeris;* **Dates on Farm:** weekly 6/26-7/31 2007; **Success Rating (0=failure, 3=control, 5=pest eradication):** 5

One on-farm trial was a convincing success. We achieved control of thrips in greenhouse cucumbers with three releases of the generalist predator *Amblyseuis cucumeris* in addition to an early release of *Orius insidiosus*. Thrips populations dropped from block counts at nearly 400 thrips (12 leafs per block, 4 randomized blocks) to 0 within a month. In the future earlier releases should be used in a preventative program. This and the below example were early learning experiences for the project team on efficiency. In this case two releases of *A. cucumeris* would have likely been sufficient.



CASE STUDY 2.
Location: Keuka Park, NY; **Crop:** Greenhouse tomatoes; **Problematic Pest:** Two-spotted Spider Mites; **Biological Control Used:** *Phytoseulis persimilis;* **Dates on Farm:** August 2007; **Success Rating (0=failure, 3=control, 5=pest eradication):** 0

This on-farm trial resulted in partial crop loss to the area where beneficial were released. We were not able to completely control a high population of spider mites on greenhouse tomatoes with a single release in early August. A non-sprayed, untreated block of plants had to be removed from the greenhouse because of the intense pest pressure. The grower sprayed a miticide to save the rest of the greenhouse. This was an example of beginning a scouting program too late and attempting to use biological control on a pest population that was too high. We learned from these mistakes and began scouting much earlier in the season the following years.

2008

CASE STUDY 3.
Location: Phelps, New York; **Crop:** High Tunnel Eggplant; **Problematic Pest:** Two-spotted Spider Mites; **Biological Control Used:** *Phytoseiulus persimilis;* **Dates on Farm:** Weekly from April 29 to October 6, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 3

Scouting at this farm began on April 29; however plots were not setup until June 9 when the row covers were taken off of the high tunnel eggplant. At this time the only pests present were flea beetles and a few aphids. Scouting continued weekly. Two spotted spider mites first started to show up on June 30. At this time four replicas of four plants each were set up and damage ratings (1=clean, 10=dead) were conducted, pressure was low (damage ratings below 1.5). The following week, July 7, numbers had increased enough to require a treatment (average damage rating greater than 1.5). At this point it was decided to order the biological control agent *Phytoseiulus persimilis*, which was released July 11. Spider mite populations continued to rise, slow and steady, over the next eight weeks (maxing out at a damage rating of just under 7). However, plants were still producing quality fruit and growing at an excellent rate. Starting on September 9th there were very few live mites found, but the damage on the plants was still very visible. Over the next four weeks the live mites were almost completely eradicated, leaving behind only their silvery markings on the eggplant leaves. The biological control agent Phytoseiulus persimilis did a good job at holding the population to a manageable level but did not completely control the spider mite pests. We have learned that spider mite populations can multiply rapidly and in subsequent years we would be more prepared to release at the very first sign of this particular pest. Other strategies may include a second release, higher rates, or combination releases with generalist predators.

CASE STUDY 4.
Location: Phelps, New York; **Crop:** High Tunnel Winter Greens; **Problematic Pest:** Aphids **Biological Control Used:** *Aphidius colemani* and *Aphidius ervi;* **Dates on Farm:** Bi-weekly from September 22 to November 5, 2008; **Success Rating (0=failure, 3=control, 5=pest**

eradication): 1.0

This farm has a long history of aphids on their farm and especially in their winter greens. This is a valuable crop on an organic farm that the grower would like to be able to save and sell for a late season market. The greens were planted into a high tunnel, during the week of September 15, after the spring/summer greens crop was removed. There were already aphids in the greenhouse earlier in the year so we kept close track of the population to try and catch them as soon as possible. However, immediately after planting the crop was covered with row covers which made scouting difficult. The crop was checked every week (9/16, 9/22) and then every other week (10/6, 10/13, 10/21, 11/5). The first sign of aphids started to show up on October 6, at very low levels (an average of 1.3 aphids per plant). Prior to this scouting date we had decided to be proactive and order and release before significant populations were reached in hopes of stopping incoming pests in their tracks. Therefore the biological control agents *Aphidius colemani* and *A. ervi* were released on October 7. The combination of *A. colemani* and *A. ervi* was selected to cover the broadest range of aphid species. On the next scouting day (10/13) the population was already on the rise with an average of 24.4 aphids per plant (approximately five leaves per plant). By the next visit the population had completely exploded, only on certain types of greens (mainly the mustards), with numbers being, on average, over 63 aphids per leaf. Unfortunately there were many factors that made this site difficult to monitor. Due to the placement of the row covers it is possible that the aphid populations were higher on the center rows allowing populations to increase without being detected. Another problem that we faced was the temperature. As we got later into October nighttime temperatures were falling below freezing. This leads us to a question worth addressing; what types of biological control agents would work best in cooler temperatures, or even hotter temperatures?

CASE STUDY 5.
Location: Keuka Park, New York; **Crop:** High Tunnel Tomatoes; **Problematic Pest:** White Flies; **Biological Control Used:** *Encarsia formosa* (Nile Delta strain); **Dates on Farm:** Weekly from July 18 to September 9, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 3.0

We visited this farm at the end of April because of a long standing history of whiteflies, figuring it would be a good site to monitor. However, the grower informed us that he had moved the high tunnel and it was sitting on all fresh soil. We all figured these factors would be a cure to the white fly problem and decided not to concentrate on weekly scouting at this site. However, in mid-July the grower contacted us regarding a white fly infestation in his high tunnel tomatoes. At this point initial counts were taken showing approximately 5.5 white flies per leaflet. The biological control agent *Encarsia formosa* (Nile Delta strain) was ordered immediately and released on July 19. Over the next month averages dropped below the initial counts, ranging from 2.9 to 5.4 whiteflies per leaflet. However on August 25 the population had jumped to 13.5

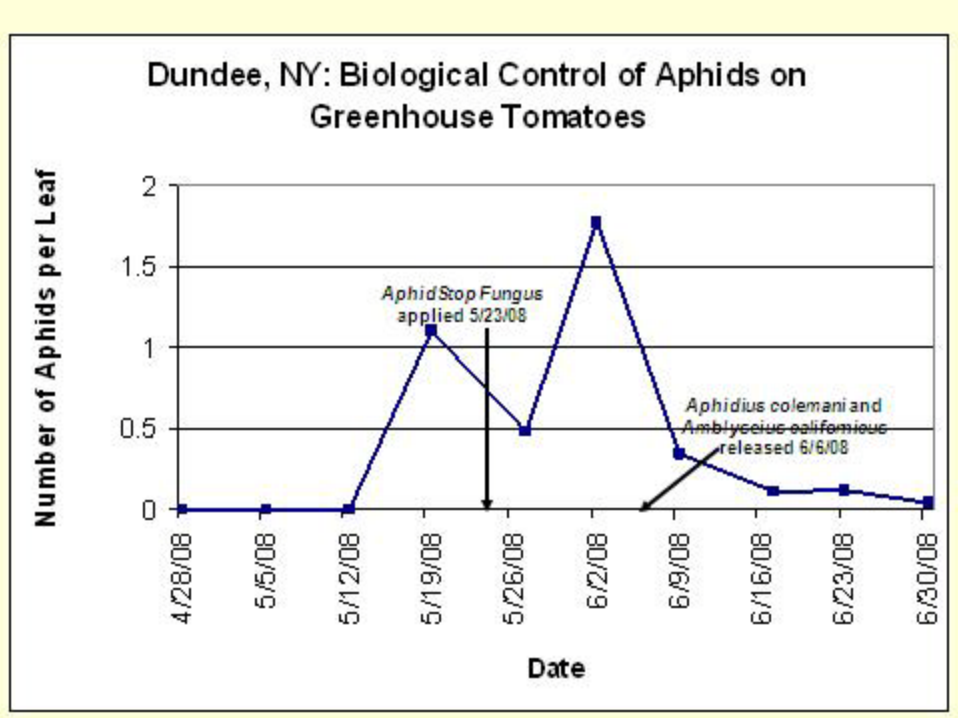
white flies per leaflet, on average and did not descend for the remainder of the season. This is a case where a second release may have helped. However the initial population was quite large and established when scouting began, which also make it difficult for the beneficial insects to work to their best ability. According to other researchers, there were questions about the viability and quality of *E. formosa* during the 2008 season.

CASE STUDY 6.
Location: Dundee, New York; **Crop:** Greenhouse Tomatoes; **Problematic Pest:** Two Spotted Spider Mites; **Biological Control Used:** *Amblyseius californicus;* **Dates on Farm:** Weekly from June 2 to October 13, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 3

This tomato crop was grown in plastic growing bags and struggled with nutrient deficiencies throughout the growing season making spider mite evaluations difficult. However, there was positively an infestation of mites that was recorded. When scouting began on June 2 the mites already had an established population (average rating of 3.4). Predators were released on July 13 when mite ratings were an average of 6 across the plot (four reps of eight plants each). The spider mite damage rating decreased every week by about one point, ending the season with a 3.5 rating, right about where we started. We have clearly learned that spider mites are a difficult pest to control, however at this site we were able to sustain a manageable level of pests without dramatic damage.

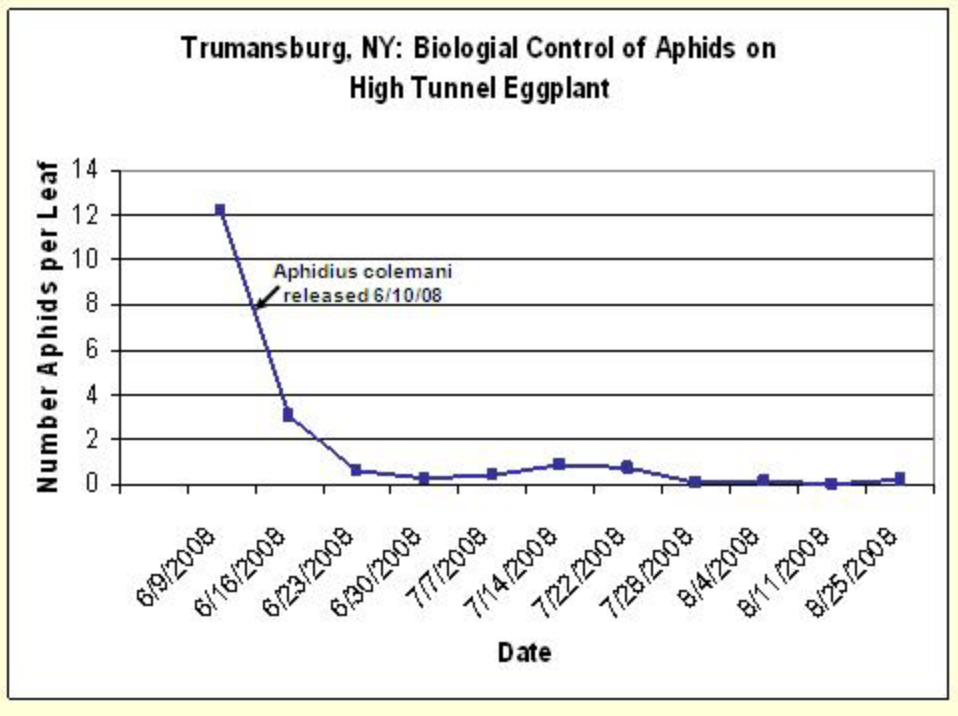
CASE STUDY 7.
Location: Dundee, New York; **Crop:** Greenhouse Tomatoes; **Problematic Pest:** Two Spotted Spider Mites and Aphids; **Biological Control Used:** *Amblyseius californicus* and *Aphidius colemani;* **Dates on Farm:** Weekly from April 28 to October 13, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 4

Scouting at this site began on April 28, at this time we detected extremely low levels of two-spotted spider mites. Scouting continued weekly throughout the season. Spider mite levels remained fairly low within the trial for the remainder of the season. Aphids were first detected on May 19. The grower decided to go ahead with one of their own biological control releases, a fungus AphidStop, on May 23. By the next week numbers had increased to almost 2 aphids per leaf. We released an Aphid and Spider Mite biological control on June 6. Aphid numbers dropped to zero over the next four weeks and spider mites remained in check.



CASE STUDY 8.
Location: Trumansburg, New York; **Crop:** High Tunnel Eggplant; **Problematic Pest:** aphids **Biological Control Used:** *Aphidius colemani;* **Dates on Farm:** Weekly from June 9 to August 25, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 5

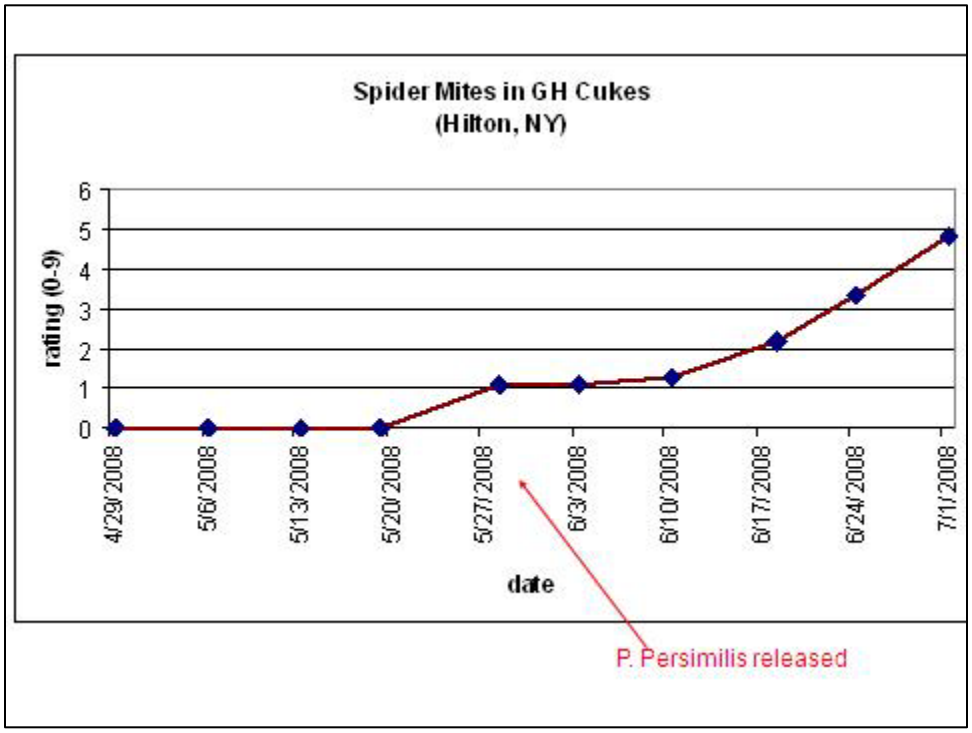
Monitoring of the Trumansburg Farm began on June 2 after noticing high levels of aphids (upwards to 100 per leaf) in their High Tunnel Eggplant crop. The following week, June 9, a plot was set up and the aphid population was reported. Initial counts, done on three leaves per plant, ranged from 6 to 22 aphids per leaf, with an average of 12.2 aphids per leaf. With pest levels sky rocketing the decision was made to spray and then release a beneficial insect. The grower sprayed pyganic on June 3 to help knock down the population, followed by the release of a biological control on June 10. The predatory insect selected to control the suspected green peach and potato aphids was *Aphidius colemani*. The week following the *Aphidius* release (June 16) the aphid population had nearly been reduced by one third, ranging from 1 to 5 aphids per leaf. Over the next two weeks (June 23 and 30) the population continued to decline to less than one aphid per leaf. Beginning on July 7 the aphid numbers slowly began to increase, however at very low incidence (still less than one per leaf). They remained this low until the crop was finished and removed in late August. Other problematic pests that were identified on the eggplant crop were flea beetles and thrips; however they remained at non-threatening levels.



CASE STUDY 9.
Location: Hilton, New York; **Crop:** Greenhouse Cucumbers; **Problematic Pest:** Two spotted spider mites; **Biological Control Used:** *Phytoseiulus persimilis;* **Dates on Farm:** Weekly from April 29 to July 15, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 3

This greenhouse grower has had problems with two-spotted spider mites in his cucumber greenhouse for several years. So much so that he plans on mites ending his production for the season. Scouting began on the vigorous cucumber plants on April 29. Very low incidences of a spider mite population were first detected on May 28. Due to the aggressive nature of this pest the biological control agent *Phytoseiulus persimilis* was ordered immediately and was released throughout the entire greenhouse one week later (June 3). Over the next four weeks pest pressure increased moderately (from a rating of 1.1 up to a rating of 4.8 over the course of the season) in the experimental plots, however certain areas of the greenhouse were being demolished. After speaking with the grower he reassured us that even though the population did eventually terminate his crop, he was able to gain two to three weeks of additional harvest time than he has

in the past. He is confident that *P. persimilis* did its job in suppressing the spider mite population.



CASE STUDY 10.
Location: Interlaken, New York; **Crop:** High Tunnel Winter Greens; **Problematic Pest:** Aphids **Biological Control Used:** *Aphidius colemani* and *Aphidius ervi;* **Dates on Farm:** Bi-weekly from October 6 to November 3, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** 5

This high tunnel had a cover crop in place before the winter greens crop was planted. The grower noticed an aphid population in the cover crop so it was likely that the new crop of winter greens would also be prone to get aphids on them. Scouting began on October 6 with an average of 3.5 aphids per plant. Biological controls *Aphidius colemani* and *A. ervi* were released the next day (October 7). Over the next month the population was essentially eradicated.

CASE STUDY 11.
Location: Hilton, New York; **Crop:** Greenhouse Tomatoes; **Problematic Pest:** none detected; **Biological Control Used:** none necessary; **Dates on Farm:** Weekly from April 29 to July 15, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** not applicable

In the past two-spotted spider mites have been problematic pests in this tomato greenhouse. However after a weekly scouting program throughout the 2008 growing season no pest pressure

was detected. Therefore biological controls were not necessary.

CASE STUDY 12.
Location: Dundee, New York; **Crop:** High Tunnel Tomatoes; **Problematic Pest:** none at problematic levels; **Biological Control Used:** none necessary; **Dates on Farm:** Weekly from April 28 to August 25, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** not applicable

At this site the high tunnel had been moved to eliminate any reoccurring pest problems. It seems to have worked. Four plots of five plants each were set up in the tomato crop on April 28 and weekly scouting was preformed for sixteen weeks. On the first visit we were concerned about aphids migrating from pepper plug trays that were being stored next to the tomato crop. However once the peppers were removed the aphids went with them. Towards the end of the season (August 18) some two spotted spider mites started to show up. However the crop was almost complete so a biological control would have been impractical.

CASE STUDY 13.
Location: Manchester, New York; **Crop:** High Tunnel Greens; **Problematic Pest:** none identified; **Biological Control Used:** none necessary; **Dates on Farm:** Weekly from April 29 to May 19, 2008; **Success Rating (0=failure, 3=control, 5=pest eradication):** not applicable

Scouting at this site began on April 29 and continued weekly until May 19. When scouting started spring greens were planted in the high tunnel, however no pests were detected. A summer crop was not planted.

2009

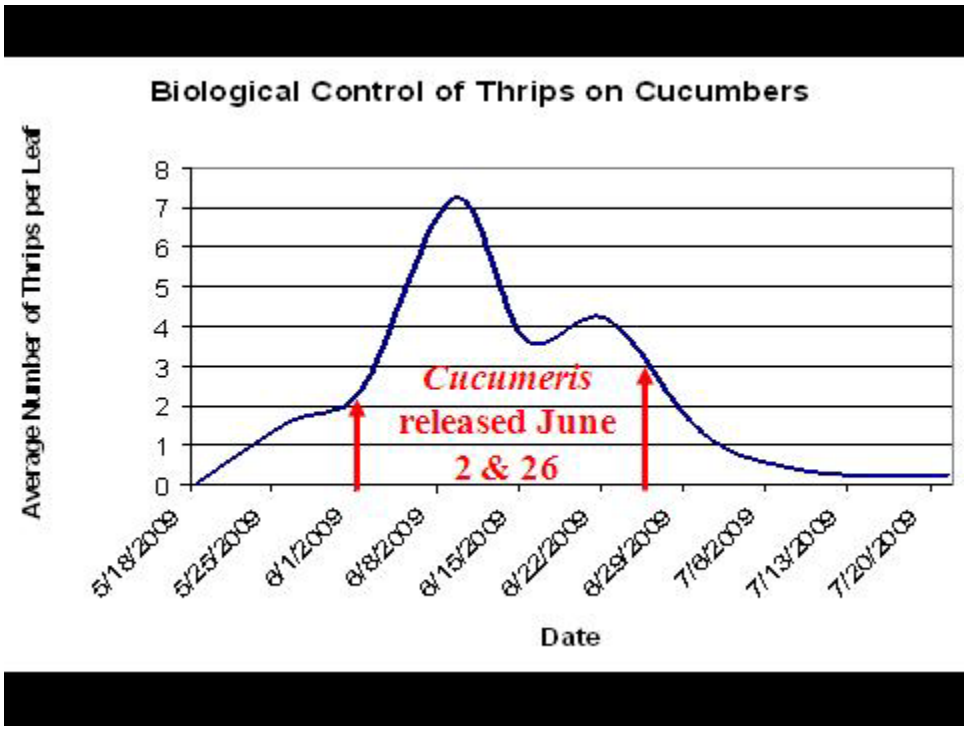
CASE STUDY 14.
Location: Penn Yan, New York; **Crop:** High Tunnel Cucumbers; **Problematic Pest:** Thrips; **Biological Control Used:** *Amblyseius cucumeris*; **Dates on Farm:** Weekly from May 11-July 28, 2009; **Success Rating (0=failure, 3=control, 5=pest eradication):** 4.75

Monitoring of this high tunnel began on May 18. 2009 was the first year growing vegetables in this structure. Initial scouting showed very low numbers of thrips on the cucumbers and no other obvious pests in the tunnel. The following week, May 26, plots were set up. Numbers were taken from 4 replicates, consisting of 5 plants each, and 3 leaves per plant.

After week two thrips counts were on the rise and we decided to order a biological control. 20,000 *Amblyseius cucumeris* were released in the high tunnel on June 2 (week 3). The following week (week 4) numbers had increased from 2 thrips per leaf to 7 per leaf. However, this is often

the case as it takes time for the biological controls to find their target, giving the thrips an opportunity to hatch out fresh nymphs and build their population. By week 5 thrips numbers had decreased by 50 percent. *Cucumeris* was doing its job. Week 6 showed another slight increase to 4 thrips per leaf so another 20,000 cucumeris were ordered and released on June 26. The thrips numbers continued to decline and were barely existent, less than one thrips per leaf, at week 10.

Having multiple crops in a high tunnel meant having multiple pest populations to deal with. Other problematic pests that have been identified in this particular tunnel were aphids on eggplant, cucumbers, and peppers, with the peppers and eggplant being the most sensitive. Biological controls and compatible pesticides where used to control these pests, with varying levels of success. Biological controls for the pest two-spotted spider mites were also released, and kept that pest at manageable levels. This farm was the site of an extension led farmer-to-farmer workshop.



CASE STUDY 15.
Location: Hilton, New York; **Crop:** Greenhouse Tomatoes; **Problematic Pest:** Two-spotted Spider Mites; **Biological Control Used:** *Phytoseiulus persimilis* and *A.californicus*; **Dates on Farm:** Weekly from May 20 – Aug 4, 2009; **Success Rating (0=failure, 3=control, 5=pest eradication):** 2.75

On-site scouting began at the end of May. Treatment blocks were set up consisting of 4 replicates of five plants each. Data was collected using a rating system, 0-9. A planted rated 0

would be perfectly healthy with no signs of mite damage; a rating of 9 signifies plant death due to mite damage.

In this particular greenhouse there were mites invading on the north and south edges. It was decided to care for these two sections separately, one side treated, the other untreated, to demonstrate biological control efficacy. Both sections had an established mite infestation at the time treatment began, June 26. Mite damage levels dropped slightly in the treated section for the first two weeks after treatment, and then slowly rose for the remainder of the season. Damage never reached yield threatening levels. Damage in the untreated section progressively rose over the course of the season, but also never reached yield threatening levels.

CASE STUDY 16.
Location: Dundee, New York; **Crop:** High Tunnel Cucumbers and Tomatoes; **Problematic Pest:** Thrips and Two-Spotted Spider Mites; **Biological Control Used:** *A. cucumeris* and *Phytoseiulis persimilis*; **Dates on Farm:** Weekly from May 11 – July 14, 2009; **Success Rating (0=failure, 3=control, 5=pest eradication):** Mites in Cucumbers: 2.5; Thrips in Cucumbers: 4.0; Mites in Tomatoes: 3.5

Scouting of this high tunnel began on May 11. This year the tunnel housed tomatoes, cucumbers, and blueberries. Two-spotted spider mites started showing up on all crops around May 18. One week later it was clear this pest was on the rise and the biological control *P. persimilis* was ordered. At this time there was also an increase in thrips on the cucumbers thus *A. cucumeris* was ordered as well. Both natural enemies were released on June 2.

P. persimilis controlled the spider mites on the tomatoes, never causing any yield-reductions; however, they continued to increase on the cucumbers. Thrips levels on the cucumbers started around 0.3 thrips per leaf. After the release of *cucumeris,* thrips numbers dropped by fifty percent within one week. Eventually they began to creep back up, but never reaching more than the initial infestation level, and never becoming threatening to yields. However, two-spotted spider mites were not successfully controlled on cucumbers.

CASE STUDY 17.
Location: Trumansburg, New York; **Crop:** High Tunnel Peppers; **Problematic Pest:** Aphids; **Biological Control Used:** *Aphidius colemani and Aphidius ervi*; **Dates on Farm:** Weekly from; July 7 – July 28, 2009; **Success Rating (0=failure, 3=control, 5=pest eradication):** 5.0

This grower contacted us when their high tunnel peppers were invaded by aphids. Plots were set up on July 7, 4 replicates, 4 plants each. The number of aphids was counted on three leaves per plant. Initial data showed over 12 aphids per leaf. The biological control agents *A. colemani* and *A. ervi* were ordered and released the following week, July 10. On July 14 pest numbers had

dropped to two aphids per leaf. Pest incidence continued to decline over the next two weeks to almost zero.

CASE STUDY 18.
Location: Penn Yan, New York; **Crop:** High Tunnel Peppers; **Problematic Pest:** Aphids; **Biological Control Used:** *A. colemani and A. ervi*; **Dates on Farm:** Scouted post-release on June 15, 22 and 30, 2009; **Success Rating (0=failure, 3=control, 5=pest eradication):** 5.0

In this circumstance the farmer scouted on their own and determined that aphid populations required control. Assistance with biocontrols was requested and subsequent scouting by program assistant found low-to-no populations.

2010

CASE STUDY 19.
Location: Penn Yan, New York; **Crop:** High Tunnel Cucumbers; **Problematic Pest:** Thrips and Two-spotted Spider Mites; **Biological Control Used:** *Phytoseiulus persimilis* and *Amblyseius cucumeris;* **Dates on Farm:** Weekly from May 24-Aug 6, 2010; **Success Rating (0=failure, 3=control, 5=pest eradication):** 4.5

Scouting at this location began at the end of May when there were very low levels of thrips and two-spotted spider mites detected on the high tunnel cucumber crop. Pest levels were monitored closely as they were on a steady rise.
The predatory mite, *Amblyseius cucumeris*, was released on June 24 and again on July 6 to control the thrips population. Thrips numbers at the time of release were just over 18 thrips per leaf. However, thrips counts began to drop after the first release and then dropped down to less than two thrips per leaf within two weeks after the second release. Numbers remained low for the remainder of the season.

The two-spotted spider mites did not become a pest of concern until the beginning of July at which time the predatory mite, *Phytoseiulus persimilis*, was introduced to the high tunnel. Mites are assessed with a damage rating of 1-10, with 1 being a clean plant and a rating of 10 once a plant has been killed due to mite populations. At the time of the predatory mite release the plants were given a rating of just under 3; within two weeks that rating dropped in half and remained low for the remainder of the season.

CASE STUDY 20.
Location: Hilton, New York; **Crop:** Greenhouse Tomatoes; **Problematic Pest:** Two-spotted Spider Mites; **Biological Control Used:** *Phytoseiulus persimilis;* **Dates on Farm:** Bi-Weekly from May 26 – July 7, 2010; **Success Rating (0=failure, 3=control, 5=pest eradication):** 3.0

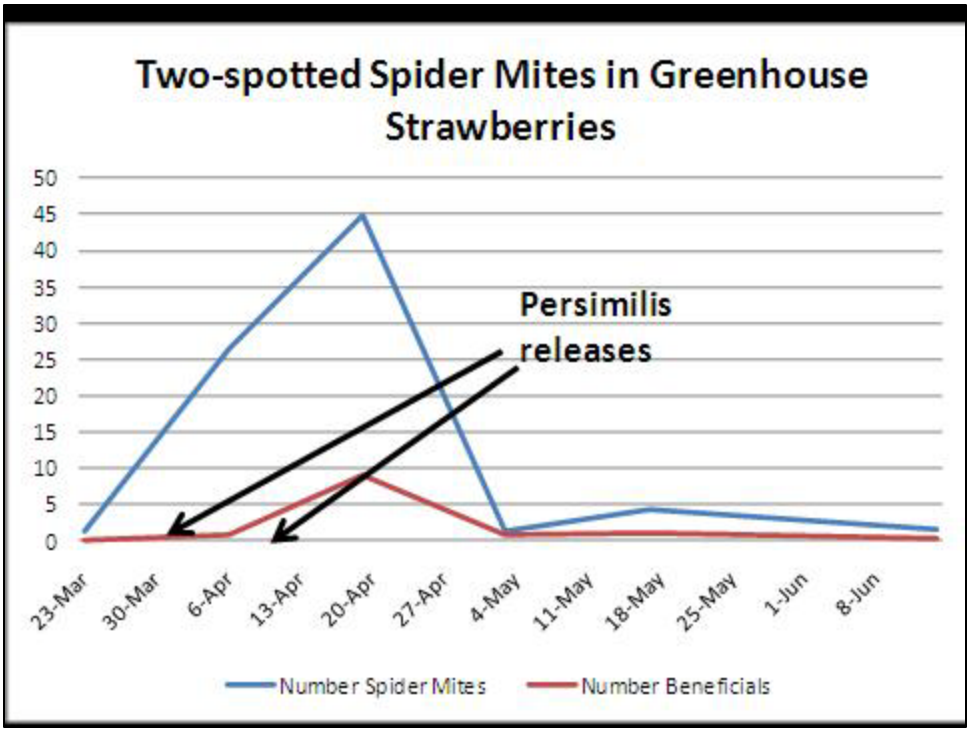
This Monroe County, greenhouse tomato farm has a small infestation of two-spotted spider mites annually. Monitoring began at the end of May in 2010 when very low levels of mites were found on the perimeter of two greenhouses. The predatory mite, *Phytoseiulus persimilis*, was released immediately along the problematic edges and surrounding areas, as we know TSSM populations can quickly progress. Pest numbers did increase slightly, but never reached rating levels (described above) higher than 2.5 and dropped soon after.

CASE STUDY 21.
Location: Trumansburg, New York; **Crop:** High Tunnel Peppers; **Problematic Pest:** Aphids; **Biological Control Used:** *Aphidius colemani* and *Aphidius ervi;* **Dates on Farm:** Weekly from; June 7 – June 28, 2010; **Success Rating (0=failure, 3=control, 5=pest eradication):** 4.75

The grower at this Seneca County farm contacted us in the beginning of June reporting that they were seeing high levels of aphids in their organic, high tunnel pepper crop. We ordered a mix of parasitic wasps, *Aphidius colemani* and *Aphidius ervi*, immediately. A mix of the two wasps is used as they control different aphid species, and we were unaware of the aphid species we were dealing with. In the meantime, it was recommended that the grower spray insecticidal safer soap to get a jump start on pest control. The safer soap was applied on June 5 with the biological control release following on June 8. Within one week aphid numbers dropped from nearly 27 aphids per leaf to under 2 aphids per leaf!

CASE STUDY 22.
Location: Interlaken, New York; **Crop:** Greenhouse Potted Strawberries; **Problematic Pest:** Two-spotted Spider Mites; **Biological Control Used:** *Phytoseiulus persimilis;* **Dates on Farm:** Weekly from March 23-June 14, 2010; **Success Rating (0=failure, 3=control, 5=pest eradication):** 4.0

Plots were set up in this mixed crop greenhouse on March 23. The focus of evaluation was on hanging basket strawberries, being marketed for retail sales, which were infested with two-spotted spider mites. As TSSM can multiply quickly, the predatory mite, *Phytoseiulus persimilis*, was ordered and released in a timely matter. Initial TSSM counts were very low (1.3 per leaf); actual pest counts were done at this location rather than damage ratings. The grower sprayed Basic H prior to the release of p*ersimilis* on March 30. By the next rating, April 6, pest numbers had jumped to 26 per leaf. Fearing that the first shipment of beneficial mites was faulty we ordered a second set which were released on April 12. TSSM numbers were up to almost 45 per leaf the following week; however the beneficial mite soon kicked in and dropped to just over one pest per leaf by May 3. The number of persimilis was also tracked at this location, showing a direct relationship between the number of beneficial mites with the decrease in TSSM.



CASE STUDY 23.
Location: Oakfield, New York; **Crop:** Greenhouse Cucumbers; **Problematic Pest:** Aphids; **Biological Control Used:** Premix of *Aphidius colemani*, *A. ervi* and *Aphelinus abdominalis;* **Dates on Farm:** Biweekly November and December 2010; **Success Rating (0=failure, 3=control, 5=pest eradication): 0.**

This grower, new to winter production of cucumbers, is growing hydroponically for local supermarkets in Western New York. He contacted our program about an aphid infestation in mid-December. Black aphids were observed in moderate numbers in several locations throughout the 0.5 acre range. Two units of a mixture of *Aphidius colemani*, *A. ervi* and *Aphelinus abdominalis* (500 parasitoids per unit) on December 15 and 2 units were released on December 29. The greenhouse temperature regime was mid 60s (degrees F) at night to mid 70's in the day, which should have been acceptable to the beneficials, however, control from the parasitoids did not occur on a significant level. Our flagged plots registered numbers in the hundred per leaf. The grower rouged out many plants, making accurate data collection impossible. Aphid numbers continued to grow to unacceptable levels which prompted the grower to adopt a spray program. Materials such as *Beuvaria bassiana* and azadiractin were the grower's first choices, continuing the natural pest management focus.