

Pepper IPM on Farm Demonstrations

Project Leader

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Cooperators

The three cooperating growers that participated in this project.

Abstract

IPM practices in peppers were demonstrated at three different farms this year. For each farm, data on pest levels, pesticide use, and damage at harvest were collected. Each field was scouted weekly for any insect pests including aphids, thrips, and mites. Traps were placed to monitor for European corn borer, and samples were taken weekly of any possible diseases and brought to the Plant Pathology and Plant-Microbe Biology Section for identification. Growers received weekly scouting reports and treatment recommendations. For all three farms the growers reported that having someone scout their peppers was extremely helpful and problems were identified much earlier than in previous years. The overall EIQ (Environmental Impact Quotient) was determined for each farm.

Background and Justification

New York state is the 7th largest fresh market bell pepper producing state based on production value ([2018 USDA Annual Vegetable Summary](#)). According to the 2018 USDA National Agricultural Statistics Service, fresh market bell peppers were planted to 1,600 acres in NY in 2018. There are many insects and disease pests of peppers and the susceptibility can vary greatly depending on variety. It is therefore important that growers identify pests early through regular scouting of their fields. Through on farm demonstrations growers can learn pest identification and threshold levels for the various pests. Knowing when a pest has reached threshold can help time sprays better and hopefully reduce the overall numbers of sprays required to control a pest.

Objectives:

1. Work with CCE field staff to identify farmers to host Pepper IPM demonstrations.
2. Interview growers to establish pre-season expectations
3. Use either split-field plots, with the farmer following IPM practices on one part of the field and his or her usual practices on the other; or IPM plots where IPM practices will be used on the whole field and results compared with typical practices and damage levels of the previous year.
4. Place one ECB (European corn borer)-E and one ECB-Z pheromone trap at all demonstrations sites and begin weekly monitoring.
5. Begin weekly scouting in both areas of the field, for split-field sites or the entire field for IPM sites.
6. Provide growers with weekly scouting reports along with pest management recommendations.
7. Conduct harvest evaluations at time of harvest and post season interviews.

Procedures

1. Three growers participated in the demonstrations, one in Erie county, one in Genesee county, and one in Tioga county.
2. All growers were interviewed prior to the start of the demonstrations to determine their typical pest management practices and pest damage levels.

3. One pepper field for each of the three participating growers was used. The field for one of the growers was a split-field plot while the other two growers followed IPM protocols on their entire field.
4. Heliothis traps for ECB- E and Z were set up in a grassy area near the edge of each pepper field. Traps were checked weekly and pheromone lures, from Trécé Inc., were replaced every two weeks.
5. Fields were scouted weekly for insects and diseases based on procedures and thresholds in the *2019 Cornell Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production*. Any unknown disease samples were brought to the Plant Pathology and Plant-Microbe Biology Section at Cornell AgriTech in Geneva, NY for identification.
6. Growers were provided with weekly scouting reports and spray recommendations for their field.
7. Harvest evaluations were conducted on each portion of the field by evaluating 4 fruit at each of 25 locations for insect and disease damage for a total of 100 fruit. Post season interview questions were sent to all participants to gauge their overall impressions of the demonstrations, their harvest, and to address any concerns they may have.

Scouting and Harvest Evaluation Results

Erie County

The Erie county site was a 3.5-acre field of bell peppers consisting of 69 rows measuring 400 feet each. It was planted primarily to *Revolution* but also *Playmaker*, *1819*, and *3984*. The grower used seed treated transplants that he grew himself and transplanted in raised beds with plastic mulch and drip irrigation the week of May 20th-24th. The field was divided into an IPM portion and a grower's portion. The IPM portion of the field consisted of 12 rows located in the southeastern portion of the field closest to a road. The grower had an additional 8 acres of peppers, including hots, located on the other side of the road.

During the initial interview the grower mentioned that his primary pests are bacterial leaf spot (BLS) (Figure 2), phytophthora blight (Figure 3), and European corn borer (ECB) (Figure 4). Phytophthora blight has been present at the farm for over 20 years. He manages it with the use of raised beds, resistant varieties, and fungicides. For ECB, he sprays lambda cyhalothrin during the time of their flight. And he uses copper and biofungicides to control the BLS. He has not had an aphid problem in over three years. Occasionally he finds thrips (Figure 5) in the flowers, but the population is kept down by the presence of Orius (minute pirate bugs) (Figure 6).

Weekly scouting began on May 29rd and continued until September 18th. Two traps, one for ECB-E and one for ECB-Z, were set up on this date, monitored weekly and lures replaced every two weeks. One ECB-Z moth was caught on June 26th and the first aphids and potato leaf hoppers were detected in both the IPM portion and growers' portion of the field on this day as well (Table 1). Aphid numbers were well below threshold throughout the season and did not require treatment. Treatment for ECB is recommended when fruit are walnut sized and trap catches are greater than 7 moths per week. Only one ECB-Z moth was caught for the entire season, so no sprays were recommended for ECB. On July 27th thrips were detected in the flowers. Total number of thrips and Orius (minute pirate bugs) was recorded for 4 flowers on 25 different plants for the remainder of the season. The thrips population never exceeded the Orius population and therefore treatment was not needed (Figure 1).

The main diseases observed in the field as well as first detection are given in Table 1. The first detection of BLS occurred in both portions of the field on July 10th. Since this grower has a history of BLS he began preventative applications on June 28th and then again on July 8th. The BLS was found primarily in the grower's portion of the field. Plants with BLS had fewer total fruit develop (anecdotal observation). Phytophthora was detected on August 28th in the grower's portion. It first appeared in a low area of the field with standing water and quickly progressed. The grower chopped down 22 rows on Sept. 18th due to the phytophthora. On September 11th a sample was taken from two plants adjacent to each other and brought to the Plant Pathology and Plant-Microbe Biology Section for identification. It was determined to be closely related to *Clavibacter michiganensis* strains and was pathogenic on both pepper and tomato (Figure 7). It did not progress beyond the two initial plants. In

In addition to the insects and diseases, two non-pathogenic disorders were seen in both portions of the field and at harvest, sunscald (Figure 8) and blossom end rot.

Table 1. List of pests detected and date of first detection for the Erie county site.

| Pest | IPM | Grower |
|-----------------------------|----------|----------|
| ECB ^a -E in trap | No catch | No catch |
| ECB-Z in trap | 6/26/19 | 6/26/19 |
| Green peach aphid | 6/26/19 | 6/26/19 |
| Potato Leaf Hopper | 6/26/19 | 6/26/19 |
| BLS ^b | 7/10/19 | 7/10/19 |
| Thrips | 7/24/19 | 7/24/19 |
| Soft rot | 8/21/19 | 8/21/19 |
| Phytophthora | 8/28/19 | 9/18/19 |
| Clavibacter | 9/11/19 | - |

a. ECB- European corn borer

b. BLS- Bacterial leaf spot

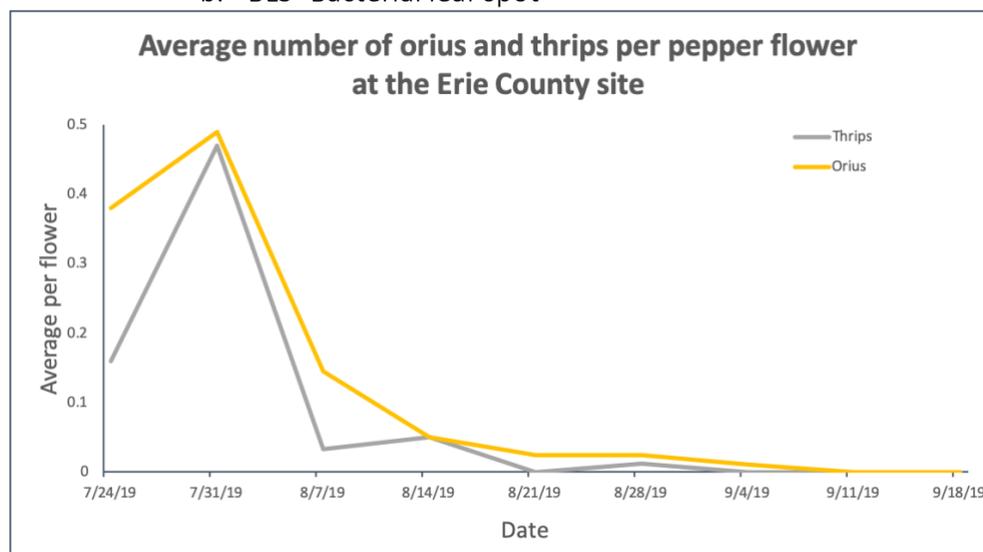


Figure 1. The average number of thrips and Orius per pepper flower at the Erie County site.

Two harvest evaluations were conducted the first on August 28th and the second on September 18th (Table 2). The primary disorder observed was BER (blossom end rot) and was found in both the grower and IPM portions of the field. Sunscald, soft rot and phytophthora were also observed during the harvest evaluation. Phytophthora blight was slightly higher in the IPM portion of the field even though it originated in the growers' portion. This may be in part due to the chopping of 22 rows in the growers portion soon after the pathogen was detected.

Table 2. Harvest evaluations for the IPM portion of the field and the grower portion of the field in Erie county. Percent of total fruit (200) with disorder, evaluated on two separate days.

| Percent fruit | | |
|------------------|-----|--------|
| Disease/Disorder | IPM | Grower |
| BER | 7 | 8 |
| Sunscald | 2.5 | 3 |
| Soft rot | 1.5 | 2.5 |
| Phytophthora | 2 | .5 |

The field was initially divided into a grower's and IPM portion and was scouted separately throughout the season. However, pesticide applications were identical for both portions of the field. He did not have to spray for any insects and since he had a history of both Phytophthora as well as BLS he made preventative applications to both portions of the field at the same time. A list of the applications, date, Rate and Environmental Impact Quotient (EIQ) are listed in Table 3 below.

Table 3. Erie county pesticide application. All applications were on both the grower and IPM portions of the field.

| Date | Product | | AI | Rate | EIQ |
|--------------|------------------|-----------------------|--|-----------|--------------------------|
| 6/18/19 | Profine 75 | herbicide | <i>Halosulfuron-methyl (75%)</i> | 1oz/A | 0.9 |
| | Maddog Plus | | <i>Glyphosate (41%)</i> | 24 oz/A | 9.4 |
| | Prowl H2O | | <i>Pendimethalin (38.7%)</i> | 2 pt./A | 23.4 |
| 6/23/19 | Lifegard WG | Growth regulator | <i>Bacillus mycoides isolate (40%)</i> | 2.25 oz/A | nf ^a |
| | Regalia | biofungicide | <i>Reynoutria sachalinensis (5%)</i> | 32 oz/A | nf |
| | Serifel | biofungicide | <i>Bacillus amyloliquefaciens strain MBI 60 (9.9%)</i> | 4 oz/A | nf |
| 6/28/19 | Lifegard WG | Growth regulator | <i>Bacillus mycoides isolate (40%)</i> | 2.25 oz/A | nf |
| | Regalia | biofungicide | <i>Reynoutria sachalinensis (5%)</i> | 32 oz/A | nf |
| | Manzate Prostick | fungicide | <i>Mancozeb (75%)</i> | 2 lbs/A | 38.6 |
| | CS2005 | Bactericide/fungicide | <i>Copper sulfate pentahydrate (5%)</i> | 20 oz/A | nf |
| 7/8/19 | Lifegard WG | Growth regulator | <i>Bacillus mycoides isolate (40%)</i> | 2.25 oz/A | nf |
| | Regalia | biofungicide | <i>Reynoutria sachalinensis (5%)</i> | 32 oz/A | nf |
| | Manzate Prostick | fungicide | <i>Mancozeb (75%)</i> | 2 lbs/A | 38.6 |
| | CS2005 | Bactericide/fungicide | <i>Copper sulfate pentahydrate (5%)</i> | 20 oz/A | nf |
| TOTAL | | | | | 110.9^b |

- nf - EIQ not found for this active ingredient
- This is only the partial EIQ since some active ingredient EIQs could not be determined.

Overall, the harvest from both the grower's and IPM portion of the field was average to above average as compared to previous years according to the grower. Since the sprays on both portions of the field were the same, there was no difference in EIQ value, 110.9, between the two portions of the field. Some of the active ingredients used did not have a calculated EIQ available. The grower found the demonstration very helpful, especially learning about ECB thresholds and that it was not necessary to spray since trap catch was low and scouting showed no signs of ECB eggs or damage. He was also able to time his sprays better to be most effective.

Genesee County

The Genesee county site was a 2.0-acre field of mixed peppers which included varieties *Boca*, *3964*, *Islamorada*, *Beacon*, *Bardo*, *Mercato*, and *Grenada*. The field consisted of 15 rows measuring 1,000 feet each. The grower used seed treated transplants that were transplanted into raised beds with plastic mulch and drip irrigation on June 7th. The entire field was managed using IPM practices.

During the initial interview the grower mentioned that he had very few problems with his peppers and has not sprayed them for insects or diseases in several years. He has not had a problem with phytophthora and attributes that to his soil type, use of raised beds, and no wet or low areas in his fields. He has not had a problem with BLS either and attributes that to his rotation.

Since the transplants did not get into the ground until June 7th, scouting did not begin until June 18th and continued until September 17th. Two traps, one for ECB-E and one for ECB-Z, were set up on June 18th, monitored weekly and lures replaced every two weeks. No ECB moths, either E or Z, were caught at this site. The grower also has ECB traps set-up near his sweet corn that caught only one ECB-Z moth on July 23rd. So, this site has very low ECB pressure. The first aphids and thrips were detected on June 25th (Table 4). Several aphid mummies were seen as well as other beneficials such as Orius, lacewings, and lady bird beetles. Neither the thrips nor aphids reach thresholds and no treatment was necessary.

No diseases were detected at this site throughout the season and therefore no treatment was required. The same two non-pathogenic disorders that were seen in Erie county were also found here, sunscald and blossom end rot.

Table 4. List of pests detected and date of first detection for the Genesee county site.

| Pest | Date |
|-----------------------------|----------|
| ECB ^a -E in trap | No catch |
| ECB-Z in trap | No catch |
| Green peach aphid | 6/25/19 |
| Potato Leaf Hopper | 7/2/19 |
| Thrips | 6/25/19 |
| Soft rot | 8/27/19 |

a. ECB- European corn borer

Two harvest evaluation were conducted the first on August 20th and the second on September 17th. A total of 4 fruits at 25 locations throughout the field were evaluated on each of the two days for a total of 200 fruit. The primary disorder observed was BER, sunscald, and soft rot (Table 5).

Table 5. Harvest evaluations for the Genesee county field. Percent of total fruit (200) with disorder, evaluated on two separate days.

| Disorder | Percent fruit |
|-----------------|---------------|
| Blossom end rot | 2.5 |
| Sunscald | 2 |
| Soft rot | 1 |

The only product that the grower sprayed was an herbicide, TapOut, on June 14th. The active ingredient of TapOut is 12.6% *Clethodim* applied at 9 fl oz/A resulting in a total EIQ for the field of 1.2.

The overall harvest was better than normal and primarily due to varieties with continuous fruit set. His biggest challenges were getting the transplants in the ground and established. It was a cold, wet spring and by the time he was able to transplant the peppers had become very tall and leggy. Once they did establish, they completely recovered and had few problems for the rest of the season. In the future he hopes to trellis some of his varieties to keep them off the ground and prevent scarring and sunscald. The grower found the demonstration very helpful even though he did not have any serious pest issues. He said having someone come out gave him peace of mind and reassured him that there was no reason to make unnecessary sprays.

Tioga County

The Tioga county site was a .25-acre field of mixed peppers consisting of 3.5 rows measuring 100 feet each. It was planted primarily to *Revolution*, *X3R Red Knight*, *Roulette*, *Carmen*, *Serrano*, and *Sweet Banana*. The grower purchased all the transplants because of previous cyclamen mite (Figure 9) problems in his green house. They were transplanted the week Of June 3rd- 7th into raised beds with plastic mulch and drip irrigation. Because there were only 3.5 rows of peppers the entire field was managed using IPM practices.

During the initial interview the grower mentioned his primary pests are BLS, aphids, ECB and cyclamen mites. He has had phytophthora in the past but does not plant susceptible crops in that location. The pepper field was previously a hay/trefoil field and has not had a solanaceous crop for 6 years. The aphids and ECB are usually at low levels. He regularly sprays fungicides, 4-6 applications, and begins when he finds early blight in his tomatoes and begins copper sprays when he finds bacterial speck in the tomatoes.

Weekly scouting began on June 13th and continued until September 19th. Two traps, one for ECB-E and one for ECB-Z, were set up on June 13th, monitored weekly and lures replaced every two weeks. One ECB-Z moth was caught on June 20th and the first aphids and potato leaf hoppers were detected on June 27th (Table 6). Aphid numbers were well below threshold throughout the season and did not require treatment. Only three ECB-Z moths were caught for the entire season, so no sprays were recommended for ECB. Only July 25th thrips were detected in the flowers. Total number of thrips and Orius (minute pirate bugs) was recorded for 4 flowers on 25 different plants for the remainder of the season. The thrips population never exceeded the Orius population and therefore treatment was not needed. Cyclamen mites have been a problem at this site for the past few years. The grower bought in his transplants this year, hoping to reduce the incidence of cyclamen mites. On August 22nd the first pepper with cyclamen mite symptoms was observed. Throughout the remainder of the season peppers with symptoms were removed. At the time of harvest the percent of peppers with cyclamen mite was below 3% (Table 7).

BLS was first detected on July 11th (Table 6) at the Tioga county site, however the grower did not spray until July 25th (Table 8). Anthracnose, which was new to the grower, was observed on August 22nd (Figure 10). It primarily affected the older fruit that was beginning to turn red. Shortly after it was discovered in the peppers it was also found in the adjacent tomatoes and was more severe there. The grower applied Luna Sensation to both his peppers and tomatoes to suppress the spread.

In addition to the insects and diseases, the two non-pathogenic disorders, sunscald and blossom end rot, were found in Tioga county.

Table 6. List of pests and date of first detection for the Tioga county site.

| Pest | Date |
|-----------------------------|----------|
| ECB ^a -E in trap | No catch |
| ECB-Z in trap | 6/20/19 |
| Green peach aphid | 6/27/19 |

| Pest | Date |
|--------------------|---------|
| Potato Leaf Hopper | 7/3/19 |
| BLS ^b | 7/11/19 |
| Thrips | 7/25/19 |
| Soft rot | 8/15/19 |
| Cyclamen mite | 8/22/19 |
| Anthracnose | 8/22/19 |

- c. ECB- European corn borer
- d. BLS- Bacterial Leaf Spot

Two harvest evaluation were conducted the first on August 22nd and the second on September 19th (Table 7). Cyclamen mites and soft rot was the most common issue at harvest with 3% of fruit infected. Soft rot, *Erwinia carotovora*, is a bacterium that infects fruit usually through wounds caused by things like ECB feeding. To decrease the incidence ECB flight should be monitored with traps and fruit scouted for any signs of damage. This site had very low ECB trap catch and only one fruit was found with ECB feeding damage.

Table 7. Harvest evaluations for Tioga county. Percent of total fruit (200) with disorder, evaluated on two separate days.

| Disease/Disorder | Percent fruit |
|------------------|---------------|
| BER | .5 |
| Sunscald | 1.5 |
| Soft rot | 3 |
| Cyclamen mite | 3 |
| Anthracnose | 1 |
| ECB | 1 |

The grower had a history of bacterial diseases in the field but did not begin copper sprays until two weeks after initial detection. Luckily the BLS did not progress and by the time of harvest evaluation no BLS was detected on the evaluated fruit. A list of the applications, date, Rate and EIQ are listed in Table 8 below.

Table 8. Tioga county pesticide application.

| Date | Product | AI | Rate | EIQ | |
|---------|---------------|-------------------------|--|------------------|------|
| 7/25/19 | Badge SC | Fungicide/antimicrobial | <i>Copper hydroxide (15.36%)</i> | 1.5 pts/A | 7.6 |
| | | | <i>Copper oxychloride (16.81%)</i> | | |
| | Previcur flex | Fungicide | <i>Propamocarb hydrochloride (66.5%)</i> | 1.2 pts/A | 19.1 |
| 8/10/19 | Oxidate 2.0 | Fungicide/Antimicrobial | <i>Hydrogen peroxide (27.1%)</i> | 32 fl oz/100 gal | 3.8 |
| | | | <i>Peroxyacetic acid (2%)</i> | | |

| Date | Product | AI | Rate | EIQ |
|--------------|--------------------------|--------------------------------|-------------|-------------------------|
| 9/1/19 | Luna Sensation Fungicide | <i>Fluopyram (21.4%)</i> | 7.6 fl oz/A | nf |
| | | <i>Trifloxystrobin (21.4%)</i> | | 3.0 |
| TOTAL | | | | 33.5^b |

- nf - EIQ not found for this active ingredient
- This is only the partial EIQ since some active ingredient EIQs could not be determined.

The grower stated that his harvest was good and that the plants were better than usual. The total calculated EIQ was 30.5, though some of the active ingredients did not have a calculated EIQ available. His biggest concern was that the fruit was not holding up most likely due to the anthracnose and soft rot. The grower now knows how to identify anthracnose and will be able identify it sooner in his field.

Project locations

Erie county, Genesee county and Tioga county, NY

Sample of Resources Developed

Zuefle, M.E., A. Dunn., and K. English [Phytophthora capsici on Peppers](#) NYSIPM. November 12, 2019. [video] Accessed February 10, 2020. <https://www.youtube.com/watch?v=UX-lwdsDsgc>



Figure 2. Bacterial leaf spot



Figure 3. *Phytophthora capsici*



Figure 4. ECB in pepper fruit



Figure 5. Thrips in pepper flower



Figure 6. Orius in pepper flower



Figure 7. *Clavibacter michiganensis*



Figure 8. Sunscald



Figure 9. Cyclamen mite symptoms.



Figure 10. Anthracnose