



Northern NY Agricultural Development Program 2018 Project Report

Identification and Physical Exclusion of Key Pests Using Hail Netting in Apple Orchards in Northern New York

Project Leader(s):

- Michael Basedow, Cornell Cooperative Extension Eastern NY Commercial Horticulture Program, 6064 Route 22 Ste. 5, Plattsburgh, NY, 12901, 518-410-6823, mrb254@cornell.edu
- Dr. Arthur Agnello, Cornell University Department of Entomology, NYS Agricultural Experiment Station, Geneva, NY, ama4@cornell.edu
- Dr. Srdjan Acimovic, Plant Pathology and Plant-Microbe Biology Section, SIPS, Cornell University, Hudson Valley Research Lab, Highland, NY

Cooperating Producers:

- Chazy Orchards, Chazy, NY
- Forrence Orchards, Peru, NY
- Northern Orchards, Peru, NY
- Gunnison Lakeshore Orchards, Crown Point, NY

Background:

Pest management is one of the largest investments fruit growers must make in terms of time, labor, and materials to produce marketable fruit and maintain healthy trees.

Many growers in Northern New York are making informed pest control decisions by implementing Integrated Pest Management (IPM) strategies. IPM relies on utilizing many management tools, including trapping protocols developed by Cornell University, web-based weather monitoring systems, and pest prediction models such as NEWA (Network for Environment and Weather Applications), and advising by private consultants.

Tracking and reporting regional, real-time pest activity over consecutive years allows for better predictions of future pest activity. These predictions, along with timely management recommendations, help growers effectively execute pest control programs.

In 2017, Northern New York apple orchards were hit by a series of hailstorms. One grower reported over 60% of his acreage was damaged by hail. Fruit with hail injury is often left blemished, or with open wounds that can serve as entry points for fruit rot. In

many cases, hail damaged fruit is not suitable for the fresh market, greatly reducing the value of the crop. Growers selling hail damaged fruit for juice that would have otherwise gone to retail marketing can see a 96% decrease of their crop value.



Figure 1. Employees at a Clinton County orchard install hail netting to a row of apple trees, NNAYDP 2018 project. Photo: A. Galimberti.

To prevent hail damage, some Northern New York apple growers have begun installing hail netting in some of their orchard blocks (Figure 1). The netting deflects hail, leaving much of the fruit uninjured. While not designed for pest control purposes, the netting may also help to exclude pests by creating a physical barrier to insect injury. This may prove to be an effective IPM tactic. Exclusion nets have been used successfully for codling moth control in France since the early 2000s and were used successfully for excluding orchard pests in a five-year study in a Quebec research orchard (*Chouinard et al., 2017*). However, the effectiveness of drape-style netting in this capacity has not been well evaluated in our local commercial orchard conditions.

The goals of our Northern New York Agricultural Development Program-funded project in 2018 were to:

- 1) continue monitoring the key insect pests in Northern NY orchards and determine how their population dynamics vary on a year-to-year basis,
- 2) communicate to orchardists season-specific pest activity and management considerations over the course of the growing season, and
- 3) determine the feasibility of using hail netting for the physical exclusion of orchard pests in Northern NY.

Methods:

Pest monitoring blocks were established in commercial orchards in Clinton and Essex counties to scout for four key insect pests of apples. These pests included codling moth (CM), Oriental fruit moth (OFM), obliquebanded leafroller (OBLR), and apple maggot (AM). Traps were monitored weekly throughout the 2018 growing season, beginning in late-April until harvest at the end of September. We compared trap catches and emergence dates to trap catch results from previous years.



Figure 2. Hail netting over orchard rows at one of the 2018 NNYADP project trial sites. Photo: A. Galimberti.

Netting pest exclusion trials were installed in five orchard blocks in Clinton and Essex counties, where growers were already utilizing Drape Net netting for hail protection (Figure 2). The Drape Net netting was originally designed in Australia, and is now sold in Clinton County, N.Y. It has a 1.5x3mm mesh size, and weights 60 grams per square meter.



Figure 3, left. Delta-style trap used to capture Oriental fruit moth, codling moth, and obliquebanded leafroller under hail netting at a trial site in Clinton County, NNYADP 2018 project. Photo: A. Galimberti.



Figure 4, right. Red sphere-style trap with apple essence lure used to capture apple maggot (AM) in an uncovered treatment row at a trial site in Clinton County, NNYADP 2018 project. Photo: A. Galimberti.

Traps for the four pests previously mentioned were placed in rows that were later covered with Drape Net hail netting to serve as the ‘netted’ treatment (Figure 3). A duplicate set of traps were placed in a nearby, uncovered orchard row to serve as the ‘open’ treatment (Figure 4). Trees were covered with nets shortly after commercial fruit thinning. This occurred in the second to fourth week of June, depending on the orchard. Traps were monitored weekly from the week following net installation, until the week prior to net removal in early September.

To determine if trap numbers related to fruit pest damage, fruit injury surveys were conducted at four of the pest exclusion trial sites at the end of July and August. At each rating, 300 fruit from each treatment were rated for pest damage. In addition to damage from the four pests we monitored this season, we also rated damage from plum curculio, tarnished plant bug, San Jose scale, and European apple sawfly. Differences in the mean weekly trap counts between treatments were evaluated using a negative binomial regression model using “R” statistical software. Differences in mean percentage of insect fruit injury data were evaluated using either a Poisson or a negative binomial regression model.

Results:

Pest Monitoring

Compared to the four-year average (2015-2018), we caught fewer OFM in our traps this season. Our first OFM capture was in Essex County on May 31, at roughly 802 Degree Days Base 43 (DD43). Degree Days (DD) are a way to express the accumulation of heat over time. Many insect growth stages are closely tied to temperatures that are over a specific temperature threshold. For example, OFM develop when temperatures are above 43 degrees (*Carrol, 2011*). In Clinton County, the first OFM were captured the week of June 5, at roughly 791 DD43. This occurred later than the previous three years in the Champlain Valley, which ranged in dates from May 18-23 and in degree days from 400–465 DD43).

Our first captures this year were also later than the average first capture observed in the Cornell University orchards at Geneva, NY over the past 33 years (223–324 DD43, *Agnello, 2017a*).

Trap catches for codling moth were similar to the four-year average of our previous study years. Captures never exceeded six moths/trap/week in our Clinton County traps. The first codling moth captures occurred on May 24-June 5 at 508-802 DD43. This is similar to the previous three years, which occurred between May 25 and 30 at approximately 560–590 DD43. These values are later than Geneva orchard observations from the past 35 years (first catch at 396–566 DD43, *Agnello, 2017b*).

OBLR captures were low, at roughly half of the four-year average weekly trap capture. Our first OBLR captures occurred from June 20 to June 28 at 1088-1494 DD43. These dates were also behind the previous three years, which ranged from May 30 to June 26 and 744-1247 DD43. These values were behind the Geneva average of 795–980 DD43 (*Agnello, 2017c*).

Unlike the previous three pests, apple maggot (AM) trap captures were higher this year in Northern New York, at three times the four-year average weekly trap capture. Our first captures in 2018 were on July 3, from approximately 1466-1771 DD43. This was earlier than the previous three years, where first captures were observed from July 17 to August 7 at 1737-2530 DD43. This year was just slightly behind the historical Geneva average first capture of 1226-1690 DD43 (*Agnello, 2018*). These elevated AM numbers were not observed in the Lake Ontario or Hudson Valley fruit production regions of New York this

year, but similarly high trap captures were observed in orchards across Lake Champlain in Vermont (*Bradshaw, 2019*).

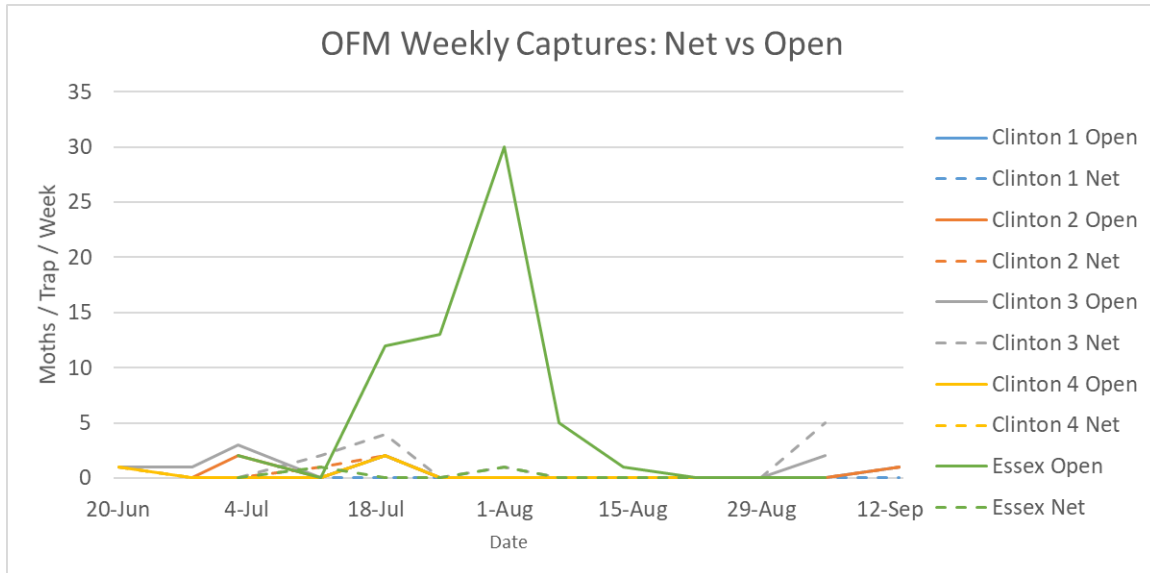


Figure 5. Trap captures of Oriental fruit moth (OFM), showing netted (dashed lines) and open (solid lines) treatments, at five monitoring sites in the Champlain Valley of Northern New York in 2018, NNYADP project 2018.

Pest Exclusion with Netting

The statistical regression model suggests traps under the netting caught significantly fewer OFM than traps in the open rows:

- at one site, OFM counts were lower under the net during the two weeks OFM were caught at the site;
- two sites had fewer OFM under the net in all but one of the weeks when OFM were present
- one site had fewer OFM under the net just one of the four weeks OFM were present, and
- one site had fewer moths under the net just two of the six weeks when OFM were present (Figure 5).

Codling moth trap captures were also significantly less under the netting. Excluding weeks where CM were not caught in either of the treatments at a site, traps from trees under the netting had consistently fewer CM at four of the five sites. At the fifth site, there was a single week where CM captures under the netting were equal to the open row, one week where captures were higher under the netting, and seven weeks where captures were lower under the netting (Figure 6).

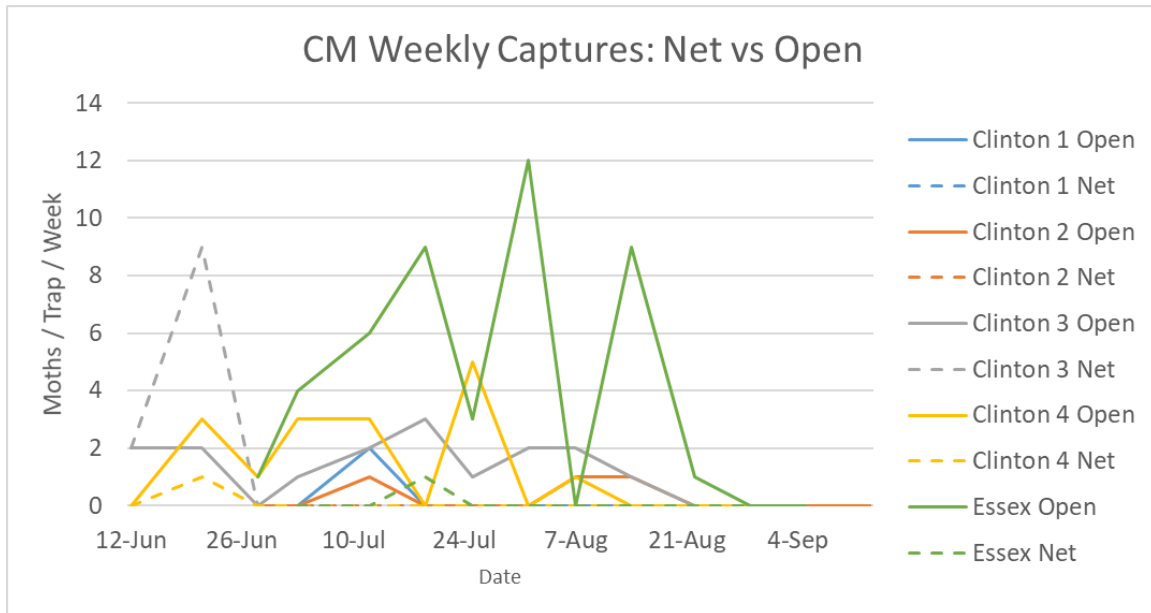


Figure 6. Trap captures of codling moth (CM), showing netted (dashed lines) and open (solid lines) treatments, at five monitoring sites in the Champlain Valley of Northern New York in 2018, NNYADP project 2018.

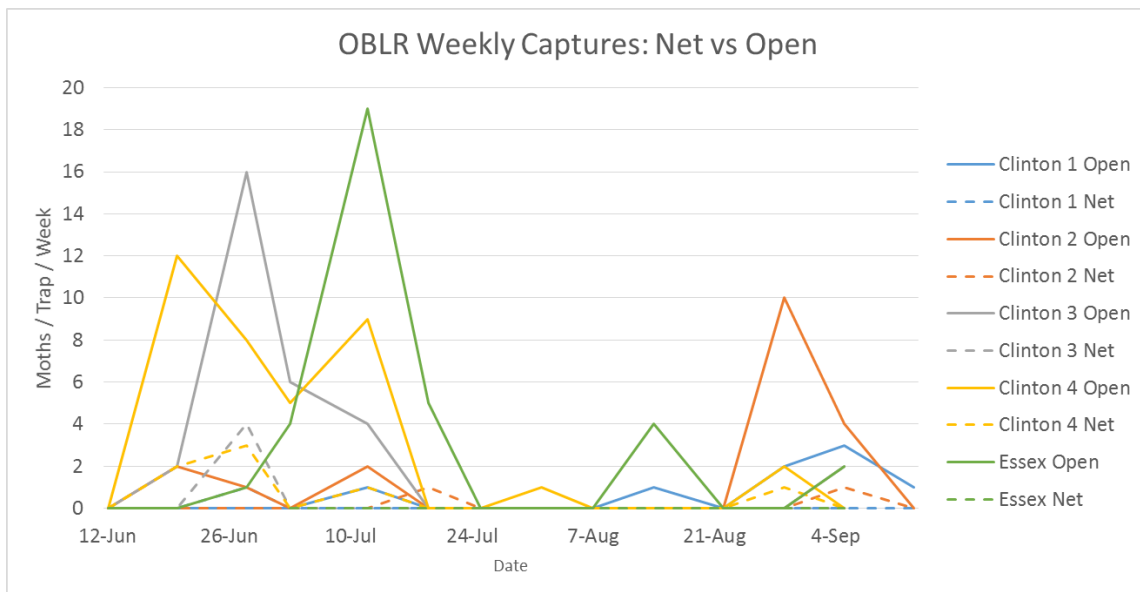


Figure 7. Trap captures of obliquebanded leafroller (OBLR), showing netted (dashed lines) and open (solid lines) treatments, at five monitoring sites in the Champlain Valley of Northern New York in 2018, NNYADP project 2018.

Traps under netted trees captured significantly fewer OBLR. In weeks where OBLR were present, captures were consistently lower under the nets than in open rows at three of the five sites. The other two sites each had one week where a single OBLR was caught on the traps under the netting, while the traps in the open rows caught none (Figure 7).

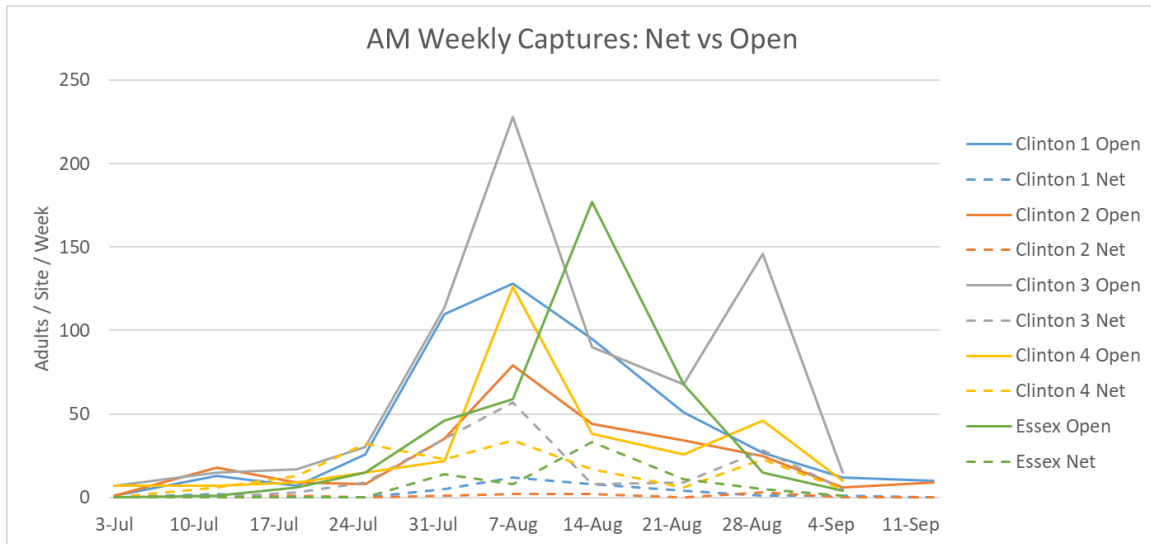


Figure 8. Trap captures of apple maggot (AM), showing netted (dashed lines) and open (solid lines) treatments, at five monitoring sites in the Champlain Valley of Northern New York in 2018, NNYADP 2018.

Apple maggot trap captures were significantly lower under the netted trees. At four of our five sites, weekly captures were always lower in the netted rows in weeks when flies were present. At a fifth site, we caught fewer flies in the netted trees in seven of ten weeks (Figure 8).

Fruit Injury Surveys

We saw no significant differences in pest injury for any of the pests on either the July or August survey date. All blocks had been treated throughout the season with each orchards' standard pest management program, so injury was very low in the netted and open row blocks in both the July and August injury surveys.

Conclusions:

With low pest pressure for three of the four pests monitored this year, the feasibility of using hail netting for pest exclusion is still uncertain. While the netting reduced the number of pests captured in our traps most weeks across our sites, the pests were often still there. Netting may help reduce pest numbers enough to reduce the total number of orchard sprays needed for some pests, particularly for pests where spray decisions are based on well-established economic thresholds, like apple maggot.

Oriental fruit moth had the greatest variability in exclusion in these trials. Since netting was not installed until after petal fall, the first generation of moth pests were likely already active within some of the tree canopies prior to netting installation. Since OFM adults are the earliest to emerge of the three moth species monitored in this study, this may help explain the greater variability we observed in OFM numbers. Greater exclusion may be possible with an earlier application of the netting, however, having netting in place earlier would likely interrupt other orchard activities, such as hand-thinning fruit.

From our general observations, the sites with the most effective exclusion had their nets tightly tied to the lower limbs and trunks of the trees. At sites that achieved less effective control, netting was attached loosely to the lower limbs, so pests were better able to enter the net from under the canopy. Canopy shape may also play a role, as the site with the best control applied netting to trees grown to a tall spindle training system, while netted trees at our other field sites were larger central leader trees, which had very wide openings at the bottom.

Since this was a first-year trial, producing one years' worth of data in a year of relatively light moth pest pressure, further trials should be conducted to determine the full potential of the use of netting for pest exclusion purposes by apple orchards. NNY grower interest in continuing the trials in 2019 is noted to determine how well netting might exclude pests in a year of high pest pressure, and growers have expressed interest to see an economic analysis of the netting systems.

Education and Outreach:

E-alerts, Phone Communications, and Newsletters

The Eastern NY Commercial Horticulture Program (ENYCHP) sent brief email alerts called 'e-alerts' to enrolled members on a weekly to twice-weekly basis throughout the growing season, containing orchard management recommendations and information about upcoming events. Each week, usually on Friday after checking traps, information was provided in e-alerts about trap captures, insect pest activity, and management recommendations.

Emails, text messages, phone calls, and farm visits between growers and ENYCHP specialists helped growers select and time pesticide applications to better control the high populations of apple maggot observed this summer. Apple maggot appeared to be well managed at our study blocks, as the highest level of damage we observed was 3% of fruit at one netted trial site.

In October, we published a newsletter article summarizing our weekly trapping records from the growing season, and discussed our results from the pest exclusion study and fruit injury surveys. This publication was sent to more than 450 enrolled members of the ENYCHP, representing orchard businesses from across Northern New York.

2018 Eastern NY Commercial Fruit and Vegetable Conference

Eight presentations related to orchard integrated pest management were presented over the course of two days at the 2018 Eastern NY Commercial Fruit and Vegetable Conference in Albany, NY on February 20 and 21, 2019. More than 200 people attended tree fruit sessions on the first day, and more than 100 attended sessions on the second day, with many orchards from Northern New York represented.

NEWA Training

A tree fruit NEWA training was offered in Voorheesville, NY, on March 28, 2018. The event was attended by 13 participants. The event included presentations by Dr. Juliet Carroll, Dr. Art Agnello, Dr. Kerik Cox, and Dan Olmstead on the NEWA website and

apple forecasting tools (insects, diseases, irrigation, thinning), with hands-on demonstrations.

Petal Fall Meeting

The annual Champlain Valley Apple Petal Fall meeting was held on May 25, 2018, at Rulfs Orchard in Peru, and was attended by 17 participants. Information was presented on insect and disease management considerations for 2018, and included IPM recommendations by Hudson Valley Research Lab Entomologist Peter Jentsch and Hudson Valley Research Lab Pathologist Dr. Srdjan Acimovic.

2018 Great Lakes Fruit Workers Conference

Results from this project were presented at the 2018 Great Lakes Fruit Workers Conference, held in Ithaca, NY, on Nov 8. This meeting was attended by more than 75 fruit research, extension, and industry professionals from across the Northeast, Upper Midwest, and Ontario.

Apple IPM Training

A one-day (five hour) training was offered in Plattsburgh, NY, on November 27, and was attended by 9 participants. In the morning, Brayton Pendell from the NYSDEC presented on how to obtain a pesticide license, while CCE regional specialists Kitty O'Neil and Mike Basedow presented on IPM and pesticide application safety. In the afternoon, participants learned about and discussed orchard IPM practices. These included developing an IPM program, using the NEWA IPM tools, and finding orchard pest information in the Private Fruit Category 22 manual. Students attending the afternoon session were provided Category 22 manuals to take home, to use as a resource for developing an IPM program for their orchard.

Next Steps:

Grower outreach events were well received and will continue through 2019. Several presentations relevant to orchard IPM will be discussed at the Eastern NY Commercial Fruit and Vegetable Conference in February 2019. The results from this project will be presented at this conference to an estimated audience of more than 150 fruit growers, representing many orchards across Northern NY.

Continued seasonal pest monitoring will be necessary to detect regional and site-specific changes in pest pressure in Northern NY orchards. Four years of data is only enough to start seeing trends, and data collection should continue in an effort to determine average calendar dates and degree days for emergence and major periods of activity of pests in Northern New York (as collected by Cornell Entomologist Art Agnello at Geneva, NY).

With low pest pressure for three of the four pests monitored this year, the feasibility of using hail netting for pest exclusion is still uncertain. The pest exclusion survey will be repeated in 2019 to determine if the netting has similar effects under different pest pressures. This work should continue for additional seasons to understand how pests will respond to the netting in various orchard conditions, so future pest management recommendations can be developed.

Acknowledgments:

This work was funded by the Northern New York Agricultural Development Program. Thank you to the technicians and regional Extension personnel who assisted with this work: Andrew Galimberti, Natasha Field, Amy Ivy, and Laura McDermott. Thanks also to the collaborating orchards involved in this project: Chazy Orchards, Forrence Orchards, Northern Orchards, and Gunnison Lakeshore Orchards.

Reports and/or articles in which results of project have been published:

Basedow, M. 2018. 2018 Northern NY Trap Data and Pest Exclusion with Hail Netting. ENYCHP Tree Fruit News, October 2018.

For More Information: Project Leader Michael Basedow, Cornell Cooperative Extension ENYCHP, 518-410-6823, mrb254@cornell.edu

References:

- Agnello, A. 2017a. (April 17). Upcoming Pest Events. Scaffolds Fruit J. 26(4): 8.
Agnello, A. 2017b. (April 24). Upcoming Pest Events. Scaffolds Fruit J. 26(5): 5.
Agnello, A. 2017c. (June 5). Upcoming Pest Events. Scaffolds Fruit J. 26(11): 4.
Agnello, A. 2018. Upcoming Pest Events. Scaffolds Fruit J. 27(14):5.
Agnello, A. 2019. Personal communication.
Bradshaw, T. 2019. Personal communication.
Carrol, J. 2011. About Degree Days. Network for Environment and Weather Applications. 2 January 2019. <http://newa.cornell.edu/index.php?page=about-degree-days>.
Chouinard, G., J. Veilleux, F. Pelletier, M. Larose, V. Phillion, and D. Cormier. 2017. Impact of exclusion netting row covers on arthropod presence and crop damage to 'Honeycrisp' apple trees in North America: a five-year study. Crop Protection. 98: 248-254.