Using Insect Netting on Existing Bird Netting Support Systems to Exclude Spotted Wing Drosophila (SWD) from a Small Scale Commercial Highbush Blueberry Planting

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The spotted wing drosophila (Drosophila suzukii) is an invasive fruit fly from Southeast Asia. It was first discovered in the United States in California in 2008, and by 2013 it was reported in all US states, with the exception of Arizona, Nevada, New Mexico and South Dakota. Spotted wing drosophila (SWD) has many hosts, including non-crop plant species, but is a major problem for raspberries, blueberries, day-neutral strawberries, cherries, peaches, plums, and other late-season, soft-skinned fruits.

During the 2012 growing season, SWD infestations were estimated to have cost NYS berry growers more than 5 million dollars in lost crop revenue (Carroll et al. 2012). Without protection, up to 80% of raspberry crops may be lost, while blueberries are vulnerable to losses of 30% or higher depending on cultivar. The participating farmer in this study lost 40% of her blueberry crop in 2012.

For highly susceptible crops such as fall raspberry and later maturing blueberry cultivars, producing a clean crop in the era of SWD is challenging, requiring frequent insecticide applications during harvest. This can be problematic, since many berry customers in the Northeast choose to buy local berries in part because they are assured of having low-spray or no-spray protocols and thus no risk of spray residue or exposure. Prior to the advent of SWD, growers were able to accomplish this feat through the use of appropriate cultural practices. Of all the fruit crops grown in the Northeast, blueberries are perhaps the most amenable to organic production. Generally speaking, pest problems are fewer than with most other fruits, and blueberry growers preferentially use ammonium nitrogen, which is a direct breakdown product of organic nitrogen sources such as manure (Carroll et al. 2015). This had allowed Northeast blueberry growers prior to 2011 to grow high quality crops with low chemical input. SWD has changed this situation. Hence, there is strong motivation for finding non-chemical alternatives to the SWD problem for blueberries and other berry crops.

Based on published research from Japan (Kawase et al. 2008), growers and researchers became interested in using netting to exclude SWD from susceptible berry crops. Promising preliminary results were obtained in 2013 using fine-mesh knitted netting over blueberries (McDermott and Nickerson 2014) and raspberries (unpublished data). These studies, however, had only looked at small-scale plots and were not conducive to commercial operations that require daily access for harvest and maintenance operations, while also allowing for worker comfort during harvest. This project, which was supported by a NE SARE Farmer grant, was designed to use exclusion netting over an existing bird netting support structure and to monitor the potential of growing a commercially acceptable blueberry crop without the use of insecticides to control SWD.

Exclusion System Construction

In 2014, custom-sewn 80-gram (80 g/m², 1.0 mm x 0.6 mm mesh size) and 60-gram (60 g/m², 1.95 mm x 0.95 mm mesh size) insect exclusion netting was purchased (Tek-Knit Industries, Montreal, QC, Canada). The 60-gram netting was 26 feet wide. A galvanized pipe and PVC frame was constructed to support the net over one row of blueberries covered with 60-gram netting. Pipes were used as weights to hold netting in place at ground level by wrapping the netting around the pipes and fastening with greenhouse clamps.

The 80-gram netting was custom-sewn into 26-foot wide pieces. This netting was laid over the existing bird net supports made of galvanized greenhouse hoops and used to cover six rows of blueberries. In 2014, there were three treatments established: six rows were covered with the 80-gram netting, one row covered by the 60-gram netting, and one row was only covered with bird netting as a control row. The netting was applied on July 12. The large sheet of 80-gram netting was applied using a purlin and then raised over the hoops for the length of the planting so that it rested in the valley between the first and second set of hoop supports. The netting was unfolded to lift the second piece of netting up over the second set of hoop supports and onto the third set of hoops. The netting was temporarily fastened to the hoops with clamps.

To weigh down the netting on the edges for the length of the planting, the netting was wrapped around purlins on the ground, fastening it with greenhouse clamps. On the windward

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side of the planting the netting was reinforced with rock bags (Figure 1). Rock bags were also used to anchor the netting on the perpendicular ends. The netting sheets were joined at the ends of the rows with a greenhouse wiggle wire channel system on the back of 4 x 4 posts. A vestibule built of 4 x 4 treated lumber formed the single entrance for workers. This was covered by 80-gram netting and used standard greenhouse wire lock channel and wiggle wire to hold the netting in place. In 2014, clips were used to hold the door flaps closed (Figure 2), but in 2015, a custom-sewn zipper improved the ease of access. The vestibules provided double protection, as workers would enter through the first doorway, get it secured, and then go through the second doorway into the planting itself, securing it after entering the planting.

Berries were sampled on a weekly basis from July 15 to September 15. Twenty-five berries, from each of 9 locations, were randomly selected from the plants each week within the 80-gram netting treatment. Twenty-five berries were randomly selected weekly from 3 locations for both the 60-gram treatment and the control treatment. The berry samples were sent via overnight mail to the Loeb lab at the NYS Agricultural Experiment Station in Geneva, NY. Upon arriving in Geneva, they were placed in rearing cups and checked every three days to track SWD emergence. Following a brief breach in the netting due to a severe thunderstorm, collected berries were also evaluated for oviposition scars and egg breathing tubes.

The control row was treated with 4 applications of pesticides, spinetoram (Delegate) and acetamiprid (Assail). Application dates were July 29, and August 5, 10, and 24. The first SWD adults were detected in traps on July 21. There was a light passing shower on July 31 and heavy rain on August 7. Research elsewhere in the country indicates that rain greatly decreases the efficacy of many of the pesticides cleared for use against SWD. The first two applications were 6 oz/A of Delegate plus 2 lb sugar/100 gal of water. The second two applications were 5.3 oz/A of Assail plus 2 lb sugar/100 gal of water. The netting was removed in October and stored it in UV-resistant tarps for the winter (Figure 3).

In 2015, the experiment was repeated without the 60-gram treatment. Seven rows were covered with 80-gram netting and the same control row was covered with bird netting. In 2015, wiggle wire was used to connect the separate pieces of netting to each other throughout the planting. Greenhouse wire lock channel was attached to all purlins on the ground and on the support structure. Purlins were connected to the hoops themselves with greenhouse connectors, instead of lying in the valley created by overlapping hoops. This allowed the entire width of the netting to be used more efficiently. The purlins were placed on hoops, then the netting was connected, two pieces at a time, with one set of wiggle wire, and then opened up like butterfly wings to reach across the planting to the next purlin.

In 2015, netting was applied on July 6. A wiggle wire system was used to attach the netting to the purlins on the ground. All fastening was done at ground level by July 9. Gravel was used
to weight the netting at two ends of the planting. The doorway entry to the vestibule was redesigned to incorporate door panels manufactured out of rip-stop nylon featuring heavy duty zippers sewn into the panels for easy entrance. The panels were attached to the vestibule frame with wiggle wire.

In 2015, samples were collected weekly from July 15 to August 15. Commercial harvest ended on August 18 in 2015, which was half the length of the 2014 season. Samples were again sent to Geneva for rearing. The control treatment was sprayed with insecticides five times in 2015. Applications were made on July 23 (5.3 oz/A Assail), July 27 (5.3 oz/A Assail plus 2 lb sugar/100 gal of water), August 4 (6 oz/A Delegate plus sugar), August 9 (6 oz/A Delegate plus sugar) and August 17 (5.3 oz/A Assail plus sugar). Rainfall on July 24 and July 26 equaled 0.20 inches. Rainfall on August 1 and the morning of August 4 equaled 0.55 inches. It rained all day on August 11 for a total of 1.2 inches, and rainfall on August 15 was 0.15 inches. Netting was once again removed in October and stored out of the elements. In both 2014 and 2015, temperature monitors were deployed in the control row and in the 80-gram netting rows. In 2015, relative humidity was also monitored.

### Exclusion Netting Lowers SWD Infestation

In 2014, the 80-gram netting treatment, which was unsprayed, experienced a very low SWD infestation rate of 0.53% over a 10-week harvest season. The 60-gram netting, also unsprayed, allowed a heavy SWD infestation rate of over 60% infestation. This may be due to the weave of the netting not being tight enough to exclude SWD, or the fact that the support structure in this treatment allowed the 60-gram netting to make contact with the plants, stretching the netting enough to allow fly entry. The control treatment had approximately 15% infestation until spraying was stopped in late August. On Labor Day weekend, temperatures reached almost 100°F and SWD populations rose rapidly. At that time, the control treatment experienced infestation levels of nearly 70% (Figure 4).

In the 80-gram exclusion netting treatment, the first berries with SWD were found on August 25, when 2 adults emerged from collected berries. The highest level of infestation in this treatment was on September 8, when 5 SWD adults emerged. Our last sampling date of September 15 had 3 adults emerge from berries. Over a 10-week period, 12 SWD adults emerged from 2250 berries sampled – a 0.53% infestation level over 10 weeks. Two-thirds of infested samples came from replication sites closest to the entry. Initially, there were significantly more SWD in the 60-gram treatment than in the control (up to 60% infestation in one sampling) because the control was treated four times with insecticide. The 60-gram treatment was never sprayed, illustrating how devastating SWD infestations can be.

In 2015, the 80-gram exclusion netting was compared with a pesticide-treated control. The 2015 season was much shorter, but over a 5-week harvest, the 80-gram netting resulted in a 0.37% infestation rate. On August 4, 2 SWD adults emerged, and on August 11, 3 SWD adults emerged from berry samples. Sampling ended on August 18. The tighter spray schedule on the control bushes also kept SWD in check better than the previous season, but on August 18, our last sampling date, 15 SWD emerged from 75 berries, approximately a 20% infestation (Figure 5).

Both years of temperature data indicate that the 80-gram netting resulted in a slightly higher daytime temperature inside the netting than the 60-gram treatment or the control (Figures 6 and 7). The night temperatures were virtually the same. In 2015, the relative humidity was slightly higher under the 80-gram netting than in the control. During the day, it could be very slightly higher, but not consistently so. At night, it was consistently higher by about 4–6%. However, both treatments were consistently over 90% relative humidity, but under 100% (Figure 8).

Two of the greatest improvements made in the design over the course of the project were zippered doorways and the improved system of using wiggle wire attachment. It’s important to prevent rubbing and abrasion of the net, which results in
holes (Figure 9). These holes can be points of entry for SWD. Other possible points of entry are at the base of the net due to uneven ground and a poor “seal”; inattention at the entryway; and poor connection of the netting “panels”.

### Exclusion Netting Cost

The retail cost of the netting to cover the half-acre of blueberries in this manner (including custom sewing) was $4600, or $0.135 per square foot. When amortized over 5 years, the cost of the netting is $657 per year for a half-acre. With proper care during the winter, Tek-Knit guarantees the netting against UV breakdown for five years. Bird netting ranges from $0.12 to $0.055 per square foot, but roll lengths of the cheaper materials were not appropriate for farm scale plantings. The warranties of bird netting products vary as much as the roll length. The grower estimates that the cost of the system can be re-couped in one year, as opposed to losing 40% of crop, or no longer being able to sell pesticide-free blueberries.

The 80-gram netting effectively excluded SWD from a half-acre blueberry planting, allowing the grower to avoid crop loss and pesticide sprays. The 80-gram netting also protects the crop from birds, deer, hail, wind, and heavy rain, and costs less per square foot than does some bird netting.

Dale Ila Riggs, owner of The Berry Patch, initiated the project, and is also the current president of the New York State Berry Growers Association. The Berry Patch is a 240-acre farm with 10 acres of fresh market vegetables and berry crops that are sold through the farm store, the Troy Farmers Market, and restaurants in the Berkshires. Greg Loeb is a research and extension professor who leads Cornell’s insect control program for small fruits. Stephen Hesler is a research support specialist in Dr. Loeb’s program. Laura McDermott is a Cornell Cooperative Extension Specialist in Eastern NY.

Literature Cited


For the full final report on this NE SARE project, please visit: http://mysare.sare.org/sare_project/fne14-813/?page=final.
For information about the Tek-Knit exclusion netting, please contact Berry Protection Solutions at berryprotection@fairpoint.net.


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