

USING ROW NETTING TO REDUCE FIREBLIGHT TRANSMISSION POTENTIAL IN HIGH DENSITY APPLES

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Produce industry applications

Fireblight Bacteria, *Erwinia amylovora*, is an economically significant disease affecting apple and pear cultivars in North America, especially in high density orchards where infections can quickly spread to an uncontrolled condition (shoot blight) that can spread between trees through insect (pest-pollinator) water & wind transmission in epiphytic infection periods (EIPs).

Orchardists spend hundreds to thousands of dollars each spring applying chemical bactericides to trees in pre-bloom, bloom and post-bloom infection control throughout the growing season. *Erwinia* can become resistant to oxytetracycline and streptomycin antibiotics, necessitating a change to Kasugamycin antibiotics during high (EIPs).

Organic blocks have limited control ability, necessitating the use of peroxide and copper based antimicrobials, with limited effectiveness. Effective antibiotic treatments using oxytetracycline streptomycin and kasugamycin were removed from the NOP approved product listing in 2013.

Serenade, a biological *Erwinia* bactericide consisting of a competing microbe, *Bacillus subtilis* was developed by Agraquest Inc. in 2007 has shown to provide some control of *Erwinia* in Apples. Serenade was purchased by Bayer Crop Sciences in 2011.

Orchardist sometimes use plant physiology regulators like prohexadione calcium (Apogee) and acibenzolar-S-methyl (Actigard) to reduce shoot and central leader growth, making trees less susceptible to Fireblight.

These protective chemical applications have significant costs for beginning orchardists and growers with limited financial resources, especially those with small acreage plantings.

What if controlling physical transmission through netting could reduce *Erwinia* spread enough to allow for the use of just Serenade, copper and peroxide products?

Challenges and opportunities

Row netting is difficult to work with and deploy. Any significant time savings resulting from improved spray intervals and timing will likely be offset by the time it takes to construct nets, fix nets and rigging when damaged by wind, as well as control woolly apple aphids and spider mites that tend to proliferate under the nets.

At this time, until better net deployment and anchoring systems are developed, it should only be recommended to use over-row netting to control fireblight during high EIP events (rainfall at or near king bloom).

Organic operators can use over-row netting to help the transition to organic when using products like Serenade and Oxidate 2.0, but because the spray droplets do not penetrate the heavy and moderate nets that well, resulting in net removal for spray events, this method is of limited benefit. Again, if better net deployment technologies were available, as well as systems for chemical deployment (chemical emitters suspended over trees using drip tape), it could be feasible to use over-row netting more.

Heavy row netting should not be used, at all, for young trees with a less than 1" central leader, unless it is well anchored and suspended away from trees. In moderate-high winds it "lufts" like a sail and easily damages trees, sometimes snapping them at the graft union.

Row netting makes it difficult to control weeds under trees, which not only causes competition for water, but makes refugia for mice, voles and rabbits that tend to girdle trees, requiring the use of rodenticides and/or traps, another unintended consequence.

Row netting overview

Row netting was purchased through NCR SARE Grant FNC18-1119 to use across three orchards in Mason County, MI.

BFG Farm Supply Netting 50 g/m ²	Heavy net
Dubois Ag innovation Netting 38 g/m ²	Moderate net
Bluefire Farm Supply Netting 25 g/m ²	Light net
No netting present	No net
Experimental design	

In spring of 2017, trellised trees were planted at Mighty Oak Orchards, Bedker Orchards and Little Red Organics as a cider apple cooperative (Malicious Apples, INC) Upon notification of FNC18-1119, additional apples were ordered from Cummins Nursery (Ithaca, NY) and additional trellises planned. Little Red Organics is a Certified Organic mixed vegetable farm, and Mighty Oak Orchards is in process of becoming Organic Certified following establishment of 2nd year trees. First year application of fireblight and scab pesticides will be conventional (Mancozeb, Agrimycin, Apogee, Actigard Kasumin-if needed and Firewall) and second year application will be Organic (Magnabon, Serenade, Sonata, Oxidate 2.0). Bedker Orchards is using conventional chemistries, but agreed to trial netting for two years.

Each farm will have a heavy net, moderate net, light net and control. The difference in the netting g/m² corresponds to the mesh diameter. Heavy is largely impervious to rainwater, pollen, large and small insects and about 50% of spray droplets from a pull-behind sprayer (using blue dye against a white sheet). It also has about 78% light transparency. Moderate is somewhat impervious to rainwater (slight beading, bleed-through) and impassable by large and small insects. It collects about 65% of spray droplets using the sheet test and has about an 85% light transparency. Light is slightly impervious to rainwater (less beading, but no large amount of rain collecting on leaves) and impassable by large insects (gnats, mites and aphids appear to get through). It collects 75% of spray droplets using the sheet test and seems to have about a 95% light transparency.

Preliminary results:

Heavy and moderate row netting on wind exposed sites (Mighty Oak Orchards, Little Red Organics led to significant tree losses and damage due to wind shear)

Apple Scab control, as a proxy for Fireblight spore control, was improved under heavy and moderate netting at Bedker Orchards, where wind exposure wasn't as severe a factor.

Row netting at Bedker Orchards (5th year trees)



Fireblight preventative applications (no lesions obs.)

The goals of this project was to see if over-trellis row netting could reduce chemical costs for beginning apple farmers with limited resources and/or needing to rent/borrow a sprayer, ease the transition to organic and improve the effectiveness of organic fireblight and scab efforts, as well as improve spray timing and lengthen spray intervals for conventional apple farmers.

Mighty Oak Orchards 1st year (2018)

3 acres of apples, 0.5 acres (8 rows of 50 trees on 2' spacing under trellis with netting suspended on 50-gauge wire over rows and held 4' away from rows at 6' height.

Copper sulfate Pentahydrate (Magnabon) 50 oz/100 gal 1 application at green tip.

Hydrogen Peroxide + Peracetic Acid (Oxidate 2.0) 32 oz/100gal, 10 day spray schedule

Streptomycin (Agrimycin) within 24 hours of a rainfall event, and every 5-7 days during bloom based on MaryBlyt™ fireblight model recommendations.

Kasugamycin (Kasumin) Oxytetracycline (Firewall) rotated with Streptomycin at least once during bloom.

Prohexadione calcium (Apogee) 4oz/100gal and acibenzar-S-methyl (Actigard) 1oz/acre and Regulaid 3oz/acre 1 application at 5 days after start of king bloom, subsequent application 15 days later.

Serenade (Bacillus subtilis inoculum) 18 oz/100 gal 5 day spray schedule between Oxidate 2.0 applications

Mighty Oak Orchards 2nd year (2019)

Copper sulfate Pentahydrate (Magnabon) 50 oz/100 gal 1 application at green tip.

Hydrogen Peroxide + Peracetic Acid (Oxidate 2.0) 32 oz/100gal, 10 day spray schedule

Serenade (Bacillus subtilis inoculum) 18 oz/100 gal 5 day spray schedule between Oxidate 2.0 applications

Fireblight preventative applications (no lesions obs.)

Mighty Oak Orchards 1st year (2018)

25 acres of apples, 0.5 acres (8 rows of 50 trees on 2' spacing under trellis with netting suspended on 50-gauge wire over rows and held 4' away from rows at 6' height.

Copper sulfate Pentahydrate (Magnabon) 50 oz/100 gal 1 application at green tip.

Streptomycin (Agrimycin) within 24 hours of a rainfall event, and every 5-7 days during bloom based on MaryBlyt™ fireblight model recommendations.

Kasugamycin (Kasumin) Oxytetracycline (Firewall) rotated with Streptomycin at least once during bloom.

Prohexadione calcium (Apogee) 4oz/100gal and Regulaid 3oz/acre 1 application at 5 days after start of king bloom, subsequent application 15 days later.

Little Red Organics 2nd year (2019)

Copper sulfate Pentahydrate (Magnabon) 50 oz/100 gal 1 application at green tip.

Hydrogen Peroxide + Peracetic Acid (Oxidate 2.0) 32 oz/100gal, 10 day spray schedule

Serenade (Bacillus subtilis inoculum) 18 oz/100 gal 5 day spray schedule between Oxidate 2.0 applications