Northeastern IPM Center Partnership Grants Program

A. Grant Data

- Today's date: September 30, 2008
- Type of Project: MINIGRANT
- Title: Dissemination and Vectoring of the Fire Blight Pathogen by the Potato Leafhopper
- Project Director: Kathleen Leahy, consultant, Polaris Orchard Management, 364 Wilson Hill Rd, Colrain, MA 01340 (413)624-5104; polaris2@rcn.com
- Team members: Duane Greene, Daniel Cooley University of MA, Amherst, MA
- State(s) involved: MA
- Funding Start Date: 5/2007
- Funding Amount: $7950

B. Nontechnical Summary. Fire blight is a serious disease of apple trees caused by a bacteria, *Erwinia amylovora*. This disease can not only destroy the current year's crop, but can destroy the tree altogether, especially in young plantings. Warmer conditions during the susceptible period in late spring and early summer, and the conversion of many orchards to new, more fire blight-susceptible varieties, have made this disease of even more concern in the Northeast in recent year. Most research on fire blight epidemiology has focused on its transmission during the spring, from bud break until after bloom. However, transmission is also possible during the summer, and insects have long been suspected of contributing to the movement and introduction of bacteria into the growing shoots during the summer.

Evidence from several research projects has led to increased focus on the potato leafhopper, a migratory pest that feeds in the phloem of a wide variety of plant species, as an important facilitator of fire blight during the summer. Potato leafhoppers may be uniquely capable of introducing bacteria into apple foliage because of the damage they cause to the plant vascular system during feeding. Controlling potato leafhoppers has been shown to significantly improve summer fire blight control. The threshold level of leafhoppers needed to transmit the disease is still unknown, as is the question of whether these insects carry bacteria from tree to tree in addition to introducing the bacteria into leaves during feeding. This project seeks to address these two important questions, which could lead to improved control of summer fire blight with significantly less pesticide use.

C. Objectives.

CI. *The first experiment will assess the facilitation of fire blight by potato leafhoppers, and try to establish both a threshold population density and a plateau density beyond which fire blight damage does not increase.* A threshold population density was determined and associated with a detectable level of leafhopper feeding injury. The plateau density was less clear, but there did not appear to be a significant increase in disease incidence between moderately and very high densities.

CII. *The second experiment will assess the possibility of the insects' vectoring the disease by carrying it to new trees on their bodies.* This objective was partially achieved. Bacteria were recovered from the bodies of a small number of insects that were released on trees that had been mist-inoculated with the fire blight bacteria. Movement from infected to uninfected trees was not seen, nor were new infections observed on uninfected trees.

D. **Approach.** Two-year-old apple trees were enclosed in 24 outdoor fabric mesh cages for both experiments. Trees were irrigated and fertilized to maintain plant health. Fungicides were applied through the end of May to control apple scab, but no sprays of any kind were applied after that. In the first experiment, all trees were misted-inoculated with a suspension of *Erwinia amylovora* bacteria. Potato leafhoppers were released into the cages in incrementally increasing numbers, from 0 to 360 leafhoppers per cage. Leafhoppers were allowed to feed freely on the inoculated foliage. Trees were examined 10 days after the inoculation and release for symptoms of fire blight.

In the second experiment, pairs of trees were placed in each cage, and a factorial experiment was done using +/- *Erwinia amylovora* on one tree of the pair, and +/- potato leafhoppers. Leafhoppers were collected at regular intervals, flash-frozen, crushed, and plated on selective medium to determine whether they were carrying *E. amylovora* on their bodies. Leaves of the paired tree, which was not directly inoculated, were collected and washed onto selective medium to determine if bacteria had been transferred by the insects from the infected to the uninfected trees. The trees were also examined 10 days and 20 days after the initial inoculation to determine if infection had been fully transmitted.

E. Results. Provide a brief explanation of your results *in 1-2 paragraphs*. Include a discussion of any unexpected events that seem noteworthy.

There was a significant increase in the incidence of fire blight when potato leahoppers were present at levels of 180 leafhoppers per cage and above. This population also correlated with visible leafhopper feeding damage, with substantial yellowing and some curling of the leaves. This confirms the preliminary field results that visible leafhopper feeding damage was correlated with increased fire blight incidence under favorable weather conditions. The correlation between visible damage and fire blight incidence is significant for insect control decisions during a fire blight outbreak, since growers have a yardstick by which to measure the risk of insects contributing to fire blight spread.

A small number of leafhoppers were found to be carrying *Erwinia amylovora* bacteria on their bodies, consistent with work that was done in Europe that indicated that

several insect species carried detectable levels of *E. amylovora*. There was no significant movement of the bacteria from infected to uninfected trees as a result of the insects. This was not unexpected owing to the likely need for extremely high numbers of leafhoppers needed to not only pick up the bacteria from infected trees, but drop it on uninfected trees under favorable weather conditions. These numbers would be likely to occur under field conditions, but are very difficult to reproduce under experimental conditions.

F. Impacts.

Potato leafhoppers are susceptible to control by a variety of integrated measures, including greatly reduced insecticide rates and low-risk insecticides, as well as suppression by the shoot growth regulator prohexadione-calcium. New recommendations will be developed using the thresholds developed in this work, in conjunction with integrated control measures. This approach could greatly reduce the use of insecticides during a fire blight outbreak. Results of this work and suggested monitoring and control methods will be communicated directly to the growers who work with Polaris Orchard Management (20 growers, 900 acres), and by newsletter to those who receive the weekly Polaris IPM Newsletter (50 growers and several Extension personnel). In cooperation with University Extension personnel, these results can also be presented at grower meetings. Results will also be posted on the Polaris IPM web site, http://www.polarisipm.com; this web site is currently under development but will have a New England-wide focus and, potentially, a significant clientele among commercial apple growers in the region.

Further work on the interface between potato leafhoppers, fire blight, and the plant vascular system has been funded on a U.S. Environmental Protection Agency Pesticide and Environmental Stewardship Program grant for 2008-2009. Upon completion of this work, further funding will be sought for implementation and dissemination of these results to a wider audience, including growers beyond the northeastern United States.