Potato Leafhopper

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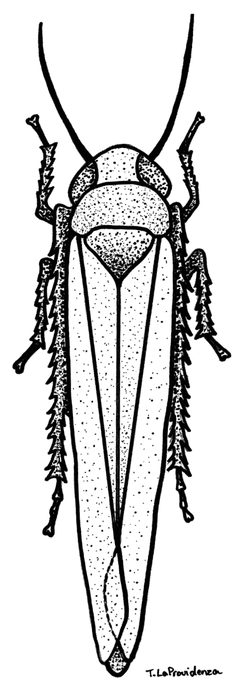
Potato leafhopper, *Empoasca fabae,* is a well-known insect pest of a variety of agriculturally important plants, including potatoes, beans, alfalfa, soybeans, and apple. Its status as a pest largely depends on the development of populations each year, from their initial migration into the northeastern states through several generations of development on various plant hosts. Unlike a number of other sap-feeding insects, potato leafhopper is not known to transmit pathogens causing plant disease. Instead, its feeding injury is relatively unique among sap-feeders because of the degree of disruption of normal plant physiological processes. Combining the rapid population development with the severe nature of its injury, potato leafhopper has the potential of being a severe pest of many vegetable crops. Here, I will discuss the reasons for the population development of potato leafhopper and its injury and conclude with a discussion of management strategies.

Population Development

Potato leafhoppers overwinter as adults in pine trees throughout the southeastern United States (Taylor and Shields 1995 a,b). In late winter, the adults move to the early growth of nearby legumes and lay eggs. After hatching and growing through five instars, nymphs mature into adults that can migrate long distances, with the help of favorable winds, to new regions and new host plants. Through several generations, leafhoppers move northward, tracking the spring development of hosts. In western Maryland, the first migrant adults are detected between mid-April and mid-May, and densities slowly increase with the passage of each weather front. The density of the first few adult migrations is too low to cause any significant injury to plants. These early migrants to the north reproduce best on deciduous trees, such as oaks, elms, and hickories (Lamp et al. 1994). The generation of adults from these local hosts typically causes the largest number of leafhoppers that invade crop plants. In Maryland, this first local generation occurs mid-June to early July. Co-occurrence of this generation with suitable host plants is associated with the greatest damage to crops. The size of this generation is highly variable. During extreme drought conditions when the tree hosts are stressed, leafhopper densities are low. During extreme wet and/or cool conditions, leafhopper densities are also low. However, densities achieve outbreak status when the tree hosts have adequate moisture in the spring, followed by warm, dry conditions in late spring and early summer. Natural enemies and the decline of host conditions are associated with the decline of densities, especially during August.

Injury and Symptoms

Potato leafhopper injures plants by feeding on vascular tissues in stems or in leaf veins. The mechanical injury of probing, combined with the injection of saliva, causes the plant to respond with abnormal cell growth (Ecale and Backus 1995). In alfalfa, this results in disruption of the normal function of translocation in the phloem and is associ-



Leafhopper adult

ated with the reduction of photosynthetic rates of leaves (Nielsen et al. 1990, Flinn et al. 1990). This injury occurs shortly after feeding commences, although visually detected symptoms may not be observed for another week. Symptoms of injury vary with the degree of injury, the plant species, the specific tissue injured on the plant, the developmental stage of the plant, and the cultivar of the plant (Cuperus et al. 1983, Walgenbach and Wyman 1985). For example, there is evidence that some potato genotypes show tip burn of leaves, while others show a curling of the leaves. For some plants, the leaves curl up; for others, the leaves curl down. Economic damage is expressed by reduced growth of the crop plants, resulting in reduced yields or, in extreme cases, death of the plants and complete crop loss.

Preventive and Responsive Management

Ideally, pest management seeks to manage pests using economically efficient and environmentally sound approaches. It relies primarily on preventive approaches, such as host plant resistance, biological control, and cultural practices to maintain pest populations and their injury below damaging levels. If preventive approaches fail, then responsive practices, such as the application of pesticides, are used on the basis of pest densities and the comparison to established economic thresholds. In recent years, new terms have developed, e.g., biologically intensive integrated pest management, biologically-based pest management, ecologically-based pest management, and total system approach to sustainable pest management. The new terms place even more emphasis on sustainable approaches for pest control, with the goal "to restore and preserve balance to the managed ecosystem by duplicating natural processes to the maximum extent possible" (U.S. Congress 1995).

For potato leafhopper and vegetable crops, preventive approaches are few. Although the leafhopper has natural enemies, they tend to be effective only after considerable injury has already occurred. Host plant resistance is effective, however, resistant varieties are not available for all crops, and generally this approach is not completely effective during severe outbreaks (Elden and McCaslin 1997). Various cultural controls may be useful for specific crop systems, such as manipulating planting dates and harvest or co-cropping in association with nonhost plants. Again, these approaches have disadvantages as well. Because of the variable nature of populations from year-to-year, a responsive approach is often the best (and only) strategy for growers: sample crop plants for leafhoppers and apply a natural or synthetic insecticide if justified on the basis of leafhopper densities.

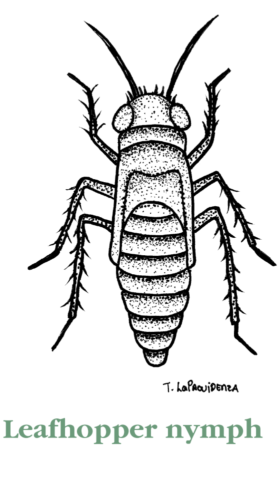
Conclusions

Conditions to the South and subsequent air movement patterns cause a random placement of migrant potato leafhoppers within the northeastern states each spring. Local conditions then determine the success of the local generation, and in some years lead to outbreaks of the leafhopper. The injury to plant physiology can be extreme, although the symptoms may be slow to develop. Thus, prevention of the leafhopper from ever injuring the crop would be best for growers but is difficult or is not an option with most vegetable crops. Instead, growers must respond to an outbreak by sampling for its occurrence and deciding quickly how to deal with the problem.

Discussion: Potato Leafhopper

Bill Lamp noted that red clover and alfalfa are good nursery plants for potato leafhopper as well as for beneficial insects. Movement of the leafhopper into vegetable crops may be stimulated by cutting alfalfa in neighboring fields. Grasses are generally not good hosts for this leafhopper species.

On the subject of monitoring and economic thresholds, Bill Lamp suggested various monitoring meth-



Leafhopper nymph

ods but was skeptical about whether an appropriate economic threshold could be developed from monitoring individual fields. Leafhoppers can be monitored by counting the nymphs per leaf, per sweep sample, or per sticky trap (using yellow Pherocon® sticky traps mounted horizontally in the field and changed once per week). Numbers of nymphs are better correlated with damage than numbers of adults. However, the problem with an economic threshold in a particular field is that abundance of nymphs or adults at a particular time is not a good predictor of the future, because these insects are so highly mobile. A more appropriate threshold would be on an area-wide basis, including information about weather systems bringing leafhoppers up from the South. He also commented that drought stress appears to increase the likelihood of potato leafhopper outbreaks.

Questions were asked and comments were made about various potential control methods. In response to a question about insecticidal soap, Bill Lamp suggested that it would not last long enough or be effective enough in preventing adults from laying eggs. He was uncertain about the effects of insecticidal soap on nymphs. In response to a question about biological control, Bill said that there has been research on a parasitic wasp, but the work is difficult, because the wasp parasitizes eggs embedded in plant tissue, and thus progress has been slow. The audience commented that Pyrenone® was used in Maine but is not allowed by organic certifiers in all states.

Wayne Hansen, a grower in Connecticut, commented that he had observed that the potato varieties 'Kennebec' and 'Blossom' were most resistant in his experience; with 'French Fingerling,' 'Purple Peruvian,' and 'LaRatte' moderately resistant; and 'Rose Finn Apple,' 'German Butterball,' 'Island Sunshine,' 'Maris Piper,' and 'Kerr's Pink' more susceptible.

[Editor's note: I have tested the potato variety 'NYL 235-4' from Cornell, bred for resistance to potato leafhopper and aphids and partial resistance to Colorado potato beetle, and found that it did have lower numbers of leafhopper nymphs, less visible damage, and higher yield under leafhopper attack than the variety 'Superior.' This resistant variety is in the Moose Tubers catalog (P.O. Box 520, Waterville, ME 04903). The mechanism of resistance is a leaf surface covered with sticky glandular trichomes (Plaisted et al. 1992). Although this variety was developed through an interspecies cross with a wild relative, it is not genetically engineered.]