FIELD CROPS

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Sampling and Management of Potato Leafhopper in Alfalfa Grown in the Northeastern United States

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Introduction

The current emphasis on high-quality forage production has made many growers and agricultural consultants aware of the economic importance of controlling the potato leafhopper (*Empoasca fabae* Harris) on alfalfa. Although rarely present in numbers large enough to damage the first cutting, the potato leafhopper is the most damaging insect pest of alfalfa during the second and third cuttings in most of the Northeast. To protect plant quality and yield, the control of this insect on alfalfa during the second and third cuttings has become a focus of Integrated Pest Management programs.

Unable to overwinter north of the Gulf States, the potato leafhopper migrates into the Northeast on warm spring winds from the south. The arrival time and the magnitude of leafhopper migration vary each year, depending on the southern spring climate, the spring crop production patterns in the South, and the weather. The arrival of leafhoppers in the Northeast varies from mid-May until late June.

Description and Life Cycle

The adult potato leafhopper is yellow-green, wedge shaped, and about 1/8 inch long (fig. 1). It is very active and either jumps or flies when disturbed. The female lays eggs in plant stems, leaf petioles, and leaf veins using a sharp ovipositor.

Young nymphs hatch from the eggs in 7 to 10 days, depending on the air temperature. The nymphs resemble adults but are smaller, lack wings, and have a more pronounced yellow color, which ranges from bright yellow to yellowish green (fig. 2). They characteristically walk sideways at a rapid pace when disturbed. During the next 14 to 17 days, the nymphs pass through five molts before molting into adults. The complete life cycle, from egg to adult, takes 21 to 30 days. Adults are long lived, and the females are capable of laying eggs throughout their lives. As a result, large population increases and overlapping generations are common through mid-August. Leafhoppers continue to reproduce until they are killed by freezing weather in the fall.

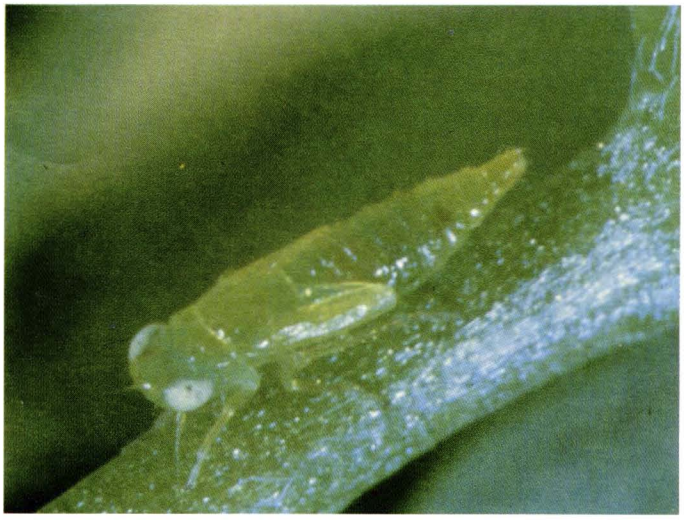

Figure 2

Figure 1

Figure 3

Feeding Damage and Economic Loss

In all stages of their life cycle, potato leafhoppers use their piercing, sucking mouth parts to extract juices from host plants. During feeding, they secrete into the plant tissue a salivary toxin that disrupts the plant's physiology, resulting in a wedge-shaped yellow (sometimes reddish) area at the leaf tip. This discoloration is called hopper burn (fig. 3). As feeding damage increases, yellowing spreads over the entire leaf, and plant growth is stunted. A field of damaged plants takes on a yellowish coloration.

Damage from leafhopper feeding has several important economic effects.

Loss of plant quality and yield. The most serious effect of leafhopper feeding is protein reduction. The salivary toxin injected by the potato leafhopper during feeding causes the plant to produce less protein and more sugars, seriously decreasing the nutritional value of the plant to livestock. Research data have shown that significant protein loss can occur with relatively small leafhopper populations. A ten-fold increase of the leafhopper population (from 5 to 50 per sweep) can reduce protein by 5 percent and reduce total dry matter yield by 20 to 40 percent.

Loss of plant vigor. Leafhopper feeding drains alfalfa of its vigor, with the following serious effects:

- Regrowth following harvest is slow.
- Plants enter dormancy in a weakened condition and winter kill and stand loss occur.
- Alfalfa yield is decreased the following season.

Research comparing alfalfa fields in which damaging potato leafhopper populations were either controlled or not controlled has shown that in stands where leafhoppers were controlled the previous year, alfalfa yield often increased by 1/2 ton per acre during the first cutting the following year.

Preventing Losses Caused by the Potato Leafhopper

To successfully avoid the losses resulting from feeding damage, it is important to detect a leafhopper problem as early as possible. Plant quality and vigor are lost quickly on young regrowth, before symptoms appear. Once symptoms are visible, further damage can be prevented but losses that have already occurred cannot be recovered.

The need for leafhopper control in alfalfa is determined by the size of the leafhopper population and the height of the crop. A damaging leafhopper population is detected by sampling the field. Sweep samples, collected with a standard 15-inch-diameter insect sweep net, are used to estimate leafhopper populations. A number of sites throughout the entire field are sampled, and the leafhoppers captured in the sweep net at each location are counted. To be accurate, a minimum of 100 total sweeps should be taken in each field. Stem samples are measured to estimate crop height.

Sampling the Field

Field sampling should begin shortly after the first cutting has been removed. If the first harvest has been greatly delayed, sampling should begin by June 10. Fields are commonly sampled in an M-shaped or X-shaped pattern (fig. 4). Fields with odd shapes require modifications of these patterns. The number of sites sampled within a field depends on the sampling procedure used.

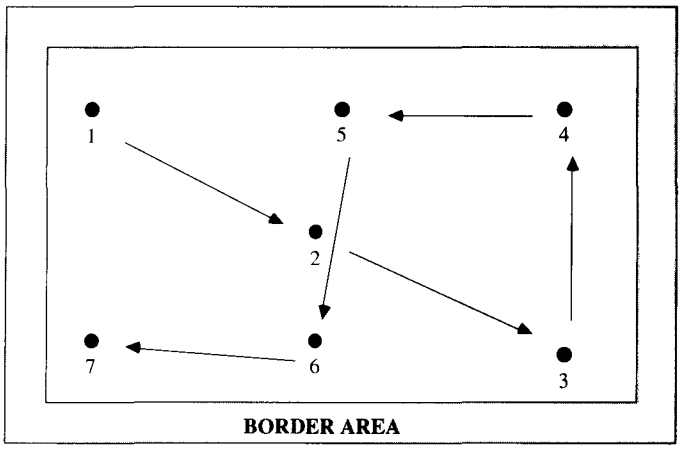

Fig. 4. Field sampling pattern. Numbers indicate the location and the order in which sites in a field are to be sampled.

Three sampling procedures are commonly used in the Northeast to estimate damaging leafhopper populations: in one method, 4 field sites are sampled with 25 sweeps per site; another uses 5 field sites with 20 sweeps per site; and the third uses 10 field sites with 10 sweeps per site. Recent research at Cornell University has shown the procedure using 10 field sites with 10 sweeps per site is the most accurate and time-efficient method.

To sample sites in a field, use the *pendulum sweeping method* to collect leafhoppers: while walking, sweep the net down into the alfalfa, side to side, like a pendulum. For each sample, count the adult and nymph leafhoppers and determine the average number per sweep of the net. Randomly measure 5 alfalfa stems at each sample site to estimate the crop height. To prevent bias, look away while selecting the stems.

Deciding on Control

The need for leafhopper control can be determined by comparing the average number of leafhoppers captured per sweep with the height of the alfalfa. If the leafhopper population in the field equals or exceeds the threshold for the stem height given on table 1, control measures are recommended.

Table 1. Treatment Thresholds for Potato Leafhopper in Alfalfa

Stem Height (Inches)	*Threshold (Average Number of Leafhoppers per Net Sweep)*
under 3	0.2 adults
3 to 6	0.5 adults
7 to 10	1.0 adult or nymph
11 to 14	2.0 adults or nymphs

Sequential Sampling Procedure

In many situations, accurate potato leafhopper management decisions can be made more rapidly using the sequential sampling procedure. Sequential sampling combines field sampling with the treatment thresholds of table 1. This procedure maximizes sampling accuracy and minimizes sampling efforts. As outlined below, growers sample 3 field sites and, based on the average plant height and the total number of leafhoppers collected for that sampling, decide to treat, not treat, or resample their field.

1. Take 10 sweeps at each of 3 different field sites in a transect diagonally across the field (sites 1–3, fig. 4). Total the number of leafhoppers (adults and nymphs) collected from the 3 sites. Measure the height of the alfalfa at each site.

2. Select the section in table 2 that most closely matches the average plant height. Compare the total number of leafhoppers collected with the treatment thresholds for 3 field sites sampled. If the number of leafhoppers matches the threshold in either the *Don't Treat* or *Treat* column, you are finished sampling the field and should take the recommended action. (Note: When the management recommendation is "treat," the crop height is greater than 10 inches, and normal harvest is less than 10 days away, consider an early harvest rather than applying an insecticide.)

3. If the number of observed leafhoppers matches the number in the *Continue Sampling* column, take another 10-sweep sample at an additional field site (site 4, fig. 4), add the number of leafhoppers collected at the additional site to the total number of leafhoppers already collected, and compare this number with the treatment thresholds for 4 field sites sampled. Repeat, adding sampling sites as necessary, until a decision is made or until you have sampled 10 field sites (the 7 sites numbered in figure 4 and 3 additional sites).

4. If after 10 field sites a treatment decision is not reached, wait 5 to 7 days and resample the field.

Example 1
After sampling 3 sites in an alfalfa field, you have counted a total of 8 potato leafhoppers (adults and nymphs) and have determined the crop height to be between 3 and 6 inches. Looking at table 2 under the treatment thresholds for a plant height of 3 to 6 inches and for 3 field sites sampled, you find your 8 collected leafhoppers match the number in the *No Treat* column. Therefore you should not treat the field for potato leafhopper. You are finished sampling and should revisit the field in 7 days to resample.

Example 2
After sampling 3 sites in an alfalfa field, you have counted a total of 45 leafhoppers (adults and nymphs) and have determined the crop height to be between 7 and 10 inches. Looking at table 2 under the treatment thresholds for a plant height of 7 to 10 inches and for 3 field sites sampled, you find your 45 collected leafhoppers match the number in the *Treat* column. The field should be treated for potato leafhopper with a registered insecticide (see the current *Cornell Recommends for Field Crops*) within the next few days to prevent leafhopper damage to the alfalfa.

Example 3
After sampling 3 sites in an alfalfa field, you have counted a total of 5 leafhoppers (adults and nymphs) and have determined the crop height to be less than 3 inches. Looking at table 2 under the treatment thresholds for a plant height of less than 3 inches and for 3 field sites sampled, you find your 5 collected leafhoppers match the number in the *Continue Sampling* column. You take an additional 10 sweeps at another field site, count 3 leafhoppers, and add them to the 5 you have already collected. Looking at table 2 under the treatment thresholds for 4 field sites sampled,

Table 2. Using Sequential Sampling to Decide on Potato Leafhopper Control on Alfalfa in New York

	Treatment Thresholds (Cumulative Number of Leafhoppers)		
Number of Field Sites Sampled	*Don't Treat*	*Continue Sampling*	*Treat*
	Plant Height <3 Inches		
3	≤ 2	3 - 8	≥ 9
4	≤ 4	5 - 10	≥ 11
5	≤ 5	6 - 12	≥ 13
6	≤ 7	8 - 14	≥ 15
7	≤ 9	10 - 15	≥ 16
8	≤ 11	12 - 17	≥ 18
9	≤ 13	14 - 19	≥ 20
10	≤ 15	16 - 21	≥ 22
	Plant Height 3-6 Inches		
3	≤ 9	10 - 19	≥ 20
4	≤ 14	15 - 24	≥ 25
5	≤ 18	19 - 29	≥ 30
6	≤ 23	24 - 34	≥ 35
7	≤ 28	29 - 39	≥ 40
8	≤ 33	34 - 44	≥ 45
9	≤ 38	39 - 48	≥ 49
10	≤ 43	44 - 53	≥ 54
	Plant Height 7-10 Inches		
3	≤ 19	20 - 40	≥ 41
4	≤ 29	30 - 49	≥ 50
5	≤ 39	40 - 59	≥ 60
6	≤ 49	50 - 69	≥ 70
7	≤ 59	60 - 79	≥ 80
8	≤ 69	70 - 89	≥ 90
9	≤ 79	80 - 99	≥ 100
10	≤ 89	90 - 109	≥ 110
	Plant Height >10 Inches		
3	≤ 44	45 - 74	≥ 75
4	≤ 64	65 - 94	≥ 95
5	≤ 84	85 - 114	≥ 115
6	≤ 104	105 - 134	≥ 135
7	≤ 124	125 - 154	≥ 155
8	≤ 144	145 - 174	≥ 175
9	≤ 164	165 - 194	≥ 195
10	≤ 184	185 - 214	≥ 215

you find 8 leafhoppers are still within the number in the *Continue Sampling* column. After taking a fifth sample, the total number of leafhoppers you have collected is 14, which fits the number in the *Treat* column. Your field sampling is finished. The field should be treated for potato leafhopper with a registered insecticide (see the current *Cornell Recommends for Field Crops*) within the next few days to prevent leafhopper damage.

Control Options

If the alfalfa crop is within 10 days of harvest, an early harvest is an alternative to the use of an insecticide for the control of potato leafhopper. The early regrowth, however, is tender and susceptible and must be closely monitored to prevent damage from surviving leafhoppers. If harvest is more than 10 days away, the application of an insecticide is the only satisfactory method of leafhopper control.

Several insecticides are registered for control of potato leafhopper and most are effective. Before selecting an insecticide, however, compare the available insecticides for applicator safety, ease of application, days until harvest, and cost. Considerable differences exist. Always price alternative chemicals sold by local chemical dealers. Insecticides currently registered for use on potato leafhopper in alfalfa are listed in the current *Cornell Recommends for Field Crops.* (This information is also regularly updated in Pest Management Recommendations for Field Crops on CENET.)

Leafhopper damage is most severe when a crop is under moisture or fertility stress. Good agronomic production practices, which include selecting a proper site, ensuring optimum soil fertility and pH, planting disease-resistant plants, and observing a proper harvest interval, encourage vigorous alfalfa plants and limit the amount of damage caused by this insect.

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