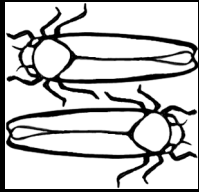


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# IPM for Potato Leafhopper on Alfalfa

by Philip Sutton and James VanKirk

## Overview



<b>Concept</b>	<b>Activity</b>	<b>Handouts</b>
Understanding the natural history of potato leafhoppers—their life cycle and the damage they cause—helps us know how to deal with them.	#1: The Natural History of the Potato Leafhopper	Your state's <i>Potato Leafhopper I.D. Sheet</i> A. <i>Potato Leafhopper Life Cycle and Characteristics</i>
To determine which management method is best for our situation, we need to learn about and compare the values of early harvest, pesticide sprays, and natural controls.  Sampling and scouting information— properly recorded— forms the basis for sound decisions on leafhopper control.	#2: Sampling for Potato Leafhopper	Your state's potato leafhopper scouting form  B. <i>Management Options for Leafhopper Control</i>
<b>Resources</b>  <i>Pest Management Recommendations for Field Crops (DE, MD, NJ, PA, VA, WV)</i>  Cornell Recommends for Field Crops	<b>Related Topics</b>  Module #3: Principles of Scientific Sampling Module #4: What Is a Threshold? Module # 5: Economic Implications of IPM	

### Here's what you'll do:

#### Beforehand

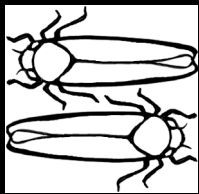
- ◆ set this up with a farmer who is likely to have problems with leafhoppers.

#### Today, on site

- ◆ discuss the kinds of leafhopper damage participants have now;
- ◆ learn how to distinguish and identify leafhoppers;
- ◆ learn their life cycle;
- ◆ practice leafhopper sampling technique;
- ◆ determine which sampling method you'll use;
- ◆ discuss what you need to do before you sample;
- ◆ scout a field for leafhopper presence;
- ◆ discuss management options.

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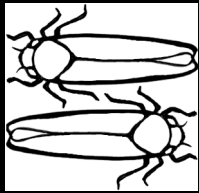
## ACTIVITY #1: The Natural History of the Potato Leafhopper

<b>Setting</b>	<b>Time Required</b>	<b>Materials</b>	<b>Handouts</b>
<i>A farmer's field shortly after first cutting, or by May 1 in DE and MD, May 15 in PA and CT, June 10 in NY and MA, June 25 in VT, NH, and ME.</i>	10 minutes	Hand lens	Your state's Potato Leafhopper I.D. Sheet A. Potato Leafhopper Life Cycle and Characteristics

<b>Q:</b>	<b>Pose a series of questions:</b>	<b>A:</b>
What kind of damage due to leafhoppers do you generally see on alfalfa, and how much of a problem is it for you?	Answers will vary... <i>Mini-lecture: Leafhoppers are a native that's probably been causing crop damage ever since the Native Americans planted beans. They migrate north every spring and south in the fall. They get into the low-level jets (jet stream) and can make it from the Gulf Coast to the Northeast in two jumps. That's not bad for something you can hardly see.</i> <i>Why don't you see leafhoppers every year? Well, some years the jets take them mostly to the Midwest, other years most end up here; some years they get dumped in the Atlantic Ocean and become fish bait.</i> <i>Leafhopper populations also seem to correlate with when people start mowing the levees along the Mississippi. When the mowing coincides with when leafhoppers hatch, not nearly as many survive to fly north.</i> <i>In most parts of the Northeast, leafhoppers cause the most damage of any alfalfa pest.</i>	
What do potato leafhoppers look like?  <i>Hand out your state's Potato Leafhopper I.D. Sheet.</i>	They are tiny (up to 1/8" long as adults). Look at the enlarged photos on the I.D. sheet to notice... <ul style="list-style-type: none"> <li>◆ lime green color (assuming your I.D. sheet is in color...)</li> <li>◆ wedge shape</li> <li>◆ wing buds on nymphs</li> <li>◆ wings on adults</li> <li>◆ white eyes</li> </ul> As we sample in the field, we'll confirm these observations with a hand lens.	
When can we expect to see potato leafhoppers?	Look for them to arrive shortly before first cutting of alfalfa, and to start inflicting damage on the young stems of regrowth.	
When do leafhoppers cause the most damage?	They usually cause the most damage on new seedlings of alfalfa or on the 2 <sup>nd</sup> and 3 <sup>rd</sup> cuttings.	

<b>Q:</b>	<b><i>The last in the series of questions</i></b>	<b>A:</b>
<i>Hand out Potato Leafhopper Life Cycle and Characteristics. Refer to column A, Life Cycle, during this discussion:</i>		
<p>What sort of damage do potato leafhoppers cause?</p>	<p>Adults use their sucking mouthparts like a two-way hypodermic needle—they inject toxins into leaves while sucking sap out. The toxins damage the plant’s vascular tissue and cause...</p> <p>HOPPER BURN: wedge-shaped yellow or reddish areas at the tips of leaves. As feeding continues, the “burned” area spreads over entire leaves, meaning...</p> <ul style="list-style-type: none"> <li>◆ plants produce more sugars and less protein;</li> <li>◆ protein content of leaves falls by up to 5%. (This may not seem like a lot. But consider: that can mean a total dry matter yield loss of up to 40%.)</li> <li>◆ plants enter winter dormancy in a weakened state;</li> <li>◆ plant stress causes increased root rot and many stand failures;</li> <li>◆ yield on first growth the following year may be reduced by up to 1/2 ton per acre.</li> </ul> <p><i>NOTE: Plant quality and vigor are lost quickly on young regrowth, before you notice visible signs of damage. Further damage can be prevented, but losses already sustained can t be recovered.</i></p>	

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# IPM for Potato Leafhopper

## ACTIVITY #2: Sampling for Potato Leafhopper

Setting	Time Required	Materials	Handouts
A farmer's field shortly after first cutting, or by May 1 in DE and MD, May 15 in PA and CT, June 10 in NY and MA, June 25 in VT, NH, and ME.	30 minutes per field. Try at least two fields to experience different conditions	sweep nets, measuring tapes, clipboards, pencils, scouting forms, magnifying lenses	Your state's potato leafhopper scouting form B. Management Options for Leafhopper Control

Q:	Pose a series of questions:	A:
		First, have everyone do a couple of practice runs with a sweep net. How do you use a sampling net? <ul style="list-style-type: none"> <li>◆ Hold the net sort of like a broom or a golf club. Swing it in front of your body like a pendulum as you walk.</li> <li>◆ Sweep 3 to 4 inches below the tops of the plants.</li> <li>◆ Each time the net passes in front of your body equals one sweep. Take a step or two between each sweep.</li> </ul>
Why do you think we're using sweep nets for leafhoppers instead of just picking them the way we did in the weevil class? (Ad lib if you haven't done a weevil class.)		Leafhoppers don't sit around and take tea.
Knowing how flighty leafhoppers are, what natural force do we need to take into account when we sweep? (Give hints if you need to.)		The wind. (The person who gets this right takes the first set of sweeps. Let's hope s/he walks into the wind!) You can sample any time the field is dry. Avoid cold or windy weather.
What techniques and procedures should we use to get a representative sample? Why?		Avoid the field borders—don't focus on the heavy spots—zigzag through the field. Reverse the "W" if you need to take more samples. Your state's guidelines may offer further clarification. Otherwise our sample is biased.
How might heavy dew or recent rain affect our sample?		Heavy dew reduces the count. (Like we said, sample only when it's dry.) A heavy rain could have knocked the leafhoppers nymphs down. (We may need to sample again in a week.) ON THE OTHER HAND: A summer storm front could bring new adults into the area. (See control options.)

Q:	<b>Pose a series of questions:</b>	A:
<p>Can you tell all the insects apart? Which ones are really leafhoppers? <i>Use your magnifying lens to look</i></p>		<p>Green aphids look like potato leafhopper nymphs. Aster leafhoppers look like potato leafhoppers! Spittlebugs are much larger and brown—but they hop a lot, and people often think they are leafhoppers. <i>Accurate ID is essential.</i></p> <ul style="list-style-type: none"> <li>◆ Show aster leafhopper if possible to avoid misidentification.</li> <li>◆ Compare with aphids, too. Aphids don't walk sideways! And the color is wrong. Note the cornicles on the aphids. Your ID sheet may give this comparison.</li> </ul> <p><i>What other species did we find?</i></p> <p>(Pea aphids, ladybirds, nabids, tarnished plant bugs, spiders...)</p> <ul style="list-style-type: none"> <li>◆ <i>Especially watch for parasitized or diseased insects these are examples of biological control.</i></li> </ul>

<b>Sampling procedure:</b>
<p><i>Distribute sweep nets, clipboards, pencils, and scouting forms for your state. Have growers fill out the forms. <b>And now it's time to start sampling.</b></i></p>
<p><i>But first, some more on using the sweep net and tallying your catch:</i></p>
<ul style="list-style-type: none"> <li>◆ Don't stop swinging till you've taken all the sweeps (<i>varies according to state</i>) at each site.</li> <li>◆ Continue swinging the net back and forth after the complete set of sweeps to force the insects into the small end of the bag. Grasp the bag quickly about a foot from the end to trap the leafhoppers.</li> </ul>
<p><i>Now for the tricky part counting the critters. They can pop out of the net easily. You may:</i></p>
<ul style="list-style-type: none"> <li>◆ unfold the net slowly and let them escape a few at a time, counting as they appear. Check the interior walls of the net for nymphs—they don't fly;</li> <li>◆ a puff from a pyrethrin canister will slow them down or kill them, and make them easier to count.</li> </ul>
<p><i>Disregard any brown leafhoppers count only the pale green ones.</i></p>
<p><i>At each site you'll measure according to your state's guidelines several alfalfa stems to estimate average crop height. So just to illustrate yet another potential bias:</i></p>
<ul style="list-style-type: none"> <li>◆ have participants pick several stems as they normally would—by looking at what they're doing!—then do it again while looking away. Compare the results.</li> </ul>
<p><i>How can we avoid height bias? Look away while picking or as you place your tape measure amongst the crop.</i></p>
<p><i>As you work through the actual sampling procedure for your state be sure everyone gets a turn!</i></p>
<p><i>PA samples five sites in a U or I pattern (see below).</i></p>
<ul style="list-style-type: none"> <li>◆ Make 20 sweeps at each of the sites. Zigzag back and forth within each site as you sweep. (See close-up, below.)</li> <li>◆ Count the leafhoppers in your net after each 20 sweeps.</li> <li>◆ Total up the numbers for all 5 sites.</li> <li>◆ Divide your total catch by 100. This gives you the average number of leafhoppers per sweep from the entire field.</li> <li>◆ Refer to your scouting card to determine your next step.</li> </ul>

**Sampling procedure, continued:**

*NY's sequential sampling scheme measures leafhoppers at three sites at a time*

- ◆ Start by sampling three sites (see diagram), taking 10 sweeps at each site.
- ◆ Tally all the leafhoppers—adults and nymphs both—in the net to get the total for the site.
- ◆ At each site add the catch onto the running total.
- ◆ Remember to pick 5 stems at each site; measure them. Be sure you look away as you pick.

*Don't record the catch till you've sampled the first three sites*

- ◆ Select from the "N" (no treatment) or "T" (treat) column according to the height of the crop. If your count falls between, keep sampling.

*Have participants verbally analyze the scouting form so you're sure they can remember how to use it when they're on their own.*

*DE, MD, NJ, WVA:*

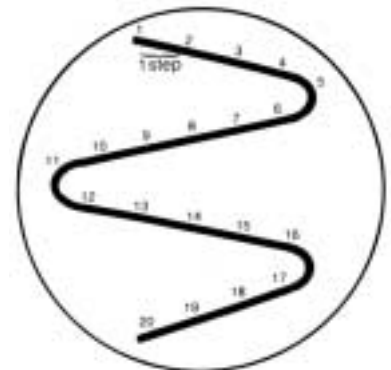
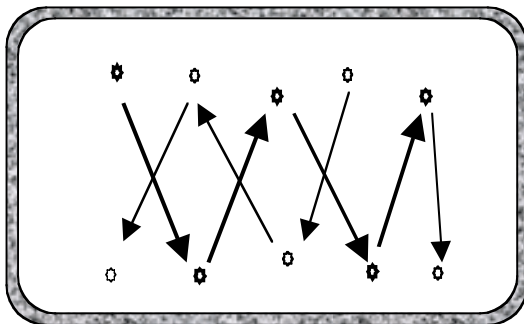
- ◆ Take 10 sweeps at 10 random sites.
- ◆ Total your count for all 10 sites.
- ◆ Multiply your average crop height by 10.

*Rule of thumb: if your total count is greater than crop height times 10, treat. (Say your crop height is 7 inches. Multiply times 10 to get 70 and 70's your threshold.)*

*If you can, go on to other fields to refine techniques and observe different levels of pest activity.*

*Hand out Management Options for Leafhopper Control and discuss.*

Below, clockwise from top left: PA; U pattern for large fields with 5 sites per field; I pattern for strips with 5 sites per field; Possible pattern to make 20 sweeps at each site; NY: Reverse the w if you need to take more samples.



*Have everyone fill out an evaluation form and remind them of the next class.*

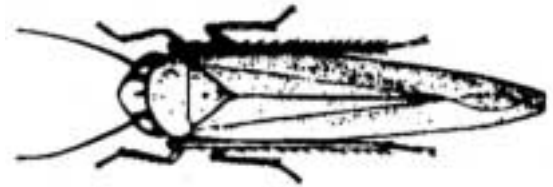
## A. Potato Leafhopper Life Cycle and Characteristics

Handout for Activity 1

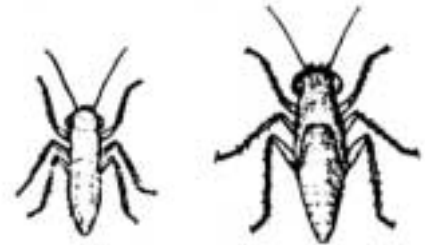
Because leafhoppers are cold-blooded\*, their entire life cycle depends on temperature. In a chilly spring, leafhoppers won't emerge down south as early as they will in a mild spring—but a prolonged warm spell might push them way ahead. So you can't predict exactly when they'll arrive, or lay eggs, or hatch, or pupate, or peak—or leave.

Adults overwinter in southern states. They move north and west on thermals, arriving in the Northeast continuously from May on, with most arriving by mid-June...

- ◆ Females lay eggs within the stems and leaf veins.
- ◆ They lay 2-3 eggs a day, every day, for each day of their long lives.
- ◆ Eggs hatch in 7-10 days.
  
- ◆ Nymphs look like small adults but lack wings. They move rapidly, walking sideways when disturbed.
- ◆ Nymphs take roughly 14-17 days to pass through five molts (instars).
- ◆ The last molt transforms nymphs into adults...
  
- ◆ ...and the females start laying eggs.
- ◆ Overlapping generations are common through August.
- ◆ In August and September adults head south on strong north winds. Those that don't leave die with the first frost.



Adult     $\text{H}$  1/8"



Nymphs  
 $\text{H}$   
 1/16" to 1/8"

What else?

Because leafhoppers are such lightweights, those that ride in on a summer storm are likely to get dumped at the hedgerow by the turbulence. It may take them a week or so to work their way into the field.

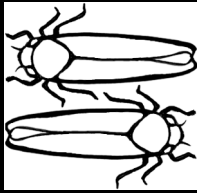
**B. Management Options for Leafhopper Control**

Handout for Activity 2

<b>Harvest</b>	<b>Pesticide</b>
<ul style="list-style-type: none"> <li>◆ Early cutting is recommended...</li> <li>◆ ... if you're within 10 days of harvest <i>OR</i>...</li> <li>◆ ...alfalfa is more than 60 percent bud or in flower <i>OR</i>...</li> <li>◆ ...more than 28 days have elapsed since your last cutting.</li> <li>◆ Staggered harvests can lead to leafhopper "herding." Bugs move easily to uncut areas—especially downwind.</li> <li>◆ If harvest takes more than three days, bugs are herded back to first cut area, damaging short regrowth.</li> <li>◆ Try to coordinate harvest with your neighbors.</li> <li>◆ If you see yellowed, stunted plants because of leafhopper injury, harvest immediately.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Consult your state's pest management recommendations for field crops.</li> <li>◆ Compare cost, effectiveness, and harvest restrictions of insecticides.</li> <li>◆ Choose proper rate for leafhoppers, not for other pests.</li> <li>◆ Apply proper gallonage with correct nozzle size.</li> <li>◆ Apply with proper overlap.</li> <li>◆ Leave unsprayed areas to provide homes and food for beneficials. Consider using check strips to evaluate effectiveness.</li> </ul> <p><i>Spraying is rarely profitable for plants over 12 inches tall. Insecticides don't carry over to the next stand. Resample fields soon after harvest to see if you need to manage again.</i></p>
<b>Natural Control</b>	<p><i>Consider:</i> How would records of this year's management choices and yields along with a forage quality analysis help you next year, and the next? How could neighbors use this information to help each other?</p>
<ul style="list-style-type: none"> <li>◆ Heavy rains may knock back populations of leafhopper nymphs.</li> <li>◆ Sample again after heavy rain—you may not need the control.</li> <li>◆ On the other hand... leafhoppers may ride in on a storm. They usually take a week or so to work their way into the field. An edge spray may work wonders here.</li> <li>◆ Resistant varieties of alfalfa are under development. Leafhoppers don't like their extra-hairy leaves. Of course, plants have to put energy into growing those hairs. Research is underway to see if, in a year with few leafhoppers, yields will be lower because of the energy the plants put into the hairs.</li> </ul>	



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# Module Feedback

## IPM for Potato Leafhopper on Alfalfa

**Tell us a little about yourself:**

<p><i>I m a</i></p> <ul style="list-style-type: none"> <li>◆ Farmer _____</li> <li>◆ Crop advisor _____</li> <li>◆ Industry rep _____</li> <li>◆ Extension educator ____</li> <li>◆ Other _____</li> </ul>	<p><i>My commodity area is:</i></p> <ul style="list-style-type: none"> <li>◆ Dairy and field crops _____</li> <li>◆ Vegetables _____</li> <li>◆ Fruits and berries _____</li> <li>◆ Greenhouse and nursery stock ____</li> <li>◆ Other _____</li> </ul>
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**Let us know what you think:**

<p>What part of the workshop was most interesting for you?</p>
<p>What part of the workshop was most valuable to you?</p>
<p>What two new ideas would you like to try on your farm or in your business?</p>
<p>Do you feel you understand IPM—and how to use it—better now?</p>
<p>What other information should be included in this module?</p>
<p>What other topics would you like us to cover in future modules?</p>

**Teachers, please fill out an evaluation as well. Photocopy and send all informative evaluations to:**

NE-IPM Modules, NYS IPM Program, Box 28 Kennedy Hall, Cornell University, Ithaca NY 14853