E-1001

POTATO LEAFHOPPER

Biology and Control

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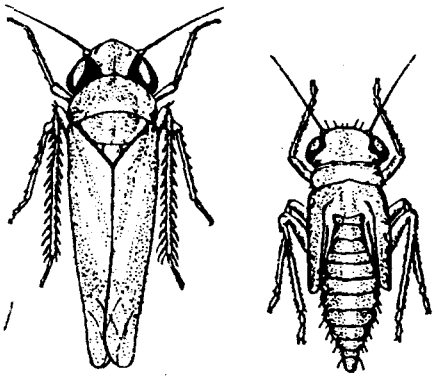
Description (Figure 1)

The potato leafhopper, *Empoasca fabae* (Harris), is a serious pest of potatoes in the north central United States. This insect also feeds on alfalfa, clover, dry beans and soybeans, and approximately 200 other plants. It is widely distributed throughout North America, but is most abundant east of the Rocky Mountains (Davidson and Lyon, 1987).



Adult Nymph

Figure 1. Potato Leafhopper, *Empoasca fabae*

The adult potato leafhopper is pale green, wedge-shaped and approximately 1/8 inch long. They are broadest at the head from which they taper evenly to the tips of the wings. Conspicuous white spots may be visible on the head and pronotum. Nymphs resemble adults but are wingless and have a more pronounced yellow coloring. Both adults and nymphs are very active and will readily jump or, in the case of adults, fly when disturbed. These insects can characteristically run backward or sideways as quickly as they move forward.

Life Cycle (Figure 2)

Potato leafhoppers are dispersed by northward winds from the South where they breed on various legumes. They have not been found to overwinter north of the Gulf states. In North Dakota, the first adults can appear in late May or early June. Females deposit their eggs within the stems, petioles and major veins of leaves. Hatching normally occurs in about 10 days, after which the newly hatched nymphs begin to feed. Leafhopper nymphs molt five times before they are fully grown. The life cycle takes approximately three weeks to complete and there may be several generations during a single season. Leafhoppers can increase sufficiently by late June or early July to damage crops and are present in the field until the first killing frost. High populations can quickly develop when there is abundant food and warm, damp nights.

Damage

The potato leafhopper has piercing-sucking mouthparts which enable it to penetrate the plant tissue and remove sap. Injection of leafhopper saliva into the phloem during the feeding process results in a toxicogenic condition known as "hopperburn." Hopperburn is a

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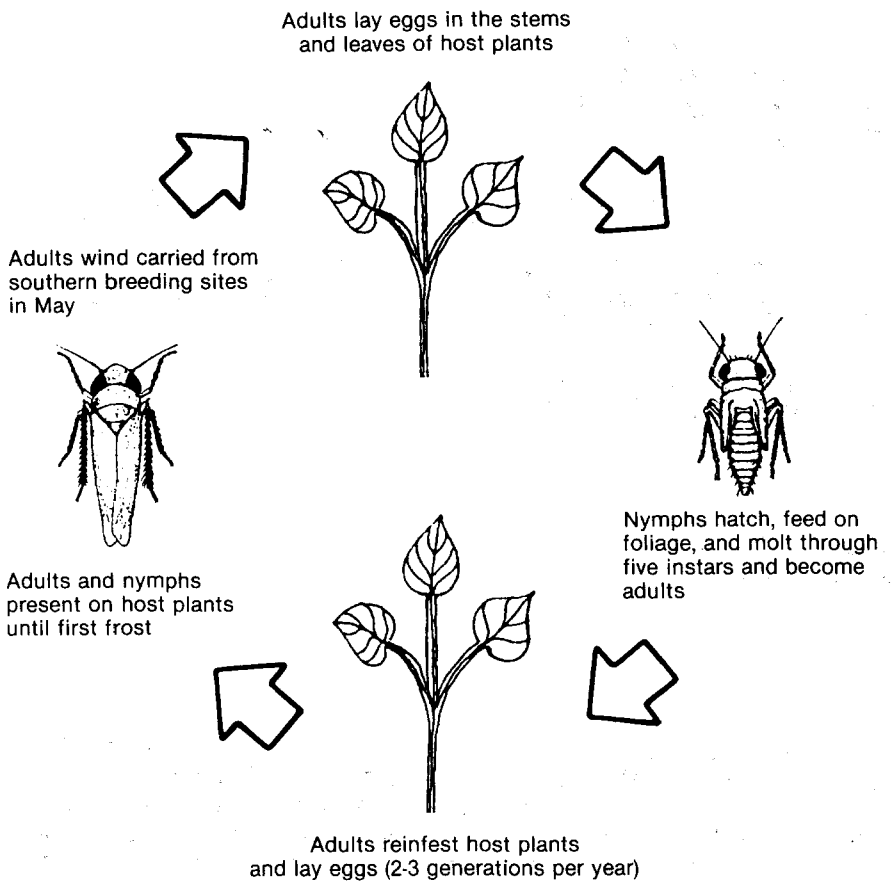

Figure 2. Life cycle of Potato Leafhopper, *Empoasca fabae*

physiological condition characterized by chlorotic leaf tips (Radcliffe, 1982). Leafhopper feeding on potatoes and alfalfa can cause curling, stunting, and dwarfing, accompanied by yellowing and browning of the foliage. Symptoms on beans and other hosts include a conspicuous curling-under of leaf margins and a crinkling effect of the upper leaf surface in addition to stunting and chlorosis. Both nymphs and adults are toxicogenic. However, late instar nymphs are reported to cause greater yield losses than adults due to their increased toxicogenic potential.

Damage by potato leafhoppers has increased in North Dakota in recent years, especially on beans. Late planted dry beans are particularly susceptible if leafhopper populations become high early in the growing season. During cool and wet seasons, leafhoppers are less attracted to potatoes until the plants are larger. Bean plants are much higher in carbohydrate (sugar) content than potatoes when they first emerge and provide a suitable host for adults. Potatoes increase in carbohydates as they grow older, and it is then that they are more likely to become infested. Soybeans are also susceptible to hopperburn although they are more tolerant than dry beans. The potato leafhopper is usually a problem on second and third cuttings of alfalfa. Rarely are populations high enough to damage the first cutting in North Dakota.

Scouting Methods (Adults and Nymphs)

It is important to detect a potential leafhopper infestation early in the season. Loss occurs quickly on new growth and may not be readily apparent. Furthermore, once visible symptoms are evident, losses have already occurred. Additional damage may be prevented by effective control measures. In any event, leafhopper damage should not be allowed to progress to the point where yellowing is pronounced.

A potential leafhopper problem can be detected using a proper insect sampling technique. Sampling should be initiated at least 100 feet from the field margins and headlands. Insect samples should be collected with a standard sweep net at five different field sites using an X pattern (Figure 3). The sampling techniques are different for each crop.

Sampling in alfalfa should begin after the first cutting. A total of 50 sweeps (each net stroke counts as one sweep) per sampling site should be taken at each of five sites if the alfalfa is less than 4 inches tall. The sample may be reduced to 20 sweeps if the alfalfa height is greater than 4 inches. The number of adults and nymphs in each sample should be counted separately and the average number of leafhoppers (adults and nymphs) per net sweep determined.

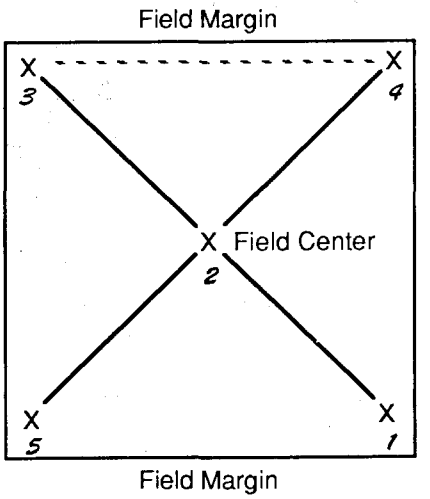

Figure 3. Field sampling pattern.

Leafhopper populations in potatoes and beans should be estimated by taking 20 net sweeps at five field locations (Figure 3). The average number of leafhoppers per sweep is then calculated from the samples. Special attention should be directed to the number of trifoliate leaves present on dry and soybean plants. All true leaves are trifoliate (three leaflets) and are borne on long petioles alternately (from side to side) on the stem (Figure 4). The number of trifoliate leaves per plant needs to be assessed in order to determine the economic thresholds for leafhoppers on beans.

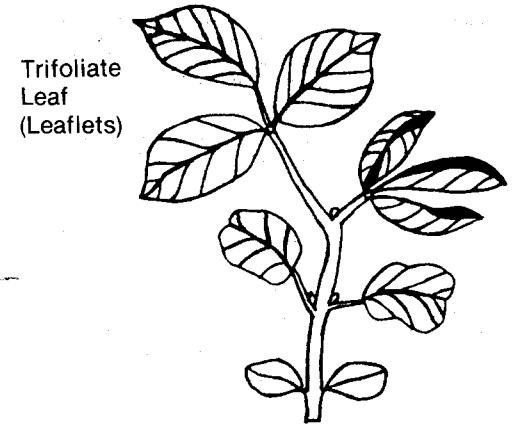

Figure 4. Trifoliate leaf of typical bean plant.

In addition to sampling with a sweep net, the number of nymphs on potato leaves may be determined. However, detecting leafhopper nymphs by visual estimate can be extremely difficult. Reliable and consistent techniques other than sweeping are not known.

Sampling should be initiated prior to the onset of symptoms, typically in mid June in North Dakota.

Economic Thresholds

The economic threshold for potato leafhoppers in alfalfa varies depending on plant height. As the crop increases in height, the number of leafhoppers required for economic injury also increases. The average number of adults or nymphs per net sweep suggesting chemical control are shown in Table 1.

Table 1. Potato leafhopper economic thresholds in alfalfa (Wilson, C.M. Improving alfalfa forage quality. AG-FO-2294. Agricultural Extension Service, University of Minnesota.).

Stem Height (inches)	Avg. no. leafhoppers per net sweep
< 3	0.2 adults
6	0.5 adults
8-10	1.0 adult or nymphs
12-14	2.0 adults or nymphs

If the number of adult leafhoppers in potatoes exceeds an average of one insect per sweep, treatment is suggested. A total of 10 nymphs per 100 leaves is also enough to suggest that control measures be implemented. Careful monitoring is necessary to detect the presence of nymphs on potato leaves.

The threshold of one leafhopper per trifoliate leaf should be used to determine if an insecticide treatment is necessary on dry and soybeans. While soybeans are susceptible to leafhopper damage, they appear to be more tolerant than dry beans. Under good growing conditions, soybeans can outgrow moderate leafhopper injury. However, if the soybeans are under stress, they are less tolerant of leafhopper feeding and the plants should be treated if symptoms are beginning to show.

Control

Effective controls for potato leafhopper should be applied before toxicogenic symptoms are evident on the plants. Insecticides provide good control of the nymphs and adults. Early season leafhoppers can be controlled with systemic soil insecticides applied at planting time. However, due to the high cost and short protection period of such a treatment as well as the uncertainty of leafhopper infestations occurring, foliar treatments based on economic thresholds may be a preferred management strategy (Tables II - IV).

Leafhopper populations may persist until the first frost, and fields should be continuously monitored in areas where substantial numbers have been determined. More than one application may be necessary if season-long control is desired.

References Cited

Davidson, R.H. and W.F. Lyon. 1987. Insect pests of farm, garden and orchard. 8th ed. New York: Wiley and Sons, Inc. pp. 287-289.

Radcliffe, E.B. 1982. Insect pests of potato. Ann. Rev. Entomol. 27:173-204.

Table II. Insecticides recommended for potato leafhopper control in alfalfa.

Insecticide and Formulation	Actual Insecticide Rate per Acre	Remarks
carbaryl (Sevin)	1.0 lb/A	No pre-harvest and grazing interval.
carbofuran (Furadan 4F*)	0.25-0.5 lb/A	Do not cut or graze within 7 days at 0.25 lb/A or 28 days at 0.5 lb/A.
chlorpyrifos (Lorsban 4E)	0.25 lb/A	Do not cut or graze within 7 days. Only one application/cutting. Limit of four applications per year.
dimethoate (Cygon, De-Fend)	0.25-0.5 lb/A	10 day pre-harvest and grazing interval. Only one application per cutting. Do not enter treated fields within 4 days after application. Fields must be posted.
malathion EC (several formulations)	1.0 lb/A	No pre-harvest or grazing interval.
parathion EC* (several formulations)	0.5 lb/A	Aerial application only. 15 day pre-harvest and grazing interval. Do not enter treated fields within 3 days after application. Fields must be posted.
parathion (Penncap-M 2EC)*	0.5-0.75 lb/A	15 day pre-harvest and grazing interval. Do not enter treated fields within 48 hours after application. Fields must be posted.
permethrin (Ambush*, Pounce*)	0.1-0.2 lb/A	Do not exceed 0.2 lb/cutting. 14 day pre-harvest interval at 0.1-0.2 lb/A.

*Restricted use pesticide.

Table III. Insecticides recommended for potato leafhopper control in potatoes.

Insecticide and Formulation	Actual Insecticide Rate per Acre	Remarks
carbaryl (Sevin)	1.0 lb/A	No pre-harvest interval.
carbofuran (Furadan 4F*)	0.5-1.0 lb/A	14 day pre-harvest interval.
dimethoate (Cygon, De-Fend)	0.5 lb/A	No pre-harvest interval. Do not enter treated fields within 4 days after application. Fields must be posted.
endosulfan (Thiodan)	1.0 lb/A	No pre-harvest interval.
esfenvalerate (Asana XL*)	0.03-0.05 lb/A	Do not exceed 0.35 lb. per season. Do not feed vines.
oxydemetonmethyl (Metasystox R)	6-8 oz/A	Do not apply within 7 days of harvest.
parathion (ethyl/methyl 6-3*)	8-21 fl oz/A	5 day pre-harvest interval. Do not enter treated fields within 3 days after application. Fields must be posted.
parathion (Penncap-M 2EC*)	0.5-1.0 lb/A	5 day pre-harvest interval. Do not enter treated fields within 48 hours after application. Fields must be posted.
permethrin (Ambush*, Pounce*)	0.1-0.2 lb/A	Do not exceed 2.4 lb/A. 7 day pre-harvest interval. Do not feed vines.
phorate (Thimet 20G*)	11.3 oz/1,000 ft of row (light or sandy soils); 17.3 oz/1,000 ft of row (heavy or clay soils)	Band application at planting. 90 day pre-harvest interval.
phosphamidon (Dimecron*)	0.5 lb/A	14 day pre-harvest interval.

*Restricted use pesticide.

Table IV. Insecticides recommended for potato leafhopper control in dry beans and soybeans.

Insecticide and Formulation	Actual Insecticide Rate per Acre	Remarks
acephate (Orthene 75S) (dry beans only)	0.5-1.0 lb/A	14 day pre-harvest interval. Do not feed vines.
azinphosmethyl (Guthion 2EC)	0.5 lb/A	30 day pre-harvest interval. Do not feed vines.
carbaryl (Sevin)	1 lb/A	0 day pre-harvest interval.
dimethoate (Cygon, De-Fend)	0.5 lb/A	0 day pre-harvest interval. Do not feed vines. Do not enter fields within 4 days after application. Fields must be posted.
disulfoton (Di-Syston 15G)	7.4 oz/1,000 ft of row — any row spacing	Band application. 60 day pre-harvest interval.
esfenvalerate (Asana XL*)	0.03-0.05 lb/A	Do not exceed 0.2 lb per season. Do not feed vines. 21 day pre-harvest interval.
malathion (several formulations)	1.0 lb/A	1 day pre-harvest interval for dry beans. 3 day pre-harvest interval for soybeans.
parathion* (several formulations)	0.5 lb/A	20 day pre-harvest interval. Do not enter treated fields within 3 days after application. Fields must be posted.
parathion (Penncap-M 2EC*)	0.5 lb/A	20 day pre-harvest interval. Do not enter treated fields within 48 hours after application. Fields must be posted.
permethrin (Ambush*, Pounce*) (soybeans only)	0.05-0.2 lb/A	Do not exceed 0.4 lb per season. 60 day pre-harvest interval. Do not feed vines.
phorate (Thimet 20G*)	4.5-7.0 oz/1,000 ft. of row (dry beans); 9 oz/1,000 ft of row (soybeans)	Drill granules to side of seed. Avoid direct seed contact. 60 day pre-harvest interval (dry beans). Do not feed vines (soybeans).

*Restricted use pesticide.

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