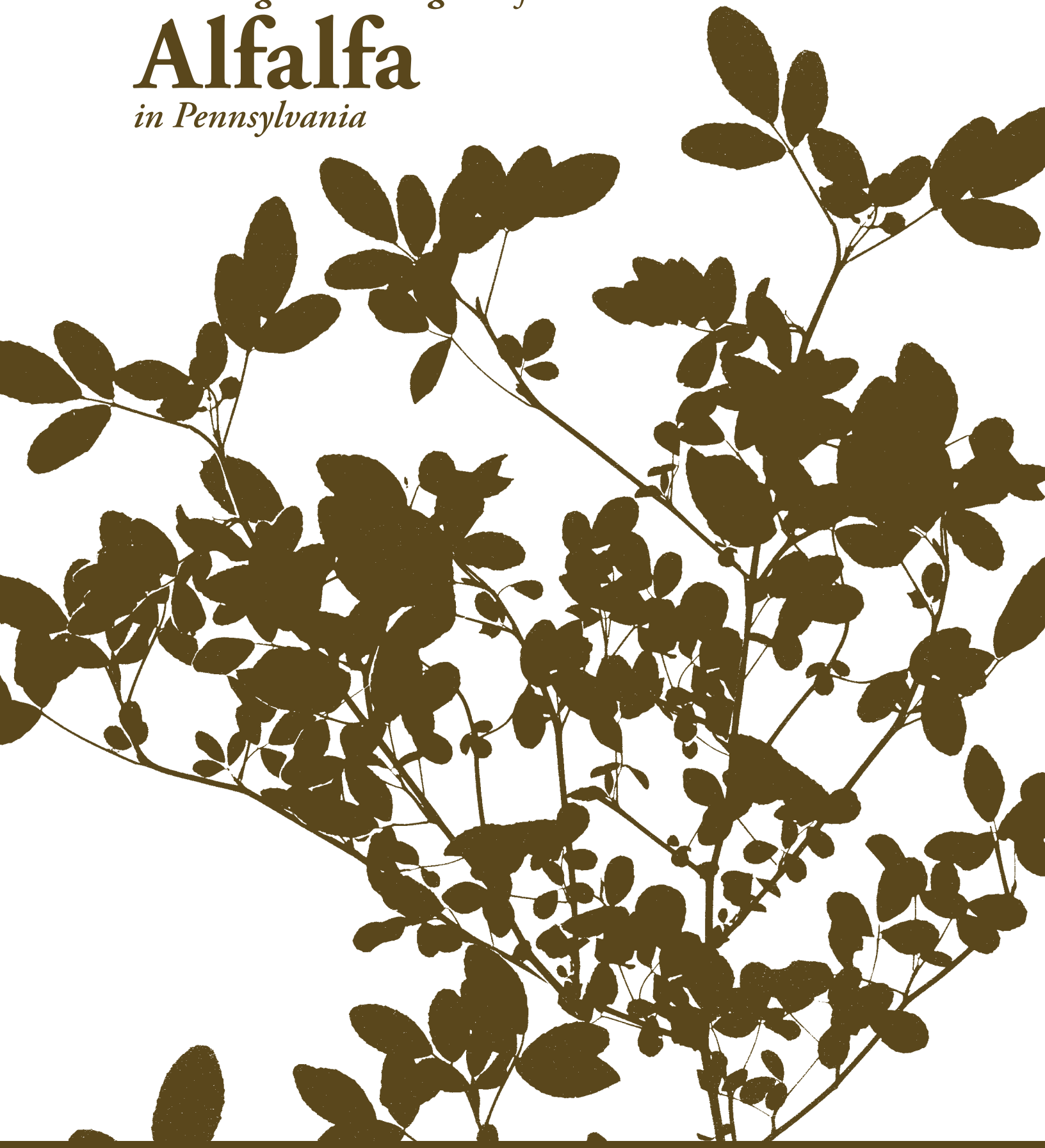
A Pest Management Program for

Alfalfa

in Pennsylvania



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Alfalfa is the second most valuable crop to the economy of Pennsylvania. Harvested on over 840,000 acres, it was valued at approximately $240 million in 1981. Another $50 to $80 million could have been realized from the crop if losses from pests had been eliminated. Because diseases, insects, and weeds can inflict high losses to alfalfa, it is often necessary for growers to manage certain pests in order to obtain acceptable yields.

Objectives of a pest management program:

- To encourage growers to incorporate a number of pest management tactics into their overall crop production systems
- To enable growers to get the maximum benefit from natural and cultural management measures
- To enable growers to take the guess work out of deciding if a pesticide application is needed to control pests
- To apply needed pesticides at the proper time for maximum benefits
- To avoid unneeded and unprofitable pesticide applications

Alfalfa plants, depending on their size and vigor, can tolerate varying degrees of stress from pests without showing any appreciable economic loss. Seedlings and small regrowth cannot tolerate as much damage or weed competition as can large, established plants. Since the impact on the plant from the various pests is often quite different, it is essential to identify the pest and understand at what level it is profitable to apply control measures. In some fields, this critical level of damage (the economic injury level) may occur at any time during the growth of the plant or may never occur. Thus, it is extremely important to know the level of pests present in relation to the development of the crop so control measures can be applied as needed to avoid unnecessary losses in yield and quality. Conversely, when pest losses are predicted to be less than the cost of a pesticide application, pesticides and application costs can be saved.

ALFALFA VARIETIES AND MANAGEMENT

Alfalfa is described as a fairly long-lived perennial plant that can produce high forage yields over several growing seasons. Well-managed stands will be productive for 3 to 10 years or more. However, stands are subject to several types of stresses that can work alone or in combination to "wear out" the plant over a period of time. Insect attack, disease attack, weed competition, nutrient deficiencies, and improper cutting management can all weaken the plants. If two or more of these stresses work at the same time, the plant can be weakened rapidly. The impact of one type of stress can also make the plant more susceptible to other stresses that may be present. Although the plant can repair some forms of damage, the effects of stresses appear to accumulate over the years to gradually wear out the stand. This wearing out of stands is apparent in the commonly observed gradual decline in yields after the first full harvest year. The secret to managing for alfalfa persistence and productivity is to limit the number and severity of stresses throughout the life of the stand.

Variety selection is an important step in designing the alfalfa management program. There are a number of important characteristics of alfalfa varieties that contribute to their long-term productivity. Disease resistance, insect resistance, growth vigor, date of maturity, and cold hardiness are important things to consider in selecting an alfalfa variety in Pennsylvania.

Varietal tolerance to feeding of the potato leafhopper, alfalfa blotch leafminer, and meadow spittlebug has not been demonstrated in varieties adapted to Pennsylvania. Also, there is no apparent advantage from fast regrowth of new varieties in tolerating stubble feeding by the alfalfa weevil.

Many of the recently introduced varieties mature earlier, show faster recovery growth after cutting, and are intermediate in winter hardiness, compared to older varieties. The newer varieties have higher yield potential and wider pest resistance than older, late-maturing, slow-recovery varieties. As a result, three- , four- , or even five-cut management plans are being used where two or three cuts were once the recommended practice. Because we are harvesting more frequently, more attention must be given to other management matters, such as fertilization, liming, and pest control. More frequent harvests tend to reduce losses caused by foliar diseases. It is apparent from research that more intensive cutting management for high yields and forage quality will shorten stand life unless nutritional and pest-related stresses are controlled.

Farmers should use recommended alfalfa varieties where possible. *The Agronomy Guide* and extension fact sheets are good sources of variety recommendations. Because of the rapid rate of new variety introduction, data on which to base recommendations may not be available on the newest varieties immediately after their introduction. Farmers considering the use of such varieties should seek assurance that the variety has good pest resistance and cold hardiness. Such information can be obtained from the seed supplier.

MINIMIZING DISEASE LOSSES

Alfalfa growers are not completely at the mercy of diseases because there are definite measures that can be taken to reduce disease losses. Most of these measures, or strategies as they are often called, fall under the broad umbrella of management. The term "pest management" is very appropriate when applied to alfalfa diseases because there is little that we can do to actually bring a disease under control once it is already evident in the field. Therefore, our approach is to manage the crop so as to reduce the impact of diseases and minimize the losses from them.

The variety grown is very important because the resistance to diseases that has been put into that variety is a primary defense against diseases. Varieties now available have various levels and types of resistance to diseases important in Pennsylvania. These diseases include bacterial wilt, anthracnose, fusarium wilt, verticillium wilt, phytophthora root rot, and foliar diseases. The impact of a specific disease will vary with your location in the state, and information on this is available through your county educator.

Quality seed contributes greatly to minimizing disease losses. Certified seed assures you of the variety you desire and also that you are getting good-quality seed. An added advantage of certification is that it identifies the state in which the seed is produced. This is usually not of great importance; however, with the outbreak of verticillium wilt in this country and its occurrence in Pennsylvania in 1981, state of origin became important. The fungus causing this disease can be spread in infected plant fragments as well as on and in alfalfa seed. Seed produced in Idaho, Washington, or Oregon is more likely to harbor the pathogen than is seed from California or Nevada, where the disease has not been found. Seed from infested areas can be treated with a contact fungicide or can be purchased already treated. Such a treatment would minimize the likelihood of introducing the fungus into your fields. No one can guarantee that such treatment will be 100 percent effective, but there is no evidence that it reduces nodulation when inoculation is done at time of planting.

Once good seed is obtained, it should be planted on a well-prepared seedbed at correct depth and rate to ensure adequate stand establishment. Vigorous seedlings are capable of "out running" the soilborne fungi that attack young seedlings and cause stand failures. Correct soil pH and adequate levels of phosphorus and potassium favor plant growth and allow for maximum expression of inherent disease resistance. Weed control also favors good seedling establishment and reduced losses from diseases.

Once a stand is established, other management practices aid in minimizing disease losses. Good control of insects reduces stress on the plants and allows the tops of the plants to feed the roots for vigorous growth, with root rot held to a slow rate of development. Commonsense mowing practices can also help to reduce disease losses. Mow youngest seeding first to prevent spread of pathogens by equipment from any diseased older stands to the healthier, younger ones. When leaf spots are severe, mow a little earlier than normal. This aids leaf retention, thereby improving hay quality and moving infected leaves from the field. The absence of infected leaves helps the next crop. Do not mow alfalfa that is still wet with dew or rain. Pathogens are spread more easily in water films, so, if possible, wait for the alfalfa to dry. Give the crop adequate time after the last harvest of the season to prepare for winter by following harvest schedules recommended for your area.

Good sanitation practices take only a little time and effort and can pay dividends. Some fungi, such as that which causes anthracnose, have difficulty surviving winters in the field; however, they do survive readily in plant fragments on equipment under shelter. Clean off your mowers, wagons, rakes, and so forth before going out to the fields each spring. The fungus may eventually become established in your new stand, but there is no need for you to help it.

Good rotation practice is a must. Once a field is taken out of alfalfa production, keep it out for at least 2 years, preferably 3 years. Grass crops, corn, and cereals are good crops for rotation with alfalfa because they are not attacked by the same pathogens as alfalfa. Nematodes rarely are a problem when good rotation is practiced.

Most management practices are aimed at minimizing stress on alfalfa, thus making the crop better able to stand the attack of pathogens. Your reward for good management is more forage of higher quality with longer-lived stands. Minimize your disease losses through management.

WEED CONTROL

The losses caused by weeds and the amount you can afford to pay for weed control and still expect an economic return are difficult to determine. Weeds are harvested along with the desirable forage species, and weeds do have some feed value. The feed value of weeds varies greatly: dandelion is equal to alfalfa in protein and TDN, grasses have about 75 percent of the quality of alfalfa, and weeds with woody stems or flower stalks (such as yellow rocket, white cockle, rough fleabane, curly dock, and broadleaf dock) have about 50 percent of the quality of alfalfa in the first cutting. Removal of dandelion will not improve the quality of hay, but its control may be of some value in reducing the time necessary to dry the hay because dandelion dries more slowly than alfalfa. Field losses from rain during harvest drying are not included in the effect of weeds on hay quality.

Herbicides for weed control are needed most during establishment. If a forage seeding can get off to a good start without competition from weeds, competition from the forage plants will control most weeds for the first 2 years of the stand. Some exceptions to this rule would be infestations of deep-rooted biennial and perennial weeds and of perennial grasses that spread by rhizomes. If these weeds are not controlled before the seeding is made, they will commonly persist throughout the life of your forage stand. The cost of controlling weeds before or at the time of seeding should be considered as an investment in the future of that stand, which should provide a high return during the life of the stand.

The control of weeds in established forages usually is of greatest benefit in the first cutting since the regrowth of forage species is much faster than weeds. Thus, weeds contribute much less to the yield in the second and succeeding harvests. Also, research has shown that when weeds are controlled, the

same or other weeds tend to fill in the areas vacated within a year after treatment. This normally is untrue early in the life of a forage stand where there are enough desirable plants to fill in the spaces vacated by the weeds. But as the stand population thins with age, there are fewer plants to fill in where weeds have been controlled with herbicides. Once the forage stand is 2 to 3 years old and up to 25 or 30 percent of the first harvest yield is weeds, it is questionable whether it pays to clean the weeds out. When 50 percent of the first harvest is weeds, it is time to rotate to another crop.

Over 95 percent of weed control in a good, healthy forage stand comes from competition provided by the forage. In order to maintain a relatively weed-free forage stand, you should make sure the forage seeding gets off to a good start with proper fertilization, cutting management, insect control, and use of disease-resistant varieties. Maintain the forage stand in a competitive state as long as possible.

LOSS OF FEED VALUE OF ALFALFA FORAGE DUE TO WEEDS

The feed value of weeds is based on the percentage protein and TDN at the time alfalfa would normally be harvested. If the weeds in the forage have one-half (50 percent) of the feed value of alfalfa, it is assumed that hay made of pure weeds (100 percent infestation) would have half the feed value of alfalfa. Refer to Table 1 to determine feed losses due to weeds.

The cost of controlling weeds in an alfalfa stand should not exceed one-half the losses caused by all the weeds that can be controlled with the herbicide. For example, if your first harvest alfalfa is 10 percent rough fleabane, 10 percent curly dock, and 20 percent quackgrass; you determine from *The Agronomy Guide* that the best herbicide treatment will give you 80 percent control of these weeds; your estimated yield is 2 ton/A; and pure alfalfa is worth $140/ton, the increased value of the alfalfa from control would be $33.60 (fleabane $11.20 + curly dock $11.20 + quackgrass $11.20). If the infestation of these weeds is only one-third as bad in the second and third harvest (since these weeds do not regrow as quickly as alfalfa), your increased crop value for the year will be $33.60 + $11.20 + $11.20 = $56.00/A. Most herbicide treatments will not provide weed control for more than a year. The cost of this treatment cannot exceed the increased value of the forage in order for the treatment to pay. Normally, you should expect $2 return for each $1 invested. In this case, the cost of the treatment should not be more than one-half of $56, or $28/A.

INSECT CONTROL

The potato leafhopper is the insect pest most destructive to alfalfa in Pennsylvania, causing average annual losses of approximately $15 million. The alfalfa weevil has also caused high losses over the past two decades. However, damage from alfalfa

Table 1. Calculating loss in feed value due to weeds for any one harvest.

	Loss in feed value (/100%)		Weed infestation (/100%)		Weed control (/100%)		Estimated yield (tons)		Market value of alfalfa (dollars)		Loss in value if not controlled (dollars)
Example											
rough fleabane	0.50	X	0.1	X	0.8	X	2	X	140	=	11.20
curly dock	0.50	X	0.1	X	0.8	X	2	X	140	=	11.20
quackgrass	0.25	X	0.2	X	0.8	X	2	X	140	=	11.20
										Total	33.60
Perennials											
dandelion	0	X	_____	X	_____	X	_____	X	_____	=	_____
docks	0.50	X	_____	X	_____	X	_____	X	_____	=	_____
quackgrass	0.25	X	_____	X	_____	X	_____	X	_____	=	_____
white cockle	0.50	X	_____	X	_____	X	_____	X	_____	=	_____
yellow rocket	0.50	X	_____	X	_____	X	_____	X	_____	=	_____
Biennials											
burdock	0.50	X	_____	X	_____	X	_____	X	_____	=	_____
rough fleabane	0.50	X	_____	X	_____	X	_____	X	_____	=	_____
wild carrot	0.50	X	_____	X	_____	X	_____	X	_____	=	_____
Annuals & Winter Annuals											
barnyard grass	0.25	X	_____	X	_____	X	_____	X	_____	=	_____
cheat	0.25	X	_____	X	_____	X	_____	X	_____	=	_____
downy brome	0.25	X	_____	X	_____	X	_____	X	_____	=	_____
fall panicum	0.25	X	_____	X	_____	X	_____	X	_____	=	_____
foxtails	0.25	X	_____	X	_____	X	_____	X	_____	=	_____
									Total loss in crop value if above weeds are not controlled	=	_____

weevil has declined and is now below the economic injury level in most fields in the state.

Several other insects, such as alfalfa blotch leafminer and meadow spittlebug, are commonly present on alfalfa, but losses from these pests have been relatively low. Major emphasis should be placed on protecting the crop from potato leafhoppers and on reducing alfalfa weevil in those fields where high populations are present.

While varietal tolerance or resistance offers reasonable protection against a number of alfalfa diseases, this is generally not an effective means of controlling our major insect pests. Biological control methods have effectively reduced alfalfa weevil damage in most areas of the state, and both cultural and biological methods help cut down leafminer populations. But chemical control measures are needed for leafhoppers and frequently for weevils and other pests.

The Potato Leafhopper

The potato leafhopper is the insect pest most destructive to alfalfa in Pennsylvania. It is responsible for reduced yields and reduced quality (especially lower protein content) and contributes to reduced longevity of stands. The stress applied to alfalfa plants by leafhoppers has resulted in increased root rot and many stand failures. This is especially evident in new seedings.

Both the adult and nymphal stages feed on the plants. They insert their mouthparts into the plant tissue to extract plant juices. This feeding process distorts and causes blockage of the tiny tubes that distribute the nutrients within the plant. The blockage results in typical leafhopper injury: triangular-shaped yellowing of the leaves and stunting of the plants ("hopper burn"). Stunted plants do not recover after the leathoppers are eliminated.

Adult potato leafhoppers are pale, yellowish green, slightly wedge shaped, have wings, and are only about ⅛ inch long. The nymphs appear similar to the adults, except they are smaller, have no wings, and are yellow to cream colored with possibly a faint tinge of green.

This species does not overwinter in Pennsylvania but moves into the state each spring in late May and early June from southern states. Since leafhoppers cannot survive our winters, we escape their damage on the first cutting of alfalfa that is harvested before June 10. The new spring seedings and regrowth of the second and third cuttings are most severely damaged.

Eggs are deposited in the stems and leaf veins. In warm weather, it takes about 3 weeks from egg to adult so very large populations of leafhoppers can build up in a short time during the summer. The adult leafhoppers are very active and will fly above the plants when disturbed. The nymphs are also active and will quickly move, usually sideways, when disturbed.

Although some potato leafhoppers can be found from late May until frost, the bulk of the damage is done from mid-June to mid-August. Normally, the population drops off rather sharply after mid-August.

When to sample for potato leafhoppers

On new spring seedings. Start sampling about June 5, or when the plants are 3 inches high if this occurs after June 5. Then resample at weekly intervals until the field is sprayed or until 10 days before harvest.

On new summer seedings. We have only limited information on leafhopper damage to July and August seedings. So to be on the safe side, start sampling when the plants are 2 inches high and resample at weekly intervals until mid September.

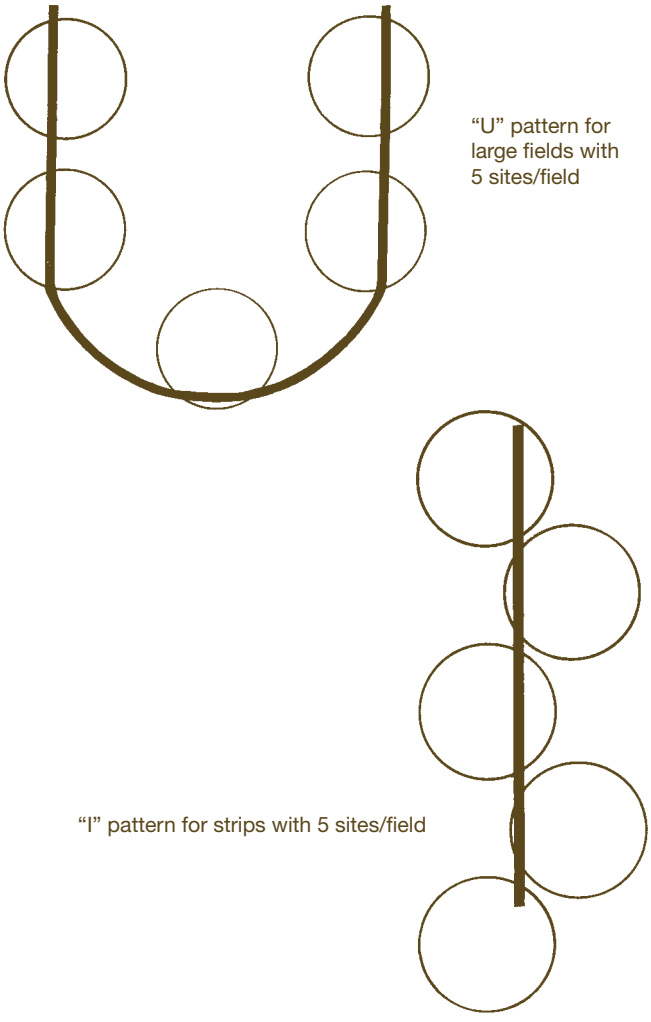
On all second and third cuttings. Start sampling when plant regrowth is 2 to 3 inches high. Then resample at weekly intervals until the field is sprayed or until 10 days prior to harvest.

Equipment needed

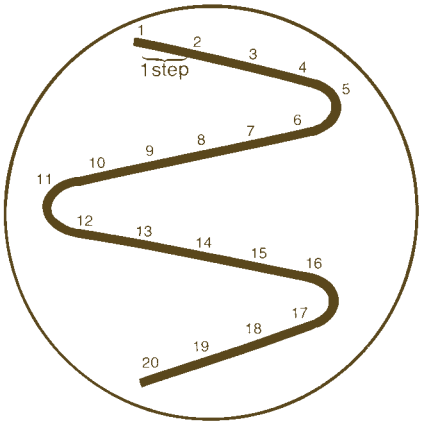
To sample alfalfa, you need an insect net with a 15-inch-diameter hoop and a rather tightly knit bag such as muslin. Satisfactory nets can be homemade (see page 8). A yardstick can be used to measure the height of the plants.

Sampling procedure for potato leafhopper

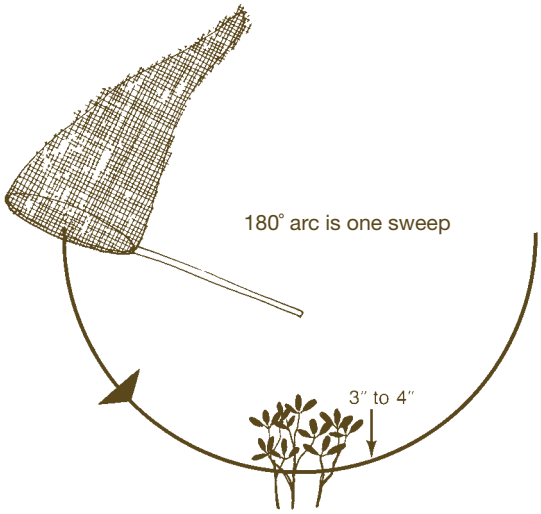
In square or rectangular fields, follow a "U" pattern. In narrow strips, an "I" pattern will probably work best. Fields can be sampled any time of the day when the alfalfa is dry. Avoid sampling in cold or windy weather and when the alfalfa is wet. Sample at five selected sites in each field as suggested on either the "U" or "I" pattern.



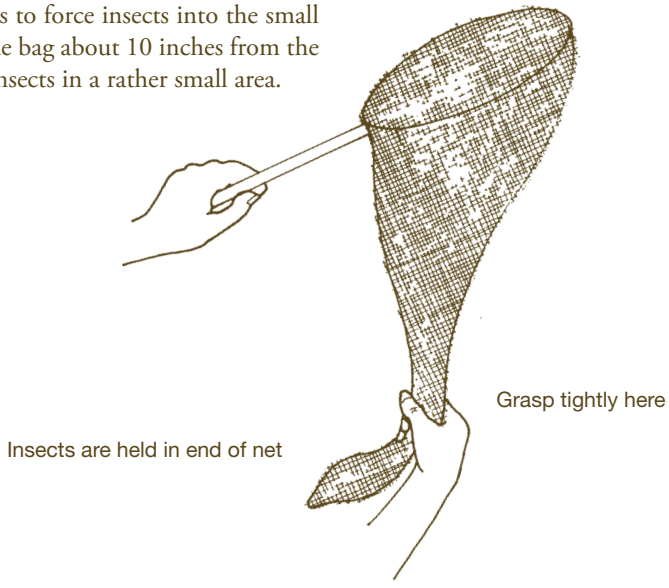
Step 1. Make 20 pendulum sweeps with the net at each of the sites, sweeping 3 to 4 inches below the tops of the plants. Don't stop swinging the net until the 20 sweeps are completed. Collect 20 sweeps from each site following a zigzag pattern. Take one or two steps between each sweep.



Possible pattern to make 20 sweeps at each site



Step 2. When the 20 sweeps are completed, continue swinging net back and forth several times to force insects into the small end of the bag. Quickly grab the bag about 10 inches from the small end in order to trap the insects in a rather small area.



Step 3. Now comes the tricky task of identifying and counting the potato leafhoppers collected. Remember, only the pale green (nymphs are yellowish green) leafhoppers are to be counted. Disregard any brown ones that may be present. You must be alert when opening the net since adult leafhoppers are very active and can easily pop out of the net without being noticed. Unfold the net slowly and let the insects escape a few at a time, counting the leafhoppers as they appear. Be careful to check the interior walls of the net for nymphs. They cannot fly and will be walking or clinging to the cloth.

It may be easier for you to kill the insects first, then count them. A puff from a pyrethrin aerosol will slow down the insects to make counting easier.

Count all stages of potato leafhoppers collected in the net. Make a note of the total. Repeat the same sampling procedure at the next four sites. This completes your 100 sweeps in the field.

Step 4. Now calculate the average number of leafhoppers per sweep for the field. Example: You collected a total of 60 leafhoppers; to find the average per sweep, divide 60 by 100 = 0.6 leathopper per sweep.

NOTE: When the leafhopper population is high (40 or more in 20 sweeps) at the first site in the field, it is of little value to spend any more time sampling the other four sites.

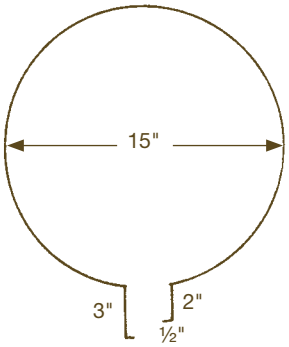
How to make an insect sweepnet

A sweepnet is a tool necessary for monitoring potato leafhopper populations in the field. Insect nets are not readily available, and where they can be purchased the average price is approximately $15.00. Materials needed can be found on most farms. The handle should be a solid piece of wood about ¼ inch in diameter and 2½ to 3 feet in length. An old broom handle cut to length will be suitable.

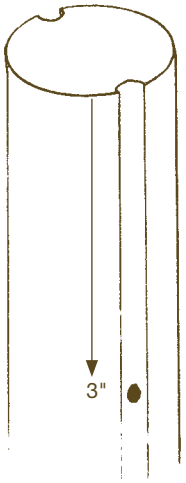
The hoop can be a piece of heavy-gauge wire or thin steel rod. You will need a piece 53 inches in length. The ends of the hoop will be securely fastened to the wooden handle by tightly wrapping them with light wire, such as baling wire, or by slipping a metal sleeve onto the handle and over the hoop ends.

To make the net you will need two pieces of cloth measuring 24 inches by 36 inches. Heavy muslin or tightly woven nylon cloth will do.

Step 1. Form the hoop into a 15-inch circle and bend the ends as shown. One end should be bent at 2 inches from the tip and the other at about 3 inches from its tip. Now bend ½ inch of both tips toward the inside.



Step 2. Groove and drill the handle to receive the ends of the hoop. Cut the grooves no wider or deeper than the diameter of the wire. You want a snug fit. One hole will be approximately 2 inches and the other 3 inches from the end. Check placement of holes with your hoop before drilling. Now drill two holes through the handle to receive the hoop tips.

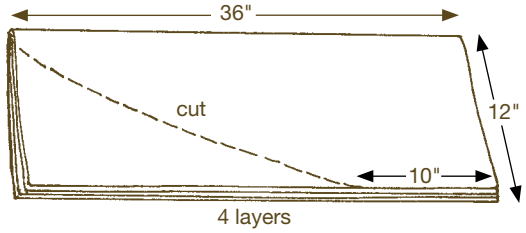


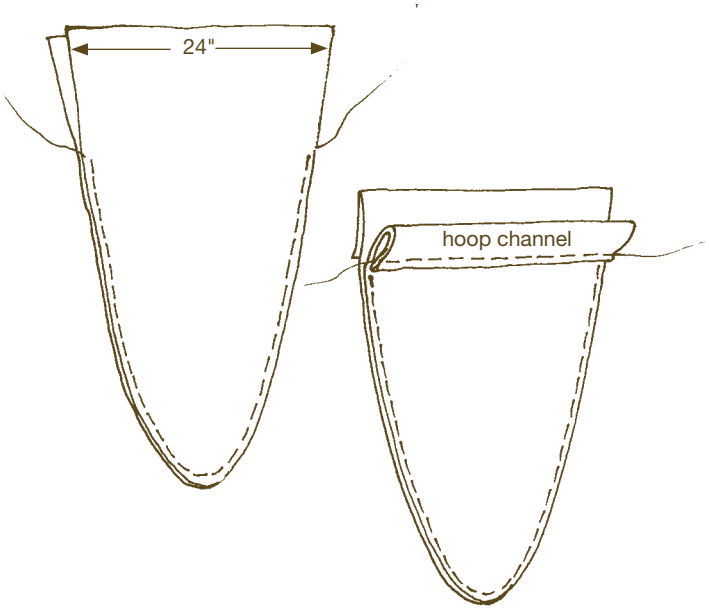
Step 3. Construct the net by placing the pieces of cloth 24 by 36 inches, one on top of the other. Fold both pieces lengthwise. Cut the cloth in an arc from near the point of the fold to 10 inches from the top.

Unfold into two bullet-shaped pieces. Now sew the edges with a ½-inch seam. Do not sew the top 10 inches on either side.

Take the top half of the net and double down the loose top 5 inches. Now double it down again and sew securely (½-inch seam). This has made a channel for sliding the hoop through.

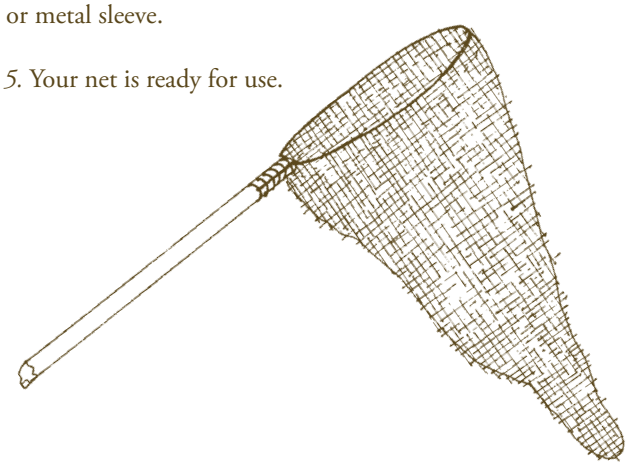
Now do the same to the other half of the net. Your net is now constructed. You may wish to double sew all seams to reinforce the stitching.





Step 4. Assemble the sweepnet. Slide the hoop through the channel at the top of net. Now fit the hoop ends into the grooves and holes on the handle. Secure hoop to handle with wire or metal sleeve.

Step 5. Your net is ready for use.



Factors used in determining the potato leafhopper economic injury threshold discussed in Table 2

Four factors are used to help determine when an insecticide application for potato leafhopper control will be profitable: (1) the number of pests present in the field, (2) the development of the plants, (3) the value of the crop, and (4) the costs of the control application.

1. Number of leafhoppers present in the field. The most practical method developed to obtain a guideline on the number of leafhoppers present is to use an insect net. By following the monitoring procedures previously described, you can get a reasonable estimate of the numbers of pests. The table is calculated on the average number of potato leafhoppers for one sweep (count both adults and nymphs). If you make 100 sweeps and collect 50 leafhoppers, the average per sweep is 0.5 leafhopper.

2. Development of plants. This is expressed as height of plants. A relatively low number of leafhoppers can inflict high losses to the crop if they are present in the field when the plants are small. Greatest crop losses from leafhoppers occur before the alfalfa plants reach 6 inches in height. Plants 12 inches and taller can tolerate leafhopper feeding without high losses resulting.

3. Value of the crop. The higher the crop value, the lower the economic injury threshold will be. Thus, with an equal pest population, spray protection will be more profitable on a crop valued at $140 per ton than on a crop valued at $60 per ton.

4. Cost of control application. As the costs of applying control measures increase, losses from pests can also be higher before an application is profitable.

The variability of each of the above factors clearly shows why the economic injury threshold is not static. Thus, the pest injury threshold should be adjusted to compensate for each of these variables. Adjustments for a fair amount of variability have been calculated into the development of Tables 2 and 3.

To spray or harvest alfalfa over 12 inches tall. If the leafhopper injury threshold is reached and the alfalfa is less than 50 to 60 percent in bud, a spray is suggested immediately. However, if the crop is 60 percent or more in bud, it will probably be advantageous to harvest the field within a week rather than spray.

Table 2. Economic injury level for potato leafhopper; average number of leafhoppers per sweep of net.

How to use table below:

1. Use plant height category that fits your fields. Leafhopper sprays are seldom profitable for plants over 12 inches.
2. Estimate value of crop in dollars per ton of hay equivalent and cost to spray per acre.
3. From monitoring field, find the average number of leafhoppers per sweep of net.
4. The number in each small box is the average number of potato leafhoppers **per sweep** for the given situation for a spray application to be profitable.

Example: Plants in field No. 1 are 3 inches high, hay is valued at $100.00 per ton, cost of spray is $10.00 per acre, and you have 35 leafhoppers in 100 sweeps (average of 0.35 *per sweep*). The number in the box is 0.3. The leafhopper population in your field is slightly above the injury threshold, so a spray will be profitable. If the leafhopper population averaged less than 0.3 per sweep, a spray would not be profitable under these conditions.

NOTE: The economic injury levels in this table are based on limited research and are intended to be used only as an aid to predict when estimated losses from leafhoppers will exceed the cost of a control spray application.

Value of hay per ton	Category I plant height 0 to 4 inches						Category II plant height 4 to 8 inches						Category III plant height 8 to 12 inches					
	$8	10	12	14	16	20	$8	10	12	14	16	20	$8	10	12	14	16	20
$ 60	0.4	0.5	0.6	0.7	0.8	1.0	0.7	0.8	1.0	1.0	1.8	1.7	2.0	2.4	2.8	3.0	3.9	5.0
$ 80	0.3	0.4	0.5	0.5	0.6	0.8	0.6	0.6	0.8	0.9	1.0	1.7	1.8	1.9	2.2	3.0	3.9	5.0
$100	0.3	0.3	0.4	0.4	0.5	0.6	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.8	2.1	2.4	3.0
$120	0.2	0.3	0.3	0.4	0.4	0.5	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.2	1.5	1.8	2.1	2.4
$140	0.2	0.2	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.5	1.8	2.0
$160	0.2	0.2	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.3	0.5	0.6	0.8	0.9	1.0	1.2	1.5	1.8

Cost of insecticide application per acre

The Alfalfa Weevil

The alfalfa weevil overwinters in two ways, in the adult and egg stages. Some eggs are deposited in the fields in the fall and survive our winters. However, about 90 percent of the eggs are deposited in the spring, with most of them laid before mid-May. Larvae that hatch from these eggs move to the tips of the plants and feed on the leaves. This feeding results in loss of both yield and quality of alfalfa.

The small, green, curved larvae, with dark brown to black heads, reach maturity in approximately 3 weeks (normally about June 1 in southern Pennsylvania). They pupate in small, round, delicate, loosely woven cocoons attached to trash, leaves, and stems, usually near ground level.

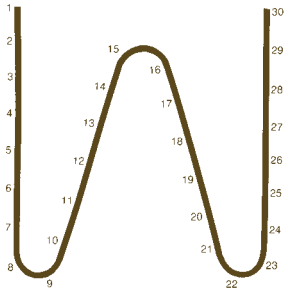
A new brood of adult weevils emerges around mid-June. Most of these weevils disappear and spend the summer months in protected sites both in and outside the fields. After the insect larvae spin their cocoons, damage can be considered over for the year since there is very little weevil activity during the summer and fall. This tells us that alfalfa weevil injury is almost entirely limited to the first cutting, with some possible damage to the regrowth of the second cutting. We can be reasonably certain the alfalfa weevil season is over by mid-June.

The rate of weevil development is tied closely to the accumulated degree days. However, due to the slow start of weevil activity each spring in Pennsylvania and the relatively low populations experienced during the past few years, accumulated degree days will not be emphasized for predicting weevil activity damage.

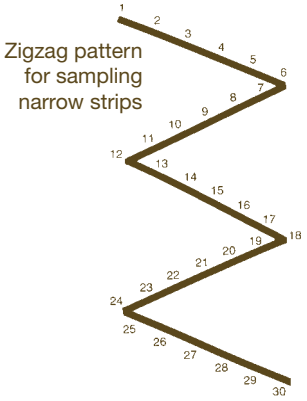
Sampling procedure for alfalfa weevil

Feeding by alfalfa weevil larvae has been negligible before the first week of May in recent years. Noticeable feeding injury to the plant tips provides the signal to start monitoring your alfalfa fields. The month of May is the crucial time for weevil control sprays to be applied if needed. Resampling of fields at weekly intervals during the month of May is recommended. This is especially important if your fields are prone to weevil damage or if you are undecided about whether or not to spray.

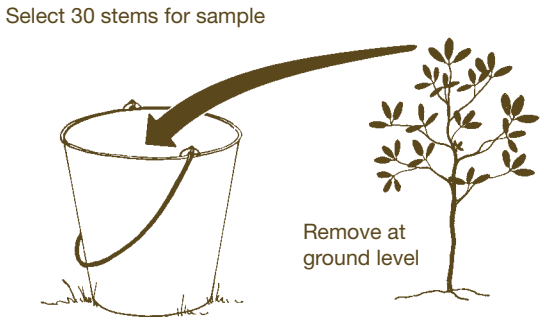
Step 1. To sample your field, carry a bucket (a 2- or 3-gallon plastic bucket will do fine) and walk through the field in either a "W"or zigzag pattern. Randomly remove an entire stem from 30 locations at approximately equal intervals in order to obtain a good representative sample of the field.



"W" pattern



Step 2. When collecting an alfalfa stem sample, carefully cup your hand around the top of the stem before removing it. This will prevent any larvae from dropping off that may have been on the stem. Now remove the stem at ground level and place it top first into the bucket. Repeat this procedure as you follow your pattern across the field.



Step 3. You now have 30 alfalfa stems, tops first, in the bucket. Separate these into 3 or 4 small bundles and beat each bundle 10 to 15 times against the inside of the bucket to dislodge the larvae from the stems. We are primarily interested in the large larvae (green in color and ¼-inch long) since the big ones do the most feeding. In most cases, only the large larvae are easily dislodged from the plant. Now count all the larvae, including the small, cream-colored ones that are in the bucket. Record this number on your field sheet.

Step 4. Measure 10 of the stems to get average height of the plants in inches. Record the average height on your field sheet.

Step 5. Observe stems and record percentage with buds. The number of flower buds present will help you decide whether to spray or harvest the field if weevil larvae numbers are near the economic threshold and the field is near the harvesting stage of development.

Factors used in determining the alfalfa weevil economic injury threshold discussed in Table 3

NOTE: This alfalfa weevil injury threshold is determined on the premises that crop losses result almost entirely from weevil larvae emerging from spring-laid eggs and that signs of feeding damage on the top leaflets are in little evidence before early May. Thus, in those areas where fall-laid eggs and early spring larval development are common (states south of Pennsylvania), we would expect the economic injury threshold to be lower than in Table 3.

As in estimating the potato leafhopper damage potential, four factors are used to help determine when a control application will be profitable for alfalfa weevil: (1) the number of pests present in the field, (2) the development of the plants, (3) the value of the crop, and (4) the cost of the control application.

1. The number of pests present in a field. The sample used is the number of larvae (all sizes combined) on 30 stems. Research has established that a 30-stem sample provides a reliable indication of the weevil larvae population in a properly monitored field. See the previous pages on how and when to monitor fields for weevils.

Crop losses from weevils are predicted on the amount of foliage one larva per sample of 30 stems will destroy in relation to the development of the crop. For example, on alfalfa 12 inches high, one larva per 30-stem sample will reduce the hay equivalent yield by 0.00159 ton per acre, or 3.18 pounds.

2. Development of plants. This is the height of the plants when the fields are monitored. Small plants infested with weevils suffer greater losses than large plants with equal numbers of weevils.

3. Value of the crop. The higher the value of the crop, the fewer the number of weevil larvae that can be tolerated.

4. Cost of control application. As costs of control measures increase, losses from the pest can also be higher before a spray application is warranted.

It is doubtful that many fields will need spray protection before May 10. Early spray applications generally are very hazardous to certain parasites that feed on weevil; for this reason alone, early spraying should be avoided if possible. Insecticides that have long residual action are more likely to destroy the parasites than are short residual insecticides. Therefore, in most situations, short residual insecticides are suggested when chemical control is needed.

Table 3. Economic injury threshold for alfalfa weevil; number of larvae from 30-stem sample.

How to use table below:
1. Use plant height category that fits the field.
2. Estimate the value of the crop in dollars per ton of hay equivalent and the cost to spray an acre.
3. From monitoring the field, find the number of alfalfa weevil larvae from a sample of 30 stems.
4. The number in each small box indicates the number of larvae per 30-stem sample that is required for a spray application to be profitable under these conditions.

Example: Plants in the field are 20 inches high (use Category II), hay is valued at $80 per ton, cost to spray is $8 per acre, and you collected 40 larvae from the sample of 30 stems. The number in the box common to $80 per ton and $8 is 75. This means that under these conditions, 75 larvae are needed before a spray would be profitable. Since you collected only 40 larvae, a spray at this time will not be profitable.

Value of hay per ton	Category I plant height 12 to 18 inches						Category II plant height 18 to 24 inches						Category III plant height 24 to 30 inches					
$ 60	91	114	137	160	183	225	99	124	149	174	199	240	104	130	156	182	209	260
$ 80	68	85	102	119	136	171	75	94	113	131	150	186	78	97	117	137	157	195
$100	54	68	81	95	108	137	62	75	90	105	120	149	63	78	94	110	126	156
$120	45	57	68	79	91	114	50	62	75	87	100	124	52	65	78	91	105	130
$140	39	49	59	68	77	99	43	54	64	75	86	107	45	56	67	78	90	112
$160	34	43	51	60	68	86	37	47	56	65	75	93	39	49	58	68	79	98
	$8	10	12	14	16	20	$8	10	12	14	16	20	$8	10	12	14	16	20

Cost of insecticide application per acre

Should the field be sprayed or cut? Some of the most difficult decisions come near harvest time of the first crop. If the crop is in full bud and Table 3 indicates spraying, it probably will be best to harvest rather than to spray. However, if harvesting is impossible for at least 3 days and the population is increasing or holding steady, then spray with a short residual insecticide that will leave no residue on the hay at harvest.

The several previous sampling records of such a field can be very helpful at this time. By comparing the last several samples of the field, you can determine if the weevil population is increasing, has reached a plateau, or is decreasing. If it is decreasing, don't spray—the weevil season is over.

When to spray the stubble. The stubble of all fields should be checked 4 to 6 days after mowing. First check those fields that were not sprayed or were sprayed fairly early in the season. If the weevil larval population is fairly high, regrowth of the second crop can be drastically held back. If weevil cocoons are present and the larval number is low, the weevil season is practically over and little additional damage is likely.

An average of two or more larvae per crown indicates a stubble spray will be profitable. Apply it as soon as the forage is removed from the field.

Costs Versus Benefits of the Pest Management Program

Unfortunately, it will take both time and labor to monitor your alfalfa fields when using this program. Let us assume you have 30 acres of alfalfa in three different fields. It will require about 20 minutes to sample each field for a total of 60 minutes. You will probably sample each field twice, once for weeds and once for alfalfa weevil. Thus, the total time for weeds and weevil monitoring is two hours. Let us assume your labor cost is $10 per hour. The cost is $20 or $0.67 per acre.

To check for leafhoppers, you will require double this amount of time because you will be monitoring both the second and third cuttings. Thus, the cost of leafhopper monitoring will be $40 or $1.33 per acre. Your total time and labor cost to monitor the three fields with 30 acres of alfalfa for both weevil and leafhopper will be 6 hours at a labor cost of $60. This averages out to $2 per acre.

Can you afford this time and expense? If this monitoring saves one spray costing $8 per acre, you are $6 per acre on the plus side. If the monitoring indicates you should spray when you had not planned to, your field and quality of hay could easily be increased by a value of $10 to $20 per acre.

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