Alfalfa Scouting Procedures
Growing Alfalfa the IPM Way

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New York State Integrated Pest Management
The goal of the New York State Integrated Pest Management (IPM) Program is to reduce the use of chemical pesticides to the minimum level necessary to produce high quality food and agricultural products that will be competitive in the marketplace, while protecting human health and environmental quality.

Additional copies of this manual can be obtained from the Media Services Distribution Center, Cornell University, 7 Business and Technology Park, Ithaca, NY 14850, 607/255-2080. Ask for a free IPM catalog.

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Italicized entries are color fact sheets.

1. OVERVIEW OF IPM METHODS

How does one successfully balance control of pests with profitable crop production and environmental protection? Integrated pest management (IPM) techniques provide a very useful and effective means of reaching these two goals. IPM is a system of pest control that uses the knowledge of many agricultural disciplines to manage pest problems in a way that optimizes net profits while minimizing the impact on the environment. Controlling pests at the lowest cost and with the least risk of loss does not necessarily require a regular spraying schedule.

A. About This Manual

As an alfalfa farmer, you can reduce pest populations by planting resistant varieties, rotating crops, and practicing cultural controls such as harvesting early, enhancing effectiveness of biological controls, or when warranted, the judicious use of appropiate chemical methods. To optimize pest-control decisions, one should know the identity and extent of pests in each field, the potential risk they pose to the crop, and consider the efficacy, costs, and impacts of all appropriate cultural, biological, chemical and other control options.

A variety of pests can attack alfalfa during the growing season. *Growing Alfalfa the IPM Way* should help you identify these pests and decide how to best manage them. The procedures described in sections 2, 3, and 4 emphasize ways of critically assessing the presence and importance of the different weeds, insects, and diseases found in alfalfa.

Since pests occur predictably throughout the season, a scouting calendar is included to help you time general scouting activities. Other helpful material such as a diagnostic guide and suggested references are located in the appendix.

This guide focuses on the how-to aspects of scouting alfalfa pests. Step-by-step instructions will be found in "boxed" paragraphs. General information on growing field crops in New York State is dealt with at length in the *Cornell Field Crops and Soils Handbook.* Specific, up-to-date information on resistant varieties and pest control guidelines, including pesticide recommendations, can be found in the latest *Cornell Recommends for Field Crops.* This manual, *Growing Alfalfa the IPM Way,* is designed to be used with those two references, both of which are available from the Media Services Distribution Center, Cornell University, 7 Business and Technology Park, Ithaca, NY 14850 (607/255-2080).

B. Six Steps to Successful Pest Management

The following six steps can help you to detect pest problems before they become significant, to prevent losses, and to avoid unnecessary pest management actions:

- Identification
- Sampling
- Analysis
- Management Alternatives
- Implementation
- Re-evaluation

This six-step program promotes "proactive" rather than "reactive" management. Careful use of these principles in the order presented will maximize the advantages of using the IPM approach.

Identification

Correct identification is the first and most important step in controlling a field problem, whether it is caused by a pest, environmental stress, nutritional deficiency, or another factor. This first step is critical to future success, since an incorrect diagnosis leads to mismanagement. Mistaking a disease problem for an

insect problem, for example, can lead to an unnecessary use of an insecticide or continued planting of disease-susceptible crop varieties.

Learn to identify the parasites and predators that help keep harmful pests in check. Although many insects and other organisms can be observed in fields, relatively few actually harm crops.

Obtain as much information about the problem as possible to determine its cause. Answering several questions will help in this process. What type of damage is observed? Is this a historical problem? Is the problem found only in particular locations, rows, or drainage patterns, or at certain times during the growing season? What part or growth stage of the plant is affected?

Dig up plants showing symptoms. Check roots and the surrounding soil for evidence of pests. This scouting manual discusses the most commonly found pests in alfalfa in New York. A diagnostic guide is included in Appendix A to help you to identify other less commonly observed problems.

Sampling

Once the pest is correctly identified, the next question arises: Is there risk of significant losses? Is the problem occasionally seen or commonly found throughout the field? What is the extent of the damage? Is the problem a growing threat?

Scientific sampling techniques have been developed for assessing the damage potential of many pests. Correct sampling helps eliminate the guesswork in pest control by providing a means to quantify an old problem or discover a new one. Use sampling knowledge and information on pest and crop biology to make better management decisions. For example, the alfalfa weevil pupates to the cocoon stage, thus alleviating a problem naturally.

Accurate sampling, or scouting, is systematic and methodical. Examine and quantify all important field information needed to make a sound pest management decision.

Analysis

The third step in the pest management process is analyzing the identification and sampling information and evaluating the need for a pest control action. Decide how bad the problem is. Is the control more costly than the damage potential? Weigh economic, environmental, and time concerns. What impact will the current pest control decision have on future crop management decisions?

Compare the observed frequency of a given pest to its "action threshold." An action threshold is the level at which action must be taken so that the pest will not significantly damage the crop. Action thresholds are based on research and growers' experiences with similar problems.

During the analysis stage, consider the relative vigor of the plants and the percentage of alfalfa in the stand. Light pest populations may actually increase yields by causing the plant to compensate. Poor stands (less than 75% alfalfa) may not return management dollars since thresholds are based on research with clear stands. Crowns should have many lush stems, and little or no signs of root or crown injury, and clear stands probably should have a minimum of five healthy crowns per square foot to justify pesticide application. Clear seeded alfalfa is usually more economical to treat for a given pest problem than mixed stands, and some pesticides cannot legally be applied to mixed stands.

Management Alternatives

When an action is needed, choose a strategy that fits with the short- and long-term plans, labor force, capital, equipment, and finances of the farm. Evaluate the costs, benefits, and risks of employing various management options. Look for opportunities to integrate different pest control strategies. What are the cultural, mechanical, biological and chemical control options? (See "IPM Options for Managing Alfalfa Pests" inside the back cover.) Which is the most practical, economical, effective choice?

Implementation

Implement the control carefully and at the right time. If pesticides are used, always follow label recommendations. Cultivation or using herbicides on weeds, for example, must be done at the right stage of development for greatest impact. Pay close attention to the quality control of pest control actions, such as correct

calibration of the application equipment and label recommendations. If appropriate, leave small, untreated areas to evaluate control effectiveness.

Re-evaluation

After a pest control action is taken, review what went wrong—and more important, what went right. Did the control work? Scout the field again and compare pest activity before and after treatment. Was the problem identified properly? Was the field sampled unbiasedly? Was a "fudge factor" added to the threshold? Was the choice of control based on sound judgement or outside pressure? What changes to the system would make it better? This step is a very important part of the IPM process since it enables you to learn from experience and find ways to improve management skills and impact.

2. FIELD SCOUTING PROCEDURES

An IPM approach to alfalfa production depends on the timely collection, analysis, and use of specific field information so that management decisions can be made.

A. General Monitoring

Monitor alfalfa fields at least once every seven days from the time fields break dormancy until at least a week after the last harvest.

Take a weed survey of each field in the spring and fall. Additionally, a stand count (alfalfa plants per square foot) should be made in the early season and following the last cutting.

Prioritize monitoring based on the alfalfa scouting calendar (inside the front cover) and the tables of common pests and diseases in new and established stands (found on the cardstock insert). Guidelines for monitoring specific pests will be provided in the sections that follow.

Walk in a “zig-zag” or “W” sampling pattern through the field. If possible, avoid sampling near (within 100-150 feet of) the edge of the field, since pest populations in these areas may not be typical of the majority of the field. A different entrance, route, and exit should be chosen each visit in order to increase the potential of finding isolated problems during the season.

Make a record of significant findings for each field visit on the Alfalfa IPM Scouting Report (pages 11-12) and keep it for future reference. This record

should always contain the date, crop stage or height, crop condition, and significant pest problems, including the pests observed and their abundance (average count, rating, or %, as appropriate).

It is critical that the pest information you collect represent the whole field. Select sampling sites *at random* throughout the field, but be sure to note any problem areas.

Since pest problems often occur annually or become more severe with time, review field records to determine chronic problems and the effectiveness of previous management actions.

Additional information on general IPM scouting techniques is presented in the *Cornell Field Crops and Soils Handbook.*

B. Equipment

The following tools will help you to gather information easily and quickly. Pack the relevant scouting equipment in a field case or backpack. Marking scouting equipment with bright surveyor's tape or bright paint helps avoid loss in the field. The handle of the sweep net or shovel can be marked in one inch increments for measuring alfalfa height.

For Identification/Sampling:

- 10X hand lens
- Pocket knife
- Yardstick or meterstick
- 15-inch-diameter sweep net
- Soil sampling probe
- Sharpshooter shovel
- Bucket
- Collection containers (ziplock bags, vials)
- 1-square-foot sampling template
- Reference materials

Example of Alfalfa IPM Scouting Form

Alfalfa IPM Scouting Form

Grower:_____ **Scout:**_____ **Date:**_____

Weather: Temp:_____ partly sunny cloudy rainy calm light wind strong wind

Field Name: _____	**Time:** in:	out:
Plant Develop.: Ht. (in.) _____ Growth Stage: _____ %Bud: _____ %Bloom: _____		
Soil Condition: wet moist dry loose light crust hard crust		

Pest	Count	Unit	Threshold	Status	MAP

COMMENTS: _____

Common Abbreviations: PLT=plant; CRWN=crown; SWP=Sweep; AW=Alfalfa Weevil, PLH=Potato Leafhopper; PRR=Phytophthora Root Rot; VERT=Verticillium Wilt

Plant Development

•Growth stage - vegetative, regrowth, pre-bud, bud, blooming, harvested
•% Bud or bloom - Estimate % of plants with green buds or flowers easily seen

Map

Map areas of special interest observed while scouting, for example: entry/exit points, sampling areas, location of significant pest (particularly weed or disease) or other problems, and landmarks for orientation.

Comments

• Specific comments about significant pests found in the field. Include information on areas of particular severity, unusual observations, special interest, etc.
• Comment on the overall field condition. What is the "take home" message based on field information?

Count

Number observed; type of count depends on pest . For example:
• 10/50 - 10 stems of 50 stems sampled positive for alfalfa weevil
• 5% - estimated 5% of plants in field or a particular area (specify) affected.
• moderate - a ranking of weed (also few, common, abundant, extreme)

Unit

Unit depends on pest:
• [per] stem - alfalfa weevil
• [per] sweep - potato leafhopper
• [per] square foot - stand counts and some pests
• [per] plant - other insects
• Field - diseases, weeds, alfalfa snout beetle, pests where an estimate or ranking of the overall presence or presence in a particular area of the field rather than a specific count is recommended.

Threshold:

• Specific economic threshold, if known

Status:

• Is pest above or below economic threshold?

For the Record:

- Field forms (in this manual)
- File folders
- Clip board
- Calculator
- Thermometer
- Note pad
- Waterproof marker pen or pencil

For Your Comfort:

- Sunscreen
- Field clothing
- Insect repellant
- Water jug for drinks

C. Stand Counts

The number of alfalfa crowns per square foot provides an indication of the productivity that can be expected from the field. Stand counts should be made in the early spring and in the fall. They are particularly easy to make while the alfalfa is short, and can be done in conjunction with other scouting activities.

Select ten sites at random throughout the field. Using the square foot template, count and record the number of alfalfa crowns observed within a square foot. Count *crowns* of alfalfa rather than the total number of *stems* present. Each crown may have a dozen or more stems, depending on the age and vigor of the crown (See Table 1). Note the locations of unique findings such as frost heaving, winterkill, excess moisture, or heavy weed infestation.

Table 1. Comparison of New Seeding and Established Stands*

Harvest Year	Optimum Stand (crowns/ft.^{2})	Adequate Stand (crowns/ft.^{2})
New Spring Seeding	25-40	12-20
1st Hay Year	12-20	6-10
2nd Hay Year	8-12	4-6
3rd and Older	4-8	2-5

*Cornell Cooperative Extension, Michigan State Field Crops Handbook.

3. WEED SCOUTING PROCEDURES

The presence of weeds in alfalfa often indicates various crop management problems such as diseases and insect pests, poor harvest management, soil infertility, and improper pH. Although many weeds have some nutritional value, their presence can affect forage yield, quality, palatability, hay drying time, and stand longevity. Certain weeds may also affect animal health.

A. Overview

The IPM strategy for weed management includes proper weed identification, knowledge of weed life cycles, and an assessment of the relative importance of a particular weed. The objective of weed scouting is to evaluate the potential competition of weeds with the alfalfa and their impact on alfalfa quality. New seedings are most vulnerable to this competition. Weed scouting also provides weed information for fields being rotated to other crops.

Proper weed identification is the key to a successful weed management program. Know the difference between broadleaf weeds, grasses, and sedges. Broadleaf weeds are easily recognized by their wide leaves, but grasses and sedges may be confusing. Closely examine the stems to distinguish between these groups. Grasses typically have stems that are round or flattened in cross section, while sedges have “edges” with triangular or three-sided stems. Refer to the weed identification fact sheets for additional information.

Knowing a weed’s life cycle is important because weed control recommendations are grouped according to life cycle. Weeds are classified as annual (summer and winter annuals), biennial, and perennial. While annual and biennial weeds

reproduce only by forming seed, perennial weeds reproduce by forming seed and by producing underground reproductive organs. Annuals usually have a simple, fibrous root system; perennials have thick, fleshy roots that grow deep into the soil. Table 2 groups common weeds in New York by life cycle.

Table 2. Common New York Weeds by Life Cycle

Annual Broadleaf	**Annual Grass**	**Biennial Weed**
Bedstraw	Barnyard grass	Bull thistle
Buckwheat	Crabgrass: large and smooth	Burdock
Chickweed	Fall panicum	Yellow rocket
Cocklebur	Foxtail: giant, green, and yellow	Wild carrot
Corn speedwell	Wild oat	
Henbit	Wild proso millet	**Perennial Weed**
Jimsonweed	Witchgrass	Bindweed: field and hedge
Lambsquarters		Buckhorn plantain
Morning glory	**Winter annual**	Canada thistle
Nightshade, black	Corn chamomile	Curly dock
Pennsylvania smartweed	Purple deadnettle	Dandelion
Pigweed: redroot and smooth	Shepherd's purse	Hemp dogbane
Purslane		Horsenettle
Ragweed		Johnson grass
Wild mustard		Milkweed
Wild radish		Quackgrass
Wild sunflower		Yellow nutsedge
		Wire stem muhly

Knowing which weeds are most competitive or cause the greatest losses will help you select the most cost-effective weed control program. Some general guidelines on the relative competitiveness of different weeds follow.

1) Perennial weeds are generally more competitive than annuals.
2) Broadleaf weeds tend to be more competitive than grasses.
3) Weeds with life cycles similar to that of the crop tend to be more competitive than weeds with different life cycles.
4) Losses due to weeds are greater when resources (such as soil moisture) are very limited than when resources are adequate for both the crop and the weeds.

B. Weed Scouting

Scout for weeds in the spring and fall. As always, take care to obtain a representative sample of weed conditions throughout the field, although weed

infestations may not be uniform across the entire field. Document the weed type rather than taking detailed counts of weed species.

Observe at least five random areas of a forty acre field; divide larger fields into two equal parts for scouting. Base these divisions on previous field history, soil type, topography, or other factors that might affect weed populations.

Scout for weeds in conjunction with other monitoring activities. Record weed type (annual, biennial, perennial, grass, sedge, and broadleaf) and relative importance from all parts of the field. Note any areas with significant weed problems. Map weed locations on the scouting form.

Check special terrain features such as droughty slopes, poorly drained areas, field borders, and fence rows for weeds. These areas can be major sources of weed contamination and differ significantly from the rest of the field.

C. Weed Assessment

Specific economic thresholds have not been established for weeds in alfalfa in New York. Instead, use the rating scale provided below and knowedge of the weed type (annual, biennial, perennial, grass, sedge, or broadleaf) to design a weed management program.

Determine the presence of each weed species according to the following rating scheme.*

None No weeds are present.

Few Weeds are present, but there are very few plants in the field. There are enough plants to produce seed but not enough to cause significant loss.

Common Plants are dispersed throughout the field. There are
a) up to 5 grassy or 3 broadleaf annual weeds per square foot, or
b) 0.3 perennial or biennial weeds per square foot (3/sq. yd), or
c) scattered spots of severe infestation.

Abundant There are fairly uniform concentrations of
a) 6 to 20 grassy or 4 to 10 broadleaf annual weeds per square foot, or
b) 0.5 to 1.0 perennial or biennial weeds per square ft (6-20/sq yd), or
c) scattered spots of severe infestation.

Extreme There are
a) concentrations of more than 2 grassy or 1 perennial or biennial weeds per square foot (20 grassy or 10 perennial or biennial/sq yd), or
b) large areas of severe infestations.

*Cornell Cooperative Extension, Michigan State Field Crops Handbook.

After rating the weeds, rank the most prevalent weed species in each field in order of severity.

Weed Control Decisions

Base weed control decisions on information from both the fall and early spring weed surveys, stand counts, and species composition. Alfalfa weed control is most economical for a healthy, vigorous stand of at least 75% alfalfa. Clear stands should have at least five healthy crowns per square foot. In a good stand, the removal of weed competition should increase the quantity *and* quality of the forage produced. In thinning stands, however, eliminating the grasses can significantly decrease the quantity and quality of harvest.

The majority of weed control measures should be practiced either very early in the spring or late in the fall. Use previous years' scouting information and weed maps to plan controls, which may include dormant treatments or rotation.

D. Weed Considerations by Years in Stand

New Seedings

Survey new seedings of alfalfa (seeded alone or with a companion crop) when annual weeds are no more than 1 to 1 1/2 inches tall (2 to 4 leaf stage). Postemergence herbicides are most effective at this stage.

In clear-seeded alfalfa, post-emergence herbicides can be used for annual broadleaf weeds as soon as the alfalfa has two to three trifoliate leaves. No chemical herbicides are currently available for new alfalfa stands seeded with a companion small grain.

Special weed problems, such as patches of perennial weeds or annual weeds that have not been controlled, should be noted in later surveys. This information will help you determine whether dormant alfalfa should be treated with a herbicide in the fall and what portion(s) of the field should be treated.

Established Stands

Problem weeds in established alfalfa are most easily recognized and scouted before the first cutting of the alfalfa in the spring. Many of the most serious perennial weeds, such as quackgrass and dandelion, and winter annuals, such as shepherd's purse and common mustard, accomplish the major portion of their growth in the spring, when they are easiest to monitor. Annual weeds may occur later in the season after harvest has opened up the alfalfa canopy, but this is uncommon.

E. Weeds Affecting Livestock

Certain weed species may present additional problems if animals are allowed to graze the field or eat large amounts of a particular weed. Some weeds affect milk flavor (Table 3) or pose a health risk to the animals (Table 4).

Table 3. Weeds Affecting Flavor of Milk and Milk By-products When Eaten in Large Quantities

Broad-Leaved Dock	Ragweed	Mustard
Burdock	Saint Johnswort	Wild Onion
Chicory	Stinkweed	Yarrow
Curled Dock	Spurges	
Jimsonweed	Wild Carrot	

Table 4. Some Weeds Known to be Harmful to Livestock When Eaten in Large Quantities*

Weed Species	Livestock Affected
Horsetail (*Equisetum* spp)	Cattle, Horses, Sheep
Pokeweed (*Phytolacca americana* L.)	Cattle
Tall Buttercup (*Ranunculus acris* L.)	Cattle, Horses, Sheep, Goats
Saint Johnswort (*Hypericum perforatum* L.)	Cattle, Horses
Nightshade:	Cattle, Horses, Sheep, Goats
Climbing (*Solanum dulcamara* L.)	
Black (*S. nigrum* L.)	
Jimsonweed (*Datura stramonium* L.)	Cattle, Horses, Sheep, Goats
Milkweed	Cattle, Horses, Sheep
Common (*Asclepias syriaca* L.)	
Whorled (*A. verticillata* L.)	
Cockle	Cattle, Horses
Cow (*Saponaria vaccaria* L.)	
Bouncing Bet (*S. officinalis* L.)	
Purple Cockle (*Agrostemma githago* L.)	
Cocklebur (*Xanthium strumarium* L.)	Cattle, Horses, Sheep
Spurge	Cattle, Horses, Sheep, Goats
Leafy (*Euphorbia esula* L.)	
Cypress (*E. cyparissias* L.)	

*Partial list. Weed information complied from: *Cornell Recommends for Field Crops, Michigan State University Field Crops Scouting Manual* and Ontario Ministry of Agriculture fact sheets: "Poisoning of Livestock by Plants," "Common Weeds Poisonous to Grazing Livestock, Part A and Part B," Agdex 130/643.

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4. INSECT SCOUTING PROCEDURES

Monitor alfalfa every seven days for insect pests. Insects multiply rapidly and their feeding can damage crops quickly.

Alfalfa fields are home to many insects, including many beneficial predators and parasites. Fortunately, relatively few insects are pests of alfalfa in New York. Common insect pests and their impact on new seedings and established stands are shown in Table 5.

Table 5. The Impact of Common Insect Pests on Stands

Insect Pest	New Seeding	Established Stand
Alfalfa Weevil	++	+++
Potato Leafhopper	+++	++
Clover Root Curculio	+	++
Alfalfa Blotch Leafminer	+	+
Alfalfa Snout Beetle [a/]	++ locally	++ locally

+ = occasionally significant; ++ = potentially significant; +++ = frequently significant and a priority for scouting, - = not expected.

[a/] Significant pest in areas of Cayuga, Clinton, Essex, Jefferson, Lewis, Oswego, St. Lawrence, and Wayne counties. New seedings and established fields are equally vulnerable to attack by migrating alfalfa snout beetles.

The principle insect pests affecting alfalfa in New York are the alfalfa weevil and the potato leafhopper. Techniques for scouting these pests are presented in detail in this section. Clover root curculio, alfalfa blotch leafminer, and alfalfa snout beetle may also cause occasional problems; however, no specific scouting methods for these pests are described. For further information on these pests, consult the *Cornell Field Crops and Soils Handbook* and the relevant fact sheets following this section.

A. Alfalfa Weevil

The alfalfa weevil, *Hypera postica* (Gyllenhal), is generally a problem only before the first harvest because it has only one generation per year, and this matures about the time the first cutting is completed in New York. Occasionally, if alfalfa weevil (AW) populations are high before harvest or if weather conditions are unusually cool or dry, AW can significantly damage alfalfa regrowth following the first cutting of hay. AW tend to be found in established stands rather than new seedings, but when significant alfalfa weevil populations are detected in older stands, new seedings should be carefully monitored for weevil activity.

A guide for timing AW sampling, Table 6, takes into account the influence of temperature on different life stages of alfalfa weevil. The accumulated heat units or "growing degree days" (GDD) can be obtained from the WEATHERDATA program available on CENET, Cornell Cooperative Extension's electronic information system. Local weather conditions and other factors such as field orientation and wind drainage may affect weevil growth stages.

Degree days can also be calculated if local temperature records are kept daily.

$$\text{Degree Day} = \frac{(\text{Max temp} + \text{Min temp})}{2} - 48$$

Total the daily degree days after March 1 to get the accumulated GDD. Negative values for degree days are considered zero. **NOTE**: Most GDD calculations for other crops, including corn, use a 50°F base temperature.

Examples:	Day 1	(36+34)/2-48=	0 Degree Days
	Day 2	(59+41)/2-48=	2
	Day 3	(70+55)/2-48=	14.5
Accumulated GDD			16.5

Table 6. Growing Degree Days for Peak (50%) Occurrence of Stage

Stage or Event	Degree Days*
eggs hatch	280
instar 1	315
instar 2	395
instar 3	470
instar 4	550
cocooning	600
pupa	725
adult emergence	815

* 48°F base temperature. Source: R. I. Carruthers

Early Season Sampling

Early season alfalfa weevil monitoring should begin when 280 GDD are reached, or in early May, whichever comes first. *Give priority to monitoring AW in established stands,* since AW populations may have built up in these fields during previous years. Closely monitor fields where AW has been a problem in the past. If alfalfa weevils are approaching threshold in the established fields, or if other alfalfa fields on the farm or in the region are significantly affected, new seedings should be carefully monitored.

Walk the field in a "zig-zag" or "W" pattern, searching for signs of adult and larval feeding. Foliar feeding causes a tattered or "shot hole" appearance to leaves, particularly young unfolding leaves. Observe small larvae by examining the affected leaves. Check plant stems for signs of feeding also.

Alfalfa weevils are small (1/4 inch long) brown snout beetles with a dark stripe down the center of the back. AW adults overwinter in noncrop areas adjacent to alfalfa fields and become active with the first series of warm days in the spring. Adults cause some damage to foliage, but it is the larvae which cause the most damage and which must be scouted.

In the spring, female weevils chew a small hole (1/16 inch) in the young succulent alfalfa stem tissue three to four inches above the soil surface. There they deposit their eggs. Occasionally weevils lay eggs inside the stems of the weed henbit (*Lamium* spp.).

To find alfalfa weevil eggs, cut the alfalfa stem lengthwise through the bored hole. The color of the eggs can indicate the relative number of days until hatch.

When first laid, eggs are a milky white. They become yellow and finally brown just prior to egg hatch. Time until hatching is seven to ten days, depending on the temperature.

The green alfalfa weevil larvae have a very characteristic black head capsule and a distinct white stripe down the middle of their back. The larvae go through four life stages or *instars:* 1st instar, 2nd instar, 3rd instar, and 4th instar. Each of these instars is progressively larger, and each consumes increasingly more alfalfa. The fourth stage larvae, about 3/8 inch long, consume 80% of the total foliage eaten by all the stages.

A fungal pathogen may help control alfalfa weevil larvae. Infected larvae will appear yellow to tan and eventually will shrivel and turn dark brown to black.

NOTE: Another green larva may sometimes be found in alfalfa during the alfalfa weevil season. This larva of the clover leaf weevil is very rarely a pest and is easily distinguished from the AW by its brown head capsule, larger body size (about 5/8 inch in the fourth instar), and reddish, triangular spots along the sides of the white stripe down the center of its back. Clover leaf weevils usually feed only on leaf edges.

As 4th instar AW larvae pupate, they spin a white net-like cocoon approximately 1/4 inch in diameter. Look for cocoons near alfalfa crowns in leaf litter or attached to the base of stems. A parasitic wasp, *Bathyplectes* spp., attack AW larvae just before the cocoon stage. In a parasitized cocoon, the weevil pupae has been eaten and replaced with a 1/8-inch-long, mahogany colored, egg-shaped wasp cocoon, which may or may not have a white band.

Sampling Before First Cutting

Since the abundance of AW larvae may vary widely across a field, try to obtain information that is representative of the entire field.

Foliar Damage Assessment. As you walk through the alfalfa field, collect 50 stems at random. Avoid sampling border areas. Check upper leaves of selected stems for a tattered, shot-hole appearance that indicates weevil feeding. If one leaf in the top inch shows signs of AW feeding, that stem should be considered "positive" for AW.

Before the first cutting, control measures are recommended when 40% or more of the stems are positive for signs of AW feeding. Base your decision to manage alfalfa weevil on the quality of the stand (% alfalfa), cost of treatment, and the number of days until cutting.

Early cutting, if within seven to ten days of harvest, manages alfalfa weevil effectively and is the preferred first option. If alfalfa is harvested early, examine stubble (particularly on plants in the windrow) for signs of weevil feeding four to six days later.

Sampling After First Cutting

Fields that have had large populations of AW larvae before cutting may be damaged by larvae feeding on the regrowth. The ratio of observed cocoons to larvae indicates the relative age of the population. If more than 50% of the AW are in the cocoon stage, the population is maturing to a non-feeding stage and will no longer be a problem for this year. If the larvae are predominantly young, however, damage may be expected, expecially if the weather is cool and dry.

When assessing alfalfa weevil damage on stubble, check areas within and outside the windrows. Consider the presence of AW cocoons, the ratio of cocoons to larvae, and the number of parasitized cocoons found when making management decisions.

Two sampling methods for AW are recommended.

1) Foliar Damage Assessment. Use the method described earlier for checking foliage for the tattered, shot-hole appearance that indicates weevil feeding.

2) Larval Counts per Crown. Take larval counts while taking stand counts after harvest. Select ten alfalfa crowns at random throughout the field and look for

signs of feeding damage. Count the number of larvae and cocoons found per crown.

After the first harvest, control measures are recommended when either 50% or more of the stems are "positive" for signs of AW feeding, or there are two or more larvae per crown. Consider the life stage and number of parasitized AW when making management decisions.

B. Potato Leafhopper

The second principle insect pest of alfalfa in New York is the potato leafhopper, *Empoasca fabae* (Harris). The potato leafhopper (PLH) is the most serious and most widespread pest of alfalfa in northeastern United States. This insect pest migrates in association with weather patterns, and the first PLH to reach New York can usually be found with a few days of a heavy rain during mid- to late June.

PLH adults have a bright lime-green to yellow-green, slender wedge-shaped body, and are 1/8 inch long. They are very active and jump or fly when disturbed. PLH nymphs, which are smaller than the adults, are more yellow-green, wingless, and walk sideways when disturbed.

General Potato Leafhopper Management

Very young plants and plants early in the stages of regrowth are the most sensitive to leafhopper damage. Damage is intensified by moisture stress during drought. In general, if the alfalfa plant is over 14 inches tall before the leafhopper begins feeding on it, no reduction in yield will result. However, if leafhoppers infest the alfalfa when it is 2-4 inches tall, densities as low as one per sweep can cause economic damage under the right circumstances.

PLH can affect second and subsequent cuttings. If PLH populations approach threshold in fields with *young* alfalfa or young regrowth, monitor *established* alfalfa stands for PLH presence. PLH may first appear in fields at higher elevations or those bordered by tall trees.

Begin monitoring PLH when regrowth is 2-4 inches high, about 5-7 days after harvest. Inspect fields at seven-day intervals until regrowth reaches 12-14 inches.

Halve action threshold for PLH damage in new seedings in times of severe drought stress.

Harvesting can affect leafhopper densities. When an alfalfa field is cut, adult leafhoppers usually migrate to nearby fields. Reliable PLH counts cannot be made less than three days after harvest.

Heavy rains often significantly decrease PLH populations established in fields. If the potato leafhopper reaches an action threshold and a hard rain is predicted, scout the field again after the rain and reevaluate the need for action.

Alfalfa underseeded into small grains cannot be effectively swept for PLH while the grain is standing. The alfalfa should be monitored for PLH within one week after the small grain is harvested.

NOTE: Another leafhopper, the aster leafhopper, may be found mid-season in alfalfa underseeded into (or adjacent to) a small grain, or in fields with grass mixtures. Aster leafhopper is slightly larger than PLH and has a cream-colored body. It is associated with the grass and does not affect alfalfa. It can, however, transmit aster yellows to such crops as carrots.

Sampling for Potato Leafhopper

Base PLH management decisions on the number of leafhoppers per sweep and the height of the crop. A number of different sampling regimes have been used in the northeastern United States to estimate PLH populations. Recent research has shown that the "sequential sampling method," which calls for up to ten sets of ten sweeps, is the most precise and efficient. The sequential sampling technique is particularly efficient when PLH numbers are well above or well below an action threshold. The "ten and ten method," based on a total of 100 sample sweeps, will also be discussed.

Taking a Sweep

Use a standard 15-inch-diameter insect sweep net. Raise the net and let it swing

down 4-6 inches into the alfalfa (depending on the plant height) in a pendulum motion as you slowly walk forward. A swing right to left or left to right constitutes one sweep.

After ten sweeps, grasp the top of the net and shake the insects to the bottom of the net. Gradually open the sweep net and count the number of nymphs and adult leafhoppers per sweep. Record the total number of PLH, the number of sweeps, and the plant height.

Method One: Sequential Sampling Technique

1) Take ten sweeps at each of three different field sites in a diagonal line across the field. Add the number of PLH adults and nymphs collected across the three sites.

2) Measure and record the average height of the alfalfa at each of the sites to determine the appropriate PLH population treatment threshold.

Select the treatment threshold that corresponds to the height category of your crop on Table 8. Compare the total number of PLH collected with the decision columns adjacent to the 3-site column. If PLH numbers match the values in the "Don't Treat" or "Treat" column, PLH sampling for that field is finished and a management action should be taken.

When the management recommendation is "Treat" and the crop height is greater than 10 inches, consider early harvest.

If PLH numbers fall within the "Continue Sampling" column, another sweep sample should be taken at an additional field site (see Figure 4 of the fact sheet "Sampling and Management of PLH…"). Add the number of PLH collected at the additional site to the total number of PLH collected in the field and refer to

the table under the appropriate number of site for a decision. Repeat with additional sampling sites until a decision is made or until 10 sites have been sampled. If no decision can be reached after 10 field sites, resample the field in 5-7 days.

Table 8. Sequential Table for Sampling PLH Adults on Alfalfa in New York

		Cumulative Number of PLH Adults		
Crop ht. (inches)	**Sample (site) no.**	**Don't treat**	**Continue sampling**	**Treat**
<3 in.	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
3-6 in.	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
7-10 in.	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
> 10 in.	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

Method Two: Ten and Ten Technique

Sample the field weekly until the alfalfa regrowth reaches 14 inches. A sample consists of 10 sets of 10 sweeps with a sweep net, each set taken in a different part of the field.

When 10 sweeps for each set have been completed, shake the insects to the bottom of the net, slowly invert the net and carefully count and record the total number of nymphs and adult leafhoppers per set.

Record the growth stage and height of a few average stems.

Divide the total number of PLH caught by the number of sweeps taken (100) to obtain the average number of PLH per sweep. When PLH numbers are very low, as in the early season, sampling may be modified to sampling four sites with 25 sweeps per site. Divide the total of the four sets by 100 to obtain the number per sweep.

Base PLH management decisions on the chart below. If the average number of leafhoppers per sweep exceeds the threshold in the right column, control is recommended.

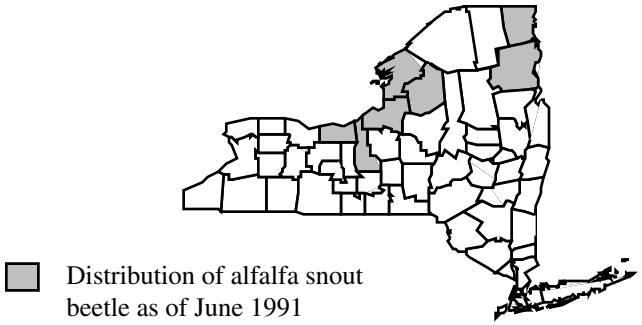
Average Stem Length (in.)	**Leafhoppers per Sweep (Threshold)**
less than 3 in. (new seedings)	0.2
3 to 7 in.	0.5
8 to 10 in.	1.0
11 to 14 in.	2.0
15 in. or above	If PLH numbers exceed 2.0 per sweep, and if regrowth is within 1 week of harvest, no action is needed. If not, use a short-residual insecticide.

For further information, consult the *Cornell Recommends for Field Crops, Cornell Field Crops and Soils Handbook,* and the Cornell fieldcrops factsheet *Sampling and Management of Potato Leafhopper in the Northeastern United States*, factsheet no. 500.00, 2/1990.

C. Alfalfa Snout Beetle

The alfalfa snout beetle, *Brachyrhinus ligustici* L., is a serious pest in areas of Cayuga, Clinton, Essex, Lewis, Jefferson, Oswego, and Wayne counties (See Figure 1). New seedings and established fields are vulnerable to attack by migrating alfalfa snout beetles (ASB) .

Figure 1. Alfalfa Snout Beetles in New York State



The ASB has a two-year life cycle. The adult beetle is gray and 1/2 to 5/8 of an inch long—at least twice as large as the alfalfa weevil. Adult beetles enter fields in large numbers in early April, about the time that two trees are in bloom: the shadbush (*Amelanchier oblongifolia* [T&G] Roemer) and pin cherry (*Prunus pennsylvanica* Linn., also known as Wild Red Cherry or Bird Cherry). The migration is best observed on warm sunny days and typically involves hundreds to tens of thousands of ASB. Seagulls seen feeding in alfalfa fields in mid-April to early May may indicate the presence of ASB.

Scouting for Alfalfa Snout Beetle

Scouting for ASB is very straightforward, since mere presence of this insect indicates the need for some action. Scout for ASB in known or suspected infested alfalfa fields within the seven counties indicated. Initial infestations tend to be associated with edges of fields, often those which border older, poorly growing alfalfa fields or newly planted corn fields. ASB eat large areas of leaves from the edges inward, damage the buds, and have been known to eat plants down to the ground.

ASB larvae feed on alfalfa roots and can cause extensive damage. Dig up declining alfalfa plants seen during times of evironmental stress or in the early fall and check for signs of larvae or larval feeding injury.

Walk inside the first 75 to 100 feet of all field borders searching for signs of the insect themselves, their 1/4-inch-diameter emergence holes in the soil, and feeding damage. Map the areas where adults and feeding injury are observed and use this map as a reference for treatment.

For further information, consult *Cornell Recommends for Field Crops* and the fact sheet *Alfalfa Snout Beetle: Management Practices for Its Suppression.*

D. Alfalfa Blotch Leafminer

Alfalfa blotch leafminer, *Agromyza frontella* (Rondani), may be found in alfalfa fields from the middle of May through the summer. The larvae of this insect eat through leaves, forming mines. Research has shown that 50 mines per 100 leaflets are necessary before economic damage occurs. Therefore, although mined leaves may be very obvious, no treatments are recommended for fewer than 50 mines per 100 leaflets. If treatment is necessary, early harvest should be considered where possible to protect the natural enemies of this pest.

For further discussion of insect control practices in New York consult the *Cornell Field Crops and Soils Handbook* and the *Cornell Recommends for Field Crops.*

5. DISEASE SCOUTING PROCEDURES

For an excellent introduction to alfalfa diseases, view the 15-minute videotape titled “Scouting for Common Alfalfa Diseases in New York State.” The tape may be available through your local Cornell Cooperative Extension agent or can be rented through the Media Services Distribution Center, Cornell University, 7 Business and Technology Park, Ithaca, NY 14850; 607/255-2091.

Diseases can reduce yield and nutritional quality of the forage and deplete carbohydrate reserves in the roots. Heavy disease pressure may cause significant loss of lower leaves, stunt or kill plants. Heavy disease pressure with other stresses such as significant insect pest or weed populations may cause additional losses.

A variety of diseases can usually be found in alfalfa fields throughout the growing season. The scouting calendar, printed inside the front cover, will provide some guidance as to when particular diseases may be anticipated. In many circumstances, these diseases are confined to the lower leaves and have little effect on yield or quality. Although these diseases are most prevalent in the spring, they can also be observed in summer months during delayed cutting. Occasionally, epidemics of leaf spot diseases such as spring black stem *(Phoma* spp.) will cause premature loss of leaves and affect yield. Early cutting generally stops foliar disease epidemics; later alfalfa growth is not affected because environmental conditions do not favor the disease.

More serious systemic crown or root diseases, such as Verticillium wilt and Phytophthora root rot, may also be observed during the growing season. No chemical treatments, other than some seed treatments, are currently available to control diseases of established forage alfalfa. However, crop production

management techniques, including the use of disease resistant-varieties, field sanitation, and proper site selection, can minimize the risk of losses from alfalfa diseases.

Alfalfa diseases may have symptoms similar to those caused by other problems such as PLH, nutritional deficiencies, frost, or herbicide injury. The fact sheet *Alfalfa Analyst* (found after this section) provides photographs of diseases and the *Alfalfa Diagnostic Guide* (Appendix A) includes descriptions of problems.

Since different diseases are favored by different environmental conditions, scout for alfalfa diseases throughout the entire growing season in conjunction with other scouting activities. Diseases may become more obvious during times of crop stress (e.g., drought or flood), and pre- or post harvest. Look for areas of stunted, yellow, wilted, or dead plants.

Symptoms of different diseases often appear similar. If a problem cannot be diagnosed in the field, dig up several plants that show typical symptoms with as much of the taproot as possible. Submit the samples to a diagnostic laboratory (follow recommendations outlined in the *Guidelines for Packaging and Sending Plant Material to the Diagnostic Laboratory* in the appendix).

Estimate the percentage of plants affected by the disease throughout the field. Record information concerning particular problem areas, noting location, size of area affected, drainage pattern, etc.

One way to manage diseases during the current year is to avoid moving diseased material to a non-infested field. Healthy fields should, where possible, be harvested first. Clean harvesting equipment of plant debris between fields and between cuttings. Correct identification of the disease can help you to minimize the risk of disease in the future—perhaps by selecting a disease-resistant variety.

Long-term management considerations for optimal field productivity include site selection, disease-resistant varieties, cropping sequence, stand establishment, adjustment of soil pH to pH 6.5 or above, balanced fertility, sanitation procedures, and appropriate harvest schedules. Further information on management of alfalfa diseases is available in the *Cornell Field Crops and Soils Handbook* and the *Cornell Recommends for Field Crops*.

Three diseases are primarily responsible for thinning alfalfa stands in New York: Verticillium wilt, Phytophthora root rot, and anthracnose (Table 8).

Table 8. Major Diseases of Alfalfa in New York

Disease	New Seeding	Established Stand
Verticillium Wilt	-	+++
Phytophthora Root Rot	++	+++
Anthracnose	+	++
Fusarium Wilt	+	++
Pythium	+++	-
Sclerotinia Crown & Stem Rot	++	+
Spring Black Stem	+, leaf spot	++, leaf spot, Crn Rot
Downy Mildew	++, systemic, significant	++, leaf spot , systemic
Leptosphaerulina Leaf Spot	+	++
Other Leaf Spots	+	+++
Crown Rot (Crn Rot)	-	+++

+ = occasionally significant; ++ = potentially significant; +++ = frequently significant, a priority for scouting; - = not expected.

A. Verticillium Wilt

Verticillium wilt (VW) is widespread and causes substantial losses throughout the state. VW is generally observed in second and third cuttings of stands two or more years old. VW is characterized by wilting, yellowing, and stunting of plants. Leaves of affected plants often show a yellow V-shaped pattern on their leaf tips, similar to symptoms of PLH burn. Leaves later become twisted and purplish in color. Stems remain green long after leaves are bleached tan and dead. Taproots in severely infected plants will have a dark brown ring when the root is cut in cross section.

Verticillium wilt can be introduced in to healthy fields by movement of contaminated plant material on farm equipment, typically harvesting equipment. For further information, consult the fact sheet *Verticillium Wilt of Alfalfa* following this section.

B. Phytophthora Root Rot

Phytophthora root rot (PRR) most often occurs in poorly drained soils. PRR symptoms include a general yellowing of the whole plant and distinctive rotting of lateral or tap roots. Root rot moves from the root tips toward the crown. Infected roots are usually yellow or reddish where the infection borders healthy tissue. Less severely affected plants may turn yellow.

Although most commonly observed in new seedings, this disease may affect alfalfa during any cropping year following a period of excessive moisture. Infected plants may survive if dry conditions prevail.

C. Anthracnose

Anthracnose, a disease of warm, wet weather, attacks alfalfa stems and crowns. This disease is generally more severe after first harvest. The stem tip wilts and bends over to form a "shepherd's crook." Diamond-shaped lesions on the stems are common. The anthracnose fungus may advance downward from the infected stem into the crown tissues. Infected crown tissues appear bluish-black near the origin of the stems and reddish-brown in the inner crown tissues. Infected plants appear straw colored and are scattered throughout the field. Anthracnose appears more prevalent in the eastern part of the state but has recently been observed in the central and north regions.

D. Fusarium Wilt

Fusarium wilt is often seen in stands two or more years old. Damage is characterized by a wilting of shoots. In early stages of the disease the leaves may wilt during the day and appear normal during the evening. A reddish tinge may be present in the leaves, with leaves and stems eventually turning a bleached color. Roots will show a characteristic partial or complete dark or reddish brown streaking or ring in cross section.

The disease is favored by injury to the root exterior. In New York this is often associated with larval feeding by clover root curculio.

E. Sclerotinia Crown and Stem Rot

Sclerotinia crown and stem rot tends to be observed during the cooler and more moist extremes of the growing season, during early spring and late summer. Seedlings are most vulnerable to infection. This same fungus also infects other forage legumes such as red clover, ladino clover, and crown vetch. Infected plants appear yellow and weak. A characteristic white fluffy mass of mycelium (fungus body) grows over the dead plant parts or on the soil surface and initiates new infections. Infected areas are very soft and water soaked. As food sources become less available, the fungus forms small, hard, black sclerotia on or in the stem or crown tissue. These sclerotia appear as small pellet-like balls about an eighth to a quarter-of-an-inch in diameter. Sclerotinia crown and stem rot is often associated with fall seedings, seedings into old pastures or hay fields, or no-till seedings into a previous legume sod.

F. Foliar Diseases

Foliar diseases can attack stands of any age but young stands are most succeptable. Disease development is greater in wet weather and moderate temperatures. Foliar diseases of concern in New York include Leptosphaerulina leaf spot, spring black stem, downy mildew and “common” leaf spot.

Leptosphaerulina Leaf Spot

Leptosphaerulina Leaf Spot, also referred to as “Lepto” or “halo” leaf spot, is a common foliar disease during warm weather, particularly as the alfalfa becomes taller and the canopy closes. Lepto leaf spot attacks primarily young leaflets but may also attack petioles and other plant parts. It is often observed in the cool moist conditions associated with early spring and late summer to early fall. Lesions generally start as small black spots and enlarge to oval or round “eyespots” 1/16 to 1/8 of an inch in diameter. The lesions typically have a light brown to tan center and darker brown borders, often surrounded by a chlorotic (yellow) area.

Spring Black Stem

Spring black stem (SBS) is commonly found in alfalfa during the first half of the production season, sometimes can be found in the cool moist periods of the fall. SBS appears as small, irregularly shaped dark brown to black tar-like spots on leaves and leaf petioles. These spots may enlarge and coalesce. Black areas may be present on lower portions of stems. In severe infections, this fungus can cause crown rot and root rot.

Downy Mildew

Downy mildew (DM) is commonly found in alfalfa during the first half of the production season. DM usually does not cause severe damage in established stands. New seedings may be severely affected if plants are infected and the disease goes systemic. Symptoms of DM are light green or yellowish blotches on leaves and a distortion of young leaflets. A dark purplish-gray fungus mat may often be observed on the under surface of infected leaves. Systemically infected stems are larger in diameter than normal stems and often produce a bunchy rosette-type growth at the stem tip.

Common or Pseudopeziza Leaf Spot

Common or Pseudopeziza leaf spot (CLS) is frequently found in alfalfa from mid-summer to the late portion of the production season. CLS typically shows a small brown to black circular spot with “gear sprocket-like” edges on the leaflets. Fully developed spots are 1/16 to 1/8 inch in diameter and do not coalesce. On older spots small fruiting structures, light-brown raised dots (apothecia) may be observed on the upper surface of the leaves. Infected leaves turn yellow and drop as the disease progresses.

G. Disease Management

Close monitoring of alfalfa fields is the first critical step in providing important, timely information to help improve management decision making. Correct diagnosis is vital for development of an effective disease management strategy. Once the disease has been correctly identified, knowledgeable management decisions can be made regarding selection of disease resistant varieties, and other cultural practices to minimize the impact of the disease.

Unlike insect or weed pests, few chemical control options exist for disease management of alfalfa grown for forage. The controls currently available are limited to seed

treatments. Fortunately, cultural practices can limit the effects or spread of important alfalfa diseases.

Promote the vigor of the stand and reduce sources of stress by maintaining balanced fertility, liming to maintain a pH of 6.5-7.0, and harvesting on a timely schedule. Timely harvesting can reduce the impact of foliar diseases. Cut fields when they are dry. Harvest diseased fields last to avoid bringing diseased material and contaminated equipment into a healthy field

Select resistant varieties. Locally-adapted disease resistant varieties are currently available for Verticillium wilt, Phytophthora root rot, anthracnose and Fusarium wilt but not for many common foliar diseases. Rotate fields with continued severe disease problems to a non-legume.

Further information on the management of alfalfa diseases is available in the *Cornell Field Crops and Soils Handbook* and the *Cornell Recommends for Field Crops*.