Forage Alfalfa Crop Profile for New Jersey

Production Facts

- **State rank**: New Jersey ranks 34th among the states in alfalfa hay production.
- **New Jersey's contribution to total US production of alfalfa**: less than 1%
- **Yearly production (1)**:
  - 1994 = 30,000 acres, 111,000 tons
  - 1995 = 30,000 acres, 105,000 tons
  - 1996 = 25,000 acres, 88,000 tons
  - 1997 = 25,000 acres, 73,000 tons
  - 1998 = 30,000 acres, 81,000 tons
- **Production costs on a yearly basis**: Alfalfa is a perennial crop so that there is an establishment year and then maintenance years. Establishment cost per acre is $370 and maintenance is $306.
- **Percent of alfalfa raised for forage** - 100%

Production Regions

New Jersey is sharply divided into 2 growing regions; the northern and southern halves of the state. These growing regions are defined by differences in soil type, elevation and latitude. Highway US 1, between Trenton and New Brunswick, serves as an approximate geographical border between the two regions.

Southern New Jersey

Most of the pure alfalfa, *Medicago sativa* L., is grown in the south in fields averaging 15 acres (2). The soils in this area are coastal plain, generally light soils ranging from sand to sandy loams, but areas of heavier, clay and silt loam soil do exist. Elevations are low with most of the area less than 200 feet. The warmest, seasonal temperatures occur in the extreme southern part of the state with the Salem County area being the warmest.

Northern New Jersey

Most of the mixed alfalfa/grass hay is raised here in fields averaging 11 acres (2). The northern soils are Piedmont and Appalachian types, heavy silt loams and shaley soils, respectively. Elevations are generally above 200 feet and reach 1800 feet at High Point in extreme northern New Jersey. The topography is more rugged than southern New Jersey with alternating ridges and valleys running approximately from the SW to the NE, ending rather abruptly at the New Jersey - New York state line. The ridges extend southwesterly into eastern Pennsylvania. These ridges are important in influencing both weather conditions and pest infestations for the north.

Cultural Practices

Tillage and soil nutrient levels - Fields to be planted to alfalfa are plowed and disked, providing a firm seed bed (8). pH levels are brought to 6.5 to 7.0 with lime and fertilizer applied prior to planting. No-till planting is not a typical practice for alfalfa in New Jersey.

Pure alfalfa stands - A perennial crop, alfalfa is seeded either in early spring March 15 to April 15 or in late summer, August 15 to September 15, at seeding rates varying from 8 to 15 pounds per acre. A pre-plant, incorporated herbicide is generally used prior to

spring planting, but is often not applied for fall seedings. In the first growing season after planting, generally no more than two cuttings or harvests are taken. In the second year after establishment, typically 3 or more cuttings are taken; usually 4 to 5 for southern New Jersey and 3 to 4 for northern New Jersey. Farmers are encouraged to follow a 28 day to 35 day cutting interval rather than relying on growth stage to initiate harvesting. Usually, when following cutting intervals closely, the alfalfa will be in the pre-bud to bud stage, which is ideal for harvesting, providing the highest nutrient levels and greatest digestible content for livestock. Farmers are encouraged to harvest the crop early rather than use pesticides if pest populations are over thresholds.

Approximately 40% of the year's total production comes from the first cutting in May or early June. Subsequent harvests 2 through 5 make up the remaining 60%. The average yields across the state are around 3 tons per acre, but some farmers who practice more intensive management produce as much as 8 tons per acre.

Region-wide differences in the growth of the alfalfa are noticeable. The first cutting in New Jersey, in both growing regions of the state, often reaches 3 feet in height and subsequent regrowth frequently attains 20 to 25 inches in height before the next cutting (2). In contrast, alfalfa grown in neighboring states of Pennsylvania and New York is usually shorter and the height difference is reflected in those states' pest thresholds and recommendations.

Alfalfa stands remain viable for about 4 to 7 years, depending upon the management of the respective farmer. Most fields are replanted to other crops after 5 years. Farmers are encouraged to take fields out of production or inter-seed with grass when the number of plants per square foot drops below 3. Older fields are frequently plowed after the first cutting in the spring and then planted immediately to other row crops, especially field corn.

Mixed alfalfa and grass hay - Grasses are often planted with alfalfa because of market needs and it usually dries more quickly than pure alfalfa. No pre-plant herbicides are used for mixed hays. Grass seeding rates depend upon the grass species used. Timothy, brome and orchard grass are the most typical species mixed with alfalfa. Herbicide use is severely restricted with mixed hays.

Harvesting - Most of the first cutting of alfalfa across the state is used for haylage, stored in either upright silos or in bunker or trench silos. Either self-propelled choppers or tractor pull-behinds green chop the alfalfa directly into wagons that are emptied into silos. In subsequent harvests most of the alfalfa is cut, rolled into windrows for drying and then baled. Typically, 40 pound, square bales are the norm for New Jersey, suitable for most consumers and farmers, but some alfalfa is baled as round bales and are sometimes wrapped in plastic. These bales are considerably larger weighing up to 1,000 pounds.

Nurse crops - Oats and peas are sometimes planted with alfalfa seed in spring plantings in southern New Jersey. Nurse crops supposedly reduce weed competition and provide a forage crop harvest from the field earlier than if the farmer depended on alfalfa alone. In nearly every instance when a nurse crop is used, potato leafhoppers must be controlled in the second cutting regrowth (2).

Irrigation - Very little (less than 5%) of the state's acreage is irrigated.

Fertilizer use - Potassium is the primary element needed by alfalfa and yearly applications are needed to keep or improve yields. Rutgers agronomists have determined that 60 pounds of potash, K_20 per acre is required for every ton per acre of yield (8). Potash is normally applied in the fall, but many farmers apply it in the spring, after the ground dries or split their applications for early spring and post-harvest, first cutting.

pH - Soil pH levels are critical to good growth of alfalfa. It grows best in a pH of 6.5 to 7.0. If the pH is too much either side of this range, alfalfa growth will not be vigorous and yields will suffer. Fields that are significantly acidic (which is the normal trend of fields in this area) will have reduced longevity and yields. Calcitic or dolomitic limestone (lime) is typically used to improve or make the soil more basic pH. The use of calcitic or dolomitic lime is dependent upon whether the soil is deficient in magnesium. The application of lime is a standard practice that cannot be ignored for most areas of New Jersey.

Insect and Mite Control

Pests are listed in order of seasonal occurrence according to cutting (4,6). In New Jersey, first cutting pests are alfalfa weevil, blue alfalfa aphid, and pea aphid. Second cutting pests include potato leafhopper, spotted alfalfa aphid, tarnished and alfalfa plant bugs, two-spotted spider mites and grasshoppers.

First cutting insect pests - March to early June

Alfalfa Weevil (*Hypera postica*) - Twenty years or more ago alfalfa weevil was a significant pest, but in recent years alfalfa weevil has become more sporadic. That is, it is present in fields every year, however, it reaches treatment thresholds only occasionally across the state. The percentage of acreage significantly damaged on a yearly basis is probably less than 20%.

Alfalfa weevil has only one generation a year. Adult weevils overwinter in fencerows and

field borders and begin laying eggs in early spring. The eggs hatch at about the time when the flowering shrub, forsythia, is in full bloom. The larval stages consume the leaves and if threshold populations are not reduced, they can strip the foliage from the plant. Once the larvae mature they transform into adults by mid-June and remain active in the field until late summer when they begin to seek out overwintering sites. Small numbers of larvae may be present throughout the growing season.

Occasionally, larvae will be abundant after the first cutting harvest and will continue to feed on the regrowth requiring control measures. This situation occurs often enough to warrant checking second cutting regrowth in those fields where weevil populations were initially abundant. Less than 5% of the fields in the state are affected, annually. Defoliated fields can experience sharp yield reductions, 50% or more, and loss of feed quality on the most critical cutting of the season. At a typical price of $120/ton this may result in a loss of about $80 per acre on 3-ton seasonal yields to $170 per acre on 7 ton per acre yields. Some severely defoliated fields may not be harvested for first cutting. Depending upon the timing of the insect population build-up, severely defoliated plants may put up new stems. The defoliated field may seem to recover before it is harvested for the first cutting.

Threshold
A dynamic threshold employing average stand height and the number of larvae per 30 stems, and length of time before first cutting harvest is used to determine the need for control (4).

Blue alfalfa aphid (*Acyrthosiphon kondoi*) - The first occurrence of this aphid in New Jersey was confirmed in 1992 (3). This introduced pest was first found in the western United States in the late seventies. It has continued to move eastward since that time. Blue alfalfa aphid (BAA) is a sporadic pest occurring only in southern New Jersey. Population levels vary considerably from year to year. The percent of fields reaching threshold varies widely from year to year, from less than 1% to as much as 40%. The degree of infestation seems linked to the severity of the preceding winter. Mild winters allow greater survivorship of the overwintering aphids.

BAA is a sucking insect, feeding only on plant sap. Severely damaged plants appear stunted, with twisted stem tips. The plants appear shiny because of the excessive amounts of honeydew produced by large numbers of aphids. The critical stage for evaluation of the aphid levels is when the alfalfa is about 10 inches tall. The primary loss is in yield reduction. Because of uneven distribution of aphids across a field, yield reductions may be slight to excessive and are difficult to estimate. Yield losses may reach 70% and possibly more in severely infested fields.

A secondary fungal pest, spring black stem, may interact with the BAA weakened plants resulting in the death of the stems. These dead areas may be sporadic, also, but usually are limited to small areas of the field. Within these dead patches the weeds will take advantage of reduced light competition from the alfalfa and fill the space once occupied by the alfalfa growth. Eventually, the alfalfa plants in these areas will grow new stems,

but will not out compete the weeds for the first cutting, which will probably lower the nutritional value of the alfalfa.

The aphids develop a winged generation, which seeks out new host plants, at about the time of bud formation in the alfalfa, just before the first cutting harvest. BAA is not a problem for the remainder of the growing season.

Threshold
Fields should be sampled in the spring when the stands are between 5 and 10 inches tall (4,6). Using a 15-inch diameter sweep net, the threshold is reached when 50 or more aphids are collected in a single sweep of foliage. Repeated sampling may be necessary until the alfalfa is near harvest.

Pea aphid (*Acyrthosiphon pisum*)- A secondary or tertiary pest, pea aphid looks very similar to the BAA, but is larger and has color phases of light pink as well as green, whereas the BAA is only dark green. Pea aphid has been established in New Jersey for many years. At one time it was a significant pest but new resistant varieties of alfalfa have diminished its pest status. Pea aphid occurs every year, almost always in abundant numbers, but with little effect on the alfalfa. Like BAA, it feeds on plant sap. Unlike BAA, pea aphid may occur throughout the growing season but is usually most abundant in the cooler and wetter portions of the season. Rarely is a control recommendation made for this pest.

Threshold
Threshold is seldom reached, but when a cup of aphids are collected per 20 sweeps, the field should be evaluated for its appearance and date of harvest to decide whether the aphids should be controlled (4).

Second to Fifth Cutting - mid June to October
Potato leafhopper (*Empoasca fabae*) - Potato leafhopper (PLH) is the major alfalfa pest in New Jersey (2). PLH is a migratory insect that overwinters along the Atlantic and Gulf Coasts. In spring, populations move northwards on storm fronts. Because of the proximity of the overwintering populations on the Atlantic Coast (overwintering as far north as southern Virginia) they are the first to arrive in New Jersey, usually in mid May. The migrants are not a problem on first cutting alfalfa.

A second wave of migrants comes up the Mississippi River Valley and fan out across the northeast. These arrive in New Jersey after coming across Pennsylvania. So far it cannot be predicted when these would arrive, but it is always after the coastal population. About 2 weeks after significant numbers of adults arrive in June the first southern fields reach threshold.

There is a difference in timing of populations between the northern and southern regions of the state. In the southern region, most (about 95%) of the fields attaining threshold occur in late June to early July. In the northern region, most (about 80%) of the fields attaining threshold occur from mid July to mid August. In the middle of August

leafhopper populations, statewide, begin to drop off. The likelihood of fields being at or exceeding thresholds in September declines significantly, although in 1988, 1997, and 1998 there were up to ten fields reaching threshold in September and in 1998, two fields were at threshold in early October. Research conducted at Cornell University indicates that leafhoppers have a reverse migration in late summer back to overwintering sites. Typically, populations of PLH are more severe in northern New Jersey than in the southern half of the state. A greater percentage of fields exceed threshold there. There may be many reasons for this. The local weather conditions may be favorable to leafhopper populations. Also, though not proven, it appears that the ridge system which runs east and west between Pennsylvania and New Jersey may help channel leafhoppers into northern New Jersey. PLH is moved about by weather fronts and these may help move the leafhoppers up the valleys between the ridges. Whatever the reason, the increased numbers of PLH have significant economic consequences for northern farmers. They have about one less cutting a year than southern farmers and smaller yields, therefore a greater portion of the northern farmer's crop value must be spent in managing leafhoppers.

PLH occurs in all alfalfa fields each year, but the percentage that exceeds threshold varies considerably, from 10% to 90%. Severely infested regions may see fields exceed threshold three times or more during the growing season. One farmer sets the number of times he will spray to three applications and if leafhoppers continue to be at threshold he will not attempt to control them.

PLH is a sap feeder like aphids. However, PLH injects toxic saliva into the plant to aid food uptake, which mechanically clogs the conductive tissue of the plant. Severely injured plants at first show chlorosis of the leaf tips (this symptom is similar to potassium deficiency symptom), which ultimately spreads throughout the plant where no controls are enacted. If untreated, leafhoppers will kill the alfalfa top growth with 100% loss in respective fields. Severe feeding damage to the plant carries over into succeeding cuttings with reduced yields and loss of plant vigor. All stages of plant growth are attacked. The threshold used in New Jersey combines nymph and adult numbers since both nymphs and adults will feed on the foliage causing damage (6).

Cultural factors, which encourage populations of PLH to build up in fields, include poor weed control, leaving strips of uncut alfalfa either in the field or along field borders, and planting a nurse crop with a spring seeding of alfalfa. Weedy fields help provide cover for leafhoppers so that weed control is essential for not only reducing competition with the alfalfa but also to remove hiding places for the leafhoppers while they wait for the alfalfa to regrow after cutting. Nurse crops stunt the growth of the alfalfa in the spring, preventing the alfalfa from dropping the older leaves on its stems. Upon cutting, the alfalfa stubble, instead of having bare stems providing little or no cover, has leaves, providing excellent cover and improves PLH survivorship (2).

Efficient management of PLH depends upon scouting of the field at regular intervals. Once the damage symptom of chlorotic leaf tips occurs, quality and yield loss has already occurred. Fields that are generally chlorotic have little feed value and will command very

poor prices for forage hay.

Threshold
The threshold used in New Jersey is dynamic, taking into account the average stand height. Sampling is done by sweep nets according to the following scheme. First, the average height across the field is estimated. Then this is compared to the average number of leafhoppers collected. If the average number of leafhoppers, when multiplied by 10, equals the average stand height, then the threshold has been reached (4).

Spotted Alfalfa Aphid (*Therioaphis maculata*) - This aphid pest occurs every year in southern New Jersey, only. Threshold populations of this aphid occur only during periods of extended dry weather, almost always on new seedings (Rutgers Field Crops IPM, unpublished data). Threshold populations can stunt or kill seedling plants, reducing plant stand counts and yields once fields recover (Davidson and Lyons, 1986). Damage symptoms are not distinctive. The plants appear stunted and wilted from drought stress. Close examination of the underside of leaflets shows small colonies of the gray, black-spotted aphids. Only about 1% of the southern acreage is affected in dry years, but what is significant is that most farmers are not aware of this pest. They may lose the field thinking that it is suffering from only drought stress and not aphids.

Threshold
Threshold has been reached when 50 or more spotted alfalfa aphids are collected in a single sweep of the foliage with a 15-inch diameter net (4).

Tarnished and Alfalfa Plant Bugs (*Lygus lineolaris*; *Adelphocoris lineolatus*) - These two species of plant bugs are common to abundant insects in alfalfa fields across the state (5). They are primarily plant feeders, feeding on plant sap, similar to aphids and leafhoppers. The tarnished plant bug may be an occasional predator of aphids and other small insects.

These insects are capable of causing yield loss on short alfalfa growth (3 to 4 inches) when numbers exceed about 5 per sweep with a 15-inch diameter sweep net. Severely damaged plants have thin twisting stems and small leaf growth. Yield reductions may be as high as 30%. However, the amount of yield reduction decreases as the height of the plant increases. If plants are 10 inches tall when threshold populations occur there is little yield reduction. If the plant height is 15 or more inches tall the insects actually cause a yield increase, presumably through the increased branching of the stem resulting from their feeding. Threshold populations and resulting economic loss probably occur on 1% or less of the total state acreage in any given year.

Threshold
An average of 5 plant bugs per sweep using a 15-inch diameter sweep on alfalfa less than 10 inches tall would be used as a threshold (4, 5, 6).

Two-spotted mites (*Tetranychus urticae*) - Mites are seldom a pest in alfalfa and New Jersey has no current threshold for them. However, in 1998, two fields in southern New

Jersey were severely infested with spider mites. Upper surfaces of leaflets were finely stippled yellow indicating feeding on the underside of the leaflets. The field conditions were excessively dry, which typically is the situation when spider mites occur in abundance on any crop.

Threshold
No current threshold exists.

Grasshoppers (various species) - These are secondary pests that seldom require control, however they have the potential to be economically important (6). Field borders adjacent to where grasses are abundant in fencerows are the most likely areas to be infested.

Threshold
When populations of nine or more occur per square yard, the threshold for managing grasshoppers has been reached.

Chemical Controls

Materials used in 1997compared with 2000 data – 2000 last available use data, NJ Pesticide Control Program

General use insecticides

Malathion - Malathion is recommended for potato leafhopper and aphids. When used for potato leafhopper control, usually only one application is needed, because the material is used close to harvest. If not, then two applications may be needed.

1997 – 198 acres treated
2000 – 35 acres treated

Restricted use insecticides

Azinphos-methyl – marketed as Guthion 3 azinphos-methyl is a broad-spectrum insecticide that effectively controls many pests. It is seldom used probably because of its toxicity and other available materials that are as effective.

1997 – no recorded uses on alfalfa
2000 – 60 acres were treated

Carbofuran – Carbofuran has been recommended for use on alfalfa weevil and potato leafhopper. This material is especially useful on potato leafhopper where using the highest rate protects the alfalfa from leafhoppers for the duration of growth from one cutting to the next. Unfortunately, there is no way to know if the insecticide will be needed at all as treated fields might not have reached a treatment threshold anyway.

1997 - 212 acres, about 1% of the total alfalfa acreage
2000 - 16 acres were treated

Chlorpyrifos - This material, which is restricted in New Jersey, is recommended for alfalfa weevil, potato leafhopper and aphid control, making it one of the more versatile insecticides for alfalfa. Usually, only one application is required to control the pest insect.

1997 - 297 acres were treated

2000 - 131 acres were treated.

Lambda-cyhalothrin – A broad-spectrum pyrethroid this material was widely used on New Jersey alfalfa in 2000.

1997 – 0 acres treated
2000 – 1469 acres were treated

Dimethoate - Dimethoate is a restricted material in New Jersey. It is recommended for use in controlling potato leafhopper, blue alfalfa aphid and spotted alfalfa aphid. It is the most widely used material for controlling leafhoppers because of its effectiveness and relatively low price. The amount of use of this material fluctuates especially with the population pressure of potato leafhopper. There are years, 1991 and 1994, for example, when leafhopper populations reached extreme levels that overall insecticide use would be up. Usually, only one application is needed for a cutting, but occasionally with intense leafhopper pressure in may be necessary to spray twice in one cutting.

1997 - 1,459 acres were treated
2000 – 868 acres treated

Permethrin - Permethrin is recommended for use on potato leafhopper. While there are some growers who attempt to use it for alfalfa weevil control, it is not a very effective material for that insect.

1997 – 417 acres treated
2000 – 128 acres treated

Diazinon - This material is no longer recommended for potato leafhopper. It is seldom used as there are more effective materials.

1997 – 16 acres were treated
2000 – 0 acres treated

Cyfluthrin - This material is recommended alfalfa weevil, pea aphid, potato leafhopper and grasshopper control. It is a relatively little used product.

1997 – 114 acres treated
2000 – 0 acres treated

Current (2003) Recommendation, Product Rates Per Acre and Use Restrictions (G=general, R=restricted) – Recommendations are based upon information contained in a regional bulletin produced for the mid-Atlantic region, including New Jersey (10). However, to the best of my knowledge, no one represents New Jersey in the development of recommendations for insect pests. Despite the relatively small area, there are considerable differences in insect populations across the region. Therefore, some pests that might be important in New Jersey are omitted in the recommendation book. For this section information is presented only for insect pests that are considered pests in New Jersey.

Alfalfa weevil
Azinphos-methyl (Guthion 3) .66 to 2 pts – R

Carbofuran (Furadan 4F) .5 to 2 pts – R
Chlorpyriphos (Lorsban 4E) 1.0 pt – R
Cyfluthrin (Baythroid 2E) 1.6 to 2.8 oz – R
Indoxacarb (Steward) 6.7 to 11.3 oz – R
Lambda-cyhalothrin (Warrior T) 2.56 to 3.84 oz – R
Methomyl (Lannate LV 2.4E, or, Lannate 90SP) 3 pt; 1 lb – R
Permethrin (Pounce 3.2EC; Ambush 2E) 4 to 8 oz; 6.4 to 12.8 oz – R
Phosmet (Imidan 50 WP) 2.0 lbs – G
Zeta-cypermethrin (Mustang 1.5EW) 2.4 to 4.3 oz.

Potato Leafhopper
Carbofuran (Furadan 4F) 1 to 2 pts – R
Chlorpyriphos (Lorsban 4E) .5 to 1.0 pt – R
Cyfluthrin (Baythroid 2E) .8 to 1.6 oz – R
Dimethoate 4EC .5 to 1 pt per acre – restricted in New Jersey
Lambdacyhalothrin (Warrior T) 1.9 to 3.2 oz – R
Permethrin (Pounce 3.2EC; Ambush 2E) 2 to 8 oz; 3.2 to 12.8 oz – R
Zeta-cypermethrin (Mustang 1.5EW) 2.4 to 4.3 oz.

Pea Aphid
Carbofuran (Furadan 4F) .5 to 2 pts – R
Cyfluthrin (Baythroid 2E) 1.6 to 2.8 oz – R
Dimethoate 4EC 1 pt per acre – restricted use in New Jersey
Lambdacyhalothrin (Warrior T) 1.9 to 3.2 oz – R
Malathion (Cythion 57% EC) 1.0 qt per acre – general use
Methomyl (Lannate LV 2.4E, or, Lannate 90SP) 2 pt; .25 to 1 lb – R

Grasshopper
Azinphos-methyl (Guthion 3) 1.33 to 2 pts – R
Carbaryl (Sevin 80S, or, Sevimol-4) 1.8 lb; .5 to 1.5 lb –G
Carbofuran (Furadan 4F) .25 to .5 pts per acre – R
Cyfluthrin (Baythroid 2E) 2.0 to 2.8 oz. – R
Malathion (Cythion 57% EC) 1.2 to 2.5 pt per acre – G

Blue Alfalfa Aphid
No regional insecticide recommendations are given for this pest.

Chemical Use in IPM Programs

Reliance on chemical management of insect pests has been critical for New Jersey alfalfa production. Aside from manipulating harvest dates, there are no other reliable means of controlling the insect pests. Various species of ladybugs and predatory syrphid fly larvae help control populations of blue alfalfa and pea aphids, but these predator populations do not build up until substantial aphid populations exist. And neither of these predators are effective in controlling spotted alfalfa aphid in warm, dry weather.

When insecticides are recommended, farmers are urged to use insecticides that are

effective, inexpensive and more selective. As a result, dimethoate is probably used more frequently than any other insecticide for alfalfa pests. The use of broad-spectrum insecticides such as Imidan, Pounce and Ambush are discouraged as these effectively kill most insects found in the fields.

Chemical Use in Resistance Management

There is no attempt of resistance management in alfalfa production, partly because pest populations are sporadic. There is no documented evidence that any of the alfalfa insect pests have developed insecticide resistance. Farmers are encouraged to rotate chemical families of insecticides, but this is probably practiced by less than 50% of the farmers.

Alternatives

Approximately 8 years ago, leafhopper resistant alfalfa was commercially introduced which showed promise in lowering both the population and damage from leafhoppers (9). The primary mechanism of resistance is the glandular hairs these varieties possess. The hairs interfere with leafhopper feeding activity on the plant as well as laying eggs. Use of the resistant varieties nearly eliminates the need for insecticide use for leafhoppers. The percentage of leafhopper resistant alfalfa of the total state acreage is estimated at 15%.

Cultural Control Practices

Early harvesting of the alfalfa crop is the most recommended cultural practice to avoid the use of insecticides. Thresholds for both alfalfa weevil and potato leafhopper suggest that if the alfalfa will normally be harvested within a week's time, then if threshold pest levels exist the field should be harvested early. This tactic saves the cost of insecticide and application. Nutritionally, there would be little difference between alfalfa in the prebud and bud stage. In addition, if an insecticide were to be applied by ground sprayer, about 2 to 5 percent of the alfalfa stand would be knocked down and likely not harvested when the cutting is taken.

Spot or perimeter spraying of insecticides is encouraged, particularly for alfalfa weevil and potato leafhopper. Both insects tend to build up in numbers along field borders and timely insecticide applications may be sufficient in controlling the pests. About 10 to 20 percent of the alfalfa farmers practice this technique.

Biological Controls

On a local or farm level, there is no effective biological control tactic to control any of the insect pests that farmers can release. William Day, ARS, Newark, DE, has released insect parasites for controlling tarnished and alfalfa plant bug. Most of the release work has been in northern New Jersey, and probably has had little effect on the state's population of plant bugs. The Phillip Alampi Beneficial Insect Laboratory was responsible for releasing 5 parasite species of alfalfa weevil in the 1970s and 1980s. These parasites, especially the larval parasites, help hold alfalfa weevil in check. A naturally occurring fungal pathogen, *Beauveria* sp. of alfalfa weevil has been very effective at sharply reducing alfalfa weevil populations. Optimal conditions for the pathogen include a degree-day accumulation of about 450 at base 50 and warm, humid weather.

Post Harvest Control Practices

None

Weed Control

Nearly all weeds are pests in alfalfa, because they will reduce the feed quality and compete with alfalfa for nutrients, water and space. Most of these weeds establish themselves as the alfalfa stand thins or becomes less vigorous. Poor crop management is probably the greatest reason for weed establishment. A few weeds are truly invasive and aggressively compete with alfalfa or are noxious to livestock. These weed pests are separated into winter annuals, summer annuals and perennials.

Threshold

Generally, weeds are considered to be at threshold when they are distributed at the rate of 1 weed per square yard. If the farmer is intending on producing high quality hay, then the threshold is 1/4 weed per square yard (4).

Winter Annuals

A native bluegrass (*Poa palustris* or *trivialis*) - This grass, difficult to identify to species, is also known locally as herdsgrass and is a serious pest of alfalfa in the southern portion of New Jersey. The bluegrass (BG) is actually a perennial weed that behaves like a winter annual, that is, new stems (tillers) are visible in August, but remain in a short vegetative phase. The plant becomes dormant in the fall and once warm weather occurs in the spring, BG grows explosively in the spring expanding its top growth and numbers of tillers. Data from Ingerson-Mahar (unpublished) suggests that BG is a strong competitor for plant nutrients. One plant per square yard is enough to depress alfalfa yields. Once a field is infested, BG spreads rapidly. Within 3 years of the initial infestation, BG may be so abundant as to overwhelm the alfalfa. It soon grows over the height of the alfalfa and matures before the alfalfa is ready for first cutting. The alfalfa may be totally obscured by the growth of BG so that viewed from a short distance away the infested field appears to be a grass hay field. Because the BG matures more quickly than the alfalfa, if the field is harvested when the alfalfa is ready, the grass will have no nutritional feed value, depressing the overall feed quality of the hay. Should there be a delay in harvesting the alfalfa, the grass stems will begin to mat down the alfalfa, encouraging disease problems and hindering harvest.

Summer Annuals

Nightshade species (*Solanum* sp.) - This broadleaf weed is a summer annual that germinates early summer and becomes a pest in the third and fourth cuttings. Plants in the solanaceous family contain glycoalkaloids, poisonous to livestock. Farmers are reluctant to allow this weed to become abundant in the alfalfa. Though the risk of animal poisoning is slight, it can occur. For this reason farmers are concerned about the amounts of nightshade in the alfalfa crop, especially for those who sell hay to horse-owners.

Perennials

Curly dock (*Rumex* sp.) - This perennial commonly occurs in low, wet and marginal

growing areas of fields. It is inconclusive whether the dock spreads in alfalfa because stands naturally thin in marginal soil areas, or whether the roots of curly dock produce a phytotoxic exudate that poisons surrounding plants. The stem and leaves are coarse and fibrous and greatly reduce feed quality of the hay.

Chemical Controls

Materials used in 1997 – last available use data, NJ Pesticide Control Program

General Use Herbicides

EPTC - Used as the product Eptam, EPTC is a pre-emergent herbicide that controls many grass weeds and some broadleaved in seedling alfalfa. The material is applied and incorporated prior to seeding. EPTC is most often used on spring-seeded alfalfa since there are more weed control problems with spring seeding when compared to fall seedings.

1997 – 169 acres were treated
2000 – 185 acres were treated

2,4–DB - This material is used primarily to control broadleaf weeds in first year alfalfa fields.

1997 – 10 acres were treated
2000 – 30 acres were treated

Clethodim – This material is primarily an annual grass herbicide although it is active on seedling johnsongrass that can be used on any stage of growth of alfalfa.

1997 – 0 acres treated
2000 – 12 acres were treated

Fluazifop-butyl – This is a grass herbicide that can be used at any stage of development of alfalfa. It can be used for both annual and perennial grass control.

1997 – 0 acres treated
2000 – 10 acres were treated

Glysophate – Glysophate is used to clean up weedy problem areas of fields or immediately after harvest when only the woody tissue of the alfalfa is present and low growing weeds are exposed.

1997 – 0 acres treated
2000 – 46 acres were treated

Hexazinone - Hexazinone is one of the primary alfalfa herbicides, because it is versatile and has a broad range of plant species that it controls. This material is used as a dormant herbicide that is applied either in late fall or early spring while the alfalfa remains dormant. It is also applied immediately after the harvested alfalfa is removed from the field before new growth appears. Usually, only one application is used per year, but it is possible that 2 applications may be made - once as a dormant application and another time as a post-harvest herbicide.

1997 – 453 acres were treated

2000 – 408 acres were treated

Imazethapyr – This herbicide is used for controlling many broad-leaved and grass weeds.

1997 – 4 acres were treated
2000 – 141 acres were treated

Sethoxydim - Sethoxydim is a grass herbicide that can be applied to alfalfa at any time of year on any age of alfalfa.

1997 – 93 acres were treated
2000 – 32 acres were treated

Restricted Use Herbicides

Paraquat – Paraquat is a burn-down herbicide that is effective on all weeds having green tissue or succulent growth. It is used in New Jersey immediately after harvest and removal of the alfalfa hay and before new growth appears in the alfalfa. Usually one application is made per season but two applications may be made depending upon weed pressure.

1997 - 484 acres were treated
2000 – 714 acres were treated

Metribuzin – Metribuzin is used primarily as a dormant spray material either in the fall or early spring. Used at these times it can also be used in alfalfa/grass hays. Usually one application is made per season.

1997 – 3 acres were treated
2000 – 70 acres were treated

Current (2000) Recommendation, Product Rates Per Acre, Intended Pest Targets and Use Restrictions (G=general, R=restricted) (10)

Alfalfa preplant
Benefin (Balan 60DF) 2. to 2.5 qt – grasses and broadleaves – G
EPTC (Eptam 7E) 3.5 to 4.5 pt – grasses and broadleaves – G
Paraquat (Gramoxone Max) 1.7 to 2.7 pt – all weeds – R
Glyphosate (Roundup Weather Max) .5 to 2.9 qt; (Touchdown) 0.75 to 4.0 qt – all weeds – G

Postemergent weeds
Bromoxynil (Buctril 2EC) 1.0 to 1.5 pt – mostly broadleaves – G
2,4 DB (Butyrac 200) 2 to 6 pt – mostly broadleaves – G
Pronamide (Kerb 50 WP) 1 to 3 lbs – grasses – R
Paraquat (Gramoxone Max) 0.75 pt – annual grasses and broadleaves and suppresses perennials – R
Diuron (Karmex 80DF) 1.5 to 2 lbs – broadleaves - G
Metribuzin (Lexone 4L, or, DF; Sencor 4F, or, DF) 4L and 4F rates = .375 to 1.0 qt; DF rates = .5 to 1.3 lb – broadleaves – G

MPCA 1 pt – broadleaves - G
Sethoxydim (Poast) 1.0 to 2.5 pt; (Poast Plus) 1.5 to 3.75 pt – grasses – G
Imathezapyr (Pursuit 70 DG) 1.09 to 2.16 oz – grasses and broadleaves – G
Imazamox (Raptor 1 AS) 4 to 6 oz. for grass control in seedling or dormant alfalfa - G
Clethodim (Select 2EC) 6 to 8 oz – grasses – G
Terbacil (Sinbar 80W) .33 to 1.5 lb – some grasses and broadleaves – G
Hexazinone (Velpar 90W) .5 to 1.5 lb – grasses and broadleaves – G

Spot Treatment and pre-harvest
Glyphosate (Roundup Max) .4 to 2.9 qt; (Touchdown) 0.5 to 4 qt – problem weeds and alfalfa – G

Chemical Use in IPM Programs

Herbicide selection for weed control depends upon the time of year, age of the stand, and the stage of development of the stand. Herbicides are recommended on the basis of what they will control and their cost. As with insect control, weed management relies almost entirely on the use of pesticides.

Chemical Use in Resistance Management

There is no attempt of resistance management in weed control in alfalfa production, except to rotate herbicides of different chemical classes where possible.

Alternatives

Some farmers, about 20%, ignore weed pests depending on how the hay crop is to be used. If the hay will be used primarily for feeding steers sold for slaughter, farmers will give the steers the poorest quality hay. Low quality hay may also be used for recreational horses.

Some of these farmers also have short crop rotations and may leave alfalfa in a field for only 3 or at most 4 years. In short rotations, if the field has been well prepared, there may not be significant weed populations until the second or third year.

Cultural Control Practices

Good overall crop management is an important aspect of weed control. Frequent soil sampling and following fertilizer and pH recommendations to ensure that the alfalfa crop is well fertilized is one of the most important things that can be done to prevent or reduce the adverse effects of weeds. A tight harvest schedule that reduces weed competition and removes weed blossoms and seed is also important.

Biological Controls

There are currently no known, effective biological control agents for weeds in alfalfa.

Post Harvest Control Practices

The use of an herbicide after cutting is recommended where weed populations are recognized as exceeding thresholds. The window of time is immediately after cutting and

before the regrowth begins. The two preferred materials at this time are Grammoxone and Velpar, for broadleafs and at least some grasses, though Poast and Fusilade can also be applied for grasses.

Disease Pests

There are several diseases that attack alfalfa in New Jersey. Most of these are foliar diseases that at times can reduce yields and the amount of succulent leaf tissue in the harvested hay. However, NJ farmers largely ignore foliar diseases. Rarely will a farmer apply a fungicide. In ten years worth of data from the Rutgers Field Crops IPM Program only one farmer is known to have applied a fungicide to attempt control of a foliar disease. No records for fungicide application appear in the 2000 pesticide use survey. There are no established thresholds for disease pests.

White mold (*Sclerotinia* sp) - This fungus attacks the lower stems of first cutting alfalfa, but this only occurs when the cutting is late and the alfalfa becomes matted down, keeping the plants moist and cool. Other than trying to harvest the hay as quickly as weather conditions permit, there is no control for this disease. Fall seeded fields are also susceptible to white mold in the first spring following planting. Significant stand reduction can occur because the seedling plants are killed before they have developed crowns. The occurrence of this disease infection is about 30% of the fall-seeded fields, depending upon weather conditions. Optimal conditions for disease development are cool temperatures, 50 to 60 degrees F, and ample amounts of rain or standing water.

Crown rots - Several fungi also afflict alfalfa crowns including Rhizoctonia, Fusarium and Verticilium. However, there are no effective means of control of these diseases other than careful management and the use of resistant varieties. Farmers are urged to reduce the number of times that heavy equipment is used in the field to limit injury to exposed crowns, decreasing the likelihood of disease infection from the soil-borne fungi.

Bacterial wilt - Bacterial wilt attacks the crown and stems of alfalfa, but this devastating disease can only be controlled by using resistant varieties. All varieties available for New Jersey are resistant to bacterial wilt.

Spring black stem (*Phoma medicaginis*) - This disease has both leaf and stem symptoms and may significantly reduce yield in fields (6, 7). The disease probably occurs in 100 % of the state's fields each year, causing up to an estimated $500,000 loss in yield. Cool, wet weather, 64 to 75 degrees F, favors this disease and while it is most prevalent in the spring, it will occur whenever conditions allow. It is most often seen in conjunction with other alfalfa pests, such as, alfalfa weevil and blue alfalfa aphid. Occasionally, it will kill the top growth over entire fields in the absence of other pests when weather conditions allow. Yield loss occurs in two ways. Foliar lesions will cause the leaflets to turn yellow and severely infected leaves may die and drop. Stem lesions cause stunting, but when the lesion girdles the stem the top growth is killed. New shoots growing up through the infected stubble may become infected when water splashes spores onto the new growth. Farmers seldom attempt to control this disease, mostly because they are unaware of the disease. In one exceptionally rainy growing season the foliar lesions were so abundant

that the fields took on a yellowish cast, which farmers mistakenly thought was potato leafhopper injury and a few insecticide applications were made. The best means of control is good crop management. Plants under stress are more susceptible to the disease.

Chemical Controls
Fungicides are seldom used on alfalfa and the typical practice would be to not use any.

Chemical Use in IPM Programs
Fungicides are seldom recommended as a pest management tool, because 1) lack of workable thresholds, 2) little concern on the effect of the disease infection to crop quality, 3) doubtful success at proper timing of fungicide or the coverage required for good control.

Chemical Use in Resistance Management
There is no attempt of resistance management in disease control in alfalfa production in New Jersey.

Alternatives
In the limited situations where foliar disease infections could severely effect yield, it was suggested to the farmers that early harvesting was the best management option to prevent further yield loss.

Cultural Control Practices
Harvesting on schedule will prevent lodging or matting down of alfalfa stems and greatly reduce the incidence of sclerotinia stem infections.

Biological Controls
There are currently no known, effective biological control agents for diseases in alfalfa.

Post Harvest Control Practices
None

Nematode Pests
A survey of the alfalfa fields in the Rutgers University Field Crops IPM Program in 1989 showed that about 10% of all fields had troublesome levels of plant parasitic nematodes. The two primary species were root lesion nematode and the more common root-knot nematode, which occurred primarily in the southern portion of the state. The effect of the nematode infestations was a decline in stand vigor and number of plants per square foot. Thinning of the stand allowed more weeds to prosper. Fields with root lesion nematodes also had greater instances of soil borne fungi attacking the alfalfa crowns, which also led to thinning.

Once nematode-infested alfalfa fields were taken out of production, the farmers were encouraged to plant non-host crops in an effort to reduce the nematode populations. No

nematicide treatments were recommended and none are used on the alfalfa crop in New Jersey. Farmers were and are now encouraged to have soil samples examined for nematode infestations at the same time soil is sampled for fertility analysis before planting susceptible crops.

Worker Activities

Most alfalfa farmers in New Jersey do not actively scout their fields. However, approximately 5% of the State's alfalfa acreage is scouted by either crop consultants or by Rutgers University personnel. Field scouting by these individuals occurs about once per week through the growing season beginning in late April and ending in early October. It is necessary for them to either refer to a bulletin board on the farm where pesticide records are displayed or to contact the respective farmer before entering the fields to scout. Most pesticides used in alfalfa production have low toxicity, however, some of the insecticides are quite toxic requiring care and close observation of reentry times. For this 5% of alfalfa growers that do actively scout, the longest reentry interval that can be tolerated without negative consequence to alfalfa crop production is 3 days.

Nearly all other times that all farmers are in their alfalfa is for the purpose of pesticide application, application of fertilizer or lime, and cutting and baling or green chopping for haylage. In all of these operations the work is accomplished while on tractors or specialized vehicles. Specifically, pesticides are mostly applied with equipment that has enclosed cabs, thus minimizing exposure to applicators. With the possible exception of baling, the farmers or their employees would not be coming into direct contact with the alfalfa. If the alfalfa is dry and dusty this dust could be wind borne. But, as long as current preharvest intervals are observed there should be no problem with pesticide residues.

There are anywhere from 3 to 5 cuttings of alfalfa during the growing season. These cuttings are typically made by the better growers on a 28 to 35 day cutting schedule. Currently, the longest pre-harvest intervals exist for carbofuran at 28 days for the highest rate, azinphos-methyl and chlorpyriphos at 21days at the highest rates, and 0 to 7 days for the remaining recommended materials. Some farmers may use a material like carbofuran just after cutting, whether it is needed or not, so that there will be no concern with later infestations of potato leafhopper. This is one drawback in having a pesticide like carbofuran in that it encourages the use of a toxic, broadspectrum insecticide even when conditions might not warrant its use. On the other hand if leafhopper pressure is severe, using the high rate of carbofuran reduces or eliminates the need to make additional insecticide applications for a cutting, thus reducing the overall amount of insecticide that otherwise would have been used. Based on an average 28 to 35 day cutting schedule, the longest pre-harvest interval that can be tolerated without negative consequence to alfalfa crop production is 30 days.

Key Contacts

David Lee
Dairy Agent,
Rutgers Cooperative Extension of Salem County
Suite 1, 53 Cheney Road
Woodstown, NJ 08098
phone: 856-769-0090; e-mail: lee@aesop.rutgers.edu

Joseph Ingerson-Mahar
Vegetable IPM Coordinator
Rutgers Cooperative Extension
243 Blake Hall
93 Lipman Drive
New Brunswick, NJ 08901
Phone: 732-932-9802; e-mail: mahar@aesop.rutgers.edu

Bradly Majek
Specialist in Weed Science
Rutgers Cooperative Extension
Rutgers Agricultural Research and Extension Center
121 Northville Road
Bridgeton, NJ 08302
Phone: 856-455-3100; e-mail: majek@aesop.rutgers.edu

References:

1) New Jersey Agricultural Statistics, 1999 Edition, New Jersey Department of Agriculture
2) Unpublished data, Rutgers Field Crops Scouting Program
3) Blue alfalfa aphid in New Jersey, FS#666, Rutgers University, Ingerson-Mahar, J.
4) Thresholds for common field crop insect and weed pests in New Jersey, FS#802, Ingerson-Mahar, J.
5) Assessing Plant Bug Injury in Forage Alfalfa in New Jersey, Ingerson-Mahar, J. and Lee, D.; New Jersey Grain and Forage Journal, vol. 4, pp 32 – 36, 1997. Rutgers Cooperative Extension
6) Diagnosing Alfalfa Problems in New Jersey, FS#879, Rutgers University, Ingerson-Mahar, J., Kluchinski, D. and Vough, L.
7) Spring black stem, FS#689, Rutgers University, Ingerson-Mahar, J. and Springer, J.
8) Rutgers Field Crop Production Bulletin, 1994 edition, Rutgers University, J. Justin, editor
9) Potato leafhopper resistant alfalfa, FS#941, Rutgers University, Singer, J. and Ingerson-Mahar, J.
10) Pest Management Recommendations for Field Crops, 2003; Bulletin 237; University of Maryland
11) Unpublished data. 2000 Pesticide Use Reported by Licensed Applicators in New Jersey: Alfalfa. New Jersey Department of Environmental Protection.