Crop Profile for Alfalfa in Tennessee

Prepared: February, 2005

General Production Information

Production Facts:

- Tennessee ranks 31st of 42 states producing alfalfa.
- Tennessee produces less than one percent of the total alfalfa produced within the United States.
- Producers harvested 30,000 acres of alfalfa during 2003, yielding approximately 3.1 tons per acre for the season. In 2004, acreage was valued at $117 per ton with an approximate state value of $10,881,000 for the season. Pricing during 2003 ranged from $105 to 120 per ton. Acreage harvested for 2004 has been estimated at 25,000 acres. Warm weather and timely rain showers resulted in an average number of cuttings per field for 2003 of two and a half cuttings per acre for the season. Newly established areas in alfalfa and alfalfa mixtures was approximately 4,000 acres for 2004. The majority of alfalfa produced is used for dairy cattle with the remainder for horses.
- Annual production costs are approximately $38.00 after subtracting $165 value of a partial crop during the establishment year. Total production cost of $278 for a four year stand.

Production Regions:
Several counties in Tennessee produce pure alfalfa stands with the majority often having dairy herds. Some of the larger production areas include: Giles, Greene, Lawrence, Lincoln, Marshall, Maury, Robertson, Rutherford, Sumner, Warren, Washington, White, and Williamson counties. Alfalfa is often mixed with other forages such as clovers and orchardgrass.

Cultural Practices:
Establishing a good stand is a key factor in obtaining high returns with alfalfa production. Several factors for establishing a good stand are listed below.

- Selecting a well-drained soil.
- Fertilize and lime according to soil tests
- Selecting a recommended variety
- Proper placement of seed into the seedbed (15 to 20 lbs per acre)
- Seed at the proper time, Fall seeded from August 15 to September 15, and Spring seeded from March 1 until May 1.
- Control weeds during establishment. This reduces competition
- Reseeding a thinning stand with alfalfa is not recommended, however drilling orchardgrass or red clover may maintain forage yields.
- Harvest at the correct stage. Yields can average from 4 to 6 tons dry matter per acre during good growing seasons on good locations. New spring seedlings should be harvested when they reach full bloom. All other harvests should be made when 10 percent of the plants are blooming. Fall seeded and established stand may be harvested at the bud stage for the first cutting, and then at the 10 per cent bloom stage for all later cuttings. Last harvest should be made before mid-September.
Worker Activities

Alfalfa production in Tennessee is heavily mechanized. Worker activities in alfalfa include field preparation, planting, nutrient and chemical application, pest monitoring, and harvest. Most of these activities are conducted by growers, family members involved with the farm, or their employees. Custom nutrient and chemical applications by commercial dealers and cooperatives are also common in Tennessee. Because of the infrequent need for workers in alfalfa, Re-Entry Intervals (REIs) have little impact on scheduling of field activities. Monitoring for pests, weeds, and diseases may necessitate entering fields soon after the termination of REIs. These activities are generally conducted by consultants, growers or their family members. Activities that bring workers in direct contact with alfalfa during the growing season are generally limited to harvest, especially the loading of rectangular bales for transport to storage or sale.

- **March-April:** Spring seeding, herbicide application to established fields if needed. A seed treatment applied by the seed company may include mefenoxam (Apron) fungicide.
- **March-May:** Alfalfa weevil or aphid control if needed, cutting.
- **April-June:** Potato leafhopper control if needed, cutting, possible herbicide application
- **June-September:** cutting, possible insecticide applications
- **August-September:** Fall seeding - herbicide application

Aggressor, Alfagraze, Cimarron VR, Fortress, Gem and Pioneer 5454. Each variety has resistance to Phytophthora root rot with Aggressor, Fortress, Pioneer 5454 having the highest levels.

Insect Pests

There are various insects which may be found feeding in alfalfa stands across the state. The most common pest is the alfalfa weevil which is one of the first noticed pests. Another pest is the pea aphid which may appear in spotty populations across infested fields. The potato leaf hopper is another common pest which causes hopper burn. Efficacy of pesticides used in alfalfa production are listed in Table 1 and estimated losses from commonly observed pests are listed in Table 2. Average costs of application are listed in the insecticides section of this document.

**Alfalfa weevil**

*(Hypera postica)*

Adult weevils feed on foliage and lay eggs in stems of alfalfa plants throughout the winter. As weather warms, eggs
hatch and larval feeding begins. Small larvae feed within plant terminals, while large larvae often feed in more exposed locations on plant leaves. Greatest effect of damage occurs in the first cutting in March to April; however, lowered stem densities and reduced plant growth may cause lower yields in the second cutting and may ultimately reduce stand longevity. Losses can be a great as 50% yield reduction. Losses usually average around 20% each year for this pest.

Chemical controls commonly available for adults:

Organophosphate insecticides:

- **Methyl Parathion** (Methyl 4EC): has a 15-day PHI. Is applied at the formulation rate of 1 pint per acre. May be phytotoxic to young plants. Product can be extremely dangerous if not applied correctly. Provides good control of this pest. Cost was approximately $4 per acre per application. This product was difficult to obtain from retailers or wholesalers, unless purchased in large quantities. Enclosed filtered tractor cabs should be used to apply this product.
- **Phosmet** (Imidan 50WP): has a 7-day PHI. May be applied at the formulation rate 2 lbs per acre. No data on efficacy of this product for this pest.

Carbamate insecticides:

- **Carbofuran** (Furadan 4F): has a 14-28-day PHI. Is applied at the formulation rate of 1 to 2 pints per acre or 0.5 to 1 lb ai per acre. Provides excellent control of this pest.
- **Carbaryl** (Sevin 80S, XLR): has a 0-day PHI. Is applied at the formulation rate of 1.875 lbs of 80S or 1 to 2 quarts of XLR per acre. Provides good control of this pest.

Pyrethroid insecticides:

- **Permethrin** (Pounce 3.2EC): has a 0-day PHI. Applied at the formulation rate of 4 to 8 oz per acre or 0.1 to 0.2 lbs ai per acre with no more than 0.2 lb ai per cutting may be applied. Provides good control of this pest.

Chemical controls commonly available for larvae:

Organophosphate insecticides:

- **Chlorpyrifos** (Lorsban 4EC): has a 14 to 21 day PHI depending method used. Applied at the formulation rate of 1 to 2 pints per acre or 0.5 to 1 lb ai per acre. Provides good control of this pest.
- **Phosmet** (Imidan 50WP): has a 7-day PHI. Applied at the rate of 2 lbs formulation per acre or 1 lb ai per acre. Efficacy is unknown for this product.
- **Malathion** (malthion 8E): has a 0-day PHI if less than 1.5 pints or 7-day PHI if 2 pint rate. Applied at the rate range of 1 to 2 pints per acre or 1 to 2 lbs ai per acre. Has Caution as the signal word and a 12 hour REI. Efficacy of this product is poor for control of this pest. This product is generally not used due to efficacy.

Carbamate insecticides:

- **Carbofuran** (Furadan 4F): has a 7-28 day PHI. Applied at the formulation rate range of 0.5 to 2 pints per acre or 0.25 to 1 lb ai per acre. May be applied once per cutting. Provides excellent control of this pest.
- **Methomyl** (Lannate LV, 90SP): has a 7-day waiting period before grazing or feeding. Applied at the formulation rate of 3 pints of LV or 1 lb of 90S or 0.9 lbs ai per acre. Provides good control of this pest.
- **Carbaryl (Sevin 80S, 50WP, XLR):** has a 0-day PHI is applied at the rate 1.875 lbs of 80S, 3 lbs of 50 WP and 1.5 quarts of XLR formulations. Provides good control of this pest.

**Pyrethroid insecticides:**

- **Permethrin (Pounce 3.2EC):** Has a 14-day PHI. Is applied at the rate range of 4 to 8 oz per acre or 0.1 to 0.2 lbs ai per acre with no more than 0.2 lbs ai per cutting. Provides good control of this pest.
- **Zeta-cyfluthrin (Warrior T, Fury 1.5EC):** has a PHI of 3-days for cutting and 7-days for harvest. Applied at the rate range of 2.56 to 3.84 oz for T formulation and 2.4 to 4.3 oz for the 1.5EC formulation. Provides good control of this pest.

**Biological controls:**

**NOTES:** growers are encouraged to scout the alfalfa closely to observe for the presence of any biological controls. High populations of these may assist in controlling many of the pest observed in alfalfa, therefore possibly eliminating pesticide application.

- *Bathyplectes curculionis* and *Bathyplectes anurus* (a larval parasite of alfalfa weevil). *Bathyplectes* spp. are small, non-stinging wasps that are parasitoids of the alfalfa weevil, a serious pest of alfalfa in the Midwest and elsewhere. They were introduced to North America in 1911 from Italy by the U.S. Department of Agriculture as part of a biological control effort against the alfalfa weevil, also a non-native. *B. anurus* has a greater reproductive potential.
- *Microctonus aethiopoides* is an endoparasitoid of the adult alfalfa weevil.
- *Entomophthora phytonomia* a fungal disease of the alfalfa weevil larvae.
- *Coccinella septempunctata* and *C. tranversoguttata* are lady beetles which are predators that feed on alfalfa weevil larvae and on aphids.

**Non-chemical pest management tools:**

- Use first cuttings for hay or feed for horses
- Scout field two or three days prior to cutting at numerous sites within the field
- Cut hay without crimping or conditioning so beetles may survive harvest and leave the drying crop before it is baled.

### Potato leaf hopper

*Empoasca fabae*

The potato leafhopper (PLH), feeds on over 100 cultivated and wild plants including alfalfa, clover, eggplants, strawberries, some garden flower varieties, potatoes, soybeans, and snap beans. It will typically achieve high populations in late May to early June.

PLH adults are lime green, slender, small (1/8" long), and somewhat wedge-shaped with heads that are slightly broader than the rest of their bodies. They usually have 6 small white dots directly behind their head that can be seen with magnification. The nymphs look similar to the adults except that they are smaller, wingless, and paler green. Both the adults and nymphs are very active. Nymphs develop between 54 to 88 F, with development most rapid at 86 F. They migrate from the southern United States on wind currents and start arriving in the in mid to late March. The females,
often fertilized, are usually the first to arrive. Large populations continue to migrate through May and early July. PLH lays eggs in the stems of susceptible plants. Each female lays 2-3 eggs per day and continues to oviposit for at least a month and up to 50 days. Eggs hatch in 7 to 10 days. Nymphs molt five times from 1st instar to adult in about two weeks. Nymphs feed primarily on the underside of the leaf. Given their limited mobility, nymphs are considered more damaging than adults. There are usually three generations per year in Tennessee. However, because of the long oviposition period, infestations usually consist of overlapping generations. PLH have piercing-sucking mouthparts with both adults and nymphs causing damage on beans. When they insert their mouthparts into the water and food conducting tissue of plants, they also inject saliva and create physical damage that plugs the vascular tissue. Sometimes, the damage is a characteristic v-shaped brown area at the leaf tip that is called hopperburn. In addition, other damage symptoms include stunted growth, shortened internodes, and fewer flowers and pods. Proper identification of the source of the damage is important for making management decisions.

**Chemical controls commonly available:**

**Organophosphates:**

- **Dimethoate** (Dimethoate 4E, 5E): has a 10-day PHI. The formulation of 4E is applied at 8 to 16 oz per acre or 0.25 to 0.5 lbs ai per acre. Provides fair control of this pest.
- **Methyl Parathion** (Methyl 4): has a 15-day PHI. Is applied at the formulation rate range of 8 to 16 oz per acre or 0.25 to 0.5 lbs ai per acre. Provides good to excellent control of this pest. Cost ranges from $2 to $4 per acre per application. Difficult to obtain this product unless purchased in large quantities.

**Carbamates:**

- **Carbaryl** (Sevin 80S, 50WP, XLR or Adios): has a 0-day PHI. Is applied at the rate of 1 lb ai per acre per application.

**Pyrethroids:**

- **Zeta-cypermethrin** (Mustang Max): has a 3 day PHI for cutting and a 7-day PHI for harvest. It is applied at the formulation rate of 2.24 to 4.0 oz per acre or 0.014 to 0.025 lbs ai per acre. Maximum of 0.025 lbs ai per acre per cutting and a maximum of 0.075 lbs ai per acre per season.

**Non-chemical pest management tools:**

- Early cutting will reduce high populations
- Scouting for damage
- Resistant varieties may be available

**Aphids, pea aphid**

(*Acyrthosiphon pisum*, and others)

Aphids extract sap from the terminal leaves and stem of the host plant. Their feeding can result in deformation, wilting, or death of the host depending upon the infestation level. Plants that survive heavy infestations are short and bunched with more lightly colored tops than those of healthy plants. Wilted plants appear as brownish spots in the field. Moreover, plants are often coated with shiny honeydew secreted by the aphids, and cast skins may give the leaves and
ground a whitish appearance. These aphids also transmit the pea enation mosaic (not observed in TN) and the yellow bean mosaic viruses.

Wingless, female aphids continue to feed and breed throughout the winter months. In spring, feeding activity increases. At this time, some winged aphids develop and migrate, usually to peas. Most of the progeny of these winged females develop into wingless females. Whenever overcrowding occurs, more winged aphids appear, migrate to different areas, and establish new colonies. Each adult female gives birth to 6 to 8 nymphs each day until she has produced about 100 offspring. Nymphs mature into adults in 10 to 14 days. Since generations overlap and reproduction continues all year, the number of annual generations is difficult to determine. The pea aphid thrives best and reproduces most quickly at temperatures around 65 degrees F (18 degrees C) and humidity near 80 percent.

**Chemical controls commonly available:**

**Organophosphate insecticides:**

- **Dimethoate (Dimethoate 400):** has a 10-day PHI. Applied at the formulation rate of 8 to 16 oz per acre or 0.25 to 0.5 lbs ai per acre. Only one application per cutting is allowed.
- **Malathion (malthion 8E):** has a 0-day PHI if less than 1.5 pints or 7-day PHI if 2 pint rate. Applied at the rate range of 1 to 2 pints per acre or 1 to 2 lbs ai per acre. Has Caution as the signal word and a 12 hour REI. Provides poor control. Some aphid populations may be resistant.

**Carbamate insecticides:**

- **Carbofuran (Furadan 4F):** has a 7 to 28 day PHI. Is applied at the formulation rate of 8 to 16 oz per acre or 0.25 to 0.5 lbs ai per acre.

**Pyrethroid insecticides:**

- **Zeta-cyfluthrin (Fury 1.5E):** has a 3-day cutting and 7-day harvest PHI. Applied at the formulation rate range of 2.4 to 4.3 oz per acre or 0.028 to 0.05 lbs ai per acre.

**Alternative Pesticide:**

- **Neem extract (various):** most labels usually have a 12 hour REI. This product is extremely expensive.

**Biological control:**

- Aphid parasite, parasitic wasp (**Aphidius matricariae**): can provide fair control.
- Aphid midge (**Aphidoletes aphidimyza**): may provide fair control.

**Non-chemical pest management tools:**

- Predators and parasites usually control this pest.
- Resistant varieties may be available.
- Early cutting in mid season.
- Scouting for predators and parasites
Blister beetles, black, margined, gray and striped
(\textit{Epicauta pennsylvanica}, \textit{E. pestifera}, \textit{E. fabricii}, \textit{E. occidentalis})

Blister beetles usually infest alfalfa fields in mid to late summer. These pests rarely cause economic damage to the alfalfa plant. However, the pest contains a caustic agent known as cantharidin. Cantharidin can cause severe injury and/or death to horses if consumed.

**Chemical controls commonly available:**

**Carbamate insecticides:**

- Carbaryl (Sevin XLR, Sevin 50WP, Sevin 80S): has a 0-day PHI. Is applied at the formulation rate of 0.66 to 1.25 lbs of 80S, 1-2 lbs of 50WP and 1 quart of XLR.
- **NOTES**: Treatment should begin when 2 beetles are observed per square foot. Beetles are toxic to livestock, especially to horses.

**Alternative Pesticide:**

- Malathion (malathion, 5E, 8E): is an organophosphate insecticide. This product is generally not used for control of these pests due to efficacy issues.

**Non-chemical pest management tools:**

- Use first cuttings for hay or feed for horses
- Scout field two or three days prior to cutting at numerous sites within the field
- Cut hay without crimping or conditioning so beetles may survive harvest and leave the drying crop before it is baled.
- Plant away from areas that have wooded borders.

**Threecornered alfalfa leaf hopper**
(\textit{Spissistilus festinus})

Threecornered alfalfa hoppers girdle stems by their feeding and egg-laying activities. Nymphs and adults weaken the lower stem by piercing it with their needle-like mouthparts and extracting plant juices. As a result, lodging and breaking usually occur weeks after attack. There is some evidence that if damage is randomly scattered and occurs before bloom, in an optimum stand, reduction of at least 25 percent may be necessary to reduce yields. Therefore, these pests rarely cause economic damage.

They overwinter as eggs in plant tissues or as adults protected by clumps of grasses. Young nymphs from overwintering eggs and overwintered adults begin feeding on weedy plants along field borders in the spring. During May or June, they migrate to soybean seedlings. Females then deposit 30 to 40 eggs, singly, in host plant stems. On the average, 50 days elapse between egg deposition and adult emergence. The adults are strong flyers and readily migrate to new fields. Although the biology of this pest has not been studied in Tennessee, there are probably at least two generations each year.
Chemical controls commonly available:

- Chemical controls would be the same as potato leaf hopper

Non-chemical pest management tools:

- Damage may be avoided by destroying weedy borders around fields
- Seeding a little more heavily

Cutworms,

Black cutworm (Agrotis ipsilon)
Variegated cutworm (Peridroma saucia)
Granulate cutworm (Feltia subterranean)

Many cutworms prefer wilted plant material and sever the plants sometime prior to feeding. Stems are chewed near the soil. Some cutworms climb the host and feed on unopened buds. Cutworms are caterpillars that feed on the stems and leaves of young plants and often cut them off near the soil line, hence their common name. Although there are many important species of cutworms, the black, granulate, and variegated cutworms are the ones most commonly encountered. Each cutworm differs slightly from the others in details of habits and appearance, but their life histories are generally similar. Adults and larvae are nocturnal and hide during the day but may become active on cloudy days. The overwintering forms of cutworms occur in the soil either as pupae or mature larvae. In the spring, the hibernating larvae pupate. Adults begin to appear in the middle of March. Female moths deposit eggs singly or in clusters, and each female can lay as many as 500 eggs. Under optimum conditions, the eggs hatch in 3 to 5 days, and larvae develop in 3 to 4 weeks passing through 6 instars. Pupae mature in 2 weeks during the summer and as many as 9 weeks in the fall. Some of the cutworms can produce as many as four generations each year.

Chemical controls commonly available:

Organophosphate insecticides:

- Methyl parathion (Methyl 4): applied at the formulation rate of 1 pint or 0.5 lb ai per acre. Cost is approximately $4 per acre. Product is highly toxic to user, however inexpensive but difficult to obtain small quantities.

Carbamate insecticides:

- Carbaryl (Sevin): Applied at the rate of 1 to 2 lbs ai per acre. Fairly safe to user and inexpensive.

Pyrethroid insecticides:

- Zeta-cypermethrin (Fury 1.5E/ Mustang Max): has a 7-day PHI for harvest and a 3-day PHI for cutting. Applied at the formulation rate range of 2.4 to 4.3 oz per acre or 0.028 to 0.05 lbs ai per acre.
- NOTES: Treatment occurs when a combination of cutworms, alfalfa caterpillars, green clover worms, and webworms are found at an average of one or more 1/2 inch larvae per plant.
Non-chemical pest management tools:

- Pheromone traps are used to monitor black cutworm adults, to determine when egg laying activity may occur.
- Scouting
- Mowing areas around seeded fields one to two weeks prior to seeding.

Grasshoppers

( *Melanoplus* spp.)

Grasshoppers feed on the leaves of alfalfa, therefore reducing the foliage on the plant. Populations vary from year to year and field to field. Populations are normally higher when the field is surrounded by weedy field borders.

Chemical controls commonly available:

Organophosphate insecticides:

- Methyl parathion (Methyl 4): has a 15-day PHI. Is applied at the rate range of 0.5 to 1 pint per acre or 0.25 to 0.5 lbs ai per acre. Cost ranges from $2 to $4 per acre per application. Provides good control. Difficult to obtain product unless purchased in large quantities.

Carbamate insecticides:

- Carbofuran (Furadan 4F): applied at the formulation rate range of 4 to 8 oz per acre or 0.125 to 0.25 lbs ai per acre. Provides excellent control.
- Carbaryl (Sevin): grasshoppers are not listed on the label however, this product would provide good control when applied at rates suggested for other pests.

Pyrethroid insecticides:

- Zeta-cypermethrin (Fury 1.5E/Mustang Max): has a 3-day cutting and a 7-day harvest PHI. Applied at the formulation rate range of 2.4 and 4.3 oz per acre or 0.028 to 0.05 lbs ai per acre.

Alternative pesticide:

- Neem (Neemix 4.5- 0.34): no PHI listed on the label. Applied at the rate of 4 to 16 ounces per acre or 0.01 to 0.04 lbs ai per acre. This product is fairly expensive. Efficacy has not been evaluated in Tennessee.

Non-chemical pest management tools:

- Mow weedy border areas

True armyworm (*Pseudaletia unipuncta*)

Fall armyworm (*Spodoptera frugiperda*)
**beet armyworm** (Spodoptera exigua)

Armyworms are a greater problem during spring and early July, after which time, natural controls keep the population below threshold level. Armyworms feed primarily at night and remain hidden in ground litter by day. They may be particularly numerous following a cool, wet, spring which tends to limit the suppression by natural controls. In contrast, fall armyworms are usually a problem later in the season (July to September), after the moths have migrated northward into the state from the Gulf Coast area. Also, the larvae are active day and night. Parasites and disease organisms will often keep fall armyworm populations in check. However, extremely hot and dry conditions reduce the activity of the fall armyworm's fungal pathogen and promote larval activity. Armyworms prefer grasses, however they can also cause significant damage to young alfalfa. Fall armyworms are somewhat more difficult to control than true armyworms, but all species have the same treatment threshold of five larvae per square foot or 10% damaged foliage. Threshold on young alfalfa may be lowered to 2-3 larvae per square foot.

**Chemical controls commonly available:**

**Organophosphate insecticides:**

- **Methyl parathion** (Methyl 4): has a 15-day PHI. Applied at the formulation rate of 0.5 to 1 pint per acre or 0.25 to 0.5 lbs ai per acre. This product is fairly inexpensive however extremely toxic. Difficult to obtain this product unless purchased in large quantities.

**Carbamate insecticides:**

- **Carbaryl** (Sevin, XLR, 50WP, 80S): applied at the rate of 1 to 1.5 lbs ai per acre. Moderately priced and fairly safe for applicator.

**Pyrethroid insecticides:**

- **Zeta-cypermethrin** (Warrior T, Fury 1.5E): as a 3-day cutting and a 7-day harvest PHI. Applied at the formulation rate range of 2.4 and 4.3 oz per acre for the 1.5E or 0.028 to 0.05 lbs ai per acre.

**Non-chemical pest management tools:**

- Scouting may help aid in determining when applications are needed.

**Table 1. Efficacy of pesticides used in alfalfa production.**

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<tr>
<th>Pesticide/Control</th>
<th>PEST</th>
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<td>Aphids</td>
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<td>Methyl parathion</td>
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<td>PEST</td>
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<td>Estimated Damage</td>
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*Loss varies from field to field and farm to farm. Other pests may be observed, however level of loss is usually less than 1%.
Insecticides

Organophosphate insecticides:

- Methyl parathion (various 4EC): has a 15-day PHI. It is applied at the formulation rate of 0.5 to 2 pint per acre or 0.25 to 1 lb active ingredient per acre. It is a restricted use pesticide with Danger as the signal word and has a 4 day REI. It is used to control alfalfa weevils, aphids, cutworms, grasshoppers, armyworms, webworms, Egyptian alfalfa weevils, lygus bugs and spider mites. Not to be applied during bloom or when surrounding weeds are in bloom. Extremely toxic and may be a hazard to the applicator even when used correctly. Must be applied with and enclosure on tractor that is filtered. Usually not found at retailers in small containers. Often must be special ordered in large containers (55 gal). Cost per application ranges from $2 to $8 per acre with $4 per acre per application being the average cost for alfalfa weevil control.

- Chlorpyrifos (Lorsban 4E): has a 14 and 21 day PHI depending on application. Applied at the formulation rate range of 0.5 to 2 pints per acre or 0.125 to 0.5 lbs active ingredient per acre. Is a restricted use pesticide with Warning as the signal word and a 4 day REI. No more than 4 applications per season or once per cutting. Controls corn rootworm adults, grasshoppers, leafhoppers. Alfalfa caterpillar, alfalfa blotch leaf miner, armyworms, aphids, cutworms, plant bugs, and spittlebugs. Moderately toxic and cost for treatment ranges from $2.44 to 9.75 per acre per application.

- Phosmet (Imidan 70W): has a 7-day PHI. It is applied at the formulation rate range of 1 to 1.3 lbs per acre or 0.7 to 0.91 lbs ai per acre. Should not be applied more than once per cutting. It has Warning as the signal word and a 24 hour REI. Should not be grazed or cut for hay within 7 days of application. Controls potato leaf hopper, leaf hoppers, aphids, grasshoppers, lygus bugs, Egyptian alfalfa weevil, alfalfa weevil larvae and larvae, and alfalfa blotch leafminer. Cost ranges from $7.45 to 9.69 per acre per application.

- Dimethoate (Dimethoate 4EC, 5EC): has a 10-day PHI. Applied at the formulation rate range of 6.4 to 12.8 floz of 5EC or 8 to 16 oz of the 4EC or 0.25 to 0.5 lbs ai per acre. Danger is the signal word and it has a 48 hour REI. Only one application per cutting. Used to control aphids, grasshoppers, leafhoppers, lygus bugs, and reduction of the alfalfa weevil larvae. Cost ranges from $1.82 to 3.63 per acre per application.

- Malathion (malathion 8): has a 0-day PHI if less than 1.5 pints or 7-day PHI if 2 pint rate. Applied at the rate range of 1 to 2 pints per acre or 1 to 2 lbs ai per acre. Has Caution as the signal word and a 12 hour REI. It is used to control alfalfa weevil larvae, aphids, armyworms, clover leaf weevil, grasshoppers, lygus bugs, pea aphid, potato leaf hoppers, spider mites, and spittle bugs. Fairly safe for applicator use. Cost ranges from $4.81 to 9.60 per acre per application. Generally not used due to efficacy issues.

Carbamate insecticides:

- Carbaryl (Sevin XLR, 50WP, 80S): has a 7-day PHI or grazing waiting period. It is applied at the formulation rate range of 0.5 to 1.5 quarts per acre or 0.5 to1.5 lbs active ingredient per acre. It has Caution as the signal word with a 12 hour REI. Should not exceed 1.5 lbs ai per cutting or one application per cutting. Controls blister beetles, alfalfa caterpillar, green clover worm, leafminers, corn earworm, cutworms, Egyptian alfalfa weevil, armyworms, thrips, leafhoppers, Japanese beetle, cucumber beetles, lygus bugs, stinkbugs, and webworms. This product may cause bleaching on tender shoots. Cost ranges from $2.50 to 12.75 per acre per application depending on formulation and rate used. The 80S formulation is the least expensive material.

- Methomyl (Lannate 2.4 LV): has a 7-day PHI or grazing waiting period. It has a 48 hour REI. Applied at the rate range of 0.75 to 3 pints per acre or 0.225 to 0.9 lbs ai per acre. It is a restricted use pesticide with Danger as
the signal word on the label. Controls the pea aphid, aphids, loopers, armyworms, cutworms, alfalfa weevils, and Egyptian alfalfa weevil larvae. No more than 10 applications per crop. No more than 4.5 lbs ai per acre per crop. Should not be applied to dormant or semi-dormant alfalfa when minimum temperature is 50F or lower. Controls aphids, lygus bugs, leafminers, aphids, Egyptian alfalfa weevil, loopers, armyworms, cutworms, alfalfa weevil larvae. Cost ranges from $5.20 to 20.78 per acre per application.

- Carbofuran (Furadan 4F): has different PHIs or grazing and harvest waiting periods ranging from 7 to 28 days depending on rate per acre used. It has a 48 hour REI. Applied at the rate range of 0.5 pint to 2 pints per acre or 0.25 to 1 lb active ingredient per acre per application. Is a restricted use pesticide with Danger as the signal word. No more than one application per season. Controls lygus bug, Egyptian alfalfa weevil, aphids, alfalfa weevil, leaf hoppers, grasshoppers, and leaf miners. Cost ranges from $ 5.06 to 20.25 per acre per application.

Pyrethroid insecticides:

- Permethrin (Ambush 25W, Pounce 3.2EC): has a 14-day PHI. Applied at the rate range of 0.1 to 0.2 lbs active ingredient per acre. Is a restricted use pesticide with Caution as the signal word with a 12 hour REI. No more than 0.2 lbs ai per cutting. Not to be applied to mixed stands of forage. Controls alfalfa caterpillar, armyworms, aphids, cutworms, loopers, alfalfa weevil, cucumber beetle, webworms, leafhoppers, stink bugs, plant bugs, Egyptian alfalfa weevil, and meadow spittlebug. Cost ranges from $1.13 to 2.26 per acre per application.

- Lambda cyhalothrin (Warrior): has a 1-day PHI for forage and a 7-day PHI for hay. It is applied at the formulation rate range of 1.92 to 3.84 oz per acre. Is a restricted use pesticide with Warning as the signal word and a 24 hour REI. Should only be applied to pure stands of alfalfa. No more that 0.03 lbs ai per cutting or 0.12 lbs ai per season. It controls alfalfa caterpillar, cutworms, green cloverworm, loopers, webworms, leafhoppers, armyworms, corn earworm, alfalfa weevil, alfalfa weevil, cowpea weevil, green June beetle, Japanese beetle, grasshoppers, thrips, aphids, meadow spittle bug, and white fringed beetle. Cost ranges from $ 4.19 to 8.28 per acre per application.

- Cyfluthrin (Baythroid 2EC): has a 7-day PHI. It is applied at the formulation rate range of 1.6 to 2.8 oz per acre or 0.025 to 0.04375 lbs active ingredient per acre. It is a restricted use pesticide with Danger as the signal word and a 12 hour REI. Controls the alfalfa looper, cutworms, green cloverworm, meadow spittlebug, leaf hoppers, alfalfa caterpillar, plant bugs, webworm, armyworms, corn earworm, cucumber beetle adults, Egyptian alfalfa weevil, Japanese and June beetle adults, loopers, grasshoppers, whiteflies, lygus bug, stink bugs, tarnished plant bug and blotch leaf miner. Cost ranges from $4.35 to 7.61 per acre per application.

- Zeta-cypermethrin (Mustang Max 0.8EC, Fury): has a 3-day PHI. It is applied at the formulation rate range of 2.24 to 4 oz per acre or 0.014 to 0.025 lbs ai per acre. Is a restricted use pesticide with Warning as the signal word which has a 12 hour REI. Controls alfalfa caterpillar, alfalfa looper, alfalfa weevil, Egyptian alfalfa weevil, cutworms, flea beetles, aphids, leaf hoppers, armyworms, grasshoppers, lygus bugs, webworms, plant bugs, stink bugs, green clover worm and meadow spittlebug. Applications may not be made any closer than 7 days apart. Maximum of 0.075 lbs ai per season. May be applied to forage mixtures. Cost ranges from $3.59 to 6.41 per acre per application. (Fury 1.5): has a 3-day PHI for cutting or grazing and 7-day PHI if harvesting for seed. Applied at the rate of 4.3 floz or 0.05 lbs ai per acre not to exceed 0.15 lbs ai per season. It is a restricted use pesticide with Warning as the signal word which has a 12 hour REI. Price is similar to Mustang Max. These are both restricted use pesticides.

Other insecticides:

- Bacillus thuringiensis (Agree WG, Crymax, Deliver, Dipel, Javelin, Lepinox, Xentari): has no PHI listed on the label. Is applied at various rates depending on brand used. Caution is the signal word and it has a 4 hour REI. Controls armyworms, alfalfa caterpillar, and loopers. Price is extremely variable due to multiple formulations and costs are usually higher than non-Bt products.

- Indoxacarb (Steward 1.25): has a 7-day PHI. It is applied at the formulation rate range of 6.6 to 11.3 oz. or
0.065 to 0.11 lbs ai per acre. Has Caution as the signal word and a 12 hour REI. Used to control alfalfa weevil larvae, Egyptian alfalfa weevil larvae, beet armyworms, western striped armyworm. No more than one application per cutting and no more than 0.44 lbs ai per acre per crop season. Cost ranges from $8.00 to 11.00 per acre per application.

- **Azadirachtin** (Neemix 4.5): is an insect growth regulator. It has no PHI listed on the label. Applied at the formulation of 5 to 16 oz per acre. Warning is the signal word and it has a 12 hour REI. Controls aphids, armyworms, cutworms, spittlebugs, and the lygus bug. Pricing not available.

**Table 3. Estimated Insecticide Usage***

<table>
<thead>
<tr>
<th>Common name</th>
<th>Trade name(s)</th>
<th>% usage</th>
<th>Ave. no apps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl parathion</td>
<td>Methyl trace</td>
<td>trace</td>
<td>1</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>Lorsban</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Phosmet</td>
<td>Imidan</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Dimethoate</td>
<td>various</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Malathion</td>
<td>various</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>Sevin</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Methomyl</td>
<td>Lannate</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Carbofuran</td>
<td>Furadan</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Permethrin</td>
<td>Ambush, Pounce</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Lambda cyhalothrin</td>
<td>Warrior</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>Baythroid</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Zeta-cypermethrin</td>
<td>Fury, Mustang</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td><em>Bacillus thuringiensis</em></td>
<td>Stewart</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Indoxacarb</td>
<td>Stewart</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Azadirachtin</td>
<td>Neemix</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Estimated percent acreage treated of 2004 crop.

**Weeds**

Various weeds occur in alfalfa production and vary from field to field and farm to farm. Johnsongrass and crabgrass are the most commonly occurring grasses. Pressure from broadleaf weeds changes mainly due crops grown or products used prior to seeding alfalfa. Weeds should be controlled during establishment of alfalfa. Competition from weeds can be one to the major factor limiting alfalfa stand establishment. Weeds such as henbit, chickweed, annual ryegrass, may pose problems in fall seeded alfalfa, while crabgrass is a major competitor in spring-seeded alfalfa. If grass is
intentionally seeded with alfalfa, a grass herbicide is normally not used. Table 4, lists products recommended for use in Tennessee and the expected response of weeds to their use. Other products are available, however are rarely used. Loss due to weed infestation averages around 15% each year.

Table 4. Expected Weed Response to at-planting and postemergence alfalfa herbicides.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Eptam</th>
<th>Butyrac</th>
<th>Pursuit</th>
<th>Poast or Poast Plus</th>
<th>Select</th>
<th>Gramoxone Between cuttings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual grasses</td>
<td>8</td>
<td>0</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Annual ryegrass</td>
<td>8*</td>
<td>0</td>
<td>--</td>
<td>8*</td>
<td>8*</td>
<td>NA</td>
</tr>
<tr>
<td>Johnsongrass-Seedling</td>
<td>9</td>
<td>0</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Johnsongrass-Rhizome</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Nutsedge</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Chickweed</td>
<td>9</td>
<td>2</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Cocklebur</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Curly dock</td>
<td>0</td>
<td>1</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Deadnettle</td>
<td>8</td>
<td>1</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Henbit</td>
<td>8</td>
<td>1</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>NA</td>
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<tr>
<td>Lambsquarter</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Morningglory</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Pigweed</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Plantain</td>
<td>0</td>
<td>2</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Ragweed</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Musk thistle</td>
<td>--</td>
<td>7**</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

*Fall application
**Newly-emerged seedlings only
NA=not applicable
0=no control, 10=100% control; -- = data not available

Herbicides

The most common herbicides used include 2,4-DB, Pursuit, for broadleaf weeds and Select and Poast for grasses. Paraquat is often used between cuttings. Paraquat or glyphosate may be applied in the fall prior to seeding. A list of
commonly used herbicides, classification and estimated use are listed in Table 5. Grazing and cutting restrictions for alfalfa herbicides in the presence of lactating dairy animals are listed in Table 6.

Preplant for No-tillage:

- **Paraquat** (Gramoxone Max 3SL): applied at the formulation rate range of 26 to 43 ounces per acre or 0.63 to 0.94 lbs active ingredient per acre. Cost ranges from $7.76 to 12.83. Use to control most annual and some perennial weeds prior to seeding. In sod, best results have been obtained with a split application (13-26 ozs./A, 10 days to 3 weeks prior to planting, followed by 13 ozs./A at planting). Apply in a minimum of 10 gallons of water per acre. Add nonionic surfactant at 2 pts. per 100 gallons of spray mix.

**Glyphosate products**

- **Glyphosate** (Touchdown and others 3AE): applied at the formulation rate range of 32-96 ounce per acre or 0.75 to 2.25 lbs active ingredient per acre. Costs ranges from $9.25 to 27.75 per acre.
- **Glyphosate** (Roundup WeatherMax 4.5AE): applied at the formulation rate range of 22-64 ounces per acre or 0.75 to 2.25 lbs active ingredient per acre. Cost ranges from $8.42 to $25.26 per acre.
- **NOTES**: Glyphosate is used for control of most annual weeds and provides better control of perennial weeds than Gramoxone Max. On most perennial weeds, glyphosate performs better in the fall than in the spring.

Preplant:

- **EPTC** (Eptam 7EC): applied at the formulation rate of 3.5 pints per acre or 3 lbs ai per acre. Apply preplant incorporated to control crabgrass, foxtails, seedling johnsongrass, chickweed, pigweed, and other annual grasses and small-seeded broadleaves. Should not be used if small grains or forage grasses are to be seeded with the legume. If possible, spray and incorporate Eptam in one operation. Cost was $14.79 per acre per application.

Seedling:

- **2,4-DB** (Butyrac 200 2SC): applied at the formulation rate range of 4 to 6 pints per acre or 1 to 1.5 lbs ai per acre. Controls small seedlings of musk thistle, turnips, cocklebur and ragweed. Does not control chickweed or henbit. Treatment should begin before weeds exceed 3 inches tall and when legumes have two or more trifoliate leaves. Cost was $17.05 to 25.57 per acre.
- **Bromoxynil** (Buctril 4EC, Connect): has a 60-day PHI. It is applied at the formulation rate range of 8 to 12 oz per acre of 4EC or 0.25 to 0.375 lbs ai and up to 1 pint per acre in chemigation. Often mixed with Pursuit or Butyrac. Warning is the signal word and it has a 12 hour REI. Should not be applied when temperatures exceed 70F. Used to control various broadleaf weeds. Cost was $7.15 to 10.73 per acre.

Established:

- **2,4-DB** (Butyrac 200 2SC): applied at the formulation rate range of 4 - 6 pints per acre or 1 to 1.5 lbs ai per acre. Controls small seedlings of musk thistle, turnips, cocklebur and ragweed. Does not control chickweed, henbit, plantain or dock. Treat before weeds exceed three inches tall. Cost similar to seedling application.
- **Hexazone** (Velpar L 2WDL): has a 30-day PHI. Formulation rate ranges from 2 to 6 pints per acre depending on organic matter content of soil and texture of soil or 0.5 to 1.5 lbs ai per acre. Danger is the signal word and has a 24 hour REI. Should not be used on alfalfa grown for seed. Used to control several broadleaf weeds and several grasses. Should not be applied when soil is covered with snow or ground is frozen. Cost ranges from $15.50 to $46.50 per acre.
• Diquat dibromide (Reglone 2EC): has a 3-day PHI and is a desiccant used for harvesting seed. Applied at the formulation rate range of 1.5 to 2 pints per acre or 0.375 to 0.5 lbs ai per acre. Has Warning as the signal word and a 24 hour REI. Forage or seed may not be used for livestock or consumption purposes. Cost ranges from $12.19 to $28.25.

**Seedling or Established Alfalfa Only:**

• Clethodim (Select 2EC, Prism 0.94): formulation rate range of 6 to 8 oz of 2EC or 0.094 to 0.125 lb ai per acre. Cost ranges from $8.83 to 11.78 per acre. It is applied overtop to control crabgrass, fall panicum, broadleaf signalgrass or other annual grasses and johnsongrass. Use 6 to 8 ozs./A of formulation in seedling alfalfa and 8 ozs./A in established alfalfa for annual grasses. Use 8 ozs./A for johnsongrass. Crop oil concentrate should be added at 1 qt./A rate.

• Imazethapyr (Pursuit 2AS, 70DG): applied at the formulation rate range of 4-6 ozs. 2AS \( \div 0 \div 3 \) or 1.44-2.16 ozs. of 70DG or 0.063-0.094 lb.ai per acre. Cost ranges from $45.80 to 68.70 per acre. This product is applied overtop in seedling or established alfalfa to control several annual broadleaf weeds and some annual grasses. Higher rate required for grass control. Seedling alfalfa must be in the 2 trifoliate stage or larger. Apply before most weeds exceed 3 inches in height. Good control of pigweed, morningglory, cocklebur, foxtails and seedling johnsongrass. Nonionic surfactant should be added at 1 qt./100 gal. of spray mix.

• Terbacil (Sinbar 80W): for established 0.5 to 1 lb formulation or 0.4 to 0.8 lbs ai per acre and seedling 0.25 to 0.5 lbs formulation or 0.2 to 0.4 lbs ai per acre. Caution is the signal word and has a 12 hour REI. Should not be used when new growth has appeared. Controls various grasses and broadleaf weeds. Should not be used in low organic matter soils. Often mixed with 2,4-DB. Cost not available.

• Norflurazon (Zorial 80): has 28-day PHI. Applied at the formulation rate range of 1.25 to 2.5 lbs or 1 to 2 lbs ai per acre. Cost ranges from $18.38 to 36.75 per acre per application. Has Caution as the signal word and a 12 hour REI. Used to control grass and broadleaf weeds. Has some plant back restrictions for other crops.

• Imazamox (Raptor 1EC): has a 20 day PHI. Is applied at the formulation rate of 4 to 6 oz per acre or 0.03125 to 0.09375 lbs ai per acre. Cost ranges from $16.64 to 24.96 per acre. Caution as the signal word and a 4 hour REI. Used to control broadleaf weeds and some grasses.

**Seedling or Established mixture:**

• Sethoxydim (Poast 1.5E, Poast Plus 1E) have a 14-day PHI for hay. Poast has Warning as the signal word and Poast Plus has Caution as its signal word. Formulation rate range of 1-2.5 pts. 1.5E or 1.5-3.75 pts.1E per acre or 0.19-0.28 lb. ai per acre. No more than 1.218 lbs ai per season. Used to control grasses. Apply low rate overtop to seedling or established crop for control of crabgrass, goosegrass, foxtails and other annual grasses. Use higher rate for johnsongrass and bermudagrass. A second application may be needed for control of regrowth. Always add crop oil concentrate at 2 pts./A. Application cost ranges from $8.62 to 21.53 of 1.5E and $7.75 to 19.50 for 1E.

• Pronamide (Kerb 50WP): no PHI was listed on the label. It is applied at the formulation rate range of 1.5 - 2 lbs or 0.75 to 1 lb ai per acre. Is a Restricted Use Pesticide with Caution as the signal word and has a 24 hour REI. No more than 2 lbs ai per season may be made. Used as a fall or winter applied product. On pure alfalfa stands, used to control chickweed and several winter grasses such as ryegrass, cheat and annual bluegrass. Applied after legumes have reached the trifoliate stage. Should not be applied if temperatures are above 55 F. This product is difficult to obtain and in many instances must be ordered. Application cost was not available.

**Dormant:**

• Paraquat (Gramoxone Max 3SL): has a 42-day PHI and a
  • Fall seeded: formulation rate range of 8-12 ozs. or 0.19-0.28 lb. ai
Established formulation rate range of 12-21 ozs. 0.28-0.5 lb ai

**NOTES**: Paraquat is applied to dormant, pure alfalfa during late fall or winter months for control of chickweed, henbit, bluegrass and downy brome, and suppression of perennial grasses including orchardgrass, timothy and smooth brome. Use a minimum of 10 gallons of water by ground, or 5 gallons of water by air. Always add a nonionic surfactant at 0.25% (1 qt. per 100 gallons of spray mix.) Application to alfalfa that is not dormant, or has broken dormancy, may result in stand and/or yield reductions. Replanting may be necessary. Green alfalfa foliage present at the time of application will be burned. Only one application per season is allowed.

**Dormant established alfalfa:**

- Metribuzin (Sencor, Lexone 4 L or 75 DF): Applied at the formulation rate range of 1-1.5 pts. 4L, or 0.67-1 lb. 75 DF or 0.5-0.75 lb. ai per acre. Cost ranges from $13.85 to 20.75 per application per acre. Apply to dormant pure alfalfa or alfalfa-grass mixtures to control chickweed, henbit and several other broadleaf weeds. A partial reduction in grass stand may occur. Should not be applied after new growth starts.

**Established or first year between cuttings:**

- Paraquat (Gramoxone Max 3SL): Formulation rate of 12 ozs. or 0.28 lb ai per acre. Apply immediately after alfalfa hay is removed for control of many seedling broadleaf and annual grass weeds. Do not treat more than 5 days after cutting. Add surfactant at 1 pt./100 gallons of spray mix. Alfalfa foliage present at time of application will be burned. First year alfalfa stands and yields may be reduced if alfalfa is allowed to regrow more than two inches.

**Table 5. Herbicide classification and estimated usage.**

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Trade name</th>
<th>Classification</th>
<th>Estimated acreage treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraquat</td>
<td>Gramoxone</td>
<td>bipyridylium</td>
<td>75%</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Touchdown, Roundup</td>
<td>Glycine</td>
<td>25%</td>
</tr>
<tr>
<td>2,4-DB</td>
<td>Butyrac 200, Butyrac 175</td>
<td>Phenoxy</td>
<td>95%</td>
</tr>
<tr>
<td>EPTC</td>
<td>Eptam</td>
<td>thiocarbamate</td>
<td>5%</td>
</tr>
<tr>
<td>Clethodim</td>
<td>Select, Prism</td>
<td>cyclohexanidine</td>
<td>25%</td>
</tr>
<tr>
<td>Imazethapyr</td>
<td>Pursuit</td>
<td>imidazolinone</td>
<td>38%</td>
</tr>
<tr>
<td>Sethoxydim</td>
<td>Poast, Poast Plus</td>
<td>cyclohexanidine</td>
<td>30%</td>
</tr>
<tr>
<td>Pronamide</td>
<td>Kerb</td>
<td>benzamide</td>
<td>2%</td>
</tr>
<tr>
<td>Metribuzin</td>
<td>Sencor, Lexone</td>
<td>Triazinone</td>
<td>5%</td>
</tr>
<tr>
<td>Bromoxynil</td>
<td>Buctril</td>
<td>Nitrile</td>
<td>1%</td>
</tr>
<tr>
<td>Hexazone</td>
<td>Velpar L</td>
<td>Triazinone</td>
<td>1%</td>
</tr>
<tr>
<td>Diquat dibromide</td>
<td>Reglone</td>
<td>bipyridylium</td>
<td>&lt;1%</td>
</tr>
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</table>
Table 6. Grazing and cutting restrictions for alfalfa herbicides-lactating dairy animals.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Growth Stage</th>
<th>Grazing</th>
<th>Hay Cutting</th>
</tr>
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<tbody>
<tr>
<td>Butyrac 200</td>
<td>Seedling</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Eptam</td>
<td>Pre</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Gramoxone Max</td>
<td>Between cuttings</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Kerb</td>
<td>Dormant</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Poast or Poast Plus</td>
<td>Pre</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Pursuit</td>
<td>Established</td>
<td>7</td>
<td>14</td>
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<tr>
<td>Pursuit</td>
<td>Established</td>
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<td>30</td>
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<tr>
<td>Roundup WeatherMax</td>
<td>Pre</td>
<td>56</td>
<td>56</td>
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<tr>
<td>Select</td>
<td>Established</td>
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<tr>
<td>Sencor/Lexone</td>
<td>Pre</td>
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<td>28</td>
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<tr>
<td>Buctril</td>
<td>Established</td>
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<tr>
<td>Zorial</td>
<td>Established</td>
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</tr>
<tr>
<td>Raptor</td>
<td>Established</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
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Diseases

Diseases can affect both the quality and yield in alfalfa. Disease problems can be separated into three major categories based on symptoms and effects: diseases that affect stand establishment and reduce persistence, those that cause root rot and stem blights, and those that cause leaf spots. Table 7, lists several diseases and estimated losses due to infection from the disease in alfalfa production.

Diseases which cause a reduction in stand and longevity include anthracnose, Fusarium wilt, Phytophthora root rot, Sclerotinia crown and stem rot, bacterial wilt, alfalfa mosaic and damping off. Alfalfa cultivars are available with resistance to anthracnose, Fusarium wilt, Phytophthora root rot and bacterial wilt. Sclerotinia crown and stem rot damage is sporadic and sometimes severe; however, a usable form of resistance has not yet been identified.

In some years southern blight can be serious, few control measures are known for stem and foliar blight diseases. However, planting cultivars adapted to the southeast and selecting sites conducive to growth will have an overall beneficial effect. The most common root rot is Phytophthora root rot and as noted above, resistant cultivars should be used to control this disease.
Leaf spots interfere with photosynthesis and cause premature defoliation. The most serious in our state are lepto leaf spot, Stemphylium leaf spot, spring leaf spot and summer leaf spot. Rust occurs during late summer and fall and can be severe if harvest is delayed. Rusts can be controlled by planting resistant cultivars, but cultivars resistant to rust as well as all four leaf spots are not available.

**Phytophthora root rot**  
(*Phytophthora megasperma*)

Infected plants wilt, and the foliage, particularly the lower leaves, becomes yellow. Regrowth of diseased plants is often slow after cutting. Lesions with diffuse margins on the taproots are yellow to brown and usually start where a lateral root emerges. The yellow discoloration of tissue that extends through the root is a diagnostic feature of the disease. Taproots of numerous surviving plants in the field may be rotted off at various depths. If conditions do not favor the disease, new roots may form.

**Chemical control:**

- Mefenoxam (Apron XL) or metalaxyl (Allegience). Seed treatment. Seed treatments may help establish a stand. Only to be used with varieties which have some level of resistance. Treatment of seed may increase pricing from $3 to $5 per acre higher than none treated seed.

**Non-chemical pest management tools:**

- Rotation
- Plant on well drained soils
- Resistant varieties (Aggressor, Fortress, Cimmaron or others)

**Sclerotinia crown and stem rot**  
(*Sclerotinia trifoliorum*)

Infected leaves and stems become yellow and wilted. A white fluffy mass of fungus grows over the dead plant parts or the soil surface and infecting new nearby plants. When no new tissue is available or environmental conditions are unsuitable for continued growth, the fungus produces small hard black structures called sclerotia on or in the stem and crown. Cultivars selected for adaptation in the southeast sustain less Sclerotinia crown and stem rot damage than those adapted to other regions. Sclerotinia may cause as much as 50% loss, if favorable conditions exist.

**Chemical control:** None.

**Non-labeled possible alternative controls:**

- Pentachloronitrobenzene (PCNB): also known as Terraclor may provide control, however the label does not list alfalfa as a crop for use.
Non-chemical pest management tools:

- Rotation in to crops not affected by Southern blight, such as sod, corn or sorghum.

**Southern blight**  
*(Sclerotium rolfsii)*

The fungus produces a white cottony growth on the stem or crown near the soil surface. The plant turns tan color and dies. Small light-brown 'BB'-shaped sclerotia form on the stems and crown and on dead plant material on the ground.

**Chemical control:** None.

Non-Labeled possible alternative controls:

- Pentachloronitrobenzene (PCNB): also known as Terraclor may provide control, however the label does not list alfalfa as a crop for use.

Non-chemical pest management tools:

- Rotation in to crops not affected by Southern blight, such as sod, corn, or sorghum.

**Lepto leafspot**  
*(Leptosphaerulina briosiana)*

This leaf spot primarily affects young leaves, but also attacks other above ground parts. Leaf symptoms vary with the plant's age, stage of growth, and environment. Lesions often start as small black spots and either remain "pepper spots," as on white clover, or enlarge to oval to round "eyespots" 1-3 mm in diameter. The lesions have light brown to tan centers and darker brown borders - often surrounded by a white or slightly yellow ring. When conditions favoring infection and disease development coincide with rapid regrowth, lesions appear as rather large, light tan to almost white areas that merge to kill the entire leaf. High light intensity increases lesion size. Dead leaflets and petioles often remain attached to the stem for a time. In older growth, the young upper leaves become infected and have typical symptoms, but seldom die before harvesting.

**Chemical control:** None.

Non-chemical pest management tools: Early cutting may aid in control.

**Stemphylium leaf spot**  
*(Stemphylium botryosum)*

Stemphylium leaf spot is caused by a fungus *Stemphylium botryosum* which has been often observed during cool
weather in alfalfa during wet springs. The fungus produces light tan lesions that are defined by a dark border. The lesions vary in size, progressing only when there is plenty of moisture and before the border is formed. Infections reduce the quality of the hay, but are rarely severe enough to cause defoliation.

**Chemical control:** None.

**Non-chemical pest management practices:** Infected alfalfa should be cut as soon as possible to reduce spore production and spread.

### Alfalfa mosaic virus
*(alfalfa mosaic virus, AMV)*

Infected plants have a light green or yellow color which may appear between the leaf veins. Plants may be stunted. Leaves may also be misshapen. This disease will normally cause plants to die after several seasons. Symptoms of alfalfa mosaic are most noticeable on new growth in the spring. However, many infected plants never show recognizable symptoms. This disease may cause greater losses and problems in other field crops such as peas, peppers and tobacco.

**Chemical control:** None.

**Non-chemical pest management tools:** Removal of infected plants

### Anthracnose
*(Colletotrichum trifolii)*

Symptoms vary from a few irregularly shaped blackened spots to large, sunken, oval to diamond-shaped lesions on stems. Examination with a magnifying glass reveals tiny black hairs within these spots. Stems eventually turn straw colored and die. These dead shoots are often easily seen scattered through the field in summer and fall. This disease can move into the crown of the plant causing a bluish-black discoloration which results in damage to the whole plant.

**Chemical controls:** None available.

**Non-chemical pest management tools:** Early cutting.

Other diseases occasionally occur in alfalfa production however, damage is usually minimal.

**Table 7. 2004 Disease loss estimate for alfalfa.**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Estimated Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sclerotinia</td>
<td>4%</td>
</tr>
<tr>
<td>Disease</td>
<td>Incidence</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Phytophthora</td>
<td>2%</td>
</tr>
<tr>
<td>Anthracnose</td>
<td>2%</td>
</tr>
<tr>
<td>Lepto leaf spot</td>
<td>3%</td>
</tr>
<tr>
<td>Stemphylium leaf spot</td>
<td>1%</td>
</tr>
<tr>
<td>Southern blight</td>
<td>3%</td>
</tr>
<tr>
<td>Alfalfa mosaic virus</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

**Fungicides**

Seed Treatments: Although a number of fungicides are registered for use as seed treatments of alfalfa, clover, etc., these crops usually do not respond to seed treatments under field conditions. Some increases in stand may result but these increases have not been reflected in increased yield. The one notable exception to this is the use of fungicide seed treatment on alfalfa for control of seedling damping-off caused by *Phytophthora*. In areas where *Phytophthora* root rot has caused a serious problem in reducing alfalfa stands or preventing establishment of alfalfa, a variety with resistance to *Phytophthora* that has been treated with a *Phytophthora* specific seed treatment is highly recommended.

**Fungicides available for use:**

- Mefenoxam (Apron XL) is normally used for seed treatment.
- Metalaxyl (Allegience) is an older product similar to mefenoxam but not as concentrated.

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