Crop Profile for Alfalfa in Colorado

Prepared: August, 2000
Revised: September, 2003

Medicago sativa (Fabaceae)

General Production Information

Colorado Facts

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<tr>
<td>Acres in Colorado:</td>
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Data from 1997-2001 Colorado Agricultural Statistics Services

Description of Crop

Perennial C₃, cool season leguminous plant noted for improving soil tilth and having a higher potential yield than any other forage crop in Colorado. Alfalfa is very drought tolerant and prefers well-drained loam soils with a pH between 6.5 - 7.5. Since it is a C₃ plant, alfalfa is adapted to growing in higher elevations, such as the San Luis Valley and Southwestern Colorado. Alfalfa roots reach eight to twelve feet into the soil.
Cropping system

Planting: Alfalfa seed should be inoculated with *Rhizobium* bacteria prior to planting. Optimal planting depth is 0.25 - 0.5 inches in heavy soils and 0.5 - 1.0 inches in lighter soils. A firm, level seed bed is needed for successful germination and emergence. Five to seven inch planting rows or broadcast seeding are common. Thirty inch row widths are suggested for use with furrow irrigation systems. Planting density is 1,300,000 plants per acre for new seeding (30 plants/sq ft) and 400,000 plants per acre (9 plants/sq ft) for older stands. Oats and rye can be used as cover crops (planted at 30 lb. per acre) to help control soil erosion (soil erosion is more of a problem with coarse soils) and weed invasions during the first year of growth. Usually alfalfa is seeded around June 1. In Southwestern Colorado, alfalfa is seeded between April 15 and May 15 while fall planting of alfalfa is between late July and August 15. In the San Luis Valley, alfalfa is seeded between May 15 and August 15 while fall planting is recommended between August 15 and August 30. The seed bed may be clean tilled. More commonly, fall seeded alfalfa is planted into small grain stubble. Optimal germinating temperatures are 65 - 77 F, and optimal growing temperatures are 60 - 75 F. Harvesting begins in mid-May subsequent cuttings go through early October.

Irrigation: Most alfalfa is irrigated by either furrow (30 inch row widths), wheel-line or center pivot sprinkler irrigation systems. Growers using center pivot irrigation recommend adding 1.0 - 1.5 inches of water every week to ensure deep root growth. Irrigation should be based on crop water use and precipitation. Avoid letting the soil moisture drop below 50% available water.

Fertilization: Ten to twenty lb. of nitrogen must be added at planting if the soil is deficient. Add and incorporate phosphorous depending on soil test results. Organic producers suggest animal manure, green manure or compost as adequate substitutes for fertilizer.

Harvest: Alfalfa should be harvested at the late bud to early bloom (10% bloom) stage for premium hay. Delaying harvest will reduce the hay quality. Taking the first cutting early will control weevil problems. In fall-planted alfalfa, first harvest occurs in late May to June, depending on the region and time of planting. Subsequent harvests are approximately every 28 days, as long as the late bud to early bloom stage of development has been reached (second harvest usually in July, third harvest September 1 - 15). The last harvest of the season should be at least two weeks before the first killing frost. At high elevations, 8 - 14 drying days are needed between cutting and baling the hay. Rain events during curing will reduce hay quality.

Alfalfa stands usually last 4 - 5 years, 5 -10 years in Southwest Colorado. After the last cutting of the final growing season, the plants should be plowed into the soil. This improves the soil by adding nitrogen and makes it easier to till for subsequent row crops. Alfalfa should not be planted directly after alfalfa because of auto-toxicity problems and the incidence of severe disease problems. Cultural practices such as rotation are very important in maintaining a perennial crop. An optimal rotation includes three years of alfalfa followed by sweet corn, then beans or potatoes, then grains and back to alfalfa. If a stand has experienced a severe disease problem during the 4 - 5 years, the residues may need
to be destroyed rather than incorporated back into the soil.

**Location of Production**

- **Northwest**
  - Boulder, Eagle, Grand, Gunnison, Larimer, Moffatt, Pitkin, Rio Blanco, Routt

- **Northeast**

- **Southeast**
  - Arapahoe, Baca, Bent, Cheyenne, Crowley, Elbert, El Paso, Kiowa, Lincoln, Las Animas, Otero, Prowers, Pueblo

- **Southwest**
  - Archuleta, Alamosa, Chaffee, Conejos, Costilla, Custer, Delta, Dolores, Douglas, Fremont, Garfield, Huerfano, La Plata, Mesa, Montezuma, Montrose, Ouray, Rio Grande, Saguache, San Miguel

**Note:** Shaded boxes indicate counties where the crop is grown. Regions have been delineated by Interstates I-70 and I-25.

**Insect Pests**

**Key Insects**
Alfalfa Weevil, *Hypera postica*

One of the most important insect pests that attack alfalfa in Colorado is the alfalfa weevil. At maturity, alfalfa weevil larvae are dark green, 0.38" in length, with a black head and a white stripe down the back. Adult weevils are small, 0.25" in length, brownish-gray snout beetles with a dark brown band down the back. The alfalfa weevil overwinters as an adult in the crowns of the alfalfa plant or under leaves and other debris. Adults emerge in the spring after average temperatures reach 60F. They chew holes in young alfalfa leaves when crop growth begins, but do not lay eggs for several weeks. Then in early April, the female weevils chew holes in alfalfa stems and deposit 1 - 40 eggs in each cavity. The eggs are small and bright yellow, darkening as they mature. Egg hatches in 1 - 2 weeks. The newly-hatched, yellowish-green larvae will feed within the stem for a few days before moving to the opening leaf buds at the tips of the stems. Later, they feed on the leaves of the alfalfa plants. Larvae can usually be found in the field for 1 - 2 months, mostly during May and June. Mature larvae move down the plant or drop to the ground and spin a fragile, lacelike cocoon attached to debris or to the plant. A new adult will emerge after 10 - 12 days. Adults can be found in the field until early fall when they move to their overwintering sites. Alfalfa weevils complete one generation each year. Alfalfa weevil larvae primarily damage the first crop of alfalfa. Pinholes in newly opened leaves are an early sign of damage. As larvae mature, these feeding holes become larger, producing a characteristic ragged or skeletonized appearance of the leaves. Severe damage gives the field a gray or white cast, as if it had been frosted. Adult alfalfa weevils usually cause only minor damage. Signs of their feeding damage include a "feathered" appearance on the leaves and scars on the stems of the alfalfa plants. Both surviving larvae and newly emerged adults may severely damage regrowth after the first cutting.

Army Cutworm, *Euxoa auxiliaris*

Army cutworm is one of several species of caterpillars that attack alfalfa in Colorado. Adult moths are brown with light brown or black markings on the forewings and have a wingspan of about 2". Larvae vary in color from dull green to brown with faint stripes on the back and have brown heads. Army cutworms produce one generation per year. Eggs hatch in the fall with sufficient moisture. Army cutworm larvae spend the winter as partially grown caterpillars. They feed only on warm days in the winter; feeding is more frequent in the spring. Army cutworms always feed above ground during the night and/or on cloudy days. They are found under soil clods and other debris during the day. Cutworm larvae build small pupation chambers several inches below the soil surface. Adult Moths emerge in May and June and migrate to higher elevations in the Rocky Mountains to escape high summertime temperatures. The adult moths, commonly referred to as Miller moths in Colorado, are a nuisance in homes, but do not lay eggs or reproduce in homes. In late summer and early fall the moths return to the plains to lay their eggs in wheat fields and in other cultivated areas not in homes. However, since many of the moths die during the summer, the return flight is less obvious. With adequate moisture, eggs hatch and larvae of the next generation begin feeding as weather conditions permit. Army cutworm caterpillars feed on plant foliage. Their feeding has the most effect on yields when there is relatively little foliage for them to feed on, increasing the likelihood of damage to the crown.

Armyworm, *Pseudaletia unipuncta*
Armyworms occur in eastern Colorado and in the San Luis Valley. Mature larvae are about 1.5" long, smooth-bodied, and dark gray to greenish-black. They are characterized by five stripes running the length of the body, three on the back and two on the sides. Stripes on the back vary in color, whereas the stripes on the sides are pale orange with a white outline. The head capsule is remarkable for its "honeycomb" of black markings. The armyworm is unable to survive Colorado winters. Instead, armyworm moths migrate into Colorado in early summer. They lay their eggs in rows or clusters on the lower leaves of various grass crops. Dense grassy vegetation is preferred for oviposition. Newly hatched larvae move with a looping (inchworm) action. Larvae feed at night and on cloudy days, and hide under crop debris during sunny periods.

Grasshoppers

Grasshoppers follow roughly a 22-year cycle in Colorado, with the last major outbreak occurring in the late 1970s and early 1980s. Grasshoppers vary considerably depending on the species. Grasshopper nymphs have a similar appearance to adults but are smaller in size. Grasshoppers lay eggs in undisturbed areas, usually in late summer and early fall. Small nymphs or "hoppers" hatch the following spring. Winged adults appear 5 - 6 weeks after eggs hatch. A few Colorado grasshopper species have eggs that hatch in late summer and overwinter as nymphs. Winged adults of these species usually appear early in the following summer, often causing undue alarm about unusually early grasshopper activity. Some of these species are important on rangeland, but none are considered a threat to field crops. The usual pattern of grasshopper damage in field crops is for early development to occur in weedy areas of roadsides, fence rows, irrigation ditches, and other non-crop areas. As these food sources are exhausted or begin to dry down, the grasshoppers leave in search of other food - often an irrigated crop. Here they first feed in the field margins and subsequently spread throughout the field. Most field crop damage is caused by the differential, red-legged, two-striped, and migratory grasshoppers.

Pea Aphid and Spotted Alfalfa Aphid, Acyrthosiphon pisum (Harris) and Therioaphis maculata

Pea aphids are more common, but spotted alfalfa aphids can also be of economic concern. Pea aphid has pale green cornicles that are black towards the tip. It is found from March to November and is common throughout the state. Spotted alfalfa aphids are pale yellow, spotted and have very short cornicles. Aphid life cycles vary with species. Pea aphids overwinter as eggs, which are glued on fallen stems and leaves of alfalfa in the fall. After hatching in the early spring, the nymphs feed on the first growth, usually found on the growing tips of the plants. After one or two generations, winged forms are produced which colonize other fields. Asexual reproduction continues through the summer. Later, males are produced, and sexual reproduction produces the overwintering eggs. Aphids have piercing-sucking mouthparts that extract plant sap. Aphid feeding can result in stunting, yellowing, leaf curling, and other physical disorders. In addition, spotted alfalfa aphids inject toxins into plants that can result in leaf vein yellowing. Aphids also secrete droplets of honeydew that interfere with cutting, drying, and baling infested alfalfa. Each species has a different potential for damaging alfalfa, so it is essential to determine which aphids are present in a field.
Additional Insects

Crickets

Foliage feeders are similar to grasshoppers as described previously.

**Alfalfa Caterpillar, Colias eurytheme**

The alfalfa caterpillar is a warm weather pest which occurs sporadically. Natural enemies maintain this insect below economic levels most years. Adults of this pest (alfalfa butterflies) are medium-sized, with yellow or white wings that are solid on the top surface and bordered by black on the lower surface. The wingspan is about 2". Larvae are green, covered with white hairs, and the larger larvae have thin white stripes along the sides of their bodies. Alfalfa caterpillars overwinter as pupae. Females lay eggs singly onto alfalfa less than 1' high. In about one week, the eggs hatch, and the larvae grow rapidly. Within three weeks, they grow to 1" long. Alfalfa caterpillar populations increase in hot, dry weather and with low natural enemy densities. Alfalfa caterpillars consume whole leaves. Damage is worse in newly planted fields, where the plants are too small to withstand much defoliation.

**Blister Beetle, Epicauta spp.**

Several species of blister beetles are prevalent in Colorado. The three striped blister beetle, *E. lemniscata*, tends to be a localized problem in southeastern Arkansas Valley. Black blister beetle, *E. pennsylvanica*, and spotted blister beetle, *E. maculata*, are more widespread. Blister beetles that exhibit swarming behavior are of the greatest concern because of the greater risk of a large number of beetles getting trapped in a small amount of hay. Of the species named above, the only swarming type is the three striped blister beetle. Most species of blister beetles have one generation per year. Adults emerge from the soil throughout the growing season, but periods of peak activity vary. Adults feed on flowers and foliage. Blister beetles are highly toxic to horses and poultry. They are occasionally trapped or crushed by the crimper and retained in hay during alfalfa harvest. The old harvest method of cutting the hay and allowing it to dry before bailing allows beetles to escape. Most problems can be avoided by cutting the hay early, specifically before bloom. Blister beetles are attracted to flowers; therefore, populations do not build up in the alfalfa. No economic level has been established for blister beetles, but if beetle swarms are noted in the field and the crop is destined for horses, an insecticide treatment such as Sevin or other carbaryl insecticides may be justified. Generally, blister beetles are controlled by harvest management.

**Flea Beetles: Potato Flea Beetle, Three-spotted Flea Beetle, Pale Striped Flea Beetle and Tuber Flea Beetle, Epitrix cucumeris, Disconycha triangularis, Systena blanda and E. tuberis**

Adult flea beetles are typically small, often shiny, and have large rear legs that allow them to jump like a flea when disturbed. Flea beetles overwinter in the adult stage hidden under leaves, dirt clods, or in other
protected sites. They become active during warm days in mid spring but may straggle out over several weeks. Many flea beetles are strong fliers and seek out emerging host plants that they locate by chemical clues the plants produce. Adults feed for several weeks. Soon thereafter, females intersperse feeding with egg laying. They lay eggs in soil cracks around the base of the plants. The minute, wormlike larvae then move to feed on small roots and root hairs. The larval stage is completed in about a month. The insects pupate and emerge from the soil as adults. There may be a second generation during the summer and, with a few species, a third generation. Flea beetles produce a characteristic injury known as "shot-holing" in which the adults chew many small holes or pits in the leaves, making them look as if a fine buckshot has damaged them. Young plants and seedlings are particularly susceptible. Growth may be seriously retarded and plants even killed. Although flea beetles are common, injuries are often insignificant to plant health. On established plants, 10 - 20% or more of the leaf area must be destroyed before there are any negative yield effects.

**Lygus Bugs, *Lygus spp.***

Alfalfa is the preferred host plant for many species of lygus bug. Lygus bug is a term given to a group of insects that are related and have similar appearance and life cycles. These insects feed primarily on flowers and developing seed, but can damage alfalfa leaves. Lygus bugs are green to brown with black and yellow markings. They are roughly 0.25" long and have a triangular patch on the back between the wings. They overwinter as adults in debris. Lygus bugs inject toxic saliva as they feed and cause alfalfa seed to shrivel. Seed fields are checked once a week for lygus bugs and their predators. Spray decisions are made on number of insects counted sweep net samples and insecticides such as Dibrom (naled) applied during bloom and seed maturation to bring lygus bug populations to less than four bugs per sweep. Late-season lygus sprays do little to prevent damage to final seed crop.

**Two-spotted Spider Mite, *Tetranychus urticae***

Adult females are pale to dark green with conspicuous dark spots on each side. Food particles showing through the transparent body wall cause these darkened areas. Eggs are spherical, clear and colorless when first laid, becoming opaque and turning ivory just before hatching. Newly hatched larvae are initially colorless and become green after feeding. Individuals from both nymphal stages are green to pale yellow. Adult females usually overwinter on the host plant or in nearby debris. Overwintering females are pale orange to straw-colored and active, though they do not produce eggs during the winter. Two-spotted spider mites usually begin colonies on the undersides of plant leaves. Webbing is visible to the naked eye and all stages of mite development occur in and beneath the webbing. Many female mites may be present on each infested leaf. Small colonies usually begin near a leaf vein, and with favorable weather, spread rapidly to nearby leaves and plants. Development from egg to adult requires 5 - 15 days. Feeding usually takes place on lower leaf surfaces, though upper leaf surfaces are occasionally infested. Light to moderate infestations on lower leaf surfaces can be detected by a marked stippling on upper leaf surfaces. As feeding continues and the mite population increases, leaf color becomes lighter as a result of chlorophyll removal from leaf tissue. Heavily damaged leaves turn yellow and have a "fired" appearance. Optimum temperatures for two-spotted spider mites are 86 - 90F and less than 50% relative humidity. In Colorado, they occur in more humid growing areas such as along river bottoms. Miticide
treatments such as Onager (hexythiazox) are prescribed if the level of infestation increases above economic thresholds. Effective control is obtained by spraying before extensive webbing and covering leaves completely with the spray. Miticides and insecticides are not tank mixed due to harmful effects on pollinators and natural enemies. Some pyrethroid insecticides are particularly harmful to the beneficial insects thus allowing spider mite numbers to explode to high levels in a very short time.

**Key Insect Management Strategies**

**Cultural Controls**

Damage to the crop can be abated by cutting (harvesting) the plant; this will break the cycle of the pest and no chemical pest control may be needed. For instance, alfalfa weevil can be controlled by timely harvest, and insecticide applications with azinphos-methyl, carbaryl, carbofuran, chloropyrifos, cyfluthrin, lambda cyhalothrin, methomyl, or permethrin that are based on economic thresholds, if needed.

Blister beetles are controlled by harvest management, pea aphids can be controlled by resistant cultivars and army cutworms and grasshoppers are controlled by insecticide such as chloropyrifos or ethyl parathion applications based on economic thresholds.

Stem nematodes pose an occasionally severe problem on flood ground; they can be controlled by rotating with crops that are not hosts to nematodes, and by water management.

**Insecticides - Alfalfa grown for Seed**

**Pesticide: hexythiazox (Onager 2E)**

- Target Pests: Spider Mites
- Recommended rate: 1.5-2.0 oz ai/A (6-8 oz product/A)
- Comments: Preharvest Interval 28 days; 24c registration for seed alfalfa

**Pesticide: methidathion (Supracide 2E)**

- Target Pests: Alfalfa weevil, Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid, Leafhoppers, Lygus Bugs
- Recommended rate: 8-16 fl oz ai/A (2-4 pt product/A)
- Comments: Preharvest Interval 28 days; 24c registration for seed alfalfa

**Pesticide: naled (Dibrom 8 Emulsive)**

- Target Pests: Lygus Bugs
• Recommended rate: 9.92-14.88 fl oz ai/A (1.0-1.5 pt product/A)
• Comments: 24c registration for seed alfalfa

Insecticides -

Pesticide: azinphos-methyl (Guthion)

• Target Pests: Alfalfa weevil
• Recommended rate: 4-8 oz ai/A (10.7-21.3 oz product/A)

Pesticide: carbaryl (Sevin XLR Plus)

• Target Pests: Alfalfa weevil, Alfalfa caterpillar, armyworm, cutworms, lygus bugs
• Recommended rate: 20 oz ai/A (48 oz product/A)
• Comments: Preharvest interval 7 days, Extremely hazardous to bees
• Use Data: 1997= rate used- 1.2 lb ai/A
  1% of total acres treated

Pesticide: carbofuran (Furadan 4F)

• Target Pests: Alfalfa weevil, Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid, grasshoppers, lygus bugs
• Recommended rate: 0.96-7.04 oz ai/A (0.12-1.0 lb. product/A)
• Comments: Preharvest Interval 7-28 days depending on rate.
• Use Data: 1992= rate used- 0.43 lb ai/A
  18% of total acres treated
  1997=rate used- 0.34 lb ai/A
  8% of total acres treated

Pesticide: chlorpyrifos (Lorsban 4E)

• Target Pests: Alfalfa weevil, alfalfa caterpillar, pea aphid, spotted alfalfa aphid, blue alfalfa aphid, armyworm, cutworms, grasshoppers, leafhoppers
• Recommended rate: 1.7-7.2 oz ai/A (0.25-1.0 lb. products/A)
• Comments: Preharvest Interval 14 days (0.5-1.0 lb.), 21 days (0.5 lb.)
• Use Data: 1992= rate used- 0.67 lb ai/A
  10% of total acres treated
  1997= rate used- 0.62 lb ai/A
  3% of total acres treated

Pesticide: cyfluthrin (Baythroid 2)
- Target Pests: Alfalfa weevil (higher rates), Army cutworms
- Recommended rate: 0.013-0.044 fl oz ai/A (0.8-2.8 fl oz product/A)
- Comments: Preharvest interval 7 days
- Use Data: 1997= rate used- 0.04 lb ai/A
  2% of total acres treated

Pesticide: **dimethoate** (Dimethoate)

- Target Pests: Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid, grasshoppers, crickets
- Recommended rate: 3.48-6.96 fl oz ai/A (0.5-1.0 pt product/A)
- Comments Preharvest Interval 10 days.
- Use Data: 1992= rate used- 0.31 lb ai/A
  1% of total acres treated
  1997= rate used- 0.20 lb ai/A
  1% of total acres treated

Pesticide: **ethyl parathion** (Parathion 8 EC)

- Target Pests: Alfalfa Caterpillar, Alfalfa Weevil, Spotted Alfalfa Aphid, Armyworm, crickets, grasshoppers, Lygus bugs, spider mites, leafhoppers, cutworms
- Recommended rate: 1.74-3.48 fl oz ai/A (0.25-0.50 pt product/A)
- Comments: Preharvest Interval 15 days.
- Use Data: 1992= rate used- 0.50 lb ai/A
  1% of total acres treated
  1997= rate used- 0.50 lb ai/A
  1% of total acres treated

Pesticide: **lambda cyhalothrin** (Warrior)

- Target Pests: Alfalfa weevil, Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid, Army cutworm
- Recommended rate: 0.16-0.48 oz ai/A (1.92-3.84 fl oz product/A)

Pesticide: **malathion** (Malathion 5E)

- Target Pests: Alfalfa weevil, Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid, grasshoppers, crickets, potato leafhoppers
- Recommended rate: 9.12-11.4 oz ai/A (1-1.25 lb product/A)

Pesticide: **malathion** (Malathion ULV)

- Target Pests: grasshoppers, crickets
Recommended rate: 7.76 fl oz ai/A (8 fl oz product/A)
Comments: Preharvest Interval 7 days
Use Data: 1997= rate used- 1.0 lb ai/A
1% of total acres treated

Pesticide: **methomyl** (Lannate LV)

- Target Pests: Alfalfa weevil, alfalfa caterpillar, Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid
- Recommended rate: 1.16-4.64 oz ai/A (0.5-1.0 lb product/A)
- Comments: Preharvest Interval 7 days

Pesticide: **methyl parathion** (Methyl Parathion 4E)

- Target Pests: Alfalfa weevil, alfalfa caterpillar, Pea Aphid, Spotted Alfalfa Aphid, Blue Alfalfa Aphid, grasshoppers, crickets, potato leafhoppers
- Recommended rate: 1.8-7.0 fl oz ai/A (0.5-2.0 pt product/A)
- Comments: Preharvest Interval 15 days
- Use Data: 1992= rate used- 0.50 lb ai/A
  1% of total acres treated
  1997= rate used- 0.90 lb ai/A
  1% of total acres treated

Pesticide: **permethrin** (Ambush 25W; Pounce 3.2E)

- Target Pests: Alfalfa weevil, alfalfa caterpillar, pea aphid, spotted alfalfa aphid, blue alfalfa aphid, army cutworm
- Recommended rate: 0.8 - 3.2 oz ai/A (3.2-12.8 oz product/A)
- Comments: Preharvest interval 14 days for rates higher than 0.1 lb

Pesticide: **permethrin** (Mustang)

- Target Pests: Alfalfa weevil, alfalfa caterpillar, pea aphid, spotted alfalfa aphid, blue alfalfa aphid, army cutworm
- Recommended rate: 0.41-0.74 fl oz ai/A (2.4 - 4.3 fl oz product/A)
- Comments: Preharvest interval 3 days for cutting or grazing and 7 days for harvesting seed
- Use Data: 1992= rate used- 0.15 lb ai/A
  1% of total acres treated
  1997= rate used- 0.20 lb ai/A
  1% of total acres treated

Weeds
Key Weeds

Canada Thistle, *Cirsium arvense*

Canada thistle, a member of the Sunflower family, was introduced from Europe. It is a creeping perennial which reproduces by seed and fleshy, horizontal roots. Canada thistle is on the Colorado noxious weed list and is designated as one of the top ten most widespread weeds causing the greatest economic impact to the State of Colorado. Stems are erect, hollow, smooth and slightly hairy, 1 - 5' tall, simple, and branched at the top. The leaves are set close on the stem, slightly clasping, and dark green. Leaf shape varies widely from oblong to lance-shaped. There are numerous sharp spines on the outer edges of the leaves, branches and main stem. The flowers are small and compact, about 0.75" or less in diameter, and light pink to rose-purple in color, occasionally white. The seed are oblong, flattened, dark brown, and approximately 0.125" long. Canada thistle emerges in April or May in most parts of Colorado. Infestations are found in cultivated fields, riparian areas, pastures, rangeland, forests, lawns, gardens, roadsides, and waste areas. Because of its seeding habits, vigorous growth, and extensive underground root system, control or eradication is difficult. It establishes easily in new alfalfa fields and is difficult to control with current available herbicides. It is distributed across Colorado in elevations ranging from 4,000 - 9,500'. Canada thistle should be cleaned up before planting alfalfa because alfalfa seed does not establish well in Canada thistle patches.

Blue Mustard, *Chorispora tenella*

Blue mustard, member of the Mustard family, is a winter annual. Blue mustard is on the Colorado noxious weed list. Seed germinates in late summer and fall. The plant overwinters as a rosette. The flower stalk usually elongates in March. The flowers are bluish-purple to purple and appear in early April. Viable seed can be produced approximately 10 days after bloom.

Curly Dock, *Rumex crispus*

Curly Dock, a member of the Buckwheat family, is a perennial weed. It forms a rosette the first year, develops a large tap root and sends up a stem that grows 2 - 5' tall. Flowers are dense and green, growing in spike-like terminal and axillary clusters. Curly dock is easily recognized because flower stalks and sometimes entire plants turn reddish brown when mature. It is normally a weed of pastures and other non-tilled areas. Tillage helps control the plant. It has become a problem in alfalfa in recent years.

Dandelion, *Taraxacum officinale*

Dandelion, a member of the Sunflower family, is a weed of alfalfa fields. The pappus, a specialized seed structure attached to the seed, carries it long distances. Flowering can occur almost nine months of the year. It is a perennial with a large taproot. It reproduces by seed and by new shoots that sprout from the root crown. It establishes easily in new alfalfa fields and is difficult to control with current available
herbicides. It is most common on moist sites. Therefore, irrigation water management plays an important role in controlling dandelion in alfalfa.

**Dodder, Cuscuta spp.**

Dodder, member of the Morning-glory family, are the only economically important parasitic plant in Colorado. It is an annual with colorless flowers that produce very small, light seed. Flowering is from July to October. It tolerates wet sites and often seed are carried to fields through irrigation water. Each species of dodder has a specific host. Dodder plants are yellow because they have no chlorophyll, and therefore cannot produce their own food; they are completely dependent on their host plants for nutrition and survival. Dodder is commonly a problem in alfalfa, and is a serious problem in seed alfalfa.

**Downy Brome, Bromus tectorum**

Downy brome, a member of the Grass family, is an annual or winter annual introduced from Europe. Downy brome is on the Colorado noxious weed list. It usually germinates in the fall, lies dormant, and produces seed early in the spring. It has smooth, slender, erect stems. The plant grows 4 to 30 inches tall from a much-branched base. The sheathes and leaves are covered with fine, soft hairs. Leaves are one eighth to one quarter of an inch wide and flat. Seed heads are branched and somewhat drooping. Seed are long and flat with an awn about as long as the seed. Downy brome matures and sets seed in early spring, before most other grass species or crops. It is a strong invader and creates a serious fire hazard when mature plants dry. Mature plants turn purple or brown. It is widely distributed in Colorado from 4,000 - 9,000' in elevation and can be a serious problem in alfalfa, especially dryland alfalfa.

**Flixweed, Descurainia sophia**

Flixweed, member of the Mustard family, is very similar to, and often confused with tansy mustard, D. pinnata. Flixweed is on the Colorado noxious weed list. It is an introduced annual or winter annual which reproduces by seed. Stems are erect, branched, and 4 - 30" high. Leaves are alternate, 2 - 4" long, dissected to give a lacy appearance. The stem and leaves are covered with fine hairs. Flowers are small, pale yellow, and grow in small clusters at the tips of elongated racemes. Seed pods are 0.25 - 0.75" long and on a stalk. Flixweed is widely distributed and is one of the first weeds to appear in spring. Most of the *Decurainia* in Colorado is flixweed. It is scattered across Colorado up to 8,000' in elevation. Flixweed is a major invader of irrigated or dryland alfalfa and very often is a contaminant at the first cutting.

**Pigweed, Amaranthus spp.**

Pigweed, member of the Amaranth family, are weed pests in several cropping systems. *A. hybridus*, smooth pigweed, was the first triazine resistant plant documented. *A. retroflexus*, redroot pigweed is probably Colorado's most common species. *A. lividus*, is a prostrate species with a notch in the tip of the
leaf. *A. spinosus*, spiny amaranth, has sharp, strong spines on the stem. *A. graecizans*, prostrate pigweed, breaks off at the ground line and being round shaped is blown around by the wind. It is a real problem in Southwestern Colorado. Redroot pigweed is ALS herbicide resistant. Pigweed is a major weed in new seedings.

**Shepherdspurse, Capsella bursa-pastoris**

Shepherdspurse has a slender, flexible, slightly hairy, white taproot, from which arises a basal rosette quite similar to that of a dandelion. Shepherdspurse is on the Colorado noxious weed list. The rosette generally grows to be 4" to 8" in diameter. The basal leaves are stalked, and the first leaves are usually rounded, while the later leaves are deeply toothed but may be rather variable. Smaller, slightly toothed, alternate leaves clasp the flower stalk, which generally reaches 6" to 18" high. White flowers are produced in clusters at the top of the stalk and are self-fertilizing. Flowering occurs from early spring through early winter. Each flower develops into a heart-shaped, two-celled seedpod containing a number of tiny seed. It is particularly a problem in Southwestern Colorado.

**Tansy Mustard, Descurania pinnata**

Tansy mustard, member of the Mustard family, is a native winter annual, 4 - 32" tall. The plant is covered with fine hairs. The stem is erect, branched and 4 - 30" high. The flowers are small, pale yellow, and occur in small clusters at the tips of elongating racemes. Leaves are alternate and pinnately dissected, 2 - 4" long. Tansy mustard has stellate pubescence and racemic inflorescences. Petals are yellow, yellowish-green to cream. Pods are linear with two rows of seed in each seed pod. Tansy mustard spreads by seed from early to late summer. It is dispersed throughout Colorado up to 8,000' in elevation.

**Additional Weeds**

**Barnyardgrass, Echinochloa crusgalli**

Barnyardgrass, member of the Grass family, is an annual that prefers wet sites. It is not usually a problem in well-drained cultivated fields but can grow heavily around irrigation pipe leaks and other wet spots in the field. It is a vigorous, warm season annual grass reaching 1 - 5' in height. Many stem bases are reddish to dark purple. Leaf blades are flat, broad, smooth, and without a ligule or auricle at the junction of sheath and blade. Seed are the only source of reproduction. It flourishes in warm conditions.

**Common Lambsquarters, Chenopodium album**

Common lambsquarters, member of the Goosefoot family, was introduced from Europe. It reproduces by seed. The stem is erect, stout, smooth, grooved, often striped with pink or purple, branched and grows 1 - 6' high. Lower leaves are alternate and ovate. Upper leaves are also alternate, but are more narrow.
The flowers are small, green, and crowded in the axils and at the tips of the stems and branches. Common lambsquarters is a succulent, fast-growing plant which rapidly removes moisture from the soil. Lambsquarters can be a problem in new seedings.

**Field Bindweed, *Convolvulus arvensis***

Field bindweed, member of the Morning-glory family, is a creeping perennial introduced from Europe. It reproduces by seed and horizontal roots. Field bindweed is on the Colorado noxious weed list and designated as one of the top ten most widespread weeds causing the greatest economic impact to the State of Colorado. The stems are smooth, slender, slightly angled, 1 - 4' long, and spread thickly over the ground or wind around erect plants or other objects. The leaves are alternate, 1 - 2" long, with great variation in shape. They are somewhat arrow-shaped with spreading, pointed, or blunt lobes at the base. The flowers are bell or trumpet-shaped, white, pink, or variegated, and about 0.75 - 1" broad. Flowering season is from June to September. It is one of the most competitive perennial weeds. A two or three-year food supply is stored in the extensive underground root system. This makes it hard to kill by cultivation because roots will live as long as their food reserve lasts. Seed can also stay viable in the soil for up to 40 years. It is widespread in cultivated and uncultivated areas, pastures, lawns, gardens, roadsides, and waste areas throughout Colorado from 4,000 - 8,000' in elevation. Control through both chemical and cultural practices should be done before planting alfalfa.

**Foxtail Barley, *Hordeum jubatum***

Foxtail barley, member of the Grass family, is a native, short-lived perennial that is very opportunistic, but not highly competitive with other dominant species. Foxtail barley spreads by seed and grows in dense bunches with shallow fibrous roots. Bunches can expand over time to an 8" diameter for a single plant. The stems (growing from 6" - 2' tall) are smooth and usually erect. Leaves are erect, rough, narrow, flat or U-shaped, gray-green, 2 - 5" long, and 0.25 - 0.5" wide. The pale green heads, or spikes, are 2 - 4" long and nodding, with spreading, slender, barbed awns that are 1 - 2.5" long. Nodding heads are an identifying characteristic of the plant. The mature head is yellow, sometimes with a slight red highlight, and breaks up readily into three spikelet clusters of which only one is fertile. The seed are yellow, hairy at the tip, and about 0.125" long. Foxtail barley acclimates well to a wide array of environmental conditions, allowing for a broad geographical distribution. Colorado infestations have been found at elevations from 3,400 - 10,000'. Typical of many grasses, foxtail barley prefers fertile, wet, non-alkaline soils. However, infestations can be found under many conditions. It is most common on moist sites. Irrigation water management plays an important role in controlling foxtail barley in alfalfa.

**Green Foxtail, *Setaria viridis***

Green foxtail, member of the Grass family, is on the Colorado noxious weed list. Other characteristics distinguishing it from other foxtail species include: shorter than other foxtails, roughened leaf sheaths, lack of hairs, and smaller seed than other foxtails. Seed are broadly oval, green and found in spike-like
panicles that are 1 - 4" long. Green foxtail is native to Eurasia, but common throughout most of North America. Green foxtail is responsible for reductions in yields, increased seed cleaning costs, and expensive control measures. Flowering and seed production are in July, August and September. Green foxtail can be a problem in new seedings.

**Kochia, Kochia scoparia**

Kochia, a member of the Goosefoot family, is native of Eurasia. It is an annual, reproducing solely by seed. Kochia is on the Colorado noxious weed list. Flowering season is from July to October. Stems are erect, round, slender, pale green, branched, and 1 - 6' tall. Leaves are narrow, bright green, hairy, numerous and are attached directly to the stem. Upper leaves are more narrow than lower leaves. Flowers are inconspicuous in the upper leaf axils. Seed are about 0.063" long, wedge-shaped, dull brown, and slightly ribbed. Kochia can be found throughout Colorado up to 8,500' in elevation. It has become a major problem on roadides, waste areas, and non-cultivated fields. In the fall, plants become red, later turning brown and breaking away from the root, causing them to tumble over the ground scattering large amounts of seed. Many kochia populations in Colorado are resistant to sulfonylurea, imidazolinone, triazine and benzoic acid herbicides, representing three very different modes of action. Therefore, care should be taken when using herbicides to control kochia. Some alternative herbicides include: fluroxypyr, bromoxynil, MCPA ester, isoxaflutole, pyridate, flufenacet, fomesafen, glyphosate, lactofen and clomazone.

**Quackgrass, Elytrigia repens**

Quackgrass, member of the Grass family, is an aggressive perennial reproducing by seed or spreading by a shallow mass of long, slender, branching rhizomes. Quackgrass is on the Colorado noxious weed list. Rhizomes are usually yellowish-white, sharp-pointed, somewhat fleshy. These rhizomes are effectively spread by tillage, increasing the distribution of the population in a field. They are able to penetrate hard soil or even tubers and roots of other plants. Stems are erect and usually 1 - 3' tall. Leaf blades are 0.25 - 0.5" wide, flat pointed and have small auricles at the junction of blade and sheath. Leaf sheaths and upper leaf blade surfaces are thinly covered with soft hairs. Spikelets are arranged in two long rows, flat wise to the stem. Florets either are awnless or have short, straight awns. Tillage is an effective control by depleting food reserves and bringing rhizomes to the surface.

**Russian Thistle, Salsola iberica and S. collina**

Russian thistle, member of the Goosefoot family, was introduced from Russia. It is an annual and reproduces by seed. It is on the Colorado noxious weed list. It is a round, bushy, branched plant growing 1 - 3.5' high. The branches are slender, succulent when young, and woody when mature. The first leaves to develop are alternate, dark green, soft, slender, and 1 - 2.5" long. These senesce early and new leaves form which are alternate, short, stiff, spiny, and not over 0.5" long, with two sharp-pointed bracts at the base. The flowers are small, inconspicuous, green-white or pink, and are usually solitary in the leaf axils. Seed are conical and 0.063" in diameter. Russian thistle grows in dry plains, cultivated fields, roadsides,
and waste areas, primarily in grain-growing areas of the state. At maturity, the plant breaks off at the base. Its round shape allows it to tumble, scattering seed for long distances. It is widespread over Colorado in elevations up to 8,500'.

**Sandbur, Cenchrus pauciflorus**

Sandbur, member of the Grass family, is a warm season annual with tufted stems. It grows 8" - 3' tall, occasionally erect, but usually spreading horizontally and forming dense mats. Leaf sheaths are flattened, very loose, and smooth with hairy margins. Burs are thickly set with stiff, sharp, spreading spines. They usually contain two light brown, oval to oblong seed.

**Yellow Foxtail, Setaria glauca (lutescens)**

Yellow foxtail, member of the Grass family, is a tufted annual, 1 - 3' tall, with erect stems that branch at the base. Yellow foxtail is on the Colorado noxious weed list. The leaf blade is smooth 0.125 - 0.375" wide with distinct hairs on leaf margins near the base. Flowers are borne in a cylindrical panicle with crowded spikelets that are subtended by 6 - 10 yellow bristles. Seed are broadly oval, green to yellow to dark brown, coarsely roughened and approximately 0.125" long. Flowering and seed production occur July to September. Yellow foxtail can reduce yields, increase seed cleaning costs, and can be expensive to control. Yellow foxtail can be a problem in new seedings.

**Key Weed Management Strategies**

**Cultural Controls**

Weeds can generally be controlled by following good cropping practices. Planting alfalfa into grain stubble in late summer/early fall prohibits significant weed establishment, and a good stand of alfalfa will choke out many annual weeds. Canada thistle can be controlled by regular alfalfa harvests. Leaving standing water in the field, however, will encourage weed infestation, so proper irrigation scheduling is important. As with all weeds, inter-planting and healthy stands helps alfalfa compete with weeds.

**Herbicides - Alfalfa grown for Seed**

Pesticide: **DCPA** (Dacthal)

- Target Pests: dodder, barnyardgrass, lambquarters, green and yellow foxtail, sandbur
- Recommended rate: 120-156 oz ai/A (10-13 lb. product/A)
- Comments: **24(c) registration** as a Pre surface treatment

Pesticide: **imazamox** (Raptor)
- Target Pests: thistle, dandelion, dodder, brome, kochia, pigweed, flixweed, barnyardgrass, lambquarters, barley, foxtail, quackgrass
- Recommended rate: 0.48-0.73 oz ai/A (4-6 oz product/A)
- Comments: Pre Harvest interval of 30 days; **24 (c) registration**

**Pesticide: pronymide (Kerb50)**

- Target Pests: Dodder, Foxtail barley
- Recommended rate: 8-32 oz ai/A (1.0-4.0 lb. product/A)
- Comments: **24 (c) registration** and Applied in fall/winter before ground freezes

**Herbicides - General**

**Pesticide: 2,4-DB (Butyrac 200)**

- Target Pests: Curly dock, pigweed, lambquarters, russian thistle
- Recommended rate: 8.32-24.96 fl oz ai/A (1-3 qt product/A)
- Comments: Pre Harvest Interval of 30 days
- Use Data: 1992= rate used- 0.50 lb ai/A
  - 1% of total acres treated
- 1997= rate used- 1.50 lb ai/A
  - 1% of total acres treated
- 2001= rate used- 1.50 lb ai/A
  - 1% of total acres treated

**Pesticide: benefin (Balan DF)**

- Target Pests: annual grasses and broadleaf weeds
- Recommended rate: 19.2-24 oz ai/A (2.0-2.5 lb. product/A)
- Comments: Pre Plant Treatment
- Use Data: 1997= rate used- 1.35 lb ai/A
  - 1% of total acres treated
- 2001= rate used- 1.35 lb ai/A
  - 1% of total acres treated

**Pesticide: bromoxynil (Buctril)**

- Target Pests: kochia, pigweed, blue mustard, common lambquarters, russian thistle
- Recommended rate: 5.3-8.0 fl oz ai/A (1.0-1.5 pt product/A)
- Comments: Post Treatment

**Pesticide: clethodim (Select 2 EC)**
- Target Pests: actively growing grasses, not effective on foxtail barley
- Recommended rate: 1.58-4.22 fl oz ai/A (6-16 fl oz product/A)
- Comments: Pre Harvest Interval of 15 days

Pesticide: **diuron** (Karmex DF)

- Target Pests: Tansy Mustard, Flixweed
- Recommended rate: 12.8 oz ai/A (1 lb. product/A)
- Use Data: 1997= rate used- 1.20 lb ai/A
  1% of total acres treated
- 2001= rate used- 1.20 lb ai/A
  1% of total acres treated

Pesticide: **EPTC** (Eptam 7E)

- Target Pests: annual grasses and broadleaf weeds
- Recommended rate: 31.6-63.2 fl oz ai/A (2.25-4.5 pt product/A)

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Pesticide: **glyphosate** (many)

- Target Pests: Canada thistle, quackgrass
- Recommended rate: Pre harvest treatment (41% ai)
- Comments: Pre harvest Interval of at least 36 hours, one application per year

Pesticide: **hexazinone** (Velpar L)

- Target Pests: blue mustard, lambquarters, flixweed, foxtail, quackgrass
- Recommended rate: 8-16 fl oz ai/A (1-2 qt product/A)
- Pesticide: **hexazinone** (Velpar DF)
- Target Pests: flixweed, blue mustard, lambquarters, tansy mustard, green and yellow foxtail
- Recommended rate: 8-16 oz ai/A (0.66-1.33 lb product/A)
- Use Data: 1992= rate used- 0.46 lb ai/A
  4% of total acres treated
- 1997= rate used- 0.50 lb ai/A
  3% of total acres treated
- 2001= rate used- 0.50 lb ai/A
  3% of total acres treated

Pesticide: **imazethapyr** (Pursuit DG)
• Target Pests: newly emerged weeds (primarily Pigweed, Kochia, Green and yellow foxtail)
  • Recommended rate: 0.75-1.5 oz ai/A (1.08-2.16 oz product/A)
  • Use Data: 1997= rate used- 0.11 lb ai/A
    1% of total acres treated
  2001= rate used- 0.11 lb ai/A
    1% of total acres treated

Pesticide: metribuzin (Sencor 4)

• Target Pests: kochia, pigweed, tansy mustard, flixweed, barnyardgrass, common lambquarters, green and yellow foxtail, russian thistle
  • Recommended rate: 3.3-13.1 fl oz ai/A (0.5-2.0 pt product/A)

Pesticide: metribuzin (Sencor 75DF)

• Target Pests: kochia, pigweed, tansy mustard, flixweed, barnyardgrass, common lambquarters, green and yellow foxtail, russian thistle
  • Recommended rate: 4-16 oz ai/A (0.33-1.33 lb product/A)
  • Comments: Pre harvest Interval of 28 days; Tank mix with paraquat (Gramoxone)

Pesticide: paraquat (Gramoxone Extra)

• Target Pests: annual grasses and some broadleaf weeds
  • Recommended rate: 9.5-11.8 fl oz ai/A (1.6-2.0 pt product/A)
  • Comments: Pre Harvest Interval of 42 days, Applied with surfactant for effective control
  • Use Data: 1992= rate used- 0.60 lb ai/A
    1% of total acres treated
  1997= rate used- 0.50 lb ai/A
    1% of total acres treated
  2001= rate used- 0.50 lb ai/A
    1% of total acres treated

Pesticide: sethoxydim (Poast)

• Target Pests: grassy weeds, not effective on foxtail barley
  • Recommended rate: 7.2 fl oz ai/A (2.5 pt product/A)

Pesticide: sethoxydim (Poast Plus)

• Target Pests: grassy weeds, not effective on foxtail barley
  • Recommended rate: 7.8 fl oz ai/A (3.75 pt product/A)
  • Use Data: 1992= rate used- 0.24 lb ai/A
Pesticide: **terbacil** (Sinbar)

- Target Pests: dandelion, downy brome, tansy mustard, flixweed, barnyardgrass, lambquarters, flixweed, foxtail
- Recommended rate: 6.4 -12.8 oz ai/A (0.5-1.0 lb. product/A)
- Comments: Use in established alfalfa

Pesticide: **trifluralin** (Trifluralin; Trifluralin 4EC)

- Target Pests: downy brome, kochia, pigweed, sandbur, barnyardgrass, lambquarters, foxtail, russian thistle
- Recommended rate: 10.3-13.7 fl oz ai/A (1.5-2.0 pt product/A)
- Comments: sugarbeets, red beets, spinach, corn, oats, and other grass crops should not be rotated in after application.
- Use Data: 1992= rate used- 1.17 lb ai/A
  1% of total acres treated
  1997= rate used- 1.60 lb ai/A
  1% of total acres treated
  2001= rate used- 1.60 lb ai/A
  1% of total acres treated

### Critical Pest Management Issues

Alfalfa weevils are treated chemically, but not many other pests are.

Cutting the alfalfa is the most effective way to control most diseases.

Dodder, a parasitic weed, causes problems in areas where alfalfa is grown for seed.

ALS herbicide resistance can be selected for very quickly, even after two applications. More commonly, population pressure due to consecutive applications or continuous production of the same crop year after year using only ALS herbicides selects for resistance. In many situations, resistance is selected for along right-of-ways and then resistant biotypes move into agricultural fields. It is important to rotate not only herbicides when controlling weeds, but also herbicide modes of action to prevent future cases of herbicide resistance.
Weeds, diseases, and insects can all develop resistance over time to pesticides. When the same pesticide is used consecutively over a period of time, the target pest can become resistant to that pesticide and render the pesticide obsolete.

### Diseases

#### Key Diseases

**Alfalfa Mosaic alfamovirus, (AMV)**

Alfalfa mosaic virus can be introduced to a field by seed or by pollen from infected plants fertilizing healthy plants. At least fourteen different species of aphids can transmit AMV by feeding on infected plants then subsequently feeding on healthy plants. The virus can also be transmitted by grafting, but not by contact between plants. Typically in alfalfa, a yellow or light-green interveinal mottling and yellow streaks parallel to the leaf veins appear in young developing leaves during cool weather. Infected leaves often become distorted and stunted. Mosaic-infected plants may die within several weeks to several years. Symptom expression is often masked in hot weather; many infected plants may never show symptoms. The virus is seed-borne and also survives in living alfalfa and other plants such as soybeans, potatoes, dry beans, and sugar beets. There are no chemical controls for AMV. Good management of aphids which are vectors for the disease will help control development and spread of the disease. Viruses can only survive in green tissue or within living plant cells.

**Fusarium Wilt, Fusarium oxysporum f. sp. medicaginis**

Fusarium wilt symptoms are drooping and epinasty (downward twisting) of leaves followed by yellowing, stunting and death. Symptoms may be one sided and progress upward, killing foliage. A cross section of the stem near the base will have characteristic reddish vascular discoloration. Fusarium wilt is favored by high air and soil temperatures and occurs most frequently in temperate areas. This fungus survives in soil and plant debris as mycelium, fungal threads and chlamydospores (survival structures of the fungus). It can also survive in infected weeds. The fungus can survive as a saprophyte indefinitely and is referred to as a soil inhabitant. This fungus can also produce damping-off and seedling blight as well as root rot and crown rot. Control is primarily through use of resistant cultivars. Resistant cultivars are essential for maximum production. Fungicide seed treatments and soil treatments are available.

**Phytophthora Root Rot, Phytophthora megasperma f. sp. medicaginis**

Phytophthora root rot is a serious disease throughout the region and a major cause of seedling death on newly established alfalfa and causes a progressive decline of established stands. It is most damaging on susceptible cultivars and where the soil remains wet due to high clay content, poor drainage, over irrigation or a combination of these. The fungus causes damping-off of seedlings, root rot, and rot of
lower stems. It may also weaken plants making them more susceptible to winter injury during severe winters. Symptoms of root rot are seen first in the above ground parts of the plant as chlorosis, wilting, stunting, necrosis, collapse, reduced yield, and eventual plant death. The affected roots, crown or stem will have darkened lesions and cankers. It is spread through infected transplants or by contaminated soil. It is referred to as a soil inhabitant. Once it is introduced, it is difficult to control. This vascular wilt is confined to the vascular (xylem) tissue and only sporulates at or near the plants surface after the plant dies. The fungus survives as oospores (specialized spores), chlamydospores (survival structures), and mycelium (fungal threads). Good drainage will reduce infection. In fields with moderate to poor drainage, resistant varieties are used along with a fungicide seed or soil treatment.

**Rhizoctonia Stem Canker, *Rhizoctonia solani***

Scattered, round to irregular areas of fungus affected plants are evident in a field. Tan to reddish or dark brown lesions form on the lower stem, crown, and tap roots. If severe, stems and roots are girdled causing the leaves and shoots to turn yellow, wilt and die. Seedlings are killed before or after emergence. The fungus survives for years in the soil as minute, irregular, dark brown-to-black sclerotia (mycelial clusters) or as a saprophyte in plant debris. It also is referred to as a soil inhabitant. *R. solani* was referred to as a "sterile fungus", but it is now known that a few species produce spores. This fungus can produce damping-off and seedling blight as well as root rot and crown rot. Broad spectrum protectant fungicides such as Kocide (copper hydroxide) are available. Microbial pesticides such as *Bacillus, Gliocladium, Aspergillus, Paecilomyces,* and *Trichoderma* spp. have been effective as well in controlling stem rot.

**Spring Black Stem, *Phoma medicaginis***

Spring black stem primarily infects the stems but attacks all above ground parts. Disease development is favored by cool, moist weather in the spring and fall. Usually the first cutting is the most damaged. Dark green, water soaked, girdling lesions develop in the stems and petioles, turning dark brown to black with age. The lesions may enlarge and merge until most of the lower parts are blackened. Young shoots may be girdled, turn yellow-to-brown, and die. Numerous small, irregular, dark brown or black spots form on the lower leaves. The lesions enlarge and may merge to cover most of the leaflets. Pycnidia (flask shaped fruiting bodies) will form in the lesions. If severe, the leaves turn yellow, wither and drop prematurely. A crown and root rot may also develop. The fungus survives in diseased plant tissue and may be seed-borne. Although some tolerant hybrids exist, none are resistant. Insects which cause injury to the stem can be controlled to reduce the incidence of *Phoma* in a field. Rotation can reduce the concentration of *Phoma* in the soil. Failure to rotate amplifies the problem in alfalfa.

**Stem Nematode, *Ditylenchus dipsaci***

Stem nematode infests stems and crowns. The most common symptom of stem nematode is an overall stunting. Stems of stunted plants are swollen and distorted. The thickened stems are usually spongy, brittle, and are especially prone to frost damage. They may succumb to only moderate frosts. The stem
nematode also attacks seed, buds, leaves, and can destroy young seedlings if present in large numbers. The nematodes enter through the stomata on the leaves or directly infest the seed. The nematode moves in free water, so infestation and damage are most severe during moist, cool, cloudy periods, when water films persist for extended times. Accordingly, stem nematode is most often a problem in cool valleys under sprinkler irrigation. It is worse in areas that have high clay content (>30%). Stem nematode may present a problem only in the first or possibly the second cuttings, because hot, dry summer weather reduces nematode activity. Crop damage and yield loss from this nematode can be severe nonetheless. Normally, symptoms of stem nematode damage appear in patches of the field, reflecting the patchy distribution of the nematode. Already infected plants may grow out slowly in the spring and continue to have poor growth throughout the season. A very small percentage of the parasitized plants will have one or more stems with leaves that are completely white. This is referred to as "white flagging" and is a useful tool in diagnosing infestations of stem nematode. Nematode infestation begins in one or more stems and, if weather conditions remain favorable, spreads throughout the crown. The nematode persists in the crown throughout the year. The nematode survives in plant debris or in the soil for long periods of time. Stem and bulb nematodes are spread from field to field in infested plant debris or contaminated soil carried by equipment, wind, irrigation water, or animals. Stem nematode predisposes the plant to fusarium and bacterial wilt by feeding and creating wounds close to or in the soil. Resistance is the most common form of control especially in irrigated fields. Prevention can be achieved by using clean seed, avoiding use of contaminated equipment or contaminated water in clean fields, and avoiding manure from cows that have fed on infected hay. Dry soil surfaces are maintained to reduce the spread of the nematode. Rotation with non-host crops on a 2 - 4 year basis should reduce the nematode population in the field.

Additional Diseases

**Bacterial Wilt, Clavibacter michiganense subsp. insidiosum**

Bacterial wilt occurs in poorly drained wet areas. The bacterium is easily spread in the field by equipment, surface water, and microorganisms in the soil. The first sign of bacterial wilt contamination is the death of scattered plants throughout a field, usually starting in the second or third year after seeding. Severely infected plants are stunted and dwarfed, bunchy, and yellow-green to bleached. Such plants are more susceptible to winter-kill. Under moisture stress, young succulent growth wilts and dies. A cut through a diseased tap root or crown reveals a yellow to brown discoloration in the vascular cylinder. The bacterium survives in crop debris or in the soil. It can enter the plant through a variety of wounds. Generally, resistant varieties are used to control this disease.

**Damping off and Seedling Blight, Pythium spp., Fusarium spp., Penicillium spp., and Rhizoctonia solani**

Pre- and post-emergence damping-off and seedling blights occur in alfalfa. Soil-inhabiting fungi cause these diseases. They are characterized by missing or collapsed plants. When pre-emergence damping-off occurs, seedlings fail to break the soil surface. The germinating seed rots while still in the ground. With
post-emergence damping-off, seedlings still in the cotyledon stage will rot at the soil line. The stem appears pinched and plants fall over. Seedling blights occur after true leaves emerge. The developing root system rots and plants collapse. Seedling diseases are problems when soils are cold and wet at or immediately following planting. These conditions can delay germination or stress developing seedlings, which allows pathogens to attack. Crusting caused by poor soil preparation, hard rain, or excessive trash on the surface also contributes to disease. Fungicide seed treatment such as captan and thiram and good soil preparation combined with avoiding cold wet soils are used to manage these diseases.


Most alfalfa plants that are more than two years old show some signs of crown and upper root rot. Symptoms of root and crown rots are seen first in the above ground parts of the plant as chlorosis, wilting, stunting, necrosis, collapse, reduced yield, and plant death. The affected roots, crown or stem will have darkened lesions and cankers. Fungi are the primary organisms associated with crown and upper root rot. Resistance is a common tool for control. Also, controlling nematode feeding can lower the ability of the pathogens to infect.

Verticillium Wilt, *Verticillium albo-atrum* and *V. dahliae*

In alfalfa, wilting and chlorosis are seen in upper leaves (flagging) followed by defoliation and death. This disease produces a characteristic V-shaped lesion on the tip of the leaf. These plants also exhibit vascular discoloration. Stems tend to remain green after leaves die. Verticillium wilt is more prevalent in hotter regions. This fungus survives in soil, plant debris and weeds as specialized structures. They commonly are spread in infected transplants. Control is primarily through use of resistant cultivars. Avoiding contamination by equipment used in an affected field is a useful strategy. Mowing younger fields first before older ones to reduce spore spread and cleaning mowing blades with 10% bleach between field cuttings can be an effective tools as well.

**Key Disease Management Strategies**

**Cultural Controls**

Planting pest resistant varieties of alfalfa is an effective pre-planting technique used to reduce the risk of harmful pest levels. Disease resistant cultivars are available, but alfalfa is such a heterogeneous crop that a cultivar deemed highly resistant is still only 51% resistant (49% susceptible).

Always use clean, pathogen-free seed to avoid contamination of a clean field.

Early cutting can be used for management of leaf diseases when they are present.
Proper irrigation, in addition to seed treatments, will also reduce the risk of disease.

Avoid water-logging on fine textured soils and avoid planting in high water table areas.

Insecticide sprays can be useful in the control of insects that vector viruses or wound plant parts creating entrances for pathogens. For suggested insecticides - see key insect management strategies for aphids.

**Fungicides -**

**Pesticide:** captan (Captan 30DD)
- Target Pests: Damping off, Seedling blights
- Recommended rate: rate per 100 lb. seed; 2.0 ai oz (6.2 fl oz)

**Pesticide:** copper hydroxide (Kocide 101)
- Target Pests: Spring black stem
- Recommended rate: rate per 100 lb. seed, 24.6 ai oz (32 oz)

**Pesticide:** metalaxyl (Apron Flowable)
- Target Pests: Damping off, Seedling blights
- Recommended rate: rate per 100 lb. seed, 0.5 ai oz (2.0 fl oz)
- Comments: High risk of resistance developing; Mechanism unknown

**Pesticide:** thiram (Thiram 42S)
- Target Pests: Damping off, Seedling blights
- Recommended rate: rate per 100 lb. seed, 0.2 ai oz (7.5 fl oz)

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