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Guidelines for Growing Alfalfa in Mississippi

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A Noble Past-A Promising Future
1878-CENTENNIAL-1978

PREFACE

Scientists working independently and as interdisciplinary teams have studied alfalfa production technology for many years. Areas of specific interest have included plant characteristics, soil and fertilizer requirements, cultural practices, harvesting methods, pest control and plant breeding to develop varieties with improved tolerance to the disease and insect complexes associated with alfalfa production. This publication begins with the most current guidelines for producing alfalfa in Mississippi and concludes with a review of the research results on which the guidelines are based.

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Guidelines for Growing Alfalfa in Mississippi

Alfalfa (*Medicago sativa* L.) often is referred to as the "queen of forage crops" (Figure 1). It is a herbaceous perennial with leaves arranged alternately on stems. Plants produce distinct taproot systems that may penetrate 20 to 25 feet or deeper in porous soils and reach a height of 20 to 30 inches. Each plant may produce 5 to 25 shoots that arise from crown tissue after harvest or after maturity of older stems.

Feeding value of alfalfa is higher than that of the more commonly-grown hay and forage crops---per acre production of digestible protein exceeds that of clovers and is four times that of corn silage. Alfalfa also is a desirable component of rations for most farm animals because of its high mineral and vitamin content.

Alfalfa may be used for hay, silage or greenchop, with 2 to 5 tons of dry matter per acre harvested in 4 to 5 cuttings annually. It also is

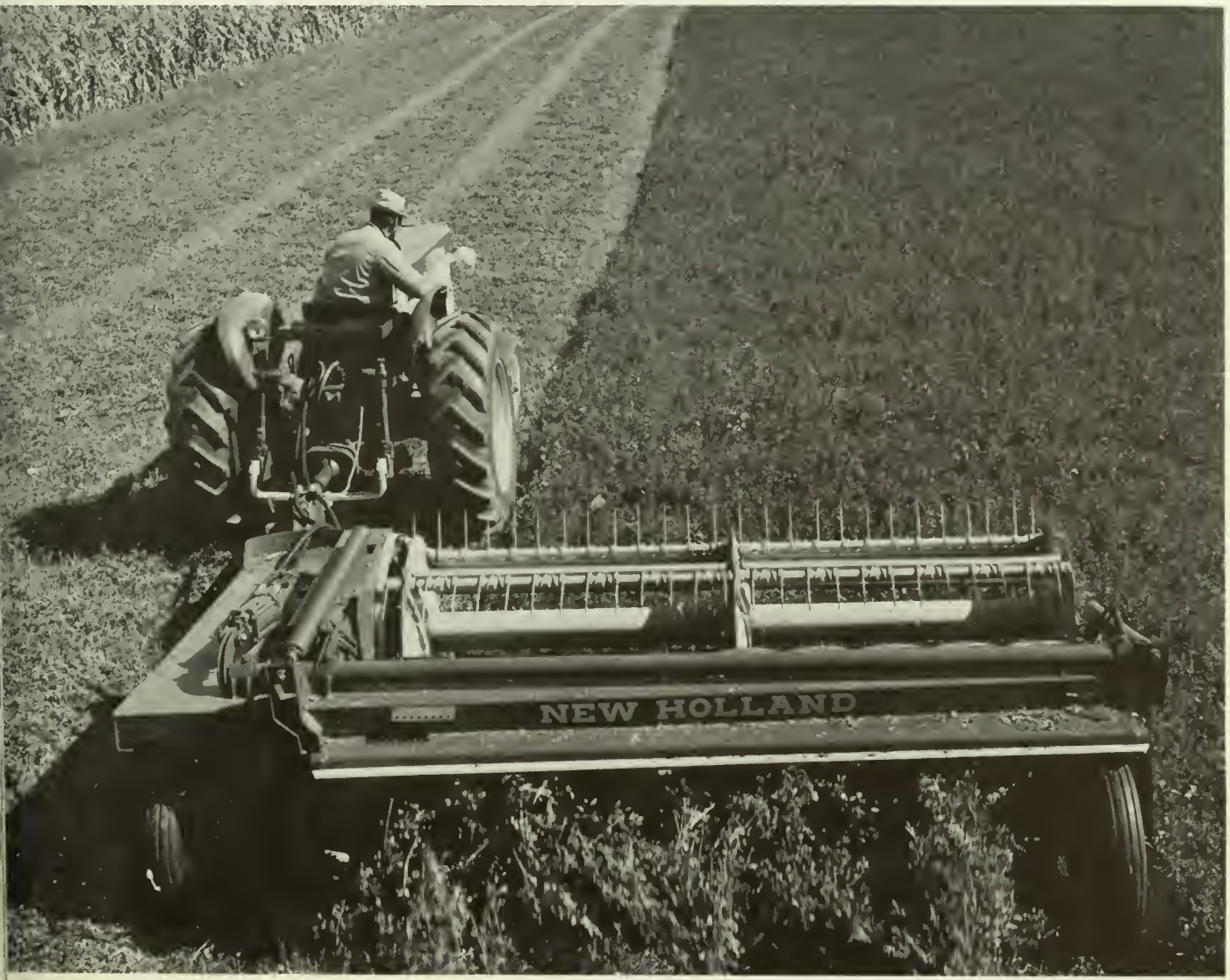

Figure 1. Harvesting a typical field of alfalfa.

an excellent pasture crop that will tolerate pasturing when grazed rotationally, but may sustain stand losses when grazed continuously. Also, poloxalene should be provided to prevent bloat of animals grazing pure stands.

The need for a reliable and relatively inexpensive source of protein for feeding livestock has stimulated interest in increasing the production of legumes for forage. Results of a recently-completed survey indicate that the 1.5 million acres of alfalfa currently grown in the Southern Region will increase to 3 to 4 million acres in the next five to ten years. Acreage increases are expected in 11 of the 13 southern states.

Alfalfa is adapted to a wide range of climates and soils and is drought resistant---plants become dormant in periods of drought stress and resume growth when soil moisture becomes favorable. It can be grown successfully in Mi sissippi if adapted varieties a planted on soils suitable for i production. Other keys t successful production are adequa fertilization (including lim proper inoculation with the corre strain of *Rhizobium* (nitroge fixing bacteria), and managing minimize damage by diseases an insects.

PRODUCTION GUIDELINES[1]

Soil Selection

Alfalfa grows best on soils with good drainage. Highest yields normally are attained on deep loam soils with porous subsoils. Silty and sandy soils also are suitable for alfalfa production, but the crop never should be planted on soils of this type with a history of Southern blight infestation. 'Delta' performs well on well-drained clay soils because of its tolerance to root and crown rots.

Fertilization

Soils should be tested for pH, phosphate and potash.[2] Lime should be applied before planting to bring the pH to 6.5 or above. Apply phosphate and potash to bring per acre levels of P_2O_5 and K_2O to 120-160 pounds of each in a 1 to 1 ratio, plus 1.5 pounds of boron. Materials should be incorporated 6 to 7 inches deep during seedbed preparation.

Maintenance requirements are liming to maintain soil pH at 6.5 or above and annual applications of 60-80 pounds P_2O_5 and 180-240 pounds K_2O in a 1 to 3 ratio, plus 1.5 pounds boron.

Seedbed Preparation

Ideal seedbeds are firm and moist to provide proper seed coverage and soil moisture adequate for germination. Fields should be cultipacked before and after planting. Cultipack before planting if soil is to be compacted only once.

Varieties

Delta, 'Cherokee', 'Arc,' 'Buffalo,' 'Cody' and 'Florida 66' are recommended for Mississippi (Table 1).

Delta has persisted in Mississippi tests longer and yields more than varieties from other areas. It also performs well on heavy clay soils because of its resistance to root and crown rots.

Cherokee has tolerance to leafhopper yellowing, alfalfa rust, crown and stem rots and certain leaf spots.

Arc carries resistance to southern anthracnose, several leaf spots, pea aphid and weevils.

Buffalo and Cody should be planted where bacterial wilt is a problem.

Florida 66 has extreme susceptibility to the spotted alfalfa aph in the area of seed production but type for resistance to this insect planned for release in the next tw years.

Inoculation

Inoculate seed with the prop strain of *Rhizobium* immediate before planting. Be sure to place t seed in direct contact with t inoculum. This normally is a complished by using a sugar-wat solution to stick the inoculum seed; however, commercial sticke are available. Applications molybdenum during the growi season may be beneficial, becau the *Rhizobium* require it for ma imum nitrogen fixation.

Planting

Seed may be broadcast, band or drilled. Banded or drilled se usually emerge faster and produ more growth the first year.

Planting Depth---A good rule thumb is to plant at a depth times the diameter of seed. Th depth prevents planting too de and permits sufficient contact seed with the soil.

[1] *The guidelines presented in this bulletin incorporate the latest MAFES research results available at t time this publication was edited. Consult your area or county Cooperative Extension Service personnel determine whether more current guidelines are available.*

[2] *In the absence of a soil test, refer to the latest* **Crop and Fertilizer Guidelines for Mississippi.** *Yo county agent has these and they are available from MAFES Editorial Department, Mississippi State, MS 397*

Table 1. Average seasonal production of 19 alfalfa varieties grown in Mississippi (15 different experiments since 1961).

Variety	No. of years tested	Avg. D.M. yield Tons/Acre[1]	Variety	No. of years treated	Avg. D.M. yield Tons/Acre
Delta	12	6.10	Cayuga	6	4.10
Cody	12	5.85	Rhizoma	4	4.31
Cherokee	12	5.36	Vernal	6	4.45
Buffalo	12	5.64	Ranger	6	5.60
Florida 66	5	6.00	Lahontan	6	4.60
DuPuits	8	5.85	Uinata	4	4.40
Kansas Common	12	5.70	Flandria	4	3.25
Williamsburg	6	5.20	Caliverde	4	4.41
Culver	6	5.62	Moapa	4	4.59
Narragansett	6	5.05			

[1]**Numbers of harvests varied from 4 to 6 per season, with first harvest about May 10.**

Planting Rate---15 to 20 pounds f seed per acre are recommended. 'lanting 20 pounds of seed normal- insures a sufficient stand.

Planting Date---Seeding may egin as early as August 25 and hould not extend past October 15. pring seeding can be successful if reemergence herbicides are used.

Veed Control[3]

Chemicals are the major means f controlling weeds and grasses in lfalfa. Herbicides normally are ot required for alfalfa seeded etween August 25 and October 15. lowever, herbicides are available iat can be applied before planting preplant) or after alfalfa has merged (postemergence).

Preplant---Apply benefin Balan®) to control most annual rasses and broadleaf weeds. The aterial should be applied within iree weeks of planting but may be pplied immediately before eding if incorporated to a depth 3 inches.

Postemergence---Apply dinoseb newly-emerged alfalfa seedlings for control of some weeds (e.g., small chickweed). Treatment may be repeated if necessary. Established stands of alfalfa also may be treated.

Apply 2,4-DB for control of many small broadleaf weeds when alfalfa seedlings reach the two-to-four-trifoliate leaf stage. Vetch, chickweed and pennycress are not controlled. Grazing and harvesting are not permitted for 60 days after application.

Apply chlorpropham (Chloro IPC®) to control germinating annual weeds and some very small weed seedlings when alfalfa is actively growing, semi-dormant or dormant. Application should not be made before November 1. This material also can be used to reduce growth of dodder, but should be applied only to wet soils that are free of litter and clods. Timing is critical and application should be made when dodder begins to germinate but before it becomes attached to alfalfa plants. Do not apply the granular formulation if alfalfa foliage is wet.

Apply pronamide (Kerb®) both preemerge and postemerge for control of grasses and many small annual broadleaf weeds. It can be applied in fall and winter to newly-established and older alfalfa stands, but should not be applied before alfalfa plants reach the first trifoliate leaf stage. Grazing and removing forage for feeding livestock are not permitted within 120 days after application of the material.

Insect Control

Planting resistant varieties and modifying cultural practices are the first lines of defense against insect damage to alfalfa. For example, much of the leaf damage that otherwise would be attributed to insects can be avoided by making the first cutting early. The alfalfa weevil was a formidable foe three decades ago and still is considered capable of reaching population levels high enough to cause economic loss to the crop.[4] However, one timely application of an effective insecticide in the

[3]*Herbicide labels change frequently and new restrictions are imposed. The recommendations given in this publication were current at the time this publication was edited. Consult your area or county Cooperative Extension Service personnel for material recommendations, rates and time of application.*

[4]*Pitre, H. N., B. C. Hurt, Jr., and C. A. Briscoe, Jr. 1969. "Insecticides evaluated in 1968 as sprays and granular applications for control of the alfalfa weevil." Miss. Farm Research 32(3):6.*

spring can be sufficient for control. Other insects generally do not require insecticide control in Mississippi.[5]

Disease Control

Planting resistant varieties and modifying cultural practices also are the first lines of defense against disease damage to alfalfa. Control by application of chemical sprays and dusts has been used infrequently.

Nematode Control

Submit soil samples to a nematologist for examination. Do not plant alfalfa if nematodes are present, because resistant varieties are the best control and varieties that do well in Mississippi are not resistant.

Harvesting

Producing alfalfa hay of the highest possible quality requires great care in cutting, conditioning and packaging for storage. Saving the most leaves possible is the primary goal and this is one of the most difficult of all crop harvesting jobs.

Alfalfa produces forage of highest quality when cut in the late-bud or early-flower stage of maturity and four to six cuttings can be made, depending on rainfall distribution. Average dry matter yields have ranged from 3.8 tons per acre with harvesting at the flower-bud stage of maturity (six cuttings per season) to 5.5 tons per acre with harvesting at full bloom (two cuttings per season). Leaves in the harvested forage decreased from 57% with harvest at the flower-bud stage to 45% with harvest at full bloom (Table 2). Cuttings after the initial spring harvest can be made at 30- to 40-day intervals, depending on th stage of maturity selected fo harvest. Harvesting should b discontinued after October 1, t allow plants to build up the roo system food reserves necessary fo stand maintenance.

A single operation for cuttin conditioning and wind-rowin with pull-type or self-propelle machines is becoming popula (Figure 2). Conventional co ditioning, raking and baling afte mowing (Figure 3) still ar preferred by some farmers but ar being replaced gradually with th new mower-conditioner-winc rowers.

Table 2. Average dry matter yield and percent leaves of twelve varieties of alfalfa harvested at different stages of maturity over a period of 10 years in Mississippi.

Stage of Maturity	Avg. No. Harvests/Year	Dry Matter Yield lbs/Acre	% Leaves
Flower Bud	6	7652	57.1
1/10 Bloom	5	8464	54.3
1/4 Bloom	5	9030	50.3
1/2 Bloom	4	10120	47.5
Full Bloom	3	10720	45.0

Figure 2. A self-propelled harvesting machine (right) for cutting, conditioning and windrowing alfalfa.

[5]*Consult your county agent, area extension specialists or Mississippi Cooperative Extension Servi Information Sheet 722 for current recommendations for control of insects in alfalfa.*

REVIEW OF RESEARCH RESULTS

Fertility Requirements

Each ton of alfalfa hay contains 100-125 lbs of calcium or base equivalent (estimated) and this makes calcium content of the soil critical. A pH of 6.5 or above is necessary for maximum production and many otherwise adaptable soils require lime---most soils east of the Mississippi River require lime for successful alfalfa production.

High levels of plant nutrients also are necessary for maximum alfalfa production. Phosphorus and potassium are essential for root and shoot development and for stand survival. Applications of boron have meant the difference in high and low yields in some areas of the Southeast.

Alfalfa will provide the nitrogen needed if soils are properly limed and fertilized and seed are inoculated at planting time with the proper strain of nitrogen-fixing bacteria. Applications of molybdenum during the growing season also may stimulate plant growth because the bacteria require it for maximum nitrogen fixation.

The bacteria live in nodules (swollen root tissue) on the roots of alfalfa plants. Cut the nodules to check their activity. The cross section of the nodule will be red if bacteria are active and fixing nitrogen.

Varieties

Alfalfa cultivars grown in the United States were developed from forms of *Medicago* that frequently are referred to as the *Medicago sativa* complex---*Medicago sativa* L. and *Medicago falcata* L., both of which are interfertile and may be classified as subspecies of the same species. *M. sativa* is native to southwest Asia, has purple flowers,

Figure 3. Some alfalfa harvesting is still done with separate cutting (top), raking (middle) and baling (bottom) operations.

and is erect with a narrow crown. Related alfalfas include Flemish, Turkestan and common types that vary in winter hardiness. *M. falcata* is native to Siberia, has a widely-branched root system, a deep-set crown with yellow flowers, and is more winterhardy than *M. sativa.*

Common---The common types originated from plants transported from Europe into South America in the 16th Century and then brought from Chile to California in the 1850's. The eastward and northward spread of people led to the evolution of established varieties in other areas. For lack of a better term, locally-grown alfalfa became known as "common." Kansas common and California common are examples. Common types are not recognized as varieties under the Federal Seed Act.

All South American common types have purple flowers and their cold hardiness ranges from none to intermediate. The non-winter-hardy types are rapid growers, even in cool weather and make rapid recovery after cutting. They have little cold resistance but are very productive for hay and seed.

Variegated---The variegated types are believed to have originated from natural crossing of *M. sativa* and *M. falcata.* Flowers are purple, blue, yellow or white. Most cold resistant cultivars grown in Canada and the northern parts of the United States are variegated.

'Vernal' is a strongly-variegated variety with high levels of winter hardiness and resistance to bacterial wilt. It currently is grown on 25-30% of the alfalfa acreage in the North Central states. 'Cayuga' and 'Narrangansett' are varieties adapted to the northeastern states. 'Culver' is the only variety bred specifically for meadow spittlebug resistance. It is a 1959 release and has *M. falcata* in its genetic background.

Synthetics---Several synthetic varieties grown in Mississippi were bred from common varieties. 'Buffalo' is a bacterial wilt resistant synthetic developed from Kansas common and was released in 1943. 'Cody' is a synthetic from a selection within Buffalo and expresses aphid and bacterial wilt resistance.

'Ranger' is a synthetic variety developed in Nebraska for resistance to bacterial wilt. It was produced by intercrossing selected inbred lines from Cossack, Ladak and Turkestan. The Turkestan types are native to Turkestan (now USSR). These types have purple flowers and generally are very susceptible to leaf spot.

Flemish---The common alfalfas of northern France frequently are referred to as the Flemish types. Plants of this group have purple flowers and, although quick to recover after cutting, are only moderately winter hardy. 'Dupuits' possesses good vigor and moderate resistance to certain foliar diseases, but is highly susceptible to bacterial wilt and some crown rots.

Alfalfa Improvement

Alfalfa improvement was affected less than that of other species by the deemphasis of legume research about the middle of the 20th Century. The number of varieties developed through public and private breeding programs had almost doubled and more than 80 varieties of *M. sativa* had been released by 1972.

Plant breeders, entomologists and pathologists working as teams in the Southern Region developed 'Cherokee,' 'Team' and 'Arc.' These cultivars were bred for improved tolerance to the disease and insect complexes in the region. Arc carries resistance to southern anthracnose, several leafspots, pea aphids and weevils. 'Liberty' is the most recent release from the North Carolina breeding program. 'Victoria' was released by the Arkansas Agricultural Experiment Station in 1969. This 9-clone synthetic performs similarly to 'Buffalo,' 'Cody' and 'Vernal.' It is resistant to the spotted alfalfa aphid; has moderate resistance to common leaf spot, downy mildew and phytophthora root rot; and has measurable levels of resistance to bacterial wilt, potato leaf hopper and thrips.

Two regionally-adapted varieties were developed by extended selection under very humid conditions. 'Delta' originated through several generations of selections from plants that survived from original populations in old fields in the Delta of Mississippi. It has persisted longer in Mississippi tests and yields more than varieties from other areas. Similar efforts created 'Florida 66.' Exploitation of the potential of this variety was hampered by extreme susceptibility to the spotted alfalfa aphid in the area of seed production. However, a Florida 66 type with resistance to this aphid is planned for release within two years.

Private companies also have developed several varieties that are used in the Southern Region. Some companies with varieties and proprietaries developed for the Southeast are the FFR Cooperative, North American Plant Breeders, Northup, King and Company, and the Waterman-Loomis Company.

Insect Pests

Losses of alfalfa forage and seed resulting from insect damage have been reported to be as high as $260 million annually in the United States. Damage inflicted by insects feeding on alfalfa leaves, stems, roots and flowers causes reductions in plant vigor and plant stands. Some insects inject toxins into the

Figure 4. The adult alfalfa weevil (left) and the emerging larvae (right).

lant while feeding and these ubstances retard plant growth nd reduce forage quality. Yield nd quality also are reduced by nsects that attack the seed head irectly or spread disease-causing rganisms by feeding from plant to lant. Insects that damage alfalfa re classified as (1) chewing insects hat feed on leaves, buds and tems, (2) sucking insects that feed n leaves, buds and stems, and (3) ther insects.

Chewing Insects

Alfalfa Weevil---The alfalfa eevil, *Hypera postica* (Gyllenhal) dark brown with a darker stripe xtending down the back for more han one half the length of the ody. The adult (Figure 4a) is about /16-inch long and has a snout ith chewing mouthparts.

Damage to alfalfa plants by the weevil is greater than that by any other insect. Most of the damage is caused by the larvae. Larval feeding reduces plant yield and forage quality by decreasing leaf area of plants.

Fully developed larvae change into pupae within cocoons attached either to alfalfa plants or to bits of debris on the ground. Adults emerge from the cocoons after one or two weeks and begin another cycle by mating and laying eggs.

The female chews holes in alfalfa stems into which she deposits 1 to 30 eggs of lemon-yellow color. The eggs turn darker as they mature and become brown before hatching. Eggs hatch in one to two weeks in warm weather but take longer in cool weather.

Emerging larvae are about 1/20-inch long and are yellowish with a shiny black head. They are 3/8-inch long after three to four weeks and are yellowish-green with distinct white stripes down their back (Figure 4b).

The alfalfa weevil usually produces one generation each year. Adults may leave the field and become inactive during the hot summer months but return in the fall to feed and lay eggs. Eggs in alfalfa stems and inactive adults in and around fields live through the winter. The eggs hatch and overwintered adults lay additional eggs when conditions are favorable the next spring.

Clover Leaf Weevil---Larvae of the clover leaf weevil, *Hypera punctata* (Fab.), resemble those of the alfalfa weevil; however, fully-grown larvae are about 1/2-inch

long and more robust than alfalfa weevil larvae. They are greenish with a brown head and have a white or pinkish stripe down the back.

Adults are about 1/4-inch long, 1/8-inch wide, and mottled brown in appearance. The females lay their eggs singly in alfalfa stems. The eggs hatch in a few days and the larvae chew small holes in alfalfa leaves.

Larvae generally complete development in April or May. Mature larvae pupate in a net-like cocoon near the base of the alfalfa plant. Adults emerge in about 11 days, feed for a short period, and then become inactive during summer.

A fungus disease controls this insect in some areas.

Clover Head Weevil and Lesser Clover Leaf Weevil---These two insect pests are similar in appearance and have similar life cycles. Newly-emerged adults of both species are about 3/16-inch long. The light brown color of young adult clover head weevils, *Hypera meles* (Fab.), turns to darker brown and black as they grow older. Young adult lesser clover leaf weevils, *Hypera nigrirostris* (Fab.), are green or blue-green, but lose this coloration and resemble the clover head weevil as they grow older.

Females of both species deposit cream-colored eggs in slits cut in clover and alfalfa stems. Emerging larvae of both species are white with black heads, but their bodies become dingy-white, mottled-green or brown as they grow older and have a light-colored stripe or stripes extending the length of their backs. Fully-developed fourth-stage larvae spin a lacy white cocoon attached to mature foliage.

Both species spend winter and summer periods of inactivity in ground litter in and around fields and are active in clover and alfalfa fields only from mid-February until June. Therefore, they produce only one new generation each year.

Both species tend to congregate in clover fields; however, they are found in alfalfa in the spring. Damage to alfalfa results from the slits made for egg laying and from larvae feeding on buds. Symptoms of damage are stunted and malformed heads.

Sucking Insects

Aphids---The pea aphid, *Acyrthosiphon pisum* (Harris) and the spotted alfalfa aphid, *Therioaphis maculata* (Buckton), are the most prevalent aphids on alfalfa.

The spotted alfalfa aphid is pale yellow with four to six rows of dark spiny spots along the back. Nymphs resemble adults but are smaller.

Winged and wingless adults of both insects give birth to living young in warm weather. Each female is capable of producing 1 to 14 offspring each day without fertilization by males and a single female may give birth to 100 or more young during her life. The young may reach maturity in one week in summer. Therefore, as many as 10 to 20 generations may be produced each year if weather is favorable. Sexual winged females and males appear and produce eggs in cool weather. These eggs usually are laid on alternate host plants.

A toxic substance injected by spotted alfalfa aphids feeding on alfalfa causes yellowing of plants. Many leaves may be shed and growth of plants may be stunted by heavy infestations.

Nymphs and adults of both aphids usually are most numerous on the underside of leaves on the lower part of the plant. A honeydew secreted by the aphids while feeding attracts a black mold that reduces the quality of hay.

Threecornered Alfalfa Hopper---The adult threecornered alfalfa hopper, *Spissistilus festinus* (Say), has a triangular form, is light green and measures about 1/4-inch long. Nymphs are similar in shape but are straw colored or have a greenish tint and are covered with prominent projections, spines and hairs. Adults emerge from overwintering and deposit white oblong eggs in long slits on alfalfa stems. Time from egg laying to adult is about 50 days and there may be four generations in a year.

Feeding adults and nymphs make punctures in a circular pattern around alfalfa stems and these result in the formation of a callous tissue. Normal circulation of water is inhibited and plants may turn yellow, wilt and die. Stems also may break before harvest.

Leafhoppers---The genera of leafhoppers most abundant on alfalfa are *Agallia, Aceratagallia, Empoasca* and *Macrosteles.* Different species of these insects overwinter in different stages. However, they may become active during warm periods and reproduce in winter in Mississippi. Eggs laid in stems, buds or leaves hatch into wingless nymphs that resemble adults. The nymphs develop directly into adults.

Adults are slender and vary from 1/16- to 1/4-inch in length. They are mottled or speckled; green, yellow, brown or gray; and hop or fly ahead of anyone walking in a field.

Alfalfa plants show lack of vigor, leaves may become yellow and growth is retarded when leafhoppers are abundant.

Tarnished Plant Bug---Adult tarnished plant bugs, *Lygus lineolaris* (Palisot de Beauvois), are about 1/4-inch long and vary in color from pale greenish to yellow brown. They overwinter as hibernating adults that emerge and lay

curved, elongated eggs in alfalfa lowers, buds and stems. Nymphs esemble adults but do not have vings. One generation requires 20 o 30 days, depending upon emperature.

Feeding by these insects causes lfalfa buds and flowers to fall and reduces seed quality.

Other Insects---The green cloverworm, *Plathypena scabra* (Fab.); corn earworm, *Heliothis zea* (Boddie); webworms, *Loxostege* spp.; spotted cucumber beetle, *Diabrotica undecimpunctata howardii* Barber; bean leaf beetle, *Cerotoma trifurcata* (Forster); armyworms; cutworms and grasshoppers infest alfalfa wherever it is grown. However, numbers usually are small and controls are not required.

Diseases

Diseases can be a factor in establishing and maintaining profitable stands of alfalfa, and may shorten the productive life of stands. No single disease appears to be of great economic importance, but the combined effect of diseases that attack alfalfa can be serious. The incidence and severity of diseases normally increase when acreage increases result in greater concentration of alfalfa fields in an area.

Some of the more prevalent diseases in alfalfa fields are:

Leaf Diseases

Downy Mildew---Downy mildew s caused by the fungus, *Peronospora trifoliorum* De Bary. The fungus produces spores that remain dormant in winter and germinate in spring.

The disease affects upper leaves of the plant first and symptoms are light-green leaves with a grayish-white, mold-like growth on both leaf surfaces. Leaves also may become twisted.

Downy mildew may weaken lfalfa plants by damaging them efore the first cutting.

Cercospora Leafspot---Cercospora leafspot (*Cercospora medicaginis* Eil. and Er.) thrives nder warm and humid conditions. ymptoms are dark brown to black ots on the leaves. The spots ppear ash-gray when humidity is gh and spores are on the lesions. Diseased leaves fall from the lant, resulting in reduced yields nd quality of hay. Cutting early (early bloom) will save some of the leaves and minimize yield reduction and quality depreciation of hay.

Alfalfa Mosaic---Alfalfa mosaic is a virus disease that aphids spread in the field. Symptoms are stunted plants with yellow and green mottling of the leaves. The disease is most prevalent in spring when it is cool and symptoms may not be observed in summer when it is hot.

Alfalfa Rust---Rust is caused by the fungus, *Uromyces striatus* Schroet. var. *medicaginis* (Pass) Arth. Leaves of diseased plants show reddish-brown masses (pustules) of fungus spores that break through the leaf surface. Pustules also may form on plant stems.

Damaged leaves shrivel and fall from the plant, resulting in reduced yields and quality of hay.

Stem Diseases

Crown and Stem Rot---Stem rot (*Sclerotinia trifoliorum* Eriks.) causes injury to the stem bases and crown branches near the soil line. The fungus develops over lesions and appears as a white-cottony mass during moist, cool weather. Diseased tissues become soft and discolored and plant tops wilt. Hard, black bodies (sclerotia) form in the fungus mat.

Control measures include planting seed free of sclerotia, plowing 8- to 10-inches deep to bury sclerotia, and clean cultivation.

Southern Anthracnose---Southern anthracnose (*Collectotrichum trifolii* Bain) symptoms appear in early summer as lesions on stems and petioles of alfalfa plants. Dark, spore-producing bodies develop in the center of the lesions. The lesions girdle stems and cause wilting and browning of plant parts above the girdled areas. This fungus attacks the crown and taproot and may kill the plant when conditions for its development are favorable.

The disease reduces plant vigor and quality of hay.

Sclerotial Blight or "Southern Blight"---Southern blight (*Sclerotium rolfsii* Sacc.) attacks the stem bases and crowns of alfalfa and is particularly evident in summer. Small, light-brown, spherical sclerotia of the fungus form on stems and crowns of plants. Plant parts above the infected area of the stem bleach to a tan color and die.

The disease is widespread in silty and sandy soils. Location of fields is important in combating this disease of alfalfa.

Root and Crown Diseases

Damping Off---*Phytophthora, Pythium, Fusarium* and *Rhizoctonia* are common soil fungi that attack and kill alfalfa seedlings either before or after they emerge from the soil. The disease is most severe in wet soils.

Bacterial Wilt---Bacterial wilt, caused by *Corynebacterium in-*

sidiosum (McCull) H. L. Jens., occurs in poorly drained soils. The disease causes stunted plants and an increase in the number of stems with smaller-than-normal diameter. It reduces the size of leaflets and turns them yellow. All woody parts of the plant show a brown color in advanced stages of the disease.

Fusarium Wilt---This is a fungus disease caused by *Fusarium oxysporium* Schlect. F. *medicaginis* (Weimer) Snyder et Hansen. Symptoms include bleaching of infected stem tissues, rapid wilting of plants in hot weather, and brown woody tissues. Appearance of fusarium wilt and bacterial wilt is somewhat similar.

Disease Control

Application of chemical sprays and dusts to control alfalfa diseases has been limited. Disease control measures that have been proven most successful are: (1) selection of land that offers the best defense against diseases known to be a problem in an area, (2) planting varieties with disease resistance and with tolerance to disease-spreading insects, and (3) modifying cultural practices to minimize damage from diseases.

Nematodes

Nematodes are very small, non-segmented roundworms that move in soil water. They attack stems and roots of plants by piercing tissues with a needle-like mouthpart (stylet) while feeding. Two major species have been reported in alfalfa:

Stem Nematodes---The stem nematode (*Ditylenchus* Dipsaci Kuhn Filipjen) causes dwarfing, yellowing, wilting and distortion of alfalfa plants. Stems become swollen and brown at the base, and may break.

Three resistant alfalfa varieties have been developed: Lahontan, Washoe and Apalachee.

Root-Knot Nematodes---Symptoms of root-knot nematode (*meloidogyne* sp.) damage are galls or growths on the roots where they feed. These distortions decrease the amount of functional root area, which results in reduced uptake of water and minerals. Feeding lesions and damaged roots provide an entry for disease-causing bacteria and fungi that contribute to destruction of the plant.

Nematode Control

Determining whether nematode control is needed requires examination of soil samples by a nematologist. Planting resistant varieties is the best control and non-resistant varieties never should be planted if soil is infested with nematodes.