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Alfalfa

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Alfalfa is the most productive legume for Missouri, with potential yields exceeding six tons of hay per acre on good soils. Unlike red or white clover, established alfalfa is productive during midsummer except during extreme drought. Alfalfa is a tap-rooted crop and can last five years and longer under proper management. Whether grazed or fed as hay, alfalfa is an excellent forage for cattle and horses.

More than 400,000 acres of alfalfa are harvested annually in Missouri, averaging about three tons of hay per acre. Alfalfa as a cash hay crop could produce more than \$60 million each year. To realize this potential, you should plant a productive, disease-resistant variety that is adapted to Missouri conditions. Once established, good management practices are necessary to ensure high yields and stand persistence. These practices include timely cutting at the proper growth stage; control of insects, diseases and weeds; and replacement of nutrients removed in the forage. Alfalfa has superior forage quality when managed properly. The major problems are getting a stand and keeping it productive. These factors are stressed in this publication.

Site selection and soil fertility

Alfalfa is best adapted to deep, fertile, well-drained soils with a salt pH of 6.0 to 6.5, but it can be grown with conservative management on more marginal soils. On sites that have more moderate drainage, you should also seed a grass, such as orchardgrass or bromegrass, with alfalfa to reduce winter heaving of the alfalfa. The grass acts as a mulch during winter to reduce variations in soil temperature, which cause repeated freezing and thawing. Grasses also help prevent weed invasion by filling in spaces between alfalfa crowns.

Alfalfa requires high levels of fertility for establishment, especially phosphorus. Soil should be tested six to 12 months ahead of planting to determine proper amounts of fertilizer and agricultural lime for successful establishment. Soil salt pH should be 6.0 or above, which allows for good nodulation by the plant use. Disk or plow down any needed limestone six to 12 months before seeding to give time for it to react in the soil and raise the salt pH.

In no-till seedings, apply needed lime a year in advance, because it cannot be incorporated. After two years of production, take another soil sample to determine if the soil needs additional limestone or fertilizer. Top-dressing limestone or fertilizer helps maintain production potential and ensures stand longevity.

Adequate available phosphorus is a key to establishing a vigorous stand of alfalfa. Phosphorus stimulates root growth for summer drought resistance, winter survival and quick spring growth. Many Missouri soils are low in phosphorus and may require 60 to 100 pounds of phosphate per acre for establishment. On a Howell County site that was low in phosphorus, plowing down 160 pounds of phosphate per acre increased hay yields in the seeding year by 2.4 tons per acre (Table 1). Yield response to phosphate in no-till alfalfa is generally lower than in conventionally tilled situations in the seeding year. You can use no-till drills with large and small seed boxes to drill 30 to 40 pounds per acre of phosphate (large box) along with the seed (small box) when planting into soils low in phosphorus.

Table 1

Alfalfa response to phosphorus (Howell County)

Fertility		Hay yield ¹		Stand characteristics after five years	
Plowdown (pounds phosphate)	Annual (pounds phosphate)	Seeding year (tons per acre)	Five year average (tons per acre)	Plants per square foot	Stems per plant
0	0	0.7	1.7	4.0	2.5
0	120	1.4	4.4	6.0	5.3
160	0	3.1	3.6	5.7	3.9
160	120	3.0	4.9	6.7	6.7

¹14 percent moisture

Nitrogen and potash are not as important as phosphorus for alfalfa establishment, but they are needed in small amounts. Soil test recommendations normally suggest 20 to 30 pounds of nitrogen at seeding along with 20 to 60 pounds of potash. The fertilizers should be worked into the soil to prevent direct contact with germinating seed.

Researchers recommend applying 20 to 30 pounds nitrogen for fall and early spring plantings to stimulate growth before development of nitrogen-fixing root nodules. You should not fertilize late spring seedings with nitrogen because of the potential for increased weed competition.

Variety selection

Several varieties of alfalfa are available, but a limited number are adapted to Missouri. There is no single "best" variety for a particular location. The most recommended varieties are those that are consistently high yielding, moderately winter hardy and have moderate or higher resistance to bacterial wilt, phytophthora root rot and anthracnose.

Each year, researchers test several varieties of alfalfa for yield at locations in northern, central and southern Missouri. The results are published in the Missouri Crop Performance: Forage, Special Report number 351, which is available at your local MU Extension center. This report also contains descriptions of disease resistance for tested varieties.

Some varieties are bred especially for creeping growth habit. These plants have the ability to spread laterally from the crown, which should lead to improved persistence. These varieties, however, generally are lower yielding than conventional varieties and have low levels of disease resistance.

Establishment

Alfalfa may be frost-seeded, broadcast, no-tilled or drilled into a prepared seedbed. You should frost-seed in January or February to allow freezing and thawing to work the seed into the soil. Planting into killed vegetation using no-till techniques or into a prepared seedbed involves less risk of failure and produces denser, more uniform stands than frost-seeding.

Whether planting no-till or into a prepared seedbed, place seed no more than one-fourth inch deep for maximum emergence. With a prepared seedbed, the soil should be very firm to ensure good soil to seed

contact. When broadcasting, you should firm the field with a cultipacker or roller before and after planting. Seeding with a Brillion-type seeder, which has a pair of heavy packing rollers, is ideal. Drills that are capable of precise seed depth control and have press wheels to firm the seedbed are also excellent.

In dry years, getting a firm seedbed is critical for seedling survival. In dry years, seedlings germinate and then die in a loose seedbed because water does not move up to the upper soil layer where the young roots are. A good rule of thumb is to firm the seedbed after planting to the point that an average person leaves a footprint less than one-fourth inch deep.

Alfalfa planted into killed, un-tilled sod is subject to stand reduction and loss of vigor from soil insects. Apply granular insecticide in the furrow or liquid formulations broadcast at planting to control soil insects. Consult your local MU Extension center for current recommendations on labeled insecticides and rates. Do not seed alfalfa into killed sod without using a soil insecticide.

You can plant alfalfa in early spring or late summer north of the Missouri river. Late summer seedings are not recommended south of the Missouri river in areas where sclerotinia crown and stem rot has occurred (section on diseases). A pre-emergence herbicide, for example EPTC, is recommended for spring seedings of pure alfalfa into a prepared seedbed. Spring seedings made with a herbicide can produce two to three cuttings of quality forage by Sept. 15. There are no pre-emergence herbicides for alfalfa-grass mixtures or alfalfa seeded with a companion crop.

You should complete spring seedings by late March or early April in southern Missouri and by mid-April in northern Missouri so seedlings are well developed before the hot, dry summer. You should make late summer seedings in late August or early September so the seedlings become winter-hardy.

Companion crop

Alfalfa is often fall-seeded with small grains such as wheat, oats and barley. Otherwise, alfalfa is broadcast into these crops during winter. The companion crop prevents excessive soil erosion, decreases weed problems, protects young alfalfa seedlings and provides some early spring forage before the alfalfa becomes productive. Use one bushel per acre in either fall or spring plantings. Although beneficial, the small grain companion crops also compete for light, water and soil nutrients. Harvest the companion crop for hay or silage no later than the boot stage to minimize competition. Alfalfa often provides one hay cutting in late August to early September when seeded with a companion crop.

Seeding rates and mixtures

When seeded alone, use 15 pounds per acre of certified seed, which is about the equivalent of 13 pounds per acre of pure, live seed (PLS). When seeded with a grass, 10 pounds per acre of bulk alfalfa seed (equal to eight pounds per acre PLS) is sufficient. Seeding rates for grasses in an alfalfa grass mixture are: brome grass — 10 pounds bulk (eight pounds PLS); orchardgrass — six pounds bulk (four pounds PLS); tall fescue — 10 pounds bulk (eight pounds PLS); or reed canarygrass — six pounds bulk (four pounds PLS) per acre.

Seeding a cool-season grass with alfalfa decreases the potential for heaving, reduces weed competition, lessens damage to soil structure by grazing animals, and reduces bloat potential when grazed. The grass will decrease forage quality but will be a major component in the first cutting only.

Make decisions about whether to include a grass based on the intended market or use of the alfalfa and on the winter-heaving potential of the site. If intended for dairy use or sale to a cubing plant, seed pure alfalfa. For grazing, beef, or horse use, an alfalfa-grass mixture is best. On sites that have a high clay content subject to heaving, alfalfa-grass mixtures are recommended.

Maintaining alfalfa stands

Proper management can allow Missouri growers to maintain a productive stand of alfalfa for five or more years. An annual fertility program and proper harvesting management are major factors determining stand productivity and longevity. Insects, diseases and weeds are problems that can reduce yields and length of stand.

Most alfalfa seedlings initially have 15 or more plants per square foot. As the stand ages, some plants die and remaining plants spread to occupy the space. MU research shows that pure stands with three or more plants per square foot can maintain high productivity. Alfalfa-grass mixtures can maintain productivity with only two alfalfa plants per square foot.

Annual fertilization

Annual applications of phosphorus, potash, boron and sometimes lime are necessary to maintain vigorous, productive stands. To avoid nutritional deficiencies, apply fertilizer each year according to soil tests. Missouri research has shown that even 6- to 10-year-old alfalfa stands can have three or more plants per square foot and produce high hay yields when you follow a program of proper annual fertilization.

Phosphorus fertilization of established stands keeps plants vigorous so that high yields can be maintained over time. Applications of phosphorus resulted in one to two more plants per square foot and almost double the number of stems per plant after five years in a Howell County study (Table 1).

Potash application improves winter survival of plants and lengthens the productive life of the stand. Where no potash was top-dressed for five years after establishment, plant density was reduced to less than three plants per square foot (Table 2). Alfalfa stands with fewer than three plants per square foot cannot maintain high yields and are often subject to increased weed invasion.

Table 2

Alfalfa response to potassium (Howell County)

Fertility		Hay yield ¹		Stand characteristics after five years	
Plowdown (pounds phosphate)	Annual (pounds phosphate)	Seeding year (tons per acre)	Five year average (tons per acre)	Plants per square foot	Stems per plant
0	0	1.9	3.1	2.8	7.2
0	180	2.3	4.0	3.8	6.3
100	0	2.3	3.3	2.2	5.5
100	180	2.4	4.7	4.4	6.1

¹14 percent moisture

Annual fertilizer recommendations vary according to phosphorus and potassium levels in the soil, but will be close to 15 pounds phosphate and 55 pounds potash per ton of expected yield. You can apply fertilizer at any time. A single application following the first cutting or a split application following the first and third cuttings are both good options. Split applications are useful for irrigated alfalfa, for high-yielding alfalfa stands or when applying high rates of potash (more than 300 pounds potash annually).

You should include boron in the top-dress fertilizer at a rate of one pound of boron per acre per year. Boron is toxic to seedlings, so you should not apply it at seeding.

Soil test every two to three years to make sure that soil salt pH, phosphorus and potassium levels are adequate. Top-dress additional lime as needed to keep the salt pH above 6.0.

Harvest management

Stage of maturity at harvest determines hay quality and affects stand life. Forage quality (protein, energy value) declines rapidly as the plant begins to flower.

For spring-seeded established stands in the seeding year, take the first harvest at the mid- to full-bloom stage. Make following harvests as flowers begin to appear.

For established stands, take the first (May 10 to 20) and second (June 15 to 25) cuttings when the plants are just beginning to bloom. For persistence of the stand, make two more harvests at about 35-day intervals before Sept. 15. Do not cut or graze between Sept. 15 and Nov. 1 to allow the plant to store root reserves to overwinter. After Nov. 1, you can take or graze a fifth cutting if the soil is well drained or a grass is used to help prevent winter heaving. With a four-cut system, a properly fertilized stand can last six or more years.

Harvesting alfalfa in the bud stage produces five cuttings of high-quality hay before Sept. 15. This practice, however, reduces stand life to three or four years.

You can graze alfalfa without a loss of stand using small pasture units and high stocking rates. Use enough animals to remove most topgrowth in less than six to 10 days. Turn animals onto the alfalfa when alfalfa is in the bud stage. Allow the alfalfa to regrow for 30 to 35 days. Reduce the chance of bloat by using poloxalene (bloat-inhibitor) blocks. Don't turn hungry animals onto lush alfalfa pastures.

Pests

Insects

The alfalfa weevil and potato leafhopper are the two major pests of alfalfa in Missouri. Regular monitoring of alfalfa fields is the best way to prevent economic injury from insects. Spray or cut when insect populations reach economic thresholds, not after insect injury symptoms are apparent.

Alfalfa weevil adults lay eggs in the older alfalfa stems in late fall and early spring, and the larva damage mainly the first cutting. Use chemical insecticides when 25 percent of the tips are skeletonized and if there are three or more larvae per stem. Instead of spraying, cut the alfalfa when it is in the bloom stage, scouting regrowth for signs of damage. In general, experts recommend chemical control of the weevil.

Potato leafhoppers migrate to Missouri in June from southern states. The immature or nymph stage stunts plants and yellows leaves. It also lowers yield and protein content by sucking juices from young upper stems. Leafhopper numbers can be large enough to warrant treatment before significant leaf yellowing occurs. Population thresholds for chemical control vary with plant height.

Weed control

Weed control in alfalfa begins with establishing a uniform dense stand of alfalfa or alfalfa/grass. Experts recommend a pre-plant incorporated herbicide for conventional spring seedings of pure alfalfa. If you want a grass in spring-seeded alfalfa, plant the alfalfa alone using a pre-plant herbicide. Drill the grass into the alfalfa stand the following spring. Numerous diskings during mid to late summer give adequate control for late summer seedings.

Control of weeds after alfalfa emergence depends on the individual weeds, the stage of growth of the alfalfa and whether there is a grass with the alfalfa. Several herbicides control weeds in pure stands of alfalfa, but only a few are available for use in alfalfa/grass stands.

Diseases

Alfalfa in Missouri is subject to several diseases, including phytophthora root rot, bacterial wilt, anthracnose and sclerotinia root and crown rot. Because no labeled chemical control methods exist for use after a disease

is found, the best control is prevention. Choose a variety with a high level of resistance to phytophthora, bacterial wilt and anthracnose. There is no varietal resistance to sclerotinia.

Sclerotinia is particularly damaging to fall-seeded alfalfa stands south of the Missouri river. The disease has killed seedling stands, and older stands are also subject to damage. Cultural controls include deep tillage of alfalfa residue to bury the inoculum that is formed in the spring on infected alfalfa. In southern Missouri, seed alfalfa in spring only, particularly in and around fields where sclerotinia has been a problem in the past. A less practical control is to maintain a three- to four-year interval between forage legumes in a rotation. Red and white or ladino clovers are also hosts of sclerotinia and can be a source of inoculum for subsequent alfalfa crops.

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Related MU Extension publications

- EC921, Alfalfa Analyst
<http://extension.missouri.edu/publications/DisplayPub.aspx?P=EC921>
- NCR547, Alfalfa Management Guide
<http://extension.missouri.edu/publications/DisplayPub.aspx?P=NCR547>

Order publications online at <http://extension.missouri.edu/explore/shop/> or call toll-free 800-292-0969.



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