How to Seed New Pastures
A good pasture can bring net profits that compare with those from grain, cotton or hay. There is no expense for harvesting and little soil depletion.

At right are examples of meat yields from pastures. They are results of tests with steers at University of Missouri experiment stations. Many farmers have obtained even larger returns from pastures through meat, milk and wool.

To get these high yields of animal products from pastures we need (1) a mixture of grass and legume, (2) species that do well in Missouri’s climate and on the type of soil where they are planted, and (3) fertilizing as suggested in this bulletin.

All pastures, except some annual pastures, should contain one or more adapted grasses and one or more adapted legumes.

In addition to supplying much of the edible herbage, the grass protects legumes from injury by heaving, holds the soil against erosion while the land is in grass and for a year or two afterward, and reduces the danger of ruminants bloating on alfalfa or clover.

Legumes furnish much palatable and nutritious herbage. They also supply the companion grass with nitrogen fixed from the air, and thereby increase the total yield and improve the quality of pasture herbage.

Several good pasture grasses and legumes grow well in Missouri. Choice of a particular grass-legume mixture will depend upon the depth, drainage, and fertility of the soil, and how long the field is to be left in grass.
Pasture Crops That Do Best in Missouri

It is best to correct unfavorable soil conditions and sow the best grass-legume mixture that is adapted to the climate. It is not always possible, however, to drain wet soils, to shatter clay-pans or to protect the land from floods.

It also may be physically impossible or economically impractical to raise an impoverished soil to a high level of fertility by the first soil treatment. Fortunately, certain grasses and legumes will produce satisfactory yields of palatable and nutritious herbage on soils that are no better than medium in fertility. Some will grow successfully on wet, heavy-textured soils and on clay-pan or other shallow soils. At least one pasture grass will survive deep flooding.

If unfavorable soil conditions are not corrected by soil treatment or drainage, it is necessary to choose the best grasses and legumes which will tolerate the unfavorable conditions.

**ROTATION PASTURES**

High animal production can be obtained from rotation pastures which consist of "hay-type" grasses and legumes grown on crop land. Rotation pastures, intended to last only 2 to 4 years, fit into the regular crop rotation, following small grain and preceding the row crop. If the spring growth is not needed for pasture it can be harvested for hay or grass silage and the summer growth used for supplementary pasture.

Grasses and legumes used in rotation pastures must be productive, palatable, nutritious and easy to establish but they need not be long-lived.
This 22 acres of irrigated ladino clover-orchardgrass pasture near Mt. Vernon carried 30 head of dairy cows all summer three years in a row.

Mixtures suitable for different situations:

For Deep, Fertile, Well-Drained Soils
1. Bromegrass 10 and alfalfa 10 pounds per acre.
2. Timothy 5-10 and alfalfa 10 pounds per acre.
3. Orchardgrass 12 pounds and alfalfa 10 pounds per acre.
4. Tall fescue 8 pounds and alfalfa 10 pounds per acre.
5. Reed canarygrass 8 pounds and alfalfa 10 pounds per acre.
6. Bromegrass 10 and ladino 1 pound per acre.

CAUTION: Mixtures 1, 2, and 6 cannot be grazed safely by cattle or sheep after having been harvested for hay or grass silage because mowed bromegrass or timothy makes too little regrowth to balance the legume and prevent bloat.

For Shallow Soils Fertilized and Limed Adequately
1. Orchardgrass 12 and ladino 1 pound per acre.
2. Tall fescue 10 and ladino 1 pound per acre.
3. Tall fescue 10 and sweetclover 10 pounds per acre.

For Infertile Soils Fertilized Only Moderately
1. Timothy 5-10 and annual lespedeza 25 pounds per acre.
2. Orchardgrass 10 and annual lespedeza 25 pounds per acre.

3. Tall fescue 10 and annual lespedeza 25 pounds per acre.

PERMANENT PASTURES

Much farm land should be left permanently in grass because of steep slopes or for other reasons. Pastures intended to occupy land 8 or more years are classed as permanent pastures. Such pastures may be renovated by tilling, fertilizing, and reseeding from time to time, but they are seldom plowed out and planted to row or close-drilled crops. At least one of the grasses and one of the legumes in permanent pasture mixtures should be long lived or a consistent reseeder.

Mixtures suitable for permanent pasture in Missouri:

For Deep, Fertile, Well-Drained Soils
1. Bromegrass 10 and ladino 1 pound per acre.
2. Bromegrass 5, timothy 3, and ladino 1 pound per acre.
3. Bromegrass 10, alfalfa 6, and ladino ½ pound per acre.
4. Orchardgrass 12 and ladino 1 pound per acre.

For Shallow Well-Drained Soils Fertilized and Limed Adequately
1. Orchardgrass 12 and ladino 1 pound per acre.
Here's a winter barley pasture helping round out a year-'round pasture program for a Crawford County farmer.

2. Tall fescue 10 and ladino 1 pound per acre.
3. Kentucky bluegrass 1, timothy 3, and birdsfoot trefoil 5-10 pounds per acre.

For Gumbo Soils Fertilized and Limed Adequately
1. Tall fescue 10, alsike 3, and ladino 1 pound per acre.
2. Orchardgrass 10, reed canarygrass 5, alsike 3, and ladino 1 pound per acre.

For Fertile Soils Subject to Flooding
1. Reed canarygrass 8, timothy 3, and alsike 3 pounds per acre.

For Infertile Soils, Limed Adequately but Fertilized Only Moderately
1. Orchardgrass 12 and annual lespedeza 15 pounds per acre.
2. Tall fescue 10 and annual lespedeza 15 pounds per acre.
3. Redtop 5 and annual lespedeza 15 pounds per acre.

These are average seeding rates. Less seed is required if it is "band seeded" on a well-prepared seedbed. More seed is required if the seedbed is cloddy or if seeding is done in a manner which distributes the seed unevenly or leaves some seed uncovered or deeper than 1 inch. Heavy seeding rates will not insure establishment on loose seedbeds, on soils less fertile than the seeded species require, in grain crops fertilized with nitrogen and harvested for grain, or if seeding is untimely.

ANNUAL PASTURE CROPS

Annual pasture crops occupy the land for only one year, although such an annual mixture as wheat-lespedeza may be grown repeatedly on the same field.

1. Rye 2 bushels per acre.
2. Rye 1 ½ bushels and hairy vetch 15 or crimson clover 10 pounds per acre.
3. Rye 1 bushel, ryegrass 10 pounds, and hairy vetch 15 or crimson clover 10 pounds per acre.
4. Wheat 1 ½ bushels per acre.
5. Wheat 1 bushel and crimson clover 10 pounds per acre.
6. Winter barley 2 bushels per acre.
7. Winter barley 1 ½ bushels and crimson clover 10 pounds per acre.
8. Winter oats 3 bushels per acre.
9. Winter oats 2 bushels and crimson clover 10 pounds per acre.
10. Annual lespedeza (in grain crop) 25 pounds per acre.
11. Sudangrass 25 pounds per acre.
How to ESTABLISH the Pastures

"Band seeding" kits can be obtained to adapt your grain drill for seeding grass.

The best time to sow perennial grasses for permanent pasture is late summer: August 15 to 31 in northern Missouri; August 20 to September 7 in central Missouri; and September 1 to 20 in southern Missouri.

If either alfalfa or ladino is to be included in the pasture mixture, it should be sown with the grass in late summer.

Late summer seedings of alsike clover or birdfoot trefoil are less dependable, but will succeed if the seedlings emerge quickly and grow vigorously. Early seedling emergence will occur only if viable seeds are covered ¼ to ½ inch deep in moist soil pressed firmly about the seed. The soil must be both moist and fertile to promote vigorous seedling growth.

Annual lousepeadea and sweetclover should be sown only in late winter or early spring.

Fall drouth and grasshoppers may kill late summer seedings, but spring seedings face the usually greater hazards of weeds and summer drouth. Furthermore, pasture established in late summer can be used fully during the first year, but only limited use can be made of spring-sown pastures during the year of seeding.

Rotation pastures usually are seeded in the spring, either on fall-sown grain or with oats. Permanent pastures also can be sown in the spring. If seeded in fall-sown grain, the grass-legume mixture should be broadcast during late February or March while the ground is still freezing at night, or it should be drilled as early after spring thaws as the seeding machine can be operated. Drilling is required if additional fertilizer is to be applied with the grass at seeding.

If the oat crop is primarily for grain production, plant it as early in March as the land can be worked and sow the grass-legume mixture at the same time. If the establishment of the grass-legume mixture is of primary importance, however, it usually pays to take more time for thorough seedbed preparation and delay the seeding until late March or early April.

Timothy, redtop, and bluegrass can be sown successfully with wheat or with other fall-sown grains after the fly-free date. If this is done, the legume should not be seeded until late winter or spring. It is not advisable to sow orchardgrass, bromegrass, or tall fescue as late as October, except in southern Missouri.

Dual or other Hessian fly resistant wheat, rye, winter barley or winter oats intended for fall and spring grazing should be sown in late August or early September. Hairy vetch or crimson clover also should be sown then. If varieties of wheat not resistant to Hessian fly are used, seeding should be delayed until the fly-free date. This later seeding usually does not make enough fall growth to be pastured before spring.
SEEDBED

To make the mellow, compact, weed- and grass-free seedbed required for the satisfactory establishment of pasture grasses under any but the most favorable weather conditions, it usually is necessary to plow. A good seedbed is essential to the success of a late summer seeding because of the necessity for prompt germination and the danger of the soil drying after seeds start to germinate. Plowing should be done several weeks before seeding to allow time for rains and for disking, harrowing and rolling to compact the soil, germinate weed seed and kill weed seedlings.

If you are renovating an old pasture that is so steep that the plowed surface might erode badly, only surface tillage with a brush and bog (cutaway) disk, disk harrow or field cultivator may be advisable. The objective is to kill existing plants and leave the dead vegetation on the surface as a mulch. Successive cultivations, each at a right angle to the preceding one, made during dry, hot periods of summer may be required to subdue old sods of bluegrass, redtop or other sod-forming grasses. Less tillage usually is required to kill competing plants where only weeds and annual grasses occupy the land. If three-fourths or more of the surface is occupied by a sod-forming grass, even steep slopes can be plowed shallow with small loss from erosion.

No special seedbed preparation is required for spring seedings made in fall-sown grain. With spring oats, however, disking and harrowing to level the surface, reduce clods, and compact the soil more than necessary to get a stand of oats may mean the difference between success and failure of the pasture seeding.

SEEDING METHODS

Poor stands develop from seed that isn’t covered or from seed that is covered too deep. Experiments have shown that the small seeds of pasture grasses and legumes produce the largest percentage of emerged seedlings and the most vigorous seedlings if the seed is covered only one-fourth to one-half inch. Few seedlings emerge from seed placed deeper than one inch. Sudangrass seedlings, because of the larger size of the seed, can push up through 2 inches of soil.

Another important seeding practice is uniform distribution. Since it is impossible to avoid placing some seed too deep in loose or cloddy soil, a compact seedbed is essential to shallow planting.

The seed can be broadcast by hand or by means of a cyclone or wheelbarrow seeder on the surface of a compact seedbed and can be covered by harrowing with the harrow teeth set nearly horizontal. No harrowing is required for an early spring seeding made in fall-sown grain if the seeding is done before night freezes cease. Rains will wash the seed into cracks in the soil surface caused by freezing and thawing and wash dirt over seed.

Good results have been obtained by rolling the land with a corrugated roller or cultipacker, broadcasting the seed and then rolling a second time at a right angle to the first. The first rolling compacts the soil and leaves shallow furrows into which much of the seed will fall. The second rolling covers the seed shallow, presses the soil firmly about the seeds so that they absorb moisture readily, and leaves a corrugated surface that is less likely to crust than a smooth one.

There is at least one seeder on the market which drops the seed between a large corrugated roller in front and a smaller one behind; rolling and seeding are done in one operation.

Grasses and legumes also can be sown with a clover-alfalfa drill or a grain drill equipped with a grass-seeding attachment. If the latter is used on a seedbed that is less firm than it should be or if fertilizer or grain is drilled at the same time grass seed is sown, the grass-seeder spouts should be tied back to drop seed behind the drill disks.

Band seeding not only gives better stands of pasture grasses and legumes but does it with one-third less seed. The short metal tubes of the grass-seeding attachment are replaced by long tubes. The lower ends of these tubes are fastened just behind and a little above the grain-fertilizer tube outlets so the grass-legume seed will drop into the drill furrow directly above the band of drilled fertilizer, with about 1½ inches of soil separating seed and fertilizer. Experiments have shown that seedlings from seed placed directly over bands of starter fertilizer grow more rapidly and have a better chance to survive adverse weather and weed competition than seedlings on either side of this band.

Seeds of similar size and weight, such as timothy and clover, can be mixed and drilled together; but if the small, heavy seed of clover, alfalfa, or timothy is mixed with the lighter seed of orchardgrass, bromegrass, or tall fescue, the jolting of the seeder may cause the heavier seed to sift to the bottom and be planted ahead of the lighter seed.

Bromegrass seed, which is light and chaffy, tends to bridge over seeder openings and clog drill tubes. Some seeding machines are equipped with special agitators for sowing bromegrass seed, but it usually is necessary to mix bromegrass seed with heavier materials to get it through a drill. Ten pounds of bromegrass mixed with 5 or 6 pecks of oats can be drilled through the grain box and 10 pounds of bromegrass seed mixed with 150 pounds of phosphate fertilizer or with 150 pounds of ground limestone can be drilled through the fertilizer attachment. Shallow seeding is as essential with this method as with any other.

Bromegrass has also been sown successfully by dribbling the seed from a scoop into an endgate seeder at the desired seeding rate.
Inoculation of Legumes

Legumes will grow successfully in the seed mixture and fix atmospheric nitrogen only if inoculated with bacteria suitable for that particular species. Unless you know the legume has been grown on the land within the past 2 or 3 years and its roots have been well nodulated, the seed should be inoculated within a few hours of sowing with a commercial culture of inoculant labeled for that particular species of legume. Commercial inoculants are sold by seed dealers. Moistening the seed slightly with skimmed milk or a dilute solution of syrup in water will cause more of the inoculant to adhere to the seed.

Legume seed inoculation by the dealer by a recently developed vacuum process may be equally effective and less troublesome.

The thorough inoculation of birdsfoot trefoil is especially important because this legume has not been grown extensively in this country and it does not cross-inoculate with any other legume, domestic or wild, which has grown here. It usually is advisable to inoculate seed of alfalfa, sweetclover, or vetch. Inoculation of lespedeza, ladino, and other true clovers (Trifolium sp.) is required less often because they are so widely grown. When in doubt, however, it always is better to inoculate.

Companion Crop

Pasture and meadow seedings often are made with a companion crop of wheat, oats, barley, or rye: (a) to produce grain while the grass-legume mixture is being established; (b) to reduce erosion until the grass-legume mixture provides a protective cover; and (c) to give the grass-legume seeding some protection from weeds.

The grain crop does retard the growth of intersown grasses and legumes by shading and by competing for soil nutrients and moisture. Seedling grasses and legumes dwarfed by the competing grain crop often fail to survive hot dry weather which follows grain harvest. Grain crops also may lodge during wet seasons, and a lodged companion crop usually destroys the pasture seeding.

Competition by the grain crop with the grass-legume seedlings can be reduced by sowing early-maturing, stiff-strawed varieties of cereals and by pasturing during March and early April before the grain "joints."

Heavy applications of fertilizer applied at seeding of fall-sown cereals and of nitrogen applied in the spring increase the harmful effects of the companion crop. Withholding one-half of the phosphate fertilizer until spring and drilling it with grass and legume seed, on the other hand, increases growth of the seedlings and helps them to survive.

Reducing the rate of seeding spring-sown companion crops reduces the competition they offer the grass seeding, but the rate of sowing fall-sown grains has little or no influence on competition.

Companion crops should not be sown with pasture seedings made in late summer. Spring oats sown at one-half the customary rate and pastured off or cut early for
hay or silage are usually less harmful, however, than the weeds with which a spring seeding must compete if no companion crop is used.

Rotation pastures are sown with whatever grain crop they are to follow in the crop sequence. If the grass-legume seeding made in grain fails, it can be made again in late summer without a companion crop.

**FERTILIZER AND LIME**

The poorest soils in Missouri will produce some pasture if seeded to annual lespedeza, hop clover, redtop, tall fescue or some combination of them. The application of lime and fertilizer is wholly impracticable on some rocky, stump-strewn, steep slopes on which seed can be scattered only by hand.

No pasture plant will make much growth, however, on impoverished soils without at least moderate applications of the required mineral plant nutrients. The more productive and palatable pasture grasses and legumes such as bromegrass, ladino, and alfalfa will not grow at all on infertile soils unless soil deficiencies are corrected by heavy applications of fertilizer and lime.

If the seed mixture includes bromegrass, alfalfa, ladino or reed canarygrass, the basic soil treatment should consist of the amount of phosphate, potash, and limestone which soil test shows the soil to require. Thus, a soil low to very low in phosphorus will require 600 to 900 pounds of 0-20-0, 250 to 400 pounds of 0-46-0, or 1000 to 1500 pounds of rock phosphate per acre. A soil low to very low in potash will require from 200 to 300 pounds of 60 percent muriate of potash an acre. A soil low in calcium will require 2 to 4 tons of agricultural limestone.

Readily available forms of phosphate and potash should be drilled into the plowed or disked soil at or ahead of seeding. Bulk rock phosphate should be plowed or disked into the soil. Limestone should be applied from 6 to 12 months before sowing alfalfa or sweet clover, legumes which do not tolerate acid soils.

In addition to the basic soil treatment, a starter fertilizer should be applied at or shortly before seeding. If you use a seeder that applies bands of fertilizer 1 ½ inches directly beneath the grass and legume seed, complete fertilizer (12-12-12 or similar ratios) should be applied at seeding.

Most grain drills, even if equipped with a grass seeder, will not sow a mixture of legume and grass seed (except timothy and reed canarygrass) through the grass seeder. It usually is necessary to sow orchardgrass, tall fescue, bromegrass or similar seed through the grain box of the drill, which places seed and fertilizer together. Phosphate fertilizer (0-20-0 or 0-46-0) does not injure grass or legume seed, but the nitrogen and potash in such fertilizers as 12-12-12 may kill seed or seedlings if drilled in contact with the seed. This type of injury can be avoided by drilling fertilizers which contain nitrogen or potash ahead of seeding.

From 200 to 300 pounds of 10-10-10, 12-12-12, 15-15-15, 0-20-0, or 100 pounds of 0-46-0 applied as starter fertilizer stimulates seedling growth and enables young grasses and legumes to better withstand weed competition and to survive unfavorable weather. This supplements but does not remove the need for the heavier basic treatment of phosphate, potash, and lime which soil test shows the soil to require.

If you are unable to make the heavy applications of fertilizer required for maximum pasture production, smaller but profitable pasture returns can be obtained by sowing orchardgrass, redtop, tall fescue or timothy with annual lespedeza on infertile soils. You will need to apply from 200 to 300 pounds of 12-12-12, 8-24-8 or similar fertilizer at or shortly before seeding. Enough limestone to satisfy the lime requirement of the soil should always be applied before seeding, if a lime spreader can be driven over the land.

If less fertilizer than the soil needs is applied, additional fertilizer will be required in a few years to maintain productivity of the pasture.

Alfalfa and ladino, when sown on soils which contain adequate supplies of mineral nutrients but are deficient in organic matter, sometimes outgrow the companion grass. It is advisable to apply 30 or 40 pounds of nitrogen per acre in mixed fertilizers or as ammonium nitrate to such soils at seeding time to stimulate grass growth.

**FIRST YEAR MOWING AND GRAZING**

If weeds threaten to smother seedling grasses and legumes, cut them with a mower. The taller the weeds are allowed to grow before mowing and the shorter they are cut, the better the control. Delay mowing until the weeds begin to injure grass-legume seedlings and then mow close to the ground.

Spring-sown pastures should not be grazed before the grass-legume mixture grows 4 or 5 inches, unless earlier grazing is required to control weeds. If weeds threaten to destroy the grass legume seedlings and mowing is not feasible, enough cattle should be turned on the pasture to graze down weeds and grass in a few days. Afterward they should be removed to allow pasture grasses and legumes to recover.

A new pasture weakened by grazing or unfavorable weather should be protected from grazing from September 15 to November 15 of the first grazing season.
Grasses

BROMEGRASS

On deep, well-drained soils that contain at least a moderate amount of organic matter and a good supply of phosphorus, calcium, and other mineral plant foods, bromegrass is productive, palatable, nutritious, and long-lived. It is more drought resistant than bluegrass, orchardgrass, or redtop. Although creeping underground stems (rhizomes) will thicken sparse stands, bromegrass crowds companion legumes less than most adapted pasture grasses and is easily eradicated by plowing.

Although an excellent pasture grass, bromegrass has limitations. Like alfalfa, its roots must have plenty of room in which to grow. If their downward extension is limited by a clay-pan, hard-pan, rock, or high-water table, the above ground growth and lateral spread are so retarded that the bromegrass yield is low and weeds and better adapted grasses invade it.

Bromegrass has an even higher nitrogen requirement than most other grasses. Unless the soil contains at least a medium supply of organic matter as indicated by dark color or by soil test, nitrogen must be added to the soil at seeding time. Where this was not done on Dexter Fine Sand of the Sikeston Ridge, too little grass was established in a bromegrass-ladino mixture to protect cattle from bloat, although bromegrass was sown at 50 percent above the recommended rate.

Bromegrass becomes "sod-bound" and makes small growth on even the more fertile soils unless nitrogen is supplied liberally by a companion legume or by annual or more frequent applications of fertilizer.

Bromegrass seed is so light and chaffy that it does not flow readily through seeders and drills. Seeding machines must be equipped with special agitators to prevent bridging over the openings or the grass seed must be mixed with heavier material such as oats, phosphate fertilizer, or limestone.

There are two well-defined types of bromegrass: southern, early maturing, and northern, late maturing. Only the southern type is adapted to the climate of Missouri. Varieties of this type now available are Achenbach, Lincoln, Elsberry, Southland, and Lancaster. Bromegrass is better adapted to northern than to southern Missouri even if southern varieties are used.

KENTUCKY BLUEGRASS

Kentucky bluegrass is the dominant species in most of the better permanent pastures of the state, especially in central and northern Missouri. In most of these pastures, bluegrass has volunteered, replacing either timothy grown for hay or blue stems and other native grasses driven out by close grazing.

Few pastures have been sown to bluegrass. Seeding it is not recommended except with timothy and birdsfoot trefoil. If the soil is suitable, bluegrass will gradually invade the pasture; so any long-time advantage which might result from bluegrass will be obtained without sowing it.

Many low-yielding bluegrass pastures can be improved by applications of lime and fertilizer, and by establishing ladino or lespedeza in them. Seldom should the bluegrass be completely destroyed in order to substitute other grasses.

ORCHARDGRASS

Orchardgrass produces as much forage as bromegrass or timothy. It is somewhat less palatable but cattle and sheep will eat enough of it to supply their nutrient requirements for high production if the pasture is grazed heavily enough or mowed to prevent excessive stem growth.
Orchardgrass lives longer under grazing than timothy, but not as long as bromegrass. Thin stands do not thicken; for this reason, orchardgrass should be sown at the rate of 10 pounds per acre in late summer if conditions are favorable and 15 pounds if conditions are unfavorable. Spring seedings should be sown at the 15-pound rate.

Orchardgrass will grow on soils low in organic matter and on shallow soils if surface drainage is good. On level clay-pan soils that retain excess moisture near the surface during winter, heaving caused by alternate freezing and thawing weakens the plants and often destroys the stand within three years. Tall fescue and redtop are better grasses for such land. The heaving is much less when the orchardgrass is grown with ladino than when grown alone or with lespedeza.

Orchardgrass is a better grass companion for ladino than bromegrass on shallow soils or on soils low in organic matter. Orchardgrass also makes more regrowth after hay or grass silage harvest; Therefore, it affords better protection against bloat by cattle or sheep grazing the grass-alfalfa or grass-clover aftermath.

Although orchardgrass is one of the better grasses to grow with ladino or alfalfa on naturally fertile or heavily fertilized soil, it also provides good pasture when grown with annual lespedeza on limed but unfertilized soils of medium fertility and on poor soils if limed and fertilized only moderately. A badly eroded and exhaustively cropped field at Columbia which was limed, fertilized, and seeded to orchardgrass and Korean lespedeza in 1945, produced an average annual beef cattle gain of 184 pounds per acre during the four years 1946, 1947, 1948, and 1951. This pasture appeared equally good during 1949 and 1950, but gains were not measured.

Useful stands of orchardgrass usually last 8 to 10 years in well-managed pastures, but orchardgrass has been killed by drouths which bromegrass and tall fescue survived.

REDTOP

Redtop is less productive and less palatable than orchardgrass, but it grows better on level, clay-pan soils and on infertile soils than any other grass except tall fescue. A mixture of redtop and lespedeza is suitable for clay-pan soils or infertile soils to which only a light application of fertilizer is made before seeding.

Beef steers gained 223 pounds per acre annually on redtop and lespedeza in three years of testing at Columbia (1946-1948). The pasture was on a naturally infertile and exhaustively cropped claypan soil, which had been limed and fertilized moderately.

The useful life of an orchardgrass-lespedeza pasture can be prolonged by adding a pound or two of redtop seed for each acre sown. Redtop does not survive drouth any better than orchardgrass.

REED CANARYGRASS

Backwater from the Missouri River which flooded plots located between Waverly and Carrollton March 17 to 19, March 25 to 27, April 16 to 21, May 15 to 20, May 23 to 31, June 6 to 9, June 15 to 27, and July 1 to 9, 1945, killed redtop and tall fescue but did not kill reed canarygrass. It put out new leaves as soon as the water drained away.

In addition to its flood tolerance, reed canarygrass is high yielding, and produces a large part of its leafy, palatable growth during summer when additional pasture often is most needed. It also is one of the more drought-resistant grasses.

Reed canarygrass is long-lived and sod-forming. This insures a gradual thickening of stands that start off thin, provided the soil is well supplied with nitrogen. Reed canarygrass does best on dark soils which have a high organic matter content. Light-colored soils must be fertilized heavily with nitrogen or must be manured heavily for the successful production of this grass.

It is advisable to sow timothy with reed canarygrass because of the high price of reed canarygrass seed. Alsike is the only legume adapted to the conditions for which reed canarygrass is best suited.

Reed canarygrass seed germinates slowly; spring seedlings do not grow fast enough to compete with summer annual weed grasses. Because of this and the frequent occurrence of spring floods on sites for which reed canarygrass is most useful, late summer (August or September) is the best time to sow.

SUDANGRASS

Sudangrass planted in late May or early June will furnish good pasture from July to October. If lespedeza is not to be available in small grain stubble, sudan is the best crop to sow for summer supplementary pasture. Even if lespedeza is available, many farmers prefer to have their producing dairy cows on sudangrass during September and October. For this purpose, sudangrass can be sown in late June on land from which wheat has been harvested or from which second-year sweetclover has been pastured. Sudangrass pasture is good drouth insurance.

There is little or no danger of cattle being poisoned by sudangrass if reasonable precautions are taken. Seed containing even a trace of sorghum seed should not be sown, and cattle and sheep should not be turned on sudangrass before it has grown 10 or 12 inches. Sudangrass which has been overgrazed or has had its growth checked by drouth or frost should not be grazed until the new shoots have grown 10 or 12 inches.

Young plants and new shoots of sudangrass contain more cyanogenic glycoside (the material which is converted into poisonous HCN in the rumen of cattle and sheep) than older plants or shoots. Even this young
growth hardly ever contains lethal amounts, except where sudan is grown on soils high in nitrogen and low in phosphorus.

A survey in 1953 of livestock losses on sudangrass, reported by William J. Murphy in Missouri Agricultural Extension Circular 659, *SUDANGRASS IN MISSOURI*, revealed that in all cases the poisoning occurred when the animals were first turned into the fields—within a few minutes or an hour or so after being turned in. There were some cases of poisoning where the cattle were turned in after having been away from the sudan for 10 days to two weeks to allow regrowth.

Precautions recommended to be followed when cattle or sheep are first turned on or returned to sudan grass pasture are:

1. The use of trial animals.
2. Close supervision for two hours after first turning in.
3. Prompt removal if animals show signs of being affected.
4. Prompt veterinary treatment of affected animals—very effective if in time.

"Some veterinarians are now selling a treatment in pill form that can be given by the farmer. While the effectiveness of this antidote has not been fully established, all reports received from farmers to date [1956] have been favorable."

**TALL FESCUE**

Tall fescue produces large yields of both forage and seed. It lives a long time, resists the encroachment of weeds, grows on almost any soil, survives drought better than either orchardgrass or redtop, is easy to sow and, when established, holds the soil against erosion. However it is less palatable than orchardgrass and no better than redtop in this respect.

Experiments have shown that most beef steers will eat only enough tall fescue during July and early August to satisfy their maintenance requirements. Yet five two-year-old steers grazing five acres of tall fescue and lespedeza at Columbia from May 6 to July 10, 1950, gained 2.18 pounds per steer daily. When they were returned to this pasture August 21, they gained 1.54 pounds per head daily until September 28. Lespedeza supplied almost none of the herbage before July 10, and less than one-half of it after August 21.

In tests at Lathrop steers gained 516 pounds per acre and 2.2 pounds per steer daily in 1950, 350 and 1.2 pounds in 1951, and 348 and 1.9 pounds in 1952 on fescue-ladino pasture. In 1953, a very dry year, they gained 236 pounds per acre and 2.0 pounds per steer daily. Steers gained 316 pounds per acre annually and 2.0 pounds per steer daily during the three years 1950 through 1952 on a tall fescue-ladino pasture at Columbia.

A mixture of tall fescue and second-year sweet clover produced beef cattle gains of 353 pounds per acre at Sikeston during 1948. After these steers were removed September 10, the fescue made enough growth, which remained fully green until January, to maintain three cows an acre from December 10 to 31.

No steer bloated in these experiments either on tall fescue and ladino or on tall fescue and sweetclover.

If the soil is suitable for growing bromegrass or orchardgrass, one of these more palatable grasses makes a better mixture with ladino. Tall fescue is the best grass to grow with ladino on wet, heavy clay, or gumbo soils, or on the level, clay-pan soils where orchardgrass is known to heave badly.

Tall fescue resists freezing and remains green later in the winter than other pasture grasses, if plenty of nitrogen is supplied by the companion legume or by nitrogen fertilizer applied early in September. The leaves sometimes remain completely green until the end of December in central and southern Missouri, and from one-half to two-thirds green all winter in the southern part of the state. Cattle show a preference for tall fescue after October even if bromegrass and orchardgrass are equally accessible.

Tall fescue does not continue to grow during cold weather but the fall growth saved provides good late fall and winter pasture. Sods mowed and fertilized with 200
pounds of ammonium nitrate per acre early in September produced new growth equivalent to 1500 pounds of hay per acre by early November. Another advantage, tall fescue sod can be pastured at times when wet or recently thawed fields of rye, wheat, or winter barley would be too soft. Tall fescue fertilized with nitrogen in March is ready to be grazed two weeks earlier in the spring than other pasture grasses.

Tall fescue sown at not less than 25 pounds of seed per acre is an excellent grass for terrace outlets, grass waterways and other soil-holding purposes.

The two varieties of tall fescue now available (Alta and Kentucky 31) appear to be equally well adapted in all sections of Missouri.

**TIMOTHY**

Timothy is another good pasture grass, but it is shortlived under grazing. It is most useful, therefore, in rotation pastures that are not intended to last longer than three years. Because the seed is cheaper and easier to sow and because fewer pounds of seed are required to establish comparable stands of grass, timothy is sometimes substituted for one-half of the bromegrass seed in establishing more permanent pastures. As the timothy plants die, bromegrass will spread and replace them.

Timothy seedlings also are less competitive than most other grass seedlings. This quality makes timothy particularly suitable for the timothy-bluegrass-birdsfoot trefoil mixture because of the inability of birdsfoot trefoil seedlings to withstand severe grass competition.

Sow 3 to 5 pounds of timothy seed per acre when sowing it in late summer without a companion crop, or when sowing it with wheat after the fly-free date. Sow 10 pounds when seeding it in the spring with oats. The spring seeding will establish a thinner stand, even at the higher seeding rate.

Timothy mixed with ladino may not grow enough during the summer to protect ruminants from bloating on the lush growth which the clover will make during a wet summer.

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**Legumes**

**ALFALFA**

Alfalfa grown with grass makes excellent pasture for all classes of livestock. Although cattle and sheep cannot graze pure stands of alfalfa safely, steers did not bloat on a bromegrass-alfalfa mixture at Lathrop during one year (1945) of grazing, or at Sikeston during three years of grazing. Alfalfa provided more than 50 percent of the forage at Sikeston one year.

The steers gained 332 pounds per acre at Lathrop, and 315 pounds per acre per year at Sikeston.

Steers gained 342 pounds an acre annually and 1.9 pounds per steer daily at Sikeston during the three-year period 1956 through 1958 on an orchardgrass-alfalfa pasture. No bloat occurred.

Alfalfa grown with orchardgrass, and possibly with tall fescue or reed canarygrass, will produce a spring crop of hay or grass silage. Afterward, it can be used to provide summer grazing to supplement less drought-resistant pastures which have been grazed to capacity during spring and early summer. Bromegrass-alfalfa or timothy-alfalfa mixtures are not suitable for this purpose. Bromegrass and timothy make too little growth recovery after mowing to provide protection against bloat.

The short life of pastured alfalfa limits its use to rotation pastures. Useful stands of alfalfa seldom persist longer than three years in pastures even if carefully managed; one year of close grazing will kill it. The useful life of bromegrass-alfalfa pastures has been extended successfully in two trials at Lathrop and in one at Sikeston by sowing ladino in the bromegrass after much of the alfalfa had died. The bromegrass sod was disked at Sikeston, but not at Lathrop.

The fact that alfalfa grown with grass for pasture, like alfalfa grown alone for hay, thrives only on soils that are deep, well-drained, and fertile limits still further its use for pasture.
ALSIKE CLOVER

Alsike is too short-lived to serve as the principal legume in permanent pastures, although it is the only legume adapted to lands which flood. It will reseed to a degree on wet lands. It is often better to sow 1/2 pound of ladino with 2 to 3 pounds of alsike than to sow 1 pound of ladino as the only legume in a grass-legume mixture on poorly drained land or on gumbo soils.

BIRDSFOOT TREFOIL

Birdsfoot trefoil is in some respects the best pasture legume. Established plants, if not diseased, withstand crowding by such competitive grasses as bluegrass and tall fescue. It is productive, palatable, and nutritious. It does not cause bloat in cattle or sheep.

The drawbacks for trefoil are that it is difficult to establish and plants two years old or older are susceptible to killing by root-rotting diseases. Better inoculation, improved seeding practices, chemical weed control, and superior varieties now in process of development may make birdsfoot trefoil easier and less expensive to grow. Until then, other legumes had better be used in most pasture seedings.

Since birdsfoot trefoil grows better than any other legume in bluegrass sod, if it gets started, it is a good idea to use some in any seed mixture that contains Kentucky bluegrass as the principal grass.

HOP CLOVER

Hop clover (Trifolium procumbens) is a yellow blossom, winter annual which has been introduced by natural seed dispersion into many Ozark pastures. Under favorable conditions, it will produce medium yields of high-quality forage which can be pastured during April, May, and June, or can be cut for hay in June. It will grow on infertile soils, and it reseeds consistently and abundantly, so that thin stands thicken.

Better stands result from broadcasting the seed on closely grazed or mowed sods than from sowing it on a well-prepared seedbed. Seeding should be done in late September as the seeds do not germinate before October. Dry weather during October is the unfavorable condition most likely to cause partial failure of a new seeding or of a natural reseeding.

Hop clover is most useful in the southern half of Missouri on land which cannot be tilled, fertilized and limed for the establishment of more productive grasses and legumes. A pound or less of seed per acre is enough.

LADINO CLOVER

Ladino is a strain of white clover which is much superior to common white clover and somewhat superior to Louisiana white clover in herbage yield and in drouth survival. It is equal to them in palatability and nutritive quality. It also releases to companion grasses more fixed nitrogen than most other legumes.

Numerous fleshy, prostrate stems (stolons) grow horizontally so that a single ladino plant may extend over several square feet. Because of this and the small size of the seed (800,000 seed per pound) a pound of seed is usually enough to sow an acre. The herbage available to grazing animals consists entirely of leaves and blooms that grow from nodes (joints) of the stolons. Fibrous roots grow from the same joints.

Ladino thrives with bromegrass on the deeper soils and also grows successfully with other grasses on shallower soils and on wet, heavy clays (gumbo), although it does not withstand a flooding longer than a few hours.

Ladino will grow on light-colored soils low in organic matter if such soils are well supplied with phosphorus, potash, and calcium (lime). It is particularly sensitive to a phosphorus deficiency. Soils low in phosphorus require from 250 to 400 pounds of 0-46-0 or from 1000 to 1500 pounds of rock phosphate per acre for the satisfactory growth of pasture mixtures containing ladino as the principal legume.

Ladino has two serious defects. It is more likely than other legumes to cause cattle and sheep to bloat and it stops growing and begins to wilt sooner than most other legumes during dry weather. Although less drought tolerant than alfalfa or birdsfoot trefoil, ladino has survived dry weather which killed common white clover.

To reduce the danger of ruminants bloating on ladino, sow with the clover a grass adapted to existing soil conditions. Sow enough grass seed, and apply enough nitrogen or mixed fertilizer to supply 30 or 40 pounds of nitrogen per acre if the soil is deficient in organic matter and in available nitrogen.

Only 0.36 inch of rain fell at Sikeston from July 15 to August 15, 1949, although rain was abundant before and after those dates. The bromegrass-alfalfa pasture and the lespedeza pasture each carried one steer per acre during this dry period, but all cattle had to be removed from the bromegrass-ladino pasture because of a shortage of forage.

A drouth-resistant pasture is needed to supplement ladino-grass mixtures during summer even more than to supplement permanent or rotation pastures which contain other legumes. If plenty of moisture is available, however, ladino is not retarded by hot weather.

Some drills and grass seeders cannot be adjusted to sow as little as 1 pound of ladino seed per acre. Ladino seed can be diluted with timothy seed. Alfalfa can be used for the same purpose; it has the additional advantage of adding a legume which tolerates dry weather better than ladino. Alaskan seed also mixes well with ladino seed and should be sown with it on wet lands.
Ladino has no equal as a pasture for hogs and poultry. They do not bloat and the sanitation hogs and poultry require to control internal parasites prevents the continued use of any pasture. Thus, grass need not be sown with ladino for hogs and poultry. For such pastures, ladino should be seeded at the rate of 2 pounds per acre without grass or grain in late summer; or in the spring with oats, which should be pastured or mowed before it shades the clover injuriously.

**ANNUAL LESPEDEZAS**

Lespedeza occupies more acres of pasture in Missouri than any other grass or legume. This is because of its wide soil adaptation, high palatability and good nutritive quality, good summer growth, ease of establishment, consistent reestablishment by self-seeding, and an abundant supply of seed at reasonable prices.

Of the two species, Korean (*Lespedeza stipulacea*) and Kobe (*Lespedeza striata*), Korean is used much more in Missouri. The seed is more plentiful and cheaper. Korean will reseed before frost in all parts of the state. The later-maturing Kobe is better than Korean for use with orchardgrass, redtop, or tall fescue in the southern one-third of Missouri. Kobe withstands the competition offered by these grasses better and is less susceptible than Korean to bacterial wilt, which is more injurious to lespedeza in grass sod than in grain stubble. Early-maturing strains of Kobe now under test may partly replace Korean in grass-legume mixtures but Korean probably will continue to be sown with cereal crops for summer pasture.

Alfalfa, ladino, and birdsfoot trefoil produce larger yields of forage than lespedeza on soils suitable for their growth. But much Missouri land used for pasture cannot be made suitable for growing alfalfa. Most of it requires expensive soil treatment to make it suitable for growing ladino, and birdsfoot trefoil is difficult and costly to establish.

Lespedeza, on the other hand, can be grown successfully on any cleared land in the state with minimum seedbed preparation and without expensive soil treatment. (Productivity of lespedeza is much increased by liming the soil according to its need for calcium and by applying at least moderate amounts of needed fertilizer.)

Steers gained 204 pounds per acre annually and 1.9 pounds per steer daily during the 12 years 1947 through 1958 on a bluegrass-lespedeza pasture near Lathrop. This soil was shown by soil test to be slightly acid and low in phosphorus, but not too low to support a 75 percent stand of bluegrass. Steers gained 268 pounds per acre annually and 2.1 pounds per steer daily during the three years 1950 through 1952 on a bluegrass-lespedeza pasture at Columbia.

Sowing lespedeza in bluegrass sod, *without* soil treatment, increased beef cattle gains 55 percent over a 5-year period (1940 through 1944) at Lathrop. But lespedeza was not the best legume to use in pastures which were heavily fertilized for maximum production. A bluegrass-lespedeza pasture to which the equivalent of 650 pounds of 0-46-0 fertilizer per acre were applied produced only 12 pounds more beef per acre annually, 1946 through 1950, than another bluegrass-lespedeza pasture which received no fertilizer. This does not indicate that fertilizing pastures does not pay, but it does demonstrate that more productive legumes (alfalfa or ladino) should be grown instead of lespedeza in the more heavily fertilized pastures.

Although lespedeza has persisted by self-seeding from 1946 through 1958 in the unfertilized bluegrass pasture at Lathrop, it could not be maintained even by repeated reseeding in the dense stand of bluegrass in the pasture that was fertilized heavily with phosphate.

Numerous experiments have shown that lespedeza grown with wheat, oats, rye, or barley will supply pasture from July to October that will give cattle gains of 100 pounds per acre, if the cereal is harvested for grain, or 150 pounds per acre, if the grain crop is pastured off or if it is cut early for hay or silage.

**WINTER VETCH AND CRIMSON CLOVER**

Although the winter annual legumes, hairy vetch and crimson clover, are used primarily as cover crops for soil improvement, they also are useful for fall, winter, and spring pastures when grown with wheat, rye, winter barley or winter oats. In Missouri their practical use for pasture is limited to the southern half of the state.

Vetch will grow on any well-drained soil, and is well adapted to sandy soils. Rye and vetch comprise the mixture most used for fall, winter, and spring pasture on sandy land. Vetch matures much later than rye and, for this reason, the mixture can be grazed later in the spring than rye alone.

Thorough inoculation is essential for the successful production of vetch.

Vetch can be managed to reestablish itself by natural reseeding. Vetch's hard seed, which causes it to volunteer in small grains, is objectionable if the cereal is to be harvested for grain.

Crimson clover is more palatable but lower yielding than hairy vetch. It grows well only on soils which are at least moderately fertile and which are well drained. Use of one of the improved "reseeding" varieties (Dixie or others) which contain some hard seed will reduce the danger of stand failure caused by quick germination following a light rain on dry soil.
Cereals for Pasture

Cattle gained 280 pounds per acre annually on wheat and lespedeza at Lathrop during the five-year period 1946 through 1950. Approximately half of this gain was made during April, May, and June, before lespedeza supplied an appreciable portion of the feed. Steers gained 288 pounds per acre annually on wheat and lespedeza at Sikeston during the 3-year period, 1948 through 1950.

Although wheat supplies more and better forage than other cereals from early April to June, it cannot be sown early enough to supply fall grazing unless Dual or other varieties resistant to Hessian fly are used.

Rye, because of its greater cold tolerance, supplies more winter pasture and is ready to be grazed earlier in the spring than other cereals. It also is better adapted to sandy soils. Rye heads and becomes starchy and unpalatable earlier in the spring than other cereals. Sowing Italian or common ryegrass with rye extends the usefulness of rye pasture later in the spring. Severe winter-killing of ryegrass is likely to occur in central or northern Missouri. This limits its use for pasture to the southern one-third of the state.

Winter barley supplies good fall and spring pasture in the southern half of Missouri and winter oats in the southern one-fourth.

Spring oats furnish too little forage to justify sowing them for pasture, but it is a good practice to pasture off oats grown primarily as a companion crop.

Additional information on growing and using cereal crops for pasture is given in Missouri Agricultural Extension Service Circular 618, An All-Year Pasture System for Missouri.

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