Improving MISSOURI PASTURES

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Improving Missouri Pastures

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Why Pastures Need Improvement

Are your pastures weedy and unproductive? Most Missouri permanent pastures are. The principal reasons for their poor condition are (1) soil infertility, (2) harmful grazing, (3) unfavorable weather, (4) diseases, and (5) insects.

Soil infertility is the most frequent cause of sparse stands and small growth of pasture grasses and legumes. Some pasture soils are deficient in potash; *most* untreated pasture soils are deficient in phosphorus and calcium. These mineral plant nutrient deficiencies can be corrected only by applying phosphate and potash fertilizers and agricultural limestone. All pasture soils contain less available nitrogen than the grass needs, unless the pasture contains a legume or is fertilized annually or more frequently with nitrogen fertilizer.

Undergrazing, overgrazing, starting too early, continuing too late in the fall, or spot grazing may reduce stands and yields of pasture grasses and legumes, and make inefficient use of what is left *(University of Missouri Station Bulletin 750, Managing Missouri Pastures).*

Stands of some of the more palatable and productive pasture grasses and legumes may be depleted or totally destroyed by drouth or excess moisture, by severe heat or cold, and by diseases or insects, even where growing on fertile soil. Sod-forming grasses such as bluegrass, bromegrass, and reed canary-grass will spread vegetatively and thicken in stand after the causes of stand depletion are removed. Grasses, like orchardgrass, and legumes, like alfalfa, which do not spread or reseed, have to be resown. Ladino clover and annual lespedeza may have to be resown, although their reestablishment sometimes occurs from a residue of seed in the soil.

Use of Fertilizer and Lime

What should be done to improve a pasture depends on (1) what causes its poor condition, (2) how much pasture increase can be used profitably, and (3) the equipment, labor, and other resources you have for pasture improvement.

For example, if drouth has killed ladino clover in recently renovated pastures without reducing stands of orchardgrass, bluegrass, or bromegrass, as actually happened at the Lathrop experiment field in 1953, nothing is needed except to re-establish the ladino. This has been

Tall fescue-ladino pasture at Columbia, September, 1950, (left) and September, 1952, (right). This pasture was sown in August, 1949, after the old sod had been plowed and worked into a good seedbed.

done without destructive sod tillage where grazing was correctly managed and precipitation was not much below normal.

However, if you want to sow bromegrass to *replace* bluegrass or to sow alfalfa or birdsfoot trefoil *instead of* the less drouth tolerant ladino, the bluegrass would have to be subdued by plowing or by thorough disking or field cultivating.

The decision whether to plow or to surface till would be governed by the slope of the land and the density of the grass sod to be destroyed.

Where a nonspreading grass like orchardgrass has thinned beyond repair, sod tillage is essential for its reestablishment, regardless of the legume chosen to be sown with it.

If a soil test shows that sparse stands and unthrifty growth of pasture grasses and legumes are due to a soil deficiency, the deficiency must be corrected before sowing either alfalfa or ladino. It is not always best, however, to undertake maximum improvement of all your pastures in any one year. It may be too expensive or you may not have enough livestock to use all of the increased forage. Moreover, you can obtain a substantial though smaller increase in the productivity of your pastures by sowing annual lespedeza, hop clover, or both in the sod without fertilizer or with only a moderate application. The soil should be limed, if practical, and if limestone is needed.

It might be most profitable at first to till thoroughly, fertilize, and lime adequately, only the more tillable 20 to 25 percent of your pasture and sow orchardgrass and alfalfa. This completely renovated portion of your pasture would supply supplementary pasture during July and August in addition to the hay harvested from it in May and June. This supplementary pasture, plus additional hay for emergencies, would enable you to make full use of the other 75 to 80 percent of your pasture during the spring when the grass is most productive, palatable, and nutritious.

Lespedeza could be sown at low cost in the beginning without sod tillage and without or with only moderate soil treatment on the other 75 to 80 percent of your pasture. Later, as more pasture is needed for a growing livestock enterprise, additional fractions of your pasture could be tilled, fertilized, limed, and seeded to more productive grasses and legumes.

Pasture improvement is never final. Useful stands of alfalfa last only 3 or 4 years in pastures, even where grazing is correctly managed. Ladino, which has lasted from 5 to 8 years in some pastures, may be killed during the first or second year by severe drouth. For that reason, its average life is no more than 3 or 4 years. Orchardgrass thinned by drouth, disease, or overgrazing will have to be resown or replaced by sowing some other grass. Annual lespedeza is the only legume which has persisted as long as 15 years in Missouri experimental pastures.

Nitrogen fertilizer can be used instead of legumes to increase pasture production. Annual or more frequent applications of ammonium nitrate or other readily available forms of nitrogen fertilizer greatly increase the spring growth of bromegrass, bluegrass, orchardgrass, tall fescue, and reed canary-grass, and the summer growth of bermudagrass, if other soil nutrient deficiencies do not limit plant growth. It is easier to apply nitrogen fertilizers to pastures than to get most legumes to grow in them. Ruminants (cattle and sheep) are less likely to bloat on nitrogen-fertilized grass than on grass-clover or grass-alfalfa mixtures. Neither lespedeza nor birdsfoot trefoil is known to have caused bloat.

Annual fertilization with nitrogen is expensive, however, and too much of the increased growth of cool season grasses, especially of bluegrass, occurs during April, May, and June. To make efficient use of this increased spring growth, the pasture must be heavily stocked until late June, after which you will have to move at least half of the animals to supplementary pasture, put them on feed, or sell them.

Ladino, which was killed by drouth in 1956, was drilléd again in this orchardgrass pasture at Columbia in 1957. Although the weather was too dry for ladino establishment in 1957, enough unsprouted seed lived over to re-establish the clover in 1958 (photographed May 4, 1959).

High pasture yields of animal products can not be produced on infertile soil. A soil test will show you what the soil lacks and the kind and quantity of fertilizer and limestone to apply to grow the grasses and legumes which the improved pasture is to contain. Your county agent is trained and equipped to make and interpret this test. He also can instruct you how to take a representative soil sample.

If pasture renovation includes the seeding of bromegrass, reed canarygrass, alfalfa, or ladino, the basic soil treatment should consist of the full amount of phosphate, potash, and limestone which soil test has shown the soil to need. A soil low to very low in phosphorus will require 600 to 900 pounds of 0-20-0 per acre, 250 to 400 pounds of 0-46-0, or 1000 to 1500 pounds of rock phosphate. The latter should be used only where the old sod is plowed or disked deeply. A soil low to very low in potassium will require from 200 to 300 pounds of 60 percent muriate of potash per acre. An acid, calcium deficient soil will require from 2 to 4 tons of agricultural limestone per acre. Dolomitic limestone should be used where the soil is deficient in both calcium and magnesium.

A starter fertilizer applied at or just before seeding will stimulate the early growth of grass and legume seedlings and better enable them to survive adverse weather and weed competition. A balanced fertilizer (15-15-15 or similar formula) applied at 200 to 300 pounds per acre is effective where renovating tillage has killed all old grass and weeds. Only phosphate fertilizer (200 pounds of 0-20-0 or 100 pounds of 0-46-0) should be used where the fertilizer is drilled with legume seed in untilled or only partially destroyed grass sod because: (1) both soluble nitrogen and potash, when drilled in contract with legume or grass seed, will injure or kill seedlings, and (2) nitrogen fertilizer will stimulate the well rooted grass competitor more than it will benefit the struggling legume seedlings.

Band seeding grass and legume seed 1½ to 2 inches above the fertilizer band will prevent nitrogen and potash injury and give maximum stimulation to seedling growth. (*University of Missouri Station Bulletin 739, How to Seed New Pastures).*

A light application of starter fertilizer supplements but does not remove the need for the heavier basic fertilization and liming where the more productive and more nutritious grasses (bromegrass, bluegrass) and legumes (alfalfa and ladino) are to be grown on infertile soil.

If you are unable to make the heavy fertilizer applications, smaller but profitable increases in production can be gained by sowing less demanding grasses (orchardgrass, tall fescue) and legumes (lespedeza, hop clover, birdsfoot trefoil) after moderate soil treatments which you can afford. Applications of 200 to 500 pounds of 15-15-15, 8-24-8, or similar fertilizers will increase yields where both grasses and legumes are sown. Applications of 100 to 200 pounds of 0-46-0 or 200 to 500 pounds of 0-20-10 will aid establishment and increase yields where legumes are sown in grass sod. Enough limestone to satisfy the soil's lime requirement always should be applied before seeding if a lime spreader can be driven over the land.

The light to medium applications of phosphate and potash fertilizers will have to be repeated every 2 or 3 years to maintain high productivity.

Sod Tillage

Tillage serves a double purpose in pasture renovation: (1) It kills existing pasture grasses and weeds which might prevent the emergence and surivival of

Orchardgrass-ladino pasture at Columbia, under rotation grazing, at the beginning (July 11, 1960, left) and at the end (August 1, 1960, right) of one grazing period.

seedlings; (2) it allows the more insoluble materials, particularly rock phosphate and limestone, to be worked into the soil.

If a different and better grass is to replace the old, tillage should be thorough enough to kill all existing grass and weeds. Where alfalfa or birdsfoot trefoil is to be sown in a bluegrass or bromegrass pasture, tillage should kill 90 percent of the old grass. No tillage is necessary where ladino clover or annual lespedeza is to be sown in sods of bluegrass, bromegrass, orchardgrass, or tall fescue unless the existing grass is to be replaced by another grass.

Surface tillage to kill 50 percent of the grass and open up the sod does aid the establishment of ladino clover and lespedeza and may even mean the difference between success and failure in a year of moderate drouth. But severe drouth will kill ladino seedlings regardless of tillage, and if precipitation is only moderately below normal, ladino can be established in untilled sod. Unessential sod tillage is not only an unnecessary expense but it also lowers the productivity of the pasture for at least one year. Correctly controlled grazing will cost less and reduce production less during the year of seeding and yet accomplish most of the objectives of partial sod destruction by tillage.

Orchardgrass pastures should not be tilled unless orchardgrass or some other grass is to be re-established by seeding.

Deep placement of most fertilizers and lime is not essential for pasture improvement. Fertilizers (0-46-0, 0-20-0, 0-20-10, 12-12-12, 0-0-60, and similar formulas) which contain soluble nitrogen, phosphorus, and potash have been effective when drilled only ½ to 1 inch deep in untilled bluegrass sod. They have also proven effective when broadcast, unless washed down slope by flowing water. Broadcast limestone also will satisfy the lime requirements of ladino and lespedeza, but it needs to be worked into acid soils before sowing alfalfa. If rock phosphate is used to correct phosphorus deficiency, it should be plowed down or worked into the soil as deeply as practical with a disk or field cultivator. Limestone should be spread after plowing and disked into the top 3 to 6 inches of soil where alfalfa is to be sown on an acid soil. If lime cannot be applied at least 6 months ahead of seeding, some of the limestone, preferably finely ground, should be drilled with the alfalfa seed.

Where the slope is steep and only sparsely covered by perennial grass, surface tillage which kills plants but leaves the dead vegetation on or only slightly below the surface will reduce soil erosion. This trash mulch also will aid seed germination and seedling survival of the sown grasses and legumes by retarding the drying of the surface soil and by reducing its crusting. It also will hold seed and seedlings in place against the moving force of hard rains.

Grasses such as bluegrass and tall fescue are difficult to kill by surface tillage. Cross tillage, each disking or field cultivation at a right angle to the preceding one, may be required. Tillage in summer, when uprooted plants dry out quickly, will kill more of the grass than fall, winter, or spring tillage. However, grass sods are more difficult to work during summer when the ground is dry and hard.

Where the old pasture grass is to be eliminated, plowing, followed by tillage for seedbed conditioning, is best if soil erosion is not a problem. Even on moderately steep slopes, shallow plowing will not expose the soil to severe erosion where a dense sod is plowed no deeper than 3 or 4 inches. The exposed surfaces of these thin, inverted, furrow slices are filled with fibrous roots which bind the soil until the new plants can form a protective cover.

What to Sow

Seeding a legume is an essential feature of pasture improvement unless the grass is to be kept productive by annual or more frequent applications of nitrogen fertilizer. Legumes serve a double purpose: (1) They produce palatable and nutritious forage. (2) If inoculated, they take nitrogen from the air to use for their growth; upon death, the plants decompose and release part of this nitrogen to the associated grass. Certain legumes (alfalfa, birdsfoot trefoil, and annual lespedeza) make more summer growth than most of the cool season grasses.

Only a small fraction of the pasture land on most farms is suitable for growing alfalfa, even after soil deficiencies are corrected. Some alfalfa grown with a suitable grass is particularly valuable, however, because of its dual usefulness for hay and grazing. Alfalfa's drouth tolerance insures enough summer regrowth to provide supplementary pasture during July and August after having been cut for hay in May and June.

Grass should be grown with alfalfa for pasture because of the danger of bloat from pure stands. Bromegrass furnishes plenty of high quality grass forage where the grass-alfalfa mixture is used for grazing only. If the spring growth is cut once or twice for hay, nearly all of the regrowth of a bromegrass-alfalfa mixture is alfalfa. Orchardgrass makes enough regrowth after mowing to protect against bloat unless severe drouth or disease checks its growth.

Reed canarygrass is more disease and drouth resistant than orchardgrass varieties now available, but it is more difficult to establish. Reed canarygrass also has a higher nitrogen requirement so that nitrogen fertilizer may have to be added in June to stimulate the regrowth needed for supplementary pasture in summer. Spring or fall applications of nitrogen may also be needed to thicken sparse stands of this sod-forming grass.

Mixtures of birdsfoot trefoil or annual lespedeza with orchardgrass or timothy may be used in renovated pastures intended for hay harvest in the spring and for supplementary pasture in the summer. These mixtures can be grown on some pasture land which cannot be made suitable for alfalfa. It does not matter that timothy, like bromegrass, makes little growth after mowing because birdsfoot trefoil and lespedeza do not cause bloat.

University of Missouri Experiment Station Bulletin 739, How to Seed Pasture, lists grass-legume mixtures that are suitable where a grass is sown with a legume in a renovated pasture simply because the unimproved pasture contains no grass or only a grass not suitable for the improved soil conditions. The adaptation and agronomic description of pasture grasses and legumes useful in Missouri are also given in this bulletin.

If you completely subdue old pasture vegetation by tillage and prepare a firm seedbed, seeding practices are the same as recommended in *Bulletin 739, How to Seed New Pastures.*

Legume seedings made in untilled or in only partially tilled grass sod are best made with a grain drill or with an alfalfa-clover drill. The advantage of drilling over broadcasting is that the drilled seed is dropped in a shallow gash in contact with soil, while much of the broadcast seed may lodge on material which separates seed from soil. Seed not in contact with the soil will not be able to absorb the moisture required for germination except during extended periods of wet weather. A grain drill with grass seeder and fertilizer attachments will place seed and phosphate fertilizer in the same shallow furrow. This banding of seed and available phosphate will stimulate the growth of ladino seedlings and better enable them to survive the competitive growth of well rooted grasses.

Many seeders can not be adjusted to sow as little as 2 pounds of ladino seed per acre. Wasteful overseeding of this comparatively expensive seed can be avoided by mixing it with equal weights of timothy seed.

If a drill equipped for sowing small seeded legumes is not available, the seed may be broadcast in untilled pastures. Broadcasting should be done earlier than drilling to allow more time for beating rain and other natural forces to bring more of the seed in contact with the soil and to cover some seed. Ladino broadcast for spring germination should be sown in late fall or winter. Trampling by grazing animals when the ground is wet will press some of the seed into the soil. Later-than-normal fall grazing serves a double purpose in the establishment of ladino, or lespedeza in grass sod: (1) It brings the seed into moisture-absorbing contact with the soil and (2) it reduces injury to the legume seedlings which might otherwise result from shading and competition from the old grass.

When and How to Sow

Where the pasture is to be improved by sowing a legume in untilled sod, use ladino clover for high production and annual lespedeza or hop clover for medium production. Where ladino is sown to replace a legume lost from a previously renovated pasture, only starter fertilizer may be needed. But if ladino is introduced into an unimproved pasture, soil deficiencies indicated by soil test must be corrected by adequate applications of fertilizer and lime.

If for any reason not enough fertilizer and lime can be applied to meet the mineral requirements of ladino clover, or if the soil is too rocky or sandy to hold enough

moisture for ladino, sow annual lespedeza, hop clover, or both. The winter annual, hop clover, will not follow the summer annual, lespedeza, in the same spots but each will reseed each year in different parts of the same pasture.

Hop clover is not adapted to the northern two-thirds of Missouri.

Severe and untimely grazing will not permanently injure bluegrass or tall fescue, but injurious grazing should be avoided where the pasture contains a non-spreading or less rugged grass like orchardgrass.

Late March or early April is a good time to drill either ladino or lespedeza. If broadcast, lespedeza should be sown in late February or March in the southern third of Missouri, or at any time during January, February, or March, farther north. Lespedeza sown too early in southern Missouri may germinate during an early warm spell and be killed later by freezes.

September is the time to sow hop clover.

Suitable seeding rates for these legumes in grass sod are: Ladino clover, 1 to 2 pounds per acre; lespedeza, 25 pounds per acre; and hop clover, 1 pound per acre. Lespedeza sown at rates lower than 25 pounds per acre will thicken in stand from year to year by natural reseeding.

Grazing Management

Grazing management before and after a legume is sown in untilled grass sod will influence the success of the seeding more than anything else but weather. The legume seedling in grass sod is an infant competing with aggressive and unsympathetic adults. Thus, grazing should be managed to retard the grass without causing undue injury to the legume seedling.

Close grazing supplemented by mowing, if necessary, during September and October when well leafed grasses build and store carbohydrate reserves not only reduces competitive growth by grass the next spring but prevents harmful shading. Early and intensive grazing in the spring also is needed to prevent the grass from out-growing the legume seedling. It is never advisable, however, to graze the grass so short that livestock can not readily consume the quantity they require for satisfactory growth or production. This is overgrazing.

Rotation grazing is essential to the survival of ladino in grass sod after the seedlings grow tall enough to be bitten off. Rotation grazing reduces spot-grazing which results in overgrazing and undergrazing within the same enclosure. Rotation grazing also is required for the maintenance of well established ladino, alfalfa, birdsfoot trefoil, or *Lespedeza striata* in pastures (see *Missouri Agr. Exp. Sta. Bulletin 750, Managing Missouri Pastures).*

The pasture should be more heavily stocked during April, May, and June than during July and August when the growth of cool season grasses slows down. This

Tall fescue-lespedeza pasture at Columbia, September 25, 1952.

Ladino, killed by drouth in 1953, was re-established in this orchardgrass pasture at Lathrop by drilling the seed in April, 1957, without sod tillage. The upper photograph was taken June 18, 1956; the lower photograph was taken July 7, 1958.

practice is called supplemented grazing because it requires the use of supplementary pasture in the latter two months unless surplus animals are sold or put on feed in summer.

In the completely renovated pasture where seedling legumes compete only with seedling grasses, any excess growth of legumes, grasses, or weeds can be controlled by mowing. Grazing need not begin until both grasses and legumes are securely established. Then grazing management becomes important because the timing and intensity of grazing not only control the grass-legume balance but also determines the efficiency with which the forage in the improved pasture is converted into salable animal products.

Performance of Pastures in Experiments

WHEN THE OLD SOD WAS TILLED

The productivity of renovated pastures and the persistence of pasture grasses and legumes in them have been measured in southeast Missouri at Sikeston, in central Missouri at Columbia, and in northwest Missouri at Lathrop[1]. Results:

1. Steers gained 360 pounds annually per acre and 2 pounds per steer per day during 1948 and 1949 on *bromegrass and alfalfa* seeded in April, 1947, at Sikeston. Rotation grazing was not practiced. Most of the alfalfa was gone from the pasture by September, 1949, but a good stand of bromegrass remained.

2. Steers gained 337 pounds annually per acre and 2 pounds per steer per day for 5 years, 1956 through 1960, on *orchardgrass-alfalfa* pastures at Sikeston. Under rotation grazing, the orchardgrass-alfalfa pasture seeded in September, 1955, had to be resown in August, 1958. This renewed pasture still contained a 49 percent[2] stand of orchardgrass and a 59 percent stand of alfalfa by October, 1960, when the experiment ended. This should have been a good pasture for at least one more year.

Another orchardgrass-alfalfa pasture seeded at Sikeston in March, 1957, and rotation-grazed 3 years, still contained a 53 percent stand of orchardgrass and a 35 percent stand of alfalfa by October, 1960.

3. During the 6 years, 1955 through 1960, steers gained 322 pounds annually per acre and 2 pounds per steer per day on *orchardgrass-ladino* pastures at Sikeston.

[1]The generous coopertion of C. L. VanBuren, who furnished all of the land and cattle and much of the management, made the Lathrop pasture experiments possible.

[2]Each numerical stand reported in this bulletin is the percent of a perfect stand of that pasture plant or group of plants as measured by a point quadrat.

This timothy-bluegrass-birdsfoot trefoil pasture 1960 right) was established in April, 1955, by sod before seeding.

One of these pastures was sown in March, 1954, and the other in August, 1957. The older pasture still contained a 78 percent stand of orchardgrass and a 37 percent stand of ladino in the fifth year. Partly because of severe armyworm infestation in 1959, these stands declined to 59 percent orchardgrass and 1 percent ladino by the sixth year.

The pasture seeded in August, 1957, contained in 1959 a 62 percent stand of orchardgrass and a 69 percent stand of ladino, which declined to 50 and 25 percent, respectively, by spring, 1960. Drouth during 1960 killed half of the orchardgrass and all of the remaining ladino in both pastures.

These orchardgrass-ladino pastures were rotation-grazed beginning with 1948 and continuing through 1960.

4. Steers gained 405 pounds annually per acre and 1.9 pounds per steer per day at Lathrop and 316 pounds per acre and 1.9 pounds per steer per day at Columbia during the 3 years 1950 through 1952 on *tall fescue-ladino* pastures seeded in August, 1949.

5. Steers gained 313 pounds annually per acre and 1.6 pounds per steer per day during the 3 years 1958 through 1960 on a *timothy-bluegrass-birdsfoot trefoil* pasture seeded in April, 1955, at Lathrop. Surviving stands by September, 1960, were 70 percent timothy, 61 percent bluegrass, 35 percent birdsfoot trefoil and 14 percent volunteer white clover (mostly ladino).

All of these renovated pastures were fertilized and limed adequately, and plowed before seeding.

WHEN THE OLD SOD WAS NOT TILLED

A legume can be sown in old sod where the pasture contains a satisfactory stand of grass, or even a sparse stand of a grass which will spread after the soil has been fertilized and limed. This is less expensive than sowing both grass and legume plus carrying out destructive sod tillage. It is also less likely to cause loss of the pasture for months or even years.

For example, a bluegrass pasture at Lathrop was plowed in 1954 for complete renovation with bromegrass, ladino, and alfalfa. Unfavorable weather caused

at Lathrop (July 7, 1958, left, and September 7,
lowing, disking, and harrowing the old tall fescue

Bluegrass pasture at Lathrop, June, 1956

the 1954 and 1955 seedings to fail and prevented seedbed preparation in 1956. The seeding made in May, 1957, finally succeeded.

Seedings of ladino made in 1954 and 1955 in an untilled bluegrass pasture at Lathrop also failed but the pasture did not. Steers gained annually 232, 180, and 136 pounds per acre during 1954, 1955, and 1956, respectively, on this bluegrass pasture, although the 1953 drouth continued in 1954 and resumed in 1956. The pasture plowed for renovation produced nothing but weeds and weedy grasses from 1953 to 1957.

WHEN LADINO WAS USED

Experiment trials have shown repeatedly that ladino clover can be established by sowing it in untilled grass sod if precipitation is not much below normal and if grazing is managed correctly. Fortunately, the grazing management required for ladino establishment in pastures (rotation-supplemented grazing, *Missouri Agr. Exp. Sta. Bulletin 750)* is the management which makes most efficient use of available pasture forage.

Fletchall and Brown reported in University of Missouri Research Bulletin 696 that ladino clover broadcast at Columbia in March, 1945, in dense but nitrogen-deficient bromegrass sods, bluegrass sods, orchardgrass sods, and of redtop sods, mowed to simulate rotation grazing, established good stands of ladino which persisted until killed by field mice in the winter of 1951-52. Drilled ladino seedings made without other tillage in dense bromegrass sods, bluegrass sods, orchardgrass sods, redtop sods, and tall fescue sods in August, 1948, April, 1949, and August, 1949, each established good stands of ladino which lasted until killed by severe drouth in 1953. These plots also were mowed to simulate rotation grazing. Ladino drilled in April, 1950, in similar grass plots failed, probably because mowing began too late in the spring and because rain was 6.8 inches below normal from April 1 to September 30. The drilled seeding of ladino made in September, 1950, also failed when the September-October precipitation was 5.2 inches below normal.

BEFORE AND AFTER . . .

Same pasture July, 1958, following the seeding of ladino in the untilled sod, April, 1957.

Same pasture, July, 1960.

Ladino drilled in April, 1954, in orchardgrass, in bluegrass, and in bromegrass pastures at Lathrop failed. The soil had been dried deep by the 1953 drouth and received 4.5 inches less than normal precipitation from October, 1953, through September, 1954. A seeding of bromegrass, ladino, and alfalfa and a seeding of timothy, bluegrass, and birdsfoot trefoil made on well prepared seedbeds also failed.

Broadcast seedings of ladino made in March, 1948, and March, 1949, at Lathrop in 6 and 7-year old bromegrass pastures established good stands of ladino which persisted under rotation grazing until killed by the 1953 drouth. Precipitation was 13.5 inches below normal from October, 1952, through September, 1953, and 10.8 inches below normal from April through September.

Ladino drilled without other sod tillage in April, 1957, at Lathrop in orchardgrass, in bluegrass, and in bromegrass pastures established medium to good stands of ladino, even though the soil and weather were dryer than normal. Precipitation October, 1955, through March, 1957, was 11.4 inches below normal and was 2.8 inches below normal April through September, 1957. Each pasture still contained a satisfactory stand of ladino during 1960 (Table 1).

Ladino drilled in March and August, 1957, without sod tillage, in 3 orchardgrass pastures at Columbia, failed to establish stands of clover. This was a dry year. Good stands of ladino became established in this pasture in 1958 without sowing any more seed (Table 2). Precipitation was 10.7 inches below normal October, 1956, through September, 1957, and 6.4 inches of that deficit occurred from April 1 to September 30. From October, 1957, through September, 1958, precipitation was normal and from April through September rainfall was 1.4 inches above normal.

Ladino clover killed by drouth has been re-established in tall fescue pastures in southeastern Missouri repeatedly by broadcasting the seed without sod tillage, but only when grazing was managed correctly.

The potential productivity of fertilized and limed pastures in which ladino is established or re-established in untilled sod is illustrated by 3-year average steer gains of over 300 pounds per acre produced at Lathrop, 1958 through 1960 (Table 3).

TABLE 1 STANDS OF GRASSES AND LEGUMES AT LATHROP IN PASTURES IN WHICH LADINO WAS DRILLED IN APRIL, 1957, WITHOUT TILLAGE

Pasture	Percent of a Perfect Stand of Each Species					
	1957			1958	1959	1960
Species	April	Aug.	Oct.			
Orchardgrass	74			89	57	75
Ladino		10	27	52	77	40
Alfalfa (1)			4	13	12	9
Bluegrass	87			87	42	50
Bromegrass	20			23	23	37
Ladino		5	22	66	79	46
Alfalfa (1)			2	5	6	16
Bromegrass	84			73	69	85
Bluegrass	7				22	23
Ladino		1	3	40	58	33
Alfalfa (1)			1			2

(1) Equal weights of alfalfa and ladino seed were mixed so that the drill would sow no more than 2 pounds of ladino seed per acre.

TABLE 2 AVERAGE STANDS OF ORCHARDGRASS AND LADINO AT COLUMBIA IN 3 PASTURES SEEDED TO LADINO WITHOUT TILLAGE IN 1957

Pasture species	Percent of a Perfect Stand of Each Species					
	1957	1958			1959	1960
	May	April	June	Oct.	May	June
Orchardgrass	50	49			54	69
Ladino	3 (1)	1	24	43	85	46

(1) By October all ladino was killed by drouth.

TABLE 3 STEERS GAIN ON GRASS-LADINO PASTURES, ON A NITROGEN FERTILIZED BLUEGRASS PASTURE, AND ON AN UNFERTILIZED BLUEGRASS-LESPEDEZA PASTURE AT LATHROP, 1958-60

Pasture		Steer Gains in Pounds				
			1958	1959	1960	Avg.
Orchardgrass		Per acre	305	329	301	312
ladino	(1)	Per steer				
P -L	(2)	per day	1.3	1.6	1.3	1.4
Bluegrass		Per acre	267	326	364	319
ladino	(1)	Per steer				
P -L	(2)	per day	1.7	1.9	1.6	1.7
Bromegrass		Per acre	305	276	332	304
ladino	(1)	Per steer				
P - L	(2)	per day	1.7	1.8	1.6	1.7
Bluegrass		Per acre	255	288	251	265
		Per steer				
N-P-L	(2)	per day	1.5	1.8	1.1	1.5
Bluegrass		Per acre	167	152	251	190
lespedeza		Per steer				
L	(2)	per day	1.3	1.2	2.0	1.5

(1) = Ladino and alfalfa drilled in 1957 without sod tillage.

(2) N = Ammonium nitrate applied each March or April at 200 lbs./A;
P = At least 300 pounds of P_2O_5 per acre; and
L = Limestone applied before 1945.

Lespedeza was re-established each year from 1945 through 1960 in this limed but unfertilized bluegrass pasture at Lathrop. The characteristic condition caused by spot grazing is clearly evident in this photograph taken July 19, 1960.

WHEN LESPEDEZA WAS USED

Lespedeza has been established in millions of acres of Missouri pastures by either drilling or broadcasting the seed in untilled sod. Lespedeza establishment has seldom failed where the pasture was grazed or mowed to prevent any large accumulation of grass and weeds during the year before seeding and where the pasture was grazed after seeding. Lespedeza seedlings do not tolerate shading by a heavy ground cover of either dead or living plants.

Kentucky bluegrass has crowded lespedeza out in tests when stimulated by heavy applications of phosphate fertilizer. Korean lespedeza re-established itself by natural reseeding in a limed but unfertilized bluegrass pasture at Lathrop every year from 1945 through 1960. A comparable bluegrass pasture with a similar initial stand of lespedeza (table 4) was fertilized with 480 pounds of 0-20-0 per acre in March, 1945, 500 pounds of 0-14-7 in March, 1947, and 300 pounds of 0-45-0 in March, 1949. All fertilizer was drilled shallow in the untilled sod. Increased competition from the bluegrass and volunteer legumes gradually drove lespedeza out of the fertilized pasture. The unfertilized pasture contained as much lespedeza in 1960 as in 1947 (Table 4).

This does not mean that perennial grass-lespedeza pastures can not be fertilized profitably. Most untreated soils in Missouri are too deficient in phosphorus to support a 75 percent stand of bluegrass with which lespedeza can live. Most permanent pastures will require 200 pounds of 0-46-0 per acre to produce stands and yields of bluegrass and lespedeza as good as those of the unfertilized pasture at Lathrop.

If the soil is heavily fertilized for maximum production, legumes that are both more competitive and more productive than lespedeza should be used (Table 5). Permanent pastures which contain lespedeza, however, are more productive than similar pastures which contain no legume. Steer gains at Lathrop during the 5 years 1940 through 1944 were 55 percent larger on a

TABLE 4 STANDS OF BLUEGRASS, LESPEDEZA, AND OTHER LEGUMES IN FERTILIZED AND UNFERTILIZED PASTURES AT LATHROP

Pasture		Percent of a Perfect Stand of Each Species					
		Species	1947	1949	1951	1953	1960
Bluegrass		bluegrass	61	86	83	95	(2)
lespedeza		lespedeza	57	29	16	0	(2)
P - L	(1)	other legumes	17	10	40	19	(2)
Bluegrass		bluegrass	79	75	74	68	77
lespedeza		lespedeza	53	21	53	38	54
L	(1)	other legumes	2	2	6	10	5

(1) P = 301 pounds P_2O_5 per acre by November, 1949;
L = limed before 1945.

(2) Seeded to ladino in 1957.

A satisfactory stand of alfalfa was maintained three years in this orchardgrass pasture at Sikeston under rotation grazing. The 10 steers had been grazing the 2½ acres in field No. 1 for 6 days when photographed April 19, 1960. They were moved to field 2, in the foreground, April 27.

TABLE 5 STEER GAINS AT LATHROP ON UNFERTILIZED BLUEGRASS-LESPEDEZA AND ON FERTILIZED BLUEGRASS-LANDINO PASTURES

Pasture	Steer Gains in Pounds per Acre			
	1958	1959	1960	Avg.
Bluegrass lespedeza no fertilizer	167	152	251	190
Bluegrass ladino plus P (1)	267	326	364	319

(1) P = 380 pounds P_2O_5 per acre 1945 to 1957.

TABLE 6 STEER GAINS ON PASTURES AT COLUMBIA, MISSOURI, 1950 THROUGH 1952

Pasture	Steer Gains in Pounds				
		1950	1951	1952	Avg.
Bluegrass lespedeza	Per acre	250	256	286	264
	per steer per day	1.7	2.1	2.2	2.0
Tall fescue ladino	Per acre	293	335	321	316
	per steer per day	1.6	2.0	2.2	1.9
Tall fescue lespedeza	Per acre	188	225	198	204
	per steer per day	1.9	2.0	2.1	2.0

bluegrass-lespedeza pasture than on the adjoining bluegrass pasture which contained no legume *(Missouri Agr. Exp. Sta. Bulletin 486, Report of Crops and Pasture Experiments at Lathrop in Northwestern Missouri; 1940-1944).* On another bluegrass-lespedeza pasture at Lathrop, steers gained 200 pounds per acre annually and 1.9 pounds per steer per day during the 15 years 1946 through 1960 (Table 7). The stand of lespedeza was renewed each year by natural reseeding (Table 8). During 3 favorable years, 1950 through 1952, steers gained 264 pounds per acre annually and 2 pounds per steer per day on a bluegrass-lespedeza pasture, 316 and 1.9 pounds on a tall fescue-ladino pasture, and 204 and 2 pounds on a tall fescue-lespedeza pasture at Columbia. The low gain per acre but high gain per day on the tall fescue-lespedeza pasture was due to the removal of the steers from this pasture during midsummer (Table 6).

NITROGEN FERTILIZER VS. LEGUMES

In the absence of legumes, nitrogen fertilizer increases grass yields substantially. Fertilizer nitrogen applied at 66 pounds per acre annually to bluegrass plots at Sni-A-Bar Farms, Grain Valley, Mo., increased grass yields 74 percent during April and May. The increase was only 15 percent after May, although ¼ of the nitrogen was applied in June and ¼ in September.

At Lathrop, ammonium nitrate was applied each March or early in April at the rate of 200 pounds per acre to a 5-acre bluegrass pasture which had been limed and which was fertilized with phosphate. The average annual steer gain, 1946 through 1960, on the nitrogen-fertilized pasture was 294 pounds per acre. This was 56 pounds per acre more than the annual gain on a similar bluegrass pasture which received no nitrogen fertilizer

TABLE 7 STEER GAINS ON THREE BLUEGRASS PASTURES AT LATHROP, 1946 THROUGH 1960

Year	Steer Gains in Pounds					
	Fertilized with phosphate but no nitrate		Fertilized with phosphate and nitrate		With lespedeza and no fertilizer	
	Per acre	Per steer per day	Per acre	Per steer per day	Per acre	Per steer per day
1946	183 (1)	1.8	249	2.1	208	1.9
1947	257	2.2	253	1.6	152	1.5
1948	248	2.3	281	1.4	232	1.8
1949	246	2.9	322	1.9	219	2.3
1950	315	2.3	419	2.6	237	2.5
1951	313	2.1	347	1.7	229	2.1
1952	246	1.8	329	1.5	215	1.9
1953	120	1.3	195	1.4	117	1.7
1954	232	2.5	303	2.3	207	2.6
1955	180	1.7	344	2.6	222	1.7
1956	136	1.7	227	1.5	183	1.7
1957	142	1.6	350	1.9	215	1.8
1958	267	1.7	255	1.5	167	1.3
1959	326	1.9	288	1.8	152	1.2
1960	364	1.6	251	1.1	251	2.0
Ave	238	2.2	294	1.8	200	1.9

(1) Undergrazed in the spring to thicken a sparse stand of bluegrass.

Ladino was sown without tillage in February, 1954, in this tall fescue pasture near Charleston after the 1952 and 1953 drouths had killed the clover but not the grass. The pasture was photographed June 21, 1955.

TABLE 8 STANDS OF BLUEGRASS, SEEDED LEGUME, AND OTHER LEGUMES IN THREE PASTURES AT LATHROP, 1946 THROUGH 1960

Year	Percent of a Perfect Stand of Pasture Grasses and Legumes								
	Fertilized with phosphate but no nitrate (1)			Fertilized with phosphate and nitrate (2)			No fertilizer (3)		
	Blue - grass	Seeded legume	Other legume	Blue - grass	Seeded legume	Other legume	Blue - grass	Seeded legume	Other legume
1947	69	0	69	74	0	18	79	53	2
1948	64	0	34	74	0	5	55	37	1
1949	82	3	42	89	0	7	75	21	2
1950	87	22	19	90	9	6	78	33	4
1951	81	4	10	95	3	2	74	53	6
1952	85	10	13	85	0	4	62	40	2
1953	95	27	20	94			68	38	10
1954	87	0	1	81			48	58	0
1955	92	0	0	99			73	36	2
1956	93	0	0	95			83	42	0
1957	87	7	8	91			73	60	0
1958	87	66	5	97			74	61	0
1959	42	85	0	95			78	42	4
1960	47	49	0	96	0	1	77	61	4

(1) Ladino seeded in 1949, 1954, and 1955; ladino and alfalfa in 1957.

(2) Lespedeza seeded in 1950.

(3) Lespedeza seeded before 1945.

but which had a variable legume content (Table 7 and 8). A ton and a half of ammonium nitrate therefore produced an 840-pound increase in live weight steer gain on pasture in 15 years.

The smaller daily gain made by steers on the nitrogen-fertilized pasture was entirely due to smaller summer gains (Table 7). Spring gains on the nitrated pasture were always good.

One important disadvantage of using nitrogen fertilizer instead of legumes to increase productivity of bluegrass pastures is the unbalanced seasonal distribution of the increase. Most of the additional herbage is produced in April, May, and June, which is the peak period of production without nitrogen fertilization. If the grass is not grazed as it grows it loses palatability and digestibility. If the pasture is grazed during April, May, and June by enough cattle to use the increased herbage efficiently, at least ½ of the cattle will have to be moved by July to supplementary pasture, feedlot, or to market (Table 9). Where any or all of these moves are practical, an annual application of nitrogen fertilizer is an easy and economical way to increase pasture production.

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TABLE 9 HIGH AND LOW RATE OF GRAZING FOUR PASTURES AT LATHROP, 1947 THROUGH 1960

Year	Number of Steers per 5-acre Pasture			
	Bluegrass legume P (1)	Bluegrass no legume N P (1)	Bluegrass legume no P	Bromegrass legume P (1)
1947	4-5	6-5	3-5	5-5
1948	5-4	7-4	4-3	5-4
1949	3-4	8-3	4-3	5-5
1950	4-5	8-3	3-3	5-5
1951	5-4	8-4	4-3	5-5
1952	5-4	10-3	4-3	5-4
1953	4-4	10-5	3-3	5-5
1954 (2)	4-5	9-5	5-5	4-6
1956	4-4	8-3	4-4	5-5
1957	4-4	10-5	4-4	6-6
1958	5-6	8-4	4-5	6-6
1959	6-5	10-3	4-4	6-5
1960	7-7	10-5	4-5	7-6
Average	4.6 - 4.7	8.6 - 4.0	3.9 - 3.9	5.3 -5.2

(1) P = At least 300 pounds P_2O_5 per acre by 1949.

N = 200 pounds ammonium nitrate per acre annually in March or April.

(2) The number of steers on the nitrogen fertilized pasture varied from 10 to 0 in 1955 when pastures were sprayed to control grasshoppers.