

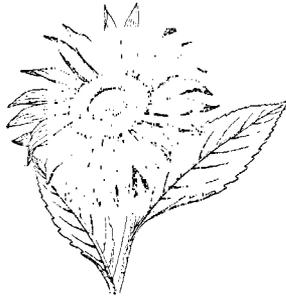
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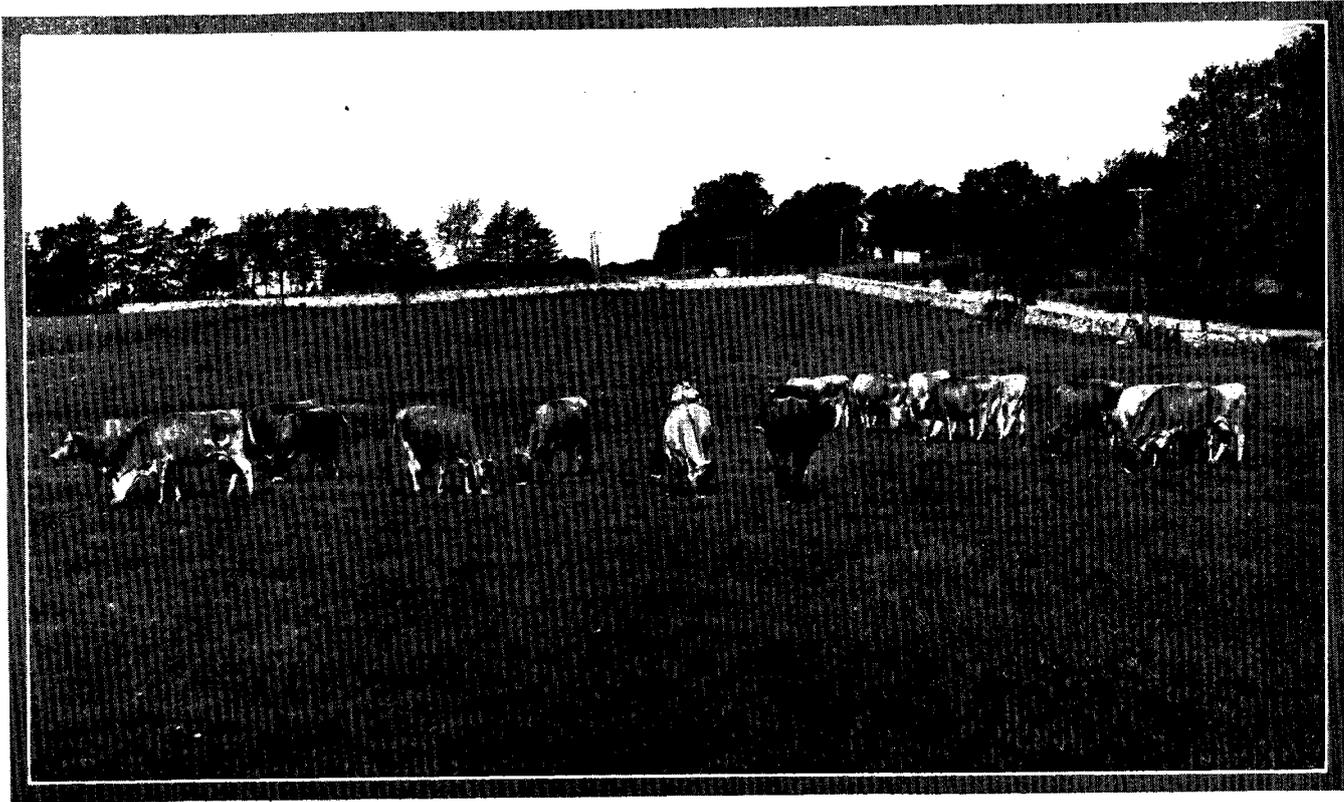
TAME PASTURES IN KANSAS



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GOOD PASTURES ARE ESSENTIAL TO THE MOST ECONOMIC PRODUCTION OF DAIRY PRODUCTS

TAME PASTURES IN KANSAS¹

A. E. ALDOUS and J.W. ZAHNLEY

INTRODUCTION

According to the biennial report of the State Board of Agriculture for the years 1927 and 1928, there are 1,291,800 acres of blue grass and other tame grasses used for pasture in Kansas. In addition, about 300,000 acres of sweet clover, Sudan grass, winter wheat, rye, and other annual or biennial forage plants are planted annually for pasture. These leave a large area of poor eroded run-down farm land in the eastern third of Kansas being used for growing various cultivated crops that could undoubtedly be improved, made to produce more and to yield a higher return, by seeding to grasses and legumes and using the land for pasture.

Pasture lands are often thought of as having low productivity. This comes from the fact that as a general rule the poorest land on the farm is used for pasture. Where equally as good land is used for pasture as for cultivated crops and given the same fertilizer treatment it has been found in humid regions that the amount of feed produced, when figured on the basis of digestible nutrients, is equally as high on the pasture land and the labor cost of the pasturage is only a fraction of the cost of the production of the tilled crops.

Pastures are the source of the cheapest and most efficient feed for live stock, particularly dairy cattle. A study made in New York covering over 1,000 farms having an area of approximately 85,000 acres located in six counties showed that for the portion of the year that the cows obtain the major part of their sustenance from pastures, which was 161 days, they returned a profit of 24 cents per cow each day, while the remainder of the year, when they were barn fed, they showed a loss of 4 cents per cow each day.

Tame pastures can be used profitably on many farms to supplement native pastures. This need is especially urgent in the early spring before the native pastures are ready and in the fall when the feed in the native pastures is either short or has little feeding value. In some instances tame pastures may be used profitably in dry hot summers to supplement the production on the native pastures. The length of the grazing season may also be extended at least two

1. Contribution No. 198 from the Department of Agronomy.

months later in the fall and a month earlier in the spring by the seeding of proper tame pasture species. Considerable winter grazing may also be obtained, especially in mild seasons, from tame pastures by either protecting a portion of the pasture or lightly grazing it during the regular grazing season. This method is now used by a number of stockmen in eastern Kansas.

Most land seeded to tame pastures has a higher value than native pastures owing to the fact that it is tillable and could be used for the production of cultivated crops. The only exception to this is where worn-out land is being seeded to pasture in order to control erosion and to restore its fertility. In order to justify the use of higher-priced land for pastures it should be made proportionately more productive. This can be accomplished mainly by (1) planting forage species that are best adapted to the conditions existing in the region where they are planted, (2) planting mixtures of tame forage species that will give the highest yield and feeding value throughout the grazing season, (3) using proper methods to establish the tame pastures, and (4) proper care of pastures to maintain their productivity.

REGIONAL ADAPTATION OF TAME GRASSES

All the tame perennial grasses that are adapted for seeding pastures are native of countries where growing conditions are more favorable than in the major portion of Kansas. Their successful use is therefore restricted to about the eastern one-third of Kansas where the annual rainfall averages more than 30 inches. In some instances their production may be extended west of this rainfall belt along the stream bottoms where growing conditions are more favorable because of richer soil and the availability of additional moisture. Soil conditions, temperatures and humidity, and length of the growing season are also important factors governing the adaptability of tame forage species for pastures in eastern Kansas.

CLASSIFICATION OF PASTURE FORAGE PLANTS

For purposes of classification pasture forage plants can be placed in two general classes: (1) Grasses and (2) legumes. The grasses may be subdivided into annuals and perennials. The perennial grasses can be classified as (1) bunch grasses and (2) sod grasses. The bunch grasses include those that have a bunched habit of growth such as orchard grass, timothy, and tall oat grasses. When planted for pastures it is usually desirable to combine them with

a filler or sod grass to fill in between the bunches and thus lessen erosion and provide additional forage. The sod grasses tiller more readily through the development of rhizomes or underground root stocks that make a complete even sod on the ground. Kentucky blue grass, brome grass, and red top are examples of this class. They are well adapted to pasturing because they produce an even sod and have strong vegetative methods of reproduction. Other grasses that can be used in seeding pastures in this state include meadow fescue, frequently called English blue grass, and Italian and perennial rye grass.

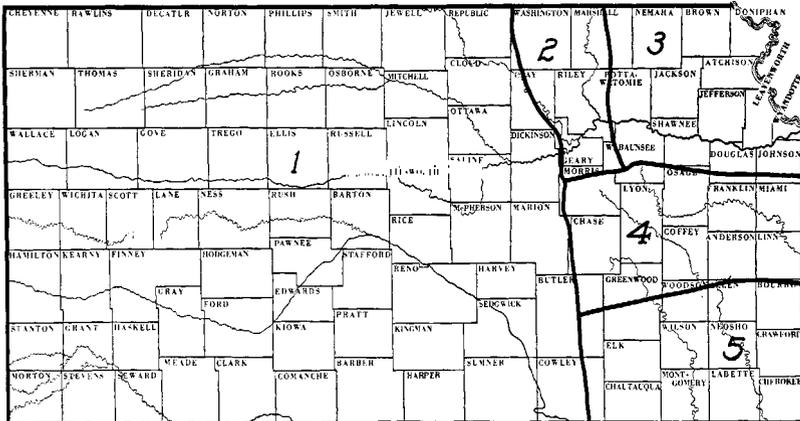


FIG. 1.—Tame-pasture areas of Kansas.

PERENNIAL GRASSES

BROME GRASS

Brome grass is a long-lived perennial that is ideally adapted to pastures. It produces an even dense sod after two years and is highly nutritious and palatable to all classes of live stock. It propagates by underground root stocks and will spread very rapidly under favorable growing conditions. Brome grass is also one of the first of the tame grasses to start growth in the spring and will endure rather dry conditions during the summer. It continues to grow until late in the fall.

Brome grass is especially adapted to regions having moderate summer temperatures. It is, therefore, best suited to the northern part of the tame-grass region, or areas 2 and 3 as indicated on the tame-pasture region map of Kansas. (Fig. 1.) In the southeastern

part of the state the yields are lower and it is not so long-lived as in the northern part of the state. It has been reported that it assumes a bunched habit of growth under higher humidity and summer temperatures.

Brome grass prefers rich loams and clay loams, but succeeds fairly well on sandy soils. It will not stand much flooding, especially where the water stands on the ground for longer than 12 hours. To be best suited for brome grass the soils should be fairly well drained and deep as the roots grow to a maximum depth of 6 feet in friable soils.

Brome grass under favorable conditions in the vicinity of Manhattan yields from about 1 ton to as much as 3 tons of hay per acre for the first four years. After this time the stand tends to get dense and sod bound. The growth may then be increased by the application of fertilizers, the kinds and amounts of which will be discussed later.

Brome grass for pastures has been used more successfully in Washington county than in any other part of the state. Some pastures there have been in brome grass for more than twenty years. Considerable seed of brome grass is also grown in that vicinity. The strain of brome grass grown in Washington county has been selected and is perhaps better suited to Kansas conditions than seed grown outside the state.

Where it is planted alone brome grass should be seeded at the rate of 18 pounds to the acre. The price of brome grass seed is usually less than most tame grasses, which makes the cost of seeding very reasonable.

ORCHARD GRASS

Orchard grass is a bunch grass and for this reason is not well adapted for pastures where seeded alone. If, however, it is seeded with a sod-forming grass, such as brome or Kentucky blue grass, this fault may be corrected. Orchard grass is the only grass that can be grown successfully throughout the humid part of Kansas, growing equally as well in the southeastern part of the state as in the northern section. It thrives in a variety of soils but does best in clay and clay loams. It does not do so well in either sandy soil or muck.

In shaded places orchard grass grows better than any other grass. Because of its tolerance for shade it might be profitably used more extensively in this state for seeding in the more open wooded areas where little pasturage is now produced. To establish it in these lo-

cations would require harrowing or disking in order to get the seed covered with the soil.

Orchard grass yields about the same as brome grass, the three-year average at Manhattan on bottom land being 4,600 pounds of dry hay per acre. The forage is very palatable and nutritious to live stock, though slightly less palatable to cattle than brome grass and Kentucky blue grass. Being a bunch grass it has a tendency to get stemmy and less palatable and nutritious when it heads out. It is a long-lived deep-rooted grass that will thrive and produce satisfactory yields in pasture for ten years on good soils and under proper pasture management. It responds as do all tame grasses to fertilizer applications, which greatly increase its yield and nutritive content.

For average conditions in Kansas, orchard grass should be seeded at the rate of about 18 pounds to the acre. The time of seeding and method of seed bed preparation for all pasture plants will be discussed later.

KENTUCKY BLUE GRASS

Kentucky blue grass is perhaps the most common tame grass in Kansas as it comes in naturally in tame pastures, under rather close grazing. On native blue stem pastures it is also increasing very rapidly, growing mainly along the draws where soil and moisture conditions are favorable. In the last three years it has increased very rapidly on ridge tops, crowding out in some instances buffalo grass. This invasion is greatly accelerated by close grazing since Kentucky blue grass makes a very rapid growth in the spring and usually matures seed the latter part of May. From this time on it goes into a semidormant condition until early September, when it is revived by fall rains. It appears to be quite resistant, to adverse conditions during the dormant stage.

Owing to the fact that Kentucky blue grass produces little feed during the summer, when forage is most needed in pastures, its invasion of native pastures lessens their grazing value. Under natural conditions or under light grazing blue grass will not replace the native bluestems, or will invade them to a very limited extent, owing to the fact that it will not stand the shading of the taller prairie grasses. Burning appears to be more detrimental to Kentucky blue grass than to any of the other grasses.

Regardless of some undesirable qualities of Kentucky blue grass it is an important and valuable tame-pasture grass. It is a sod grass spreading mainly by abundant short root stocks each of which

eventually produces a tuft of grass. It is very palatable and nutritious, being equal if not superior in these qualities to brome grass. It is one of the first grasses to start growing in the spring, and after it revives from the dormant summer period it grows late in the fall, making a very good spring and fall pasture grass. In the eastern part of the state it is used to a limited extent for winter pasture. Where it is used in this manner it is either protected or lightly grazed during its growing period. To obtain the greatest utilization of Kentucky blue grass it should be seeded in mixtures with grasses that will supply forage during the summer season.

In tests conducted at Manhattan the yield of Kentucky blue grass was slightly more than half the yield obtained from brome and orchard grass. Where planted alone Kentucky blue grass is usually seeded at the rate of 18 pounds to the acre and it takes about two years for the sod to become well established.

MEADOW FESCUE

Meadow fescue, commonly called English blue grass, at one time was the most common tame grass grown in Kansas. It was grown principally for seed and mainly in the extreme east central part of the state, or the eastern half of area 4 as outlined on the map of the tame-pasture areas of Kansas. (Fig. 1.)

While meadow fescue does not spread very much by root stocks it produces a fairly good sod, making it well adapted for pastures. It is a long-lived perennial living four to six years in pastures given average attention. In the eastern part of the state it will eventually be replaced by Kentucky blue grass and white clover, where it is seeded in mixtures with these species. The best growth of meadow fescue is made in rich, moist, or even wet soils, but it will not stand very long periods of flooding. It is also not well adapted for use on poor upland soils. Meadow fescue grows fairly well in the shade.

The yield of meadow fescue on rich bottom land at Manhattan has been a little higher than orchard grass for a three-year period. However, the stand has not persisted so well as the orchard grass. The palatability and nutritive value are about the same as for orchard grass. In wet years there is a tendency for meadow fescue to rust, which greatly decreases its palatability and yield.

Meadow fescue is grown most generally in mixtures. One of its greatest values in a pasture mixture is its rapid maturity after planting, as it will furnish feed in the latter part of the same season when seeded in the spring. If seeded in early fall it will supply con-

siderable forage in June or early July of the following year. In pasture mixtures it is therefore valuable for supplying forage while the slower-growing species are becoming established. It also starts growing early in the spring and continues until late fall. The yield is very much reduced by drought. When grown alone it is seeded at the rate of 15 pounds to the acre.

RED TOP

Red top is a sod grass producing vigorous root stocks 2 to 6 inches long, which makes it well suited for pasturage. It thrives best on wet to moist soils and will even grow in shallow ponds which later become dry. The best growth is made on loams and clay loams, but if moisture is abundant no marked preference is shown for any soil type. Regardless of its preference for wet soil, red top will stand considerable drought and will grow better on sandy soils than most other tame grasses. It will not grow in the shade. Red top is adapted to conditions existing in the eastern part of Kansas and is particularly well suited to the southeastern part, where it is one of the most common pasture grasses because of its tolerance to acid soils. The yield of red top in favorable locations is a little larger than that of orchard grass. In southeastern Kansas it yields more than any other of the tame grasses. Its palatability, however, is a little less than that of most of these species.

Where planted alone red top is usually seeded at the rate of 12 pounds to the acre. It is seldom seeded alone but usually in mixtures with orchard grass and white clover, alsike clover, or lespedeza. The cost of the seed is usually lower than most tame grasses and the great number of seeds per pound makes the cost of seeding low.

TIMOTHY

Timothy is more extensively grown than any of the other tame grasses. It is used largely for hay. Because of its bunched habit of growth timothy, like orchard grass, should not be seeded alone, but should be planted with a filler or sod-forming grass. Timothy is a long-lived perennial adapted to a rather heavy moist soil. It will not stand much drought so is not well suited to the poorer upland soils. It is not resistant to close grazing and tramping during hot dry periods.

In Kansas it is well adapted to the eastern part of areas 3 and 4 (fig. 1), although it can be successfully grown in moist, bottom lands throughout the humid belt. Timothy is a northern grass, hence its yield is reduced when grown in the southeastern part of

this state. It produces a high yield of palatable nutritious forage. At Manhattan its yield on bottom land exceeded that of orchard grass. The main advantages of timothy for use in pastures are that a stand can be obtained easily and the price of the seed is moderate. Where it is seeded in mixtures of the more vigorous sod grasses such as Kentucky blue grass or brome grass it will eventually be replaced by them.

PERENNIAL RYE GRASS

Perennial rye grass is a short-lived rapid growing grass, living usually not over two years, especially on poorer soils. Its use for pastures in this state is limited to mixtures where it has some value in providing early forage and at the same time keeping down weeds while the slower-maturing species are becoming established. Where perennial rye grass is seeded in mixtures in the early fall it makes its maximum growth the next season and provides considerable forage. The second year it will be about one-half replaced by the longer-lived grasses and the third year it will be practically eliminated.

Perennial rye grass thrives best on well-drained rich soils, but does not do well on sandy soils, nor is it tolerant to very wet soil. It is very palatable and nutritious and produces a large quantity of forage for one or two years.

ITALIAN RYE GRASS

The growing characteristics and requirements of Italian rye grass are about the same as for perennial rye grass. The question regarding which of these species to use in a mixture should be answered by the price of the seed. If the price is about the same the perennial rye grass should be planted as a little higher yield will be obtained from it. Neither species is recommended for seeding alone because of its short life. The yield would not justify the expense of the seed, which is rather high considering the rate of seeding necessary to obtain a good stand.

REED CANARY GRASS

Reed canary grass, while not grown in Kansas, may have some value for planting on flooded lands where the period of flooding is too long to grow crops and too long for other tame grasses. This grass grows naturally in wet soils that are subjected to periodic flooding. According to the reports from the Ohio Agricultural Ex-

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periment Station it will also stand considerable drought. It does best in cool climates but it probably can be grown with success in eastern Kansas. It has been reported to be growing naturally in the Cheyenne bottoms in central Kansas.

The foliage of reed canary grass is reported to be very palatable to all classes of live stock. It also yields well, starts growing early in the spring, and continues to grow until late fall. At the present time seed of reed canary grass is very scarce and sells from \$1 to \$1.50 a pound. It is seeded at the rate of 4 to 5 pounds to the acre. Until more fully tested in Kansas it is suggested that the seeding of this grass be limited to small areas.

BERMUDA GRASS

The successful use of Bermuda grass for pastures is limited to the cotton belt. However, it can be grown as far north as Manhattan, but the season is not quite long enough even in the southeastern part of Kansas for Bermuda grass to stand very heavy grazing. The yield therefore would not warrant its use for pastures. It is also very sensitive to cold and produces little forage in this state before June. Growth is checked by the first light frost in the fall.

BENT GRASSES

Numerous inquiries are received at the Agricultural Experiment Station regarding the adaptability of bent grasses for pastures in Kansas. Some of the inquiries come from the western third of the state. The inquiries are perhaps stimulated by popular articles regarding the qualities of this grass without limiting its use and range. Bent grasses, particularly the creeping bents, are shallow-rooted grasses that must have a liberal moisture supply at all times during the growing season. Even in the most humid sections of the state it is questionable whether creeping bent grasses would grow without artificial watering during dry spells. They are therefore not suitable for pasture in any part of Kansas.

CANADA BLUE GRASS

Canada blue grass is grown very little, if any, in Kansas because the yields obtained are comparatively low. It will, however, grow on some of the poorer soils where none of the other tame grasses will grow. So located it will produce a small yield of very palatable forage and prove effective in checking erosion.

CRESTED WHEAT GRASS

Crested wheat grass is a northern grass, grown quite extensively in western North Dakota and in portions of eastern Montana, where growing conditions are more favorable. It is unsuited for the humid region, but may have value in the northwestern part of Kansas.

SLENDER WHEAT GRASS

Slender wheat grass is another species better adapted to northern conditions. This grass may have limited value in the western half of the state.

YIELD OF GRASSES

Table I records the yields of the tame grasses growing in the grass nursery at the Agronomy Farm of the Agricultural Experiment Station. (Fig. 2.) This is located on bottom land having a rich black loam soil. These grasses were planted September 6, 1926.

TABLE I.—YIELDS OF TAME GRASS HAY
 (Grass nursery, Agronomy Farm, Manhattan, Kan.)

| SPECIES. | Pounds of hay to the acre. | | | | Condition of stand, April, 1930. |
|------------------------------|----------------------------|-------|-------|----------|---|
| | 1927. | 1928. | 1929. | Average. | |
| Brome grass..... | 6,200 | 3,890 | 3,520 | 4,530 | Good. |
| Kentucky blue grass..... | 4,120 | 4,720 | 2,160 | 3,660 | Good. |
| Timothy..... | 6,180 | 3,360 | 5,580 | 5,041 | Good. |
| Meadow fescue..... | 7,660 | 5,040 | 3,200 | 5,310 | Decreased about one-fifth. |
| Red top..... | 9,240 | 3,560 | 3,200 | 5,330 | Good. |
| Orchard grass..... | 7,200 | 3,440 | 3,200 | 4,613 | Good. |
| Tall oat grass..... | 11,000 | 4,720 | 3,928 | 6,549 | Reduced about one-third. |
| Perennial rye grass..... | 4,600 | 3,520 | | 4,060 | Replaced by orchard grass in 1 |
| Italian rye grass..... | 6,200 | 2,320 | | 4,260 | None on plot in 1929. |
| Slender wheat grass (a)..... | | | 1,040 | 1,040 | Fair. |
| Crested wheat grass (b)..... | | 2,440 | 3,040 | 2,740 | One-half stand, remainder weeds. |
| Canada blue grass..... | 1,800 | 3,320 | 2,720 | 2,610 | Thin. One-half other grasses, mainly red top, in 1928 and 1929. |
| Bermuda grass (c)..... | 2,600 | 1,200 | 1,600 | 1,800 | Two-thirds stand. Yield 50 per cent red top. |

(a) Planted August, 1928. (b) Planted August, 1927. (c) Planted May 26, 1927.

In order to give an idea of the adaptability of grasses for southeastern Kansas, Table II, containing yields of hay from the different grasses grown on the southeastern Kansas experiment fields at Columbus, Cherokee county, is presented.

Only two years' results are available. These grasses were planted in the late summer of 1926.



FIG. 2.—Experimental nursery for testing the adaptation of grasses and legumes for use in pastures and for forage.

TABLE II.—YIELDS OF TAME-GRASS HAY
 (Columbus, Kan.)

| SPECIES. | Pounds of hay to the acre. | | |
|--------------------------|----------------------------|-------|----------|
| | 1927. | 1928. | Average. |
| Red top..... | 4,680 | 4,710 | 4,700 |
| Timothy..... | 4,420 | 3,900 | 4,160 |
| Kentucky blue grass..... | 2,580 | 780 | 1,680 |
| Meadow fescue..... | 5,400 | 1,500 | 3,440 |
| Orchard grass..... | 4,660 | 1,410 | 3,020 |
| Perennial rye grass..... | 3,300 | 840 | 2,060 |
| Tall oat grass..... | 4,040 | 1,920 | 2,980 |
| Brome grass..... | 1,440 | 2,720 | 2,080 |

ESTABLISHING TAME PASTURES

In establishing tame pastures it is of prime importance that extreme care be given to the preparation of the ground, choice of seed, and planting. The cost of seed alone is usually from \$3 to \$5 an acre and the difficulty of obtaining a stand is greater than with most field crops. It is therefore economy in the long run to reduce the chances for failure to a minimum.

RATE OF SEEDING AND COST OF SEED

Table III shows the rate of seeding tame grasses and the approximate cost of the seed based largely upon 1930 prices. These prices are subject to the usual market fluctuations.

TABLE III.—RATE OF SEEDING TAME GRASSES AND COST OF SEED

| SPECIES. | Rate of seeding—pounds per acre. | Approximate cost of seed. | |
|------------------------------|----------------------------------|---------------------------|----------------|
| | | Cents per pound. | Cost per acre. |
| Brome grass..... | 18 | 15 | \$2.70 |
| Orchard grass..... | 18 | 20 | 3.60 |
| Kentucky blue grass..... | 18 | 25 | 4.50 |
| Timothy..... | 12 | 6 | .72 |
| Meadow fescue..... | 15 | 15 | 2.25 |
| Red top..... | 12 | 16 | 1.92 |
| Perennial rye grass..... | 24 | 13 | 3.12 |
| Italian rye grass..... | 24 | 15 | 3.60 |
| Tall oat grass..... | 24 | 20 | 4.80 |
| Canada blue grass..... | 18 | 35 | 6.50 |
| Slender wheat grass..... | 16 | 15 | 2.40 |
| Crested wheat grass (a)..... | 16 | 25 | 4.00 |
| Reed canary grass (a)..... | 5 | 150 | 7.50 |

(a) Seed supply usually limited.

PREPARATION OF THE GROUND

Plans for getting the ground in condition should usually be made at least a year before seeding. The preceding crop should be one which will be removed in time to plow the ground at least two months before seeding time. Small grain such as wheat or oats is desirable to precede the grass crop if it is desired to plant in the fall. The ground should be plowed early in July, as soon as possible after the grain is cut. The plowing should be followed immediately by disking to aid in settling the ground and to conserve moisture. The disk should be used after each shower until seeding time. If there is little rain during July and August and the ground is cloddy a cultipacker or corrugated land roller should be used after disking and harrowing early in August. (Fig. 3.)

Just before seeding the ground should be disked, harrowed, and packed by a roller. If the surface is uneven a plank drag should be used after the harrow and preceding the packer. An uneven

surface results in a waste of seed and reduction of the stand by allowing some seed to remain uncovered and some to be buried so deep it never comes up.



FIG. 3.—The cultipacker, one of the most satisfactory implements with which to firm the ground for seeding grasses.

PLANTING

The grass drill or alfalfa drill is the best implement for seeding legumes and most grasses. (Fig. 4.) This places the seed at an even depth in moist soil in rows four inches apart. Unless the ground is very moist and well packed the corrugated roller should follow the drill. Seed of a few grasses do not feed well through a drill. Brome grass seed is large and light and usually contains bits of straw or chaff, while seed of tall oat grass and Italian rye grass are bearded, which holds the seeds together, thus interfering with their feeding through a drill. Most grain drills can be provided with an attachment for seeding grass. In cases where a grass drill or a grain drill with proper attachment are not available, or the seed is of such a nature that the drill cannot be used, broadcasting the seed by hand or with a suitable hand seeder is necessary. More even distribution can usually be obtained by going over the ground twice, sowing half of the seed the first time over then crossing the field in the opposite direction.

When a drill or seeder is used to seed a mixture of clover and grass seed the mixture must be stirred frequently as there is a tendency for the clover to work to the bottom and be planted first.

If the seed is to be sown broadcast, it is a good practice to use the corrugated roller just before sowing. This leaves the surface of the ground in alternate small furrows and sharp ridges. The seed collects in the furrows and is evenly covered by harrowing lightly. The ground should be rolled again after the seed has been covered.

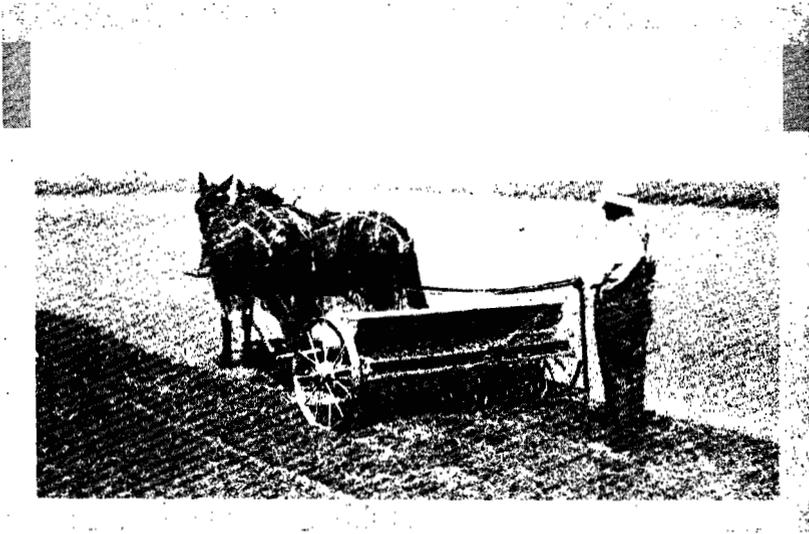


FIG. 4.—A drill is the best implement for seeding grasses as it insures an even distribution of seed and a uniform depth of covering.

TIME OF SEEDING

Grasses may be sown in either fall or spring. Seeding about September 1 is preferred for several reasons. There is much less trouble from weeds when grass is seeded in the fall. The plants become more firmly established before the hot dry weather of the first summer, which often seriously injures spring-sown grass. When sown in the fall the grass will yield considerable pasture the first season. When fall seeding cannot be done grass may be sown during the last half of March. The land should be fall plowed and the seed bed prepared as described above. Occasionally it is necessary to take precautions to prevent blowing of the soil.

CHOICE OF SEED

Only seed of known purity and germination should be used. Low-grade cheap seed should be avoided. Noxious weed seeds are commonly found in seed of grasses and clovers because of the methods of producing these crops and the difficulty of separating certain weed seeds from them. The docks, plantains, chess or cheat, and certain members of the mustard family, as shepherd's purse and pennycress, are among the many weeds spread in grass and clover seed.

LEGUMES FOR PASTURE

It is a well-recognized fact that plants of the legume family are as a rule beneficial to the soil because of their ability to utilize the nitrogen of the air through the action of bacteria which live in nodules on their roots. It is considered good practice to include a legume with all tame-pasture mixtures. This not only aids by benefiting the soil, but also adds to the quality of the feed produced, and may indirectly aid the growth of grass. Legumes are for the most part deeper-rooted than the grasses so they utilize moisture and plant food from below the root zone occupied by most of the grasses. The legumes best adapted to use in pastures in Kansas are sweet clover, white clover, alsike clover, red clover, and Korean and Japanese lespedeza.

Some legumes are better suited to growing alone for pasture than to growing in mixtures. Alfalfa for hog pasture and sweet clover are notable examples of legumes which are usually better grown alone.

SWEET CLOVER

VALUE AND UTILIZATION

No legume crop, with the possible exception of alfalfa, will furnish more pasturage from early spring to late fall than sweet clover when properly handled. It rarely causes bloat and for that reason is more desirable than alfalfa for certain kinds of stock. Its value for pasture is well shown by experiments conducted by the Agricultural Experiment Station at Manhattan. In one test 3.8 acres of sweet clover carried four cows for a period of five months. This is equivalent to 5.3 months' pasture for one cow from an acre. The cows received 1 pound of a grain mixture for each 4 pounds of milk produced. Besides giving excellent returns in milk produced, the cows gained 20 pounds each in weight. In another instance 12 acres of

sweet clover pasture, with 22 acres of very poor blue-grass pasture, carried 60 head of cattle from April 15 to June 1, and 24 head the remainder of the season. Most of the pasture was obtained from the sweet clover. It is a highly desirable crop for pasturing sheep as well as cattle. It also makes a fairly satisfactory substitute for alfalfa for hogs.

Occasionally stock will not eat sweet clover readily at first, especially if it is coarse and stemmy. If pastured early in the spring when the plants are tender and the animals are hungry for green feed they soon acquire an appetite for it and eat it readily.

Sweet clover may cause bloat. The danger can usually be averted by turning the animals in only a short time each day for a while after they have had access to dry feed. Turning in when the animals are hungry, when the plants are wet, or on a rank growth in the spring just after it has been heavily frosted increases the danger of bloat.

Sweet clover is a biennial plant and when sown in the spring normally bears seed the second year and then dies. If sown in the fall it behaves as a winter annual. When used for pasture enough seed is usually produced to continue the stand from year to year. If grown on tillable land it is advisable to rotate with other crops, utilizing the soil-improving qualities of the sweet clover as well as the pasture. When let stand several years the field frequently becomes weedy.

GROWING THE CROP

Sweet clover should be planted on a firm seed bed that is relatively free from weeds. Clean corn stubble can be put in good condition for sweet clover by disking and harrowing. It is often seeded with a nurse crop of oats or sown on wheat in the spring. Oats is the more desirable nurse crop as wheat affords too much competition. If the crop is planted primarily for pasture it is perhaps better planted alone.

Sweet clover is usually sown during March. However, if the seed is unhulled or contains a large per cent of hard seed it may be sown during the winter. A good stand may be obtained by sowing 15 pounds to the acre of seed of high germination. Unhulled seed or that containing a high per cent of hard seed must be planted at a higher rate. A germination test of the seed is always desirable and is the safest guide as to the amount of seed to plant.

During the first year sweet clover uses most of its energy in

producing a strong root system. Food which is made in the leaves during this period is used more for the development of roots than of tops. For this reason pasturing early or too close starves the roots and reduces the yield the following season. Light grazing may be practiced the first season after the root system is well developed. At the end of the season before the tops freeze it may be grazed close or cut for hay without injury to the crop.

The second season growth begins very early, and is extremely rapid because of the large amount of stored food in the roots. Pasturing should begin as soon as the growth is large enough for a cow to get a good bite. From that time on for the next 60 or 90 days sufficient stock should be kept on the field to prevent the tops from becoming rank and coarse. Two or more head of live stock per acre must be available during this period to keep the pasture in good condition. During the late summer the crop may be grazed lightly and allowed to reseed the ground for pasture. A common practice is to remove the stock earlier and allow the crop to produce seed. After the seed crop is harvested the land may be fall plowed for corn or other spring crops.

Sweet clover may be used with rye and Sudan grass in a temporary pasture rotation system which will furnish pasture over a period of about nine months of the year. Sweet clover and Sudan grass alone may be so managed as to provide pasture over a longer period than native pasture and with a much higher carrying capacity.

CLOVERS

WHITE CLOVER

White or dutch clover is a low-growing perennial with creeping stems which grow along the surface of the ground and take root, thus forming new plants and spreading rapidly by this means. It is used mainly for pasture and in lawns where it is usually grown with blue grass. It spreads naturally in closely grazed pastures in southeastern Kansas on account of its greater tolerance to sour soils. White clover does not grow tall enough to cut for hay, but will stand more pasturing and tramping by live stock than the other clovers. It is never sown alone for pasture in this state, but a seeding of 1 or 2 pounds to the acre with a mixture of grasses is frequently used. The high cost of seed somewhat restricts its use in mixtures. Grass will crowd out white clover if not kept pastured down fairly close, but in closely grazed areas the clover maintains itself by reseeding as well as producing new plants from runners.

LADINO CLOVER

Ladino clover is a very rank growing variety of white clover which is being grown experimentally in this state. Results of limited tests have been very promising. The yield produced is fully double that obtained from white or dutch clover. Further tests to determine its hardiness to climatic extremes here should be made before recommending it for general use.

ALSIKE CLOVER

Alsike clover is best adapted to a cool moist climate and cannot be expected to give good results in this state where the annual rainfall is much less than 35 inches. It grows well on soil which is low in lime or is poorly drained, where most other clovers will not thrive. It is well suited to pasture mixtures. It is longer lived than red clover and reseeds rather readily, often maintaining its stand in tame pasture several years with fairly close grazing and considerable tramping. Alsike grows almost as tall as red clover, but the stems are not so upright. The seeds are about the same size as those of white clover and only two-fifths as large as seeds of red clover. Two or three pounds to the acre sown with a mixture of grasses is usually the best means of growing alsike for pasture in this state.

RED CLOVER

Red clover has been an important crop for hay, pasture, and soil improvement in this country for nearly 200 years. It is adapted only to the eastern fourth of Kansas and to soils that are not deficient in lime. Over 60 per cent of the red clover in this state is grown in five counties in the extreme northeastern corner. It is grown primarily for hay, but makes excellent pasture, especially for young stock. The fall growth after a hay crop has been harvested is generally utilized for pasture. Red clover should be sown in early spring on a well-prepared firm seed bed. When sown alone with a drill 8 to 10 pounds of seed to the acre are sufficient, but if broadcast 12 to 15 pounds should be used. It may usually be pastured lightly in the fall of the first season, especially if sown without a nurse crop. The second season a crop of hay may be cut and the second crop left for seed or utilized for pasture.

As a rule most of the plants die at the end of the second year. If pastured with cattle or sheep care must be taken to prevent bloat by feeding plenty of dry roughage before turning on the pasture and by keeping them off when the crop is wet. Red clover is generally grown in mixtures with grasses when it is to be used for pasture.

LESPEDEZA

JAPANESE LESPEDEZA

In southeastern Kansas Japanese clover or Japanese lespedeza has been spreading for several years and is recognized as a desirable plant in pastures. This plant has spread naturally throughout southern states much as white clover has farther north. Japanese lespedeza is a small, fine-stemmed, annual legume with leaves resembling those of alfalfa more than clover. It must come from the seed every year as all plants are killed by the first frost in the fall. Japanese lespedeza requires a long growing season and will not produce seed except in the extreme southeastern part of Kansas.

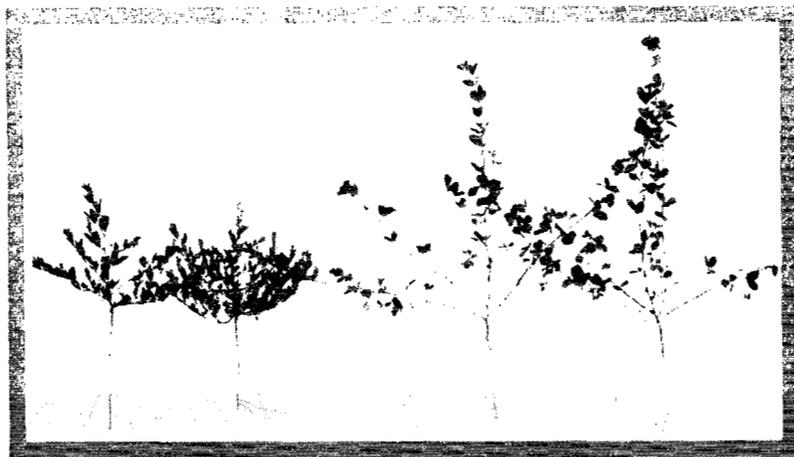


FIG. 5.—Typical plants of Japanese (left) and Korean (right) lespedeza.

This limits its use entirely to that region. Because of this and its inferior growth it is less valuable than the Korean species. The longer growing period of the Japanese lespedeza may be regarded as an advantage where seasons are long, because it affords grazing somewhat later than the Korean species. (Fig. 5.)

KOREAN LESPEDEZA

Korean lespedeza is a low-growing, much-branched annual legume with very fine stems. In general appearance it somewhat resembles alfalfa. The plants seldom grow more than 10 to 12 inches high, but where they are some distance apart they branch profusely, the lower branches sometimes becoming 15 to 20 inches long and spreading almost horizontally near the ground.

Korean lespedeza grows much more rapidly in the early part of the season than Japanese lespedeza and makes a ranker growth and more pasture to the acre. Korean lespedeza will mature as far north as Nebraska. Seed production seems to be certain in Kansas wherever it has been tried and when once started in pastures it spreads spontaneously. Even where it has been pastured rather closely enough seed is formed to renew the stand the following spring. Seedlings which come up early in the spring are sometimes killed by freezing. It is a distinct advantage that Korean lespedeza makes its greatest growth during the hot weather of July and August when other pasture usually is making little growth.

Korean lespedeza is adapted to a wide range of soils. It has given good results on poor or eroded fields and does not seem sensitive to sour land. It has a rather extensive root system and stands considerable drought after the plants get well started.

Korean lespedeza is better adapted for pasture than for any other purpose. It is well suited to growing in mixtures of tame grasses. It must not be planted in early fall because any plants which come up in the fall will be killed by the first freeze. If the grass is seeded in the fall the lespedeza seed may be broadcast in early spring at the rate of 2 to 4 pounds per acre. If this is done while the ground is honeycombed or checked by freezing and thawing the seed will usually be covered sufficiently when the ground is settled by rains later in the spring. If the soil is in such condition that a light harrowing will not injure the grass the seed may be covered by this means or by a brush drag. Probably the most economical use of the seed will be made by sowing shortly before the last frost in the spring.

In old native or tame-grass pastures where the grass has become thin or weedy Korean lespedeza can be readily established and the pasture improved. It adds greatly to the yield of blue-grass pasture because of the fact that its greatest growth is produced during July and August, during which time Kentucky blue grass produces little or no growth and affords no competition for the lespedeza.

Under such conditions disking the ground lightly before sowing the seed and harrowing to cover it is desirable. From 2 to 10 pounds of seed to the acre may be used, depending on the amount of grass on the area to be seeded and whether one is willing to wait for the lespedeza to spread. As little as 1 or 2 pounds to the acre will usually establish the crop within two or three seasons.

Inoculation of Korean lespedeza seed does not seem to be necessary. When grown alone in a full stand for pasture or seed about 12 pounds of seed to the acre are required. Grown in this way it should be planted on clean ground on account of difficulties with weeds. The ground should be fall plowed and thoroughly worked down by means of a disk, harrow, and packer to provide an excellent seed bed. If seeding is delayed until April the early weeds may be killed before the crop is planted.

KUDZU

Kudzu is a large-leaved woody leguminous vine native to Japan. It grows with remarkable rapidity in warm weather after the plants are well established. When planted in fields where there is nothing to support them these vines creep along the ground, take root at the joints and start new plants. When the ground becomes well covered with the vines upright twining branches are produced at the joints which have struck root. The prostrate vines die off between the joints which have taken root, thus producing new and independent plants. When these plants become a good stand, a mass of herbage 155 to 3 feet thick, resembling a dense growth of cowpeas or soy beans, is produced.

Kudzu is best adapted to regions where the summers are long and warm. Even a light frost kills the leaves and stops all growth. In Kansas the plants survive the winters but the new growth in the spring is frequently killed by late freezes. Owing to the short summers in Kansas the growth is not so rank as in the South and new plants formed by the vines taking root do not become so well established the first season and may winter-kill. More time is therefore required to establish a stand, and weeds cause considerable trouble for the first season or two.

New fields of kudzu are started by setting plants taken from an established field. The crop should not be pastured or cut until the third season. A maximum growth will usually not be obtained until the third season or later.

Kudzu has been tried in a limited way at the Kansas Agricultural Experiment Station and found to withstand recent winters and to make a good growth during warm weather. It does not appear to thrive on soils that are not well drained or on sandy soils.

On account of the expense and time involved in establishing a stand and the shortness of seasons here, which greatly reduces the yield, and the fact that kudzu cannot be used advantageously in rotations, it is doubtful if it will ever become a popular crop in this

state. On rough, gullied, or stony land in eastern Kansas, where sweet clover cannot be grown successfully or where it is desirable that the land should remain in permanent pasture, it may find a place.

VETCH

Of the several species of vetch the winter annual one known as hairy, winter, or villose vetch is the most valuable in this state. It thrives best in cool weather and is grown mainly as a winter cover crop and for green manure in orchards. It is extremely resistant to cold, continuing growth until the ground freezes in the fall, and is one of the first plants to become green in the spring. It makes excellent pasture for hogs, sheep, and cattle, but is little used for that purpose in this state, probably because of the high price of the seed and the fact that sweet clover, alfalfa, rye, etc., are in competition and produce more feed to the acre.

Vetch should be sown about September 1 on land which has been prepared by plowing in July and working down to a good seed-bed condition such as would be suitable for alfalfa. When sown alone 30 to 40 pounds of seed are required to the acre. Frequently it is mixed with rye, in which case 20 to 25 pounds of vetch and 40 to 50 pounds of rye are used. Vetch may be pastured in the fall and in the spring. It matures in the latter part of June and the plants die. The crop may be pastured lightly early in the spring and the stock removed in time to allow it to produce a seed crop. When grown with rye the seed crop is supported in a more upright position, which makes harvesting more convenient.

PASTURE MIXTURES

ADVANTAGES OF MIXTURES

To obtain the highest yield at all times during the grazing season, as well as to obtain the greatest feeding value of the forage, a pasture should contain a mixture of several grasses and one or two legumes. It should also combine sod-forming grasses with bunch grasses in order to produce a good turf. The mixture should contain rapid-growing grasses to supply feed and keep down weeds while the slower-growing permanent grasses are becoming established.

REGIONAL DIVISIONS AND ADAPTED MIXTURES

The eastern third of Kansas can be divided into four general areas as outlined on the pasture area map of Kansas. (Fig. 1.) Each of the general regions has sufficient differences in soil and climate to

TAME PASTURES IN KANSAS

justify making changes in the species planted. Mixtures for the four regions are as follows:

Area 2—North Central Kansas

| | |
|--|------------------------|
| Brome grass | 10 pounds per acre |
| Orchard grass | 6 pounds per acre |
| Perennial rye grass or Italian rye grass or meadow fescue. | 4 pounds per acre |
| Biennial white sweet clover..... | 4 pounds per acre |
| Total | 24 pounds per acre |

Approximate cost of mixture, \$3 per acre.

Area 3—Glaciated Soils in Northeastern Kansas

| | |
|---------------------------|-------------------|
| Brome grass | 6 pounds per acre |
| Orchard grass | 4 pounds per acre |
| Timothy | 3 pounds per acre |
| Meadow fescue | 3 pounds per acre |
| Kentucky blue grass | 2 pounds per acre |
| Sweet clover | 4 pounds per acre |
| Red clover | 2 pounds per acre |

Approximate cost of mixture, \$3.50 per acre.

Area 4—East Central Kansas

| | |
|--|-------------------|
| Red top | 6 pounds per acre |
| Orchard grass | 6 pounds per acre |
| Meadow fescue | 6 pounds per acre |
| Kentucky blue grass | 2 pounds per acre |
| Alsike clover or white clover or sweet clover..... | 4 pounds per acre |

Approximate cost of mixture, \$4.25 per acre.

Area 5—Southeastern Kansas

| | |
|--|-------------------|
| Orchard grass | 6 pounds per acre |
| Meadow fescue | 4 pounds per acre |
| Red top | 5 pounds per acre |
| Kentucky blue grass | 3 pounds per acre |
| Alsike or white clover on acid lands and sweet clover on nonacid soils | 4 pounds per acre |
| Korean lespedeza | 2 pounds per acre |

Approximate cost of mixture, \$5 per acre.

The above mixtures are suitable for the average conditions existing in each area and may be modified to meet the conditions that the soil and availability of seed may demand. The mixture in Area 2 is rather simple and is well adapted to a major portion of this region. The mixture can be simplified by omitting the rye grasses or meadow fescue, in which case an additional 2 pounds of brome grass seed should be planted. A mixture of 12 pounds of brome grass and 6 pounds of sweet clover makes a simple mixture that will provide

a large amount of forage. Under rather heavy grazing, the sweet clover will disappear in about three years.

In case it is not desired to obtain quick pasturing the meadow fescue can be eliminated from Area 3. If the land is nonacid sweet clover or red clover can be seeded, the former being cheaper and providing the greater amount of forage. On acid soils white clover or Korean lespedeza should be used.

Orchard grass and red top are used as base grasses in Area 4, the amount of each depending on the soil conditions. On dryer upland soils orchard grass should be planted in larger amounts, while on bottom lands red top should be seeded in slightly larger quantities than orchard grass. Timothy may also be used on bottom lands. On rather wet acid land alsike clover is the best legume to use, while on rather dry acid upland either white clover or Korean lespedeza should be seeded. The latter must be seeded in the spring, as fall seeding will be killed by the frost. On limed soils sweet clover is recommended.

Area 5, southeastern Kansas, has a wider range of soil conditions than any of the other areas, hence more complicated conditions prevail for obtaining the best pasture mixture. Red top can probably be used as a base grass for all soil conditions. Orchard grass and meadow fescue also do very well and can be placed in mixtures. For acid soils alsike clover is best adapted to the wet soils, while white clover or lespedeza can be used more successfully on the drier or better-drained soils. Sweet clover will provide the largest amount of forage on limed or nonacid soils.

CARE OF PASTURES

GROWING REQUIREMENTS OF PASTURE PLANTS

The life and yield of pasture will be determined largely by the grazing practices used. The critical period in the growth of perennial herbaceous forage plants is the early spring when they start to grow. At this time the plant is drawing on a reserve of plant food to make the initial growth, and this reserve is drawn on until the plant has enough leaf surface to manufacture sufficient food to meet its growing needs. After this stage of development is reached it is necessary for the plant to maintain its vigor not only to supply its growing needs but to replace the reserve used up at the beginning of the growing season. If the growing requirements of the pasture plants are not met they naturally are starved, and if continued for a long enough time the best forage species will be killed and re-

placed by less desirable species and weeds. This is not so serious with tame pastures where it is possible to plow and replace them with another crop as it is with nontillable pastures where it is not possible to till the soil and reseed the land after the forage species have been killed.

Since, however, it is expensive to seed and it is not always possible to obtain a good stand of tame forage plants on pastures, some consideration should be given to their maintenance. This is also important in order to obtain the greatest yield of forage which gives the highest grazing capacity and greatest return from the pasture.

TIME OF STARTING GROWTH

The tame grasses start growing much earlier than the native grasses and as a general rule they can be grazed without injury about three weeks ahead of the native species. The date for starting grazing will vary considerably with seasonal conditions as well as for different parts of the state, depending on altitude and latitude. The southeastern section is about ten days to two weeks ahead of the northeastern part. In the vicinity of Manhattan the tame pastures in an average year can be grazed the first part of April. At this time the grass is at least 4 or 5 inches high so an animal can easily obtain a good mouthful and does not have to wander around continually in a vain attempt to satisfy its appetite.

By protecting the pasture a little longer in the early spring a great increase in the yield of forage can be obtained. Experiments conducted in England show that orchard grass cut eight times between May 5 and September 9 yielded 40 per cent more forage than plots cut three times before May 5. Delayed or light spring grazing will also make it possible to graze and utilize the forage much closer later in the season.

Stock should also be kept off the closely grazed pastures during the nongrowing season because at this time the land is frequently wet and much damage is done to the sod by tramping and tearing. The tramping during the time the ground is wet also packs the soil so it will absorb less water and will be less productive. Trailing is naturally greater in the early spring or other out-of-season periods when feed is short or unpalatable.

USE OF MANURE AND FERTILIZERS ON TAME PASTURES

The productivity of pastures in humid regions is to a large measure governed by the fertility of the soil. This is reflected not only in the yield obtained, but also in the quality or feeding value of the

forage. Pastures having thin unproductive soil will not stand so heavy usage as the ones having fertile soils, and the desirable forage plants will be replaced much quicker by weeds following improper grazing practices. In the eastern part of the United States the fertilizing of pastures is one of the principal means suggested for bringing back the palatable forage plants which under proper grazing management will gradually replace the weeds.

Pastures containing a good stand of forage plants are reduced very little in fertility by proper grazing. This is due to the fact that there is no erosion, which is the cause of the rapid depletion of sloping land planted to tilled crops. The droppings from the cattle also aid in maintaining the fertility of pastures. Regardless of these, however, there may be more plant food removed from the soil in animal products on high-producing pastures than is replaced by the vegetative accumulations.

There are several treatments that may be used to improve the quantity and quality of forage produced in pastures. The most common of these is barnyard manure. The application of manure to grasses will greatly increase their yield. Experiments conducted by the Kansas Agricultural Experiment Station show that the application of about six tons of manure to the acre on tame pasture mixture consisting of orchard grass, brome grass, and sweet clover, increased the yield about 60 per cent over a three-year period. In addition to the increased yield the feeding value of the forage was increased about one-third. The feasibility of placing manure on pastures depends upon the amount of manure available and the length of the haul. Very frequently, however, pasture land affords a very convenient place to spread manure when it is not possible to apply it to cultivated fields.

On medium to thin lands in eastern Kansas mineral fertilizers may be profitably used to increase the yield and nutritive value of the grass on some of the better tame pastures that are intensively used, particularly for dairy stock. Where pastures have sour soils the greatest improvement often can be made by the application of lime. Since lime is being used more extensively every year and the cost is decreasing, the increase in yield on some soils would more than pay for the cost of the time and labor to apply it. Lime is especially valuable in stimulating growth of legumes and certain of the grasses. Before lime is applied to pastures, care should be exercised to determine as near as possible the amount to apply.

Where lime is used it is often advisable, also, to make an appli-

cation of about 200 pounds of superphosphate to the acre in alternate years. The cost of this fertilizer would be about \$3 an acre. Superphosphate is most valuable for stimulating the growth of clovers, but may also greatly increase the growth of grass.

Nitrogen fertilizers stimulate grass more than any other. The nitrogenous fertilizers most commonly used are sodium nitrate or ammonium sulphate. About 150 pounds per acre of either of these fertilizer materials should be applied to obtain the most satisfactory results. The cost of this material would be about \$4.50 per acre. At the present cost of nitrogenous fertilizers perhaps it is only on a very few of the more intensely used pastures in the more humid part of the state that it would be profitable to apply this treatment.

Experiments conducted by the Kansas station near Manhattan show that the greatest increase in the production of pasture vegetation from mineral fertilizers was obtained from the application of a complete fertilizer consisting of 100 pounds of ammonium sulphate applied annually in the early spring and 200 pounds of superphosphate and 25 pounds of potash, both applied at the same time every other year. This treatment increased the yield of a pasture mixture, consisting mainly of brome and orchard grass, from 2,070 pounds of hay per acre to 3,050 pounds. In addition, the protein content was increased from 13.6 to 18.4 per cent, or about 35 per cent. The cost of the complete fertilizers when all three are applied is about \$7 per acre, but in alternate years, when only the ammonium sulphate is applied, the cost is only \$3 per acre, making the average yearly acre cost \$5.

Owing to the high cost of all mineral fertilizers a careful analysis should be made of the soil conditions to determine whether the cost would be justified, and if so the kind of mixtures of fertilizers that should be applied.

WEED AND BRUSH CONTROL

A large per cent of Kansas pastures is producing too many weeds. The first step in the improvement of weedy or brushy pastures is the eradication of this worthless growth. Then comes the correction of the cause, which is usually overgrazing or too early grazing or, in many instances, a combination of the two.

In the eradication of weeds or brush pasture experiments have shown that the time of eradication is a very important factor in whatever method of eradication is used. This is due to the fact that all perennial plants use reserve food to start growth in the spring.

This supply is drawn on until the plant has made enough leafy growth to manufacture food in sufficient amount to supply the growing needs of the plant, after which the reserve supply is gradually restored. Eradication is most effective if done about the time food reserves are lowest in the plant, as it is weakest at this time and has the least power of resistance.

The time that plants can be most effectively eradicated will vary

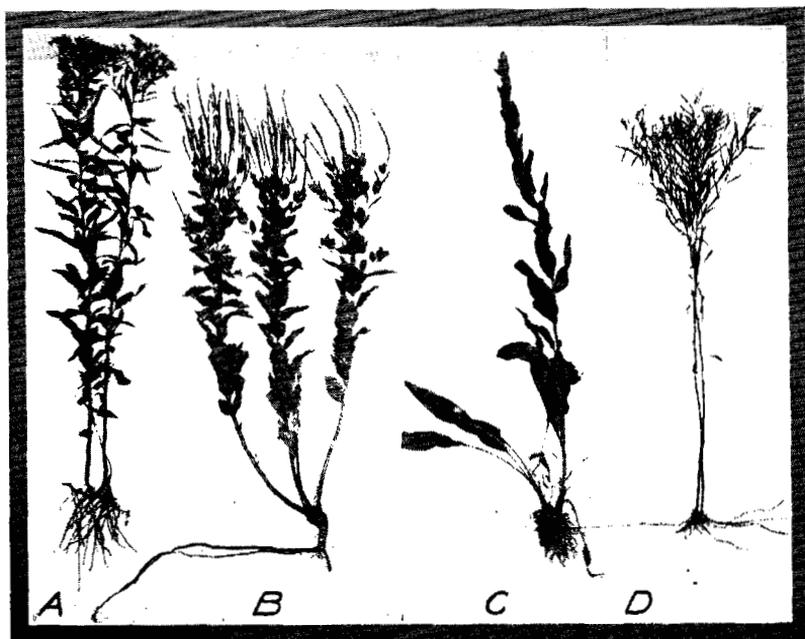


FIG. 6.—Common pasture weeds in Kansas: (A) Iron weed, (B) vervain, (C) stiff-leaved goldenrod, and (D) broomweed.

with different species; also with various parts of the state, according to altitude and latitude. With most species on which experimental work has been done the most effective time of eradication is about the time flower buds first appear.

Mowing is perhaps the most effective method to be used in controlling weeds or brush in tame pastures. Some of the most common perennial weeds, such as ironweed and vervain (fig. 6, A and B), should be mowed about the middle of June in the average year for growing conditions existing at Manhattan. For the southeastern part of the state the time might be about ten days earlier. Stiff-

leafed goldenrod (fig. 6, C), a very common pasture weed in south-eastern Kansas, should be mowed about the middle of July. Ragweed and broomweed (fig. 6, D), which come later in the season, can be most effectively mowed about the middle of August.

With buckbrush the most effective time of cutting is the early part of May (fig. 7), while with sumac the time that the plant can be killed most easily is about a month later. If the clippings are made a month earlier or later than this date they have little or no effect on killing the plants. Eradication experiments have shown that most weeds can be destroyed by clipping as directed for two seasons. Three or four cuttings are required for buckbrush and sumac.

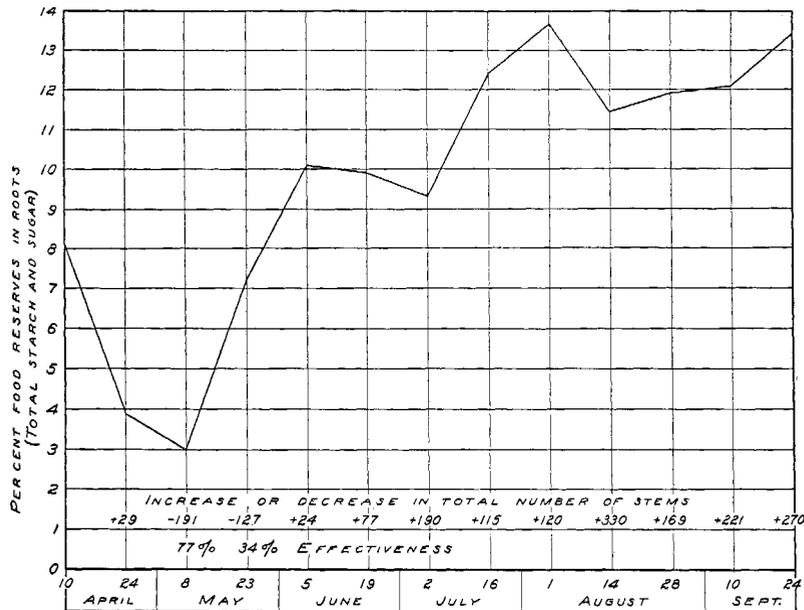


Fig. 7.—Chart showing relation of food reserves in roots to effectiveness of killing buckbrush by cutting on different dates. Each plat was cut on the same date for three consecutive years. Only the May cuttings were effective.

TEMPORARY PASTURE CROPS

SUDAN GRASS

VALUE AND UTILIZATION

Sudan grass is the best summer pasture crop known for Kansas. (Fig. 8.) It will carry more live stock from July until frost than any other pasture crop grown in the state. It grows rapidly and thrives in the hot dry months when other pastures are least productive. It is, therefore especially valuable as a supplementary pasture to provide an abundance of feed of good quality during that



FIG. 8.—Dairy cows on summer pasture of Sudan grass.

period of the summer when it is most needed. Small fields near the farmstead can be made to yield large returns by seeding to sudan grass for pasture. The work horses, milk cows, sheep, pigs, or chickens will make profitable use of small fields sown to sudan grass or of old feed lots which are too often left to produce only weeds.

Tests carried on by the Kansas Agricultural Experiment Station at Manhattan, Dodge City and Hays show that Sudan grass is unexcelled as a summer pasture for dairy cows and that it will carry from two to four times as many head of live stock for a given area as the native grasses. At Dodge City during a dry season, with only 9.4 inches of rain from May to October 1, Sudan grass pasture carried one cow for each 1 1/2 acres for a period of six months. At Man-

hattan the grass carried approximately one head per acre during the dry summer of 1919. Results with Sudan grass for hog pasture have also been satisfactory. In 1925 the Agricultural Experiment Station at Manhattan pastured 15 head of young hogs on 1½ acres of the grass from the latter part of June until the end of the growing season. An acre of Sudan grass under fair seasonal conditions will carry from eight to twelve head of mature hogs all summer. It may be used to good advantage to supplement alfalfa pasture for hogs and to prevent excessive grazing of the alfalfa when growth is retarded by dry weather.

Sudan grass, although a species of sorghum, rarely poisons live stock, the only serious case reported having occurred in a field badly injured by drought.

PREPARATION OF GROUND AND PLANTING

The ground for Sudan grass should be well prepared before seeding. Fall or early spring plowing is desirable if possible. Careful preparation of the seed bed by disking and harrowing will pay good returns. On late-plowed land the cultipacker or corrugated roller should also be used. The seed should not be sown until the ground is warm. About the middle of May in the southern part of the state and June 1 in the northern part, is sufficiently early. Nothing is gained by planting too early. Poor stands and trouble from weeds usually result from such practice. The seed used should be free from Johnson grass, which is a serious weed pest, especially in the southern half of Kansas.

Planting can be done best with a grain drill. In the eastern part of the state, 20 to 25 pounds of good seed should be used to the acre. In western Kansas 15 to 20 pounds is sufficient.

If weather conditions are favorable the crop should be ready to pasture about one month after seeding. It is often desirable to have the field divided into two parts to be grazed alternately. If the grass makes too much growth it should be mowed and the extra feed taken off for hay. Better results are obtained if sufficient stock is used to keep the growth down, and it is desirable to vary the number of stock on a given area according to the growth of the grass.

The value of Sudan grass is not fully recognized in some sections and the crop is deserving of wider use, especially as a supplementary pasture crop.

**RYE AND WHEAT
PLANTING AND UTILIZATION**

Rye makes the best temporary fall, winter and early spring pasture in this state. (Fig. 9.) Sown early in September it will furnish pasture in Kansas from the middle of October until the last of December, and following normal winters it will again furnish pasture from about March 15 until June. The ground can then be plowed and planted to Sudan grass or some other late-planted crop.



FIG. 9.—Sheep on rye pasture. Rye is an excellent spring and fall pasture for all live stock.

For best results the ground for rye should be plowed in July and worked occasionally to keep down weeds and conserve moisture. Early in September it should be disked and harrowed and the seed planted with a drill in the same manner as wheat. A somewhat heavier rate of seeding may be used when sown for pasture than when grown for seed production. From 4 to 6 pecks per acre of good seed are usually sown.

FEEDING VALUE

Plants of rye and wheat before the period of jointing are surprisingly high in feed value, especially protein and minerals. The results of analyses made at the Agricultural Experiment Station in 1929 are given in Table IV.

TABLE IV.—FEED CONSTITUENTS OF GROWING PLANTS OF RYE AND WINTER WHEAT
 (Manhattan, 1929)

| CROP. | Date collected. | Total moisture. | Per cent of dry weight. | | | | | Condition of growth |
|------------|-----------------|-----------------|-------------------------|--------------------|------|-------------------|-----------------|---|
| | | | Protein. | Carbo- hydrate. | Fat. | Mineral (ash). | Crude fiber. | |
| Rye..... | Apr. 27 | 86.19 | 28.00 | 33.72 | 4.97 | 13.85 | 19.46 | Being pastured. Tallest plants 16 inches high. |
| Rye..... | Nov. 4 | 83.18 | 29.97 | 36.16 | 5.90 | 12.90 | 15.07 | Vigorous. Tallest plants 10 inches high. |
| Wheat..... | Apr. 26 | 79.38 | 17.76 | 46.10 | 3.18 | 11.44 | 21.52 | Vigorous. Tallest plants 16 inches high. |
| Wheat..... | Nov. 4 | 82.55 | 28.28 | 41.54 | 4.59 | 12.34 | 13.25 | Vigorous. Tallest plants 9 inches high. Average, 6 inches high. |

The very high protein and mineral content of both rye and wheat pasture shows why growing lambs, pigs and calves, and producing stock like milk cows and laying hens do so well on rye or wheat pasture.

There is some prejudice against the use of rye in the wheat belt of Kansas because of the danger of spreading rye to the wheat fields. There is little danger of this, however, if proper care is exercised in the use of planting, threshing and cleaning machinery. Where small areas are planted exclusively for pasture rye is better than wheat because of its greater hardiness.

Another objection to rye and wheat pasture for milk cows is the tendency of the feed to taint milk. This may be largely corrected by removing the cows about two hours before milking and properly cooling the milk.

Wheat pasture is an important by-product of wheat production and may add materially to the profits of wheat raising. If judiciously done wheat may be pastured without reducing the yield of grain. Grazing too close or too late in the spring is very injurious to the crop. Pasturing too soon in the fall or when the ground is wet also reduces the yield. Planting wheat early with the object of obtaining more pasture may result in greater losses from Hessian fly injury. Since rye is practically free from attacks of Hessian fly early planting of it may be practiced without this danger.

RAPE

Rape is an excellent pasture crop for hogs, sheep (fig. 10), young poultry and calves. Cows eat rape readily but it has a tendency to taint the milk and the animals do considerable injury to the crop by

tramping. It tends, also, to discolor the yolk of eggs when laying hens are fed rape. It is generally grown for hogs or sheep. At the Iowa Agricultural Experiment Station rape produced fully as good gains on pigs as alfalfa. It has been utilized to good advantage at Manhattan as pasture for sheep.

Rape is a cool-weather crop and is not very resistant to heat or drought. It should be seeded soon after oats is planted and if



FIG. 10.—Sheep on rape pasture.

weather conditions are favorable should be ready for pasturing by June 1. During hot, dry weather in July and August it may suffer severely and produce little feed, but if the plants do not die they will resume growth around September 1, when rains come, and produce good pasture throughout the autumn months. It is desirable to sow two or three patches and alternate the grazing during the season.

The usual method of planting rape is with a grain drill. Six pounds of good seed per acre is sufficient if the seed-bed conditions are favorable. Usually double that amount of seed is used, but as a rule too heavy seeding results in a poorer growth because the plants are crowded. The seed should not be covered much over a

half inch. Imperfect stands frequently result from covering the seed too deep. The Dwarf Essex is practically the only variety planted in this state. Rape could be used more extensively for pasture in the eastern half of Kansas.

A COMBINATION OF RYE, RAPE, AND SUDAN GRASS

With the three temporary pasture crops, rye, rape, and Sudan grass, it is possible to have pasture for hogs, sheep or other stock throughout nine months or more of the year. A rotation pasture consisting of these crops should work out satisfactorily. The approximate time for seeding and period during which pasture may be expected under normal conditions in eastern Kansas are as follows:

| | Time of seeding | Period of pasturing. |
|------------|-----------------|--|
| Rye | September 1 | Oct. 20 to Dec. 20 and March 15 to June 1. |
| Rape | April 1 | June 1 to July 10 and Sept. 1 to Nov. 10. |
| Sudangrass | June 1 | July 1 to October 20. |

Two fields would be required for such a rotation. The same field would be used for the rye and Sudan grass by plowing under the rye about June 1 and preparing the ground immediately for Sudan grass.