

AGRICULTURAL EXPERIMENT STATION

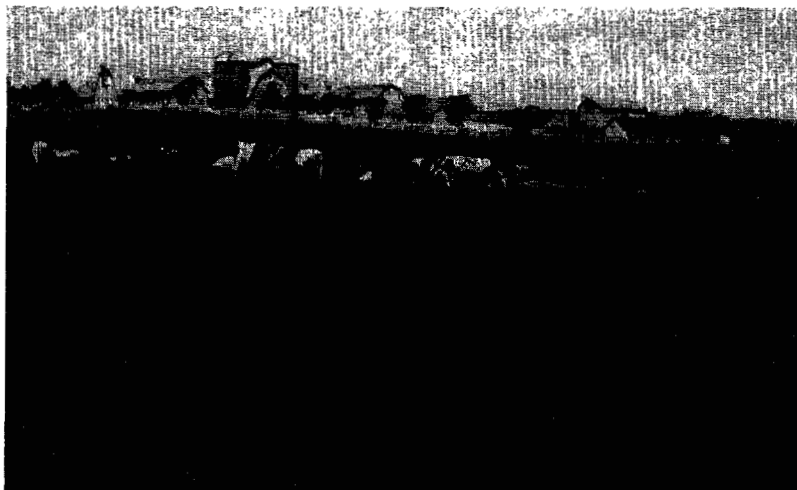
KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE

MANHATTAN, KANSAS

DEPARTMENT OF AGRONOMY

TAME PASTURES IN KANSAS¹

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Tame Pastures Produce Inexpensive Feed

Introduction

The increased use of cultivated land for pasture crops amounted to approximately a quarter of a million acres in Kansas from 1928 to 1936 for the tame perennial grasses alone. Pastures are commonly considered to be low in productivity, but this is due chiefly to the practice of using the poorest land on each farm for pasture, and to the fact that it has been a common practice to utilize grazing land as intensively and as long each season as possible without consideration for future productivity and maintenance of stands. Almost all of the most productive grassland and a great deal more that is only medium to poor has been put to cultivation, resulting in a shortage of good pasture and an urgent need for more grass.

1. Contribution No. 814, Department of Agronomy.

Fortunately Kansas, with approximately 15 million acres of native grassland, still produces large quantities of pasturage. This is generally used for summer grazing, especially in eastern Kansas, leaving at least half of each year without native pasture during which time livestock must either be fed in the dry lot or provided with supplementary pasture. Of these two alternatives the latter is far more desirable, and many acres of cultivated land in Kansas are seeded each year to supplementary pasture crops. This practice serves a double purpose in that it provides large quantities of good, low-cost livestock feed and makes possible the protection of native pastures during seasons when grazing is likely to be injurious to them.

By the use of supplementary pastures it is possible to provide grazing for at least ten months in each year except in seasons of extreme drought or when snows lie on the ground for long periods. Grazing seasons of some cultivated pasture crops for Kansas are shown in Figure 1, in comparison to the grazing seasons of native pastures. It will be seen that, even without native grassland, it is possible to provide pasture for the greater part of the year, thereby reducing the need for dry-lot feeding. This makes for cheaper and more efficient production of livestock products.

It is possible to produce more and better feed with pasture than with tilled crops, and costs of production are lower. Perennial pastures are seeded only once in several seasons, thereby distributing such costs as seedbed preparation, cost of seed and cost of seeding over a period of several years. There are no tillage operations except occasional mowing for weed control, and there are no harvesting costs because the crop is harvested by the grazing animal. Furthermore, the soil is benefited by having been used for pasture. It is enriched by the addition of organic matter, improved in physical condition, and protected from the harmful effects of soil erosion.

Records obtained over a five-year period on 478 Corn Belt farms which produced beef calves showed that on an average the breeding cows obtained their entire supply of feed from pasture for 200 days each year, being fed roughage and concentrates the remaining 165 days. The total annual feed bill for these cows was \$24 per head, of which \$8.50 was for pasture. Pastures, which furnished over half the total feed, did so at only one-third the cost.

In the light of facts such as these, it appears profitable to utilize some of the better cultivated land for grazing and not to limit pasture planting to poor land. It is desirable to make perennial pastures a part of the regular, long-time crop rotations in regions where the tame perennial grasses are adapted, and to include temporary pastures in the shorter rotations or where the tame perennial grasses cannot be grown. These practices are followed on many Kansas farms. There is a growing realization of the value of grass as a crop in Kansas and an increasing demand for knowledge concerning the establishment and culture of pastures.

FIG. 1.—Grazing seasons for some Kansas pasture crops.

PASTURE CROP.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.
Bluestem.....										
Shortgrass.....									or protect	for fall and
Tame perennial grasses and grass mixtures.									winter gra-	zing.
First year, sweet clover.....						(a)				
Second year, sweet clover.....										
Grain cereals (fall sown), rye, wheat, barley.			-----			(b)				
Grain cereals (spring sown).....										
Korean lespedeza.....										
Sudan grass.....								to frost		
Rape.....										

(a) First-year sweet clover may be grazed earlier than September 1 in good years or on rich, moist soils.
 (b) Dotted line indicates time when livestock are normally removed from wheat fields grown primarily for grain.

Classification of Pasture Plants

For purposes of classification pasture plants may be divided into two general groups: (1) grasses and (2) legumes. These in turn may be subdivided into annuals, biennials, and perennials. The perennial grasses may be classified as (1) bunch grasses and (2) sod-forming grasses. The bunch grasses are those which, like orchard grass and timothy, do not spread vegetatively to form a complete sod but remain in tufts or clumps. For this reason they are generally not seeded alone for pasture but are combined in mixtures with one or more of the sod-forming grasses. The latter spread rapidly by underground stems and when planted alone or in mixtures with bunch grasses soon form a dense, uniform turf that is resistant to trampling by livestock as well as to runoff and soil erosion. Kentucky bluegrass, bromegrass, and redtop are examples of sod-forming grasses.

The annuals and biennials are used for temporary pastures, but some of the short-lived legumes may be included in mixtures with the perennial grasses. Among the more important annual pasture crops are the cereal grains, Sudan grass, and Korean lespedeza. Sweet clover is the most important of the biennials in Kansas.

The Tame Perennial Grasses

The tame perennial grasses are those grown on cultivated land for pasture, hay, or for their seed. The term "tame" is used to designate that they are cultivated crops in contrast to the native or wild pasture grasses which occur in the unplowed prairies and plains. All of the tame perennial grasses commonly grown in Kansas are native to countries where climatic conditions are more favorable than in the major portion of this state, most of them having originated in Europe. Their use is restricted to approximately the eastern one-third of the state, where the yearly rainfall averages 30 inches or more, although successful plantings are reported in local areas west of this region. Farther west the use of tame grasses is limited to stream bottoms or other favored locations where the soils are rich and well-watered, or to irrigated lands.

Tame grasses differ somewhat in growth habit from the native species, starting growth fully a month earlier in the spring and continuing to grow later in the fall, whereas the growth of native grasses is stopped by frost. The tame grasses also differ in respect to the season at which they produce their seed. Most species native to Kansas do not seed until late summer or early fall while the tame grasses all mature during the early part of the summer. Since the tame grasses are best adapted to fairly cool, moist climatic conditions, they usually grow much more slowly during the summer and may suspend growth entirely in periods of high temperature and drought, resuming growth with the return of cooler weather and the coming of fall rains. Since their fall growth does not stop until the weather is quite cold, they will provide grazing until early winter.

The ability of the tame grasses to provide both early and late pasture fits them particularly well for use in conjunction with, or as a supplement to, the summer-growing native grasses. The use of these two types of grasses in the grazing program permits protection of the native pastures during the first few weeks of their growing season and makes possible the protection of the tame pastures during their summer dormancy. Both types of pasture are thereby benefitted, although this often is not fully appreciated. Tests at Manhattan, Kan.,² have shown that yields of grass on the native blue-stem pastures can be increased at least one-third by deferred grazing, and that stands of grass can be improved. The use of tame pastures for spring grazing makes deferred grazing possible.

Carrying Capacity of Tame Pastures

The carrying capacity of tame perennial pastures will vary considerably, depending on soil fertility, rainfall, and temperature. On good land tame pastures will outyield the native pastures by a wide margin, except during the summer dormancy which occurs in dry years. During the spring and fall months when the most rapid growth is taking place a tame pasture should support at least one mature cow or steer per acre. During the summer dormancy it is best to remove the livestock to native pasture or to some other summer growing crop such as Sudan grass or Korean lespedeza.

Palatability of the Tame Perennial Grasses

In carefully controlled experiments it is possible to show differences in palatability among the tame grasses. They are all palatable to livestock, however, and where the grazing animal does not have free choice among them, any of these grasses is readily taken. Differences in palatability due to stage of maturity or to environmental influences are probably greater under farm conditions than those due to species. When tame grasses are planted in mixtures the grazing animal is not given free choice and if the pasture is properly grazed does not discriminate between species which mature at about the same time. Patches or clumps of grass allowed to mature will, of course, be avoided, but the same thing will occur in plantings of single species and cannot be attributed entirely to species variations in palatability.

Descriptions of the Tame Grass Species

Brome Grass.— Brome grass (also called smooth brome or awnless brome) is the most important tame perennial grass for use in the seeding of cultivated pastures in eastern Kansas. It is a long-lived perennial which propagates both by seed and by rootstocks. It spreads rapidly under favorable growing conditions by means of rootstocks and quickly occupies bare or open places in the turf. This spreading habit of growth permits the formation of a dense turf or

2. Kan. Agr. Expt. Sta. Bul. 291, 1940, Deferred Grazing of Bluestem Pastures.



Tame Pasture Grasses for Kansas

Brome
grass

Blue-
grass

Meadow
fescue

Orchard
grass

Timothy

Crested
wheat

Brome Grass (*Bromus inermis*). This grass, sometimes called smooth brome or Hungarian brome, is an erect perennial with spreading, sometimes nodding, seed heads. It spreads rapidly by underground stems to form a dense turf. The plant varies in height from about 2 feet to 4 feet at maturity, the heads from 4 to 8 inches in length. The leaf blades are smooth and dark green, sometimes as much as one-half inch in width. There are no appreciable beards or awns on brome grass, but the seed is light and chaffy and sometimes difficult to drill.

Kentucky Bluegrass (*Poa pratensis*). Kentucky bluegrass is smaller than most other tame grasses, seldom attaining a height of more than three feet. Its stems are slender but erect, and its leaves fairly long but narrow and boat-shaped at the tip. Its heads are spreading and erect, the seeds small. It spreads by rootstocks.

Meadow Fescue (*Festuca elatior*). Meadow fescue, sometimes called English bluegrass, is a tall perennial with erect or somewhat nodding seed heads. It is bright green in color and in its younger stages of growth resembles Kentucky bluegrass somewhat. Its heads are less spreading and the seed is larger than that of bluegrass. It often has rather weak rhizomes, but for practical purposes it may be considered as a bunch grass under Kansas conditions.

Orchard Grass (*Dactylis glomerata*). This is an erect bunch grass growing to a height of 2 to 4 feet. It is easily distinguished by the tufted heads. Its leaves are long and often folded. Its color is somewhat lighter and more gray than that of brome grass.

Timothy (*Phleum pratense*). Timothy is a tall bunch grass, its erect stems arising from swollen or bulblike bases. The heads are dense and cylindrical, resembling true spikes in appearance, a character which makes timothy easily recognizable at heading time.

Crested Wheat Grass (*Agropyron cristatum*). Crested wheat grass is a perennial bunch grass somewhat shorter than brome, orchard grass and meadow fescue. It is dark green in color and distinguished by the crested head which in this grass is a true spike. It is rather fine stemmed, but the leaves and stems become somewhat harsh as they mature.

sod even in pastures where rather sparse stands existed at first. When planted in mixtures, brome grass tends to fill the areas between individual plants of the bunch grasses and make a turf that is highly resistant to grazing and to trampling as well as to runoff and soil erosion.

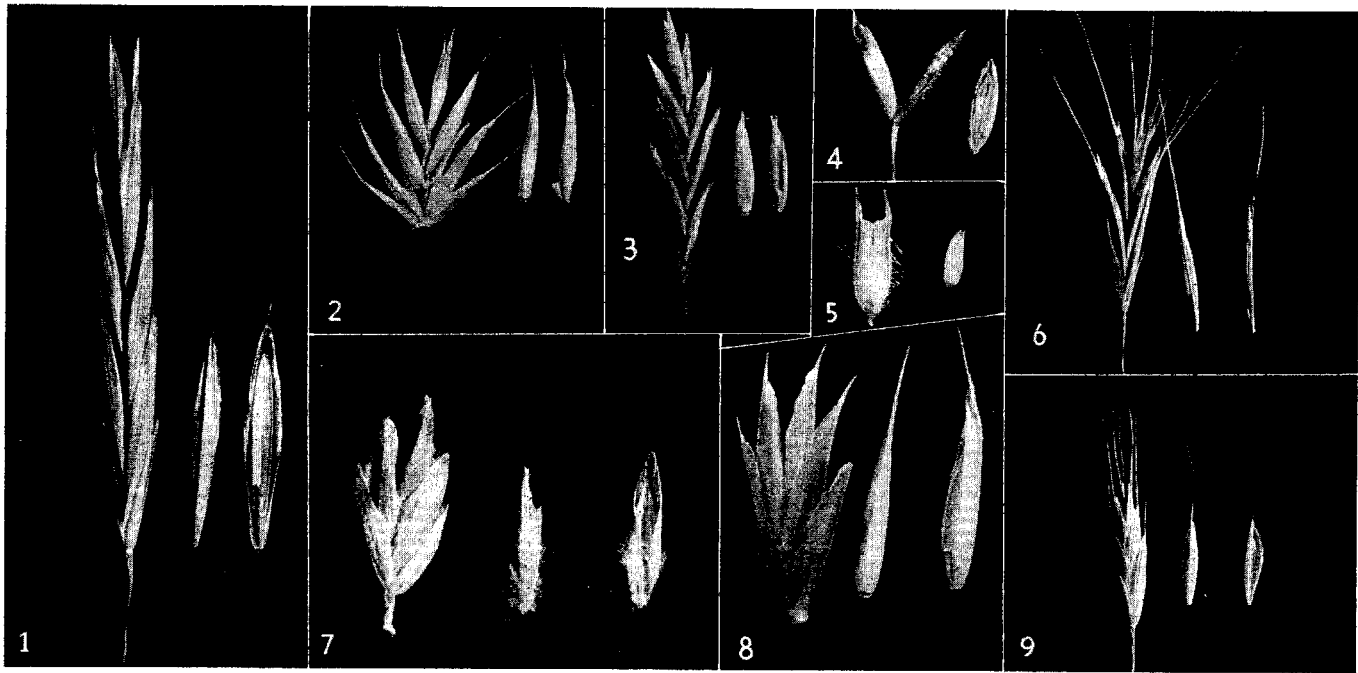
Brome grass is a highly palatable and nutritious pasture grass, but is less valuable than timothy for hay. It starts growth early in the spring, but like most other tame grasses it becomes semidormant during hot, dry summers. It is one of the most drought resistant of the tame grasses and quickly resumes growth with fall rains, continuing to grow and furnish pasturage until early winter.

Brome grass may be grown on a wide variety of soils, but prefers rich loams and clay loams. It will tolerate considerable drought, but water which remains standing is harmful to it. The soils should therefore be well drained. Deep soils are preferred, but fairly good brome grass pastures may be established and maintained on the thinner soils.

Old stands of brome grass often become greatly decreased in productivity and are commonly said to be "sod-bound." This condition is due to a reduction in the amount of available nitrogen in the soil and can be corrected by the use of fertilizers which carry this element. It is more satisfactory to prevent the occurrence of this "sod-bound" condition by planting legumes with the grass to provide nitrogen which is utilized by the brome and results in increased growth. It is suggested that a legume, preferably alfalfa, always be included with brome grass seeded for pasture. A small amount of alfalfa is also desirable in brome grass grown primarily for seed, as it aids in maintaining higher seed yields.

Where it is planted alone, brome grass is seeded at the rate of about 18 to 20 pounds per acre. This seeding rate may be reduced somewhat when a legume or other grass is added. It is important to obtain good brome grass seed, and especially to obtain seed of Kansas origin. A great deal of northern grown brome grass seed has been brought into this state during recent years, but has not given satisfactory results. Brome is by nature a northern plant, but strains have become acclimated to Kansas conditions after having grown here for many generations. Seed brought directly from the North has not been subjected to the selective effect of the climate that exists here, hence is not adapted to Kansas conditions and should not be used.

The most serious weed of brome grass fields is chess (commonly referred to as "wild oats" and sometimes as "cheat"). There are three common species of chess, two of which are shown in figure 3. These are wild, annual species of brome introduced to this country from Europe. Every effort should be made to secure brome grass seed practically free from these weeds. Brome seed which contains more than a trace of chess cannot be certified in Kansas. Where the brome is planted carefully in a well-prepared seedbed so as to insure the establishment of good stands, chess usually will not be troublesome even though a slight trace was present in the seed.



Details of the seeds of common pasture grasses

1. Brome grass. 2. Crested wheat. 3. Meadow fescue. 4. Redtop. 5. Timothy. 6. Chess (*Bromus tectorum*). 7. Kentucky bluegrass. 8. Orchard grass. 9. Chess (*Bromus commutatus*).

Orchard Grass.—Orchard grass is well adapted to all of eastern Kansas, but, is perhaps more valuable in the southern than in the northern part. It can well be included in pasture mixtures anywhere east of the Flint Hills.



Two Species of Chess

FIG. 3.—There are three species of wild annual brome which, for practical purposes, may be thought of as one. *Bromus tectorum* (left), *Bromus japonicus* (right), and *Bromus commutatus* (not shown). These are introduced winter annuals resembling brome grass somewhat in appearance. They are usually much shorter, their leaves and stems are hairy, their seed chaffier and with beards. They germinate in the fall and die following seed production in the following spring.

Orchard grass is a long-lived, perennial bunch grass adapted to a wide variety of soils but does not grow well on sandy soils. It is somewhat more tolerant of high humidity than brome, and it grows well in partial shade, hence the name orchard grass.

Since orchard grass is a bunch grass it should not be planted alone for pasture but with some sod grass such as brome. It is seeded at the rate of about 18 pounds per acre if planted alone for the production of seed.

Kentucky Bluegrass.—Kentucky bluegrass is one of the most common tame grasses. Many good bluegrass pastures still exist in eastern Kansas, but the droughts of 1934 and 1936 were particularly injurious to this species and a great many stands were destroyed. It is a long-lived sod grass, highly palatable and nutritious to livestock but somewhat less productive, under Kansas conditions, than several of the other tame grasses. Except in local areas where it is known to be particularly valuable, it is not seeded alone for pasture but is often included as a small part of mixtures.



Redtop (*Agrostis alba*)

This grass is a long-lived perennial with creeping underground rootstocks, erect stems and open spreading panicles. The seed is small and threshes free from the chaff. There is but a single seed in each spikelet and awns or beards are not present.

rapidly the first season and helps provide pasture sooner after seeding than does brome or orchard grass. It will gradually be replaced by brome or other sod grasses.

Meadow fescue prefers rich, moist soils but will not tolerate flooding. It is adapted to all of eastern Kansas.

Meadow Fescue. — Meadow fescue was once all important seed crop in eastern Kansas but is no longer widely used except as a small part of some pasture mixtures. It is a fairly long-lived perennial and is both palatable and nutritious but somewhat less productive than such grasses as orchard grass or brome. It is susceptible to rust, which decreases its yield and palatability in some seasons. Its chief value in a pasture mixture is that it grows more

Redtop. — Redtop, a long-lived and a vigorous sod-former, is an important pasture grass for southeastern Kansas. It thrives best on moist or wet soils and will grow in shallow ponds. It is extremely tolerant to acid soils and hence is adapted to certain soils in southeastern Kansas. When seeded alone, 10 to 12 pounds of seed per acre should be used, but this amount is reduced when mixtures are planted. Many regard redtop to be less palatable than the other tame grasses. Its ability to tolerate flooding and soil acidity more than compensates for any slight differences in palatability, however.

Timothy. — Timothy is one of the chief hay grasses in the United States. It is palatable and nutritious to livestock when grazed and should be more widely used for pasture in eastern Kansas. It is strictly a bunch grass so should not be seeded alone for pasture but may be included with such grasses as brome, which will spread rapidly to occupy the space between the bunches of timothy. An important consideration in the use of timothy in pasture mixtures is that seed is cheap and easy to plant. Good stands may generally be obtained without difficulty.

Perennial and Italian Ryegrass. — The ryegrasses are short-lived perennials, usually disappearing the second season. Their chief use is in mixtures where, because of their rapid early growth, they provide pasture sooner after planting than do the longer-lived but slower growing grasses. It is difficult to obtain pure seed of either Perennial or Italian ryegrass, but mixtures of these two species known as "Domestic" ryegrass may be had.

Reed Canary Grass. — Reed canary grass is the only one of our tame grasses native to the United States. It is a hardy, long-lived sod-former that prefers wet soils. It is palatable and nutritious. While not commonly grown in Kansas it may have a place on areas subject to flooding. Under such conditions it may be planted in the fall at the rate of about 10 pounds per acre and it is suggested that redtop be included with it. The chief disadvantages are the high cost of seed and the difficulty in obtaining satisfactory stands.

Bermuda Grass. — Bermuda grass is a low-growing, sod grass of subtropical origin that spreads both by underground stems and by surface runners. It seeds poorly in Kansas but is readily started in the spring and early summer by spot-sodding or by planting small pieces of the rootstocks. Sod pieces 2 to 4 inches square may be set firmly in moist soil. The distance between these will vary from 2 to about 5 feet, depending on the availability of sod and labor. If pieces of rootstock are planted these may be strewn in furrows and partly covered by plowing, or they may be disked into the soil and packed. At the present time the most successful use of Bermuda grass for pastures is limited to the Cotton Belt. Unless more winter-hardy strains are developed, its use in Kansas will continue to be limited to the extreme southeastern portion of the state. In that area it is finding a place in the control of soil erosion and is assuming some importance as a lawn grass.

Crested Wheat Grass.—Crested wheat grass is a northern species, being used extensively in the Northern Great Plains and in Canada. It has been tried in Kansas but with very little success except in a few local areas. Some growers in north central Kansas report fairly successful fields and a few have also been reported from the south central counties. Elsewhere in Kansas it has not been successful.

Crested wheat grass is hardy and drought resistant, but is apparently susceptible to injury by summer heat. It has a long dormant period during the summer but usually responds to fall rains. It may be somewhat less palatable than brome, but if grazing is started early this can largely be overcome.

Crested wheat grass is extremely susceptible to the foot-rot disease of wheat, a factor which often causes serious reductions in older stands and may prevent establishment of the seedlings.

Legumes for Tame Perennial Pastures

Every tame perennial pasture should contain legumes. Legumes not only increase yields by making available additional nitrogen in the soil, but they improve the palatability and nutritive value of the forage by the addition of protein resulting from the presence of the legume in the feed.

Grasses are known to require a great deal of nitrogen and to exhaust the available supply after a few years. When the supply of available nitrogen becomes reduced the familiar "sod-bound" condition is seen. The presence of a legume in the mixture will delay or entirely prevent the occurrence of this condition and will help maintain the production of pasturage at a high level.

Alfalfa.—Alfalfa is the best of the legumes for use in a tame pasture mixture in Kansas because of its long life, high productivity, and its ability to resist grazing, and because it provides pasturage over a long season. Alfalfa is seeded in the fall with the grasses at the rate of 3 or 4 pounds per acre, whereas most of the other legumes are seeded in the spring after the grasses have gone through their first winter.

Alfalfa is not adapted to acid soils, so if it is to be used where this condition exists it will be necessary to add lime to the soil before planting, otherwise some acid-tolerant legume will have to be used. Unless the nodule forming bacteria are known to be present in the soil, alfalfa seed should be inoculated before planting.

Some stockmen object to the use of alfalfa in pastures for cattle and sheep because of the danger of bloat. This is a problem where alfalfa is used alone for grazing, but in grass mixtures, where only 3 or 4 pounds of alfalfa seed are planted per acre, the stand of vegetation is composed mainly of grasses and the grazing animal obtains alfalfa in small quantities, thoroughly mixed with grass, practically eliminating the danger of bloat.

Alfalfa is occasionally used alone for pasture, especially for hogs. It may be pastured by other classes of livestock, but the danger of losses from bloat must be recognized. Whenever alfalfa is used for pasturing cattle and sheep, the animals should not be turned into the pasture until after they have been fed all the roughage they will eat. This practice will prevent them from eating excessive quantities of green alfalfa in a short time. Cattle and sheep are not generally grazed when the alfalfa is wet with dew or rain unless they are known to be accustomed to this practice. When utilizing pure stands of alfalfa for pasture, the livestock should be watched carefully and removed at the first sign of bloat.

Sweet Clover.—Sweet clover, a biennial legume, is occasionally seeded in mixtures of tame perennial grasses at the rate of about 4 pounds per acre. Where the stand of grass is fairly thin, sweet clover will usually volunteer in sufficient amounts after the second year to maintain itself. In heavy stands of grass the amount of sweet clover will gradually decrease because of the difficulty encountered by the germinating seedlings which are smothered by the heavy grass.

Sweet clover is not seeded in the fall with the grasses when used in the pasture mixture but broadcast in the spring following the establishment of the grass the previous fall. When seeded in the fall, sweet clover behaves as a winter annual and makes a tall, rather rank growth the first year, produces seed and dies. This tall, rank growth is extremely injurious to seedling grasses and may delay their establishment.

Like alfalfa, sweet clover is not adapted to acid soils. It can usually be established following light applications of lime, however.

Sweet clover is more frequently seeded alone for pasture than in mixtures of perennial grasses. Its use for this purpose will be discussed later.

Red Clover.—Red clover is grown primarily for hay, alone and in mixtures with timothy, but it also makes excellent pasture. It is inferior to alfalfa because of its short life and also because of its limited range of adaptability. In Kansas, because of climatic conditions, red clover is limited to the northeastern part of the state. It is not successful on acid soils unless lime is applied. Like alfalfa, it can cause bloat, but there is little danger of this in mixtures.

Red clover is seeded in the spring and will usually live through two seasons, but it will not maintain itself in good stands of grasses. Three to four pounds of seed are planted when red clover is used in tame grass mixtures.

Alsike Clover.—Alsike clover is longer lived than red clover and is adapted to poorly drained, acid soils. It grows almost as tall as red clover, but the stems are less upright. When used in grass mixtures 2 to 3 pounds of seed are planted. It is more likely to maintain itself by volunteering than is red clover.

Korean Lespedeza.—Korean lespedeza is an annual legume which, because of its ability to reseed itself, can be used in permanent pastures. It is adapted to acid soils and is therefore recommended in regions where alfalfa or sweet clover cannot be grown. Like red clover or alsike, it is broadcast in the spring after the grass has been planted the previous autumn. Four to six pounds of seed are used where this legume is seeded in tame pastures.

Pasture Mixtures

Grass species seeded alone seldom make as satisfactory pastures as do mixtures. The mixture need not contain a great number of species, but it should by all means include a legume, and bunch grasses should only be planted with sod-formers. In general, mixtures of pasture plants produce more and better feed, tend to give a somewhat longer grazing season, and provide good pasture during a greater part of the regular grazing period than do single species. A comparison of yields of grasses seeded alone and in mixtures both with and without legumes is shown in Table 1. Bunch grasses, such as timothy, pure stands of which are not resistant to trampling and for this reason are not satisfactory for pasture when seeded alone, are valuable in mixtures with sod-formers.

Mixtures may be designed to contain a small percentage of early maturing thought comparatively short-lived grasses like the rye-grasses or meadow fescue. These provide pasture soon after planting but are gradually replaced by longer-lived species such as brome and redtop. They tend to produce quick cover which may be of benefit in protection from soil erosion and may aid somewhat in checking weed growth by occupying the space before weeds can gain foothold.

TABLE 1.—Yield of tame grasses and grass mixtures, Agronomy farm, Manhattan, Kansas (6 year average, 1927-'32, inclusive).

	<i>Air dry hay, Lbs. per acre</i>
Single species:	
Brome grass	3,802
Orchard grass	3,782
Meadow fescue	4,016
Kentucky bluegrass	2,717
Timothy	4,182
Redtop	4,016
Crested wheat grass	2,889
Mixtures with legume:	
Brome, orchard grass, Ky. bluegrass and alfalfa	7,708
Brome, orchard grass, and alfalfa	6,533
Timothy and sweet clover	5,125
Orchard grass and sweet clover	4,804
Brome, orchard grass, and sweet clover	4,778
Mixtures without legume:	
Brome and orchard grass	4,251
Brome, perennial rye and slender wheat grass	4,801
Redtop, orchard grass and meadow fescue	3,508

Selection of Grass Mixtures

The selection of grasses for the pasture mixture will be governed by several factors, the most important of which is the adaptability of the grass species to soil and climatic conditions of the immediate locality. It is important to select grasses and legumes that are known to grow well in the particular area rather than some unknown variety, although the latter may be highly advertised. When the mixture has been determined it is advisable to secure seed known to be of local origin rather than from some other region.

Another important consideration in selecting grasses for the mixture is the relative cost of seed of the various species. It is often possible to make considerable reductions in the cost of seeding a pasture by using grasses in the mixture, the seed of which is cheap and abundant. For instance, timothy seed is usually less costly than most other grasses. Furthermore, it is usually easy to obtain good stands of this grass in extreme eastern Kansas. In years when the price of orchard grass or of brome grass seed is high, timothy can be substituted for a part of the brome or for the orchard grass in the mixture.

It is not implied that cheap seed should be planted; rather it is recommended that only high quality seed of known purity and germination be used. It is always safest to buy seed bearing state seed laboratory analyses.

In view of the fact that there are several good pasture grasses available to eastern Kansas farmers, there will naturally be a great deal of variation in the mixtures used, depending upon the factors discussed above and upon individual preference. In general, 16 pounds of brome grass and 4 pounds of alfalfa per acre may be considered a standard mixture for all of eastern Kansas. Local conditions such as extreme soil acidity may make this mixture entirely unsatisfactory, but wherever it can be used it should be considered the basis about which to build the pasture mixture, adding or substituting such grasses and legumes as may be desirable. Where any of the other tame grasses are adapted, they may be substituted for part or all of the brome.

There is also considerable opportunity for variation in the type of legumes used in pasture mixtures. The choice of a legume will depend upon local conditions. Wherever possible alfalfa should be used. Sweet clover will take the place of alfalfa, but is a biennial and therefore likely to be eliminated in good stands of grass. Red clover, too, is short-lived and likely to be eliminated. These three legumes are susceptible to injury by acid soil, so where such soils exist and cannot be limed, one of the acid tolerant legumes, Alsike clover or Korean lespedeza, should be planted instead. Alsike is adapted to all of eastern Kansas, but is not particularly long-lived. Korean lespedeza does best in the southern portion of the region adapted to tame grasses, but its zone of usefulness appears to be extending northward gradually. Lespedeza is an annual which vol-

unteers readily and usually maintains itself in a pasture once it becomes established. In the northeastern part of the state it may not maintain itself because of failure to mature seed.

From these facts it is readily seen that no specific mixtures can be recommended as being the best for any one locality. Some farmers will want fairly complicated mixtures, while others prefer one or two grasses and a legume.

The following mixtures are suggested for northeastern Kansas, based on average conditions and subject, of course, to considerable variation:

Brome grass	16 to 18 pounds per acre
Alfalfa or sweet clover	4 pounds per acre

or if a more complex mixture is desired:

Brome grass	10 to 12 pounds per acre
Orchard grass, timothy or meadow fescue	4 to 6 pounds per acre
Alfalfa or sweet clover	4 pounds per acre

The mixtures recommended for northeastern Kansas are adapted also in east central and southeastern Kansas, but if the soil is acid and for some reason cannot be limed, it is suggested that redtop be included, and that Alsike clover or Korean lespedeza be used as the legume in the mixture, as follows:

Brome or redtop	10 pounds per acre
Orchard grass or timothy	6 pounds per acre
Alsike or lespedeza	4 pounds per acre

It must be recognized that these mixtures are merely types based on general environmental conditions and can be modified to suit local needs. The important thing is to plant adapted species. The exact amount of each in the mixture is of minor importance.

Seeding the Pasture

Seeding tame grass pastures requires a great deal of care, for it is seldom possible to obtain good stands by haphazard methods. There are four main considerations in the establishment of a tame grass pasture:

- (a) Quality of the seed.
- (b) Preparation of the seedbed.
- (c) Date of seeding.
- (d) Method of seeding.

Since seeding pastures entails considerable labor and expense, the cheapest insurance of obtaining good stands is to plant good, adapted seed. Use only seed known to be fresh and viable and which is free of weed seeds. Buy only tested seed bearing accurate and dependable statements as to its germination and purity, avoiding seed that contains either large amounts of inviable seed or of weed seed and other foreign matter.

Poor seedbeds are probably the most common cause of failure to secure good stands of the tame grasses. The seeds of grasses are small and the seedlings delicate. They need every encouragement to germinate quickly and make rapid early growth. A delay of but a day or two in germination may mean the difference between success and failure of the stand.

To obtain a suitable seedbed it is necessary to start planning at least a year in advance of the planting of the pasture. The crop preceding the grass should be one which matures in the spring so the land may be plowed early. It should leave the soil in such a condition that seedbed preparation is easy. The winter cereals are satisfactory, although oats or flax seeded in the spring are usually better because any volunteer plants of these crops which might appear are almost always winterkilled. Volunteer winter wheat and rye are not likely to be winterkilled and may give trouble the following year. When winter wheat or rye precede the establishment of grass, they should be grazed closely so as to utilize them completely for pasturage rather than as a grain crop. The land should be plowed before any seed can be matured so as to eliminate the problem of volunteer growth.

Another good plan is to precede the grass with a sweet clover pasture, plowing it before seed can mature. This crop produces a large amount of pasturage and the early plowing permits the preparation of an excellent seedbed. If sweet clover is allowed to mature there may not be sufficient time for the preparation of a satisfactory seedbed, the storage of moisture, or liberation of nutrients. Small amounts of volunteer sweet clover in the new pasture are not objectionable, although plants which start growth in the fall often become so large the following spring as to offer serious competition to the grasses for light, moisture, and soil nutrients. One of the chief benefits of growing sweet clover before the seeding of grasses is that it enriches the soil, providing the nitrogen necessary to rapid growth of grasses.

The crop preceding grass should be removed before July 1 if possible, so that the land may be plowed early and allowed to lie fallow during the summer. During this period it should be worked as often as necessary to keep down weed growth, because weeds reduce the supply of available moisture and plant nutrients.

By late August or early September the seedbed will be worked down until it is mellow but firm, with a fine surface mulch. It will then be ready for planting as soon in September as moisture conditions are favorable. It is necessary to have an extremely well prepared seedbed for such small seeded crops as the grasses and pasture legumes. The seed must be placed in direct contact with moist soil to encourage rapid germination and early seedling growth. The hot, dry weather which often occurs in September may dry the soil rapidly. Grass seedlings are delicate and unless the roots can grow rapidly enough to maintain contact with moist soil the planting is sure to fail. Poorly prepared, loose, cloddy soils dry rapidly, so for

these reasons a seedbed such as is recommended for alfalfa is necessary. Soil that is plowed early, disked occasionally during the summer to keep down weed growth, then given a final thorough disking, harrowing, and packing before planting will usually provide an ideal seedbed. After drilling it may be necessary to pack the land again.

Fallow in Preparation for Seeding Tame Grasses

In most of the tame grass area a full year of fallow in the preparation for seeding tame pastures is not necessary. On the western edge of this area, where moisture is likely to be deficient at times, fallow may have a place, especially on fairly level lands where soil erosion is not an important factor. Often a crop such as sweet clover or alfalfa will have exhausted the subsurface moisture. If these crops are grown previous to the time of seeding grass, the grass seedlings may suffer acutely when they begin to require moisture from the deeper levels in the soil. Under those conditions a year of fallow in the western part of the tame grass area will be profitable. Not only will fallow provide a supply of subsurface moisture, but it will also encourage the accumulation of available nitrogen in the soil, hastening fall growth and promoting early establishment of the stand of grass.

Where soil erosion is a problem fallow may not be feasible, but instead it would be advisable to grow some early maturing crop to precede the grass, and to depend upon the summer rains to provide sufficient moisture for the new stand of grass.

Importance of Soil Fertility in Establishing Tame Pastures

Grasses may be grown on poor, thin soils, but since they can utilize large amounts of soil nutrients, especially nitrogen, the best results may be expected on fairly fertile soil. Grasses can easily be established on good land without applying fertilizers, but on poor land much better results may be obtained if some soil building program is carried out to improve the soil before planting. Commercial fertilizers may be used for this purpose. Applications of about 100 pounds per acre of ammoniated phosphate (10-20-0) will increase the chances of obtaining stands on poor or eroded soils. In southeastern Kansas both lime and phosphate are needed on most soils and will give profitable responses when applied before seeding the new pasture wherever there is a deficiency of these elements. North of the Kansas river the soils are less likely to be deficient in lime and phosphorus, but their condition should be determined before seeding the pasture. The phosphate tends to promote increased growth of the legumes in the mixture, and they provide nitrogen for the grasses.

A cheap and effective method of improving the soil prior to seeding grasses is to grow a crop of sweet clover for seed or for pasture, preferably the latter. This leaves the land in condition to permit easy seedbed preparation and enriches the soil so that seedling estab-

lishment is more rapid. Korean lespedeza will have somewhat the same effect as sweet clover, but may have to be grown longer. If lime and phosphate are needed, both should be applied before seeding the sweet clover, then only phosphate need be applied when seeding the grass.

If barnyard manure is available it may be applied in rather liberal quantities as a top dressing during the early spring following fall seeding. The extra growth resulting from increased soil fertility aids in quick establishment and the formation of a better turf. The use of barnyard manure shortly before seeding grass is not recommended because of the danger of introducing large quantities of weed seed. Weeds offer serious competition to the grass but are less important in established stands.

Time of Seeding

The best time to seed grasses is in the fall, although successful spring seedings are reported. Fall seedings are more likely to succeed for several reasons. Seedbeds which have been worked several times during the summer in preparation for fall planting usually have fewer weeds to compete with the seedling grasses. The grasses can also start growth earlier in the spring, being already well established, and can thereby gain control before spring weeds can offer competition. Fall planted grasses are more firmly established by the end of spring and thereby better able to withstand summer heat and drought than those planted in the spring. Another advantage for seeding in the fall is that considerable grazing may often be obtained the first season. This is seldom the case when grasses are seeded in the spring.

September 10 to 15 is usually considered the best time to plant the tame grasses, but the exact date of seeding will depend upon moisture conditions. As early as September 1 is satisfactory if the seedbed is moist. It is not advisable to plant so early that the seedlings will be subjected to extremely hot weather, because they are delicate in their early stages of growth and susceptible to injury by heat. Neither is it advisable to plant too late, because the seedlings are not permitted to become well established before winter. Late planted grasses are likely to suffer from winterkilling.

When seeded in the spring the grasses should be planted as soon as the danger of severe freezing is past. Light frosts will not harm them, but they cannot stand extreme cold. The seedbed for spring seeded grasses should be prepared in the same manner as for fall planted.

Method of Seeding

Grasses should be drilled, if possible, regardless of time of planting. Drilling is more economical of seed than broadcasting because it provides for more uniform distribution of the seed and permits more accurate planting rates, and also because the seed is all placed at the proper depth for quick germination instead of being scattered

on the surface of the soil and at various depths. It is important that grasses germinate quickly in order that their roots may penetrate to permanently moist soil before the surface soil can dry out.

The seed of some grasses is extremely light and chaffy, so it will be necessary to take care that the drill spouts do not become obstructed. Frequent stirring of the seed in the drill box will be of benefit. If heavy seeded varieties such as timothy or alfalfa are included, they should not be mixed in the drill box with the chaffy seed of grasses such as brome, because the heavy seed will sift to the bottom and be planted first. In drills with grass or alfalfa seeding attachments the light seeds may be placed in the regular grain box and the heavier ones in the grass seeding box. Ordinary grain drills of the newer types are usually satisfactory for drilling grasses, but the heavy seeded species should be planted separately, necessitating two drilling operations but insuring uniform distribution. Whenever mixtures of grass seed are placed together in the drill, they should be stirred frequently to keep them well mixed.

For broadcast plantings the seedbed should be as well prepared as for drilling. Land freshly packed with a cultipacker is left in alternate small furrows and sharp ridges. On such a seedbed much of the seed falls into the furrows where it may easily be covered by harrowing lightly. It should then be packed again with the cultipacker to insure close contact between the seed and the soil.

The seed is broadcast either by hand or with some such device as an endgate seeder. To insure uniform stands it is best to go over the land twice, broadcasting half the seed in one direction, then crossing this with the remainder of the seed. Broadcasting is difficult on windy days, as light, chaffy seed may be blown about and result in patchy stands. Light seed should not be broadcast together with heavy seed, because the heavier seed will be thrown farther. It is better to scatter first one and then the other.

Care of the New Pasture

It is important to care for a new pasture in such a way as to encourage rapid growth of the seedling plants. The new pasture almost always contains some weeds which will have to be eradicated. Mowing is the most effective means of accomplishing this, cutting the weeds at the time, or just before, they bloom. At this time the weedy plants are most susceptible to injury by clipping, and in addition they are prevented from producing seed. The cutterbar of the mower should be raised somewhat to avoid close cutting of the seedling grasses.

A new stand of grass should be protected from grazing during its early period of growth. During this time all the energy that can be produced by the plant is utilized for growth, both of tops and of roots. The top growth should be left undisturbed until the plant has attained considerable size. It is usually not advisable to graze a spring sown tame pasture until its second season and then only

lightly at first. A fall seeded tame pasture may be grazed lightly late the first season, but it is safest to wait until after it has gone through the summer dormancy and resumed fall growth. Where a pasture has been seeded in the fall, there may be considerable growth the first spring, tempting one to utilize it for pasture. This growth serves a useful purpose in that it manufactures foods necessary to the formation of a strong and vigorous root system. To remove it by grazing early the first season is to delay this root establishment and to reduce the vigor of the plant. In severe summer seasons such a delay and reduction of vigor may lead to loss of stands due to drought injury. Firmly rooted seedlings are better able to withstand heat and drought. Furthermore, the new pasture will be able to carry its full grazing load sooner if it is protected during the early part of its establishment period.

Care of Older Pastures

Once a tame pasture has become well established it is fairly resistant to close grazing, although it must be allowed to produce some top growth. The green portion of any plant manufactures all the organic plant food used by the plant for growth. Removal of the top growth curtails root development, and where grazing is too heavy the plants are destroyed.

Tame grasses usually begin spring growth late in March. After they have made 4 to 6 inches of top growth they are ready for grazing and can be grazed closely until late June. When the hot summer weather begins, the grazing load should be lightened, and in severe summers all the livestock should be removed, but may be replaced when fall growth is restored.

When grazed so closely as to reduce the stand of grass, weeds appear in tame pastures. These may be destroyed by mowing to prevent seed set. Mowing for weed control is a practice which should be widely used in eastern Kansas, but it is effective only when accompanied by carefully regulated grazing practices to encourage the return of grasses.

Temporary Pastures

Pastures should be managed so as to yield a maximum amount of pasturage and yet maintain their productivity. The use of temporary crops in the grazing system makes possible the protection of the perennial grasses at seasons when they are most susceptible to injury by close grazing. For instance, the tame perennial grasses become semi-dormant in hot, dry summer weather. At this time close grazing is likely to be injurious, but injury can be avoided if temporary pastures of Sudan grass or Korean lespedeza are available. Native grasses, on the other hand, are most susceptible to injury by close grazing at the beginning of their growing season. Spring protection afforded by the use of such temporary crops as the cereal grains, or sweet clover, will not only prevent injury to the

native pastures but will increase their productivity and bring about improvement in their stand.

The growing of temporary pasture is one of the most profitable uses to which farm land can be put. Furthermore, the most efficient use of permanent pastures depends upon their being supplemented by temporary pastures. Many permanent pastures in Kansas have so deteriorated from excessive use that they now serve only as exercise lots, furnishing no grazing other than that which can be obtained from weeds and annual grasses. The perennial grasses have been weakened by continuous grazing and in many cases have entirely disappeared. Perennial pastures should not be considered an exercise lot, but rather a feed-producing unit.

The temporary pasture crops should not be considered merely as supplements to the permanent pastures, for they are valuable pasture crops in themselves. It is possible to provide pasture, for at least 10 months of the year by the use of temporary crops. They are highly productive, yielding large quantities of good feed when it is most needed.

The Cereal Grains for Pasture

Winter Wheat.—Winter wheat is the most widely used temporary pasture crop in Kansas, being adapted to all parts of the state. Large acreages of wheat sown for grain are pastured during a part of the growing season each year. This may be done without apparent injury to the wheat crop and in some cases may result in increased yields of grains⁸.

Wheat that is grown primarily for pasture may be seeded somewhat earlier than the optimum date for grain production. It is often advisable to plant some wheat early to be used for grazing only. If the wheat planted later for grain production makes enough growth to permit grazing that, too, may be pastured in the fall and early spring. The livestock must be removed about April 1 to avoid reducing the yield of grain. The animals may then be turned into the area seeded especially for pasture, which can be grazed closely until hot summer weather stops its growth.

Wheat for pasture should be seeded as soon after September 1 as possible, and in normal seasons will be available for grazing from early October to late December. In mild winters winter wheat may continue to make some growth through January and February, but in normal years it does not resume spring growth until late February or early March, depending on temperatures. It may be grazed from March until June.

The seedbed for wheat pasture should be prepared in the usual manner, but the rate of seeding is higher than normal. About one and one-half to two times the regular rate is recommended to insure a dense stand. Farther west on drier soils the planting rate is not increased except on fallowed land.

8. Swanson, A. F. Pasturing winter wheat in Kansas. Kan. Agr. Expt. Sta. Bul. 271. 1935.

It must be recognized that planting wheat early may permit Hessian fly damage in seasons when this insect is abundant, but it usually pays to plant at least a small area at the early date.

Winter Rye.—Winter rye will yield more pasture than any of the other cereal grains, due partly to the fact that it is more tolerant to cold, continuing to grow later in the fall and resuming spring growth earlier than wheat. It is also less susceptible to chinch bug and Hessian fly damage.

Common rye is the most widely used variety and is adapted to all of Kansas. Recently Balbo rye, a new variety of Italian origin, has been successfully grown in southeastern Kansas. This new variety is somewhat more palatable than common rye, and under adapted conditions it yields more pasturage. Its type of growth is more erect than that of common rye, a factor which may add to its value for pasture. There is little evidence regarding the winter hardiness of Balbo rye in north central and northwestern Kansas, but it has survived well at Manhattan during the winters of 1938-'39 and 1939-'40, neither of which was severe.

Rye, like wheat, should be seeded about September 1 for pasture. It is seeded at the same rate as wheat and will furnish grazing during approximately the same seasons, but it may furnish slightly more feed during the months of January and February.

There are two objections to the use of rye for pasture, but both may be overcome rather easily. Rye is known to flavor the milk of cows grazing on it, but if milk cows are removed from the pasture three or four hours before being milked, the milk will be free of the objectionable flavor. Many dairymen who follow this practice are able to market their milk in large cities with no complaints about its flavor. The other objection to rye is that it may escape into wheat fields and thereby lower the quality of the wheat crop. This may be avoided by keeping the rye closely grazed to delay maturity and then plowing the pasture before seed can mature. It is also necessary to see that the drill is cleaned thoroughly after planting the rye, or mixtures will occur.

Winter Barley.—Winter barley is a popular temporary pasture crop in southeastern and south central Kansas. It provides pasture quickly after planting and is readily taken by livestock. For pasture it should be planted at about the same date and rate as wheat, but it must be recognized that in certain seasons there is some danger of Hessian fly damage. It is also susceptible to injury by chinch bugs in the spring, but this is less important when the crop is used for pasture.

Reno winter barley is a winter-hardy variety adapted to Kansas. Missouri Early Beardless, another winter barley, has given excellent results in southeastern Kansas, but grain yields of this variety do not equal those of Reno.

Oats and Spring Barley.—Oats and spring barley may be planted early in September and used for fall pasture, as they start growth quickly and continue to produce a large quantity of feed

until heavy frosts occur. They are killed by winter temperatures and for this reason are used mostly for spring pasture. They are planted at the regular spring seeding date, but like the other cereal grains are planted at a heavier rate when seeded for pasture. They may be grazed by early April and will continue to furnish pasture until June.

Sudan Grass.—Sudan grass is the best temporary crop for summer pastures in Kansas. It is adapted to the entire state and is widely used in all sections.

Sudan grass is a warm weather crop and therefore should not be planted early. Plantings May 25 to June 1 are usually most satisfactory and will be ready for grazing by July 1. Earlier plantings are seldom ready for grazing much earlier.

Sudan grass is drilled at the rate of 12 to 15 pounds per acre in western Kansas and 20 to 25 pounds in the eastern part of the state, where moisture is more abundant. In the west it makes the best growth on land that has been summer fallowed. Recently it has become a fairly common practice to plant it in widely spaced rows on the contour either with a lister, with a surface planter, or with a grain drill in which all but a few of the downspouts have been stopped. Planting in this manner requires only about one-third as much seed and permits cultivation should weeds become a problem. Yields are usually about the same as where planted in close drills but they may be greater in dry years.

The only objection to Sudan grass for pasture is the occasional loss of livestock from prussic acid poisoning. It has been found that most such cases are due to the presence of volunteer grain sorghum or sorgo (cane) or sorghum X Sudan grass hybrids. Pure Sudan grass is the least likely of all the sorghums to cause prussic acid poisoning and the use of certified seed will reduce this danger to a minimum because it will not contain cane or cane X Sudan grass hybrids.

Sudan grass should be grazed in such a manner as to prevent it from becoming coarse and stemmy. If this occurs it may be clipped to remove the coarse stems, thereby inducing new, leafy growth. Many farmers divide their Sudan grass pasture into two paddocks and graze them alternately for periods of about two weeks each. This will increase the yield of forage.

Sudan grass is susceptible to damage by chinch bugs which migrate from the grain fields after harvest.

Sweet Clover.—No other crop in eastern and central Kansas will provide as much pasture as a good stand of second-year sweet clover. This crop is palatable to all classes of livestock and is less likely to cause bloat than alfalfa. In addition to its importance as a pasture crop, sweet clover is an excellent soil builder. It may be used as a green manure crop, but it is considered more profitable to graze it before plowing it under. Any reduction in its value as a green manure crop will be more than repaid by the pasture it will provide.

Either the common yellow or white varieties are suitable for grazing, the white being somewhat more desirable. Recently the Kansas Agricultural Experiment Station has released a new variety, Madrid, that has superior seedling vigor which is important in the establishment of stands. It has finer stems than the common white blossom variety, a factor which makes it more desirable for grazing. Its leaves remain green longer in the fall, and in addition they remain attached to the plant much later. This provides a longer fall grazing season the first year.

Sweet clover is a biennial, producing its seed at the end of the second growing season, after which time the plants die. It is normally drilled in the spring, about March 1, in a seedbed such as is prepared for the grasses or for alfalfa. Seeding rates are 12 to 15 pounds per acre. The first season's growth is devoted to building a strong root system and storing foods to be used the following year. It is not advisable to graze sweet clover its first season until considerable top growth has been made, as a reduction in the amount of leaf area will hinder proper storage of food in the roots. Since the purpose of this stored food is to promote vigorous second year growth, early grazing the first year will result in reduced yields the following year. First-year sweet clover should be ready for grazing by September 1 and will continue to provide feed until early winter.

The second year's growth starts early and will be ready for grazing by April 1 or before. As soon as there is sufficient top growth to permit the animal to graze readily, the second year growth is ready to be pastured. The pasture should be grazed closely the second year. Since sweet clover is a biennial and will die after the second season, there is no reason to permit a large top growth. Instead, it should be kept grazed to a height of 6 or 8 inches. It is important to utilize the pasture in such a manner that no coarse, stemmy growth is permitted, but if tall stems appear, they may be cut back with a mower.

Sweet clover may also be planted in the fall, in which case it behaves as a winter annual, producing its seed the next summer. It is drilled about August 20 on a good seedbed at the same rate as when planted in the spring. It should not be pastured during the fall, but will be ready for grazing in the spring almost as soon as second-year sweet clover and is grazed in the same manner. Fall planted sweet clover will not yield as much pasture as that seeded the previous spring.

Like alfalfa, sweet clover does not grow well on acid soil. Where this condition exists lime should be applied before seeding sweet clover. It also responds well to the application of phosphate fertilizers where this mineral is lacking in the soil.

Korean Lespedeza.—Korean lespedeza is an annual legume introduced from the Orient. It grows during the summer and prefers warm, moist climates. For this reason it is best suited to the southeastern part of Kansas. On good land it is less productive than al-

falfa and sweet clover but has the advantage that it can be grown on thin or acid soil without the addition of lime and phosphates.

Lespedeza may be drilled in April at the rate of about 25 pounds per acre or it may be broadcast in February. Alternate freezing and thawing of the soil will cover the seed, which will then germinate when warm weather begins. It is ready to be grazed sometime in late June and will continue to provide pasturage until after frost.

Lespedeza is frequently used alone for pasture, but a better plan is to grow it in combination with some cereal grain, preferably oats. It is seeded with the oats in the spring. The oats is used for pasture, and then in June or early July after it has been utilized the lespedeza can be grazed. Lespedeza will produce seed in the fall, even after having been grazed closely, and will volunteer the next year. A grain crop may be planted each year, and the lespedeza will continue to maintain itself if the land is not plowed before its seed can be matured in the fall. This ability to reseed itself from year to year makes lespedeza a valuable addition to tame grass mixtures in areas where the growing season is long enough to permit it to seed.

Lespedeza is frequently used in retiring thin, eroded soils from cultivation in southeastern Kansas. It may be drilled at the rate of 8 to 12 pounds per acre on a well prepared seedbed, or it may be broadcast after disking lightly, then covered with a harrow, packer, or brush drag. When the seed is drilled planting is usually delayed until April. The land may then be worked late enough to kill a crop of spring weeds. Broadcasting is usually done somewhat earlier. On sloping land where any tillage operation that might be used in the preparation of the seedbed will tend to increase soil erosion, lespedeza seed may be planted without seedbed preparation by broadcasting sometime in February. If the ground is covered with snow the seed may be scattered directly on it. Alternate freezing and thawing cause the soil to check and the seed falling into these checks is covered by rains. It then germinates at the regular time.

Thin stands of native pasture may be improved by broadcasting lespedeza in them in the manner described above. The lespedeza occupies the denuded areas and furnishes additional feed during the time the grasses are being restored by carefully regulated grazing practices. If, on the other hand, the presence of the lespedeza encourages more intensive overgrazing in an effort to utilize all the feed present, it will have been a detriment rather than a benefit to the native grasses.

Lespedeza is palatable to all classes of livestock and is best used for pasture. It can be cut for hay and produces a fine-stemmed, rather high-quality product. Its yield of hay or pasturage is lower than that of sweet clover or alfalfa, so where these crops are adapted they are generally used instead of lespedeza. The use of Korean lespedeza is limited to the southeastern part of Kansas westward to the Flint Hills and north almost to the Kaw River, although successful plantings are reported farther north than this.

Rape.—Rape is not widely used for pasture in Kansas as it is a cool weather crop and not resistant to heat and drought. Its range of adaptability is limited to the northeastern portion of the state. It should be seeded soon after oats is planted and will be ready for grazing by about June 1. During the hot, dry months of July and August it may suffer severely, but it usually resumes growth about September 1 and provides good pasture during the fall.

Rape is usually planted with a grain drill at a depth of one-half to one inch. In well prepared seedbeds 6 pounds of good seed per acre are sufficient. Ten or twelve pounds are generally sown, but, where germination is high, the stand may become so dense as to result in poor growth.

Rape is most generally used for grazing hogs, sheep and calves. Cows graze it readily, but it has a tendency to impart an off-flavor to the milk and heavy animals injure the stand by trampling.

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