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Grasses and Legumes for South Dakota

M. W. Adams
South Dakota State University

J. G. Ross
South Dakota State University

W. W. Worzella

A. N. Hume

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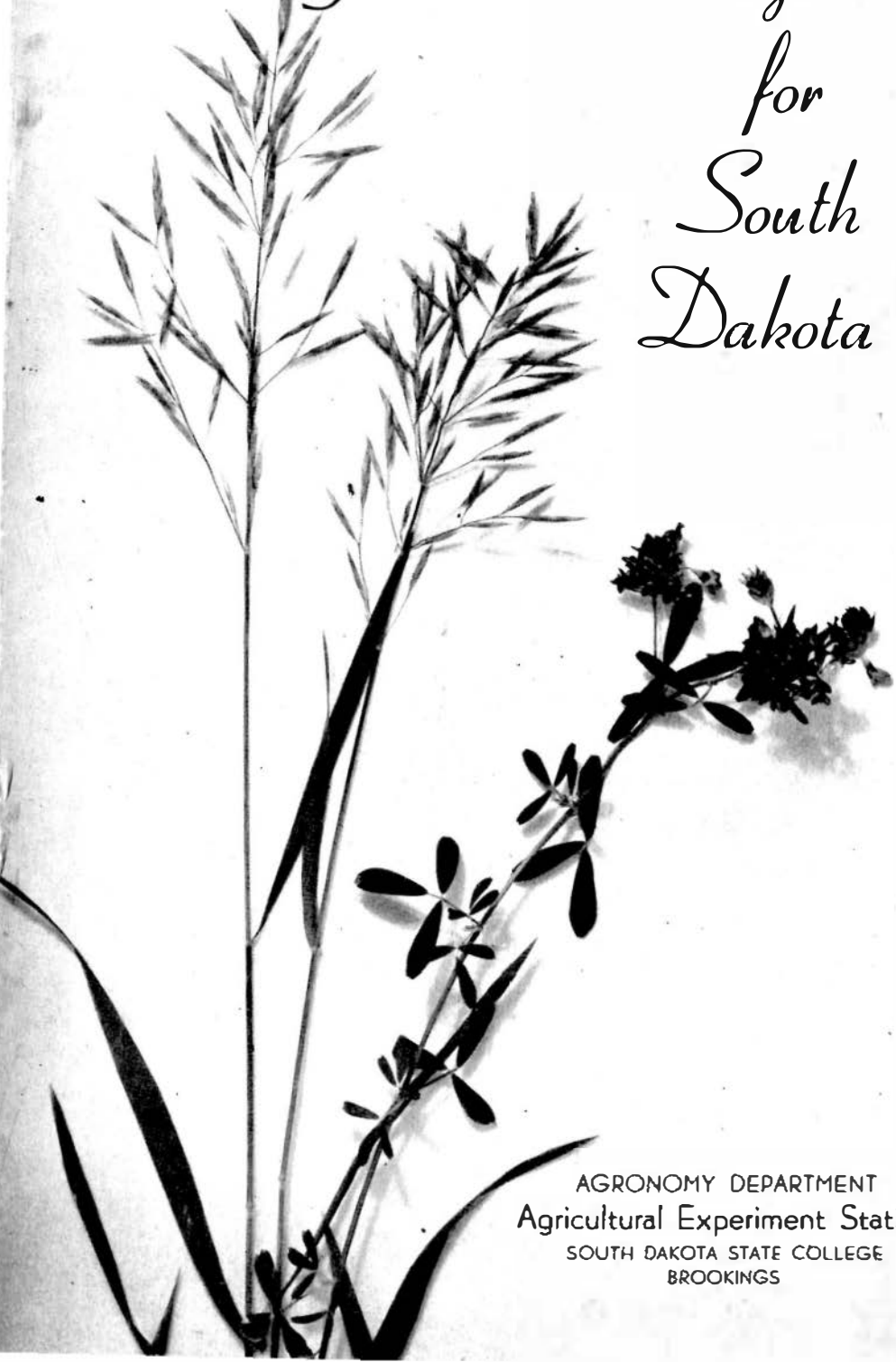

AGRONOMY DEPARTMENT
Agricultural Experiment Station
SOUTH DAKOTA STATE COLLEGE
BROOKINGS

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Grasses and Legumes for South Dakota

M. W. Adams, J. G. Ross, W. W. Worzella and A. N. Hume[1]

Farm operators in South Dakota are seeding considerable acreages of previously cropped land back to grasses and legumes. In recent years the state agricultural experiment stations and the United States Department of Agriculture have introduced or developed species of grasses and legumes which are superior to our native types for seed, hay and grazing purposes. A few outstanding contributions in this field of research have been the work with crested wheatgrass, Ree wheatgrass, and Ladak, Cossack and Ranger alfalfa.

Grasses and legumes rank far ahead of any other crop in importance in this state. At present, more than 28,400,000 acres (Fig. 1), twice the acreage of all other crops combined, are in grasses and legumes which furnish a major portion of feed for our grazing animals. An increase in the acreage of grasses and legumes has been adopted as a national policy because forage crops not only aid in conserving the soil but contribute to a better balanced agriculture.

More Forage Can Be Used

The "back to grass" movement may cause fear in some quarters that too much grass may be produced. More grass, however, can be used without an excessive increase in the numbers of livestock, since it can be substituted for more concentrated feeds. Grass and legume hay can be readily stored in stacks and used when most needed. Those ranchers and farmers who stored an ample carryover of hay withstood the drought years of the thirties with least hardship. Production of more forage crops and better feeding would insure a more uniform number of livestock, over a series of years, by reducing losses and forced sales of stock because of feed shortages.

Our Climate Favors Seed Set

South Dakota's climate favors the production of seed, and considerable alfalfa, sweetclover and bromegrass seed is harvested each year. South Dakota's seed is in great demand in other states, as it long has been known for its drought resistance and winter-hardiness. States that possess the climatic condition needed for seed-set are in a very favorable position and should take advantage of the expanding market, since seeds of grasses and legumes will be used much more extensively in the future.

Value of Grass Underestimated

The value of grasses and legumes is greatly underestimated by many operators. Often they are grown on the poorest soil, or where grain crops cannot be planted. Usually little attention is given to the choice of adapted varieties, or to sound management practices, especially with perennial plants where adequate root reserves are necessary for survival and large yields. Because they have not had the same opportunity as grain crops, grasses and legumes have not produced as much direct income and therefore have been regarded as secondary in importance. Under most conditions they will return as much income per acre as grain crops.

[1]Assistant agronomists, agronomist and associate agronomist, respectively, South Dakota Agricultural Experiment Station.

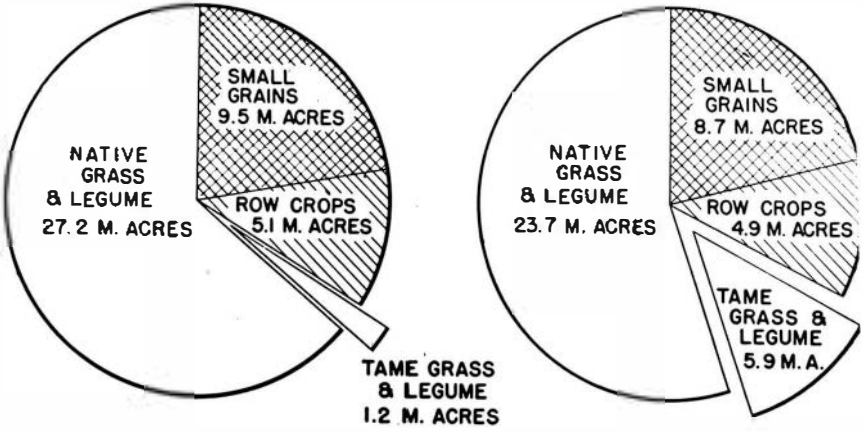

Fig. 1. Land Use in South Dakota (Source: SDSC Mimeo Report, 1948)

Indirect Values Important

In addition to the direct values obtained from forage and seed, several important indirect benefits must be credited to the grass and legume crop. Of greatest importance are the benefits of added nitrogen, organic matter, greater waterholding capacity, and improved physical structure of the soil when grass-legume mixtures are a part of a crop rotation. They are a tool against erosion and floods. They guard the water supplies of cities, and insure against losses from hail and insects. Grasses and legumes do all of these; they are not just a crop.

Our Rotations Need Grasses and Legumes

Experimental results indicate that about 25 percent of the cultivated land used for crop production should be in grasses and legumes. Fig. 2 shows the present use of cropland in this state as well as that needed to maintain the fertility and physical structure of our soils and sustain a high level of productivity. The proposed change does not deny full use of the land to any generation of owners. It does require that each generation observe land-use practices that insure sustained production.

Shift in Acreage Necessary to Sustain Production

There are about 43 million acres in South Dakota from which agricultural revenue is obtained. At present, (Fig. 1) about 14.6 million acres are in row and small grain crops; 1.2 million acres in tame grasses and legumes; and 27.2 million acres in native grasses. In order to form a stable agriculture, according to the best sources of information now available, the amount of acreage in cropland and grasses should be shifted so that about 19.4 million acres are in cropland and 23.7 million acres in native grass. Since approximately 5.9 million acres of the cropland acreage would be in tame grasses and legumes, about 13.4 million acres would remain for row and small grain crops. That would leave about 29.6 million acres in tame and native grasses and legumes each year.

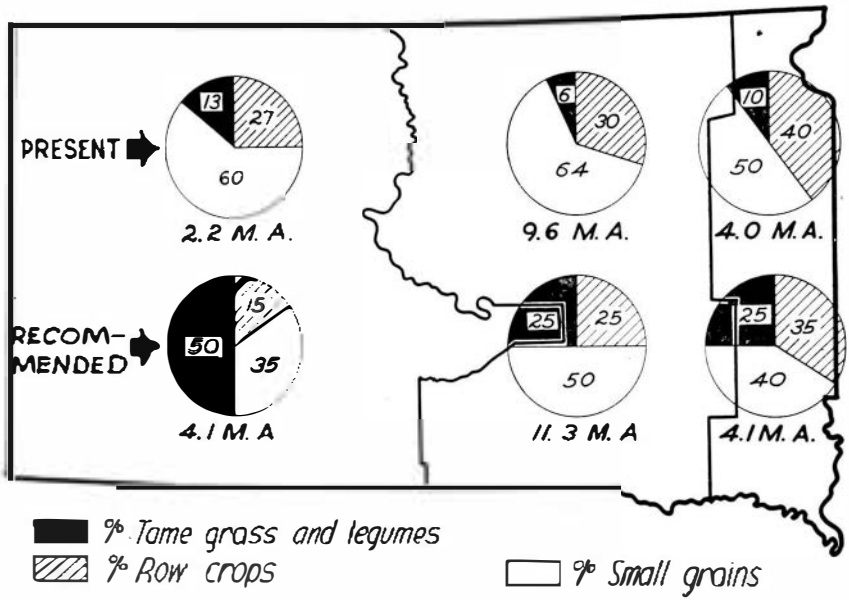

Fig. 2. Use of Cropland in South Dakota. (Source: SDSC Mimeo Report, 1948)

Important Grasses for South Dakota

Western wheatgrass *(Agropyron smithii)* is a native sod-forming grass. Its grayish-blue color makes it easily identified from a distance, especially where it forms almost the only covering on the bottom and bench lands in western South Dakota. It is alkali enduring and for this reason is sometimes known as alkali grass.

Western wheatgrass occurs widely throughout the state. It makes an early spring growth, but is considerably later than crested wheatgrass. Palatable and highly nutritive forage is provided by this grass if harvested before it starts to mature. This grass is the first perennial grass to cover "go-back" land, since it grows from root stocks which have survived in the soil during cultivation. These underground root stocks, or rhizomes, enable it to spread rapidly over large areas. Seed production is erratic and undependable.

Blue grama *(Bouteloua gracilis)* is a low-growing, warm season native grass which forms a dense sod in patches on hill tops and other fairly dry locations in western South Dakota. The flowering stems are 12 to 18 inches tall, each stem usually having two purplish spikes that extend at a sharp angle from the main stem.

It forms a palatable forage in midsummer with a high carrying capacity and withstands grazing very well. Under heavy grazing it may form almost pure stands after the associated grasses have disappeared.

Seed production is undependable, but occasionally a large seed crop may be produced.

Buffalograss *(Buchloe dactyloides)* is a low-growing, fine-leaved native peren-

nial grass. It may be distinguished from blue grama by its stolons, above ground runners, which spread in a manner similar to strawberry plants. It spreads rapidly by these runners and forms a dense, matted turf. Plants are generally only one-sexed. The male flowers are born on short stems and resemble the spikes of blue grama but are much smaller. The female flowers are found on stemless heads hidden among the leaves close to the ground.

Buffalograss is highly palatable and nutritious. Both this grass and blue grama provide excellent grazing in July and August when most other grasses are dormant.

Feather bunchgrass *(Stipa viridula)*, needle and thread *(Stipa comata)*, side-oats grama *(Bouteloua curtpendula)*, big bluestem *(Andropogon fucatus)*, little bluestem *(A. scoparius)* and dry land sedges, as well as many others, are native forages of lesser importance. In some cases they may make up a large part of the native range, but in general, the main forage producers are western wheatgrass, blue grama and buffalograss.

Crested wheatgrass *(Agropyron cristatum)* is a drought resistant perennial bunchgrass providing palatable and nutritious pasturage in the early spring and late fall. Its leaves are about one-fourth inch wide with fine hairs on the upper surface. The spikes or heads are 4 to 6 inches long on stems and 1½ to 3 feet high. The head is made up of crowded and overlapping spikelets spreading outwards and upwards giving it a crested appearance. The root system is very extensive, providing feeding surfaces in both the upper and lower layers of soil and adding an abundance of organic matter.

Standard crested wheatgrass is a strain originally imported from Russia by Dr. N. E. Hansen of South Dakota State College. This strain is taller, coarser, and more drought resistant than the Fairway crested wheatgrass selected from *A. cristatum* (also from Russia). Standard crested wheatgrass is adapted to the west-central and western parts of the state. In these areas it is particularly useful as early spring pasture supplementary to the native grasses. Its early spring growth provides valuable feed for stock before the native grasses have begun to produce forage, and gives them a chance to make adequate growth before being subjected to heavy grazing. The Fairway strain with its higher moisture and lower temperature requirements is adapted to certain areas of high elevation in the north-eastern part. The extensive root system of crested wheatgrass gives this grass the ability to make use of any rain falling during the dry summer months. After a rain, its normal summer dormancy is quickly broken and forage is produced within a short time. High quality hay is produced if cut after heading and before blooming has commenced, but the hay is tough and unpalatable if cut at later stages.

Reed wheatgrass *(Agropyron intermedium)* sometimes called intermediate wheatgrass, was released and distributed by the South Dakota Experiment Station in 1945. It is a coarse-leaved perennial grass, spreading by means of stout rhizomes and forming fairly open sod. The leaves are palatable and nutritious, one-fourth to one-half inches wide and varying from almost smooth to densely hairy. The spikes are open, 8 to 10 inches in length, borne on stout stems, 4 to 5 feet in height. The seeds are large and the seedlings strong and vigorous.

This grass is less drought resistant than crested wheatgrass, but more so than bromegrass. It is, therefore, adapted primarily to the central and eastern areas.

Smooth bromegrass *(Bromus inermis)* is a fast growing perennial grass, nutritious and palatable to livestock. Its rhizomes spread rapidly, forming a dense

sod, resistant to trampling. The smooth leaves are about one-fourth to one-half inches wide and are frequently characterized by a W-shaped wrinkling a short distance from the tip. The seed head is open and flexible, light brown to purple in color, 4 to 8 inches in length and borne on a stout stem, 1 to 4 feet high.

This grass requires a fairly moist, well-drained soil for best growth and exhibits only moderate drought resistance. It is, therefore, generally limited to the eastern and east central areas and the Black Hills region.

"Southern bromegrass" is a type introduced from central Europe and is adapted to higher summer temperatures than the "northern type" whose source was Siberia. The "southern type," therefore, represented by such improved strains as Lincoln, Achenbach, and Fischer, is adapted to the southern areas of the state. The cooler higher altitudes in the north are more suitable for the "northern type" bromegrass.

Seed produced from fields established locally for 30 or 40 years is preferable, since it will produce stands superior in such important respects as seedling survival, vigor and subsequent yield.

Reed canary grass *(Phalaris arundinacea)* grows in large clumps and has an abundance of leaves and flowering stems which grow to a height of 4 to 6 feet. The heads are dense, 2 to 8 inches long, and become whitish as the seed matures. The plants are very long-lived. For low areas which are flooded for two or three weeks in the spring, this grass is exceptionally suited. It also produces on upland soils, and will stand summer droughts surprisingly well. The forage is abundant, but not as nutritious or palatable as bromegrass and Ree wheat grass. It is particularly adapted for potholes which do not contain alkali.

Timothy *(Phleum pratense)* is a short-lived grass, 20 to 40 inches tall. Thickened internodes, or "corms," form at the base of this plant in early summer, and give rise to the new growth the following spring. The dense panicle is spike-like and 2 to 4 inches long. Forage production is relatively low, but quantities of seed are available at reasonable prices. Grown in a mixture with red clover, it is found suitable in short rotations in the extreme eastern part of the state.

Kentucky bluegrass *(Poa pratense)*, sometimes called June grass, is a long-lived grass with rhizomes which make a dense sod. It has small awnless spikelets and open, spreading panicles. It may be distinguished by its boatshaped leaf tips. In general, it grows 18 to 24 inches in height. It is used principally for lawn and turf purposes and also for pasture in the eastern area. The pasture and hay yield, however, are less than that from bromegrass or Ree wheatgrass. It becomes dormant during the hot periods of summer.

Important Legumes for South Dakota

Alfalfa *(Medicago sativa)* is a perennial forage plant of high quality and productivity. It commences growth early in the spring, produces two or more cuttings of hay per season, tolerates the heat and drought of summer, and survives the extreme cold of winter. Alfalfa seedlings emerge rapidly and make a vigorous early summer growth. At this stage the primary root has developed the taproot form and may be 6 to 10 inches in length. By early fall, small crown buds have formed and the enlarged tap root has been stored with starches which nourish and protect the plant during the first winter. The following spring the crown buds elongate rapidly at the initial expense of the stored starch in the root. Within three to four weeks, however, the root is again replenished and large food reserves are accumulated for the maintenance of continued vigor, hardiness and productiveness.

Alfalfa can be grown throughout South Dakota. For best results a moderately fertile, well-drained soil is required. Alfalfa does not thrive in wet soils. Only hardy varieties survive the winters in this region. Cossack and Ladak have the growth characteristics most suited to survival on the Northern Great Plains. South Dakota Common, Grimm, and Ranger also are adapted.

Proper management is second in importance to use of an adapted variety in the maintenance of productive, long-lived stands of alfalfa for hay or pasture. Proper management for alfalfa, and indeed for most perennial forages, consists of leaving foliage uncut long enough to maintain the carbohydrate root reserves at a normal level for each growth phase. This reserve will promote the development of strong new buds for the forthcoming cutting or season. Attention also should be given to soil management and insect and disease control.

Cutting alfalfa for hay during the critical fall period (Sept. 1—Oct. 25) invariably causes winter-killing, weakened stands, slow recovery and reduced yields the next season. Too frequent cutting during the growing season, or cutting repeatedly at too early growth stages likewise results in very thin stands.

White sweetclover *(Melilotus alba)* and yellow sweetclover *(M. officinalis)* are biennial legumes productive of seed and forage, particularly valuable in the renovation of run-down soils and in the maintenance of nitrogen fertility and organic matter of soils. The young seedlings of sweetclover develop rapidly and by mid-summer are able to tolerate considerable drought. By early fall, two fleshy crown buds are formed at the base of the main stem. Food reserves are stored in these coronal buds and in the thick white tap root. In the second year the plants grow rapidly and usually become rank and coarse with advancing maturity. Aftermath growth in the second year comes entirely from the small buds located on the base of the main stems. In dense stands, where the first cutting is delayed, these buds may receive insufficient light for survival. Their position varies on the stem; in general, the more dense the stand the higher are the active buds. In the second year, if the first cutting is made too close to the ground, most of the active buds will be removed and the crop killed. To keep the stand alive after the first cutting a stubble of about 12 inches should be left.

Yellow biennial sweetclover is 10 days to two weeks earlier blooming than the biennial white. It is finer stemmed, leafier, but not as productive of total dry matter. Both species thrive throughout South Dakota, though the yellow species predominates. Sweetclover grows vigorously on most soils in the state, but it presents certain problems, in curing and

storing hay and in seed harvesting, which have restricted its utility. At least one of these drawbacks may soon be corrected by breeding strains which do not possess the bitter, toxic substance (coumarin) found in common sweetclover.

The annual white sweetclover *(M. alba annua),* variety Hubam, is not well-suited to the greater part of South Dakota because its period of most rapid growth and development comes during the critical mid-summer droughts which may occur. Stands established from spring seedings are usually very weedy and fail completely during the latter part of the summer. Where Hubam escapes the drought it may fail to mature a seed crop because of its late maturity. Its soil-improving qualities are considerably less than that of common biennial types. It has been used principally as a green manure and as an emergency legume where other forage legumes have winter-killed.

Red clover *(Trifolium pratense)* is a biennial, though under favorable conditions a few plants carry over into the third year. It is used primarily for hay either in pure stand or in mixtures with grass. Red clover develops a branched tap root and its basal buds form a short-lived crown. It is only moderately drought tolerant and not as winter-hardy as alfalfa and sweetclover. It is an efficient soil-building legume wherever it is adapted. Red clover makes its most vigorous vegetative growth under conditions of moderate to high rainfall, cloudy and cool weather. The so-called "corn soils," i.e., deep, well-drained, fertile soils, high in organic matter and of fine texture, are considered most satisfactory for red clover.

In South Dakota red clover can be grown satisfactorily in the eastern tier of counties, and in the Black Hills area. It is not recommended for most of the state because it has neither the drought resistance nor winter-hardiness required of a legume in the northern plains.

Ladino clover *(Trifolium repens)* is a larger, more vigorous form of common white clover which has limited adaptation in South Dakota. It spreads aggressively by means of above-ground runners (called stolons) which root at the joints. Buds located at each joint give rise to large succulent leaves and flowering heads. It is best adapted to regions of relatively cool summers and moderately high rainfall which is well distributed throughout the growing season. Because of its spreading growth form, it is most useful in mixed pasture seedings. Ladino is fairly winter-hardy under good management, but will not survive long under the summer and winter climatic conditions of the Northern Great Plains. In South Dakota its area of adaptation, though not definitely determined, appears to be restricted to the south-eastern pocket and to local situations where irrigation water is available and winter temperatures not extreme.

Birdsfoot trefoil *(Lotus corniculatus)* is a perennial legume possessing a tap root with small side branches, very fine stems and leaves, and yellow blossoms. The seed pods when ripe are brown and hard and occur in clusters which resemble a bird's foot. In South Dakota, this legume is not so productive as alfalfa and only moderately drought tolerant and cold resistant. In nutritive value it approximates alfalfa. Birdsfoot is somewhat lower growing than alfalfa, and, though useful for hay, has been particularly useful in pasture mixtures in areas where it is adapted. Its area of adaptation in South Dakota has not been clearly defined. Birdsfoot trefoil would appear to be sufficiently hardy to survive in south-eastern South Dakota. A complete loss of stand may result if late fall cutting or severe fall grazing is practiced.

Yields of Grasses and Legumes

Yield of Bromegrass Strains

Different strains of grasses vary in their yielding ability. To determine the best source of seed for planting in South Dakota an experiment using both local and imported bromegrass seed was set out in 1945. The data are presented in Table 1.

Table 1. Average yield in tons per acre of hay from different strains of bromegrass at Brookings, South Dakota

Strain	1946	1947	1948	1949	Average
S. D. Source*	2.91	1.77	1.00	.41	1.52
Lincoln	2.66	1.70	.87	.49	1.43
Parkland	2.66	1.93	.82	.30	1.43
Canadian	2.64	1.30	.83	.41	1.29

*Seed obtained from fields established 35 to 45 years ago.

It will be noted from the data that bromegrass seed obtained from old fields in South Dakota out-yielded other sources in most years, and made a higher average yield for the four years tested. Of importance, also, are the decreasing yields of all strains as the stands become older. This decrease in yield is due to what is commonly called "sod-binding," and is associated with depletion of nitrogen in the soil.

Grass and Alfalfa Yields at Highmore

To determine forage production in the central part of the state, three grasses and alfalfa were seeded in an experiment at Highmore in 1941. Yields of these are shown in Table 2.

Table 2. Yields of hay in pounds per acre of grasses and alfalfa at Highmore, South Dakota, 1942–48

Year	Crested Wheatgrass	Western Wheatgrass	Bromegrass	Alfalfa
1942	630	501	324	798
1943	323	1543	757	2927
1944	1524	1108	860	2167
1945	928	1477	1616	1560
1946	540	750	617	3333
1947	567	867	1100	2600
1948	467	433	873	1017
Average	**711**	**954**	**892**	**2057**

The most striking fact shown in Table 2 is the high production of alfalfa in relation to the grasses. Crested wheatgrass did not yield as much as bromegrass or western wheatgrass. Crested wheatgrass, however, makes its growth early and would probably yield more than the other grasses during drier seasons.

Yields of Alfalfa Varieties

Hay yields for various alfalfa varieties are shown in Tables 3 and 4. Ladak, Cossack, and Dakota Common have been somewhat superior to other standard varieties in yield of forage at the Highmore station. Unadapted varieties, such as Arizona Chilean and Buffalo, are low-yielding in central South Dakota, largely because of their inability to resist the severe winter conditions of the area.

The superiority of Cossack and Ladak in this state is shown again in the results reported in Table 4. In recent years, however, some of the newer varieties have performed quite satisfactorily. These have not been tested for long enough periods of time to have been exposed to extreme conditions of cold or drought. Consequently their full adaptation has not been measured.

How Often to Harvest Native Hay

Hay yields from native grass, largely western wheatgrass, have been obtained at the Range Field station, Cottonwood, and the North Central station, Eureka, since 1943. The data are reported in Table 5.

On the yearly basis, the average yield was about the same for plots harvested every year and those cut once every two years. Plots harvested once in three years, however, yield much less when computed on a yearly basis. During the five years of this experiment the hay harvested

Table 3. Hay yields of alfalfa varieties at Highmore, South Dakota, in 1947.

Variety	Tons per acre
Atlantic	2.2
Buffalo	1.9
Ranger	2.2
Ladak	2.7
Cossack	2.8
Dakota Common	2.6
Grimm	2.6
Baltic	2.2
Arizona Chilean	0.6

Table 4. Hay yields in tons per acre of alfalfa varieties at Brookings, South Dakota

Variety	1942-46 (5-year av.)	1947	1949
Williamsburg	—	—	4.3
Narragansett	—	—	5.0
Atlantic	—	5.2	4.5
Buffalo	—	4.4	4.0
Ranger	4.4	4.4	4.3
Ladak	4.6	4.8	5.1
Cossack	4.8	4.5	—
Dakota Common	4.3	4.4	—
Grimm	4.4	4.7	4.4
Baltic	4.3	5.2	—
Arizona Chilean	2.3	—	—
Argentine	—	3.5	—

each year and every other year was of high quality. Hay from plots harvested once every three years was of poorer quality because of the dead grass from the previous years' growth. Those plots harvested every year were invaded by annual weeds during the last years of the experiment. For this reason, as well as the greater harvesting cost involved when grass is cut every year, it appears that harvesting every two years is best.

Why a Mixture of Grass and Legume

For pasture and hay a mixture of grass and legume is best. For seed production, however, a pure stand of one or the other is generally better because of harvesting difficulties encountered with a mixture. Grass-legume mixtures are best because of the following:

1. Forage yields of mixtures are always higher than grass alone and quite often more than the legume by itself. This is shown by results obtained at Brookings and at Highmore (Tables 6 and 7). The greater yield of the mixture is illustrated in Fig. 3.

2. Pasture or hayland will continue in high production if a legume is included in the mixture. This is shown in Table 7. In a pure stand of grass, plant nutrients are soon exhausted and yields drop. A legume supplies nitrogen to the grass growing with it and so yield is maintained. Satisfactory yields were obtained from bromegrass or the alfalfa-brome mixture the first year after the stand was established. Following the first year, the yields of bromegrass declined each succeeding year. The alfalfa-brome mixture produced good yields throughout the 4-year period of these trials. The differences between the bromegrass and alfalfa-brome mixture were not as great at Highmore owing to lack of moisture.

3. Grasses in a legume mixture contain

Table 5. Hay yields in pounds per acre of native hay cut (a) each year (b) once in two years and (c) once in three years at Cottonwood and Eureka.

Year harvested	COTTONWOOD Harvested			EUREKA Harvested		
	Each year	Every 2 yrs.	Every 3 yrs.	Each year	Every 2 yrs.	Every 3 yrs.
1945	1287	2160	2084	1816	3128	2844
1946	772	1491	2233	—	—	—
1947	383	988	1412	1388	1900	2277
1948	1193	1607	2091	872	2704	2794
1949	272	924	849	892	1756	2608
Average	**781**	**1434**	**1734**	**1242**	**2372**	**2631**
On yearly basis	781	717	578	1242	1186	877

Table 6. Hay yields in tons per acre of grass, alfalfa and mixture at Brookings, South Dakota.

	(First cuttings only) 1945	1946	1947	1948	Av.
Brome	2.44	1.93	2.08	0.77	1.80
Ree	2.22	1.81	1.36	1.15	1.61
Alfalfa	6.08	3.11	2.68	3.03	3.72
Brome and Alfalfa	5.78	2.82	2.81	3.16	3.64
Ree and Alfalfa	5.61	3.15	2.60	2.97	3.58
Ree, Brome and Alfalfa	6.54	3.11	3.71	3.11	4.12

a higher percentage of protein than grass grown alone.

4. The inclusion of grass with a legume reduces the chance for bloat from legumes.

5. Better erosion control is effected and better soil structure restored when grass is included with a legume.

6. Control of weeds is given by grass when included with a legume. Grass fills up all vacant spaces.

7. The hazards affecting young seedlings of two species will not be the same so that seeding a mixture may provide more assurance of a stand.

8. A number of species will tend to accommodate themselves to the range of conditions within the field and assure a complete forage cover.

Table 7. Hay yields in tons per acre of bromegrass alone, and a mixture of bromegrass and alfalfa at Brookings and Highmore, South Dakota, 1946–1949

	BROOKINGS			HIGHMORE		
Year	Bromegrass	Bromegrass and alfalfa	Percent Increase of mixture over grass alone	Bromegrass	Bromegrass and alfalfa	Percent increase of mixture over grass alone
1946	2.80	3.78	135	1.10	1.28	116
1947	1.69	5.56	329	2.20	2.50	113
1948	0.90	3.32	369	1.17	1.88	160
1949	0.39	1.88	482	—	—	—
Average	1.44	3.63	329	1.49	1.89	129

A B

Fig. 3. Grass-legume mixture (A) always produces more forage than grass alone (B).

Pasture and Hay Mixtures

The following are reliable mixtures adapted to the designated areas of the state (Fig. 4).

1. **Black Hills and eastern areas** (Areas 1, 5 and 8)

Mixture A

Smooth bromegrass	5 lbs.
Ree wheatgrass	4 lbs.
Alfalfa or sweetclover	4 lbs.

Mixture B*

Timothy	3 lbs.
Red clover	4 lbs.
Alsike clover	1 lb.

*This mixture may be useful under the more favored conditions where a short term rotation is desired.

2. **James River areas** (Areas 4 and 7)

Mixture A

Smooth bromegrass	5 lbs.
Ree wheatgrass	4 lbs.
Alfalfa or sweetclover	4 lbs.

Mixture B

Crested wheatgrass	6 lbs.
Alfalfa or sweetclover	4 lbs.

3. **Central areas** (Areas 3 and 6)

Mixture A

Ree wheatgrass	6 lbs.
Alfalfa or sweetclover	4 lbs.

Mixture B

Smooth bromegrass	6 lbs.
Alfalfa or sweetclover	4 lbs.

Mixture C

Crested wheatgrass	5 lbs.
Alfalfa or sweetclover	4 lbs.

4. **West river area** (Area 2)

Mixture A

Crested wheatgrass	5 lbs.
Alfalfa or sweetclover	4 lbs.

Mixture B

Western wheatgrass	5 lbs.
Crested wheatgrass	3 lbs.
Alfalfa or sweetclover	4 lbs.

One grass may be used instead of two in any of the above mixtures, but the amount of seed should be adjusted. The pounds per acre may be increased or de-

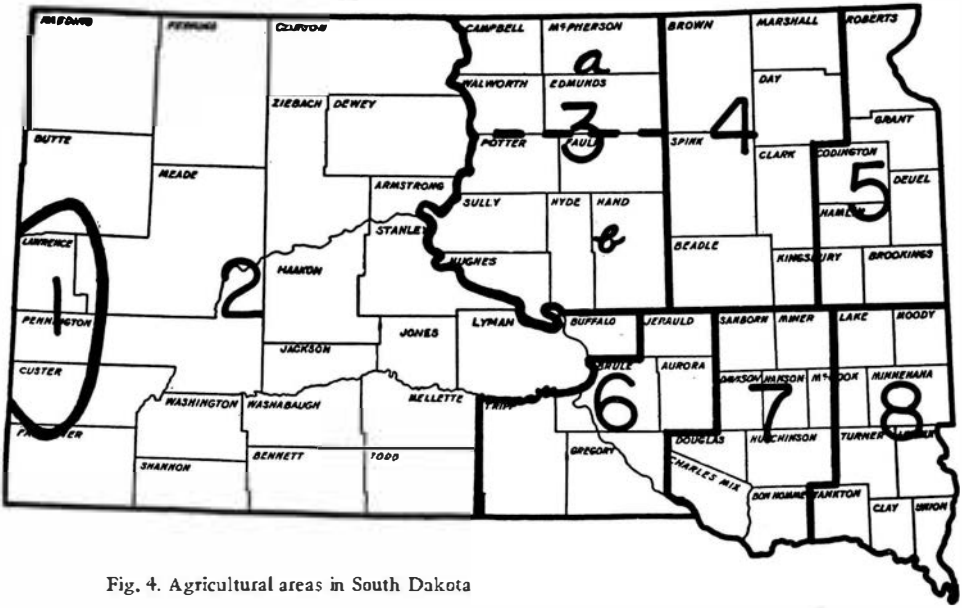

Fig. 4. Agricultural areas in South Dakota

creased depending upon the purpose of the seeding, as well as to the condition of the soil. In drier locations, for instance, a lower rate of seeding than stated may be preferable. If the stand will be used for pasture, a smaller proportion of legume is recommended as a safeguard against the occurrence of bloat in animals.

It must be recognized that within every area special circumstances may call for a special grass. For example, a low wet area which is flooded for a few weeks in the year is suited to Reed canary grass.

Establishing Stands

When to Seed

The early spring and early fall periods are suitable for seeding grasses and legumes, but late fall seeding after fall growth has stopped often gives good results in the western areas. Selection of time to seed depends mostly on moisture conditions. In the eastern part of the state, spring seeding usually results in better emergence and higher survival than early or late fall seeding. Early fall plantings from the 15th of August to the 15th of September sometimes give good stands of grass, but is hazardous for legumes. In the central and western parts of the state, factors such as moisture content, soil blowing and grasshopper populations are of major consideration in selecting the best date of seeding.

Seed Bed Preparation

A firm seed bed is of prime importance. Stubble ground which has been disced and harrowed provides a firm soil surface, and assures a close contact between the seed and soil as well as protection from soil blowing. The success of establishing stands is assured in most cases if there is not competition from weeds. It is, therefore, desirable to seed upon soil as free from weeds as possible. Corn stubble quite often makes a good seed bed. Plowed land is not suitable unless well packed before seeding. In the western part of the state, seeding crested wheatgrass on unprepared stubble or "go-back" land in late fall has proved satisfactory.

How Deep?

Shallow seeding is essential for good stands. In most cases seed should not be planted deeper than three-fourths of an inch. Seeding in sandy soil, however, may be successful at slightly over an inch in depth. Drill seeding is superior to broadcasting since a uniform shallow depth may be obtained. A press drill is preferable since the soil is packed directly over the seeds. All pressure should be removed from the discs of the drill by releasing the spring tensions. Culti-packing after seeding with the ordinary drill will give futher assurance of a stand, provided wind erosion is not a problem, or provided it is controlled by a trash cover.

Companion Crop?

Where moisture is limited, a companion crop may compete so successfully with the grass seedlings as to reduce severely their chances of survival. Flax is the safest companion crop to use. Other small grains, because of their vigorous growth, often give too much competition. When used, however, their rate of seeding should be cut in half by plugging every other drill hole. Better stands generally result if the grass and/or legume are seeded with a companion crop.

Weed growth is generally heavy after late fall and early spring seedings. Weeds should be clipped at a height of about 6 to 8 inches to prevent injury to the grass

and legume seedlings and clipping should be done preferably during cool weather. Since legumes are injured by 2,4-D, spraying to control weeds in a grass-legume mixture should not be practiced. New seedings should not be cut for hay or pastured the first season. In the case of early fall seedings a cutting of hay often can be taken the following summer.