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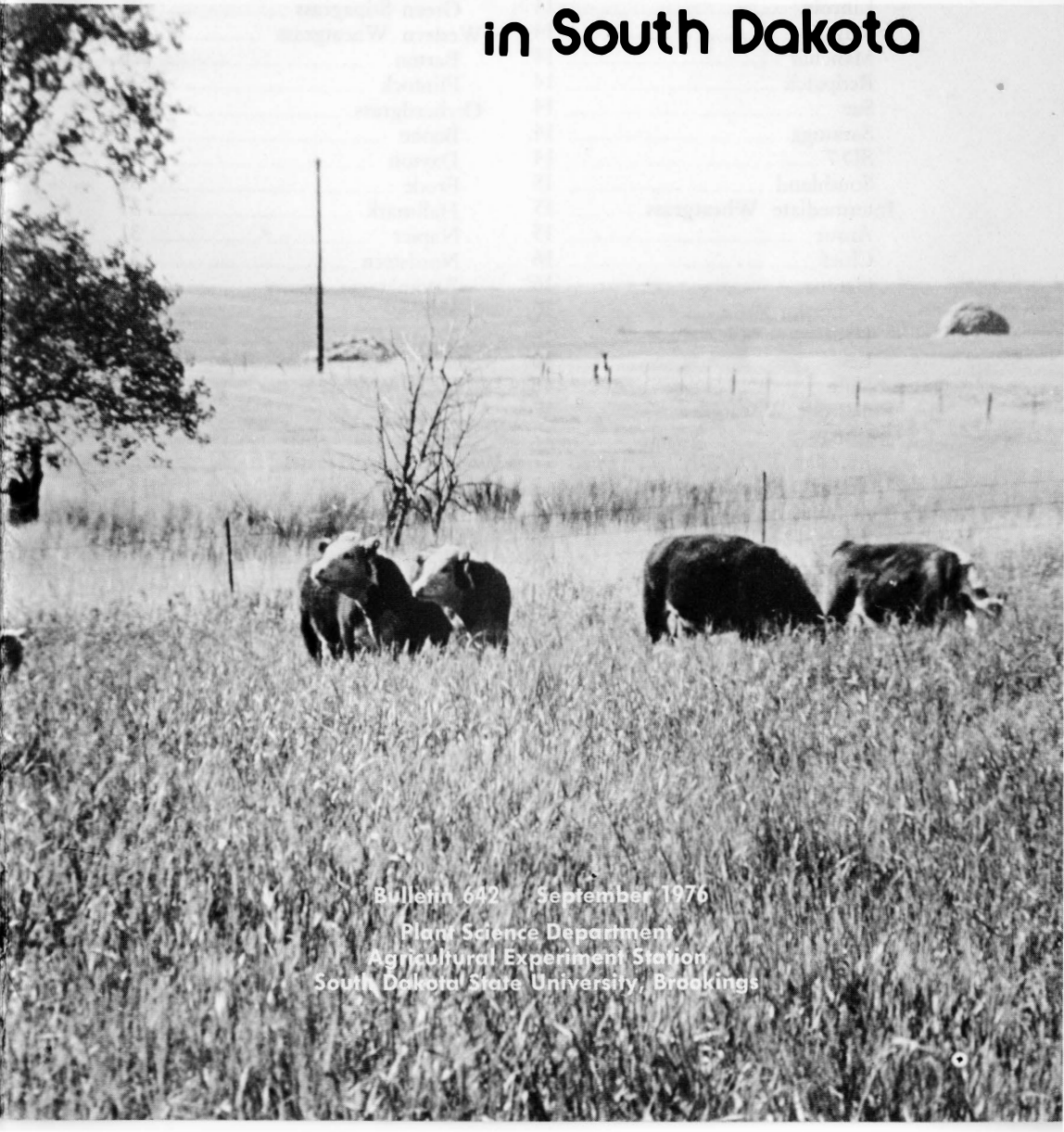

Bulletin 642 September 1976
Plant Science Department
Agricultural Experiment Station
South Dakota State University, Brookings

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# GRASS SPECIES and VARIETY PERFORMANCE in SOUTH DAKOTA

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Grasslands of South Dakota total about 28 million acres and are one of the most important but least appreciated sources of agricultural income in the state. When best varieties of most productive species are combined with proper management, grassland yields can be greatly increased — in some instances more than doubled. This bulletin reports selected comparative grass yield research in grassbreeding and pasture projects over the past 30 years. Locations of these tests are designated on Figure 1 which also indicates average annual precipitation.

### Two Main Grass Groups

Grasses are divided into two main groups: cool-season and warm-season. Cool-season grasses grow best in spring and fall. Warm-season grasses grow most in summer. A successful pasture program, demands use of both cool- and warm-season grasses to produce maximum forage throughout the entire growing season. (Grazing seasons for each important grass and how it may be coordinated into a pasture program are discussed in South Dakota Cooperative Extension Service Fact Sheets: EC 709, Alternative Pasture and Forage Systems; FS 503, Planting Tame Pastures and Hayland; FS 422, Interseeding Pastures; FS 425, Fertilizing Pasture and Hayland; and FS 426, Chemical Weed Control in Pasture, Range and Hayland.) Cool-season grasses are generally better suited for hay production than warm-season grasses and are most useful when planted in mixtures with alfalfa.

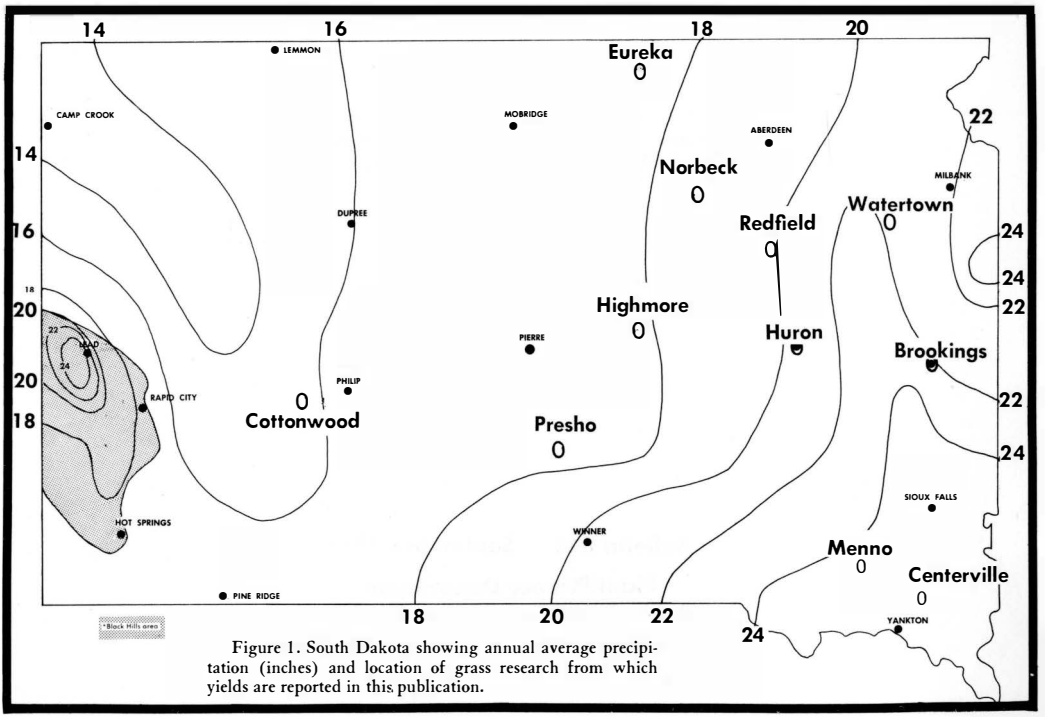



Figure 1. South Dakota showing annual average precipitation (inches) and location of grass research from which yields are reported in this publication.

**Fertilizers for Grasses**

Supplemental nitrogen is necessary for maximum grass growth. Nitrification (release of nitrogen by the action of soil bacteria) does not take place until soil temperatures increase in late spring. After the first year of production from a new stand, the limiting factor for growth is nitrogen, unless it is supplied by commercial fertilizer or by a legume growing in association with the grass.

Forage yield was maintained at about the same level year after year in a grass-legume mixture, but yield of grass alone decreased rapidly in an experimental plot at Brookings (Table 1). Yield of bromegrass alone decreased from 2.8 tons per acre the first year after establishment to 0.4 tons in the fourth year. The grass-legume mixture yielded 36% more the first year than the grass alone. The proportional yield increases of the grass-legume mixture continued each succeeding year as the nitrogen supply became exhausted in the soil where grass alone was grown. Finally, in the fourth year the mixture yielded 382% more than the pure grass. This increase in production of grass-alfalfa over grass-alone is also found for other species (Table 2). Average yield increases of 36% to 100% over the 4-year period were observed. The grass-alfalfa maintained its yield because alfalfa fixes nitrogen from the air and makes available part of this nitrogen to the grass. With increasing costs of nitrogen fertilizer, the use of a legume in a mixture is becoming more important.

An approximation of the amount of nitrogen added by alfalfa to the grass was obtained in an experiment at Brookings. One hundred pounds of nitrogen (300 pounds of ammonium nitrate) per acre were applied to the bromegrass alone and the brome-alfalfa mixture. This stand had been established for 5 years with no fertilizer used previously. Seed yields for Homesteader, Lincoln, and Canadian commercial are shown in Table 3. Lincoln, the lowest yielding variety without nitrogen, showed the greatest stimulation in seed yield with fertilizer.

The 100-pound nitrogen treatment increased the seed yield by an average of 593 pounds compared with a yield of 400 pounds of seed from the untreated grass-alfalfa mixtures. From this it can be estimated that alfalfa contributed about 67 ($400/593 \times 100$) pounds per acre of nitrogen as fertilizer for the grass.

**Table 1. Yields of bromegrass and bromegrass-alfalfa mixtures established in 1945 at Brookings.**

| Years after establishment | Brome-grass | Bromegrass-alfalfa | Increase |
|---|---|---|---|
| | tons/acre | | % |
| 1 | 2.8 | 3.8 | 36 |
| 2 | 1.6 | 5.6 | 229 |
| 3 | 0.9 | 3.3 | 269 |
| 4 | 0.4 | 1.9 | 382 |

**Table 2. Yields of grass-alone and grass-alfalfa mixtures at Brookings during 1949-52.**

| Species | Grass | Grass-alfalfa |
|---|---|---|
| | tons/acre | |
| Intermediate wheatgrass | 2.4 | 3.3 |
| Smooth bromegrass | 2.2 | 3.0 |
| Crested wheatgrass | 1.7 | 3.0 |
| Kentucky bluegrass | 1.4 | 2.8 |

Fertilizing grass-alfalfa mixtures gave only nominal increases indicating that nitrogen was being supplied at almost the optimum rate by the alfalfa. The lower yield of grass seed of the grass-alfalfa mixtures compared with the fertilized grass alone may be due in part to the competitive effect of the alfalfa and also to a smaller plant population of grass in the mixture. It is probable that the nitrogen released to the grass by the alfalfa was in excess of 67 pounds or equivalent to more than 200 pounds of ammonium nitrate per acre.

Relative pasture yields of bromegrass and an alfalfa-bromegrass mixture were measured at Brookings from 1953 to 1957 (Table 4). Fifty pounds of 0-43-0 were applied each year on both types of pasture. In addition, 33 pounds of nitrogen were applied in April and again in July of each year. Although 66 pounds of nitrogen were applied on season, yields as measured by amounts consumed by steers and also by pounds of beef per acre were higher for the alfalfa-bromegrass mixture. After the first season when the bromegrass during the grazing the proportion of alfalfa to brome was nearly 50-50, no trouble with bloat occurred. During the first season of grazing when alfalfa (hay-type) was about 90% of the mixture, severe bloat losses resulted in production of only 60 pounds of saleable beef per acre. The importance of having a high proportion of grass in a grass-alfalfa mixture is emphasized by these results. In the first year after seeding, forage should be harvested for hay or silage if the proportion of alfalfa is too high. A

**Table 4. Forage consumed and beef produced from bromegrass and alfalfa-bromegrass pastures at Brookings.**

| Year | Forage | | Beef | |
|---|---|---|---|---|
| | Brome-grass | Alfalfa-brome | Brome-grass | Alfalfa-brome |
| | Tons/Acre | | Pounds/Acre | |
| 1953 | 2.06 | 3.09 | 212 | 344* |
| 1954 | 1.92 | 2.13 | 207 | 247 |
| 1955 | 1.48 | 1.86 | 252 | 339 |
| 1956 | 2.26 | 2.46 | 295 | 346 |
| 1957 | 1.84 | 2.10 | 214 | 263 |
| Average | 1.91 | 2.33 | 236 | 308 |

*In 1953 forage in the alfalfa-brome mixture was about 90% alfalfa. Numerous cases of bloat occurred on this pasture and eight animals died of bloat. Net saleable beef was 60 pounds per acre. Bloat was not a problem in subsequent years when a satisfactory grass-legume mixture became established.

**Table 3. Comparison of nitrogen fertilizer applications and nitrogen from alfalfa on yields of smooth bromegrass seed at Brookings.***

| Bromegrass variety | Grass alone | | Grass-alfalfa | |
|---|---|---|---|---|
| | Without fertilizer | 100 pounds nitrogen | Without fertilizer | 100 pounds nitrogen |
| | pounds/acre | | | |
| Homesteader | 209 | 809 | 626 | 624 |
| Lincoln | 83 | 690 | 437 | 663 |
| Canadian commercial | 259 | 831 | 689 | 738 |
| Average | 184 | 777 | 584 | 692 |
| Increase over grass without fertilizer | | 593 | 400 | 508 |

*5-year-old stand.

pasture-type alfalfa, such as Travois, should be used because bloat has not been reported with this variety. In addition to higher yields of a grass-alfalfa mixture over grass alone plus reduction of bloat risk over the pure alfalfa, better erosion control and greater control of weeds are provided by a mixture than by a pure stand of alfalfa.

Warm-season grasses start growth in early June when sufficient nitrogen has been released in the soil. Nitrogen application in late May is desirable to maintain production. Because of their late growth, warm-season grasses are not well adapted for seeding in a mixture with an early growing legume, such as alfalfa.

Under irrigation, nitrogen application is necessary to obtain maximum yield. A more complete discussion of fertilizer requirements of grass is given in Fact Sheet 425, Fertilizing Pasture and Hayland.

### Moisture Needs of Grasses

When irrigation is not possible, more moisture per plant may be made available by limiting plant population. Row planting and cultivation between rows are profitable practices for seed production. Under conditions of low rainfall at Cottonwood, forage production and stands of intermediate wheatgrass have been maintained by tillage between rows. Economic considerations in maintaining production of forage will determine if this practice is practical. Certain species, such as crested wheatgrass, are drought resistant and will maintain stands when other species may die.

### Seeding Dates

Grasses should be seeded in a weed-free seedbed. For cool-season grasses, fall seeding (from August 15 to September 10 when moisture is in the soil) provides a weed-free seedbed and has given best results. Summer fallowing for fall seeding to ensure a better supply of moisture may be desirable. Legumes may be established with the grass if they are seeded before mid-August, so that energy reserves are stored by the legume seedlings before winter. Late fall seeding (after November 15) or spring seeding of cool-season grasses may also be used. A more complete discusison of recommendations concerning establishment of forages is given in Fact Sheet 503, Planting Tame Pastures and Hayland.

Warm-season grasses should be seeded after weeds have been killed in the spring and early summer, to assure a soil surface comparatively free of weed seeds. Unless they are eliminated, weed seeds may germinate and compete with grass seedlings. Seedings of Summer switchgrass were made at Eureka in 1970 on June 16, July 16, and August 25 with and without oats as a companion crop using a grain drill on well-packed summer fallowed soil. On October 18, 1970 the first two seedings had good stands although there were more weeds in the June 16 planting. The last seeding produced small plants which did not survive the winter. Counts were made from 10 areas each 3-square-feet in size in each of the plots on July 19, 1971 (Table 5). These data indicate that seeding as late as the


SWITCHGRASS
PLANTED
MAY 17


SWITCHGRASS
PLANTED
JULY 12


SWITCHGRASS
PLANTED
MAY 31


SWITCHGRASS
PLANTED
JULY 26


SWITCHGRASS
PLANTED
JUNE 14


SWITCHGRASS
PLANTED
AUGUST 9


SWITCHGRASS
PLANTED
JUNE 28


SWITCHGRASS
PLANTED
AUGUST 23

**Table 5. Comparison of Summer switchgrass stands planted on three dates with and without a companion crop at Eureka.***

| | 1970 Planting date | | |
|---|---|---|---|
| | June 16 | July 16 | August 25 |
| | Plants/3 sq. ft. | | |
| Alone | 45.3 | 51.1 | 0 |
| With oats | 34.1 | 32.1 | 0 |

*Counts were made on July 19, 1971.

middle of July can give good stands of Summer switchgrass at Eureka. Stands without a companion crop were better than with oats.

In 1971, seedings were made at Norbeck with a Nesbit grassland drill in a four-replicate trial at 14-day intervals from May 17 to August 23. The experiment was harvested on September 28, 1972 to estimate the comparative stands. According to Table 6, using dry matter yield as a measure of establishment success, stands were better without a companion crop and June 14 was the best planting date. Seedlings from early seedings could not compete with weeds while those from later seedings did not survive the dry July weather.

These two experiments indicate that seeding without a companion crop in early- or mid-June is probably the safest time to seed switchgrass in South Dakota. Success in obtaining a stand depends upon rainfall after seeding. Therefore, in a very dry season earlier seeding in the first week of June might give the best results, especially in southern South Dakota counties.

## COOL-SEASON GRASSES

Performance tests at six South Dakota locations provide information about highest yielding species of grasses. Table 7 compares yields of various grasses in solid stands. Highest yielding species were intermediate wheatgrass, smooth bromegrass, and crested wheatgrass, in that order. Higher yields were obtained in eastern South Dakota and under irrigation where moisture was not a limiting factor for production. Intermediate wheatgrass and bromegrass were the highest yielding grasses under these conditions. Crested wheatgrass yielded proportionately more under conditions of less rainfall. At Cottonwood, crested wheatgrass yielded more than bromegrass but less than intermediate wheatgrass. Western wheatgrass, a native grass, has yielded about the same as crested wheatgrass and bromegrass in central and western areas of the state. Russian wildrye has a different growth habit than species with jointed stems. When cut, it grows back quickly and probably would have produced

**Table 6. Comparison of switchgrass stands planted at 14-day intervals with and without a companion crop at Norbeck.***

| | 1971 Planting date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | May 17 | May 31 | June 14 | June 28 | July 12 | July 26 | Aug. 9 | Aug. 23 |
| | pounds/acre | | | | | | | |
| Alone | 207 | 220 | 1354 | 1113 | 364 | 23 | 0 | 0 |
| With oats | 151 | 173 | 946 | 814 | 421 | 89 | 0 | 0 |

*Yields are the average of the varieties Nebraska 28, Pathfinder, and Summer planted in a four-replicate experiment and harvested on September 28, 1972.

more forage if harvested more frequently each year.

Varieties of cultivated grasses have become available from breeding programs of Agricultural Experiment Stations in the north-central area and more recently from private breeders. Merits of these varieties plus general discussions of species follow.

**Table 7. Performance of grass species at six locations in South Dakota (tons per acre)**

| Species and varieties | Brookings 1949-53 dryland | Cotton-wood 1949-53* dryland | Eureka 1949-53 dryland | High-more 1949-55† dryland | Huron 1951-52 irrigation | Redfield 1952-53 irrigation | Harvest-year averages 28 |
|---|---|---|---|---|---|---|---|
| Smooth bromegrass | | | | | | | |
| Lincoln | 2.17 | 0.36 | ..... | 0.58 | ..... | ..... | ..... |
| Homesteader | 2.05 | 0.35 | 0.44 | 0.49 | 1.66 | 1.49 | 0.91 |
| Lyons | 2.00 | ..... | ..... | 0.52 | ..... | ..... | ..... |
| Lancaster | 1.91 | ..... | ..... | 0.53 | ..... | 1.29 | ..... |
| Intermediate wheatgrass | | | | | | | |
| Ree | 2.19 | 0.67 | 0.53 | 0.58 | 1.65 | 1.76 | 1.05 |
| Crested wheatgrass | 1.58 | 0.47 | 0.43 | 0.50 | 1.30 | ..... | 0.80 |
| Western wheatgrass | ..... | 0.51 | ..... | 0.41 | ..... | ..... | ..... |
| Slender wheatgrass | ..... | 0.36 | 0.37 | 0.45 | ..... | ..... | ..... |
| Tall wheatgrass | ..... | ..... | ..... | ..... | 1.50 | ..... | ..... |
| Green needlegrass | | | | | | | |
| Green Stipagrass | ..... | 0.38 | 0.43 | ..... | ..... | ..... | ..... |
| Canada wildrye | | | | | | | |
| Mandan | ..... | ..... | 0.42 | ..... | ..... | ..... | ..... |
| Russian wildrye | ..... | 0.22 | 0.26 | 0.40 | 1.15 | ..... | ..... |
| Blue grama | ..... | ..... | ..... | 0.10 | ..... | ..... | ..... |
| Creeping red fescue | 1.53 | ..... | 0.21 | 0.33 | ..... | ..... | ..... |
| Tall fescue (Alta) | ..... | ..... | ..... | ..... | 1.41 | ..... | ..... |
| Kentucky bluegrass | 1.25 | ..... | ..... | 0.35 | ..... | ..... | ..... |
| Reed canarygrass | ..... | ..... | ..... | ..... | ..... | 1.41 | ..... |
| Tall oatgrass | ..... | ..... | ..... | ..... | 1.64 | 1.36 | ..... |
| Orchardgrass | ..... | ..... | ..... | ..... | ..... | 1.31 | ..... |

*Excluding 1950.
†Excluding 1954.

| | Brookings | | | | | Center-ville | Cotton-wood | Eureka | | | Highmore | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Established: | 1957 | 1958 | 1962 | 1965 | 1970 | 1962 | 1957 | 1957 | 1965 | 1970 | 1957 | 1965 |
| Years harvested: | 3 | 4 | 3 | 5 | 2 | 2 | 3 | 4 | 1 | 2 | 3 | 3 |
| Southland | 2.24 | 3.03 | 2.70 | ..... | 2.77 | 2.65 | 1.14 | 0.97 | ..... | 1.44 | 2.15 | ..... |
| Lancaster | 2.08 | 2.95 | 2.74 | 2.16 | ..... | 2.60 | 0.93 | 1.34 | 1.90 | ..... | 2.17 | 2.18 |
| Canadian commercial | 2.15 | 2.79 | 3.15 | 2.35 | 2.08 | 2.11 | 0.92 | 0.98 | 2.08 | ..... | 1.79 | 2.05 |
| Achenbach | 2.19 | 2.79 | 3.16 | 2.34 | 2.91 | ..... | 0.97 | 1.25 | 2.64 | 1.09 | 2.21 | 2.50 |
| Lincoln | 2.14 | 2.88 | 2.86 | 2.34 | 2.98 | 2.58 | 1.00 | 1.31 | 1.99 | 1.09 | 2.16 | 2.40 |
| Manchar | 2.11 | 2.57 | 3.04 | 2.30 | 2.69 | 2.21 | 0.87 | 0.98 | 1.83 | 1.26 | 2.16 | 2.32 |
| Saratoga | ..... | 3.02 | 3.26 | 2.40 | 2.73 | 2.55 | 1.03 | 1.46 | 2.30 | 1.36 | 2.28 | 2.25 |
| Homesteader | 2.24 | 2.93 | ..... | ..... | ..... | 2.36 | ..... | 1.18 | ..... | ..... | 2.05 | ..... |
| Sac | ..... | ..... | 2.90 | 2.40 | 3.09 | 2.65 | ..... | ..... | 2.13 | 1.40 | ..... | 2.13 |
| Carlton | ..... | ..... | ..... | 2.30 | 2.68 | ..... | ..... | ..... | 1.81 | 1.49 | ..... | 2.34 |
| Fox | ..... | ..... | ..... | ..... | 2.65 | ..... | ..... | ..... | ..... | 1.22 | ..... | ..... |
| Magna | ..... | ..... | ..... | ..... | 2.87 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Blair | ..... | ..... | ..... | ..... | 3.19 | ..... | ..... | ..... | ..... | 1.31 | ..... | ..... |
| Redpatch | ..... | ..... | ..... | ..... | 2.49 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| SD 7 | ..... | ..... | ..... | 2.49 | 3.13 | ..... | ..... | ..... | 2.55 | 1.35 | ..... | 2.35 |

*One harvest per year.

## SMOOTH BROMEGRASS

*Bromus inermis* Leyss.

This grass was introduced into the United States from the Old World in 1884 and quickly found a place as one of the most valuable cultivated pasture and hay species. Smooth bromegrass formed the most desirable forage mixture with alfalfa of any grass tested by the South Dakota Agricultural Experiment Station even before the beginning of this century.

It is a cool-season, sod-forming perennial that spreads by means of rhizomes. It has maintained itself in established stands in eastern and central South Dakota for 60 to 70 years although it tends to become "sod-bound" and low producing unless fertilized or renovated. Its drought resistance and ability to withstand extremes in climatic conditions are well established. Under dry and hot summer conditions it becomes dormant, but grows when moisture and temperatures become more favorable in autumn.

Smooth bromegrass is a relatively high-yielding forage grass at all locations in South Dakota (Table 8). It is adapted to all soil types, but makes its best growth on fertile

**Table 8. Average hay yields (tons/acre) of smooth bromegrass varieties***

| Menno | Nor-beck | Presho | | Watertown | | Harvest-year averages | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1957 | 1965 | 1958 | 1960 | 1957 | 1962 | | | | | | | | | |
| 2 | 8 | 5 | 3 | 6 | 1 | 58 | 51 | 49 | 46 | 45 | 44 | 30 | 24 | 21 |
| 1.35 | ..... | 1.70 | 1.20 | 1.96 | 2.28 | ..... | ..... | ..... | ..... | 1.88 | ..... | ..... | 1.95 | ..... |
| 1.36 | 1.23 | 1.70 | 1.10 | 2.09 | 2.41 | ..... | ..... | 1.86 | 1.84 | 1.88 | 1.89 | ..... | 2.00 | ..... |
| 1.20 | 1.34 | 1.10 | 0.80 | 1.64 | 2.35 | 1.74 | 1.78 | 1.77 | 1.75 | 1.64 | 1.77 | ..... | 1.72 | ..... |
| 1.34 | 1.47 | ..... | 1.00 | 1.98 | 2.21 | ..... | 1.98 | 1.94 | 1.92 | ..... | 1.95 | ..... | 1.93 | 1.98 |
| 1.34 | 1.39 | 1.70 | O.90 | 2.16 | 2.78 | 2.00 | 1.97 | 1.93 | 1.91 | 1.90 | 1.94 | 1.98 | 2.00 | 1.91 |
| ..... | 1.48 | ..... | 0.80 | 2.03 | 2.18 | ..... | ..... | ..... | ..... | ..... | 1.83 | 1.94 | 1.95 | 1.90 |
| 1.28 | 1.56 | ..... | 0.80 | 2.08 | 2.46 | ..... | ..... | ..... | 1.99 | ..... | 2.01 | 2.05 | ..... | 1.99 |
| 1.34 | ..... | 1.40 | 1.00 | 1.96 | 2.15 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.93 | ..... |
| ..... | 1.51 | ..... | 1.00 | ..... | 2.87 | ..... | ..... | ..... | ..... | ..... | ..... | 2.05 | ..... | 1.98 |
| ..... | 1.45 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.92 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | 1.56 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2.07 |

sandy loam or silt loam soils with plenty of moisture. Its extensive root system improves soil tilth and structure.

Because of its high forage yield, it requires large amounts of nitrogen fertilizer to maintain yields. The "sod-bound" condition results from lack of nitrogen, and under saline conditions in lowlands from lack of phosphorus. In combination with alfalfa or with applications of nitrogen fertilizer, stands of bromegrass continue to produce high yields for many years. Seed yields are excellent when fertility and moisture are favorable.

Smooth bromegrass is highly palatable when grazed or used as hay. Digestibility and forage production are high when hay is cut shortly after heading.

Regrowth may be delayed by cutting for hay or by severe grazing before the middle of May. This is because the crown buds that produce regrowth are not sufficiently developed until smooth bromegrass is in the boot stage. Summer dormancy is often prolonged when harvesting occurs prior to the boot stage. A discussion of preferred management practices is given in Fact Sheet 302, Grazing Management Based on How Grasses Grow.

Tables 7 and 8 show hay yields of smooth bromegrass varieties at various South Dakota locations. Yields are lower in the western areas than in the east because of lower rainfall. Higher yields were obtained in recent years (Table 8) because optimum nitrogen fertility was maintained on these stands. Sixty pounds of nitrogen per acre were applied annually in the eastern locations and 40 or 50 pounds on the western sites.

Smooth bromegrass strains may be classified by their growth habits into northern, intermediate, or southern types. The northern type is not aggressive in its spreading habit since it does not have abundant rhizomes. It is not as high yielding as the intermediate or southern types under most conditions in South Dakota and is also more susceptible to leaf diseases. Smooth bromegrass imported from Canada is of this type. Intermediate-type bromegrass (for example, Manchar) is between the northern and southern types in spreading habit. Southern types have been selected in southern states and are high yielding and disease resistant, but tend to produce less seed. They become "sod-bound" sooner and require nitrogen fertilizer to maintain high yields. Examples are Lincoln, Lancaster, Achenbach, and Southern.

To determine if varietal differences in ease of stand establishment occur, nine varieties were sown in the greenhouse on March 17 and in the field at Brookings on May 2, and at Eureka on May 18, 1970. Results are shown in Table 9. Plants from four replicates of 25 seeds each were counted in the greenhouse on April 22 and rates of seeding equated for each variety, so 8.5 pounds of pure-live-seed per acre were planted in the field. In the greenhouse, Fox and Carlton had the best percentage germination, but Southland, Manchar, Achenbach, and Blair had higher per plant dry weights than Fox and Carlton on July 14. Under field conditions a higher stand count was obtained at Eureka than

at Brookings. Differences among varieties were low at Brookings but high at Eureka. Manchar and Carlton had poorer stands than the other varieties at Eureka. These experiments indicate that differences in establishment among the varieties were not great enough to be of practical significance in obtaining stands.

Brief descriptions of the smooth bromegrass varieties mentioned in Table 8 together with discussions of their adaptability in South Dakota follow:

**Achenbach** came from an old field planted in Kansas in 1895 and was released by the Kansas Agricultural Experiment Station in 1944. It is leafy, spreads rapidly, and is somewhat disease resistant. It is similar to Lincoln in yield.

**Blair** was selected by the Rudy-Patrick Research Center, Ames, Iowa, for desirable forage and seed characteristics and released in 1964. In limited tests in South Dakota it has performed well.

**Canadian commercial.** This is not a variety, but the sample tested represents the northern-type bromegrasses. The samples tested were randomly selected from bromegrass imported from Canada. Forage yields for this northern type were the lowest for all the harvest averages. It does not spread aggressively and is susceptible to leaf spot diseases.

**Carlton** was selected at the Canada Department of Agriculture Research Station, Saskatoon, Saskatchewan for superior seed yield and was released in 1961. It is a northern-type bromegrass, but has yielded considerably more than Canadian commercial in tests in South Dakota.

**Homesteader** originated from old fields in South Dakota. High yielding strains were put together to produce this variety which was released by the South Dakota Agricultural Experiment Station in 1951. It is intermediate in aggressiveness and well adapted to South Dakota conditions. On the 24-harvest-year average it was 0.07 tons per acre below Lincoln.

**Table 9. Smooth bromegrass variety establishment tests at Brookings and Eureka in 1970.**

| Location: | Greenhouse Brookings | | Field Brookings | Eureka |
|---|---|---|---|---|
| Date of seeding: | March 17 | | May 2 | May 18 |
| Date counted or weighed: | April 22 | July 14 | September 24 | April 12 |
| | Germ. % | Wt. per plant. gm. | Plants/3 sq. ft. | Plants/3 sq. ft. |
| Blair | 43 | 0.14 | 15 | 26 |
| Southland | 40 | 0.20 | 15 | 28 |
| Saratoga | 42 | 0.09 | 14 | 24 |
| Sac | 35 | 0.06 | 13 | 30 |
| Achenbach | 33 | 0.15 | 12 | 29 |
| Fox | 85 | 0.12 | 12 | 30 |
| Manchar | 48 | 0.17 | 11 | 12 |
| Lincoln | 48 | 0.10 | 11 | 29 |
| Carlton | 85 | 0.12 | 11 | 18 |

**Fox** was selected for seedling vigor and seedling resistance to root rot and leaf spot diseases at the Minnesota Agricultural Experiment Station and released in 1968. In South Dakota it has not been superior in forage yield or outstanding in seedling vigor or ease of establishment (Table 9).

**Lancaster** was selected from clones in old fields in Nebraska and released in 1950 by the Nebraska Agricultural Experiment Station and Crops Research Division, Agricultural Research Service (ARS). This variety has fine stems and somewhat drooping heads and yielded slightly less than Lincoln (Table 8).

**Lincoln** originating from old fields established in Nebraska before 1898, was released by the Nebraska Agricultural Experiment Station and Crops Research Division, ARS in 1942. This variety has given consistently high yields in South Dakota as shown by the average harvest yields in Tables 7 and 8. It has good seedling vigor and is relatively easy to establish. Seed yield is somewhat low, but the slightly higher seed cost is more than offset by greater forage yield. Recently, domestically produced seed is often classed in the seed trade as "Lincoln type." Unfortunately, this is no guarantee of performance because seed from stands of unknown origin is also so designated. The only sure way of obtaining seed of this variety is to buy certified seed.

**Magna** was selected at the Canada Department of Agriculture Research Station, Saskatoon, Saskatchewan and is intermediate between the northern and southern types. It was released in 1968.

**Manchar** was developed by the Plant Materials Center, Soil Conservation Service (SCS) at Pullman, Washington, from a Manchurian introduction and was released in 1946. It is intermediate in rhizome production or spreading habit. It produces good yields of seed and forage, but under South Dakotaa conditions is susceptible to leaf spot diseases. It has yielded slightly less than Lincoln in the 44, 30, 24, and 21-harvest-year averages.

**Redpatch** was selected at the Central Experimental Farm, Ottawa, Canada for high forage yield and released in 1963.

**Sac** was selected at the Wisconsin Agricultural Experiment Station following continuous selection of superior types over many generations It was released in 1960. It is coarse, has high forage yield, and is resistant to leaf spot diseases. Hay yields of this variety in South Dakota have been 0.07 tons per acre more than Lincoln for the 30- and 21-harvest-year averages. Seed yields have not been superior to Lincoln.

**Saratoga** was selected at the New York Agricultural Experiment Station from a wide variety of seed lots from plant breeders throughout the United States and released in 1955. It has vigorous seedlings, good regrowth, and yields about 0.08 tons per acre more than Lincoln according to the 46-harvest-year averages.

**SD 7** was selected at the South Dakota Agricultural Experiment Station for high forage and seed

yield and resistance to leaf spot diseases. It has not been released because it has not yielded significantly more forage.

**Southland.** Selections were made at the Oklahoma Agricultural Experiment Station to form this variety. It was released in 1953. It has coarse stems, broad leaves, and is somewhat resistant to leaf diseases. Yields were slightly less than Lincoln on the 45-harvest-year average.

## INTERMEDIATE WHEATGRASS

*Agropyron intermedium* (Host) Beauv.

This cool-season grass species was introduced from the USSR and first recognized as a valuable forage grass at the South Dakota Agricultural Experiment Station in 1938. This first introduction was later released as the variety Ree in 1945. Intermediate wheatgrass has superior forage yielding ability, higher than any of the other grasses at most of the testing stations throughout the state as shown by the 28-harvest-year averages (Table 7). It has abundant rhizomes, but is easily killed when a stand is plowed. Stems are somewhat more coarse than those of most bromegrass varieties, however, intermediate wheatgrass has many leaves so a highly satisfactory, palatable forage is produced. Seed is large and is situated in heads or spikes. Seedlings are vigorous and easily established.

Under conditions of 14- to 15-inch rainfall, intermediate wheatgrass does not maintain stands as well as crested wheatgrass, but does produce more forage yield during the first years after establishment. Better stands have been obtained from fall rather than spring seedings.

Yields of various varieties are shown in Table 10.

All varieties, except Amur, originated at least partly from an introduction (PI 98568) obtained by the United States Department of Agriculture in 1932 from the Maikop region of the USSR. This introduction segregated for green and blue-green plants and for pubescence or short hairs on the spikelets, as well as other characteristics.

**Amur** originated from an original introduction (PI 131532) from Manchuria, China. Awned types were selected from the original population and it was released by the New Mexico Agricultural Experi-

ment Station and SCS Nursery, Albuquerque, in 1952. It is uniformly blue-green and has somewhat larger seeds than the other varieties. It did not produce as much forage or seed as Oahe in South Dakota tests.

**Chief** was selected at the Canada Department of Agriculture Research Station, Saskatoon, Saskatchewan from a USSR introduction and the Ree variety and released in 1961. Selected for high forage and seed yield, it has produced slightly more forage than Oahe in the 16-harvest-year averages.

**Greenar** was developed at the Plant Materials Center, SCS, Pullman, Washington from PI 98568. Green-leaved plants were selected from the original population. This variety has yielded less than other varieties tested in South Dakota as shown in the 33-harvest-year averages in Table 10.

**Nebraska 50** was also selected from PI 98568 for blue-green color and lack of pubescence on the spikelet by the Nebraska Agricultural Experiment Station. Released in 1950, it is similar in yield and seed production to Ree and the original introduction.

**Oahe** was selected from PI 98568 and released by the South Dakota Agricultural Experiment Station in 1962. It produces more forage and seed than other varieties. Poor seed production has been a common failing of all varieties previously used in South Dakota. Availability of Oahe seed at reasonable prices has promoted use of this valuable species on South Dakota farms and ranches. This variety is uniformly blue-green in color and was selected for rust resistance. It is more easily established than most other grass varieties.

**Ree** was the original unselected introduction (PI 98568) released by the South Dakota Agricultural Experiment Station in 1945. It yielded well but seed production was poor.

**Slate** was selected at the Nebraska Agricultural Experiment Station, Lincoln, Nebraska from PI 98568 and Amur for plant type and foliage. It was released in 1969.

**Table 10. Average hay yields (tons/acre) of intermediate wheatgrass varieties.***

| | | | Brookings | | | | Center-ville | Cottonwood | | Eureka | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Established: | 1957 | 1957 | 1958 | 1962 | 1965 | 1973 | 1962 | 1957 | 1958 | 1954 | 1957 |
| Years harvested: | 5 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 1 | 2 | 3 |
| Oahe | ----- | 1.49 | 2.26 | 2.99 | 2.53 | 4.20 | 2.21 | ----- | 1.99 | 0.94 | ----- |
| Nebraska 50 | 2.80 | ----- | ----- | 2.89 | ----- | ----- | ----- | 1.65 | 1.67 | 0.88 | 2.11 |
| Ree | 2.81 | 1.42 | ----- | ----- | ----- | ----- | ----- | 1.59 | 1.28 | 0.81 | 1.60 |
| Amur | 2.77 | 1.42 | 2.12 | 2.81 | 2.25 | 4.00 | 2.11 | 1.40 | 1.25 | 0.85 | 1.63 |
| Greenar | 2.46 | ----- | ----- | ----- | ----- | ----- | 2.10 | 1.34 | 1.18 | ----- | 1.94 |
| Chief | ----- | ----- | ----- | ----- | 2.88 | ----- | ----- | ----- | ----- | ----- | ----- |
| Slate | ----- | ----- | ----- | ----- | ----- | 3.80 | ----- | ----- | ----- | ----- | ----- |

*One harvest per year.

## PUBESCENT WHEATGRASS

*Agropyron intermedium var. trichophorum* (Link) Halac.

Pubescent wheatgrass differs from intermediate wheatgrass mainly by having pubescence or short hairs on the heads and seeds. In general, this grass forms a more open sod, produces less forage, and certain varieties are more drought resistant than intermediate wheatgrass.

In Table 11, yields of Mandan 759 are higher than the other varieties. This variety resembles intermediate wheatgrass in all easily recognized aspects, except for its pubescence. The two entries A-1488 and Utah 109 have not been released as varieties since they have not been outstanding in yield.

**Luna** was increased from PI 105328 introduced from Tashkent, Turkestan, USSR in 1934. It was released by the New Mexico Plant Materials Nursery, SCS in 1965. It has grayish green foliage and is drought resistant.

**Mandan 759** was selected at the United States Northern Great Plains Field Station, ARS, in North Dakota. It was increased directly from PI 116252 introduced from USSR. It has higher forage and seed yields and greater persistence than other varieties of pubescent wheatgrass at Mandan. It has been equal to intermediate wheatgrass varieties in yielding ability in South Dakota. The foliage is deep green in color.

**Topar** was selected from PI 107330 introduced from Tashkent,

**Table 11. Average hay yields (tons/acre) of pubescent wheatgrass varieties.***

| | Brookings | | | Centerville | Cottonwood | Eureka | | Highmore | Menno | Norbeck | Watertown | Harvest-year averages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Established: | 1957 | 1962 | 1965 | 1962 | 1957 | 1962 | 1965 | 1957 | 1958 | 1965 | 1958 | | |
| Yrs. harvested: | 4 | 2 | 3 | 1 | 3 | 1 | 4 | 2 | 2 | 8 | 2 | 14 | 9 |
| A-1488 | 1.56 | | | 1.50 | 0.89 | 1.46 | | | 1.62 | | 0.77 | 1.30 | |
| Utah 109 | 1.82 | | | 1.52 | 1.02 | 1.50 | | | 2.05 | | 0.89 | 1.48 | |
| Mandan 759 | 2.59 | 3.13 | | 1.44 | 1.71 | 1.84 | | 1.82 | 2.67 | | 1.24 | 2.00 | 1.99 |
| Topar | | 1.82 | | 1.43 | 0.87 | 1.44 | | 1.58 | | | | | 1.35 |
| Luna | | | 1.90 | | | | 1.06 | | | 1.49 | | | |

*One harvest per year.

| | Highmore | | | Menno | Norbeck | Presho | | Watertown | | Harvest-year averages | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | 1957 | 1959 | 1965 | 1957 | 1965 | 1958 | 1960 | 1957 | 1962 | | | |
| 2 | 4 | 1 | 3 | 3 | 8 | 5 | 3 | 6 | 2 | 39 | 33 | 16 |
| 1.66 | | 2.71 | 2.37 | | 1.57 | 1.70 | 2.00 | | 2.29 | 1.93 | | 1.91 |
| | 2.10 | | | 1.28 | | 1.50 | 1.50 | 1.59 | 2.18 | | 1.84 | |
| | 1.83 | 2.08 | | 1.30 | | 1.50 | 1.90 | 1.73 | | | 1.81 | |
| 1.27 | 2.08 | 2.05 | 2.30 | 1.28 | 1.56 | 1.50 | 1.70 | 1.70 | 2.12 | 1.76 | 1.70 | 1.79 |
| | 1.98 | | | 1.13 | | 1.50 | 1.90 | 1.51 | | | 1.69 | |
| 1.89 | | | 2.35 | | 1.66 | | | | | | | 2.05 |
| | | | | | | | | | | | | |

Turkestan, USSR in 1934. It was released cooperatively by the Washington, Idaho, Oregon, and California Agricultural Experiment Stations and SCS Plant Materials Center in 1953. This grass in vigorous and drought resistant. It is adapted to lower fertility and more alkaline sites than intermediate wheatgrass varieties.

## TALL WHEATGRASS
### *Agropyron elongatum* (Host) Beauv.

This species is a tall, coarse, late-maturing bunchgrass with blue-green leaves originating from Turkey and the USSR. It is able to produce good yields under conditions of high water tables and high soil salinity but it is not palatable to livestock at later stages of maturity. It is a special purpose grass and should not be grown except in saline areas where other more desirable species do not grow well. Under upland conditions it is gradually replaced by other species. Because of its tall upright growth, it is often planted in rows to provide field windbreaks. Varieties of this species (Table 12) are discussed below.

**Alkar** was selected from PI 98526 at the Plant Materials Center, SCS, Pullman, Washington, and released in 1951. It is highly productive on subirrigated and irrigated saline soils.

**Largo** is an introduction PI 109452 from Turkey and was released in 1937 cooperatively by the New Mexico Agricultural Experiment Station and the Nursery Division, SCS. It resembles the other tall wheatgrasses in its use and adaptation. In South Dakota it yields about the same as other varieties tested.

**Nebraska 98526** was increased directly from PI 98526 introduced into the United States from the USSR in 1932. It appears to be more resistant to high water tables and high salt conditions than some other introductions. Data in Table 12 show that this introduction is superior in the 17-harvest-year averages and essentially equal to the best of the other strains in the 7-harvest-year averages.

**Table 12. Average hay yields (tons/acre) of tall wheatgrass varieties***

| | Brookings | | Cotton-wood | Eureka | High-more | Menno | Presho | | Water-town | Harvest-year averages | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Established: | 1956 | 1962 | 1957 | 1957 | 1957 | 1957 | 1958 | 1960 | 1957 | | |
| Years harvested: | 1 | 2 | 1 | 2 | 2 | 1 | 5 | 3 | 3 | 17 | 7 |
| Alkar | ..... | 2.81 | ..... | ..... | ..... | ..... | ..... | 1.90 | ..... | ..... | ..... |
| S-64 | 1.60 | 2.92 | 0.84 | 1.65 | 1.94 | 2.02 | 0.80 | 1.90 | 1.07 | 1.45 | 1.20 |
| A-12465 | ..... | 3.03 | ..... | ..... | ..... | ..... | ..... | 2.00 | ..... | ..... | ..... |
| Nebraska 98526 | 1.44 | 2.61 | 0.68 | 1.43 | 1.85 | 2.27 | 1.40 | ..... | 0.91 | 1.52 | 1.22 |
| Mandan 1422 | ..... | ..... | 0.81 | 1.49 | ..... | 1.89 | 1.40 | 1.90 | 0.97 | ..... | 1.23 |
| A-13044 | 1.04 | ..... | 0.75 | 1.26 | 1.75 | 2.42 | ..... | ..... | 0.53 | ..... | 1.04 |
| Largo | 1.19 | ..... | 0.72 | 1.99 | ..... | 1.64 | ..... | ..... | 0.75 | ..... | 1.23 |

*One harvest per year.

## CRESTED WHEATGRASS
**(Standard crested wheatgrass)**
***Agropyron desertorum* (Fisch.) Schult.**

Crested wheatgrass was formerly divided into Standard crested wheatgrass and Fairway crested wheatgrass until it was realized that these were actually two species. The names have been changed so the taller, slimmer spiked, and more drought resistant species with 28 chromosomes is now called crested wheatgrass. The more leafy, somewhat shorter, and less drought resistant species with 14 chromosomes is called fairway wheatgrass. In general, crested wheatgrass yields slightly more forage than fairway wheatgrass (Table 13).

Crested wheatgrass is a long-lived, drought resistant, bunchgrass which makes its growth and provides best grazing early in the season. It was introduced into the United States at the end of the 19th century, but its value in the Great Plains was not realized until the late 1920's and early 1930's. Under conditions of 9 to 15 inches annual precipitation it has maintained stands for more than 40 years.

Deterioration of most range sites in the Northern Great Plains results in domination by warm-season short grasses which do not begin growth until late May and will cure by late August or early September. In such deteriorated range, the remnants of cool-season grasses may not green up until a month after the same species has begun to grow on ranges in high condition. Plants weakened by repeated close grazing may fail to regrow in fall

even when soil moisture is adequate. In such a situation, crested wheatgrass pastures grazed only in the spring or in the fall can extend the green forage season by as much as 3 months and provide a cool-season deferment which will hasten recovery of the depleted range.

Crested wheatgrass normally flowers early in June and matures early in July. It should be grazed in the spring or fall when it is very palatable to all livestock. After it begins to mature in late June it becomes coarse and unpalatable.

Crested wheatgrass tends to form clumps or bunches of dead vegetation when not properly managed. Heavy grazing should be practiced in the spring or fall with an intervening period to allow recovery of the root energy reserves.

Crested wheatgrass is not as productive in eastern South Dakota as either intermediate wheatgrass or smooth bromegrass (Table 7). Under conditions of more limiting rain-

fall at Highmore, Eureka, and Cottonwood, yields were about equal to these grasses. In 28-harvest-year averages a yield of 0.80 tons per acre for crested wheatgrass compared with 0.91 for bromegrass and 1.05 for intermediate wheatgrass. These averages, however, are weighted by the more favorable moisture conditions present under the irrigation or eastern-region experiments.

This species does well on clay loam or sandy soils, but is not tolerant to saline conditions or extended flooding. Since it is a bunchgrass, it is not adapted for erosion control on steep slopes.

**Commercial** entries used in the tests (Table 13) were representative of seed sold on the market without a variety name.

**Mandan 2359** was selected at the United States Northern Great Plains Field Station, ARS, North Dakota but not released. It is uniformly tall and erect. The heads are compact with a high seed production. In South Dakotas tests it has not shown a yield advantage over Nordan.

**Nebraska 10** was increased at the Nebraska Agricultural Experiment Station cooperating with SCS and ARS from an accession of unknown source. It has superior seedling vigor. In the 18-harvest-year-averages (Table 13) it yielded slightly more than Nordan but has not been released.

**Nordan** was selected at the United States Northern Great Plains Field Station, ARS, North Dakota from selections made in an old nursery at Dickinson, North Dakota in 1937. It was released in 1953 by the North Dakota Agricultural Experiment Station and the Crops Research Division, ARS.

It is more erect, leafy, and uniform than commercial and has yielded slightly more in South Dakota tests. Nordan yielded 1.63 tons per acre compared with 1.57 for the commercial in the 39-harvest-year averages, 1.65 tons per acre compar-

**Table 13. Average hay yields (tons/acre) crested, fairway, Siberian wheatgrass varieties.***

| | Brookings | | | | Cotton-wood | Eureka | | | Highmore | | Menno | Nor-beck |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Established: | 1956 | 1957 | 1962 | 1965 | 1957 | 1957 | 1962 | 1965 | 1957 | 1965 | 1957 | 1965 |
| Years harvested: | 2 | 5 | 2 | 3 | 4 | 2 | 1 | 1 | 4 | 3 | 3 | 8 |
| Crested wheatgrass | | | | | | | | | | | | |
| Commercial | ..... | 2.44 | 3.20 | 2.28 | 0.80 | 1.18 | ..... | 1.82 | ..... | 2.50 | 0.83 | 1.38 |
| Nordan | 1.61 | 2.55 | 3.22 | 2.16 | 0.92 | 1.39 | 1.01 | 1.40 | 1.66 | 2.52 | 0.97 | 1.49 |
| Summit | 1.58 | 2.48 | ..... | 2.44 | 1.01 | 1.20 | 1.12 | 1.61 | 1.86 | 2.56 | 1.02 | 1.45 |
| Summit 62 | ..... | ..... | ..... | 2.35 | ..... | ..... | ..... | 2.03 | ..... | 2.40 | ..... | 1.45 |
| Mandan 2359 | ..... | 2.45 | ..... | ..... | 0.91 | 1.20 | ..... | ..... | 1.82 | ..... | 0.92 | ..... |
| Utah 42-1 | 1.48 | 2.59 | ..... | ..... | 0.81 | 1.02 | ..... | ..... | 1.75 | ..... | 0.96 | ..... |
| Nebraska 10 | 1.62 | 2.63 | ..... | ..... | 0.88 | 1.70 | 1.08 | ..... | 1.73 | ..... | 1.12 | ..... |
| Fairway wheatgrass | | | | | | | | | | | | |
| Commercial | 1.49 | 2.33 | 2.95 | 2.17 | 1.02 | 1.49 | 1.08 | 1.93 | 1.77 | 2.31 | 0.79 | 1.43 |
| Ruff | ..... | 2.28 | ..... | ..... | 0.94 | 1.48 | 1.08 | ..... | ..... | ..... | 0.99 | ..... |
| A-1770 | 1.21 | ..... | ..... | ..... | 0.70 | ..... | ..... | ..... | 1.60 | ..... | ..... | ..... |
| Siberian wheatgrass | | | | | | | | | | | | |
| P27 | ..... | ..... | 2.76 | 1.95 | ..... | ..... | ..... | 2.22 | 1.34 | 2.45 | 0.50 | 1.35 |

*One harvest per year.

ed with 1.61 in the 30-harvest-year averages, and 1.55 vs. 1.42 in the 18-harvest-year averages. Nordan has vigorous seedlings and produces good quality large seeds.

**Summit** and **Summit 62** were released by the Canada Department of Agriculture Research Station, Saskatoon, Saskatchewan, Canada. They were increased from an introduction from the Western Siberian Experiment Station, USSR, made in 1957. They are similar to commercial standard in appearance but yield more forage (Table 13).

**Utah 42-1** was selected at the Utah Agricultural Experiment Station from plants in an old field in northern Utah but not released. This strain shows no advantage over Nordan.

| Presho | | Watertown | | Harvest-year averages | | |
|---|---|---|---|---|---|---|
| 1959 | 1961 | 1957 | 1962 | | | |
| 5 | 3 | 4 | 1 | 39 | 30 | 18 |
| 1.20 | 1.20 | 1.31 | 2.50 | 1.57 | 1.61 | 1.42 |
| 1.20 | 1.50 | 1.44 | 2.28 | 1.63 | 1.65 | 1.55 |
| 1.20 | ..... | 1.46 | 2.90 | 1.66 | ..... | 1.54 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1.00 | 1.40 | 1.18 | ..... | ..... | ..... | 1.43 |
| ..... | ..... | 1.28 | ..... | ..... | ..... | 1.46 |
| 1.10 | ..... | 1.28 | ..... | ..... | ..... | 1.59 |
| 1.10 | 1.20 | 1.44 | 1.89 | 1.56 | 1.42 | 1.49 |
| 1.10 | 1.30 | 1.55 | ..... | ..... | ..... | 1.52 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1.00 | 1.40 | ..... | 0.48 | ..... | 1.43 | ..... |

## FAIRWAY WHEATGRASS

**(Fairway crested wheatgrass)**

***Agropyron cristatum* (L.) Gaertn.**

Fairway is shorter, finer stemmed, and generally less productive than crested. It is well suited to the Coteau area in northeastern South Dakota as shown by the yields at Watertown (Table 13). This species is well suited to dryland lawns and general-purpose turf in central South Dakota.

**A-1770** was increased at SCS nursery in New Mexico from PI 109012 introduced from Turkey in 1934. It is rhizomatous, somewhat smaller than other fairway strains and yields less in South Dakota tests (Table 13). The plants form dense bunches even though rhizomes develop.

**Ruff** was selected at the Nebraska Agricultural Experiment Station, Lincoln, from commercial lots and Experiment Station accessions and was released in 1974. It is early maturing and leafy. It has yielded only slightly more than commercial in the 18-harvest-year averages (Table 13).

## SIBERIAN WHEATGRASS

***Agropyron sibiricum* (Willd.) Beauv.**

This species is similar to crested wheatgrass in appearance, but has more narrow, awnless heads than crested. It is drought resistant, has good seed yields, and is well adapted to light droughty soil.

**P27** was selected at SCS Plant Materials Center at Pullman, Wash-

ington from PI 180434 introduced from the USSR in 1934 and released cooperatively with the Idaho Agricultural Experiment Station in 1953. Generally, in South Dakota, it has not yielded as well as crested wheatgrass (Table 13). In 30-harvest-year averages, it yielded 1.43 compared with 1.42 tons per acre for commercial Fairway, and 1.65 tons per acre for Nordan crested wheatgrass.

## RUSSIAN WILDRYE
### *Elymus junceus* Fisch.

This species is a long-lived drought resistant bunchgrass. It was introduced into the United States from the Western Siberian Experiment Station, USSR. This grass has survived at the Cottonwood Field Station in the original rows for almost 40 years, but there has been no reproduction. It has an extensive root system whose efficiency under dryland conditions prevents the intrusion of other species between plants. Leaves are produced profusely from the crown. Upright seed producing stems have few leaves. Seed matures late in June and must be harvested immediately when mature to prevent shattering.

Very early grazing is afforded by this grass. In some locations it grows earlier and provides forage sooner than crested wheatgrass. However, at Mandan, North Dakota, where it has been tested extensively, it is not equal to crested wheatgrass for early spring grazing. Since the leaves grow mainly from the base of the plant, this grass is better as pasture than as hay. It has extremely good regrowth after harvest. It is useful as late summer and fall pasture because of its quick regrowth characteristic. Since it is less dependent on fall rain than crested wheatgrass, it is generally better for fall pasture.

Russian wildrye should not be sown in hillsides or erosion-prone sites because wind and water erosion between plants occurs after the plants become well established. This grass grows well on all soil types in South Dakota, except very saline sites.

Nitrogen application is necessary if yields are to be maintained. This grass provides nutritious high protein forage under heavy nitrogen applications. Forage containing 22% protein has been obtained after high nitrogen applications under irrigation at Redfield.

**Sawki** was selected at the Canada Department of Agriculture Research Station, Saskatoon, Saskatchewan.

**Table 14. Average hay yields (tons/acre) of Russian wildrye varieties.***

| | Brookings | Cottonwood | Eureka | Highmore | Norbeck | Presho | |
|---|---|---|---|---|---|---|---|
| Established: | 1965 | 1958 | 1965 | 1958 | 1965 | 1958 | 1960 |
| Years harvested: | 3 | 2 | 1 | 2 | 7 | 2 | 2 |
| Vinall | 1.71 | 0.46 | 1.36 | 1.04 | 1.24 | 1.00 | 0.90 |
| Commercial | | 0.47 | | 1.05 | | 1.00 | 0.80 |

*One harvest per year.

**Vinall** is a variety selected at the Northern Great Plains Field Station in North Dakota and released cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division, ARS, in 1960. Forage yield is not greater than commercial (Table 14). This variety, however, produces about 75% more seed than the commercial type.

## REED CANARYGRASS
### *Phalaris arundinacea* L.

Reed canarygrass is a long-lived, tall, leafy grass with strong rhizomes which allow it to spread rapidly. It is adapted to low areas and will withstand flooding for as long as 5 to 7 weeks. This grass tolerates moderately saline soils, but should not be planted where salinity is a problem.

Under irrigation, reed canarygrass produces large quantities of forage. In Table 7, the average yields for 1952 and 1953 at Redfield were not as high as would be expected under irrigated conditions.

Reed canarygrass grows well on uplands, but normally in South Dakota under dryland conditions smooth bromegrass and intermediate wheatgrass provide higher yields, better quality forage, and are easier to establish.

Reed canarygrass produces the most palatable and nutritious forage if harvested when the heads have just emerged from the boot, especially if optimum nitrogen has been applied for growth of the plant. In most instances, reports of unpalatability and lack of nutritious forage from this grass can be attributed to lack of proper cutting or grazing and fertilizing management. Where ample moisture and fertility are available, two cuttings may be obtained each season. At Brookings, two cuttings were made in 1963 and one in 1964 and 1965 (Table 15). In all years, Frontier yielded considerably more forage than Ioreed.

**Castor** was selected at the Canada Department of Agriculture Research Station, Beaverlodge, Alberta, for resistance to seed shattering. Preliminary tests at Brookings have indicated that this high degree of seed retention has not reduced forage yield (Table 15).

**Frontier** was selected at the Central Experimental Farm, Ottawa, Canada. General distribution of this variety was made in 1965. It is very vigorous and produces a large amount of forage. It yielded almost a ton more forage than Ioreed in each of 3 years (Table 15). Seed shatters readily when near maturity.

**Ioreed** is a variety selected and released by the Iowa Agricultural Experiment Station with the coop-

eration of the SCS from collections derived from various parts of the nation. It is vigorous, moderately productive, and resistant to leaf diseases. It is susceptible to seed shattering before harvest.

**Rise** was selected at Rudy-Patrick Research Center, Ames, Iowa for improved seed yield, seed quality, shattering resistance, and stand establishment. In the one harvest comparison at Brookings, it was slightly less in forage yield than the other varieties tested.

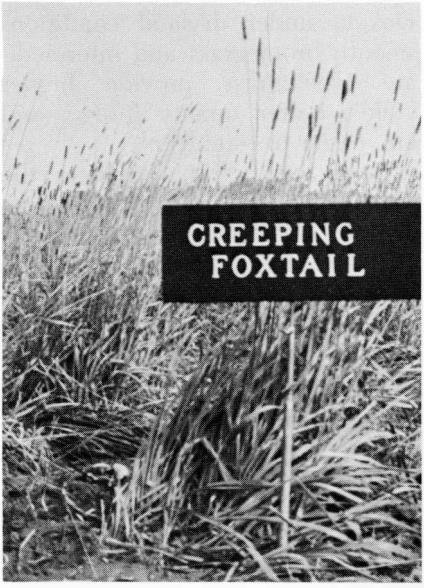
**SD 18** was selected at the South Dakota Agricultural Experiment Station for resistance to seed shattering. This strain was equal to other varieties in forage yield in the single year tested.

**Table 15. Average hay yields (tons/acre) of reed canarygrass and creeping foxtail varieties at Brookings.**

| Established: | | | 1962 | | | 1972 | Harvest-year |
|---|---|---|---|---|---|---|---|
| Harvested: | | 1963 | | 1964 | 1965 | 1973 | averages |
| Cutting: | 1 | 2 | Total | 1 | 1 | 1 | 3 |
| Reed canarygrass | | | | | | | |
| Ioreed | 2.10 | 3.14 | 5.24 | 3.16 | 3.90 | ..... | 4.10 |
| Frontier | 2.58 | 3.50 | 6.08 | 4.04 | 5.07 | ..... | 5.06 |
| Rise | ..... | ..... | ..... | ..... | ..... | 2.73 | ..... |
| Castor | ..... | ..... | ..... | ..... | ..... | 2.86 | ..... |
| SD 18 | ..... | ..... | ..... | ..... | ..... | 2.96 | ..... |
| Commercial | ..... | ..... | ..... | ..... | ..... | 2.94 | ..... |
| Creeping foxtail | | | | | | | |
| Garrison | 3.00 | 2.21 | 5.21 | 2.44 | 2.04 | 1.20 | 3.23 |
| SD 32 | ..... | ..... | ..... | ..... | ..... | 1.36 | ..... |

## CREEPING FOXTAIL

***Alopecurus arundinaceus* Poir.**




Creeping foxtail resembles common meadow foxtail (*A. pratensis* L.), but spreads more rapidly by means of vigorous rhizomes. The leaves are also somewhat broader. It grows very early in spring and produces cylindrical panicles or heads in early June. Seed tends to shatter when ripe, so windrowing and use of a combine has given more seed than other methods. Although it matures early some producers are able to obtain good pasturage for 3 to 4 months.

**Garrison** is a strain found near Max, North Dakota and was appar-

ently introduced from western USSR by early immigrants. It is well adapted to wetland sites and produces good yields of high quality forage early in the season. This strain yielded a total of 5.21 tons per acre in 1963 (Table 15) which was as much as Ioreed reed canarygrass. The average yield for the 3 years, however, was 3.23 tons per acre compared with 4.10 for Ioreed and 5.06 for Frontier.

**SD 32** was selected at the South Dakota Agricultural Experiment Station for resistance to seed shattering and increased forage yield. Preliminary results indicate that this selection is superior to Garrison.

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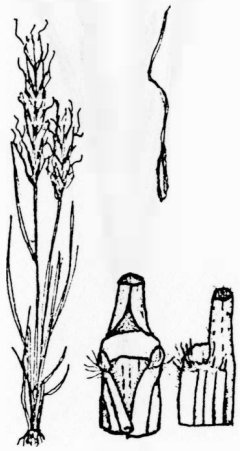
## GREEN NEEDLEGRASS
### *Stipa viridula* Trin.

This grass is native to South Dakota. It grows early in the season and also makes good regrowth throughout the summer. This species is a valuable component of native range. It has short awned seeds that are not harmful to livestock. However, two of its close native relatives, western needlegrass or needle and thread (*S. comata* Trin.) and porcupine grass (*S. spartea* Trin.) are objectionable because of their long, sharp, needlelike seeds. In early and late periods in the growing season when seeds are not present, these grasses provide palatable and nutritious forage. Seed harvested from native stands is frequently used for seeding in western South Dakota.



**Lodorm** was selected at the Northern Great Plains Field Station, ARS, Mandan, North Dakota, for low seed dormancy after harvest. It is comparable in forage and seed yield to Green Stipagrass, but has not maintained stands as well.

**Green Stipagrass** is a variety selected at the Northern Great Plains Field Station, ARS, and released in 1946 cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division, ARS. It is superior to common green needlegrass in forage and seed yields as well as having better regrowth characteristics. It had comparable yields to the common introduced grasses at Eureka and Cottonwood during the years 1949-53 (Table 7). However, under conditions where nitrogen is limiting, this grass does not have a high yield potential.

## WESTERN WHEATGRASS
### *Agropyron smithii* Rydb.

This is a native cool-season species which forms a dense sod. It spreads by means of vigorous rhizomes and is a dominant grass on most range sites in high range condition. Western wheatgrass is somewhat salt tolerant and often is the most important species on mildly saline lowlands. It is the best yielding and most palatable grass adapted to such areas. It is also drought resistant and persistent. This grass readily colonizes abandoned farm land because it is able to spread so rapidly by rhizomes. Pure stands are often established 4 to 6 years after croplands are abandoned.

Western wheatgrass is one of the first grasses to grow in spring on the range. Season-long grazing should be delayed until the new growth is 4 to 6 inches tall. If western wheatgrass is to be used for early spring grazing, it should be grazed only at that time and rested for the remainder of the year. Western wheatgrass makes a high quality hay when cut just after the heads have emerged from the boot.

It can be established by seeding in well prepared ground early in the spring. Seed harvested from native stands is frequently used. It is preferable to obtain seed originating not more than 250-300 miles south or 150-200 miles north of the location to be seeded. Two named varieties are available, but have not been tested in South Dakota.

**Barton** was increased from a seed collection made in Barton County, Kansas by the SCS and was released cooperatively by the Plant Materials Center, SCS, Manhattan, the Kansas Agricultural Experiment Station, and ARS. It is strongly rhizomatous, leafy, and has ranked first in seed culm development and yield in comparison with 16 other accessions in Kansas tests.

**Flintock** was selected from 30 collections made in 1957 in central and southwestern Nebraska and northwestern Kansas. Flintock has excelled in forage and seed production and quality. Seed will not be available to the general public until 1978.

## ORCHARDGRASS

### *Dactylis glomerata* L.

Orchardgrass is a cool-season bunchgrass which is not winterhardy under most conditions in South Dakota. In the eastern part of the state, it will commonly survive for one or two seasons and then winterkill. This species is easily damaged from ice sheets which suffocate the plants. Seedings should be made only in well drained areas.

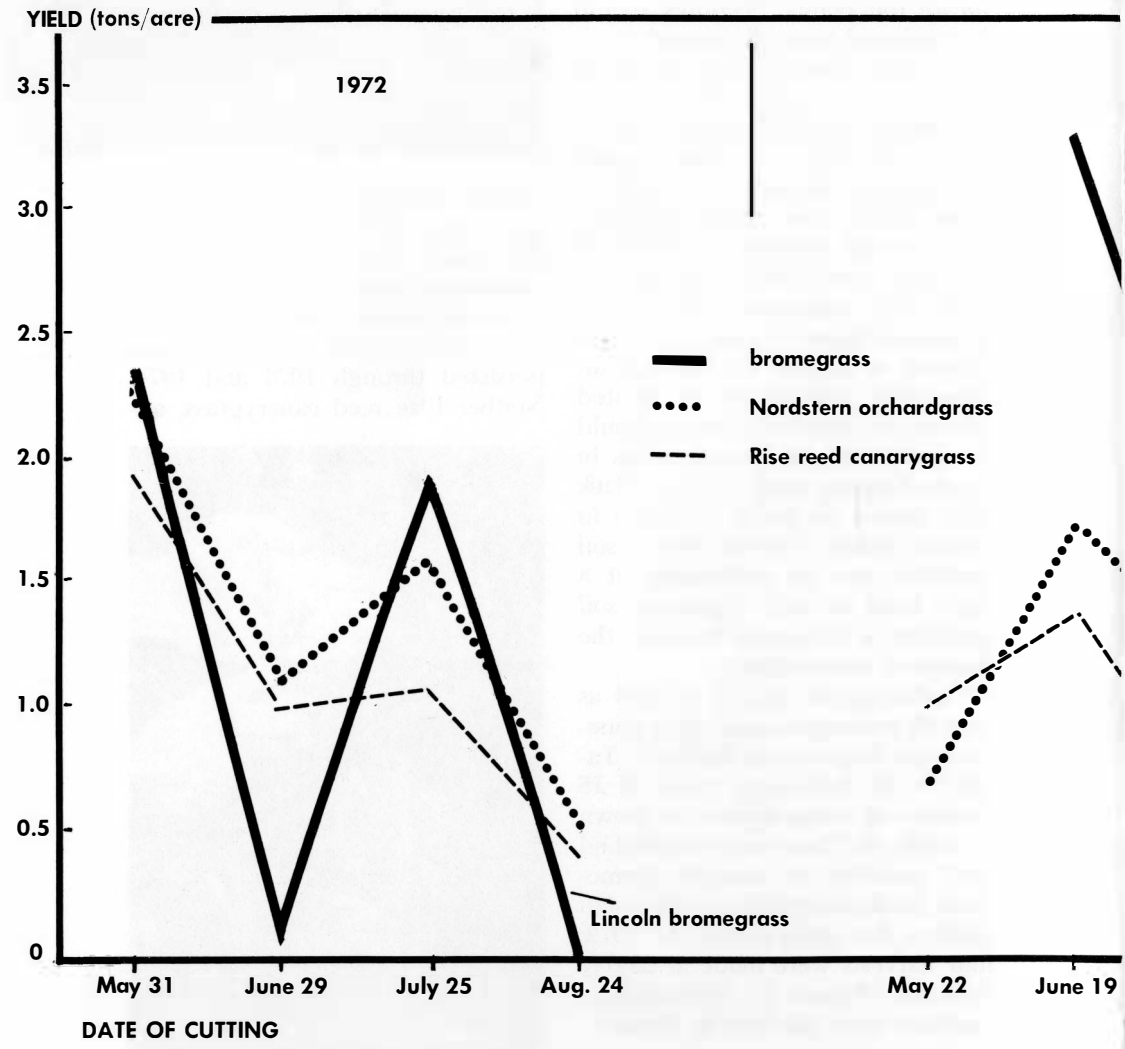
It starts growth early in spring and recovers rapidly after grazing or cutting. The first cutting is usually not as large as from smooth bromegrass, but since it is able to grow better under warm temperatures second cuttings are higher if moisture is available. It grows well under fall conditions and remains green until frost. It is not as drought tolerant as smooth bromegrass, intermediate wheatgrass, or crested wheatgrass. Because of this it should be grown only in specific areas in South Dakota, such as the Black Hills region or under irrigation in eastern South Dakota where soil moisture can be maintained at a high level in fall. Optimum soil moisture in fall seems to lessen the danger of winterkilling.

Orchardgrass yielded as well as smooth bromegrass and other grasses under irrigation at Redfield (Table 7). At Brookings, yields of 15 varieties of orchardgrass are shown in Table 16. These were established with varieties of smooth bromegrass, reed canarygrass, and Russian wildrye for comparison. In 1972, four harvests were made at 28-day intervals (Figure 2). Orchardgrass varieties were not hurt by these repeated cuttings, but Lincoln bromegrass was killed completely after the third harvest. Experimental bromegrass strains that were selected for regrowth ability were planted in late August 1972 and these persisted through 1973 and 1974. Neither Rise reed canarygrass, an-


other jointed grass, nor Russian wildrye, a nonjointed grass, were killed as a result of intensive clipping, but they were weakened to a greater degree than orchardgrass. The growing point of orchardgrass is not removed by the mower when repeated harvests are made.

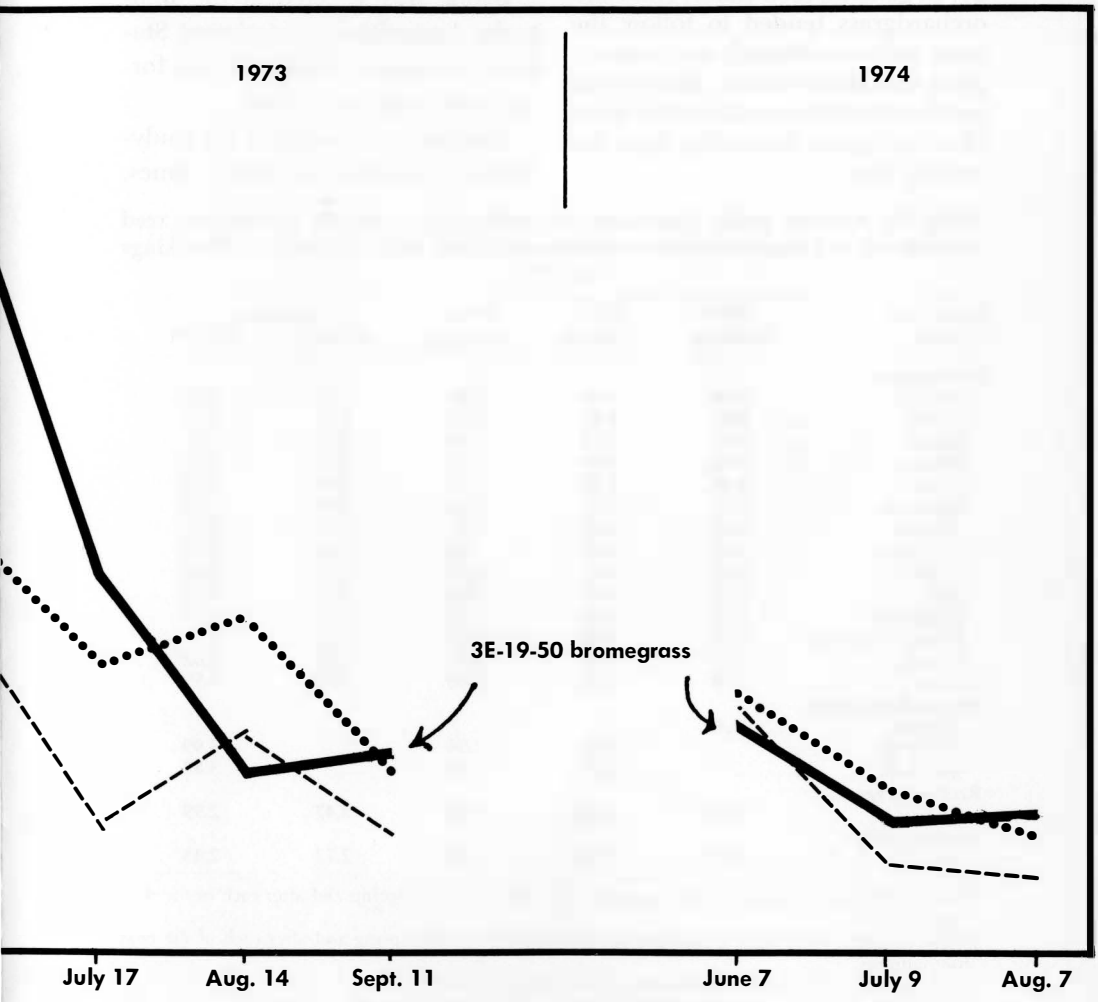
In February 1973, an ice sheet formed over two replicates and killed the orchardgrass plants. Only the remaining two replicates were

**Figure 2. Yield comparisons (tons/acre) at successive cutting dates of Nordstern orchardgrass, Rise reed canarygrass, Lincoln bromegrass, and 3E-19-50 bromegrass in 1972, 1973 and 1974 under irrigation at Brookings.**



included in the 1973 and 1974 harvests. In 1974, nitrogen was applied only once in May, so yields were not as high as in other years and also only three harvests were made. There was no regrowth from any of the grasses after the third cutting. The 1972 and 1973 season yields followed the same varietal order. The 1974 harvests were made when the plants were under more stressed conditions, but varietal yields corresponded quite well with the other 2 years. Except for the effect of the ice sheet, all varieties showed extremely good winter hardiness.

Vinall Russian wildrye gave the lowest yields: Rise reed canarygrass



the next lowest. Lincoln bromegrass was slightly lower than reed canarygrass in 1972, but the newly seeded bromegrass strains were similar in yield to Nordstern orchardgrass for the 1973-74 averages. Comparative yields of Nordstern orchardgrass, Rise reed canarygrass, and Lincoln bromegrass are shown for each cutting during the three years (Figure 2). In general, reed canarygrass and orchardgrass tended to follow the same pattern although reed canarygrass was always lower. Bromegrass yields varied above and below those of orchardgrass depending upon the cutting date.

This test demonstrates that orchardgrass can be maintained under irrigated conditions in eastern South Dakota and that with frequent cutting, high yields may be obtained. Optimum soil moisture in fall is important in maintaining stands. Certain varieties have given consistently high yields.

**Boone** was selected at the Kentucky Agricultural Experiment Station, Lexington, Kentucky, for forage yield and persistence.

**Dayton** was selected at the Rudy-Patrick Research Center, Ames,

**Table 16. Average yields (tons/acre) of orchardgrass, smooth bromegrass, reed canarygrass, and Russian wildrye varieties established under irrigation at Brookings in 1971.**

| Species and varieties | 1972* 4 cuttings | 1973† 5 cuttings | 1974‡ 3 cuttings | Averages 1972-74 | Averages 1973-74 |
|---|---|---|---|---|---|
| Orchardgrass | | | | | |
| Sterling | 5.90 | 6.25 | 2.20 | 4.78 | 4.23 |
| Napier | 5.82 | 6.15 | 2.32 | 4.76 | 4.24 |
| Boone | 5.85 | 6.11 | 2.30 | 4.74 | 4.21 |
| Potomac | 5.98 | 6.04 | 2.29 | 4.77 | 4.17 |
| Frode | 5.46 | 5.85 | 2.33 | 4.55 | 4.09 |
| Hallmark | 5.79 | 5.78 | 2.47 | 4.68 | 4.13 |
| Dayton | 5.62 | 5.76 | 2.22 | 4.53 | 3.99 |
| Nordstern | 5.53 | 5.67 | 2.18 | 4.46 | 3.93 |
| Tardus | 5.36 | 5.61 | 2.39 | 4.45 | 4.00 |
| Able | 5.34 | 5.53 | 2.04 | 4.30 | 3.79 |
| Pennmead | 5.17 | 5.48 | 2.12 | 4.36 | 3.80 |
| Danish imported | 5.14 | 5.42 | 2.15 | 4.24 | 3.79 |
| Pennlate | 5.13 | 5.21 | 2.02 | 4.12 | 3.62 |
| Latar | 4.78 | 5.11 | 2.06 | 3.98 | 3.59 |
| Smooth bromegrass§ | | | | | |
| Lincoln | 4.40 | | | | |
| 3E-19-50 | | 6.03 | 1.94 | | 3.99 |
| 2A-21-28 | | 5.64 | 2.00 | | 3.82 |
| Reed canarygrass | | | | | |
| Rise | 4.44 | 4.34 | 1.64 | 3.47 | 2.99 |
| Russian wildrye | | | | | |
| Vinall | 3.19 | 3.56 | 1.40 | 2.72 | 2.48 |

*Four replicates, 100 pounds of nitrogen per acre applied in early spring and after each of the next two cuttings.

†Two replicates, 50 pounds of nitrogen per acre applied in early spring and after each of the next four cuttings.

‡Two replicates, 50 pounds of nitrogen per acre applied in early spring.

§Lincoln was killed out after the third cutting in 1972. These plots were reseeded to 2 replicates each of strains 3E-19-50 and 2A-21-28.

Iowa, for desirable forage and seed attributes.

**Frode** was selected at the Swedish Seed Association, Svalof, Sweden, for superior winterhardiness, leafiness, and vigor.

**Hallmark** was selected by the Farmers Forage Research Cooperative, West Lafayette, Indiana, for superior forage and seed yield.

**Napier** was selected at the Rudy-Patrick Research Center, Ames, Iowa, for desirable forage and seed attributes with emphasis on rust and leaf blight resistance.

**Nordstern** was selected by Northrup, King, and Co., Minneapolis, Minnesota, for winter survival, disease resistance, late maturity, and forage yield.

**Potomac** was selected at the Plant Industry Station, Beltsville, Maryland, for rust resistance, leafiness, persistence, and vigor.

**Sterling** was selected at the Iowa Agricultural Experiment Station, Ames, Iowa, for superior hardiness, forage, and seed yield.

**Tardus** was selected at the Weibullsholm Plant Breeding Institute, Landskrona, Sweden, for winterhardiness, late maturity, and leafiness.

The lower ranking varieties are not described since they do not appear to be as well adapted in South Dakota.

## SLENDER WHEATGRASS

*Agropyron trachycaulum* (Link) Malte

Slender wheatgrass is a short-lived, native, bunchgrass. Neither as palatable nor as persistent as smooth bromegrass or intermediate wheatgrass, it does produce good yields of high quality seed. Seedlings are strong and easily established. It is useful for short-term hayland or pasture, but normally disappears after the second year of establishment. It is frequently used in a native-grass mixture because of its vigorous initial growth. It is able to withstand moderately saline conditions. At Highmore and Cottonwood (Table 7), this species yielded similarly to the introduced grasses.

## CANADA WILDRYE
*Elymus canadensis* L.

This species is a short-lived, native bunchgrass found on uplands in the west. It yields as much forage as introduced grasses when first established, but stands are not maintained. It is palatable, although under grazing has not given good beef gains. The adequate seed yields are difficult to process because of long awns.

**Mandan wildrye** is a variety selected at the Northern Great Plains Field Station from collections made near Mandan, North Dakota, and released cooperatively in 1946 by the North Dakota Agricultural Experiment Station and the Crops Research Division, ARS.

It has more and softer textured leaves than the unselected grass. Stems are somewhat shorter and it is longer lived than unselected material.

## KENTUCKY BLUEGRASS
*Poa pratensis* L.

This species is a cool-season, vigorously spreading, rhizomatous grass adapted to eastern and central South Dakota. It stands intense grazing and is therefore the chief component of overgrazed pastures in eastern South Dakota. Although palatable and productive for good early pasture, it does not yield well (Table 7). It was the lowest yielding grass at Brookings and was inferior to smooth bromegrass, intermediate wheatgrass, and crested wheatgrass at Highmore.

In some years, native stands are harvested for lawn seed and are profitable for the farmer and rancher. Since seed production is dependent to a great extent upon abundant spring moisture, application of nitrogen fertilizer to help insure seed production has been extremely hazardous from the standpoint of profitability.

## WARM-SEASON GRASSES

Warm-season grasses have a different season of growth and different habits of growth compared with cool-season grasses. They must be managed accordingly.

### Digestibility

In 1965, an experiment with four warm-season grass species of two varieties or strains each, was planted in two replicates at Centerville. Simazine (2 pounds per acre active ingredient) was applied May 16 and the grasses were harvested the following August 29 leaving a 2.5-inch stubble height. Yields of dry matter and digestible dry matter are shown in Table 17. Digestibility was determined by a laboratory artificial rumen technique to estimate percentage of forage that would be digested by a ruminant animal. To equate digestibility of these varieties to a known forage, they were compared with a good quality alfalfa hay.

**Table 17. Average yields and digestibilities of warm-season grasses established at Centerville in 1965.***

| Species and varieties | Dry matter | In vitro digestible dry matter | |
|---|---|---|---|
| | tons/acre | % | tons/acre |
| Indiangrass | | | |
| Nebraska Black | 5.85 | 46.0 | 2.69 |
| Nebraska Brown | 6.01 | 46.0 | 2.76 |
| Big bluestem | | | |
| Pawnee | 5.17 | 47.8 | 2.47 |
| Champ | 3.89 | 47.8 | 1.86 |
| Switchgrass | | | |
| Nebraska 28 | 4.52 | 44.0 | 1.99 |
| Summer | 4.44 | 44.0 | 1.95 |
| Sideoats grama | | | |
| Pierre | 1.32 | 49.5 | 0.65 |
| Butte | 2.50 | 49.5 | 1.24 |
| Alfalfa | | | |
| Vernal | | 64.0 | |

*Grasses were harvested on August 29, 1966. Alfalfa was cut at first-flower stage.

Grass digestibilities were considerably below that of the alfalfa, however, the grasses were harvested at a much later stage of maturity than is recommended for grazing. Ordinarily these grasses are not used for hay, but are grazed from early July to late August, so digestibility would be much higher for grazed forage than when cut for hay August 29. At grazing time in early July their digestibility might approach that of alfalfa.

No differences in digestibility between varieties within a species were found. Sideoats grama was the most digestibile species and switchgrass the least in this test. Highest yields were obtained from Indiangrass and big bluestem and the lowest from sideoats grama. Large varietial differences in yield were indicated in big bluestem (Pawnee over Champ) and in sideoats grama (Butte over Pierre).

In 1971 and 1972, Summer switchgrass was harvested at weekly intervals at Brookings to study changes in forage yield and quality with advance in maturity (Figure 3). Yields increased until mid-August while digestibility and protein content decreased. Total digestible yield reached a maximum in late July. Because the entire aboveground plant was harvested, forage quality obtained in this experiment was lower than would be expected if consumed by a grazing animal. A grazing animal selects only the leaves and top portions of the plant, and rejects the less digestible stems. Both digestibility and protein content are higher in the upper plant parts and leaves.

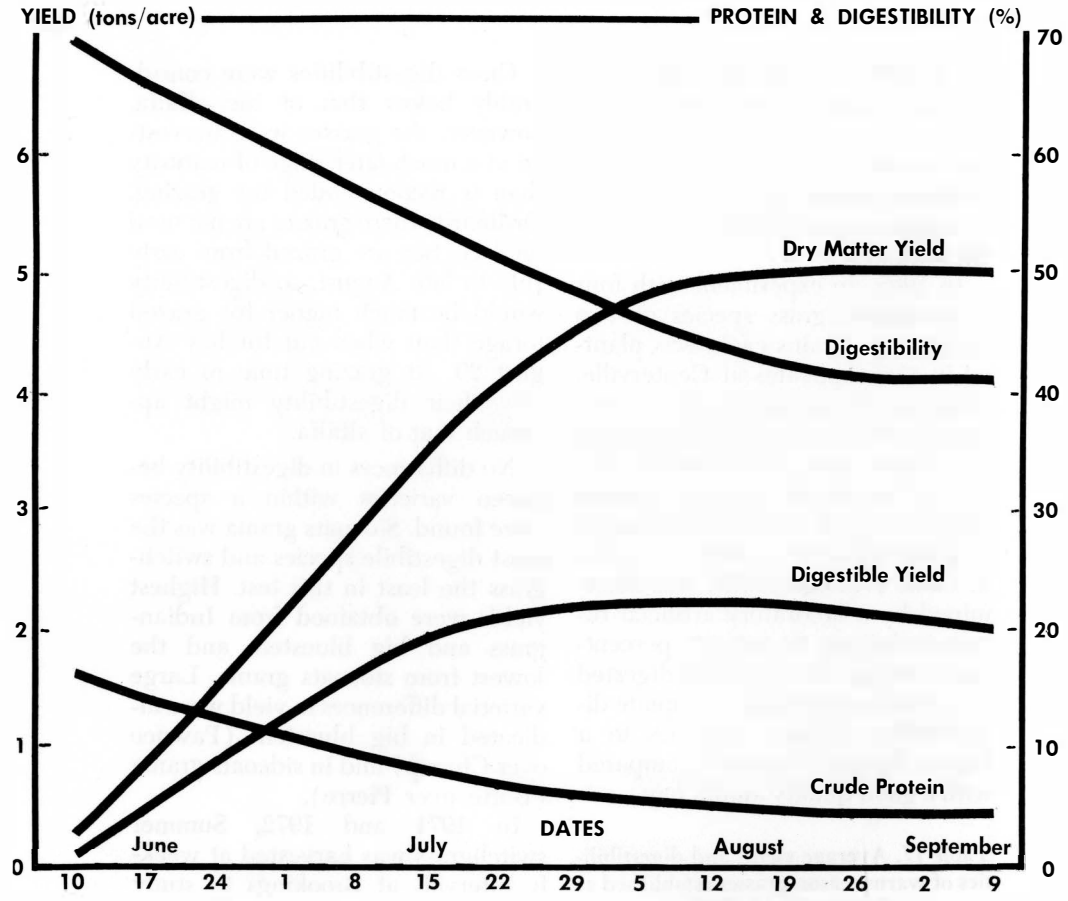



Figure 3. Relationships between yield of dry matter and quality measurements taken weekly from an established stand of Summer switchgrass at Brookings in 1971-72.

### Grazing Management

Total carbohydrate reserves in the crowns of Summer switchgrass were measured at Brookings in 1972 (Figure 4). During the rapid growth period (mid-May to mid-June), plants used carbohydrate reserves to produce top growth and crown reserves dropped rapidly.

The lowest level of reserves occurred during the jointing stage of growth in late June and early July. After sufficient top growth accumulated, more carbohydrates were produced than were used, and crown reserves were replenished. In late September, crown carbohydrate reserves were at a maximum level. Some reserves are used during the dormant winter period to maintain the living plant processes resulting in a decrease of energy levels in the crowns during winter. If adequate reserves are not maintained, the plants will die.

Early observations at Centerville indicated that close clipping of switchgrass resulted in severe loss of stands. This prompted a study of the effect of various management

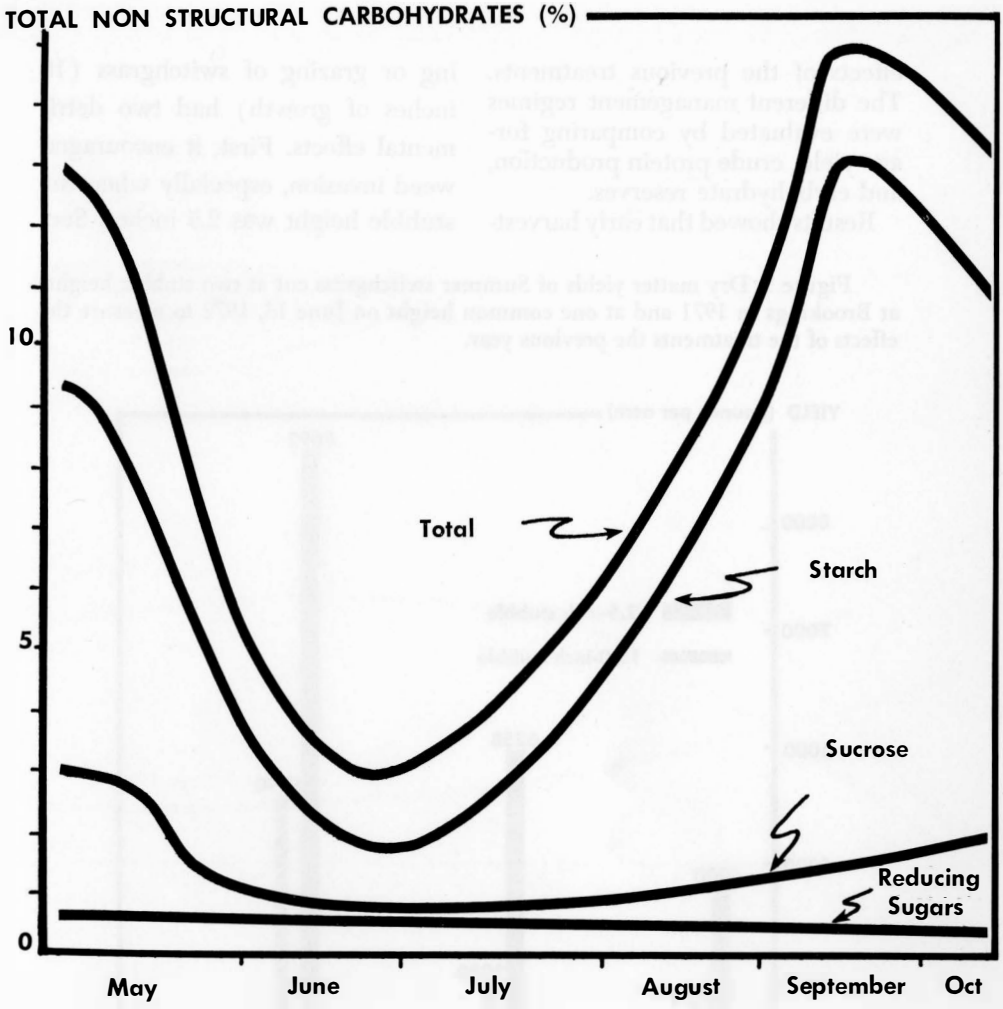


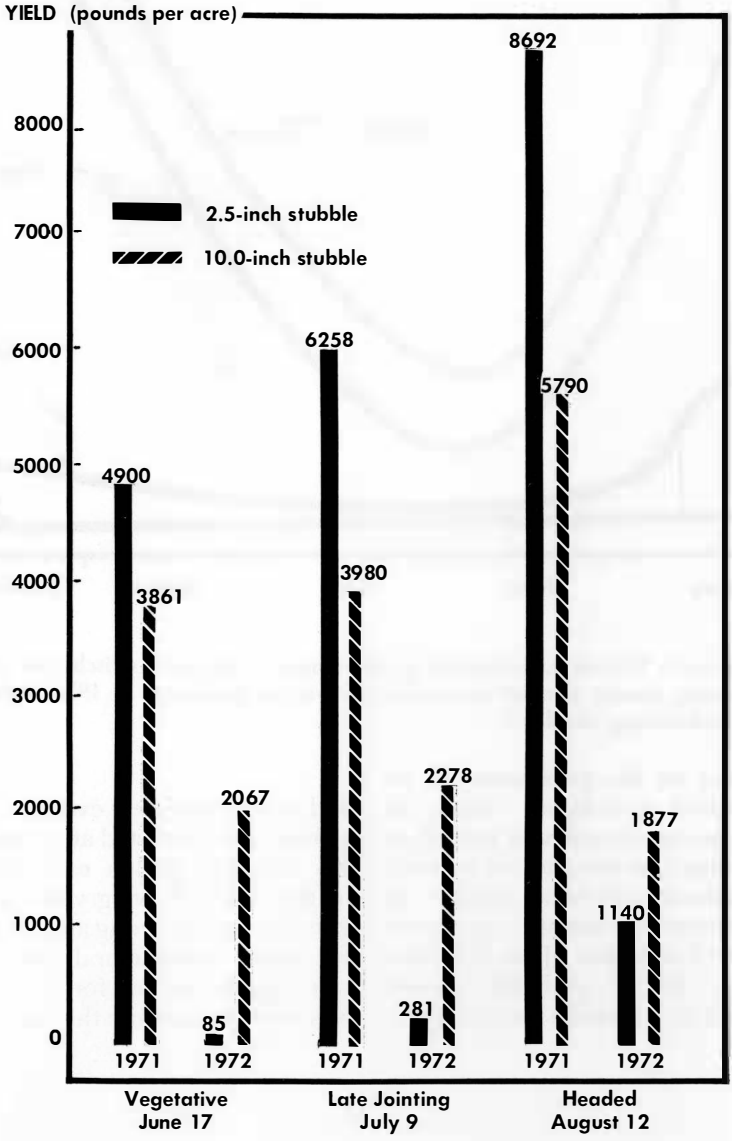

**Figure 4. Percent carbohydrate in the crown of Summer switchgrass during the growing season, sampled at weekly intervals at Brookings in 1972 beginning May 1 and ending October 9.**

practices on the persistence of an established switchgrass stand. In 1971, an experiment was started at Brookings that consisted of harvesting Summer switchgrass initially at three stages of maturity: vegetative growth of 16 inches (June 17), late-jointing (July 9), and 100% headed (August 12). Stubble heights of 2.5 and 10.0 inches were evaluated. Regrowth was harvested at 14- and 28-day intervals within each stubble height. The following year, switchgrass crowns were dug and analyzed for total nonstructural carbohydrates and a residual forage harvest was made to measure the carry-over

effects of the previous treatments. The different management regimes were evaluated by comparing forage yield, crude protein production, and carbohydrate reserves.

Results showed that early harvesting or grazing of switchgrass (16 inches of growth) had two detrimental effects. First, it encouraged weed invasion, especially when the stubble height was 2.5 inches. Sec-

**Figure 5. Dry matter yields of Summer switchgrass cut at two stubble heights at Brookings in 1971 and at one common height on June 13, 1972 to measure the effects of the treatments the previous year.**




**Switchgrass on May 25, 1972 following cutting the previous year at either a 10-inch stubble (top) or 2.5-inch stubble (bottom).**


ond, it produced less total forage because of the minimal regrowth ability of switchgrass after its growing point is removed (Figure 5). However, delaying the initial cutting or grazing until the 100% headed stage resulted in poor quality forage and low yields of crude protein per acre. The best time for harvesting or starting to graze was at the late-jointing stage of growth. Allowing dry matter production to accumulate before grazing is a compromise between obtaining maximum forage quality and maximum forage yield.

Maintaining a 10-inch stubble resulted in higher yields the following year, regardless of the stage of growth at initial harvest (Figure 5). Crown carbohydrate reserves were also highest when a 10-inch stubble remained compared with a 2.5-inch stubble. Proper stubble height is probably the single most important factor in maintaining maximum switchgrass production over a period of years.

While carbohydrate reserves are generally low at the recommended start of grazing, animals graze switchgrass systematically from top to bottom over the grazing period. This allows leaf tissue to remain on

plants sufficiently long to synthesize carbohydrates for the next year. Since little regrowth occurs, reserves are accumulated if sufficient stubble is allowed to remain.

### Stand Establishment

Five warm-season grasses were established in replicated four-acre pastures at the Pasture Research Center, Norbeck, in 1965. Best stands were with Nebraska 28 and Summer switchgrass and Pierre sideoats grama. Only fair stands were established with Pawnee big bluestem and Holt Indiangrass. Dry matter yields in early July 1973 and 1974 reflect the inherent yield capacity of the forage species, as well as the ease of stand establishment (Table 18).

Another test of warm-season grass varieties was seeded at Brookings on June 26, 1972 to determine relative ease of stand establishment and yield. A dense growth of weeds occurred after seeding and the next year only switchgrass was successfully established. In spring of 1974, atrazine was applied at the rate of 1 pound per acre active ingredient in early May. Comparative stands as reflected by dry matter yields (Table 18) were obtained on October 17, 1974. Practically no plants of either big bluestem or Indiangrass could be found. Cave-in-rock switchgrass had less of a stand than the other varieties of switchgrass, but generally this species was well established. From this experiment, it appears that switchgrass is superior in ease of establishment to the other warm-season grasses tested.

**Table 18. Average yields (tons/acre) of warm-season grasses at Norbeck and Brookings***

| Established: | Norbeck, 1965 | | Brookings, 1972 |
|---|---|---|---|
| Harvested: | 1973 | 1974 | 1974 |
| Switchgrass | | | |
| Nebraska 28 | 1.23 | 1.20 | 4.14 |
| Summer | 1.28 | 1.33 | 3.82 |
| Pathfinder | ..... | ..... | 3.92 |
| Forestburg | ..... | ..... | 3.18 |
| SD 30 | ..... | ..... | 3.50 |
| Cave-in-rock | ..... | ..... | 2.60 |
| Big bluestem | | | |
| Champ | ..... | ..... | 0.00 |
| Pawnee | 1.08 | 1.14 | ..... |
| SD 42 | ..... | ..... | 0.00 |
| Indiangrass | | | |
| Holt | 0.89 | 0.89 | 0.00 |
| SD 45 | ..... | ..... | 0.00 |
| Sideoats grama | | | |
| Pierre | 0.44 | 0.52 | ..... |

*One harvest per year.

To determine if varietal differences in ease of establishment of switchgrass might occur, Nebraska 28, Pathfinder, and Summer were planted at the same rate of pure-live-seed per acre at Norbeck in 1971. Plantings were made at 14-day intervals to see if there was a different performance at different dates of seeding. Yields in 1972 indicated that on all dates, Nebraska 28 produced a better stand than the other two varieties (Table 19). This may be related to the larger seed size of this variety and the fact that Summer may be outside its region of adaptability in northern South Dakota.

A high degree of dormancy occurs in seeds of these native warm-season grasses, so poor stand establishment may in some instances be caused by this effect. The use of 2- or 3-year-old seed will often give better stands than new seed.

Table 19. Comparison of switchgrass varieties planted at 14-day intervals at Norbeck.*

| | 1971 Planting date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | May 17 | May 31 | June 14 | June 28 | July 12 | July 26 | Aug. 9 | Aug. 23 |
| | pounds/acre | | | | | | | |
| Nebraska 28 | 255 | 339 | 1634 | 1335 | 511 | 77 | 0 | 0 |
| Pathfinder | 204 | 232 | 1140 | 1046 | 415 | 16 | 0 | 0 |
| Summer | 79 | 17 | 676 | 510 | 252 | 75 | 0 | 0 |

*Yields are the mean of eight replications established with and without an oat companion crop and harvested on September 28, 1972.

## SWITCHGRASS
### *Panicum virgatum* L.

Switchgrass is a tall, warm-season native grass with short rhizomes. It has coarse stems and leaves and grows 3 to 5 feet high.

This grass starts growth about the first of June and makes its maximum growth during the warm part of summer when cool-season grasses are dormant. It requires abundant moisture and fertile soil for maximum growth. Its palatability is not as high as smooth bromegrass or intermediate wheatgrass.

**Forestburg** was selected at the Plant Materials Center, SCS, Bismarck, North Dakota, for leafy upland type of growth. This variety has not been exceptional for yield or ease of establishment in eastern South Dakota tests.

**Nebraska 28** was selected at the Nebraska Agricultural Experiment Station in cooperation with ARS and


SCS from a native collection from Holt County, Nebraska, and released in 1949. This variety is an early maturing strain, representative of sand hill types. Plants are fine stemmed, moderate in height, and leafy. It is well adapted to different soil conditions and is suitable for warm-season pasture. In South Dakota tests, this variety has shown excellent seedling vigor and was more easily established than other varieties tested. It has a large seed which may contribute to this characteristic.

**Pathfinder** was selected at the Nebraska Agricultural Experiment Station, Lincoln, for winterhardiness, vigor, leafiness, late maturity, and rust resistance. From the standpoint of ease of establishment, it has not been as good as Nebraska 28 at Norbeck (Table 19).

**Summer** was selected at the South Dakota Agricultural Experiment Station and released in 1964. It came from a native collection made by W. C. Tolstead and L. C. Newell south of Nebraska City, Nebraska.

This variety is tall, upright and leafy, and somewhat late in maturity. In a variety trial at Brookings in 1962, only Summer and Nebraska 28 showed no winter injury. Forage yield of Summer at Brookings in 1963 was 2.40 tons per acre compared with 1.68 tons per acre for Nebraska 28. At Centerville 500 pounds of seed per acre were obtained from Summer grown in rows and cultivated.

In more recent tests, forage yields have been less than Nebraska 28. The small seed of this variety may lead to difficulty in establishment as indicated at Norbeck (Table 19). Good stands have been obtained in eastern South Dakota.

## BIG BLUESTEM

***Andropogon gerardi* Vitman**

Big bluestem is a tall, sod-forming, warm-season native grass with short rhizomes. Growth begins in late May or early June and continues during the warm part of sum-

mer. It is the dominant species in well managed eastern South Dakota native pastures and provides abundant palatable forage during summer months. It will stand extensive grazing if allowed to make an initial growth during the first part of the season. Good pasture management similar to that suggested for switchgrass is necessary to prevent stands from being depleted. Under stress conditions it forms a clumped leafy growth without flowering stems. At Norbeck, big bluestem has appeared to have low palatability when in this stress condition. It was not readily grazed by steers confined to it during July and August, except where high nitrogen applications were made. Big bluestem yields well under good growing conditions and is normally very palatable. This species has not been as easily established as switchgrass.

**Champ** was developed at Nebraska Agricultural Experiment Station, Lincoln. It is moderately late maturing, leafy, and has superior seed set and quality.

**Pawnee** was selected at Nebraska Agricultural Experiment Station, Lincoln, for high forage yield, superior seed yields, and quality.

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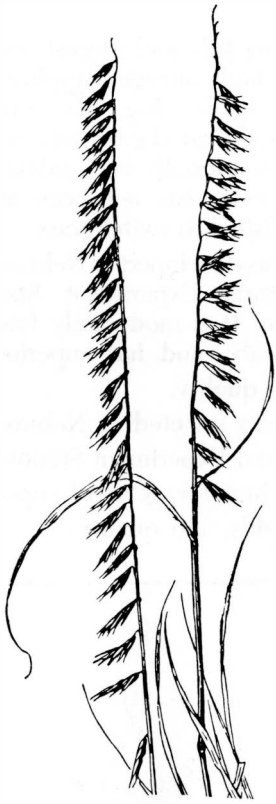
## INDIANGRASS

*Sorghastrum nutans* (L.) Nash

This warm-season tall bunchgrass does best on fertile bottom lands and sandy soils. It is palatable in early season, but may be damaged by overgrazing.

**Holt** was selected at the Nebraska Agricultural Experiment Station, Lincoln, for early maturity, leafiness, and yield. It has not been easily established in trials in eastern South Dakota.



## SIDEOATS GRAMA

***Bouteloua curtipendula* (Michx.) Torr.**

This native warm-season bunchgrass has a slight spreading tendency. It is about 20-30 inches tall and does not produce as much forage as the taller warm-season species (Tables 17 and 18).

**Butte** was selected at the Nebraska Agricultural Experiment Station, Lincoln, for ease of establishment and seedling vigor from collections made in Holt and Platte Counties in Nebraska.

**Pierre** originated from a composite of seed collected 5 miles west of Pierre, South Dakota, and was increased at the Plant Materials Center, SCS, Bismarck, North Dakota. It is vigorous, leafy, and free from disease. It has been somewhat lower than Butte in yield at Centerville (Table 17), but shows promise for range seedings in western South Dakota.

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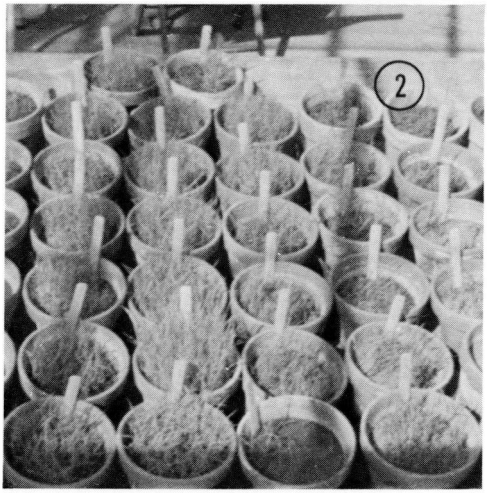
## BLUE GRAMA

***Bouteloua gracilis* (H.B.K.) Lag. ex Steud.**

This species is a short, native, warm-season grass, which spreads by means of short rhizomes. It is found as the predominant species on exposed sites where growing conditions are poor or in overgrazed ranges in western South Dakota. Since it is a short grass, it escapes grazing and is not over utilized as readily as taller species. It is palatable and nutritious, but because of its low yield (Table 7) is not desirable as the major component in a pasture.

A Photo Report...

# Major Steps in Developing New Grasses



**Major Steps in Developing New Grasses**

1—Crossing grass plants in the greenhouse.

2—Seedlings from selected plants.

3—Seedlings placed in plant bands for transplanting into the field.

4—Transplanting seedlings into a nursery for selection of outstanding plants. Each plant is watered as it is transplanted.

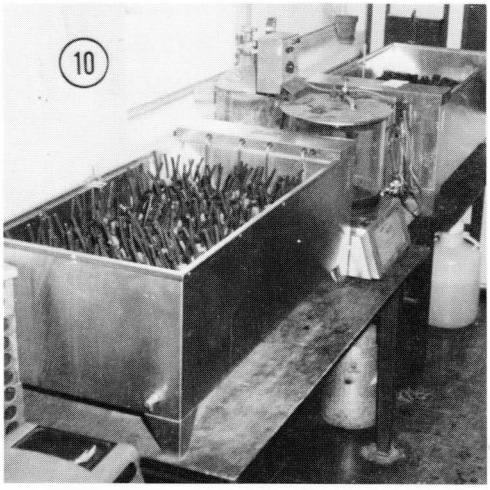
5—Newly transplanted nursery.



6—Outstanding plants are selected from a nursery to form a new variety.

7—Harvesting new strains of grasses to measure their yields.






8—Yields from each plot are weighed for selection of a superior new variety.

9—Laboratory method used to select for quality. Weighing forage sample.

10—Artificial rumen used to test for digestibility. Each stoppered tube in the bin has a different selection of grass.

11—Final stage is increasing seed prior to release of a new variety to farmers. Shown here is Oahe.

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Yearling steers grazing experimental grasses at the Pasture Research Center, Norbeck, South Dakota.

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