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J. G. Ross

S. S. Bullis

R. A. Moore

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Agronomy Department
Agricultural Experiment Station
South Dakota State University, Brookings

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Grass Performance in South Dakota

By **J. G. Ross,** professor; **S. S. Bullis,** assistant agronomist; and **R. A. Moore,** associate professor, Department of Agronomy.

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. By proper management grassland yields can be greatly increased, in some instances even doubled.

MANAGEMENT

Grasses may be divided into two main classes: cool season and warm season. Cool season grasses grow best in the spring and fall while warm season grasses make most of their growth in the summer. A forage program, therefore, demands the use of grasses in both of these categories to produce maximum pasture throughout the whole growing season. Grazing seasons for each of the important grasses and how they may be coordinated into a pasture program are discussed in detail in Cooperative Extension Service Fact Sheet "A Pasture System for You." Grazing pressure and management for each of these grasses is also discussed in other fact sheets. ("Interseeding Pastures," "Fertilizing Pasture and Hayland," and "Chemical Weed Control in Crops.")

FERTILITY

Cool season grasses make their greatest growth in spring. Supplemental nitrogen is necessary for maximum growth since nitrification, which releases nitrogen by the action of bacteria in the soil, does not take place until later in the spring when soil temperature has increased. This means that after the first year of production from a new stand the limiting factor for growth is nitrogen, unless it is supplied as a fertilizer by a legume in association with the grass.

Yield of forage is maintained at about the same level year after

Table 1. Effect of Alfalfa on Maintenance of Yield (tons per acre) in Smooth Bromegrass at Brookings

	Grass* alone	Grass* with alfalfa	Percent increase
1946	2.8	3.8	36
1947	1.6	5.6	229
1948	0.9	3.3	269
1949	0.4	1.9	382

*Stand established in 1945.

Table 2. Grass Alone and Grass-Alfalfa Yields at Brookings 1949-52 in Tons Per Acre

	Grass alone	Grass with alfalfa
Intermediate Wheatgrass	2.4	3.3
Brome	2.2	3.0
Standard Crested	1.7	3.0
Kentucky Bluegrass	1.4	2.8

year in a mixture of grass and legume, but yield of grass alone decreases rapidly as shown in table 1. The yield of bromegrass by itself decreased from 2.8 tons per acre in 1946 to 0.4 tons in 1949. The grass-legume mixture yielded 36% more in 1946 than the grass alone. The proportional yield increase 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 1949 the mixture yielded 382% more than the grass alone. 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 1949-52 were found.

An approximation of the amount of nitrogen added by the alfalfa to the grass was obtained in an experiment at Brookings in 1950. One hundred pounds of nitrogen (300 pounds of ammonium nitrate) per acre was applied to the bromegrass alone and with alfalfa. This stand had been established for 5 years. No fertilizer had previously been used. The yields of seed for the three varieties Homesteader, Lincoln and Canadian Commercial in each of the treatments are shown in table 3. Lincoln, the lowest yielding variety without nitrogen, showed the greatest proportionate stimulation in seed yield by the fertilizer.

The 100-pound nitrogen treatment increased seed yield 593 pounds compared to a yield of 400

Table 3. Comparison of Effect of Nitrogen Application and Nitrogen from Alfalfa on Yield of Smooth Bromegrass Seed in Pounds Per Acre at Brookings

	Grass alone*		Grass-alfalfa*	
	Without fertilizer	100 lbs. nitrogen	Without fertilizer	100 lbs. nitrogen
Homesteader	209	809	626	674
Lincoln	83	690	437	663
Canadian Commercial	259	831	689	738
Average Yield	184	777	584	692
Increase over Control		593	400	508

*Five-year-old stand.

pounds of seed from the untreated grass-alfalfa mixtures. From this it can be determined that alfalfa added about 67 pounds of nitrogen to the grass. $\left\{\frac{400 \times 100}{593} = 67\right\}$

Fertilizing the grass-alfalfa gave only a nominal increase indicating that nitrogen was being supplied at almost the optimum rate by the alfalfa. The lower yield of grass seed of the grass-alfalfa over the grass alone, fertilized, may in part be due to the competitive effect of the alfalfa and also, of course, to the smaller plant population of the 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.

Warm season grasses start growth in the first part of June when sufficient nitrogen has been released in the soil to insure adequate growth. Where high yields are obtained, nitrogen application in mid-June may be desirable in order to maintain production. Under irrigation, nitrogen application is necessary to obtain maximum yield.

A more complete discussion of fertilizer requirements of grass is given in Fact Sheet "Fertilizing Pasture and Hayland."

MOISTURE

Where 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 (see Agricultural Experiment Station Bulletin 502 "Producing Grass Seed in South Dakota"). Under conditions of low rainfall at Cottonwood, forage production and stands of intermediate wheatgrass have been maintained by tillage between rows. Economic considerations concerned in maintaining production of forage will determine whether this practice is practical.

STAND ESTABLISHMENT

Grasses should be seeded on a weed-free seed bed. For cool season grasses, fall seeding (from August 15 to September 20 when moisture is present in the soil) has given best results. Summer fallowing to ensure a better supply of moisture is desirable especially in drier portions of the state. Legumes may be established with the grass if they are seeded before mid-August so that root reserves may be stored by the legume seedlings before winter. Late fall seeding (after November 15) or spring seeding of cool season grasses may also be made. A more complete discussion of recommendations concerning establishments of forages is given in Fact Sheet "Planting Tame Pastures and Haylands."

Warm season grasses should be seeded after weed growths have been killed in the spring and early summer so the surface of the soil is free of weed seeds. Unless they are eliminated weed seeds may germinate and compete with grass seedlings. Seeding late in June or during the first week of July has given good stands in eastern South

Dakota. In drier parts of the state the first week of July is probably too late to seed. On comparatively weed-free land, earlier seedings have been successful.

COMPARATIVE YIELDS

To obtain information about highest yielding species of grasses, tests at various locations in the state have been made. Table 4 compares yields of various grasses in solid stands. The highest yielding species are 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

Table 4. Performance of Species of Grasses at Different Locations in South Dakota as Expressed by Average Yearly Yield in Tons Per Acre

Species	Brookings 1949-53 dryland	Huron 1951-52 irrigation	Redfield 1952-53 irrigation	Highmore 1949-55* dryland	Eureka 1949-53 dryland	Cotton-wood 1949-53† dryland	Average 28 harvests
Smooth brome							
Lincoln	2.17	—	—	.58	—	.36	—
Homesteader	2.05	1.66	1.49	.49	.44	.35	0.91
Lyons	2.00	—	—	.52	—	—	—
Lancaster	1.91	—	1.29	.53	—	—	—
Intermediate wheatgrass							
Ree	2.19	1.65	1.76	.58	.53	.67	1.05
Standard crested	1.58	1.30	—	.50	.43	.47	0.80
Western wheatgrass	—	—	—	.41	—	.51	—
Slender wheatgrass	—	—	—	.45	.37	.36	—
Tall wheatgrass	—	1.50	—	—	—	—	—
Green needlegrass							
Green Stipagrass	—	—	—	—	.43	.38	—
Canada wildrye							
Mandan	—	—	—	—	.42	—	—
Russian wildrye	—	1.15	—	.40	.26	.22	—
Blue grama	—	—	—	.10	—	—	—
Creeping red fescue	1.53	—	—	.33	.21	—	—
Tall fescue (Alta)	—	1.41	—	—	—	—	—
Kentucky bluegrass	1.25	—	—	.35	—	—	—
Reed canarygrass	—	—	1.41	—	—	—	—
Tall oatgrass	—	1.64	1.36	—	—	—	—
Orchardgrass	—	—	1.31	—	—	—	—

*Excluding 1954
†Excluding 1950

wheatgrass and bromegrass in central and western areas of the state.

Varieties of cultivated grasses are available as a result of breeding programs of agricultural experiment stations in the north central area. Merits of these varieties plus general discussions of species follow.

Smooth Bromegrass
Bromus inermis Leyes

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 grass, perennial and sod-forming by means of rhizomes. It has maintained itself in established stands in eastern and central South Dakota for 50 to 60 years in certain recorded cases, 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 is therefore well established. Under dry summer conditions it becomes dormant but grows when moisture and temperature become more favorable in the autumn.

Smooth bromegrass is a high yielding forage grass at all locations in South Dakota as shown in table 4. It is adapted to all soil types but makes its best growth on fertile sandy loam or silt loam soils with plenty of moisture. It has an extensive root system and maintains soil tilth and structure when used in rotation.

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

Smooth bromegrass is highly palatable both when grazed and used as hay. Digestability and forage production are high when hay is cut after panicles have emerged but before flowering.

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

In both tables 4 and 5 hay yields of several varieties of smooth bromegrass are shown at various locations. Yields are lower in the western areas than in the east because of lower rainfall. Higher

yields were obtained in recent years (table 5) because optimum nitrogen fertility was maintained on these stands. Sixty pounds of nitrogen per acre were applied in the eastern and 40 or 50 pounds in the western region.

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 type under most conditions in South Dakota and is also more subject to leaf diseases. Smooth bromegrass imported from Canada is of this type. Intermediate type bromegrass, for example, Homesteader or Manchar, is intermediate between the northern and southern types in spreading habit. The southern types have been selected in the southern regions and are high yielding and disease resistant but tend to produce less seed. They tend to become "sod-bound" sooner and require nitrogen fertilizer to maintain high yields. Examples of these are Lincoln, Lancaster, Achenbach and Southern.

Brief descriptions of the varieties mentioned in table 5 together with discussions of their adaptability in South Dakota follow.

Lincoln originated from old fields established in Nebraska before 1898 and was released by the Nebraska Experiment Station and Crops Research Division, Agricultural Research Service in 1942. This variety has given consistantly

Table 5. Average Hay Yields* in Tons Per Acre of Bromegrass Varieties

	Brookings			Watertown		Centerville	Menno	Highmore	Eureka	Cotton-wood	Presho		Averages	
Seeded:	1957	1958	1962	1957	1962	1962	1957	1957	1957	1957	1958	1960		
Harvests:	3	4	3	6	1	2	2	3	4	3	5	3	24	39
Southland	2.24	3.03	2.70	1.96	2.28	2.65	1.35	2.15	.97	1.14	1.70	1.20	1.95	1.92
Lancaster	2.08	2.95	2.74	2.09	2.41	2.60	1.36	2.17	1.34	.93	1.70	1.10	2.00	1.94
Canadian Commercial	2.15	2.79	3.15	1.64	2.35	2.11	1.20	1.79	.98	.92	1.10	.80	1.72	1.69
Achenbach	2.19	2.79	3.16	1.98	2.21	----	1.34	2.21	1.25	.97	----	1.00	1.93	----
Lincoln	2.14	2.88	2.86	2.16	2.78	2.58	1.34	2.16	1.31	1.00	1.70	.90	2.00	1.95
Manchar	2.11	2.57	3.04	2.03	2.18	2.21	----	2.16	.98	.87	—	.80	1.95	—
Saratoga	----	3.02	3.26	2.08	2.46	2.55	1.28	2.28	1.46	1.03	----	.80	----	—
Homesteader	2.24	2.93	----	1.96	2.15	2.36	1.34	2.05	1.18	—	1.40	1.00	1.93	—
Sac	----	—	2.90	—	2.87	2.65	—	—	—	—	—	1.00	—	—

*One harvest made each year.

high yields in South Dakota as shown by the average 24- and 39-harvest yields in table 5. It has good seedling vigor and is relatively easy to establish. Seed yield is inclined to be 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 are also so designated. The only sure way of obtaining seed of this variety is to buy certified seed.

Lancaster was selected from clones in old fields in Nebraska and released in 1950 by the Nebraska Experiment Station and Crops Research Division, ARS. This variety was equal to Lincoln in yield in the 24-harvest average and just below it in the 39-harvest average (table 5). At Lincoln, Nebraska, it has been the leading variety in forage and seed yield tests. This variety has fine stems and some-what drooping panicles.

Southland. Selections were made at the Oklahoma 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 of this variety in South Dakota have been satisfactory.

Manchar was developed by the Plant and Materials Center, SCS at Pullman, Washington, from a Manchurian introduction. It was released as Manchar in 1946. It is intermediate in rhizome production or spreading habit. It produces good yields of seed and forage but under South Dakota conditions is susceptible to leaf spot diseases.

Homesteader originated from old fields in South Dakota. High yielding strains were put together to produce this variety which was released in 1951. It is intermediate in aggressiveness and well adapted to South Dakota conditions.

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

Saratoga clones which formed this variety were selected at the New York Experiment Station from a wide variety of seed lots from plant breeders throughout the United States and released in 1955. It has vigorous seedlings and is similar to Lincoln in forage yield and disease resistance.

Sac was selected at the Wisconsin Experiment Station following continuous selection of superior types over many generations and was released in 1960. It is coarse, high forage yielding and resistant to leaf spot diseases. Seed yields have not been superior to Lincoln. Hay yields of this variety in tests made in South Dakota have ranked near the top.

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 both in the 24- and 36-harvest averages. It does not spread

aggressively and is subject to leaf spot diseases.

Intermediate Wheatgrass
Agropyron intermedium (Host) Beauv.

This cool-season grass species was introduced from Russia 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. It has superior yielding ability higher than any of the other grasses at most of the testing stations throughout the state (table 4). Intermediate wheatgrass yielded more than the other species as shown by the 28-harvest averages. This grass has abundant rhizomes but is easily killed when a stand is plowed. The stems are somewhat coarser than those of most bromegrass varieties but many leaves are produced so a highly satisfactory forage is produced. The forage is palatable to livestock.

The seed is large and is produced on 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.

More success has been obtained from fall than from spring seedlings.

Yields of the various varieties available are shown in table 6. Oahe yielded higher than other strains in all tests in which it was included. Nebraska 50 and Ree were about equal in yield and were higher than Amur and Greenar in the 33-harvest averages. Greenar gave the lowest average in these tests.

All varieties except Amur originated from an introduction (PI 98568) from the Markop region of Russia obtained by the United States Department of Agriculture in 1932. This introduction segregated for green and blue-green plants and for pubesence or short hairs on the spikelets, as well as other characters.

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.

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 seed of this variety at reasonable prices should promote use of this valuable species on South Dakota farms. This variety is uniformly blue-green in color and has been selected for rust resistance.

Nebraska 50 was also selected from PI 98568 for blue-green color and lack of pubescence on the spikelet. It was released from the Nebraska Experiment Station in 1950. It is similar in yield and seed production to the original introduction.

Greenar was developed at the Plants Material Center, SCS, Pullman, Washington from PI 98568. Green-leaved plants were selected from the original population. This variety has yielded less than the

Table 6. Average Hay Yields* in Tons Per Acre of Intermediate Wheatgrass

		Brookings			Watertown		Center.	Menno	Highmore		Eureka		Presho		Cottonwood		Averages	
Seeded:	1957	1957	1958	1962	1957	1962	1962	1957	1957	1959	1957	1954	1958	1960	1957	1958		
Harvests:	5	3	2	2	6	2	3	3	4	1	3	2	5	3	3	1	33	23
Oahe	---	1.49	2.26	2.99	---	2.29	2.21	---	---	2.71	---	.94	1.70	2.00	---	1.99	---	1.95
Nebr. 50	2.80	---	---	2.89	1.59	2.18	---	1.28	2.10	---	2.11	.88	1.50	1.50	1.65	1.67	1.84	---
Ree	2.81	1.42	---	---	1.73	---	---	1.30	1.83	2.08	1.60	.81	1.50	1.90	1.59	1.28	1.81	---
Amur	2.77	1.42	2.12	2.81	1.70	2.12	2.11	1.28	2.08	2.05	1.63	.85	1.50	1.70	1.40	1.25	1.79	1.74
Greenar	2.46	---	---	---	1.51	---	2.10	1.13	1.98	---	1.94	---	1.50	1.90	1.34	1.18	1.69	---

*One harvest made each year.

other varieties tested in South Dakota as shown in the 33-harvest averages in table 6.

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 Experiment 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 tests in South Dakota (See Fact Sheet "Oahe Intermediate Wheatgrass.")

Pubescent Wheatgrass
Agropyron trichophorum (Link) Richt.

Pubescent wheatgrass differs from intermediate wheatgrass chiefly by having pubescence or short hairs on the heads and on the seeds. In general, this grass forms a more open sod, produces less forage and is more drought resistant than intermediate wheatgrass. It is better adapted to regions in western South Dakota.

In table 7 yields of Mandan 759 are higher than the other varieties. This variety resembles intermediate wheatgrass in all easily recognized respects except for its pubescence.

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 Russia. 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

Table 7. Average Hay Yields* in Tons Per Acre of Varieties of Pubescent Wheatgrass

Seeded	Brookings		Water-town	Center-ville	Menno	High-more	Eureka	Cotton-wood	Averages	
Harvests:	1957 4	1962 2	1958 2	1962 1	1958 2	1957 2	1962 1	1957 3	14	9
A-1488	1.56	—	.77	1.50	1.62	—	1.46	.89	1.30	—
Utah 109	1.82	—	.89	1.52	2.05	—	1.50	1.02	1.48	
Mandan 759	2.59	3.13	1.24	1.44	2.67	1.82	1.84	1.71	2.00	1.99
Topar	—	1.82	—	1.43	—	1.58	1.44	.87	—	1.35

*One harvest made each year.

yielding ability in South Dakota. The foliage is deep green in color.

Topar was selected from PI 107330 introduced from Tashkent, Turkestan, Russia in 1934. It was released cooperatively by the Washington, Idaho, Oregon and California Agricultural Experiment Stations and SCS Plant Material Centers in 1953. This grass is vigorous and drought resistant. It is adapted to lower fertility and more alkaline sites than intermediate wheatgrass.

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

Tall Wheatgrass
Agropyron elongatum
(Host) Beauv.

This species is a tall, coarse, late-maturing bunch grass with blue-green leaves. It is able to produce good yields in areas with a high water table and high salt content, but 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 cannot be grown. Under upland conditions it is gradually replaced by other species. The named varieties of this species (table 8) are discussed below.

Nebraska 98526 was increased directly from PI 98526 introduced into the United States from Russia in 1932. It appears to be more resistant to high water table and high salt conditions than some other introductions. In table 8 the yield of this introduction is shown to be superior in the 17-harvest averages and essentially equal to the best of the other strains in the 7-harvest averages.

Alkar was selected from PI98526 at the Plant Materials Center, SCS, Pullman, Washington, and released in 1951. It has been found to be highly productive on subirrigated and irrigated saline soils.

Largo is an introduction PI 109452 from Turkey which has been extensively tested and was released in 1937 cooperatively by the New Mexico Agricultural Experiment Station and the Nursery Division, SCS. Recently it has been named Largo. It resembles the other tall wheat grasses in its use and adap-

Table 8. Average Hay Yields* in Tons Per Acre of Tall Wheatgrass

	Brookings		Watertown	Menno	Cotton-wood	Highmore	Eureka	Presho		Averages	
Seeded:	1956	1962	1957	1957	1957	1957	1957	1958	1960		
Harvests:	1	2	3	1	1	2	2	5	3	7	17
Alkar	—	2.81	—	—	—	—	—	—	1.90	—	—
S-64	1.60	2.92	1.07	2.02	.84	1.94	1.65	.80	1.90	1.20	1.45
A 12465	—	3.03	—	—	—	—	—	—	2.00	—	—
Nebr. 98560	1.44	2.61	.91	2.27	.68	1.85	1.43	1.40	—	1.22	1.52
Mandan 1422	—	—	.97	1.89	.81	—	1.49	1.40	1.90	1.23	—
A 13044	1.04	—	.53	2.42	.75	1.75	1.26	—	—	1.04	—
Largo	1.19	—	.75	1.64	.72	—	1.99	—	—	1.23	—

*One harvest each year.

Table 9. Average Hay Yields* in Tons Per Acre of Crested and Siberian Wheatgrass at Locations in South Dakota

	Brookings			Watertown		Menno	High-more	Eureka		Cottonwood	Presho		Averages			
Seeded:	1956	1957	1962	1957	1962	1957	1957	1957	1962	1957	1959	1961				
Harvests:	2	5	2	4	1	3	4	2	1	4	5	3	18	31	29	18
Standard Crested Wheatgrass																
Commercial	—	2.44	3.20	1.31	2.50	.83	—	1.18	—	.80	1.20	1.20	1.42	—	1.52	—
Nordan	1.61	2.55	3.22	1.44	2.28	.97	1.66	1.39	1.01	.92	1.20	1.50	1.55	1.52	1.62	1.60
Summit	1.58	2.48	—	1.46	2.90	1.02	1.86	1.20	1.12	1.01	1.20	—	1.54	1.56	—	—
Mandan 2359	—	2.45	—	1.18	—	.92	1.82	1.20	—	.91	1.00	1.40	1.43	—	—	—
Utah 42-1	1.48	2.59	—	1.28	—	.96	1.75	1.02	—	.81	—	—	1.46	—	—	—
Nebr. 10	1.62	2.63	—	1.28	—	1.12	1.73	1.70	1.08	.88	1.10	—	1.59	—	—	—
Fairway Crested Wheatgrass																
Commercial	1.49	2.33	2.95	1.44	1.89	.79	1.77	1.49	1.08	1.02	1.10	1.20	1.49	1.46	1.51	1.48
Nebr. 3576	—	2.28	—	1.55	—	.99	—	1.48	1.08	.94	1.10	1.30	1.52	—	—	—
A1770	1.21	—	—	—	—	—	1.60	—	—	.70	—	—	—	—	—	—
Siberian Wheatgrass																
P27	—	—	2.76	—	.48	.50	1.34	—	—	—	1.00	1.40	—	—	—	1.22

*One harvest made each year.

tation. In South Dakota it has yielded about the same as other varieties tested.

Crested Wheatgrass

Agropyron desertorum (Fisch.) Schult

A. cristatum (L.) Gaertn

Crested wheatgrass is a long lived, drought resistant, bunch grass 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 latter part of the 1920's and early 1930's. Under conditions of 9-15 inches average annual precipitation it has maintained stands for more than 40 years, although yields decline with advancing age of the stand. Crested wheatgrass and store some nutrients before being subjected to grazing pressure in the spring.

Crested wheatgrass may be useful as a supplementary pasture to the native ranges, particularly to depleted ranges so as to extend the green forage season. A pasture of crested wheatgrass extends the grazing season by allowing normally an additional 2 weeks of grazing in April and the same period in October. The native grasses are given an opportunity to begin growth and store some nutrients before being subjected to grazing pressure in the spring.

On most range sites of the Northern Great Plains, range deterioration results in ranges dominated 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 pastures, 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 range condition. Such plants weakened by repeated close use may fail to regrow in the 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.

If suitable land for crested wheatgrass is not available, early grazing on green grass can be provided by native range in excellent range condition deferred for spring grazing. Methods of extending the green forage season are discussed in Fact Sheet "Graze Longer and Feed Less Roughage."

Crested wheatgrass normally flowers early in June and matures early in July. It should be utilized in the spring and 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 and fall with an intervening period to allow recovery of the root reserves.

Crested wheatgrass is not as productive in eastern South Dakota as intermediate wheatgrass and smooth bromegrass (table 4). Under conditions of more limiting rainfall at Highmore, Eureka, and Cot-

tonwood, yields are about equal to these grasses. When 28 harvests were averaged, a yield of 0.80 tons per acre for crested wheatgrass was obtained in comparison to 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 bunch grass it is not adapted for erosion control on steep slopes.

Crested wheatgrass is divided into 2 types. Standard [*Agropyron desertorum* (Fisch.) Schult.] is taller, more upright and with a more extended head than the Fairway type [*A. cristatum* (L.) Gaertn.]. Fairway has a shorter broad head and many basal leaves. In general the variety Nordan which is a standard type has higher yield when measured as yield of hay (table 9). When commercial Fairway, however, is compared with commercial Standard in the 18-harvest averages the difference was in favor of the Fairway (1.49 to 1.42 tons per acre). Fairway appears to be finer stemmed, is leafier has a shorter summer dormancy period.

The commercial samples used in the tests in table 9 were representative of the seed being sold on the market without a variety name.

Standard Crested Wheatgrass

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 tests in South Dakota. Nordan yielded 1.55 tons per acre in comparison to 1.42 for the commercial in the 18-harvest averages and 1.62 tons per acre in comparison to 1.52 in the 29-harvest averages.

Nordan has vigorous seedlings and produces good quality large seeds.

Summit was released by the Canada Agricultural Research Station, Saskatoon, Saskatchewan, Canada. It was increased from an introduction from the Western Siberian Experiment Station made in 1957.

It is similar to commercial standard appearance but yields slightly more forage as shown in table 9.

Mandan 2359 was selected at the United States Northern Great Plains Field Station, ARS, North Dakota. It is uniformly tall and erect. The heads are compact with a high seed production. In tests in South Dakota it has shown no yield advantage over Nordan. Not released.

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

Nebraska 10 was increased at the Nebraska Experiment Station cooperating with SCS and ARS from

an accession of unknown source. It has superior seedling vigor.

In the 17-harvest averages table 9, it yielded slightly more than Nordan. This variety has been released.

Fairway Crested Wheatgrasses

Nebraska 3576 was selected at the Nebraska Agricultural Experiment Station from commercial lot and experiment station accessions. It is early maturing, leafy and productive of forage and seed. It yielded only slightly more forage than commercial Fairway in tests in South Dakota. Not released.

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 tests in South Dakota as shown in table 9. Though rhizomes are developed, plants still form dense bunches. Not released.

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 Centers at Pullman, Washington, from PI 108434 introduced from Russia in 1934 and released cooperatively with the Idaho Agricultural Experiment Station in 1953. In South Dakota, in general, it has not yielded as well as either Fairway or Standard Wheatgrass. In 18-harvest averages in yielded 1.22 in comparison to 1.48 for commercial Fairway and 1.60 tons per acre for Nordan Standard.

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 will produce large quantities of forage. In table 4 the average yields for 1952 and 1953 at Redfield, however, were not as high as would be expected under irrigation conditions that were well established.

Reed canarygrass grows well on uplands but normally smooth bromegrass and intermediate wheatgrass provide higher yields and better quality forage under those conditions.

Reed canarygrass produces palatable and nutritious forage if harvested at the time the panicles have emerged from the boot especially if optimum nitrogen has been made available for the growth of the plant. Reports of unpalatability and lack of nutritious forage from this grass in some instances may certainly be traced to lack of proper time of harvest and fertility maintenance. Where ample moisture and fertility are available two cuttings may be obtained each season. In table 10 yields at Brookings in 1963 and 1964 are shown. Two cuttings were made in 1963 and one in 1964. In both years Frontier

yielded considerably more forage than Ioreed.

Ioreed is a variety selected and released by the Iowa Experiment Station with the cooperation 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.

Frontier was selected at the Central Experiment Farm, Ottawa, Canada. General distribution of this variety was made in 1965. It is very vigorous, and produced a large amount of forage. It yielded almost a ton more forage than Ioreed in each of the three years shown in table 10. Seed shatters readily when near maturity.

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 the spring and produces cylindrical panicles or heads in early June. The seed tends to shatter when ripe so windrowing and use of a combine has given more seed than other methods.

Garrison is a strain found near Max, North Dakota apparently introduced from eastern Germany of western Russia by early immigrants. It is well adapted to wetland sites and produces good yields of apparently good quality forage, available early in the season. This strain yielded a total of 5.2 tons per acre in 1963 which was as much as Ioreed Reed canarygrass. The average yield for the 3 years, however, was 3.13 tons per acre in comparison to 4.10 for Ioreed and 5.06 for Frontier.

Green Needlegrass

Stipa viridula Trin.

This grass is native to South Dakota. It grows in the early part of the season and also makes good aftermath growth throughout the summer. This species has short awns which are not harmful to livestock and is a valuable component of native range. Its close relatives among the native grasses, western needlegrass or needle and thread (*S. comata* Trin.), and porcupine grass (*S. spartea* Trin.),

Table 10. Hay Fields in Tons Per Acre of Varieties of Reed Canarygrass and Creeping Foxtail at Brookings

	Seeded 1962					
	1963 harvest			1964 harvest	1965 harvest	Average 3
	1st cutting	2nd cutting*	Total	1 cutting	1 cutting	harvests
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
Creeping Foxtail						
Garrison	3.00	2.21	5.21	2.44	2.04	3.23

*Because of optimum growing conditions 2 cuttings were taken.

are objectionable because of the long sharp needles on the seeds. In early and late periods in the growing season when needles are not present on these grasses, they provide palatable and nutritious forage.

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. As shown in table 4 it had comparable yields to the common introduced grasses at Eureka and Cottonwood during the years 1949-53. Under conditions where nitrogen is not limiting, however, this grass does not have high yield potentiality.

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 conditions. Western wheatgrass is somewhat salt tolerant and often is the most important species on mildly saline lowlands. It is the best yielding and the most palatable grass adapted to such areas. It is also drought resistant and persistent. This grass readily colonizes abandoned farm land since it is able to spread so rapidly by rhizomes. Pure stands are quite often established 4 to 6 years after croplands are abandoned.

Western wheatgrass is one of the first grasses to grow in the spring on the ranges. Season-long grazing should not start as soon as growth begins but 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 season and rested for the remainder of the year. Crested wheatgrass pasture may also be used for very early spring grazing. Western wheatgrass makes a high quality hay when cut just after heads have come out of the boot.

It can be established by seeding on well prepared ground early in the spring. No commercial varieties are available but seed harvested from native stands is frequently used. It is preferable to obtain seed originating not more than 250 or 300 miles south or 150 or 200 miles north of the location to be seeded.

Russian Wildrye
Elymus junceus Fish.

This species is a long-lived drought resistant bunch grass. (It was introduced into the United States from the Western Siberian Experiment Station). This grass has survived on the Cottonwood Field Station in the original rows for almost 30 years, but there has been no reproduction and the original plots are senescent. 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 while the upright seed producing stems quite often have very

few leaves. Seed matures late in June and since it shatters fairly readily must be harvested immediately when mature.

Very early grazing is afforded by this grass. In some locations it grows earlier and provides forage sooner than crested wheatgrass. Since the leaves grow mainly from the base of the plant, this grass is better utilized as pasture than as hay. It has extremely good aftermath growth after harvest. It is useful as late summer and fall pasture because of this quick regrowth characteristic.

Russian wildrye should not be sown on hillsides or erosion-prone sites since 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 soils.

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.

Vinall is a variety selected at the Northern Great Plains Field Station in North Dakota and released cooperatively by the North Dakota Experiment Station and the Crops Research Branch, ARS, in 1960. Forage yield is not greater than commercial as shown in table 11. This variety, however, produces about 75% more seed than the commercial type.

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 the western part of the state. 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 4) is not desirable as the major component in a pasture.

Slender Wheatgrass
Agropyron trachycaulum (Link) Malte

Slender wheatgrass is a short-lived, native, bunch grass. It is not as palatable or as persistent as smooth bromegrass or intermediate wheatgrass, but produces good yields of high quality seed. The seedlings are strong and easily established. It is useful for short

Table 11. Average Hay Yields in Tons Per Acre of Russian Wildrye at Locations in South Dakota

	Highmore	Presho		Cottonwood
Seeded:	1958	1958	1960	1958
Harvests:	2	2	2	2
Vinall	1.04	1.0	.90	.46
Commercial	1.05	1.0	.80	.47

term hayland or pasture but normally disappears after the second year of establishment. It is able to withstand moderately saline conditions.

At Highmore and Cottonwood (table 4), this species yielded similarly to the introduced grasses.

No varieties of this grass are available.

Canada Wildrye
Elmyus canadensis L.

This species is a short-lived, native bunch grass found on uplands in eastern South Dakota and drainage-ways in the west. This grass yields as much as the introduced grasses when first established but stands are not maintained. It is palatable but under grazing trials has given disappointing gains. Adequate yields of seed are produced but processing is difficult because of the 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 Experiment Station and the Crops Research Division, ARS.

It has more and softer textured leaves than the unselected grass. The 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. It is palatable and produces good early pasture but does not yield well (table 4). It was the lowest yielding grass at Brookings and inferior to smooth bromegrass, intermediate wheatgrass and crested wheatgrass at Highmore.

In some seasons seed harvests for lawn seed from native stands are extensively made and are profitable for the farmer or rancher. Since seed production is dependent to such a great degree upon the presence of abundant spring moisture, application of nitrogen fertilizer to help insure seed production has been extremely hazardous from the standpoint of profitability.

Orchardgrass
Dactylis glomerata L.

Orchardgrass is a cool-season bunch grass which is not winter hardy under most conditions in South Dakota. In eastern South Dakota it will commonly survive for one or two seasons and then winterkill. It starts growth early in the spring and recovers rapidly after grazing or cutting. The first cutting is not as large as smooth bromegrass but since it is able to grow better under warm temperatures second cuttings are high if moisture is available. It grows well under fall conditions and remains green until freezing weather. It is not as drought resistant as smooth bromegrass, intermediate wheatgrass or crested wheatgrass and should be grown only in certain favored 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 the fall. Optimum soil moisture in the fall has been found to lessen the danger of winterkilling.

Orchardgrass yielded as well as smooth bromegrass and other grasses under irrigation at Redfield (table 4). Use of this grass, however, is not recommended except in the Black Hills area because of its lack of winter hardiness.

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 the summer when cool-season grasses are dormant. It requires abundant moisture and fertile soil in order to make its maximum growth. Its palatability is not as high as smooth bromegrass or intermediate wheatgrass.

Summer Switchgrass was selected at the South Dakota 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 in Nebraska.

This variety is tall, coarse and leafy and somewhat late in maturing.

In a variety test seeded at Brookings in 1962, only Summer and Nebraska 28 showed no winter injury. Forage yields of Summer at Brookings in 1963 was 2.40 tons per acre in comparison to 1.68 tons per acre for Nebraska 28. At Centerville 500 lbs. of seed per acre were obtained from this variety grown in rows and cultivated.

Nebraska 28 was selected at the Nebraska 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, of moderate height and leafy. It is well adapted to different soil conditions and is suitable for warm season pasture.

Big Bluestem

Andropogon gerardii Vitman

Big bluestem is a tall sod-forming warm season native grass with short rhizomes. Growth begins in early June or the last of May and continues during the warm part of the summer. It is the dominant species in eastern South Dakota in well managed native pastures and provides abundant palatable forage during the summer months. It will stand extensive grazing if allowed to make an initial growth during the first part of the season. Good pasture management is necessary to prevent stands from being depleted.