Adaptability and Yield of Eleven Grasses Grown on the Oregon High Desert[1]

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The most widely accepted grass for seeding ranges in the sagebrush-bunchgrass area is crested wheatgrass (*Agropyron desertorum*). This particular grass has been outstanding because it can withstand heavy use in the spring and because it does well in areas of low precipitation.

There is a continuous need, however, to search for more productive grasses. This need necessitates continuous testing of species and strains within species in adaptability trials. This paper reports the results of one such trial.

Experimental Procedure

The study was conducted on the range unit of the Squaw Butte-Harney Experiment Station. This unit is approximately 42 miles west of Burns, Oregon and lies within the Oregon High Desert at an elevation of 4,600 feet.

Soils of this area are mostly sandy loam of basaltic origin which are underlaid with a caliche layer varying from 2 to 4 feet below the surface. These soils are characteristic of much of the 96,000,000 acres of sagebrush range.

Temperature and precipitation is extremely variable. Average annual precipitation is approximately 11 inches, with most of it being received in the winter months. During the last 19 years the lowest precipitation recorded was 5.9 inches and the highest 18.1 inches. All months have experienced temperatures below 32° F.; however, the average frost-free period is 50 days. Average monthly precipitation and temperature for the period 1937-1951 inclusive are shown in Table 1. Seasonal precipitation during the years of this study are presented with herbage yields (Table 2).

Table 1. Average monthly precipitation and temperature at the range unit of the Squaw Butte-Harney Experiment Station (1937-1951 inclusive.)

Month	Precipitation	Temperature
	Inches	°F
January	1.19	23
February	1.05	29
March	0.80	35
April	0.65	43
May	1.28	52
June	1.37	55
July	0.27	66
August	0.54	64
September	0.69	58
October	1.11	46
November	1.17	35
December	1.36	28
Annual Avg.	11.47	45

Four strains of crested wheatgrass (*A. desertorum*), 2 strains of fairway wheatgrass (*A. cristatum*), and 1 strain each of siberian wheatgrass (*A. sibericum*), Whitmar beardless wheatgrass (*A. inerme*), tall wheatgrass (*A. elongatum*), big bluegrass (*Poa ampla*), and hard fescue (*Festuca ovina* var. *duriuscula*) were seeded at 10 pounds per acre in 5-row nursery plots in May, 1952. Rows were spaced 1 foot apart and were 20 feet in length. Plots were replicated 3 times and were sprinkled occasionally in 1952 to insure stand establishment.

On August 1, 1953, 1954, 1955, and 1956 herbage yields were obtained by harvesting 16 feet of the 3 center rows of each plot. In 1957 two levels of nitrogen (0 and 30 lb. N/A) were randomly assigned to one-half of each replication. Yield samples were taken on August 1 by harvesting 8 feet of the 3 center rows on each subplot. Yield samples were oven dried, and yields are expressed on an oven-dry basis plus 10 percent moisture.

Results and Discussion

Grass Yields

The 2 highest yielding grasses for the 5-year period were big bluegrass and siberian wheatgrass (Table 2). Differences among other species were not significant; however there was a tendency for both tall wheatgrass and Whitmar beardless wheatgrass to be higher yielding than crested and fairway wheatgrasses. Likewise, strains of crested wheatgrass appeared to be higher yielding than fairway wheatgrass.

Big bluegrass did not attain its peak in yield performance until the third and fourth growing season, whereas other grasses in the trial attained peak performance in the second growing sea-

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Table 2. Mean yields and relative rank of grasses on August 1 in each of 5 years.

	1953		1954		1955		1956		1957		Avg.	
Species	Lbs. per Acre	Rel. Rank	Lbs. per Acre	Rel. Rank	Lbs. per Acre	Rel. Rank	Lbs. per Acre	Rel. Rank	Lbs. per Acre	Rel. Rank	Lbs. per Acre	Rel. Rank
P. ampla	1421	(7)	1336	(1)	715	(1)	1977	(1)	1394	(1)	1372	(1)
A. sibericum	2129	(1)	820	(2)	486	(2)	1991	(2)	1115	(5)	1308	(2)
A. elongatum	2119	(2)	499	(5)	240	(11)	1630	(3)	1069	(6)	1112	(3)
A. inerme	1551	(4)	582	(3)	405	(3)	1315	(5)	912	(8)	953	(5)
A. desertorum												
Commercial	1492	(6)	406	(7)	317	(9)	1368	(4)	955	(7)	908	(7)
Mandan 571	1579	(3)	403	(8)	321	(8)	1258	(9)	1168	(3)	946	(6)
Nebr.-10	1506	(5)	453	(6)	341	(5)	1296	(6)	1236	(2)	971	(4)
Utah 42-1	1408	(8)	371	(9)	338	(6)	1260	(8)	1126	(4)	901	(8)
A. cristatum												
Commercial	1386	(9)	318	(10)	344	(4)	1163	(10)	858	(10)	800	(9)
A-1770	1276	(10)	252	(11)	270	(10)	1266	(7)	906	(9)	793	(10)
F. ovina var. duriuscula	1106	(11)	509	(4)	332	(7)	1043	(11)	701	(11)	780	(11)
Average	1543		541		374		1417		1040		983	
5% L.S.D.	629		310		180		431		296		358	
Oct.-June Precip. (in.)	12.47		9.78		5.79		13.23		12.99			

son. Following the second growing season, however, big bluegrass was highest yielding in all years. The yielding ability of this grass in comparison with other range grasses has been noted elsewhere (Hafenrichter, *et al.,* 1949). Big bluegrass began growth earliest in the spring. It has a winter growth habit (Schwendiman, 1956) and often becomes green in the fall and remains green throughout the winter.

On the basis of its performance in this trial big bluegrass could readily replace crested wheatgrass on many areas. However, it has one serious weakness. It is readily pulled up by grazing livestock. Attempts are being made to overcome this weakness through breeding to obtain a stronger root system.

Big bluegrass is also difficult to establish. Because of its small seed it cannot be seeded as deeply as the wheatgrasses and thus is more subject to drought in the surface layer of soil. Our experience indicates that it may be seeded very early in the spring to obtain stands.

Siberian wheatgrass is a close relative of and closely resembles crested wheatgrass. In this trial it outyielded crested wheatgrass in all years except 1957, when yields of the unfertilized grasses were comparable. The superior yielding ability of siberian as compared to crested wheatgrass has been noted at several dryland sites in Washington and Oregon.[2] On the basis of its performance in this trial siberian wheatgrass might replace crested wheatgrass on many of our drier sites. The species is in certified seed production in Oregon, Idaho, and Nevada, and it is estimated that total 1957 seed production was about 40,000 pounds.[2]

Tall wheatgrass yielded well in years with above average precipitation; however, in the extremely dry year of 1955 it was the lowest yielding of all grasses. This grass was later maturing than the other grasses and was always subject to drought prior to flowering. It is believed that tall wheatgrass is not adapted to this low rainfall area.

Whitmar beardless wheatgrass yields were comparable to those of crested wheatgrass. This grass is well adapted to this area but cannot be grazed as early in the spring as crested wheatgrass. It also has less seedling vigor than crested wheatgrass, and generally produces thinner stands.

Hard fescue was the lowest yielding of all grasses. This grass is a low producer and it is quite unpalatable. Its main use has been considered to be for conservation purposes. At the present time it is not considered to be of value in this area.

Precipitation-yield Relationship

Average yields of the grasses varied widely among years and were in proportion to the amount of precipitation received during the period October-June, inclusive (Table 2). With respect to precipitation, the relative yield rank of grasses (Table 2) is of interest. Both big bluegrass and siberian wheatgrass ranked high in all years regardless of precipitation. Tall wheatgrass ranked fairly high in the wetter years but ranked last in the dry year of 1955. Hard fescue tended to increase in rank in the dryer years and to decrease in rank in the wetter years. The commer-

[2] *Private communication with John L. Schwendiman.*

cial fairway wheatgrass ranked fourth in the dry year of 1955 but was ninth or tenth in the other years.

In testing range grasses the relationship of yield to precipitation is of much importance. The most desirable grass for this area is one which will produce good yields in dry years and respond to favorable years.

The influence of nitrogen fertilization upon grass yields is shown in Table 3. The response to nitrogen is striking and clearly illustrates that nitrogen is a major factor in the growth of range grasses when soil moisture is adequate. Soil moisture was not limiting through most of the growth period in 1957, which was an exceptionally good year.

The response to nitrogen varied among species as shown by the yield increase percentages listed in Table 3. The very poor response of hard fescue to nitrogen fertilization indicated that this grass may have a low nitrogen requirement. The response of tall wheatgrass to nitrogen was very poor. This is reasonable because its period of most active growth occurs later in the season than for the other grasses and at a time when soil moisture is rapidly becoming depleted. The magnitude of the response of a grass to nitrogen is dependent upon the availability of soil moisture and in particular on the availability of moisture in the surface foot of soil, for it is in this area that most of the nitrogen from a fertilizer application will be concentrated.

Table 3. Yields of 7 grass species with and without nitrogen in 1957.

Species	Nitrogen Treatment		Yield increase
	None	30 Lbs./Acre	
	Pounds per Acre	Pounds per Acre	Percent
A. sibericum	1115	3600	223
A. cristatum	880	2680	205
A. desertorum	1120	2800	150
A. inerme	912	2239	146
P. ampla	1394	3319	138
A. elongatum	1069	1792	67
F. ovina var. *duriuscula*	701	901	28
Average	1027	2476	

Conclusion

On the basis of the data presented both big bluegrass and siberian wheatgrass merit further consideration. Big bluegrass, because of its earliness and high yielding ability, could readily replace crested wheatgrass for range seedings if a strain can be developed which has a stronger root system. Siberian wheatgrass shows considerable promise and should be seeded on limited acreages for observation under grazing.

Until both of these grasses receive further evaluation, crested wheatgrass should continue to be the principal grass used in operations on the Oregon High Desert.

Summary

Four strains of crested wheatgrass, 2 strains of fairway wheatgrass, and 1 strain each of siberian wheatgrass, Whitmar beardless wheatgrass, tall wheatgrass, big bluegrass, and hard fescue were seeded in 1952. Herbage yields were measured in each of the succeeding 5 years. In 1957 the response to nitrogen fertilization was measured.

Big bluegrass and siberian wheatgrass were the two highest yielding species for the 5-year period.

Tall wheatgrass yielded well in good years but was a poor performer in years of low precipitation and is not believed to be adapted to this area.

Whitmar beardless wheatgrass is well adapted but cannot be used as early in the spring as crested wheatgrass and has weaker seedling vigor.

There were no significant differences among strains of crested or fairway wheatgrass.

Hard fescue is not believed to be of value because of its low yielding ability and low palatability.

Average yields of grasses varied widely among years and were in proportion to the amount of precipitation received during the period October-June, inclusive.

Nitrogen fertilization caused striking increases in the yields of all species except hard fescue and tall wheatgrass. The poor response of hard fescue was attributed to a low nitrogen requirement for this grass, and the poor response of tall wheatgrass was attributed to its most active growth period occurring later in the season than the other grasses and at a time when inadequate soil moisture limited the response to nitrogen.

It was concluded that if a stronger root system can be developed, big bluegrass would be preferred on many sites, and that siberian wheatgress may be substituted for crested wheatgrass, if grazing tests prove it to be tolerant of grazing. At the present time, however, crested wheatgrass is preferred in range seeding operations on the Oregon High Desert.

LITERATURE CITED

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