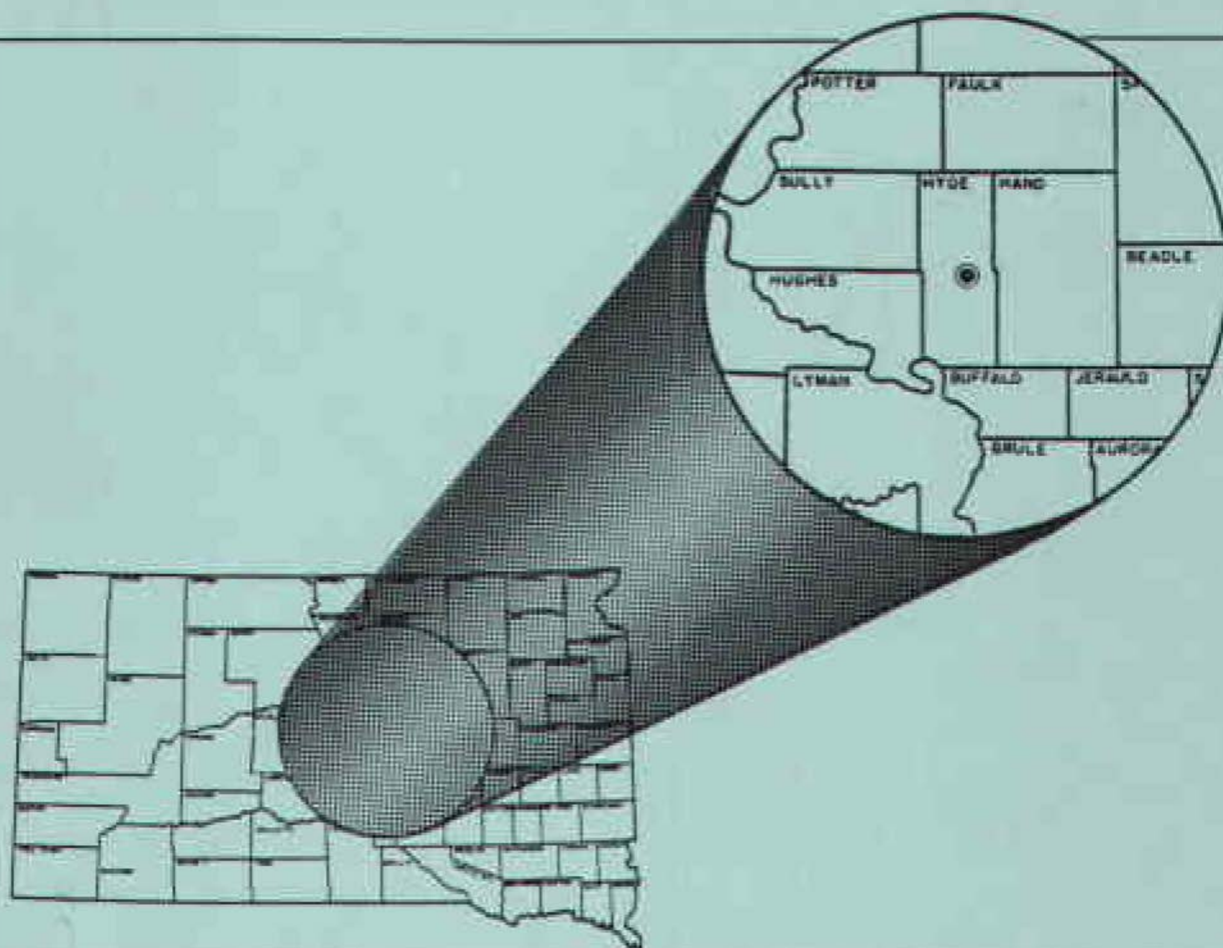
Plant Science Pamphlet No. 16
ANNUAL PROGRESS REPORT

January, 1989

Progress Report 1988

Central Crops and Soils Research Station Highmore, South Dakota



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This report of the Central Crops and Soils Research Station at Highmore, South Dakota is a progress report and, therefore, the results presented are not necessarily complete nor conclusive. Any interpretation given is tentative because additional data from continuation of these experiments may produce conclusions different from those of any one year. The data presented in this report reflect the 1988 growing season.

Commercial companies and trade names are mentioned in this publication solely for the purpose of providing specific information. Mention of a company does not constitute a guarantee or warranty of its products by the Agricultural Experiment Station or an endorsement over products of other companies not mentioned.

This publication also reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and Federal agencies before they can be recommended. A complete set of 1988 results from SDSU herbicide demonstrations is available as Extension Circular 678 from your County Agent or SDSU.

South Dakota Agricultural Experiment Station
Brookings, South Dakota 57007

Dr. David Bryant, Dean   Dr. Raymond Moore, Director

INTRODUCTION....................................Brad G. Farber, Manager

This progress report marks the completion of the 89th consecutive year of agricultural research at the Central Crops and Soils Research Station at Highmore, South Dakota. Research began in the Spring of 1899 shortly after Highmore residents, Frank and Lillie Drew, donated 117 acres of land on the outskirts of Highmore. This land was given to the Agricultural Experiment Station with the stipulation that research be conducted to determine "drought resisting forage crops".

Much of the current research at this station continues to emphasize the development, improvement and management of forages suited to environmental conditions that exist in central South Dakota. New forages are continually being evaluated and Highmore serves as a testing location for selecting new varieties of existing forage crops.

Small grains and row crops have also been evaluated since the farm began, for resistance to the various environmental and biological stresses. This station generally allows plant breeders the ability to evaluate their experimental materials under more adverse conditions than those in eastern South Dakota.

Other ongoing research on this station includes: determining nitrogen requirements for corn in central South Dakota; weed control demonstrations in wheat, corn, sorghum, and other crops; potential new crops for the central area; soybean research; establishment of trees using drip irrigation; and evaluation of trees and shrubs for central South Dakota.

Weather conditions at the research farm in 1988 were similar in many respects to the rest of South Dakota. However, total rainfall for the year was only two inches below average (Table 4). The primary stress that damaged nearly all crops in 1988 was the severe heat. Table 3 shows that temperatures in all months from March through August were above the long-term average. June heat most likely hurt yields of small grains more than moisture stress. Precipitation and temperature data for 1987 are also included since a progress report was not printed in 1987 (Tables 1 and 2).

Maintenance and repairs to the residence and seedhouse were begun in 1988. All windows were replaced and new vinyl siding installed on the residence. Similar work will begin on the seedhouse in the spring of 1989. This maintenance was long overdue and will add greatly to the function and appearance of these facilities. A new 10' x 14' insulated garage door was added to the west end of the maintenance shop in 1988. This will allow backing of tractors and implements into the shop without unhitching and enable us to repair and maintain equipment during winter months. Two present garage doors on the south side will be closed in to make the shop more energy efficient.

The annual twilight tour of research plots was held on June 22, 1988. The tour was well attended and participants listened to talks on small grain varieties, herbicide evaluations, forage research, potential new forages, alfalfa seeding rates, and tree establishment. Members of U.S. Wheat, the South Dakota Wheat Commission, and wheat industry/government officials from several foreign countries toured the farm on August 9, 1988.

The hard work of everyone involved in conducting the research, input and promotion of the farm by Advisory Board members and County Agents, and most of all support from producers and ranchers in the area is greatly appreciated. If anyone has comments or suggestions pertaining to research on the farm or questions and input on any other matter, please write or call.

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Table 1. Temperatures at the Central Research Farm - 1987.

Month	1987 Average Temperatures[a] Max.	Min.	Average	Normal[b]	Departure from normal
	°F				
January	36.5	14.2	25.4	12.6	+12.8
February	41.9	21.6	31.8	19.5	+12.3
March	40.0	22.9	31.5	29.7	+ 1.8
April	67.2	37.3	52.3	45.7	+ 6.6
May	77.0	50.5	63.8	57.5	+ 6.3
June	86.2	55.4	70.8	67.3	+ 3.5
July	91.3	61.9	76.6	74.0	+ 2.6
August	81.9	56.0	69.0	72.7	- 3.7
September	76.3	47.6	62.0	62.0	0.0
October	59.5	30.5	45.0	50.1	- 5.1
November	46.4	27.4	36.9	32.4	+ 4.5
December	34.2	16.5	25.4	19.9	+ 5.5

[a] Calculated from daily observations.
[b] 30 year average (1951-1980).

Table 2. Precipitation at the Central Research Farm - 1987.

Month	1987 Precipitation	Normal[a]	Departure from normal	Greatest amount	Date
	inches				
January	0.15	0.34	-0.19	0.10	3
February	2.55	0.57	+1.98	1.20	28
March	4.00	0.91	+3.09	2.70	17
April	0.77	2.08	-1.31	0.62	13
May	1.94	2.69	-0.75	0.87	20
June	1.60	3.28	-1.68	0.95	21
July	2.97	2.57	+0.40	1.35	12
August	3.34	2.33	+1.01	0.95	27
September	1.51	1.32	+0.19	0.45	16
October	0.10	1.24	-1.14	0.10	16
November	0.68	0.53	+0.15	0.25	16
December	0.30	0.47	-0.17	0.10	10
TOTALS:	19.91	18.33	+1.58		

[a] 30 year average (1951-1980).

Table 3. Temperatures at the Central Research Farm - 1988.

Month	1988 Average Temperatures[a] Max.	Min.	Average	Normal[b]	Departure from normal
	°F				
January	22.7	1.6	12.2	12.6	-0.4
February	29.0	6.3	17.7	19.5	-1.8
March	48.9	21.5	35.2	29.7	+5.5
April	64.6	31.7	48.2	45.7	+2.5
May	74.5	49.7	62.1	57.5	+4.6
June	90.3	61.5	75.9	67.3	+8.6
July	92.0	61.1	76.6	74.0	+2.6
August	90.5	60.6	75.6	72.7	+2.9
September	75.4	46.5	61.0	62.0	-1.0
October[c]	62.3	30.0	46.2	50.1	-3.9
November[c]	41.2	19.8	30.5	32.4	-1.9
December	32.7	11.8	22.3	19.9	+2.4

[a] Calculated from daily observations.
[b] 30 year average (1951-1980).
[c] October and November data from a recording station 23 miles north-northwest of Highmore.

Table 4. Precipitation at the Central Research Farm - 1988.

Month	1988 Precipitation	Normal[a]	Departure from normal	Greatest amount	Date
	inches				
January	0.05	0.34	-0.29	0.05	12
February	0.15	0.57	-0.42	0.10	9
March	0.15	0.91	-0.76	0.15	12
April	1.35	2.08	-0.73	0.55	30
May	4.31	2.69	+1.62	1.23	22
June	2.22	3.28	-1.06	1.15	13
July	2.19	2.57	-0.38	1.40	1
August	1.84	2.33	-0.49	0.79	2
September	1.90	1.32	+0.58	1.20	19
October[b]	0.06	1.24	-1.18	0.05	27
November[b]	0.86	0.53	+0.33	0.30	12
December	1.10	0.47	+0.63	0.55	22
TOTAL	16.18	18.33	-2.15		

[a] 30 year average (1951-1980).
[b] October and November data from a recording station 23 miles north-northeast of Highmore.

PERENNIAL WARM-SEASON GRASS BREEDING

Arvid Boe and Kathy Robbins

Switchgrass (*Panicum virgatum*) and big bluestem (*Andropogon gerardii*) are tall, native, perennial, warm-season grasses that have the potential to produce large amounts of good quality forage during the summer when native and introduced cool-season grasses are dormant and of poor forage quality.

Space-plant nurseries were established in 1986 and 1987 for big bluestem and switchgrass, respectively. These nurseries are comprised of open-pollinated progenies of genotypes selected at Brookings for forage and seed yield and quality characteristics.

Since the traits of interest for these long-lived species are influenced to a significant degree by the interaction of particular genotypes with local environments, data will be collected for 2-3 years before further selections are made. Synthetic varieties will be developed based on the performance of these progenies at Highmore and Brookings, and will be subjected to broad-scale forage and seed yield tests prior to cultivar release.

The long-range goal of this research is the development of switchgrass and big bluestem cultivars adapted to central South Dakota that possess enhanced seed production and quality and improved forage quality characteristics compared to present-day cultivars.

WARM-SEASON ANNUAL GRASS PRODUCTION

Arvid Boe and Kathy Robbins

Warm-season annual grasses, such as Sudangrass (*Sorghum bicolor*) and foxtail millet (*Setaria italica*), grow well under warm and dry conditions and can be used to help meet feed shortages during mid- to late-summer when cool-season perennial grass pastures decline in forage productivity and quality.

Warm-season annual grasses exhibit great diversity in growth rate, recovery after clipping or grazing, plant height, and forage production and quality. Production of high quality forage in central South Dakota cannot be maximized unless appropriate harvest management schemes are developed for each species.

The objective of this preliminary research was to determine the effects of time of harvest on first crop and regrowth forage production of Sudangrass, foxtail millet, and teff (*Eragrostis tef*). These results, when combined with data obtained from other experiments in subsequent years at Highmore and other locations in the state, will provide the basis for development of management recommendations for each species.

EXPERIMENTAL APPROACH

'Piper' Sudangrass, common foxtail millet, and SD100 teff were planted on June 17, 1988 in a randomized complete block design of 8 replications of single-row plots that were 30 feet long. The interrow spacing between plots within and between replications was 3 feet. Planting rates were 30, 20, and 10 pounds pure live seed/acre for Sudan, f. millet, and teff, respectively. The first harvest was made on July 19, 1988. At that time, each row was divided into three 10 foot subplots, one of which was harvested to a stubble height of approximately 2 inches. The harvested forage was weighed in the field and moisture samples were obtained from each plot for determination of dry matter percentage. The Sudangrass was in early anthesis, the f. millet was in the soft dough stage, and the teff was in the early head stage.

The second harvest was made on August 9, 1988 from a second 10 foot subplot in each row as described above for the first harvest. The Sudangrass was in the medium to hard dough stage, the f. millet had approximately 75% mature (orange) seed, and the teff was in the hard dough stage.

Regrowth for the first and second harvest subplots was harvested on September 13, 1988 as described above for the first and second harvests. No regrowth was obtained from the second harvest of f. millet and teff subplots.

RESULTS AND DISCUSSION

'Piper' Sudangrass produced significantly more dry matter forage than f. millet or SD100 teff (Table 1). A separate analysis of the Sudangrass data revealed that the July 19 + regrowth harvests treatment (6.5 tons/acre) significantly outyielded the August 9 + regrowth treatment (4.7 tons/acre). These results suggested that full-season forage yields of Sudangrass can be strongly influenced by stage of plant development at initial harvest and have important ramifications regarding managing the crop for quality as well as yield. The difference in regrowth production may be related to a higher degree of tillering in the first harvest regrowth plots in addition to the longer period over which regrowth occurred.

Regrowth yields from the first harvest were small for f. millet and teff (Table 1), and essentially no growth was obtained from the second harvest subplots. Forage yields of teff were influenced by a heavy infestation of a tiny chalcid wasp (Eurytomidae), larvae of which fed inside the basal 2-3 internodes of the stem.

Results of this preliminary study suggested that timing of the initial and subsequent harvests should be further evaluated as a management tool for influencing the production and quality of warm-season annual grasses. Experiments planned for 1989 and subsequent years will address this concept.

Table 1. Mean dry matter forage yields of 3-warm season annual grasses planted at Highmore on June 17, 1988.

	Harvest[1]					
	First	Regrowth of first		Second	Regrowth of second	
Species	July 19	Sept. 13	Total	Aug. 9	Sept. 13	Total
	tons/A					
Sudangrass	3.3a	3.2a	6.5a	4.0a	0.7	4.7a
Millet	1.5b	0.4b	1.9b	2.2b	--	2.2b
Teff	0.7c	0.4b	1.1c	1.1c	--	1.1c

[1] Within-row means followed by a different letter are significantly different by LSD 0.05.

SUMMER ANNUAL LEGUME PRODUCTION

Arvid Boe and Kathy Robbins

In the northern Great Plains, cool-season grass pastures decline in productivity and forage quality in mid- to late summer. Some practical solutions to forage shortages during the summer period include perennial warm-season grass pastures (e.g. big bluestem, switchgrass, Indiangrass, side-oats grama), warm-season annual grass pastures (e.g. Sudangrass, forage sorghum, foxtail millet, pearl millet), greenchop, hay, or silage.

Summer annual legumes have been used for soil improvement, pasture, hay, and silage in the southern United States. Mungbeans (*Vigna radiata*) have been grown quite extensively in Oklahoma for food and forage. Cowpeas (*Vigna unguiculata*) are grown on about 200,000 acres annually in the United States, with Georgia, California, and Texas accounting for about 65% of the total acreage. They are grown primarily as a vegetable and dry bean, but have been utilized for hay, silage, and pasture. Approximately 50,000 tons of cowpea hay were harvested in the United States in 1969. Both crops grow well on infertile, sandy soils and are tolerant of drought and hot weather.

Objectives of recent research at SDSU have been to evaluate effects of row spacing and plant population (density) on forage production of cowpeas and mungbeans at several locations in South Dakota. Data obtained should be useful for determining the adaptability of these legumes to diverse environments and forage production systems in the northern Great Plains.

Experimental Approach

'Victor' cowpeas and a mungbean blend were planted at 2 rates (100,000 and 200,000 pure live seeds/acre) in 3 row-spacings (10-, 20-, and 30-inch) treatments, replicated 3 times in a randomized complete block design on May 25, and harvested on July 27 when plants were in early pod stages.

Results

Forage yields for both cowpeas and mungbeans increased with decreased row-spacing, indicating superiority of narrow rows for forage production (Table 1). The forage yield advantage of narrow rows may be due to less intra-row plant competition in the narrow rows. Distances between plants in wide rows were closer than distances between plants in narrow rows at the same planting rates.

'Victor' cowpeas outyielded the mungbean blend, but evaluations of more cultivars of each species are needed for identifying cultivars that are well-adapted to the northcentral part of the state.

Forage yields of the 100,000 and 200,000 pure live seeds/acre seeding rates were similar, indicating no practical advantage to the higher seeding rate. Stand establishment was excellent for both planting rates. However, increased plant density in the high seeding rate plots was generally offset by larger individual plant size in the low seeding rate plots. As part of the study, data were also collected on forage yield components and leaf-to-stem ratio. Results were inconclusive and suggest further research is needed to determine if population density and inter- and intra-row spacing can be utilized to influence forage quality in these species.

Discussion

This preliminary study indicated cowpeas and mungbeans offer potential as summer annual or emergency forage crops in northcentral South Dakota. These annual legumes produced at least 2 tons of dry matter/acre at 3 locations during the drought year of 1988 from plantings made in late May to early June and harvested for forage in late July to mid August. During the severe droughts of the mid 1930's, when most crops were failures, mungbeans grew well in central Oklahoma, and cowpeas are also well-known for their ability to grow in areas with heat and drought stresses too extreme for other annual legumes.

Both species have been successfully utilized as hay and silage. Hay from these legumes may be somewhat stemmy, but no fermentation or palatability problems have been associated with mungbean silage.

Seed costs have been low ($2.00-$5.00/ acre; 15-20 lbs/acre at $18.00-$30.00/100 lbs), but will fluctuate with domestic production. Both species can be easily planted with conventional equipment. Grain drills were used to plant evaluation plots (1-5 acres) adjacent to experimental plots at each location in 1988, and excellent stands were obtained. In Oklahoma, mungbeans are drill-planted after winter wheat to provide a late summer or early fall hay or silage crop (Leroy Mack, Johnston Seed Co., Enid, OK; personal communication). Additional studies are needed to determine if double-cropping with small grains is a viable alternative in our area.

The encouraging results of this preliminary research have provided strong incentive for additional studies on these and other annual legume and grass species. New forages that complement or supplement our traditional perennial grasses and legumes add flexibility to forage production systems and can be extremely valuable to forage producers in the climatically unpredictable northern Great Plains.

Table 1. Dry matter forage production of cowpeas and mungbeans planted at Highmore on May 25 and harvested on July 27, 1988.

Legume	Row Spacing 10"	20"	30"	Grand mean[1]
	tons/acre			
Cowpea	3.1	2.5	2.5	2.7[a]
Mungbean	1.9	1.6	1.5	1.7[b]
Grand Mean[1]	2.5a	2.0[b]	2.0[b]	

[1] Means in species column and row-spacing row that are followed by a different letter are significantly different at the 0.05 level.

ALFALFA SEEDING RATE EXPERIMENT

K. D. Kephart, E. K. Twidwell, and R. Bortnem

An experiment was planted in 1985 to determine the yield response of two modern alfalfa cultivars ('Big-10' and '532') to seeding rate (2 to 30 lbs PLS per acre in 2 lbs per acre increments). Plots were not harvested for yield in the seeding year (1985). In 1986, total seasonal dry matter yield increased with increasing seeding rate up to about 10 lbs PLS per acre (Fig. 1a). The two cultivars did not significantly differ in response to seeding rate. Total seasonal dry matter yield did not respond to seeding rate in 1987 (Fig. 1b).

Yield component measurements were obtained by hand-harvesting in 1988. Additionally, alfalfa roots were excavated to reliably determine stand density. Similar to 1987, alfalfa yield did not respond to seeding rate in 1988 (Fig. 2a). Yield components, however, differed significantly according to seeding rate. Stand density was lowest for the low seeding rate, whereas, shoots per plant and shoot weight was greatest for the low seeding rate (Fig. 2b-2d). At the high seeding rate there were approximately 25 plants per ft^2, but each plant had only 1 to 2 shoots and each shoot was considerably lighter than those for the low seeding rates.

Weed yields were highest for the low seeding rates. Leaf-to-stem ratio and stem length were not significantly affected by seeding rate suggesting that forage quality was not greatly influenced by seeding rate.

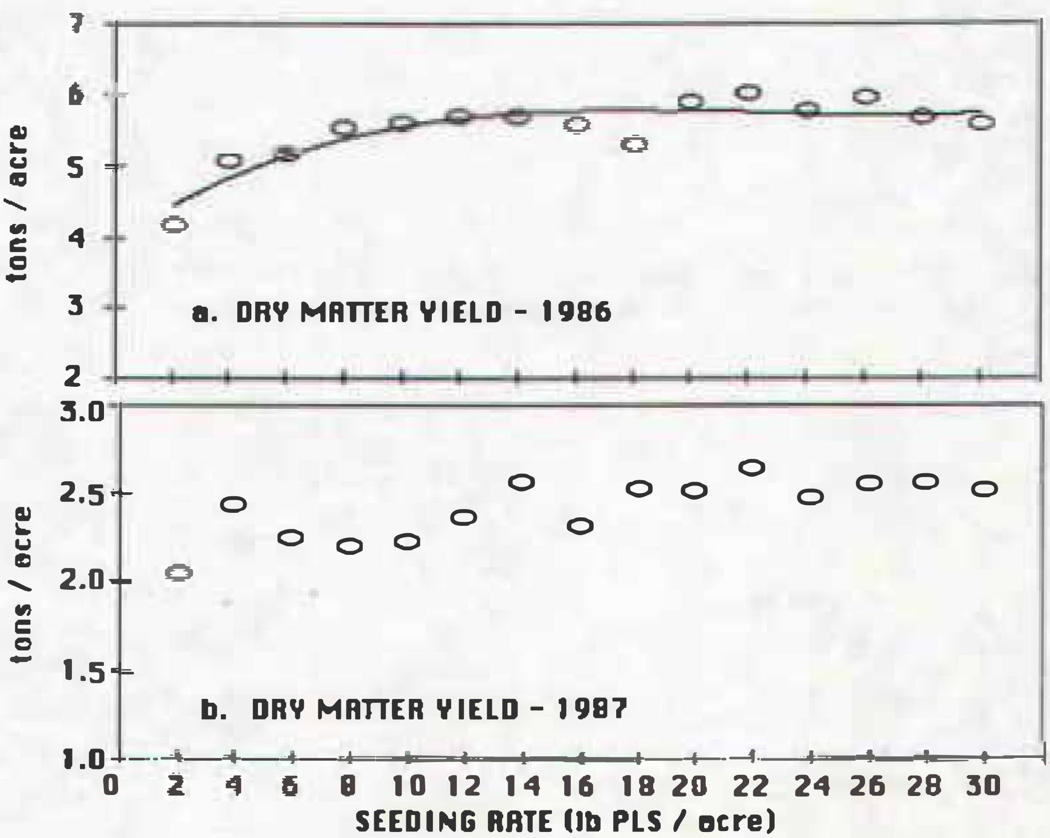


Figure 1.

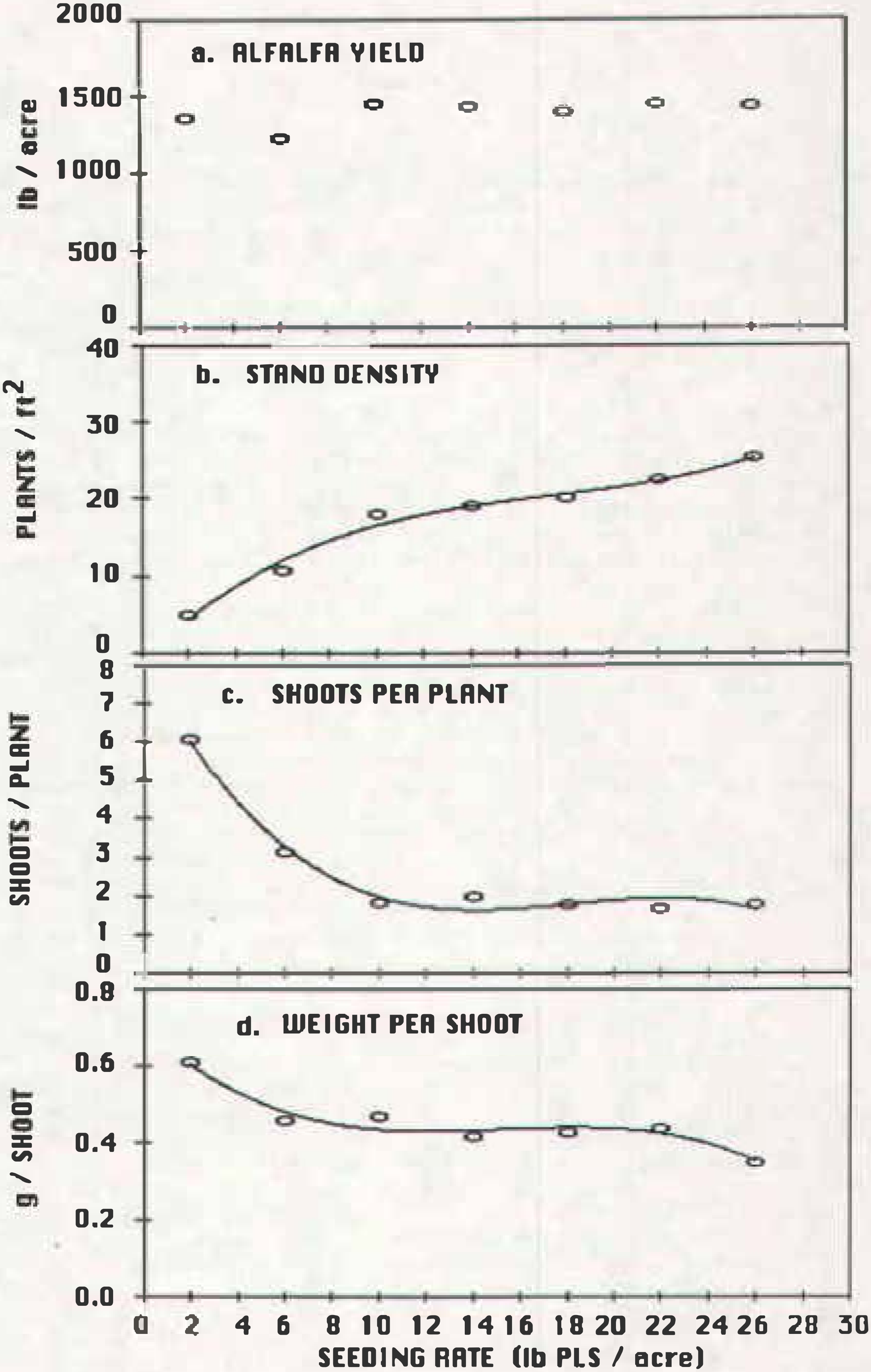

a. ALFALFA YIELD
lb / acre
2000
1500
1000
500
0
b. STAND DENSITY
PLANTS / ft²
40
30
20
10
0
c. SHOOTS PER PLANT
SHOOTS / PLANT
8
7
6
5
4
3
2
1
0
d. WEIGHT PER SHOOT
g / SHOOT
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
SEEDING RATE (lb PLS / acre)

Figure 2.

ALFALFA CULTIVAR YIELD TEST - 1987

E. K. Twidwell, K. D. Kephart, and R. Bortnem

Four alfalfa cultivar yield experiments were conducted at the Central Crops and Soils Research Station during 1987. The objective of these studies was to determine the yield performance of various alfalfa cultivars and experimental lines when grown in central South Dakota.

The first of these experiments included 36 hay-type alfalfa cultivars and was planted on 17 April 1985. No yield data was collected in 1985 because of limited alfalfa growth and weed infestations. Environmental conditions were conducive for alfalfa production in 1986 as four harvests were obtained. Average seasonal dry matter yield for this experiment was 5.67 tons per acre with a range of 1.51 tons per acre (Table 2). Two harvests were obtained during the 1987 growing season, and this is the last year that field data will be collected from this study. The average total seasonal dry matter yield for this experiment was 2.26 tons per acre. Precipitation was the major factor that limited the number of harvests in 1987. Two-year average dry matter yields of the cultivars ranged from 4.38 to 3.47 tons per acre.

The second experiment was also established on 17 April 1985. This experiment consisted of 19 pasture-type cultivars and experimental lines. Similar to the first study, no harvests were obtained in 1985, four were obtained in 1986, and two were obtained in 1987. In 1986 the average total seasonal dry matter yield was 4.01 tons per acre (Table 1), which was 1.7 tons per acre less than the first study. This difference is due to differences in growth habit between pasture-type and hay-type alfalfa cultivars. Pasture-type cultivars are less erect, slower to recover after cutting, and more winterhardy than most hay-type alfalfas. These cultivars are better suited to grazing because they have broad, deep-set crowns and spreading root systems. In 1987 the average total seasonal dry matter yield was 1.83 tons per acre, which was 0.43 ton per acre less than the first study. Two-year average dry matter yields of the cultivars ranged from 3.87 to 1.37 tons per acre. Results of this study indicate that there are some dramatic yield differences among these pasture-type cultivars.

The third experiment consisted of 24 hay and pasture-type cultivars and was established on 10 April 1986. Three harvests were obtained in both 1986 and 1987 with average seasonal dry matter yields of 2.26 and 2.88, respectively (Table 3). Two-year average dry matter yields of the cultivars ranged from 3.00 to 1.87 tons per acre. This yield difference was probably due to the inclusion of both hay and pasture-type cultivars in the study, with the hay-types generally having higher dry matter yields.

The fourth experiment consisted of 24 hay-type cultivars and was seeded on 27 April 1987. The study was cut once in July; however yield data were not determined because of weedy conditions and limited alfalfa growth.

Results of these studies are useful in selection of alfalfa cultivars for hay and pasture production. Measurements of forage yield taken over several years of production are usually more useful than are averages from a single year. Most of the higher yielding hay-type cultivars in these studies are relatively modern and have moderate fall dormancy. Most pasture-type cultivars are lower yielding than the hay-types, but generally are more winterhardy. The major factors to consider when selecting an alfalfa cultivar include multiple disease and pest resistance, moderate fall dormancy, yield potential, intended use, and cost per unit of pure live seed.

Table I. Yield performance of 19 pasture-type alfalfa cultivars planted on 4-17-85 at the Central Crops and Soils Research Station, Highmore, SD[a].

	1986	1987 (tons DM/A)				%
Cultivar	4-Cut Total	Cut-1 5/14	Cut-2 6/29	2-Cut Total	2-yr Avg	Relative Performance[b]
Cossack	5.10	1.37	0.73	2.10	3.87	132
Ladak 65	5.08	1.52	0.78	2.30	3.70	127
Maverick	4.77	1.47	0.84	2.31	3.54	121
Beaver	4.68	1.34	0.75	2.09	3.39	116
Narragansett	4.52	1.43	0.71	2.14	3.33	114
Heinrich's	4.16	1.32	0.73	2.05	3.11	106
Teton	4.19	1.32	0.69	2.01	3.10	106
MT-0	4.18	1.37	0.66	2.03	3.10	106
Spredor II	4.64	1.36	0.63	1.99	3.09	106
Kane	4.25	1.22	0.63	1.85	3.05	104
Travois	4.23	1.17	0.58	1.75	2.98	102
Roamer	3.94	1.18	0.60	1.78	2.86	98
MT-1	3.96	1.20	0.58	1.78	2.74	94
Rangelander	3.48	1.09	0.50	1.59	2.53	87
Drylander	3.54	1.05	0.46	1.51	2.52	86
Rambler	3.40	1.02	0.57	1.59	2.49	85
Semipalitinsk	3.33	1.04	0.48	1.52	2.42	83
Smith's	3.27	0.95	0.44	1.39	2.33	80
Anik	1.72	0.86	0.16	1.02	1.37	47
Average	4.01	1.23	0.61	1.83	2.92	
LSD (0.05)	0.61	0.23	0.17	0.32	0.54	

[a] Insufficient growth in seeding year, no data were collected in 1985.
[b] % Relative Performance based on 2-year average.

Table 2. Yield performance of 36 hay-type alfalfa cultivars planted on 4-17-85 and grown at the Central Crops and Soils Research Station, Highmore, SD[a].

Cultivar	1986 4-Cut Total	1987 (tons DM/A) Cut-1 5/14	Cut-2 7/1	2-Cut Total	2-yr Avg	% Relative Performance[b]
DK 135	6.39	1.54	0.84	2.38	4.38	110
Futura	6.48	1.59	0.70	2.29	4.38	110
Dawson	6.16	1.53	0.93	2.46	4.31	108
Cimarron	6.11	1.57	0.82	2.39	4.24	107
MN 6216	5.98	1.50	0.91	2.41	4.19	106
5432	6.00	1.54	0.77	2.31	4.15	104
XAF31	5.98	1.56	0.76	2.32	4.15	104
Magnum +	6.39	1.62	0.87	2.49	4.14	104
Magnum	5.92	1.58	0.77	2.35	4.14	104
MN 5617	5.65	1.74	0.88	2.62	4.14	104
NY 8412	5.85	1.53	0.85	2.38	4.12	104
Kingstar	5.86	1.51	0.82	2.33	4.09	103
Horizon	5.80	1.61	0.74	2.35	4.08	103
Sparta	5.81	1.50	0.84	2.34	4.08	103
Eagle	6.13	1.38	0.61	1.99	4.06	102
Big 10	5.82	1.43	0.86	2.29	4.05	102
Vernema	5.75	1.58	0.76	2.34	4.04	102
SX 217	5.73	1.48	0.82	2.30	4.02	101
Mohawk	5.68	1.55	0.81	2.36	4.02	101
NY 8413	5.51	1.50	0.88	2.38	3.94	99
Saranac	5.64	1.50	0.74	2.24	3.94	99
8016 PCa3	5.52	1.57	0.75	2.32	3.92	99
Oneida Vr	5.45	1.48	0.90	2.38	3.91	98
120	5.66	1.48	0.66	2.14	3.90	98
Saranac AR	5.55	1.44	0.75	2.19	3.87	97
Baker	5.45	1.53	0.70	2.23	3.84	97
Elevation	5.54	1.42	0.66	2.08	3.81	96
532	5.11	1.57	0.86	2.43	3.77	95
Iroquois	5.46	1.37	0.67	2.04	3.76	95
MN 6209	5.34	1.39	0.72	2.11	3.77	95
Max 85	5.24	1.52	0.65	2.17	3.70	93
526	5.42	1.36	0.60	1.96	3.70	93
Blazer	5.41	1.27	0.64	1.91	3.66	92
Vernal	5.07	1.48	0.60	2.08	3.57	90
Megaton	5.02	1.38	0.68	2.07	3.54	89
Agate	4.88	1.36	0.69	2.05	3.47	87
Average	5.67	1.50	0.76	2.26	3.97	
LSD (0.05)	0.67	1.19	NS	0.36	0.63	

[a] Insufficient growth in seeding year, no data were collected in 1985.
[b] % Relative performance based on 2-year average.

Table 3. Yield performance of 24 alfalfa cultivars planted on 4-10-86 and grown at the Central Crops and Soils Research Station, Highmore, SD.

Cultivar	1986 3-Cut Total	1987 Yield (tons DM/A) Cut 1 5/14	Cut 2 7/1	Cut 3 8/11	3-Cut Total	2-Year Avg	% Relative Performance[a]
5432	2.67	1.59	1.10	0.64	3.33	3.00	117
Edge	2.36	1.54	1.13	0.67	3.34	2.85	111
526	2.50	1.70	1.03	0.46	3.19	2.85	111
Drummor	2.37	1.58	1.12	0.58	3.28	2.82	110
Cimarron	2.83	1.54	0.91	0.31	2.76	2.80	109
Crown	2.60	1.53	1.02	0.44	2.99	2.79	108
AP 45	2.37	1.64	1.00	0.56	3.20	2.78	108
Dart	2.44	1.58	1.01	0.49	3.08	2.76	107
532	2.50	1.50	0.94	0.54	2.98	2.74	107
Surpass	2.24	1.59	0.98	0.62	3.19	2.71	105
120	2.35	1.65	0.98	0.34	2.97	2.66	104
Epic	2.45	1.46	0.95	0.43	2.84	2.65	103
SX 424	2.29	1.51	0.95	0.44	2.90	2.60	101
MTO S82	2.14	1.56	0.94	0.41	2.91	2.52	98
Vernal	2.25	1.58	0.88	0.29	2.75	2.50	97
SX 217	2.50	1.36	0.78	0.38	2.52	2.50	97
WL 225	2.21	1.48	0.84	0.33	2.65	2.43	94
Arrow	2.11	1.57	0.85	0.32	2.74	2.43	94
Heinrich's	1.89	1.33	0.95	0.56	2.84	2.37	92
MTO N82	1.96	1.45	0.89	0.30	2.64	2.30	89
Rangelander	1.83	1.48	0.64	0.56	2.68	2.26	88
Roamer	1.77	1.39	0.73	0.58	2.70	2.23	87
Rambler	1.89	1.23	0.65	0.56	2.44	2.16	84
Drylander	1.63	1.14	0.63	0.34	2.11	1.87	73
Average	2.26	1.50	0.91	0.46	2.88	2.57	
LSD (0.05)	0.06	0.20	0.26	NS	0.64	0.55	

[a] % Relative Performance based on 2-year average.

ALFALFA CULTIVAR YIELD TEST - 1988

K. D. Kephart, E. K. Twidwell, and R. Bortnem

Two alfalfa cultivar yield experiments were conducted at the Central Crops and Soils Research Station during 1988. The objective of these studies was to determine the yield performance of various alfalfa cultivars and experimental lines when grown in South Dakota.

The first of these experiments included 24 hay and pasture-type alfalfa cultivars and was established on 10 April 1986. Three harvests were obtained annually in 1986 and 1987, while only two harvests occurred in 1988. This was due to the drought during the 1988 growing season. The average total seasonal dry matter yield in 1988 was 1.06 tons per acre, compared to 2.26 and 2.88 tons per acre in 1986 and 1987, respectively (Table 1). Three-year average dry matter yields of the cultivars ranged from 2.36 to 1.62 tons per acre. This yield difference was probably due to the inclusion of both hay and pasture-type cultivars in the study. Pasture-type cultivars are generally more winterhardy and slower to recover after cutting than are hay-types. Because of these characteristics, pasture-type cultivars usually yield less than the hay-types. Results from this study support this statement, and it is concluded that if producers desire cultivars for optimum forage production, they should select hay-types.

The second experiment was seeded on 27 April 1987 and included 24 alfalfa cultivars and experimental lines. The study was cut once in July of 1987; however yield data were not determined because of weedy conditions and limited alfalfa growth. Two harvests were made in 1988, with the first and second harvests having average dry matter yields of 1.44 and 0.30 tons per acre, respectively (Table 2). The two-harvest total dry matter yields of the cultivars ranged from 2.23 to 1.24 tons per acre. Although this is a relatively large range in yield performance, no significant yield differences among the cultivars were detected because of the high variability present during the dry conditions in 1988. As uncontrollable variation increases, the power to detect significant differences decreases. It will, however, be interesting to monitor the yield performance of these cultivars during 1989 and determine if the drought conditions have any effect on subsequent yields.

Results of these studies are useful in selection of alfalfa cultivars for hay and pasture production. Measurements of forage yield taken over several years of production are usually more useful than are averages from a single year. The major factors to consider when selecting an alfalfa cultivar include multiple disease and pest resistance, fall dormancy, yield potential, intended use, and cost per unit of pure live seed.

Table 1. Forage yield of 24 alfalfa cultivars planted April 10, 1986 at the Central Crops and Soils Research Station, Highmore, SD.

Cultivar	1986 3-Cut Total	1987 3-Cut Total	1988 Yield (tons DM/A) Cut 1 6/20	Cut 2 8/11	2-Cut Total	3 Year Avg	% Relative Performance[a]
5432	2.67	3.33	0.88	0.22	1.09	2.36	114
526	2.50	3.20	0.90	0.21	1.11	2.27	110
Edge	2.37	3.34	0.86	0.22	1.08	2.26	110
Drummor	2.37	3.27	0.85	0.21	1.06	2.23	108
AP 45	2.37	3.21	0.85	0.21	1.06	2.21	107
Cimarron	2.83	2.77	0.81	0.21	1.02	2.21	107
Crown	2.60	2.99	0.79	0.18	0.97	2.19	106
Dart	2.45	3.08	0.79	0.25	1.03	2.19	106
532	2.50	3.02	0.82	0.21	1.04	2.19	106
Surpass	2.24	3.19	0.82	0.26	1.08	2.17	105
120	2.35	2.98	0.80	0.22	1.02	2.12	103
SX 217	2.49	2.86	0.78	0.21	0.99	2.11	102
Epic	2.46	2.84	0.81	0.21	1.01	2.10	102
Arrow	2.11	2.93	0.79	0.18	0.96	2.00	97
Heinrich's	1.90	2.84	0.98	0.21	1.19	1.98	96
Vernal	2.26	2.76	0.73	0.18	0.90	1.97	96
SX 424	2.30	2.62	0.76	0.17	0.93	1.95	94
MTO S82[b]	2.25	2.62	0.84	0.14	0.98	1.95	94
Roamer	1.77	2.70	1.09	0.27	1.36	1.94	94
WL 225	2.21	2.66	0.74	0.15	0.89	1.92	93
Rangelander	1.83	2.68	0.98	0.23	1.21	1.91	92
MTO N82[b]	1.96	2.64	0.89	0.14	1.02	1.87	91
Rambler	1.88	2.44	1.04	0.20	1.25	1.86	90
Drylander	1.63	2.11	0.98	0.14	1.12	1.62	78
Average	2.26	2.88	0.86	0.20	1.06	2.06	
Maturity[c]			4.8	6.7			
LSD (0.05)	0.34	0.63	NS	NS	NS	0.33	

[a] % Relative performance = cultivar 3-year average yield/3-yr average of all cultivars.
[b] Experimental line, currently not marketed.
[c] Average harvest maturity. Value based on Kalu & Fink (1983) Index, mean stage by count.

Table 2. Forage yield of 24 alfalfa cultivars planted April 27, 1987 at the Central Crops and Soils Research Station, Highmore, SD.

	1988 Forage Yield (tons/DM/A)			%
Cultivar	Cut 1 6/20	Cut 2 8/9	2-Cut Total	Relative Performance[a]
Mohawk	1.75	0.48	2.23	128
Saranac	1.72	0.49	2.21	127
Saranac AR	1.63	0.55	2.18	125
636	1.58	0.49	2.08	119
Iroquois	1.61	0.33	1.94	112
120	1.54	0.35	1.89	109
Big 10	1.48	0.39	1.87	108
Vernal	1.54	0.31	1.85	106
8016 PCa3	1.48	0.33	1.81	104
Magnum III	1.44	0.34	1.79	103
526	1.52	0.22	1.74	100
DK 135	1.40	0.30	1.70	98
MTO N82[b]	1.51	0.19	1.70	98
Cimarron	1.36	0.30	1.65	95
MTO N82[b]	1.53	0.12	1.65	95
Emerald	1.34	0.28	1.61	93
SC 424	1.25	0.35	1.61	92
Blazer	1.35	0.24	1.59	91
Eagle	1.34	0.22	1.56	90
WL 225	1.27	0.22	1.50	86
532	1.28	0.20	1.48	85
NAPB 31	1.30	0.14	1.44	83
Dynasty	1.28	0.14	1.42	82
SX 217	1.08	0.16	1.24	71
Average	1.44	0.30	1.74	
Maturity[c]	4.7	7.7		
LSD (0.05)	0.35	NS	NS	

[a] % Relative performance = cultivar 2-cut total average yield/2-cut average of all cultivars.

[b] Experimental line, currently not marketed.

[c] Average harvest maturity. Value based on Kalu & Fick (1983). Index, mean stage by count.

ALFALFA SEED CHALCID BIOLOGY AND TAXONOMY

Arvid Boe and Burruss McDaniel

The alfalfa seed chalcid (*Bruchophagus roddi*) is a small wasp (the adult is about 1/16 inch long) that may destroy more than 90% of the alfalfa seed crop in certain localities and years. The female chalcid lays her eggs in developing seeds by forcing her ovipositor through the green pod. The larva devours the entire contents of the seed, leaving only the seed coat. The germinability of the seed is completely destroyed as a result of the larvae consuming the embryo.

Seed pod collections made at numerous locations in central and eastern South Dakota in 1987 and 1988 revealed the alfalfa seed chalcid occurs throughout the eastern one-half of the state. The insect was first recorded in South Dakota from Newell in the early 1900's, and it is undoubtedly present wherever alfalfa is grown in the state.

Objectives of research at Highmore are to (1) determine the frequency of seed predation by natural populations of the alfalfa seed chalcid in first and second cutting seed crops, and (2) determine life history characteristics and biological control potential of naturally-occurring parasites (these are also tiny wasps) of the alfalfa seed chalcid.

In summer and fall 1988, random samples of pods were collected from nursery plants that were either allowed to produce seed from the initial spring growth or from regrowth produced after cutting in early June. Pods collected in the field were placed in rearing chambers in the laboratory at Brookings, and adult seed chalcids and parasites are being trapped, identified, and counted as they emerge from the pods.

Seven parasites (all chalcid wasps) have been obtained to date (10 Jan. 1989) from the samples, indicating several potential biological control species occur at Highmore. Data are currently being obtained on the frequency of seed predation by the alfalfa seed chalcid as it relates to time of seed development, which was controlled by cutting.

Future experiments will continue to address life history characteristics of the alfalfa seed chalcid and its parasites and the effects of timing of seed development on seed predation by the alfalfa seed chalcid. Results will be reported in the 1989 and subsequent annual reports.

THE INFLUENCE OF FERTILIZER PHOSPHORUS ON CRESTED WHEATGRASS

Ron Gelderman, Jim Gerwing and Ed Twidwell

Data correlating soil tests to yield response of grass due to added phosphorus is lacking in South Dakota. In fact, very few studies are available throughout the region studying grass seed yields in relation to phosphorus additions. The available data indicate little grass forage yield response with a Bray-1 soil test above 15 lb/A. However additional studies are needed with tests below this critical level.

The objective of this study is to determine the influence of added phosphorus 1) on crested wheatgrass seed and forage yields 2) on phosphorus uptake by crested wheatgrass and 3) on soil test P levels under grass.

METHODS

The study was conducted on the Mike Cowan farm in Hyde County, legal description - NW1/4,NE1/4,Sec. 27,R73W,T111N. The soil at this site is classified as Highmore (fine-silty, mixed, mesic typic Arguistoll). These soils are silt loams formed from a silty glacial drift. The soil test levels for the plot area are given in Table 1. The soil tests indicate fairly typical soil fertility levels for soils under grass in this area. Potassium and organic matter are high, pH is near neutral and phosphorus is considered medium (17 lb/A/6"). Available nitrate-nitrogen is very low as is typically found under grassland conditions.

The site has a good stand of crested wheatgrass estimated to be at least 15 years old. Very little fertilizer or manure had been applied to the stand over this time. The rates of phosphorus applied were 0, 30, 60, 90 and 180 lb/A of P_2O_5 as 0-46-0 (Triple super phosphate). The experimental design was a randomized complete block with four replications. Sixty pounds of N/A (as urea) was applied over the whole plot to eliminate nitrogen as a limiting nutrient. The fertilizer was hand spread on 28 March 1988. At the time of application, the soil was moist to a depth of 8 inches and the grass was just breaking dormancy.

Forage harvest was done with a lawn mower on 12 June 1988, by cutting an area of 19.5 square feet. The sample was weighed and a subsample was taken for moisture determination. A random sample of standing plant material was hand clipped for phosphorus determination to eliminate soil contamination from the mechanical mower. Seed yields were taken on 18 July 1988 by clipping seed heads from one square yard of plot area. These samples were dried, cleaned and weighed. An estimate of fertile seed was determined by applying air to the cleaned seed. The weight of seed that settled to the bottom of the air chamber was divided by total seed weight x 100 to determine % fertile seed.

The remainder of plant material was removed from the plots on 18 July. Soil samples were taken from each plot on 27 September 1988 and composited by replicate.

Rainfall for the growing season at this site was considered fair. However, the high temperatures in May and June limited growth of the cool season crested wheatgrass. Rainfall through 13 June, 18 July and 27 September was 5.55, 8.65 and 10.85 inches respectively.

RESULTS

The influence of the application of phosphorus on crested wheatgrass is shown in Table 2. Added phosphorus significantly increased forage yield (0.13 level). The 180 lb P_2O_5 rate increased yields by 15% over check yields. Added P_2O_5 significantly increased forage phosphorus content. Although the absolute increase is small (0.035%), it is very consistent and shows that the applied phosphorus was taken into the plant. This data is also displayed graphically in Figure 1. Seed yields were not influenced by added phosphorus fertilizer nor was seed fertility. There was considerable variability in seed yields. This reflects the low seed yield at the site and possibly a sampling area that was too small. Weather conditions were not conducive to cool season grass-seed production in the spring of 1988.

Two months after the treatments were applied there were a number of phosphorus fertilizer granules still laying on the surface, apparently only partially dissolved. An analysis of some of the pellets revealed an average P_2O_5 content of 29%. The amount of material still undissolved is difficult to quantify. An estimate of 10-30% of the total granules applied were still identifiable on the soil surface on 6 June, after 4.65 inches of rainfall. In fact, on 27 September, many granules were still visable on the soil surface after 10.85 inches of moisture.

The efficiency of phosphorus uptake may have been limited because of slow dissolution of phosphorus on the soil surface. This conclusion is supported somewhat by higher yield and forage P content with the highest rate of P_2O_5 (Table 2, Figure 1). Generally, if phosphate is mixed with the soil, yield and uptake are maximized before a rate of 180 lb/A P_2O_5 is reached.

To determine if the phosphorus fertilizer raised Bray-I soil phosphorus, soil samples were taken in the fall by 2 inch increments, to a depth of 6 inches. Care was taken not to sample over a recognizable fertilizer pellet. The results of these analysis are shown in Table 3.

From these results it can be seen that most of the increase in soil test P occured in the surface two inches. In other words, phosphorus does not move a great deal after it is applied and no tillage is done. However, there is an increase in the concentration of the 2-4" soil P test level with increasing rates of P. This would indicate some movement downward. Because of the very dry conditions in the spring of 1988, the rains that did fall probably did not wet the soil further than 6 inches. Therefore, surface applied phosphorus would have been available when rains allowed adequate soil moisture to permit root feeding in the upper soil surface.

The average Bray-I soil test value (0-6") for each rate was calculated and is shown in Table 3 and Figure 2. The application of P fertilizer increased the Bray-1 soil test in a linear manner. The equation for this line is Soil Bray P test = 15.7 + 0.16 (fertilizer P_2O_5). This says that it takes about 6.3 pounds of fertilizer P_2O_5 to raise soil test P one pound. This appears to be good efficiency in that many soils have a ratio of 7 or 8 to 1. However, most of the fertilizer P is in the top 2 inches of soil and therefore, is not exposed to as much soil as cultivated soils.

This experiment will be continued to monitor the affect of the residual phosphorus on grass production. In addition, a placement study may be initiated to determine if phosphorus utilization can be improved over broadcast placement under grassland conditions.

Table 1. Spring soil test levels, Phosphorus Grass study, Hyde Co. 1988.

Depth	NO_3-N	P	K	OM	pH	salts
inches	------ lb/A	------		%		mmho/cm
0-3	2	12	720	4.7	6.7	0.3
3-6	1	5	600	3.8	6.6	0.3
6-24	3	---	---	---	---	---

Table 2. Influence of applied phosphorus on crested wheatgrass parameters, Hyde Co. 1988.

Rate of P_2O_5	Forage yield[1]	Forage P content	Seed yield	Seed fertility
lb/A	lb/A	% P	lb/A	%
0	2019	0.120	108	72
30	2038	0.138	133	71
60	2200	0.140	119	70
90	2054	0.145	138	76
180	2317	0.155	104	66
Pr>F	0.13	0.004	0.63	0.59
CV%	8.2	6.9	30.3	11.3

1 Dry matter basis

Table 3. Influence of broadcast phosphorus fertilizer on soil test P level under grass, Hyde Co. 1988.

Rate of P_2O_5	----- Bray-1 test Depth (inches) 0-2	2-4	4-6	------- Ave. 0-6
lb/A	---- ppm		----	lb/A
0	14	4	3	14
30	22	6	3	21
60	27	7	3	25
90	39	8	3	33
180	50	10	4	43

Figure 1. Influence of broadcast phosphorus fertilizer on crested wheatgrass P concentration.

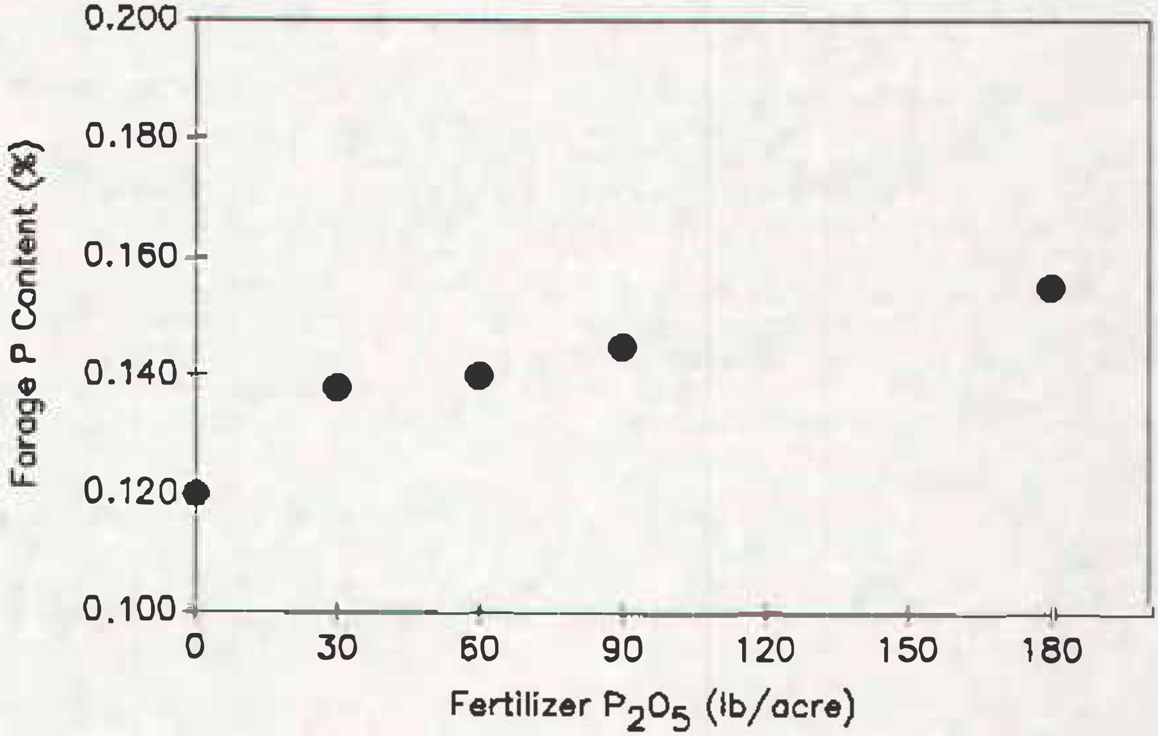
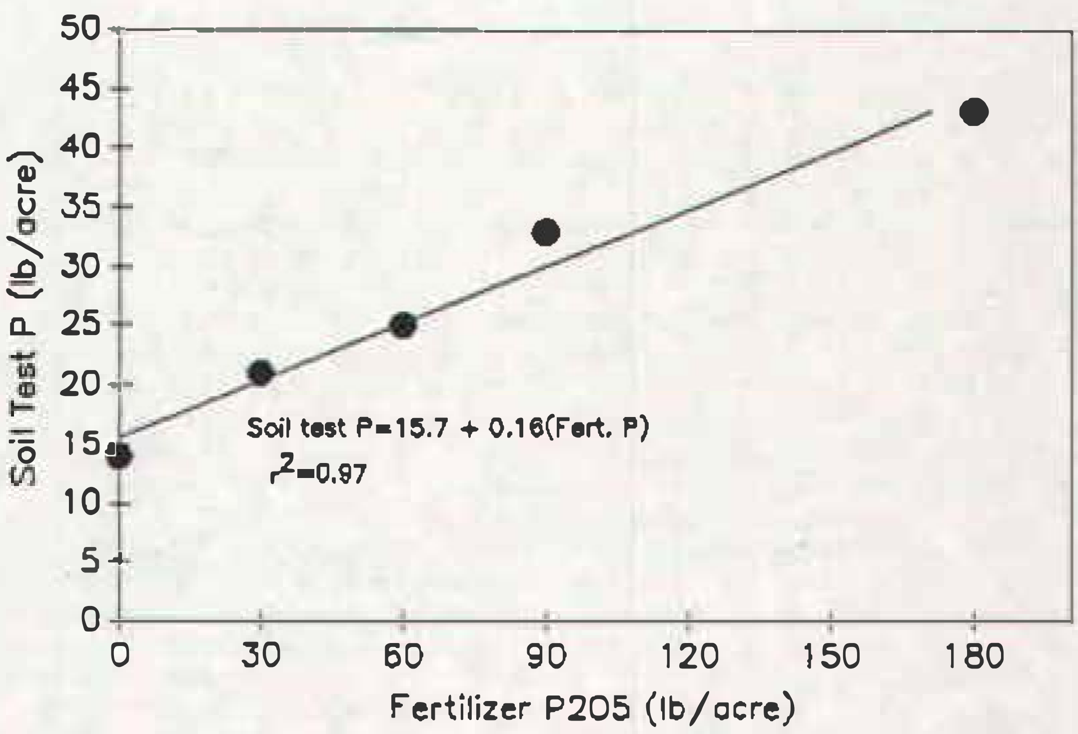


Figure 2. Influence of broadcast fertilizer phosphorus on soil test P under grass, Hyde Co.



OAT RESEARCH

D. L. Reeves and Lon Hall

A test which has been grown at this station for many years is the Tristate. This has 10 new entries every year from each of the Dakotas and Minnesota. The Tristate test is grown at only three locations in each state. It tests only new selections which appear to have potential. Selections go through this test before being entered in a formal regional test.

A preliminary herbicide testing program was started this year in cooperation with the extension weed workers. This is our western location. Due to weather and other problems only one of the three locations was harvested this year. We used 6 varieties and 9 treatments. The treatments included MCPA at 1/2 and 1 lb. rates, 2,4-D Amine at 1/2 and 1 lb., Bronate at 3/4 and 1 1/2 lb., and a Banvel + MCPA mix.

There are three objectives to this program. One is to see how oats are reacting to environmental conditions when sprayed on a given year. The second is to see how our selections approaching release as a variety respond to commonly used herbicides. The third is to see what could be expected in the field if the sprayer overlapped. Due to an error, we didn't get data this year, but it will be continued next year.

In addition to these tests, we've used this station as a test site whenever we've had a number of advanced lines that needed the better ones identified. In 1987 we had 26 selections in a test of that type here.

SPRING WHEAT BREEDING

F. A. Cholick and K. M. Sellers

The advance yield trial was grown at eight locations through out the spring wheat production area in addition to the Highmore Station. The primary objective of this trial is to identify new genetic combinations as potential new varieties. In 1988, 37 experimental lines from the SDSU spring breeding, and one experimental line from each North Dakota and Minnesota were compared to nine check (named) varieties. This experiment was planted April 6 and harvested July 19. The mean yield was 16.1 bu/A which was approximately 60 percent less than the seven year average. The range in grain yield was 21.4 to 9.5 bu/A which is a greater range than normal. Among the named varieties Stoa and Guard were in the top yielding group in 1988. On a three year average, Butte-86, Stoa, and Prospect were the top yielding checks. In 1988, 12 experimental lines yielded equal to or exceeded the best named varieties. The primary evaluations in 1988 were for heat and moisture stress, and several early lines were in the top yielding group. The data from 1988 experiments aided in evaluating experimental lines for stress conditions. Test weights ranged from 59.5 to 51.2 lbs/bu among the experimental lines which also illustrates the high level of stress. The differential responses that occur among breeding materials are valuable in that lines can be discarded from consideration for variety release due to poor performance. The relatively large range also illustrates that the material differed in its' ability for growth and development under the high stress conditions.

Blend Yield Trial 1988

This experiment was not conducted at the Highmore station; however, it was conducted at Brookings, Watertown, Redfield, Brentford and Selby in 1987 and 1988 to evaluate the effects of blending varieties on grain yield and protein content. Four varieties, Butte-86, Guard, Marshall and Stoa were grown as pure varieties and all possible two way blends. The following table summarizes the grain yields and protein contents.

Table 1. Yield and protein results form blend experiment in 1988.

	LOCATIONS											
	Brookings		Redfield		Watertown		Brentford		Selby		Average	
Variety	yld bu/A	pro %	yld bu/A	pro %	yld bu/A	pro %	yld bu/A	pro %	yld bu/A	pro %	yld bu/A	pro %
Butte-86	20	17.8	20	17.2	19	17.1	18	17.4	24	16.6	20	17.2
Marshall	17	16.5	18	17.2	16	18.3	18	18.3	20	16.3	18	17.3
Guard	24	16.6	18	17.4	19	18.4	16	17.4	23	16.2	20	17.2
Stoa	20	16.7	21	16.9	19	19.0	18	18.0	24	16.6	20	17.4
B/G	20	16.6	22	17.0	21	17.8	16	17.9	23	17.3	20	17.3
B/M	20	16.8	19	17.3	16	18.5	17	18.2	21	16.5	18	17.5
B/S	22	17.3	21	17.3	18	18.6	19	18.6	25	16.2	21	17.6
G/M	19	16.3	17	17.1	17	18.0	17	18.1	22	16.5	19	17.2
G/S	22	15.9	19	16.8	18	18.7	17	17.8	22	16.4	20	17.1
M/S	20	16.6	19	17.1	18	18.1	17	18.1	22	16.4	19	17.3
LSD 0.05 yield	2.7		2.6		2.3		3.7		2.1		1.8	

The grain yields that are underlined are in the highest yielding group. Protein was determined on a composite of the three replications; therefore, there is no LSD. These results were similar to 1987 and other composite or blend experiments. In general, there appears to be little or no advantage to blending varieties because the best blends grain yields were not superior to the best pure variety. In 1987 Butte-86 and Stoa and their blend were the top yielding treatments averaged over locations. In 1988 only the variety Marshall yielded less than the other three and the three blends with Marshall were also lower yielding. The range among varieties for protein in 1988 was extremely small, and therefore it is difficult to evaluate this trait. However, as with yield there appears to be little advantage of blending varieties with high and low protein contents to maintain protein content.

SMALL GRAIN TRIALS - CPT

J. J. Bonnemann

Small Grain Performance Trials were conducted on the Central Substation in 1988. Four small grains were grown; barley, oats, spring wheat and winter wheat.

The yields and quality of the grain were quite variable. Winter wheat yields were generally good, especially for the stress of the 1988 growing season. The barley and oat yields were also better than might be expected for the hot, dry conditions during the year. The spring wheat yields and quality were poor.

Additional yield and agronomic data for the Central Substation and all trials in the State are found in EC 774 (rev.) 1989 Variety Recommendations (1988 crop performance results). This publication is available from local County Extension offices or the Bulletin Room, SDSU, Brookings, SD 57007.

Table 1. 1988 CPT Spring Wheat and Oat Trials, Highmore, SD.

Variety	B/A	TW	Variety	B/A	TW
TALLS					
Alex	12.8	53	Benson	37.9	34
Amidon	15.1	52	Burnett	43.3	35
Butte 86	20.0	54	Don	61.9	35
Chris	9.9	50	Hazel	61.3	36
Stoa	16.9	52	Hytest	43.7	37
Shield	16.8	53	Kelly	32.0	37
SEMI-DWARFS			Lancer	44.6	36
Angus	11.4	51	Lyon	42.8	32
Celtic	13.8	53	Moore	35.8	30
Challenger	20.3	53	Nodaway 70	25.5	35
Guard	19.8	53	Ogle	62.2	33
Leif	9.5	49	Otee	48.8	35
Len	9.7	54	Porter	44.6	31
Leo 747	16.1	53	Preston	45.9	34
Marshall	11.0	50	Proat	34.1	31
Nordic	13.7	54	Sandy	30.3	27
Norseman	12.2	51	Starter	51.7	37
Prospect	18.3	53	Steele	35.0	31
Telemark	15.9	52	Trucker	43.0	33
Wheaton	18.1	50	Valley	46.0	32
W2501	16.4	48	Webster	57.9	34
W2502	18.2	49	Wright	40.4	35
2369	18.7	53			
2385	17.8	54	Means	45.6	33
2375(X)	22.5	56	LSD (.05)	9.8	
HS84-873(X)	17.0	50	CV = %	15.4	
Westbred 926(X)	19.0	54			
Means	16.5	52			
LSD (.05)	3.2				
CV - %	13.9				

Table 2. 1988 CPT Barley Trials.

Entry	B/A	TW
Azure	37.4	42
Bowman	53.2	49
Gallatin	43.3	45
Glenn	45.3	45
Hazen	36.2	44
Morex	24.9	43
Primus II	53.3	46
Robust	39.6	44
ND 7691	33.4	44
ND 8671	42.2	48
B1602	38.2	43
Means	40.4	44
LSD (.05)	8.1	
CV - %	14.1	

Table 3. 1988 Winter Wheat Trials, CPT

Variety	B/A	TW	Variety	B/A	TW
Abilene	38.2	55	Norkan	34.5	55
Agassiz	25.5	50	Norwin	22.5	46
Arkan	35.8	52	Quantum 542	50.2	54
Arapahoe	48.5	53	Quantum 562	44.5	52
Bennett	43.0	54	Quantum XH696	43.9	51
Bounty 205	40.5	54	Redland	40.9	50
Bounty 301	37.5	53	Rodeo	39.1	54
Lancota	32.7	51	Rose	30.0	49
Brule	42.3	51	Roughrider	29.5	51
Centura	40.1	52	Sage	38.4	54
Centurk 78	37.6	49	Scout 66	33.4	56
Cody	42.7	50	Seward	30.4	48
Colt	37.3	50	Siouxland	44.4	51
Dawn	39.7	53	TAM 107	26.2	54
Dodge	36.9	54	Thunderbird	43.6	56
			Means	37.3	52
			LSD (.05)	4.6	
			C.V. - %	8.8	

WINTER WHEAT BREEDING

Jeff Gellner and Roy Schut

Approximately 500 7-row plots and 400 1-row plots were planted in 1988. Although the state experienced a drought, yields of winter wheat at Highmore were certainly acceptable. The standard variations averaged 37.3 bu/acre. Five experimental lines were included. In particular, SD82102 and SD76598-7 are being evaluated for possible release. Their performance at Highmore, however, was not as good as expected. Included below are yield and test weight data for several high yielding varieties and the two advanced lines.

	Yield bu/A	TW lb/bu
Abilene	38	55
Arapahoe	49	53
Brule	42	51
Siouxland	44	51
Thunderbird	43	56
SD76598-7	39	51
SD82102	36	48
Rose	30	49
Seward	30	48
Roughrider	30	51

In the above table, the higher yielding varieties are generally less winterhardy than those with lower yields. The past several winters in South Dakota have been generally mild and the summers hot. This weather favors less winterhardy varieties.

In response to this we are using more wheat lines developed in the Southern Plains in our breeding program. Below are the top five yielding advanced bulk populations to show for comparison.

	Yield bu/A	TW lb/bu
SD84451	48	56
SD84347	47	56
SD84272	47	56
SD84326	45	56
SD84277	44	55

The same number of plots were seeded on September 15, 1988 to summer fallowed land. Stands were good.

CORN BREEDING PROJECT

Zeno Wicks III and Gary Scholten

The Highmore Research Farm is where our corn genotypes are evaluated for moisture stress. The materials being screened were planted on May 11, 1988. After emergence, rows were thinned to a final plant population of 13,000 plants per acre. The corn was harvested with a combine on September 23, 1988. Two studies were evaluated at Highmore in 1988.

In the first study, yield and agronomic data collected from seven diverse inbreds, along with various single cross hybrid combinations from these inbreds, was compared with the same materials grown under an irrigation system that produces mini moisture environments. The objective of this study is to develop a controlled irrigation system that simulates multi-location yield trials of various moisture regimes. Linear regression slopes of irrigated trials and multi-locational yield trials have been found to be in close agreement. This system would allow the breeder to evaluate material under a controlled irrigation program and alleviate the need and expense associated with yield trials at several locations for assessing stability.

The second experiment evaluates the potential of farmer use of modified double cross hybrids in place of single cross hybrid seed corn in the traditionally lower yielding corn growing areas of South Dakota.

Fifteen single-cross hybrids were used in making three separate double-cross hybrid populations. Six of the fifteen hybrids, of approximately the same maturity, were used in combination in each population. The entries consisted of the single cross hybrids, a double-cross population with one-sixth of the mixture being selfed seed, and a double cross population containing no selfed seed.

The results of this study in 1988 are shown in the following table.

		Yield (bu/A)	Diff. (bu)	Diff. (%)	Avg.[1] (bu/A)
Pop. 1	6 hybrids	19.22	-	-	
	Double-cross (no selfs)	17.36	1.86	-10.0	
Pop. 2	6 hybrids	26.49	-	-	60.57
	Double-cross (with selfs)	25.19	-1.30	-4.9	61.62
	Double-cross (no selfs)	23.42	-3.07	-11.6	
Pop. 3	6 hybrids	27.50	-	-	49.42
	Double-cross (with selfs)	23.71	-3.79	-13.8	47.30
	Double-cross (no selfs)	22.50	-5.00	-18.2	

[1] Population 2 average of 3 years data; Population 3 average of 2 years data.

Population 2 has shown the most promise, although this may not be the best hybrid combination that could potentially be produced.

Double-cross hybrid corn could be produced and sold to farmers at one-third to half the cost of single-cross hybrid corn with little or no yield reduction. Input costs for producing corn in central South Dakota would decrease as a result.

SOYBEAN RESEARCH

Brad Farber and Mike Volek

There is a growing interest in the potential offered by soybeans as a cropping option in central South Dakota. Soybeans have the ability to withstand and recover from periods of drought and heat stress and are successfully being grown by many producers in traditional small grain areas of central, north central, and northeastern South Dakota. An earlier study in 1985 indicated very positive results when compared to small grains. Due to continued interest in soybeans by area farmers, an experiment was planned using three varieties of differing maturity groups commonly grown in the state.

The varieties chosen were Dawson, a Group 0 medium early maturing variety; Sibley, a Group I medium maturity variety; and Elgin 87, an early Group II later maturing variety. Group 0 and Group I maturity soybeans are generally recommended for growers in central South Dakota. The study was planted in a randomized complete block design with three replications to minimize variability associated with problems such as soil differences and border effects. Treflan herbicide was incorporated prior to planting for weed control. The soybean seed was inoculated with Rhizobium sp. innoculant at planting time. Planting was done on 30-inch row spacings at approximately 110,000 seeds per acre on May 12, 1988. The soybeans were also cultivated twice for additional weed control during the growing season. At maturity, two rows ten feet in length were hand harvested from each plot on September 22, 1988 for determining grain yields.

RESULTS

Grain yields are shown in the following table.

Variety	Group	Grain Yield
		---bu/A---
Dawson	0	12.4
Sibley	I	15.1
Elgin 87	II	11.8
	Average	13.1
C.V. = 22.6%		

Although differences did occur, they are not statistically different due to the large degree of sampling variability in 1988. The high coefficient of variability (C.V.) indicates that we should have harvested a larger area in each plot and perhaps increased the number of replications to reduce the variability.

It appears, even in this limited trial, that soybeans may be a viable alternative to farmers in the central region of South Dakota. Considering the high soybean prices of 1988 and farm program prices for wheat, comparable or better net returns could have been achieved by growing soybeans. Yields of spring wheat in 1988 at the research farm were 60 percent less than the past seven year average.

The soybean study conducted on the farm in 1985 with five varieties of differing maturity groups also showed very positive results when compared to wheat. The five varieties in the study averaged 25 bushels per acre. Wheat yields in 1985 were severely reduced due to early heat and drought stress. Soybeans were able to take advantage of above normal precipitation during the remainder of the growing season.

Soybeans may offer the farmer another alternative for crop rotations as a way of breaking weed, disease or insect cycles. They may also provide a means for diversification of a producers operation which ultimately adds to the stability of income for that producer. If inoculated at planting, they provide a nitrogen credit of one pound of N per bushel of soybeans produced. This amount can be subtracted directly from the nitrogen rate recommended by a soil test. Soybean research will be continued and hopefully expanded at the Central Crops and Soils Research Farm in the future.

NITROGEN ADDITIONS FOR CORN

R. Gelderman, S. Swartos and M. Volek

INTRODUCTION

Approximately 50% of the total fertilizer nitrogen applied in South Dakota is used on corn. The need for efficient and profitable nitrogen recommendations for corn is apparent. The best guide available for recommending fertilizer is a soil test. Soil tests need to be correlated to field response data such as reported here.

The objective of this study is to determine the relationship of the nitrate-nitrogen soil test to yield response of corn to nitrogen fertilizer.

METHODS

The study was located on the west side of the Highmore experiment farm on a Stickney soil. These soils are deep, moderately well-drained, nearly level soils formed in glacial till. Results of soil tests from samples taken in the spring are shown in Table 1.

Table 1. Soil test results of nitrogen corn study at planting, Highmore, 1988.

NO_3-N					
0-24	0-60	OM	P	K	pH
lb/A		%	lb/A		
55	86	3.2	58	1300	6.4

The soil tests indicated a fairly low level of available nitrogen in the top two feet with normal levels from two to five feet. Phosphorus and potassium are considered very high. The soil is slightly acidic in reaction.

The previous crop was spring wheat. The area was fall chiseled and disked before planting Pioneer 3902 (85 day maturity) on 12 May 1988 at a population of approximately 16,000 plants per acre. The fertilizer rate treatments were spread on the soil surface as ammonium nitrate about two weeks after planting. The rates used were 0, 30, 60, 90, and 120 lb of actual nitrogen per acre. Each treatment was replicated four times. The plots were harvested for grain on 20 September 1988.

RESULTS AND DISCUSSION

Unlike most of the state, rainfall was adequate here for the growing season. A total of 8.15 inches fell in the period of June-September, another 3.42 inches of rain was received in May. As a result, fair corn yields were produced (Table 2). Hot, dry winds at pollination did limit yield to some degree.

The yields were not affected by rate of nitrogen. Apparently the residual nitrogen that was available in the spring, plus nitrogen mineralization from soil organic matter met the needs of the 70 bu/A corn.

This work will be continued at least one more year. Results of several other studies will be summarized at that time to determine how soil tests can be better used to predict fertilizer N needs for corn.

Table 2. Grain yield as influenced by rate of nitrogen, Highmore, 1988.

Rate of N	Grain Yield* (15% moisture)
0	72
30	70
60	67
90	78
120	64
Sign.	non-significant (F = 0.61)

CHEATGRASS IN WINTER WHEAT

Leon J. Wrage and Paul O. Johnson

PURPOSE:

To evaluate performance of experimental compounds on cheatgrass control in winter wheat. There are presently no product registered for postemergence control.

METHODS:

Plot Design: Randomized Complete Block
Plot Size: 10'x 50'
Previous Crop: Winter wheat
Soil: Silty loam; 2.6 O.M.; 6.0 pH
Crop: Rose
Planted: 9/21/87
Herbicide: FALL: 10/10/87
EARLY SPRING: 4/1/88
Evaluated: 7/6/88
Rainfall: 1st week Trace
2nd week 0.00 inches

RESULTS:

Due to very dry fall conditions, treatments were not activated to the extent needed. Only one treatment gave above 80 percent control and this one also had a high crop response. Past years have given more successful control. The products will continue to be evaluated.

1988
CHEAT IN WINTER WHEAT
Highmore Research Farm

Treatment	lb/A act.	Percent Control Tamu	Dobr	% VCRR
FALL				
Check	----	0	0	0.0
+Tycor+Sencor/Lexone	1+.06	51	22	0.0
+Tycor+Sencor/Lexone	1+.125	44	46	0.0
+Tycor+Sencor/Lexone	1+.125	68	54	0.0
+Sencor/Lexone	.25	65	22	0.0
+Sencor/Lexone	.5	81	46	0.0
+Bladex+Sencor/Lexone	.5+.125	85	38	5.0
+Atrazine	.5	72	15	25.0
EARLY SPRING				
+Tycor+Sencor/Lexone	1+.125	56	54	0.0
+Tycor+Sencor/Lexone	1.25+.5	35	82	37.5
LSD (.05)		38.7	18.8	10.7

+ Experimental

Evaluated: 7/6/88
FALL: 10/10/87
EARLY SPRING: 4/1/88
Planting Date: 9/21/87
Rainfall: 1st week Trace
2nd week None

Average 2 reps

Tamu=Tansy mustard
Dobr=Downy brome

VCRR=Visual Crop Response Rating

WINTER WHEAT/KOCHIA SCREENING

Leon J. Wrage and Paul O. Johnson

PURPOSE:

To evaluate performance of labeled herbicides and experimental compounds on control of kochia in winter wheat. Replicated plots provide an excellent opportunity to evaluate a number of herbicides for control and yield.

METHODS:

Plot Design: Randomized Complete Block
Plot Size: 10' x 50'
Previous Crop: Spring wheat
Soil: Silty loam; O.M. 2.6; pH 6.0
Crop: Rose
Planted: 9/21/87
Herbicide: FALL: 10/10/87
TILLER: 4/28/88
JOINTING: 5/24/88
Evaluated: 7/6/88

RESULTS:

Due to dry conditions no yields were taken. Several treatments were above 90 percent kochia control. Glean in the spring also provided above 90% grass control. The pressure was light due to dry conditions, no secondary flushes were observed.

1988
WINTER WHEAT/KOCHIA SCREENING
Highmore Station

Treatment	lb/A act.	Percent Control Grass	Percent Control Kochia
FALL			
Check	----	0	0
2,4-D ester	.5	0	15
Glean+X-77	.021+.5%	58	95
Banvel+2,4-D amine	.125+.25	0	38
Glean+2,4-D ester	.021+.25	79	94
TILLER			
Glean+X-77	.021+.25%	95	96
Glean+2,4-D ester+X-77	.021+.25+.25%	96	97
JOINTING			
Ally+X-77	.004+.5%	52	97
Ally+2,4-D amine+X-77	.004+.25+.25%	46	96
+Harmony Extra+X-77	.023+.25%	34	96
+Harmony Extra+Banvel+X-77	.023+.125+.25%	25	96
+Express+X-77	.023+.25%	18	92
+Express+Banvel+X-77	.023+.125+.25%	9	92
Banvel+MCPA amine	.125+.25	0	78
Banvel+2,4-D ester	.125+.33	0	91
Bronate	.75	0	89
Bronate+2,4-D ester	.5+.25	0	86
2,4-D amine	.5	0	55
2,4-D ester	.5	0	74
Tordon 22k+2,4-D ester	.015+.25	0	75
LSD (.05)		11.2	9.3

+ Experimental

Average 4 reps

Evaluated: 7/6/88
FALL: 10/10/87
TILLER: 4/28/88
JOINTING: 5/24/88
Planting Date: 9/21/88

Grass=Green foxtail
Kocz=Kochia

Rainfall: 1st week 0.67 inches
2nd week 0.77 inches

GRAIN SORGHUM SCREENING

Leon J. Wrage and Paul O. Johnson

PURPOSE:

To evaluate performance of labeled and experimental herbicides for weed control in semi-arid climate. Screening trials provide side-by-side comparisons and replicated observations to insure uniformity. Evaluation of performance during 1988 provides control comparisons based on this year's conditions.

METHODS:

Plot Design: Randomized Complete Block
Plot Size: 10' x 50'
Previous Crop: Wheat
Soil: Silty loam; 2.6 O.M.; 6.0 pH
Crop: Pioneer 894
Planted: 5/25/88
Cultivation: None
Herbicide: PRE: 5/26/88
POST: 6/16/88
LPOS: 7/6/88
Evaluated: 9/23/88
Rainfall: 1st week .25 inches
2nd week Trace

RESULTS:

Plots were visually evaluated for percent grass control, visual crop response, and yield. Crop response showed up mostly in the late applications. This is also where reduced yields are indicated. Grass pressure was moderate and really only showed a reduction in yield on the check.

1988
GRAIN SORGHUM SCREENING
Highmore Research Farm

Treatment	lb/A act.	% Control Grass	% VCRR	Yield bu/A
PREEMERGENCE				
Lasso	2.5	--	---	56.6
Dual	2	--	---	52.5
Ramrod	5	--	---	51.8
Check	---	0	0.0	38.5
POSTEMERGENCE				
Atrazine+COC	1+1 qt	55	0.0	51.9
+Tough+atrazine	.9+1	74	0.0	51.2
Banvel+atrazine	.5+1	62	0.0	49.3
PREEMERGENCE & POSTEMERGENCE				
+Ramrod&Tough+atrazine	3&.45+.6	94	0.0	53.5
Ramrod&Laddok+COC	3&1+1 qt	82	0.0	65.4
Ramrod&Laddok+28% N	3&1+1 gal	88	0.0	64.6
Ramrod&2,4-D ester	3&.25	82	0.0	59.3
+Ramrod&2,4-D ester	3&.5	89	7.5	56.3
Ramrod&2,4-D amine	3&.5	86	0.0	57.1
Ramrod&Banvel	3&.12	83	0.0	57.3
Ramrod&Banvel	3&.25	87	2.5	51.1
Ramrod&Banvel+X-77	3&.25+.63%	82	0.0	57.0
Ramrod&Buctril	3&.375	85	0.0	56.1
Ramrod&Buctril+atrazine	3&.25+.5	82	0.0	64.8
Ramrod&Buctril+atrazine	3&.375+1	90	0.0	57.3
+Ramrod&Ally	3&.0037	76	0.0	58.0
+Ramrod&Ally+2,4-D amine	3&.0037+.125	82	0.0	55.4
PREEMERGENCE & LATE POSTEMERGENCE				
Ramrod&2,4-D ester	3&.25	84	0.0	64.3
+Ramrod&2,4-D ester	3&.5	86	0.0	53.8
Ramrod&2,4-D amine	3&.5	80	0.0	52.5
Ramrod&Banvel	3&.12	88	0.0	54.3
Ramrod&Banvel	3&.25	84	4.0	44.5
Ramrod&Banvel+X-77	3&.25+.63%	84	9.9	40.0
Ramrod&Buctril	3&.375	76	0.0	56.7
Ramrod&Buctril+atrazine	3&.375+1	79	0.0	55.0
+Ramrod&Ally	3&.0037	62	72.5	34.2
+Ramrod&Ally+2,4-D	3&.0037+.125	67	57.5	41.3
LSD (.05)		6.4	5.0	21.7

+Experimental

Average 2 reps

Evaluated: 9/23/88
PRE: 5/26/88
POST: 6/16/88
LPOS: 7/6/88
Planting Date: 5/25/88

VCRR=Visual Crop Response Rating
Grass=Yellow foxtail

Rainfall: 1st week 0.25 inches
2nd week 0.00 inches

CORN HERBICIDE DEMONSTRATION

Leon J. Wrage and Paul O. Johnson

PURPOSE:

To evaluate performance of labeled and soon to be labeled herbicides for weed control in semi-arid climate. Demonstration plots provide side-by-side comparisons of herbicides. These plots were included on field tours and the information is used in educational programs. Evaluation of performance during 1988 provides control comparisons based on this year's conditions.

METHODS:

Plot Design: Demonstration
Plot Size: 10' x 100'
Previous Crop: Wheat
Soil: Silty loam; 2.6 O.M.; 6.0 pH
Crop: Corn - Funks G-4084
Planted: 5/25/88
Cultivation: None
Herbicide: PPI: 5/25/88
PRE: 5/26/88
Post: 6/16/88
Evaluated: 6/22/88
Rainfall: 1st week 0.25 inches
2nd week Trace

RESULTS:

Plots were visually evaluated for percent grass and broadleaf weed control. Herbicides were broadcast over seedbed. Green foxtail pressure was heavy. Redroot pigweed was light to moderate pressure. Cropstand was uniform.

Results in 1988 were good. Rainfall was below normal for the season. Preplant incorporated treatments were excellent. Also preemergence treatments requiring minimal rainfall for activation were good. Other herbicides were somewhat erratic. Seven treatments exceeded 90% control of all weed species. Preplant incorporated treatments not needing rainfall for activation provided excellent results alone or in combination.

1988
CORN HERBICIDE DEMONSTRATION
Highmore Research Farm

Treatment	lb/A act.	Percent Weed Control 1988* Gr	Bdlf
PREPLANT INCORPORATED			
Check .	----	0	0
Eradicane	4	98	94
Eradicane+atrazine	4+1	98	96
Eradicane+Bladex	4+1.5	98	95
Eradicane+Bladex	2+1	95	92
Eradicane+Bladex+atrazine	4+1+.5	98	96
Sutan+	4	93	95
SHALLOW PREPLANT INCORPORATED			
Lasso	3	90	90
Dual	2.5	82	80
PREEMERGENCE			
Atrazine	2.5	50	92
Bladex	3	72	75
Dual	2.5	75	73
Lasso	3	82	80
Prowl	1.5	70	75
Ramrod	6	79	50
+Tophand	2.34	92	75
Lasso+Bladex	1.25+2	73	75
Dual+atrazine	2+1	68	75
Ramrod+Bladex	4+2	75	82
Prowl+Banvel+atrazine	1+.25+.5	78	80
POSTEMERGENCE			
Prowl+atrazine	1.5+1	65	70
Prowl+Bladex	1.5+1.5	70	74
Atrazine+COC	1.5+1 qt	62	72
Bladex+X-77	2+.5%	70	70
Tandem+Bladex+atrazine+X-77	.5+1+.5+.5%	78	85
Prowl+Bladex+Banvel+atrazine	1+1.5+.25+.5	70	80
PREEMERGENCE & POSTEMERGENCE			
Ramrod&Banvel	4&.25	80	85
Ramrod&2,4-D amine	4&.5	80	65
Ramrod&Buctril	4&.38	82	86
Ramrod&Buctril+atrazine	4&.25+.5	80	90
Ramrod&Banvel+atrazine	4&.25+.5	78	90
+Ramrod&M6316+COC	4&.0039+1 qt	80	80

PPI&Planting: 5/25/88
PRE: 5/26/88
POST: 6/16/88
Evaluated: 6/22/88

Rainfall:
1st week .25 inches
2nd week Trace

+ Experimental

Gr=Green foxtail
Bdlf=Redroot pigweed

FIELD EVALUATION OF WOODY PLANT MATERIALS

Russell Haas, Plant Materials Specialist

The field evaluation site at Highmore, South Dakota, continues to be the "garden spot" of the 12 field evaluation plantings located in North Dakota, South Dakota, and Minnesota. The excellent maintenance is reflected in the good survival and rate of growth of the trees.

Performance data from this site has been used to support the cooperative release of several tree and shrub cultivars in the past few years. Among them are:

'Cardan' green ash (1979)
'Oahe' hackberry (1982)
'Scarlet' Mongolian cherry (1984)
'Sakakawea' silver buffaloberry (1984)
'Centennial' cotoneaster (1987)

These cultivars are now in large scale production and have been well accepted and extensively used for field and/or farmstead windbreaks, wildlife, recreation, and highway rights-of-way plantings in the Dakotas and Minnesota. Some of these cultivars are being tested for adaptation in Montana, Wyoming, Colorado, Kansas, Nebraska, Missouri, Iowa, and the east coast.

Promising accessions being considered for future release are:

ND-14 harbin pear (1989-90)
ND-20 arnold hawthorn (1989-90)
ND-11 amur honeysuckle
ND-629 amur maple
ND-1879 honeylocust
SD-131 mayday
ND-83 late lilac
ND-283 Russian almond

1988 Activities

April 25 - Survival of winter injury data was recorded on the accessions planted in 1987. Most plants survived well and few replacements were needed.

Minor pruning was done to remove damaged branches; and plants in weak condition due to poor adaptation and performance were removed.

September 19 - Survival and growth measurements were recorded on the accessions planted in the spring and older accessions scheduled for evaluation. Severe heat and drought stress was noted on nearly all species. Overall survival at this site in 1988 was better than at any other site.

The following new accessions were added for evaluation:

Accession Number	Genus/Species Origin/Source	Acession Number	Genus/Species Origin/Source
ND-3744 9019577	Korean barberry *Barberis koreana* NDSU	ND-1567 9005751	hawthorn *Crataegus sp.* Wells Co., ND USDA, SCS, PMC, Bismarck, ND
ND-2103 399414	highbush cranberry *Viburnum opulus* P.I. Sta., Ames, IA	Red-Wing 477008	autumn olive *Elaeagnus umbellata* USDA, SCS, PMC, Rose Lake, MI
9057409	American hazel *Corylus americana* Turtle Mountains, Bottineau Co., ND	ND-2507 9047228	pigmy caragana *Caragana pygmaea* NDFS, Bottineau, ND
Meadow Lark 9005886	forsythia *Forsythia ovata* P.I. Sta., Ames, IA	323597	chokeberry *Aronia melanocarpa* P.I. Sta., Ames, IA
Hedge King	honeysuckle *Lonicera xylosteum* Wedge Nursery, Albert Lea, MN	Rem-Red 421135	amur honeysuckle *Lonicera maackii* USDA, SCS, PMC, Cape May, NJ
ND-2506 9047227	maximowicz caragana *Caragana maximowicziana* USDA, SCS, PMC, Bismarck ND, Increase Block	9057413	ponderosa pine *Pinus ponderosa* Glendive, MT NDFS
ND-83 9006228	late lilac *Syringa villosa* Res. Sta., Morden, CA	9057411	lodgepole pine *Pinus contorta* Edmonton, Alberta, Canada NDFS
Redbird 9004972	Cornelian dogwood *Cornus mas* USDA, SCS, PMC, Elsberry, MO	9057412	bur oak *Quercus macrocarpa* NDFS Foster Co., ND
9047231	Russian olive *Elaeagnus angustifolia* Chinle, AZ	9057410	hackberry *Celtis occidentalis* NDFS Bottineau Co., ND
ND-276 9057404	nannyberry *Viburnum lentago* Res. Sta., Morden, CA		

GENERAL COMMENTS

-- Several tree species suffered herbicide damage in 1987, some evidence of borers in older green ash.

-- The tall tree block (Block #1), the medium tall tree block (Block #2), and the shrub block (Block #3) are completely filled.

-- The low, wet area in the southwest corner of the tall tree block will be used to evaluate accessions of hybrid poplars.

-- Overflow from the tall tree block (Block #1) will be planted in the open areas in the conifer block (Block #4). This new block will be considered Block #5.

-- Due to the lack of space, we will have to begin a program of removal of those accessions that do not exhibit potential for release. This will mean removal of common species that have been valuable as specimens for demonstration purposes.

-- Fruit/seed has been harvested from trees of several of the released cultivars and provided to nurseries in North Dakota, South Dakota, and Minnesota. The resulting trees are utilized in field and farmstead windbreaks, etc., in those states.

DRIP IRRIGATION PROJECT - HICBMORE 1988

Sheridan Dronen

This project was established in 1985 and has gone through four growing seasons. It appears that there is no advantage to drip irrigating shrubs. There is very good growth on all shrubs in both the dry and drip plots. The Mongolian cherry had to be replanted in the drip plots because of chemical damage and therefore, it is shorter than the dryland plots.

There are differences in growth on most of the midsize and tall deciduous and conifer trees. Growth comparisons are listed on the attached table.

Only the Colorado blue spruce, in the annual survival plot, showed a big increase in survival (90 vs. 20) on the drip plot.

1988 Growth Comparisons Drip vs. Dryland

	% Increase and Treatment With Best Growth*
Set #1	
Skunkbrush sumac	same
Caragana	same
Cotoneaster ND-177	same
Peking Cotoneaster	14% - drip
Common lilac	same
American plum	same
Sakakawea silver buffaloberry	same
Scarlet Mongolian cherry	30% - dry
Set #2	
Arnold hawthorne	13% - drip
Siberian crabapple	14% - drip
Siberian apricot	15% - drip
Harbin pear	same
Schuberts chokecherry	46% - drip
Amur maple	same
Midwest crabapple	same
Russian olive	20% - drip
Set #3	
Black Hills spruce	48% - drip
Ponderosa pine (Rosebud)	14% drip
Eastern redcedar	same
Rocky Mt. juniper	same
Colorado blue spruce	22% - drip
Scotch pine	32% - drip
Ponderosa pine (Lead)	31% - drip
Siberian larch	11% - drip
Set #4	
Common green ash	same
Cardan green ash	same
Siberian elm	14% - drip
Black walnut	same
Honeylocust ND-1879	17% - drip
Oahe hackberry	17% - drip
Bur oak	46% - drip
Silver maple	same

	Percent Survival	
Set #5	Drip	Dry
Ponderosa pine (bareroot)	60%	60%
Ponderosa pine (potted)	80%	80%
Hackberry	90%	80%
Bur oak	100%	100%
Green ash	100%	100%
Colorado blue spruce	90%	20%

*If the differences in height growth were less than 10%, they were considered the same.