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Progress Report 2002

Central Crops and Soils Research Station
Highmore, South Dakota

SDSU
SOUTH DAKOTA STATE UNIVERSITY • Plant Science Department • Brookings, SD 57007

Contents

On the cover: Sunflower plots used in the study of resistance to the red sunflower seed weevil. Project cooperators were from USDA-ARS Sunflower Research Unit at Fargo, N.D., and South Dakota State University. Photo by Kathy Grady, taken July 31,2002

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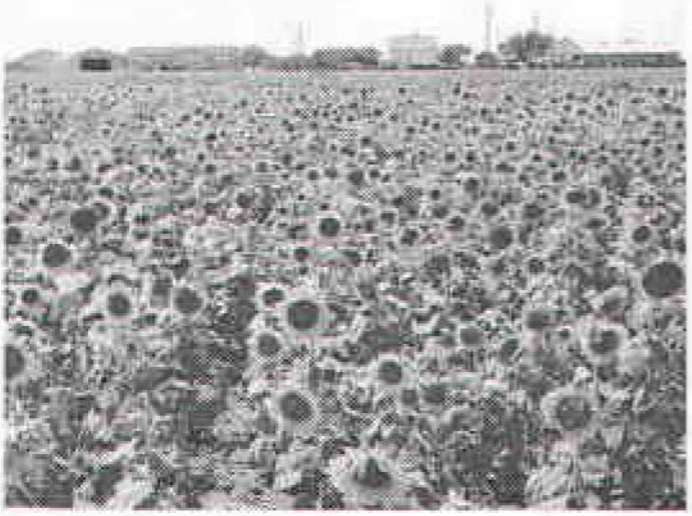

Progress Report 2002

Central Crops and Soils Research Station
Highmore, South Dakota

Welcome

The 2002 growing season was an extremely dry one for Hyde County. Though initial plans had been to conduct an afternoon tour of ongoing research by Leon Wrage (SDSU Extension weeds specialist) and associates, drought conditions inhibited stand establishment and production of several projects earmarked for the tour. Hopefully conditions will enable us to conduct an additional afternoon tour in 2003.

Even though numbers were down at this year's annual twilight tour with less than 25 people attending, Mike Volek and crew, several Plant Science personnel, and all the speakers worked hard to ensure the tour was a success. Dixie Volek and daughters Shandra and Sherise prepared the desserts and helped serve the meal. Pioneer Garage of Highmore provided the pickups and trailers used for the tour. I'd like to take this time to thank all who were involved.

The research conducted each year and included in this report involves long hours by staff from many disciplines at SDSU and the Highmore Research Farm. Their efforts in contributing to this publication each year are greatly appreciated. Support and input from area producers, ranchers, Advisory Board members, and county Extension educators is also greatly appreciated.

A special thanks to Nancy Kleinjan for her assistance in preparing this report.

Robin Bortnem
Manager

Greetings

On behalf of the Plant Science Department at South Dakota State University, let me extend my greetings and best wishes to each of you. This annual progress report marks another year at the Highmore Research Farm. The following pages represent some of the research and Extension activities during the 2002 season. Mother Nature was not very kind last year, and the studies reported here reflect this. Still, we hope the results are of value to you in making management decisions on your own operations.

As I try to do each year, I would like to thank Mike Volek for his continued hard work and dedication to the Highmore research farm. The day-to-day, on-site activities are conducted in an efficient and effective manner. The farm is always neat and organized, and the researchers and Extension specialists from Brookings appreciate this. I would also like to extend another thank you to Robin Bortnem for her continued efforts as station manager, to all the faculty and staff in the Plant Science Department at SDSU for their work at the farm, and to the NRCS personnel for their continued evaluation studies.

Finally, the biggest thanks goes to each one of you for taking the time to read this report and for giving us input into the research that needs to be done here in Highmore. Your continued comments and suggestions are more than welcome.

Dale Gallenberg
Head, Plant Science Department

Growing season temperature and precipitation data for the research station during 2002.

	Temperature (°F)		No. days	Precipitation
Month	Maximum	Minimum	Max ≥ 90°	(inches)
April	61	32	0	0.90
May	67	37	0	0.95
June	84	52	7	3.00
July	92	62	22	2.27
August	84	58	8	6.72
September	77	52	8	0.97

2002
Central Crops and Soils Research Station
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2002 Report

Field Evaluation of Woody Plant Materials Highmore, South Dakota

Dwight Tober
Plant Materials Specialist, USDA/NRCS
Bismarck, N.D.

Objectives

1. Assemble and evaluate the adaptation and performance of selected woody plant material for field and farmstead windbreaks, wildlife habitat, and streambank and lakeshore plantings in the Northern Great Plains
2. Select and cooperatively release superior woody conservation plants for increase by commercial nurseries.

Activities in 2002

A total of 140 accessions of 87 different species are currently being evaluated. The latest new entries were planted on May 14, 2001, and included black currant (*Ribes americanum*), redleaf rose (*Rosa rubrifolia*), rugosa rose (*Rosa rugosa*), and Meyer's spruce (*Picea* spp.).

No new entries were added in 2002 and it is anticipated that no new material will be added in the future because of shading and lack of room.

Significant information can still be documented from existing entries, and data collection will continue on a scheduled annual basis. The first entries were planted at the Highmore site on April 11, 1978. Data is summarized annually and documented in the Annual Technical Report. Anyone desiring a copy of the latest summary report from Highmore can contact me at (701) 530-2075 or e-mail at< Dwight.Tober@nd.usda.gov>. The report is about 40 pages in length.

Weed control and maintenance were good. A major renovation effort in 2000 included removal of broken branches and limbs resulting from snow damage, removal and pruning of natural dieback of some species (primarily shrubs), and cutting and removal of contaminant species (primarily Siberian elm and mulberry).

All of the apricot (8 entries) and some entries of crabapple, poplar, Russian olive, and other species were removed at various times during the summer by staff at the station. Some of the remaining stumps of the apricot have resprouted.

Selected trees and shrubs were evaluated on September 4, 2002, with assistance from the NRCS Field Office staff at Highmore and from Greg Yapp, NRCS Resource Conservationist at Huron. Measurements and notes were taken on crown spread and plant height, disease and insect damage, drought and cold tolerance, fruit production, survival, vigor, and snow and animal damage.

Most of the mature entries continued to perform well; however, some winter dieback or other problems were noted on ND-37773 willow, Mich-433 Laurel willow, Roselow sargent crabapple, ND-1567 hawthorn, ND-995 prairie willow, Japanese cherry, Streamco willow, and ND-3902 sandbar willow.

Summary of Accomplishments

Selected accessions/cultivars that have performed well at the Highmore site and show promise for additional testing and/or promotion for conservation use include the following:

'Cardan' green ash
'Centennial' cotoneaster
'Sakakawea' silver buffaloberry
'Indigo' silky dogwood
ND-1134 hybrid plum
ND-3902 sandbar willow
ND-1879 honeylocust
'Legacy' late lilac
9058862 tamarack
ND-170 cotoneaster
'Bighorn' skunkbush sumac
14272 hybrid poplar
9069081 littleleaf linden
9063130 river birch
9016318 Siberian elm
Arnold's Red honeysuckle
9057409 American hazel
ponderosa pine (ND-1763, 9067413)
Scot's pine (9063156, 9063154)
9063148 corktree
'Oahe' hackberry
'Scarlet' Mongolian cherry
'McDermand' Ussurian pear
'Regal' Russian almond
ND-21 nannyberry
9047238 sea buckthorn
9008041 false indigo
ND-1863 honeylocust
'Meadowlark' forsythia
'Midwest' Manchurian crabapple
323957 chokeberry
ND-2103 highbush cranberry
hybrid poplar 9069086 (Theves)
9047228 pygmy caragana
ND-46 Timm's juneberry
ND-3744 Korean barberry
Siberian larch (SL–383, ND-1765)
9057411 lodgepole pine
9057410 hackberry
9063116 black ash

Data from this planting have been used to document the cooperative release of the cultivars listed below. These cultivars are currently in large scale production and use in conservation plantings throughout the Northern Great Plains. Several more releases are anticipated in the near future. Information gathered concerning plant performance assists cooperating nurserymen and plant researchers in determining the range of adaptation of many other accessions/cultivars also included in the test planting.

Formal Releases with Supporting Documentation from the Highmore Site

'Cardan' green ash (1979)
'Oahe' hackberry (1982)
'Sakakawea' silver buffaloberry (1984)
'Scarlet' Mongolian cherry (1984)
'Centennial' cotoneaster (1987)
'McDermand' Ussurian pear (1990)
'Homestead' Arnold hawthorn (1993)
'CanAm' hybrid poplar (1995)
'Regal' Russian almond (1997)
'Legacy' late lilac (1999)

2002 Report

Evaluation of a Naturalized Rangeland Population of Alfalfa

Arvid Boe and ***Robin Bortnem***
South Dakota State University

Livestock producers, land managers, wildlife biologists, and wildlife support groups are showing increasing interest in the development of an alfalfa cultivar that would be adapted for establishment, persistence, and the potential for natural spread in poor condition semiarid rangeland of the northern Great Plains of the U.S. and the Prairie Provinces of Canada.

With that need in mind, during August 2000 we collected seed from about 200 individual alfalfa plants in a population that has become naturalized on the Grand River National Grassland (GRNG) near Lodgepole, S.D.

The origin of this population undoubtedly traces back to introductions of Russian yellow-flowered alfalfa to ranches in that area during the early 1900s by N.E. Hansen, horticulturist on the faculty of SDSU and plant explorer for the U.S. Department of Agriculture.

In May 2001 we transplanted seedlings derived from the seed of the GRNG plants (hereafter referred to as families) and 'Vernal' and Pioneer '5454' into a nursery comprised of two replications of 7-plant plots for each entry. Spacing between plots was 3 feet. Spacing between plants within plots was about 1 foot. The entire nursery was oversown with crested wheatgrass in September 2001 and again in March 2002.

Data collected during 2002 included maturity and flower color in June and dry matter forage production, seed pod shape, and seed production potential in late July.

Dry matter forage yields of the families and check cultivars ranged from less than 800 pounds/acre to greater than 3500 pounds/acre. The check cultivars Vernal and 5454 produced 2660 and 1770 pounds/acre, respectively. Forty of the GRNG families produced in excess of 2850 pounds/acre, with the highest being 3550 pounds/acre.

These results indicated considerable genetic variation within this naturalized population and good potential for forage yield under droughty conditions.

Maturity, flower color, and pod shape data provide the information that will determine relative contributions of different genetic sources of alfalfa to the development of this promising population under natural selection in northwestern South Dakota.

We expect to collect data for at least 2 more years before identifying the most promising families for cultivar development. This population is also being evaluated in the form of family rows at Ames, Iowa, Mandan, N.D., Brandon and Miami, Manitoba, and Logan, Utah.

2002 Report

Winter Wheat Breeding and Genetics

Amir Ibrahim, Steve Kalsbeck, and *Rich Little*
South Dakota State University

Summary of Activities

The winter wheat breeding and genetics program utilizes the Central Research Station at Highmore primarily for early-generation testing and evaluation of advanced-generation lines. Field trials also are conducted at several other sites throughout South Dakota.

Central Research Station trials conducted in 2002 included:

1. The CPT Variety Trial under the overall coordination of Bob Hall. The trial included 37 entries consisting of 24 released varieties (including new releases from other states), 13 advanced experimental lines from our program, and one experimental line from Nebraska. This trial was also grown at 13 other sites in South Dakota.

   Prior to cultivar release, promising elite lines must be grown in the CPT Variety Trial for 3 years to accurately measure potential performance across a range of environmental conditions. Performance of 2002 CPT entries is given in Tables 1 and 2.

2. The South Dakota Advanced Yield Trial (AYT) with both hard red and hard white lines. The AYT nursery included 45 entries consisting of 38 advanced experimental lines and 7 checks. Twelve of the experimental lines have the white bran color. The AYT nurseries were also grown at six other sites in South Dakota.

   Each year, three to six superior experimental lines are selected from these nurseries and advanced to the CPT Variety Trial and the Northern Regional Testing Program.

3. Early-generation F_2-bulk populations, consisting of 185 different cross combinations. Undesirable F_2 populations are eliminated, based largely on visual observations, pedigree and parental characteristics, and bulk yield. Desirable F_2 populations are advanced to the F_3 bulk nursery for further evaluation prior to head selection the following year.

Trial Conditions

The nurseries at Highmore were planted 0.75 inches deep into soybean cover with moist top soil on September 21, 2001. Plots were sprayed on April 26, 2002, with 5 quarts Ramrod per acre and in early May with 1.5 pints Bronate per acre. Yield and agronomic data are presented in Tables 1 and 2 for the Crop Performance Trial.

Acknowledgements

Each year, 600 to 800 new cross combinations are made and 600 to 800 new experimental lines are developed by the winter wheat breeding program. In addition to the excellent support of our wheat pathology programs (small grains pathology and virology), the solid and consistent financial support from the South Dakota Wheat Commission and the South Dakota Crop Improvement Association are vitally important to ensuring continued availability of improved winter wheat varieties for producers in South Dakota.

Table 1. Yield results of entries in the 2002 Crop Performance Testing (CPT) nursery.

ID	HAY*	MAR	OEL	STU	HIG	SEL	WIN	WAL	WAT	PLA	BRO	AVG**
QUANTUM7406	40	76	50	46	33	28	36	36	47	63	55	48
JAGALENE	37	68	49	55	32	35	43	31	34	58	55	45
MILLENNIUM	34	54	50	44	30	32	27	32	49	54	52	45
WAHOO	33	55	48	43	33	29	20	35	43	57	54	45
WESLEY	34	68	46	47	29	25	34	32	39	60	52	44
EXPEDITION	31	60	45	47	25	28	40	32	42	58	54	44
SD97W604	31	55	49	47	27	32	46	32	45	52	52	44
SD97250	28	46	39	49	25	30	35	30	46	60	55	44
ARAPAHOE	29	60	44	47	29	32	24	32	45	58	52	44
TANDEM	33	58	45	44	33	28	37	33	41	57	49	43
SD97049	29	42	46	47	24	28	35	30	41	56	52	43
NUFRONTIER	35	52	46	45	30	23	33	32	33	57	52	43
SD96306	33	49	47	42	24	24	27	30	45	46	54	42
NEKOTA	35	66	46	42	25	26	35	30	39	55	49	42
TREGO	31	52	44	43	24	25	42	29	42	55	53	42
FALCON	29	64	40	43	36	32	40	31	41	56	54	42
SD97W650	30	53	45	39	27	28	26	30	39	55	57	42
Ch (SD97W604)	30	55	48	43	29	31	41	31	40	53	50	42
ALLIANCE	33	51	44	39	25	27	39	32	38	57	51	42
HARDING	30	56	41	44	29	25	27	28	45	53	51	42
STANTON	30	58	46	45	26	27	34	31	37	54	49	42
2137	27	50	44	46	22	29	36	31	38	57	50	42
NUPLAINS	27	50	40	41	30	26	33	29	36	52	65	41
SD92107-5	28	57	40	46	30	27	28	25	45	51	53	41
NW98S059	29	59	46	37	29	27	30	28	42	52	52	41
SD92107-3	27	49	37	46	34	30	36	28	46	50	51	41
JERRY	31	49	38	39	33	22	27	26	44	53	53	41
SD98102	29	47	46	39	30	27	35	30	35	51	52	40
SD97432	29	51	40	40	31	25	17	30	41	53	48	40
SD97088	27	47	46	41	26	32	32	23	43	52	50	40
RANSOM	28	44	41	41	27	22	31	24	39	47	53	39
NUHORIZON	30	51	43	40	20	17	39	29	27	54	49	39
SD98W198	26	42	41	40	25	22	27	26	33	53	54	39
CRIMSON	26	44	40	40	31	23	23	27	38	51	50	39
AVALANCHE	31	53	47	43	27	26	49	29	23	48	48	39
SCOUT66	29	49	44	39	27	20	28	28	31	50	48	38
JAGGER	32	56	41	38	30	24	41	28	26	59	36	37
Mean	31	54	44	43	28	27	33	30	39	53	52	42
LSD 05***	4.9	16	4.2	7.1	7.6	7.4	12	4.4	6.6	6.6	9	
CV% ****	12	18	7	8	17	16	17	11	12	9	12	

* HAY= Hayes, MAR=Martin, Oel=Oelrichs, STU=Sturgis, HIG=Highmore, SEL=Selby, WIN=Winner, WAL=Wall, WAT=Watertown, PLA=Platte, BRO=Brookings.

** Data from Martin, Highmore, Selby, and Winner were not used in calculating state average grain yield due to high CV%.

*** The LSD (least significant difference) is the minimum value by which two entries must differ in order for that difference to be meaningful (and not be due to random chance alone). If the difference between two entries is equal to or less than the LSD value, the entries are not statistically different.

**** The CV (coefficient of variability) is a statistical measure of experimental error. In general, yield trials with a CV of 16% or greater are considered to contain too much experimental error for reliable data interpretation.

Table 2. Testweight results of entries in the 2002 Crop Performance Testing (CPT) nursery.

ID	HAY*	MAR	OEL	STU	HIG	SEL	WIN	WAL	WAT	PLA	BRO	AVG
QUANTUM7406	61.5	626	57.0	58.7	60.3	56.6	51.3	60.4	56.0	60.5	58.6	58.4
JAGALENE	61.5	642	57.1	62.1	603	57.7	554	607	58.4	61.0	59.5	59.8
MILLENNIUM	60.9	624	56.5	59.8	59.4	58.1	49.3	593	566	59.1	60.3	58.3
WAHOO	584	600	53.3	56.7	57.9	54.9	48.1	57.4	54.1	56.8	56.2	55.8
WESLEY	59.8	627	52.7	580	586	56.6	51.1	58.7	55.6	58.3	58.2	57.3
EXPEDITION	604	63.1	56.5	596	59.4	57.2	544	58.8	55.4	56.5	59.3	584
SD97W604	625	63.3	56.8	61.0	59.1	57.8	57.3	60.4	56.3	59.9	59.7	59.5
SD97250	59.5	61.0	54.0	60.9	58.1	57.2	52.3	58.5	55.3	58.9	58.6	57.7
ARAPAHOE	59.1	608	54.1	588	582	56.4	49.7	57.8	55.8	58.4	57.9	57.0
TANDEM	61.7	62.9	58.1	61.5	59.5	57.6	54.5	59.3	56.8	60.1	58.0	59.1
SD97049	59.7	607	56.3	59.7	58.7	55.8	52.8	58.1	54.5	56.7	58.4	57.6
NUFRONTIER	61.5	61.8	56.2	59.6	60.2	54.3	52.8	59.7	55.0	59.7	57.8	58.0
SD96306	59.3	61.9	54.3	58.6	58.0	56.9	50.1	57.5	56.0	58.8	58.3	57.2
NEKOTA	61.1	62.7	57.2	599	58.7	56.5	52.0	59.9	56.1	59.4	60.6	58.5
TREGO	61.0	625	57.1	596	61.2	58.1	54.4	588	57.7	60.3	60.8	59.2
FALCON	57.5	61.9	52.6	57.4	57.4	53.0	49.8	54.3	54.5	55.6	57.3	55.6
SD97W650	60.0	63.1	57.4	59.1	60.4	57.8	52.5	59.0	56.3	59.8	58.3	58.5
Ch (SD97W604)	62.6	63.2	56.1	606	597	58.1	54.3	60.8	56.6	59.6	61.9	594
ALLIANCE	59.5	59.6	54.1	569	57.5	54.5	52.8	57.3	53.9	57.9	57.4	56.5
HARDING	59.2	61.6	52.9	60.3	58.5	560	51.1	56.0	55.4	57.2	602	57.1
STANTON	61.0	62.8	56.8	593	59.3	57.7	51.6	58.4	56.5	60.1	598	58.5
2137	57.5	61.0	53.8	589	586	55.7	50.3	58.7	55.7	58.0	586	57.0
NUPLAINS	63.2	62.8	56.8	58.9	61.2	58.2	54.8	60.8	58.1	61.1	60.4	59.7
SD92107-5	58.5	623	54.6	595	586	57.0	50.4	556	55.5	57.6	595	57.2
NW98S059	61.0	61.9	56.9	58.2	603	56.7	50.3	57.6	56.2	58.7	580	57.8
SD92107-3	58.8	61.8	53.8	61.2	586	57.0	52.9	56.4	56.0	56.8	600	57.6
JERRY	58.9	60.0	54.1	57.3	57.1	54.7	48.9	53.6	55.6	57.1	56.7	55.8
SD98102	604	62.1	55.2	57.8	596	57.2	53.4	57.2	56.5	57.9	59.1	57.8
SD97432	59.2	61.0	54.7	58.4	589	55.8	47.7	58.4	55.3	58.6	58.5	56.9
SD97088	59.1	59.7	54.2	58.7	58.1	56.3	52.5	56.7	55.6	57.7	59.0	57.0
RANSOM	57.9	59.0	51.9	55.3	56.4	52.7	49.9	54.2	53.5	54.4	56.7	54.7
NUHORIZON	63.2	62.2	55.3	586	596	55.2	55.2	59.5	55.7	58.7	599	585
SD98W198	61.9	62.2	55.9	60.2	59.7	57.6	53.4	59.4	57.1	60.3	59.5	58.8
CRIMSON	600	61.2	55.8	57.6	606	56.5	47.0	56.1	57.8	58.4	60.3	57.4
AVALANCHE	60.6	62.4	57.7	60.5	600	58.0	56.0	59.8	55.6	59.4	61.5	59.2
SCOUT66	61.3	63.0	56.6	59.5	59.5	56.0	54.2	58.8	55.9	59.3	61.0	586
JAGGER	61.4	61.0	56.1	57.5	598	56.9	53.9	59.8	55.8	59.2	56.7	58.0
Mean	60.3	61.8	55.4	59.1	59.1	56.5	52.1	58.2	55.9	58.8	59	57.8
LSD .05**	1.12	2.42	1.63	2.22	0.88	1.25	3.35	0.96	1.02	1.26	2.5	
CV%***	1.31	2.4	2.11	1.9	0.92	1.33	3.2	1.18	1.3	1.53	2.9	

* HAY= Hayes, MAR=Martin, Oel=Oelrichs, STU=Sturgis, HIG=Highmore, SEL=Selby, WIN=Winner, WAL=Wall, WAT=Watertown, PLA=Platte, BRO=Brookings

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*** The CV (coefficient of variability) is a statistical measure of experimental error. In general, yield trials with a CV of 16% or greater are considered to contain too much experimental error for reliable data interpretation.

2002 Report

Oat Research

Lon Hall
South Dakota State University

Yield, yield stability, and test weight are the most important characteristics associated with the identification and eventual release of oat varieties.

Several additional factors contribute to expression of these primary characteristics. Resistance to lodging, Barley Yellow Dwarf Virus (BYDV), stem rust, and crown rust all affect yield potential and test weight. Other traits that are considered prior to release include hull, protein, and oil percentages, along with maturity, hull color, plant height, and the hulled/hulless trait.

Consumers want different characteristics for specific needs. Millers generally want high protein oats. Livestock producers prefer tall varieties with high levels of protein and oil. The racehorse industry desires a high quality, white-hulled, or hulless oat variety. A considerable quantity of oats is shipped out of state as racehorse feed and seed for forage oats. Tall varieties, such as Troy, are popular forage oats.

Buff, a hulless oat released in 2002, has high yield potential, good test weight, and moderate crown rust and BYD resistance. Reeves, a white-hulled oat also released in 2002, is an early maturing, high yielding, excellent quality oat with good disease resistance; it may replace the popular variety Don.

The main emphasis of the oat breeding programs is development of white-hulled varieties. The racehorse industry desires white hulled varieties, and hull color is not a concern for livestock producers or millers. Recently there also has been interest in hulless oats for feed and other specialty uses; therefore, increased effort has gone into developing a high oil hulless oat.

Plant breeding is a long drawn-out process. The bulk breeding method takes, on average, at least 10 years from initial cross to variety release. This may be shortened 2 years by using the single seed descent method, which involves two extra generations in the greenhouse. Each year there are approximately 37,000 non-segregating plants and head rows observed in this program. In 2002, there were 4414 unique non-segregating lines yield tested and 6720 yield plots.

Data from regional nurseries provide valuable information for variety release and germplasm selection for crossing in our program. The Tri-State regional nursery is made up of 30 lines and 6 checks. The 30 lines are 10 advanced lines each from Minnesota, North Dakota, and South Dakota. The best lines are then entered in either the Uniform Early Nursery (UEO) or the Uniform Midseason Nursery (UMO) the following year.

The UEO is a regional nursery made up of 20 early maturing lines from breeding programs across the U.S. We entered five lines in the UEO in 2002. Out of these five, SD00843 and SD00731 ranked number one and two, respectively, for yield averaged over two South Dakota locations.

The UMO is made up of 32 advanced medium- and late-maturing lines, usually one to three lines (we had two lines) from each participating state and Canadian breeding programs. In the 2002 UMO, SD96024A averaged third in yield for the three South Dakota locations. On average, it outyielded its nearest competitor, Killdeer, by 8 bushels on a 3-year average in the 2000-2002 South Dakota Standard Variety Oat Trials.

SD96024A has been increased with intent to release in 2004, pending approval of the South Dakota Crop Improvement Association release committee.

2002 Report

Spring Wheat Breeding

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Our primary objective is to improve agronomic, milling, and baking characteristics of spring wheat varieties that are well adapted to South Dakota.

Prior to the release of a new variety to growers, its advantageous features must be well documented. Characterization of material within the breeding program begins during the second growing season after a cross has been made.

Thousands of breeding lines, each representing a potential variety, are created yearly and are subject to removal from consideration based on their susceptibility to disease and lack of agronomic promise. Lines chosen for additional testing are more heavily scrutinized with each successive testing year. Therefore, the number of lines included in preliminary and advanced yield tests is relatively few compared to early generation tests.

Spring wheat production environments in our state can be dramatically different from year-to-year and even from location-to-location within a year. Unfortunately, this prevents varieties from being optimally adapted to all production environments and necessitates that preliminary and advanced yield tests be conducted in several environments throughout the state.

This station is one of eight locations used for testing material in our Advanced Yield Trial (AYT) test. Generally, breeding lines that do very well over 2 or 3 years of consideration in our AYT test are the most likely to be released as varieties. Dry conditions at the Central Crops and Soils Research Station led us to abandon our AYT plots in 2002. Consequently, they were not harvested.

Twenty-seven lines that appear to hold potential for varietal release are grown each year in our AYT test along with nine released varieties used for comparative purposes. Not all 27 entries are advanced to a second year of AYT testing. Table 1 presents yield and test weight observations collected from 10 experimental entries, along with check varieties, that were grown in both the 2001 and 2002 AYT tests.

Among these potential varieties, SD3546 appears most promising as it has above-average yield potential, high test weight, moderate scab resistance, and a high level of leaf rust resistance (disease data not presented).

SD3641 and SD3623 also appear to hold potential, although SD3641 is only moderately resistant to leaf rust and SD3623 is susceptible (rust data not presented). Regrettably, this level of susceptibility will likely prevent SD3623 from ever being released, even though its yield potential is quite high.

We appreciate the financial support provided by the SDSU Plant Science Department, South Dakota Wheat Commission, and South Dakota Crop Improvement Association.

Table 1. Yield and test weight observations of 9 checks and 10 potential hard red spring wheat varieties evaluated in 2001 and 2002 Advanced Yield Trials at five South Dakota locations and ranked in order of descending average yield values calculated over all test locations.

	State*	Brookings		Groton		Redfield		Selby		Watertown	
Line	YLD	YLD	TW	YLD	TW	YLD	TW	YLD	TW	YLD	TW
SD3623	42.3	53.6	58.0	51.7	48.5	40.7	57.8	41.3	56.6	42.5	52.7
SD3546	42.1	56.8	58.0	53.6	57.2	41.5	59.5	40.1	58.1	38.8	54.6
SD3618	42.0	55.2	55.5	53.2	53.1	43.4	56.6	37.1	56.5	39.3	52.7
SD3540	41.9	57.7	57.3	53.8	51.7	41.2	57.6	35.8	56.9	38.5	52.7
BRIGGS	41.5	53.6	55.8	53.7	52.9	36.3	56.2	39.7	54.6	41.8	50.9
SD3635	41.3	57.6	55.4	50.3	57.1	37.5	58.0	39.8	57.4	39.8	52.3
SD3641	41.1	47.6	57.8	53.3	57.3	38.3	58.0	38.0	57.7	43.5	54.0
OXEN	41.0	53.4	55.3	51.6	55.7	43.3	56.5	35.5	55.5	38.4	52.9
SD3533	40.9	53.6	55.7	53.5	54.0	37.4	58.1	38.4	57.6	37.6	53.3
RUSS	40.4	53.5	54.3	50.2	54.0	39.2	56.1	38.3	56.3	39.4	52.2
FORGE	39.8	50.7	53.1	50.0	51.1	38.9	55.3	40.0	57.4	38.2	47.9
SD3506	39.6	51.1	55.1	50.3	58.0	35.7	58.0	38.7	58.8	37.2	55.4
INGOT	39.4	51.8	57.4	49.5	56.4	36.8	59.9	38.5	59.9	36.5	55.2
SD3496	38.6	55.1	54.9	50.3	52.4	34.3	54.5	35.8	56.4	34.1	51.9
SD3603	38.1	51.6	54.5	49.3	55.7	34.9	57.6	34.4	56.0	35.2	53.5
BUTTE 86	38.1	49.3	55.6	47.7	48.1	35.5	56.2	34.5	55.2	40.8	50.0
WALWORTH	37.7	51.9	54.9	46.3	56.7	36.3	56.9	32.3	56.2	35.5	53.8
2375	35.0	48.5	57.0	43.5	57.2	30.5	57.8	29.0	57.6	37.3	53.9
CHRIS	29.2	42.8	47.4	35.1	51.4	27.4	51.0	28.4	52.4	25.3	49.6
Average	39.5	52.3	55.4	49.8	54.1	37.3	56.9	36.6	56.6	37.8	52.6
LSD	2.2	4.1	3.0	5.6	6.1	5.9	3.5	5.1	2.3	4.1	2.4
CV	12.7	6.7	4.7	11.3	11.3	13.7	5.3	12.1	3.5	10.7	4.7

* Additional locations not presented in this table were used in the calculation of the statewide yield average.

2002 Report

Resistance of Sunflower Germplasm to the Red Sunflower Seed Weevil

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This trial was conducted as a cooperative experiment between the South Dakota Experiment Station, SDSU, and the USDA-ARS Sunflower Research Unit, Fargo, N.D.

Sunflower germplasms tested were lines developed by the USDA-ARS through a recurrent selection breeding procedure and Plant Introductions (PI) obtained from the Plant Introduction Station, Iowa State University, Ames, Iowa.

Three replications were planted and seed was harvested from each replication. The sunflower insect laboratory of the USDA-ARS evaluated each seed sample and counted the number of seed infested by the red sunflower seed weevil. Two hundred seeds were evaluated from each replication.

Data from this study will be distributed to public and industry sunflower plant breeders for incorporation into their breeding programs.

Red Sunflower Seed Weevil Trial, Highmore, 2002.

SOURCE	SUNFLOWER LINE	NO.OF INFESTED SEED/200
HYBRID 894	HYBRID 894	60
98 1851-3	USDA RSSW	85
98 1852-1	USOA RSSW	69
981853	USDA RSSW	55
98 1854	USDA RSSW	26
98 1855	USDA RSSW	34
98 1858	USDA RSSW	57
98 1859	USDA RSSW	46
98 1860	USDA RSSW	39
98 1861-1	USDA RSSW	71
98 1862	USDA RSSW	63
981864	USDA RSSW	42
981865	USDA RSSW	53
98 1866-3	USDA RSSW	77
98 1867	USDA RSSW	38
98 1868	USDA RSSW	74
98 1869-1	USDA RSSW	57
98 1870	USDA RSSW	65
98 1871	USDA RSSW	34
98 1872	USDA RSSW	72
98 1873	USDA RSSW	44

SOURCE	SUNFLOWER LINE		NO OF INFESTED SEED/200
981874-3	USDA RSSW		63
981875	USDA RSSW		48
981876	USDA RSSW		67
981877	USDA RSSW		86
981878	USDA RSSW		47
98 1879-4	USDA RSSW		28
981881	USDA RSSW		25
81882	USDA RSSW		16
98 1883	USDA RSSW		47
98 1884	USDA RSSW		15
98 1885	USDA RSSW		19
98 1886	USDA RSSW		65
98 1887	USDA RSSW		66
98 1888	USDA RSSW		90
98 1892	USDA RSSW		31
98 1893	USDA RSSW		45
98 1894	USDA RSSW		68
98 1895	USDA RSSW		73
98 1896	USDA RSSW		79
98 1898	USDA RSSW		26
HYBRID 894	HYBRID 894		74
AMES 3269	GERMANY	PURPUREUS	36
AMES 3412	CANADA	S11 V8883 4/1-1	87
PI 599786	USA	RHA 271	24
PI 167387	TURKEY	AYCICEGI	67
PI 170411	TURKEY	No. 2728	99
PI 172906	TURKEY	No.8188	74
PI 219649	AUSTRIA	LODGING RESISTANCE	108
PI 251465	TURKEY	No K1918	49
PI 291403	HUNGARY	NAIN NOIR	104
PI 343801	IRAN	TCHERNIANKA SELECT	101
PI 480471	ZAMBIA	FS-a-3	103
PI 486366	FMR USSR	CAKINSKIJ 269	16
PI 526262	ZIMBABWE	AMM 687	110
PI 431506	POLAND	T 6551-1-2	102
LOW MEAN			15
HIGH MEAN			110
EXP MEAN			59
C.V. %			41
LSD 5%			39
LSD 1%			51
# OF REPS			3

2002 Report

Weed Control

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The Highmore station provides a strategic location for several weed control field evaluation and demonstration trials. The plots provide data for the statewide Extension weed control program and are used for field tours.

The station has been the primary site for evaluating downy brome (cheatgrass) control in winter wheat. A block is devoted to maintaining the weed infestation and provides the winter wheat crop for comparing herbicides, including experimental products.

Comparisons of weed control programs in no-till cropping systems have been expanded.

2002 Projects

Projects initiated include cheatgrass and wild oat control in winter wheat, experimental Clearfield wheat, sunflower, herbicide-resistant sunflower, wild oat in spring wheat, edible bean, soybean, grain sorghum, oats, and safflower.

Fall and winter precipitation was very limited. Cheatgrass emergence was primarily in the spring.

Drought conditions impacted crops and herbicide performance in 2002. Row crop emergence was uneven and delayed. Postemerge treatments could not be timed properly.

Wild oat tests in winter wheat and spring wheat could not be evaluated due to dessication from severe moisture stress. Alfalfa no-till burndown was also affected; the normal stage for optimum control produced poor results.

Only early season plants had sufficient moisture for active growth. Weed control evaluations are reported and plots were harvested where there was sufficient crop to harvest yield.

NOTE: Data reported in this publication are results from field tests that include labeled product uses, experimental products or experimental rates, combinations, or other unlabeled uses for herbicide products. Tradenames of products used are listed; there frequently are other brand products available in the market. Refer to the appropriate weed control fact sheet available from county Extension offices for herbicide recommendations.

Table 1. No-Till Corn Herbicide Demonstration

RCB; 3 reps
Varieties: DeKalb DKC 44-46RR;
Pioneer 37H27 LL; Pioneer 37M36 Clearfield
Planting Date: 4/30/02
PRE: 4/30/02
EPOST: 6/4/02
POST: 6/19/02

Soil: Clay loam; 2.3% OM; 6.3 pH

Precipitation:

PRE:	1st week	0.23 inches
	2nd week	0.32 inches
EPOST:	1st week	0.00 inches
	2nd week	Trace
POST:	1st week	2.70 inches
	2nd week	0.00 inches

Grft=Green foxtail
Rrpw=Redroot pigweed

Comments: Cornerstone applied at 2 qt at PRE application. Difficult weather conditions for most programs in the treatment comparisons. Lack of precipitation after planting reduced preemergence activity. Considerable late flush after postemergence application.

Treatment	Rate/A	8/19/02		9/22/02	
		% Grft	% Rrpw	% Grft	% Rrpw
Check	----	0	0	0	0
ROUNDUP READY - DeKalb DKC 44-48RR					
PREEMERGENCE					
Harness	2.3 pt	74	92	63	85
Balance Pro	2.25 oz	71	99	69	95
Balance Pro+atrazine	2.25 oz+1 qt	94	95	91	93
Bicep Lite II Magnum	2 qt	91	99	94	96
Guardsman	2.3 qt	73	96	70	93
PREEMERGENCE & POSTEMERGENCE					
Balance Pro&Buctril/Atrazine	2.25 oz&1 qt	77	97	72	93
Surpass&Aim EW+atrazine+NIS+28% N	2.75 pt&.5 oz+1 qt+.25%+2 qt	91	90	83	90
Harness&Yukon+NIS+AMS	2.5 pt&4 oz+.25%+2 lb	82	95	77	92
Dual II Magnum&Callisto+COC+28% N	1.67 pt&3 oz+1%+2 qt	85	97	85	90
Dual II Magnum&Northstar+NIS+28% N	1.67 pt&5 oz+.25%+2 qt	90	99	85	96
Outlook&Distinct+NIS+28% N	21 oz&4 oz+.25%+1 qt	80	98	84	95
Surpass&Accent+Atrazine+COC+28% N	1.25 pt&.67 oz+1.5 pt+1%+2 qt	88	92	82	95
Harness&Basis Gold+Clarity+COC+28% N	1.25 pt&14 oz+4 oz+1%+2 qt	76	92	75	94
EARLY POSTEMERGENCE					
Option+Marksman+28% N	1.5 oz+2 pt+2 qt	70	99	67	95
Basis Gold+COC+28% N	14 oz+1%+2 qt	62	89	60	84
POSTEMERGENCE					
Steadfast+atrazine+COC+28% N	.75 oz+1 pt+1%+2 qt	50	98	18	90

Table 1. No-Till Corn Herbicide Demonstration (cont)

Treatment	Rate/A	6/19/02 % Grft	6/19/02 % Rrpw	6/27/02 % Grft	6/27/02 % Rrpw
EARLY POSTEMERGENCE					
Accent+Northstar+NIS+28% N	.33 oz+5 oz+.25%+2 qt	76	98	77	95
Roundup Ultramax+AMS	26 oz+2 lb	65	98	58	95
POSTEMERGENCE					
Roundup Ultramax+AMS	26 oz+2 lb	60	98	43	95
EARLY POSTEMERGENCE & POSTEMERGENCE					
Roundup Ultramax+AMS&Roundup Ultramax+AMS	26 oz+2 lb&24 oz+2 lb	57	98	50	95
PREEMERGENCE & POSTEMERGENCE					
Harness&Roundup Ultramax+AMS	1 pt&26 oz+2 lb	71	98	55	92
Atrazine&Roundup Ultramax+AMS	1.5 qt&26 oz+2 lb	87	99	85	96
LIBERTY LINK - Pioneer 37H27					
EARLY POSTEMERGENCE					
Liberty+atrazine+AMS	32 oz+1 pt+3 lb	62	95	38	90
EARLY POSTEMERGENCE & POSTEMERGENCE					
Liberty+atrazine+AMS&Liberty+AMS	24 oz+1 pt+3 lb&24 oz+3 lb	51	94	40	93
CLEARFIELD - Pioneer 37M38					
EARLY POSTEMERGENCE					
Lightning+NIS+28% N	1.28 oz+.25%+2 qt	76	57	70	53
Lightning+Marksman+NIS+28% N	1.28 oz+2 pt+.25%+1 qt	79	78	63	67
LSD (.05)		11	9	15	8

Table 2. No-Till Soybean Herbicide Demonstration

RCB: 3 reps
Variety: Asgrow AG1301
Planting Date: 6/5/02
PRE: 6/5/02
POST: 7/15/02

Soil: Clay loam; 2.3% OM; 6.5 pH

Precipitation:

PRE:	1st week	0.00 inches
	2nd week	Trace
POST:	1st week	0.90 inches
	2nd week	0.27 inches

Grft=Green foxtail
Prte=Prickly lettuce
Colq=Common lambsquarters
KOCZ=Kochia

Comments: Lack of effective precipitation for preemergence programs. Authority, Valor, and glyphosate treatments provided very good late season kochia control. High glyphosate required for lambsquarter. Glyphosate product performance was similar.

Treatment	Rate/A	% Grft 10/6/02	% Prte 10/6/02	% Colq 10/6/02	% KOCZ 10/6/02
Check	----	0	0	0	0
PREEMERGENCE					
Prowl+Authority	3.6 pt+4 oz	17	10	94	93
PREEMERGENCE & POSTEMERGENCE					
Valor&Poast Plus+COC	3 oz&1.5 pt+1 qt	78	28	35	18
Valor&Roundup Ultramax+AMS	3 oz&20 oz+2 lb	96	96	96	97
Authority&Poast Plus+COC	4 oz&1.5 pt+1 qt	67	22	90	72
Authority&Roundup Ultramax+AMS	4 oz&26 oz+2 lb	97	97	98	98
Prowl&Flexstar+FirstRate+MSO+28% N	3.6 pt&12 oz+.3 oz+1%+2 qt	32	73	42	67
Authority&Roundup Ultramax+AMS	4 oz&20 oz+2 lb	97	95	98	95
POSTEMERGENCE					
Extreme+NIS+AMS	1.5 qt+.25%+2 lb	97	93	98	97
EARLY POSTEMERGENCE					
Roundup Ultramax+AMS	13 oz+2 lb	92	98	75	87
Roundup Ultramax+AMS	26 oz+2 lb	96	96	97	97
EARLY POSTEMERGENCE & POSTEMERGENCE					
Roundup Ultramax+AMS&Roundup Ultramax+AMS	20 oz+2 lb&26 oz+2 lb	96	98	97	98
POSTEMERGENCE					
Roundup Ultramax+AMS	26 oz+2 lb	97	96	98	97
Roundup Ultramax+AMS	52 oz+2 lb	98	98	98	96
Credit+AMS	1 qt+2 lb	98	98	98	97
Mirage+AMS	1 qt+2 lb	98	98	97	98
Clearout 41 Plus+AMS	1 qt+2 lb	96	97	97	97
Cornerstone+AMS	1 qt+2 lb	98	98	98	96
LSD (.05)		6	6	10	7

Tabla 3. Weed Control in Safflower Demonstration

RCB; 3 reps
Variety: S-208
Planting Date: 4/30/02
PPI/PRE: 4/30/02
POST: 6/4/02

Soil: Clay loam; 2.1% OM; 6.7 pH

Precipitation:

PPI/PRE:	1st week	0.23 inches
	2nd week	0.32 inches
POST:	1st week	0.00 inches
	2nd week	Trace

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Grft=Green foxtail
Colq=Common lambsquarter

Comments: Very dry conditions. Light weed pressure. Somewhat more crop stunting (VCRR) than in previous tests noted for some treatments. Experimental Tough and high rate of Spartan caused excessive crop response.

Treatment	Rate/A	Safflower % VCRR 9/12/02	% Grft 9/12/02	% Colq 9/12/02	Yield bu/A
Check	----	0	0	0	981
PREPLANT INCORPORATED					
Treflan	1 qt	20	98	92	938
Sonalan	1.5 qt	13	98	95	1040
Prowl	3.3 pt	8	98	92	1062
PREEMERGENCE					
Dual II Magnum	2 pt	3	88	37	1236
PREEMERGENCE & POSTEMERGENCE					
Dual II Magnum&Tough 3.75L+COC	2 pt& 2 pt+1 qt	82	73	75	396
Valor&Poast Plus+COC	3 oz&1 pt+1 qt	7	97	53	837
Spartan&Poast Plus+COC	4 oz&1 pt+1 qt	8	98	87	1171
Spartan&Poast Plus+COC	8 oz&1 pt+1 qt	30	98	98	1024
POSTEMERGENCE					
Poast Plus+COC	1 pt+1 qt	0	98	0	1107
Assure II+COC	8 oz+1 qt	0	98	0	1447
Select+COC	7 oz+1 qt	0	98	0	1540
Pinnacle+NIS	.25 oz+.25%	0	0	52	1215
Pinnacle+NIS	.5 oz+.25%	0	0	68	1163
LSD (.05)		9	5	16	522

Table 4. Oat Herbicide Tolerance

RCB: 2 reps
Variety: Jerry
POST: 6/4/02

Precipitation:
POST: 1st week 0.00 inches
2nd week Trace

Soil: Clay loam; 2.1% OM; 6.4 pH

Comments: Severe drought conditions. Considerable crop stress. Very light weed pressure. Several yielded less than Check.

Treatment	Rate/A	Oat Yield bu/A	Oat Test Wt. lb/bu
Check	----	22	34
POSTEMERGENCE			
2,4-D amine	1 pt	10	35
Salvo	.8 pt	10	35
2,4-D ester	1 pt	15	34
MCPA amine	1 pt	17	35
Bronate Advanced	8 pt	16	34
Clarity+MCPA amine	3 oz+ 5 pt	15	33
Starane+LI-700	6.7 pt+ 25%	14	34
Aim EW+NIS	.5 oz+ 25%	15	34
Aim EW+NIS	1 oz+ 25%	21	34
Aim+NIS	.67 oz+.25%	20	34
Harmony GT+NIS	.3 oz+.25%	19	35
Stampede CM+COC	1 pt+1 pt	14	35
LSD (.05)		6	1

Table 5. Sorghum Herbicide Demonstration

RCB: 3 reps
Planting Date: 6/4/02
PRE: 6/4/02
Soil: Clay loam; 2.3% OM; 6.5 pH

Precipitation:
PRE: 1st week 0.00 inches
2nd week Trace

Grft=Green foxtail
Rrpw=Redroot pigweed

Comments: Notes on preemergence treatments. Very dry conditions after planting. Uneven and delayed crop emergence. Postemergence planned treatments not applied due to inadequate stand.

Treatment	Rate/A	% Grft 8/19/02	% Rrpw 8/19/02	% Grft 9/22/02	% Rrpw 9/22/02
Check	----	0	0	0	0
PREEMERGENCE					
Bicep Lite II Magnum	1.9 qt	86	97	80	88
Dual II Magnum	1.67 pt	82	80	76	75
Outlook	21 oz	71	78	65	63
Lasso	2 qt	42	62	30	83
LSD (.05)		11	22	14	15

Table 6. Alfalfa Kill

Demonstration
EPOST: 4/30/02
POST: 6/4/02
Soil: Clay loam; 2.75 OM; 6.7 pH

ALFZ=Alfalfa

Comments: Spring application to established alfalfa. Early (1-3 in.) application was more effective than late (5-6 in.). This is opposite of expected results in normal conditions. Severe drought affected growth early; little active growth at later application.

Treatment	Rate/A	% ALFZ 8/16/02	% ALFZ 9/12/02
Check	----	0	0
EARLY POSTEMERGENCE			
2,4-D amine	1 qt	90	50
2,4-D ester	1 qt	99	60
Roundup Ultramax+AMS	26 oz+2 lb	90	20
Roundup Ultramax+AMS	52 oz+2 lb	90	50
Touchdown 3L+AMS	32 oz+2 lb	60	20
RT Master+AMS	1 qt+2 lb	95	0
RT Master+AMS	2 qt+2 lb	90	70
Roundup Ultramax+2,4-D ester+AMS	26 oz+1 pt+2 lb	85	65
Curtail	2 pt	—	98
Stinger	.75 pt	—	98
Distinct+NIS+AMS	6 oz+.25%+1 lb	—	0
Clarity	8 oz	—	50
Roundup Ultramax+Clarity+AMS	26 oz+8 oz+2 lb	—	80
2,4-D ester+Clarity	1 qt+6 oz	—	80
POSTEMERGENCE			
2,4-D amine	1 qt	50	0
2,4-D ester	1 qt	40	20
Roundup Ultramax+AMS	26 oz+2 lb	45	7
Roundup Ultramax+AMS	52 oz+2 lb	35	20
Touchdown 3L+AMS	32 oz+2 lb	50	0
RT Master+AMS	1 qt+2 lb	75	0
RT Master+AMS	2 qt+2 lb	15	20
Roundup Ultramax+2,4-D amine+AMS	26 oz+1 pt+2 lb	5	0
Curtail	2 pt	—	20
Stinger	.75 pt	—	70
Distinct+NIS+AMS	6 oz+.25%+1 lb	—	0
Clarity	8 oz	—	10
Roundup Ultramax+Clarity+AMS	26 oz+8 oz+2 lb	—	20
2,4-D ester+Clarity	1 qt+6 oz	—	30
EARLY POSTEMERGENCE & POSTEMERGENCE			
Roundup Ultramax+2,4-D ester+AMS&Roundup Ultramax+AMS	26 oz+1 pt+2 lb&26 oz+2 lb	95	70
Roundup Ultramax+AMS&Roundup Ultramax+AMS	26 oz+2 lb&26 oz+2 lb	97	40
Roundup Ultramax+AMS&Roundup Ultramax+AMS	26 oz+2 lb&52 oz+2 lb	80	50

2002 Report

Fertilizer and Soil Test Effects on Wheat Yield, Highmore

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Soil testing research has shown that knowledge of soil test levels can improve the profitability of fertilizer use. Profits increase if more fertilizer is used when soil test levels are low and or when little or no fertilizer is used when test levels are high. Frequently, however, the major nutrients (NPK) and sometimes zinc and sulfur are applied without a current soil test.

This experiment demonstrates the long-term effects of applying phosphorus, potassium, zinc, and sulfur regardless of soil test. The intent is to continue the experiment on the same location for a number of years. The planned rotation is soybean and wheat. The objective is to demonstrate soil testings' ability to predict crop response to fertilizer and fertilizer influence on soil tests.

Materials and Methods

The experiment was established on a Glenham loam soil series in 1997. Glenham soils are deep, well drained soils formed in friable glacial till. Fertilizer treatments consisted of a check where no fertilizer was applied, 25 lb/acre nitrogen and 25 lb/acre nitrogen plus either 35 lb phosphorus (0-46-0), 50 lb/acre potassium (0-0-60), 25 lb sulfur (21-0-0-24), or 5 lb zinc/acre ($ZnSO_4$ – 35%).

The nitrogen source was urea except in the sulfur treatment where the nitrogen was applied as part of the ammonium sulfate. The 25-lb nitrogen rate was determined by using SDSU fertilizer recommendations for a 65-bushel wheat yield goal, the 2-foot nitrate soil test (Table 1), and legume credits for the 2001 soybean crop.

Dry conditions in 2001 resulted in low yields and a very high nitrate soil test of 121 lb/acre. Therefore, only 25 lb of nitrogen was recommended for a 65-bushel wheat yield goal. In addition to the fertilizer treatments, 105 lb phosphorus was applied to all treatments except the nitrogen-only and the nitrogen plus phosphorus treatment to raise phosphorus soil test levels and make phosphorus non limiting in those treatments.

Fertilizer was broadcast into the untilled soybean residue from 2001 on April 10 and incorporated by disking. Oxen spring wheat was planted on April 11.

Results and Discussion

Soil analysis on samples taken on November 16, 2001, is reported in Table 1. The 50 lb nitrogen applied to the previous soybean crop resulted in a 41 lb/acre increase in soil residual nitrate over the check where no nitrogen had been applied since the start of the study in 1997. No nitrogen would have been recommended for soybeans. For this study, however 50 lb N had been applied to determine its influence on soybean yield.

The sulfur soil test was high and no sulfur would have been recommended. Previous applications of sulfur increased sulfur soil test by 60 lb/acre. The 25 lb phosphorus and 50 lb potassium applied each year since 1997 increased phosphorus soil test from 9 ppm in the check to 20 ppm and potassium soil test from 482 to 632 ppm. The phosphorus test (9 ppm) was in the medium range, and 30 lb phosphorus fertilizer would have been recom-

mended for a 65-bushel wheat yield goal. The potassium soil test was very high and none would have been recommended.

The zinc soil test was raised from 0.85 ppm to 5.60 ppm by the annual addition of 5 lb zinc for 5 years. The check zinc soil test (0.85 ppm) was in the high soil test range. No zinc would have been recommended regardless of soil test since wheat is usually not responsive to zinc.

Wheat yield and protein content are reported in Table 2. Wheat yields were severely limited by drought conditions and high temperatures during the entire growing season. Compounding the dry conditions was the lack of subsoil moisture due to the very dry summer and fall of 2001.

Yields were extremely variable due to the dry conditions, and five plots which had almost no yield were not included in the analysis shown in Table 2. Wheat yields averaged about 21 bushels/acre for all treatments and were not statistically different. The lack of significant differences was likely due to the variability (CV of 19.2%).

Visual observations showed the phosphorus treatment had better growth the entire season, and it yielded 6 bushels (30%) more than the average of the other treatments. A phosphorus recommendation would have been made for wheat with the soil test level at this site.

The 25-lb nitrogen application increased protein from 17.0% to an average of 18.1% even though it had no effect on grain yield. This is consistent with previous work that shows added nitrogen beyond what is needed for maximum wheat yield will normally increase protein up to 1%.

This site will be rotated back to soybeans in 2003. Similar fertilizer treatments (N rate will change) will be applied to the same plots. Yields and soil tests from the previous years of this study can be found in the 1997 - 2001 Highmore annual reports or in the 1997 - 2001 SDSU Plant Science Department Soil/Water Science Research Annual Report, TB No. 99.

Table 1. Soil Test Levels, Highmore, 2002.

*Soil Test**	*Check*	*Treated*
Nitrate-N, lb/a		
0 – 6 in.	33	54
6 in. – 24 in.	47	67
Sulfate-S, lb/a		
0 – 6 in	10	34
6 in – 24 in.	18	54
Phosphorus, ppm	9	20
Potassium, ppm	482	632
Zinc, ppm	0.85	5.60
OM, %	2.5	
pH	6.6	
Salts, mmho/cm	.05	

* Sampled 11/16/01

Table 2. Wheat Yield and Protein Fertilizer Trial, Highmore, 2002

*Fertilizer Treatment** lb/a*	*Wheat*	
	*Yield*** *bu/a*	*Protein %*
1.	23	17.0
2. 25 N	21	18.2
3. 25 N + 35 phosphorus	26	17.9
4. 25 N + 50 potassium	18	18.4
5. 25 N + 25 sulfur	21	18.0
6. 25 N + 5 zinc	19	18.2
Pr. > F	0.68	.003
CV%	19.2	1.9
LSD	NS	***

* Treatments 1,4,5,6 received 105 lb P_2O_5

** 5 plots excluded due to drought

*** Can not calculate LSD due to missing plots

2002 Report

Influence of Planting Date on Insect Infestations, Viral Plant Disease, Plant Growth, and Yield in Winter Wheat

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Summary

1. Yields and test weights, respectively, did not differ among plantings of winter wheat, based on combine harvest. Winter wheat yielded 32.7 bu/a with a test weight of 62.2 lb/bu across all planting dates. Results obtained through hand harvesting showed no dramatic differences in yield or yield components across the three planting date treatments.

2. Measurements of the ratio of wheat-leaf area to the ground area upon which the wheat was grown (leaf area index – LAI) revealed that early-planted winter wheat had a thicker crop canopy than the other planting dates when measured at the late boot – early head crop development stage.

3. Cereal aphid infestations and damage from chewing insects were light across all planting dates in fall 2001. Grasshopper infestations were also low in early summer 2002. In all cases, levels were below economic thresholds for each planting date.

4. Incidence of viral disease was relatively low and did not differ among three plantings. Overall, 3.7% of plants had symptoms of wheat streak mosaic, and 4.7% showed symptoms of barley yellow dwarf.

Winter wheat yield can be reduced by fall infestations of insect pests such as cereal aphids and grasshoppers. Also, some viral diseases of wheat, such as barley yellow dwarf (BYD) and wheat streak mosaic (WSM), become prevalent when cereal aphids and wheat curl mites, which transmit the viruses that cause the respective diseases, are abundant in the fall. Planting date of winter wheat may potentially be a key factor in limiting fall infestations of arthropod pests and the incidence of viral plant diseases, but this has not been determined for winter wheat in South Dakota.

Our objective was to measure insect population levels and damage, incidence of viral diseases, and plant growth and yield in winter wheat planted over a range of three dates.

Winter wheat plots

'Crimson' winter wheat was sown at three different planting dates (early, August 31; middle, September 10; and late, September 22, 2001) at the Central Research Station. Seed was sown about one inch deep using a Kirschman drill in furrows about 12 inches apart. Seed was treated with fungicides (mixture of 10% AI carboxin and 10% AI thiram, 6.8 fl oz (total product)/cwt)) to limit several seed- and soil-borne diseases of wheat. Plots (30 by 60 ft) of each planting were randomized and replicated four times. Fertilizer (46-0-0 (N-P-K), 100 lb ac^{-1} and 14-36-13, 52 lb ac^{-1}) was applied at planting.

Insect sampling. We sampled 25 tillers (from five groups of five plants) per wheat plot for insect infestations and chewing insect damage on September 20 (early plots only), September 27 (early and intermediate plots), and October 4 and October 18 (all plots).

For each 25-tiller sample, we counted the number of cereal aphids per tiller. We also measured damage per 25 tillers by insects with chewing mouthparts (e.g., grasshoppers, wireworms, and cutworms) in fall 2001, and we counted grasshoppers along a 40-ft transect within each field plot in summer 2002.

Viral diseases. On June 13, we sampled incidence of viral diseases by walking through plots in a W-pattern and classifying about 300 randomly selected plants per plot as either having or not having symptoms of WSM or BYD.

Leaf area measurements. The ratio of wheat-leaf area to the ground area upon which the wheat was grown was measured on June 4 using the leaf-area index (LAI) feature of the LAI-2000 crop canopy analyzer. An above-canopy reference measurement was a benchmark for four within-canopy measurements per plot. Data were averaged across treatments and standard error of data means calculated using SAS software.

Yield data. Plots were harvested by hand and by a Massey-Ferguson 8XP combine on July 15. Hand-harvested yield was taken from three 1-foot sections of row per plot. Plants were cut at ground level with scissors. Leaves, stems, and grain heads were put into paper bags and dried to ambient humidity in a greenhouse. Heads were counted, and grain was manually separated from the chaff. Total grain weight and 100-kernel weight were then measured. Combine yield was taken from two 6-ft-wide combine strips within each plot; exact measurements of strips were made immediately after each pass. Moisture was measured for each strip, yield data were adjusted to equivalent weight at 13.5% moisture. Test weight and moisture content of combined grain were measured with a Dickey-John seed tester.

Results

Insects. Cereal-aphid levels were low in fall 2001, with a peak of only 3.8 aphids per 25 tillers on October 4 in the middle planting. Samples of 25 tillers contained no cereal aphids on some sampling dates. These low levels of cereal aphids are not damaging to the growth and yield of wheat. Damage by grasshoppers and other chewing insects was low in fall 2001 (peak incidence of 7% of plants damaged, middle planting, October 4), and grasshopper counts in summer 2002 were also low (less than 2.8 grasshoppers per 40-ft transect per planting). Such levels were too low to have an impact on yield.

Viral diseases. Incidence of viral disease was relatively low and did not differ among the three plantings. Overall, 3.7% of plants had symptoms of WSM and 4.7% showed BYD symptoms.

Leaf area. Early-planted winter wheat had a thicker crop canopy than the other planting dates when measured at the late boot – early head crop development stage (Table 1).

Yield. Results of hand harvesting showed no dramatic differences in yield or yield components across the three planting date treatments (Table 1).

Results from combine-harvest samples showed no statistical differences in yield or test weight of winter wheat among plantings. Winter wheat yielded 32.7 bu/a with a test weight of 62.2 lb/bu across all planting dates.

Acknowledgments

We thank Mike Volek and Cecil Tharp for establishing the winter wheat and Dave Schneider, Cecil Tharp, Connie Cihlar, Toby Bryant, Erika Eggers, and Malissa Mayer for assistance in sampling within the wheat plots.

Table 1. Yield results from hand harvest of 'Crimson' winter wheat, July 15, 2002.

Planting*	Crop canopy** (LAI)	Total heads (per foot of row)	Total seeds (per foot of row)	Seed weight (g per 100 seeds)	Yield (g foot^{-1})
Early	1.47 ± 0.13	52 ± 5	841 ± 89	0.0227 ± 0.0004	19.2 ± 2.1
Middle	1.13 ± 0.15	46 ± 5	722 ± 132	0.0220 ± 0.0011	17.2 ± 3.3
Late	1.01 ± 0.15	49 ± 6	784 ± 135	0.0245 ± 0.0005	19.9 ± 3.6

* Values represent average ± standard deviation for four replicates per planting of winter wheat (early, Aug. 31; middle, Sep. 10; and late, Sep. 22, 2001).

** Crop canopy characteristics were measured with a LAI-2000 leaf area index (LAI) meter on June 4, 2002, at the late boot – early head crop development stage.

2002 Report

Influence of Planting Date on Insect Infestations, Viral Plant Diseases, Plant Growth, and Yield of Spring Wheat

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Summary

1. Results of combine harvest showed that yields in early and middle plantings were greater than that of the late planting. Test weights declined significantly with later plantings, being greatest in the early planting, intermediate in the middle planting, and lowest in the late planting. Results obtained through hand harvesting showed a dramatic reduction in yield and yield components in the late-planted spring wheat when compared with the other date treatments.

2. Measurements of the ratio of wheat-leaf area to ground area upon which the wheat was grown (leaf area index – LAI) revealed that late-planted spring wheat had a thinner crop canopy than other planting dates when measured at the late boot – early head crop development stage.

3. Cereal aphid infestations and damage from chewing insects were both light in spring wheat plots regardless of planting date and could not have directly limited plant growth or yield.

4. Incidence of viral disease was relatively low and did not differ among the three plantings. Overall, 3.4% of plants had symptoms of wheat streak mosaic, and 1.6% showed symptoms of barley yellow dwarf.

Introduction

Yield of spring wheat can be reduced by infestations of insect pests such as cereal aphids and by viral diseases such as wheat steak mosaic (WSM) and barley yellow dwarf (BYD). Planting date can directly influence plant yield. It may also influence infestation levels of insects and the vectors of viruses responsible for WSM and BYD. Specific differences in infestation levels and viral disease incidence have not been determined for various planting dates of spring wheat in South Dakota. Our objective was to measure insect infestation levels and damage, viral disease infection rates, plant growth, and yield of spring wheat planted over a range of three dates.

Spring wheat plots

'Ember' spring wheat was sown in 2002 at three different planting dates (early, April 11; middle, April 20; and late, April 30). Seed was sown about 1 inch deep using a John Deere press drill in 7.5-inch-wide rows. Seed was treated with fungicides to limit several seed- and soil-borne diseases. Plots of each planting (30 by 60 ft) were randomized within the study area and replicated four times. Fertilizer (46-0-0 (N-P-K), 138 lb ac^{-1} and 14-36-13, 52 lb ac^{-1}) was applied at planting.

Insect sampling. We sampled 25 tillers (from five groups of five plants) per wheat plot for insect infestations and chewing insect damage several times from late April to mid-June. For each 25-tiller sample, we counted number of cereal aphids per tiller and the percentage out of 25 tillers damaged by insects with chewing mouthparts (e.g., grasshoppers, wireworms, and cutworms).

Viral diseases. On June 28, we sampled for incidence of viral diseases in wheat by walking along three transects per plot and classifying about 300 randomly selected plants as either having or not having symptoms of WSM or BYD.

Leaf area measurements. The ratio of wheat-leaf area to the ground area upon which the wheat was

grown was measured using the leaf-area index (LAI) feature of the LAI-2000 crop canopy analyzer in the early, middle, and late plantings on June 16. An above-canopy reference measurement was used as a benchmark for four within-canopy measurements per plot. Data were averaged across treatments and standard error of data means calculated using SAS software.

Yield data. Plots were harvested by hand on July 23 and by Massey-Ferguson 8XP combine on July 15 (early planting) and July 23 (middle and late plantings). Hand-harvest yield was derived by taking three 1-foot sections of row per plot on July 23. Plants were cut at ground level using scissors. Leaves, stems, and grain heads were placed into paper bags and dried to ambient humidity in a greenhouse. Heads were counted, and grain manually separated from the chaff. Total grain weight and 100-kernel weight were then measured.

Combine yield was taken from two 6-ft wide combine strips within each plot; exact measurements of strips were made immediately after each pass. Moisture was measured for each strip sample, and yield data were adjusted to equivalent weight at 13.5% moisture. Test weight and moisture content of grain combined over date of planting treatments were measured using a Dickey-John seed tester.

Results

Insects. Cereal aphid infestations were extremely low across all plantings (peak of 1.8 aphids per 25 tillers, May 24, late planting), and damage from chewing insects (peak incidence of 8%, May 24, early planting) was low regardless of planting date. Such levels were too low to directly limit plant growth or yield.

Viral diseases. Incidence of viral disease was relatively low and did not differ among the three plantings. Overall, 3.4% of plants had symptoms of WSM and 1.6% showed symptoms of BYD.

Leaf area. Late-planted spring wheat had a thinner crop canopy than that of other planting dates when measured at the late boot – early head crop development stage (Table 1).

Yield. Results of hand harvesting showed dramatic reductions in yield and yield components in the late-planted spring wheat when compared with the other planting date treatments (Table 1). Results of combine harvest showed that yields differed by planting date (Table 2). Yields in the early and middle planting were greater than that of the late planting. Test weights declined significantly with later plantings, being greatest in the early planting, intermediate in the middle planting, and lowest in the late planting (Table 2). Yields for all plantings and test weights for middle and late plantings were substantially lower compared with typical values from other years; this may have been due to both the lack of soil moisture and high summer temperatures.

Acknowledgments

We thank Mike Volek for establishing the spring wheat plots and Dave Schneider, Cecil Tharp, Toby Bryant, Connie Cihlar, Erika Eggers, and Malissa Mayer for assistance in sampling the wheat plots.

Table 1. Yield results from hand harvest of 'Ember' spring wheat, Central Research Station, Highmore, 2002.

Planting*	Crop canopy** (LAI)	Total heads (per foot of row)	Total seeds	Seed weight (g per 100 seeds)	Yield (g foot-1)
Early	1.22 ± 0.14	21 ± 2	466 ± 58	0.0244 ± 0.0005	10.7 ± 1.5
Middle	1.38 ± 0.11	20 ± 1	459 ± 35	0.0211 ± 0.0005	9.8 ± 0.8
Late	0.90 ± 0.07	17 ± 1	301 ± 33	0.0199 ± 0.0007	6.1 ± 0.7

* Values represent average (± standard error) for 4 replicates of spring wheat planting-date treatments (early, April 11; middle, April 20; and late, April 30).

** Crop canopy characteristics were measured with a LAI-2000 leaf area index (LAI) meter on June 16 at the late boot to early heading stages of crop development.

Table 2. Yield results from combine harvest of 'Ember' spring wheat, Central Research Station, Highmore, 2002.

Planting	Yield bu acre^{-1}	Test weight lb bu^{-1}
Early*	19.3 ± 3.3 a	60.3 ± 0.4 a
Middle**	16.7 ± 1.1 a	55.3 ± 0.3 b
Late**	8.0 ± 0.4 b	52.5 ± 1.2 c

Values represent an average for four replicates per planting of spring wheat (early, April 11; middle, April 20; and late, April 30, 2002). Yields and test weights, respectively, followed by different letters have a probability less than 1 in 20 that they are similar statistically.

* Harvested July 15.

** Harvested July 23.