ANNUAL PROGRESS REPORT 2004

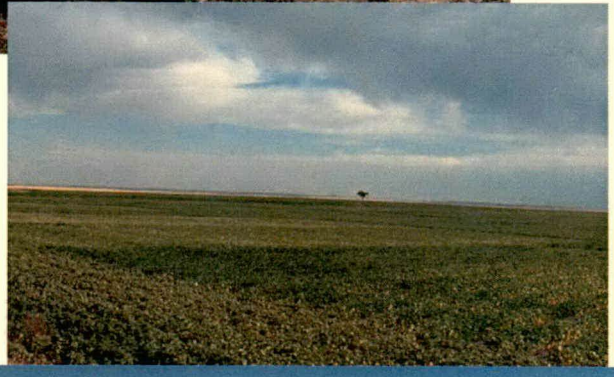
SOUTH DAKOTA STATE UNIVERSITY

WEST RIVER AG CENTER

CROPS AND SOILS RESEARCH

PLANT SCIENCE PAMPHLET #18

FEBUARY 2005



South Dakota State University

SDSU

INTRODUCTION

This is an annual progress report of the West River Crops and Soils Research Projects, South Dakota Agricultural Experiment Station. The equipment storage and processing facilities are located approximately one mile southwest of Box Elder, SD at 22735 Radar Hill Road. The office facilities are located at 1905 Plaza Boulevard; Rapid City, SD 57702. Telephone (605)394-2236, e-mail: Nleya.Thandiwe@ces.sdstate.edu, Rickertsen.John@ces.sdstate.edu or Swan.Bruce@ces.sdstate.edu

Internet web page: wrac.sdstate.edu

The Research Projects serve the western part of South Dakota. They are unique in that all experimental plots are cooperatively located with farmers. All the studies are located on farmer fields rather than at a particular experiment station. This allows for more mobility and localized data collection. This system is very dependent upon farmer cooperators and local extension agronomy educators.

This research tests the adaptability of new crops, varieties and farming methods. This report does not include results of work conducted by SDSU projects headquartered on campus at Brookings, South Dakota.

FIELD PLOT COOPERATORS

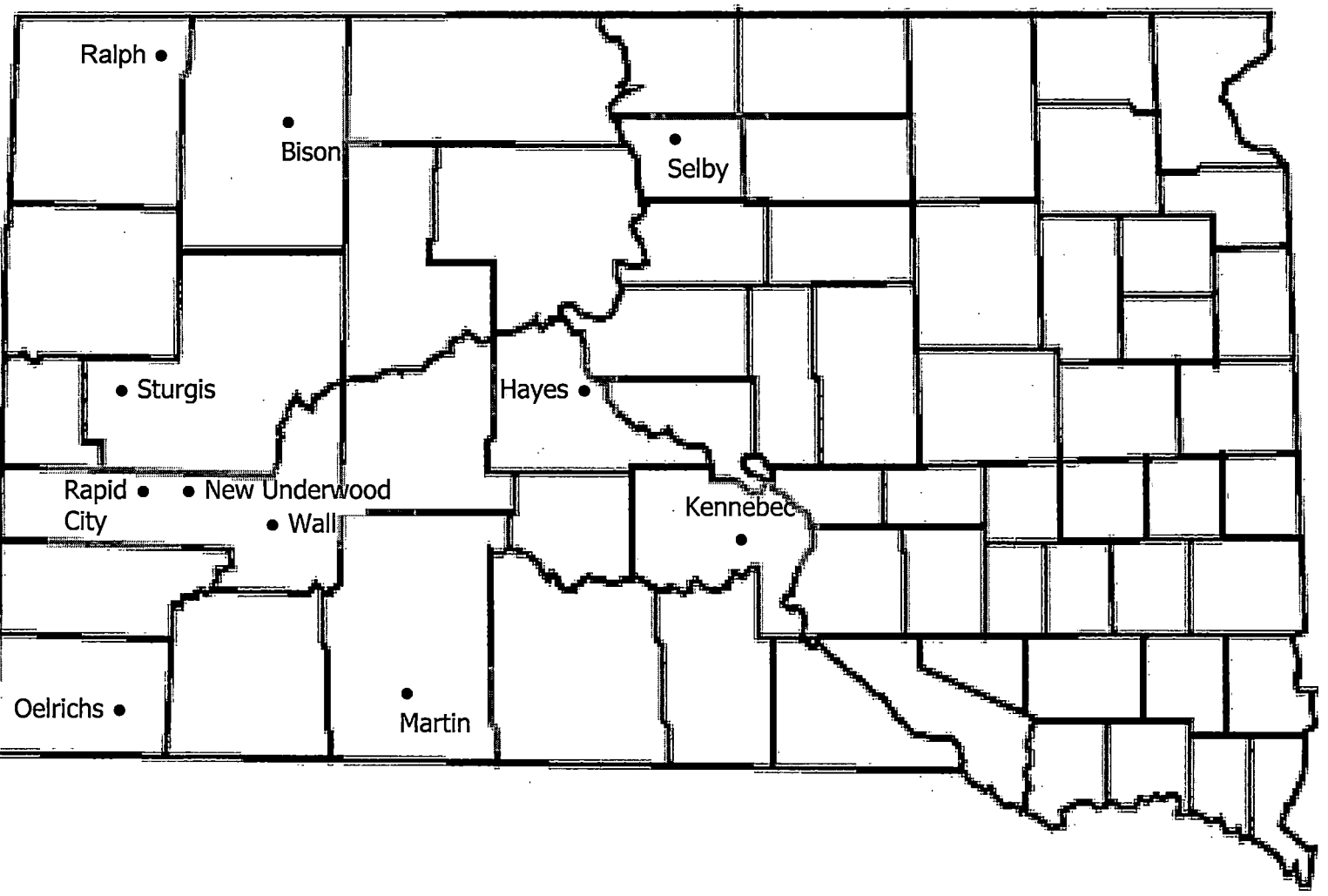
Name	Address	County
Larry Novotny	Martin 57551	Bennett
Jim & Rod Buckle	Martin 57551	Bennett
William Miller	Oelrichs 57763	Fall River
Roger Rosenow	Ralph 57650	Harding
Kip Matkins	Sturgis 57785	Meade
Gregg Krebsbach	New Underwood 57761	Pennington
Don Hackens	New Underwood 57761	Pennington
Merritt Patterson & Sons	Wall 57790	Pennington
Crown Partnership	Wall 57790	Pennington
James Talty	Wall 57790	Pennington
Ron Seidel	Bison 57620	Perkins
David Neuharth	Hayes 57537	Stanley
Rex Haskins	Hayes 57537	Stanley
Mark Stiegelmeier	Selby 57472	Walworth

This is an annual report, some trials are ongoing and will require additional testing before final conclusions can be made.

350 copies printed at an estimated cost of $ 4.47 each. February 2005

South Dakota State University, South Dakota Counties, and U.S. Department of Agriculture Cooperating.

TESTING LOCATIONS



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ACKNOWLEDGMENTS

The following County Extension Educators assisted in locating cooperators and conducting the research: Sandy Huber-Martin, Mark Fanning-Hot Springs, Bart Krautschun-Belle Fourche, Mike Huber-Timber Lake, Robert Fanning-Kennebec, Julie Walker -Ft. Pierre, Valerie Mitchell-Murdo, Justin Keyser - Burke, and Robin Salverson - Buffalo.

The results reported in this pamphlet were funded under Plant Science Projects SD-00956 Research Substation, H-284 Diversified Cropping Systems in Western South Dakota, SDSU Research Support Fund and USDA-CSREES Consortium for Alternative Crops. Additional financial support was received from The South Dakota Crop Improvement Association, The South Dakota Wheat Commission, South Dakota Foundation Seed Stocks Division-SDSU, South Dakota Oilseed Council, Monsanto Agricultural Company, Pioneer Hi-Bred and Warne Chemical Co.

Research was conducted by Thandiwe Nleya - Assistant Professor, John R. Rickertsen-Research Associate, and Bruce A. Swan-Senior Ag Research Technician, in conjunction with Kevin D. Kephart - Director Ag Experiment Station, Dale J. Gallenberg - Dept. Head Plant Science, Bob Hall, Bob Pollmann, Jack Ingemansen, Amir Ibrahim, Martin Draper, Leon Wrage, and Karl Glover.

A special thank you is extended to Jerry Swane and John Fortune Sr. for their help during the summer of 2004.

This publication was written and edited by Thandiwe Nleya, John R. Rickertsen and Bruce A. Swan.

WEATHER SUMMARY

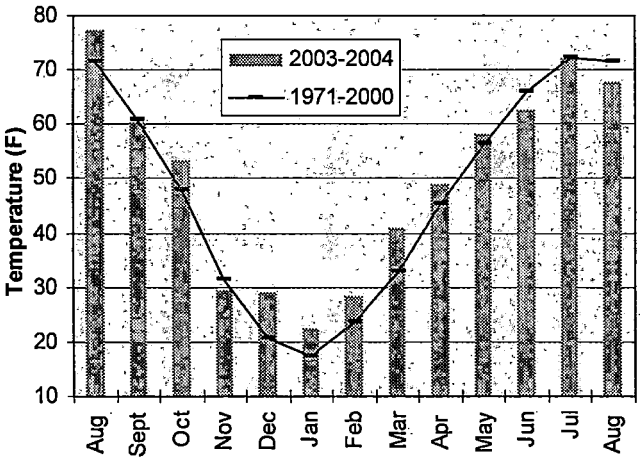
The data in the weather summaries presented in the following charts and table were obtained from the National Oceanic and Atmospheric Administration (NOAA) publication, Climatological Data - South Dakota; from Dennis Todey, State Climatologist at South Dakota State University; and from the South Dakota Crop-Weather Summary published by the South Dakota Statistical Reporting Service-USDA. Weather data were also collected at our weather station located at the Wall Rotation Study at Wall, South Dakota.

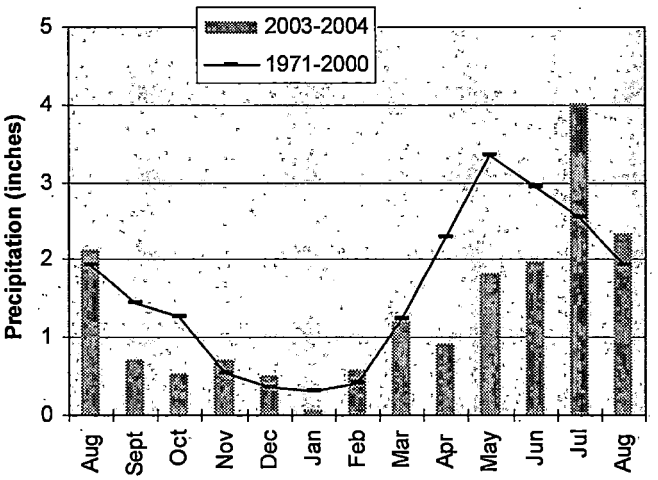
The drought conditions persisted for the 2003-2004 growing season. In particular the southwestern part of the state was very dry, with Oelrichs and Martin having below normal precipitation for most of the months from August 2003 to August 2004. In the fall of 2003, the northwest locations had above normal precipitation, with the west central near normal and central locations below normal. November through March precipitation was below normal at most locations. April was very dry with all locations getting less than an inch of rain, many less than a ½ inch. May was better in the central and west central locations, but still dry in the southwest and northwest. June was below normal for rainfall at all locations but Ludlow and Kirley. The situation improved in July with above normal rain at most locations, with August having normal to somewhat below normal conditions.

Temperatures in western South Dakota were normal from August through October. November was cool with temperatures 2 to 6 degrees below normal. It warmed up in December with average temperatures 6 to 8 degrees above normal. The readings for the months January through May were normal at all locations. June was cool with temperatures ranging 3 to 5 degrees below normal. Conditions returned to normal in July and finished off in August 3 to 5 degrees below normal.

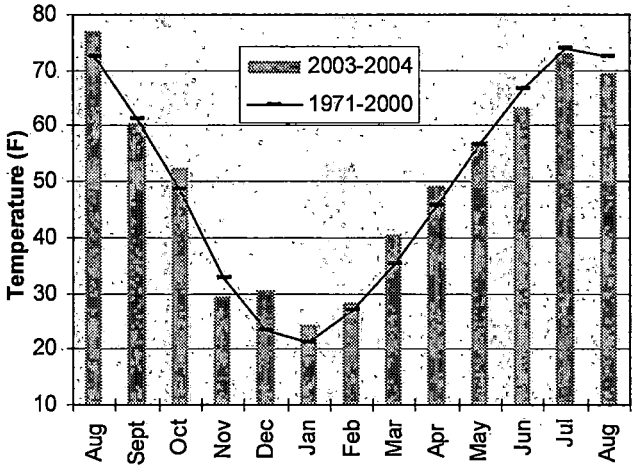
It was not a good year for winter wheat production with the dry fall conditions leading to poor stand establishment. The conditions worsened with the very dry April and early May stressing the wheat to the point where many acres were sprayed out or hayed. The cool June conditions helped the wheat and other cool season crops that were not hayed to produce better yields than expected earlier in the year. The wet and warm July helped produce decent corn and millet crops, but the lack of late summer moisture limited sunflower, safflower and soybean yields.

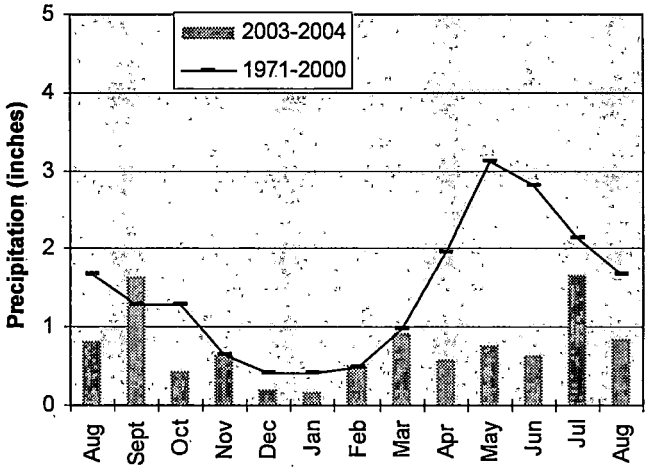
Temperature and Precipitation Charts for Martin (Bennett County Reporting Station).



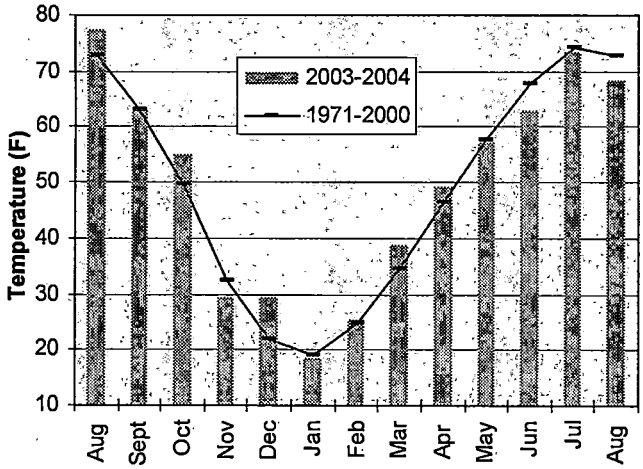


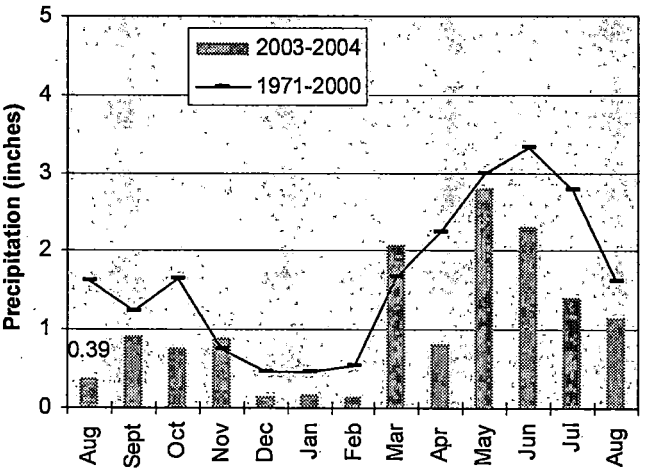
Temperature and Precipitation Charts for Oelrichs (Fall River County Reporting Station).





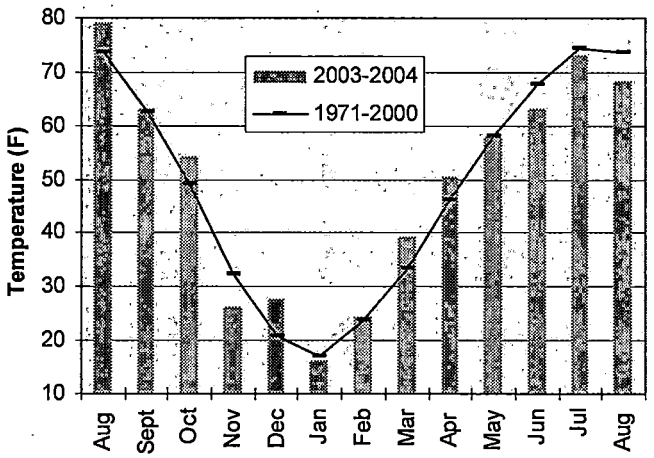
Temperature and Precipitation Charts for Murdo (Jones County Reporting Station).

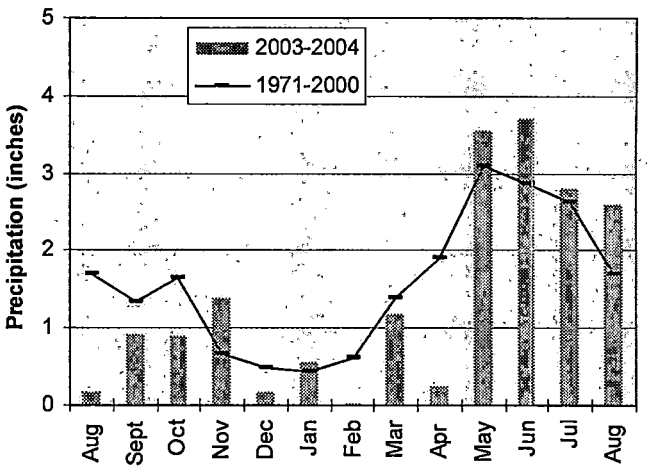




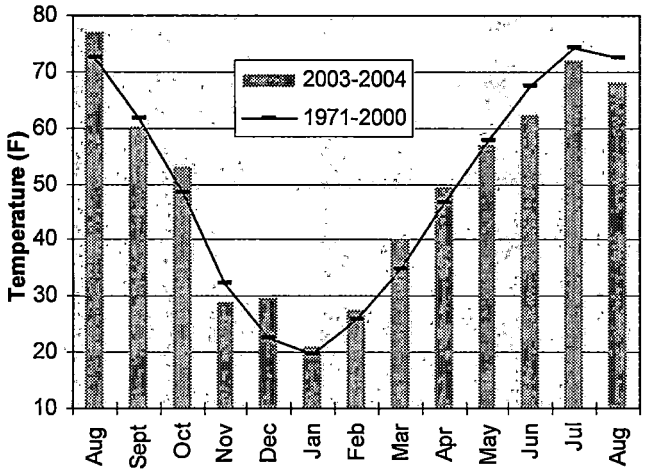
Average temperatures and precipitation obtained from NOAA Climatological Data. Weather data is collected from the reporting station nearest the experimental sites.

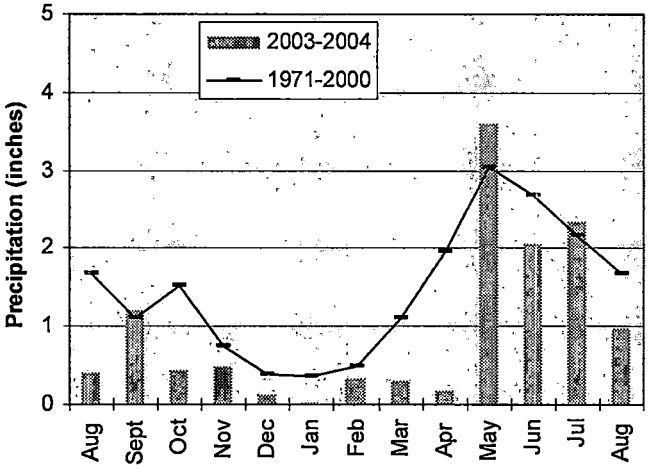
Temperature and Precipitation Charts for Kirley (Haakon County Reporting Station).



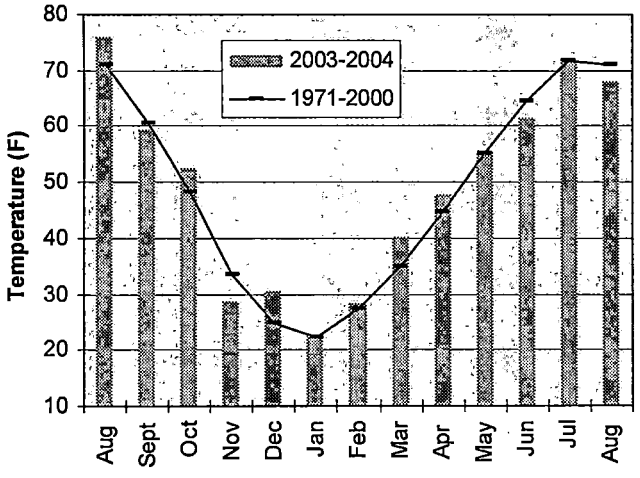


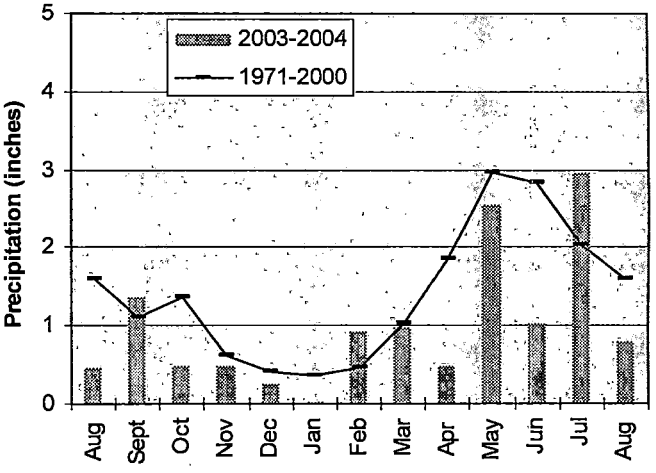
Temperature and Precipitation Charts for Wall (Rotation Study Site).





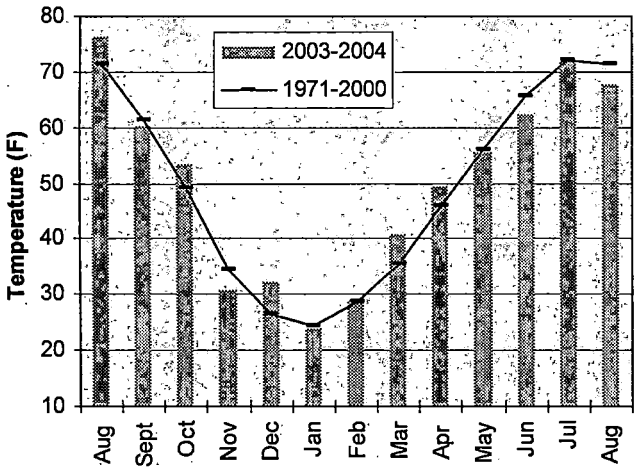
Temperature and Precipitation Charts for Rapid City Airport (Pennington County Reporting Station).

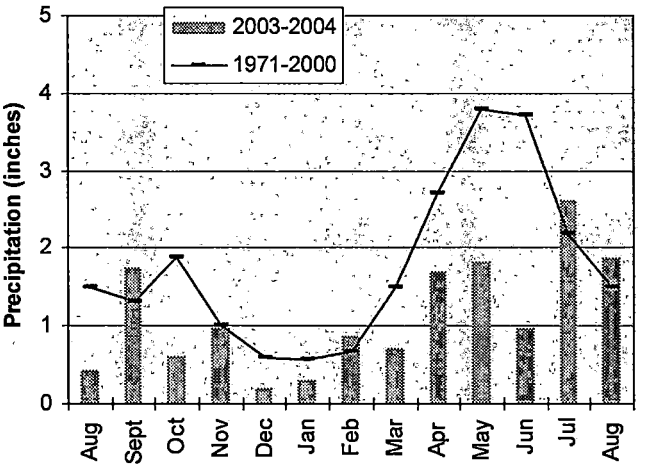




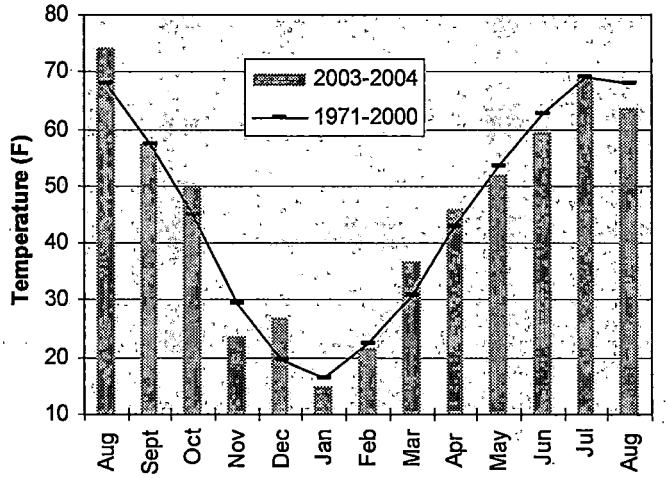
Average temperatures and precipitation obtained from NOAA Climatological Data. Weather data is collected from the reporting station nearest the experimental sites.

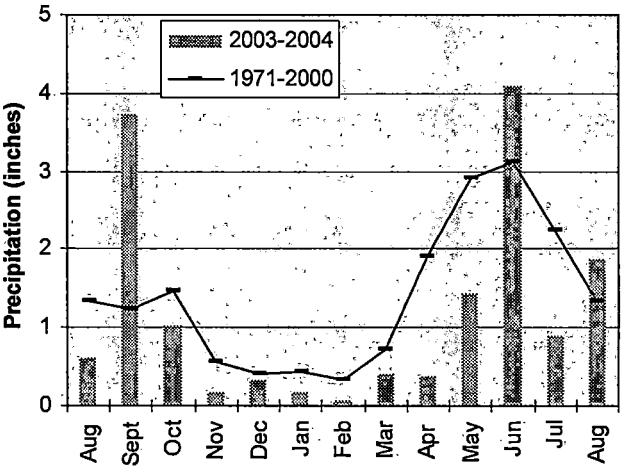
Temperature and Precipitation Charts for Ft. Meade (Meade County Reporting Station).



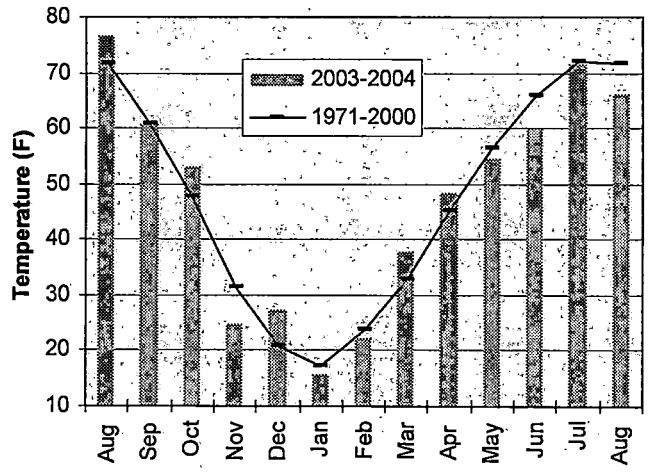


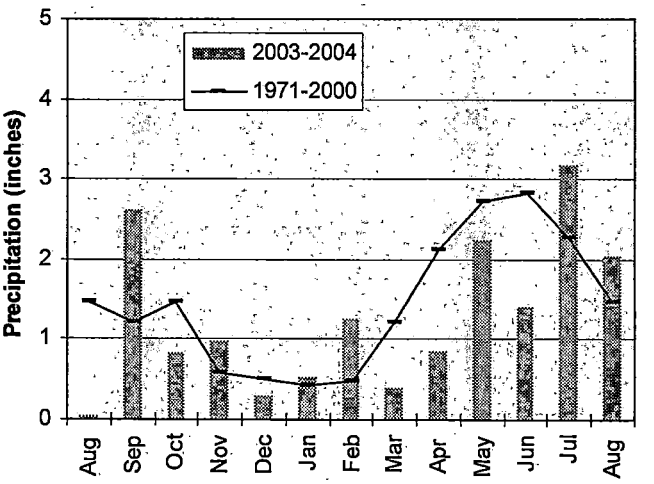
Temperature and Precipitation Charts for Ludlow (Harding County Reporting Station).





Temperature and Precipitation Charts for Bison (Perkins County Reporting Station).

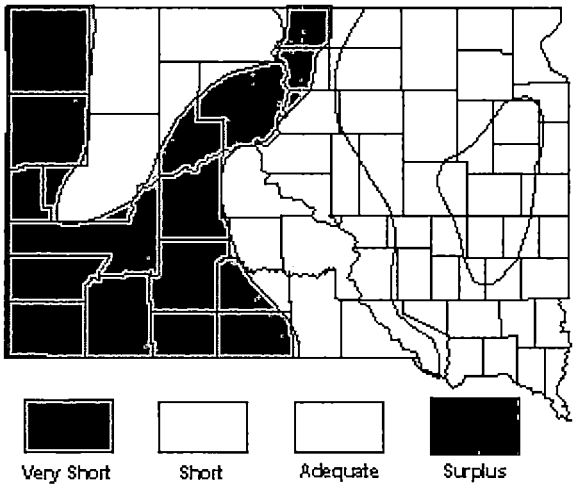




Average temperatures and precipitation obtained from NOAA Climatological Data. Weather data is collected from the reporting station nearest the experimental sites

Figure 1. Topsoil Moisture Conditions During The 2004 Growing Season.
(Crop and Livestock Reporting Service - USDA)

As of Sunday, April 11, 2004.



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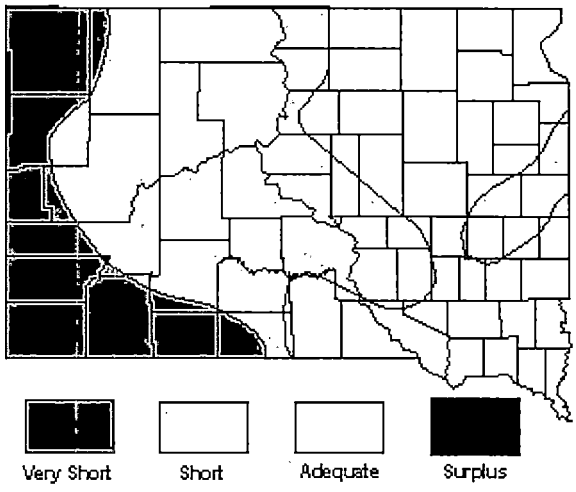

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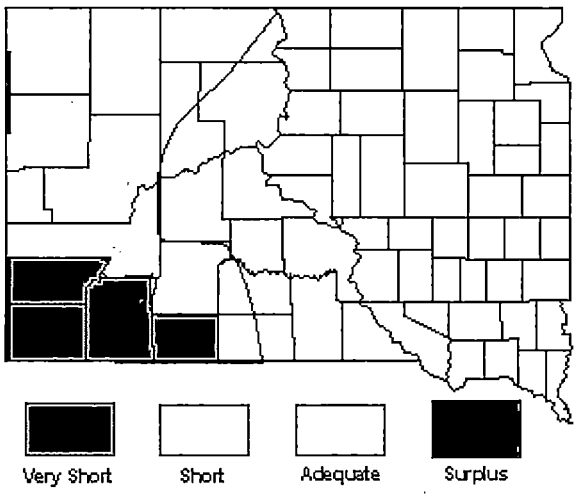

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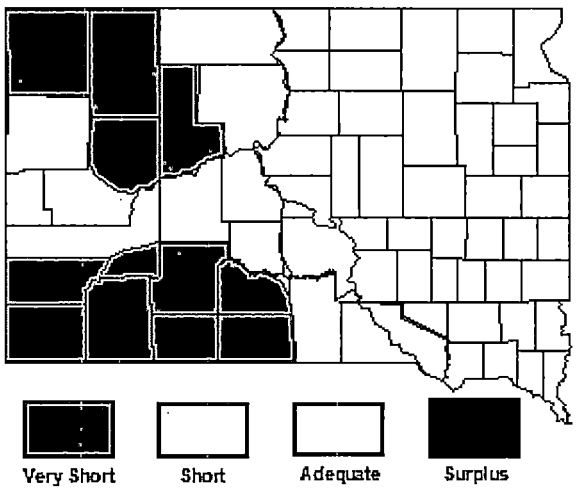

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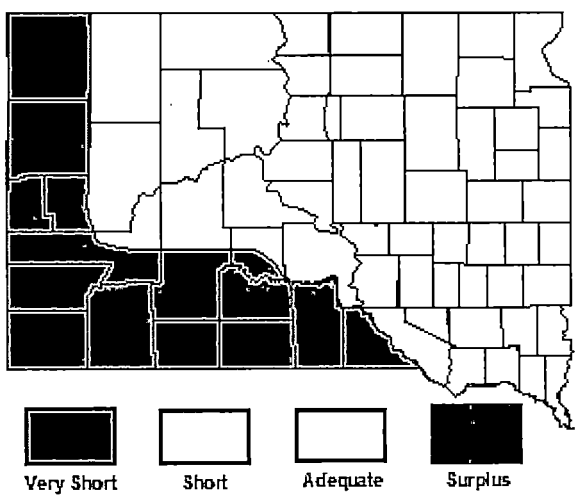

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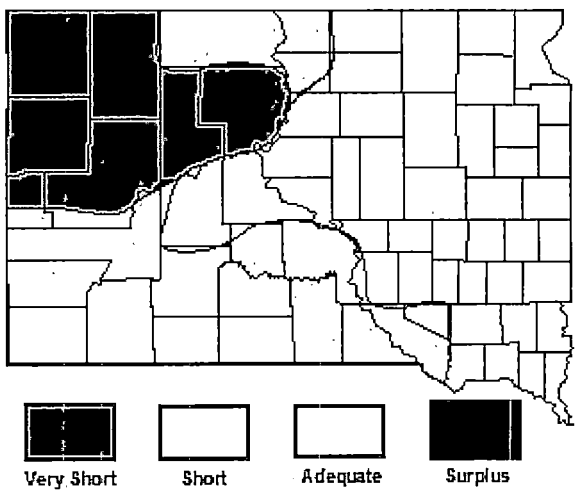


Table 1. Weather Data - Date of Critical Temperatures and Total Useable Precipitation in Counties with Experimental Plots (2003-2004).

Location	Date of Temperature*		Total	Total Useable Moisture**	
	First	Last	Moisture#	Aug. 03-July 04	April 04-July 04
Bennett County (Martin)	Oct. 1, 2003 27 °F	May 2, 2004 21 °F	15.27"	7.03"	4.77"
Fall River County (Oelrichs)	Oct. 1, 2003 26 °F	May 14, 2004 27 °F	9.04"	3.22"	0.87"
Harding County (Ludlow)	Sept. 30, 2003 27 °F	May 14, 2004 20 °F	13.38"	8.13"	4.62"
Jones County (Murdo)	Oct. 26, 2003 23 °F	May 2, 2004 27 °F	12.98"	6.75"	4.62"
Meade County (Ft. Meade)	Oct. 26, 2003 23 °F	May 2, 2004 27 °F	13.04"	7.11"	4.19"
Pennington County (Rapid City AP)	Oct. 25, 2003 21 °F	May 2, 2004 24 °F	12.05"	6.43"	4.02"
Pennington County (Wall)	Oct. 25, 2003 25 °F	May 14, 2004 28 °F	10.79"	6.07"	5.66"
Perkins County (Bison)	Oct. 30, 2003 24 °F	May 14, 2004 28 °F	14.74"	8.61"	4.94"
Haakon County (Kirley)	Oct. 1, 2003 26 °F	May 14, 2004 27 °F	15.65"	9.11"	7.27"
Butte County (Newell)	Oct. 31, 2003 20 °F	May 13, 2004 26 °F	14.76"	8.23"	4.80"
Lyman County (Kennebec)	Sept. 30, 2003 27 °F	May 14, 2004 25 °F	16.67"	10.57"	6.24"

* = First 28° temperature in Fall or last 28° temperature in Spring, reported in degrees Fahrenheit.

** = Sum of all precipitation where amounts are in excess of .25 inch or totaled over .25 inch in two contiguous days.

= Total moisture from August 1, 2003 to July 31, 2004.

WINTER WHEAT VARIETY TRIALS

Objective: To evaluate standard and experimental hard red and hard white winter wheat varieties for yield, agronomic characteristics and adaptation to western South Dakota.

Procedure: Plots were seeded at seven locations in September 2004 with a John Deere 610 double disk (fallow) or John Deere 750 (no-till) plot drills with 10 inch spacing. The experimental design was a randomized complete block with four replications. The seeding rate was 950,000 seeds per acre (60 Lb/A). The plots received 7.4 lbs N and 25 lbs P_2O_5 per acre as 10-34-0 with the seed. Herbicides were applied in either the fall or spring and varied according to weeds present. Visual stand ratings were taken in October 2003 and April 2004. The plots were trimmed to 5' x 25' after heading. The wheat was harvested in July with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Location Summaries:

Locations not harvested

Location	Reason
Perkins County - Bison	Drought, May freeze
Stanley County – Hayes	Poor stands, drought
Bennett County – Martin	Drought

Fall River County - Oelrichs

Planted: September 24, 2003 Herbicide: Glean ($^1/_3$ oz/A)
Harvested: August 3, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

Yields at Oelrichs were very low in 2004 due to the extremely dry conditions. The wheat averaged only 9 Bu/A with the location having a great amount of variability. Because of this variability, yields are not reported for this location.

Pennington County - Wall

Planted: September 20, 2003 Herbicide: None
Harvested: July 19, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

Growing conditions at Wall were still droughty in 2004, but the cool conditions along with good stored soil moisture allowed the plot to average 49 Bu/A. The rain that did come in June favored the later varieties in the trial. The best yielding varieties this year were Wahoo and Harding. There was little difference in the three-year average yields. The results are presented in Table 2.

Meade County - Sturgis

Planted: September 16, 2003 Herbicide: Harmony Extra ($^{3}/_{10}$ oz/A) + 2,4-D LV6 (5 oz/A)
Harvested: July 26, 2004 Additional Nitrogen: None
Previous crop: Chemical fallow, no-till planted

Sturgis like most of western South Dakota suffered from the continuing drought in 2004. The yields averaged 25 Bu/A with a light average test weight of 57.0 Lb/Bu. There was a fair amount variation with a CV of 20.4. Therefore variety comparisons should not be made from this data. The results are presented in Table 3.

Table 2. Hard Winter Wheat Variety Trial - Pennington County (Wall), 2002-2004.

Variety	Height	Lodging	Test Wt	Protein	Yield	Bu/A
	Inches	1-9*	Lb/Bu	Percent	2004	3-Year
Hard Red						
ALLIANCE	22	1	63.0	13.6	46.1	41
ARAPAHOE	24	1	61.3	15.3	40.3	36
JAGALENE	19	1	63.2	14.6	52.2	39
NEKOTA	20	1	62.9	14.5	44.8	39
JERRY	27	1	62.4	14.4	52.8	.
WESLEY	19	1	62.3	15.0	47.6	41
MILLENNIUM	23	1	62.9	14.1	47.2	40
WAHOO	25	1	62.0	14.1	**56.5**	44
CRIMSON	25	1	61.0	14.2	48.3	39
EXPEDITION	18	1	63.0	14.7	46.9	39
HARDING	23	1	61.8	14.0	**55.7**	41
TANDEM	20	1	62.8	15.2	51.0	42
SD92107-5	25	1	63.0	13.7	**60.7**	.
SD97250	23	1	61.7	15.2	46.3	.
SD98102	24	1	61.8	14.1	49.1	.
SD97538	23	1	62.6	13.8	53.5	.
SD97059-2	28	1	61.8	15.0	52.3	.
SD97380-2	25	1	62.3	15.0	45.3	.
SD97394-1	26	1	62.7	15.1	47.2	.
SD99073	20	1	61.4	14.3	49.2	.
SD00032	24	1	61.5	15.3	46.4	.
SD00111	25	1	62.7	14.9	46.4	.
SD00258	24	1	61.9	14.2	49.6	.
NE99533-4	22	1	63.6	15.1	49.8	.
Hard White						
TREGO	18	1	62.3	14.4	35.7	34
WENDY	20	1	61.7	15.1	38.8	39
SD97W604	19	1	62.2	14.3	45.3	.
SD97W671-1	23	1	62.9	15.4	46.9	.
SD00W024	20	1	60.9	12.5	**59.5**	.
SD00W041	24	1	62.0	15.5	49.3	.
Average	22.6	1.0	62.2	14.6	48.7	40
LSD (P=.05)	.	0.0	1.0	.	5.6	**NS**
CV	.	0.0	1.2	.	8.2	10

* 1=No lodging, 9 = 100% lodged.

Table 3. Hard Winter Wheat Variety Trial - Meade County (Sturgis), 2004.

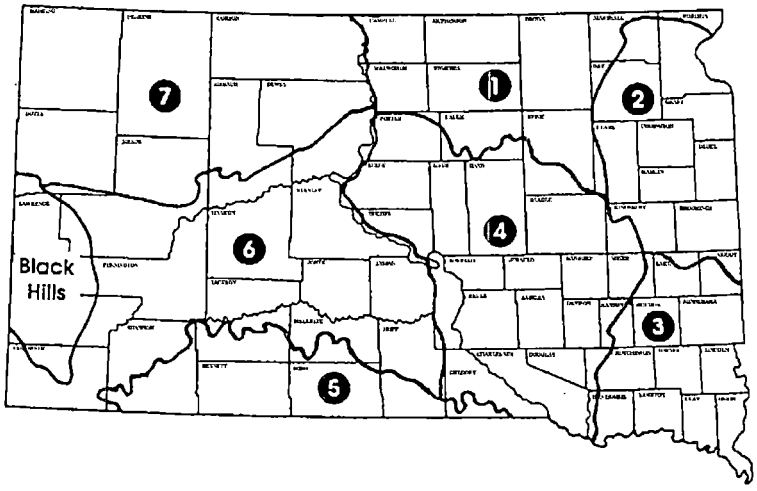
Variety	Height Inches	Lodging 1-9*	Test Wt Lb/Bu	Protein Percent	Yield Bu/A
Hard Red					
ALLIANCE	20	1	57.9	14.5	29.2
ARAPAHOE	21	1	55.8	16.9	19.5
JAGALENE	20	1	59.6	16.2	28.9
NEKOTA	20	1	57.6	16.3	26.3
JERRY	24	1	53.7	17.1	25.6
WESLEY	20	1	55.9	16.9	25.8
MILLENNIUM	24	1	58.1	15.4	31.8
WAHOO	22	1	56.3	15.8	26.3
CRIMSON	23	1	57.1	18.0	24.8
EXPEDITION	20	1	58.6	16.2	23.2
HARDING	22	1	54.2	16.7	26.1
TANDEM	22	1	60.6	17.4	24.8
SD92107-5	21	1	54.7	16.9	25.3
SD97250	23	1	56.0	16.4	26.3
SD98102	24	1	58.2	16.0	29.8
SD97538	21	1	57.5	16.2	27.6
SD97059-2	21	1	55.0	16.1	24.2
SD97380-2	23	1	55.9	16.5	23.5
SD97394-1	24	1	57.6	15.8	28.3
SD99073	22	1	56.9	16.2	24.1
SD00032	23	1	56.1	17.3	19.5
SD00111	22	1	57.4	16.2	24.7
SD00258	22	1	54.3	16.6	21.3
NE99533-4	21	1	59.0	16.8	31.4
Hard White					
TREGO	21	1	59.7	15.5	30.8
WENDY	20	1	56.7	16.3	21.8
SD97W604	20	1	59.4	16.6	21.2
SD97W671-1	22	1	56.8	16.6	21.6
SD00W024	21	1	57.3	17.0	28.2
SD00W041	23	1	57.5	17.1	22.8
Average	21.6	1.0	57.0	16.5	25.5
LSD (P=.05)	2.1	0.0	1.7	.	7.3
CV	6.9	0.0	2.1	.	**20.4**

*1=No lodging, 9 = 100% lodged.

WHEAT VARIETY RECOMMENDATIONS FOR 2005

Crop Adaptation Areas for South Dakota

(Revised 1992)



WINTER WHEAT

Recommended:

Variety	*Crop Adaptation Area*
Alliance [PVP]	3,4 [pc],5,6
Arapahoe [PVP]	1 [pc],3,4 [pc],5,6,7 [pc]
Harding [PVP]	1 [pc],2 [pc],4,7
Jagalene [PVP]	1 [pc],3,4 [pc],5,6,7 [pc]
Millennium [PVP]	1 [pc],4 [pc],5,6,7 [pc]
Wesley	1 [pc],3,4 [pc],5,6,7 [pc]

Acceptable/Promising:

Variety	*Crop Adaptation Area*
Expedition [PVP]	1 [pc],4 [pc],5,6,7 [pc]
Tandem [PVP]	1 [pc],3,4 [pc],5,6,7 [pc]
Wahoo [PVP]	3,4 [pc],5,6
Trego (white) [PVP]	5,6,7 [pc]

SPRING WHEAT

Recommended:

Variety	*Crop Adaptation Area*
Briggs [PVP]	Statewide
Forge [PVP]	Statewide
Ingot [PVP]	Statewide
Granger [PVP]	Statewide
Knudson [PVP]	Statewide
Norpro [PVP]	1,2,7
Oxen [PVP]	Statewide
Reeder [PVP]	Statewide
Russ [PVP]	Statewide

Acceptable/Promising:

Variety	*Crop Adaptation Area*
Alsen [PVP]	1,2,7
Parshall [PVP]	1,7
Walworth [PVP]	Statewide

DURUM WHEAT

Durum wheat is not part of the statewide CPT program, so no recommendations are made. There were trials planted at Bison and Ralph with the results presented on page 16.

[PVP] U.S. Plant Variety Protection applied for and/or issued; seed sales of these varieties are restricted to classes of certified seed.

[pc] Plant into protective cover.

Source - Small Grains 2005 Variety Recommendations, EC774, South Dakota State University. (http://plantsci.sdstate.edu/varietytrials/vartrial.html)

SPRING WHEAT VARIETY TRIALS

Objective: To evaluate standard and experimental hard red spring wheat varieties for yield, agronomic characteristics and adaptation to western South Dakota.

Procedure: Plots were seeded at three locations in April 2004 with a John Deere 750 plot drill with 10 inch spacing. The experimental design was a randomized complete block with four replications. The seeding rate was 1,220,000 seeds per acre (90 Lb/A). The plots received 7.4 lbs N and 25 lbs P_2O_5 per acre as 10-34-0 with the seed. Herbicides were applied in May and varied according to weeds present. Plots were trimmed to 5' x 25' after heading. The wheat was harvested in July and August with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Location Summaries:

Pennington County – Wall

Planted: April 6, 2004 Herbicide: Bronate (1 pint/A)
Harvested: July 29, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

The growing conditions at Wall were dry early on but turned more favorable in late May and June with some timely rains and cool temperatures. The trial averaged 35 Bu/A with test weights averaging 62.1 Lb/Bu. The top yielding varieties in 2004 were Norpro, Russ, Polaris, Oxen, Granite, Walworth and Freyer. There was no significant difference in yield among varieties with three year averages. Results are shown in Table 4.

Perkins County – Bison

Planted: April 12, 2004 Herbicide: Bronate (1 pint/A)
Harvested: August 10, 2004 Additional Nitrogen: 30 lb/A
Previous crop: Durum Wheat, No-Till planted

Bison yields were somewhat below normal because of drought conditions. Yields averaged 29 Bu/A with test weights averaging 58.4 Lb/Bu. The top yield group in 2004 included Polaris, Reeder, Norpro and Forge. There are no three year average yields for Bison. Results are shown in Table 5.

Harding County - Ralph

Planted April 12, 2004 Herbicide: Ally ($^1/_{10}$ oz/A) +2,4-D LV6 (6 oz/A)
Harvested: August 9, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

The Ralph trial was excellent this year with good rainfall and cool temperatures producing yields averaging 55 Bu/A with test weights averaging 59.9 Lb/Bu. The varieties in the top yield group in 2004 were Norpro and Polaris, both late varieties. There are no three year average yields for Ralph. Results are shown in Table 6.

Table 4. Hard Red Spring Wheat Variety Trial – Pennington County (Wall), 2002-2004.

Variety	Height	Lodging	Test Wt.	Protein	Yield	Bu/A
	Inches	0-9*	Lb/Bu	Percent	2004	3 Year
ALSEN	23	0	62.5	17.3	29.7	27
BRIGGS	24	0	62.4	18.2	35.5	27
CHRIS	28	0	61.0	18.0	33.1	26
DANDY	25	0	61.8	16.6	34.4	.
DAPPS	25	0	61.7	18.3	32.5	26
FORGE	24	0	62.9	16.9	**36.3**	30
FREYR	26	0	62.6	16.1	35.4	.
GRANGER	24	0	62.1	16.3	34.5	29
GRANITE	24	0	64.7	16.9	**37.3**	28
INGOT	25	0	62.4	17.3	30.7	29
KNUDSON	22	0	61.8	16.7	29.2	26
MERCURY	19	0	61.1	17.2	28.8	.
NORPRO	22	0	63.2	16.1	**39.5**	28
OKLEE	21	0	61.1	17.4	30.6	28
OXEN	23	0	60.8	17.2	**37.3**	31
POLARIS	24	0	62.5	16.2	**37.4**	.
REEDER	24	0	63.3	17.4	34.5	30
RUSS	25	0	61.4	16.9	**37.8**	30
STEELE-ND	25	0	62.6	17.7	34.7	.
TROOPER	20	0	63.7	16.5	32.2	.
WALWORTH	23	0	60.8	16.6	**36.5**	31
BZ998-44	23	0	61.8	15.7	**36.7**	.
MN 97803	24	0	62.3	17.2	33.9	.
ND 751	27	0	63.5	17.1	**37.7**	.
SD 3618	26	0	61.0	17.3	**36.3**	.
SD 3623	26	0	62.4	16.9	34.7	.
SD 3635	25	0	61.7	16.7	**39.2**	.
SD 3668	25	0	62.0	17.0	34.6	.
SD 3687	23	0	59.9	16.5	33.8	.
SD 3746	24	0	61.6	15.4	**36.3**	.
SD 3747	22	0	60.9	15.8	**38.5**	.
SD 3827	26	0	62.9	16.4	**38.7**	.
SD 3860	25	0	62.2	15.1	**39.4**	.
SD 3868	25	0	61.9	14.2	**36.7**	.
Average	23.9	0.0	62.1	16.7	35.1	28
LSD (P=.05)	2.2	0.0	0.6	.	3.7	**NS**
CV	6.5	0.0	0.7		7.5	9

* 0=No lodging, 9 = 100% lodged.

Table 5. Hard Red Spring Wheat Variety Trial – Perkins County (Bison), 2004.

Variety	Height	Lodging	Test Wt.	Protein	Yield Bu/A
	Inches	0-9*	Lb/Bu	Percent	2004
ALSEN	27	0	61.2	17.5	26.9
BRIGGS	27	0	58.0	17.3	28.0
CHRIS	33	0	57.4	17.5	25.8
DANDY	27	0	58.3	16.0	26.7
DAPPS	29	0	56.7	18.5	22.5
FORGE	26	0	58.6	15.7	30.5
FREYR	29	0	59.2	17.8	26.7
GRANGER	27	0	59.8	17.0	29.8
GRANITE	24	0	59.6	17.2	27.3
INGOT	28	0	60.0	17.5	25.0
KNUDSON	25	0	58.7	17.4	23.5
MERCURY	23	0	59.0	16.9	25.7
NORPRO	27	0	59.9	18.0	31.4
OKLEE	24	0	58.6	18.4	27.6
OXEN	25	0	56.8	17.8	26.7
POLARIS	25	0	58.9	14.8	33.5
REEDER	26	0	58.0	17.0	29.8
RUSS	28	0	56.4	16.5	29.2
STEELE	29	0	58.3	18.4	26.9
TROOPER	23	0	59.0	16.3	25.7
WALWORTH	28	0	58.0	17.4	28.5
BZ998-44	26	0	57.7	16.9	30.0
MN 97803	25	0	57.9	16.7	28.2
ND 751	29	0	57.7	18.0	26.9
SD 3618	27	0	57.7	15.9	31.0
SD 3623	27	0	58.8	17.5	29.2
SD 3635	26	0	58.6	16.2	27.2
SD 3668	27	0	60.5	16.5	31.0
SD 3687	26	0	57.5	16.4	31.4
SD 3746	27	0	57.3	16.0	29.5
SD 3747	25	0	55.7	15.7	30.5
SD 3827	30	0	58.3	15.8	32.7
SD 3860	30	0	58.3	15.3	**38.8**
SD 3868	29	0	58.0	17.2	23.3
Average	26.8	0.0	58.4	16.9	28.8
LSD (P=.05)	2.5	0.0	2.2	--	4.08
CV	6.8	0.0	2.7	--	10.0

* 0=No lodging, 9 = 100% lodged.

Table 6. Hard Red Spring Wheat Variety Trial – Harding County (Ralph), 2004.

Variety	Height Inches	Lodging 0-9*	Test Wt. Lb/Bu	Protein Percent	Yield Bu/A 2004
ALSEN	31	0	59.2	14.2	54.0
BRIGGS	31	0	59.4	14.2	51.8
CHRIS	36	0	58.0	16.9	42.3
DANDY	31	0	61.5	15.3	53.7
DAPPS	35	0	59.0	16.7	45.9
FORGE	31	0	62.0	12.0	56.8
FREYR	30	0	60.7	14.4	52.4
GRANGER	35	0	60.9	13.5	55.0
GRANITE	29	0	60.3	14.3	54.0
INGOT	35	0	61.5	14.7	50.2
KNUDSON	29	0	60.0	16.5	55.4
MERCURY	26	0	60.7	11.9	56.6
NORPRO	28	0	59.0	14.6	**60.6**
OKLEE	28	0	59.3	13.9	45.0
OXEN	29	0	59.5	13.3	57.2
POLARIS	31	0	58.3	12.0	**60.2**
REEDER	31	0	59.0	13.8	56.6
RUSS	32	0	59.2	15.7	56.8
STEELE	33	0	59.6	15.5	56.4
TROOPER	26	0	59.5	13.4	51.6
WALWORTH	29	0	59.4	12.2	56.9
BZ998-44	30	0	59.3	13.2	**60.4**
MN 97803	31	0	59.3	14.9	50.0
ND 751	34	0	60.4	14.0	52.4
SD 3618	33	0	60.0	11.9	55.0
SD 3623	38	0	61.0	12.0	52.8
SD 3635	34	0	60.2	14.0	57.7
SD 3668	33	0	60.7	13.7	48.7
SD 3687	33	0	58.9	13.9	52.7
SD 3746	33	0	59.9	12.3	**60.9**
SD 3747	27	0	60.4	12.8	**59.3**
SD 3827	35	0	60.0	10.7	53.5
SD 3860	35	0	60.2	10.9	**62.9**
SD 3868	34	0	60.0	12.4	**59.6**
Average	31.4	0.0	59.9	13.7	54.6
LSD (P=.05)	2.6	0.0	0.3	--	4.0
CV	4.0	0.0	0.6	--	5.4

* 0=No lodging, 9 = 100% lodged.

DURUM WHEAT VARIETY TRIALS

Objective: To evaluate standard and experimental durum wheat varieties for yield, agronomic characteristics and adaptation to northwestern South Dakota.

Procedure: Plots were seeded at three locations in April 2004 with a John Deere 750 plot drill with 10 inch spacing. The experimental design was a randomized complete block with four replications. The seeding rate was 1,220,000 seeds per acre (90 Lb/A). The plots received 7.4 lbs N and 25 lbs P_2O_5 per acre as 10-34-0 with the seed. Herbicides were applied in late May and varied according to weeds present. Plots were trimmed to 5' x 25' after heading. The wheat was harvested in August with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Location Summaries:

Perkins County – Bison

Planted: April 12, 2004 Herbicide: Bronate (16 oz/A)
Harvested: August 10, 2004 Additional Nitrogen: 30 Lb/A
Previous crop: Millet, No-till planted

Bison yields were low in 2004 averaging 23 Bu/A with light test weights averaging only 54.9 Lb/Bu. The trial had a high coefficient of variation (CV), so yield comparisons cannot be safely made. There are no three year yield averages for Bison. Results are shown in Table 7.

Harding County - Ralph

Planted: April 12, 2004 Herbicide: Ally ($^1/_{10}$ oz/A) +2,4-D LV6 (6 oz/A)
Harvested: August 9, 2004 Additional Nitrogen: 50 Lb/A
Previous crop: Conventional fallow

Ralph yields averaged 41 Bu/A in 2004 with test weights averaging 63.1 Lb/Bu. There was little difference in yields with no statistically significant difference among varieties in 2004 or over the past three years. Results are shown in Table 8.

Table 7. Durum Wheat Variety Trial – Perkins County (Bison), 2004.

Variety	Height	Lodging	Test Wt	Protein	Yield	Bu/A
	Inches	0-9*	Lb/Bu	Percent	2004	
AC Avonlea	27	0	52.1	16.7	21.6	
Ben	27	0	55.8	17.6	22.5	
Dilse	26	0	54.4	17.7	22.4	
Lebsock	25	0	56.7	17.0	20.5	
Maier	27	0	56.3	16.7	22.1	
Mountrail	27	0	54.4	16.3	27.0	
Pierce	29	0	56.2	16.4	24.4	
Plaza	26	0	55.8	17.0	26.6	
Renville	27	0	51.8	15.4	20.6	
Vic	28	0	55.5	16.7	22.8	
Average	26.8	0.0	54.9	16.8	23.0	
LSD (P=.05)	2.4	0.0	3.8	--	**NS****	
CV	6.2	0.0	4.5	--	**21.4**	

* 0=No lodging, 9 = 100% lodged.
** NS= No significant differences among treatments.

Table 8. Durum Wheat Variety Trial – Harding County (Ralph), 2002-2004.

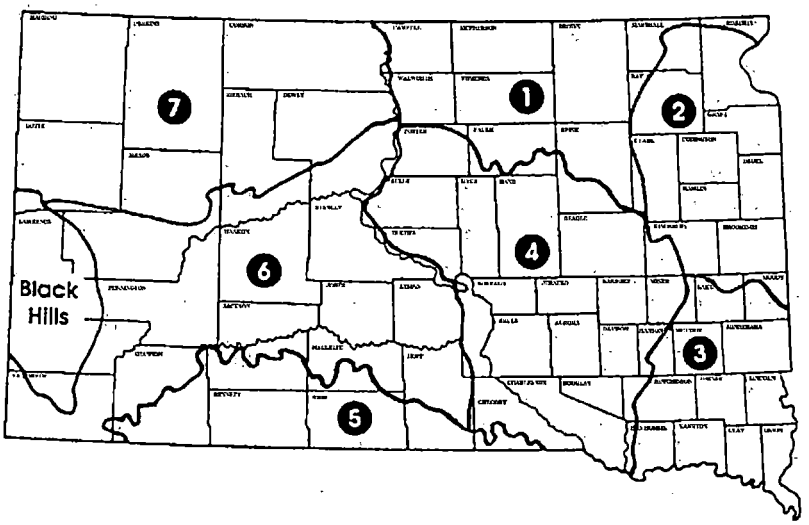
Variety	Height	Lodging	Test Wt	Protein	Yield	Bu/A
	Inches	0-9*	Lb/Bu	Percent	2004	3 Year
AC Avonlea	28	0	57.4	14.6	46.6	--
Ben	31	0	58.8	14.7	39.9	29.9
Dilse	30	0	57.7	14.0	42.0	31.3
Lebsock	30	0	58.1	13.6	37.8	29.6
Maier	29	0	59.8	13.3	46.6	33.3
Mountrail	25	0	57.3	12.0	44.3	32.2
Pierce	25	0	58.7	12.8	37.6	30.8
Plaza	24	0	57.1	12.3	38.3	--
Renville	28	0	56.7	12.4	42.3	29.4
Vic	29	0	58.4	14.2	37.5	29.1
Average	27.9	0.0	58.0	13.4	41.3	30.7
LSD (P=.05)	--	0.0	2.8	--	**NS****	**NS****
CV	--	0.0	3.3	--	**17.9**	16.9

* 0=No lodging, 9 = 100% lodged.
** NS= No significant differences among treatments.

OAT AND BARLEY VARIETY RECOMMENDATIONS FOR 2005

Crop Adaptation Areas for South Dakota

(Revised 1992)



OATS

Recommended:

Variety	*Crop Adaptation Area*
Don	1,4,5,6,7
Loyal	1,2,4,6,7
Jerry [PVP (non-title V status)]	Statewide
Reeves	Statewide

Acceptable/Promising:

Variety	*Crop Adaptation Area*
HiFi	1,2,7
Morton	1,2,7
Buff (hull-less)	Statewide

SPRING BARLEY

Recommended:

Variety	*Crop Adaptation Area*
6 Row	
Excel [PVP]	1,2,4,6,7
Lacey [PVP]	Statewide

Acceptable/Promising:

Variety	*Crop Adaptation Area*
6 Row	
Drummond [PVP]	Statewide
Robust [PVP]	1,2,4,6,7
2 Row	
Conlon [PVP]	1,4,6,7
Haxby [PVP] (feed)	6,7
Valier [PVP] (feed)	6,7

Conlon, Drummond, Excel, Foster, Lacey, Legacy, Morex, Robust and Tradition are approved American Malting Barley Association varieties for South Dakota - 2004.

[PVP] U.S. Plant Variety Protection applied for and/or issued; seed sales of these varieties are restricted to classes of certified seed.

Source - Small Grains 2005 Variety Recommendations, EC774, South Dakota State University. (http://plantsci.sdstate.edu/varietytrials/vartrial.html)

OAT VARIETY TRIALS

Objective: To evaluate standard and experimental oat varieties for yield, agronomic characteristics and adaptation to western South Dakota.

Procedure: Plots were seeded at two locations in April 2004 with a John Deere 750 plot drill with 10 inch spacing. The experimental design was a randomized complete block with four replications. The seeding rate was 1,220,000 seeds per acre (64 Lb/A). The plots received 7.4 lbs N and 25 lbs P_2O_5 per acre as 10-34-0 with the seed. Herbicides were applied in May and varied according to weeds present. Plots were trimmed to 5' x 25' after heading. The oats were harvested in July and August with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Location Summaries:

Pennington County - Wall

Planted: April 6, 2004
Harvested: July 29, 2004
Previous crop: Conventional fallow

Herbicide: Bronate (1 pint/A)
Additional Nitrogen: None

Oat yields at Wall averaged 51 Bu/A with test weights averaging 40.9 Lb/Bu. The varieties HiFi, Jerry and Loyal did the best in 2004. There was no significant difference in yield among hulled varieties with three-year averages. Among the hull-less varieties Buff performed significantly better than Paul over the past three years. Results are presented in Table 9.

Perkins County - Bison

Planted: April 12, 2004
Harvested: August 10, 2004
Previous crop: Millet, No-till planted

Herbicide: Bronate (1 pint/A)
Additional Nitrogen: 30 Lb/A

Yields at Bison averaged 59 Bu/A with 36.8 Lb/Bu average test weights. The varieties Loyal, HiFi and Morton were the top yielding varieties in 2004. There are no three-year averages for Bison. Results are shown in Table 10.

Table 9. Oat Variety Trial - Pennington County (Wall), 2002-2004.

Variety	Height	Lodging	Test Wt	Yield	Bu/A
	Inches	1-9*	Lb/Bu	2004	3 Year
BUFF HULLESS	25	0	50.5	45.6	46
PAUL HULLESS	29	0	46.5	26.5	29
STARK HULLESS	30	0	44.9	36.9	.
DON	25	0	39.8	50.7	**58**
HIFI	28	0	39.5	**63.1**	**55**
HYTEST	30	0	42.6	49.8	**52**
JERRY	28	0	40.6	**57.7**	**60**
LOYAL	30	0	38.1	**55.9**	**51**
MORTON	30	0	38.9	54.6	**51**
REEVES	28	0	40.0	51.5	**55**
SD 366	28	0	41.2	50.3	.
SD 366-7	30	0	41.4	54.3	.
SD 366-15	28	0	41.8	**55.4**	.
SD 366-23	27	0	42.0	42.7	.
SD 366-36	28	0	42.3	53.9	.
SD 010062	31	0	42.6	52.2	.
SD 011315	26	0	39.2	**57.4**	.
SD 011226	28	0	39.6	**60.7**	.
Everleaf 114	22	0	35.2	53.4	.
Everleaf 126	23	0	31.1	55.8	.
Average	27.5	0.0	40.9	51.4	51
LSD (P=.05)	2.4	0	1.2	7.9	10
CV	6.1	0	2.1	10.9	9

* 0 = No Lodging, 9 = 100% lodged.

Table 10. Oat Variety Trial - Perkins County (Bison), 2004.

Variety	Height Inches	Lodging 0-9*	Test Wt Lb/Bu	Protein Percent	Yield Bu/A 2004
BUFF HULLESS	25	0	39.8	18.4	49.2
PAUL HULLESS	31	0	39.6	20.5	44.7
STARK HULLESS	32	0	36.7	19.2	55.0
DON	26	0	34.8	15.7	55.8
HIFI	30	0	34.3	16.3	61.0
HYTEST	32	0	38.3	17.5	56.8
JERRY	29	0	36.4	17.0	63.3
LOYAL	29	0	36.6	15.7	**68.0**
MORTON	30	0	35.0	17.4	61.3
REEVES	31	0	34.6	14.7	51.3
SD 366	29	0	37.7	15.9	57.9
SD 366-7	31	0	38.2	15.4	54.0
SD 366-15	30	0	38.0	17.3	61.7
SD 366-23	32	0	37.0	15.6	57.9
SD 366-36	31	0	37.0	16.6	60.0
SD 010062	35	0	36.5	16.2	57.0
SD 011315	32	0	36.0	16.0	**77.9**
SD 011226	30	0	36.0	16.9	62.4
Average	30.2	0.0	36.8	16.8	58.7
LSD (P=.05)	3.0	0.0	0.3	--	10.8
CV	7.0	0.0	2.6	--	12.9

* 0 = No Lodging, 9 = 100% lodged.

SPRING BARLEY VARIETY TRIALS

Objective: To evaluate standard and experimental spring barley varieties for yield, agronomic characteristics and adaptation to western South Dakota.

Procedure: Plots were seeded at three locations in April 2004 with a John Deere 750 plot drill with 10 inch spacing. The experimental design was a randomized complete block with four replications. The seeding rate was 1,220,000 seeds per acre (117 Lb/A for two row, 83 Lb/A for six-row). The plots received 7.4 lbs N and 25 lbs P_2O_5 per acre as 10-34-0 with the seed. Herbicides were applied in May and varied according to weeds present. Plots were trimmed to 5' x 25' after heading. The barley was harvested in July and August with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Location Summaries:

Pennington County - Wall

Planted: April 6, 2004 Herbicide: Bronate (1 pint/A)
Harvested: July 19, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

At Wall, yields averaged 56 Bu/A and test weights averaged 42.6 Lb/Bu. With our new combine weighing system, barley test weight numbers were low due to problems with awns in the sample. All the varieties but Legacy were in the top yield group in 2004. There were no significant differences in three-year yields. The varieties Haxby, Valier and Eslick are varieties from Montana State University that were bred and selected for their feeding qualities for beef production. In feeding studies at MSU, calves fed Valier barley showed a ten percent increase in gain over calves fed traditional varieties. This puts these varieties feed value on par with corn-based rations. Results are shown in Table 11.

Perkins County - Bison

Planted: April 12, 2004 Herbicide: Bronate (1 pint/A)
Harvested: August 10, 2004 Additional Nitrogen: 30 Lb/A
Previous crop: Millet, No-till planted

Barley yields at Bison averaged 36 Bu/A with 40.7 Lb/Bu average test weights in 2004. The trial had a high coefficient of variation (CV), so yield comparisons should not be made. There are no three-year averages for Bison. Results are shown in Table 12.

Harding County - Ralph

Planted: April 12, 2004 Herbicide: Ally ($^1/_{10}$ oz/A) +2,4-D LV6 (6 oz/A)
Harvested: August 9, 2004 Additional Nitrogen: 50 Lb/A
Previous crop: Conventional fallow

The average yield was 59 Bu/A with test weights averaging 43.9 Lb/Bu at Ralph in 2004. Robust was the only variety to yield significantly less that all the other varieties in 2004 and over the past three years. Results are presented in Table 13.

Table 11. Spring Barley Variety Trial - Pennington County (Wall), 2002-2004.

	Height Inches	Lodging 0-9*	Test Wt Lb/Bu**	Protein Percent	Yield 2004	Bu/A 3 Year
TWO ROW						
CONLON	19	0	42.8	12.8	**55.2**	**48**
ESLICK	18	0	45.5	13.5	**54.9**	--
HAXBY	20	0	48.6	13.7	**63.0**	--
VALIER	20	0	46.8	14.3	**55.5**	--
ND 19-119	21	0	44.6	11.8	**60.0**	--
SIX ROW						
DRUMMOND	20	0	42.2	13.3	**55.4**	**42**
EXCEL	19	0	39.4	12.9	**58.2**	**45**
LACEY	19	0	42.5	13.2	**52.1**	**44**
LEGACY	21	0	39.6	13.5	53.5	**44**
ROBUST	21	0	43.3	14.0	**60.2**	**42**
TRADITION	19	0	38.8	13.5	**55.9**	--
ND 16301	19	0	37.6	12.1	47.6	--
Average	19.7	0.0	42.6	13.2	56.0	43
LSD (P=.05)	2.4	0.0	2.5	--	9.6	7
CV	8.6	0.0	4.1	--	11.9	13

* 0 = no lodging, 9 = 100% lodged.

Table 12. Spring Barley Variety Trial - Perkins County (Bison), 2004.

Variety	Height Inches	Lodging 0-9*	Test Wt Lb/Bu**	Protein Percent	Yield 2004	Bu/A
TWO ROW						
CONLON	22	0	41.0	13.3	41.6	
ESLICK	22	0	42.8	12.8	49.4	
HAXBY	23	0	38.3	14.7	29.2	
VALIER	22	0	39.6	13.4	41.3	
ND 19-119	24	0	40.5	12.9	28.8	
SIX ROW						
DRUMMOND	26	0	41.9	13.0	37.0	
EXCEL	23	0	39.9	12.8	32.9	
LACEY	25	0	39.9	--	39.7	
LEGACY	27	0	41.9	13.2	40.3	
ROBUST	26	0	41.8	13.9	24.7	
TRADITION	24	0	40.0	13.3	35.8	
ND 16301	24	0	41.4	13.2	37.8	
Average	23.8	0.0	40.7	13.3	36.5	
LSD (P=.05)	3.2	0.0	3.0	--	9.7	
CV	9.2	0.0	5.0	--	**18.5**	

* 0 = no lodging, 9 = 100% lodged.

** Light test weight due to awns in the sample.

Table 13. Spring Barley Variety Trial - Harding County (Ralph), 2002-2004.

Variety	Height Inches	Lodging 0-9*	Test Wt Lb/Bu**	Protein Percent	Yield 2004	Bu/A 3 Year
TWO ROW						
CONLON	25	0	43.7	12.2	**59.2**	**38**
ESLICK	23	0	45.7	12.2	**65.3**	--
HAXBY	22	0	47.0	11.7	**58.3**	--
VALIER	19	0	45.7	12.2	**65.7**	--
ND 19-119	22	0	44.9	11.8	**59.9**	--
SIX ROW						
DRUMMOND	30	0	41.0	12.0	**60.0**	**38**
EXCEL	23	0	42.7	11.4	**61.0**	**44**
LACEY	25	0	44.2	11.8	**61.9**	**41**
LEGACY	27	0	42.2	11.9	**64.6**	**45**
ROBUST	23	0	43.7	12.2	46.5	32
TRADITION	26	0	41.9	11.9	**57.9**	--
ND 16301	24	0	43.4	11.6	52.6	--
Average	23.9	0.0	43.8	11.9	59.4	39
LSD (P=.05)	4.2	0.0	0.8	--	9.9	7
CV	7.9	0.0	2.9	--	11.5	15

* 0 = no lodging, 9 = 100% lodged.

** Light test weight due to awns in the sample.

SAFFLOWER VARIETY TRIALS

Objective: To evaluate safflower varieties for yield and adaptation to western South Dakota.

Procedure: Safflower varieties were planted at 18 Lb/A in a randomized complete block experiment with four replications near Wall, Sturgis and Oelrichs, South Dakota. The plots were planted in April with a John Deere 750 drill set to 10-inch row spacing. The plots received 7.4 lbs N and 25 lbs P_2O_5 per acre as 10-34-0 with the seed. Plots were trimmed to 5' x 25' before harvest. Height, shatter, and lodging notes were taken at the time of harvest. The plots were harvested with a small plot combine.

Pennington County - Wall

Planted: April 14, 2004 Herbicide: Treflan 4L (1 qt/A)
Harvested: October 5, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

Meade County - Sturgis

Planted: April 19, 2004 Herbicide:
Harvested: October 4, 2004 Additional Nitrogen: None
Previous crop: Winter wheat, No-till planted

Fall River County - Oelrichs

Planted: April 22, 2004 Herbicide: Treflan 4L (1 qt/A)
Harvested: October 6, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

Discussion: In 2004, safflower yields were affected by the drought conditions, but the seed quality was good. The seed had good color and test weights were excellent averaging 43.9 Lb/Bu at Sturgis and Wall. The yields averaged 465 Lb/A at Oelrichs, 1380 Lb/A at Wall and 867 Lb/A at Sturgis. A total lack of useable precipitation at Oelrichs adversely affected yields there, with Sturgis being only slightly better. The varieties Finch, S-541, Montola 2000, S-518 and S-719 did well in 2004. Finch would be the best variety to plant for the birdseed market with its combination of white hull, good test weights and consistent top yields. For the oil markets, S-541 is the best linoleic type and S-518, Montola 2004 and Montola 2000 are the best oleic types. Results are shown in Tables 14 - 16.

Table 14. Safflower Variety Trial –Pennington County (Wall) 2002-2004.

Variety	Hull Type	Height Inches	Lodging 0-9*	Oil Percent	Test Wt Lb/Bu	Yield 2004	Lb/A 3-Year
Linoleic types							
Centennial	Stripe	25	0	41.6	42.2	1281	631
Finch	White	23	0	37.1	47.2	1350	754
Morlin	Stripe	24	0	36.8	44.3	950	.
SeedTec S-541	Stripe	27	0	39.9	43.8	**1725**	682
Oleic types							
Montola 2000	White	22	0	39.9	43.5	1446	711
Montola 2001	Stripe	22	0	37.7	42.4	1220	708
Montola 2003	White	25	0	38.9	42.9	1220	666
Montola 2004	White	23	0	36.7	43.8	1255	.
SeedTec S-518	Stripe	24	0	40.2	42.0	**1681**	784
SeedTec S-719	White	25	0	39.1	43.9	1612	.
Experimentals							
9022 hybrid		25	0	33.6	44.2	1490	.
9030E hybrid		25	0	31.2	46.0	1255	.
9048 hybrid		25	0	35.1	45.7	**1891**	.
9050HP hybrid		24	0	33.2	43.9	1420	.
SeedTec 2107exp	White	22	0	36.6	44.8	1420	.
SeedTec 8150exp	White	24	0	40.2	45.2	1559	.
SeedTec 9262exp	White	22	0	39.5	45.0	1080	.
MT91B3842		23	0	45.7	39.0	984	.
Average		23.7	0.0	37.9	43.9	1380	694
LSD (P=.05)		3.0	0	.	2.3	246	.
CV		5.9	0	.	3.7	12.6	.

*0=No lodging, 9= 100% lodged.

Table 15. Safflower Variety Trial – Fall River County (Oelrichs) 2004.

Variety	Height Inches	Lodging 0-9*	Test Wt Lb/Bu	Yield Lb/A
Linoleic types				
Centennial	19	0	39.9	478
Finch	18	0	37.8	408
Morlin	19	0	40.0	467
SeedTec S-541	21	0	41.4	443
Oleic types				
Montola 2000	18	0	.	540
Montola 2001	18	0	.	348
Montola 2003	16	0	.	436
Montola 2004	16	0	.	392
SeedTec S-518	17	0	.	497
SeedTec S-719	17	0	.	462
Experimentals				
9022 hybrid	18	0	.	505
9030E hybrid	22	0	.	470
9048 hybrid	21	0	.	610
9050HP hybrid	20	0	.	558
SeedTec 2107exp	17	0	.	540
SeedTec 8150exp	21	0	.	497
SeedTec 9262exp	17	0	.	375
MT91B3842	18	0	.	348
Average	18.3	0.0	39.8	465
LSD (P=.05)	3.4	0.0	.	113
CV	8.9	0.0	.	**17.0**

*0=No lodging, 9= 100% lodged.

Table 16. Safflower Variety Trial –Meade County (Sturgis) 2004.

Variety	Height Inches	Lodging 0-9*	Oil Percent	Test Wt Lb/Bu	Yield Lb/A
Linoleic types					
Centennial	19	0	40.9	44.1	941
Finch	18	0	--	49.2	880
Morlin	19	0	36.9	39.7	836
SeedTec S-541	21	0	42.0	44.1	950
Oleic types					
Montola 2000	18	0	41.0	41.0	984
Montola 2001	18	0	35.7	.	592
Montola 2003	16	0	37.5	.	645
Montola 2004	16	0	38.1	42.5	810
SeedTec S-518	17	0	41.4	41.7	1028
SeedTec S-719	17	0	40.4	45.5	958
Experimentals					
9022 hybrid	18	0	34.5	43.2	802
9030E hybrid	22	0	31.9	45.1	749
9048 hybrid	21	0	35.5	47.7	1263
9050HP hybrid	20	0	33.3	.	714
SeedTec 2107exp	17	0	35.6	.	723
SeedTec 8150exp	21	0	40.0	42.7	1028
SeedTec 9262exp	17	0	36.8	44.4	906
MT91B3842	18	0	46.2	.	802
Average	18.3	1.0	38.1	43.9	867
LSD (P=.05)	3.4	0.0	.	1.9	255
CV	8.9	0.0	.	2.8	**20.8**

*0=No lodging, 9= 100% lodged.

FIELD PEA VARIETY TRIALS

Objective: To evaluate field pea varieties for yield and adaptation to western South Dakota.

Procedure: Field peas were planted in a randomized complete block experiment with four replications near Selby, Hayes, Wall and Bison, South Dakota. The seeding rate was 300,000 seeds/A (90 - 220 Lb/A) and the peas were inoculated with a granular pea inoculum (*Rhizobium leguminosarium* biovar *viceae)* just prior to planting. A John Deere 750 with 10-inch spacing was used to plant the trials in April 2004. The peas were harvested for grain in July and August with a small plot combine equipped with vine lifters and a pickup reel.

Location Information:

Pennington County – Wall

Planted: April 6, 2004
Harvested: July 23, 2004
Previous crop: Conventional fallow
Herbicide: Treflan 4L (2 pints/A)
Additional Nitrogen: Inoculated

Perkins County - Bison

Planted: April 12, 2004
Harvested: August 10, 2004
Previous crop: Millet, No-till planted
Herbicide: Pursuit (3 oz/A), Poast (1 pint/A)
Additional Nitrogen: Inoculated

Stanley County - Hayes

Planted: April 08, 2004
Harvested: July 30, 2004
Previous crop: Wheat, no-till planted
Herbicide: Spartan
Additional Nitrogen: Inoculated

Walworth County - Selby

Planted: April 08, 2004
Harvested: July 28,2004
Previous crop: Winter wheat, no-till planted
Herbicide: Spartan
Additional Nitrogen: Inoculated

Summary: Even with the lack of moisture, good conditions for field peas prevailed in 2004. The cool weather in June favored pea growth during the critical time of flowering. The dry conditions in April and May were certainly the limiting factor for yields with the West River locations averaging 24 Bu/A. At Bison, the extreme dry conditions April through June with rain finally coming in July favored the later maturing normal leaf varieties. Past years at Bison with more normal weather conditions, the semi-leafless varieties have yielded better than the forage types. Yields at Wall would have been much higher, but a thunderstorm with hail and high winds a week before harvest caused a large amount of shatter. Some counts taken after harvest showed 10 to 15 Bu/A of seed on the ground with the semi-leafless varieties being hit the hardest. The semi-leafless varieties are earlier in maturity than the forage varieties so they were more susceptible to shatter when the storm hit. Otherwise the semi-leafless varieties would have out yielded the normal leaf types. The Selby location was highly variable due to root rot problems in that part of the field, therefore data is not shown here. The better plots at Selby yielded 65 Bu/A, which was typical of the yields we saw in East River South Dakota this year. Good yielding yellow grain varieties in 2004 were Grande, CDC Mozart, Admiral, Eclipse and Salute and the best green types were Majoret and Crusier. The varieties Arvika, 40-10 Magda, Forager and Journey make excellent forage peas with their long vines, normal leaf type and vigorous growth. Variety characteristics are presented in Table 17 and yield results in Table 18.

Table 17. Field Pea Characteristics.

Variety	Leaf type	Height Inches	Lodging 0-9*	Test Wt Lb/Bu	Seed Size Seeds/Lb
Forage					
40-10 Magda	Normal	30	8	62.4	3055
Arvika	Normal	31	8	61.0	2990
Forager	Normal	31	8	61.4	2175
Yellow Cotyledon					
Lifter	Normal	20	8	62.0	2300
Victoria (forage)	Normal	33	8	62.1	2890
Grande (dual purpose)	Normal	22	4	62.8	1915
Admiral	Semi-leafless	18	0	61.6	1990
Carneval	Semi-leafless	19	1	62.9	2245
Circus	Semi-leafless	17	1	62.6	2210
Delta	Semi-leafless	16	1	63.7	2155
Eclipse	Semi-leafless	16	0	62.5	2005
CDC Mozart	Semi-leafless	15	0	64.1	2140
Salute	Semi-leafless	18	1	63.0	2175
Green Cotyledon					
Crusier	Semi-leafless	18	1	62.1	2280
Journey (forage)	Normal	27	8	62.1	2825
Majoret	Semi-leafless	18	0	62.7	2020
Millennium	Semi-leafless	15	0	62.4	1930
Stirling	Semi-leafless	14	1	62.8	2340

* 0=No lodging, 9 = 100% lodged.

Table 18. Field Pea Variety Trial Yields (Bu/A), 2004.

Variety	Bison	Wall	Hayes	Average
Forage				
40-10 Magda	25.3	**26.3**	25.2	25.6
Arvika	**27.9**	**27.9**	22.6	26.1
Forager	**30.9**	**30.6**	**30.1**	**30.5**
Yellow Cotyledon				
Lifter	20.5	18.7	24.5	21.2
Victoria (forage)	**29.9**	**30.8**	25.8	**28.8**
Grande (dual purpose)	**29.6**	25.4	**31.2**	**28.7**
Admiral	24.4	25.1	**32.0**	27.2
Carneval	22.5	14.2	26.7	21.1
Circus	21.5	21.1	25.6	22.7
Delta	23.2	**26.6**	**27.6**	25.8
Eclipse	24.1	24.8	**28.6**	25.8
CDC Mozart	21.1	23.8	**28.1**	24.3
Salute	23.8	21.6	**32.5**	26.0
Green Cotyledon				
Crusier	23.2	21.6	26.6	23.8
Journey (forage)	22.2	25.4	22.2	23.3
Majoret	22.4	24.4	25.9	24.2
Millennium	17.0	20.3	15.0	17.4
Stirling	15.0	22.2	23.9	20.4
Average	23.6	23.9	26.4	24.6
LSD (P=.05)	4.4	4.5	4.9	2.9
CV	13.2	13.2	13.1	14.1

CHICKPEA VARIETY TRIALS

Objective: To evaluate chickpea varieties for yield and adaptation to western South Dakota.

Procedure: Chickpea varieties were planted in a randomized complete block experiment with four replications near Oelrichs, Hayes and Wall, South Dakota. Most of the varieties are large kabuli types, which are grown for the large seeded garbanzo bean market. Two of the varieties (Amit and Chico) are a smaller sized kabuli for export into the desi market. The other varieties are desi types, which accounts for 85-90% of the market outside the United States and is grown as a protein source for humans and livestock. Large kabuli types used a planting rate of 130,000 seeds/A (120-160 Lb/A), small kabuli and desi types 174,000 seeds/A (75-110 Lb/A). The plots were planted in April and May with a John Deere 750 drill set to 10-inch row spacing and inoculated with chickpea inoculum (*Mesorhizobium* sp. *ciceri)* just prior to planting. The plots were harvested in July-September with a small plot combine.

Pennington County - Wall

Planted: April 14, 2004
Harvested: August 18, 2004
Previous crop: Conventional fallow
Herbicide: Treflan 4L (2 pint/A)
Additional Nitrogen: Inoculated

Fall River County - Oelrichs

Planted: April 22, 2004
Harvested: Not Harvested
Previous crop: Conventional fallow
Herbicide: Treflan 4L (2 pint/A)
Additional Nitrogen: Inoculated

Stanley County - Hayes

Planted: April 15, 2004
Harvested: August 6, 2004
Previous crop: Wheat, No-till planted
Herbicide: Spartan
Additional Nitrogen: Inoculated

Discussion: Chickpea yields were decent in 2004, though somewhat hampered by the dry conditions. Hayes and Wall averaged 1318 and 1163 Lb/A respectively. The Oelrichs trial suffered from severe drought and deer grazing and was not harvested. The best large kabuli varieties are Dwelly, Sierra and CDC Xena. These varieties combine good yield and large seed size. Other varieties yielded better but do not have large enough seed to grade well. Table 19 shows chickpea agronomic characteristics and Table 20 shows yields. The varieties Amit and Chico also did well in 2004 and would be another option as markets become available for the small kabuli. Desi chickpeas typically have good yields in South Dakota but currently have a very limited market in the United States. Chickpeas are well adapted to the dry, semi-arid climate of western South Dakota and can be a profitable crop if quality characteristics are met.

Table 19. Chickpea Variety Characteristics.

Variety	Seed Color	Height Inches	Lodging 1-9*	Seed Size Seeds/oz	Test Wt Lb/Bu
Large Kabuli					
Dwelly	Cream	18	1	**64**	55.9
Sierra	Cream	18	1	**69**	54.3
CDC Diva	Cream	16	1	71	58.1
CDC Frontier	Cream	17	1	97	59.2
CDC Yuma	Cream	19	1	81	57.0
CDC Xena	Cream	17	1	**69**	56.7
CDC ChiChi	Cream	17	1	95	55.7
Small Kabuli					
CDC Chico	Cream	17	1	132	58.6
Amit (B-90)	Cream	17	1	126	58.4
Desi					
CDC Anna	Brown	17	1	172	58.0
CDC Cabri	Brown	17	1	110	54.1
CDC Desiray	Brown	16	1	162	51.3
Myles	Brown	15	1	182	53.9
CDC Nika	Brown	16	1	122	56.6
CA0090B659D	Brown	19	1	109	49.8
Large Kabuli experimentals					
CA9783163C	Cream	16	1	79	54.4
CA9990I604C	Cream	16	1	**62**	54.7
CA0090B347C	Cream	17	1	77	57.0
CA0090B383C	Cream	18	1	83	55.9
CA9890233W	White	16	1	94	51.6
CA9990I875W	White	16	1	74	48.7
CA9990B015W	White	15	1	80	54.1
Average		17	1	101	54.9

*1=No lodging, 9= 100% lodged.

Table 20. Chickpea Variety Trial Yields (Lb/A), 2003-2004.

	Wall		Hayes		Average
Variety	2004	2-year	2004	2-year	2004
Large Kabuli					
Dwelly	**1372**	**1098**	1037	1002	1204
Sierra	**1176**	**1146**	1133	1180	1154
CDC Diva	**1318**	**1213**	1437	**1373**	**1378**
CDC Frontier	**1363**	--	**1847**	--	**1605**
CDC Yuma	**1165**	**1139**	1228	1150	1197
CDC Xena	**1220**	**1163**	1437	**1400**	**1329**
CDC ChiChi	**1405**	--	1559	--	**1482**
Small Kabuli					
CDC Chico	991	1067	1481	**1447**	1236
Amit (B-90)	**1165**	1087	1359	**1392**	1262
Desi					
CDC Anna	1045	1058	1464	**1473**	1254
CDC Cabri	1067	--	**1612**	--	**1340**
CDC Desiray	1089	1059	1437	**1389**	1263
Myles	1045	995	1403	**1363**	1224
CDC Nika	958	1067	1551	**1481**	1255
CA0090B659D	**1154**	--	1150	965	1152
Large Kabuli experimentals					
CA9783163C	**1253**	1068	880	965	1065
CA9990I604C	**1296**	**1267**	1333	**1391**	**1314**
CA0090B347C	**1361**	--	1507	--	**1434**
CA0090B383C	**1252**	--	1586	--	**1419**
CA9890233W	741	775	871	941	806
CA9990I875W	1056	933	784	902	920
CA9990B015W	1089	--	906	--	998
Average	1163	1076	1318	1257	1240
LSD (P=.05)	277	169	257	184	185
CV	16.8	15.8	13.8	14.6	15.2

WINTER PEA VARIETY TRIALS

Objective: To evaluate winter field pea varieties for yield and adaptation to western South Dakota.

Procedure: Winter field pea varieties from Washington State University were planted in a randomized complete block experiment with four replications near Wall and Pierre, South Dakota. The seeding rate was 520,000 seeds/A (115 - 150 Lb/A) and the peas were inoculated with a granular pea inoculum (*Rhizobium leguminosarium* biovar *viceae)* just prior to planting. A John Deere 750 with 10-inch spacing was used to plant the trials in September 2003. The peas were harvested for grain in August with a small plot combine equipped with vine lifters and a pickup reel.

Location Information:

Pennington County – Wall

Planted: September 15, 2003 Herbicide: Poast (1 pint/A)
Harvested: Not harvested Additional Nitrogen: Inoculated
Previous crop: Spring wheat, No-till planted

Hughes County – Dakota Lakes (limited irrigation)

Planted: September 23, 2003 Herbicide: Spartan (5.3 oz/A)
Harvested: August 6, 2004 Additional Nitrogen: Inoculated
Previous crop: Wheat, No-till planted

Summary: This is the second year winter peas have been grown in South Dakota. The concept of another crop we can plant in the fall, especially a broadleaf, is exciting. The trial at Wall did not survive the winter very well and was not harvested. At Dakota Lakes the trial had lots of variability so yield comparisons can not be made, but yields ranged from 17 to 50 Bu/A. These yields were less than spring peas planted elsewhere at the Dakota Lakes farm. This is also what we observed in 2003, so it looks like winter peas for grain are not a viable option yet. They do look interesting for a cover crop or forage though. The peas could be harvested for forage a couple weeks sooner than spring types, early June from what we have observed so far. Research continues as this trial was planted again at Wall, Bison and Dakota Lakes.

Table 21. Winter Field Pea Variety Trial - Hughes County (Dakota Lakes), 2004.

Variety	Fall Stand Percent	Spring Stand Percent	Height Inches	Lodging 0-9*	Seeds/Lb	Test Wt Lb/Bu	Yield Bu/A
PS9430706	90	81	54	9.0	3710	58.3	17.1
PS7530726	90	76	39	9.0	4030	58.3	39.2
PS9630448	90	89	51	9.0	3740	58.5	34.7
Spector (PS9830F009)	90	88	62	9.0	3560	59.6	34.8
PS9830F010	90	84	52	9.0	3560	59.6	35.0
PS9830F011	90	88	31	9.0	3280	60.0	49.5
PS9830S358	90	89	29	8.5	3140	59.9	47.4
PS9830S431	90	83	46	9.0	4030	56.7	22.3
Mean	90.0	85	45.3	8.9	3632	58.8	35.0
LSD (P=.05)	0.0	6.7	10.0	0.6	--	3.1	13.8
CV	0.0	6.7	9.4	2.8	--	3.5	**26.9**

* 0=No lodging, 9 = 100% lodged.

WINTER LENTIL VARIETY TRIALS

Objective: To evaluate winter lentil varieties for yield and adaptation to western South Dakota.

Procedure: Winter lentil varieties from Washington State University were planted in a randomized complete block experiment with four replications near Wall and Pierre, South Dakota. The seeding rate was 520,000 seeds/A (25 - 35 Lb/A) and the lentils were inoculated with a granular lentil inoculum (*Rhizobium leguminosarium* biovar *viceae)* just prior to planting. A John Deere 750 with 10-inch spacing was used to plant the trials in September 2003. The lentils were harvested for grain in July and August with a small plot combine equipped with vine lifters and a pickup reel.

Location Information:

Pennington County – Wall

Planted: September 15, 2003 Herbicide: Poast (1 pint/A)
Harvested: July 21, 2004 Additional Nitrogen: Inoculated
Previous crop: Spring wheat, No-till planted

Hughes County – Dakota Lakes (limited irrigation)

Planted: September 23, 2003 Herbicide: Spartan (5.3 oz/A)
Harvested: August 6, 2004 Additional Nitrogen: Inoculated
Previous crop: Wheat, No-till planted

Summary: This is the second year winter lentils have been grown in South Dakota. The lentils once again had excellent winter survival and yields were on par with our past yields of spring types, especially considering the dry weather. Wall averaged 905 Lb/A with Dakota Lakes averaging 1474 Lb/A. The winter lentils mature earlier than spring types with the Wall location being harvested at the same time as winter wheat. As with the winter peas, winter lentils look interesting as a cover crop in wetter climates. Their excellent survivability and small seed size would make lentils fit well into no-till systems as a winter cover crop. Research continues as we planted this trial again at Wall and Dakota Lakes. Results are shown in Tables 22 and 23.

Table 22. Winter Lentil Pea Variety Trial - Pennington County (Wall), 2004.

Variety	Fall Stand Percent	Spring Stand Percent	Height Inches	Lodging 1-9*	Seed Size Seeds/Lb	Test Wt Lb/Bu	Yield Lb/A
WA8649041	90	90	14	0	16210	64.8	1033
LC9976079	90	90	12	0	12780	65.2	645
LC9978057	90	90	11	0	13980	66.7	910
LC9978094	90	90	12	0	13850	66.2	791
Morton (LC9979010)	90	90	12	0	15070	66.3	825
LC9979062	90	90	11	0	15370	66.0	976
LC9979065	90	90	11	0	18340	65.9	923
LC9979120	90	90	11	0	18200	66.7	1136
Mean	90	90	11.6	0	15475	66.0	905
LSD (P=.05)	0.0	0.0	2.6	0	--	1.1	314.7
CV	0.0	0.0	15.1	0	--	1.1	**23.6**

* 1=No lodging, 9 = 100% lodged.

Table 23. Winter Lentil Pea Variety Trial - Hughes County (Dakota Lakes), 2004.

Variety	Fall Stand Percent	Spring Stand Percent	Height Inches	Lodging 1-9*	Test Wt Lb/Bu	Yield Lb/A
WA8649041	90	90	21	0	61.3	1535
LC9976079	90	90	18	0	59.9	1546
LC9978057	90	90	19	0	61.7	1100
LC9978094	90	90	20	0	60.9	1677
Morton (LC9979010)	90	90	18	0	61.9	1307
LC9979062	90	90	19	0	61.1	1634
LC9979065	90	90	18	0	62.3	1655
LC9979120	90	90	18	0	60.1	1339
Mean	90	90	18.4	0	61.2	1474
LSD (P=.05)	0.0	0.0	4.5	--	1.8	519
CV	0.0	0.0	10.2	--	2.0	**23.9**

* 1=No lodging, 9 = 100% lodged.

OAT / FIELD PEA FORAGE TRIAL

Objectives: 1. To evaluate different seeding rates of oats and field peas planted in a mix.
2. Compare oat / field pea mix to peas and oats planted alone.
3. Compare long vine forage pea to short vine semi-leafless type.

Procedure: The study was planted in a randomized complete block experiment with four replications near Wall, South Dakota. The ground was black fallow the previous year. A John Deere 750 plot drill with 10-inch spacing was used to plant the trial on April 6, 2004. The peas were inoculated with a granular pea inoculum (*Rhizobium leguminosarium* biovar *viceae)* just prior to planting. Soil tests showed 166 lb/A of nitrogen in the top two feet of soil, so no additional fertilizer was added. The oat variety Jerry along with the pea varieties Arvika (long vine forage type) and Carneval (semi-leafless grain type) were used. The seeding rates are listed in the table below. The trial was harvested on June 28, 2004 when the peas were at mid-pod fill and the oats milk to early dough stage. Subsamples from each plot were analyzed for acid detergent fiber (ADF), neutral detergent fiber (NDF) and crude protein. The ADF and NDF numbers were then used to calculate relative feed value (RFV) with a higher RFV being better quality forage.

Seeding Rates Used for Forage Study

	Full Rate*	½ Rate	¼ Rate
Jerry Oat	64 lb/A	32 lb/A	16 lb/A
Carneval Pea	150 lb/A	75 lb/A	
Arvika Pea	90 lb/A	45 lb/A	

** Full and ½ rate of peas are 300,000 and 150,000 seeds/acre respectively.*

Summary: The trial averaged 1.3 ton/A, which was fairly good considering the dry conditions. Seeding rates in a mix of 32 lb/A for oats and 150,000 seeds/acre for field peas were adequate to maximize yield. The oats alone and the mixes yielded the same; peas alone were lower yielding than the mixes. There was no yield difference between the forage and grain type pea.

Arvika had higher protein content than Carneval and Jerry oat. Carneval and Jerry had the same protein levels. The only mix that showed an increase in protein over oats alone was the mix with the Full Arvika / ¼ Oat seeding rate. For the relative feed values (RFV), Arvika was the highest and Jerry oats the lowest with Carneval in between. When the peas and oats were planted together, only the two mixes with Arvika and the ¼ Oat seeding rate had a higher RFV. The higher protein levels and RFV in Arvika peas may be partly due to its later maturity than Carneval. Overall this study showed no yield or quality advantage to pea/oat mixes over oats alone. Since no LDP can be obtained from a field planted to a mix, a producer might want to consider planting one field to peas and one to oats and mix the hay when feeding.

Table 23. Oat / Field Pea Forage Trial – Pennington County (Wall), 2004.

Treatment	Moisture Percent	Yield Ton/A 13%	% Crude Protein	NDF %	ADF %	RFV
Full Arvika	75	1.16	17.4	26.5	18.2	263
Full Carneval	73	1.15	13.2	36.0	23.7	187
Full Oat	67	**1.30**	13.3	44.2	25.4	150
Full Arvika / Full Oat	67	**1.27**	14.1	43.8	24.9	148
Full Arvika / ½ Oat	68	**1.45**	13.4	42.4	24.0	155
Full Arvika /¼ Oat	71	1.23	15.2	36.6	22.1	184
½ Arvika / Full Oat	69	1.25	12.4	47.5	26.5	135
½ Arvika / ½ Oat	69	**1.48**	12.3	47.5	26.7	133
½ Arvika / ¼ Oat	71	1.11	14.0	41.6	24.3	160
Full Carneval / Full Oat	67	**1.47**	12.4	48.9	26.8	130
Full Carneval / ½ Oat	69	**1.28**	13.6	45.7	25.8	141
Full Carneval / ¼ Oat	71	**1.37**	12.5	44.4	26.6	143
½ Carneval / Full Oat	64	**1.42**	11.6	47.2	25.9	136
½ Carneval / ½ Oat	69	**1.27**	13.0	46.8	26.3	136
½ Carneval / ¼ Oat	71	1.03	13.7	43.6	25.6	149
½ Arvika / ½ Triticale	67	1.00	13.4	40.3	23.7	163
Average	69	1.27	13.4	42.7	24.8	157
LSD (P=.05)	3	0.22	1.6	5.7	2.1	27
CV	3.2	12.3	8.1	9.4	5.9	11.8

FIELD PEA PLANTING DATE STUDY

Objective: To determine the effect of planting date on the yield of four field pea varieties

Procedures: Four varieties of field pea were planted at five planting dates at two locations in western South Dakota. The locations were Sturgis (Meade County) and Hayes (Stanley County). The four pea varieties were Carneval, CDC Mozart, Grande and Arvika. The first planting date was April 1, 2004 with other four planting dates following on two week intervals. The experimental design was a Randomized Complete Block with treatments arranged in a split-plot design. Planting date was the main plot and variety sub-plot. Treatments were replicated four times. The experiment was planted at 10-inch row spacing using the John Deere 750 drill. Spartan was applied prior to planting to control weeds. No N fertilizer was applied to the crop. Granular pea inoculant was placed with the seed in the furrow. Plots were harvested using a Wintersteiger small plot combine equipped with lifters and a pickup reel.

Results and Discussion: At Sturgis, the experimental plots suffered significant damage from wildlife and had to be abandoned. Results from Hayes are presented on Tables 24, 25 and 26. Extremely dry conditions in April resulted in poor and uneven seedlings emergence at Hayes. Thus, field pea planted on April 1 yielded lower than field pea planted on April 15, April 30 and May 15. The pea yields from the May 30 planting date were very low (average 255 Lb/Acre) and were excluded from the analysis. Field pea yields were similar when pea was planted on April 15, April 30 or May 15 (Table 24).

In general, pea yields were low at Hayes due to drought stress. Particularly, the first planting date was at a disadvantage due to extreme dry conditions early in April. Our earlier research has shown that planting as early as April 1 can result in higher field pea yields than was observed in 2004. Also important to note is that field pea is very sensitive to high temperatures during flowering and that when seeding is delayed beyond mid-May the crop will likely flower around mid-July increasing the risk of flower abortion due to heat stress.

Table 24. Effect of planting date on test weight and seed yield of field pea at Hayes (Stanley County)

Planting Date	Test weight (Lb/Bu)	Yield (Lb/Acre)
April 1	61.7	587
April 15	62.5	1104
April 29	62.0	1236
May 11	61.3	1173
LSD (0.05)	**NS**	**1025**
CV (%)	**2.1**	**14.5**

Table 25. Test Weight and Yield of Four Pea Varieties at Hayes in 2004

Variety	Test Weight (Lb/Bu)	Yield (Lb/Acre)
Carneval	61.8	1050
Mozart	63.9	999
Grande	62.1	1127
Arvika	59.9	925
LSD (0.05)	**NS**	**NS**
CV (%)	**2.1**	**14.5**

Table 26. Test Weight and Yield of Four Pea Varieties at Four Planting Dates at Hayes in 2004

Variety	Test Weight (Lb/Bu)	Yield (Lb/Acre)
April 1		
Carneval	61.1	553
Mozart	62.5	274
Grande	61.7	647
Arvika	61.6	706
April 15		
Carneval	62.1	1230
Mozart	65.0	1101
Grande	62.0	1159
Arvika	60.9	927
April 29		
Carneval	62.3	1278
Mozart	64.2	1254
Grande	62.4	1341
Arvika	59.3	1074
May 11		
Carneval	61.7	1171
Mozart	63.8	1166
Grande	62.1	1362
Arvika	57.6	994
Average	**61.9**	**1025**
C.V.	**2.1**	**14.7**

FIELD PEA PLANT POPULATION STUDY

Objectives: To evaluate the response of normal and semi-leafless field pea varieties to six plant populations

Procedures: Considering the high cost of field pea seed, proper plant populations are important for optimizing yield and economic returns. A variety and population density study was conducted at two locations (Wall and Hayes) in western South Dakota. Four field pea varieties, two semi-leafless and the other two normal-leaf were planted at six population densities on April 1 2004 at Hayes and on April 6, 2004 at Wall. The semi-leafless varieties were Carneval and CDC Mozart. Carneval is a popular variety in South Dakota whereas CDC Mozart is a new variety from Saskatchewan, Canada which has shown good potential under western South Dakota conditions. The normal leaf variety Grande was chosen because it is one of the well established varieties in the State. The other normal leaf variety Arvika, was chosen because it produces high biomass and has a potential as a forage variety.

Pea variety	Leaf type	Seed color/Use
Carneval	semi-leafless	yellow
CDC Mozart	semi-leafless	yellow
Grande	normal leaf	yellow
Arvika	normal leaf	green/forage

Seeding rate for each variety was adjusted to give six target plant populations of 100 000, 150 000, 200 000, 250 000, 300 000 and 350 000 plants per acre were evaluated. The recommended plant population is 300 000 plants per acre.

The experimental design was a Randomized Complete Block with treatments arranged in a factorial design. Treatments were replicated four times. Measurements taken include stand count taken 21 days after emergence, biomass, pod and seed production, seed yield, and harvest index. Harvest index is a measure of the ratio of grain weight to total plant weight. At Wall, peas were planted on land that been fallowed the previous year. At Hayes we planted peas into winter wheat stubble thus, although both locations experienced drought in 2003, there was relatively more moisture at Wall than at Hayes. No nitrogen fertilizer was applied to the plots. Granular pea inoculant was placed with the seed into the furrow. Spartan was applied at both locations prior to planting to control weeds.

Results and Discussion: Plant count 21 days after emergence showed that plant stands at both locations were close to target populations. The effect of plant population on plant height, number of pods per plant, number of seeds per plant, harvest index and grain yield at Wall are presented on Tables 27 and 28. At Wall where soil moisture was least limiting, plant population had no significant effect on the yield of peas meaning that the lower plant populations yielded as good as the higher plant populations. Our results also showed that where plant populations were low, field pea plants produced more pods and more seeds per pod compensating for the lower plant populations.

Table 27. Effect of plant population on plant height, number of pods per plant, number of seeds per pod, harvest index and grain yield of field pea at Wall in 2004

Target Plant Population (Plants/A)	Observed Plant Population (Plants/A)	Plant Height (Inches)	# of Pods /Plant	# of Seeds/Pod	Harvest Index	Yield (Lb/A)
100 000	118 404	24.9	7	6	36.6	954
150 000	186 461	23.6	6	5	35.6	976
200 000	220 363	24.4	6	5	35.4	941
250 000	275 517	23.1	5	5	33.3	989
300 000	296 516	24.2	5	5	33.8	1087
350 000	333 454	23.2	5	4	33.3	1017
LSD (0.05)		**NS**	**1.1**	**0.59**	**2.2**	**NS**
CV (%)		**9.4**	**27.7**	**16.7**	**8.8**	**15.0**

In a drier environment at Hayes, field pea yield increased as plant population density increased with the 300 000 population yielding 285 pounds more than the 100 000 population. Although lower populations produced more pods per plant and more seeds per pod, soil moisture limited the extent of this plasticity and thus, did not help the yield as much as we observed at Wall.

The response to plant population density was the same for normal leaf and semi-leafless varieties. With adequate space, moisture, and nutrients, field pea will compensate for lower plant density through branching and heavier pod set and other studies seem to indicate that normal-leaf varieties are more 'plastic' than semi-leafless varieties. The very dry conditions experienced in 2004 may have limited the 'plasticity' of pea varieties. The study will be repeated in 2005. While lower plant densities may look promising, weed control may be a problem in an open canopy. We observed higher weed pressure where plant populations was lower than 200 000 plants/acre at Hayes and this should be taken into consideration when deciding on seeding rates.

Table 28. Effect of seeding rate on yield, number of pods per plant and number of seeds per pod of field pea at Hayes

Target Plant Population (Plants/A)	Observed Plant Population (Plants/A)	Plant Height (Inches)	# of Pods /Plant	# of Seeds/Pod	Harvest Index	Yield (Lb/A)
100 000	109 549	21.3	6	6	50.3	694
150 000	142 692	20.7	6	5	47.5	771
200 000	171 028	21.3	5	5	46.9	822
250 000	229 471	20.3	5	5	44.8	831
300 000	303 600	20.6	4	5	47.2	978
350 000	322 069	19.9	4	5	45.6	953
LSD (0.05)		**NS**	**0.90**	**0.42**	**3.91**	**128.6**
CV (%)		**16.6**	**26.3**	**11.3**	**11.8**	**21.7**

WINTER WHEAT STARTER FERTILIZER DEMOSTRATION

Objective: To evaluate the response of winter wheat to different types of starter fertilizer.

Procedure: Plots were seeded at five locations in September 2004 with a John Deere 610 double disk (fallow) or John Deere 750 (no-till) plot drills with 10 inch spacing. The experimental design was a randomized complete block with four replications. The variety Wesley was planted at 950,000 seeds per acre (60 lb/A). The starter fertilizer treatments were 55 lb/A diammonium phosphate (18-46-0), 55 lb/A triple superphosphate (0-46-0), 30 lb/A ammonium nitrate (32-0-0) and an untreated check. The granular fertilizer treatments were applied directly with the seed. Herbicides were applied in either the fall or spring and varied according to weeds present. Visual stand ratings were taken in October 2003 and April 2004. The plots were trimmed to 5' x 25' after heading. The wheat was harvested in July and August with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Location Summaries:

Locations not harvested

Location	Reason
Perkins County - Bison	Drought, May freeze
Stanley County – Hayes	Poor stands, drought
Bennett County – Martin	Drought

Fall River County - Oelrichs

Planted: September 24, 2003 Herbicide: Glean ($^1/_3$ oz/A)
Harvested: August 3, 2004 Additional Nitrogen: None
Previous crop: Conventional fallow

Meade County - Sturgis

Planted: September 16, 2003 Herbicide: Harmony Extra ($^3/_{10}$ oz/A) + 2,4-D LV6 (5 oz/A)
Harvested: July 26, 2004 Additional Nitrogen: None
Previous crop: Chemical fallow, no-till planted

Summary: Most of the locations were not harvested due to the poor condition of the winter wheat. Oelrichs was harvested, but the data was too variable to be used. At Sturgis the 18-46-0 treatment yielded significantly more than the check. The other two starter treatments did not show any statistical yield difference from the untreated check. The results are presented in Table 29.

Table 29. Winter Wheat Starter Fertilizer Trial - Meade County (Sturgis), 2004.

Variety	Height	Lodging	Test Wt	Yield	Protein
	Inches	1-9*	Lb/Bu	Bu/A	Percent
Check	24	1	54.4	20.9	16.1
55 lb/A 18-46-0 (diammonium phosphate)	24	1	55.9	28.7	15.5
55 lb/A 0-46-0 (triple superphosphate)	23	1	54.3	25.7	15.8
30 lb/A 32-0-0 (ammonium nitrate)	24	1	53.3	23.4	15.6
Average	23.7	1.0	54.5	24.7	15.8
LSD (P=.05)	2.0	0.0	1.3	5.37	--
CV	5.4	0.0	1.6	13.6	--
				(Lb/A)	
Soil Test Recommendations	OM%	pH	N	P	K
	2.0	6.1	0	25	0

* 1=No lodging, 9 = 100% lodged.

WINTER WHEAT FERTILIZER DEMONSTRATION - 2004

James Talty Farm
Scenic, SD

Objective:

1.) To evaluate fertilizer response of Wesley Winter wheat.

Procedures: Wesley Winter wheat was planted on two fallow strips in the first week of October of 2003 by the cooperator. No starter fertilizer was applied at planting time. Soil tests were taken on March 17, 2004. Soil-test results are listed below. The NE strip was reported by the cooperator to be more productive over the past years than the SW strip. It held true again this year.

Fertilizer treatments of 25#N (8.4 gallons/acre of 28-0-0), 50#N (16.7 gallons/acre of 28-0-0), and 75#N (25.0 gallons/acre of 28-0-0) plus a control (no fertilizer) were top-dressed with a 4-wheel ATV sprayer on March 17, 2004. Soil temperatures were at 45 degrees Fahrenheit on the day of Nitrogen application. The treatments were laid out in a randomized complete block design with four replications. The plots were 12 1/2 feet wide x 40 feet long. A 5 foot x 35 foot sample was harvested out of the middle of each plot to eliminate any border effect. The wheat was harvested on July 20, 2004 with a small plot combine. Protein content was determined with a Near Infrared Spectrophotometer (Technicon InfraAlyzer 400).

Talty Farm Soil Analysis for the 2004 Season

Location	2004 Crop and estimated yield goal	Soil Texture	Soil pH	Soluble Salts	NO3-N # / acre 0-6"	NO3-N # / acre 0-24"	P ppm	K ppm	Add N #/A	Add P205 #/A	Add K2O #/A	2003 Crop History
					top	total						
Talty NE	Winter Wheat-60bu	Medium	6.6	0.3	18	42	12	392	110	15	0	Fallow
Talty SW	Winter Wheat-60bu	Medium	6.4	0.2	10	19	8	307	130	30	0	Fallow

Note: to convert P & K values to #/A take ppm value x 2.
Example: 50 ppm is equal to 100#/Acre.

Discussion: Both fields have been in Winter Wheat / Fallow for many years and have historically not been fertilized. Poor growing conditions this year were compounded not only by lack of moisture, but also by low nitrogen and low phosphorus levels in the soil. Yields, crop color and protein content of the wheat did improve as nitrogen levels were increased. Because of the very poor yields at the southwest (SW) site caused by drought conditions the application of nitrogen was not cost effective. At the northeast (NE) location the application of additional nitrogen was cost effective even with yields around only 20 bushels per acre. Normal yields on fallow would be 50-60 bushels per acre in this area and that is the yield goal that one would fertilize for. The soil test showed low phosphorus levels, so a positive crop response to phosphorus would be very likely. The phosphorus should be applied at planting time to maximize its benefits.

Results:

Table 30. Winter Wheat Fertilizer Demonstration – Pennington County (Scenic) 2004.

Wheat Strip Location	Nitrogen Added	Grain Value per Bushel **	Yield (Bu/acre)	Test Wt (lbs/bu)	Protein Content (%)	Gross Income per Acre	Fertilizer cost / acre including $3.50/A application	Net Gain Due to Fertilizing ($ / Acre)
NE	None	$3.20	14.7	57.5	12.0	$47.04	$ 0.00	0
NE	25# N	$3.23	19.0	55.5	12.7	$61.37	$11.25	$3.08
NE	50# N	$3.30	19.1	54.6	14.0	$63.03	$19.00	$-3.01
NE	75#N	$3.32	24.1	52.0	14.5	$80.01	$26.75	$6.22
	LSD (.05)		4.9	3.5				
	CV		16.0	4.0				
SW	None	$3.29	4.7	59.7	13.8	$15.46	$ 0.00	0
SW	25# N	$3.30	7.3	59.1	14.0	$24.09	$11.25	$-2.62
SW	50# N	$3.34	6.6	57.8	16.8	$22.70	$19.00	$-11.76
SW	75#N	$3.46	7.1	57.7	17.3	$24.56	$26.75	$-17.65
	LSD (.05)		0.7	1.9				
	CV		6.7	2.0				

** = Grain sale values are quoted from Dakota Mill and Grain as of December 21, 2004.
See chart on page 83.

SAFFLOWER SEEDING RATE STUDY

Objective: To evaluate the response of conventional and hybrid safflower to different seeding rates.

Procedure: Safflower was planted in a factorial (variety x seeding rate) experiment with four replications near Wall, South Dakota. The varieties Finch (conventional) and 9022 (hybrid) were planted at 50 000, 100 000, 150 000, 200 000, 250 000 and 400 000 seeds/A, equivalent to 5, 10, 15, 20, 25 and 30 pounds/A. Treflan 4L (2 pints/A) was applied on April 6th and double pass incorporated to control weeds. The trial was planted on April 14th with a John Deere 750 research drill. Liquid starter fertilizer (10-34-0) was applied at 7.4 lbs N and 25 lbs P_2O_5 per acre with the seed. The safflower was harvested for grain on October 5th with a Wintersteiger small plot combine. The results are given in Table 31.

Summary: This study was undertaken to see if hybrid safflower could be planted at lower seeding rates than conventional varieties. Lower seeding rates would offset some of the cost of the higher priced hybrid seed. Unfortunately the study had field bindweed problems which caused an unacceptable amount of variation (CV = 24.1 for yield). Because of this, no conclusions can be made about yield differences. This study will be planted again in 2005.

Table 31. Safflower Seeding Rate Study – Pennington County (Wall) 2004.

Treatment	Height Inches	Lodging 1-9*	Test Wt Lb/Bu	Yield Bu/A	Oil Percent
Variety					
Finch	23	1	47.3	1469	35.8
9022 hybrid	26	1	44.8	1520	32.1
LSD (P=.05)	0.8	NS	0.81	NS	--
Seeding Rate					
50,000 (5 Lb)	24	1	45.5	1063	33.2
100,000 (10 Lb)	25	1	45.9	1388	33.4
150,000 (15 Lb)	24	1	46.4	1655	34.2
200,000 (20 Lb)	25	1	45.6	1673	34.9
250,000 (25 Lb)	25	1	46.9	1644	34.0
300,000 (30 Lb)	25	1	46.0	1545	34.2
LSD (P=.05)	NS	NS	NS	NS	--
Variety x Seeding Rate					
Finch 50,000	23	1	46.7	871	35.3
Finch 100,000	23	1	46.9	1313	34.7
Finch 150,000	24	1	47.5	1754	36.0
Finch 200,000	24	1	46.6	1615	36.7
Finch 250,000	24	1	48.7	1673	35.7
Finch 300,000	24	1	47.5	1591	36.6
9022 hybrid 50,000	25	1	44.2	1255	31.1
9022 hybrid 100,000	27	1	44.9	1464	32.1
9022 hybrid 150,000	25	1	45.4	1557	32.4
9022 hybrid 200,000	27	1	44.6	1731	33.0
9022 hybrid 250,000	27	1	45.1	1615	32.2
9022 hybrid 300,000	27	1	44.6	1498	31.8
LSD (P=.05)	NS	NS	NS	NS	--
Average	24.8	1.0	46.1	1495	34.0
CV	4.5	0.0	2.8	**24.1**	--

*1=No lodging, 9=100% lodged.

SAFFLOWER PLANTING DATE STUDY

Objectives:

1) To evaluate the effect of delayed planting on the yield, test weight and oil content of safflower.
2) To determine if the leaf spotting disease Alternaria can be lessened by delaying planting.

Procedures: Safflower was planted in a factorial (varieties x planting date) experiment with four replications near Wall, South Dakota on April 14, May 6, May 14, and May 27, 2004. The herbicide Treflan 4L (2 pints/A) was double pass incorporated on April 6, 2004 to control weeds. Four varieties of Safflower (Finch, S-541, S-518, and Montola 2003) were seeded at 210,000 seeds per acre rate with a John Deere 750 no-till research drill. Starter fertilizer at 6 gallons per acre of liquid ammonium phosphate (10-34-0) was applied with the seed at planting time. All 4 planting dates were harvested on October 6, 2004. Results of the 2002 – 2004 trials are shown in Tables 32 – 34.

Discussion: . Lack of precipitation has been the major factor limiting safflower yields the past three years. In 2004 there was virtually no rain in April and early May. This combined with dry topsoil conditions caused the first three dates to germinate and emerge at the same time. So effectively there was only two planting dates in 2004, May 14 and May 27. What we have seen over the past three years is that plant height and test weight decreased with later planting dates, but yield trends have varied over the years. Leaf infection from Alternaria has not been a factor the past three years due to the dry summers that have limited the amounts of dewy conditions that promote infection.

Table 32. Safflower Planting Date Trial – Pennington County (Wall) 2004.

Treatment	Height Inches	Lodging 1-9*	Test Wt Lb/Bu	Yield Lb/A	Maturity 50% Bloom	Oil Percent
Planting Date						
April 14	23	1	44.3	1549	July 24	39.1
April 28	24	1	44.0	1629	July 24	38.8
May 11	24	1	43.6	1699	July 24	38.6
May 25	19	1	42.1	1531	Aug 8	37.3
LSD (P=.05)	0.8	NS	0.8	**NS**		--
Variety						
Finch	23	1	46.2	1405	July 27	35.9
S-541	22	1	43.4	**1708**	July 27	38.8
S-518	22	1	40.6	**1788**	July 28	38.5
Montola 2003	22	1	43.8	1507	July 28	37.8
LSD (P=.05)	0.8	NS	0.8	143		--
Variety x Planting Date						
Finch April 14	24	1	46.8	1472	July 24	36.0
Finch April 28	24	1	45.6	1376	July 24	35.7
Finch May 11	23	1	47.3	1411	July 24	36.3
Finch May 25	21	1	44.9	1359	August 7	35.4
S-541 April 14	22	1	43.7	1664	July 24	41.4
S-541 April 28	24	1	44.9	1716	July 24	41.3
S-541 May 11	25	1	43.4	1795	July 24	40.8
S-541 May 25	19	1	41.5	1655	August 7	39.7
S-518 April 14	23	1	41.5	1751	July 24	39.8
S-518 April 28	25	1	41.3	1786	July 24	39.6
S-518 May 11	24	1	40.6	1934	July 24	39.0
S-518 May 25	18	1	39.0	1681	August 9	38.4
Montola 2003 April 14	23	1	45.1	1307	July 24	39.0
Montola 2003 April 28	23	1	44.3	1638	July 24	38.7
Montola 2003 May 11	23	1	43.2	1655	July 24	38.1
Montola 2003 May 25	19	1	42.9	1429	August 9	37.8
LSD (P=.05)	NS	NS	NS	**NS**		--
Average	22	1.0	43.5	1601	--	38.6
CV	4.8	0.0	2.5	12.5	--	--

Table 33. Safflower Planting Date Trial – Pennington County (Wall) 2003.

Treatment	Height Inches	Lodging 1-9*	Test Wt Lb/Bu	Yield Lb/A	Maturity 50% Bloom	Oil Percent
Planting Date						
April 14	22	1	40.4	**560**	July 14	35.7
April 28	20	1	41.9	444	July 20	38.2
May 11	19	1	41.9	413	July 24	36.5
May 25	17	1	39.8	372	July 28	36.9
LSD (P=.05)	1.2	NS	1.1	60	--	--
Variety						
Finch	20	1	41.7	**443**	July 21	33.4
S-541	21	1	41.2	**456**	July 21	39.1
S-518	19	1	39.8	**494**	July 21	38.8
Montola 2003	18	1	41.3	396	July 22	36.3
LSD (P=.05)	1.2	NS	1.1	60	--	--
Variety x Planting Date						
Finch April 14	22	1	41.5	530	July 15	33.1
Finch April 28	21	1	42.3	478	July 18	35.1
Finch May 11	20	1	42.4	388	July 23	31.0
Finch May 25	18	1	40.5	375	July 28	34.4
S-541 April 14	23	1	39.7	570	July 14	36.4
S-541 April 28	22	1	43.0	430	July 20	40.4
S-541 May 11	20	1	42.2	467	July 24	39.4
S-541 May 25	18	1	39.8	357	July 28	40.0
S-518 April 14	22	1	39.7	610	July 14	39.2
S-518 April 28	20	1	40.2	529	July 20	40.0
S-518 May 11	17	1	40.4	412	July 24	38.6
S-518 May 25	16	1	39.1	426	July 27	37.5
Montola 2003 April 14	20	1	40.6	530	July 14	34.4
Montola 2003 April 28	18	1	42.3	338	July 20	37.5
Montola 2003 May 11	18	1	42.6	385	July 24	37.3
Montola 2003 May 25	16	1	39.6	330	July 27	36.0
LSD (P=.05)	NS	NS	NS	**NS**	--	--
Average	19.2	1.0	41.0	447	--	36.9
CV	8.5	0.0	3.8	19.1	--	--

Table 34. Safflower Date of Planting Trial –Pennington County (Wall) 2002.

Treatment	Height Inches	Lodging 1-9*	Test Wt Lb/Bu	Yield Lb/A	Maturity 50% Bloom	Oil Percent
Planting Date						
April 23	17	1	42.3	496	July 10	35.7
May 6	15	1	43.0	**640**	July 15	38.2
May 21	13	1	42.6	**643**	July 18	36.5
June 4	11	1	43.3	570	July 31	36.9
LSD (P=.05)	0.7	NS	0.6	70	--	--
Variety						
Finch	14	1	43.4	**658**	July 18	36.7
S-541	14	1	42.8	**655**	July 17	37.0
Montola 2003	14	1	42.2	448	July 20	39.3
LSD (P=.05)	NS	NS	0.5	61	--	--
Variety x Planting Date						
Finch April 23	18	1	42.8	552	July 11	37.5
Finch May 6	15	1	43.5	756	July 14	37.3
Finch May 21	13	1	43.5	690	July 17	35.4
Finch June 4	12	1	43.8	635	July 30	36.6
S-541 April 23	18	1	42.3	598	July 10	37.6
S-541 May 6	15	1	43.0	739	July 14	37.8
S-541 May 21	13	1	43.0	702	July 17	36.3
S-541 June 4	12	1	42.9	582	July 30	36.3
Montola 2003 April 23	17	1	41.8	338	July 10	38.5
Montola 2003 May 6	15	1	42.5	424	July 18	39.4
Montola 2003 May 21	13	1	41.3	536	July 20	38.8
Montola 2003 June 4	11	1	43.1	492	August 3	40.7
LSD (P=.05)	NS	NS	NS	**NS**	--	--
Average	14.1	1.0	42.8	587	--	37.7
CV	5.9	0.0	1.6	14.3	--	--

SOYBEAN ROW SPACING and POPULATION STUDY

Objective: To evaluate the response of soybeans to wide rows and low populations in both dryland and irrigated environments.

Procedure: Soybeans were planted in a factorial (row spacing x population) experiment with two replications near New Underwood and Martin, South Dakota. New Underwood was dryland and Martin was under center pivot irrigation. The treatments were 20", 40" and 60" rows planted at 20 000, 40 000, 80 000 and 160 000 seeds pre acre. A check entry planted in 10" rows at 160 000 seeds per acre was included as a solid seeded comparison. Producers Hybrids150RR was used for the study, a 1.5 maturity Roundup Ready® bush type variety. Both locations were planted on May 26th with a John Deere 7100 planter with 20" row spacing and residue managers. New Underwood was planted into wheat stubble and Martin into soybean stubble. Both locations had Roundup herbicide applied three times; just prior to planting, in late June and in mid August to control weeds. The plots were 20' x 250' with the middle ten feet harvested for yield. New Underwood was harvested on September 30th and October 7th. The Martin trial was harvested on October 19th. The plots were harvested with a Wintersteiger Delta small plot combine. Prior to harvest, five random plants were taken from each plot and used for pod counts, seed counts and seed size data. The results are given in Tables 35 and 36.

Summary: It was a dry year for growing soybeans at New Underwood. At the nearest weather reporting station at the Rapid City airport, April through August precipitation was 7.8", 3.5" below normal. Because of the lack of rainfall, soybean yields were limited to an average of 8.9 bu/A. Under these dry conditions, yields increased as row width widened with the 60" rows yielding 11 bu/A, which produced twice as much as the 10" rows. For the other agronomic traits; height increased, test weight decreased and seed size increased with wider rows. Row spacing had no effect on the number of pods or seeds per plant. Population had no significant effect on yields, with all the populations having similar yields. Test weight and seed size decreased with higher populations along with a slight decrease in the number of seeds per pod. As would be expected, the number of pods and seeds per plant increased as plant population was reduced. For New Underwood results see Table 35.

The Martin location averaged a respectable 44 bu/A under irrigation with the top treatments producing 51 bu/A. Yield decreased with the 40" and 60" rows, otherwise row spacing did not have a significant effect on the other traits measured. The 160,000 and 80,000 treatments did not yield significantly different, but the 40,000 and 20,000 treatments yielded 6 and 12 bu/A less. Higher populations increased plant height and decreased the number of seeds and pods per plant. Test weight, seeds per pod and seed size were not greatly affected by plant population. Martin results are presented in Table 36.

On dryland, yields increased with row width, because the space between the rows stored moisture for use later in the season. On irrigated ground 10" and 20' rows were the best with the 60" rows yielding 7 bu/A less. At low populations wider rows were easier to harvest because the plants grew taller and more upright. The 40" and 60" rows would normally require late season weed control since the plants do not canopy the row (Figure 5). Overall, planting dryland soybeans at very low populations in wide rows does offer increased yields in a semi-arid climate. But these yields still may not be high enough for soybeans to be a viable crop in western South Dakota.

Studies for next year include planting the same experiment at two to three dryland locations and getting yields from winter wheat planted over the plots at New Underwood.

Table 35. Soybean Row Spacing x Population Study – Pennington County (New Underwood) 2004.

Treatment	Height Inches	Lodging 0-9*	Test Wt Lb/Bu	Yield Bu/A	Pods / Plant	Seeds / Plant	Seeds / Pod	Seed Size Seeds/Lb
Row Spacing								
20" Rows	15	0	58.7	7.7	42	102	2.4	4654
40" Rows	17	0	57.4	8.9	37	87	2.3	4588
60" Rows	20	0	55.4	11.1	48	112	2.3	4355
LSD (P=.05)	1	0.0	1.0	0.6	NS	NS	NS	114
Population								
20,000 seeds/A	19	0	58.1	8.9	77	188	2.5	4283
40,000 seeds/A	18	0	57.0	9.3	49	115	2.4	4448
80,000 seeds/A	17	0	57.5	8.9	29	63	2.2	4700
160,000 seeds/A	17	0	56.0	9.8	15	35	2.3	4697
LSD (P=.05)	1	0.0	1.1	0.7	13	29	0.1	131
Row Spacing x Population								
20" Rows 20K	17	0	58.3	7.8	70	176	2.6	4410
20" Rows 40K	16	0	59.3	8.0	57	133	2.4	4535
20" Rows 80K	13	0	58.7	7.2	29	65	2.3	4875
20" Rows 160K	13	0	58.5	7.7	14	34	2.4	4795
40" Rows 20 K	19	0	58.2	8.3	70	166	2.4	4285
40" Rows 40K	18	0	58.6	8.7	38	90	2.4	4530
40" Rows 80K	17	0	58.9	8.4	26	60	2.3	4735
40" Rows 160K	17	0	54.0	10.1	14	32	2.3	4800
60" Rows 20K	21	0	57.8	10.5	91	222	2.5	4155
60" Rows 40 K	20	0	53.3	11.3	51	122	2.4	4280
60" Rows 80K	20	0	55.0	11.0	32	66	2.1	4490
60" Rows 160K	20	0	55.4	11.6	17	39	2.3	4495
10" Rows 160K	11	0	56.2	5.1	13	31	2.4	4905
LSD (P=.05)	1.5	0.0	1.9	1.2	21.2	47.4	0.2	217
Average	17	0	57.1	8.9	40	95	2.3	4561
CV	4.2	0.0	1.5	6.1	24.2	22.9	4.0	2.2

Table 36. Soybean Row Spacing x Population Study – Bennett County (Martin) 2004.

Treatment	Height Inches	Lodging 0-9*	Test Wt Lb/Bu	Yield Bu/A	Pods / Plant	Seeds / Plant	Seeds / Pod	Seed Size Seeds/Lb
Row Spacing								
20" Rows	35	0	56.3	46.1	107	261	2.5	3389
40" Rows	34	0	56.0	44.3	107	266	2.5	3334
60" Rows	35	0	56.4	40.3	99	238	2.4	3226
LSD (P=.05)	NS	0	NS	1.6	NS	NS	NS	86
Population								
20,000 seeds/A	32	0	55.7	36.3	182	442	2.4	3218
40,000 seeds/A	34	0	56.2	42.5	112	275	2.5	3338
80,000 seeds/A	36	0	56.4	47.3	76	185	2.4	3393
160,000 seeds/A	37	0	56.5	48.1	47	117	2.5	3315
LSD (P=.05)	1.8	0	0.6	1.9	21	46	NS	100
Row Spacing x Population								
20" Rows 20K	30	0	55.5	36.8	201	480	2.4	3330
20" Rows 40K	35	0	56.3	45.2	113	279	2.5	3425
20" Rows 80K	37	0	56.6	51.1	73	179	2.5	3490
20" Rows 160K	38	0	56.7	51.4	42	106	2.6	3310
40" Rows 20 K	32	0	55.7	37.4	172	424	2.5	3135
40" Rows 40K	34	0	55.9	43.8	114	284	2.5	3390
40" Rows 80K	35	0	56.2	47.1	86	221	2.6	3435
40" Rows 160K	36	0	56.1	48.8	55	136	2.5	3375
60" Rows 20K	34	0	55.9	34.7	174	424	2.5	3190
60" Rows 40 K	35	0	56.5	38.5	109	262	2.4	3200
60" Rows 80K	35	0	56.5	43.7	70	156	2.3	3255
60" Rows 160K	36	0	56.7	44.2	44.1	109.5	2.5	3260
10" Rows 160K	40	0	56.9	51	34	85	2.6	3380
LSD (P=.05)	3	0.0	1.0	3.4	34	76	0.3	169
Average	35	0.0	56.3	44.1	99	242	2.5	3321
CV	3.8	0.0	0.9	3.5	15.9	14.5	6.2	2.3

Figure 2. Comparison of Plants from 60", 40", 20" and 10" Rows at 160,000 Seeds/Acre, New Underwood, SD - September 2, 2004.

Figure 3. Comparison of Plants from 60", 40" and 20" Rows at 20,000 Seeds/Acre, New Underwood, SD - September 2, 2004.

Figure 4. 10" Rows at New Underwood, SD - September 2, 2004.

Figure 5. 60" Rows at New Underwood, SD - September 2, 2004.

SDSU REDUCED TILLAGE AND NO-TILL CROP ROTATION STUDY
WALL, SOUTH DAKOTA 2004

Funding: The South Dakota Wheat Commission, South Dakota Oil Seeds Council, USDA-CSREES Consortium for Alternative Crops and SDSU.

Cooperator: Crown Partnership of Wall, South Dakota.

OBJECTIVES

1. To determine crop productivity in varied rotations with different crop intensities.
2. To determine economic returns from various rotation systems with varied levels of crop intensification and diversity.

PROCEDURES

The study with eleven different rotations was established in the spring of 1994. The rotations are two to six years in duration and we have completed at least one full cycle in all of the rotation sequences. All phases in each rotation are grown each year. Reduced and no-till production practices are used to grow the crops except for the winter wheat conventional fallow treatment. Millet, peas, spring wheat and winter wheat were planted with a JD 750 no-till drill at 10 inch row spacing. The fallow winter wheat is planted with a JD 610 drill at 12 inch row spacing. The safflower, corn and sunflower are planted with a JD 7100 corn planter in 20 inch rows. Nitrogen and phosphorus fertilizer are injected in the fall using strip tillage preparing the zone for planting by the JD 7100 corn planter the following summer.

The experimental design is a randomized complete block with four replications. Plots are 25'x80' in size, the small size allows all the plots to be located on the same soil type and reduces variability due to soil characteristics. The crop yields were measured from each plot and analyzed to compute the average yields for each rotation. Detailed records of all the cultural practices including spraying for insect pests, diseases and weeds are kept and the cost of each practice is recorded. These records are given in Appendix 1. This allows for yield and economic comparisons to be made each year.

RESULTS AND DISCUSSION

Long term trends

Long term results have shown that the inclusion of broadleaf crops such as sunflower, safflower and peas; along with warm season grass crops like corn and millet, helps to break weed and disease cycles and improves wheat yields and profitability.

The ten-year (1995-2004) average yield of winter wheat following millet in a rotation where a broadleaf crop or corn was grown prior to the millet was 38 bu/A. The winter wheat grown in a continuous winter wheat-millet rotation had an average yield of 32 bu/A. This indicates a 6 bushels per acre difference due to introducing a broadleaf or warm season crop into the rotation as the same management practices were applied in both rotations over ten years. These results indicate the importance of crop diversity in a rotation system. For comparison, the winter wheat-fallow rotation had an average yield of 44 bu/A while recrop wheat in diversified rotations yielded 75% of the fallow wheat over the past ten years.

Introducing safflower, sunflower and pea crops in the winter wheat-millet rotation would be expected to increase demand for soil moisture and thus decrease winter wheat compared to the winter wheat-millet rotation. The rotations with safflower, sunflower and pea, however, yielded more than the

wheat-millet rotation, indicating the increasing problem with root diseases in the undiversified winter wheat-millet rotation (Table 37). The increased income from the higher yields of winter wheat along with the opportunity to produce a profitable broadleaf crop like sunflower or safflower increased the net profit of these rotations. The favorable effect on yields can be seen in the attached charts containing five year averages for net income and yields (Table 39). It should be noted that the drought of 2002 had a large impact on profitability and that if 2002 data are left out of the averages the more diverse rotations would have more consistent profitability.

We continue to refine the strip tillage system that we use for corn, sunflowers and safflower. The fertilizer is injected in the fall using a narrow point opener which leaves about a four inch area strip tilled. Last year we added some reverse mounted closing disks to fill the trench formed by the injector, but still having minimal soil disturbance. In the spring; corn, safflower and sunflowers are planted over the same strips. Since going to this system, plant stands of corn and sunflowers have improved. The residue managers on our planter work better in the strip tilled wheat stubble and it also has the added bonus of putting the fertilizer right were the plants will utilize it. We have lowered plant populations for corn and sunflowers, since the last few dry years have shown us that our plant populations were probably unrealistically high. We are doing row spacing and populations studies on corn and we may be going back to wider rows that allow moisture to be saved for later in the growing season.

Future changes in this study include looking at other green fallow options besides field peas, changing the spring wheat to feed barley, and possibly combining or reconfiguring some of the less diverse rotations to give us more five to six year diverse rotations. Our one six-year rotation has shown us that longer diverse rotations are better than the mostly three -year rotations we started with. We plan to introduce some flex cropping options with moisture conditions helping us to decide which crop to plant or whether to fallow.

2004 Results

Rotation 1: Winter Wheat / Fallow

This is the base rotation that all other rotations in the study are compared to. Jagalene winter wheat was planted on September 22, 2003 with a JD 610 drill. Liquid starter fertilizer was applied at planting time at six gallons of 10-34-0 per acre. Winter wheat stands were poor in the fall of 2003 due to dry soil conditions. The dry conditions persisted until spring with only 0.19 inches of precipitation in the month of April. These are ideal conditions for crown rot infection. This probably contributed to this rotations poor yields compared to the wheat planted into fallow in the more diverse Rotation 2. The crop was not sprayed for weeds during the growing season due to moisture stress conditions. Fallow wheat yielded 17.7 bu/A in 2004, much lower than the six year average of 48.5 bu/A. If the drought year of 2002 is excluded from the analysis, fallow wheat yields are at a 5 year average of 52.5 bu/A (Table 37).

Rotation 2: Winter Wheat-a / Sunflower / Millet / Winter Wheat-b / Corn / Fallow

This is a very diverse rotation that provides many opportunities for weed control and disease suppression. On the long term, yields from this rotation have been respectable even in the dry years. The best winter wheat yields from this rotation have been from winter wheat following fallow (Winter wheat –a) that has consistently outyielded the fallow wheat in Rotation 1 by 5 bu/Acre each year over the last six years. On the other hand, winter wheat following millet on average yielded about 74% the yield of the fallow wheat. Sunflower yields have averaged 1454 Lb/Acre (Table 40) with extremely low yields in 2002 and 2003 due to drought stress. Millet yields in this rotation have averaged 929 Lb/Acre (Table 40) with yield lower in the last three years due to drought. Sunflower is deep rooted and tends to dry out the soil profile considerable, thus millet grown after the sunflower crop is very dependant upon spring rains to recharge the top two feet of soil. This rotation requires nitrogen applications on every crop so there are no fertilizer savings as is observed in rotations with legumes. The diversity of warm

and cool season crops in this six-year rotation spreads the work-load out for the producer. This rotation requires more equipment than other rotations without row crops.

Rotation 3: Winter Wheat / Safflower / Millet

Winter wheat in this rotation yielded 24 bu/A in 2004 and has averaged 37 bu/A long term. The safflower yields were 957 lb/A in 2004 and averaged 1,100 pounds/Acre in a 5 year period (Table 40). Millet yields were 867 lb/A in 2004 with a 5-year average of 1069 lb/A. The safflower crop is deep-rooted and dries out the ground for the upcoming millet crop. During dry seasons, a summer fallow treatment could be used to replace the millet crop. Yields of millet have been variable in this rotation depending upon amount of snow catch in the safflower stubble and the amounts of rainfall before and during the millet crop.

This rotation provides the diversity of a broadleaf crop along with cool season and warm season grass crops. The rotation can be planted with small grain equipment and therefore does not require an additional investment in equipment. The two warm season crops are relatively drought tolerant and the winter wheat makes most of its growth during the cool portion of the summer. This rotation will make full use of all precipitation received.

Rotation 4: Winter Wheat / Millet

This is a no-till rotation alternating between winter wheat and Proso (grain) millet. The millet crop is a good replacement for summer fallow. Winter Wheat yields in this rotation have averaged 39 bu/A over

Table 37. Hard Red Winter Wheat Yields from Different Rotations at Wall in 2004 and Long Term (1999-2004)

Rotation	Crop Sequence	Protein 2004	Test Wt 2004	Yield 2004	Protein w/o 2002 1999-04	Ave Yield w/o 2002 1999-04
		%	Lb/Bu	Bu/A	%	Bu/A
1	**WW** / F	15.0	59.9	17.7	13.3	52.5
2a	WW / C / F/ **WW** / Su / M	14.9	62.0	34.3	13.1	58.4
2a	**WW** / C / F/ WW / Su / M	13.4	60.0	27.1	11.9	44.4
3	**WW** / Sa / M	14.7	57.5	24.2	11.7	42.5
4	**WW** / M	12.6	60.3	28.9	12.3	39.9
5a	**WW** / C / Su / SW	13.3	60.9	34.1	12.2	37.2
6a	**WW** / WW / Su / PF	14.1	57.2	34.5	13.4	48.6
6a	WW / **WW** / Su / PF	14.1	59.0	24.7	12.6	35.2
9a*	**WW*** / WW / Sa / PF	N/A*	N/A*	N/A*	13.3*	54.8*
9a	WW / **WW** / Sa / PF	13.7	60.2	27.5	13.0	34.0
10	**WW** / CP / M	13.5	59.7	22.5	11.7	47.2
11	**WW** / C / M	14.2	58.6	28.2	11.7	44.3
LSD =				6.2		
CV =				17.0		

*The first year of wheat after pea/fallow in 9a failed in 2004. The long term value does not include 2002 wheat yield. WW = winter wheat, F=fallow, C=corn, Su=sunflower, M=millet, Sa=safflower, PF=pea fallow, CP=chickpea, SW=spring wheat

Table 38. Net Returns from 2004 Crop at The Wall Rotation

	Rotations and Crop Yields:							Dollars Return / A.
1	Winter Wheat 17.7 bu	/	Fallow					$ -43.26
2a	Winter Wheat-A 34.3 bu	/	Sunflower 1093 lbs	/	Millet 449 lbs	/	Winter Wheat-B 27.1 bu	/ Corn 70.3 bu / Fallow	$ -21.33
3	Winter Wheat 24.2 bu	/	Safflower 957 lbs	/	Millet 867 lbs				$ -18.75
4	Winter Wheat 28.9 bu	/	Millet 1888 lbs						$ -7.53
5a	Winter Wheat 34.1 bu	/	Corn 54.9 bu	/	Sunflower 455 lbs	/	Spring Wheat to Millet 426 lbs		$ -53.00
6a	Winter Wheat-B 24.7 bu	/	Sunflower 818 lbs	/	Pea-Fallow	/	Winter Wheat-A 34.5 bu		$ -30.06
9a	Winter Wheat-B 27.5 bu	/	Safflower 617 lbs	/	Pea-Fallow	/	Winter Wheat–A to Millet 1028 lbs		$ -48.99
10	Winter Wheat 22.5 bu	/	Chickpeas 976 lbs	/	Millet 1197 lbs				$ 10.11
11	Winter Wheat 28.2 bu	/	Corn 76.6 bu	/	Millet 1017 lbs				$ -17.96

the last five years (Table 37). Millet yields, on the other hand, have averaged 1540 lb/A over the last five years (Table 40). In 2004, the winter wheat yields (29 bu/A) were below the six-year average while the millet yields (1888 lb/A) were slightly above average. In some years large amounts of residue on the soil surface after the winter wheat crop has caused some difficulty in establishing a good stand of millet. On average, winter wheat in this rotation has yielded 75 percent of the fallow winter wheat yields from Rotation 1.

This is a rather narrow rotation that does not provide adequate diversity of crops for good weed control. Use of Olympus for downy brome / Japanese brome in the fall may improve weed control in this rotation. Root rot diseases tend to hamper the wheat yields of this rotation.

Rotation 5a: Winter Wheat / Corn / Sunflower / Spring Wheat:

This is a very intensive rotation with high moisture demand. That coupled with drought in the past few years has spelled economic disaster. Winter wheat yields have averaged about 37 bu/A over a five-year period(Table 37). Corn yields are at 64 bu/A over five years. However, corn totally failed in 2002 and 2003 due to drought stress. Sunflower yields from this rotation have been the lowest of the sunflower yields in the study in the last few years. Spring wheat has not performed well after sunflower more so in drier years. Sunflower is harvested late in the fall, and leaves limited stubble to catch snow. Spring wheat needs to be planted early in order for it to perform well and consequently, there is very limited moisture recharge prior to planting the spring wheat crop. We are looking at replacing the spring wheat with spring barley in 2005.

Rotation 6a: Winter Wheat-a / Winter Wheat-b/ Sunflower / Pea Fallow:

The pea/fallow in this rotation is designed to lower the demand for fertilizer nitrogen in the rotation. The peas were grown only until early bloom and then killed by a herbicide spray. By bloom, peas have accumulated a good amount of biomass to benefit the following crop and at the same time killing the crop at this stage allows for potential soil moisture recharge before the winter wheat crop. The winter wheat grown after the pea-fallow seem to have benefited averaging 48 bu/A over a five-year period compared to the 35 bu/A five-year average for the second winter wheat in the rotation. Sunflower yields from this rotation have been high with a five-year average of 1727 lb/A. Yields have been poor in dry years.

The cost of growing the peas and killing them is very high averaging about $18/A over the cost of maintaining fallow plots in Rotation 1. The benefits from the pea fallow are not enough to justify the cost. In 2005, the peas in this rotation will be grown to grain stage.

Rotation # 9: Winter Wheat-a / Winter Wheat-b / Safflower / Pea Fallow

This rotation is similar to rotation 6a except the sunflower has been replaced by safflower. The winter wheat grown after the pea-fallow has averaged 54 bu/A over a five-year period. The second winter wheat crop has averaged 34 bu/A in the last five-year period (1999-2003). The safflower in this rotation has the highest yield of safflower treatments in the study with a five-year average of 1234 lb/A. Thus, results from this rotation are very similar to those from rotation 6a indicating that sunflower and safflowers have a similar water use pattern.

Like in rotation 6a, the pea fallow segment of the rotation has not been cost effective. High cost of pea seed and the tendency of the pea stubble to be blown away late in the summer before winter wheat planting time are obvious drawbacks for this rotation. In 2005, we will replace peas in this rotation with hairy vetch. Hairy vetch has a more prostrate growth habit and should provide a better cover crop than the peas and has lower seed costs per acre.

Rotation 10: Winter Wheat / Chickpea / Millet:

This is a well diversified rotation and historically, this rotation has produced some of the best recrop winter wheat in the entire study. In 2004, winter wheat yielded poorly (23 bu/A) due to drought stress. On the long term, winter wheat in this rotation has averaged 47 bu/A over the last five years (1999, 00, 01, 03, 04). With the year 2002 drought year included, winter wheat has averaged 41bu/A. The four-year average (2001, 02, 03, 04) yield for the chickpea crop is 830 lb/A. This includes 2002 drought year that yielded 95 lb/A. In 2004, chickpea yield was 976 lb/A. Millet yields after the pea crop have been consistently high with a five-year average of 1429 lb/A.

This is a high risk and high potential rate of return rotation depending on how the chickpea crop performs. Chickpea is an expensive crop to grow due to the high cost of seed. However, if the crop yields well the returns are extremely good.

Rotation 11: Winter Wheat / Corn / Millet

This is an intensive continuous crop rotation. The winter wheat has averaged 44 bu/A over the last five years (1999,00,01,03,04) and yielded 28 bu/A in 2004. Corn planting populations were reduced to 14,200 plants/Acre in 2004 to reduce seed costs and plant competition. The five-year average corn yields are 76 bu/A. In 2003 the corn yielded 39.7 bu/A while corn rotations 2a and 5a totally failed. Corn in Rotation 11 has the highest long-term corn yields in the study. Millet yields have averaged over 1100 lb/A over the last six years (1999-04).

Inclusion of corn in the rotation allows us to do a much better job of cleaning up weed problems. The injection of fertilizer in the fall allows us to plant the corn into a tilled strip that is 2 to 4 degrees warmer than the non-tilled area between the rows.

Table 39. Economic Returns Wall Rotation

Rotation	1996-2003	1996-2001
WW-Fallow	-$4.46	-$ 6.13
WW-Millet	-$7.90	-$10.57
WW-Corn-Millet	-$9.08	$ 4.00
WW-Safflower-Millet	-$7.10	$ 4.28
WW-Pea-Millet	-$1.29	$12.21
WW-Sun-Millet-WW-Corn-Millet	-$1.03	$15.67

Table40. Long-Term Yield Trends of The Wall Rotation Study (1994-2004)

Yield per acre

Crop	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Ave Yield (1999-04)	Ave Yld 99-04 (minus 2002)
Winter Wheat	19.6@	67.7	30.0	32.9^	67.4	**70.9**	**58.3**	**38.6**	**28.6**	**77.1**	**17.7**	**48.5 bu**	**52.5**
Fallow	0	0	0	0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Winter Wheat-a						**67.1**	**66.9**	**51.1**	**30.9**	**72.8**	**34.3**	**53.8 bu**	**58.4**
Sunflower						**2091**	**2602**	**2082**	**400**	**584**	**1093**	**1475 Lb**	**1690**
Millet						**1500**	**1300**	**2000**	**326**	**0**	**449**	**929 Lb**	**1050**
Winter Wheat-b						**62.8**	**46.0**	**40.2**	**10.7**	**46.3**	**27.1**	**38.8 bu**	**44.4**
Corn						**107.6**	**65.8**	**97.5**	**0**	**0**	**70.3**	**56.8 bu**	**68.2**
Fallow						**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Winter Wheat	19.8@	32.5	32.0	33.5	41.9	**57.2**	**45.4**	**38.1**	**9.8**	**47.8**	**24.2**	**37.0 bu**	**42.5**
Safflower	1061	905	1366	1010	1025	**976**	**1391**	**1575**	**360**	**614**	**957**	**978 Lb**	**1102**
Millet	1360	1500	1998	2752	1361	**1500**	**1266**	**2000**	**783**	**0**	**867**	**1069 Lb**	**1126**
Winter Wheat	19.7@	25.0	26.9	24.4	29.7	**47.2**	**32.6**	**33.7**	**14.7**	**57.4**	**28.9**	**35.7 bu**	**39.9**
Millet	1275	1500	2063	2781	1150	**1500**	**1370**	**1800**	**1182**	**1500**	**1888**	**1540 Lb**	**1611**
Winter Wheat				31.7	33.0	**36.5**	**47.6**	**33.1**	**3.4**	**34.9**	**34.1**	**31.6 bu**	**37.2**
Corn				86.8	91.5	**100.9**	**50.2**	**101.6**	**0**	**0**	**54.9**	**51.2 bu**	**61.5**
Sunflower				1822	1690	**2010**	**1958**	**1443**	**250**	**722**	**455**	**1139 Lb**	**1317**
Spring Wheat				41.7	33.6	**36.3**	**31.8**	**28.4**	**1.6**	**26.2**	**# 0**	**20.7 bu**	**24.5**
Winter Wheat-a						**63.9**	**60.8**	**48.0**	**10.8**	**35.9**	**34.5**	**42.3 Lb**	**48.6**
Winter Wheat-b						**34.1**	**48.9**	**33.0**	**5.2**	**35.4**	**24.7**	**30.2 bu**	**35.2**
Sunflower						**2210**	**2468**	**2011**	**200**	**1132**	**818**	**1473 Lb**	**1727**
Pea / Fallow						**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Winter Wheat-a				42.7^	67.1	**68.3**	**57.1**	**50.0**	**9.2**	**44.0**	**# 0**	**38.1 bu**	**43.8**
Winter Wheat-b				30.1	49.0	**29.8**	**43.0**	**38.2**	**4.9**	**31.7**	**27.5**	**29.1 bu**	**34.0**
Safflower				1167	1121	**1277**	**1546**	**1624**	**230**	**1106**	**617**	**1066 Lb**	**1234**
Pea / Fallow				0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Winter Wheat			30.1	35.4	36.6	**65.1**	**48.9**	**40.8**	**13.1**	**58.7**	**22.5**	**41.5 bu**	**47.2**
Pea			1290*	1306*	3144*	**2334***	**1074***	**1585****	**95****	**667****	**976****	**830Lb**(4yr)**	**1076** (3yr)**
Millet			2266	3642	1520	**1500**	**1524**	**2000**	**622**	**925**	**1197**	**1294 Lb**	**1429**
Winter Wheat	19.8@	31.1	35.8	27.6	39.4	**54.2**	**37.8**	**42.2**	**13.5**	**59.4**	**28.2**	**39.2 bu**	**44.3**
Corn	51.6	72.7	54.1	85.2	81.6	**99.2**	**60.2**	**106.4**	**0**	**39.7**	**76.6**	**63.6 bu**	**76.4**
Millet	1260	250	1920	2309	755	**1500**	**1300**	**2000**	**829**	**0**	**1017**	**1107 Lb**	**1163**
Rainfall(Apr-Aug)			**10.40"**	**19.34"**	**15.00"**	**13.44 "**	**8.20 "**	**12.29 "**	**5.59 "**	**5.24 "**	**9.20 "**		

@ = planted to spring wheat to start the trial.
* = planted to field peas,
** = planted to chickpeas,
^ = spring wheat replanted into failed winter wheat,
# = failed crop replanted to Proso Millet.

Table 41. Long-Term Economic Trends of the Wall Rotation Study (1995-2004)

Net Income per Acre

Rot	Crop	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Ave Net Return (99-04)
1	W. Wht	$209.11	$45.13	$-23.91	$90.58	$90.54	$70.94	$10.04	$25.01	$116.40	$-30.23	$47.11
	Fallow	-52.98	-63.26	-58.24	-57.32	-59.62	-61.35	-57.03	-72.57	-66.64	-56.29	-62.25
	Ave Inc.	78.06	-9.07	-41.08	16.63	15.46	$4.79	-23.49	-23.78	24.88	-43.26	-7.56
2a	W. Wht-a	220.29	74.19	13.46	88.12	82.99	95.54	40.94	42.76	107.49	21.04	65.12
	Sunf	-1.59	7.52	32.48	66.80	40.45	84.65	39.43	-109.29	-92.02	3.19	-5.59
	Millet	-93.12	22.39	22.39	-23.20	-27.28	4.37	-19.28	-57.29	-77.58	-73.57	-41.77
	W Wht-b	60.44	51.60	1.71	4.98	24.74	19.17	9.61	-69.50	39.15	-19.59	0.59
	Corn	79.70	10.83	2.23	40.80	36.30	-25.08	56.84	-160.22	-125.56	-14.84	-38.76
	Fallow	-43.22	-46.22	-60.79	-46.25	-47.40	-52.47	-62.28	-58.69	-52.82	44.25	-52.98
	Ave Inc.	37.08	20.05	1.91	21.87	18.30	21.03	10.87	-68.70	-33.55	-21.33	-12.23
3	W. Wht	59.16	40.60	-2.96	6.75	20.18	14.85	4.42	-72.08	34.93	-34.58	-5.38
	Saff	-16.04	71.99	-100.09	-11.68	-23.86	17.92	51.48	-84.25	-46.52	23.70	-10.25
	Millet	7.25	31.91	20.58	-29.53	-27.28	11.01	-19.28	-1.81	-77.58	-45.38	-26.72
	Ave Inc.	16.79	48.17	-27.49	-11.49	-10.32	14.59	12.20	-52.71	-29.72	-18.75	-14.11
4	W Wht	27.21	19.03	-30.72	-23.25	4.41	- 9.30	-11.92	-58.02	57.89	-15.32	-5.37
	Millet	1.64	24.56	21.78	-66.08	-28.73	9.27	-35.90	49.06	-48.44	0.25	-9.08
	Ave Inc.	14.43	21.80	-4.47	-44.67	-12.16	-.01	-23.91	-4.48	4.72	-7.53	-7.22
5a	W. Wht			-11.71	-24.96	-32.84	3.34	-13.59	-103.59	15.17	1.12	-21.73
	Corn			12.77	12.83	27.19	-50.34	64.63	-160.22	-140.82	-42.72	-50.38
	Sunf			27.07	51.67	44.59	48.17	-4.34	-102.05	- 64.26	-75.40	-25.54
	S. Wht			14.94	4.47	-10.77	-18.70	-27.00	-77.45	- 35.88	-95.02*	-44.13
	Ave Inc.			10.77	11.00	7.04	-4.40	4.92	-110.82	-56.44	-53.00	-35.44
6a	W. Wht-a					51.82	74.21	36.47	-67.85	11.19	11.43	19.54
	W. Wht-b					-30.42	6.57	-12.52	-103.59	18.43	-26.09	-24.60
	Sunfl					51.61	73.12	33.46	-132.12	-42.33	-30.69	-7.82
	Pea/Fallow					-65.17	-76.53	-89.83	-95.48	-77.86	74.92	-79.96
	Ave Inc.					1.96	19.34	-8.10	-99.76	-22.64	-30.06	-23.21
9a	W. Wht-a			-12.17	77.94	79.59	64.60	38.81	-72.45	32.84	-70.44*	12.15
	W. Wht-b			3.56	18.63	-37.55	6.43	-1.55	-106.51	6.48	-18.12	-25.13
	Saff			-94.60	-3.24	-5.09	35.58	57.55	-107.23	24.70	-32.50	-4.49
	Pea/Fallow			-54.77	-46.25	-65.17	-76.53	-89.83	-107.36	-77.86	74.92	-81.94
	Ave Inc.			-39.50	11.77	-7.06	7.52	1.24	-98.38	- 3.46	-48.99	-24.85
10	W. Wht		32.58	-.43	-9.53	37.47	20.19	9.91	-62.61	69.60	-33.43	6.85
	Pea		-.71	.43	33.07	23.28	-62.54	72.63	-155.62	-14.54	87.41	-8.23
	Millet		38.06	57.07	-22.75	-27.28	37.73	-19.28	-25.53	-62.01	-23.64	-20.00
	Ave Inc.		23.30	19.02	.26	11.16	-1.54	21.08	-81.25	- 2.31	10.11	-7.12
11	W. Wht	53.20	56.67	-24.22	-2.65	23.06	-1.29	16.24	-61.47	65.64	-15.14	4.50
	Corn	72.66	1.49	7.43	8.89	15.42	-34.38	73.76	-160.22	-62.72	-3.44	-28.59
	Millet	-77.89	29.82	-.13	-64.57	-27.85	13.60	-19.28	16.85	-87.98	-35.30	-23.32
	Ave Inc.	15.99	29.33	-5.64	-19.44	3.54	-7.35	23.57	-68.28	-28.35	-17.96	-15.80
	Total Rainfall	*(Apr-Aug)* 10.40"		19.34"	15.00"	13.44"	8.20"	12.29"	5.59"	5.24"	9.20"	

Note: * = in 2004 Spring wheat in 5a and Winter wheat-a in 9a failed so the crop was replanted to Proso millet.

Appendix 1 Detailed Cultural Practices For Each Rotation in 2004

Rotation 1
WINTER WHEAT / SUMMER FALLOW

Cost / A.	2004 Winter Wheat
$26.29	-Plant to Jagalene @ 62 lbs or 950,000 seeds/acre. Planted w / JD 610 drill at 12" rows + 6 gal / A liquid 10-34-0. on September 22, 2003.
19.03	-Top dress 28-0-0 liquid Nitrogen fertilizer on dormant winter wheat at 50#N / Acre rate. - March 16, 2004.
15.30	-Harvest 17.7 bu/A winter wheat – July 21, 2004 Test weight – 59.9# / bu (Protein content – 15.0%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$89.52	Total Cost of Winter Wheat Production

Rotation 1
WINTER WHEAT / *SUMMER FALLOW*

Cost / A.	2004 Summer Fallow
$12.04	-Spray w / 16 oz Roundup Ultra Max + 5 oz Banvel 4L + liquid Ammonium Sulfate at 50 ml/gal. 8 gpA spray rate. – April 19, 2004
5.25	-Work w / 24" under cutter sweeps. – June 15, 2004
5.25	-Work w / 12" sweeps. – July 14, 2004
5.25	-Work w / 12" sweeps and harrow. – August 19, 2004
28.50	-Land Charges 2004
$56.29	Cost of Summer Fallow

Rotation 1 SUMMARY 2004

Crop	Income		Expenses		Net Income Per Acre
Winter Wheat	$ 59.29	-	$ 89.52	=	$ -30.23
Fallow	$ 0.00	-	$ 56.29	=	$ -56.29
	$ 59.29	-	$ 145.81	=	$ -86.52 / 2 = $-43.26

$ - 43.26 Average Income / acre for Rotation 1 - 2004

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Rotation 2a
WINTER WHEAT-A / SUNFLOWER / MILLET / WINTER WHEAT-B / CORN / FALLOW

Cost / A.	2004 Winter Wheat-A
$26.29	-Plant to Jagalene @ 62 lbs or 950,000 seeds/acre. Planted w / JD 610 drill at 12" rows + 6 gal / A liquid 10-34-0. on September 22, 2003.
19.03	-Top dress 28-0-0 liquid Nitrogen fertilizer on dormant winter wheat at 50#N / Acre rate. - March 16, 2004.
19.30	-Harvest 34.3 bu/A winter wheat – July 21, 2004 Test weight – 62.0# / bu (Protein content -14.9%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$93.52	Total Cost of Winter Wheat Production

Rotation 2a

WINTER WHEAT-A / *SUNFLOWER* / MILLET / WINTER WHEAT -B / CORN / FALLOW

Cost / A.	2004 Sunflowers
$36.26	-Inject 28-0-0 + 10-34-0 (80#N / 30# P2O5) with injector implement set @ 20" row spacing. –October 21, 2003
19.30	-Spray w / Roundup Ultra Max @ 16 oz / acre + 50 ml / gal liquid Ammonium Sulfate + Spartan @ 4 ounces per acre. 10 gpA spray rate. – April 19, 2004.
26.02	-Planted to Mycogen 8N421 Nusun oil-type sunflowers @ 18,200 seeds / acre w / JD 7100 planter. Seed box treated w / Lindane for wire worm control. – May 29, 2004
10.60	-Spray w / Lorsban 4EC to control Army Cutworms @ 24 oz or 1 ½ pints / 10 gallons of water. – June 3, 2004.
23.28	-Harvest 1093# / Acre Sunflowers – October 28, 2004. Test weight – 29.6 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$144.36	Total Cost of Sunflower Production

Rotation 2a

WINTER WHEAT-A / SUNFLOWER / *MILLET* / WINTER WHEAT-B / CORN / FALLOW

Cost / A.	2004 Millet
$19.21	-Spray w / 8.3 gallons per acre 28-0-0 plus 16 oz Roundup Ultra Max + 5 oz Banvel 4L / Acre. – May 13, 2004.
24.88	-Planted to Sunup Proso millet w / JD750 drill. w/ starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004.
11.78	-Spray w / 16 oz Roundup Ultra Max plus ½ ounce per acre of Aim + 1 gallon per acre 28-0-0 to aid in uptake of the chemical. 10 gpA spray rate. – June 3, 2004.
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
14.17	-Harvest 449 # / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$105.00	Total Cost of Millet Production

Rotation 2a

WINTER WHEAT-A / SUNFLOWER / MILLET / *WINTER WHEAT-B* / CORN / FALLOW

Cost / A.	2004 Winter Wheat –B
$16.54	-Spray w / 16 oz Roundup + Liquid ammonium sulfate + Penetrate II + 1 ½ pints Lorsban to dessicate millet and to kill aphids that may transfer BYD to the following wheat crop. – September 18, 2003.
26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
19.03	-Top dressed with 28-0-0 @ 50# N / acre. - March 16, 2004.
17.44	-Harvest 27.1 bu/A winter wheat – July 21, 2004 Test weight – 60.0# / bu (Protein content - 13.4%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$108.20	Total Cost of Winter Wheat Production

Rotation 2a

WINTER WHEAT-A / SUNFLOWER / MILLET / WINTER WHEAT-B / *CORN* / FALLOW

Cost / A.	2004 Corn
$36.26	-Injected 28-0-0 + 10-34-0 (80#N/acre plus 30# P2O5 per acre). 20 inch row spacing. -October 21, 2003
12.04	-Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal + 5 oz Banvel 4L / Acre. 8 gpA spray rate. – April 19, 2004.
33.62	-Plant to Dekalb DKC 44-46 RR/YG @ 14,200 seeds / acre. Planted w / JD 7100 Corn planter. 20 inch row spacing. 16 inch spacing between seed. Seed box treated with lindane for wireworm control.- May 6, 2004.
12.04	-Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal + 5 oz Banvel 4L / Acre. 8 gpA spray rate. –June 7, 2004.
8.84	- Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal for Pigeon grass, Kochia and Russian Thistle control. – July 1, 2004.
28.66	-Harvest 70.3 bushels / acre corn – October 28, 2004 Test weight – 56.6 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$160.36	-Total Cost of Corn Production

Rotation 2a

WINTER WHEAT-A / SUNFLOWER / MILLET /WINTER WHEAT-B / CORN / *FALLOW*

Cost / A.	2004 Summer Fallow
$5.25	-Work w / 24" under cutter sweeps. – June 15, 2004
5.25	-Work w / 12" sweeps and harrow. – July 14, 2004
5.25	-Work w / 12" sweeps. – August 19, 2004
28.50	-Land Charges 2004
$44.25	Total Cost of Summer Fallow

Rotation 2a SUMMARY 2004

Crop	Income	Expenses	Net Income Per Acre
Winter Wheat-A	$114.56 -	$128.92 (93.52+35.40)	= $ - 14.36
Sunflower	$147.55 -	$153.21(144.36+8.85)	= $ - 5.66
Millet	$ 31.43 -	$105.00	= $ - 73.57
Winter Wheat-B	$ 88.61 -	$108.20	=$ - 19.59
Corn	$145.52 -	$160.36	=$ - 14.84
Fallow	$ 0.00 -	$ 0.00*	=$ *
	$527.67 -	$655.69	=$-128.02 / 6 = $-21.33

*The expense of the fallow ($44.25) was split 80% to the Winter Wheat-A ($35.40) and 20% to the Sunflowers ($8.85).

$ - 21.33 Average Income / acre for Rotation 2a – 2004

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WINTER WHEAT / SAFFLOWER / MILLET

Cost / A.	2004 Winter Wheat
$16.54	-Spray w / 16 oz Roundup + Liquid ammonium sulfate + Penetrate II + Lorsban @ 1 ½ pints per acre to dessicate millet and to kill aphids that may transfer BYD to the following wheat crop. – September 18, 2003.
26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
26.75	-Top dressed with 28-0-0 @ 75# N / acre. - March 16, 2004.
16.68	-Harvest 24.2 bu/A winter wheat – July 21, 2004 Test weight – 57.5# / bu (Protein content - 14.7%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$115.16	Total Cost of Winter Wheat Production

Rotation 3

WINTER WHEAT / *SAFFLOWER* / MILLET

Cost / A.	2004 Safflower
$8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal ammonium sulfate. 8 gpA spray rate. – October 15, 2003.
30.03	-Injected 28-0-0 plus +10-34-0 (60#N/acre + 30# P2O5 / acre) - October 21, 2003.
13.27	-Apply Treflan granules @ 1.3# ai / acre. Granules not incorporated. – October 21, 2003.
19.30	-Spray w / Roundup Ultra Max @ 16 oz / acre + liquid ammonium sulfate @ 50 ml / gallon + Spartan @ 4 oz / acre. 10 gpA spray rate. – April 19, 2004.
22.05	-Plant to Finch w / JD 7100 planter at 210,000 seeds/acre (25 lbs/acre) Seed box treated w / Lindane for wire worm control. – May 29, 2004.
16.60	-Harvest 957 # / Acre Safflowers – October 5, 2004; Test weight – 46.4 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$138.99	Total Cost of Safflower Production

Rotation 3

WINTER WHEAT / SAFFLOWER / *MILLET*

Cost / A.	2004 Millet
$19.21	-Spray w / 8.3 gallons per acre 28-0-0 plus 16 oz Roundup Ultra Max + 5 oz Banvel 4L / Acre + liquid ammonium sulfate @ 50 ml/gal. – May 13, 2004
24.88	-Planted to Sunup proso millet w / JD750 drill. w/ starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004
11.78	-Spray w / 16 oz Roundup Ultra Max plus ½ ounce per acre of Aim + 1 gallon per acre 28-0-0 to aid in uptake of the chemical. 10 gpA spray rate. – June 3, 2004
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
15.24	-Harvest 867# or 17.3 bushels / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$106.07	Total Cost of Millet Production

Rotation 3 SUMMARY 2004

Crop	Income		Expenses		Net Income Per Acre
Winter Wheat	$ 80.58	-	$115.16	=	$-34.58
Safflower	$162.69	-	$138.99	=	$ 23.70
Millet	$ 60.69	-	$106.07	=	$-45.38
	$303.96	-	$360.22	=	$-56.26/ 3 = $ -18.75

$-18.75 Average Income / acre for Rotation 3 - 2004

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Rotation 4
WINTER WHEAT / MILLET

Cost / A.	2004 Winter Wheat
$16.54	-Spray w / 16 oz Roundup + Liquid ammonium sulfate + Penetrate II + 1 ½ pints Lorsban to dessicate millet and to kill aphids that may transfer BYD to the following wheat crop. – September 18, 2003.
26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
19.03	-Top dressed with 28-0-0 @ 50# N / acre. - March 16, 2004.
17.90	-Harvest 28.9 bu/A winter wheat – July 21, 2004 Test weight – 60.3# / bu (Protein content – 12.6%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$108.66	Total Cost of Winter Wheat Production

Rotation 4
WINTER WHEAT / *MILLET*

Cost / A.	2004 Millet
$8.84	-Spray w / 16 oz per acre Roundup Ultra Max + 50 ml / gal liquid Ammonium Sulfate. 8 gpA spray rate. – October 15, 2003.
12.04	-Spray w / Roundup Ultra Max @ 16 oz / acre + liquid Ammonium Sulfate @ 50 ml / gal + 5 oz Banvel 4L / acre. 8 gpA spray rate. – April 19, 2004.
19.21	-Spray w / 8.3 gallons per acre 28-0-0 plus 16 oz Roundup Ultra Max + 5 oz Banvel 4L / Acre + liquid ammonium sulfate @ 50 ml/gal. – May 13, 2004
24.88	-Planted to Sunup Proso millet w / JD750 drill. w/ starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004
11.78	-Spray w / 16 oz Roundup Ultra Max plus ½ ounce per acre of Aim + 1 gallon per acre 28-0-0 to aid in uptake of the chemical. 10 gpA spray rate. – June 3, 2004
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
20.20	-Harvest 1888# or 37.7 bushels / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$131.91	Total Cost of Millet Production

Rotation 4 SUMMARY 2004

Crop	Income		Expenses		Net Income Per Acre
Winter Wheat	$ 93.34	-	$108.66	=	$-15.32
Millet	$132.16	-	$131.91	=	$ 0.25
	$225.50	-	$240.57	=	$-15.07/ 2 = $ - 7.53

$ - 7.53 Average Income / acre for Rotation 4 - 2004

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Rotation 5a

WINTER WHEAT / CORN / SUNFLOWER / SPRING WHEAT to Millet

Cost / A.	2004 Winter Wheat
$26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
8.84	-Sprayed w / Roundup Ultra Max @ 16 oz / acre + liquid ammonium sulfate @ 50 ml / gal. 8 gpA spray rate. – September 29, 2004
26.75	-Top dressed with 28-0-0 @ 75# N / acre. - March 16, 2004.
19.26	-Harvest 34.1 bu/A winter wheat – July 21, 2004 Test weight – 60.9# / bu (Protein content – 13.3%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$110.04	Total Cost of Winter Wheat Production

Rotation 5a

WINTER WHEAT / *CORN* / SUNFLOWER / SPRING WHEAT to Millet

Cost/A.	2004 Corn
$36.26	-Injected 28-0-0 + 10-34-0 (80#N/acre plus 30# P2O5 per acre). 20 inch row spacing. -October 21, 2003
12.04	-Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal + 5 oz Banvel 4L / Acre. 8 gpA spray rate. – April 19, 2004.
33.62	-Plant to Dekalb DKC 44-46 RR/YG @ 14,200 seeds / acre. Planted w / JD 7100 Corn planter. 20 inch row spacing. 16 inch spacing between seed. Seed box treated with lindane for wireworm control.- May 6, 2004.
12.04	-Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal + 5 oz Banvel 4L / Acre. 8 gpA spray rate. –June 7, 2004.
8.84	- Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal for Pigeon grass, Kochia and Russian Thistle control. – July 1, 2004.
24.66	-Harvest 54.9 bushels / acre corn – October 28, 2004 Test weight – 56.5 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$156.36	Total Cost of Corn Production

Rotation 5a

WINTER WHEAT / CORN / *SUNFLOWER* / SPRING WHEAT to millet

Cost / A.	2004 Sunflower
$36.26	-Inject 28-0-0 + 10-34-0 (80#N / 30# P2O5) with injector implement set @ 20" row spacing. –October 21, 2003.
19.30	-Spray w / Roundup Ultra Max @ 16 oz / acre + 50 ml / gal liquid Ammonium Sulfate + Spartan @ 4 ounces per acre. 10 gpA spray rate. – April 19, 2004
26.02	-Planted to Mycogen 8N421 Nusun oil-type sunflowers @ 18,200 seeds / acre w / JD 7100 planter. Seed box treated w / Lindane for wire worm control. – May 29, 2004
10.60	-Spray w / Lorsban 4EC to control Army Cutworms. 24 oz or 1 ½ pints / 10 gallons of water. – June 3, 2004
15.74	-Harvest 455# / Acre Sunflowers – October 28, 2004. Test weight – 31.1# / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$136.82	Total Cost of Sunflower Production

Rotation 5a

WINTER WHEAT / CORN / SUNFLOWER / *SPRING WHEAT to Millet*

Cost / A.	2004 Spring Wheat to Millet
$8.84	-Spray w / 16 oz per acre Roundup Ultra Max + 50 ml / gal liquid Ammonium Sulfate. 8 gpA spray rate. – October 15, 2003.
29.38	- Plant to Russ spring wheat @ 108 pounds / acre plus 10-34-0 @ 6 gpA rate. Seed treated w / Vitavax / Thiram / RTU @ 14 ml / 10 pounds of seed. Planted w / JD 750 drill, 10" row spacing. – March 23, 2004.
12.68	-Spray w / Roundup Ultra Max @ 16 oz / acre + liquid Ammonium Sulfate @ 50 ml / gal + 6 oz Banvel 4L / acre. 8 gpA spray rate. – May 28, 2004.
24.88	-Planted to Sunup proso millet w / JD750 drill. w/ starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
14.10	-Harvest 426 # / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$124.84	Total Cost of Spring Wheat to Millet Production

Rotation 5a SUMMARY 2004

Crop	Income		Expenses		Net Income Per Acre
Winter Wheat	$111.16	-	$110.04	=	$ 1.12
Corn	$113.64	-	$156.36	=	$ -42.72
Sunflower	$ 61.42	-	$136.82	=	$ -75.40
Spring Wheat to Millet	$ 29.82	-	$124.84	=	$ -95.02
	$316.04	-	$528.06	=	$-212.02 / 4 = $ - 53.00

$ -53.00 Average Income / acre for Rotation 5a - 2004

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Rotation 6a

WINTER WHEAT-B / SUNFLOWER / PEA-FALLOW / WINTER WHEAT-A

Cost / A.	2004 Winter Wheat -B
$26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
8.84	-Sprayed w / Roundup Ultra Max @ 16 oz / acre + liquid ammonium sulfate @ 50 ml / gal. 8 gpA spray rate. – September 29, 2003.
26.75	-Top dressed with 28-0-0 @ 75# N / acre. - March 16, 2004.
16.82	-Harvest 24.7 bu/A winter wheat – July 21, 2004 Test weight – 59.0# / bu (Protein content – 14.1%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$107.60	Total Cost of Winter Wheat –B Production

Rotation 6a

WINTER WHEAT-B / *SUNFLOWER* / PEA-FALLOW / WINTER WHEAT-A

Cost / A.	2004 Sunflower
$36.26	-Inject 28-0-0 + 10-34-0 (80#N / 30# P2O5) with injector implement set @ 20" row spacing. –October 21, 2003
19.30	-Spray w / Roundup Ultra Max @ 16 oz / acre + 50 ml / gal liquid Ammonium Sulfate + Spartan @ 4 ounces per acre. 10 gpA spray rate. – April 19, 2004
26.02	-Planted to Mycogen 8N421 Nusun oil-type sunflowers @ 18,200 seeds / acre w / JD 7100 planter. Seed box treated w / Lindane for wire worm control. – May 29, 2004
10.60	-Spray w / Lorsban 4EC to control Army Cutworms. 24 oz or 1 ½ pints / 10 gallons of water. – June 3, 2004
20.04	-Harvest 818# / Acre Sunflowers – October 28, 2004. Test weight – 30.5 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$141.12	Total Cost of Sunflower Production

Rotation 6a

WINTER WHEAT-B / SUNFLOWER / *PEA-FALLOW* / WINTER WHEAT-A

Cost / A.	2004 Pea-Fallow
$8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal liquid Ammonium Sulfate. 8 gpA spray rate. – October 15, 2003.
24.90	-Plant to Arvika peas @ 300,000 seeds per acre (90#/A) + 5 # / acre granular innoculum w / JD 750 drill. – March 23, 2004.
12.68	-Spray to terminate peas w / 16 oz Roundup Ultra + 50 ml / gal liquid ammonium sulfate + 6 oz Banvel 4L. 8 gpA spray rate. –June 18, 2004.
28.50	-Land Charges 2004
$74.92	Total Cost of Pea-Fallow

Rotation 6a

WINTER WHEAT-B / SUNFLOWER / PEA-FALLOW / *WINTER WHEAT-A*

Cost / A.	2004 Winter Wheat –A
26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
8.84	-Sprayed w / Roundup Ultra Max @ 16 oz / acre + liquid ammonium sulfate @ 50 ml / gal. 8 gpA spray rate. – September 29, 2003.
19.03	-Top dressed with 28-0-0 @ 50# N / acre. - March 16, 2004.
19.36	-Harvest 34.5 bu/A winter wheat – July 21, 2004 Test weight – 57.2# / bu (Protein content – 14.1%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$102.42	Total Cost of Winter Wheat-A Production

Rotation 6a SUMMARY 2004

Crop	Income		Expenses	Net Income Per Acre
Winter Wheat -B	$ 81.51	-	$122.58 ($107.60+ $14.98)	=$-41.07
Sunflower	$110.43	-	$141.12	= $-30.69
Pea-Fallow	$ 0.00	-	$ 0.00*	= $ 0.00*
Winter Wheat -A	$113.85	-	$162.36 ($102.42 + $59.94)	= $-48.51
	$305.79	-	$426.06	= $-120.27 / 4 = $-30.06

*The expense of the pea-fallow ($74.92) was split 80% ($59.94) to the Winter Wheat-A and 20% ($14.98) to the Winter Wheat-B.

$ -30.06 Average Income / acre for Rotation 6a - 2004

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Rotation #8

The plots from rotation #8 were added to Rotations 5, 6 and 9 to make longer 4 year rotations in 1998.

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Rotation 9a

WINTER WHEAT -B / SAFFLOWER / PEA-FALLOW / WINTER WHEAT-A to Millet

Cost / A.	2004 Winter Wheat –B
$26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal ammonium sulfate. 8 gpA spray rate. – September 29, 2003.
26.75	-Top dressed with 28-0-0 @ 75# N / acre. - March 16, 2004.
17.54	-Harvest 27.5 bu/A winter wheat – July 21, 2004 Test weight – 60.2# / bu (Protein content –13.7%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$108.32	Total Cost of Winter Wheat–B to Millet Production

Rotation 9a

WINTER WHEAT-B / *SAFFLOWER* / PEA-FALLOW / WINTER WHEAT-A to Millet

Cost / A.	2004 Safflower
$8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal ammonium sulfate. 8 gpA spray rate. – October 15, 2003.
30.03	-Injected 28-0-0 plus +10-34-0 (60#N/acre + 30# P2O5 / acre) - October 21, 2003.
13.27	-Apply Treflan granules @ 1.3# ai / acre. Granules not incorporated. – October 21, 2003.
19.30	-Spray w / Roundup Ultra Max @ 16 oz / acre + liquid ammonium sulfate @ 50 ml / gallon + Spartan @ 4 oz / acre. 10 gpA spray rate.
22.05	-Plant to Finch w / JD 7100 planter at 210,000 seeds/acre (25 lbs/acre) Seed box treated w / Lindane for wire worm control. – May 29, 2004.
15.00	-Harvest 617 # / Acre Safflowers – October 5, 2004 Test weight – 45.7 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$137.39	Total Cost of Safflower Production

Rotation 9a

WINTER WHEAT-B / SAFFLOWER / *PEA-FALLOW* / WINTER WHEAT-A to Millet

Cost / A.	2004 Pea-Fallow
$8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal liquid Ammonium Sulfate. 8 gpA spray rate. – October 15, 2003.
24.90	-Plant to Arvika peas @ 300,000 seeds per acre (90#/A) + 5 # / acre granular inoculums w / JD 750 drill. – March 23, 2004.
12.68	-Spray to terminate peas w / 16 oz Roundup Ultra + 50 ml / gal liquid ammonium sulfate + 6 oz Banvel 4L. 8 gpA spray rate. –June 18, 2004.
28.50	-Land Charges 2004
$74.92	Total Cost of Pea-Fallow

Rotation 9a

WINTER WHEAT-B / SAFFLOWER / PEA-FALLOW / *WINTER WHEAT-A to Millet*

Cost / A.	2004 Winter Wheat-A to Millet
$26.29	-Plant to Jagalene @ 62 lbs or 950,000 seeds / acre. Planted w/JD750 drill at 10" rows + 6 gal/A liquid 10-34-0. on September 25, 2003.
8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal liquid Ammonium Sulfate. 8 gpA spray rate. – September 29, 2003.
19.03	-Top dress 28-0-0 liquid Nitrogen fertilizer at 50#N / Acre rate. - March 16, 2004.
12.68	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal ammonium sulfate + 6 oz Banvel 4L. 8 gpA spray rate. – May 28, 2004.
24.88	-Planted to Sunup Proso millet w / JD750 drill. w/ starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
15.72	-Harvest 1028# or 20.5 bushels / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$142.40	Total Cost of Winter Wheat-A to Millet Production

Rotation 9a SUMMARY 2004

Crop	Income	Expenses	Net Income Per Acre
Winter Wheat-B	$ 90.20 -	$123.30 ($108.32 + $14.98)	= $ -33.10
Safflower	$104.89 -	$137.39	= $ -32.50
Pea-Fallow	$ 0.00 -	$ 0.00	= $ 0.00*
Winter Wheat-A to Millet	$ 71.96 -	$202.34 ($142.40+ $59.94)	= $ -130.38
	$267.05 -	$463.03	= $ -195.98 / 4 = $-48.99

*The expense of the pea-fallow ($74.92) was split 80% ($59.94) to the Winter Wheat-A and 20% ($14.98) to the Winter Wheat-B.

$ -48.99 Average Income / acre for Rotation 9a - 2004

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Rotation 10

WINTER WHEAT / CHICKPEAS / MILLET

Cost / A.	2004 Winter Wheat
$16.54	-Spray w / 16 oz Roundup + Liquid ammonium sulfate + Penetrate II + 1 ½ pints Lorsban to desiccate millet and to kill aphids that may transfer BYD to the following wheat crop. – September 18, 2003.
26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
19.03	-Top dressed with 28-0-0 @ 50# N / acre. - March 16, 2004.
16.24	-Harvest 22.5 bu/A winter wheat – July 21, 2004 Test weight – 59.7# / bu (Protein content –13.5%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$107.00	Total Cost of Winter Wheat Production

Rotation 10

WINTER WHEAT / *CHICKPEAS* / MILLET

Cost / A.	2004 Chick Peas
$8.84	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal liquid ammonium sulfate / acre. 8 gpA spray rate. – October 15, 2003.
95.62	-Plant to Sierra Chickpeas @ 130,600 seeds per acre (152 # / acre) + chickpea peat-based inoculums @ 5# / acre. Seed treated w / LSP / Apron / Maxim. Planted w/ JD 750 drill. - April 14, 2004.
19.30	-Spray w / 16 oz Roundup Ultra Max + 50 ml / gal liquid ammonium sulfate / acre + Spartan @ 4 oz/acre. 10 gpA spray rate. – April 19, 2004.
15.10	-Harvest 976# or 16.2 bushels / Acre Sierra chickpeas - August 25, 2004. Test weight – 59.3 # / bushel
28.50	-Land Charges 2004
$167.36	Total Cost of Chickpea Production

Rotation 10

WINTER WHEAT / CHICKPEAS / *MILLET*

Cost / A.	2004 Millet
$19.21	-Spray w / 8.3 gallons per acre 28-0-0 plus 16 oz Roundup Ultra Max + 5 oz Banvel 4L – May 13, 2004
24.88	-Planted to Sunup Proso millet w / JD750 drill. W / starter fertilizer (10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004
11.78	-Spray w / 16 oz Roundup Ultra Max plus ½ ounce per acre of Aim + 1 gallon per acre 28-0-0 to aid in uptake of the chemical. 10 gpA spray rate. – June 3, 2004
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
16.60	-Harvest 1197# or 23.9 bushels / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$107.43	Total Cost of Millet Production

Rotation 10 SUMMARY 2004

Crop	Income		Expenses		Net Income Per Acre
Winter Wheat	$ 73.57	-	$107.00	=	$-33.43
Chickpeas	$254.77	-	$167.36	=	$ 87.41
Millet	$ 83.79	-	$107.43	=	$-23.64
	$412.13	-	$381.79	=	$ 30.34 / 3 = $10.11

$10.11 Average Income / acre for Rotation 10 - 2004

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Rotation 11

WINTER WHEAT / CORN / MILLET

Cost / A.	2004 Winter Wheat
$16.54	-Spray w / 16 oz Roundup + Liquid ammonium sulfate + Penetrate II + 1 ½ pints Lorsban to desiccate millet and to kill aphids that may transfer BYD to the following wheat crop. – September 18, 2003.
26.29	-Plant to Jagalene @ 62 pounds / acre plus 10-34-0 @ 6 gpA rate. Planted w / JD 750 drill, 10" row spacing. – September 25, 2003.
19.03	-Top dressed with 28-0-0 @ 50# N / acre. - March 16, 2004.
17.72	-Harvest 28.2 bu/A winter wheat – July 21, 2004 Test weight – 58.6# / bu (Protein content –14.2%)
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$108.48	Total Cost of Winter Wheat Production

Rotation 11

WINTER WHEAT / *CORN* / MILLET

Cost / A.	2004 Corn
$36.26	-Injected 28-0-0 + 10-34-0 (80#N/acre plus 30# P2O5 per acre). 20 inch row spacing. -October 21, 2003
12.04	-Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal + 5 oz Banvel 4L / Acre. 8 gpA spray rate. – April 19, 2004.
33.62	-Plant to Dekalb DKC 44-46 RR/YG @ 14,200 seeds / acre. Planted w / JD 7100 Corn planter. 20 inch row spacing. 16 inch spacing between seed. Seed box treated with lindane for wireworm control.- May 6, 2004.
12.04	-Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal + 5 oz Banvel 4L / Acre. 8 gpA spray rate. –June 7, 2004.
8.84	- Spray w / 16 oz Roundup Ultra Max + liquid ammonium sulfate @ 50 ml / gal for Pigeon grass, Kochia and Russian Thistle control. – July 1, 2004.
30.30	-Harvest 76.6 bushels / acre corn – October 28, 2004 Test weight – 55.8 # / bushel
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$162.00	Total Cost of Corn Production

Rotation 11

WINTER WHEAT / CORN / *MILLET*

Cost / A.	2004 Millet
$19.21	-Spray w / 8.3 gallons per acre 28-0-0 plus 16 oz Roundup Ultra Max + 5 oz Banvel 4L / Acre + liquid ammonium sulfate @ 50 ml/gal. – May 13, 2004
24.88	-Planted to Sunup Proso millet w / JD750 drill. W / starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 20#/A. – June 2, 2004
11.78	-Spray w / 16 oz Roundup Ultra Max plus ½ ounce per acre of Aim + 1 gallon per acre 28-0-0 to aid in uptake of the chemical. 10 gpA spray rate. – June 3, 2004
6.06	-Spray w / 4 oz Banvel 4L (Kochia and Russian Thistle control) 8 gpA spray rate. – July 1, 2004
15.66	-Harvest 1017# or 20.3 bushels / acre Millet – September 9, 2004
.40	-Soil Sampling / acre
28.50	-Land Charges 2004
$106.49	Total Cost of Millet Production

Rotation 11 SUMMARY 2004

Crop	Income		Expenses		Net Income Per Acre
Winter Wheat	$ 93.34	-	$108.48	=	$ -15.14
Corn	$158.56	-	$162.00	=	$ - 3.44
Millet	$ 71.19	-	$106.49	=	$ -35.30
	$323.09	-	$376.97	=	$ -53.88 / 3 = $ - 17.96

$ -17.96 Average Income / acre for Rotation 11 - 2004

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COST OF INPUTS – 2004

SEED

Jagalene Winter Wheat.....$ 7.00 / Bu
Russ Spring Wheat.....$ 5.00 / Bu
Arvika Forage Peas.....$ 9.00/Bu
($.15 per pound) (60 lbs)
Sierra Kabuli Chick Peas.....$55.00 / 100 lbs
(Note: the seed is treated w/ LSP / Apron / Maxim)
Finch.....$23.00 / 50 lbs
Dekalb DKC 44-46 RR/YG Corn..$130 / 80,000 kernel bag
Mycogen 8N421 – Size 3. $170. 00 / 200,000 kernel bag
Sunup Millet.....$ .29 / lb

HERBICIDES

(From Warne Chemical-November 19, 2003)
Bronate (Brox M).....$47.40/gal
Roundup Ultra Max.....$38.50/gal
Atrazine 90df.....$ 2.25/lb
Harmony GT.....$11.49/oz
Harmony Extra.....$12.65/oz
Ally.....$23.02/oz
Treflan 10% granules.....$ .79 / lb
LV6 (2,4D Ester).....$19.50/gal
Clarity (dicamba).....$82.37/gal
Poast.....$66.40/gal
Spartan 75df.....$41.32/ lb ($2.58/oz)
Tilt.....$340 / gallon
Starane.....$89.50/gallon
Spartan 75df.....$42.06/lb
Maverick.....$14.25 / oz
Olympus.....$10.56 / oz
Aim.....$163.80 / quart ($5.11 / oz)

Penetrate II.....$16.49/gal
Ammonium Sulfate.....$5.75/gal
Crop Oil.....$6.20/gal

INSECTICIDES

Enhance Plus (indane).....$15.06 / lb
Lorsban 4E.....$37.88 / gallon

LIQUID FERTILIZERS

10-34-0.....$245.10 / Ton or $1.43/gallon
on March 23, 2004 at Johnson Ranchers Supply.

28-0-0.....$ 172.60 / Ton or $ .93 / gallon or
$ .31 / lb of N on March 16, 2004 At Johnson's
Ranchers Supply.

SEED TREATMENTS

Granular inoculum for peas....$55.95 / 40# bag ($1.39/ lb)
Peat base inoculum for peas..$ 0.60/bu
Vitavax/Thiram/RTU.....$33.41/gal (5oz/100#seed)
Seed treatment fee.....$ 0.25/Acre

EQUIPMENT CHARGES

Planting.....$10.50 / Acre
Mechanical Tillage.....$ 5.25 / Acre

Spray Application
Herbicide.....$ 3.50 / Acre
Fertilizer.....$ 3.50 / Acre
Treflan Granules.....$ 3.00 / Acre

Harvest
Base.....$13.00 / Acre
Over 20 Bu / Acre.....$ 0.13 / Bushel
Trucking.....$ 0.13 / Bushel

Soil Sampling & Analysis.....$ 0.40 / Acre

LAND CHARGES

$350 / A x .07=$24.50 + $4 land tax=$28.50/Acre

GRAIN SALE VALUES

(Grain Prices for 2004 crop)

Winter Wheat.....See chart on next page.
Spring Wheat.....See chart on next page.
Sierra Chickpeas.....See chart on next page.
Sunflowers (oil-type).....$13.50 / cwt
Corn #2 yellow.....($1.90 + $.17 LDP) $2.07 / bu
Safflowers (oil-type).....$17.00 / cwt
Proso Millet.....$ 7.00 / cwt

Winter and Spring Wheat Sale Price Per Bushel with Protein Adjustment.
(Prices from Dakota Mill and Grain, Rapid City as of December 21, 2004)
(Average sale value for fall of 2004)

Protein Content	Winter Wheat	Spring Wheat
10.0%	$3.00	
10.2	$3.02	
10.4	$3.04	
10.6	$3.06	
10.8	$3.08	
11.0	$3.10	
11.2	$3.12	
11.4	$3.14	
11.6	$3.16	
11.8	$3.18	
12.0	**$3.20**	$3.20
12.2	$3.21	$3.22
12.4	$3.22	$3.24
12.6	$3.23	$3.26
12.8	$3.24	$3.28
13.0	$3.25	$3.30
13.2	$3.26	$3.38
13.4	$3.27	$3.46
13.6	$3.28	$3.54
13.8	$3.29	$3.62
14.0	$3.30	**$3.70**
14.2	$3.31	$3.86
14.4	$3.32	$4.02
14.6	$3.33	$4.18
14.8	$3.34	$4.34
15.0	$3.35	$4.50
15.2	$3.36	$4.52
15.4	$3.37	$4.54
15.6	$3.38	$4.56
15.8	$3.39	$4.58
16.0	$3.40	$4.60
16.2	$3.41	$4.62

Sierra Chickpea Values from Hinrichs Trading,
Pullman, Washington
(December 21, 2004)

Seed Size	Percentage and Seed Value / Pound	
22/64" round	95% of 976# @ $0.27 =	$250.29
20/64" round	3% of 976# @ $0.12 =	$3.48
18/64" round	2% of 976# @ $0.05 =	$1.00
	Total crop value per acre =	$254.77

Precipitation for September 1999 through August 2004

Wall Rotation Rain-Fall Data (1999-00)

Month	Total Precip. (inches)	Month	Total Precip. (inches)	Month	Total Precip. (inches)
September 99..	1.33"	January 00...	0.04"	*May*.....	1.19"
October.....	0.13"	February.....	0.09"	*June*.....	1.96"
November.....	0.85"	March.....	2.42"	*July*.....	1.65"
December.....	0.15"	*April*.....	3.27"	*August*.....	0.13"

(Accumulative total precipitation from Sept.1, 1999 to Aug. 31, 2000 is 13.21 ")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2000 is 8.20")

Wall Rotation Rain-Fall Data (2000-01)

Month	Total Precip. (inches)	Month	Total Precip. (inches)	Month	Total Precip. (inches)
September 00..	0.25"	January 01...	0.10"	*May*.....	1.45"
October.....	1.22"	February.....	0.24"	*June*.....	4.13"
November.....	0.80"	March.....	0.42"	*July*.....	3.68"
December.....	0.15"	*April*.....	2.10"	*August*.....	0.93"

(Accumulative total precipitation from Sept.1, 2000 to Aug. 31, 2001 is 15.47 ")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2001 is 12.29")

Wall Rotation Rain-Fall Data (2001-02)

Month	Total Precip. (inches)	Month	Total Precip. (inches)	Month	Total Precip. (inches)
September 01..	0.82"	January 02...	0.11"	*May*.....	1.41"
October.	0.42"	February.....	0.05"	*June*.....	0.58"
November.....	0.02"	March.....	0.23"	*July*.....	0.79"
December.....	0.00"	*April*.....	0.92"	*August*.....	1.89"

(Accumulative total precipitation from Sept.1, 2001 to Aug. 31, 2002 is 7.24 ")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2002 is 5.59")

Wall Rotation Rain-Fall Data (2002-03)

Month	Total Precip. (inches)	Month	Total Precip. (inches)	Month	Total Precip. (inches)
September 02..	2.61"	January 03...	0.14"	*May*.....	1.55"
October.....	0.73"	February.....	0.32"	*June*.....	0.66"
November.....	0.01"	March.....	1.35"	*July*.....	0.74"
December.....	0.03"	*April*.....	1.88"	*August*.....	0.41"

(Accumulative total precipitation from Sept.1, 2002 to Aug. 31, 2003 is 10.43 ")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2003 is 5.24")

Wall Rotation Rain-Fall Data (2003-04)

Month	Total Precip. (inches)	Month	Total Precip. (inches)	Month	Total Precip. (inches)
September 03..	1.22"	January 04...	0.08"	*May*.....	3.62"
October.....	0.43"	February.....	0.02"	*June*.....	2.05"
November.....	0.09"	March.....	0.30"	*July*.....	2.35"
December.....	0.03"	*April*.....	0.19"	*August*.....	0.99"

(Accumulative total precipitation from Sept.1, 2003 to Aug. 31, 2004 is 10.79 ")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2004 is 9.20 ")

1971-2000 Average Total Precipitation from September 1 – August 31 is 17.24"
1971-2000 Average Total Precipitation from April 1 – August 31 is 11.53"

Wall Rotation Study Soil Analysis - As of December 21, 2004 for the 2005 Season

Plot No.	2005 Crop and estimated yield goal	Soil Texture	Soil pH	Solubl e Salts	Organic Matter %	NO3-N # / acre 0-6" 0-24"		P ppm	K ppm	Add N #/A	Add P205 #/A	Add K2O #/A	2004 Yield (Bushels/A or Lbs / acre)
						top	total						
101-1	Fallow	Medium	6.5	0.4	1.6	47	85	10	395	--	--	--	HRW-17.7 bu
102-1	HRW-60bu	Medium	6.3	0.3	1.6	16	56	12	427	95	15	--	Fallow
117-2a	Fallow	Medium	6.5	0.3	1.9	14	37	13	519	--	--	--	70.3 bu Corn
118-2a	HRW-60bu	Medium	6.5	0.3	1.8	28	75	11	511	75	20	--	Fallow
119-2a	Sunf 2000#	Medium	6.8	0.5	1.7	17	50	19	409	50	0	0	34.3 bu HRW-a
103-2a	Mil-1500#	Medium	6.7	0.3	1.6	7	19	8	406	35	15	0	1093# Sunflower
104-2a	HRW-45bu	Medium	6.2	0.3	1.8	21	55	11	405	60	15	0	449# Millet
105-2a	Corn-80bu	Medium	6.5	0.3	1.7	6	26	15	333	70	5	0	27.1 bu HRW-b
106-3	Mil-1500#	Medium	6.5	0.3	1.9	13	58	13	388	0	5	0	957# Safflower
107-3	HRW-45bu	Medium	6.5	0.3	1.8	11	25	11	389	90	15	0	867# Millet
108-3	Saff-1200#	Medium	6.7	0.3	1.8	5	20	11	461	40	10	0	24.2 bu HRW
109-4	Mil-2000#	Medium	6.6	0.3	1.8	8	23	10	380	45	10	0	28.9 bu HRW
110-4	HRW-40bu	Medium	6.7	0.3	1.9	8	15	16	442	85	0	0	1888# Millet
111-5a	HRW-40bu	Medium	6.7	0.4	1.7	18	53	17	487	45	0	0	426# Millet
122-5a	Corn-70bu	Medium	6.5	0.3	1.9	8	26	16	452	60	0	0	34.1 bu HRW
112-5a	Sunf 1500#	Medium	6.6	0.4	1.6	25	82	22	398	0	0	0	54.9 bu Corn
113-5a	Barley-50bu	Medium	6.8	0.4	1.7	30	127	9	395	0	15	0	455# Sunflower
114-6a	HRW-45bu	Medium	6.7	0.3	1.8	19	87	13	445	25	10	0	34.5 bu HRW-a
115-6a	Saff 1500#	Medium	6.8	0.3	1.9	6	32	8	458	45	25	0	24.7 bu HRW-b
121-6a	F. Pea-1800#	Medium	7.0	0.5	1.8	50	80	11	503	0	15	0	818# Sunflower
116-6a	HRW-60bu	Medium	6.4	0.3	1.7	22	73	19	348	75	0	0	Pea/Fallow
123-9a	HRW-45bu	Medium	6.8	0.3	1.7	23	84	11	437	30	15	0	1028# Millet
124-9a	Saff-1500#	Medium	6.3	0.3	1.7	5	17	9	393	60	20	0	27.5 bu HRW-b
125-9a	Hairy Vetch	Medium	6.4	0.3	1.8	20	58	12	387	0	20	0	617# Safflower
120-9a	HRW-60bu	Medium	6.8	0.4	1.8	22	61	9	452	90	30	0	Pea/Fallow
126-10	Mil-2000#	Medium	6.6	0.3	1.8	14	64	9	404	5	15	0	976# Chick peas
127-10	HRW-45bu	Medium	6.7	0.3	1.8	11	28	10	333	85	20	0	1197# Millet
128-10	C Pea-1500#	Medium	6.5	0.3	1.8	4	13	15	459	0	5	0	22.5 bu HRW
129-11	Mil-1500#	Medium	6.3	0.3	1.9	8	20	11	402	35	10	0	76.6 bu Corn
130-11	HRW-45bu	Medium	6.3	0.3	1.9	12	26	16	419	85	0	0	1017# Millet
131-11	Corn-80bu	Medium	6.4	0.3	1.9	19	28	37	442	70	0	0	28.2 bu HRW

Note: To convert P & K values to #/A take ppm value x 2.
Example: 500 ppm is equal to 1000#/Acre

Nitrogen Needs for Wall Rotation Study (1994-2005)

Nitrogen Needs (Lbs / Acre)

Rotation	Crop	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Ave N req (1999-05)
1	Winter Wheat	--	--	80	115	85	115	130	65	105	75	40	95	*90*
	Fallow	--	--	--	--	--	--	--	--	--	--	--		--
2a	Winter Wheat-a	--	--	--	--	100*	120	115	85	60	85	55	75	*85*
	Sunflower	--	--	--	--	60*	65	70	65	65	0	55	50	*55*
	Millet	--	--	--	--	55*	60	55	40	55	0	15	35	*40*
	Winter Wheat-b	--	--	--	--	90*	100	100	85	100	75	35	60	*80*
	Corn	--	--	--	--	65*	75	85	60	60	25	50	70	*60*
	Fallow	--	--	--	--	--	--	--	--	--	--	--	--	--
3	Winter Wheat	--	--	100	85	100	100	105	90	100	70	60	90	*90*
	Safflower	--	--	55	60	55	55	65	70	85	30	25	40	*55*
	Millet	--	--	45	50	50	55	60	60	60	5	35	0	*40*
4	Winter Wheat	--	--	100	80	100	95	85	80	100	80	55	85	*85*
	Millet	--	--	50	55	45	50	50	30	35	30	40	45	*40*
5a	Winter Wheat	--	--	--	--	90	100	90	70	65	0	75	45	*65*
	Corn	--	--	--	--	80	70	80	70	70	40	50	60	*65*
	Sunflower	--	--	--	--	65	65	90	80	85	25	35	0	*55*
	Spring Wheat to S.Barley in 2005	--	--	--	--	90	90	95	80	80	80	20	0 0	*65* *0*
6a	Winter Wheat-a	--	--	--	--	--	140	100	100	90	85	45	75	*90*
	Winter Wheat-b	--	--	--	--	--	100	100	70	50	0	60	25	*60*
	Sunflower(99-04)	--	--	--	--	--	70	90	65	85	50	35		*65*
	Safflower-(2005)												45	*45*
	Pea/Fallow to Field Pea in 2005	--	--	--	--	--	--	--	--	--	--	--	--	--
9a	Winter Wheat-a	--	--	--	--	--	115	120	95	105	85	50	90	*95*
	Winter Wheat-b	--	--	--	--	--	95	80	70	70	0	75	30	*60*
	Safflower	--	--	--	--	--	50	60	65	80	5	0	60	*45*
	Pea/Fal to Hairy Vetch in 2005	--	--	--	--	--	--	--	--	--	--	--	--	--
10	Winter Wheat	--	--	95	75	100	100	100	95	100	80	50	85	*85*
	Pea	--	--	0	0	0	0	0	0	0	0	0	0	*0*
	Millet	--	--	55	45	45	50	25	45	50	20	25	5	*30*
11	Winter Wheat	--	--	90	75	100	100	105	90	105	80	45	85	*85*
	Corn	--	--	75	80	80	70	65	65	60	25	60	70	*60*
	Millet	--	--	50	55	55	60	55	35	55	25	25	35	*40*

* = Not combined into a 6 year rotation yet. Yield goals are: Fallow Winter wheat-60 bu., Recrop Winter wheat-40 or 45 bu., Spring Wheat – 40 bu., Spring Barley – 50 bu, Sunflower-1500# or 2000#., Safflower-1200# or 1500#., Millet- 1500# or 2000#., Corn- 70 or 80 bu., Chickpea-1500#

1999 Wall Rotation Yields, Expense/Acre, Break-Even Costs & Break-Even Yields

Rotation & Net return/A	Crop	(A) Yield	(B) Expense of Crop/Acre	(C) Cost of Production	(D) Yield to Break-Even
1	W Wheat	70.9 bu	$164.76	$2.32/bu	58.8 bu
($15.46)	Fallow at $59.62/acre.				
2a	W Wheat-A	67.1 bu	$142.14	$2.12/bu	50.8 bu
($18.30)	Sunflower	2091#	$165.17	$.079/#	1761#
	Millet	1500#	$ 98.53	$.066/#	2074#
	W Wheat-B	62.8 bu	$127.86	$2.04/bu	45.7 bu
	Corn	107.6 bu	$157.38	$1.46/bu	87.4 bu
	Fallow at $47.40/acre.		($37.92 + $9.48)*		
3	W Wheat	57.2 bu	$118.82	$2.08/bu	42.4 bu
($-10.32)	Safflower	976#	$126.34	$.129/#	1203#
	Millet	1500#	$ 98.53	$.066/#	2074#
4	W Wheat	47.2 bu	$116.42	$2.47/bu	41.6 bu
($-12.16)	Millet	1500#	$ 99.98	$.066/#	2105#
5a	W Wheat	36.5 bu	$121.54	$3.33/bu	43.4 bu
($7.04)	Corn	108.1 bu	$167.39	$1.55/bu	93.0 bu
	Sunflower	2010#	$143.95	$.072/#	1535#
	S Wheat	36.3 bu	$109.14	$3.01/bu	39.0 bu
6a	W Wheat-B	34.1 bu	$122.76	$3.60/bu	43.8 bu
($1.96)	Sunflower	2210#	$155.69	$.070/#	1660#
	Fallow at $47.40/acre.		($37.92 + $9.48)*		
	W Wheat-A	63.9 bu	$141.38	$2.21/bu	50.5 bu
9a	W Wheat-B	29.8 bu	$126.30	$4.24/bu	45.1 bu
($-7.06)	Safflower	1277#	$139.18	$.109/#	1326#
	Fallow at $47.40/acre.		($37.92 + $9.48)*		
	W Wheat-A	68.3 bu	$150.94	$2.21/bu	53.9 bu
10	W Wheat	65.1 bu	$120.72	$1.85/bu	43.1 bu
($11.16)	Peas	38.9 bu	$112.87	$2.90/bu	32.2 bu
	Millet	1500#	$ 98.53	$.066/#	2074#
11	W Wheat	54.2 bu	$117.86	$2.17/bu	42.1 bu
($.47)	Corn	99.2 bu	$163.14	$1.64/bu	90.6 bu
	Millet	1500#	$ 99.10	$.066/#	2086#

Grain Values for determining Yield to Break-Even Point (E)

Winter Wheat	$2.80	Corn	$1.80/bu
Peas	$3.50/bu	Millet	$.0475/lb
Sunflower	$.0938/lb	Safflower	$.105/lb

C = B / A D = B / E

*The fallow expense was separated at 80% for the first crop year and 20% to the second crop year.

(1999 Total Precipitation) April-2.65" **May**-3.22" **June**-3.33" **July**-2.21" **August**-2.03"

2000 Wall Rotation Yields, Expense/Acre, Break-Even Costs & Break-Even Yields

Rotation & Net return/A	Crop	(A) Yield	(B) Expense of Crop/Acre	(C) Cost of Production	(D) Yield to Break-Even	(E) Sale Value $/B
1	W Wheat	58.3 bu	$166.47	$2.86/bu	55.1 bu	$3.02
($4.79)	Fallow at $61.35/acre.					
2a	W Wheat-A	66.9 bu	$149.14	$2.23/bu	49.2 bu	3.03
($28.19)	Sunflower	2602#	$169.90	$.065/#	1811#	
	Millet	1300#	$112.63	$.087/#	1251#	
	W Wheat-B	46.0 bu	$115.15	$2.50/bu	39.4 bu	2.92
	Corn	65.8 bu	$150.10	$2.28/bu	79.0 bu	
	Fallow at $52.47/acre.		($41.98 + $10.49)*			
3	W Wheat	45.4 bu	$114.99	$2.53/bu	40.2 bu	2.86
($14.59)	Safflower	1391#	$149.00	$.107/#	1242#	
	Millet	1266#	$102.93	$.081/#	1144#	
4	W Wheat	32.6 bu	$107.75	$3.31/bu	35.7 bu	3.02
($-.01)	Millet	1370#	$114.03	$.083/#	1267#	
5a	W Wheat	47.6 bu	$126.13	$2.65/bu	46.4bu	2.72
($-4.40)	Corn	50.2 bu	$145.81	$2.90/bu	76.7 bu	
	Sunflower	1958#	$135.49	$.069/#	1444#	
	S Wheat	31.8 bu	$116.31	$3.66/bu	37.9 bu	3.07
6a	W Wheat-B	48.9 bu	$141.74	$2.90/bu	52.1 bu	2.72
($19.34)	Sunflower	2468#	$158.37	$.064/#	1688#	
	Fallow at $76.53/acre.		($61.22 + $15.31)*			
	W Wheat-A	60.8 bu	$168.80	$2.78/bu	56.5 bu	2.99
9a	W Wheat-B	43.0 bu	$136.16	$3.17/bu	46.0 bu	2.96
($7.52)	Safflower	1546#	$149.94	$.097/#	1250#	
	Fallow at $76.53/acre.		($61.22 + $15.31)*			
	W Wheat-A	57.1 bu	$167.92	$2.94/bu	56.0 bu	3.00
10	W Wheat	48.9 bu	$118.19	$2.42/bu	41.8 bu	2.83
($-1.54)	Peas	17.9 bu	$124.84	$6.97/bu	35.7 bu	
	Millet	1524#	$ 99.43	$.065/#	1105#	
11	W Wheat	37.8 bu	$113.17	$2.99/bu	38.2 bu	2.96
($-7.35)	Corn	60.2 bu	$148.76	$2.47/bu	78.3 bu	
	Millet	1300#	$103.40	$.080/#	1149#	

Grain Values for determining Yield to Break-Even Point (**E**)

Winter Wheat	See Chart Above (E)	Corn	$1.90/bu
Peas	$3.50/bu	Millet	$.09/lb
Sunflower	$.0938/lb	Safflower	$.12/lb

C = B / A **D = B / E**

*The fallow expense was separated at 80% for the first crop year and 20% to the second crop year.

Note: Winter Wheat values have been adjusted for protein content in column (E).

(2000 Total Precipitation) April-3.27" **May**-1.19" **June**-1.96" **July**-1.65" **August**-0.13"

2001 Wall Rotation Yields, Expense/Acre, Break-Even Cost & Break-Even Yields

Rotation & Net return/A	Crop	(A) Yield	(B) Expense of Crop/Acre	(C) Cost of Production	(D) Yield to Break-Even	(E) Sale Value ($/Bu)
1	W Wheat	38.6 bu	$158.93	$4.11/bu	54.8 bu	$2.90
($-23.49)	Fallow at $57.03/acre					
2a	W Wheat-A	51.1 bu	$152.47	$2.98/bu	54.2 bu	2.81
($10.87)	Sunflower	2082#	$170.82	$.082/#	1798#	
	Millet	2000#	$ 95.28	$.047/#	2507#	
	W Wheat-B	40.2	$ .99.33	$2.47/bu	36.6 bu	2.71
	Corn	97.5 bu	$151.81	$1.55/bu	70.9 bu	
	Fallow at $62.28/acre		($49.82 + $12.46)*			
3	W Wheat	38.1 bu	$ 98.83	$2.59/bu	36.4	2.71
($12.20)	Safflower	1575#	$153.27	$.097/#	1179#	
	Millet	2000#	$ 95.28	$.047/#	2507#	
4	W Wheat	33.7 bu	$106.95	$3.17/bu	37.9 bu	2.82
($-23.91)	Millet	1800#	$104.30	$.057/#	2744#	
5a	W Wheat	33.1 bu	$104.61	$3.16/bu	38.0 bu	2.75
($4.92)	Corn	101.6 bu	$152.79	$1.50/bu	71.3 bu	
	Sunflower	1443#	$141.42	$.098/#	1488#	
	S Wheat	28.4 bu	$109.64	$3.86/bu	37.6 bu	2.91
6a	W Wheat-B	33.0 bu	$122.56	$3.71/bu	43.9 bu	2.79
	Sunflower	2011#	$157.58	$.078/#	1658#	
	Fallow at $89.83/acre		($71.86 + $17.97)*			
	W Wheat-A	48.0	$175.07	$3.64/bu	60.1 bu	2.91
9a	W Wheat-B	38.2 bu	$123.80	$3.24/bu	45.3 bu	2.73
	Safflower	1624$	$153.57	$.094/#	1181/#	
	Fallow at $89.83/acre		($71.86 + $17.97)*			
	W Wheat-A	50.0 bu	$175.55	$3.51/bu	64.3 bu	2.73
10	W Wheat	40.8 bu	$101.47	$2.48/bu	36.8 bu	2.75
($21.08)	Peas	26.4 bu	$109.64	$4.15/bu	15.8 bu	
	Millet	2000#	$ 95.28	$.047/#	2507#	
11	W Wheat	42.2 bu	$ 99.81	$2.36/bu	33.7 bu	2.96
($23.57)	Corn	106.4 bu	$153.93	$1.44/bu	71.9 bu	
	Millet	2000#	$ 95.28	$.047/#	2507#	

Grain Values for determining Yield to Break-Even Point **(E)**

Winter Wheat.....See Chart Above (E)	Corn.....$2.14/bu
Peas.....$6.90/bu	Millet.....$.038/lb
Sunflower.....$.095/lb	Safflower.....$.13/lb

C = B / A **D = B / E**

*The fallow expense was separated at 80% for the first crop year and 20% to the second crop year.

Note: Winter Wheat values have been adjusted for protein content in column (E)

(2001 Total Precipitation) April-2.10" **May**-1.45" **June**-4.13" **July**-3.68" **August**-0.93"

2002 Wall Rotation Yields, Expense/Acre, Break-Even Costs & Break-Even Yields

Rotation & Net return/A	Crop	(A) Yield	(B) Expense of Crop/Acre	(C) Cost of Production	(D) Yield to Break-Even	(E) Sale Value ($/Bu)
1	W Wheat	28.6 bu	$176.26	$6.16/bu	39.1bu	$4.50
($-23.78)	Fallow at $72.57 /acre.					
2a	W Wheat-A	30.9 bu	$143.24	$4.63/bu	31.8 bu	4.50
($-68.70)	Sunflower	400#	$169.03	$ .42 / #	1408#	
	Millet	326#	$106.19	$.32/#	707#	
	W Wheat-B	10.7 bu*	$101.60	$9.49/bu	33.8 bu	3.00
	Corn	0 bu	$160.22	$ N/A	65.3 bu	
	Fallow at $58.69/acre.		($46.95 + $11.74)*			
3	W Wheat	9.8 bu*	$101.48	$10.35/bu	33.8 bu	3.00
($-52.71)	Safflower	360#	$149.05	$.41/#	828#	
	Millet	783#	$119.26	$.15/#	795#	
4	W Wheat	14.7 bu*	$102.12	$6.94/bu	34.0 bu	3.00
($-4.48)	Millet	1182#	$128.24	$.108/#	854#	
5a	W Wheat	3.4 bu	$103.59	$30.46/bu	23.0 bu	4.50
($-110.83)	Corn	0 bu	$160.22	$ N/A	65.3 bu	
	Sunflower	250#	$132.05	$ .52/#	1100#	
	S Wheat	1.6 bu*	$ 77.47	$48.41/bu	25.8 bu	3.00
6a	W Wheat-B	5.2 bu*	$122.69	$23.59/bu	40.8 bu	3.00
($-99.76)	Sunflower	200#	$156.12	$.78/#	1301#	
	Fallow at $95.48/acre.		($76.38 + $19.10)*			
	W Wheat-A	10.8 bu	$176.63	$16.35/bu	39.2 bu	4.50
9a	W Wheat-B	4.9 bu*	$142.68	$29.11/bu	47.5 bu	3.00
($-98.38)	Safflower	230#	$148.63	$.64/#	825#	
	Fallow at $107.36/acre.		($85.89+ $21.47)*			
	W Wheat-A	9.2 bu*	$185.94	$20.21 / bu	61.9 bu	3.00
10	W Wheat	13.1 bu*	$101.91	$7.77/bu	33.9 bu	3.00
($-81.25)	Chickpea	95#	$170.82	$1.79/#	1067#	
	Millet	622#	$118.83	$ .19/#	792#	
11	W Wheat	13.5 bu*	$101.97	$7.55/bu	33.9 bu	3.00
($-68.28)	Corn	0 bu	$160.22	$ N/A	65.3 bu	
	Millet	829#	$107.50	$.129 / #	716#	

Grain Values for determining Yield to Break-Even Point (**E**)

Winter Wheat	$4.50bu	Corn	$2.45/bu
Chickpea	$16.00/cwt	Millet	$.15/lb
Sunflower	$ .12/lb	Safflower	$.18/lb
Winter Wheat * (under 55# test wt.)	$3.00/bushel		

C = B / A **D = B / E**

*The fallow expense was separated at 80% for the first crop year and 20% to the second crop year.

Note: Winter Wheat values have been adjusted for protein content in column (E).

(2002 Total Precipitation) April-0.92" **May**-1.41" **June**-0.58" **July**-0.79" **August**-1.89"

2003 Wall Rotation Yields, Expense/Acre, Break-Even Costs & Break-Even Yields

Rotation & Net return/A	Crop	(A) Yield	(B) Expense of Crop/Acre	(C) Cost of Production	(D) Yield to Break-Even	(E) Sale Value ($/Bu)
1	W Wheat	77.1 bu	$182.31	$2.36/bu	60.5 bu	$3.01
($24.88)	Fallow at $66.64 /acre.					
2a	W Wheat-A	72.8 bu	$156.81	$2.15/bu	51.4 bu	3.05
($-33.55)	Sunflower	584#	$162.44	$ .278 / #	1584#	
	Millet	0 #	$ 77.58	$ N/A	1410#	
	W Wheat-B	46.3 bu	$108.54	$2.34/bu	34.0 bu	3.19
	Corn	0 bu	$125.56	$ N/A	55.8 bu	
	Fallow at $52.82/acre.		($42.26 + $10.56)*			
3	W Wheat	47.8 bu	$108.94	$2.27/bu	36.1 bu	3.01
($-29.72)	Safflower	614#	$138.62	$.225/#	1352#	
	Millet	0 #	$ 77.58	$ N/A	1410#	
4	W Wheat	57.4 bu	$111.44	$1.94/bu	37.7 bu	2.95
($4.72)	Millet	1500#	$130.94	$.087/#	2380#	
5a	W Wheat	34.9 bu	$ 98.95	$2.83/bu	30.2 bu	3.27
($-56.44)	Corn	0 bu	$140.82	$ N/A	62.5 bu	
	Sunflower	722#	$138.26	$ .19/#	1348#	
	S Wheat	26.2 bu	$124.96	$4.76/bu	36.7 bu	3.40
6a	W Wheat-B	35.4 bu	$114.66	$3.23/bu	34.5 bu	3.32
($-22.64)	Sunflower	1132#	$158.36	$.139/#	1544#	
	Fallow at $77.86/acre.		($62.29 + $15.57)*			
	W Wheat-A	35.9 bu	$168.13	$4.68/bu	51.5 bu	3.26
9a	W Wheat-B	31.7 bu	$113.70	$3.58/bu	34.4 bu	3.30
($-3.46)	Safflower	1106#	$141.20	$.127/#	941#	
	Fallow at $77.86/acre.		($62.29+ $15.57)*			
	W Wheat-A	44.0 bu	$170.25	$3.86 / bu	53.2 bu	3.20
10	W Wheat	58.7 bu	$111.78	$1.90/bu	36.1 bu	3.09
($-2.31)	Chickpea	667#	$162.20	$.243/#	772#	
	Millet	925#	$112.88	$ .122/#	2052#	
11	W Wheat	59.4 bu	$111.96	$1.88/bu	37.4 bu	2.99
($-28.35)	Corn	39.7 bu	$152.04	$ 3.82/bu	67.5 bu	
	Millet	0 #	$ 87.98	$ N/A	1600#	

Grain Values for determining Yield to Break-Even Point (**E**)

Winter Wheat	$4.50bu	Corn	$2.25/bu
Chickpea	$21.00/cwt	Millet	$.055/lb
Sunflower	$ .1025/lb	Safflower	$.15/lb

C = B / A **D = B / E**

*The fallow expense was separated at 80% for the first crop year and 20% to the second crop year.

Note: Winter Wheat values have been adjusted for protein content in column (E)

(2003 Total Precipitation) April-1.88" **May**-1.55" **June**-0.66" **July**-0.74" **August**-0.41"

2004 Wall Rotation Yields, Expense/Acre, Break-Even Costs & Break-Even Yields

Rotation & Net return/A	Crop	(A) Yield	(B) Expense of Crop/Acre	(C) Cost of Production	(D) Yield to Break-Even	(E) Sale Value ($/Bu)
1	W Wheat	17.7 bu	$145.81	$8.23/bu	43.5 bu	$3.35
($-43.26)	Fallow at $56.29 /acre.					
2a	W Wheat-A	34.3 bu	$128.92	$3.75/bu	38.5 bu	3.34
($-21.33)	Sunflower	1093#	$153.21	$.14 / #	1134#	
	Millet	449#	$105.00	$.233/#	1500#	
	W Wheat-B	27.1 bu	$108.20	$3.99/bu	33.0 bu	3.27
	Corn	70.3 bu	$160.36	$2.28/bu	77.4 bu	
	Fallow at $44.25/acre.		($35.40 + $8.85)*			
3	W Wheat	24.2 bu	$115.16	$4.75/bu	34.5 bu	3.33
($-18.75)	Safflower	957#	$138.99	$.145/#	817#	
	Millet	867#	$106.07	$.122/#	1515#	
4	W Wheat	28.9 bu	$108.66	$3.75/bu	33.6 bu	3.23
($-7.53)	Millet	1888#	$131.91	$.069/#	1884#	
5a	W Wheat	34.1 bu	$110.04	$3.22/bu	33.7 bu	3.26
($-53.00)	Corn	54.9 bu	$156.36	$2.84/bu	75.5 bu	
	Sunflower	455#	$136.82	$.30/#	1013#	
	S Wheat to millet	426#	$124.84	$.293/#	1783#	
6a	W Wheat-B	24.7 bu	$122.58	$4.96/bu	37.1 bu	3.30
($-30.06)	Sunflower	818#	$141.12	$.172/#	1045#	
	Fallow at $74.92/acre.		($59.94+ $14.98)*			
	W Wheat-A	34.5 bu	$162.36	$4.70/bu	49.2 bu	3.30
9a	W Wheat-B	27.5 bu	$123.30	$4.48 /bu	37.5 bu	3.28
($-48.99)	Safflower	617#	$137.39	$.222/#	808#	
	Fallow at $74.92/acre.		($59.94+ $14.98)*			
	W Wheat-A to millet	1028#	$202.34	$.196 / #	2890#	
10	W Wheat	22.5 bu	$107.00	$4.75/bu	32.7 bu	3.27
($10.11)	Chickpea	976#	$167.36	$.171/#	636#	
	Millet	1197#	$107.43	$.089/#	1534#	
11	W Wheat	28.2 bu	$108.48	$3.84/bu	32.7 bu	3.31
($-17.96)	Corn	76.6 bu	$162.00	$2.11/bu	78.2 bu	
	Millet	1017#	$106.49	$.104/#	1521#	

Grain Values for determining Yield to Break-Even Point (**E**)

Winter Wheat	See Chart	Corn	$2.07/bu
Chickpea	$15.66bu	Millet	$.07/lb
Sunflower	$..135/lb	Safflower	$.17/lb

C = B / A **D = B / E**

*The fallow expense was separated at 80% for the first crop year and 20% to the second crop year.

Note: Winter Wheat values have been adjusted for protein content in column (E).

(2004 Total Precipitation) April-0.19" **May**-3.62" **June**-2.05" **July**-2.35" **August**-0.99"

Wall Rotation Study Weed Counts – 2004

Objectives: 1) To determine what weeds and intensity are present in each rotation.
2) To determine what effects crop rotations have on weed control.

Procedures: All 124 plots of the Wall Rotation Study were evaluated (visually rated) on April 15, July 15, and October 15, 2004 for weed type and density in each plot. A rating of (**0**) means that the plot was completely weed free. A rating of (**5**) indicates that the plot was totally covered with weeds. The **Weed Rating** is derived from adding up the weed scores in all 4 plots and dividing by 4. The **Rotation weed mean** is derived from adding up the plot rating and dividing by the number of cropping treatments in each rotation. With the **Weed Rating** and **Rotation weed mean**, the lower the number, the lower the incidence of weeds.

Discussion: There are approximately 35 weed species that are identified at this rotation study (Table 43). Approximately half of these weeds are of major economic importance and are directly competing with the crops at some point for valuable moisture, nutrients and sunlight. The overall highest incidence of weeds in 2004 was observed during the July 15 rating. The second highest was seen on the April 15 rating and the fewest weeds present were at the October date (Table 42). If we look at the net return over the last 5 years 1999-2004 (not counting the drought disaster of 2002), 5 rotations stand out. Rotations 1, 2, 3, 10, and 11. These rotations all have weed pressure but they also have the means of removing weeds from the system.

None of the winter wheat in the entire study was sprayed until after harvest. It is interesting to note that Rotation 1 (Wheat/Fallow) was the weediest rotation in the study during the July observation date and the cleanest in the study at the October date. Mechanical tillage of the fallow during the heat of the summer and spraying during the cool seasons worked very well to keep weeds under control.

Rotation 2 (Wheat/Sunflower/Millet/Wheat/Corn/Fallow) has many opportunities during the growing season and fallow periods to effectively clean up the weed problems in the various crops. Rotation 3 (Wheat/Safflower/Millet) has excellent diversity for a short term rotation.

Rotation 10 (Wheat/Chickpea/Millet) has many similarities to rotation 3. Chickpeas are a high value crop but herbicide options are limited. Chickpeas are not as moisture use intensive as the Safflower is. Rotation 11 (Wheat/Corn/Millet) is unique in that there is no broad leaf in this rotation. The corn segment is very weed free and the millet is a short term and shallow rooted crop.

The weediest rotation this year over the 3 rating dates was Rotation 4. This rotation has about 11 months of fallow period after harvest of the wheat crop to planting of the millet crop. This non-crop period is too long. Rotation 4 was sprayed 5 times this year verses 3 sprayings in the other millet plots at this study.

Weed pressure in the rotations will vary from year to year depending upon soil and air temperatures, rainfall, canopy effect, mechanical tillage, types of herbicides used and timing of planting and so on. Ultimately, it is important to get a thorough weed cleansing at least one time during the crop season and/or during the fallow periods. Every crop in this rotation has a fallow period of at least a few months where there is no crop growing. It is critical to get good weed control during these opportunity windows of the fallow periods. Spraying pre-plant of the crops and also in the late fall are excellent times to keep weed populations in check. It is important to be versatile on herbicide options. We have inadvertently selected for ALS resistant Kochia at this study in the past by continued use of sulfonylurea herbicides. We have since moved on to alternative types of herbicides that will control the new strains of Kochia that we now have.

Table 42. Wall Rotation Weed Ratings.

Rotation	April 15, 2004		July 15, 2004		October 15, 2004	
	Weed Rating	Weeds Present	Weed Rating	Weeds Present	Weed Rating	Weeds Present
Rotation 1						
W. Wheat	0.25	db	4.00	ko, rt, sg, lq, byg	0.00	
Fallow	3.25	v w, ko, db	2.00	ko, rt, fxt	0.25	pc
Rot Mean	**1.75**		**3.00**		**0.12**	
Rotation 2a						
Corn	3.25	ko, v w, db	0.00		1.50	sg,pl,pc,tg,bl
Fallow	1.25	bl, v w, db	2.75	ko, fxt, rt, pig, pw	0.00	
W. Wheat-a	0.25	db	3.00	ko, sg, fxt	0.00	
Sunflower	4.00	v w, ko, pl	2.00	fxt, ko, d, byg	2.00	sg,db,wbw
Millet	1.75	v w, d, pl	0.75	ko, rt, byg	1.00	pc,bl,db
W. Wheat-b	0.75	ko	1.50	ko, fxt, rt, pl	0.00	
Rot Mean	**1.87**		**1.66**		**0.75**	
Rotation 3						
Safflower	1.00	db, ko	1.25	ko, fxt, rt, pl	0.00	
Millet	2.50	db, v w, pl, ko	0.75	ko, rt, p sp	0.87	db,pc
W. Wheat	1.00	db, ko	2.75	rt, ko, f mar, jbr	0.00	
Rot Mean	**1.50**		**1.58**		**0.29**	
Rotation 4						
W. Wheat	1.00	db, bl,	3.00	rt, ko, f mar, jbr, fxt	0.00	
Millet	4.25	db, ko	1.00	sg, rt, ko	1.75	db, v w
Rot Mean	**2.62**		**2.00**		**0.87**	
Rotation 5a						
S. Wheat	0.25	ko	1.00	ko, rt, sg	1.00	pc, d
W. Wheat	0.50	db, ko	1.00	jbr, ko, rt, f mar, fxt	0.00	
Corn	4.75	v w, ko, db	0.00		1.75	d, bl, sg, pc,v w
Sunflower	1.25	db, v w	1.75	sg, p sp, byg	1.75	sg, vw, bl, db
Rot Mean	**1.68**		**0.93**		**1.12**	
Rotation 6a						
W. Wheat-a	0.25	db	2.75	db, jbr, rt, ko, f mar, pl, lq	1.75	db
W. Wheat-b	1.00	db	1.50	jbr, ko	0.00	
Sunflower	4.25	v w, ko, pl	1.50	ko, p sp, pw, fxt	1.75	v w, sg, d, LLs
Pea/Fallow	0.00		0.25	tg	0.00	
Rot Mean	**1.37**		**1.50**		**0.87**	
Rotation 9a						
W. Wheat-a	0.25	db	0.75	sg, fxt	0.62	db, pc
W. Wheat-b	1.00	v w, db	1.75	ko, jbr, db	0.00	
Safflower	2.00	ko, db	1.12	v w, ko	0.00	
Pea/Fallow	1.00	db, ko	0.00		0.50	db
Rot Mean	**1.06**		**0.90**		**0.28**	
Rotation 10						
Chickpeas	1.25	db	1.75	ko, fxt, p sp, sg, lls	0.00	
Millet	2.00	db, ko, v w	0.75	ko, rt, d, f.mar	1.00	pc, db
W. Wheat	2.00	db, ko	2.75	ko, f mar, jbr, rt	0.00	
Rot Mean	**1.75**		**1.75**		**0.33**	
Rotation 11						
Corn	2.75	v w, ko, db	0.00		2.00	pc, sg
Millet	0.75	v w, bl, d, db	2.75	ko, sg, byg, wg	1.00	pc
W. Wheat	0.75	bl	3.00	ko, lq, rt, jbr	0.00	
Rot Mean	**1.41**		**1.91**		**1.00**	

Note: Weeds listed above are listed from most to least.

Note: On the July 15 evaluation date, downy brome and Japanese brome are listed separately because they were easy to differentiate.

Legend: db-downy brome, jbr - Japanese brome, vo-volunteer wheat, ko-kochia (ALS & non - ALS strains), pl-prickly lettuce, d - dandelion, bl-blue lettuce, fxt – green or yellow foxtail, rt – Russian thistle, sg – stinkgrass, lq – lambs quarters, byg – barnyard grass, pig - red root pigweed, pw – poverty weed, f mar – fetid marigold, p sp – prostrate spurge, tg – tumble grass, lls – lance-leaf sage, pc – pennycress, wg – witchgrass, pl – prickly lettuce.

Table 43. Weeds at the Wall Rotation Study and their characteristics.

Common Name	Growth Form	Life Span	Origin	Season or flowering dates	Reproduction
ALS Kochia	Forb	Annual	Eurasia	July-October	Seeds
Non-ALS Kochia	Forb	Annual	Eurasia	July-October	Seeds
Russian Thistle	Forb	Annual	Europe	Aug-October	Seeds
Dandelion	Forb	Perennial	Eurasia	Apr-October	Seeds
Prickly Lettuce	Forb	Annual	Europe	July-Sept	Seeds
Pennycress	Forb	Ann / W. Ann	Europe	April-June	Seeds
Green Foxtail	Grass	Annual	Eurasia	Warm	Seeds
Yellow Foxtail	Grass	Annual	Europe	Warm	Seeds
Downy Brome	Grass	Winter Annual	Europe	Cool	Seeds
Japanese Brome	Grass	Winter Annual	Europe	Cool	Seeds
Volunteer Wheat	Grass	Winter Annual		Cool	Seeds
Stink grass	Grass	Annual	Europe	Warm	Seeds
Green Foxtail	Grass	Annual	Eurasia	Warm	Seeds
Mare's Tail	Forb	Annual	Native	June-Sept	Seeds
Curlycup gumweed	Forb	Biennial/sl Per	Native	July-October	Seeds
Black Nightshade	Forb	Annual	Native	May-October	Seeds
Blue Lettuce	Forb	Perennial	Native	June-Sept	Rhizomes / seed
Lambsquarters	Forb	Annual	Europe	June-Sept	Seeds
Barnyard Grass	Grass	Annual	Europe	Warm	Seeds
Redroot Pigweed	Forb	Annual	Native	July-October	Seeds
Tansy Mustard	Forb	Annual	Native	March-Aug	Seeds
Common Sunflower	Forb	Annual	Native	July-Sept	Seeds
Fetid Marigold	Forb	Annual	Native	July-Sept	Seeds
Prostrate Spurge	Forb	Annual	Native	June-October	Seeds
Tumblegrass	Grass	Perennial	Native	Warm	Seeds
Lance leaf Sage	Forb	Annual	Native	June-October	Seeds
Witchgrass	Grass	Annual	Native	Warm	Seeds
Sand bur	Grass	Ann / sl per.	Native	Warm	Seeds
Common Purslane	Forb	Annual	Eurasia	May-Nov	seed/stem fragments
Buffalo bur	Forb	Annual	Native	May-October	Seeds
Wild Buckwheat	Forb	Annual	Europe	June-Sept	Seeds
Western Salsify	Forb	Biennial/sl Per	Eurasia	May-July	Seeds
Field Bindweed	Forb	Perennial	Eurasia	June-Sept	Rhizomes / seed
Canada Thistle	Forb	Perennial	Eurasia/N. Africa	June-August	Rhizomes / seed

ALS Kochia = Acetolactate Synthase (ALS) resistant Kochia has the ability to produce enzymes to counter the effects of sulfonylurea herbicides.

Note: The **bolded weeds** above are listed from the most to least prevalent in the Wall Rotation Study.

Legend: sl per. = short lived perennial.

Data in the above table is from "*Weeds of Nebraska and the Great Plains*" Published by Nebraska Department of Agriculture.

2004-2005 PREVIEW

The following is a partial listing of experiments that are either ongoing or soon will be initiated this coming spring. Data will be collected through the following year and presented in next years Annual Report.

1) SDSU Wheat and Oilseed Crop Rotation Study at Wall, SD

This 14-acre trial was initiated in the spring of 1994. There are nine cropping sequences that are currently being evaluated. This rotation study looks at the economics, sustainability, and conservation compliance of wheat when grown in combination with minor oil seed crops (safflower, sunflower). This very important part of crop research in western South Dakota is funded by the South Dakota Wheat Commission and the South Dakota Oil Seeds Council.

2) Variety Testing of Winter Wheat and Spring Grains (8 locations)

There are currently eight Crop Performance Test (CPT) sites in western South Dakota for evaluation of winter wheat and three sites for evaluating spring grains (SG). The Crop Performance Testing Sites (CPT's) are located at Bison (SG), Ralph (SG), Hayes, Kennebec, Sturgis, Wall (SG), Oelrichs, and Martin. Spring grains to be tested include oats, barley, spring wheat and durum wheat.

3) Winter Pulse Trials

In this trial, winter field pea and winter lentil varieties are being evaluated for winter survival and yield at Wall and Dakota Lakes, South Dakota.

4) Field pea, Chickpea and Lentil Spring Planting Date Study and Variety Testing

Field pea, chickpea and lentil varieties will be grown again at five planting dates starting in the spring of 2005 at two sites in western South Dakota and evaluated for performance. In addition, field pea and chickpea varieties will be planted at Selby, Hayes, Wall, and Bison and evaluated for grain yield. Field pea will be further investigated as a cover crop. Chickpeas (garbanzo beans) are a high risk but potentially high return crop. We are seeing more interest in the production of pulse crops in the West River area.

5) Field Pea Plant Population Study

In this study, four field pea varieties will be planted at six plant populations at two locations in western South Dakota starting in the spring of 2004. The objective of this study is to determine the optimum plant population density for different pea varieties under western South Dakota conditions.

6) Chickpea Planting Date x Seeding Rate Study

In this study a single chickpea variety will be planted at four planting dates and four seeding rates. The objective of this study is to determine whether the effect of seeding rate on chickpea performance will vary depending on planting date. We will also evaluate the effect of seeding rate and planting date on disease pressure, insect pressure and on seed size.

7) Safflower Planting Date Study

This multi-year study was started in the spring of 2002. This trial compares popular safflower varieties planted at several planting dates. The objective of this study is to determine the effect of planting date on disease development (e.g. alternaria), weed competition, insect pressure, seed color, oil content and yield of the safflower varieties.

8) Mustard Evaluation

This is a multi-state study conducted in conjunction with the University of Nebraska, Kansas State University, University of Wyoming and University of Colorado. This project will look at the adaptability of canola (*Brassica napus)* and oilseed mustard (*Brassica juncea)* and their potential for biodiesel production.

9) Soybean Row Spacing x Population Study

This trial was initiated in the summer of 2004. We will again look at various row spacing and plant populations of soybeans in 2005 to determine if there is an advantage to ultra low seeding rates and wider rows in semi-arid environments.

10) Winter Wheat Planting Date Trials

Eight popular winter wheat varieties were planted in the fall of 2004 at Wall (black fallow) and Sturgis (no-till). They are five planting dates in the study (Sept. 16, Sept. 30, Oct 13, Nov. 2, and Dec. 15). We will evaluate for winter hardiness, disease occurrence, protein content, test weight, and yield of the wheat varieties.

11) Pulse Crops – Winter Wheat Sequence Study

This trial looks at planting winter wheat back on spring wheat, field pea, and chickpea stubbles. We are looking at the effect of different crop stubbles on soil moisture recharge, nitrogen fertilizer requirements, grain quality, and yield. Various rates of fertilizer will be applied in the spring to the winter wheat.