# ANNUAL PROGRESS REPORT 2008

## SOUTH DAKOTA STATE UNIVERSITY

## WEST RIVER AG CENTER

## CROPS AND SOILS RESEARCH

PLANT SCIENCE PAMPHLET #38 MARCH 2009

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 North Plaza Boulevard; Rapid City, SD 57702-9302.
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This publication can be found on the internet at: http://wrac.sdstate.edu/pubs/plant/plant.html

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 |
| Bill Greenough | Oelrichs 57763 | Fall River |
| Lennis Erickson | Ralph 57650 | Harding |
| Henry Roghair | Okaton 57562 | Jones |
| Merle Aamot | Kennebec 57544 | Lyman |
| Dave Wilson | Sturgis 57785 | Meade |
| Pat Brown | Scenic 57780 | Pennington |
| Merritt Patterson & Sons | Wall 57790 | Pennington |
| Crown Partnership | Wall 57790 | Pennington |
| James Talty | Scenic 57780 | Pennington |
| Ron Seidel | Bison 57620 | Perkins |
| 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.

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

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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, TJ Swan-Belle Fourche, Mike Huber-Timber Lake, Robert Fanning-Kennebec, Ruth Beck-Ft. Pierre, Valerie Mitchell-Murdo, Justin Keyser –Burke, Dave Vander Vliet –Mound City, Bob Drown - Bison and Robin Salverson – Buffalo.

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Research was conducted by Thandiwe Nleya – Assistant Professor, John R. Rickertsen-Research Associate II, and Bruce A. Swan-Senior Ag Research Technician, in conjunction with John D Kirby – Director Ag Experiment Station, Sue Blodgett – Dept. Head Plant Science, Robert Hall, Neal Foster, Jack Ingemansen, Amir Ibrahim, Ron Gelderman, Michael Moechnig, and Karl Glover.

A special thank you is extended to Charlie Ellis and Michael Swan for their help during 2008.

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

## WEATHER SUMMARY

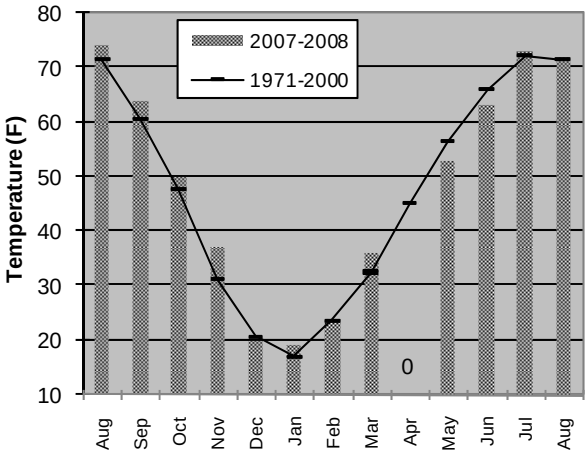
The data in the weather summaries presented in the following charts and table were obtained from the National Oceanic and Atmospheric Administration (NOAA) publication, Climatological Data – South Dakota; and from Dennis Todey, State Climatologist at South Dakota State University. Weather data were also collected from the weather station located at the Wall Rotation Study near Wall, South Dakota. For more information about South Dakota's climate, visit the South Dakota climate website *climate.sdstate.edu*

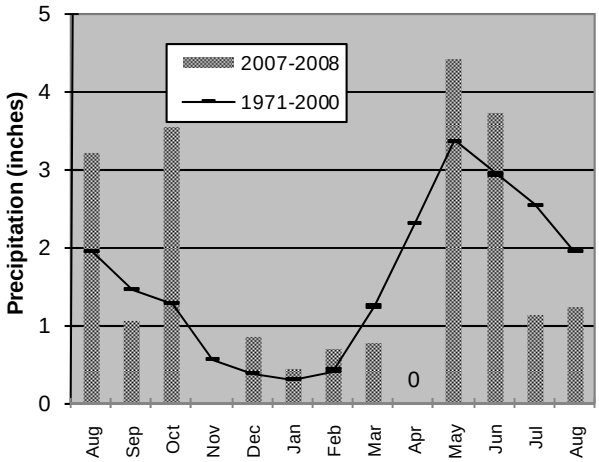
Precipitation was average in the southwest in September and dry in the northwest and far west. The trend continued in October with above average rainfall for the southwest and central parts of the state, but dry in the northwest. November thru March was below average at all locations. April was 1" or more below average at all locations. The spigot turned on in May with all locations 1 – 2" above average and that trend continued in June with totals 1 – 5" above average. July was more varied with totals 1½" below to 1½" above average. August was dry with most locations 1" below the average.

It was a warm fall in western South Dakota with temperatures above average for September thru November. December thru March were near the average, while late spring was cool with April thru June temperatures below normal. May and June were especially cool with readings 3 – 5 degrees below average. Conditions then warmed up with July and August being near the average.

It was an excellent year for winter wheat and other cool season crops in most of western South Dakota with decent October rainfall and a cool wet spring. There was an area from Sturgis east to north of Phillip that had a very dry fall and winter which caused the winter wheat to fail. The summer annual crops like sunflower and millet also benefitted from the plentiful spring moisture and normal summer temperatures. Overall, it was a good year for crop production with much better moisture conditions than the past several years have seen.

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

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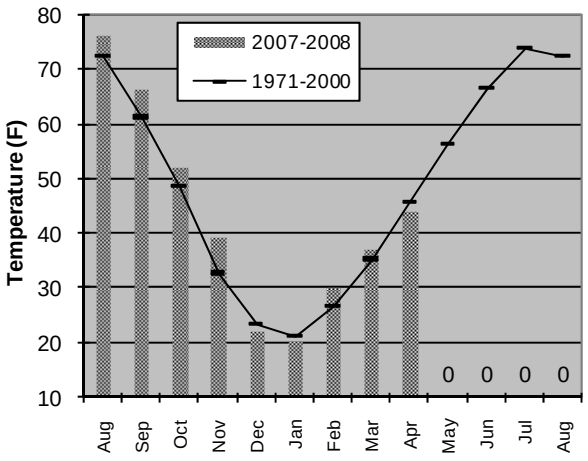
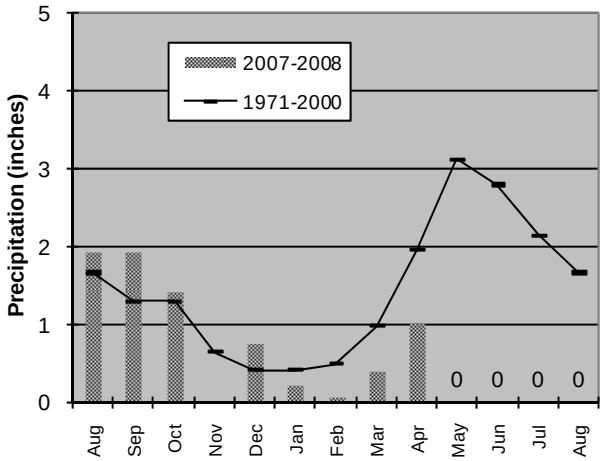
Temperature and Precipitation Charts for Oelrichs (Fall River County Reporting Station).

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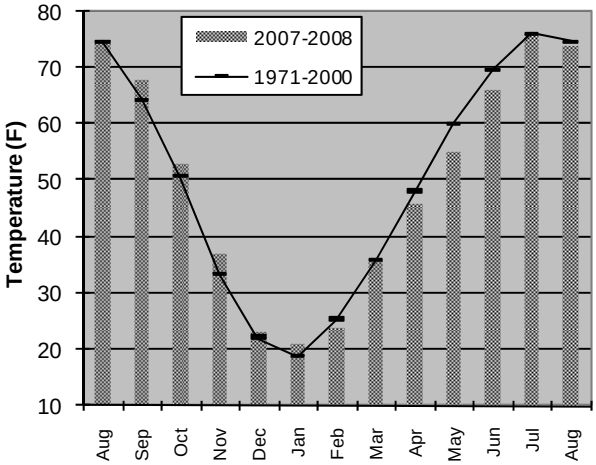
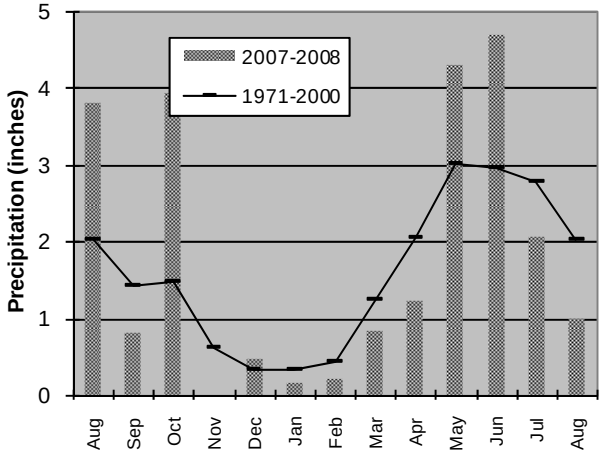
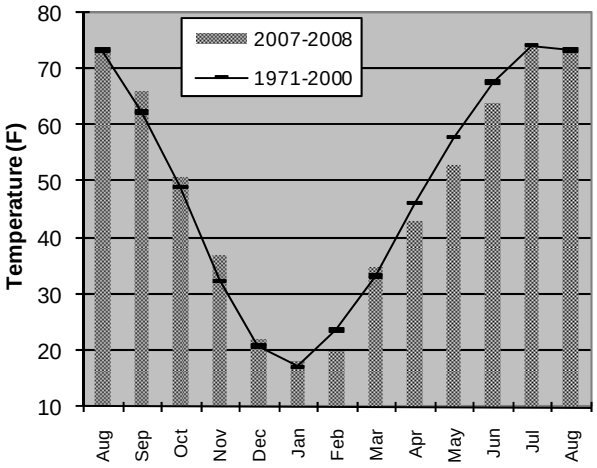
Temperature and Precipitation Charts for Kennebec (Lyman County Reporting Station).

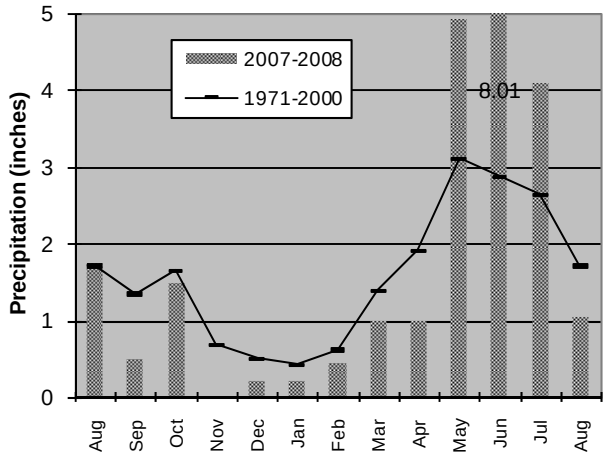


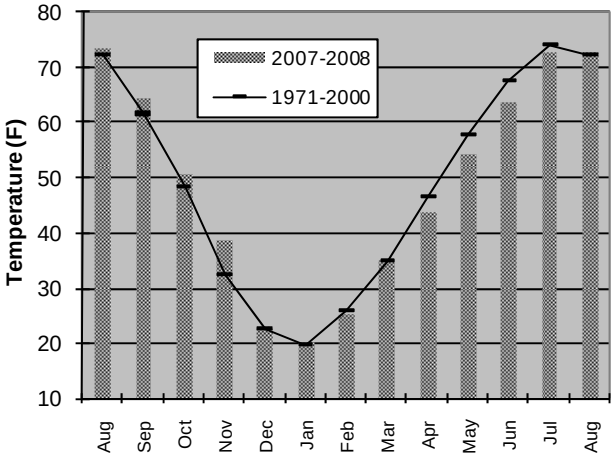

Average temperatures and precipitation obtained from NOAA Climatological Data. Weather data is collected from the reporting station nearest the experimental sites.

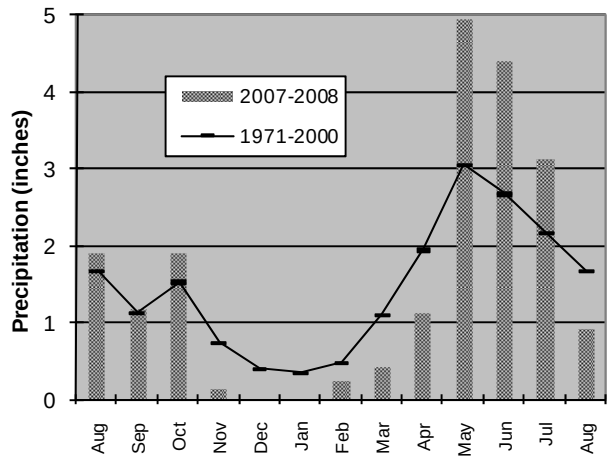
Temperature and Precipitation Charts for Kirley (Haakon County Reporting Station).



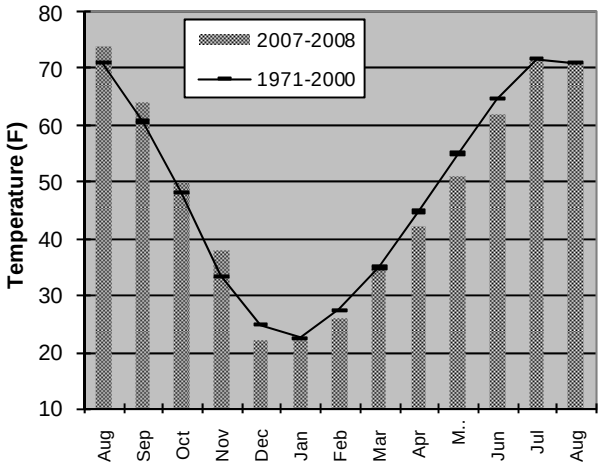



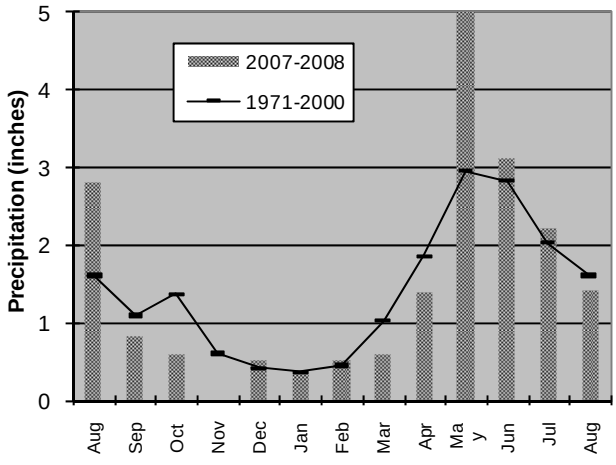

Temperature and Precipitation Charts for Wall (Rotation Study Site).



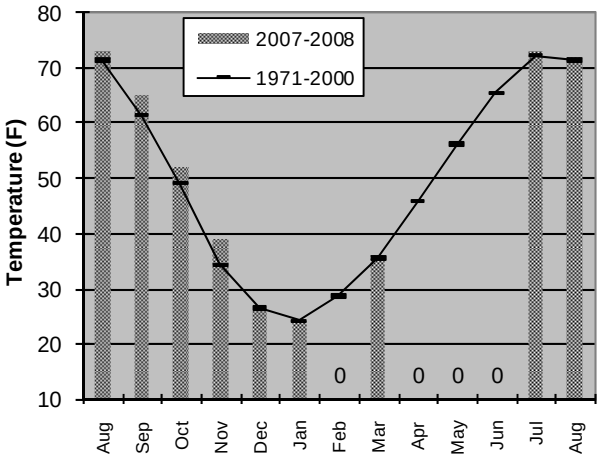

Temperature and Precipitation Charts for Rapid City Airport (Pennington County Reporting Station).

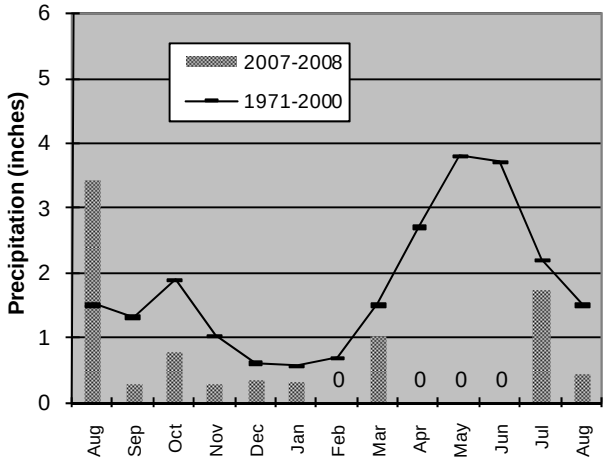



Average temperatures and precipitation obtained from NOAA Climatological Data. Weather data is collected from the reporting station nearest the experimental sites.

Temperature and Precipitation Charts for Fort Meade *(Sturgis)* (Meade County Reporting Station).

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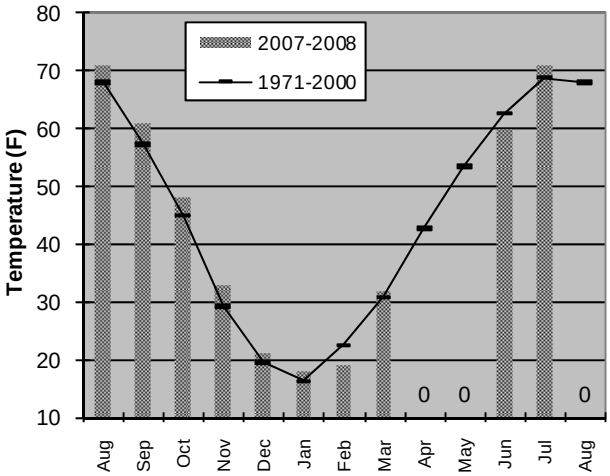
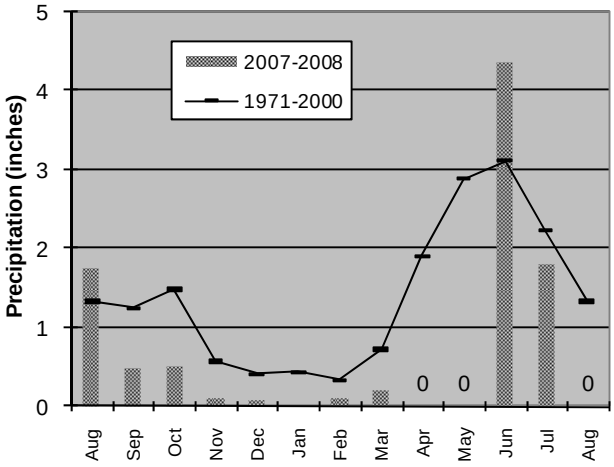
Temperature and Precipitation Charts for Ludlow (Harding County Reporting Station).

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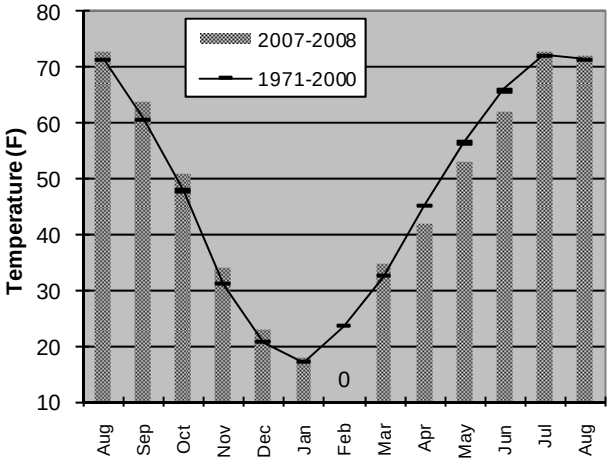
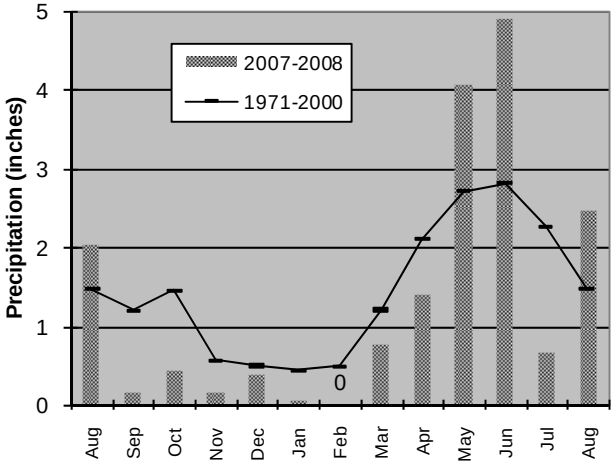
Temperature and Precipitation Charts for Bison (Perkins County Reporting Station).




*0 = Missing Data*

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

Table 1. Weather Data – Date of Critical Temperatures and Total Useable Precipitation in Counties with Experimental Plots (2007-2008).

| Location | Date of Freeze* | | Total | Total Useable Precipitation** | |
|---|---|---|---|---|---|
| | First | Last | Moisture# | Aug. 07-July 08 | April 08-July 08 |
| Bennett County (Martin) | Sept 14, 2007 26$^{O}$ F | May 11, 2008 22$^{O}$ F | 19.80” M | 12.18” | 6.57” |
| Fall River County (Oelrichs) | Missing | Missing | 4.58” M | 5.92” M | 2.80” M |
| Harding County (Ludlow) | Sept 14, 2007 25$^{O}$ F | Missing | 9.38” M | 5.21” M | 3.94” M |
| Jones County (Murdo) | Nov 3, 2007 28$^{O}$ F | April 28, 2008 28$^{O}$ F | 23.65” | 15.42” | 8.83” |
| Meade County (Ft. Meade) | Sept 14, 2007 28$^{O}$ F | Missing | 8.16” M | 4.15” M | 1.00” M |
| Pennington County (Rapid City AP) | Oct 22, 2007 28$^{O}$ F | May11, 2008 28$^{O}$ F | 20.18” | 13.57” | 11.23” |
| Pennington County (Wall) | Oct 27, 2007 28$^{O}$ F | April 28,2008 27$^{O}$ F | 17.51” M | 12.21” M | 9.32” M |
| Perkins County (Bison) | Sept 14, 2007 27$^{O}$ F | May 1, 2008 28$^{O}$ F | 15.07” M | 8.89” M | 7.53” |
| Haakon County (Kirley) | Oct 27, 2007 28$^{O}$ F | April 29,2008 28$^{O}$ F | 23.73” | 16.45” | 13.88” |
| Butte County (Newell) | Oct 22, 2007 28$^{O}$ F | April 29, 2008 26$^{O}$ F | 21.29” | 14.47” M | 13.08” M |
| Lyman County (Kennebec) | Sept 14, 2007 28$^{O}$ F | May 11, 2008 27$^{O}$ F | 22.47” | 15.05” | 8.45” |

* = First 28$^{o}$ temperature in Fall or last 28$^{o}$ temperature in Spring, reported in degrees Fahrenheit.

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

# = Total moisture from August 1, 2007 to July 31, 2008.

M = partial missing data from weather station site.

## 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 2007 with a John Deere 610 double disk (conventional 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 960,000 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 2007 and April 2008. 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:**

### Fall River County – Oelrichs

Planted: September 18, 2007 Herbicide: Cleanwave (14 oz/A)
Harvested: July 22, 2008 Additional Nitrogen: 80 Lb/Ac
Previous crop: Conventional fallow

Yields at Oelrichs were decent in 2008 averaging 44 Bu/A. The top yielding varieties in 2008 were Hatcher, Wahoo, Overland, Ripper and Jagalene. Top varieties over the past three years were . Results are presented in Table 2.

### Bennett County – Martin

Planted: October 1, 2007 Herbicide: Harmony GT ($^1/_2$ oz/A)
Harvested: July 31, 2008 Additional Nitrogen: 50 Lb/A
Previous crop: Millet stubble, no-till planted

Martin had excellent yields in 2008 with an average yield of 63 Bu/A recroped behind millet. The top yield group in 2008 consisted of Hatcher, Infinity CL, Wahoo, Expedition, Settler CL, Lyman and Wesley. The best varieties over the past three years were Hatcher, Wesley, Wahoo, Darrell and Arapahoe. Results are presented in Table 3.

### Lyman County – Kennebec

Planted: September 21, 2007 Herbicide: Amber (0.4oz/A)
Harvested: July 21, 2008 Additional Nitrogen: 50 Lb/A
Previous crop: Conventional fallow

Yields were excellent at Kennebec averaging 81 Bu/A. The top yielding varieties in 2008 were Lyman, Overland, Millennium and Arapahoe. There are no three year averages for Kennebec. Results are presented in Table 4.

Table 2. Hard Winter Wheat Variety Trial – Fall River County (Oelrichs), 2008.

| Variety | Height | Lodging | Test Wt | Yield | Protein |
|---|---|---|---|---|---|
| | Inches | 0-9* | Lb/Bu | Bu/A | Percent |
| ***Hard Red*** | | | | | |
| ALLIANCE | 34 | 0 | 58.3 | 45 | 12.0 |
| ARAPAHOE | 36 | 0 | 57.8 | 42 | 14.5 |
| BUTEO | 35 | 0 | 59.2 | 43 | 12.4 |
| DARRELL | 34 | 0 | 59.9 | 43 | 12.2 |
| EXPEDITION | 31 | 0 | 58.8 | 41 | 12.6 |
| HARDING | 35 | 0 | 57.3 | 42 | 12.4 |
| HATCHER | 30 | 0 | 60.7 | **53** | 10.8 |
| JAGALENE | 32 | 0 | 63.5 | **47** | 11.1 |
| JERRY | 36 | 0 | 57.4 | 41 | 13.6 |
| MILLENNIUM | 34 | 0 | 61.0 | 44 | 13.1 |
| OVERLAND | 35 | 0 | 61.5 | **48** | 11.0 |
| OVERLEY | 32 | 0 | 61.6 | 40 | 13.1 |
| RIPPER | 29 | 0 | 61.4 | **49** | 12.4 |
| TANDEM | 34 | 0 | 60.8 | 46 | 12.2 |
| WAHOO | 33 | 0 | 58.6 | **52** | 10.9 |
| WESLEY | 29 | 0 | 58.4 | 45 | 13.1 |
| ***Hard White*** | | | | | |
| ALICE | 30 | 0 | 61.4 | 39 | 13.3 |
| DANBY | 31 | 0 | 53.9 | 37 | 12.8 |
| NUDAKOTA | 28 | 0 | 58.3 | 45 | 12.7 |
| WENDY | 30 | 0 | 61.2 | 39 | 13.0 |
| Average | 32.3 | 0.0 | 59.5 | 44.0 | 12.5 |
| LSD (P=.05) | 1.8 | 0.0 | 2.0 | 6.2 | . |
| CV | 3.9 | 0.0 | 2.4 | 10.0 | . |

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

Table 3. Hard Winter Wheat Variety Trial - Bennett County (Martin), 2006-2008.

| Variety | Height | Lodging | Test Wt | Protein | Yield | Bu/A |
|---|---|---|---|---|---|---|
| | Inches | 0-9* | Lb/Bu | Percent | 2008 | 3 - Year |
| ***Hard Red*** | | | | | | |
| ARAPAHOE | 37 | 0 | 59.6 | 9.2 | 61 | **49** |
| DARRELL | 37 | 0 | 60.7 | 9.3 | **68** | **49** |
| EXPEDITION | 34 | 0 | 60.5 | 10.3 | **68** | **48** |
| FULLER | 32 | 0 | 59.9 | 9.1 | 62 | -- |
| HARDING | 39 | 0 | 60.1 | 8.6 | 59 | 44 |
| HATCHER | 34 | 0 | 59.4 | 8.6 | **71** | **52** |
| HAWKEN | 30 | 0 | 61.6 | 8.7 | 63 | -- |
| JAGALENE | 33 | 0 | 61.5 | 8.9 | 54 | 39 |
| JERRY | 39 | 0 | 60.3 | 10.1 | 55 | 43 |
| LYMAN | 37 | 0 | 60.3 | 8.2 | **66** | -- |
| MILLENNIUM | 38 | 0 | 61.4 | 8.1 | 63 | **47** |
| OVERLAND | 34 | 0 | 61.7 | 9.6 | 59 | **47** |
| SMOKY HILL | 32 | 0 | 61.9 | 8.8 | 58 | -- |
| TANDEM | 37 | 0 | 61.4 | 10.4 | 62 | 46 |
| WAHOO | 36 | 0 | 57.6 | 9.1 | **69** | **50** |
| WESLEY | 30 | 0 | 59.2 | 9.4 | **64** | **52** |
| INFINITY CL | 33 | 0 | 59.7 | 8.7 | **67** | -- |
| SETTLER CL | 36 | 0 | 61.7 | 9.9 | **69** | -- |
| SD01058 | 37 | 0 | 60.3 | 8.8 | 64 | -- |
| SD01273 | 36 | 0 | 61.9 | 10.5 | **67** | -- |
| ***Hard White*** | | | | | | |
| ALICE | 32 | 0 | 61.6 | 10.5 | 63 | **48** |
| NUDAKOTA | 29 | 0 | 60.0 | 9.4 | 58 | 47 |
| RONL | 34 | 0 | 60.6 | 10.5 | 60 | -- |
| WENDY | 29 | 0 | 62.5 | 9.8 | 60 | **48** |
| THUNDER CL | 31 | 0 | 60.0 | 8.1 | 62 | -- |
| SD98W175-1 | 31 | 0 | 61.9 | 10.8 | 58 | -- |
| SD05118 | 35 | 0 | 61.6 | 9.2 | **69** | -- |
| SD05210 | 36 | 0 | 60.5 | 8.7 | 56 | -- |
| SD05W012 | 36 | 0 | 59.5 | 8.9 | **68** | -- |
| SD05W018 | 36 | 0 | 61.1 | 9.7 | **71** | -- |
| Average | 34.2 | 0.0 | 60.7 | 9.3 | 63.0 | 63 |
| LSD (P=.05) | 2.1 | 0.0 | 1.4 | . | 7.5 | 8 |
| CV | 4.3 | 0.0 | 1.7 | . | 8.4 | 8 |

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

Table 4. Hard Winter Wheat Variety Trial - Lyman County (Kennebec), 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Protein Percent | Yield Bu/A |
|---|---|---|---|---|---|
| ***Hard Red*** | | | | | |
| ARAPAHOE | 43 | 0 | 62.0 | 12.0 | 86 |
| DARRELL | 39 | 0 | 63.2 | 11.5 | 81 |
| EXPEDITION | 40 | 0 | 59.8 | 10.6 | 77 |
| FULLER | 37 | 0 | 61.6 | 12.8 | 75 |
| HARDING | 43 | 0 | 63.4 | 11.5 | 86 |
| HATCHER | 35 | 0 | 61.6 | 10.6 | 73 |
| HAWKEN | 33 | 0 | 62.3 | 12.4 | 78 |
| JAGALENE | 37 | 0 | 59.4 | 11.8 | 62 |
| JERRY | 42 | 0 | 62.3 | 12.3 | 76 |
| LYMAN | 43 | 0 | 63.1 | 11.7 | **95** |
| MILLENNIUM | 43 | 0 | 63.8 | 11.2 | 89 |
| OVERLAND | 41 | 0 | 63.9 | 11.7 | **91** |
| SMOKY HILL | 36 | 0 | 63.0 | 11.7 | 84 |
| TANDEM | 45 | 0 | 63.0 | 11.3 | 82 |
| WAHOO | 41 | 0 | 58.4 | 12.2 | 82 |
| WESLEY | 36 | 0 | 59.7 | 11.7 | 76 |
| INFINITY CL | 37 | 0 | 59.7 | 10.6 | 75 |
| SETTLER CL | 42 | 0 | 63.0 | 11.0 | 82 |
| SD01058 | 39 | 0 | 61.4 | 12.1 | 79 |
| SD01273 | 42 | 0 | 62.9 | 10.9 | 83 |
| ***Hard White*** | | | | | |
| ALICE | 36 | 0 | 62.3 | 10.7 | 77 |
| NUDAKOTA | 34 | 0 | 60.9 | 11.1 | 84 |
| RONL | 38 | 0 | 60.7 | 11.0 | 79 |
| WENDY | 35 | 0 | 61.5 | 11.9 | 79 |
| THUNDER CL | 35 | 0 | 57.9 | 11.3 | 68 |
| SD98W175-1 | 39 | 0 | 63.8 | 11.9 | 78 |
| SD05118 | 39 | 0 | 63.9 | 10.5 | **92** |
| SD05210 | 41 | 0 | 62.8 | 11.4 | 88 |
| SD05W012 | 41 | 0 | 62.3 | 11.2 | 88 |
| SD05W018 | 40 | 0 | 63.5 | 11.0 | 85 |
| Average | 39.0 | 0.0 | 61.9 | 11.5 | 80.9 |
| LSD (P=.05) | 2.3 | 0.0 | 1.3 | . | 5.8 |
| CV | 4.1 | 0.0 | 1.4 | . | 5.1 |

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

### Stanley County - Hayes

Planted: September 17, 2007 Herbicide: Widematch
Harvested: July 25, 2008 Additional Nitrogen: 60 lb/A
Previous crop: Wheat, no-till planted

Hayes had yields averaging 76 Bu/A with the varieties Smoky Hill, Wendy, Tandem, Expedition, Darrell, Settler CL and Overland showing top yields in 2008. There are no three year averages for Hayes. Results are presented in Table 5.

### Pennington County - Wall

Planted: September 15, 2007 Herbicide: None
Harvested: July 20, 2008 Additional Nitrogen: 80 lb/A
Previous crop: Chemical fallow, no-till planted

The good moisture at Wall in 2008 led to an average yield of 74 Bu/A. The best yielding varieties at Wall were Overland, Wendy, Smoky Hill, Expedition, Hawken and Wesley. The best yielding varieties the past three years were Wendy, NuDakota, Overland, Expedition Wesley, Alice, Wahoo and Jagalene. The results are presented in Table 6.

### Meade County - Sturgis

Planted: September 20, 2007 Herbicide: Amber (0.4 oz/A)
Harvested: August 12, 2008 Additional Nitrogen: 80 lb/A
Previous crop: Wheat, no-till planted

Dry conditions continued at Sturgis in 2008 with limited fall moisture leading to less than ideal stands and tillering. These conditions limited yields to 37 Bu/A. The varieties with the best yields in 2008 were Overland, Hatcher, Smoky Hill, Darrell and Alice. The varieties in the top yield group over the past three years were Darrell, Millenium, Overland, Wahoo and Wesley. The results are presented in Table 7.

### Perkins County - Bison

Planted: September 19, 2007 Herbicide: None
Harvested: August 13, 2008 Additional Nitrogen: 80 lb/A
Previous crop: Wheat, no-till planted

Though Bison was also dry again this year, winter wheat yields averaged 47 Bu/A, good for recrop wheat. Because of the variability in the plot no yield comparisons can be made in 2008. There are no three year averages for Bison. Results are presented in Table 8.

Table 5. Hard Winter Wheat Variety Trial - Stanley County (Hayes), 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Protein Percent | Yield Bu/A |
|---|---|---|---|---|---|
| ***Hard Red*** | | | | | |
| ARAPAHOE | 40 | 8 | 56.8 | 13.0 | 73 |
| DARRELL | 39 | 1 | 59.4 | 11.9 | **79** |
| EXPEDITION | 37 | 1 | 60.2 | 12.2 | **81** |
| FULLER | 35 | 0 | 58.6 | 11.3 | 76 |
| HARDING | 42 | 2 | 58.6 | 13.5 | 71 |
| HATCHER | 33 | 2 | 57.7 | 10.2 | 71 |
| HAWKEN | 32 | 1 | 59.0 | 12.9 | 73 |
| JAGALENE | 36 | 3 | 59.3 | 11.1 | 70 |
| JERRY | 44 | 4 | 59.0 | 11.1 | 66 |
| LYMAN | 38 | 1 | 60.1 | 12.3 | 75 |
| MILLENNIUM | 41 | 3 | 60.1 | 12.2 | 77 |
| OVERLAND | 39 | 2 | 59.9 | 10.5 | 78 |
| SMOKY HILL | 35 | 1 | 60.0 | 12.4 | **85** |
| TANDEM | 39 | 3 | 61.3 | 12.5 | **82** |
| WAHOO | 40 | 6 | 55.0 | 11.9 | 75 |
| WESLEY | 34 | 3 | 58.2 | 11.8 | 77 |
| INFINITY CL | 36 | 1 | 58.6 | 12.8 | **79** |
| SETTLER CL | 37 | 5 | 60.0 | 12.0 | 78 |
| SD01058 | 38 | 2 | 59.0 | 11.3 | 72 |
| SD01273 | 39 | 3 | 61.2 | 10.8 | 77 |
| ***Hard White*** | | | | | |
| ALICE | 35 | 4 | 61.4 | 10.7 | 74 |
| NUDAKOTA | 33 | 3 | 58.9 | 11.6 | 75 |
| RONL | 36 | 2 | 60.6 | 9.7 | 75 |
| WENDY | 34 | 1 | 61.0 | 12.2 | **83** |
| THUNDER CL | 35 | 5 | 58.8 | 11.6 | 76 |
| SD98W175-1 | 37 | 2 | 60.5 | 12.6 | 73 |
| SD05118 | 38 | 5 | 58.8 | 11.9 | **78** |
| SD05210 | 40 | 2 | 56.8 | 13.8 | 69 |
| SD05W012 | 35 | 2 | 59.8 | 11.1 | 73 |
| SD05W018 | 38 | 1 | 59.5 | 11.9 | 74 |
| Average | 37.1 | 2.6 | 59.3 | 11.8 | 75.5 |
| LSD (P=.05) | 2.4 | . | 2.1 | . | 6.8 |
| CV | 4.6 | . | 2.5 | . | 6.4 |

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

Table 6. Hard Winter Wheat Variety Trial - Pennington County (Wall), 2006-2008.

| Variety | Yield Bu/A | |
|---|---|---|
| | 2008 | 3 - Year |
| ***Hard Red*** | | |
| ARAPAHOE | 71 | 56 |
| DARRELL | 73 | 55 |
| EXPEDITION | **80** | **61** |
| FULLER | 78 | -- |
| HARDING | 67 | 52 |
| HATCHER | 65 | 56 |
| HAWKEN | 79 | -- |
| JAGALENE | 77 | **58** |
| JERRY | 62 | 49 |
| LYMAN | 72 | -- |
| MILLENNIUM | 76 | 56 |
| OVERLAND | **85** | **61** |
| SMOKY HILL | **81** | -- |
| TANDEM | 68 | 55 |
| WAHOO | 75 | **58** |
| WESLEY | **79** | **61** |
| INFINITY CL | 72 | -- |
| SETTLER CL | 75 | -- |
| SD01058 | 67 | -- |
| SD01273 | 71 | -- |
| ***Hard White*** | | |
| ALICE | 77 | **60** |
| NUDAKOTA | 78 | **62** |
| RONL | 71 | -- |
| WENDY | **84** | **64** |
| THUNDER CL | 75 | -- |
| SD98W175-1 | 74 | -- |
| SD05118 | 75 | -- |
| SD05210 | 71 | -- |
| SD05W012 | 69 | -- |
| SD05W018 | **82** | -- |
| Average | 74 | 57 |
| LSD (P=.05) | 7 | 7 |
| CV | 6 | 10 |

Table 7. Hard Winter Wheat Variety Trial - Meade County (Sturgis), 2006-2008.

| Variety | Height | Lodging | Test Wt | Protein | Yield | Bu/A |
|---|---|---|---|---|---|---|
| | Inches | 0-9* | Lb/Bu | Percent | 2008 | 3 - Year |
| ***Hard Red*** | | | | | | |
| ARAPAHOE | 32 | 0 | 57.3 | 14.0 | 28 | 32 |
| DARRELL | 31 | 0 | 57.2 | 9.9 | **40** | **37** |
| EXPEDITION | 31 | 0 | 58.7 | 10.1 | **41** | 34 |
| FULLER | 28 | 0 | 57.2 | 8.5 | **38** | -- |
| HARDING | 35 | 0 | 56.6 | 11.4 | 34 | 33 |
| HATCHER | 29 | 0 | 57.2 | 9.9 | **45** | 40 |
| HAWKEN | 27 | 0 | 56.5 | 10.8 | 35 | -- |
| JAGALENE | 29 | 0 | 57.2 | 9.8 | **38** | 34 |
| JERRY | 33 | 0 | 55.2 | 11.6 | 33 | 32 |
| LYMAN | 34 | 0 | 60.0 | 10.6 | **40** | -- |
| MILLENNIUM | 32 | 0 | 59.4 | 9.4 | **45** | **36** |
| OVERLAND | 28 | 0 | 58.9 | 11.2 | **41** | **36** |
| SMOKY HILL | 35 | 0 | 57.2 | 10.3 | **37** | -- |
| TANDEM | 31 | 0 | 56.1 | 11.8 | **39** | 35 |
| WAHOO | 28 | 0 | 57.0 | 8.4 | **39** | **36** |
| WESLEY | 32 | 0 | 56.7 | 11.0 | **38** | **36** |
| INFINITY CL | 27 | 0 | 56.5 | 11.8 | 33 | -- |
| SETTLER CL | 31 | 0 | 58.8 | 11.2 | 33 | -- |
| SD01058 | 32 | 0 | 59.2 | 10.8 | **39** | -- |
| SD01273 | 33 | 0 | 61.0 | 10.7 | **40** | -- |
| ***Hard White*** | | | | | | |
| ALICE | 28 | 0 | 58.0 | 11.5 | **40** | 35 |
| NUDAKOTA | 26 | 0 | 56.8 | 10.0 | **38** | 33 |
| RONL | 31 | 0 | 58.4 | 11.1 | **37** | -- |
| WENDY | 27 | 0 | 58.5 | 11.0 | 30 | 30 |
| THUNDER CL | 28 | 0 | 58.2 | 11.3 | 36 | -- |
| SD98W175-1 | 29 | 0 | 58.9 | 9.3 | 35 | -- |
| SD05118 | 30 | 0 | 58.5 | 10.0 | 35 | -- |
| SD05210 | 31 | 0 | 57.0 | 10.0 | 32 | -- |
| SD05W012 | 30 | 0 | 56.1 | 11.8 | 26 | -- |
| SD05W018 | 31 | 0 | 58.2 | 10.9 | 36 | -- |
| Average | 30.4 | 0.0 | 57.7 | 10.7 | 36.7 | 35 |
| LSD (P=.05) | 3.0 | 0.0 | 2.8 | . | 8.5 | 5 |
| CV | 6.0 | 0.0 | 2.9 | . | 14.3 | 9 |

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

Table 8. Hard Winter Wheat Variety Trial - Perkins County (Bison), 2008.

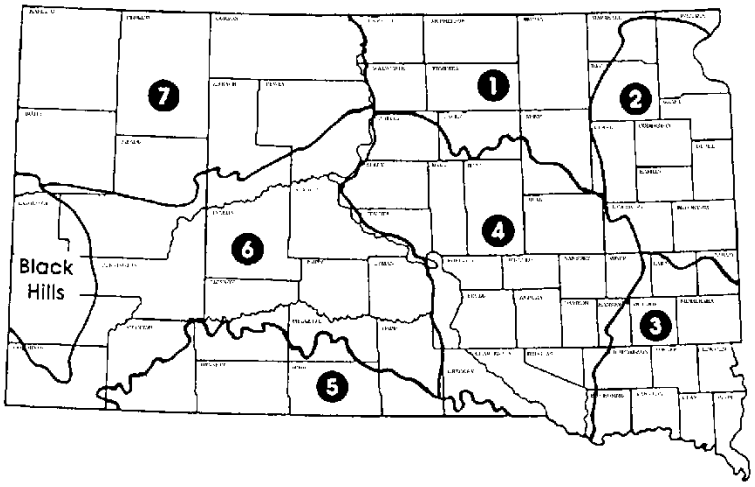
| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Protein Percent | Yield Bu/A |
|---|---|---|---|---|---|
| ***Hard Red*** | | | | | |
| ARAPAHOE | 34 | 0 | 53.3 | 12.9 | 37 |
| DARRELL | 35 | 0 | 55.4 | 13.0 | 49 |
| EXPEDITION | 35 | 0 | 55.9 | 12.4 | 56 |
| FULLER | 33 | 0 | 55.0 | 13.0 | 53 |
| HARDING | 38 | 0 | 53.8 | 14.0 | 37 |
| HATCHER | 32 | 0 | 54.7 | 11.8 | 48 |
| HAWKEN | 32 | 0 | 56.4 | 13.0 | 52 |
| JAGALENE | 34 | 0 | 56.7 | 13.1 | 48 |
| JERRY | 38 | 0 | 54.5 | 14.3 | 36 |
| LYMAN | 36 | 0 | 52.0 | 14.0 | 43 |
| MILLENNIUM | 37 | 0 | 56.2 | 12.8 | 46 |
| OVERLAND | 34 | 0 | 58.0 | 12.1 | 49 |
| SMOKY HILL | 31 | 0 | 56.8 | 13.3 | 46 |
| TANDEM | 39 | 0 | 56.1 | 13.5 | 42 |
| WAHOO | 34 | 0 | 52.1 | 12.5 | 47 |
| WESLEY | 31 | 0 | 54.2 | 14.0 | 49 |
| INFINITY CL | 36 | 0 | 54.2 | 12.6 | 48 |
| SETTLER CL | 32 | 0 | 53.9 | 13.6 | 45 |
| SD01058 | 37 | 0 | 54.4 | 12.7 | 48 |
| SD01273 | 39 | 0 | 56.6 | 13.0 | 52 |
| ***Hard White*** | | | | | |
| ALICE | 30 | 0 | 58.3 | 13.3 | 43 |
| NUDAKOTA | 30 | 0 | 54.4 | 12.3 | 49 |
| RONL | 34 | 0 | 57.3 | 12.4 | 51 |
| WENDY | 33 | 0 | 56.6 | 12.8 | 55 |
| THUNDER CL | 34 | 0 | 55.4 | 12.8 | 48 |
| SD98W175-1 | 34 | 0 | 56.7 | 12.8 | 47 |
| SD05118 | 37 | 0 | 54.0 | 13.3 | 50 |
| SD05210 | 34 | 0 | 52.9 | 13.2 | 41 |
| SD05W012 | 34 | 0 | 54.5 | 12.7 | 48 |
| SD05W018 | 34 | 0 | 55.1 | 12.8 | 42 |
| Average | 34.3 | 0.0 | 55.2 | 13.0 | 46.8 |
| LSD (P=.05) | 3.7 | 0.0 | 2.2 | . | **NS** |
| CV | 6.6 | 0.0 | 2.4 | . | **18.1** |

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

## WHEAT VARIETY RECOMMENDATIONS FOR 2008

### Crop Adaptation Areas for South Dakota

(Revised 1992)




## WINTER WHEAT

**Recommended:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| Alice (white) [PVP] | 1 [pc],4 [pc],5,6,7 [pc] |
| Expedition [PVP] | 1 [pc],4 ,5,6,7 [pc] |
| Harding [PVP] | 1 [pc],2 [pc],4,7 |
| Millennium [PVP] | 1 [pc],4 [pc],5,6,7 [pc] |
| NuDakota [PVP] | 5,6,7 [pc] |
| Overland [PVP] | 1 [pc],3,4 [pc],5,6,7 [pc] |
| Wendy (white) [PVP] | 5,6,7 [pc] |
| Wesley | 5,6,7 [pc] |

**Acceptable/Promising:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| Arapahoe [PVP] | 1 [pc],3,4 [pc],5,6,7 [pc] |
| Darrell [PVP] | 1 [pc],4 [pc],5,6,7 [pc] |
| Hatcher [PVP] | 5,6,7 [pc] |
| Hawken [PVP] | 3, 4 [pc],5,6 |

## SPRING WHEAT

**Recommended:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| Briggs [PVP] | All except 3 |
| Faller [PVP] | Statewide |
| Howard [PVP] | Statewide |
| Granger [PVP] | All except 3 |
| RB07 [PVP] | All except 3 |
| Steele-ND [PVP] | All except 3 |
| Traverse [PVP] | Statewide |

**Acceptable/Promising:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| Glenn [PVP] | Statewide |
| Tom [PVP] | 3,4 |

## 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 19.

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[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 and Field Peas, 2009 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 2008 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 with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest.

**Location Summaries:**

### Locations not Harvested

| Location | Reason |
|---|---|
| Harding County – Ralph | Hail |

### Perkins County – Bison

Planted: April 17, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 13, 2008 Additional Nitrogen: 50 lb/A
Previous crop: Wheat, no-till planted

The growing conditions at Bison were somewhat dry in 2008 with yields averaging 28 Bu/A with test weights averaging 58.1 Lb/Bu. There was too much variation in the plot for valid yield comparisons to be made in 2008 (CV = 17.2). There are no three year averages for Bison. Results are shown in Table 9.

### Pennington County - Wall

Planted April 15, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 5, 2008 Additional Nitrogen: 30 lb/A
Previous crop: Chemical fallow

Wall had good growing conditions for spring wheat with yields averaging 44 Bu/A with light test weights averaging 55.6 Lb/Bu. Top yielding varieties in 2008 were Tom, Granger, Samson, Traverse, Faller and Briggs. There are no three year averages for Wall. Results are shown in Table 10.

Table 9. SDSU Hard Red Spring Wheat Variety Trial – Perkins County (Bison), 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt. Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|
| ADA | 28 | 0 | 57.4 | 26.4 | 14.5 |
| ALBANY | 27 | 0 | 54.0 | 29.6 | 14.6 |
| ALSEN | 31 | 0 | 54.5 | 28.5 | 13.6 |
| BRIGGS | 32 | 0 | 47.8 | 28.2 | 14.3 |
| CHRIS | 35 | 0 | 50.4 | 22.2 | 15.1 |
| FALLER | 31 | 0 | 49.4 | 25.7 | 14.6 |
| GLENN | 33 | 0 | 46.9 | 25.4 | 14.6 |
| GRANGER | 35 | 0 | 56.2 | 30.7 | 17.0 |
| HAT TRICK | 29 | 0 | 57.4 | 30.1 | 15.5 |
| HOWARD | 31 | 0 | 51.0 | 26.1 | 14.8 |
| KELBY | 27 | 0 | 56.9 | 32.8 | 14.1 |
| KUNTZ | 27 | 0 | 55.6 | 24.6 | 13.7 |
| RB07 | 30 | 0 | 57.1 | 33.8 | 14.5 |
| REEDER | 29 | 0 | 54.1 | 25.5 | 15.0 |
| SAMSON | 29 | 0 | 53.4 | 28.8 | 13.7 |
| STEELE-ND | 32 | 0 | 47.2 | 26.7 | 14.0 |
| TOM | 29 | 0 | 51.2 | 23.6 | 14.4 |
| TRAVERSE | 34 | 0 | 53.6 | 30.1 | 14.5 |
| ND 901CL | 31 | 0 | 49.0 | 25.4 | 15.3 |
| 01S0042-10 | 26 | 0 | 57.8 | 27.8 | 14.5 |
| ND SW0449 | 29 | 0 | 53.8 | 25.5 | 16.6 |
| ND 806 | 32 | 0 | 53.7 | 24.8 | 15.2 |
| ND 809 | 31 | 0 | 55.8 | 25.7 | 13.6 |
| MN 03358-4 | 31 | 0 | 54.4 | 33.4 | 14.3 |
| SD 3851 | 34 | 0 | 51.2 | 33.4 | 14.3 |
| SD 3948 | 34 | 0 | 53.3 | 28.8 | 13.6 |
| SD 3983 | 35 | 0 | 52.4 | 29.9 | 13.3 |
| SD 3997 | 35 | 0 | 57.4 | 31.9 | 12.5 |
| SD 4007 | 31 | 0 | 51.3 | 30.4 | 13.6 |
| SD 4018 | 32 | 0 | 52.8 | 30.4 | 14.7 |
| SD 4024 | 27 | 0 | 54.2 | 24.8 | 13.8 |
| SD 4027 | 34 | 0 | 57.7 | 30.4 | 13.6 |
| SD 4036 | 29 | 0 | 55.6 | 29.2 | 16.7 |
| SD 4073 | 32 | 0 | 51.3 | 29.0 | 13.9 |
| Average | 31 | 0.0 | 53.4 | 28.2 | 14.5 |
| LSD (P=.05) | 2.7 | 0.0 | 2.8 | 6.7 | . |
| CV | 6.2 | 0.0 | 3.7 | **17.0** | . |

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

Table 10. Hard Red Spring Wheat Variety Trial – Pennington County (Wall), 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt. Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|
| ADA | 31 | 0 | 58.3 | 42.5 | 14.4 |
| ALBANY | 31 | 0 | 53.6 | **46.0** | 15.0 |
| ALSEN | 31 | 0 | 55.7 | 42.7 | 13.9 |
| BRIGGS | 35 | 0 | 55.8 | **47.6** | 14.7 |
| CHRIS | 40 | 0 | 54.3 | 35.3 | 15.4 |
| FALLER | 34 | 0 | 53.9 | **47.9** | 15.1 |
| GLENN | 37 | 0 | 57.8 | 35.0 | 14.9 |
| GRANGER | 37 | 0 | 58.7 | **49.5** | 15.1 |
| HAT TRICK | 32 | 0 | 55.7 | **46.7** | 15.7 |
| HOWARD | 32 | 0 | 53.9 | 42.0 | 15.1 |
| KELBY | 30 | 0 | 57.6 | **45.5** | 13.8 |
| KUNTZ | 29 | 0 | 57.5 | **42.8** | 14.3 |
| RB07 | 30 | 0 | 56.3 | **46.4** | 14.3 |
| REEDER | 32 | 0 | 35.2 | 37.7 | 15.3 |
| SAMSON | 29 | 0 | 55.0 | **48.3** | 13.7 |
| STEELE-ND | 33 | 0 | 55.3 | 40.6 | 14.1 |
| TOM | 33 | 0 | 58.5 | **50.3** | 14.9 |
| TRAVERSE | 36 | 0 | 54.8 | **48.1** | 14.4 |
| ND 901CL | 35 | 0 | 53.8 | 37.2 | 15.6 |
| 01S0042-10 | 29 | 0 | 59.0 | **45.9** | 15.0 |
| ND SW0449 | 33 | 0 | 55.6 | 33.6 | 16.5 |
| ND 806 | 36 | 0 | 56.4 | 42.0 | 15.1 |
| ND 809 | 35 | 0 | 57.0 | **43.3** | 14.3 |
| MN 03358-4 | 33 | 0 | 56.5 | **48.6** | 13.4 |
| SD 3851 | 36 | 0 | 57.0 | **43.7** | 14.2 |
| SD 3948 | 37 | 0 | 57.7 | **44.4** | 13.4 |
| SD 3983 | 37 | 0 | 56.3 | 42.6 | 13.5 |
| SD 3997 | 38 | 0 | 57.8 | **49.2** | 12.4 |
| SD 4007 | 33 | 0 | 55.1 | **44.3** | 13.7 |
| SD 4018 | 34 | 0 | 55.1 | **45.6** | 14.7 |
| SD 4024 | 29 | 0 | 57.0 | **42.8** | 14.4 |
| SD 4027 | 36 | 0 | 58.8 | **48.4** | 13.7 |
| SD 4036 | 29 | 0 | 56.3 | **46.9** | 16.1 |
| SD 4073 | 33 | 0 | 53.9 | **50.3** | 14.0 |
| Average | 33.3 | 0.0 | 55.6 | 44.2 | 14.5 |
| LSD (P=.05) | 2.6 | 0.0 | 6.7 | 7.5 | . |
| CV | 5.6 | 0.0 | 8.5 | 12.0 | . |

* 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 two locations in April 2008 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 July with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest.

**Location Summaries:**

**Locations not Harvested**

| Location | Reason |
|---|---|
| Harding County – Ralph | Hail |

**Perkins County – Bison**

Planted: April 17, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 14, 2008 Additional Nitrogen: 50 lb/A
Previous crop: Wheat, no-till planted

Durum wheat yields averaged 26 Bu/A at Bison with light test weights averaging 50.6 Lb/Bu. There were little significant differences in yield among the varieties tested with only Alkabo yielding less than the others. There are no three year averages at Bison. Results are shown in Table 11.

Table 11. Durum Wheat Variety Trial – Perkins County (Bison), 2008.

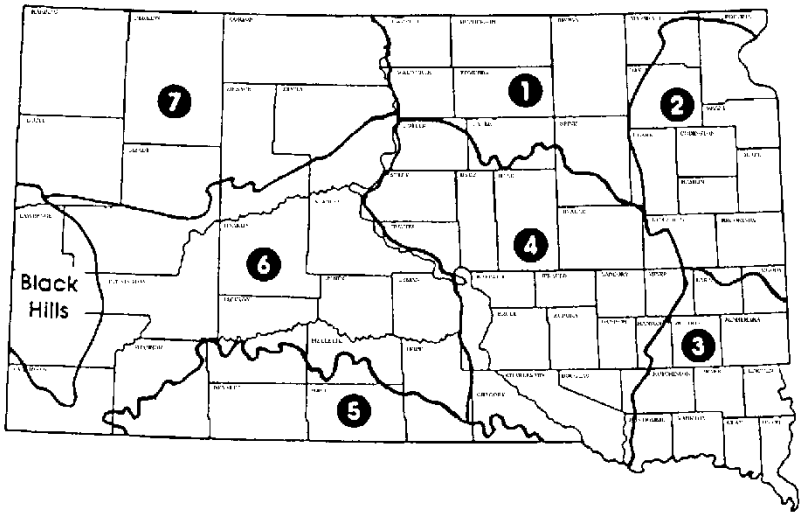
| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|
| ALKABO | 30 | 0 | 52.2 | 22.3 | 15.8 |
| BEN | 35 | 0 | 49.5 | **27.1** | 14.0 |
| DIVIDE | 32 | 0 | 51.5 | **24.9** | 13.3 |
| GRENORA | 29 | 0 | 49.8 | **27.7** | 15.3 |
| LEBSOCK | 33 | 0 | 53.0 | **28.3** | 15.3 |
| MOUNTRAIL | 31 | 0 | 47.5 | **27.9** | 14.7 |
| Average | 32 | 0.0 | 50.6 | 26.4 | 14.7 |
| LSD (P=.05) | 2.3 | 0.0 | 2.4 | 3.3 | -- |
| CV | 4.1 | 0.0 | 2.6 | 6.9 | -- |

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

## OAT AND BARLEY VARIETY RECOMMENDATIONS FOR 2008

### Crop Adaptation Areas for South Dakota

(Revised 1992)




## OATS

**Recommended:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| Beach | 5,6,7 |
| Jerry [PVP] (non-title V status) | 5,6,7 |
| Morton | 1,2,7 |
| Souris [PVP] | Statewide |
| Stallion | Statewide |

**Acceptable/Promising:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| Don | 5,6,7 |
| HiFi [PVP] | 1,2,7 |
| Reeves | 5,6,7 |
| Buff (hull-less) | Statewide |

## SPRING BARLEY

**Recommended:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| *6 Row* | |
| Lacey [PVP] | Statewide |
| Tradition [PVP] | Statewide |
| *2 Row* | |
| Conlon [PVP] | 1,4,6,7 |
| Eslick [PVP] (feed) | 6,7 |
| Rawson (feed) | 1,2,7 |

**Acceptable/Promising:**

| *Variety* | *Crop Adaptation Area* |
|---|---|
| *6 Row* | |
| Drummond [PVP] | Statewide |
| Rassmusson [PVP] | Statewide |
| *2 Row* | |
| Pinnacle | 1,2,7 |

Conlon, Drummond, Lacey, Legacy, Robust, Stellar-ND and Tradition are approved American Malting Barley Association varieties for South Dakota - 2008.

[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 and Field Peas 2009 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 three locations in April 2007 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 with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest.

**Location Summaries:**

### Perkins County – Bison

Planted: April 17, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 20, 2008 Additional Nitrogen: 50 lb/A
Previous crop: Wheat, no-till planted

The trial at Bison averaged 70 Bu/A with test weights averaging 38.5 Lb/Bu. The top yield group in 2008 consisted of Souris, Jerry, Morton and Don. There are no three year averages for Bison. Among the hull-less varieties, Buff and Streaker performed significantly better than Stark in 2008. Results are presented in Table 12.

### Jones County - Okaton

Planted: April 9, 2008 Herbicide: None
Harvested: July 30, 2008 Additional Nitrogen: 80 lb/A
Previous crop: Proso millet

Oat yields were tremendous at Okaton this year averaging 142 Bu/A with average test weights of 39.7 Lb/Bu. The best yielding varieties in 2008 were Souris, Stallion, Beach and HiFI. There are no three year averages for Okaton. Results are presented in Table 13.

### Pennington County - Wall

Planted April 15, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 5, 2008 Additional Nitrogen: 30 lb/A
Previous crop: Chemical fallow

The yields at Wall averaged 57 Bu/A with average test weights of 36.9 Lb/Bu. The best yielding varieties in 2008 were Souris, Jerry and HiFI. There are no three year averages for Wall. Results are presented in Table 14.

Table 12. Oat Variety Trial - Perkins County (Bison), 2008.

| Variety | Relative Heading | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|---|
| BUFF (hulless) | 3 | 33 | 0 | 42.6 | 60.8 | 19.4 |
| STARK (hulless) | 6 | 32 | 0 | 36.4 | 44.5 | 20.7 |
| STREAKER (hulless) | 3 | 38 | 0 | 42.8 | 61.1 | 19.9 |
| | | | | | | |
| BEACH | 6 | 37 | 0 | 36.6 | 73.8 | 16.1 |
| COLT | 1 | 35 | 0 | 39.9 | 70.1 | 17.7 |
| DON | 1 | 32 | 0 | 37.8 | 59.7 | 16.8 |
| HIFI | 8 | 36 | 0 | 33.8 | **77.5** | 16.8 |
| HYTEST | 4 | 39 | 0 | 40.7 | 58.9 | 18.6 |
| JERRY | 5 | 37 | 0 | 37.0 | **81.1** | 17.7 |
| MORTON | 7 | 38 | 0 | 35.6 | **79.7** | 16.3 |
| REEVES | 2 | 40 | 0 | 38.1 | 49.3 | 17.7 |
| SOURIS | 6 | 33 | 0 | 35.6 | **84.2** | 16.7 |
| STALLION | 8 | 36 | 0 | 36.2 | 70.1 | 17.0 |
| | | | | | | |
| SD 020883-109 | -- | 35 | 0 | 40.7 | 71.8 | 17.8 |
| SD 031128-245 | -- | 38 | 0 | 39.9 | **83.4** | 16.9 |
| SD 031128-330 | -- | 38 | 0 | 39.6 | 74.1 | 16.6 |
| SD 041405 | -- | 34 | 0 | 38.3 | **78.6** | 16.8 |
| SD 060966 | -- | 33 | 0 | 41.1 | 76.3 | 17.7 |
| Average | -- | 36 | 0.0 | 38.5 | 69.7 | 17.6 |
| LSD (P=.05) | -- | 3.0 | 0.0 | 1.6 | 7.5 | -- |
| CV | -- | 5.0 | 0.0 | 3.0 | 7.6 | -- |

* Heading Date, relative difference in days compared to Don.

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

Table 13. Oat Variety Trial – Jones County (Okaton), 2008.

| Variety | Leaf Disease 0-9 | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|---|
| BUFF (hulless) | 2 | 40 | 0 | 42.1 | 110.9 | 18.8 |
| STARK (hulless) | 0 | 44 | 0 | 35.6 | 95.2 | 20.3 |
| STREAKER (hulless) | 5 | 43 | 0 | 43.4 | 114.7 | 19.2 |
| | | | | | | |
| BEACH | 1 | 48 | 0 | 38.7 | **155.5** | 15.2 |
| COLT | 2 | 40 | 0 | 40.5 | 138.9 | 17.2 |
| DON | 1 | 37 | 0 | 38.7 | 146.9 | 15.3 |
| HIFI | 0 | 48 | 0 | 37.2 | **154.5** | 16.8 |
| HYTEST | 3 | 46 | 0 | 41.5 | 121.5 | 18.3 |
| JERRY | 2 | 46 | 0 | 39.5 | 150.4 | 18.2 |
| MORTON | 1 | 47 | 0 | 38.0 | 151.7 | 16.8 |
| REEVES | 1 | 45 | 0 | 40.1 | 132.6 | 16.7 |
| SOURIS | 0 | 40 | 0 | 38.2 | **162.1** | 17.2 |
| STALLION | 5 | 46 | 0 | 38.4 | **160.7** | 15.4 |
| | | | | | | |
| SD 020883-109 | 1 | 42 | 0 | 40.7 | 140.2 | 16.4 |
| SD 031128-245 | 0 | 44 | 0 | 40.7 | 150.3 | 17.2 |
| SD 031128-330 | 0 | 44 | 0 | 40.8 | 149.5 | 16.2 |
| SD 041405 | 1 | 39 | 0 | 39.3 | **159.1** | 16.3 |
| SD 060966 | 2 | 39 | 0 | 41.1 | **154.2** | 16.3 |
| Average | 1.4 | 43.1 | 0.0 | 39.7 | 141.6 | 17.1 |
| LSD (P=.05) | 0.7 | 2.1 | 0.0 | 0.7 | 8.7 | -- |
| CV | 37.7 | 3.5 | 0.0 | 1.3 | 4.3 | -- |

* 0 = No disease, 9 = leaf gone.
****** 0 = No Lodging, 9 = 100% lodged.

Table 14. Oat Variety Trial – Pennington County (Wall), 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|
| BUFF (hulless) | 32 | 0 | 41.5 | 49.9 | 19.5 |
| STARK (hulless) | 39 | 0 | 32.5 | 42.6 | 20.2 |
| STREAKER (hulless) | 36 | 0 | 39.7 | 58.8 | 20.0 |
| | | | | | |
| BEACH | 40 | 0 | 38.2 | 63.8 | 16.4 |
| COLT | 35 | 0 | 37.8 | 48.7 | 17.6 |
| DON | 30 | 0 | 36.1 | 47.2 | 16.7 |
| HIFI | 37 | 0 | 34.7 | **66.9** | 18.2 |
| HYTEST | 38 | 0 | 36.3 | 39.6 | 18.5 |
| JERRY | 40 | 0 | 35.1 | **66.0** | 18.5 |
| MORTON | 40 | 0 | 35.5 | 48.9 | 17.3 |
| REEVES | 38 | 0 | 35.4 | 51.8 | 17.3 |
| SOURIS | 33 | 0 | 36.3 | **76.4** | 18.0 |
| STALLION | 36 | 0 | 36.6 | 57.6 | 17.2 |
| | | | | | |
| SD 020883-109 | 36 | 0 | 38.1 | 54.5 | 18.0 |
| SD 031128-245 | 40 | 0 | 38.0 | **71.0** | 17.1 |
| SD 031128-330 | 37 | 0 | 37.6 | **68.5** | 16.7 |
| SD 041405 | 34 | 0 | 36.6 | 61.5 | 17.3 |
| SD 060966 | 32 | 0 | 37.9 | 49.7 | 18.2 |
| Average | 36.1 | 0.0 | 36.9 | 56.9 | 17.9 |
| LSD (P=.05) | 2.9 | 0.0 | 1.6 | 9.2 | -- |
| CV | 5.8 | 0.0 | 3.0 | 11.4 | -- |

***** 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 2008 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.

**Location Summaries:**

### Locations not Harvested

| Location | Reason |
|---|---|
| Harding County – Ralph | Hail |

### Perkins County – Bison

Planted: April 17, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 20, 2008 Additional Nitrogen: 50 lb/A
Previous crop: Wheat, no-till planted

At Bison, yields averaged 33 Bu/A and test weights averaged 45.8 Lb/Bu. There was a fair amount of variation in the plot (CV =15.1) so yield comparisons are difficult. Also the varieties Conlon and Rawson suffered from wildlife damage which greatly reduced their yields. There are no three year averages for Bison. Results are shown in Table 15.

### Pennington County - Wall

Planted April 15, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 5, 2008 Additional Nitrogen: 30 lb/A
Previous crop: Chemical fallow

Yields averaged 51 Bu/A at Ralph with a 47.1 Lb/Bu average test weight. The Wall location was also somewhat variable and yields were similar for most varieties There are no three year averages for Wall. There are no three year averages for Wall. Results are shown on Table 16.

Table 15. Spring Barley Variety Trial - Perkins County (Bison), 2008.

| | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|
| ***TWO ROW*** | | | | | |
| CONLON **+** | 32 | 0 | ** | 13.4 | 11.5 |
| ESLICK | 26 | 0 | 43.4 | 60.8 | 12.3 |
| PINNACLE | 31 | 0 | 46.6 | 38.5 | 10.9 |
| RAWSON **+** | 33 | 0 | ** | 10.1 | 11.3 |
| ***SIX ROW*** | | | | | |
| LACEY | 31 | 0 | 48.7 | 19.0 | 11.9 |
| TRADITION | 33 | 0 | 48.3 | 41.3 | 11.5 |
| STELLAR-ND | 31 | 0 | 44.6 | 36.7 | 10.9 |
| DRUMMOND | 34 | 0 | 45.7 | 21.0 | 11.9 |
| RASMUSSON | 31 | 0 | 46.3 | 34.2 | 11.2 |
| ROBUST | 34 | 0 | 45.9 | 23.6 | 12.2 |
| M122 | 33 | 0 | 46.0 | 35.0 | 11.1 |
| Average | 31 | 0.0 | 45.8 | 32.9 | 11.6 |
| LSD (P=.05) | 2.2 | 0.0 | 2.5 | 8.8 | -- |
| CV | 7.0 | 0.0 | 3.2 | **15.8** | -- |

**+** Colon and Rawson yields were adversely affected by wildlife damage.
* 0 = no lodging, 9 = 100% lodged.
** Not enough sample for a test weight.

Table 16. Spring Barley Variety Trial – Pennington County – (Wall), 2008.

| | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A | Protein % |
|---|---|---|---|---|---|
| ***TWO ROW*** | | | | | |
| CONLON | 32 | 0 | 51.0 | 31.5 | 11.0 |
| ESLICK | 27 | 0 | 48.1 | 54.6 | 10.7 |
| PINNACLE | 32 | 0 | 47.0 | 46.3 | 9.3 |
| RAWSON | 34 | 0 | 46.6 | 27.9 | 10.9 |
| ***SIX ROW*** | | | | | |
| LACEY | 33 | 0 | 47.2 | 59.4 | 11.0 |
| TRADITION | 32 | 0 | 47.0 | 55.4 | 11.3 |
| STELLAR-ND | 33 | 0 | 45.8 | 64.7 | 11.2 |
| DRUMMOND | 34 | 0 | 45.7 | 54.3 | 11.0 |
| RASMUSSON | 32 | 0 | 46.4 | 59.4 | 11.0 |
| ROBUST | 36 | 0 | 46.9 | 42.3 | 12.3 |
| M122 | 35 | 0 | 46.4 | 56.7 | 11.5 |
| Average | 32.2 | 0.0 | 47.1 | 50.8 | 11.0 |
| LSD (P=.05) | 2.7 | 0.0 | 1.7 | 11.1 | -- |
| CV | 5.8 | 0.0 | 2.5 | **15.1** | -- |

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

## SPRING TRITICALE VARIETY TRIAL

**Objective:** Spring Triticale varieties have done well in North Dakota trials and have potential as use for flour in certain bread products. This trial was initiated to evaluate standard and experimental spring triticale varieties for yield, agronomic characteristics and adaptation to western South Dakota.

**Procedure:** Spring triticale varieties and two spring wheat checks (Briggs and Glenn) were planted near Bison, South Dakota. The experimental design was a randomized complete block with four replications. A seeding rate of 1,390,000 seeds per acre was used and liquid starter fertilizer (10-34-0 at 6.3 gal/A) applied at 7.4-25-0 pounds per acre. Plots were trimmed to 5' x 25' after heading. The plot was harvested in July and August with a small plot combine. Height, shatter, and lodging notes were taken at the time of harvest.

**Summary:**

### Perkins County –Bison

Planted: April 17, 2008 Herbicide: Starane NXT (20oz/A)
Harvested: August 14, 2008 Additional Nitrogen: 50 lb/A
Previous crop: Wheat, no-till planted

Like the other crops at Bison, the triticale yields were below average at Bison due to the dry conditions. The plot averaged 2119 Lb/A, with the better triticale varieties yielding 30% more than the spring wheat checks. The newer varieties targeted for grain production are much shorter, have better seed quality and test weight than the older varieties that have been tested in the past. The results are shown in Table 17.

Table 17. Spring Triticale Variety Trial – Perkins County (Bison), 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Lb/A | Protein % |
|---|---|---|---|---|---|
| TRICAL 96 | 26 | 0 | 47.9 | 2226 | 12.5 |
| TRICAL 98 | 28 | 0 | 43.1 | **2518** | 12.5 |
| TRICAL 116 | 28 | 0 | 43.2 | **2494** | 12.8 |
| TRIMARK 118 | 29 | 0 | 50.0 | **2761** | 12.5 |
| | | | | | |
| 03T63063 | 28 | 0 | 42.3 | 1934 | 13.0 |
| 03T63111 | 29 | 0 | 45.7 | 2165 | 13.5 |
| 01T40264 | 28 | 0 | 48.1 | 2226 | 14.2 |
| 03T63037 | 25 | 0 | 44.6 | 2153 | 12.7 |
| 03T63053 | 26 | 0 | 49.1 | 2214 | 12.5 |
| 02T71211 | 26 | 0 | 45.6 | 1764 | 13.0 |
| 37812 | 27 | 0 | 45.4 | 2323 | 13.0 |
| | | | | | |
| MAH 2601 | 33 | 0 | 41.4 | 2129 | 13.4 |
| FL9707-01H1 | 32 | 0 | 43.3 | 1764 | 13.7 |
| MAH20555-8/ | 34 | 0 | 39.2 | 2019 | 13.6 |
| MAH28246 | 38 | 0 | 41.1 | 2177 | 12.0 |
| 177956 | 41 | 0 | 43.0 | 1727 | 13.9 |
| 163927 | 36 | 0 | 42.3 | 2153 | 12.8 |
| 180476 | 29 | 0 | 40.7 | 1776 | 14.2 |
| | | | | | |
| BRIGGS (Spring Wheat) | 35 | 0 | 46.4 | 1958 | 14.7 |
| GLENN (Spring Wheat) | 36 | 0 | 50.4 | 1897 | 14.5 |
| Average | 31 | 0.0 | 44.7 | 2119 | 13.3 |
| LSD (P=.05) | 3.0 | 0.0 | 3.4 | 355 | . |
| CV | 5.8 | 0.0 | 4.7 | 10.1 | . |

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

## SAFFLOWER VARIETY TRIAL

**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, South Dakota. The trial was planted on April 15, 2008 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.

### Pennington County - Wall

Planted: April 16, 2008
Harvested: Not harvested
Previous crop: Winter Wheat
Herbicide: Prowl $H_20$ (3 pt/A)
Additional Nitrogen: None

**Discussion:** The safflower trial suffered from severe weed pressure, especially from kochia, and was abandoned prior to harvest.

## SUNFLOWER VARIETY TRIAL

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

**Procedure:** Plots of four rows, 30 feet long, spaced 30 inches apart were planted on June 16, 2008 with a no-till planter into wheat stubble. The plot layout was in a randomized complete block design with four replications. The experiment was randomized for a nearest neighbors statistical analysis, which removes effects of field trends. Seed of most of the hybrids entered in the trials were pre-treated with Cruiser insecticide, and most were also treated with fungicide. Spartan herbicide was applied for weed control. Plots were overseeded and thinned to a plant population of 17,400 plants/acre. The center two rows of each plot were harvested with a Wintersteiger Delta small plot combine on October 30, 2008. Oil content was determined by NMR analysis. Oil values for NuSun and high oleic hybrids were adjusted for oleic acid content.

**Discussion:** Yields at Bison averaged 1727 lbs/acre and 42.4% oil content. Because of the uneven and poor stands, which caused a large amount of plot variability (CV = 20%) yield comparisons are difficult to make. Information on the statewide trials this location was part of can be found in the publication “Sunflower, South Dakota Hybrid Performance Trials, EC909”, which can be found at the following website http://plantsci.sdstate.edu/varietytrials/ Results are presented in Table 18.

Table 18. Oilseed Sunflower Hybrid Trial - Perkins County (Bison), 2007 - 2008.

| Brand | Hybrid | Type* | Seed Yield | | | Oil | Height | Lodg | Moist | Tst Wt | Pop 1000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2008 | 2007 | 2-Yr | % | cm | % | % | lb/bu | plt/ac |
| Advanta Pacific LLC | F30008NS,CL | NS/CL | 1858 | -- | -- | 39.8 | 156 | 0 | 15.1 | 25.7 | 15 |
| Croplan Genetics | CG 306 DMR NS | NS | 1868 | -- | -- | 42.6 | 145 | 2 | 14.0 | 27.6 | 11.8 |
| Croplan Genetics | CG 3080 DMR NS | NS | 2006 | -- | -- | 47.2 | 136 | 0 | 10.0 | 27.5 | 15.3 |
| Croplan Genetics | CG 325 DMR NS | NS | 1448 | -- | -- | 42.4 | 138 | 0 | 10.2 | 26.9 | 11.0 |
| Croplan Genetics | CG 356 NS | NS | 1931 | -- | -- | 43.1 | 144 | 0 | 16.6 | 28.4 | 13.7 |
| Croplan Genetics | CG 369 DMR NS | NS | 1512 | -- | -- | 42.6 | 156 | 1 | 15.4 | 26.6 | 10.6 |
| Croplan Genetics | CG 378 DMR NS | NS | 1878 | -- | -- | 41.1 | 152 | 0 | 15.3 | 25.8 | 10.4 |
| Croplan Genetics | CG 528 CL NS | NS/CL | 1912 | -- | -- | 42.7 | 146 | 1 | 11.5 | 28.1 | 13.2 |
| Croplan Genetics | CG 551 CL NS | NS/CL | 1317 | -- | -- | 40.3 | 157 | 0 | 14.5 | 24.8 | 12.1 |
| Croplan Genetics | CG 564 CL NS | NS | 1531 | -- | -- | 41.0 | 148 | 8 | 23.2 | 27.2 | 11.1 |
| Dekalb | DKF 29-30 | NS | 1059 | 1235 | 1147 | 43.6 | 139 | 0 | 7.1 | 29.0 | 12.7 |
| Dekalb | DKF 34-33 | NS | 1577 | 850 | 1213 | 42.9 | 136 | 4 | 13.8 | 26.8 | 8.5 |
| Dekalb | DKF 34-80CL | NS/CL | 1630 | 1345 | 1487 | 42.6 | 140 | 0 | 11.2 | 26.6 | 11.8 |
| Dekalb | DKF 37-31 | NS | 1256 | 1411 | 1333 | 44.7 | 134 | 0 | 14.9 | 28.7 | 10.0 |
| Dekalb | DKF 38-45 | NS | 1963 | 1865 | 1914 | 45.5 | 146 | 0 | 7.8 | 28.2 | 14.4 |
| Dekalb | DKF 3875 | Trad. | 2012 | 1679 | 1845 | 42.8 | 145 | 0 | 13.5 | 29.7 | 12.5 |
| Dekalb | DKF 39-80CL | NS/CL | 1666 | -- | -- | 38.9 | 169 | 0 | 14.3 | 25.4 | 10.2 |
| Dekalb | IS 7120 | HO | 1671 | 1255 | 1463 | 43.1 | 133 | 0 | 11.7 | 27.2 | 12.2 |
| Garst Seed Co. | 4651NS | NS | 1846 | -- | -- | 40.7 | 161 | 2 | 15.8 | 25.9 | 10.1 |
| Garst Seed Co. | NX43489 | NS | 1799 | -- | -- | 42.2 | 148 | 0 | 12.7 | 29.7 | 12.5 |
| Garst Seed Co. | NX44166 | HO | 1790 | -- | -- | 43.4 | 152 | 1 | 14.6 | 29.9 | 10.6 |
| King Seed Inc. | SunKing 4404 NSCL | NS/CL | 2246 | -- | -- | 37.8 | 153 | 0 | 16.3 | 26.1 | 15.2 |
| King Seed Inc. | SunKing 4505 | Trad. | 1754 | -- | -- | 44.4 | 161 | 1 | 9.9 | 28.6 | 10.8 |
| Monsanto | MH6640 | NS | 1604 | -- | -- | 44.0 | 140 | 2 | 13.6 | 29.7 | 11.0 |
| Monsanto | MH6643 | NS | 1414 | -- | -- | 44.5 | 143 | 0 | 11.7 | 27.6 | 10.9 |
| Monsanto | MH7632 | NS | 2008 | -- | -- | 43.3 | 141 | 0 | 14.9 | 28.9 | 14.0 |
| Monsanto | MH7633 | NS | 1550 | -- | -- | 40.5 | 150 | 3 | 15.1 | 28.3 | 9.2 |
| Mycogen Seeds | 8D481 | NS | 1803 | -- | -- | 39.9 | 146 | 0 | 13.1 | 30.5 | 10.5 |
| Mycogen Seeds | 8H449DM | HO | 2129 | 1273 | 1701 | 45.6 | 142 | 3 | 20.2 | 27.7 | 12.7 |
| Mycogen Seeds | 8N187 | NS | 1811 | -- | -- | 39.3 | 119 | 1 | 17.9 | 27.0 | 12.1 |
| Mycogen Seeds | 8N270 | NS | 1722 | 1454 | 1588 | 40.8 | 123 | 0 | 11.4 | 27.9 | 13.7 |
| Mycogen Seeds | 8N358CL | NS/CL | 1881 | 666 | 1273 | 43.7 | 141 | 0 | 15.6 | 27.2 | 13.5 |
| Mycogen Seeds | 8N453DM | NS | 1766 | 1815 | 1790 | 46.9 | 137 | 0 | 18.9 | 27.4 | 13.4 |
| Mycogen Seeds | 8N510 | NS | 1587 | 1630 | 1609 | 41.2 | 140 | 0 | 17.6 | 27.3 | 11.6 |
| Pannar | Pan 7813 | NS | 1844 | 2008 | 1926 | 41.2 | 146 | 1 | 21 | 27.6 | 10.7 |
| Pannar | Pan 7924 | NS | 1820 | 1704 | 1762 | 38.7 | 159 | 4 | 23.8 | 24.9 | 10.5 |
| Pannar | Pan 7986 | NS | 1911 | -- | -- | 40.2 | 154 | 1 | 15.0 | 28.5 | 15.1 |
| Pannar | Pan 9501 | Trad. | 1680 | 1525 | 1602 | 38.4 | 158 | 1 | 14.0 | 27.5 | 14.8 |
| Triumph Seed Co. | s678 | NS | 1783 | 1650 | 1717 | 42.7 | 140 | 0 | 21.4 | 26.3 | 14.7 |
| Triumph Seed Co. | s671 | NS | 1978 | -- | -- | 43.5 | 118 | 0 | 21.2 | 26.7 | 15.9 |
| USDA (check) | USDA 894 | Trad. | 1094 | 867 | 980 | 44.0 | 141 | 0 | 16.7 | 26.8 | 10.9 |
| USDA (check) | cms HA412/RHA 377 | Trad. | 1610 | -- | -- | 48.2 | 145 | 2 | 12.7 | 27.7 | 12.8 |
| Grand Mean | | | 1727 | 1385 | 1550 | 42.4 | 145 | 0.9 | 14.9 | 27.5 | 12.2 |
| LSD 5% | | | 484 | 574 | 395 | 1.7 | 12 | NS | 3.4 | 2.3 | NS |
| C.V. | | | 20.0 | 20.4 | 19.9 | 2.9 | 6.1 | 298 | 16.3 | 5.9 | 25.6 |

* NS=NuSun, HO=High Oleic, Trad.=Traditional linoleic, CL=Clearfield, DM=downy mildew resistant, SU=Express-resistant.
Yield is reported at 10% moisture. Oil % is adjusted for oleic acid content.

## CAMELINA VARIETY TRIAL

**Objective:** To evaluate Camelina (*Camelina sativa)* varieties for yield, agronomic characteristics and adaptation to western South Dakota.

**Procedure:** Camelina, also known as falseflax, is an oilseed crop with potential for biodiesel production. Prowl $H_20$ was applied just after planting at a location near Wall, South Dakota. The plots were seeded on March 26, 2008 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 3 pounds per acre. Plots were trimmed to 5' x 25' after heading.

**Summary:** The camelina trial had very poor stands and then was devastated by grasshoppers in 2008. Therefore there are no results to report in 2008. The average yield for camelina the previous three years was 265 Lb/A. From our observations it appears that camelina is not well adapted to the typical hot weather that starts in mid June in southwestern South Dakota.

## 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, 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 drill with 10-inch spacing was used to plant the trials in April 2008. The peas were harvested for grain in July with a small plot combine equipped with vine lifters and a pickup reel.

**Location Information:**

***Pennington County – Wall***

Planted: April 15, 2008 Herbicide: Prowl $H_2O$ (3pint/A)
Harvested: July 23, 2008 Additional Nitrogen: Inoculated
Previous crop: Wheat, no-till planted

***Perkins County - Bison***

Planted: April 17, 2008 Herbicide: Prowl $H_2O$ (3pint/A)
Harvested: August 20, 2008 Additional Nitrogen: Inoculated
Previous crop: Wheat, no-till planted

***Walworth County - Selby***

Planted: April 23, 2008 Herbicide: Spartan
Harvested: July, 2008 Additional Nitrogen: Inoculated
Previous crop: Soybeans, no-till planted

**Summary:** Yields at Wall and Bison were near average for West River, with Wall averaging 26 Bu/A and Bison 33 Bu/A. The yields East River averaged 26 and 62 Bu/A at Selby and South Shore respectively. The Selby location suffered from hail damage in early June which adversely affected plant growth and yields. Top yielding varieties at South Shore were Spider, Cooper, Arcadia and Eclipse. There was little difference in yields of the varieties tested over the past two years. The Bison location had a planting error and too many plots were missing to do variety comparisons. The top yielding varieties at Wall in 2008 were Polestead, K2, DS-Admiral, Cooper and CDC Striker. Variety characteristics are presented in Table 19 and yield results in Table 20. Table 21 presents the results of the USDA-ARS Western Regional Field Pea Variety Trial, which consists of experimental varieties from the USDA dry pea breeding program.

Table 19. Field Pea Characteristics.

| Variety | Seed Color | Maturity* | Height Inches | Lodging (0-9)~ | Protein Percent | Fusarium Wilt@ | Mycos-phaerella Blight@ | Powdery Mildew@ |
|---|---|---|---|---|---|---|---|---|
| Arcadia | Green | M | 20 | 7 | 24.5 | -- | -- | -- |
| Camry | Green | M | 16 | 8 | 25.7 | F | F | VG |
| CDC Striker | Green | M | 19 | 2 | 29.1 | F | F | P |
| Cooper | Green | L | 20 | 5 | 25.7 | F | F | VG |
| K2 | Green | E | 17 | 1 | 25.6 | F | F | P |
| CDC Golden | Yellow | M | 18 | 2 | 27.1 | F | F | VG |
| CDC Meadow | Yellow | E | 20 | 3 | 25.3 | F | F | VG |
| DS Admiral | Yellow | E | 20 | 2 | 25.7 | F | F | VG |
| Eclipse | Yellow | M | 21 | 7 | 28.4 | F | F | VG |
| Fusion | Yellow | M | 19 | 6 | 24.2 | P | P | VG |
| Polestead | Yellow | M | 17 | 4 | 27.9 | P | P | VG |
| Spider | Yellow | -- | 21 | 7 | 28.2 | -- | -- | -- |
| SW Midas | Yellow | E | 18 | 7 | 24.2 | F | F | VG |
| Tudor | Yellow | M | 20 | 4 | 26.3 | F | P | VG |

* Maturity rating E = early, M = medium, L = late.
~ 0=No lodging, 9 = 100% lodged.
@ VG - Very good, G - good, F - fair, P - poor disease resistance.

Table 20. Field Pea Variety Trial Yields (Bu/A), 2007 - 2008.

| Variety | South Shore | | Selby | | Wall | | Average | |
|---|---|---|---|---|---|---|---|---|
| | 2008 | 2 Yr | 2008 | 2 Yr | 2008 | 2 Yr | 2008 | 2 Yr |
| ***Green Cotyledon*** | | | | | | | | |
| Arcadia | **68** | . | 22 | . | 27 | . | 39 | . |
| Camry | 60 | . | 26 | . | 21 | . | 36 | . |
| CDC Striker | 63 | **50** | 28 | 40 | 28 | 29 | 40 | 40 |
| Cooper | **69** | **66** | 28 | 45 | 28 | 27 | 42 | 46 |
| K2 | 55 | 45 | 23 | 37 | 29 | 30 | 36 | 37 |
| ***Yellow Cotyledon*** | | | | | | | | |
| CDC Golden | 63 | **66** | 26 | 43 | 26 | 27 | 38 | 45 |
| CDC Meadow | 63 | **59** | 27 | 42 | 26 | 30 | 39 | 44 |
| DS Admiral | 60 | **60** | 28 | 40 | 28 | 32 | 39 | 44 |
| Eclipse | **66** | **66** | 22 | 41 | 25 | 29 | 38 | 45 |
| Fusion | 55 | **60** | 20 | 36 | 24 | 29 | 33 | 42 |
| Polestead | 61 | . | 26 | . | **35** | . | 41 | . |
| Spider | **74** | . | **37** | . | 23 | . | 45 | . |
| SW Midas | 51 | **56** | 25 | 42 | 18 | 26 | 31 | 41 |
| Tudor | 64 | . | 27 | . | 26 | . | 39 | . |
| Average | 62 | 59 | 26 | 41 | 26 | 29 | 38 | 43 |
| LSD (P=.05) | 9 | 20 | 4 | **NS** | 4 | **NS** | -- | -- |
| CV | 10 | 9 | 11 | 7 | 10 | 7 | -- | -- |

Table 21. USDA-ARS Western Regional Field Pea Variety Trial - Wall, South Dakota 2008.

| Variety | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Bu/A |
|---|---|---|---|---|
| PS02100026 | 16 | 8 | 57.2 | 14.1 |
| PS03101445 | 17 | 4 | 52.5 | 23.4 |
| PS04100328 | 19 | 5 | 49.0 | 18.6 |
| PS04100462 | 15 | 8 | 57.2 | 13.0 |
| PS04100505 | 15 | 8 | 58.0 | 15.9 |
| PS01102958 | 18 | 5 | 57.8 | 31.4 |
| PS03101822 | 16 | 7 | 57.6 | 20.3 |
| PS04100710 | 17 | 8 | 51.6 | 15.1 |
| PS04100910 | 14 | 7 | 51.5 | 13.4 |
| PS04100922 | 15 | 3 | 55.1 | 23.2 |
| | | | | |
| Stirling | 15 | 6 | 58.2 | 18.2 |
| DS Admiral | 19 | 1 | 55.5 | 26.7 |
| CDC Mozart | 15 | 7 | 60.9 | 16.5 |
| Grande | 22 | 4 | 57.6 | 32.3 |
| Average | 16.6 | 5.9 | 55.7 | 20.2 |
| LSD (P=.05) | 2.3 | 1.4 | 4.5 | 6.2 |
| CV | 8.4 | 13.8 | 4.4 | **18.3** |

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

## CHICKPEA VARIETY TRIAL

**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 Wall, South Dakota. Most of the varieties are large kabuli types, which are grown for the large seeded garbanzo bean market. One of the varieties (Amit) is a smaller sized kabuli for export into the desi market. The variety CDC Anna is a desi type, which accounts for 85-90% of the market outside the United States and is grown as a protein source for humans and livestock. A planting rate of 174,000 was used (75-180 Lb/A) and the seed was inoculated with chickpea inoculum (*Mesorhizobium* sp. *ciceri)* prior to planting. The plots were planted in April with a John Deere 750 drill set to 10-inch rows. The plots were harvested with a small plot combine.

### Pennington County - Wall

Planted: April 15, 2008 Herbicide: Prowl $H_2O$ (3pint/A)
Harvested: September 15, 2008 Additional Nitrogen: Inoculated
Previous crop: Wheat, no-till planted

**Discussion:** Chickpea yields were hurt by weed competition in 2008. The trial averaged only 747 Lb/A, but quality and seed size were excellent. For chickpeas, the best varieties should yield well and have large seed size. Preferred varieties should grade out 80% or better larger than 22/64, as this is the size that is worth the most. The best large kabuli varieties are Dwelly, Dylan, Sierra and CDC Xena. These varieties have shown good yield potential and large seed size in trials over the past several years. Other varieties have yielded as well or better but do not have large enough seed to grade well. Table 22 shows chickpea agronomic characteristics and yields.

Table 22. Chickpea Variety Trial, Pennington County(Wall) 2008.

| Variety | Seed Color | Height Inches | Lodging 0-9* | Test Wt Lb/Bu | Yield Lb/A | Seed Size Seeds/Oz |
|---|---|---|---|---|---|---|
| ***Large Kabuli*** | | | | | | |
| Dwelly | Cream | 14 | 0 | 58.7 | 987 | 50 |
| Sierra | Cream | 13 | 0 | 58.7 | 755 | 55 |
| Troy | Cream | 13 | 0 | 54.8 | 523 | 50 |
| CDC Xena | Cream | 12 | 0 | 58.9 | 953 | 53 |
| CDC Yuma | Cream | 14 | 0 | 61.0 | 720 | 59 |
| ***Small Kabuli*** | | | | | | |
| Amit (B-90) | Cream | 14 | 0 | 61.0 | 499 | 99 |
| ***Desi*** | | | | | | |
| CDC Anna | Brown | 13 | 0 | 59.1 | 778 | 153 |
| ***Large Kabuli experimentals*** | | | | | | |
| CA0090B347C | Cream | 13 | 0 | 59.8 | 825 | 65 |
| CA0390B007C | Cream | 14 | 0 | 59.5 | 697 | 56 |
| CA0469C020C | Cream | 14 | 0 | 60.3 | 662 | 69 |
| CA0469C025C | Cream | 12 | 0 | 59.3 | 685 | 69 |
| CA04900443C | Cream | 12 | 0 | 56.4 | 743 | 51 |
| CA04900612C | Cream | 13 | 0 | 56.8 | 685 | 53 |
| CA04900716C | Cream | 13 | 0 | 58.3 | 929 | 51 |
| CA04900851C | Cream | 14 | 0 | 58.5 | 923 | 49 |
| CA04900509C | Cream | 13 | | 57.0 | 581 | 53 |
| Average | | 13 | 0.0 | 58.6 | 747 | 65 |
| LSD (P=.05) | | 1.7 | 0.0 | . | 253.7 | . |
| CV | | 6.2 | 0.0 | . | **20.3** | . |

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

Table 23. Chickpea Seed Size Grades, Pennington County(Wall) 2008.

| Variety | under 18/64” | over 18/64” | over 20/64” | over 22/64” |
|---|---|---|---|---|
| ***Large Kabuli*** | | | | |
| Dwelly | 0% | 1% | 3% | 97% |
| Sierra | 2% | 2% | 4% | 92% |
| Troy | 0% | 1% | 3% | 96% |
| CDC Xena | 1% | 1% | 4% | 95% |
| CDC Yuma | 1% | 2% | 9% | 88% |
| ***Small Kabuli*** | | | | |
| Amit (B-90) | 12% | 62% | 24% | 2% |
| ***Desi*** | | | | |
| CDC Anna | 52% | 44% | 4% | 0% |
| ***Large Kabuli experimentals*** | | | | |
| CA0090B347C | 0% | 3% | 15% | 82% |
| CA0390B007C | 0% | 1% | 3% | 96% |
| CA0469C020C | 1% | 4% | 29% | 66% |
| CA0469C025C | 1% | 3% | 22% | 74% |
| CA04900443C | 2% | 2% | 5% | 92% |
| CA04900612C | 1% | 0% | 2% | 97% |
| CA04900716C | 0% | 1% | 2% | 97% |
| CA04900851C | 0% | 1% | 1% | 98% |
| CA04900509C | 1% | 1% | 4% | 93% |

## WINTER PEA AND WINTER LENTIL VARIETY TRIALS

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

**Procedure:** Winter field pea and lentil varieties from Washington State University were planted in a randomized complete block experiment with four replications near Wall, South Dakota. The seeding rate was 520,000 seeds/A (115 - 150 Lb/A for peas 25 – 35 Lb/A for lentils) and the seeds were inoculated with a granular pea/lentil inoculum (*Rhizobium leguminosarium* biovar *viceae)* just prior to planting. A John Deere 750 drill with 10-inch spacing was used to plant the trial on September 27, 2007.

**Location Information:**

**Pennington County – Wall**

Planted: September 26, 2007 Herbicide: Pursuit (3 oz/A)
Harvested: Not harvested Additional Nitrogen: Inoculated
Previous crop: Spring wheat, No-till planted

**Summary:** Both the peas and lentils did not survive through the winter in 2008. This is the sixth year we have grown winter peas and lentils in western South Dakota. Three of those years the winter pulse trials have winterkilled, on the other years, yield of the winter peas have been less than spring peas planted at the same location. The lentils look more promising than the peas, but neither looks readily adaptable until winter hardiness can be improved. This year we are looking to see if planting the first of September will improve winter survivability.

## EVALUATION OF COOL AND WARM SEASON ANNUAL FORAGES

**Objectives:** To evaluate warm and cool season crops for forage yield and quality.

**Background:** Perennial forages provide most of the supplemental livestock feed in western South Dakota, a major livestock producing region. The frequent occurrence of drought in the past few years has resulted in shortage of livestock feed, driving a high demand for alternative sources of forages. Annual crops can be of great value in developing a year round forage system. They can be used to provide early grazing before perennials are available, extend the grazing period or increase hay and silage production. Annual crops differ in growth habit and in forage quality. The selection of a particular crop for forage should be based on intended end use. There is a lack of detailed information on yield and quality of some of the forage species for our region.

**Procedures:**
***Cool Season Annual Forages:*** The study had ten entries which are listed in the table below. The experimental design was a randomized complete block with four replications. The study was conducted at three locations, Ralph, Oelrichs and Wall, South Dakota. The oats, barley and spring triticale were also grown in a mixtures with Arvika pea at a seeding rate of 60% of recommended seeding rate for the cereal crop and 40% of the recommended seeding rate for the forage pea at each location. Entries were planted in six-row plots, 5 ft. wide by 30 ft. long using a John Deere 750 drill with 10-inch row spacing. Glyphosate herbicide was applied as a burn down just prior to planting; otherwise no other herbicides were applied to the plots. Nitrogen fertilizer as 28-0-0 was applied at 50 Lb/A actual N to all locations. The study was planted during the first week of April. At Ralph only three harvesting dates starting July 2 and weekly thereafter were done on the cool season study before it was destroyed by a hail storm. At each harvest date, forage yield was determined by harvesting four center rows five feet long with a Jeri mower. At Wall and Oelrichs, the entire plot was harvested on the same day with a small plot forage harvester. A subsample of about 500 g was randomly selected from the harvested sample and dried determine forage yield on a dry matter basis. The same sample was used to determine ADF, NDF and protein content.

**Cool Season Annual Forages - 2008**

| ***Crop (Variety)*** | ***Seeding Rate (lbs / acre)*** |
|---|---|
| Pea (Arvika) | 96 |
| Pea (Mozart) | 150 |
| Hairy Vetch | 20 |
| Oat (Troy) | 75 |
| Oat/Pea (60% Troy / 40%Arvika) | 45 / 38 |
| Barley (Haybet) | 119 |
| Barley/Pea (60% Haybet / 40% Arvika) | 71 / 38 |
| Spring Triticale (Common) | 84 |
| Spring Triticale / Pea (60%s.trit/40%Arvika) | 50 / 38 |
| Spring Wheat (Traverse) | 97 |

***Warm-Season Annual Forages :*** This study had ten entries planted in a randomized complete block design with four replications at Wall, Oelrichs and Ralph, South Dakota. The entries and seeding rates are listed in the table below. Entries were planted in six-row plots, 5 ft. wide by 30 ft. long using a John Deere 750 drill with 10-inch row spacing. Glyphosate herbicide was applied as a burn down just prior to planting, otherwise no other herbicides were applied to the plots. Nitrogen fertilizer as 28-0-0 was applied at 50 Lb/A actual N to all locations. The Ralph location was intended to be harvested at five dates to evaluate forage maturity vs. feed value, but was heavily damaged by a hailstorm. Therefore the Wall location was harvested over five dates instead. At each harvest date, four center rows by five feet long were harvested with a Jari Mower for forage yield determination. At Ralph and Oelrichs the entire plot was harvested with a small plot forage harvester. Forage samples were collected for ADF, NDF, protein and moisture content determination at each harvest date.

**Warm Season Annual Forages - 2008**

| ***Crop (Variety)*** | ***Seeding Rate (lbs / acre)*** |
|---|---|
| Teff Grass (Tiffany) | 8 |
| Foxtail Millet (Manta) | 12 |
| Foxtail Millet (Golden German) | 12 |
| Foxtail Millet (White Wonder) | 12 |
| Proso Millet (Sunup) | 15 |
| Pearl Millet (Producers Pro Millet) | 12 |
| Sorghum Sudan (Honey Sweet) | 20 |
| Sorghum Sudan (Honey Sweet 2) | 20 |
| Sorghum Sudan (Honey Sweet BMR) | 20 |
| Cowpea (Red Ripper) | 35 |

**Planting and Harvest Dates - 2008**

| Trial | Planting Date | Harvest Date |
|---|---|---|
| Wall Cool Season | April 15 | July 3 |
| Oelrichs Cool Season | April 16 | July 8 |
| Ralph Cool Season | April 17 | July 2, 9, 16 |
| Wall Warm Season | June 9 | August 11, 18, 25, Sept 2, 8 |
| Oelrichs Warm Season | June 11 | August 26 |
| Ralph Warm Season | June 17 | August 17 |

**Definition of Forage Quality Values:** *Crude Protein (CP):* Laboratories measure the nitrogen (N) content of the forage and calculate crude protein using the formula: CP = % N x 6.25. Crude protein will include both true protein and non-protein nitrogen. Cattle can use both types to some varying degree. Crude protein values give no indication if heat damage has occurred, which may alter protein availability.

*Neutral Detergent Fiber (NDF)*: Structural components of the plant, specifically cell wall. NDF is a predictor of voluntary intake because it provides bulk or fill. In general, low NDF values are desired because NDF increases as forages mature.

*Acid Detergent Fiber (ADF):* The least digestible plant components, including cellulose and lignin. ADF values are inversely related to digestibility, so forages with low ADF concentrations are usually higher in energy.

*Relative Feed Value (RFV):* A prediction of feeding value that combines estimated intake (NDF) and estimated digestibility (ADF) into a single index. The RFV system was developed using legume forages and intake responses of lactating dairy cows, it works best when applied to that situation. RFV is often used as a benchmark of quality when buying or selling alfalfa hay. While RFV works to some extent with alfalfa, it is absolutely useless for comparing alfalfa with either alfalfa-grass or pure grass. If RFV is used to compare forages, then 150 RFV alfalfa (optimum quality) is approximately equivalent to 115 RFV grass (optimum quality).

**Results and Discussion:** First year results from the cool season study at Ralph showed greater forage yield as harvesting date was delayed to later maturity stages of the crops. The first harvesting was done at heading for cereal grains and flowering –to- early podding for legume crops. The latest harvesting was conducted at milk-to-soft dough stage for the cereal grains and late podding for the legume crops (Table 26). On average, forage yield increased from1.5 t/acre at the first harvesting date to 2.1 t/acres at the third harvesting date. When individual entries were compared, barley had the greatest yield for the first and second harvesting dates and tied for greatest yield with spring triticale for the third harvesting date. Forage yield averaged 1.6 t/a at Wall and 1.9 t/a at Oelrichs. Barley also had the greatest forage yield at Wall and Oelrichs.The two pea entries performed similarly and had lower forage yield than cereal crops. The other legume crop in the study, hairy vetch, had a slow start in spring and had barely covered the ground during the first harvesting date. Forage yield for hairy vetch was the lowest for all entries.

Forage quality measured by crude protein content decreased with delayed harvesting to later maturity stages for all crops (Table 27). Hairy vetch forage had the highest crude protein at all harvest dates. Crude Protein was improved significantly by adding a legume to the cereal forage. Relative Feed Value (RFV) generally improved as the legume portion was added to the forage.

The diversity of crops used in the warm season study made it difficult to match individual harvesting dates to the same maturity stage for all crops. For example, at the first harvesting date, foxtail millets were at early grain filling stage, pearl millet was at early heading stage and the sorghum hybrids were at pre-heading stage. On average at Wall, forage yield increased as harvesting date was delayed to later maturity stages for all crops with the lowest forage yield of 2.1 t/ha recorded for the August 11 harvesting date and the highest forage yield of 3.5 t/ha recorded for the September 8 harvesting date. When individual crops were compared, the sorghum hybrids gave the greatest yields while cowpea had the lowest forage yield for all harvesting dates. Teff grass had poor yield earlier in the season but gave similar yields to foxtail millets later in the season. At Ralph forage yields were low due to hailstorm damage from which the cowpea crop did not recover.

Crude protein content was the same for the first two harvest dates but decreased with delayed harvesting to later maturity dates. When individual crops were compared, cowpea had the highest crude protein at all harvest dates. Among cereal crops, Teff grass had the highest crude protein content. Relative feed value was greatest for cowpea.

Table 24. Forage Yield (Tons/Acre) of Cool Season Crops at Ralph, Wall, and Oelrichs, SD in 2008.

| Crop (Variety) | Ralph July 2, 2008 | Ralph July 9, 2008 | Ralph July 16, 2008 | Wall July 8, 2008 | Oelrichs July 3, 2008 | Average |
|---|---|---|---|---|---|---|
| Pea (Arvika) | 1.2 | 1.7 | 1.3 | 0.5 | 2.0 | 1.3 |
| Pea (Mozart) | 1.2 | 1.8 | 1.4 | 0.6 | 2.0 | 1.4 |
| Hairy Vetch | 0.2 | 0.4 | 0.5 | 0.2 | 0.2 | 0.3 |
| Oat (Troy) | 1.9 | 2.5 | 2.8 | 2.2 | 2.4 | 2.3 |
| Oat/Pea (60% Troy / 40%Arvika) | 1.7 | 2.2 | 2.3 | 1.8 | 2.0 | 2.0 |
| Barley (Haybet) | 2.1 | 3.0 | 2.9 | 2.4 | 2.6 | 2.6 |
| Barley/Pea (60% Haybet / 40% Arvika) | 2.0 | 2.2 | 2.5 | 2.1 | 2.3 | 2.2 |
| Spring Triticale (Common) | 1.8 | 2.6 | 2.9 | 2.0 | 1.8 | 2.1 |
| Spring Triticale / Pea (60%s.trit/40%Arvika) | 1.3 | 2.0 | 2.1 | 2.0 | 1.7 | 1.8 |
| Spring Wheat (Traverse) | 1.7 | 2.3 | 2.5 | 2.2 | 1.8 | 2.1 |
| Mean | 1.5 | 2.1 | 2.1 | 1.6 | 1.9 | 1.8 |
| LSD (.05) | 0.3 | 0.5 | 0.4 | 0.3 | 0.3 | -- |
| CV | 15.2 | 17.2 | 14.1 | 14.8 | 12.3 | -- |

Table 25. Forage Yield (Tons/Acre) of Warm Season Crops at Ralph, Wall, and Oelrichs, SD in 2008.

| | Ralph | Wall | | | | | Oelrichs | Average |
|---|---|---|---|---|---|---|---|---|
| Crop (Variety) | Aug 27, 2008 | Aug 11, 2008 | Aug 18, 2008 | Aug 25, 2008 | Sept 2, 2008 | Sept 8, 2008 | Aug 26, 2008 | |
| Teff Grass (Tiffany) | 0.9 | 1.0 | 1.3 | 2.1 | 2.3 | 2.2 | 0.9 | 1.2 |
| Foxtail Millet (Manta) | 1.3 | 1.1 | 1.3 | 1.4 | 1.7 | 1.7 | 1.5 | 1.4 |
| Foxtail Millet (Golden German) | 1.3 | 1.8 | 2.1 | 2.6 | 2.2 | 3.3 | 1.4 | 1.7 |
| Foxtail Millet (White Wonder) | 1.0 | 1.8 | 2.2 | 2.2 | 2.3 | 2.7 | 1.6 | 1.6 |
| Proso Millet (Sunup) | 1.2 | 1.6 | 1.6 | 1.6 | 1.5 | 2.2 | 1.5 | 1.5 |
| Pearl Millet (Producers Pro Millet) | 0.9 | 2.6 | 2.9 | 3.1 | 3.3 | 3.5 | 1.4 | 1.8 |
| Sorghum Sudan (Honey Sweet) | 1.3 | 4.0 | 3.6 | 4.5 | 3.4 | 5.5 | 1.5 | 2.3 |
| Sorghum Sudan (Honey Sweet 2) | 1.0 | 3.0 | 2.9 | 3.9 | 2.8 | 6.2 | 1.1 | 2.0 |
| Sorghum Sudan (Honey Sweet BMR) | 0.9 | 4.0 | 4.3 | 4.6 | 3.6 | 7.0 | 2.3 | 2.6 |
| Cowpea (Red Ripper) | 0.0 | 0.5 | 0.6 | 0.7 | 0.8 | 1.1 | 0.3 | 0.3 |
| Mean | 1.0 | 2.1 | 2.3 | 2.7 | 2.4 | 3.5 | 1.4 | 1.6 |
| LSD (.05) | 0.3 | 0.8 | 1.2 | 0.9 | 0.8 | 1.3 | 0.6 | -- |
| CV | 18.4 | 25.6 | 37.5 | 23.7 | 24.0 | 25.8 | 28.7 | -- |

Table 26: Harvest Date, Moisture and Crop Stage of Cool Season Crops at Ralph, SD in 2008.

| Crop (Variety) | July 2, 2008 Mois % * | July 2, 2008 Crop Stage | July 9, 2008 Mois % * | July 9, 2008 Crop Stage | July 16, 2008 Mois % * | July 16, 2008 Crop Stage |
|---|---|---|---|---|---|---|
| Pea (Arvika) | 78 | Flowering | 75 | Late bloom/early pod fill | 70 | Pods green, leaves turning yellow |
| Pea (Mozart) | 80 | Early pod | 74 | Mid pod fill | 70 | Pods yellow, leaves turning yellow |
| Hairy Vetch | 79 | No blooms | 75 | 10% bloomed | 73 | 80% bloom to early podding |
| Oat (Troy) | 76 | Headed | 68 | Late anthesis | 61 | Late milk stage |
| Oat/Pea (60% Troy / 40% Arvika) | 77 | | 70 | | 64 | |
| Barley (Haybet) | 73 | Headed | 61 | Late milk to soft dough | 54 | Soft dough |
| Barley/Pea (60% Haybet / 40% Arvika) | 73 | | 66 | | 59 | |
| Spring Triticale (Common) | 79 | Early heading | 64 | Anthesis | 57 | Late anthesis |
| Spring Triticale / Pea (60%s.trit/40% Arvika) | 77 | | 69 | | 61 | |
| Spring Wheat (Traverse) | 74 | Headed | 56 | Late anthesis | 53 | Late milk stage |
| Mean | 76 | | 68 | | 62 | |
| LSD (P=.05) | 3.0 | | 5.1 | | 4.8 | |
| CV | 2.7 | | 5.2 | | 5.2 | |

*Moist % = Moisture percent at harvest.

Table 27. Forage Quality Analysis of Cool Season Crops by Harvest Date at Ralph, SD in 2008.

| Crop (Variety) | July 2, 2008 | | | | July 9, 2008 | | | | July 16, 2008 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crude Protein (%) | NDF (%) | ADF (%) | RFV | Crude Protein (%) | NDF (%) | ADF (%) | RFV | Crude Protein (%) | NDF (%) | ADF (%) | RFV |
| Pea (Arvika) | 19.6 | 31.7 | 21.8 | 211 | 17.4 | 28.2 | 22.0 | 237 | 12.7 | 34.4 | 24.2 | 191 |
| Pea (Mozart) | 19.7 | 27.8 | 20.3 | 247 | 14.9 | 28.0 | 20.6 | 242 | 12.4 | 30.7 | 20.9 | 222 |
| Hairy Vetch | 26.3 | 34.8 | 26.6 | 182 | 27.1 | 35.6 | 27.3 | 177 | 23.3 | 38.0 | 26.0 | 169 |
| Oat (Troy) | 11.6 | 52.5 | 30.4 | 116 | 10.4 | 55.1 | 31.0 | 110 | 10.2 | 54.8 | 30.3 | 111 |
| Oat/Pea (60% Troy / 40%Arvika) | 14.9 | 45.4 | 26.5 | 141 | 11.6 | 48.6 | 28.3 | 129 | 9.8 | 53.2 | 29.2 | 116 |
| Barley (Haybet) | 11.7 | 52.9 | 30.2 | 115 | 7.6 | 55.5 | 31.7 | 108 | 6.1 | 61.4 | 34.3 | 94 |
| Barley/Pea (60% Haybet / 40% Arvika) | 12.8 | 50.4 | 28.8 | 123 | 11.7 | 48.2 | 28.0 | 130 | 8.2 | 56.5 | 32.6 | 105 |
| Spring Triticale (Common) | 14.0 | 50.9 | 29.2 | 121 | 11.6 | 57.8 | 33.0 | 102 | 9.7 | 58.7 | 32.0 | 102 |
| Spring Triticale / Pea (60%s.Trit/40%Arvika) | 17.3 | 44.2 | 26.2 | 145 | 14.7 | 48.8 | 28.8 | 128 | 9.4 | 58.8 | 32.5 | 101 |
| Spring Wheat (Traverse) | 13.4 | 51.4 | 29.0 | 120 | 8.3 | 54.6 | 31.0 | 111 | 6.8 | 59.9 | 33.2 | 98 |
| Mean | 16.1 | 44.2 | 26.9 | 152 | 13.5 | 46.0 | 28.2 | 147 | 10.8 | 50.7 | 29.5 | 131 |
| LSD | 2.9 | 5.7 | 2.7 | 29 | 2.5 | 6.2 | 3.2 | 21 | 2.0 | 4.7 | 4.1 | 30 |
| CV (%) | 8.0 | 5.7 | 4.5 | 8.4 | 8.3 | 6.0 | 5.0 | 6.3 | 8.2 | 4.1 | 6.2 | 10.2 |

NDF = Neutral detergent fiber.
ADF = Acid detergent fiber.
RFV = Relative feed value

Table 28. Forage Quality of Cool Season Crops at Wall and Oelrichs in 2008.

| Crop (Variety) | Wall | | | | | Oelrichs | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Crude Protein (%) | Mois (%) | NDF (%) | ADF (%) | RFV | Crude Protein (%) | Mois (%) | NDF (%) | ADF (%) | RFV |
| Pea (Arvika) | 20.4 | 81 | 30.1 | 23.0 | 222 | 19.6 | 69 | 37 | 25 | 177 |
| Pea (Mozart) | 19.1 | 82 | 28.2 | 21.2 | 247 | 19.0 | 66 | 36 | 24 | 182 |
| Hairy Vetch | 24.7 | 82 | 40.7 | 28.6 | 154 | 26.2 | 76 | 42 | 27 | 151 |
| Oat (Troy) | 10.9 | 74 | 52.5 | 30.7 | 116 | 11.5 | 66 | 57 | 31 | 106 |
| Oat/Pea (60% Troy / 40%Arvika) | 12.1 | 74 | 49.6 | 29.5 | 125 | 12.0 | 66 | 57 | 32 | 106 |
| Barley (Haybet) | 8.9 | 69 | 55.1 | 32.0 | 109 | 8.9 | 59 | 61 | 34 | 96 |
| Barley/Pea (60% Haybet / 40% Arvika) | 12.4 | 73 | 48.5 | 30.1 | 128 | 10.4 | 58 | 58 | 32 | 103 |
| Spring Triticale (Common) | 11.4 | 71 | 58.3 | 34.9 | 99 | 13.0 | 64 | 62 | 34 | 94 |
| Spring Triticale / Pea (60%s.Trit/40%Arvika) | 12.4 | 72 | 56.5 | 30.5 | 109 | 14.3 | 64 | 58 | 32 | 102 |
| Spring Wheat (Traverse) | 9.8 | 69 | 54.4 | 32.5 | 109 | 11.3 | 59 | 61 | 34 | 97 |
| Mean | 14.2 | 75 | 47.4 | 29.3 | 142 | 14.6 | 65 | 53 | 31 | 121 |
| LSD | 1.8 | 1.7 | 3.6 | 3.8 | 24 | 1.7 | 6.9 | 3.5 | 2.4 | 16.5 |
| CV (%) | 8.9 | 1.6 | 5.2 | 9.0 | 11.7 | 8.0 | 7.3 | 4.6 | 5.4 | 9.3 |

Mois (%) = moisture % at harvest.
NDF = neutral detergent fiber.
ADF= acid detergent fiber.
RFV=Relative Feed Value.

Table 29: Harvest Date, Moisture and Crop Stage of Warm Season Crops at Wall, SD in 2008.

| Crop (Variety) | August 11 | | August 18 | | August 25 | | Sept 2 | | Sept 11 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mois % * | Crop Stage | Mois % * | Crop Stage | Mois % * | Crop Stage | Mois % * | Crop Stage | Mois % * | Crop Stage |
| Teff Grass (Tiffany) | 71 | Early heading | 67 | Heading | 63 | Headed | 60 | Hard dough | 61 | Boot stage – grasshopper damage |
| Foxtail Millet (Manta) | 70 | Grain filling – grasshopper damage | 65 | Soft dough | 64 | Soft to hard dough | 59 | Hard dough | 61 | Hard dough |
| Foxtail Millet (Golden German) | 76 | Early grain filling | 68 | Late anthesis | 63 | Hard dough | 57 | Hard dough | 59 | Hard dough |
| Foxtail Millet (White Wonder) | 77 | Early grain filling | 70 | Late anthesis | 65 | Soft to hard dough | 59 | Hard dough | 59 | Hard dough |
| Proso Millet (Sunup) | 71 | Soft dough | 68 | Hard dough | 65 | Hard dough | 63 | Hard dough | 64 | Hard dough |
| Pearl Millet (Producers Pro Millet) | 78 | Early heading | 73 | Early heading | 71 | Early heading | 71 | Soft to hard dough | 62 | Soft dough |
| Sorghum Sudan (Honey Sweet) | 69 | Early heading | 70 | Late anthesis | 64 | Milk stage | 67 | Soft to hard dough | 56 | Milk to soft dough |
| Sorghum Sudan (Honey Sweet 2) | 70 | Pre-heading | 71 | Jointing to pre-heading | 64 | Boot stage | 70 | Heading | 51 | Boot to early heading |
| Sorghum Sudan (Honey Sweet BMR) | 66 | Pre-heading | 68 | Early heading | 65 | Early heading | 73 | Milk stage | 52 | Heading |
| Cowpea (Red Ripper) | 86 | Pre-flowering | 85 | Pre-flowering | 81 | Vegetative | 80 | Vegetative – grasshopper damage | 76 | Vegetative |
| Mean | 73 | | 71 | | 67 | | 66 | | 60 | |
| LSD (P=.05) | 3.1 | | 5.8 | | 4.0 | | 4.0 | | 3.0 | |
| CV | 2.9 | | 5.6 | | 4.1 | | 4.2 | | 3.4 | |

* Mois % = Moisture percent at harvest.

Table 30. Forage Quality Analysis of Warm Season Crops by Harvest Date at Wall, SD in 2008.

| Crop (Variety) | August 11 | | | | August 18 | | | | August 25 | | | | September 2 | | | | September 8 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CP (%) | NDF (%) | ADF (%) | RFV | CP (%) | NDF (%) | ADF (%) | RFV | CP (%) | NDF (%) | ADF (%) | RFV | CP (%) | NDF (%) | ADF (%) | RFV | CP (%) | NDF (%) | ADF (%) | RFV |
| Teff Grass (Tiffany) | 11.0 | 67.5 | 37.1 | 83 | 11.7 | 69.0 | 37.4 | 81 | 10.2 | 67.5 | 37.1 | 83 | 9.1 | 65.8 | 39.0 | 83 | 8.2 | 66.6 | 35.5 | 86 |
| Foxtail Millet (Manta) | 7.9 | 63.6 | 35.9 | 89 | 8.5 | 63.7 | 34.8 | 91 | 7.3 | 63.6 | 35.9 | 89 | 6.4 | 63.7 | 35.3 | 90 | 5.5 | 64.5 | 34.9 | 89 |
| Foxtail Millet (Golden German) | 6.8 | 65.0 | 37.5 | 86 | 8.4 | 64.1 | 36.2 | 88 | 6.1 | 65.0 | 37.5 | 86 | 5.1 | 66.6 | 39.1 | 82 | 5.4 | 63.7 | 35.7 | 90 |
| Foxtail Millet (White Wonder) | 7.3 | 54.4 | 37.6 | 107 | 8.9 | 64.5 | 35.1 | 89 | 6.7 | 54.4 | 37.6 | 107 | 5.5 | 64.9 | 37.7 | 86 | 5.0 | 65.2 | 36.3 | 87 |
| Proso Millet (Sunup) | 9.1 | 61.4 | 33.1 | 96 | 10.2 | 60.0 | 29.9 | 102 | 7.3 | 61.4 | 33.1 | 96 | 7.4 | 61.0 | 31.1 | 99 | 7.6 | 59.5 | 30.1 | 103 |
| Pearl Millet (Producers Pro Millet) | 9.1 | 63.3 | 34.6 | 92 | 10.0 | 63.6 | 34.2 | 91 | 8.7 | 63.3 | 34.6 | 92 | 7.2 | 60.9 | 32.7 | 97 | 6.3 | 62.9 | 33.8 | 93 |
| Sorghum Sudan (Honey Sweet) | 6.9 | 57.8 | 32.8 | 102 | 10.7 | 61.5 | 33.4 | 96 | 7.3 | 57.8 | 32.8 | 102 | 5.9 | 58.1 | 32.2 | 103 | 5.1 | 60.9 | 33.4 | 97 |
| Sorghum Sudan (Honey Sweet 2) | 7.1 | 57.8 | 31.6 | 104 | 8.1 | 61.8 | 32.7 | 96 | 6.7 | 57.8 | 31.6 | 104 | 6.1 | 58.8 | 31.9 | 102 | 5.2 | 47.3 | 24.8 | 137 |
| Sorghum Sudan (Honey Sweet BMR) | 8.2 | 59.2 | 33.8 | 99 | 8.3 | 60.9 | 33.2 | 96 | 6.9 | 59.2 | 33.8 | 99 | 6.9 | 59.5 | 33.2 | 99 | 6.8 | 53.2 | 29.4 | 118 |
| Cowpea (Red Ripper) | 16.6 | 45.9 | 32.7 | 131 | 16.6 | 39.2 | 28.7 | 158 | 13.8 | 45.9 | 32.7 | 131 | 13.1 | 46.5 | 31.9 | 128 | 13.0 | 46.8 | 32.6 | 127 |
| Mean | 9.0 | 59.6 | 34.7 | 99 | 10.1 | 60.8 | 33.6 | 99 | 8.1 | 59.6 | 34.7 | 99 | 7.3 | 60.6 | 34.4 | 97 | 6.8 | 59.0 | 32.7 | 102 |
| LSD | 3.8 | 14.2 | 4.0 | 33 | 4.0 | 2.5 | 2.4 | 6.0 | 3.4 | 14.2 | 4.0 | 33 | 2.1 | 4.9 | 4.4 | 13 | 3.6 | 9.4 | 31.6 | 45 |
| CV (%) | 18.6 | 10.6 | 5.2 | 14.6 | 17.3 | 1.8 | 3.1 | 2.7 | 18.7 | 10.6 | 5.2 | 14.6 | 12.7 | 3.6 | 5.6 | 6.1 | 23.4 | 7.1 | 38.9 | 20.0 |

CP = Crude protein.
NDF = Neutral detergent fiber.
ADF= Acid detergent fiber.
RFV = Relative feed value.

Table 31. Harvest Date and Crop Stage of Warm Season Crops at Wall, Oelrichs and Ralph, SD in 2008.

| | Wall (Aug 25) | | Oelrichs (Aug 26) | | Ralph (Aug 27) | |
|---|---|---|---|---|---|---|
| Crop (Variety) | Mois % * | Crop Stage | Mois % * | Crop Stage | Mois % * | Crop Stage |
| Teff Grass (Tiffany) | 63 | Headed | 54 | Some seed | 65 | Hard dough to ripe |
| Foxtail Millet (Manta) | 64 | Soft to hard dough | 43 | Mature | 55 | Hard dough to ripe |
| Foxtail Millet (Golden German) | 63 | Hard dough | 59 | Dough | 72 | Dough |
| Foxtail Millet (White Wonder) | 65 | Soft to hard dough | 60 | Dough | 71 | Dough |
| Proso Millet (Sunup) | 65 | Hard dough | 63 | Half ripe | 62 | Tops ripe |
| Pearl Millet (Producers Pro Millet) | 71 | Early heading | 71 | Flowering | 73 | Early heading |
| Sorghum Sudan (Honey Sweet) | 64 | Milk stage | 66 | Flowering | 72 | Heading to flower |
| Sorghum Sudan (Honey Sweet 2) | 64 | Boot stage | 64 | Flowering | 71 | No heads |
| Sorghum Sudan (Honey Sweet BMR) | 65 | Early heading | 67 | Flowering | 73 | No heads |
| Red Ripper (Cowpea) | 81 | Vegetative | 73 | Stunted | 0 | Hailed out |
| Mean | 67 | | 62 | | 62 | |
| LSD | 4.0 | | 6.4 | | 3.0 | |
| CV (%) | 4.1 | | 7.1 | | 3.4 | |

* Mois % = moisture percent at harvest.

Table 32. Forage Quality Analysis of Warm Season Crops at Oelrichs and Ralph, SD in 2008.

| Crop (Variety) | Oelrichs CP (%) | Oelrichs NDF (%) | Oelrichs ADF (%) | Oelrichs RFV | Ralph CP (%) | Ralph NDF (%) | Ralph ADF (%) | Ralph RFV |
|---|---|---|---|---|---|---|---|---|
| Teff Grass (Tiffany) | 14.7 | 55 | 24 | 119 | 13.8 | 63 | 30 | 97 |
| Foxtail Millet (Manta) | 12.3 | 55 | 26 | 117 | 12.1 | 59 | 30 | 104 |
| Foxtail Millet (Golden German) | 13.5 | 51 | 23 | 130 | 13.3 | 54 | 27 | 118 |
| Foxtail Millet (White Wonder) | 13.2 | 50 | 22 | 134 | 14.1 | 56 | 27 | 113 |
| Proso Millet (Sunup) | 12.3 | 55 | 25 | 120 | 12.5 | 55 | 27 | 114 |
| Pearl Millet (Producers Pro Millet) | 13.1 | 55 | 24 | 119 | 15.2 | 59 | 28 | 106 |
| Sorghum Sudan (Honey Sweet) | 10.9 | 53 | 23 | 124 | 13.3 | 57 | 27 | 111 |
| Sorghum Sudan (Honey Sweet 2) | 13.1 | 52 | 21 | 131 | 14.5 | 58 | 27 | 109 |
| Sorghum Sudan (Honey Sweet BMR) | 11.6 | 56 | 25 | 116 | 14.3 | 57 | 29 | 108 |
| Cowpea (Red Ripper) | 18.8 | 43 | 22 | 161 | 0.0 | 0 | 0 | 0 |
| Mean | 13.4 | 52 | 24 | 127 | 12.3 | 52 | 25 | 98 |
| LSD | 3.3 | 5.2 | 3.6 | 20.3 | 0.9 | 2.2 | 1.4 | 5.7 |
| CV (%) | 17.2 | 6.8 | 10.5 | 11.0 | 5.1 | 2.9 | 3.8 | 4.0 |

CP = Crude protein.
NDF = Neutral detergent fiber.
ADF= Acid detergent fiber.
RFV = Relative feed value.

## TIME OF NITROGEN APPLICATION FOR NO-TILL WHEAT

**R.H. Gelderman, J. Rickertsen, H. Woodard, and A. Bly**

### Introduction

Application of nitrogen (N) for wheat production in South Dakota has historically occurred in the spring. Winter wheat producers would typically wait until potential winter injury has been assessed before applying nitrogen in late winter or early spring. Spring wheat producers would generally wait until just prior or after planting.

No-till wheat production has increased dramatically in the last 10 – 15 years, especially in Western and Central areas of South Dakota. Time savings, better equipment and herbicides have been major drivers in this change. Urea is the primary N source used by South Dakota producers. It is economical, and can be handled easily and safely. However, application of urea to a soil/residue surface (without tillage) can lead to potential N volatilization (N gas loss). High temperatures, low precipitation, and heavy residue conditions can lead to estimated losses of 25 to 35% of the applied N under worst case scenarios. One management tool to limit potential N volatilization is time of N application. Applying urea in the early spring when the probability for low temperatures and higher rainfall are highest should limit potential gaseous N loss. However, a number of producers wanting to decrease spring workloads and take advantage of lower urea prices will apply urea in late-fall. Late winter (Feb.-Mar.) application has also been used by a number of producers when snow conditions allow field access. Effectiveness of urea when applied to frozen soils or upon snow is still a question. Much producer interest has been shown in delaying at least part of the nitrogen until after tillering. With N prices at record highs, increasing N efficiency is a necessity to maintain profitability in wheat production.

### Objective

Determine time to apply nitrogen for most efficient N utilization for no-till winter and spring wheat production.

**Table 33. Materials and Methods**

| | Location | |
|---|---|---|
| Location | Cresbard | Sturgis |
| Wheat type | Spring | Winter |
| N Application Timing Trts. | | |
| Planting = P | 4-18-08 | 9-20-07 |
| Late Fall = LF | 11-8-07 | 12-17-07 |
| Winter = W | na | 1-24-08 |
| Early Spring = ES | 2-27-08 | 4-3-08 |
| Sub-Surface = SS | 4-18-08 | 9-20-07 |
| Feekes 5.5 = F5 | 6-13-08 | na |
| Foliar N application rate | 30 lbs N/a | na |
| Foliar N application timing | 7-11-08 | na |
| Variety | Traverse | Expedition |
| N Rates | 0 at P and SS | 0 at P and SS |
| | 50 at LF,P,ES,SS,F5 | 50 at P, LF, W, ES |
| | 100, 150, and 200 at P | 100, 150 at P |
| N Sources | urea and ammonium nitrate (AMN) | |
| Replications | 4 | |
| Split plot design (RCBD) | Main block = N timing, Split = N source and rate | |
| Statistics | SAS, ANOVA | |

note: Environmentally Smart Nitrogen (ESN) use at Sturgis only.

**Results and Discussion**

**N Rate:** Carryover soil nitrogen was low at each site, Cresbard (52 lbs NO3-N/a) and Sturgis (28 lbs NO3-N/a). Applied N significantly increased grain yield at Sturgis and Cresbard (Tables 34 and 38). Maximum yield was attained with 50 and 100 lbs N/a at Cresbard and Sturgis, respectively.

**N Timing:** The time of nitrogen application had a significant influence on grain yield at Cresbard (Pr>F = 0.02) and somewhat at Sturgis (Pr>F = 0.11) (Tables 35 and 36). At Cresbard, applying N at F5 (Feekes 5.5) significantly reduced yield (Table 35) and probably associated with very dry surface soil conditions that made the N positionally unavailable. At Sturgis, the late fall (LF) and winter (W) application timings had reduced yields.

**N Source:** Nitrogen source significantly influenced grain yield at Cresbard (Table 35) but not at Sturgis (Table 39). The urea N source, applied at the early spring timing at Cresbard which had 3-4 inches of snow ground cover, had significantly lower yield when compared to AMN (Table 39). All other urea and AMN comparison yields were very similar. There are differences between urea and AMN yields at Sturgis but no trend in the data could explain these differences (Table 39). Possible volatilization of N may have existed at the early spring application at both Cresbard and Sturgis. However, volatilization loss was not high enough to quantify with the sensitivity of the studies.

**N Placement:** Possible immobilization of N in residue did not seem to be a problem at either site because the sub-surface and surface broadcast placements of N produced similar yields (Tables

36 and 40). There was a trend for yield improvement with sub-surface urea and AMN application at Cresbard because the Pr>F statistic was nearing a significant level (80% confidence). ESN did not significantly influence grain yield when compared to urea or AMN at Sturgis (Table 40).

**Protein:** Nitrogen rate significantly influenced both spring and winter wheat grain protein (Tables 42 and 43). However, the effects were opposite between the sites. Increase N rate increased spring wheat grain protein while decreasing winter wheat protein. With the spring wheat, N was non-limiting beyond the 50 lb. N/a rate which provided extra N to increase grain protein levels. In contrast, the winter wheat grain yield responded to the incremental increase in soil applied N, resulting in less N available for grain protein partition at the higher N rates. Foliar application of N on spring wheat plots further increased spring wheat grain protein (Table 42). It is speculated that foliar N application on the winter wheat would have greatly increased grain protein.

**Precipitation:** For both sites, precipitation frequency increases as we move from late fall to planting (Tables 37 and 41).

**Conclusions:** Soil applied N increased wheat grain yield at each site. Grain yield was maximized with 50 and 100 lbs N/a for the spring and winter wheat, respectively. The spring wheat site had 50 lbs NO3-N/a residual N while the winter wheat site had 28. Grain yield was significantly reduced by applied N at the Feeke's 5.5 (F5.5) stage for spring wheat and the late fall (LF) and winter (W) applications for winter wheat. Dry soil conditions at the spring wheat site during the F5.5 stage kept applied N at the soil surface mostly unavailable for the wheat plant root systems. Grain protein positively responded to increased N rate and foliar application at the spring wheat site. In contrast, increasing N rate applications were more limiting to grain protein partitioning with the winter wheat because N was more limiting and required for grain yield (dry matter) response.

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Table 34. Nitrogen rate influence on spring wheat grain yield near Cresbard SD, in 2008.

| N rate | Grain Yield |
|---|---|
| lbs/a | bu/a |
| 0 | 40.7 |
| 50 | 47.2 |
| 100 | 45.1 |
| 150 | 45.2 |
| 200 | 44.7 |
| Pr>F | 0.44 |
| LSD(.10) | NS |
| CV % | 10.6 |
| Orthogonal No N vs N (Pr>F) | 0.07 |

sunflower was previous crop
lbs $NO_3$-N/a = 52 lbs/a sampled before planting
N applied at planting (4-18-08)

Table 35. Influence of N source and N application timing on spring wheat grain yield at Cresbard SD, in 2008.

| Time of N Application | N Source | | N Source Statistics for N timing | |
|---|---|---|---|---|
| | Ammonium Nitrate | Urea | Pr>F | CV |
| | ---------- bu/a ---------- | | | |
| Late Fall | 47.3 a | 47.9 a | 0.50 | 2.2 |
| Early Spring | 44.6 a | 41.2 b | 0.01 | 2.1 |
| Planting | 47.2 a | 45.7 a | 0.15 | 2.4 |
| 5 Leaf Stage | 39.9 b | 40.2 b | 0.75 | 2.2 |
| | | | | |
| Pr>F | 0.03 | 0.02 | | |
| LSD(.05) | 4.0 | 3.9 | | |
| CV % | 6.8 | 6.7 | | |
| | | | | |
| other Statistics: | | | | |
| N Source (S) | 0.04 | | | |
| N Timing (T) | 0.02 | | | |
| S x T | 0.02 | | | |

N rate = 50 lbs N/a
Means with similar lower case letter are not significantly different within a comparison column.

Table 36. Influence of tillage and N application position on spring wheat grain yield at Cresbard SD, in 2008.

| N Application Method | N Rate and Source | | |
|---|---|---|---|
| | 0 | 50 Urea | 50 AMN |
| | | | |
| Surface Broadcast[A] | 40.7 | 45.7 | 47.2 |
| Sub-Surface | 41.1 | 50.7 | 49.8 |
| | | | |
| $LSD_{(.10)}$ | NS | NS | NS |
| Pr>F | 0.94 | 0.21 | 0.22 |

AMN = ammonium nitrate
[A] broadcast applied after planting
[B] Applied with drill (7 inch spacings, 2-3 inch depth) before planting.
NS = non-significant

Table 37. Precipitation frequency summary at the spring wheat N timing site near Cresbard SD, in 2008.

| N Application Timing | 0.25 inch of Precipitation | |
|---|---|---|
| | Total | Event |
| | ---------- days* ---------- | |
| Late Fall | 47 | 134 |
| Winter / Early Spring | 27 | 28 |
| Planting | 13 | 13 |
| 5 Leaf Stage | 6 | 11 |

* days after N application to 0.25 inch total precipitation or a single event

Table 38. Nitrogen rate influence on winter wheat grain yield at Sturgis SD, in 2008.

| N Rate[A] | Grain Yield |
|---|---|
| | ----- bu/a ----- |
| 0 | 25.6 b |
| 50 | 40.3 a |
| 100 | 44.7 a |
| 150 | 44.4 a |
| | |
| Statistics: | |
| Pr>F | 0.001 |
| $LSD_{(.10)}$ | 4.5 |
| CV% | 8.9 |

[A] ammonium nitrate surface applied at planting.
Soil $NO_3$-N = 28 lbs/a

Table 39. Influence of N source and N application timing on winter wheat grain yield at Sturgis SD, in 2008.

| Time of N | N Source | | N Source Statistics for N timing | |
|---|---|---|---|---|
| Application | Ammonium Nitrate | Urea | Pr>F | CV |
| | ---------- bu/a ---------- | | | |
| Sub | 38.8 | 36.7 | 0.20 | 4.6 |
| Planting | 37.9 | 39.1 | 0.59 | 7.3 |
| Late Fall | 35.4 | 35.3 | 0.95 | 11.5 |
| Winter | 34.8 | 37.3 | 0.19 | 6.0 |
| Early Spring | 40.3 | 38.7 | 0.09 | 2.3 |
| | | | | |
| Pr>F | 0.18 | 0.24 | | |
| LSD(.05) | NS | NS | | |
| CV % | 9.0 | 6.6 | | |
| | | | | |
| other Statistics: | | | | |
| N Source (S) | 0.97 | | | |
| N Timing (T) | 0.11 | | | |
| S x T | 0.44 | | | |

N rate = 50 lbs N/a
Means with similar lower case letter are not significantly different within a comparison column.

Table 40. Influence of tillage and N application position on winter wheat grain yield at Sturgis SD, in 2008.

| N Application Method | N Rate and Source | | | Pr>F |
|---|---|---|---|---|
| | 50 ESN | 50 Urea | 50 AMN | |
| | ---------- bu/a ---------- | | | |
| Surface Broadcast[A] | 38.2 | 39.1 | 37.9 | 0.72 |
| Sub-Surface | 38.4 | 36.7 | 38.8 | 0.52 |
| $LSD_{(.10)}$ | NS | NS | NS | |
| Pr>F | 0.91 | 0.21 | 0.73 | |

AMN = ammonium nitrate
[A] broadcast applied after planting
[B] Applied with drill (10 inch spacings, 2-3 inch depth) before planting.
NS = non-significant

Table 41. Precipitation frequency summary at the spring wheat N timing site near Sturgis SD, in 2008.

| N Application Timing | 0.25 inch of Precipitation | |
|---|---|---|
| | Total | Event |
| | ---------- days* ---------- | |
| Planting | 17 | 135 |
| Late Fall | 33 | 50 |
| Winter | 14 | 14 |
| Early Spring | 8 | 8 |

* days after N application to 0.25 inch total precipitation or a single event

Table 42. Influence of N rate and Foliar N application on spring wheat grain protein near Cresbard SD in 2008.

| | Foliar[A] | | | |
|---|---|---|---|---|
| N rate | No | Yes | Pr>F[B] | CV % |
| lbs/a | ---------- %[C] --------- | | | |
| 0 | 12.4 b | 13.9 c | yes | 4.4 |
| 50 | 12.8 b | 13.6 c | no | 4.2 |
| 100 | 14.8 a | 15.2 b | yes | 0.5 |
| 150 | 15.2 a | 15.9 ab | yes | 1.5 |
| 200 | 15.7 a | 16.5 a | yes | 1.5 |
| Pr>F[B] | yes | yes | | |
| CV % | 6.2 | 5.2 | | |

Overall Statistics

| | |
|---|---|
| Foliar (F) | 0.001 |
| N Rate (NR) | 0.001 |
| F X NR | 0.109 |

[A] 30 lbs N/a as 10 gpa UAN (28-0-0) and 10 gpa water applied at Feekes 10.8 (post-pollination)
[B] A “no” is where Pr.F is > than 0.10
[C] adjusted to 13% grain moisture.

Table 43. Influence of N rate on winter wheat grain protein at Sturgis SD, in 2008.

| N rate[A] | Grain Protein[B] |
|---|---|
| lbs/a | % |
| 0 | 11.9 a |
| 50 | 11.5 ab |
| 100 | 11.3 b |
| 150 | 10.7 c |
| $LSD_{(.10)}$ | 0.5 |
| Pr>F | 0.02 |
| CV% | 3.5 |

[A] applied as ammonium nitrate at planting
[B] adjusted to 13% grain moisture

## ROTATIONAL IMPACTS OF BROADLEAF CROPS ON WINTER WHEAT (SCENIC AND WALL, SOUTH DAKOTA)

**Objectives:**

1) To determine the performance and yield of winter wheat planted on five different types of crop stubble.
2) To determine response of winter wheat to various rates of nitrogen applied in the spring.

**Procedures:**

The experiment was conducted at two locations in western South Dakota (Wall and Scenic). The trial was managed using minimum tillage practices. The design of the experiment included growing broadleaf crops (field pea, chickpea, lentil and safflower) and spring wheat in year 1. Blocks of spring wheat (Briggs), dry peas (Grande), Lentils (Morton), Chickpeas (B-90) and Safflower (Finch) were planted on May 2, 2007. All blocks were planted with a 5 foot research JD 750 no-till drill. The spring wheat block at the Scenic location was top dressed with 28-0-0 (50 lb N / acre) on May 1, 2007 with 32 oz / A of Roundup in the mix for weed control. This block was sprayed twice at 8.3 gpA to get the intended fertilizer rate. Blocks of the other four crops were sprayed with Prowl (3 pts/A) + Roundup Original Max (24 oz / A). The spring wheat and safflower were fertilized with 10-34-0 at both locations. The seeding rate for the crops were as follows: spring wheat (Briggs) 90 lbs/a, lentils (Morton) 20 lbs/a + inoculum, field peas (Grande) 140 lbs/a + inoculum, chickpeas (B-90) 70 lbs/a + inoculum, safflower (Finch) 20 lbs/a. At the Scenic site, all five blocks were harvested on August 1, 2007. The block at the Wall site had been planted to camelina, field pea and chickpea variety trails in the spring of 2007. The safflower stubble next to the variety trials was also used for planting winter wheat.

In the fall of 2007each broadleaf crop block at Wall and Scenic was recropped to winter wheat. Before planting , the Wall site was sprayed with 19 oz Roundup Original Max/A + liquid ammonium sulfate +12 oz LV6 at 10 gpA spray rate on August 29, 2007. The Scenic location was sprayed on September 28, 2007 with 20 oz Roundup Original Max + liquid Ammonium Sulfate (50 ml/gal) at 8 gpA spray rate. Both locations were planted to Expedition Winter Wheat on September 26, 2007. The wheat crop was planted with a JD 750 drill at 1,089,000 seeds per acre with liquid starter fertilizer (10-34-0) added at 6 gallons / acre. Soil moisture samples were taken on each of the blocks that were seeded to winter wheat plots on November 5, 2007. On November 6, 2007; the location at Scenic was sprayed with .9 oz Olympus + Penetrate II + 32-0-0 @ 1 gallon per acre. The 32-0-0 liquid fertilizer was added to improve the coverage and absorption of the Olympus herbicide.

In spring, four fertilizer N rates and a control (with no N fertilizer application) were applied to the winter wheat. The rates were 30, 60, 90 and 120 Lb N/Acre. The source of N was ammonium nitrate (34-0-0). The granular fertilizer was broadcast with a JD 750 drill. Plots, within each crop stubble, were arranged in randomized complete block design with treatments replicated four times. Each fertilizer treatment was broadcast over a 10 foot wide x 60 foot long plot. The Scenic location was sprayed on May 7, 2008 with 27 oz / A Starane NXT + Penetrate II @ 18 ml / gallon + Harmony GT @ .6 oz / acre at a spray rate of 10 gallon per acre. The Wall location was sprayed on May 7, 2008 with 27 oz / A Starane NXT + Penetrate II @ 18 ml / gallon using a 10 gallon per acre spray rate. The harvested plot size was 5 foot wide x 60 foot long for each fertilizer rate in each replication. Performance of winter wheat was evaluated by measuring plant height, number of heads per square foot, number of kernels per head, number of seeds per pound, grain yield, test weight and grain protein.

The planting/harvest dates of the spring wheat and broadleaf crops at Scenic are as follows:

| Crop | Planting Date | Harvest Date |
|---|---|---|
| Spring Wheat | May 2, 2007 | August 1, 2007 |
| Lentil | May 2, 2007 | August 1, 2007 |
| Dry Pea | May 2, 2007 | August 1, 2007 |
| Chickpea | May 2, 2007 | August 1, 2007 |
| Safflower | May 2, 2007 | August 1, 2007 |

The planting/harvest dates of the broadleaf crops at Wall are as follows:

| Crop | Planting Date | Harvest Date |
|---|---|---|
| Safflower | April 30, 2007 | August 20, 2007 |
| Camelina | April 4, 2007 | July 18, 2007 |
| Chickpea | April 4, 2007 | August 1, 2007 |
| Dry Pea | April 4, 2007 | July 18, 2007 |

**Results and Discussion in 2008:** Winter wheat stands were good at both locations in the fall of 2007. The Scenic location had downy brome infestation so it was sprayed with Olympus the day after planting. The Wall location was not sprayed and downy brome infestation occurred during winter primarily in the camelina and chickpea blocks that were planted back to wheat.

At Scenic, the highest winter wheat yield was on spring wheat stubble. The Scenic location was very dry (Table 46) and residue cover on the spring wheat ground might have helped conserve soil moisture. The lowest winter wheat yield was on Safflower stubble, due to low soil moisture availability. At Wall, the highest winter wheat yield was on the safflower stubble. Safflower stands were weak in 2007 but weed control was good, thus soil moisture was not limiting for the winter wheat crop. The lowest winter wheat yields were on camelina stubble where soil moisture was most limiting.

Winter wheat grain yield increased with increasing nitrogen fertilizer application at both locations but yields were not different at 60, 90 and 120 lb/ac (Table 47). Grain yield increased by 15 to 20 bushels with the addition of 60 pounds of nitrogen. Nitrogen fertilizer application also increased plant height, number of heads per sq ft., number of kernels per head, and seed protein content. Seed size (seeds / lb) got slightly smaller as nitrogen rates were increased. Test weights decreased as nitrogen levels were increased.

Our intent at both locations was to determine how much soil moisture was present on broadleaf crops stubble for a recrop situation. Soil moisture levels were the highest at the 0-12” depth and got progressively dryer deeper into the soil profile down to 48 inches. Overall, soil moisture was slightly better in November of 2007 at the Wall location as compared to the Scenic location. We had difficulties getting the deep soil samples at Scenic because the soil was so dry.

**Table 44. Scenic Nutrient Analysis as of November 5, 2007. These blocks were planted back to Expedition Hard Red Winter Wheat on September 26, 2007.**

| Cropping Block Sampled | Texture Class | pH | Soluble Salts mmho / cm | O. M. % | NO3-N Lbs / A (0-24") | Phosphorus Lbs / Acre | Potassium Lbs / Acre |
|---|---|---|---|---|---|---|---|
| **S. Wheat** | Medium | 6.4 | 0.3 | 1.2 | 34 | 50 | 778 |
| **Lentil** | Medium | 6.3 | 0.1 | 1.2 | 16 | 30 | 742 |
| **Dry Pea** | Medium | 6.5 | 0.2 | 0.9 | 28 | 22 | 582 |
| **Chickpea** | Medium | 6.9 | 0.3 | 0.6 | 16 | 22 | 564 |
| **Safflower** | Medium | 6.7 | 0.2 | 0.6 | 74 | 20 | 480 |

**Table 45. Wall Nutrient Analysis as of November 5, 2007. These blocks were planted back to Expedition Hard Red Winter Wheat on September 26, 2007.**

| Cropping Block Sampled | Texture Class | pH | Soluble Salts mmho / cm | O. M. % | NO3-N Lbs / A (0-24") | Phosphorus Lbs / Acre | Potassium Lbs / Acre |
|---|---|---|---|---|---|---|---|
| **Safflower** | Medium | 6.5 | 0.2 | 1.7 | 18 | 50 | 1346 |
| **Camelina** | Medium | 6.3 | 0.2 | 1.6 | 34 | 32 | 1140 |
| **Chickpea** | Medium | 6.3 | 0.3 | 1.6 | 56 | 24 | 868 |
| **Dry Pea** | Medium | 6.5 | 0.3 | 1.6 | 44 | 44 | 1212 |

**Table 46. Soil Moisture Percent Values by Previous Crop, sampled on November 5, 2007.**

| Previous Crop in 2007 | Soil Depth in Inches | Soil Moisture % at Scenic | Soil Moisture % at Wall |
|---|---|---|---|
| **Spring Wheat at Scenic** | 0-12” | 11.0% | |
| | 12-24 | 9.4 | |
| | 24-36 | 7.4 | |
| | 36-48 | 6.2 | |
| **Mean** | | **8.5** | |
| **Lentil at Scenic / Camelina at Wall** | 0-12 | 8.9 | 11.3 |
| | 12-24 | 8.0 | 10.5 |
| | 24-36 | 6.8 | 9.2 |
| | 36-48 | -- | 7.3 |
| **Mean** | | **7.9** | **9.5** |
| **Dry peas** | 0-12 | 9.5 | 13.1 |
| | 12-24 | 7.8 | 11.9 |
| | 24-36 | -- | 10.0 |
| | 36-48 | -- | 8.9 |
| **Mean** | | **8.6** | **10.9** |
| **Chickpea** | 0-12 | 9.4 | 12.5 |
| | 12-24 | 6.9 | 10.6 |
| | 24-36 | -- | 8.5 |
| | 36-48 | -- | 8.4 |
| **Mean** | | **8.1** | **10.0** |
| **Safflower** | 0-12 | 9.4 | 13.2 |
| | 12-24 | 6.0 | 10.9 |
| | 24-36 | 4.8 | 8.8 |
| | 36-48 | -- | 8.2 |
| **Mean** | | **6.7** | **10.2** |

(--) indicates that the soil was so dry that the soil probe would go no further down.

**Table 47: Mean Effects of N Fertilizer and Previous Crop on Yield of Winter Wheat at Scenic, SD in 2008.**

| | Height (Inches) | No. of Heads / Sq. Ft. | No. of Kernels / Head | No. of Seeds / Pound | Seed Protein (%) | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|---|
| **N03-N Rate (Lbs/A)** | | | | | | | |
| 0 | 25.8 | 36.3 | 21.0 | 14826 | 9.3 | 61.0 | 27.1 |
| 30 | 27.6 | 40.3 | 21.9 | 14984 | 9.8 | 58.9 | 38.9 |
| 60 | 28.5 | 40.8 | 21.9 | 15544 | 11.2 | 57.0 | 44.7 |
| 90 | 28.9 | 43.7 | 22.4 | 15880 | 11.9 | 56.4 | 46.0 |
| 120 | 29.2 | 46.7 | 23.0 | 15892 | 12.5 | 56.2 | 47.0 |
| **LSD (0.05)** | **0.8** | **5.0** | **1.6** | **660** | **0.5** | **0.7** | **2.4** |
| **Previous Crop** | | | | | | | |
| Spring Wheat | 28.6 | 42.3 | 22.3 | 14459 | 9.9 | 60.3 | 50.3 |
| Lentil | 28.6 | 43.2 | 22.8 | 15819 | 10.7 | 58.0 | 39.8 |
| Field Pea | 28.5 | 43.2 | 22.8 | 15403 | 11.8 | 56.6 | 41.8 |
| Chickpea | 27.3 | 41.3 | 21.9 | 16086 | 11.4 | 57.0 | 36.1 |
| Safflower | 27.0 | 37.7 | 20.4 | 15358 | 11.0 | 57.6 | 35.8 |
| **LSD (0.05)** | **0.8** | **5.0** | **1.6** | **660** | **0.5** | **0.7** | **2.4** |
| **CV (%)** | **4.29** | **19.11** | **11.77** | **6.77** | **6.9** | **2.01** | **9.12** |

**Table 48: Mean Effects of N Fertilizer and Previous Crop on Yield of Winter Wheat at Wall, SD in 2008.**

| | Height (Inches) | No. of Heads / Sq. Ft. | No. of Kernels / Head | No. of Seeds / Pound | Seed Protein (%) | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|---|
| **N03-N Rate (Lbs/A)** | | | | | | | |
| 0 | 28.0 | 34.8 | 23.0 | 15328 | 9.4 | 59.6 | 38.1 |
| 30 | 30.1 | 44.7 | 24.8 | 15722 | 9.7 | 59.2 | 48.3 |
| 60 | 31.5 | 47.6 | 26.3 | 16469 | 10.5 | 57.5 | 53.6 |
| 90 | 31.9 | 49.7 | 27.0 | 17862 | 11.3 | 56.5 | 55.6 |
| 120 | 32.2 | 50.0 | 26.5 | 17797 | 12.0 | 55.5 | 53.2 |
| **LSD (0.05)** | **0.9** | **7.5** | **2.3** | **1042** | **0.3** | **1.1** | **2.8** |
| **Previous Crop** | | | | | | | |
| Safflower | 27.0 | 51.8 | 27.0 | 18036 | 9.9 | 56.7 | 57.6 |
| Camelina | 32.0 | 42.1 | 23.9 | 16981 | 10.6 | 57.6 | 42.1 |
| Chickpea | 32.6 | 42.3 | 24.9 | 16136 | 10.8 | 57.4 | 48.7 |
| Dry Pea | 31.4 | 45.3 | 26.4 | 15390 | 10.9 | 59.0 | 50.6 |
| **LSD (0.05)** | **0.8** | **6.7** | **2.1** | **932** | **0.3** | **1.0** | **2.5** |
| **CV (%)** | **4.75** | **25.71** | **14.01** | **9.76** | **4.98** | **3.06** | **8.75** |

**Table 49: Effect of Previous Crop and N Fertilizer on Performance of Winter Wheat at Scenic in 2008.**

| Previous crop & N03-N Rate (Lbs/A) | Height (Inches) | No. of Heads / Sq. Ft. | No. of Seeds/ Head | No. of Seeds / Pound | Seed Protein (%) | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|---|
| **---Spring Wheat---** | | | | | | | |
| **0** | 26.6 | 33.0 | 20.0 | 14255 | 8.9 | 62.9 | 31.6 |
| **30** | 27.4 | 36.0 | 23.0 | 13933 | 8.8 | 61.1 | 48.1 |
| **60** | 29.4 | 41.8 | 22.5 | 14195 | 9.8 | 59.8 | 54.6 |
| **90** | 29.6 | 46.8 | 22.8 | 14790 | 10.6 | 58.9 | 57.7 |
| **120** | 30.0 | 53.8 | 23.0 | 15124 | 11.3 | 58.9 | 59.7 |
| **Mean** | **28.6** | **42.2** | **22.2** | **14459** | **9.8** | **60.3** | **50.3** |
| **---Lentil---** | | | | | | | |
| **0** | 25.4 | 42.0 | 21.8 | 14998 | 9.2 | 61.4 | 22.7 |
| **30** | 28.5 | 35.5 | 23.5 | 15144 | 9.5 | 59.3 | 37.4 |
| **60** | 29.3 | 47.3 | 21.8 | 16451 | 10.7 | 57.0 | 44.9 |
| **90** | 29.7 | 44.3 | 22.8 | 15800 | 11.7 | 56.2 | 47.0 |
| **120** | 30.0 | 47.0 | 24.0 | 16704 | 12.3 | 56.2 | 47.0 |
| **Mean** | **28.5** | **43.2** | **22.7** | **15819** | **10.6** | **58.0** | **39.8** |
| **---Dry pea---** | | | | | | | |
| **0** | 27.7 | 41.5 | 21.0 | 15484 | 9.7 | 59.1 | 33.0 |
| **30** | 28.4 | 44.5 | 21.5 | 15616 | 10.9 | 57.5 | 42.1 |
| **60** | 28.7 | 42.8 | 23.0 | 14969 | 12.2 | 55.7 | 43.2 |
| **90** | 29.1 | 46.8 | 24.5 | 15967 | 12.8 | 55.7 | 45.5 |
| **120** | 28.8 | 40.5 | 23.8 | 14980 | 13.3 | 55.3 | 45.5 |
| **Mean** | **28.5** | **43.2** | **22.7** | **15403** | **11.7** | **56.6** | **41.8** |
| **---Chickpea---** | | | | | | | |
| **0** | 24.9 | 35.8 | 20.8 | 14625 | 9.3 | 60.9 | 25.0 |
| **30** | 27.5 | 44.5 | 22.3 | 15109 | 10.0 | 58.8 | 35.7 |
| **60** | 27.5 | 42.0 | 22.0 | 16806 | 11.8 | 56.0 | 40.5 |
| **90** | 27.9 | 43.5 | 22.3 | 17707 | 12.7 | 54.6 | 39.6 |
| **120** | 28.4 | 40.8 | 22.3 | 16184 | 13.3 | 54.9 | 39.8 |
| **Mean** | **27.2** | **41.3** | **21.9** | **16086** | **11.4** | **57.0** | **36.1** |
| **---Safflower---** | | | | | | | |
| **0** | 24.3 | 29.0 | 21.3 | 14771 | 9.4 | 60.9 | 23.3 |
| **30** | 26.2 | 41.0 | 19.3 | 15117 | 10.2 | 57.8 | 31.5 |
| **60** | 27.7 | 30.0 | 20.0 | 15299 | 11.6 | 56.5 | 40.5 |
| **90** | 28.3 | 37.3 | 19.8 | 15137 | 11.7 | 56.8 | 40.3 |
| **120** | 28.5 | 51.3 | 21.8 | 16467 | 12.3 | 55.8 | 43.3 |
| **Mean** | **27.0** | **37.7** | **20.4** | **15358** | **11.0** | **57.5** | **35.7** |
| **Previous Crop x N level** | | | | | | | |
| **LSD (0.05)** | **1.70** | **11.23** | **3.66** | **1477.88** | **1.07** | **1.65** | **5.26** |
| **CV (%)** | **4.29** | **19.11** | **11.77** | **6.77** | **6.9** | **2.01** | **9.12** |

NS = not significant.

**Table 50: Effect of Previous Crop and N Fertilizer on Performance of Winter Wheat at Wall in 2008.**

| Previous crop & N03-N Rate (Lbs/A) | Height (Inches) | No. of Heads / Sq. Ft. | No. of Seeds/ Head | No. of Seeds / Pound | Seed Protein (%) | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|---|
| **---Safflower---** | | | | | | | |
| **0** | 23.7 | 44.0 | 24.0 | 15305 | 8.3 | 57.2 | 46.7 |
| **30** | 26.2 | 50.0 | 27.3 | 16347 | 9.1 | 59.4 | 58.4 |
| **60** | 27.8 | 54.8 | 28.0 | 17647 | 9.7 | 56.9 | 61.0 |
| **90** | 28.7 | 50.5 | 27.0 | 21373 | 11.0 | 55.3 | 60.5 |
| **120** | 28.6 | 59.5 | 28.5 | 19506 | 11.5 | 54.7 | 61.6 |
| **Mean** | **27.0** | **51.7** | **26.9** | **18035** | **9.9** | **56.7** | **57.6** |
| **---Camelina---** | | | | | | | |
| **0** | 30.2 | 20.5 | 20.5 | 15575 | 9.9 | 60.1 | 28.8 |
| **30** | 31.5 | 42.0 | 21.5 | 15913 | 9.6 | 59.0 | 40.4 |
| **60** | 32.5 | 33.5 | 25.5 | 16693 | 10.6 | 57.4 | 47.4 |
| **90** | 33.0 | 54.5 | 27.5 | 16796 | 11.1 | 56.7 | 52.7 |
| **120** | 32.9 | 60.0 | 24.5 | 19927 | 12.0 | 54.8 | 41.3 |
| **Mean** | **32.0** | **42.1** | **23.9** | **16980** | **10.6** | **57.6** | **42.1** |
| **---Chickpea---** | | | | | | | |
| **0** | 29.4 | 40.0 | 22.8 | 15223 | 9.5 | 60.3 | 37.8 |
| **30** | 32.1 | 39.8 | 25.0 | 15296 | 9.9 | 58.3 | 47.4 |
| **60** | 33.4 | 47.3 | 24.5 | 16215 | 10.7 | 57.1 | 52.3 |
| **90** | 33.8 | 41.5 | 26.0 | 16860 | 11.7 | 56.0 | 53.3 |
| **120** | 34.5 | 43.0 | 26.0 | 17084 | 12.4 | 55.1 | 52.7 |
| **Mean** | **32.6** | **42.3** | **24.8** | **16135** | **10.8** | **57.3** | **48.7** |
| **---Dry Pea---** | | | | | | | |
| **0** | 28.6 | 34.5 | 24.8 | 15208 | 10.2 | 60.9 | 39.0 |
| **30** | 30.8 | 47.0 | 25.5 | 15332 | 10.2 | 59.9 | 47.2 |
| **60** | 32.4 | 55.0 | 27.0 | 15332 | 10.9 | 58.5 | 53.6 |
| **90** | 32.3 | 52.3 | 27.5 | 16419 | 11.3 | 58.1 | 55.9 |
| **120** | 32.8 | 37.5 | 27.0 | 14670 | 12.1 | 57.5 | 57.4 |
| **Mean** | **31.3** | **45.2** | **26.3** | **15392** | **10.9** | **58.9** | **50.6** |
| **Previous Crop x N level** | | | | | | | |
| **LSD (0.05)** | **2.09** | **16.66** | **5.11** | **2320** | **0.75** | **2.52** | **6.22** |
| **CV (%)** | **4.75** | **25.71** | **14.01** | **9.76** | **4.98** | **3.06** | **8.75** |

NS = not significant.

## CHICKPEA SEEDING RATE STUDY – (2005-2008)

**Objectives:** To evaluate the response of two chickpea varieties to various seeding rates.

**Procedures:** Two chickpea varieties, Dwelly and Sierra, were planted at six seeding rates near Wall in 2007 and 2008. The same study was conducted at two locations, Wall and Hayes in 2005 and 2006. The chickpea variety CDC Yuma was used instead of Sierra in 2005. The experimental design was a randomized complete block with four replications. Treatments were arranged in a factorial design. The plots were planted with a John Deere 750 small plot drill with ten inch row spacing. Granular inoculant (Mesorhizobium sp. Ciceri) was added to each seed packet prior to planting. The six seeding rates were 10 seeds $m^2$, 20 seeds $m^2$, 30 $m^2$, 40 seeds $m^2$, 50 seeds $m^2$, and 60 seeds $m^2$. A seeding rate of 10 seeds $m^2$ is about equivalent to 1 seed / square foot. Measurements taken included height, biomass at harvest, pod and seed production (taken from 5 random plants / plot), seed grading, seeds / lb, test weight, grain yield, net return and harvest index. *Harvest Index* is a measure of the ratio of grain weight to total plant weight. The plots were harvested with a Wintersteiger Delta research combine. Spartan and glyphosate herbicides were applied at all locations prior to planting to control weeds in 2005, 2006, and 2007.

**Planting and Harvest Dates 2005 – 2008.**

| Location (year) | Planting Date | Harvest Date |
|---|---|---|
| Wall (2008) | April 15 | September 15 |
| Wall (2007) | April 16 | August 1 |
| Wall (2006) | May 3 | August 10 |
| Wall (2005) | April 25 | August 17 |
| Hayes (2006) | May 3 | August 2 |
| Hayes (2005) | April 28 | August 22 |

**Discussion and Results:** In 2008, the trial was sprayed with Roundup before harvest time to desiccate plants. Moisture was adequate in 2008 but heavy weed pressure limited the yields. Yields increased with increasing seeding rate with the best yield obtained at 30 seeds per $m^2$ but with no differences among seeding rates of 20 to 60 seeds $m^2$ (Table 51). Harvest index was highest at low seeding rates while pods /plant and seeds per pod decreased with increasing seeding rate. Number of seeds per pound did not change with increasing seeding rate. In 2008, we had problems with herbicide damage (poor agitation of Prowl H20) which led to Kochia and Russian thistle problems in the plot.

In 2007, yield increased with increasing seeding rate with the best yield obtained at 30 seeds per $m^2$. The yield at a seeding rate of 30 seeds per $m^2$ was statistically the same as the yield at 40 or 50 seeds per square meter. Harvest index was highest at low seeding rates while pods /plant and seeds per pod decreased with increasing seeding rate. Number of seeds per pound increased with increasing seeding rate, indicating smaller seeds at the higher seeding rates.

In 2006, at the Wall and Hayes locations, a seeding rate of 30 seeds per square meter was adequate. At both locations, a seeding rate of 30 seeds per square meter had statistically the same yield as the 40 or 50 seeds per square meter rates. Yields were lowered when the seeding rate was increased to 60 seeds / square meter at Hayes. Net returns in 2006 were the best at 10 seeds $m^2$ rate although in most years this low seeding rate would invite much more weed pressure due to the lack of canopy cover. A seeding rate of 30 seeds per square meter is a good seeding rate for chickpeas in most years in the Hayes area.

In 2005, yield increased with increase in seeding rate at both locations with the greatest yield obtained at 40-50 seeds per square meter. The higher seeding rate of sixty seeds per square meter resulted in lower yields than seeding rates of 40 or 50 seeds per square meter. Number

of pods/plant and number of seeds/plant were greater at lower seeding rates, indicating that chickpea plants compensated for lower seeding rates by producing more pods and more seeds. The variety CDC Yuma yielded greater than Dwelly at both locations. The response to seeding rate was the same for both chickpea varieties. The effect of seeding rate on plant height, number of pods per plant, number of seeds per plant, harvest index and grain yield at Wall and Hayes are presented in Tables 51 through 60.

Overall this study showed that increasing seeding rate beyond 30 seeds per square meter is not warranted as there is no statistical advantage on yield and it is cost prohibitive because of expensive seed prices. A seeding rate of less than 30 seeds per square meter (3 seeds/sq.ft.) is not recommended as it would not provide adequate ground cover resulting in heavy weed pressure.

Table 51. Mean Effects of Seeding Rate and Variety on Plants/m2, Height, Harvest Index, Pods/Plant, Seeds/Plant, Seeds / lb, Test Wt, and Yield of chickpeas at Wall in 2008.

| Seeding Rate (seeds / m2) | Plants / m2 (Final stand) | Height (Sept 15, 08) | Harvest Index (%) | Pods / Plant | Seeds / Plant | Seeds / Lb | Test Wt. (Lb/Bu) | Yield (Lb/A) |
|---|---|---|---|---|---|---|---|---|
| 10 | 8 | 14 | 44 | 21 | 20 | 1158 | 59 | 412 |
| 20 | 19 | 15 | 43 | 16 | 16 | 1133 | 58 | 534 |
| 30 | 23 | 15 | 42 | 16 | 15 | 1152 | 58 | 627 |
| 40 | 36 | 14 | 40 | 12 | 12 | 992 | 58 | 592 |
| 50 | 40 | 14 | 41 | 10 | 9 | 1037 | 59 | 575 |
| 60 | 52 | 14 | 39 | 8 | 7 | 1000 | 58 | 558 |
| LSD (0.05) | 6 | 1 | 4 | 4 | 4 | 171 | 1 | 207 |
| *Variety* | | | | | | | | |
| Dwelly | 29 | 14 | 41 | 14 | 13 | 1102 | 59 | 521 |
| Sierra | 30 | 14 | 42 | 14 | 13 | 1056 | 58 | 579 |
| LSD (0.05) | 3 | 1 | 2 | 2 | 2 | 99 | 1 | 120 |
| CV (%) | 16.7 | 5.1 | 8.5 | 24.5 | 23.9 | 13.2 | 1.3 | 31.5 |

Table 52. Mean Effects of Seeding Rate on Seed Size and Net Return at Wall in 2008.

| Seeding Rate (seeds / m2) | < 18/64" (%) | > 18/64" (%) | > 20/64" (%) | > 22/64" (%) | Yield (lbs/A) | Value ($/A) | Seed Cost/A | Net Return* ($/A) |
|---|---|---|---|---|---|---|---|---|
| 10 | 2 | 5 | 21 | 72 | 412 | $115.39 | $20.80 | $94.59 |
| 20 | 3 | 3 | 18 | 76 | 534 | $151.53 | $41.60 | $109.93 |
| 30 | 3 | 4 | 18 | 75 | 627 | $176.57 | $62.40 | $114.17 |
| 40 | 1 | 2 | 12 | 85 | 592 | $176.01 | $83.20 | $92.81 |
| 50 | 2 | 3 | 14 | 81 | 575 | $166.94 | $104.00 | $62.94 |
| 60 | 2 | 4 | 15 | 79 | 558 | $160.33 | $124.80 | $35.53 |
| LSD (.05) | 2 | 3 | 6 | 10 | 207 | n/a | n/a | n/a |
| CV | 120.5 | 79.7 | 36.2 | 12.4 | 31.5 | n/a | n/a | n/a |

Commodity Value for 2008 <18/64"=no value, >18/64"=$.10/lb, >20/64"=$.23/lb, >22/64"=$.31 ½ lb.
*Net Return ($/A)=Value($/A) minus seed cost/Acre.

Table 53. Mean Effects of Seeding Rate and Variety on Harvest Index, Pods/Plant, Seeds/Plant, Seeds/Lb, Test Wt., and Grain Yield of Chickpea at Wall in 2007.

| Seeding Rate (seeds / m2) | Harvest Index (%) | Pods / Plant | Seeds / Plant | Seeds / Lb | Test Wt. (Lb/Bu) | Yield (Lb/A) |
|---|---|---|---|---|---|---|
| 10 | 33 | 21.4 | 22.4 | 1337 | 59.6 | 451 |
| 20 | 32 | 12.1 | 11.9 | 1362 | 59.2 | 505 |
| 30 | 29 | 12.0 | 11.1 | 1452 | 59.0 | 536 |
| 40 | 25 | 7.8 | 7.4 | 1461 | 59.5 | 488 |
| 50 | 23 | 6.0 | 5.2 | 1437 | 59.2 | 531 |
| 60 | 22 | 7.3 | 6.0 | 1545 | 59.1 | 477 |
| LSD (0.05) | 5.7 | 4.1 | 4.7 | 66.1 | .61 | 66 |
| *Variety* | | | | | | |
| Dwelly | 27 | 10.4 | 10.4 | 1464 | 59.2 | 468 |
| Sierra | 28 | 11.8 | 11.0 | 1401 | 59.3 | 529 |
| LSD (0.05) | 2.4 | 2.4 | 2.7 | 38.1 | .35 | 38 |
| CV (%) | 14.6 | 36.5 | 43.3 | 4.5 | 1.0 | 13.0 |

Table 54. Mean Effects of Seeding Rate on Seed Size and Net Return at Wall in 2007.

| Seeding Rate (seeds / m2) | < 18/64" (%) | > 18/64" (%) | > 20/64" (%) | > 22/64" (%) | Yield (lbs/A) | Value ($/A) | Seed Cost/A | Net Return* ($/A) |
|---|---|---|---|---|---|---|---|---|
| 10 | 8 | 20 | 43 | 29 | 451 | $91.59 | $20.80 | $70.79 |
| 20 | 9 | 21 | 45 | 25 | 505 | $98.97 | $41.60 | $57.37 |
| 30 | 12 | 27 | 43 | 18 | 536 | $92.44 | $62.40 | $30.04 |
| 40 | 15 | 28 | 42 | 15 | 488 | $78.71 | $83.20 | $-4.49 |
| 50 | 14 | 26 | 41 | 19 | 531 | $90.42 | $104.00 | $-13.58 |
| 60 | 18 | 30 | 40 | 12 | 477 | $70.68 | $124.80 | $-54.12 |
| LSD (.05) | 3.6 | 3.9 | 4.5 | 7.1 | 94.0 | n/a | n/a | n/a |
| CV | 27.6 | 15.2 | 10.3 | 35.7 | 13.0 | n/a | n/a | n/a |

Commodity Value for 2007 <18/64"=no value, >18/64"=$.05/lb, >20/64"=$.24/lb, >22/64"=$.31/lb.
*Net Return ($/A)=Value($/A) minus seed cost/Acre.

Table 55. Mean Effects of Seeding Rate and Variety on Harvest Index, Pods/Plant, Seeds/Plant, Seeds/Lb, Test Wt., and Grain Yield of Chickpea at Wall in 2006.

| Seeding Rate (seeds / m2) | Harvest Index (%) | Pods / Plant | Seeds / Plant | Seeds / Lb | Test Wt. (Lb/Bu) | Yield (Lb/A) |
|---|---|---|---|---|---|---|
| 10 | 37 | 22.8 | 27.7 | 1216 | 60.1 | 554 |
| 20 | 35 | 15.3 | 15.9 | 1237 | 59.8 | 677 |
| 30 | 34 | 14.1 | 14.8 | 1290 | 60.1 | 781 |
| 40 | 32 | 10.7 | 11.1 | 1297 | 60.2 | 824 |
| 50 | 32 | 9.8 | 10.9 | 1316 | 60.3 | 838 |
| 60 | 27 | 8.1 | 8.4 | 1317 | 60.1 | 857 |
| LSD (0.05) | 8 | 6.1 | 8.4 | 54.3 | n/a | 87 |
| *Variety* | | | | | | |
| Dwelly | 37 | 14.0 | 15.8 | 1328 | 60.5 | 903 |
| Sierra | 29 | 12.9 | 13.8 | 1230 | 59.7 | 608 |
| LSD (0.05) | 5 | 3.5 | 4.8 | 31.3 | n/a | 122.9 |
| CV (%) | 25.7 | 44.9 | 56.2 | 4.1 | n/a | 11.2 |

Table 56. Mean Effects of Seeding Rate on Seed Size and Net Return at Wall in 2006.

| Seeding Rate (seeds / m2) | < 18/64" (%) | > 18/64" (%) | > 20/64" (%) | >22/64" (%) | Yield (lbs/A) | Value ($/A) | Net Return* ($/A) |
|---|---|---|---|---|---|---|---|
| 10 | 2 | 11 | 51 | 36 | 554 | $97.27 | $76.47 |
| 20 | 2 | 14 | 53 | 31 | 677 | $113.11 | $71.51 |
| 30 | 2 | 11 | 52 | 35 | 781 | $136.27 | $73.87 |
| 40 | 2 | 15 | 49 | 34 | 824 | $139.58 | $56.38 |
| 50 | 4 | 20 | 46 | 30 | 838 | $131.56 | $27.56 |
| 60 | 2 | 15 | 42 | 41 | 857 | $151.76 | $26.96 |

Seed Value <18/64"=no value, >18/64"=$.05/lb, >20/64"=$.15/lb, >22/64"=$.26/lb.
*Net Return ($/A) = Value ($/A) minus seed cost / Acre.

Table 57. Mean Effects of Seeding Rate and Variety on Harvest Index, Pods/Plant, Seeds/Plant, Seeds/lb, Test Wt., and Grain Yield of Chickpea at Hayes in 2006.

| Seeding Rate (seeds / m2) | Harvest Index (%) | Pods / Plant | Seeds / Plant | Seeds / Lb | Test Wt. (Lbs/Bu) | Yield (Lbs/A) |
|---|---|---|---|---|---|---|
| 10 | 19 | 13.7 | 15.0 | 1396 | 58.7 | 308 |
| 20 | 18 | 11.7 | 12.5 | 1415 | 59.7 | 374 |
| 30 | 18 | 11.0 | 11.9 | 1407 | 59.0 | 459 |
| 40 | 15 | 9.4 | 10.3 | 1516 | 59.1 | 417 |
| 50 | 15 | 9.2 | 9.4 | 1428 | 58.8 | 440 |
| 60 | 14 | 8.8 | 9.3 | 1593 | 59.6 | 384 |
| LSD (0.05) | 3 | 3.8 | 4.3 | 133.9 | n/a | 46 |
| *Variety* | | | | | | |
| Dwelly | 17 | 11.8 | 12.4 | 1455 | 59.2 | 417 |
| Sierra | 16 | 9.4 | 10.3 | 1463 | 59.2 | 377 |
| LSD(0.05) | 2 | 2.2 | 2.5 | 77.3 | n/a | 64.8 |
| CV (%) | 22.0 | 35.7 | 37.3 | 9.0 | n/a | 11.3 |

Table 58. Mean Effects of Seeding Rate on Seed Size and Net Return at Hayes in 2006.

| Seeding Rate (per m2) | < 18/64" (%) | > 18/64" (%) | > 20/64" (%) | >22/64" (%) | Yield (lbs/A) | Value ($/A) | *Net Return ($/A) |
|---|---|---|---|---|---|---|---|
| 10 | 2 | 12 | 52 | 34 | 308 | $53.08 | $32.28 |
| 20 | 3 | 14 | 46 | 37 | 374 | $64.38 | $22.78 |
| 30 | 5 | 18 | 46 | 31 | 459 | $72.79 | $10.39 |
| 40 | 8 | 23 | 46 | 23 | 417 | $58.49 | $-24.71 |
| 50 | 4 | 20 | 63 | 13 | 440 | $60.85 | $-43.15 |
| 60 | 11 | 35 | 32 | 22 | 384 | $47.11 | $-77.69 |

Seed Value <18/64"= no value, >18/64"=$.05/lb, >20/64"=$.15/lb, >22/64"=$.26/lb.
*Net Return ($/A) = Value ($/A) minus seed cost / Acre.

Table 59. Mean Effects of Seeding Rate and Variety on Harvest Index, Pods/Plant, Seeds/Plant, Seeds/Lb, Test Wt., and Grain Yield of Chickpea at Wall in 2005.

| Seeding Rate (seeds / m2) | Harvest Index (%) | Pods / Plant | Seeds / Plant | Seeds / Lb | Test Wt. (Lbs/Bu) | Yield (Lbs/A) |
|---|---|---|---|---|---|---|
| 10 | 29 | 28 | 27 | 1329 | n/a | 619 |
| 20 | 33 | 27 | 25 | 1350 | 50.1 | 797 |
| 30 | 33 | 23 | 20 | 1381 | 47.4 | 876 |
| 40 | 32 | 19 | 16 | 1342 | 50.4 | 919 |
| 50 | 32 | 16 | 14 | 1389 | 49.2 | 963 |
| 60 | 31 | 13 | 12 | 1409 | 53.4 | 910 |
| LSD (0.05) | 4 | 3.9 | 3.8 | 58.3 | 0.5 | 80 |
| *Variety* | | | | | | |
| Dwelly | 31 | 19.6 | 19.4 | 1355 | 49.1 | 819 |
| CDC Yuma | 33 | 22.1 | 19.1 | 1378 | 50.1 | 876 |
| LSD (0.05) | n.s. | 2.2 | n.s. | n.s. | n.s. | 46 |
| CV (%) | 12.5 | 18.3 | 19.5 | 4.2 | 5.7 | 9.2 |

Table 60. Mean Effect of Seeding Rate and Variety on Harvest Index, Pods/Plant, Seeds/Plant, Seeds / Lb, Test Wt., and Yield of Chickpea at Hayes in 2005.

| Seeding Rate (seeds / m2) | Harvest Index (%) | Pods / Plant | Seeds / Plant | Seeds / Lb | Test Wt. (Lbs/Bu) | Yield (Lbs/A) |
|---|---|---|---|---|---|---|
| 10 | 34 | 32 | 31 | 1256 | 53.8 | 518 |
| 20 | 36 | 26 | 25 | 1281 | n/a | 675 |
| 30 | 39 | 21 | 21 | 1290 | 55.3 | 767 |
| 40 | 37 | 21 | 20 | 1254 | 54.2 | 1041 |
| 50 | 39 | 17 | 16 | 1251 | 55.4 | 1041 |
| 60 | 39 | 17 | 16 | 1280 | 55.4 | 954 |
| LSD (0.05) | 4 | 2.0 | 2.0 | 50.6 | 0.8 | 277 |
| *Variety* | | | | | | |
| Dwelly | 36 | 18.7 | 18.9 | 1262 | 56.5 | 727 |
| CDC Yuma | 39 | 25.8 | 24.2 | 1275 | 54.2 | 938 |
| LSD(0.05) | 2 | 3.1 | 2.9 | n.s. | 0.5 | 160 |
| CV (%) | 9.6 | 23.7 | 23.3 | 3.9 | 3.7 | 32.6 |

## SKIP-ROW SUNFLOWER FOR DROUGHT AVOIDANCE IN DRYLAND CROPPING SYSTEMS - 2007-2008

### Background:

Sunflower (*Helianthus annuus*) is a major crop in South Dakota. In 2005, 550,000 acres were planted and production totaled 876.95 million pounds. Currently, most of sunflower production is grown in the central part of the state. Although the crop is well adapted to the eastern part of the state, sunflower production in eastern South Dakota has been replaced by corn and soybean in recent years. The production acres lost to corn and soybean can be replaced by increasing sunflower production in the western part of the state. Sunflower is well adapted to western South Dakota but lack of adequate soil moisture is a major limitation to sunflower yields in the region. The crop frequently runs out of moisture before seed production, lowering yield potential and increasing yield variation from year to year. The skip-row technique which involves leaving some rows unplanted has been reported to improve yields of corn compared to conventional planting. This technique uses wider rows to store soil moisture between the rows by keeping the developing plants from using all the available soil moisture early in the growing season. The skip-row technology has not been evaluated as a drought avoidance strategy for sunflower in South Dakota

### Objectives:

The objectives of the study were 1) to determine the impact of planting arrangement (plant one/skip one row, plant two/skip two rows, and conventional planting in 20-inch rows) and plant population on performance of sunflower in a semi-arid environment in western South Dakota and 2) to assess how the skip-row technology would affect weed pressure and weed management in a sunflower crop.

### Materials and Methods:

The study was conducted on under dry land conditions in Pennington County near Scenic, South Dakota. In 2007 and 2008. Treatments included three plant arrangements; conventional planting in 20-inch rows (conventional), plant one/skip one row (P1S1), and plant two/skip two rows (P2S2) and two plant populations (12,500 plants/acre and 16,600 plants/acre). Treatments were arranged in factorial combination giving a total of six treatments. The experimental design was a randomized complete block with treatments replicated four times. Plots were planted using a JD 7100 planter with five rows, 20 inches apart. Each plot was 33.3 ft. wide (four passes) and 100 ft long. Seed boxes on the planter were disconnected as necessary to achieve desired row width. A sunflower hybrid, Pannar Seeds 8560 NS/CL/Cruiser was used in the study. The field was sprayed with a recommended rate of Spartan to control weeds before planting. The experiment was planted on June 11 in 2007 and June 12 in 2008. In 2007, the first planting had to be written-off due to severe wildlife damage and the experimented replanted on June 28, 2007. Crop stands were much better in 2008 although Kochia and Russian Thistle weed pressure came later in the growing season. The trial was harvested with a Wintersteiger Delta research combine on November 13, 2007and October 23, 2008.

Table 61. 2008 Sunflower Skip Row Study, Scenic, South Dakota.

| Treatment | Weed Pressure (0-9)* Oct 8, 08 | Lodging (%) Oct 8, 08 | Plant Height (Inches) Oct 8,08 | Final stand (Plants/A) Oct 8, 08 | Test Wt (Lb/Bu) Oct 23, 08 | Yield (Lb/Ac) Oct 23, 08 |
|---|---|---|---|---|---|---|
| Population (plants / A) | | | | | | |
| 12,500 | 6.1 | 0.8 | 55.7 | 7209 | 25.4 | 754 |
| 16,600 | 5.3 | 1.0 | 57.5 | 10378 | 25.9 | 823 |
| LSD (0.05) | ns | ns | ns | 1556 | 0.4 | ns |
| ---Row Arrangement (RA)---------- | | | | | | |
| Conventional | 4.8 | .3 | 55.6 | 8786 | 25.4 | 833 |
| P1S1 | 6.3 | .4 | 56.3 | 8463 | 25.8 | 743 |
| P2S2 | 6.1 | 2.0 | 57.9 | 9132 | 25.9 | 790 |
| LSD (0.05) | 1.0 | ns | ns | ns | ns | ns |
| ---Pop x RA---------- | | | | | | |
| 12,500- Conventional | 5.5 | 0.0 | 55.0 | 6793 | 25.1 | 789 |
| 12,500-P1S1 | 6.5 | 0.8 | 55.3 | 6862 | 25.6 | 739 |
| 12,500-P2S2 | 6.3 | 1.5 | 56.8 | 7972 | 25.5 | 734 |
| 16,600 -Conventional | 4.0 | 0.5 | 56.3 | 10778 | 25.7 | 878 |
| 16,600-P1S1 | 6.0 | 0.0 | 57.3 | 10064 | 26.0 | 746 |
| 16,600-P2S2 | 6.0 | 2.5 | 59.0 | 10292 | 26.2 | 846 |
| LSD (0.05) | ns | ns | ns | ns | ns | ns |
| C.V. (%) | 17.1 | 259 | | 20.3 | 1.7 | 11.9 |

* Weed pressure assessed at a scale of 0 to 9; 0 = weed free 9 = completely covered by weeds.

Table 62. Sunflower Skip Row Study - Nutrient Analysis as of June 11, 2007.

| Texture Class | pH | Soluble Salts mmho / cm | O. M. % | NO3-N Lbs / A (0-24") | Phosphorus Lbs / Acre | Potassium Lbs / Acre |
|---|---|---|---|---|---|---|
| Medium | 5.6 | 0.3 | n/a | 130 | 32 | 1104 |

Table 63. 2007 Sunflower Skip Row Study, Scenic, South Dakota.

| Treatment | Weed Pressure (1-9)* Nov 9, 07 | Plant Height (inches) Nov 9, 07 | Test Weight (Lb/Bu) Nov 13, 07 | Yield (Lb/Ac) Nov 13, 07 |
|---|---|---|---|---|
| ---Population (Pop) (plants/Ac)--- | | | | |
| 12,500 | 3.6 | 40.6 | 26.2 | 598 |
| 16,600 | 1.5 | 41.1 | 26.7 | 517 |
| LSD (0.05) | - | NS | NS | 69.5 |
| ---Row Arrangement (RA)- --------- | | | | |
| Conventional | 2.7 | 41.0 | 26.6 | 557 |
| P1S1 | 2.5 | 39.9 | 26.4 | 558 |
| P2S2 | 2.3 | 41.7 | 26.4 | 558 |
| LSD (0.05) | - | NS | NS | NS |
| ---Pop x RA---------- | | | | |
| 12,500- Conventional | 3.7 | 40.5 | 26.1 | 590 |
| 12,500-P1S1 | 3.7 | 40.0 | 26.2 | 565 |
| 12,500-P2S2 | 2.7 | 41.5 | 26.2 | 639 |
| 16,600 -Conventional | 1.7 | 41.5 | 27.1 | 523 |
| 16,600-P1S1 | 1.2 | 39.7 | 26.6 | 550 |
| 16,600-P2S2 | 1.7 | 42.0 | 26.7 | 476 |
| C.V. (%) | - | 7.1 | 3.1 | 14.3 |

* Weed pressure assessed at a scale of 1 to 9; 1 = weed free 9 = completely covered by weeds.

**Results of 2008.** Growing season ( April to September) precipitation mounted to 14.4 inches. Measurements taken during the growing season included stand assessment, plant height, weed pressure, and yield. 2008 results are given in Table 1 below. Final actual stands were evaluated on October 8, 2008. The final plant stand was only 58% of the original intended stand of 12,500 plants/acre and at 10,378 or 63% of the original stand for the 16,600 population. Soil crusting may have been a factor on reduced final stands. Sunflowers have a strong ability to compensate for stand when developing yield. Weed pressure was greater under skip-row plant arrangement compared to conventional planting. Sunflower plants were slightly tall at higher population of 16,600 plants/ac in all row arrangements. Test weights were not influenced by row arrangement or plant population. Seed yield was greatest under conventional seeding at a higher population of 16,600 plants/ac and lowest at a lower population of 12,500 under the P2S2 row arrangement.

In 2007, plant stands were thin due to cutworm damage. Weed pressure was higher at low plant populations. Test weight and plant height was the same for the two populations. Seed yield was slightly higher when sunflowers were planted at a lower population of 12,500 plants/ac. Overall, row arrangement had little effect on all measured traits. However, there was clearly higher weed pressure under low plant population irrespective of row arrangement. On the other hand, the P2S2 row arrangement showed a slight yield advantage over the other two arrangements at lower population but showed the lowest yield of the three row arrangements at higher plant population. Thin stands may have confounded treatment effects resulting in lack of major differences among treatments.

Clearly there were differences in response to treatments between the two years. The study will be repeated in 2009 to provide data from an additional year before firm conclusions can be drawn.

## DRY PEA PLANTING DATE STUDY – OKATON, SD - 2008

**Objective:** To evaluate the impact of planting date on yield and agronomic characteristics of field pea varieties in west-central South Dakota.

**Procedures:** Four dry pea varieties (Arvika, Grande, CDC Mozart, Cooper) were planted in a randomized complete block experiment with four replications at 5 planting dates near Okaton, South Dakota in the spring of 2008. Glyphosate (Roundup) was sprayed on as a burn down in the fall of 2007 and Assure II was applied for grassy weed control in the spring of 2008. The seeding rate was at 330,000 seeds/A. The peas were inoculated with a granular pea inoculum at 10 grams/packet (*Rhizobium leguminosarium* biovar *viceae)* prior to planting. A John Deere 750 drill with 10-inch spacing was used to plant the trials at five planting dates on March 4, March 25, April 9, April 22, and May 19, of 2008. Height notes and plant samples (five plants per plot) were taken on July 10, 2008 before harvesting. The peas were harvested for grain on July 23, 2008 with a Delta Wintersteiger combine equipped with vine lifters and a pickup reel. The May 19, 2008 planting date was not harvested due to plant injury caused by herbicide carry over in the soil . Five plants were collected per plot to calculate pods per plant, seeds per pod, and harvest index values. The variety characteristics of the peas are listed in Table 64.

**Planting Date Comments:**

**March 4, 2008**: Planting conditions were wet and very muddy. The very top was frozen earlier in the morning but had thawed before we started planting at 10:15am. The drill picked up a lot of straw and mud. All openers worked ok and did not plug, but the closing wheels didn't close the furrow very well. It snowed soon after this planting date.

**March 25, 2008**: Planting conditions were very good. All furrows closed well and the drill remained clean. The March 4 date was starting to germinate and the furrows had swelled shut to close the rows at this time.

**April 9, 2008**: Seeding conditions were good. A rain storm was moving in as we planted and it started to rain shortly after we planted the third date. There was plenty of soil moisture but the plots seeded nice and there was very minimal soil sticking to the JD 750 drill.

**April 22, 2008**: Ideal seeding conditions. Good soil moisture and the drill worked very well.

**May 19, 2008**: It was too wet to plant any earlier so planting was delayed until May 19th. This date had ideal seeding conditions and the drill worked very well.

**Table 64. Dry Pea Variety Characteristics**

| Variety | Seeds / lb | Leaf Type | Seed Color | Maturity |
|---|---|---|---|---|
| Arvika (forage type) | 3690 | Normal | Mottled | Late |
| Grande | 2730 | Normal | Yellow | Medium |
| CDC Mozart | 2223 | Semi-leafless | Yellow | Early |
| Cooper | 1776 | Semi-leafless | Green | Late |

**Summary:**

Planting on March 4th was far from ideal soil conditions as we did not get good furrow closure on that day. Stands from the first planting date were thin and soil temperatures were very cold which delayed germination of the first planting date. The other four dates had good soil conditions for planting and stand establishment. Because of the poor stands the first date had decreased yield, with the following three dates having yields similar to each other. Harvest index (ratio of seed weight to plant biomass), seeds per plant and pods per plant decreased with later planting dates. The March 4th date had much higher pods per plant numbers as these plants were compensating for the weak stand this date had. Height was similar for the first three dates and the fourth date was slightly shorter. In 2008 the best time to plant was the last week of March thru the first half of April. From earlier studies we have done, we have found that planting dry peas later than early May is not recommended in western South Dakota. This is because peas are very sensitive to high temperatures during flowering. If peas are planted later than early May they flower in July when temperatures are typically hot. This study will be repeated in 2009 to provide additional data.

**Acknowledgments:** Thank you to our cooperator Henry Roghair.

**Results:**

**Table 65. Planting Date vs Plant Height, Peas/Plant, Pods/Plant, Harvest Index, Test Weight and Yield of Dry Peas at Okaton, SD (Jones County) in 2008.**

| Planting Date | Height (inches) | Seeds / plant | Pods / plant | Harvest Index | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|
| March 4, 2008 | 25 | 38 | 8 | 57 | 61.5 | 28.4 |
| March 25, 2008 | 25 | 24 | 6 | 55 | 62.5 | 34.7 |
| April 9, 2008 | 26 | 29 | 6 | 52 | 62.1 | 33.5 |
| April 22, 2008 | 22 | 21 | 5 | 46 | 61.0 | 30.8 |
| Date Mean | 24.3 | 28 | 6.2 | 52.3 | 61.7 | 31.8 |
| LSD (.05) | 2 | 5 | 1 | 3 | 0.7 | 3.1 |
| CV | 11.5 | 23.6 | 25.6 | 8.9 | 1.9 | 13.8 |

**Table 66. Variety vs Plant Height, Peas/Plant, Pods/Plant, Harvest Index, Test Weight and Yield of Dry Peas at Okaton, SD (Jones County) in 2008.**

| Variety | Height (inches) | Seeds / plant | Pods / plant | Harvest Index | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|
| Arvika | 35 | 35 | 7 | 48 | 61.7 | 28.8 |
| Grande | 24 | 25 | 6 | 52 | 61.2 | 32.2 |
| CDC Mozart | 18 | 26 | 6 | 57 | 62.8 | 30.4 |
| Cooper | 20 | 26 | 6 | 52 | 61.4 | 35.9 |
| Variety Mean | 24.3 | 28 | 6.2 | 52.3 | 61.7 | 31.8 |
| LSD (.05) | 2 | 5 | 1 | 3 | 0.7 | 3.1 |
| CV | 11.5 | 23.6 | 25.6 | 8.9 | 1.9 | 13.8 |

**Table 67. Effect of Planting Date by Variety on Performance of Field Pea at Okaton, SD (Jones County) in 2008.**

| Planting Date | Variety | Height (inches) | Seeds / plant | Pods / plant | Harvest Index | Test Wt. (Lb/Bu) | Yield (Bu/A) |
|---|---|---|---|---|---|---|---|
| **March 4, 08** | Arvika | 39 | 52 | 10 | 51 | 63.2 | 32.4 |
| | Grande | 22 | 35 | 8 | 58 | 59.3 | 28.7 |
| | CDC Mozart | 19 | 34 | 8 | 61 | 62.0 | 21.6 |
| | Cooper | 21 | 33 | 8 | 56 | 61.7 | 30.9 |
| **Mean** | | **25** | **39** | **9** | **57** | **61.5** | **28.4** |
| **March 25, 08** | Arvika | 36 | 30 | 6 | 52 | 62.3 | 27.7 |
| | Grande | 26 | 22 | 6 | 54 | 62.5 | 37.2 |
| | CDC Mozart | 17 | 21 | 5 | 61 | 63.8 | 32.7 |
| | Cooper | 20 | 22 | 5 | 53 | 61.5 | 41.1 |
| **Mean** | | **25** | **24** | **6** | **55** | **62.8** | **34.7** |
| **April 9, 08** | Arvika | 36 | 39 | 7 | 48 | 62.2 | 28.5 |
| | Grande | 26 | 23 | 6 | 52 | 62.1 | 34.7 |
| | CDC Mozart | 20 | 27 | 7 | 56 | 62.7 | 33.7 |
| | Cooper | 21 | 28 | 5 | 50 | 61.5 | 37.0 |
| **Mean** | | **26** | **29** | **6** | **52** | **62.0** | **33.5** |
| **April 22, 08** | Arvika | 28 | 20 | 4 | 41 | 59.4 | 26.8 |
| | Grande | 24 | 20 | 5 | 43 | 61.0 | 28.3 |
| | CDC Mozart | 17 | 21 | 5 | 52 | 62.8 | 33.7 |
| | Cooper | 19 | 23 | 5 | 49 | 60.9 | 34.4 |
| **Mean** | | **22** | **21** | **5** | **46** | **61.0** | **30.8** |
| | LSD (0.05) | 4 | 9 | 2 | 6 | 1.4 | 6.2 |
| | CV (%) | 11.5 | 23.6 | 25.6 | 8.9 | 2.0 | 13.8 |

## SDSU REDUCED TILLAGE AND NO-TILL CROP ROTATION STUDY
## 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 nine 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. No-till production practices are used to grow all crops except for the winter wheat conventional fallow treatment. Proso millet, field peas, chickpea, hairy vetch, hay millet, spring barley 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 10 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 spring.

The experimental design is a randomized complete block with treatments replicated four times. Plots are 25' x 80' 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 are 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 weed control are kept and cost of each practice assessed, and are given on 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 helps to break weed and disease cycles and can improve wheat yields and profitability. It should be noted that we do not include any farm program payments except loan deficiency payments (LDP) when applicable, in our economic analysis.

The ten year (1999-2008) average yield of winter wheat following millet in a rotation where a broadleaf crop or corn was grown prior to the millet was 41.8 Bu/A. The winter wheat grown in a continuous winter wheat-millet rotation had a ten year average yield of 36.4 Bu/A. This indicates a 5.4 bushels per acre difference due to introducing a broadleaf or warm season crop into the rotation as similar management practices were applied in both rotations over the ten year period. These results indicate the importance of crop diversity in a rotation system. For comparison, the winter wheat-fallow rotation had an average yield of 49.1 Bu/A while fallow wheat in the diversified rotation of 2a yielded 57.3 bushels per acre over the 10 year period. It should also be noted that Rotation 11 (Winter Wheat / Corn / Millet) has no broadleaf crops included and wheat yields are equally as good as those for continuous crop rotations that have broadleaf crops as part of the rotation. The two warm season grass crops (corn and millet) have high demand for soil moisture late in summer while winter wheat has high demand for soil moisture early in spring. This rotation makes full use of all the rainfall received during the growing season. The winter wheat in this rotation seems to benefit from the diverse soil moisture use pattern of the crops. The diversity of crops in this rotation makes for easier weed management.

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 yield compared to the winter wheat-millet rotation. The winter wheat in rotations with safflower, sunflower and pea, however, yielded more than the winter wheat-millet rotation, indicating the increasing problem with root diseases in the undiversified winter wheat-millet rotation (Table 68). The increased income from the

higher yields of winter wheat along with the opportunity to produce a profitable broad-leaf crop like sunflower or safflower can increase the net income of these rotations, particularly in the wetter years.

We continue to use a strip tillage system 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. We have 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, crop stands of corn and sunflowers have improved. The residue managers on our planter work better in the strip tilled wheat stubble and it has the added bonus of putting the fertilizer right where the new planted crop will utilize it.

In 2008; Winter wheat yields were good because of good stands in the fall. Decent rains in the fall and snow catch in the winter months helped the young crop along. March was dry at 0.43" and April had 1.13" rainfall for the month. May and June were wet with nearly 5 inches of rainfall in May and 4.41" in June. Corn stands were poor due to cool, wet soil conditions for nearly a month after planting. Wireworm pressure along with poor germination and delayed emergence greatly reduced the corn stands. Soil temperatures at planting time (April 29, 2008) were at 60 degrees for corn and 70 degrees for safflower. Shortly after planting, it started raining and cooled off for the entire month of May. The corn seed had Poncho 250 for wireworm control but this lower rate along with cool, damp conditions (slow growth) after seeding was inadequate to control the wire worms. The corn had a final stand of about 42% of the intended 12,500 kernels / acre that we had planned on. We had a final stand of 5200 plants per acre and this was inadequate. Weed competition was not a serious issue but we were short of plants to produce a good corn crop. Safflower and sunflower stands were excellent this year. The safflower was planted on April 29, 2008 and the sunflowers were planted on June 11, 2008. The hay millet did well due to rainfall of 1.93 inches received in July and .94 inch in August. The proso millet was planted on June 9. 2008. The proso millet plots were sprayed two days after planting to control pigeon grass and broadleaf weeds. A late flush of stinkgrass competed with the proso millet crop all season long.

Recent cropping changes in this study include: 1) in Rotation 5a, substituting feed barley for spring wheat. 2) in Rotation 6a, growing dry peas for grain rather than spraying them off as a green manure crop, and in 9a, using hairy vetch as a green fallow option rather than using forage peas (the hairy vetch stubble holds better to the soil surface than the field pea stubble), 3) in 2007; Rotation 10 was changed to winter wheat / proso millet / chickpea. This placed the chickpea ahead of the wheat crop. This would give nitrogen credit towards the wheat crop and allow more time between chickpea harvest and wheat planting time). The 2008 growing season in Rotation 10 found weed explosions in the Proso millet. Weeds and Ascochyta Blight disease nearly totally took the chickpea crop. It was decided in the winter of 2008 to readjust this rotation again. The new sequence will be winter wheat / proso millet / dry peas. 4) For Rotation 2a, in 2007 we substituted Golden German hay millet in where proso millet was. Proso millet yields in this rotation have been historically the lowest in the entire trial. The hay millet stands were good in 2007 and 2008. Our six-year rotation has shown us that longer diverse rotations are better than the mostly three-year rotations we started with. The down side is that Rotation 2a requires more types of equipment thus making it more expensive to operate. Another cultural practice change in 2a that we implemented in the spring of 2008 is that we are no longer doing mechanical tillage during the fallow period. We want to determine if mechanical tillage is necessary during the fallow period to maintain better yields in 2a fallow wheat (8.2 bushels wheat yield advantage over a 10 year period as compared to the fallow wheat of Rotation 1).

Table 71 shows the estimated yield goals used for fertilizer recommendations of each crop and rotation since 1999. Thus, all crops have been adequately fertilized with nitrogen since the beginning of the study in 1994. However, our long term results show that attained yields for most crops have been below yield goals (Table 70). For economic reasons, we decided starting in 2006, to adjust yield goals to match long-term average yields for each crop and rotation.

**Wall Rotation - Total Precipitation by Month (inches) – September 2007 to August 2008**

| | | | | | |
|---|---|---|---|---|---|
| September 2007 | 1.19” | January 2008 | 0.00” | May 2008 | 4.96” |
| October 2007 | 1.92” | February 2008 | 0.26” | June 2008 | 4.41” |
| November 2007 | 0.16” | March 2008 | 0.43” | July 2008 | 3.13” |
| December 2007 | 0.03” | April 2008 | 1.13” | August 2008 | 0.94” |

## 2008 YIELD RESULTS AND DISCUSSION BY ROTATION

**Rotation 1: Winter Wheat / Fallow:**
This is the base rotation that all other rotations in the study are compared to. This rotation has had 2 to 3 mechanical tillages each year during the fallow period since we started the rotation study in 1994. We spray in the fall and spring during the cooler months for weed control.

Alice, a hard white winter wheat variety was planted on September 21, 2007 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 good in the fall due to decent soil moisture conditions. Spring rainfall was adequate with 1.13 inches in April, 4.96 inches in May and 4.41 inches in June. In 2008, winter wheat yields were at 56.2 Bu/A. The 10-year average yield on winter wheat in Rotation 1 is 49.1 Bu/A. This rotation had a net return of $48.47 / acre in 2008.

**Rotation 2: Winter Wheat-a / Sunflower / Hay Millet / Winter Wheat-b / Corn / Chem. 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 above average even in the dry years. The best winter wheat yields from this entire rotation study have come from winter wheat following fallow (Winter wheat –a) that has consistently out-yielded the fallow wheat in Rotation 1 by an additional 8.2 Bu/Acre over the last ten years. Sunflower yields have averaged 1281 Lb/Acre (Table 70) with extremely low yields in 2002, 2003, and 2007 due to drought stress. Sunflower is deep rooted and tends to dry out the soil profile considerably, thus millet grown after the sunflower crop is very dependant upon spring rains to recharge the top two feet of soil. Proso millet seed yields in this rotation have averaged 909 Lb/Acre over the last 8 years (1999-06). Proso millet yields were lower in this rotation than any other in the trial. It was decided to plant Golden German hay millet and cut it for hay in 2007. Hay millet yields were at 1.57 tons per acre in 2007 and 2.5 tons per acre in 2008. (Table 70). The recrop winter wheat following millet on average, yielded 72% the yield of the fallow wheat in this rotation.

This six-year 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 most other rotations. The fallow segment was chemical fallowed in 2008. We are currently evaluating whether the mechanical tillage is necessary during the fallow period to maintain the 8.2 bushel per acre advantage over the fallow wheat in Rotation 1. This rotation had a net return of $49.21 / acre in 2008.

**Rotation 3: Winter Wheat / Safflower / Proso Millet:**
Winter wheat in this rotation yielded 51.0 Bu/A in 2008 and has averaged 41.2 Bu/A long term. Safflower yields were 1483 Lb/A in 2008 and averaged 891 Lb/A in the ten-year period of 1999-2008. (Table 70). Millet yields were 1224 Lb/A in 2008 with a ten-year average of 1125 Lb/A. The safflower crop is deep-rooted and dries out the ground for the upcoming millet crop. During dry years, a summer fallow could be used to replace the millet crop. In 2008, safflower yields were good and prices were at $.30 per pound. Wheat yields were good too. Yields of Proso millet have been variable in this rotation depending upon amount of snow catch in the safflower stubble and the amount 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 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. The rotation can be planted with small grain equipment and therefore does not require any additional investment in equipment. This rotation had a net return of $86.51 / acre in 2008.

**Rotation 4: Winter Wheat / Proso Millet:**

This rotation alternates between winter wheat and proso (grain) millet. The proso millet crop is a good replacement for summer fallow for a short term basis. Winter wheat yields in this rotation have averaged 36.4 Bu/A over a ten-year period. Millet yields, on the other hand, have averaged 1428 Lb/A over the last ten years. In 2008, the winter wheat yields (36.8 Bu/A) were slightly above the ten-year average while the millet yields (949 Lb/A) were well below average. This rotation is not well diversified and will harbor crown and root rot diseases over time. 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 74 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. Rotation 4 does not utilize soil moisture very well. This rotation had a net loss in 2008 of $ - 44.99 per acre.

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

This is a very intensive rotation with high moisture demand. Winter wheat yields have averaged 36.0 Bu/A over the ten-year period. Corn yields averaged 42.6 Bu/A over the last ten years though corn failed completely in 2002, 2003, and 2006 due to drought/heat stress. Sunflower yields from this rotation have been the lowest yielding in the study over the ten-year period (1999-2008). Sunflower is harvested late in the fall, and will leave limited stubble to catch snow. Spring wheat did not perform well after sunflower in wet years and did even worse in drier years. Spring barley replaced spring wheat in 2005. Barley is more drought tolerant than spring wheat and matures before spring wheat. Barley yields in 2008 were at 73.7 Bu/A. This rotation had a net return of $26.84 / acre in 2008.

**Rotation 6a: Winter Wheat-a / Winter Wheat-b/ Safflower / Dry Pea:**

This rotation was changed in 2005. The original rotation had peas grown as a green-fallow crop. The pea green-fallow in this rotation was intended 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 allowed for potential soil moisture recharge before the winter wheat crop. The problem came at winter wheat planting time when the desiccated pea stubble is cut off by the no-till drill at ground level and then blown away in the wind, leaving the ground bare. Because of this problem, we went to harvesting the peas for grain.

The first winter wheat (WW-a) in Rotation 6a has a ten year average of 42.4 bu / acre. The second winter wheat (WW-b) has a 34.6 bu / acre average over the ten year period (Table 70). Safflower yields averaged 782 lbs/acre for the last 4 years. Safflower and sunflower yields are very comparable in dry years but the sunflower will out yield safflower in wetter years. Growing the field peas for grain is a better option. Peas have proven to be too expensive to grow as a green-fallow crop. The field pea grain yields have an average yield of 1472 Lb/A over the last four years. Planting dry peas eliminates the need to add nitrogen fertilizer during that year and reduces the nitrogen needs of the following wheat crop. Olympus was sprayed on both wheat crops in April of 2008. This was done to suppress downy brome/Japanese Chess. Although Olympus has some winter annual activity, it was necessary to spray for weed control using Starane NXT (27 oz/A) + Penetrate II on both wheat crops in May of 2008. All 4 crops performed well and prices were better this year. No additional Nitrogen was applied to the winter wheat-a crop after the field pea crop. Protein levels of the grain and some reduction in yield of winter wheat-a suggested that more Nitrogen would have been beneficial. Nitrogen was applied on winter wheat-b at 80 lbs N / acre. The safflower received 60 lbs N / 30 lbs $P_2O_5$ injected in 20 inch rows in the fall. The safflower is deep rooted and although it was fertilized for a 1200 pound crop; adequate moisture, good weed control and deep rooting pushed the crop to 1650 pounds per acre. The field peas are a legume so they were inoculated at seeding time and no additional nitrogen was applied to them.

This rotation appears to be sustainable with good yields and reduced need to apply nitrogen to the crops. Another advantage includes no need for additional equipment for planting or harvest. This rotation showed the best economic returns of any in the study for 2008 at $122.77 net return per acre.

**Table 68. Hard White Winter Wheat Yields from The Nine Rotation Sequences at Wall in 2008 and Long Term (10 year) data (1999-2008).**

| Rotation | Crop Sequence | Protein 2008 (%) | Test Wt 2008 (Lb/Bu) | Yield 2008 (Bu/A) | Ave Yield 1999-08 (Bu/A) |
|---|---|---|---|---|---|
| 1 | **WW** / F | 11.9 | 63.4 | 56.2 | 49.1 |
| 2a | WW / C / F/ **WW** / Su / HM | 11.6 | 62.0 | 69.3 | 57.3 |
| 2a | **WW** / C / F/ WW / Su / HM | 9.6 | 61.6 | 47.6 | 41.2 |
| 3 | **WW** / Sa / PM | 9.2 | 62.3 | 51.0 | 41.2 |
| 4 | **WW** / PM | 8.9 | 61.1 | 36.8 | 36.4 |
| 5a | **WW** / C / Su / S Bar | 9.5 | 60.8 | 45.9 | 36.0 |
| 6a | **WW** / WW / Sa / FP | 9.9 | 62.6 | 43.6 | 42.4 |
| 6a | WW / **WW** / Sa / FP | 10.8 | 62.2 | 50.0 | 34.6 |
| 9a | **WW** / WW / Sa / HV | 10.5 | 62.5 | 59.2 | 43.2 |
| 9a | WW / **WW** / Sa / HV | 10.0 | 61.2 | 48.5 | 35.2 |
| 10 | **WW** / PM / CP | 10.5 | 63.4 | 29.9 | 41.2 |
| 11 | **WW** / C / PM | 9.3 | 62.5 | 54.8 | 43.0 |
| | **Mean** | 10.2 | 62.1 | 49.4 | 41.7 |
| | **LSD (.05)** | 1.1 | 1.5 | 10.4 | -- |
| | **CV** | 7.7 | 1.7 | 14.6 | -- |

WW = winter wheat, F=fallow, C=corn, Su=sunflower, PM=proso millet, HM=hay millet, Sa=safflower, FP=field peas, HV=hairy vetch, CP=chickpea, S Bar=spring barley

**Table 69. Net Returns from 2008 Crop at The Wall Rotation**

| **Rotations and Crop Yields:** | | | | | | | **Dollars Return / A.** |
|---|---|---|---|---|---|---|---|
| 1 | Winter Wheat<br>56.2 bu | / | Fallow | | | | $ 48.47 |
| 2a | Winter Wheat-A<br>69.3 bu | / Sunflower<br>1690 lbs | / Hay Millet<br>2.5 Tons / A | / Winter Wheat-B<br>47.6 bu | / Corn<br>33.0 bu | / Fallow | $ 49.21 |
| 3 | Winter Wheat<br>51.0 bu | / | Safflower<br>1483 lbs | / | Proso Millet<br>1224 lbs | | $ 86.51 |
| 4 | Winter Wheat<br>36.8 bu | / | Proso Millet<br>949 lbs | | | | $ -44.99 |
| 5a | Winter Wheat<br>45.9 bu | / Corn<br>33.0 bu | / Sunflower<br>1494 lbs | / Spring Barley<br>73.7 bu | | | $ 26.84 |
| 6a | Winter Wheat-B<br>50.0 bu | / Safflower<br>1650 lbs | / Dry Pea<br>2004 lbs | / Winter Wheat-A<br>43.6 bu | | | $122.77 |
| 9a | Winter Wheat-B<br>48.5 bu | / Safflower<br>1559 lbs | / Hairy Vetch | / Winter Wheat–A<br>59.2 bu | | | $ 89.97 |
| 10 | Winter Wheat<br>29.9 bu | / | Proso Millet<br>764 lbs | / | Chickpeas<br>0 lbs | | $-101.81 |
| 11 | Winter Wheat<br>54.8 bu | / | Corn<br>29.7 bu | / | Proso Millet<br>1228 lbs | | $ -16.27 |

**Rotation 9: Winter Wheat-a / Winter Wheat-b / Safflower / Hairy Vetch:**

The winter wheat grown after the legume-fallow (winter wheat-a) has averaged 43.2 Bu/A over a ten-year period. The second winter wheat crop (winter wheat-b) has averaged 35.2 Bu/A in the same time frame (1999-2008). Safflower in this rotation has the highest yield in the study with a ten-year average of 990 Lb/A. This rotation saw changes in 2005 with the addition of Hairy Vetch to replace pea green fallow. Hairy vetch produces more biomass, is more vegetative and the stubble tends to cling to the ground better than the pea stubble. The better ground cover of the hairy vetch provides better snow catch which will benefit the following winter wheat crop. The hairy vetch is planted into the safflower stalks in late September. The hairy vetch seems to establish very well in the fall and winter hardiness is good. This allows the crop to initiate growth sooner in the spring, and give the ground plenty of cover until the wheat is planted in the fall. Olympus was sprayed on both wheat crops in April of 2008. This was done to suppress downy brome/Japanese Chess. Although Olympus has some winter annual activity, it was necessary to spray for weed control using Starane NXT (27 oz/A) + Penetrate II on both wheat crops in May of 2008. This rotation had a net return of $89.97 / acre in 2008.

**Rotation 10: Winter Wheat / Proso Millet / Chickpea:**

This is a well diversified rotation and historically, this rotation has produced some of the best recrop winter wheat yields in the entire study. On the long term, winter wheat in this rotation has averaged 41.2 Bu/A over the last ten years (1999-2008). The eight-year average (2001-2008) yield for the chickpea crop is 639 Lbs/A. Millet yields after the pea crop have been consistently good with a ten-year average of 1293 Lbs/A. Yields in 2008 included: winter wheat – 29.9 bu / acre, proso millet – 764 lbs / acre, and chickpeas – 0 lbs / acre.

This rotation was changed to Winter Wheat / Proso Millet / Chickpea in 2007. This was done to compare the performance of winter wheat after legume crops. Various legume crops are being evaluated in the rotation study. They include: dry peas in Rotation 6a, hairy vetch in Rotation 9a, and chickpeas in Rotation 10.

This is a high risk and potentially high 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 good. It should be noted that three years between chickpea crops is too close because of ascochyta disease concerns. The recommended interval between chickpea crops should be at least four years. We learned about ascochyta first hand in 2008 with a heavy flare up of disease. Having test plots in close proximity made it very easy for the disease to transfer from one plot to the next. That coupled with switching the rotation sequence in 2007 brought on a heavy weed pressure problem that totally destroyed the economics of this rotation. We are planning to replace the chickpeas with dry peas in 2009. The new rotation will be; Rotation 10a: Winter Wheat / Proso Millet / Dry Peas. This rotation had a net loss of $ - 101.81 per acre in 2008.

**Rotation 11: Winter Wheat / Corn / Proso Millet:**

This is an intensive but well balanced continuous crop rotation. Inclusion of glyphosate tolerant corn in the rotation allows us to manage weeds much better. The injection of fertilizer in the fall allows us to plant corn into a tilled strip that is 2 to 4 degrees warmer than the non-tilled area between the rows. The winter wheat has averaged 43.0 Bu/A over the last ten years (1999-2008) and yielded 54.8 Bu/A in 2008 (Table 68). Corn plant populations were reduced to14,200 seeds/acre in 2004 and 2005 in an effort to reduce seed costs and to optimize plant competition for soil moisture. In 2006, 07, and 08, corn population was further reduced to 12,500 seeds/acre. The ten-year average yield for corn is 50.2 Bu/A and this includes 2002 and 2006 that were total crop failures. Proso millet yields have averaged 1159 Lbs/A over the last ten years (1999-08). In 2008; wheat yields were good at 54.8 bushels per acre. Corn yields were poor (29.7 bu/a) due to cool growing conditions at germination time and wireworms. Proso Millet yields were decent at 1228 pounds per acre. This rotation had a net loss of $ - 16.27 per acre in 2008.

## Table 70. Long-Term Yield Trends at The Wall Rotation Study (1999-2008).

| Rotation & Crop | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | Ave Yield (Bu/A) or (Lb/A) (1999-08) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Rotation 1*** | | | | | | | | | | | |
| **Winter Wheat** | **70.9** | **58.3** | **38.6** | **28.6** | **77.1** | **17.7** | **60.0** | **31.0** | **52.2** | **56.2** | **49.1 bu** |
| **Fallow** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| ***Rotation 2a*** | | | | | | | | | | | |
| **Winter Wheat-a** | **67.1** | **66.9** | **51.1** | **30.9** | **72.8** | **34.3** | **70.0** | **49.8** | **60.4** | **69.3** | **57.3 bu** |
| **Sunflower** | **2091** | **2602** | **2082** | **400** | **584** | **1093** | **860** | **1030** | **382** | **1690** | **1281 lb** |
| **Millet** | **1500** | **1300** | **2000** | **326** | **0** | **449** | **1405** | **300** | **Hay millet 1.57T** | **Hay millet 2.5 T** | **2.04 Tons (2007-08)** |
| **Winter Wheat-b** | **62.8** | **46.0** | **40.2** | **10.7** | **46.3** | **27.1** | **50.0** | **38.1** | **43.7** | **47.6** | **41.2 bu** |
| **Corn** | **107.6** | **65.8** | **97.5** | **0** | **0** | **70.3** | **55.0** | **0** | **30.0** | **33.0** | **45.9 bu** |
| **Fallow** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| ***Rotation 3*** | | | | | | | | | | | |
| **Winter Wheat** | **57.2** | **45.4** | **38.1** | **9.8** | **47.8** | **24.2** | **50.0** | **40.3** | **43.3** | **51.0** | **41.2 bu** |
| **Safflower** | **976** | **1391** | **1575** | **360** | **614** | **957** | **685** | **489** | **375** | **1483** | **891 lb** |
| **Millet** | **1500** | **1266** | **2000** | **783** | **0** | **867** | **1906** | **400** | **1307** | **1224** | **1125 lb** |
| ***Rotation 4*** | | | | | | | | | | | |
| **Winter Wheat** | **47.2** | **32.6** | **33.7** | **14.7** | **57.4** | **28.9** | **35.0** | **37.8** | **39.2** | **36.8** | **36.4 bu** |
| **Millet** | **1500** | **1370** | **1800** | **1182** | **1500** | **1888** | **1848** | **1000** | **1241** | **949** | **1428 lb** |
| ***Rotation 5a*** | | | | | | | | | | | |
| **Winter Wheat** | **36.5** | **47.6** | **33.1** | **3.4** | **34.9** | **34.1** | **49.7** | **37.0** | **37.6** | **45.9** | **36.0 bu** |
| **Corn** | **100.9** | **50.2** | **101.6** | **0** | **0** | **54.9** | **50.0** | **0** | **30.0** | **33.0** | **42.6 bu** |
| **Sunflower** | **2010** | **1958** | **1443** | **250** | **722** | **455** | **680** | **N/A** | **63** | **1494** | **958 lb** |
| **S Wheat (1999-04) to Barley (2005-08)** | **36.3** | **31.8** | **28.4** | **1.6** | **26.2** | **0** | **41.6** | **15.8** | **37** | **73.7** | **42.0 Bu (4 yrs)** |
| ***Rotation 6a*** | | | | | | | | | | | |
| **Winter Wheat-a** | **63.9** | **60.8** | **48.0** | **10.8** | **35.9** | **34.5** | **55.6** | **25.5** | **45.6** | **43.6** | **42.4 bu** |
| **Winter Wheat-b** | **34.1** | **48.9** | **33.0** | **5.2** | **35.4** | **24.7** | **52.5** | **26.5** | **35.5** | **50.0** | **34.6 bu** |
| **Sunflower (1999-04) to Safflower(05-08)** | **2210** | **2468** | **2011** | **200** | **1132** | **818** | **651 saff** | **548 saff** | **278 saff** | **1650 saff** | **782 lb Saff (4 yrs)** |
| **Pea Fallow (1999-04) to Field Pea (05-08)** | **0-pf** | **0-pf** | **0-pf** | **0-pf** | **0-pf** | **0-pf** | **1405 fp** | **1308 fp** | **1170 fp** | **2004 fp** | **1472 lb** |
| ***Rotation 9a*** | | | | | | | | | | | |
| **Winter Wheat-a** | **68.3** | **57.1** | **50.0** | **9.2** | **44.0** | **0** | **64.8** | **34.4** | **44.7** | **59.2** | **43.2 bu** |
| **Winter Wheat-b** | **29.8** | **43.0** | **38.2** | **4.9** | **31.7** | **27.5** | **56.8** | **35.2** | **36.4** | **48.5** | **35.2 bu** |
| **Safflower** | **1277** | **1546** | **1624** | **230** | **1106** | **617** | **885** | **516** | **539** | **1559** | **990 lb** |
| **Pea Fallow (1999-04) to H. Vetch (2005-08)** | **0-pf** | **0-pf** | **0-pf** | **0-pf** | **0-pf** | **0-pf** | **0 - hv** | **0-hv** | **0-hv** | **0-hv** | **0-hv** |
| ***Rotation 10*** | | | | | | | | | | | |
| **Winter Wheat** | **65.1** | **48.9** | **40.8** | **13.1** | **58.7** | **22.5** | **45.0** | **33.5** | **45.8** | **29.9** | **41.2 bu** |
| **Chickpea(1999-06) *to millet (2007-08)*** | | | **1585** | **95** | **667** | **976** | **292** | **800** | ***1420*** | ***764*** | **639 Lb (8 yrs) *1092 lb (2 yrs)*** |
| **Millet(1999-06) *to Chickpea (2007-08)*** | **1500** | **1524** | **2000** | **622** | **925** | **1197** | **2000** | **900** | ***700*** | ***0*** | **1293 lbs *350 lbs (2 yrs)*** |
| ***Rotation 11*** | | | | | | | | | | | |
| **Winter Wheat** | **54.2** | **37.8** | **42.2** | **13.5** | **59.4** | **28.2** | **53.0** | **41.7** | **45.0** | **54.8** | **43.0 bu** |
| **Corn** | **99.2** | **60.2** | **106.4** | **0** | **39.7** | **76.6** | **55.0** | **0** | **35** | **29.7** | **50.2 bu** |
| **Millet** | **1500** | **1300** | **2000** | **829** | **0** | **1017** | **1634** | **600** | **1483** | **1228** | **1159 lb** |
| ***Rainfall(Apr-Aug)*** | **13.44 "** | **8.20 "** | **12.29 "** | **5.59 "** | **5.24 "** | **9.20 "** | **10.89"** | **5.72"** | **9.08"** | **14.57"** | |

N / A = Sunflowers were destroyed by deer when heads were 2" in diameter.

**Table 71. Estimated Yield Goals of The Wall Rotation Study (1999-2008).**

| Crop | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rotation 1** | | | | | | | | | | | |
| **Winter Wheat** | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 55 | 55 | 55 | 55 bu |
| **Fallow** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Rotation 2a** | | | | | | | | | | | |
| **Winter Wheat-a** | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 bu |
| **Sunflower** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1600 | 1600 | 1600 | 1600 lb |
| **Millet (hay millet '07up)** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1500 | 1200 | 2 tons/a | 2 tons/a | 2 tons/a |
| **Winter Wheat-b** | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 bu |
| **Corn** | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 bu |
| **Fallow** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Rotation 3** | | | | | | | | | | | |
| **Winter Wheat** | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 bu |
| **Safflower** | 1500 | 1500 | 2000 | 2000 | 2000 | 1500 | 1200 | 1200 | 1200 | 1200 | 1200 lb |
| **Millet** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1500 | 1500 | 1500 | 1500 | 1500 lb |
| **Rotation 4** | | | | | | | | | | | |
| **Winter Wheat** | 45 | 45 | 45 | 45 | 45 | 45 | 40 | 35 | 35 | 35 | 35 bu |
| **Millet** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1500 | 1500 | 1500 | 1500 lb |
| **Rotation 5a** | | | | | | | | | | | |
| **Winter Wheat** | 45 | 45 | 45 | 45 | 45 | 45 | 40 | 40 | 40 | 40 | 40 bu |
| **Corn** | 80 | 80 | 80 | 80 | 80 | 80 | 70 | 80 | 80 | 80 | 80 bu |
| **Sunflower** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1500 | 1300 | 1300 | 1300 | 1300 lb |
| **Spring Barley** | n/a | n/a | n/a | n/a | n/a | n/a | 50 | 60 | 60 | 60 | 60 bu |
| **Rotation 6a** | | | | | | | | | | | |
| **Winter Wheat-a** | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 45 | 45 | 45 | 45 bu |
| **Winter Wheat-b** | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 bu |
| **Safflower** | n/a | n/a | n/a | n/a | n/a | n/a | 1500 | 1200 | 1200 | 1200 | 1200 lb |
| **Dry Peas** | n/a | n/a | n/a | n/a | n/a | n/a | 1800 | 1800 | 1800 | 1800 | 1800 lb |
| **Rotation 9a** | | | | | | | | | | | |
| **Winter Wheat-a** | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 45 | 45 | 45 | 45 bu |
| **Winter Wheat-b** | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 bu |
| **Safflower** | 1500 | 1500 | 2000 | 2000 | 2000 | 1500 | 1500 | 1200 | 1200 | 1200 | 1200 lb |
| **Hairy Vetch** | n/a | n/a | n/a | n/a | n/a | n/a | -- | -- | -- | -- | -- |
| **Rotation 10** | | | | | | | | | | | |
| **Winter Wheat** | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 bu |
| **Chickpea (1999-2006)** | n/a | n/a | n/a | 1500 | 1500 | 1500 | 1500 | 1500 | | | |
| **Millet (2007-09)** | | | | | | | | | 1500 | 1500 | 1500 lb |
| **Millet (1999-2006)** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1500 | | | |
| **Chickpea (2007-08)** | | | | | | | | | 1500 | 1500 | |
| **Dry pea (2009)** | | | | | | | | | | | 1800 lb |
| **Rotation 11** | | | | | | | | | | | |
| **Winter Wheat** | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 bu |
| **Corn** | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 bu |
| **Millet** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 1500 | 1500 | 1500 | 1500 | 1500 lb |
| ***Rainfall (Apr-Aug)*** | 13.44 " | 8.20 " | 12.29 " | 5.59 " | 5.24 " | 9.20 " | 10.89" | 5.72" | 9.08" | 14.57" | -- |

**Table 72. Long-Term Economic Trends of The Wall Rotation Study (1999-2008)**
**(Net Income - $ per Acre)**

| Rot | Crop | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | Ave Net Return ($) (1999-2008) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | W. Wht | $90.54 | $70.94 | $10.04 | $25.01 | $116.40 | $-30.23 | $46.30 | $21.88 | $236.39 | $215.13 | 80.24 |
| | Fallow | -59.62 | -61.35 | -57.03 | -72.57 | -66.64 | -56.29 | - 73.72 | -59.50 | -86.26 | -118.19 | -71.11 |
| | *Ave Inc.* | 15.46 | $4.79 | -23.49 | -23.78 | 24.88 | -43.26 | - 13.71 | -18.81 | 75.06 | 48.47 | 4.56 |
| 2a | W. Wht-a | 82.99 | 95.54 | 40.94 | 42.76 | 107.49 | 21.04 | 96.03 | 102.54 | 309.85 | 285.42 | 118.46 |
| | Sunflower | 40.45 | 84.65 | 39.43 | -109.29 | -92.02 | 3.19 | -80.10 | -29.44 | -113.89 | 69.54 | -18.74 |
| | Millet | -27.28 | 4.37 | -19.28 | -57.29 | -77.58 | -73.57 | -22.11 | -76.21 | -9.97 | 41.70 | -31.72 |
| | W Wht-b | 24.74 | 19.17 | 9.61 | -69.50 | 39.15 | -19.59 | 21.67 | 21.64 | 170.92 | 82.39 | 30.02 |
| | Corn | 36.30 | -25.08 | 56.84 | -160.22 | -125.56 | -14.84 | -51.30 | -133.25 | -68.70 | -88.64 | -57.44 |
| | Fallow | -47.40 | -52.47 | -62.28 | -58.69 | -52.82 | -44.25 | -63.08 | -49.25 | -86.26 | -95.10 | -61.16 |
| | *Ave Inc.* | 18.30 | 21.03 | 10.87 | -68.70 | -33.55 | -21.33 | -16.48 | -27.32 | 33.65 | 49.21 | -3.43 |
| 3 | W. Wht | 20.18 | 14.85 | 4.42 | -72.08 | 34.93 | -34.58 | 3.41 | 31.09 | 157.74 | 82.57 | 24.25 |
| | Safflower | -23.86 | 17.92 | 51.48 | -84.25 | -46.52 | 23.70 | -33.35 | -57.25 | -72.94 | 238.61 | 1.35 |
| | Millet | -27.28 | 11.01 | -19.28 | -1.81 | -77.58 | -45.38 | 7.12 | -56.00 | -5.90 | -61.65 | - 27.67 |
| | *Ave Inc.* | -10.32 | 14.59 | 12.20 | -52.71 | -29.72 | -18.75 | -7.60 | -27.38 | 26.30 | 86.51 | - 0.69 |
| 4 | W Wht | 4.41 | - 9.30 | -11.92 | -58.02 | 57.89 | -15.32 | -41.08 | 40.01 | 114.40 | 20.46 | 10.15 |
| | Millet | -28.73 | 9.27 | -35.90 | 49.06 | -48.44 | 0.25 | 3.96 | -30.94 | -11.50 | -110.45 | - 20.34 |
| | *Ave Inc.* | -12.16 | -.01 | -23.91 | -4.48 | 4.72 | -7.53 | -18.56 | 4.53 | 51.45 | -44.99 | - 5.09 |
| 5a | W Wht | | | | | | | | 41.07 | 143.54 | 51.14 | 78.58 |
| | Corn | | | | | | | | -133.25 | -68.70 | -103.45 | - 101.80 |
| | Sunflower | | | | | | | | -80.50 | -150.76 | 49.36 | - 60.63 |
| | S. Barley | | | | | | | | -77.88 | -16.10 | 110.31 | 5.44 |
| | *Ave Inc.* | | | | | | | | -62.64 | -23.00 | 26.84 | - 19.60 |
| 6a | W Wht-a | | | | | | | | 21.44 | 194.41 | 83.14 | 99.66 |
| | W Wht-b | | | | | | | | -8.47 | 93.98 | 69.06 | 51.52 |
| | Safflower | | | | | | | | -48.60 | -93.95 | 287.37 | 48.27 |
| | Dry Pea | | | | | | | | -20.98 | 15.15 | 51.52 | 15.23 |
| | *Ave Inc.* | | | | | | | | -14.15 | 52.39 | 122.77 | 53.67 |
| 9a | W Wht-a | | | | | | | | -40.74 | 99.03 | 59.55 | 39.28 |
| | W Wht-b | | | | | | | | 3.01 | 96.68 | 39.25 | 46.31 |
| | Safflower | | | | | | | | -53.29 | -37.39 | 261.11 | 56.81 |
| | H. Vetch* | | | | | | | | 00.00* | 00.00* | 00.00* | 00.00* |
| | *Ave Inc.* | | | | | | | | -22.75 | 39.58 | 89.97 | 35.60 |
| 10 | WWht(07-08) | | | | | | | | | 174.58 | -15.21 | 79.68 |
| | *Mil(07-08)* | | | | | | | | | *-19.53* | *-118.60* | - 69.06 (2 yrs) |
| | CP(07-08) | | | | | | | | | -22.84 | -171.63 | - 97.23 (2 yrs) |
| | *Ave Inc.* | | | | | | | | | 44.07 | -101.81 | - 28.87 |
| 11 | W. Wht | 23.06 | -1.29 | 16.24 | -61.47 | 65.64 | -15.14 | 7.31 | 37.08 | 179.68 | 101.19 | 35.23 |
| | Corn | 15.42 | -34.38 | 73.76 | -160.22 | -62.72 | -3.44 | -51.30 | -133.25 | -53.00 | -99.96 | - 50.90 |
| | Millet | -27.85 | 13.60 | -19.28 | 16.85 | -87.98 | -35.30 | -9.53 | -52.99 | 8.40 | -50.06 | - 24.41 |
| | *Ave Inc.* | 3.54 | -7.35 | 23.57 | -68.28 | -28.35 | -17.96 | -17.84 | -49.72 | 45.02 | -16.27 | - 13.36 |

**Note:** No Federal Government farm payments are calculated into these values.
(*) Expense of hairy vetch is prorated 80% to W Wht-a and 20% to W Wht-b.

## Appendix 1 Detailed Cultural Practices for Each Rotation in 2008

### Rotation 1
*WINTER WHEAT* / SUMMER FALLOW

| Cost / A. | 2008 Winter Wheat |
|---|---|
| $30.33 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 610 drill at 10" rows + 6 gal / A liquid 10-34-0. on September 21, 2007. |
| 18.20 | -Top dress 28-0-0 liquid Nitrogen fertilizer on dormant winter wheat at 20 lb N / Acre rate (6.7 gal/Acre). – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 30.78 | -Harvest 56.2 bu/A winter wheat – July 29, 2008 Test weight – 63.4 lb / bu (Protein Content – 11.9 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $146.79 | Total Cost of Winter Wheat Production |

### Rotation 1
WINTER WHEAT / *SUMMER FALLOW*

| Cost / A. | 2008 Summer Fallow |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate + 12 oz LV6 / acre.10 gpA rate. – August 6, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate. 8 gpA –September 27, 2007. |
| 14.02 | -Spray w / 16 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate + 4 oz Banvel 4L. 8 gpA – May 20, 2008. |
| 16.10 | -Spray w / 16 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate + 8 oz Banvel 4L. 8 gpA – June 19, 2008. |
| 7.50 | -Work w / 24" sweeps. – June 24, 2008. |
| 7.50 | -Work w / 12" sweeps. – August 5, 2008. |
| 46.00 | -Land Charges 2008 |
| $118.19 | Cost of Summer Fallow |

### Rotation 1 SUMMARY 2008

| Crop | Income | | Expenses | Net Income Per Acre |
|---|---|---|---|---|
| Winter Wheat | $361.92 | - | $146.79 | = $ 215.13 |
| Fallow | $ 0.00 | - | $118.19 | = $ -118.19 |
| | $361.92 | - | $264.98 | = $ 96.94 / 2 = $48.47 |

**$ 48.47** Average Income / acre for Rotation 1 - 2008

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## Rotation 2a

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

| Cost / A. | 2008 Winter Wheat-A |
|---|---|
| $ 30.33 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 610 drill at 10" rows + 6 gal / A liquid 10-34-0. on September 21, 2007. |
| 28.10 | -Top dress 28-0-0 liquid Nitrogen fertilizer on dormant winter wheat at 35 lb N / Acre rate (11.7 gal/Acre). – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 34.96 | -Harvest 69.3 bu/A winter wheat – July 29, 2008 Test weight – 63.4 lb / bu (Protein content – 11.9 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $160.87 | Total Cost of Winter Wheat Production |

## Rotation 2a

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

| Cost / A. | 2008 Sunflowers |
|---|---|
| $12.26 | -Spray w / 16 oz Roundup Original Max + liq Ammonium Sulfate @ 50 ml / gal. 8 gpA spray rate. – September 27, 2007. |
| 71.34 | -Inject 28-0-0 + 10-34-0 (80 lb N / 30 lb P2O5) with injector implement set @ 20” row spacing. – October 24, 2007. |
| 17.72 | -Spray w / 16 oz Roundup Original Max + liquid ammonium Sulfate @ 50 ml / gal + 4 oz / acre Spartan75 df. 10 gpA spray rate. – May 14, 2008. |
| 27.85 | -Plant to Pannar 8560 NS/CL @ 16,600 seeds / acre w / JD 7100 planter. Note: Seed was treated w / Cruiser for wire worm control. – June 11, 2008. |
| 21.63 | -Spray with 4 oz / acre Beyond 1L + Penetrate II @ 32 oz / acre + 28-0-0 @ 16 oz / acre rate. 10 gpA spray rate. - July 10, 2008. |
| 37.36 | -Harvest 1690 lb / Acre Sunflowers – October 27, 2008. Test weight – 29.0 lb / bushel |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $234.66 | Total Cost of Sunflower Production |

## Rotation 2a

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

| Cost / A. | 2008 Hay Millet |
|---|---|
| $12.26 | -Spray w / 16 oz Roundup Original Max + 50 ml / gal Liquid Ammonium Sulfate. 8gpA spray rate. – May 20, 2008. |
| 30.62 | -Planted to Golden German Hay millet w / JD750 drill. w/ starter fertilizer(10-34-0) at 6 gal / Acre. Row spacing was at 10". Seeding rate was at 12 lb/A. – June 9, 2008. |
| 43.92 | -Swathe & bale 2.5 Tons / Acre Hay Millet @ 13.5% Moisture – August 28, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $133.30 | Total Cost of Hay Millet Production |

**Hay Millet Quality and Yield - 2008.**

| NDF % | ADF % | RFV | Crude Protein % | Yield (Tons/A) |
|---|---|---|---|---|
| 65.0 | 35.0 | 89 | 6.8 | 2.5 |

## Rotation 2a

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

| Cost / A. | 2008 Winter Wheat –B |
|---|---|
| $32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 64.40 | -Top dressed with 28-0-0 @ 90 lb N / acre. – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 28.02 | -Harvest 47.6 bu/A winter wheat – July 29, 2008 Test weight – 61.6 lb / bu (Protein content - 9.6 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $192.73 | Total Cost of Winter Wheat-B Production |

## Rotation 2a

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

| Cost / A. | 2008 Corn |
|---|---|
| $12.26 | -Spray w / 16 oz Roundup Original Max + liquid Ammonium Sulfate at 50 ml/gal. 8 gpA spray rate. – September 27, 2007. |
| 71.34 | -Injected 28-0-0 + 10-34-0 (80 lbN/acre plus 30 lb P2O5 per acre). 20 inch row spacing. –October 24, 2007. |
| 32.65 | -Plant to Econo Brand Dekalb RR/YG 90 day @ 12,500 seeds / acre. Planted w / JD 7100 Corn planter. 20 inch row spacing. - April 29, 2008. |
| 14.02 | - Spray w / 16 oz Roundup Ultra Max + Liquid Ammonium Sulfate + 4 oz Banvel 4L. 8 gpA spray rate. – May 20, 2008. |
| 12.26 | - Spray w / 16 oz Roundup Ultra Max + Liquid Ammonium Sulfate. 8 gpA spray rate. – June 19, 2008. |
| 23.36 | -Harvest 33.0 bushels / acre corn – October 6, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $212.39 | -Total Cost of Corn Production |

## Rotation 2a

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

| Cost / A. | 2008 Summer Fallow |
|---|---|
| $14.02 | -Spray w / 16 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate + 4 oz Banvel 4L. 8 gpA – May 20, 2008. |
| 16.10 | -Spray w / 16 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate + 8 oz Banvel 4L. 8 gpA – June 19, 2008. |
| 18.98 | -Spray w / 32 oz Roundup Original Max + 50 ml/gal Liquid Ammonium Sulfate. 8 gpA – July 11, 2008. |
| 46.00 | -Land Charges 2008 |
| $95.10 | Cost of Summer Fallow |

## Rotation 2a SUMMARY 2008

| Crop | Income | | Expenses | Net Income Per Acre |
|---|---|---|---|---|
| Winter Wheat-A | $ 446.29 | - | $ 236.95 ($160.87 + $76.08) | = $ 209.34 |
| Sunflower | $ 304.20 | - | $ 253.68 ($234.66 + $19.02) | = $ 50.52 |
| Hay Millet | $ 175.00 | - | $ 133.30 | = $ 41.70 |
| Winter Wheat-B | $ 275.12 | - | $ 192.73 | = $ 82.39 |
| Corn | $ 123.75 | - | $ 212.39 | = $ - 88.64 |
| Fallow | $ 0.00 | - | $ 0.00* | = $ * |
| | $1324.36 | - | $1029.05 | = $ 295.31 / 6 = $49.21 |

*The expense of the fallow ($95.10) was split 80% to the Winter Wheat-A ($76.08) and 20% to the Sunflowers ($19.02).

**$ 49.21** Average Income / acre for Rotation 2a – 2008

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## Rotation 3

*WINTER WHEAT* / SAFFLOWER / MILLET

| Cost / A. | 2008 Winter Wheat |
|---|---|
| $12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 64.40 | -Top dressed with 28-0-0 @ 90 lb N / acre. – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 29.12 | -Harvest 51.0 bu/A winter wheat – July 29, 2008 Test weight – 62.3 lb / bu (Protein content – 9.2 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $206.09 | Total Cost of Winter Wheat Production |

## Rotation 3

WINTER WHEAT / *SAFFLOWER* / MILLET

| Cost / A. | 2008 Safflower |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 58.14 | -Injected 28-0-0 plus +10-34-0 (60 lb N/acre + 30 lb P2O5 / acre) - October 24, 2007. |
| 26.26 | -Spray w / 16 oz Roundup Original Max + liquid ammonium sulfate @ 18 ml / gal + 3 ½ pints Prowl H2O. 8 gpA spray rate. – April 18, 2008. |
| 21.70 | -Plant to Finch w / JD 7100 planter @ 210,000 seeds/acre rate. (20 lbs/acre). – April 29, 2008. |
| 24.64 | -Harvest 1482 lb / Acre Safflowers – September 10, 2008. Test weight – 44.8 lb / bushel |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $205.99 | Total Cost of Safflower Production |

## Rotation 3

WINTER WHEAT / SAFFLOWER / *MILLET*

| Cost / A. | 2008 Millet |
|---|---|
| $11.39 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon. 8 gpA spray rate. –September 27, 2007. |
| 14.02 | -Sprayed w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate + 4 oz/A Banvel 4L . 8 gpA spray rate. – May 20, 2008. |
| 30.32 | -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 18 lb/A. – June 9, 2008. |
| 20.60 | -Harvest 1224 lb / acre Test weight- 55.3 lbs/bushel – September 9, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $135.09 | Total Cost of Millet Production |

### Rotation 3 SUMMARY 2008

| Crop | Income | | Expenses | | Net Income Per Acre |
|---|---|---|---|---|---|
| Winter Wheat | $288.66 | - | $206.09 | = | $ 82.57 |
| Safflower | $444.60 | - | $205.99 | = | $ 238.61 |
| Millet | $ 73.44 | - | $135.09 | = | $ - 61.65 |
| | $806.70 | - | $547.17 | = | $ 259.53 / 3 = $ 86.51 |

**$ 86.51** Average Income / acre for Rotation 3 – 2008

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## Rotation 4

*WINTER WHEAT* / MILLET

| Cost / A. | 2008 Winter Wheat |
|---|---|
| $13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 44.60 | -Top dressed with 28-0-0 @ 60 lb N / acre (20 gpA). – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 24.56 | -Harvest 36.8 bu/A winter wheat – July 29, 2008 Test weight – 61.1 lb / bu (Protein content - 8.9 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $183.41 | Total Cost of Winter Wheat Production |

## Rotation 4

WINTER WHEAT / *MILLET*

| Cost / A. | 2008 Millet |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon. 8 gpA spray rate. –September 27, 2007. |
| 18.20 | -Top dressed with 28-0-0 @ 20 lb N / acre (6.7 gpA). – March 11, 2008. |
| 14.02 | -Sprayed w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate + 4 oz/A Banvel 4L . 8 gpA spray rate. – May 20, 2008. |
| 30.32 | -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 18 lb/A. – June 9, 2008. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon. 8 gpA spray rate. –June 11, 2008. |
| 19.02 | -Harvest 949 lb / acre Test weight- 56.2 lbs/bushel – September 9, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $167.39 | Total Cost of Millet Production |

### Rotation 4 SUMMARY 2008

| Crop | Income | | Expenses | | Net Income Per Acre |
|---|---|---|---|---|---|
| Winter Wheat | $203.87 | - | $183.41 | = | $ 20.46 |
| Millet | $ 56.94 | - | $167.39 | = | $ - 110.45 |
| | $260.81 | - | $350.80 | = | $ - 89.99 / 2 = $ - 44.99 |

**$ - 44.99** Average Income / acre for Rotation 4 – 2008

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## Rotation 5a

*WINTER WHEAT* / CORN / SUNFLOWER / SPRING BARLEY

| Cost / A. | 2008 Winter Wheat |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 44.60 | -Top dressed with 28-0-0 @ 60 lb N / acre (20 gpA). – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 26.88 | -Harvest 44.0 bu/A winter wheat – July 29, 2008 Test weight – 60.8 lb / bu (Protein content - 9.5 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $200.54 | Total Cost of Winter Wheat Production |

## Rotation 5a

WINTER WHEAT / *CORN* / SUNFLOWER / SPRING BARLEY

| Cost/A. | 2008 Corn |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 29, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + liquid Ammonium Sulfate at 50 ml/gal. 8 gpA spray rate. – September 27, 2007. |
| 71.34 | -Injected 28-0-0 + 10-34-0 (80 lb N/acre plus 30 lb P2O5 per acre). 20 inch row spacing. –October 24, 2007. |
| 32.65 | -Plant to Econo Brand Dekalb RR/YG 90 day @ 12,500 seeds / acre. Planted w / JD 7100 Corn planter. 20 inch row spacing. - April 29, 2008. |
| 14.02 | - Spray w / 16 oz Roundup Ultra Max + Liquid Ammonium Sulfate + 4 oz Banvel 4L. 8 gpA spray rate. – May 20, 2008. |
| 12.26 | - Spray w / 16 oz Roundup Ultra Max + Liquid Ammonium Sulfate. 8 gpA spray rate. – June 19, 2008. |
| 23.36 | -Harvest 33.0 bushels / acre corn – October 6, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $227.20 | Total Cost of Corn Production |

## Rotation 5a

WINTER WHEAT / CORN / *SUNFLOWER* / SPRING BARLEY

| Cost / A. | 2008 Sunflower |
|---|---|
| $71.34 | -Inject 28-0-0 + 10-34-0 (80 lb N / 30 lb P2O5) with injector implement set @ 20" row spacing. – October 24, 2007. |
| 17.72 | -Spray w / 16 oz Roundup Original Max + liquid ammonium Sulfate @ 50 ml / gal + 4 oz / acre Spartan75 df. 10 gpA spray rate. – May 14, 2008. |
| 27.85 | -Plant to Pannar 8560 NS/CL @ 16,600 seeds / acre w / JD 7100 planter. Note: Seed was treated w / Cruiser for wire worm control. – June 11, 2008. |
| 21.63 | -Spray with 4 oz / acre Beyond 1L + Penetrate II @ 32 oz / acre + 28-0-0 @ 16 oz / acre rate. 10 gpA spray rate. - July 10, 2008. |
| 34.52 | -Harvest 1494 lb / Acre Sunflowers – October 27, 2008. Test weight – 28.6 lb / bushel |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $219.56 | Total Cost of Sunflower Production |

## Rotation 5a

WINTER WHEAT / CORN / SUNFLOWER / *SPRING BARLEY*

| Cost / A. | 2008 Spring Barley |
|---|---|
| $44.60 | -Top dressed with 28-0-0 @ 60 lb N / acre (20 gpA). – March 11, 2008. |
| 30.17 | -Plant to Eslick Barley @ 69.7 lb or 1,219,680 seeds (1.45 bushels) / acre rate. Seeded w / JD 750 drill. Starter fertilizer 10-34-0 was applied at 6 gallons per acre rate. – March 25, 2008. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + liquid Ammonium Sulfate at 50 ml/gal. 8 gpA spray rate. – April 2, 2008. |
| 20.98 | -Spray barley with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 29.98 | -Harvest 73.7 bu/A Barley – July 29, 2008 Test weight –51.8 lb / bu (Protein content - 11.4 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $184.49 | Total Cost of Spring Barley Production |

## Rotation 5a SUMMARY 2008

| Crop | Income | | Expenses | | Net Income Per Acre |
|---|---|---|---|---|---|
| Winter Wheat | $251.68 | - | $200.54 | = | $ 51.14 |
| Corn | $123.75 | - | $227.20 | = | $ -103.45 |
| Sunflower | $268.92 | - | $219.56 | = | $ 49.36 |
| Spring Barley | $294.80 | - | $184.49 | = | $ 110.31 |
| | $939.15 | - | $831.79 | = | $ 107.36 / 4 = $26.84 |

**$ 26.84** Average Income / acre for Rotation 5a - 2008

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## Rotation 6a

*WINTER WHEAT-B* / SAFFLOWER / FIELD PEA / WINTER WHEAT-A

| Cost / A. | 2008 Winter Wheat – B |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 64.40 | -Top dressed with 28-0-0 @ 90 lb N / acre (30 gpA). – March 11, 2008. |
| 15.68 | -Spray wheat with Olympus @ .9 oz / acre rate Plus Penetrate II @ 18 ml / gallon. 10 gpA spray rate. – April 18, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 28.80 | -Harvest 50.0 bu/A winter wheat – July 29, 2008 Test weight – 62.2 lb / bu (Protein content - 10.8 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $237.94 | Total Cost of Winter Wheat –B Production |

## Rotation 6a

WINTER WHEAT-B / *SAFFLOWER* / FIELD PEA / WINTER WHEAT-A

| Cost / A. | 2008 Safflower |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 58.14 | -Injected 28-0-0 plus +10-34-0 (60 lb N/acre + 30 lb P2O5 / acre) - October 24, 2007. |
| 26.26 | -Spray w / 16 oz Roundup Original Max + liquid ammonium sulfate @ 50 ml / gal + 3 ½ pints Prowl H2O. 8 gpA spray rate. – April 18, 2008. |
| 21.70 | -Plant to Finch w / JD 7100 planter @ 210,000 seeds/acre rate. (20 lbs/acre). – April 29, 2008. |
| 25.98 | -Harvest 1649 lb / Acre Safflowers – September 10, 2008. Test weight – 44.6 lb / bushel |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $207.33 | Total Cost of Safflower Production |

## Rotation 6a

WINTER WHEAT-B / SAFFLOWER / *FIELD PEA* / WINTER WHEAT-A

| Cost / A. | 2008 Field Pea |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 29, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 27, 2007. |
| 34.61 | -Plant to Grande peas @ 300,000 seeds per acre (138.2 lbs/A) (2170 seeds/lb)+ 8 lb / acre granular innoculum w / JD 750 drill. No starter fertilizer added. – March 25, 2008. |
| 17.72 | -Spray w / 16 oz / acre Roundup Original Max + 50 ml / gal liquid Ammonium Sulfate + Spartan @ 4 ounces per acre. 10 gpA spray rate. – April 2, 2008. |
| 23.48 | -Harvest 2004 lb or 33.4 bushels / Acre Grande peas – July 29, 2008. Test weight – 65.0 lb / bushel |
| 46.00 | -Land Charges 2008 |
| $148.88 | Total Cost of Field Pea Production |

## Rotation 6a

WINTER WHEAT-B / SAFFLOWER / FIELD PEA / *WINTER WHEAT-A*

| Cost / A. | 2008 Winter Wheat – A |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 15.68 | -Spray wheat with Olympus @ .9 oz / acre rate Plus Penetrate II @ 18 ml / gallon. 10 gpA spray rate. – April 18, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 26.74 | -Harvest 43.6 bu/A winter wheat – July 29, 2008 Test weight – 62.6 lb / bu (Protein content - 9.9 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $171.48 | Total Cost of Winter Wheat-A Production |

## Rotation 6a SUMMARY 2008

| Crop | Income | | Expenses | | Net Income Per Acre |
|---|---|---|---|---|---|
| Winter Wheat - B | $ 307.00 | - | $ 237.94 | = | $ 69.06 |
| Safflower | $ 494.70 | - | $ 207.33 | = | $ 287.37 |
| Field pea | $ 200.40 | - | $ 148.88 | = | $ 51.52 |
| Winter Wheat - A | $ 254.62 | - | $ 171.48 | = | $ 83.14 |
| | $ 1256.72 | - | $ 765.63 | = | $ 491.09 / 4 = $122.77 |

**$ 122.77** Average Income / acre for Rotation 6a - 2008

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## Rotation 7

The plots from rotation #7 (WW-Corn-Fallow) were combined with rotation #2 (WW-Sunflower-Millet) to make a longer six year rotation (2a) in 1999.

## 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 / Hairy Vetch / WINTER WHEAT-A

| Cost / A. | 2008 Winter Wheat –B |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 44.60 | -Top dressed with 28-0-0 @ 60 lb N / acre (20 gpA). – March 11, 2008. |
| 15.68 | -Spray wheat with Olympus @ .9 oz / acre rate Plus Penetrate II @ 18 ml / gallon. 10 gpA spray rate. – April 18, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 28.32 | -Harvest 48.5 bu/A winter wheat – July 29, 2008 Test weight – 61.2 lb / bu (Protein content - 10.0 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $217.66 | Total Cost of Winter Wheat–B |

## Rotation 9a

WINTER WHEAT-B / *SAFFLOWER* / Hairy Vetch / WINTER WHEAT-A

| Cost / A. | 2008 Safflower |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 58.14 | -Injected 28-0-0 plus +10-34-0 (60 lb N/acre + 30 lb P2O5 / acre) - October 24, 2007. |
| 26.26 | -Spray w / 16 oz Roundup Original Max + liquid ammonium sulfate @ 18 ml / gal + 3 ½ pints Prowl H2O. 8 gpA spray rate. – April 18, 2008. |
| 21.70 | -Plant to Finch w / JD 7100 planter @ 210,000 seeds/acre rate. (20 lbs/acre). – April 29, 2008. |
| 25.24 | -Harvest 1559 lb / Acre Safflowers – September 10, 2008. Test weight – 44.6 lb / bushel |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $206.59 | Total Cost of Safflower Production |

## Rotation 9a

WINTER WHEAT-B / SAFFLOWER / *Hairy Vetch* / WINTER WHEAT-A

| Cost / A. | 2008 Hairy Vetch |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 29, 2007. |
| 42.70 | -Plant to Hairy Vetch @ (20 lb/A) + 5 lb / acre granular pea/lentil inoculum w / JD 750 drill. – September 25, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 27, 2007. |
| 14.33 | -Spray with Assure II @ 8 oz / acre + 9.5 ml / gallon Penetrate II. 10 gpA spray rate. – May 20, 2008 |
| 16.10 | -Spray to terminate hairy vetch w / 16 oz Roundup Original Max + 50 ml / gal liquid ammonium sulfate + 8 oz / A Banvel 4L. 8 gpA spray rate. – June 19, 2008. |
| 46.00 | -Land Charges 2008 |
| $146.20 | Total Cost of Hairy Vetch Production |

## Rotation 9a

WINTER WHEAT-B / SAFFLOWER / HAIRY VETCH / *WINTER WHEAT-A*

| Cost / A. | 2008 Winter Wheat-A |
|---|---|
| $13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 18.20 | -Top dressed with 28-0-0 @ 20 lb N / acre (6.7 gpA). – March 11, 2008. |
| 15.68 | -Spray wheat with Olympus @ .9 oz / acre rate Plus Penetrate II @ 18 ml / gallon. 10 gpA spray rate. – April 18, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 31.74 | -Harvest 59.2 bu/A winter wheat – July 29, 2008 Test weight – 62.5 lb / bu (Protein content –10.5 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $179.87 | Total Cost of Winter Wheat-A Production |

## Rotation 9a SUMMARY 2008

| Crop | Income | Expenses | Net Income Per Acre |
|---|---|---|---|
| Winter Wheat-B | $ 286.15 | - $246.90 ($217.66 + $29.24) | = $ 39.25 |
| Safflower | $ 467.70 | - $206.59 | = $ 261.11 |
| Hairy Vetch | $ 0.00 | - $ 0.00 | = $ 0.00* |
| Winter Wheat-A | $ 356.38 | - $296.83 ($179.87 + $116.96) | = $ 59.55 |
| | $1110.23 | - $750.32 | = $ 359.91 / 4 = $ 89.97 |

*The expense of the hairy vetch ($146.20) was split 80% ($116.96) to the Winter Wheat-A and 20% ($29.24) to the Winter Wheat-B.

**$ 89.97** Average Income / acre for Rotation 9a - 2008

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## Rotation 10

*WINTER WHEAT* / MILLET / CHICKPEA

| Cost / A. | 2008 Winter Wheat |
|---|---|
| $ 14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 21, 2007. |
| 13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 28.10 | -Top dressed with 28-0-0 @ 35 lb N / acre (11.7 gpA). – March 11, 2008. |
| 15.68 | -Spray wheat with Olympus @ .9 oz / acre rate Plus Penetrate II @ 18 ml / gallon. 10 gpA spray rate. – April 18, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 22.36 | -Harvest 29.9 bu/A winter wheat – July 29, 2008 Test weight – 63.4 lb / bu (Protein content –10.5 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $195.20 | Total Cost of Winter Wheat Production |

## Rotation 10

WINTER WHEAT / *MILLET* / CHICKPEA

| Cost / A. | 2008 Millet |
|---|---|
| $14.81 | -Spray w / 19 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon + 12 oz LV6 / acre. 10 gpA spray rate. – August 6, 2007. |
| 12.26 | -Spray w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate @ 50 ml / gallon. 8 gpA spray rate. –September 27, 2007. |
| 28.10 | -Top dressed with 28-0-0 @ 35 lb N / acre (11.7 gpA). – March 11, 2008. |
| 14.02 | -Sprayed w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate + 4 oz/A Banvel 4L . 8 gpA spray rate. – May 20, 2008. |
| 30.32 | -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 18 lb/A. – June 9, 2008. |
| 18.43 | -Harvest 764 lb / acre Test weight- 55.1 lbs/bushel – September 9, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $164.44 | Total Cost of Proso Millet Production |

## Rotation 10

WINTER WHEAT / MILLET / *CHICKPEA*

| | 2008 Chickpeas |
|---|---|
| $13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8gpA spray rate. – September 14, 2007. |
| 17.72 | -Spray w / 16 oz Roundup Original Max + liquid ammonium Sulfate @ 50 ml / gal + 4 oz / acre Spartan75 df. 10 gpA spray rate. – April 2, 2008. |
| 79.09 | -Plant to Sierra Chickpeas @ 130,000 seeds per acre (120 lb/A) (1080 seeds / lb) + 3 lb / acre granular inoculums w / JD 750 drill. No starter fertilizer added. – April 15, 2008. |
| 14.88 | -Spray w / 16 oz Poast + 24 oz crop oil concentrate / acre. 10 gpA spray rate. – June 23, 2008. |
| 0.00 | -Harvest 0 lb or 0.0 bushels / Acre Sierra chickpeas - September 9, 2008. (Heavy ascochyta pressure) |
| 46.00 | -Land Charges 2008 |
| $171.63 | Total Cost of Chickpea Production |

**Rotation 10 SUMMARY 2008**

| Crop | Income | | Expenses | Net Income Per Acre |
|---|---|---|---|---|
| Winter Wheat | $179.99 | - | $195.20 | = $ - 15.21 |
| Millet | $ 45.84 | - | $164.44 | = $ - 118.60 |
| Chickpea | $ 0.00 | - | $171.63 | = $ - 171.63 |
| | $225.83 | - | $531.27 | = $ - 305.44 / 3 = $ - 101.81 |

**$ - 101.81** Average Income / acre for Rotation 10 - 2008

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**Rotation 11**

*WINTER WHEAT* / CORN / MILLET

| Cost / A. | 2008 Winter Wheat |
|---|---|
| $13.94 | -Spray w / 20 oz Roundup Original Max + Liquid Ammonium Sulfate. 8 gpA spray rate. –September 14, 2007. |
| 32.83 | -Plant to Alice @ 73.0 lbs or 950,000 seeds/acre. Planted w / JD 750 drill at 10" rows + 6 gal / A liquid 10-34-0. - September 25, 2007. |
| 64.40 | -Top dressed with 28-0-0 @ 90 lb N / acre (30 gpA). – March 11, 2008. |
| 20.98 | -Spray wheat with 27 oz / acre Starane NXT + Penetrate II @ 6 oz / acre. 10 gpA spray rate. – May 7, 2008. |
| 30.32 | -Harvest 54.8 bu/A winter wheat – July 29, 2008 Test weight – 62.5 lb / bu (Protein content – 9.3 %) |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $208.97 | Total Cost of Winter Wheat Production |

**Rotation 11**

WINTER WHEAT / *CORN* / MILLET

| Cost / A. | 2008 Corn |
|---|---|
| $12.26 | -Spray w / 16 oz Roundup Original Max + liquid Ammonium Sulfate at 50 ml/gal. 8 gpA spray rate. – September 27, 2007. |
| 71.34 | -Injected 28-0-0 + 10-34-0 (80 lb N / acre plus 30 lb P2O5 per acre). 20 inch row spacing. –October 24, 2007. |
| 32.65 | -Plant to Econo Brand Dekalb RR/YG 90 day @ 12,500 seeds / acre. Planted w / JD 7100 Corn planter. 20 inch row spacing. - April 29, 2008. |
| 14.02 | - Spray w / 16 oz Roundup Ultra Max + Liquid Ammonium Sulfate + 4 oz Banvel 4L. 8 gpA spray rate. – May 20, 2008. |
| 12.26 | - Spray w / 16 oz Roundup Ultra Max + Liquid Ammonium Sulfate. 8 gpA spray rate. – June 19, 2008. |
| 22.30 | -Harvest 29.7 bushels / acre corn – October 6, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $211.33 | Total Cost of Corn Production |

## Rotation 11

WINTER WHEAT / CORN / *MILLET*

| Cost / A. | 2008 Millet |
|---|---|
| $14.02 | -Sprayed w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate + 4 oz/A Banvel 4L . 8 gpA spray rate. – May 20, 2008. |
| 30.32 | -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 18 lb/A. – June 9, 2008. |
| 12.26 | -Sprayed w / 16 oz Roundup Original Max + Liquid Ammonium Sulfate . 8 gpA spray rate. – June 11, 2008. |
| 20.64 | -Harvest 1228 lb / acre Test weight - 55.1 lbs/bushel – September 9, 2008. |
| .50 | -Soil Sampling / acre |
| 46.00 | -Land Charges 2008 |
| $123.74 | Total Cost of Proso Millet Production |

### Rotation 11 SUMMARY 2008

| Crop | Income | | Expenses | | Net Income Per Acre |
|---|---|---|---|---|---|
| Winter Wheat | $310.16 | - | $208.97 | = | $101.19 |
| Corn | $111.37 | - | $211.33 | = | $- 99.96 |
| Millet | $ 73.68 | - | $123.74 | = | $- 50.06 |
| | $495.21 | - | $544.04 | = | $ - 48.83 / 3 = $ - 16.27 |

**$ - 16.27** Average Income / acre for Rotation 11 - 2008

**********

## COST OF INPUTS – 2008

### SEED

| | |
|---|---|
| Alice Winter Wheat | $ 7.00 / Bu |
| Eslick Barley | $ 3.00 / Bu |
| Grande Field Peas | $ 9.00 / Bu |
| Sierra Kabuli Chickpea | $52.00 / 100 lbs |
| *(Note: the seed is treated w/ LSP / Apron / Maxim)* | |
| Finch Safflower | $23.00 / 50 lbs |
| Dekalb Econo Brand RR/YG Corn (80,000 kernels) | $129.00 / bag |
| Pannar 8560 NS / CL + Cruiser Sunflower – Size 3 (200,000 seeds) | $185.00 / bag |
| Golden German Hay Millet | $ .40 / lb |
| Sunup Millet | $ .25 / lb |
| Hairy Vetch | $1.50 / lb |

### HERBICIDES

*(From Warne Chemical, Rapid City, SD – Dec, 2007)*

| | |
|---|---|
| Assure II | $142.22 / gal |
| Beyond 1L | $541 / gal |
| Bronate (Brox M) | $39.58 / gal |
| Roundup Original Max | $53.60 / gal |
| Atrazine 90df | $ 2.33 / lb |
| Harmony GT | $12.90 / oz |
| Harmony Extra (Affinity TM) | $15.20 / oz |
| Ally | $24.21 / oz |
| Treflan 10% granules | $ 0.83 / lb |
| 2,4D Ester LV6 | $21.32 / gal |
| Clarity (dicamba) | $62.50 / gal |
| Poast | $69.30 / gal |
| Spartan 75df | $41.32 / lb ($2.58 /oz) |
| Spartan 4F | $386 / gal |
| Starane | $111.36 / gal |
| Starane NXT | $72.45/gal |
| Maverick | $14.80 / oz |
| Olympus WG | $10.94 / oz |
| Olympus Flex | $ 3.65 / oz |
| Aim | $171.42 / quart ($5.35 / oz) |
| Cleanwave | $46.20 / gallon |
| Crop Oil | $ 6.60 / gal |
| Penetrate II | $18.50 / gal |
| Ammonium Sulfate | $ 6.06 / gal |
| Prowl H2O | $32.24 / gal |

### INSECTICIDES

| | |
|---|---|
| Lorsban 4E | $37.88 / gallon |

### FUNGICIDES

| | |
|---|---|
| Tilt | $340.00 / gallon |
| Headline | $292.90 / gallon |

### FERTILIZER

*(Warne Chemical, Rapid City, SD – Sept 2007)*

10-34-0 $380.00 / Ton ($2.22 / gallon)

*(Johnson's Ranchers Supply, Wall, SD – March 11, 2008)*

28-0-0 $370.00 / Ton ($1.97 / gallon) ($.66/lb N)

### SEED TREATMENTS

| | |
|---|---|
| Granular Inoculum for chickpeas | $55.95 / 40 lb bag |
| Vitavax/Thiram/RTU | $33.41 / gal |
| Raxil MDW | $87.80 / gal |
| Seed treatment fee | $ 0.25 / acre |
| Field Pea/Vetch innoculum (peat base) | $ 0.60 / bu |

### EQUIPMENT CHARGES

| | |
|---|---|
| No-till Planting | $12.50 / acre |
| Conventional Planting | $10.00 / acre |
| Mechanical Tillage | $ 7.50 / acre |
| Swathing hay | $10.59 / acre |
| Baling hay | $10.00 / 1500 lb bale |

### APPLICATION RATES

| | |
|---|---|
| Herbicide | $ 5.00 / acre |
| Top dress Fertilizing | $ 5.00 / acre |
| Injection Fertilizing | $ 8.00 / acre |

### HARVEST RATES

| | |
|---|---|
| Base | $16.00 / acre |
| Over 20 bu/acre | $ 0.16 / bu |
| Trucking | $ 0.16 / bu |

Soil Sampling & Analysis $ .50 / acre

### LAND CHARGES

$600 / A x .07=$42.00 + $4 land tax=$46.00/Acre

### GRAIN SALE VALUES

*(Grain Prices for 2008 crop from Dakota Mill & Grain, Rapid City, SD - December 15, 2008)*

| | |
|---|---|
| Winter Wheat | See chart on next page. |
| Sierra Chickpeas | crop failure |
| Sunflower (oil-type) | $ 18.00 / cwt. |
| Corn #2 yellow | $ 3.75 / bu |
| Safflower | $ 30.00 / cwt |
| Proso Millet | $ 6.00 / cwt |
| Barley | $ 4.00 / bu |
| Field peas | $ 6.00 / bu * |

*(*price quote from Howe Seeds, Dec 18, 2008)*

### HAY SALE VALUES

Golden German millet hay $70.00 / ton

**Winter Wheat Value Per Bushel with Protein Adjustment.**
**(Prices from Dakota Mill and Grain, Rapid City as of December 15, 2008)**
**(Average sale value for fall of 2008)**

| Protein Content | Winter Wheat $ / bu |
|---|---|
| 8.8% | $5.54 |
| 9.0 | $5.60 |
| 9.2 | $5.66 |
| 9.4 | $5.72 |
| 9.6 | $5.78 |
| 9.8 | $5.84 |
| 10.0 | $5.90 |
| 10.2 | $5.96 |
| 10.4 | $6.02 |
| 10.6 | $6.08 |
| 10.8 | $6.14 |
| 11.0 | $6.20 |
| 11.2 | $6.26 |
| 11.4 | $6.32 |
| 11.6 | $6.38 |
| 11.8 | $6.44 |
| **12.0%** | **$6.50** |
| 12.2 | $6.52 |
| 12.4 | $6.54 |
| 12.6 | $6.56 |
| 12.8 | $6.58 |
| 13.0 | $6.60 |
| 13.2 | $6.62 |
| 13.4 | $6.64 |
| 13.6 | $6.66 |
| 13.8 | $6.68 |
| 14.0 | $6.70 |
| 14.2 | $6.72 |
| 14.4 | $6.74 |
| 14.6 | $6.76 |
| 14.8 | $6.78 |
| 15.0 | $6.80 |
| 15.2 | $6.82 |
| 15.4 | $6.84 |
| 15.6 | $6.86 |
| 15.8 | $6.88 |
| 16.0 | $6.90 |
| 16.2 | $6.92 |

**Precipitation for September 2003 through August 2008**

**Wall Rotation Rainfall Data - 2003-04 (inches)**

| Month | Total Precip. | Month | Total Precip. | Month | Total Precip. |
|---|---|---|---|---|---|
| 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 ")

**Wall Rotation Rainfall Data - 2004-05 (inches)**

| Month | Total Precip. | Month | Total Precip. | Month | Total Precip. |
|---|---|---|---|---|---|
| September 04.. | 3.48” | January 05… | 0.03” | *May……* | 4.75” |
| October……. | 0.76” | February…… | 0.00” | *June……* | 1.95” |
| November……. | 0.08” | March……. | 0.50” | *July……* | 1.82” |
| December……. | 0.07” | *April……..* | 1.35” | *August……* | 1.02” |

(Accumulative total precipitation from Sept.1, 2004 to Aug. 31, 2005 is 15.81 ")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2005 is 10.89 ")

**Wall Rotation Rainfall Data - 2005-06 (inches)**

| Month | Total Precip. | Month | Total Precip. | Month | Total Precip. |
|---|---|---|---|---|---|
| September 05.. | 0.39” | January 06… | 0.17” | *May……* | 1.21” |
| October……. | 0.63” | February…… | Missing | *June……* | 1.08” |
| November……. | 0.24” | March……. | Missing | *July……* | 0.89” |
| December……. | 0.28” | *April……..* | 1.36” | *August……* | 1.18” |

(Accumulative total precipitation from Sept.1, 2005 to Aug. 31, 2006 is 7.43" + missing data in Feb and Mar.)
(Accumulative total precipitation from Apr.1 to Aug. 31, 2006 is 5.72”)

**Wall Rotation Rainfall Data - 2006-07 (inches)**

| Month | Total Precip. | Month | Total Precip. | Month | Total Precip. |
|---|---|---|---|---|---|
| September 06.. | 2.59” | January 07... | 0.02” | *May……* | 1.81” |
| October. …….. | 0.31” | February….. | 0.29” | *June……* | 3.23” |
| November……. | 0.29” | March……. | 1.51” | *July……* | 1.56” |
| December……. | 0.02” | *April……..* | 0.56” | *August……* | 1.92” |

(Accumulative total precipitation from Sept.1, 2006 to Aug. 31, 2007 is 14.11")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2007 is 9.08”)

**Wall Rotation Rainfall Data – 2007-08 (inches)**

| Month | Total Precip. | Month | Total Precip. | Month | Total Precip. |
|---|---|---|---|---|---|
| September 07.. | 1.19 ” | January 08… | 0.00” | *May……* | 4.96” |
| October……. | 1.92” | February…… | 0.26” | *June……* | 4.41” |
| November……. | 0.16” | March……. | 0.43 ” | *July……* | 3.13” |
| December……. | 0.03” | *April……..* | 1.13” | *August……* | 0.94” |

(Accumulative total precipitation from Sept.1, 2007 to Aug. 31, 2008 is 18.56")
(Accumulative total precipitation from Apr.1 to Aug. 31, 2008 is 14.57”)

**1971-2000 (30 year average) Total Precipitation from September 1 – August 31 is 17.24”**
**1971-2000 (30 year average) Total Precipitation from April 1 – August 31 is 11.53”**

Wall Rotation Study Soil Analysis - As of December 10, 2008 for the 2009 Season.

| Plot No. - Rotation | 2009 Crop and estimated yield goal | Soil Texture | Soil pH | Soluble Salts | Organic Matter % | NO3-N lb / acre 0-6" 0-24" | | P ppm | K ppm | Add N lb/A | Add P205 lb/A | Add K2O lb/A | 2008 Yield (Bushels, tons, Lbs / acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | top | total | | | | | | |
| 101-1 | Fallow | Medium | 7.1 | 0.5 | 1.3 | 29 | 47 | 14 | 401 | -- | -- | -- | 56.2 bu HRW |
| 102-1 | HRW-55bu | Medium | 6.6 | 0.4 | 1.5 | 54 | 95 | 8 | 436 | 40 | 30 | 0 | Fallow |
| | | | | | | | | | | | | | |
| 117-2a | HRW-45bu | Medium | 6.4 | 0.3 | 1.4 | 9 | 19 | 19 | 511 | 95 | 0 | 0 | 2.5 T/a Millet Hay |
| 118-2a | Corn-80bu | Medium | 6.4 | 0.3 | 1.4 | 15 | 30 | 15 | 494 | 65 | 5 | 0 | 47.6 bu HRW-b |
| 119-2a | Fallow | Medium | 6.8 | 0.3 | 1.3 | 10 | 22 | 27 | 494 | -- | -- | -- | 33.0 bu Corn |
| 103-2a | HRW-60bu | Medium | 6.5 | 0.4 | 1.3 | 34 | 90 | 14 | 399 | 60 | 10 | 0 | Fallow |
| 104-2a | Sunf 1600 lb | Medium | 6.6 | 0.3 | 1.6 | 13 | 26 | 10 | 397 | 30 | 10 | 0 | 69.3 bu HRW-a |
| 105-2a | Mil- 2 tons/a | Medium | 6.2 | 0.3 | 1.5 | 8 | 18 | 24 | 390 | 35 | 0 | 0 | 1690 lb Sunflower |
| | | | | | | | | | | | | | |
| 106-3 | HRW-45bu | Medium | 6.4 | 0.3 | 1.4 | 9 | 22 | 15 | 365 | 90 | 5 | 0 | 1224 lb Millet |
| 107-3 | Saff-1200 lb | Medium | 6.5 | 0.3 | 1.3 | 18 | 34 | 14 | 434 | 25 | 5 | 0 | 51.0 bu HRW |
| 108-3 | Mil-1500 lb | Medium | 6.4 | 0.3 | 1.2 | 10 | 23 | 16 | 451 | 30 | 0 | 0 | 1483 lb Safflower |
| | | | | | | | | | | | | | |
| 109-4 | Mil-1500 lb | Medium | 6.4 | 0.3 | 1.7 | 18 | 32 | 23 | 460 | 20 | 0 | 0 | 36.8 bu HRW |
| 110-4 | HRW-35bu | Medium | 6.6 | 0.3 | 1.5 | 7 | 19 | 14 | 372 | 70 | 5 | 0 | 949 lb Millet |
| | | | | | | | | | | | | | |
| 111-5a | HRW-40bu | Medium | 6.3 | 0.3 | 1.5 | 12 | 23 | 21 | 491 | 75 | 0 | 0 | 73.7 bu Barley |
| 122-5a | Corn-80bu | Medium | 6.0 | 0.2 | 1.7 | 15 | 24 | 23 | 504 | 70 | 0 | 0 | 45.9 bu HRW |
| 112-5a | Sunf 1300 lb | Medium | 6.8 | 0.4 | 1.4 | 11 | 33 | 19 | 397 | 30 | 0 | 0 | 33.0 bu Corn |
| 113-5a | Barley 60bu | Medium | 6.6 | 0.3 | 1.5 | 10 | 24 | 16 | 474 | 80 | 0 | 0 | 1494 lb Sunflower |
| | | | | | | | | | | | | | |
| 114-6a | HRW-b 45bu | Medium | 6.6 | 0.3 | 1.5 | 15 | 30 | 12 | 436 | 80 | 10 | 0 | 43.6 bu HRW-a |
| 115-6a | Saff-1200 lb | Medium | 6.6 | 0.3 | 1.4 | 14 | 26 | 8 | 402 | 35 | 15 | 0 | 50.0 bu HRW-b |
| 121-6a | Dry Pea-1800 lb | Medium | 6.4 | 0.3 | 1.6 | 7 | 13 | 13 | 516 | 0 | 5 | 0 | 1650 lb Safflower |
| 116-6a | HRW-a 45bu | Medium | 6.0 | 0.4 | 1.5 | 46 | 69 | 24 | 440 | 45 | 0 | 0 | 2004 lb dry pea |
| | | | | | | | | | | | | | |
| 123-9a | HRW-b 45bu | Medium | 6.3 | 0.3 | 1.6 | 25 | 42 | 13 | 459 | 70 | 10 | 0 | 59.2 bu HRW-a |
| 124-9a | Saff-1200 lb | Medium | 6.8 | 0.3 | 1.4 | 14 | 28 | 7 | 410 | 30 | 20 | 0 | 48.5 bu HRW-b |
| 125-9a | Hairy Vetch | Medium | 6.7 | 0.3 | 1.5 | 6 | 21 | 10 | 514 | 0 | 0 | 0 | 1559 lb Safflower |
| 120-9a | HRW-a 50bu | Medium | 6.3 | 0.4 | 1.6 | 49 | 73 | 11 | 436 | 50 | 15 | 0 | HVetch g. manure |
| | | | | | | | | | | | | | |
| 126-10 | HRW-45bu | Medium | 6.4 | 0.3 | 1.7 | 12 | 28 | 18 | 425 | 85 | 0 | 0 | 0 lb Chickpeas |
| 127-10 | Mil-1500 lb | Medium | 6.6 | 0.4 | 1.5 | 21 | 41 | 12 | 464 | 10 | 5 | 0 | 29.9 bu HRW |
| 128-10 | Dry Pea-1800 lb | Medium | 6.7 | 0.3 | 1.5 | 6 | 14 | 16 | 432 | 0 | 0 | 0 | 764 lb Millet |
| | | | | | | | | | | | | | |
| 129-11 | HRW-45bu | Medium | 6.1 | 0.2 | 1.4 | 8 | 23 | 24 | 410 | 90 | 0 | 0 | 1228 lb Millet |
| 130-11 | Corn-80bu | Medium | 6.2 | 0.3 | 2.0 | 21 | 38 | 11 | 428 | 60 | 15 | 0 | 54.8 bu HRW |
| 131-11 | Mil-1500 lb | Medium | 6.2 | 0.3 | 1.3 | 11 | 28 | 24 | 433 | 25 | 0 | 0 | 29.7 bu Corn |

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

**2008 Wall Rotation Yields, Expense/Acre, Break-Even Costs & Break-Even Yields**

| Net return/A | Rotation & Crop | (A) Yield/Acre | (B) Expense of Crop/Acre | (C) Cost of Production | (D) Yield to Break-Even |
|---|---|---|---|---|---|
| 1 | W Wheat | 56.2 bu | $146.79 + $118.19 | $ 4.71/bu | 41.1 bu |
| ($48.47) | Fallow at $118.19 / acre. | | | | |
| 2a | W Wheat-A | 69.3 bu | $160.87+ *$76.08* | $ 3.42 / bu | 36.8 bu |
| ($49.21) | Sunflower | 1690 lb | $234.66+ *$19.02* | $ .15 / lb | 1409 lb |
| | Hay Millet | 2.5 Tons | $133.30 | $53.32 / ton | 1.90 tons |
| | W Wheat-B | 47.6 bu | $192.73 | $ 4.05 / bu | 33.3 bu |
| | Corn | 33.0 bu | $212.39 | $ 6.44 / bu | 56.6 bu |
| | Fallow at | *$95.10* / acre. | *($76.08+$19.02)**| | |
| 3 | W Wheat | 51.0 bu | $206.09 | $ 4.04 / bu | 36.4 bu |
| ($86.51) | Safflower | 1483 lb | $205.99 | $ .14 / lb | 686 lb |
| | Millet | 1224 lb | $135.09 | $ .11 / lb | 2251 lb |
| 4 | W Wheat | 36.8 bu | $183.41 | $ 4.98 / bu | 33.1 bu |
| ($-44.99) | Millet | 949 lb | $167.39 | $ .18 / lb | 2789 lb |
| 5a | W Wheat | 45.9 bu | $200.54 | $ 4.37 / bu | 36.6 bu |
| ($26.84) | Corn | 33.0 bu | $227.20 | $ 6.88 / bu | 60.6 bu |
| | Sunflower | 1494 lb | $219.56 | $ .15 / lb | 1219 lb |
| | Barley | 73.7 bu | $184.49 | $ 2.50 / bu | 46.1 bu |
| 6a | W Wheat-B | 50.0 bu | $237.94 | $4.76 / bu | 38.8 bu |
| ($122.77) | Safflower | 1650 lb | $207.33 | $ .13 / lb | 691 lb |
| | Field Pea | 33.4 bu | $148.88 | $4.46 / bu | 24.8 bu |
| | W Wheat-A | 43.6 bu | $171.48 | $3.93 / bu | 29.4 bu |
| 9a | W Wheat-B | 48.5 bu | $217.66 + *$29.24* | $ 5.09 / bu | 41.8 bu |
| ($89.97) | Safflower | 1559 lb | $206.59 | $ .13 / lb | 688 lb |
| | Hairy Vetch (green fallow) | | *$146.20 / acre. ($116.96+$29.24)** | | |
| | W Wheat-A | 59.2 bu | $179.87 + *$116.96* | $ 5.01 / bu | 49.3 bu |
| 10 | W Wheat | 29.9 bu | $195.20 | $ 6.53 / bu | 32.4 bu |
| ($ -101.81) | Millet | 764 lb | $164.44 | $ .22 / lb | 2741 lb |
| | Chickpea | 0 lb | $171.63 | crop failure | crop failure |
| 11 | W Wheat | 54.8 bu | $208.97 | $ 3.81 / bu | 36.9 bu |
| ($ -16.27) | Corn | 29.7 bu | $211.33 | $ 7.11 / bu | 56.3 bu |
| | Millet | 1228 lb | $123.74 | $ .10 / lb | 2062 lb |

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

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

| | |
|---|---|
| Winter Wheat……See Chart Below | Corn…… $ 3.75 / bu |
| Hay Millet……$ 70 / ton | Proso Millet……$ .06 / lb |
| Sunflower…… $ .18 / lb | Safflower……$ .30 / lb |
| Barley……$ 4.00 / bu | Field Pea…… $ 6.00 / bu |

Winter Wheat Chart (values adjusted for protein content) **(E)**

| | | | |
|---|---|---|---|
| Rot 1 - $6.44 / bu | Rot 3 - $5.66 / bu | Rot 6a-a -$5.84 / bu | Rot 9a-b - $5.90 / bu |
| Rot 2a-a - $6.44 / bu | Rot 4 - $5.54 / bu | Rot 6a-b - $6.14 / bu | Rot 10a - $6.02 / bu |
| Rot 2a-b - $5.78 / bu | Rot 5a - $5.48 / bu | Rot 9a-a - $6.02 / bu | Rot 11 - $5.66 / bu |

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

## WALL ROTATION STUDY WEED RATINGS

**Objectives:** 1) To determine weed species and weed intensity in each rotation.
2) To evaluate the effects of crop rotations on weed control.

**Procedures:** All 124 plots of the Wall Rotation Study were evaluated (visually rated) for weed species presence and weed density on April 15, July 15, and October 15, 2008. A rating of zero (**0**) means that the plot was completely weed free. A rating of five (**5**) indicates that the plot was totally covered with weeds. The **Weed Rating Score** is derived from adding up the weed scores in the four plots of one rotation with the same cropping treatment and dividing by 4. The **Rotation Weed Mean** is derived from adding up weed scores for each crop in the rotation and dividing by the number of cropping treatments in each rotation. The lower the **Weed Rating** score and **Rotation Weed Mean**, the lower the incidence of weeds.

**Discussion:** Overall, the most weed free rotation in 2008 was Rot 9a (Wheat/Wheat/Safflower/Hairy Vetch). This is partly due to the fact that both wheat-a and wheat-b of Rotation 9a were sprayed w / Olympus in the spring of 2008. Both wheats in Rot 6a and Rot 10 wheat were also sprayed with Olympus in April of 2008. The intent of using Olympus is to control downy brome and Japanese Chess but it also has activity on some winter annual broadleaf weeds. Olympus is working well now but it should be cautioned that continued use of Olympus will in time, allow resistant strains of weeds to develop. Starane NXT was applied to every winter wheat and barley plot of the rotation study in May of 2008 for control of all Kochia types. Starane NXT also has some other broadleaf weed activity (wild buckwheat, lambsquarters, annual sunflower and russian thistle). There is a green fallow period in Rotation 9a (hairy vetch) that helps to smother out weeds. The hairy vetch is planted in the fall and although it doesn't produce ground cover quickly in the early spring, it does have a very dense growth by the time it is sprayed off with herbicide in June. The canopy of sprayed off hairy vetch eliminates weed pressure during that time period.

The rotation in 2008 with the most overall weed pressure was Rotation 10a (Wheat/Millet/Chickpea). This occurred because we changed the sequence of this rotation, placing the chickpea before winter wheat. The chickpea planted on chickpea which is not recommended at all but was necessary to rearrange the sequence, exploded with weeds. Ascochyta Blight was also a major problem in the chickpeas in 2008. This rotation will be changed in 2009 to (Winter Wheat / proso millet / dry pea).

Rotation 5a was nearly as weedy overall in 2008 as Rotation 10a. See Table 73. This was due to 2008 being a wetter year starting in May that got more weed seed started.

Rotation 4 has historically been a weedy rotation especially in April and July. Olympus was sprayed in the fall of 2006 and 2007 for winter-annual grassy weed control (downy brome, Japanese Chess) in the winter wheat crop. In April of 2008, Rotation 4 (Winter wheat/Proso millet) was the cleanest rotation at the study. The cleanest rotation as of July 15, 2008 was Rotation 1 (Wheat/Fallow). The cleanest rotation as of October 15, 2008 was again Rotation 4 (Winter Wheat / Proso Millet). Rotation 4 is much cleaner in the spring of 2008, indicating that the Olympus is performing very well. Rotation 4 has about 11 months of fallow period between harvest of the wheat crop to planting of the millet crop. This non-crop period has in the past, proven to be problematic. Proso Millet in Rotation 4 requires more sprayings per summer than the other millet plots in this study. Crown rot disease and weed problems are an ongoing problem in rotation 4 and soil moisture is not being properly utilized.

Table 74 is a combined average of April, July, and October weed pressure over a 5 year period (2004-2008). It indicates that Rotation 9a is the over-all cleanest rotation with a rating of 1.4. There are six rotations that are in the middle with ratings of 2.2 to 2.8. Rotations 10a and 4 are definitely the weediest in the trial at 3.6 and 3.8 respectively.

Table 75 shows what weeds are present at the 3 rating dates of April 15, July 15, and October 15 in 2008. Weeds are listed from highest count to least in each of the crops or fallow listed.

Table 76 lists the weeds at the Wall Rotation, their life span, origin and characteristics. 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 **bolded weeds** are the most prevalent at the study, followed by the non-bolded weeds that are present but not in high numbers.

Weed pressure in the rotations will vary from year to year depending upon soil and air temperature, rainfall, canopy cover, mechanical tillage, and types of herbicides used and timing of planting. 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 so resistant species of weeds do not develop.

**Table 73. Wall Rotation Weed Rating Scores and Rankings - 2008.**

| Rotation | Rank as of 4-15-08 | Apr 15, 2008 rating | Rank as of 7-15-08 | July 15, 2008 rating | Rank as of 10-15-08 | Oct 15, 2008 rating | **Overall Rank Apr,Jul,Oct 2008** | **Total Weed Pressure (Apr 15, July 15, Oct 15) 2008** |
|---|---|---|---|---|---|---|---|---|
| 1 | 5th | 0.3 | 1st | 0.1 | 6th | 1.0 | 2nd | 0.4 |
| 2a | 3rd | 0.2 | 3rd | 0.8 | 8th | 1.3 | 6th | 0.8 |
| 3 | 8th | 1.0 | 5th | 0.9 | 2nd | 0.4 | 5th | 0.7 |
| 4 | 1st | 0.0 | 6th | 1.8 | 1st | 0.3 | 4th | 0.7 |
| 5a | 6th | 0.3 | 6th | 1.8 | 9th | 2.4 | 8th | 1.5 |
| 6a | 2nd | 0.2 | 4th | 0.9 | 3rd | 0.5 | 3rd | 0.5 |
| 9a | 4th | 0.2 | 2nd | 0.3 | 3rd | 0.5 | 1st | 0.3 |
| 10 | 9th | 1.6 | 9th | 2.9 | 7th | 1.0 | 9th | 1.8 |
| 11 | 7th | 0.7 | 6th | 1.8 | 3rd | 0.5 | 7th | 1.0 |
| Total | | 4.5 | | 11.3 | | 7.9 | | 7.7 |

**Table 74. Wall Rotation Weed Rating Scores and Rankings - (2004 - 2008).**

| Rotation | Average for April 15th, (2004,05,06,07,08) | Average for July 15th, (2004,05,06,07,08) | Average for October 15th, (2004,05,06,07,08) | Total Weed Pressure 4-15,7-15,10-15 for (2004,05,06,07,08) | Overall Ranking |
|---|---|---|---|---|---|
| 1 | 0.6 | 1.1 | 0.9 | 2.6 | 5th |
| 2a | 0.8 | 0.8 | 0.7 | 2.4 | 4th |
| 3 | 1.0 | 0.9 | 0.4 | 2.3 | 3rd |
| 4 | 1.5 | 1.6 | 0.6 | 3.8 | 9th |
| 5a | 0.8 | 0.8 | 1.0 | 2.7 | 6th |
| 6a | 0.6 | 1.1 | 0.5 | 2.2 | 2nd |
| 9a | 0.4 | 0.6 | 0.3 | 1.4 | 1st |
| 10 | 1.2 | 1.7 | 0.6 | 3.6 | 8th |
| 11 | 0.9 | 1.0 | 0.8 | 2.8 | 7th |
| Total | 7.8 | 9.6 | 5.8 | 2.6 (*Mean*) | |

## Table 75. Wall Rotation Weed Ratings, 2008.

| Rotation Number & crop | April 15, 2008 | | July 15, 2008 | | October 15, 2008 | |
|---|---|---|---|---|---|---|
| | Weed Rating | Weeds Present | Weed Rating | Weeds Present | Weed Rating | Weeds Present |
| **Rotation 1** | | | | | | |
| Fallow | 0.500 | Pc, db, s | 0.000 | none | 0.000 | none |
| W. Wheat | 0.125 | Db | 0.375 | Db, fxt, pl | 2.000 | vw |
| *Rot Mean* | **0.312** | | **0.187** | | **1.000** | |
| **Rotation 2a** | | | | | | |
| Sunflower | 0.250 | Pc, db, sp | 0.000 | none | 3.500 | Vw |
| Forage Millet | T | Traces of sp, pc, db,dan | 3.500 | Sg, tg, pl, sp, ko | 0.000 | none |
| W. Wheat-b | 0.000 | none | 0.125 | Pl, ps, db | 0.000 | none |
| Corn | T | Traces of db | 1.375 | Pw, wg | 2.000 | Vw |
| Fallow | 1.000 | Pc, sp, db | T | Traces of tg | 2.750 | Sg |
| W. Wheat-a | 0.125 | Db | T | Traces of pl, byg, db | 0.000 | none |
| *Rot Mean* | **0.229** | | **0.833** | | **1.375** | |
| **Rotation 3** | | | | | | |
| Safflower | 2.500 | Db, pc | 1.000 | Jc, f mar, sal, sun, rt, pl, tg | 1.250 | Vw |
| Proso Millet | 0.500 | Pc, db | 1.500 | Rt,sg,fmar,lls,wg,tg,ko,pw,wg | 0.000 | none |
| W. Wheat | T | Traces of pc | 0.375 | Sg, pl, db | 0.000 | none |
| *Rot Mean* | **1.000** | | **0.958** | | **0.416** | |
| **Rotation 4** | | | | | | |
| Proso Millet | 0.125 | Db, pc, s, sp | 2.250 | Sg,sun,ps | 0.625 | Vw, tg |
| W. Wheat | T | Traces of pc | 1.500 | Sg, pl, tg, db, jc, sal | 0.125 | dan |
| *Rot Mean* | **0.062** | | **1.875** | | **0.375** | |
| **Rotation 5a** | | | | | | |
| Sunflower | 0.750 | Db, pc, sp | 0.000 | none | 3.750 | Sg, fxt |
| S. Barley | T | Traces of sprayed sp | 0.125 | Sg, tg, db | 3.000 | Sg |
| W. Wheat | 0.250 | Pc, db | 0.500 | Pl, ps, jc | 0.000 | none |
| Corn | 0.250 | Db, pc | 1.250 | Pw, sg, pig, wg | 3.000 | Vw |
| *Rot Mean* | **0.312** | | **1.875** | | **2.437** | |
| **Rotation 6a** | | | | | | |
| Field Pea | 0.250 | Sprayed db | 0.125 | Sal, pl, db | 0.000 | none |
| W. Wheat-a | 0.375 | db | 0.625 | Db, sg, pl | 0.500 | Dry peas |
| W. Wheat-b | T | Traces of db, pc | 1.750 | Tg, pl | 0.000 | none |
| Safflower | 0.250 | Pc, db | 1.250 | Tg, sal, pl | 1.750 | Vw, tg |
| *Rot Mean* | **0.218** | | **0.937** | | **0.562** | |
| **Rotation 9a** | | | | | | |
| Hairy Vetch | 0.250 | Pc, db | 0.000 | none | 0.000 | none |
| W. Wheat-a | 0.375 | Db, pc, sp | 0.250 | Tg, db | 0.000 | none |
| W. Wheat-b | T | Traces of db | 0.000 | Db, pl, sal | 0.000 | none |
| Safflower | 0.375 | Db, pc, tm, vw | 1.125 | Db, pl, hv, tg, sal, ko ,mt | 2.250 | vw |
| *Rot Mean* | **0.250** | | **0.343** | | **0.562** | |
| **Rotation 10** | | | | | | |
| Proso Millet | 2.500 | Db, pc | 3.500 | Sg, wg, ps | 2.250 | Vw, db |
| Chickpea | T | Traces of db | 1.375 | Ps, tg, sp, f mar, pl, mt | 0.625 | Mt, sal |
| W. Wheat | 2.500 | db | 4.000 | Db | 0.250 | Dan |
| *Rot Mean* | **1.666** | | **2.958** | | **1.041** | |
| **Rotation 11** | | | | | | |
| Corn | 1.250 | db | 1.500 | Wg, pw | 1.500 | Vw |
| Proso Millet | 1.000 | Sp, pc, s, db | 4.000 | Sg, pw, ko, pl | 0.000 | none |
| W. Wheat | 0.125 | pc | 0.125 | Pl, sg | 0.000 | none |
| *Rot Mean* | **0.791** | | **1.875** | | **0.500** | |

**Note:** Weeds listed above are listed from most to least prevalent.
**Note:** T = traces of weeds.
**Legend**: db-downy brome, jc - Japanese chess, vw-volunteer wheat, ko-kochia (ALS & non - ALS strains), pl-prickly lettuce, dan - dandelion, bl-blue lettuce, fxt – green or yellow foxtail, s-sedge, rt – Russian thistle, sg – stinkgrass, lq – lambs quarters, byg – barnyard grass, pig - red root pigweed, saf – volunteer safflower, vol millet – volunteer millet, an sun – annual sunflower, pw – poverty weed, f mar – fetid marigold, ps – prostrate spurge, tg – tumble grass, lls – lance-leaf sage, pc – pennycress, wg – witchgrass, pl – prickly lettuce, tm – tansy mustard, sal-salsify.

**Table 76. Weeds at the Wall Rotation Study and their Characteristics - 2008.**

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

Note: The **bolded weeds** above are listed from the most to least prevalent in the Wall Rotation Study in the 2008 growing season.

ALS Kochia = Acetolactate Synthase (ALS) resistant Kochia has a less sulfonylurea-sensitive ALS enzyme.

Legend: sl per. = short lived perennial.

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