PROJECT TITLE: Evaluation of Continuous Spring Wheat Cropping – 2011 (4W2756)

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OBJECTIVES: To evaluate production of continuously cropped spring wheat using no-tillage and spring tillage.

MATERIALS AND METHODS:
History of the site: Tall wheatgrass barriers were first established in the summer of 1965 as part of another experiment. The experiment contained 2-row grass barriers with a distance of 42 inches between the grass rows. Four of the barrier strips had inside crop dimensions of 30' by 265'. Three other barriers were of 60' by 265' inside dimensions. For check purposes, an exterior area without grass barriers was provided for in the experiment. The tall wheatgrass barriers eliminated from this study in 1998

During the 1966-71 crop years, the grass barrier system was cropped each year to either spring or winter wheat. Data was collected on the efficiency of the barriers in trapping snow, preventing soil erosion, and affecting temperature relations over the crop. No fertilizer treatments were applied to the site and no program of controlling annual weeds was instituted. By 1971, the fertility status of the soil had declined to a low level and such annual weeds as wild oats, green foxtail, and yellow foxtail infested the land to a moderately serious degree. Beginning in 1971, an attempt to control these weed populations with herbicides was initiated. Safflower was grown in the barrier system in 1972, but thereafter spring wheat was continuously cropped in the barrier system utilizing effective herbicides and fertilizer. The 30 ft. barriers were eliminated in the fall of 1979 to provide two additional 60 ft. barriers for further continuously cropped studies under no-till and till-and plant conditions. The decision to eliminate the 30 ft. barriers was based on our research results indicating the 30 ft. barriers were too narrow to compensate for yield loss due to land removed from crop production. In 1998, the 60 ft. tall wheatgrass barriers were eliminated. The decision to eliminate the 60 ft. barriers was based on previous results indicating the barriers only compensated for yield loss due to land removed from crop production on dry years when the yield was less then 20 bushels per acre and because of volunteer tall wheatgrass problems in the wheat associated with the tall wheatgrass of the barrier strips. Three of the barrier strips removed were tilled and three of the barrier strips were killed with Roundup herbicide without any tillage.

MATERIALS AND METHODS FOR THE 2011 SEASON: No tillage was performed on the plots in the fall of 2010 and the stubble was allowed to stand over winter to collect snow. Residual soil N to 3 ft on the no-till and spring till plots was 26 lb N/ac and residual soil P to 6 in was 57 ppm. Residual soil N to 3 ft on the summer fallow plot was 82 lb N/ac and residual soil P to 6 in was 29 ppm. N was applied at a rate of 40 lb N/ac as 28-0-0 on April 27, 2011 on the no-till and spring till plots. No N was applied on the summer fallow plot. Plots scheduled for tillage were worked twice with a tandem disc on May 18 and the summer fallow plot was triple K'd twice just prior to planting. All the plots were sprayed with Roundup herbicide at the rate of 2.0 pints per acre on May 5, 2011 to control emerging weeds. Plots were planted on May 26 with Vida spring wheat using a Versatile Noble No. 2000 no-till double disc drill with leading coulters and 9-inch row spacing at the rate of 78 pounds/acre.

The type of tillage and planting for the various plots were as follows:

Open Field Stubble - Continuous Crop
Plot A - no-till and no-till planting
Plot B - spring till and seeding
Plot C - no-till and no-till planting
Plot D - no-till and no-till planting
Plot E - spring till and seeding
Plot F - spring till and seeding (40 ft. barrier for this plot only)
Plot G - no-till and no-till planting
Plot H - spring till and seeding

Summer Fallow - (wheat-fallow) Rotation
Plot I - spring till and seeding on fallow
Plot J - summer fallow

Plots were sprayed with Brox M at the rate of 1.5 pints/acre and 1.0 pints/acre of Axial for broadleaf and grassy weed control on June 15.

Precipitation April – August, 2011: 12.80 in
Ave (62 yr) precipitation April – August: 9.55 in
Precipitation September 2010 – August 2011:19.62 in
Ave (62 yr) precipitation September – August: 14.06 in

RESULTS AND DISCUSSION:

All of the plots in the study were harvested for yield determinations on September 4, 2009. Grain samples were obtained for test weight and protein analyses.

CONTINUOUS CROPPING RESULTS FROM 2011

	Method of Seeding	Plant Height Inches	Test Weight Lbs/Bu	Grain Protein %	Yield Bu/Acre
1. Continuous Crop					
Plot A	no-till	20.5	60.5	15.7	13.2
Plot B	till	20.9	60.5	13.7	16.0
Plot C	no-till	20.5	58.0	14.6	10.8
Plot D	no-till	22.8	60.0	15.3	12.0
Plot E	till	22.4	60.5	15.2	16.4
Plot F	till	19.3	60.5	14.5	14.3
Plot G	no-till	19.7	60.0	15.0	13.1
Plot H	till	20.5	60.5	15.0	14.0
2. Summer Fallow					
Plot I	till	23.2	60.0	15.9	27.7

On continuous wheat cropping in 2011, tilled and planted plots averaged 15.2 bu/ac with 14.6% protein, while no-till plots averaged 12.3 bu/ac with 15.2% protein. Open field stubble continuous wheat produced an average yield of 13.8 bu/ac with 14.9% protein, while the wheat on summer fallow produced a yield of 27.7 bu/ac with 15.9% protein. The principal weed in 2011 was green foxtail with a few broadleaf weeds which were effectively controlled by herbicide application. Damage by rodents, sawflies, or other pests were not noted in 2011. The principal disease noted was Pyrenophora trichostoma (tan spot) but the flag leaf was not affected.

continuous cropped spring wheat	Plant Height Inches		Grain Protein Percent		Grain Test Wt. Lbs/Bu		Grain Yield Bu/Acre	
Open Field Stubble	*No-Till*	*Till*	*No-Till*	*Till*	*No-Till*	*Till*	*No-Till*	*Till*
1978	30.0	31.4	13.2	14.7	61.5	60.5	31.1	44.0
1979	21.6	22.9	14.5	16.1	61.0	59.5	19.5	19.7
1980	8.0	8.0	16.2	17.1	58.0	57.5	3.9	3.9
1982	26.0	26.0	14.3	15.5	57.5	57.5	24.9	27.6
1983	26.0	27.0	16.0	17.7	61.0	60.0	23.7	24.9
1984	22.0	20.0	16.7	16.0	58.2	58.5	10.8	9.2
1985	11.0	11.0	15.6	16.6	57.0	55.7	11.2	10.6
1986	25.0	26.0	12.1	12.7	61.3	61.2	18.6**	30.8
1987	22.0	19.0	16.6	16.7	60.5	59.0	27.3	24.6
1988	--	--	--	--	--	--	0.0	0.0
1989	22.0	20.0	17.1	17.8	56.5	56.0	20.0	20.6
1990	20.0	17.0	16.3	16.6	59.0	59.0	10.9	9.6
1991	33.0	33.0	14.0	14.7	61.5	61.5	34.7	31.9
1992	36.5	36.5	12.9	13.2	62.5	62.0	38.0	53.5
1993	33.9	33.1	14.2	14.6	57.0	57.0	28.2	22.9
1994	32.3	35.4	10.3	11.9	62.5	63.0	35.0	38.5
1995	29.1	26.8	11.3	13.6	62.5	62.5	17.9	22.7
1996	20.9	18.5	11.7	11.6	55.5	56.0	24.4	29.7
1997	24.0	23.9	13.2	13.9	55.0	54.0	26.0	33.4
1998	29.1	29.5	10.8	11.9	58.5	58.5	26.2	30.1
1999	27.8	27.9	10.3	10.8	60.8	61.0	25.7	35.4
2000	--	--	13.3	13.3	63.5	63.4	28.6	32.4
2001	24.5	26.2	12.8	13.1	61.3	61.4	34.7	39.8
2002	22.8	21.8	12.5	13.1	59.8	59.6	24.8	26.2
2003	28.9	28.6	13.8	15.6	61.3	60.4	35.1	37.6
2004	27.2	25.6	14.3	14.4	61.4	60.4	28.9	33.2
2005	30.3	27.8	15.8	14.9	56.4	58.0	50.5	51.8
2006	25.9	25.9	14.3	13.4	55.1	55.6	26.6	29.2
2007	28.5	29.3	14.0	13.4	59.4	59.5	41.1	45.2
2008	14.8	12.8	15.4	16.2	58.5	58.0	9.4	7.3
2009	23.9	23.2	13.7	14.1	61.1	60.9	36.5	39.1
2010	25	25.2	13.4	15	60.3	56.8	27.1	36.4
2011	20.9	20.8	15.2	14.6	59.6	60.5	12.3	15.2
Average	24.9	24.5	13.9	14.5	59.5	59.2	24.8	27.8

* Data in 1981 were omitted as different varieties were planted in no-till and till and plant plots. In 1988, continuous cropped wheat plots were a complete crop failure.

**Deep seed placement contributed to the lower yield of the no-till plots in 1986.

A 38-year summary of data obtained from the continuous spring wheat and wheat-fallow systems are reported below.

Snow Moisture Collection System	Plant Height Inches	Grain Protein Percent	Grain Test Weight Lbs/Bushel	Grain Yield Bushel/Acre
Open field stubble				
1974	20.0	15.2	60.0	26.0
1975	25.0	16.1	59.5	30.4
1976	28.0	--	62.5	40.3
1977	15.3	16.4	60.3	4.2
1978	30.7	14.0	61.0	37.6
1979	22.3	15.3	60.3	19.6
1980	10.8	16.7	57.8	3.9
1981	--	14.9	58.0	19.8
1982	26.0	14.9	57.5	27.6
1983	26.5	16.9	60.5	24.3
1984	21.0	16.4	58.4	10.0
1985	11.0	16.4	56.4	10.9
1986	25.5	12.4	61.3	24.7
1987	20.5	16.7	59.8	26.0
1988	--	--	--	0.0
1989	21.0	17.5	56.3	20.3
1990	18.0	16.5	59.0	10.3
1991	33.0	14.4	61.5	33.3
1992	36.5	13.1	62.3	45.6
1993	33.5	14.4	57.0	25.6
1994	33.9	10.8	62.8	36.8
1995	28.0	12.4	62.5	20.3
1996	19.7	11.7	55.8	27.1
1997	24.0	13.6	54.5	29.7
1998	29.3	11.4	58.5	28.2
1999	27.9	10.6	60.9	30.5
2000	--	13.2	63.4	30.5
2001	25.3	12.9	61.3	37.2
2002	22.3	12.8	59.7	22.5
2003	28.8	14.7	60.8	36.3
2004	26.4	14.3	60.9	31.0
2005	29.0	15.4	57.2	50.0
2006	25.9	13.9	55.4	27.9
2007	28.9	13.7	59.4	43.1
2008	13.8	15.8	58.3	8.4
2009	23.6	13.9	61.0	37.8
2010	25.1	14.5	58.5	31.7
2011	20.8	14.9	60.1	13.7
Average	24.5	14.4	59.5	25.9

Snow Moisture Collection System	Plant Height Inches	Grain Protein Percent	Grain Test Weight Lbs/Bushel	Grain Yield Bushel/Acre
Summer fallow				
1974	21.0	16.9	58.5	45.4
1975	28.0	16.4	59.0	35.3
1976	32.0	--	61.0	62.5
1977	19.5	16.2	59.5	18.5
1978	32.5	14.5	60.5	54.7
1979	23.4	16.7	61.0	24.9
1980	12.0	15.6	59.0	23.0
1981	--	17.1	59.5	23.4
1982	26.0	15.6	57.0	32.9
1983	28.0	16.6	60.0	26.0
1984	21.0	17.3	58.1	22.9
1985	18.0	16.9	56.2	12.0
1986	28.0	13.2	60.9	38.9
1987	23.0	15.0	59.5	36.0
1988	13.0	18.4	57.5	3.7
1989	23.0	16.3	57.5	27.0
1990	23.0	16.5	58.3	21.9
1991	32.0	14.8	61.5	38.4
1992	37.5	13.8	62.0	67.4
1993	32.5	12.8	57.0	40.4
1994	38.4	12.2	62.5	49.9
1995	30.7	14.1	62.0	27.4
1996	21.3	12.4	56.0	39.6
1997	26.1	14.4	53.5	38.6
1998	30.7	14.2	56.5	41.2
1999	33.1	12.6	59.0	53.8
2000	--	15.0	63.0	47.0
2001	28.7	14.6	61.5	48.1
2002	23.2	15.0	58.0	30.5
2003	30.3	15.4	59.5	45.6
2004	33.5	15.0	59.5	52.0
2005	30.3	12.8	59.5	59.1
2006	26.8	15.0	53.0	37.1
2007	32.7	13.1	59.0	51.2
2008	20.9	16.6	58.5	20.9
2009	26.4	13.8	61.0	31.6
2010	30.7	15.6	54.0	50.5
2011	23.2	15.9	60.0	27.7
Average	26.7	15.1	58.9	37.0

During the past 38-year period of this continuous cropped spring wheat study, grain test weights have averaged 0.6 lb/bu higher under continuous cropping than under crop/fallow. Conversely, grain protein content of wheat on fallow has averaged 0.7% higher than wheat on open field continuous cropping. Average yields for continuous crop spring wheat is 25.9 bu/ac for open field continuous cropped spring wheat and 37.0 bu/ac for summer fallow.

In 1977, no-till treatments were added to this long-term continuous cropping system for comparison with conventional till plant plots. Over 33 years, spring-tilled wheat outyielded no-till wheat by 3 bu/ac. In 1978 the no-till plots had a larger population of wild oats than conventional till and plant plots. In 1986 when the no-till plots were seeded with a no-till versatile Noble No. 2000 drill deep seed placement contributed to the lower yields in the no-till plots. In 1992 – 2004, the lower no-till yields were attributed in part to volunteer wheatgrass in the no-till plots and a higher incidence of disease in the no-till plots. Since 2004, the lower no-till yields have been attributed principally to a higher incidence of disease. Test weights have been slightly higher in no-till plots whereas protein has averaged 0.6% lower in no-till plots than tilled plots despite the no-till plots' lower yield of 2.9 bushels per acre.

The incidence of the disease *Pyrenophora trichostoma* (tan spot) and *Septoria* has been highest in the no-till plots. Conversely, the incidence of annual weeds such as wild oats, green foxtail, and yellow foxtail has been usually greater in the spring-tilled plots with the exception of 1978, 1997, 1998, 1999 and 2000 when wild oats occurred in the no-till plots. Volunteer tall wheatgrass was an annual problem in all the barrier plots each spring, necessitating an annual application of Roundup herbicide to destroy the volunteer wheatgrass prior to seeding. This treatment has also been effective in controlling annual weeds that have emerged in the no-till plots prior to seeding time.

FUTURE PLANS:

The long-term influences of no-till, spring tillage, and continuous cropping on wheat growth, vigor, yield, quality and other crop performance characteristics is a continuing objective. Continuation of this long-term study could include detailed soils analyses to determine the long-term influence of no-till, spring tillage, and continuous cropping on soil health. It may also prove beneficial to assay the soils of the continuous cropping wheat plots for potential biocontrol agents for wheat diseases and/or other wheat pests and test the use of foliar-applied fungicides and fungicide seed treatments to help control fungal diseases.