

PROJECT TITLE: Evaluation of continuous spring wheat under minimum-till, no-till, and crop/fallow cropping systems – 2013 (4W4145)

PRINCIPAL INVESTIGATOR:

Joyce Eckhoff, Eastern Agricultural Research Center, 1501 N Central Ave, Sidney, MT 59270
phone: (406)433-2208 e-mail: joyce.eckhoff@montana.edu

OBJECTIVES:

To evaluate production of continuously cropped spring wheat using no-tillage and spring tillage.
To compare production of continuously cropped spring wheat to crop/fallow production.

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. 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 than 20 bushels per acre and because of volunteer tall wheatgrass problems in the wheat associated with the tall wheatgrass of the barrier strips.

MATERIALS AND METHODS FOR THE 2013 SEASON: No tillage was performed on the plots in the fall of 2012 and the stubble was allowed to stand over winter to collect snow, although there was little snow. A severe grassy weed problem has been developing over the years, including green foxtail, brome, barnyard grass, and remnant tall wheatgrass from the barriers. No wheat was planted in 2013, instead, the area was sprayed with Roundup at a rate of 32 oz/ac on June 28 and August 15. This seemed to do a good job of killing the grassy weeds.

Precipitation April – August, 2013: 17.75 in

Ave (64 yr) precipitation April – August: 9.36 in

Precipitation September 2012 – August 2013: 22.37 in

Ave (64 yr) precipitation September – August: 14.09 in

Comments: Conditions were wet at planting. May, June and August had much above average precipitation. A major hail storm severely damaged the crop on August 10.

RESULTS AND DISCUSSION:

During the past 38-year period of this continuous cropped spring wheat study, grain test weights have averaged 0.5 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 25.4 bu/ac for open field continuous

cropped spring wheat and 36.3 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 2.9 bu/ac. In 1978 the no-till plots had a larger population of wild oats than spring till 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.

FUNDING SUMMARY: Expenditure information to be provided by OSP. No other grants support this project.

MWBC FY2014 GRANT SUBMISSION PLANS: It is planned to submit this project for funding consideration in the next fiscal year.

A 33-year summary of data obtained from the tillage and no-tillage plots are reported below.

year	Plant Height Inches		Grain Protein Percent		Grain Test Wt. Lbs/Bu		Grain Yield Bu/Acre	
	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
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	25.0	25.2	13.4	15.0	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
2012	16.5	16.2	11.0	11.6	60.0	59.5	6.7	7.1
Average	24.7	24.3	13.8	14.4	59.5	59.2	25.1	28.0

Data in 1981 were omitted as different varieties were planted in no-till and spring tillage 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. CC- continuous cropping C/F-crop/fallow

year	Plant Height		Grain Protein		Grain Test Weight		Grain Yield	
	Inches		Percent		Lbs/Bushel		Bushel/Acre	
	CC	C/F	CC	C/F	CC	C/F	CC	C/F
1974	20.0	21.0	15.2	16.9	60.0	58.5	26.0	45.4
1975	25.0	28.0	16.1	16.4	59.5	59.0	30.4	35.3
1976	28.0	32.0	--	--	62.5	61.0	40.3	62.5
1977	15.3	19.5	16.4	16.2	60.3	59.5	4.2	18.5
1978	30.7	32.5	14.0	14.5	61.0	60.5	37.6	54.7
1979	22.3	23.4	15.3	16.7	60.3	61.0	19.6	24.9
1980	10.8	12.0	16.7	15.6	57.8	59.0	3.9	23.0
1982	26.0	26.0	14.9	15.6	57.5	57.0	27.6	32.9
1983	26.5	28.0	16.9	16.6	60.5	60.0	24.3	26.0
1984	21.0	21.0	16.4	17.3	58.4	58.1	10.0	22.9
1985	11.0	18.0	16.4	16.9	56.4	56.2	10.9	12.0
1986	25.5	28.0	12.4	13.2	61.3	60.9	24.7	38.9
1987	20.5	23.0	16.7	15.0	59.8	59.5	26.0	36.0
1988	--	13.0	--	18.4	--	57.5	0.0	3.7
1989	21.0	23.0	17.5	16.3	56.3	57.5	20.3	27.0
1990	18.0	23.0	16.5	16.5	59.0	58.3	10.3	21.9
1991	33.0	32.0	14.4	14.8	61.5	61.5	33.3	38.4
1992	36.5	37.5	13.1	13.8	62.3	62.0	45.6	67.4
1993	33.5	32.5	14.4	12.8	57.0	57.0	25.6	40.4
1994	33.9	38.4	10.8	12.2	62.8	62.5	36.8	49.9
1995	28.0	30.7	12.4	14.1	62.5	62.0	20.3	27.4
1996	19.7	21.3	11.7	12.4	55.8	56.0	27.1	39.6
1997	24.0	26.1	13.6	14.4	54.5	53.5	29.7	38.6
1998	29.3	30.7	11.4	14.2	58.5	56.5	28.2	41.2
1999	27.9	33.1	10.6	12.6	60.9	59.0	30.5	53.8
2000	--	--	13.2	15.0	63.4	63.0	30.5	47.0
2001	25.3	28.7	12.9	14.6	61.3	61.5	37.2	48.1
2002	22.3	23.2	12.8	15.0	59.7	58.0	22.5	30.5
2003	28.8	30.3	14.7	15.4	60.8	59.5	36.3	45.6
2004	26.4	33.5	14.3	15.0	60.9	59.5	31.0	52.0
2005	29.0	30.3	15.4	12.8	57.2	59.5	50.0	59.1
2006	25.9	26.8	13.9	15.0	55.4	53.0	27.9	37.1
2007	28.9	32.7	13.7	13.1	59.4	59.0	43.1	51.2
2008	13.8	20.9	15.8	16.6	58.3	58.5	8.4	20.9
2009	23.6	26.4	13.9	13.8	61.0	61.0	37.8	31.6
2010	25.1	30.7	14.5	15.6	58.5	54.0	31.7	50.5
2011	20.8	23.2	14.9	15.9	60.1	60.0	13.7	27.7
2012	16.4	19.7	11.3	13.0	59.7	60	6.9	8.9
Average	24.3	26.6	14.3	15.0	59.5	59.0	25.4	36.3