CONSERVATION CROPPING SYSTEMS PROJECT

5th ANNUAL REPORT
2006

Kelly Cooper Farm Manager

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PROJECT DESCRIPTION

The Conservation Cropping Systems Project (CCSP) is located on a 130-acre tract of farm land two miles south of Forman, ND along Highway 32, Figure 1. A 14 member Board of Directors composed of local producers in northeastern South Dakota and southeastern North Dakota advises the CCSP staff. Professionals from ag research, as well as natural resource conservation agencies and non-profit interest groups, assist the Board with technical advice and support. Diverse crops are grown in rotations that range from two to six years under no-till cropping systems. Rotations are studied to compare their effect on water and wind erosion, soil tilth, soil moisture retention, organic matter changes, infiltration and most importantly, profitability. Each crop within a rotation is grown every year and replicated three times. This project has a planned duration of at least 12 years. The goal is for this demonstration to go on indefinitely.

The project provides producers data that allows them to qualify and quantify the advantages and disadvantages of a range of crop rotations in no-till crop production. The effective use of crop rotations to break weed, disease, and insect cycles is demonstrated. The placement of legumes in rotations reduces dependence on fertilizer N. The ability to efficiently cycle plant nutrients in diverse rotations reduces nutrient runoff into surface water and leaching into ground water. This project will be a living classroom to demonstrate that agriculture can produce food and fiber in an environmentally favorable manner, preserving and enhancing wildlife habitat and water quality, while providing producers with good economic returns.

Figure 1. Aerial picture of the Conservation Cropping Systems Project.

PROJECT PURPOSE

The landscape of eastern ND and SD is dissected by numerous tributaries and sub-watersheds that eventually end up in Hudson Bay or the Gulf of Mexico. The land is composed of rolling topography and wetland complexes of the prairie coteau, undulating features of the drift prairies, transitional beach ridges and the level cropland of the Red River Valley Basin. The sub-humid to semi-arid climate of this region receives significantly more precipitation than the central and western Dakotas. The growing season is also longer. Rotations from the western Dakotas where strategy is to conserve and store moisture may be problematic in the east where moisture-intense crops and possibly cover crops are needed to use excess moisture. Currently there is an absence of information on no-till cropping systems in this region. It is the purpose of this project to evaluate and demonstrate the use of crop rotations and crop management strategies that are effective in sustaining the environment and producing ample food and fiber within the climate, hydrology, soils and social aspects of this geographic area.

PROJECT SPONSORS

The Conservation Cropping System Project is funded through the sponsorship of governmental, corporate and private parties. The Wild Rice Soil Conservation District is the principle cooperating agency, supplying office space, facilities and administration of the project. Other cooperating agencies are the Natural Resources Conservation Service (NRCS), North Dakota State University (NDSU), South Dakota State University (SDSU). Sponsorship is either as a cash donation, in-kind or both. There are four levels of sponsorship: Platinum ($10,000 or greater), gold ($5,000 - $9,999), silver ($2,500 - $4,999) and bronze ($500 - $2,499). We wish to thank our sponsors listed below for their support! Without them this project would not exist.

PROJECT SPONSORS

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Special Thanks
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CROP ROTATIONS AT CCSP

Ten crop rotations ranging from two to six years in length are being studied, Table 2. Six crops are present in rotations: HRSW, HRWW, corn, soybean, alfalfa and flax. Three seeding techniques: disk drill, shank drill and strip till, are being studied within the HRSW-HRWW-corn-soybean rotation. Additional crops will be added and subtracted as deemed necessary. The key components of rotations are their moisture intensity and their plant diversity. Moisture intensity of the rotation must be increased as one moves from arid to humid climates and when the cropping system is changed to no-till. Cover crops may be required in climates where precipitation exceeds evapotranspiration even though high moisture crops are grown. Conversely, low-water-use crops may be required in arid climates to store soil moisture. Crop diversity is needed to reduce the level of pathogens (weeds, disease, insects) specific to a crop type.

Table 2. Crop rotations at the Cropping Systems Project at Forman, ND, 2005.

Rotation	
HRSW - HRWW - Corn - Soybean disk drill	A
HRSW - HRWW - Corn - Soybean shank drill	B
HRSW - HRWW - Corn - Soybean strip-till	C
HRSW - Corn - Soybean	D
HRSW - Soybean	E
Corn - Soybean	F
HRSW - Corn - Soybean - Corn - Soybean	G
HRSW - HRWW - Corn - Soybean - Corn - Soybean	H
HRSW - HRWW - Flax - Corn - Corn - Soybean	I
HRWW - Soybean - Corn - Corn - Flax	J
HRSW - HRWW - Corn - Corn - Soybean - Soybean	***L***
HRSW - HRWW - Alfalfa - Alfalfa - Corn - Soybean	N

Figure 3, shows the location of each crop within each rotation. Each plot is 60 feet by 200 feet. Each crop within the rotation sequence is present each year. Each rotation sequence has 3 replications. For example in rotation F, corn is replicated three times as Fc1, Fc2 and Fc3.

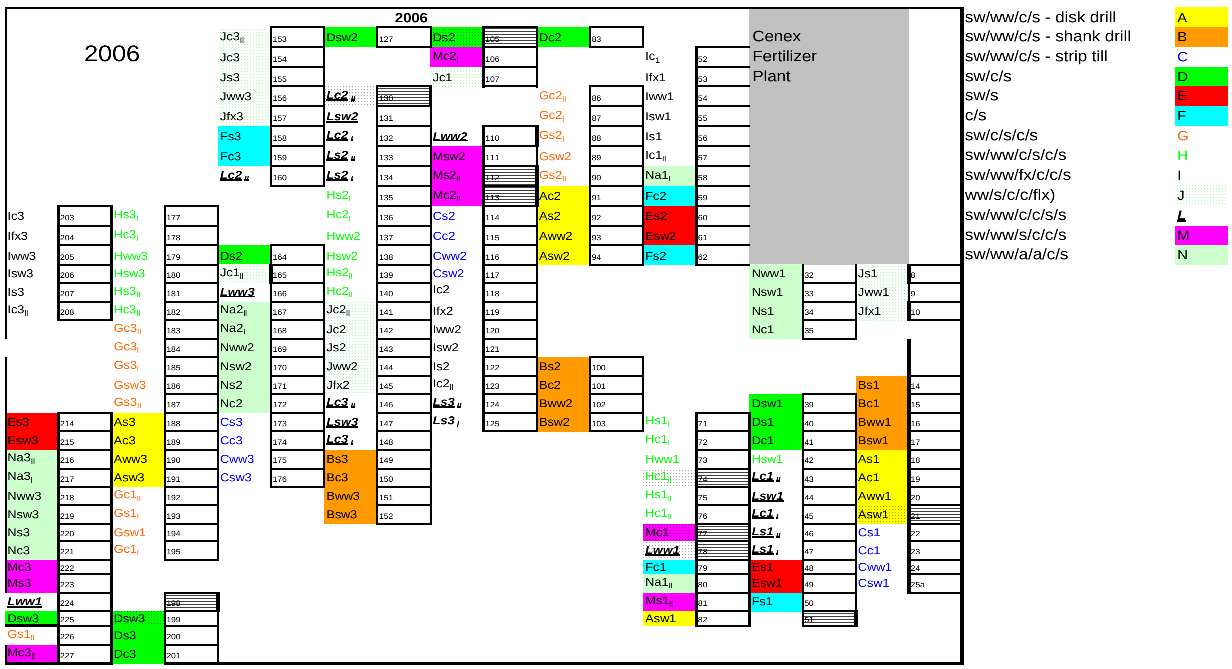

Figure 3. Plot map of rotations and their location in 2006.

Weather

The 2006 growing season can be characterized as starting wet, then in May transitioning to dry and hot compared to a warm, wet growing season in 2005., Temperatures averaged 1, 2, 5, and 2 degrees above normal for May, June, July and August, respectively, in 2006 as seen in table 2. Numbers do not always convey the dramatic impact seen on crops or people. The 5 degree above normal temperatures of July had a much higher negative impact on people and plants than the 17 degree above normal temps of January. In figure 3, you can see that a drier year like 2006, will have higher spreads between highs and lows. In wet years higher surface moisture tends to buffer out heat. These comparisons are between Oakes data in 2005, and Forman data in 2006, but serve to illustrate a well proven phenomena. GDU's for Forman were 2413 from May 1 through September 29. which was 68 higher than the 15 year average.

Table 2. Growing season temperature and precipitation at Forman, ND in 2006.

Calender year 2006 Weather

	Temperature (f)			**Precipitation (in)**		
Month	64 Yr Mean	2006 Mean	deviation	64 Yr Mean	2006 Total	deviation
January	7.6	24.1	*17*	0.5	0.2	*-0.3*
February	11.9	15.3	*3*	0.5	0.4	*-0.2*
March	26.0	29.2	*3*	0.8	1.2	*0.4*
April	44.0	49.3	*5*	2.0	1.3	*-0.7*
May	55.7	56.6	*1*	3.0	2.8	*-0.2*
June	65.0	67.0	*2*	3.6	1.3	*-2.3*
July	70.1	75.4	*5*	2.9	1.7	*-1.2*
August	68.2	69.8	*2*	2.8	3.5	*0.8*
September	59.5	56.0	*-4*	2.1	3.3	*1.2*
October	46.0	42.3	*-4*	1.4	0.3	*-1.1*
November	28.6	30.7	*2*	0.6	0.1	*-0.5*
December	15.3	24.4	*9*	0.6	0.8	*0.2*
mean totals	**41.5**	**45.0**	***3.5***	**20.6**	**16.8**	***-3.8***

Precipitation in 2006 was below the long term average by 3.8 inches for the year. All growing season months except August were below normal on rain compounded with above average temperatures. By mid-July drought symptoms were apparent in soybeans, corn and alfalfa. Starting on the 20th of July, we received several rains that substantially improved the appearance of the corn and soybeans. Growing degree days were above the long term average as noted in figure 4. The high Gdu's were needed. We had extremely wet conditions in May which were the result of heavy rainfall in the fall of 2005, and possibly aggravated by an early winter ice storm that effectively capped the soil surface all winter. May brought average temperatures, and normal rainfall, but few really good drying days until late in the month. We planted spring wheat in all but 5 plots on April 18 with a 20 foot John Deere single disk 2 point drill pulled by a tractor with duals front and back. All spring wheat was planted on soybean ground with a high amount of residue. Conditions were marginal at best but the soil although wet was firm. The residue allowed for flotation of the tractor and drill so mud did not build up on the openers. Soil conditions slowly improved and on April 29 we seeded flax. On April 30 rain began and during the next 10 days nearly 3 inches fell. Soil conditions were very wet for planting. Whether farmers were no-till or conventional, all methods of drying out the soil were implemented. We started planting corn May 18 on the driest plots with great difficulty. We used no drags or rotary hoes to help with drying. By May 30, all corn plots had been planted. Soybean planting went well although delayed due to parts unavailability. Adequate amounts of small showers brought good germination. Those small showers were the last significant rains until July 20th. Harvest went smoothly on all crops. Fall rains in August and September worked nicely to germinate alfalfa and winter wheat. We were able to take the soybeans off between rains. The alfalfa was seeded latter then desired but as of today, April 1, 2007 the plants appear to be growing and have made it so far this spring. The winter wheat looks very nice as well.

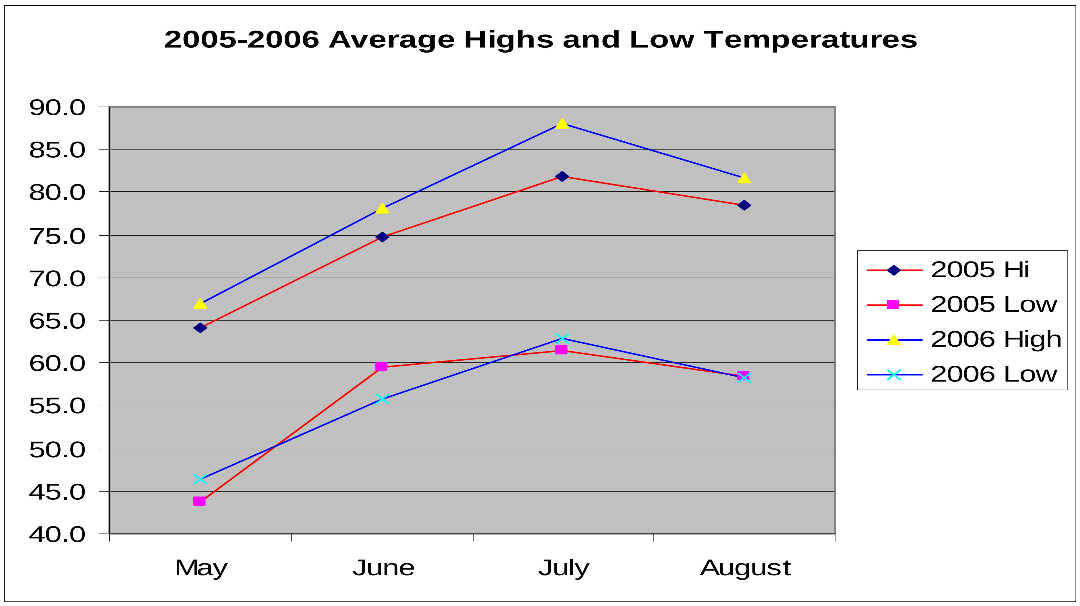

Figure 3. Average highs and lows of 2005 and 2006.

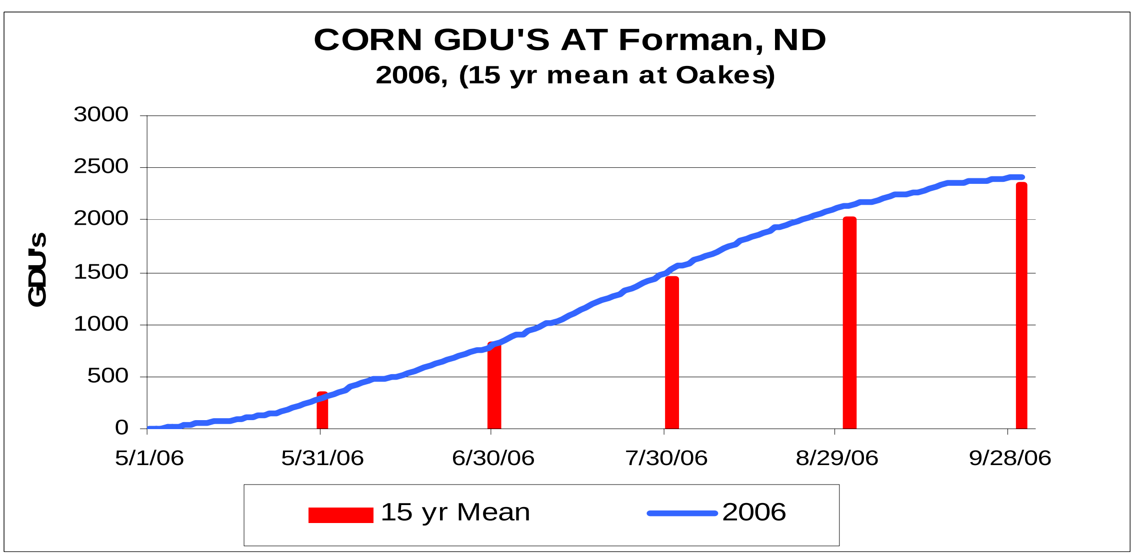

Figure 4. Growing degree units accumulated for corn at Forman, ND, 2413 in 2006 and the 15-yr mean of 2345.

CROP FERTILITY

The amount of fertilizer applied to crops in rotations is presented in Table 3. Fertility recommendations were based on 2005 fall samples. Total applied N in HRSW and HRWW were reduced due to lodging concerns and nutrient cycling expectations. Table 4. shows the amount fertilizer N or fertilizer N plus soil residual N plus an N credit were appropriate per bushel of corn yield in cropping sequences. A nitrogen credit of 100 lb/ac was used in alfalfa ground and 40 lb N/ac in soybean ground.

Table 3. Fertilizer application in crops in 2005.

Crop 2005	Crop 2006	Planter P	Planter N	Post N	Total N
		lb/ac	lb/ac	lb/ac	lb/ac
Corn	Corn	35	97	0	97
Flax	Corn	35	97	0	97
Soybean	Corn	35	97	0	97
Alfalfa	Corn	35	97	0	97
HRSW	Corn	35	97	0	97
HRWW	Corn	35	97	0	97
Soybean	HRSW	62	13	65	78
HRSW	HRWW	44	9	110 [a]	119
Flax	HRWW	44	9	110 [a]	119
Soybean	Soybean	39	12		12
HRSW	Soybean	39	12		12
HRWW	Soybean	39	12		12
Corn	Soybean	39	12		12

[a]Post N applied in two applications.

Table 4. Nitrogen per bushel of corn production for total soil N plus fertilizer N plus an N credit where appropriate and fertilizer N alone in 2006.

Previous Crop	Fall soil nitrate 2005	Fertilizer N	Bu/AC	N Credit + Soil N+Fert N Lb/bu	Fertilizer N Lb/bu
Alfalfa	46	97	153	1.6	0.6
Corn	20	97	119	1.0	0.8
flax	70	97	158	1.1	0.6
Soybean	20	97	155	1.0	0.6
HRSW	35	97	163	0.8	0.6
HRWW	43	97	163	0.9	0.6
HRWW/No stip-till	43	97	143	1.0	0.7

AGRONOMIC PRACTICES AND YIELD

A general outline of agronomic practices in crops is listed in Table 5. CDC Falcon HRWW was planted on October 11, 2005 with a John Deere (JD) 1560 single disk drill with 7.5-inch spacing and on October 3 with a 10-foot Concord air drill with triple shot Anderson seed boots at a10-inch spacing. Briggs spring wheat was planted with the JD 1560 drill on April 18, 2006. Shank till plots were planted to Briggs on April 23, with the Concord drill. Starter fertilizer at a rate of 120 lb/ac of 11-55-0 was placed with the seed in all wheat plots. Fertilizer N applications of 16 gal/ac 28-0-0 was applied with stream bars to HRWW on April 26, and on May 24, 22 gallons 28-0-0 was put on the HRSW. An application of 21 gal/ac of 28-0-0 with stream bars was applied to HRWW on May 27. York flax was planted with the 1560 JD drill on April 27. Flax received a post application of 35 lbs/ac Nitrogen as 28-0-0. Dekalb DKC42-95 was planted with an 8-row John Deere7200 planter with 30-inch spacing equipped with Sunco residue cleaning wheels, seed firmers with in-furrow fertilizer placement on May 18-30. Corn received 30 gal/ac of 28-0-0 and 6.5 gal/ac 10-34-0 placed in a 3” by 2” band at planting. A strip-till operation was performed on November, 7th and November, 8th 2005 to all 2006 corn plots except rotation A. NK S06L6 soybeans were planted in 30-inch rows with the John Deere 7200 planter on June 9-12. Soybean plots received 10 gal/ac of 34-0-0 in a 3” by 2” band at planting.

Table 5. General agronomic practices for crops at the Conservation Cropping
Systems Project in 2006.

Crop	Planting Date	Harvest Date	Planting Rate	Chemical	Rate	Date
Alfalfa 1st Yr	5-Aug-05	28-Jun-05	15 #			
		18-Jul-05				
Alfalfa 2nd Yr	23-Aug-04		15#			
Alfalfa(establish)	28-Aug-06		15 #	select	5 oz	9/12/2006
HRSW	18-Apr-06	31-Jul-06	116 #	Bronate Advanced	1.2 pt/ac	27-May-06
				Headline	3 oz/ac	27-May-06
				Folicur	4 oz/ac	19-Jun-06
				Roundup Ultra Max II	22 oz	20-Jul-06
				Roundup Ultra Max II	22 oz	11-Sep-06
HRWW	5-Oct-04	29-Jul-05	114 #	Tilt	4 oz/ac	7-May-06
				Bronate Advanced	1.2 pt/ac	27-May-06
				Headline	3 oz/ac	27-May-06
				Folicur	4 oz/ac	13-Jun-06
				Roundup Ultra Max II	22 oz	9-Aug-06
				Roundup Ultra Max II	22 oz	11-Sep-06
Corn	18-May-06	25-Oct-06	29,200	Roundup Ultra Max II	22 oz	30-May-06
	through			Lumax	3 pt	30-May-06
	30-May-06			Roundup Ultra Max II	22 oz	26-Jun-06
Soybean	10-Jun-06	15-Oct-06	175,000	Roundup Ultra Max II	22 oz	16-Jun-06
				Roundup Ultra Max II	22 oz	23-Jul-06
				Warrior	2.5 oz	3-Aug-06
				Lorsban	4.0 oz	3-Aug-06
Flax	15-Apr-05	15-Aug-05	140#	Select	5 oz	16-Jun-06

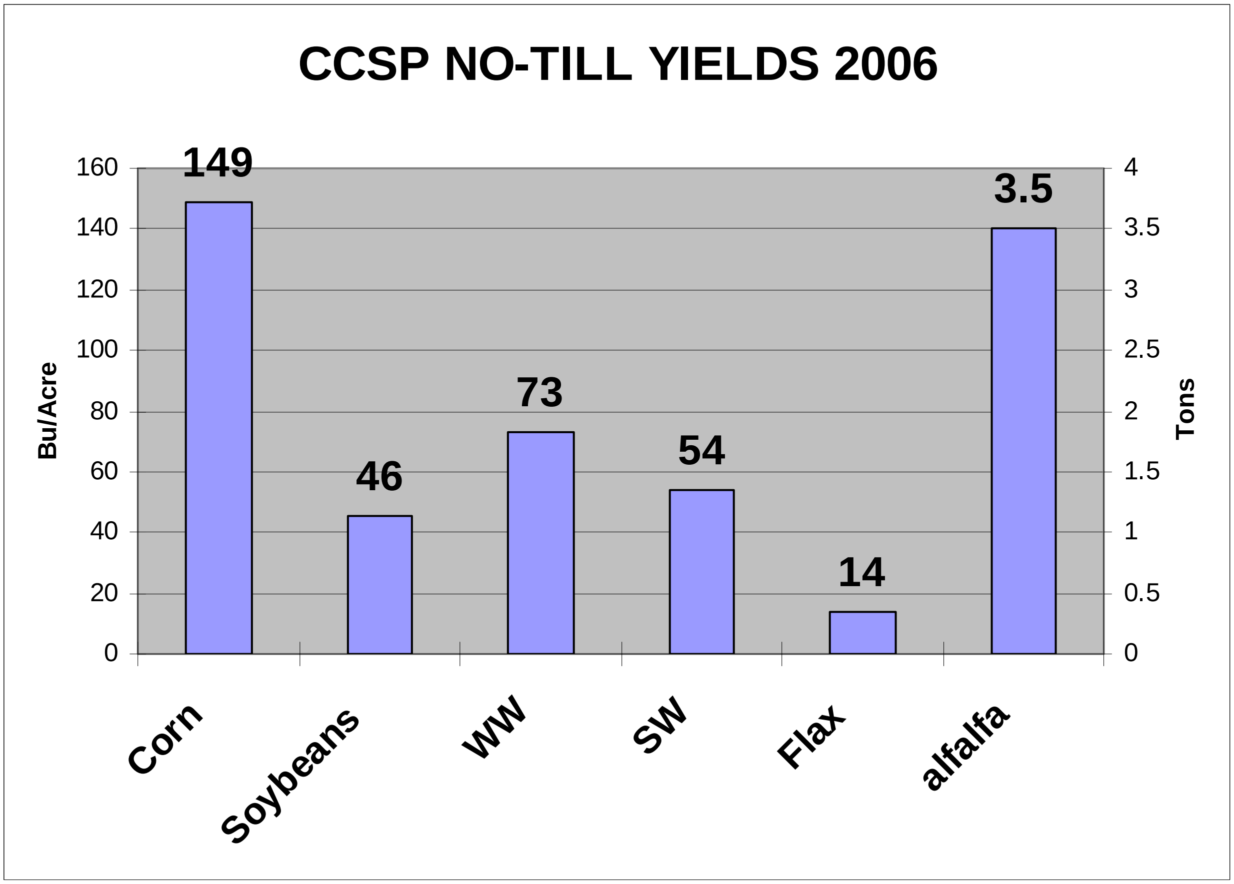

Figure 5. Crop yield averaged across all rotations at the Conservation Cropping Systems Project in 2006.

We were pleased with all yields except flax. It is our understanding that flax does not do well in a hot year. Wild oats, which has not been a problem on the farm turned out to be one this years. Foxtail barley also impacted some plots. We have decided to use a wild oat treatment in 2007 and made a late season application of glyphosate to help control foxtail barley. Two cuttings of second year alfalfa averaged 3.5 ton. The dry growing season prevented a 3rd cutting. Test weights for HRSW and HRWW were 62.1 and 59.8 lb/bu and yields were respecatble. Protein contents were 13.5% and 12.3% in HRSW and HRWW. Soybeans performed nicely. Soybean aphids required treatment based on high numbers in small areas. Whether an entire field would have treated at the levels we found would have been questionable. The levels were such that treatment was needed to prevent differences from plot to plot.

Rotation effect on corn yield
The most dramatic observation of 2006 for corn was the highest yield coming on strip-tilled wheat and the much lower yield of the "corn on corn" as seen in figure 6. Figure 7 shows the difference between corn planted on non strip tilled wheat. The same nitrogen rate was used across all rotations for reasons relating to late planting and the limitations of the corn planter.

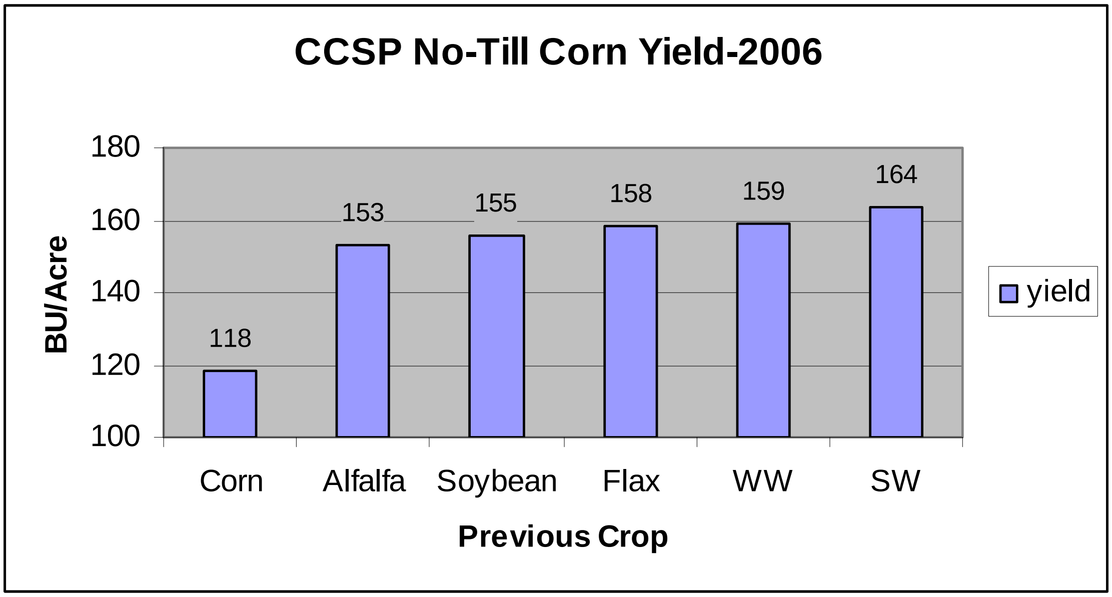

Figure 6. The effect of previous crop on corn yield in 2006.

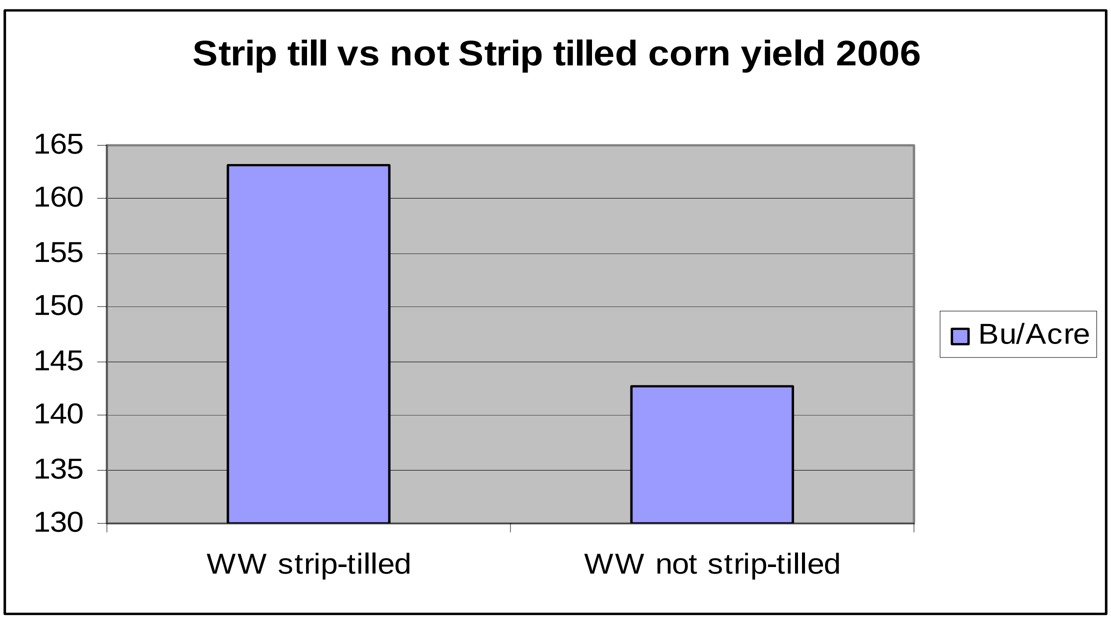

Figure 7. Corn on Strip tilled Winter Wheat vs non strip tilled.

Final comments from the Farm Manager.

I have personally enjoyed the opportunity to work with CCSP board and do some hands on farming once again. The long term implications of allowing soil erosion beyond the “T” limits are not desirable. We all must realize that farmers are business men that compete in a low margin environment. If these producers are not presented with alternatives to high erosion farm practices that are equally profitable soil erosion will continue at unacceptable levels. I have other employment that takes me across the southeastern corner of North Dakota where it becomes obvious that the farther west one goes, the more no-till farming you see. As moisture becomes the limiting factor for crop production, no-till is becoming the principal farming practice. Under wet condition, things get a little more challenging, and that is why we are here. The 2006 wet spring allowed us to observe the growth of corn where seeding was nearly impossible. Right up to where the planter plugged up with mud the corn that was seeded did perfectly fine. Other researchers have commented the wet soil conditions are not an agronomic problem as much as machinery engineering challenge. The observations I have made confirm that statement. I had early commented about the marginal condition in seeding spring wheat. The firmness of the soil combined with the residue allowed me to plant no-till when worked ground would have been impossible. As the season progressed, what we thought to be excess soil moisture was not as the rains quite and temperatures soared.

The revelation that food will be tied to energy in price brings on new opportunity and challenges. New technologies that we have acquired include a RTK equipped tractor generously donated by Titan Machinery. We hope to overcome some of the yield drag we observed in “corn on corn” by using strip till placed precisely between the old corn rows and coming back and planting right on the strip. Growing corn on corn will no doubt become a standard practice and we need to rise to the occasion to find ways to do this in a no-till or strip-till environment.

Another opportunity is the development of biomass crops that will compete economically and be compatible with soil and water conservation. Switch grass is commonly referenced but much works need to done. It is in our plans to work with switch grass on the farm starting in 2007 to get some background information on stand establishment, weed control, and yields.