CONSERVATION CROPPING SYSTEMS PROJECT

4th ANNUAL REPORT

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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.

WEATHER AND FARMING 2005

Weather data for 2005 is presented in Table 1. The winter of 2004–2005 was mild as temperatures from November 2004 through February 2005 averaged 5.0 degrees above the long-time average. Winter wheat did well despite light snow cover as the temperatures dipped below zero degrees on just six occasions. The coldest night on December 24 of -11.5 degrees was followed by a warm period reaching 38 degrees on December 30. Light snow falls on January 1, nine and eleven provided enough insulation to protect winter wheat from 20 below temperatures from Jan 13-17. Spring arrived early as March and April temperatures averaged 2.9 and 4.5 degrees above the long-time average and precipitation was below normal.

Wheat was being seeded the first week in April and corn was going into the ground by the third week. May 2005 was the fourth consecutive year that May temperatures averaged below the long time average. Corn emergence and seedling growth were impeded by these cool temperatures. Freezing temperatures on nine days from April 23-May 3, were particularly stressful for flax and winter wheat. The thermometer recorded 19 degrees on May 3. Flax stands were reduced 60 percent or more. Winter wheat was set back at least a week by the frosts. Significant stand losses were noted in winter wheat planted with a single disk drill in spring wheat stubble. Crown roots were close to the soil surface due to heavy residue, and were damaged by frost.

June was a wet month as precipitation exceeded the long time average by six inches. Warm, humid weather during the month resulted in significant scab infestations in wheat. Except for excessive rains in June, the weather was ideal for corn growth from June through September. June temperatures made up for GDU lost in May, and GDU accumulated in July and August were near to the 15 yr average. Corn finished off strong in September accumulating 99 GDU above the 15 yr average. Little or no heat stress and precipitation totaling 3.4 inches set soybeans up for high yields in August. The first killing frost was recorded on October 7.

Table 1. Temperature and precipitation at Forman, ND in 2005

	Temperature		Precipitation	
	64 Yr	2005	64 Yr	2005
Month	Mean	Mean	Mean	Total
January	7.6	8.5	0.5	1.2
February	11.9	19.7	0.5	0.3
March	26.0	28.9	0.8	0.1
April	44.0	48.5	2.0	0.6
May	55.7	53.9	3.0	3.3
June	65.0	67.1	3.6	9.6
July	70.1	71.6	2.9	2.2
August	68.2	68.3	2.8	3.4
September	59.5	63.5	2.1	2.7
October	46.0	47.8	1.4	1.1
November	28.6	32.5	0.6	0.1
December	15.3	17.1	0.6	0.4
MEAN	**41.5**	**43.9**	**20.6**	**25.0**
TOTAL				

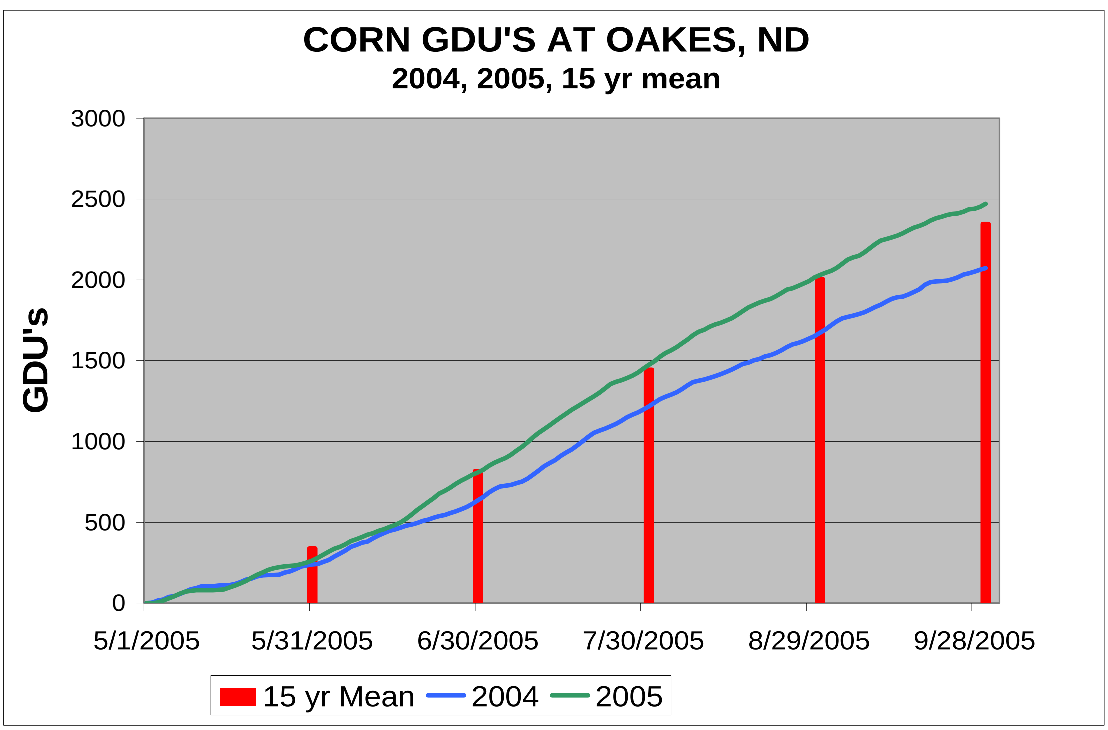

Figure 2. Growing degree units accumulated for corn at Oakes, ND in 2005 compared to 2004 and the 15-yr average at Oakes, ND.

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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North Dakota Community Foundation
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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 - Canola	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.

CROP FERTILITY

The amount of fertilizer applied to crops in rotations is presented in Table 3. Fertility recommendations were based on 2004 fall samples. Recommendations for fertilizer N were based on yield goals of 150 bu/ac for corn, 100 bu/ac for HRWW and 80 bu/ac for

HRSW. Total applied N in HRSW and HRWW were backed down to 125 lb/ac due to lodging concerns. 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.

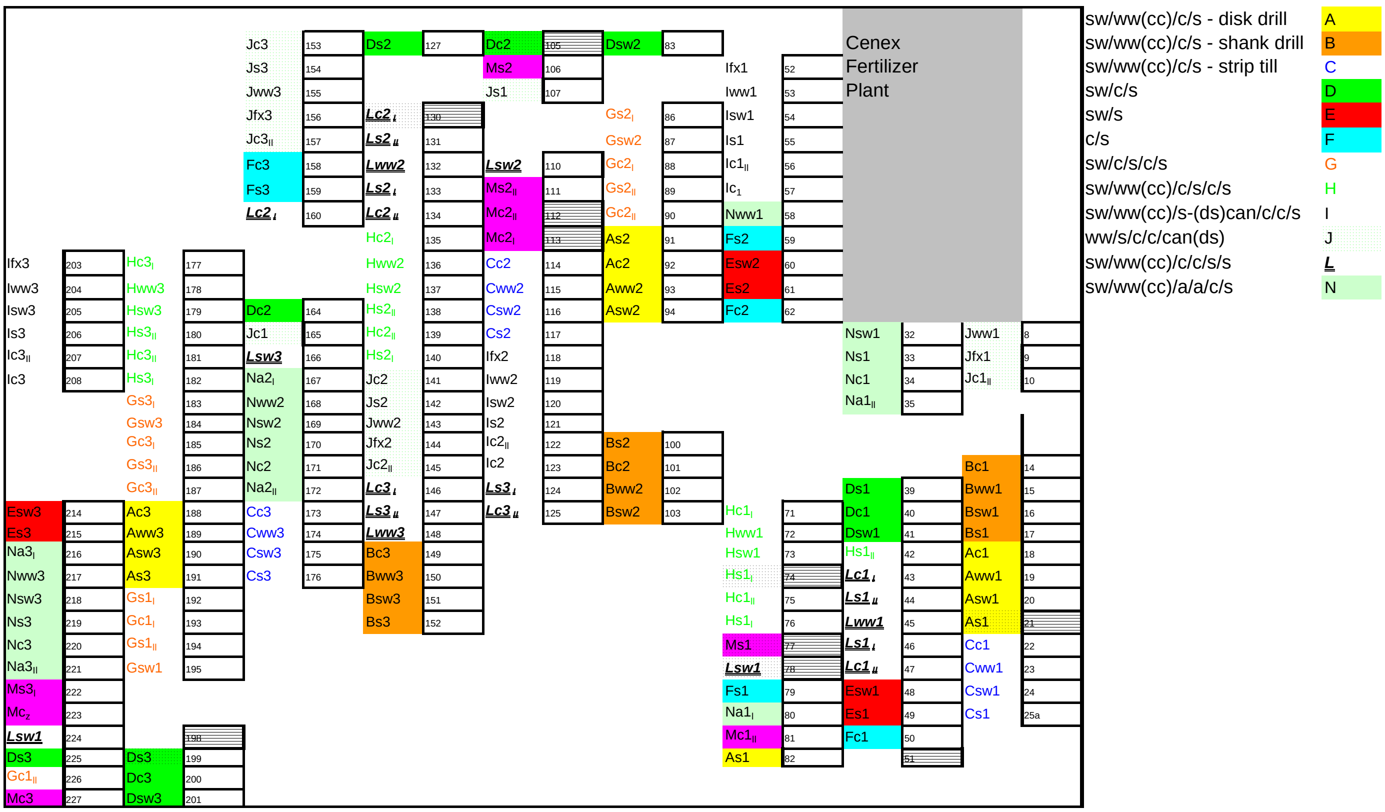

Figure 3. Plot map of rotations and their location in 2005.

Table 3. Fertilizer application in crops in 2005.

Crop 2004	Crop 2005	Planter P	Planter N	Post N	Total N
		lb/ac	lb/ac	lb/ac	lb/ac
Corn	Corn	39	105	43	148
Canola	Corn	39	105	43	148
Soybean	Corn	39	105		105
Alfalfa	Corn	39	105		105
HRSW	Corn	39	105	55	160
HRWW	Corn	39	105	43	148
Soybean	HRSW	44	9	116 [a]	125
HRSW	HRWW	44	9	116 [a]	125
Canola	HRWW	44	9	116 [a]	125
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 2005

Previous Crop	Fall soil Nitrate 2004	Fertilizer N 2005	Yield 2005	N Credit + Soil N+ Fert N	Fertilizer N
		lb/ac	bu/ac	lb/ac	lb/bu
Alfalfa	11	105	217	1.0	0.5
Corn	36	148	180	1.0	0.8
Canola	36	148	197	0.9	0.8
Soybean	33	105	193	0.9	0.5
HRSW	19	160	188	1.0	0.9
HRWW	35	148	182	1.0	0.8
HRWW/Strip-till	35	148	194	0.9	0.8

AGRONOMIC PRACTICES AND YIELD

A general outline of agronomic practices in crops is listed in Table 5. CDC Falcon HRWW was planted on October 5, 2004 with a John Deere (JD) 1560 single disk drill with 7.5-inch spacing and on October 7 with a 10-foot Concord air drill with triple shot Anderson seed boots at a 10-inch spacing. Briggs spring wheat was planted with the JD 1560 drill on April 6, 2005. Shank till plots were planted to Briggs on April 7, with the Concord drill. Starter fertilizer at a rate of 80 lb/ac of 11-55-0 was placed with the seed in all wheat plots. Fertilizer N applications of 22 gal/ac as 28-0-0 was applied with stream bars to HRWW on April 19, and on April 25 in HRSW. An application of 17 gal/ac as 28-0-0 with stream bars was applied to HRWW and HRSW on May 11 and May 16. York flax was planted with the 1560 JD drill on April 15, with 80 lb/ac of 11-55-0 applied in the seed furrow. Flax received at post application of 33 gal/ac of 28-0-0 to promote growth in stands decimated by frost.

Table 5. General agronomic practices for crops at the Conservation Cropping Systems Project in 2005.

Crop	Planting Date	Harvest Date	Planting Rate	Chemical	Rate	Date
Alfalfa 1st Yr	23-Aug-04	23-Jun-05	15 #			
		23-Jul-05				
		30-Aug-05				
Alfalfa 2nd Yr	2-Apr-04	as 1st Yr	13 #			
Alfalfa(establish)	5-Aug-05		15 #	Select	6 oz	9/2/2005
HRSW	6-Apr-05	2-Aug-05	116 #	Bronate Advanced	1.2 pt/ac	23-May-05
				Headline	3 oz/ac	23-May-05
				Headline	3 oz/ac	10-Jun-05
				Folicur	4 oz/ac	21-Jun-05
				Roundup Ultra Max II	22 oz	8-Sep-05
				Roundup Ultra Max II	22 oz	14-Sep-05
HRWW	5-Oct-04	29-Jul-05	114 #	Bison Advanced	1.2 pt/ac	23-May-05
				Headline	3 oz/ac	23-May-05
				Headline	3 oz/ac	9-Jun-05
				Folicur	4 oz/ac	18-Jun-05
				Roundup Ultra Max II	22 oz	8-Sep-05
				Roundup Ultra Max II	22 oz	14-Sep-05
Corn	4-May-05	26-Oct-05	29,200	Roundup Ultra Max II	22 oz	5/18/2005
				Lumax	3 pt	31-May-05
				Roundup Ultra Max II	22 oz	31-May-05
				Roundup Ultra Max II	22 oz	5-Jul-05
				Corn on alfalfa ground	***not sprayed***	***5-Jul-05***
Soybean	19-May-05	21-Sep-05	175,000	Roundup Ultra Max II	22 oz	25-May-05
				Roundup Ultra Max II	22 oz	6/24/2005
				Roundup Ultra Max II	22 oz	27-Jul-05
				Select	4 oz	27-Jul-05
Flax	15-Apr-05	15-Aug-05	33 #	Bronate Advanced	1pt	2-Jun-05

Dekalb DKC42-95 was planted with an 8-row Case IH 1200 planter with 30-inch spacing equipped with residue cleaning wheels, spading wheels and seed firmers on May 4-6. Corn received 32 gal/ac of 28-0-0 and 10 gal/ac 34-0-0 placed in a 3" by 2" band at planting. Corn planted on previous HRWW, HRSW, corn or canola ground received an additional 14-18 gal/ac of 28-0-0 on May 16, depending on rotation. Croplan RT0907 soybeans were planted in 30-inch rows with the CIH 1200 planter on May 19-20. Soybean plots received 10 gal/ac of 34-0-0 in a 3" by 2" band at planting.

Crop yields averaged across rotations in 2005 and for 2004-2005 are shown in figures 4. Three cuttings of second year alfalfa averaged 5.9 and 5.8 in 2004 and 2005. Wheat was severely infected with scab. HRSW had 2.6% damage (scab) and 3.0% vomitoxin compared to 2.2% damage and 2.5% vomitoxin in HRWW. Test weights for HRSW and HRWW were 60.4 and 58.0 lb/bu. Protein contents were 14.5% and 12.3% in HRSW and HRWW. Yields of HRWW on ground previously canola or HRSW have been similar figure 5.

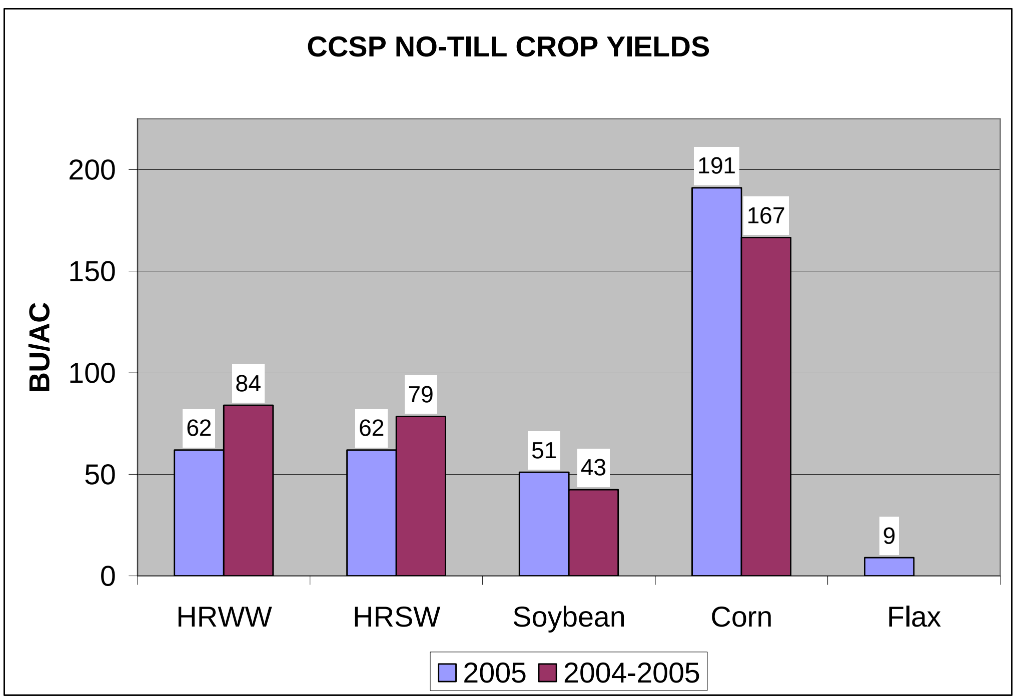

Figure 4. Crop yield averaged across all rotations at the Conservation Cropping Systems Project in 2005 and 2004-2005.

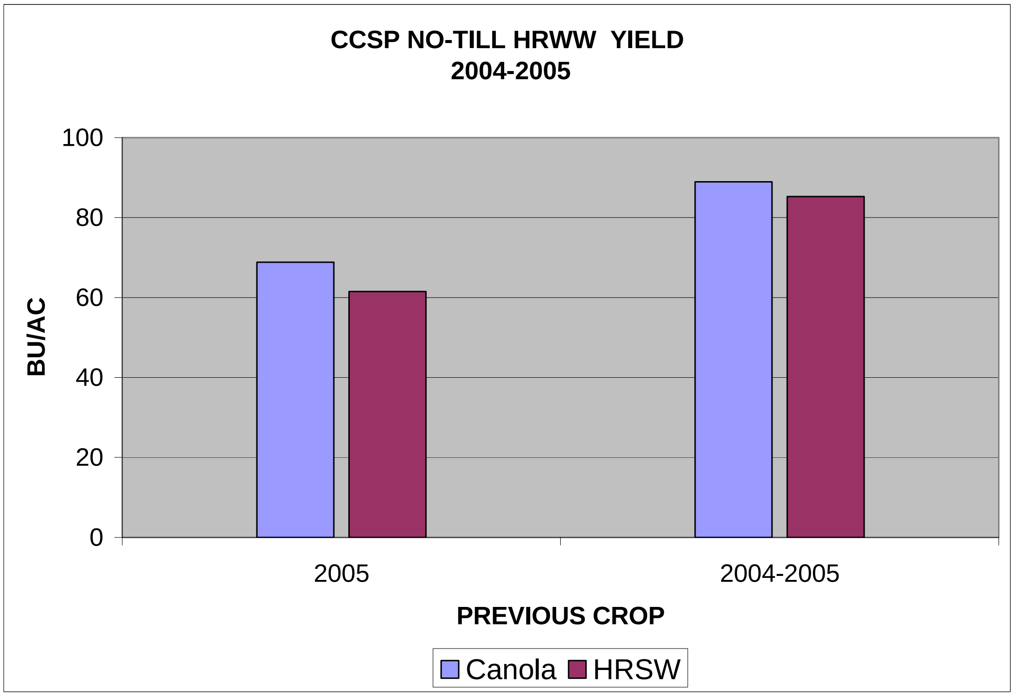

Figure 5. HRWW yield for previous crops at the Conservation Cropping Systems Project in 2005 and 2004-2005.

Soybean yield on ground previously in corn, HRSW and soybean were nearly the same in 2005, figure 6. When soybean yield is averaged from 2004-2005 the previous crop had no effect on yield.

Corn is the crop that is the most affected by previous crop figure 7 and crop sequence figure 8, at the CCSP site. Yields were highest when corn followed a cool or warm season broadleaf and lowest when corn followed a cool or warm season grass. In this study, grass is any combination of corn and wheat and broadleaf is any combination of soybean or canola. All the N and P fertilizer was placed in the fall strip-till operation in the fall of 2003. No fertilizer was placed in the fall strip-till operation in 2004. Corn grown on strip-tilled HRWW ground in 2005 yielded 12 bu/ac more than HRWW ground not strip-tilled. Corn grown on strip-tilled HRWW ground yielded just 4 bu/ac less than corn grown on soybean ground from 2004-2005. Additional data is required to see if this small yield difference between soybean and strip-till HRSW ground can be maintained.

Silk date is the agronomic parameter most related to yield at the CCSP site. All effects that slow or retard germination, seedling and vegetative growth are expressed in delayed silk date and thus yield. The effect of silk date on corn yield is shown in Figure 9. When comparing silk dates in figure 10 to corn yields in figure 7, we see the effect of previous crop on silk date and ultimately yield.

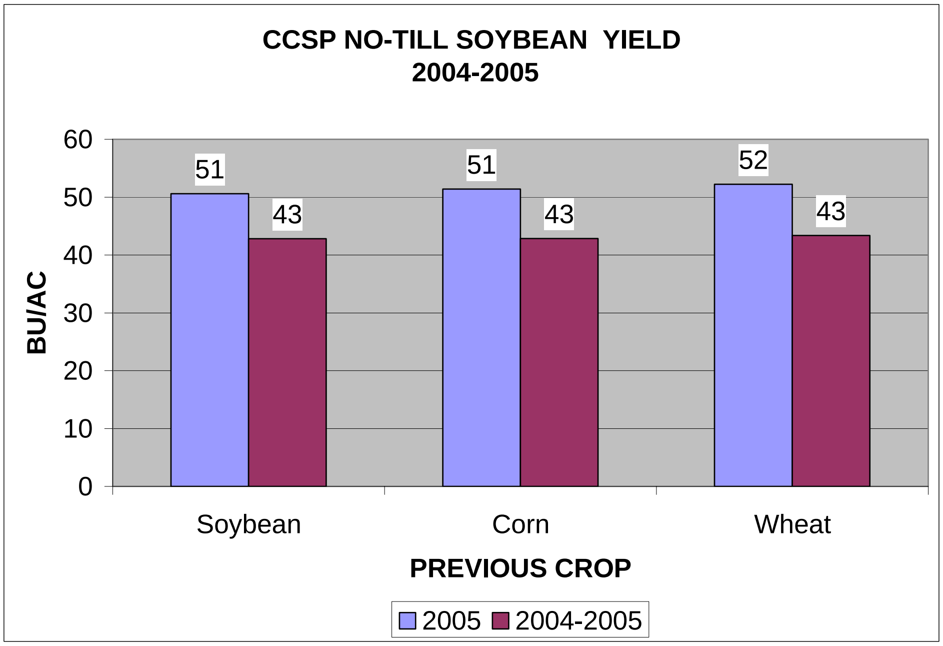

Figure 6. Soybean yield for previous crops at the Conservation Cropping Systems Project in 2005 and 2004-2005.

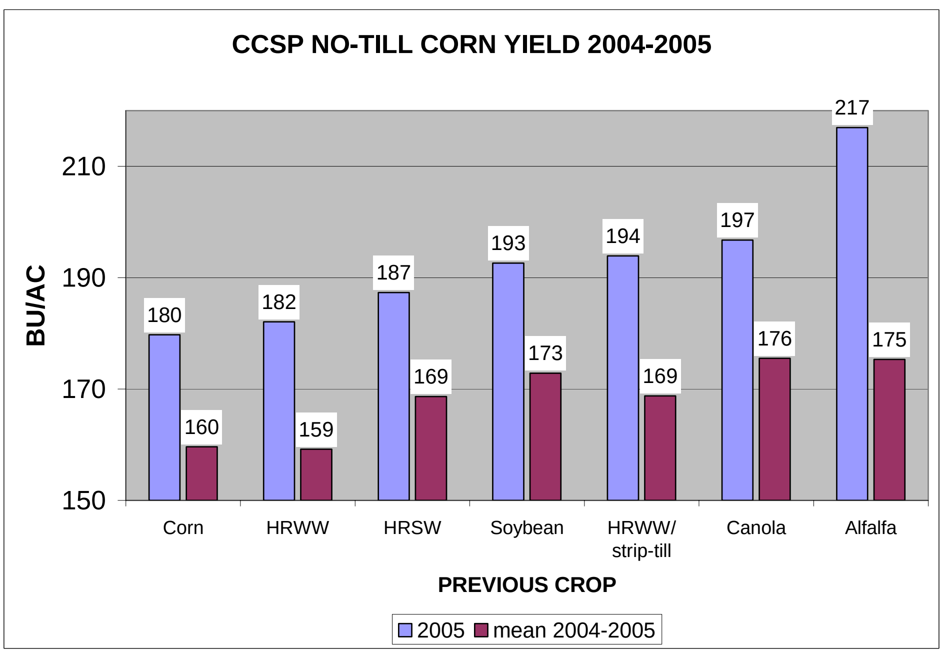

Figure 7. Corn yield for previous crops at the Conservation Cropping Systems Project in 2005 and 2004-2005.

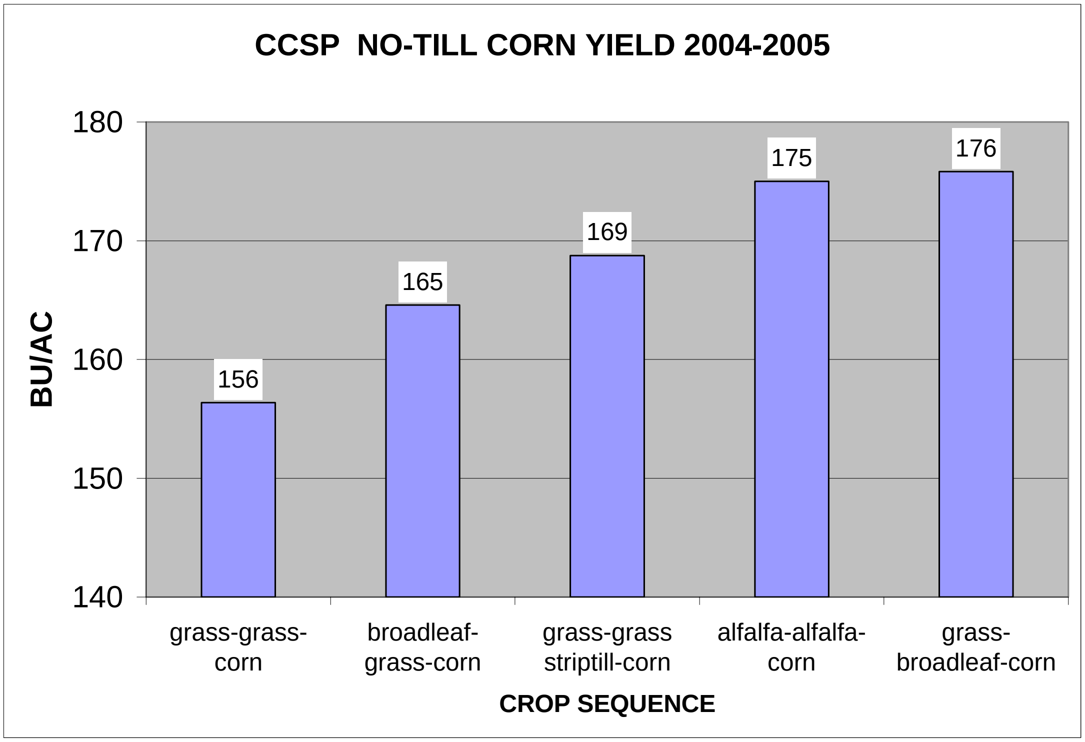

Figure 8. Corn yield for cropping sequences at the Conservation Cropping Systems Project for 2004-2005.

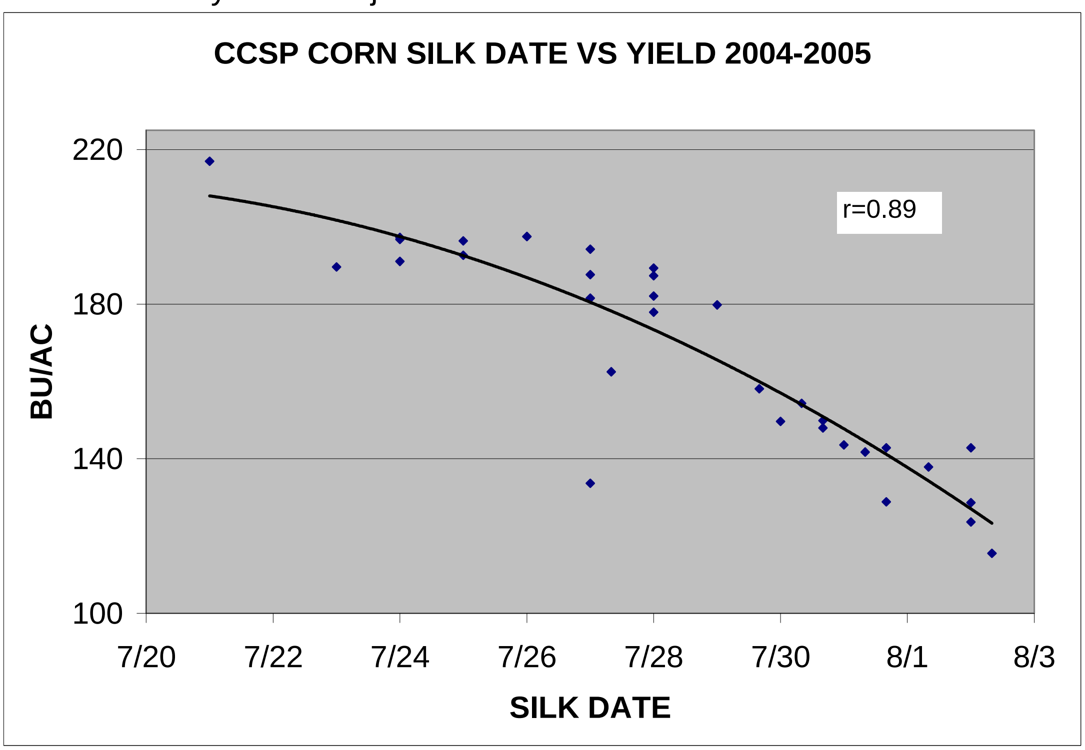

Figure 9. Corn yield vs silk date at the Conservation Cropping Systems Project in 2004-2005.

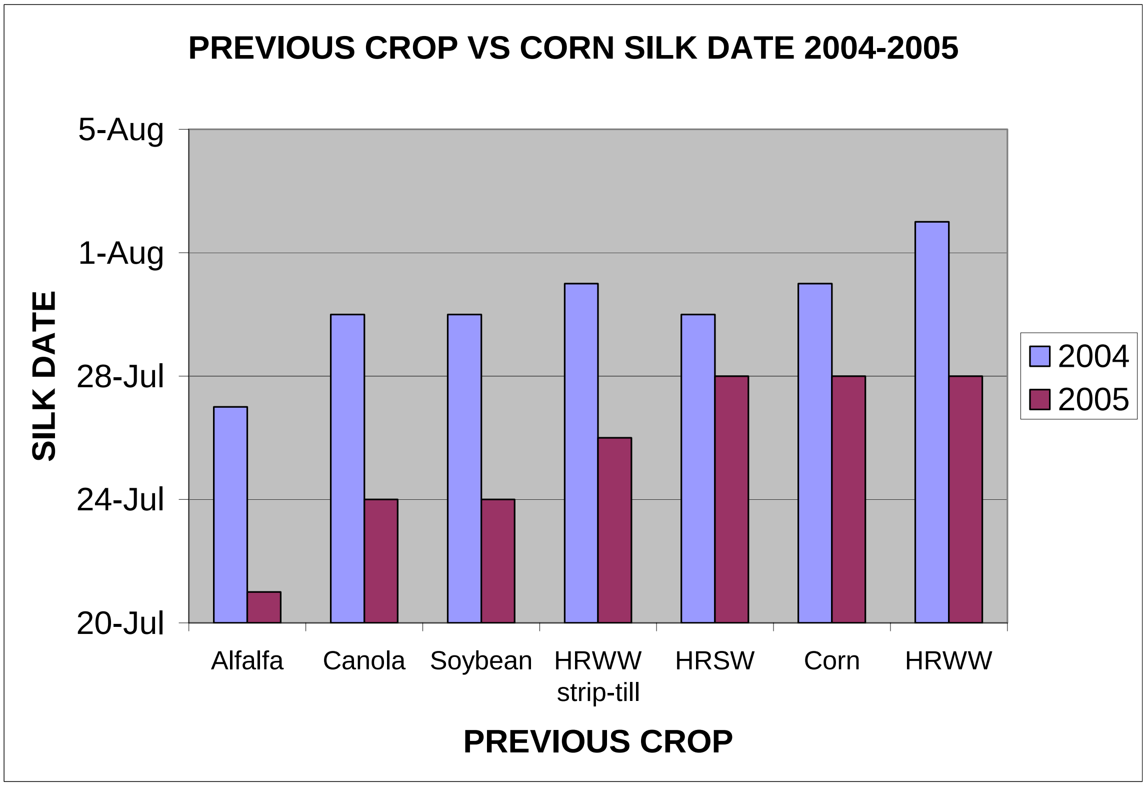

Figure 10. The relationship of previous crop on corn silk date at the Conservation Cropping Systems Project for 2004 and 2005.