Strip-Till, Corn on Corn, Nitrogen Rate Study

Walt Albus, Leonard Besemann and Heidi Eslinger

Corn grain production has made amazing increases in both yield and number of acres planted in North Dakota in the past 11 years. Figure 1 shows the corn acres planted and total bushels harvested in North Dakota from 1997-2008. North Dakota is currently planting about 2.5 million acres of corn and producing about 280 million bushels annually. The current 2008 estimate of 285 million bushels of corn produced in North Dakota includes about 20 million bushels to be harvested in the spring of 2009.

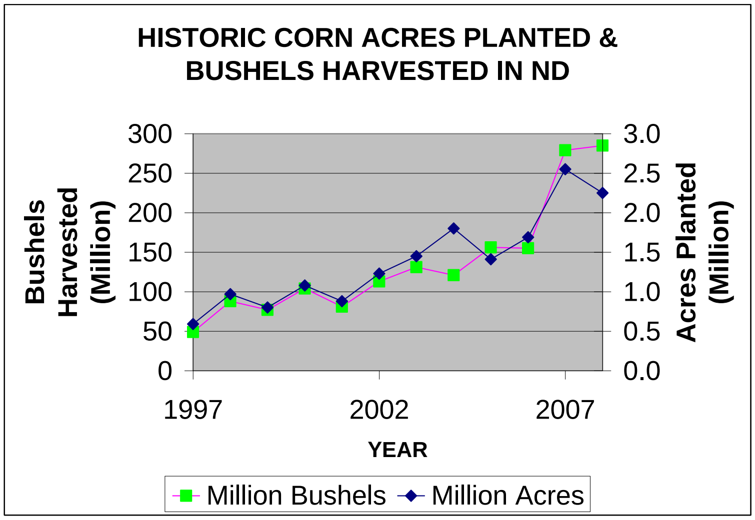

Figure 1. Acres planted to corn and total bushels harvested from 1997-2008 in North Dakota.

It is estimated that if all ethanol and high fructose corn sweetener plants in the state were operating and the Williston and Scranton ethanol plants came online, they would use about 225 million bushels of corn annually. Although corn for several of these plants comes from out of state, corn acres must increase in North Dakota to meet future demand. Increasing corn acres in southeastern North Dakota will require more continuous corn in crop rotations. Conventional-grown continuous corn requires extensive tillage with high fuel use. Continuous corn requires about 40 lbs. more N/acre than corn grown on soybean ground. Fuel and fertilizer prices have increased dramatically with higher energy costs.

The objectives of this study were to grow continuous corn in a strip-till system that eliminates full width tillage and to find efficient nitrogen rates.

Materials and Methods

Soil:	Embden sandy loam and Hecla sandy loam; soil-P and soil-K were high; soil-S was medium.
Previous crop:	2007 - field corn; 2006 - field corn; 2005 - soybean.
Seedbed preparation:	Strip-tilled on November 14, 2007, with a shank machine with leading coulters, mole knives and closing disks.
Planting:	Planted on May 1 in 30-inch rows at 33,000 seeds/acre.
Plots:	Plots were 140 ft. long by 20 ft. (8 rows) wide. There were four replications.

Fertilizer:	On November 14, 2007, during strip-till operation, banded 12 lbs. N/acre and 42 lbs. P_2O_5 as 10-34-0. On May 15 applied 38 lbs. N/acre as 32-0-0 on all plots except the 12 pound N-rate plots. On June 17 applied N as 32-0-0 in 50 lb./acre increments for a total of 100, 150 and 200 lbs total N/acre on the respective N-rate treatments (0, 50, 100, 150 and 200 lbs. N/acre).
Irrigation:	Hand-move sprinkler irrigation as needed.
Pest control:	Lumax (3 pt/acre) + Buccaneer Plus (32 oz/acre) + NIS (0.5% v/v) + AMS (10 lbs/100 gal) on May 31, Cornerstone Plus (40 oz/acre) + AMS (10 lbs/100 gal) on June 18.
Chlorophyll Testing:	Relative chlorophyll meter readings were taken on ear leaves with a Minolta Spad 502 chlorophyll meter on August 6, 15, and September 5.
Remote Sensing:	Green color reflectivity for treatments was obtained from aerial digital pictures taken on August 7. The green reflectivity was related to N rate.
Stalk Test:	Eight stalk segments, 8 inches in length were cut, 6 inches above ground in each plot and tested for nitrate-N.
Harvest:	Harvested on November 3 with a JD 4400 combine. Harvest area was the middle four rows of each plot 137 feet long.

Results

Increasing N rates increased grain yield, grain moisture, chlorophyll meter readings on all dates, and grain protein. Grain starch decreased with increasing N rates. Remote sensing on August 7 did an excellent job of predicting corn N status. Green reflectivity in plots from aerial digital photography was inversely related to N rate. The lower the reflectivity, the greener the corn tissue. Corn seedling growth has been suppressed in the higher N rate treatments from an excessive build up of plant residue in second- and third-year corn (2007-2008). Even with fall strip-till and planter-mounted row cleaners, plant residue is falling back into the rows and reducing soil temperatures. This large amount of residue in the higher N treatments is also immobilizing the broadcast pre-emerge N application causing N deficiencies before the side-dress application. For 2009 our strip-till operation will be very aggressive. We will strip-till to an 8-inch depth and set fluted closing coulters to make a 12-inch wide black strip for planting corn. Also, pre-emerge fertilizer N will be banded over the row in a 10-inch or less width.

Table 1. Strip-till, corn on corn, nitrogen rate study at the Oakes Irrigation Research Site in 2008.

Fertilizer N Rate	Grain[1] Yield	Harvest Moisture	Test Weight	Soil Nitrate-N 2007	Soil Nitrate-N 2008	Chlorophyll Meter Reading 6-Aug	Chlorophyll Meter Reading 15-Aug	Chlorophyll Meter Reading 5-Sep
lb/ac	bu/ac	%	lb/bu	0-24"	0-24"			
12	75.9	27.0	51.6	13	9	34.4	33.9	25.9
50	96.0	28.5	50.4	11	8	41.7	40.6	31.7
100	140.8	28.8	51.8	16	8	51.6	51.5	47.3
150	171.1	29.2	51.6	18	9	54.7	56.9	55.5
200	184.1	29.5	52.2	20	11	54.5	58.6	58.5
MEAN	133.6	28.6	51.5	15	9	47.4	48.3	43.8
LSD 0.05	5.8	1.4	NS	5	NS	2.2	2.5	2.1
C.V. (%)	2.8	3.2	1.8	20	19	3.0	3.4	3.1

Fertilizer N Rate	Stalk Nitrate-N	Grain Oil	Grain Protein	Grain Starch	Silk Date	Green Color Reflectivity	Mature Date
	ppm	%	%	%			
12	218	3.4	6.8	71.5	8/3	176.6	10/15
50	182	3.5	6.7	71.4	8/3	162.8	10/15
100	134	3.3	7.3	70.9	8/2	141.7	10/13
150	969	3.3	8.2	70.6	8/2	134.9	10/16
200	488	3.2	8.7	70.4	8/1	134.5	10/16
MEAN	398	3.3	7.5	71.0		150.1	
LSD 0.05	NS	NS	0.4	0.5		4.2	
C.V. (%)	185.36	5.16	3.02	0.44		1.8	

We would like to thank Pioneer Hi-Bred International and Pro Ag Supply Inc of Aberdeen, South Dakota for their support.