Final Progress Report to the Nebraska Wheat Board
FY 2009 Funding Cycle

Project Title: Improved Nitrogen Management for High Quality White Wheat

Project Year/Time Period: New and continuing Project, Year 4 of 5 Years (FY06-FY10)

PRINCIPAL INVESTIGATOR:
Dr. Gary W. Hergert, Panhandle Research and Extension Center, Scottsbluff, NE (308) 632-1372, ghergert1@unl

PROJECT DESCRIPTION:

Hard white wheat acreage has the potential to grow in Nebraska and expand rapidly depending on market factors. While most Nebraska wheat is grown under dryland conditions more wheat is being irrigated because of declining water resources in many areas. There is limited information on N management for irrigated wheat in Nebraska (red or white). Irrigated wheat production is dramatically different from dryland production because of improved water availability and yield potential. To enhance yields and manage protein, more detailed information on N rates and timing is required for irrigated wheat. The objective of this work is to investigate intensive N management for hard white wheat to determine effects on yield and protein.

Specific Objectives.

1. Determine optimum N rates and timing to achieve specific yield and protein content goals for irrigated white wheat based on soil nitrate-N and organic matter levels.
2. Determine N rate and timing effects on selected crop parameters (test weight, harvest index, moisture, baking quality).

PROCEDURES.

A factorial arrangement of N rate (60, 100, 140 lb N/a) and three timing regimes (all preplant, 1/3 at planting 2/3 at jointing, or 1/4 at planting, ½ jointing and 1/4 at boot) are being used. At the PHREC site plots also include 3 irrigation levels (4, 8, 12 inches).

PROGRESS:

The 2006 plots were at the High Plains Ag Lab at Sidney, at Scottsbluff (PHREC) and near Alliance. The Scottsbluff site included 3 irrigation levels (low (4"), limited (8") and full (12"). Soil test information is shown in Table 1. Antelope white winter wheat was planted at all 2006 locations except Alliance where Lakin was included. Planting dates were September 23, 2005 for Alliance and Sidney and September 26, 2005 at Scottsbluff. All these dates are about 7 to 10 days later than optimum for maximum yield potential, but wheat followed dry beans at 2 locations (Alliance and Scottsbluff), so yields are representative of predominate cropping systems where irrigated wheat will be planted in the panhandle.

Plots in 2007 were at the same three panhandle locations plus three sites were added in West Central: WCREC at North Platte and two sites between Imperial and Brandon, NE. Planting

dates were October 3, 2006 for Alliance, September 27, 2007 for Sidney and September 14, 2006 at Scottsbluff with variety Antelope. For West Central, North Platte was planted October 16, 2006, Hajek site September 29, 2006 and Krajewski on October 31, 2006 all with Agripro NuDakota. Several of these dates are later than optimum for maximum yield potential, but wheat followed dry beans at 3 locations (Alliance, Hajek, Krajewski), so yields should be representative of cropping systems where irrigated wheat is planted after dry beans (late) in western NE.

In 2008 plots were at the same three panhandle locations plus one site on a producer's field near Sidney and one site in West Central. Planting dates were October 1, 2007 for Alliance, September 19, 2008 for Sidney and September 14, 2007 at Scottsbluff using Antelope. Imperial was planted October 7, 2007 with Agripro NuDakota. Several of these dates are later than optimum for maximum yield potential, but wheat followed dry beans at Alliance and Imperial, so yields should be representative of that cropping system.
Residual nitrate at Alliance and Sidney in 2006 were much higher than desired, but Scottsbluff was low enough for a good N response. Residual nitrate levels in 2007 were high at four of the six locations, but site selection was limited.

For 2009, plots were at the same three panhandle locations plus one site at the West Central Research & Extension Center.

Table 1. Soil test information for 2006, 2007 and 2008 sites.

Location	pH	OM	Olsen P	ppm NO3-N			# NO3-N
				0-8"	8-24"	24-48"	in 4 feet
Alliance06	7.0	2.1%	29	20.4	10.1	4.6	130
Sidney06	7.8	2.2%	48	17.2	15.3	18.5	240
Scottsbluff06	8.2	1.2%	12	0.6	1.8	5.3	50
Alliance07	7.3	1.8%	25	12.1	7.2	4.9	120
Sidney07	8.0	2.0%	79	10.9	19.0	36.1	370
Scottsbluff07	7.6	1.4%	17	12.6	9.4	16.1	190
Hajek07	6.3	1.8%	15	15.1	4.3	5.0	110
Krajewski07	7.1	1.9%	6*	13.7	25.9	8.4	224
North Platte07	7.3	2.4%	14	6.2	3.8	2.5	55
Alliance08	7.1	1.9%	18	12.1	2.0	3.5	60
Imperial08	7.6	1.9%	9	13.2	4.1	3.5	86
Scottsbluff08	8.1	1.5%	11	17.6	5.5	9.5	187
Sidney08	6.8	2.6%	18	13.3	3.8	11.4	132

*50 lbs phosphate added to plot area due to low soil P.

The 2006 data showed a slight N response at Alliance and Scottsbluff 12 inch irrigation level (Table 2). Yield levels were very good at Alliance and Scottsbluff but were lower than expected at Sidney, due to the site, later planting date, poor emergence and stand.

Table 2. 2006 irrigated white wheat grain yields.

		Alliance	Alliance	PREC-4"	PREC-8"	PREC-12"	Sidney
Variety		Antelope	Lakin	Antelope	Antelope	Antelope	Antelope
N Rate and Timing		----------Bushels/acre ----------					
0	Preplant*	83	85	77	88	90	66
30	Preplant	--	--	81	--	--	--
60	Preplant	91	90	82	83	87	72
100	Preplant	90	90	85	88	97	69
140	Preplant	76	75	--	80	100	66
30	1/4p-1/2j-1/4b	--	--	83	--	--	--
60	1/4p-1/2j-1/4b	82	93	85	94	99	66
100	1/4p-1/2j-1/4b	82	89	85	83	100	67
140	1/4p-1/2j-1/4b	78	90	--	77	98	65
30	1/3p-2/3b	--	--	84	--	--	--
60	1/3p-2/3b	81	92	85	90	99	68
100	1/3p-2/3b	83	80	87	90	96	66
140	1/3p-2/3b	69	85	--	95	95	67

*Preplant = all N applied broadcast preplant; 1/4p-1/2j-1/4b = N application with one-fourth preplant, one half at jointing and the remaining one-fourth at boot stage; 1/3p-2/3b = one-third preplant and 2/3 at jointing.

The 2007 data showed a slight N response at Alliance and Scottsbluff 12 inch irrigation level (Table 3). Yield levels were very good at Alliance and Scottsbluff but were again low at Sidney, due to the site and poor stand. There were significant N responses at WCREC and Hajek but the very late planting, poor stands and very high nitrate-N contributed to no N response at Krajewski.

Table 3. 2007 irrigated white wheat grain yields.

		PHREC			Alliance	HPAL
		4 inch	8 inch	12 inch		
Treatment	N Rate	----------Bushels/A ----------				
All Preplant	0	62	80	89	102	65
	30	58	----	----	----	----
	60	49	78	96	106	68
	100	50	74	90	111	63
	140	----	77	92	113	65
1/4P-1/2J-1/4B	30	54	----	----	----	----
	60	62	82	93	106	63
	100	59	78	99	113	64
	140	----	71	99	115	63
1/3P-2/3J	30	57	----	----	----	----
	60	59	79	96	109	62
	100	53	77	98	109	62
	140	----	77	96	115	68

White Wheat 2007 grain yield.

		Krajewski *	Hajek	North Platte
Treatment	N Rate	Bushels/A		
All Preplant	0	54	64	57
	40	49	71	67
	100	50	82	65
	160	48	89	82
1/4P-1/2J-1/4B	40	55	74	75
	100	54	87	79
	160	51	89	71
1/3P-2/3J	40	52	78	71
	100	80	87	73
	160	47	92	75

* N rates were 0, 40, 80 and 120 lb N/acre.

Table 4. 2008 irrigated white wheat grain yields.

		Alliance	Imperial	PREC-4"	PREC-8"	PREC-12"	Sidney
Variety		Antelope		Antelope	Antelope	Antelope	Antelope
N Rate and Timing		----------Bushels/acre ----------					
0	Preplant*	78	59	70	88	96	82
30	Preplant	--	--	71	--	--	--
60	Preplant	88	68	71	87	108	75
100	Preplant	85	73	69	88	107	79
140	Preplant	72	73	--	88	104	71
30	1/4p-1/2j-1/4b	--	--	71	--	--	--
60	1/4p-1/2j-1/4b	82	76	70	85	108	79
100	1/4p-1/2j-1/4b	77	74	76	88	108	78
140	1/4p-1/2j-1/4b	79	77	--	90	111	80
30	1/3p-2/3b	--	--	72	--	--	--
60	1/3p-2/3b	76	76	71	85	102	81
100	1/3p-2/3b	78	72	74	86	106	78
140	1/3p-2/3b	77	67	--	86	108	75

The 2008 data showed a slight N response at Alliance, Imperial and the Scottsbluff 12 inch irrigation level (Table 4). Yield levels were somewhat low at Alliance and Imperial. The Imperial site did not have P applied and that probably limited yield and response. The HPAL site produced good yields for this site under our linear move. Scottsbluff yields under full irrigation were excellent, although because of high residual nitrate (187# Table 2) there was no N response.

In 2009 the drought was broken, but the extra moisture caused some disease problems which were not detected early enough for spraying. The Alliance plot was lost to hail in early June. The Scottsbluff and Sidney plots have been harvested at this writing, but data have not been statistically analyzed. Scottsbluff did not have hail, but disease limited yields to about 70 bushels per acre. At Sidney, rainfall was excellent but there was some disease and there was about 15 to 20% hail damage once wheat matured. Yields at Sidney were only in the 60 bushel per acre range.

The significant information from three year's of research is the importance of measuring residual N. Yield levels were high at some locations, but usually a total of fertilizer N plus residual soil nitrate-N in 4 feet of 180 to 200 pounds N maximized yields. Further data analysis will be done to include the 2009 results but was not completed in time for this report.

Too much N can cause problems in wheat. Note that when all the N was applied preplant, yields tended to be reduced at the higher N rates, especially the 140 lb rate. As N rates increased, regardless of application method, yields often decreased. This again supports the idea that testing for residual nitrate is as important in irrigated wheat production as dryland. This work will continuing at four locations planted for 2010 (3 in the panhandle and 1 in west central).

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