

Spring Wheat and Durum Yield Response to Nitrogen Fertilization

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In 2014, a trial was established at the CREC to evaluate the effects of N fertilization on grain yield of hard red spring wheat (HRSW) and durum wheat at five rates of N. This trial also serves to establish differences in the amount of residual nitrates in the soil for the next growing season. The N rates applied were 0, 50, 100, and 200 lbs/ac broadcast as urea at planting. The trial was planted on May 21 and was harvested on September 8.

The results show that N rates had significant effects ($p < 0.05$) on yield and grain protein content of both crops (Table 1). HRSW reached maximum yield of 60 bu/ac at 100 lbs N and durum wheat reached its maximum yield of 46 bu/ac at 150 lbs N. Grain protein concentration had a seemingly linear response to N rates for both crops. By further increasing N fertilizer rates, the protein concentration is expected to reach its maximum and then start to decline. The drop in protein concentration of durum wheat at the 50 lb N rate is not an expected result and is likely not caused by the applied treatment but is due to other circumstances that caused variability in the field.

Table 1. Nitrogen treatment effect on the grain yield and quality of HRSW and durum.

Trt	Crop	N-rate	Yield bu/ac	Protein %	Test Weight lb/bu
1	HRSW	0	30 b	10.69 b	59
2	HRSW	50	51 a	11.49 b	59
3	HRSW	100	60 a	13.45 a	60
4	HRSW	150	58 a	13.78 a	60
5	HRSW	200	54 a	14.39 a	59
Means			51	12.76	60
Tukey-Kramer's MSD			16.487	1.2656	2.0379
Pr > F			0.0001	<.0001	0.6299
C.V.			19.212	5.849	2.019
1	Durum	0	25 c	10.84 b	54
2	Durum	50	36 b	10.76 b	54
3	Durum	100	42 ab	12.34 b	54
4	Durum	150	46 a	14.85 a	54
5	Durum	200	43 ab	15.99 a	54
Means			38	12.96	54
Tukey-Kramer's MSD			7.9503	1.7901	1.3025
Pr > F			<.0001	<.0001	0.2803
C.V.			12.192	8.149	1.424

a, b Means followed by the same letter are not significantly different at $P = 0.05$.

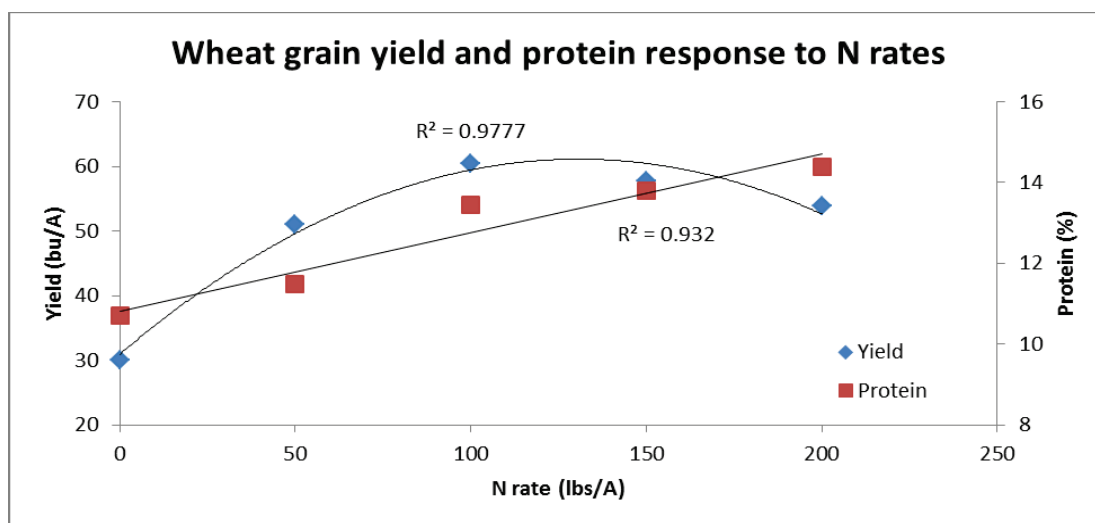


Figure 1. Wheat grain yield and protein response to N rates.

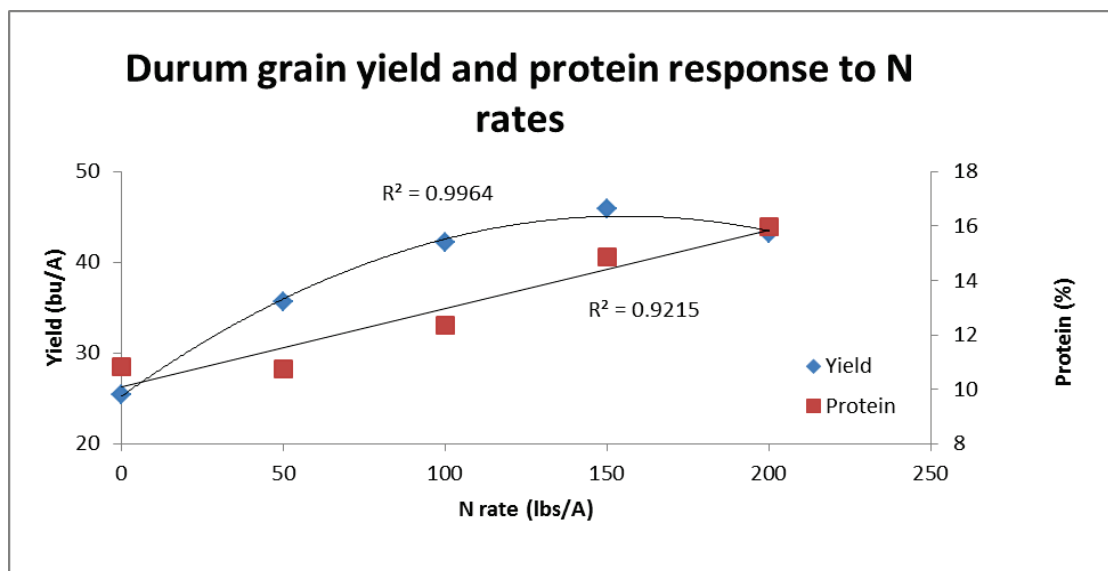


Figure 2. Durum grain yield and protein response to N rates.

Economic analysis

Based on current market prices HRSW reached optimum economic yield at 100 lbs N and durum reached optimum economic yield at 150 lbs N in this trial. The economic analyses presented in Tables 2 and 3 do not take anything other than fertilization costs into account.

Table 2. Analysis of the economics of broadcast N application on HRSW.

N rate	Cost of N+ application \$/ac	Yield bu/ac	Protein %	Gross Income ¹ \$/ac	Protein Premium or Discount \$/bu	Adjusted Gross Income \$/ac	Change in Income due to N \$/ac
0	0	30.1	10.69	165.02	-1.62	116.32	0.00
50	30.65	51.0	11.49	279.87	-1.38	209.52	93.20
100	55.15	60.5	13.45	332.14	-0.54	299.47	128.00
150	79.65	57.7	13.78	316.65	-0.36	295.89	99.92
200	104.15	53.8	14.39	295.62	0.15	303.70	83.23

¹ Price per bushel at 14% protein set at \$5.49/bu.

Table 3. Analysis of the economics of broadcast N application on durum wheat.

N rate	Cost of N+ application \$/ac	Yield bu/ac	Protein %	Potential Gross Income ¹ \$/ac	Protein Premium or Discount \$/bu	Adjusted Gross Income \$/ac	Gross Income Less N Application Cost \$/ac
0	0	25.4	10.84	328.10	refused	0.00	0.00
50	30.65	35.6	10.76	459.85	refused	0.00	-30.65
100	55.15	42.2	12.34	544.44	-0.35	529.67	474.52
150	79.65	45.9	14.85	591.47	no premium	591.47	511.82
200	104.15	43.1	15.99	556.61	no premium	556.61	452.46

¹ Price per bushel at 13% protein set at \$12.90/bu.

Data on cash prices and protein premiums and discounts were taken from Central City Grain for HRSW and Dakota Growers Pasta Company for durum wheat. The price for N fertilizer is based on Central City Grain's November 2014 price for urea. Fertilizer application cost is taken from the 2013 Custom Farm Work Rates bulletin for broadcast applied dry fertilizer (Table 4).

Table 4. Market values used for the economic assessment of N fertilization of HRSW and durum wheat.

Fertilization costs	
Cost of N (\$/lb)	0.49
Cost of application (\$/ac)	6.15
HRSW cash price (\$/bu)	
price at 14% protein	5.49
premium above 14% protein every 0.2%	0.15
discount (13 to 14%) every 0.2%	0.18
further discount below 13% every 0.2%	0.06
Durum cash price (\$/bu)	
price at 13% protein	12.90
discount 12-13% every 0.1%	0.05
below 12%	refused