Title: Effect of seeding rate and nitrogen on yield and quality of spring wheat and durum.

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Location: Western Triangle Agricultural Research Center, Conrad, MT 59425.

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Introduction and Objectives: Low and high seeding rates can adversely affect durum quality and kernel characteristics. Low rates result in green kernels and poor color in the harvested grain. High rates can reduce test weight and kernel size below industry requirements. Nitrogen fertilizer is essential for durum to achieve adequate hard vitreous amber color, and may interact with seed rate to affect kernel characteristics. The objectives were to determine the optimum range of seed rates in durum, to determine N requirements for desired protein and vitreous levels, and to compare the responses between durum and spring wheat.

Procedures: Plots were planted with a four-row planter with one-foot spacing. Phosphorus fertilizer was applied with the seed and N and potassium (K) fertilizers were broadcast during planting.

Results and Discussion: Agronomic and kernel characteristic data are presented in Table 1. The low seeding rate (15 seeds/ft^2) increased green kernels to unacceptable levels in all but the zero nitrogen rate. Seeding rate did not significantly affect yield, test weight, and kernel size, under the conditions of this test. As shown in Table 1, both durum and spring wheat responded to additional N. Using these data in a regression analysis, the amount of N required to produce Utopia durum at 13% protein would be 145 lbs. N/a (includes fertilizer N and soil nitrate-N in the top three feet of soil, in this case 51 lbs. N/a), and it would produce 71 bu/a or about 2 lbs. N/bu of grain. Similarly, Utopia durum would require 165 lbs. N/a to produce 13.5% protein and 72 bu/a or 2.3 lbs. N/ bu of grain. In comparison McNeal spring wheat needs 190 lbs. N/a to produce 70 bu/a at 14% protein or 2.7 lbs N/ bu of grain. Note that Utopia durum would produce about 73 bu/a at 14% protein with 190 lbs. N/a. However, the durum protein level tends to "level out" at about 14.5% with additional N, whereas spring wheat protein would continue to increase.

Future Plans: Continue this test in 2000 and 2001 in order to sample a variety of growing season conditions.

Table 1. Effect of seeding rate and N on spring wheat and durum yield and quality. The experiment was located at Western Triangle Ag. Research Center, Conrad, MT. 1999.

Crop	Fertilizer N (lbs./a)	Seeding Rate (seed/ft²)	Grain Yield (bu/a)	Test Weight (lbs./bu)	Protein (%)	Protein Yield (lbs./a)	DHV[1] (%)	Green Kernel (%)	Large Kernel[2] (%)
DU	225	30	81.3	59.5	14.7	709.0	99	0.0	40
DU	225	15	80.1	60.5	14.5	689.9	100	5.0	44
DU	75	30	79.1	61.3	12.0	567.7	96	0.2	52
SW	150	30	77.2	60.5	14.3	655.6			
DU	150	30	77.0	60.5	14.2	652.1	100	0.2	49
DU	225	20	76.5	60.4	14.6	660.3	100	0.2	43
DU	75	25	76.4	60.9	12.3	563.0	69	0.0	44
SW	225	25	75.0	60.5	15.0	674.1			
SW	150	15	7437	61.0	14.5	645.1			
DU	150	20	74.7	60.3	14.2	632.6	98	0.0	52
SW	225	20	73.8	60.2	15.0	659.6			
SW	150	20	73.5	60.1	14.8	646.6			
DU	150	15	73.1	60.7	14.1	615.8	98	5.0	49
DU	150	25	72.9	60.1	14.1	616.2	99	0.2	44
SW	225	15	72.3	60.7	14.8	640.4			
DU	225	25	71.4	58.9	15.1	643.8	98	0.0	35
SW	225	30	71.1	60.0	15.2	645.8			
SW	150	25	69.6	59.6	15.1	622.1			
SW	75	15	69.2	60.7	13.7	566.9			
SW	75	20	37.9	60.4	13.5	550.8			
SW	75	25	66.6	59.8	13.6	540.5			
SW	75	30	66.6	59.7	13.6	538.2			
DU	0	20	66.4	62.7	9.5	378.1	47	0.0	73
SW	0	30	66.2	60.4	10.4	413.2			
DU	75	15	66.0	60.8	12.4	488.3	97	3.0	43
DU	75	20	65.4	60.0	12.9	502.5	98	0.2	35
DU	0	30	64.1	62.2	9.7	372.8	56	0.2	62
DU	0	25	63.8	62.2	9.5	365.5	37	0.2	72
DU	0	15	62.4	62.6	9.8	367.7	42	1.0	72
SW	0	25	61.3	61.4	10.7	392.8			
SW	0	20	57.3	61.8	10.7	367.5			
SW	0	15	57.0	61.6	10.8	369.4			

[1] Dark Hard Vitreous

[2] Large Kernel Percent equal seed left on a 2.78 mm screen.

Summary Statistics

	Grain Yield (Bu/a)	Test Weight (lbs./bu)	Protein (%)	Protein Yield (lbs./a)
Experimental Means	70.3	60.7	13.1	554.8
Error Mean Square	91.14	1.707	0.4787	3368
P-Value	0.0190	0.0083	0.0000	0.0000
Standard Error of the Mean	4.773	0.6533	0.3459	29.02
C.V. 1: (s/mean)*100	13.58	2.152	5.283	10.46
LSD (0.05)	13.4	1.8	1.0	81.5

Variety Summary

Utopia	71.9	60.9	12.7	551.6
McNeal	68.7	60.6	13.5	558.0
LSD (0.05)	NS	NS	0.3	NS

Seeding Rate Summary

15	69.3	61.1	13.1	547.9
20	69.4	60.7	13.1	549.8
25	69.6	60.4	13.2	552.2
30	72.8	60.6	13.0	569.3
LSD (0.05)	NS	NS	NS	NS

Nitrogen Summary

0	62.3	62.0	10.1	378.4
75	69.7	60.5	13.0	539.7
150	74.1	60.4	14.4	635.8
225	75.2	60.1	14.9	665.4
LSD (0.05)	4.7	0.6	0.3	28.7
Interaction P-value	0.9726	0.9796	0.8770	0.9956

Notes:

Varieties: Durum = Utopia Spring Wheat = McNeal

Seeding Date: 4/13/99 Harvest Date: 8/23/99

Growing Season ppt: 7.88" Previous Crop: Fallow

Fertilizer: N applied as urea (broadcast) while planting. Thirty lbs. P_2O_5 applied with the seed as mono-ammonium phosphate while planting. 30 lbs K/ac as KCl was applied, (broadcast), while planting.

Herbicide: Achieve @ 0.25 lbs. ai/ac and Bronate @ 1½ pt./ac applied on 5/27/98.

General Mills kernel characteristics for durum:

	#2 Durum	#1 Durum
Test Weight (lbs./bu)	58	60
Dockage (%)	1	0
Dark Hard Vitreous (%)	85	90
Protein (%)	13	13.5

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Soil Test Summary[1]:

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	330	26.5	0.15	2.29	8.1
	NH_4-N	NO_3-N	SO_4-S	Cl	
	---------- lbs/ac ----------				
0 - 1	11.8	27.2	131.7	14.6	
1 - 2	10.1	16.7	134.1	12.3	
2 - 3	11	6.7	3651.7	12.8	
3 - 4	10.3	4.8	4797.7	12.9	

[1]The soil was sampled during the autumn of 1998.