

2009 Small Grain Research Report



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Small Grain Variety Performance Trials

San Luis Valley Research Center

Center, Colorado

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Summary

Each year small grain variety performance trials are conducted at the San Luis Valley Research Center to identify varieties of wheat, barley, oats and other small grains that are productive and adapted for commercial production in the San Luis Valley. Yields of small grains were varied this year. The barley and soft white spring wheat trial produced excellent yields; the barley trial average 152 bu/acre and the SWS wheat trial averaged 130 bu/acre. The Hard Spring Wheat Trial; however, averaged only 103 bu/acre because of sprinkler irrigation problems. The field with these trials was not watered from June 19 until rain June 25, a span of 6 days without water instead of the normal 3 day span. Drought stress was visible in many of the trials. Some trials, especially the barley, may have escaped the stress since it was already pollinated inside the boot. Both the SWS Wheat and the Hard Spring Wheat Trials suffered stress which resulted in many tall, late-maturing sucker heads and this may have reduced the grain yield. The Hard Spring Wheat Trial particularly yielded much less than it appeared that it would. The plots looked like they might yield 130+ bu/acre but produced only 103 bu/acre.

The 2009 season temperatures were close to normal during the growing season, except that May was warmer 4.3 F warmer than normal. Rainfall was higher than normal: April was +.46, May was +.43 and June was +1.16 inches. July and August were below normal and September was above normal. For the 6 months growing season, precipitation was 6.58 inches compared to a 1948-04 average of 4.88 inches. There were few problems with Miller/Coors malting barley this year.

Grain yields in the soft white spring (SWS) wheat trial were above average this year, about the same as last year. The average yield was 130 bu/acre and the high yield was 154 bu/acre. Hard wheat grain yields (HRS, HWS and durum) were below average as described above. The high yield of 125 bu/acre and the average was only 103 bu/acre. Grain yields in the barley trial were very good; the high yield was 175 bu/acre and the average was 152 bu/acre. The oat variety performance trial was evidently fertilized too much as most cultivars severely lodged by time for harvest. Therefore, the oat trial was not harvested for grain. The other measured agronomic characteristics are presented.

Introduction and Objectives

Small grains of various kinds of wheat, barley and oats have been produced in the San Luis Valley for many years. Oat acreage has greatly declined from historically highs; however, oats were grown on 27,000 acres in 2004; mostly grown for hay or for alfalfa seeding cover crop. Barley acreage is pretty consistently between 40-50,000 acres with a value of \$15-20 million. Value jumped to nearly \$39 million in 2008. Wheat acreage varies greatly depending on the wheat price; jumping from 10,000 acres to 25,000 acres when prices are more promising. Wheat value ranged from \$4-10 million until 2008 when it jumped to \$19 million. Wheat types also vary with demand and grower preferences. Durum acreage is small but fairly steady. SWS acreage varies with price; the dominant market being in Denver. HRS acreage is somewhat being replaced by hard white spring wheat. Winter wheat acreage remains very small. The objective of this research was to evaluate wheat, barley and oat cultivars and experimental lines performance under high-yield center pivot conditions in the San Luis Valley.

Materials and Methods

These field research trials were conducted primarily at the San Luis Valley Research Center but sometimes on neighboring farms. The wheat, barley, and oat trials this year were all located at the Research Center, grown in a barley field but fertilizer amounts varied depending on the crop. The part of the field planted to variety trials received different irrigations at certain times of the growing season. All trials are conducted as a randomized complete block design with four replications. This means all varieties were planted on the same day, irrigated and otherwise treated the same all season and all plots were also harvested the same. Each variety is planted four times in randomized locations within the trial. Plots are planted to 35 foot lengths and trimmed at harvest to about 30 foot. Nine rows are planted in 8-inch rows which makes a plot 6 feet wide. Unless the plots are severely lodged, only the middle 7 rows (4.7 feet) are harvested with the Hege small plot combine.

Entry fees are solicited for privately owned varieties. Wheat yields are corrected to 12% moisture and 60 lbs/bushel. For barley, yields are corrected to 48 lbs/bushel and oats are corrected to 38 lbs/bushel. Wheat protein and hardness are determined by the wheat breeding program at Colorado State University (Thanks to Dr. Scott Haley). Malt barley protein and screenings are tested at the Mille/Coors office.

Table 1. Soft White Spring Wheat Variety Performance Trial at Center, CO.

By Merlin Dillon, Area Extension Agent, Agronomy, San Luis Valley Research Center, Center, CO.

Variety	Grain Yield ¹	Bushel Weight	Heading Date ²	Grain Moisture	Plant Height	Grain Hardness	Grain Protein
	bu/ac	lbs/bu	(June)	%	inches	test	%
Blanca	154.5*	60.9*	33.5	19.0*	35.7	40.5	10.1*
Centennial	152.3*	61.0*	30.5	18.8*	33.6	41.1	9.9*
IDO 599	144.7*	58.9	29.8	18.8*	36.0	34.3*	10.6
IDO 671	138.7	59.2	35.5	19.1	36.9	36.8*	10.3*
Alturas	132.8	59.1	34.3	18.4*	37.2	40.7	10.4*
IDO 644	132.4	58.7	30.3	18.6*	34.8	43.0	10.3*
AO2695-S3	128.2	59.7	29.0	17.8*	30.9*	32.9*	11.1
Pettit	127.6	58.2	27.8*	19.3	30.6*	38.0*	10.6
IDO 563	124.4	58.5	27.0*	20.0	33.6*	45.1	11.0
Cataldo	124.2	57.9	28.3*	19.8	34.5	47.5	11.5
A97158S-8B-2	114.1	58.2	32.3	19.7	31.2*	33.6*	11.0
IDO 630W	90.0	58.6	34.3	20.1	36.3	41.0	11.0
Average	130.3	59.1	31.0	19.1	34.3	39.5	10.7
LSD, 10%	14.5	1.21	1.27	1.19	2.65	5.3	0.67
CV, %	9.3	1.7	3.4	5.2	77.4	11.2	5.3

* Top statistical yield group; average of four replications.

¹ Yield corrected to 60 lbs/bu and 12 % moisture.

² Heading date; days after June 1.

Site Information:

Previous Crop: Potato

Date Planted: April 24

Irrigation: center pivot

Herbicide: Bronate, 1.6 pt/ac

Nitrogen: 85+40+30 lbs/acre fertigation

Date Harvested: September 4

Seed Rate: 120 lbs/acre

Row Spacing: 8-inch

Plot Size: 6 ft. x 25ft; 9 rows planted 8 inches apart

Note: Sprinkler problem stressed barley; watered after 7 days instead of 3 day interval; stress was observable.

Many plots had lots of tall, late maturing tillers.

Note #2: Light hail on July 30 caused about 15% damage; this might have caused more damage to earlier, more mature cultivars.

Comments: Planting was rather late for us; harvest was late also. Excellent growing conditions produced healthy, tall plants and good yield potential. Sprinkler problems and moisture stress did not seem to affect yields in this trial as much as the hard wheat. The average yield was 130 bu/acre. It seems that late maturing cultivars were not hurt particularly by the drought.

Blanca, Centennial, and IDO599 made up the top yield group; Blanca produced the highest yield at 155 bu/acre. Even though many Idaho lines were compared this year and in previous years, it does not seem there is a new cultivar to replace Centennial.

Grain quality measurements include grain hardness and grain protein. In general, lower hardness and low protein are desired for soft white spring wheats. Grain hardness and protein were all acceptable. Centennial, the most widely grown variety widely in the San Luis Valley, was acceptable for hardness and was in the top statistical group for low protein.

Table 2. Two Yr (2008-09) and 5 Yr Average (2005-09) Soft White Spring Wheat Variety Performance Trial at Center, CO.

By Merlin Dillon, Area Extension Agent, Agronomy, San Luis Valley Research Center, Center, CO.

Variety	Grain Yield ¹	Grain Yield ¹	Grain Yield ¹	Bushel Weight	Heading Date ²	Grain Moisture	Plant Height ⁴	Plant Lodging ³	Grain Protein
	2-Yr	3-Yr	5 Yr Average						
	bu/ac	bu/ac	bu/ac	lbs/bu	(June)	%	Inches	%	%
Centennial	147.6	127.6	129.7	61.7	27.1	12.9	34.7	11.5	9.9
IDO 563	133.3	106.6	125.3	60.5	24.3	13.8	36.1	3.8	10.2
Alturas	130.5	142.1	137.5	60.9	30.0	12.9	38.0	38.8	9.7
IDO 599	140.2	150.9	146.6	60.3	26.4	13.4	38.3	32.5	9.9
IDO 630w	115.3	124.4	120.7	60.0	31.4	13.4	37.0	7.5	10.2
Average	129.0	132.7	131.2	60.4	27.9	13.2	36.7	28.7	10.1

* Top statistical yield group; average of four replications.

¹ Yield corrected to 60 lbs/bu and 12 % moisture.

² Heading date; days after June 1.

³ Data from 2008 only, the only year with plant lodging.

⁴ Data for 4 years; 2007 plant heights not available.

Comments:

The 2 year average (2008-09) was following fumigation to eradicate Columbia Root Knot Nematode (CRKN). Centennial performed very well without the nematodes.

The 3 year average (2005-07) was before fumigation when CRKN were high. Alturas and IDO599 performed very well and both seem to have good tolerance to this nematode. Centennial and IDO563 seemingly perform poorly when CRKN is very high.

The 5 year average includes both high and low levels of CRKN. Five year yield data points out that Alturas and IDO 599 might be good replacements for Centennial. However, both showed a fairly high lodging in 2008. Alturas is not as early maturity as Centennial. IDO 599 is slightly earlier than Centennial but is taller. Centennial is shorter, has less lodging and better bushel weight than most cultivars or experimental lines. However, Centennial is not a good choice when CRKN level is high.

Table 3. Hard Spring Wheat Variety Performance Trial at Center, CO.

By Merlin Dillon, Area Extension Agent, Agronomy, San Luis Valley Research Center, Center, CO.

Variety	Wheat Type	Source	Grain Yield ¹	Bushel Weight	Heading Date ²	Plant Lodging	Grain Moisture	Plant Height	Grain Hardness	Grain Protein
			bu/ac	lbs/bu	(June)	%	%	Inches	rating	%
Yecora Rojo	HRS	CIMMYT	125.1*	61.4*	26.5*	0.0	10.2*	27.0*	51.5	15.1*
Orita	Durum	Arizona	122.8*	58.9	27.3*	0.0	8.3	30.0	59.1	14.9
Sky	Durum	Ariz. Grain	121.9*	58.7	28.5	8.8	9.2	29.7	58.1	13.6
Westmore	Durum	Ariz. Grain	113.3*	60.8*	28.3	5.0	9.2	30.6	60.3	14.1
Plata	HWS	Res. Seeds	113.1*	60.6	30.0	11.3	9.2	31.8	59.8	14.2
WB 881	Durum	Westbred	107.7*	60.1	30.8	0.0	9.1	34.2	64.7*	14.5
IDO 706	HRS	U. Idaho	106.8*	61.6*	30.3	11.3	10.2*	37.2	63.7*	13.6
Jerome	HRS	U. Idaho	104.5*	60.5	27.5*	0.0	9.6	32.7	56.9	15.0
IDO 702	HRS	U. Idaho	99.6	60.6	32.5	30.0*	9.3	38.4	59.3	13.8
Winchester	HRS	U. Idaho	94.5	60.6	31.8	26.3*	9.1	36.3	55.6	14.4
Pristine	HWS	Westbred	88.6	62.0*	28.8	0.0	9.1	38.1	63.5*	15.8*
Blanca Grande	HWS	Res. Seeds	83.5	61.2*	36.3	15.0	9.1	35.7	56.5	12.9
Kuntz	HRS	AgriPro	82.6	60.8*	34.5	5.0	9.3	36.6	56.5	13.3
WB 336	HWS	Westbred	75.2	59.9	31.5	3.8	8.9	33.9	58.3	15.2*
Average			102.8	60.5	30.3	7.77	9.16	33.7	58.8	14.3
LSD, 10%			21.6	0.94	1.39	16.5	0.34	2.5	3.94	0.76
CV, %			17.6	1.3	3.9	178	3.1	6.17	5.6	4.6

* Top statistical yield group; average of four replications.

¹ Yield corrected to 60 lbs/bu and 12 % moisture.² Days after June 1.**Site Information:****Previous Crop:** Potato**Date Planted:** April 25**Date Harvested:** September 29**Irrigation:** center pivot**Seed Rate:** 120 lbs/acre; durums @ 150 lbs/ac.**Herbicide:** Bronate, 1.6 pt/ac**Row Spacing:** 8-inch**Nitrogen:** 85+40+100+30 fertigation (lbs/acre) **Plot Size:** 6 ft. x 25ft; 9 rows planted 8 inches apart**Note:** Sprinkler problems delayed irrigation from 3 days to 8 days (5 days stress) in late June, from June 19-27. Moisture stress was observable. Many plots developed tall, late maturing tillers.**Note #2:** Light hail on July 30 caused about 15% damage.**Comments:**

Planting was rather late for us; harvest was late also. Excellent growing conditions produced tall, healthy plants with good yield potential. Sprinkler problems and moisture stress greatly influenced this trial; 1st and 4th replications were stressed more severely and had more late sucker heads. Later maturing cultivars seemed to have been damaged more severely.

One could say that the good reps and poor reps more closely represent a range of growing conditions in the San Luis Valley. This is true; however, the drought stress did reduce the precision of the trial. Rep I yielded 97 bu/acre; Rep II yielded 130 bu/acre; Rep III yielded 106 bu/acre and Rep IV yielded 76 bu/acre for an overall

average of 102.8 bu/acre.

Yecora Rojo was the highest yielding cultivar, producing 125 bu/acre. Rojo is an older variety, one of the earliest maturing cultivars and its yield is closely followed by other early maturing cultivars. Rojo is an older variety is known for being brittle, meaning that if things are not just right, it will not do well. However, these early cultivars must have escaped some drought stress. The top four cultivars were early maturing ones. There were 8 cultivars that made up the top yield group; this included all 4 durum wheats.

Some cultivars that performed very well last year did poorly this year. For example: Kuntz and Blanca Grande. Plant height was very adequate; averaging 33.7 inches. Most plots appeared much better than they actually yielded.

Bushel weights averaged 60.5 lbs/bu. Four cultivars had high bushel weight.

Only two cultivars lodged significantly; these were IDO 702 and Winchester.

Leaf disease was obvious at harvest; each plot was rated twice. Results are not shown.

By waiting until September 29 to harvest; the grain moisture was low, averaging 9.2%

Grain quality tests conducted include grain hardness and grain protein. Pristine was in the top group for both with a hardness rating of 63.5 and a protein content of 15.3%. This was related to a very poor yield of only 88.6 bu/acre. Grain hardness for all cultivars averaged only 58.8. The protein content was probably influenced by the relatively low yield of this trial. The protein content of all cultivars averaged 13.8%; but the grain yield was only 103 bu/acre.

Table 4. Malting Barley Variety Performance Trial at Center, CO.

By Merlin Dillon, Area Extension Agent, Agronomy, San Luis Valley Research Center, Center, CO.

Variety	Source	Grain Yield ¹	Bushel Weight	Heading Date ²	Grain Moist.	Plant Height	Grain Screen.	Grain Protein
		bu/ac	lbs/bu	(June)	%	Inches	% ⁴	% ⁴
C 69	Miller/Coors	174.5*	50.1	32.5	10.3*	31.8*	0.5*	10.9
Idagold II	MV Co-op	170.7*	51.4	32.0	13.1	30.9*	1.3*	12.5
2032-04 ³	R G Comm	169.1*	51.3	32.8	11.7	34.8	0.9*	11.6
C 69	Miller/Coors	169.0*	50.4	32.5	10.9*	32.4*	0.9*	11.5
Geraldine	Mont. St.	159.3	51.4	30.8	10.8*	40.2	1.7	11.7
0232-22 ³	R G Comm	156.3	51.2	32.0	11.1*	32.7*	0.3*	12.5
Ab13449	U. Idaho	154.5	46.7	25.3*	11.5	38.1	0.8*	9.2
Baronesse	U. Idaho	154.3	51.0	27.5	11.2*	34.2	2.3	11.6
Lenetah	U. Idaho	154.1	51.2	25.8	10.8*	34.2	1.5	11.7
Mt 010158	Mont. St.	153.9	51.5*	27.3	11.5	35.7	1.8	12.5
Scarlett ³	R G Comm.	144.9	51.8*	32.5	10.4*	33.9*	0.4*	12.5
Moravian 14	Miller/Coors	142.0	51.9*	24.8*	11.1*	31.2*	2.2	13.1*
Eslick	Mont. St.	131.6	51.5*	27.0	10.4*	34.2	1.0*	12.1
Haxby	Mont. St.	126.8	51.0	25.0*	13.7	34.2	0.7*	13.3*
Craft	Mont. St.	124.6	51.4	26.0*	11.5	36.6	1.7	13.5*
Trial Average		151.7	51.0	28.8	11.4	34.1	1.28	12.0
LSD, 10%		9.8	0.41	1.3	1.0	2.2	1.48	0.59
CV, %		5.5	0.7	3.8	7.7	65.5	97.1	4.1

* Top statistical yield group; average of four replications.

¹ Yield corrected to 48 lbs/bu and 12 % moisture.

² Days after June 1.

³ Entered by Rio Grande Commodities; both are experimental lines from Malt Europe.

⁴ Courtesy of Miller/Coors in Monte Vista, CO; grain screenings through a 6/64 inch screen and protein content.

Site Information:

Previous Crop: Potato

Date Planted: April 24

Date Harvested: September 4

Irrigation: center pivot

Seed Rate: 120 lbs/acre

Herbicide: Bronate, 1.6 pt/ac

Row Spacing: 8-inch

Nitrogen: 85+40+30 fertigation (lbs/acre)

Plot Size: 6 ft. x 25ft; 9 rows planted 8 inches apart

Note: Sprinkler problem stressed barley; watered after 7 days instead of 3- day interval; no irrigation from 6/19 to 6/27; stress was observable.

Note #2: Light hail on July 30 caused about 15% damage; this might have more damaged to earlier, more mature cultivars.

Comments: Planting was rather late for us; harvest was late also. Excellent growing conditions produced healthy, tall plants and good yield potential. Sprinkler problems and moisture stress did not seem to affect this trial as much as the hard wheat. Grain yield may have been reduced by the hail and by the moisture stress. Later maturing cultivars were among the high yield group; which indicates they were not hurt particularly.

C 69 was entered twice and performed very well. Idagold II entered by Monte Vista Co-op for a malting barley contract, also made it into the top yield group. The other cultivar in the top yield group was 2032-04, an experimental entered by Rio Grande Commodities from Malt Europe.

Table 5. Spring Oats Variety Performance Trial at Center, CO.

By Merlin Dillon, Area Extension Agent, Agronomy, San Luis Valley Research Center, Center, CO.

-----No Grain Yield Harvest-----

Variety	Heading Date ¹	Plant Height	Lodging 8/08	Lodging 8/15
	(June)	Inches	%	%
Maverick	39.0	48.9*	11.3*	33.8
Monico	36.3*	52.2	1.3*	27.5
Monida	39.8	54.3	57.5	71.3
Ab 11136	47.3	53.1	20.0*	87.5
Ab 10971	38.5	51.6	0.0*	48.8
Lamont (HL)	43.3	54.3	0.0*	6.3*
Provena (HL)	42.3	51.6	1.3*	5.0*
Ab 12770	39.5	54.0	50.0	68.8
Average	40.7	52.5	17.7	43.5
LSD, 10%	1.3	1.55	23.0	22.2
CV, %	2.69	29.2	103	43.4

* Top statistical yield group; average of four replications.

¹ Heading date; days after June 1.

Site Information:

Previous Crop: Potato

Date Planted: April 24

Irrigation: center pivot

Herbicide: Bronate, 1.6 pt/ac

Nitrogen: 85 + 30 fertigation (lbs/acre)

Date Harvested: No yield harvest

Seed Rate: 120 lbs/acre

Row Spacing: 8-inch

Plot Size: 6 ft. x 25ft; 9 rows planted 8 inches apart

Note: Sprinkler problem stressed the crop; watered after 7 days instead of 3 day interval; stress was observable. No tall, late maturing tillers in oats.

Note#2: Not harvested for grain because of severe lodging at harvest time. Almost all varieties were badly lodged. Last year I harvested a similar trial only to get meaningless results for grain yield.

Comments:

Planting was rather late for us. Excellent growing conditions produced healthy, tall plants and good yield potential. Sprinkler problems and moisture stress did not seem to affect growth in this trial.

As usual, Monico was the earliest maturing cultivar. Maverick is about the same as Monida. Maverick is 5 inches shorter than Monida which helps to reduce lodging. Maverick did produce less lodging than Monida. Maverick usually has less lodging than Monico, but this year they were about the same. Lodging percentages between Monico and Maverick were not statistically different. Lamont and Provena are hullless (HL) cultivars. Both lodged very little this year.

Table 6. Spring Oats Forage Variety Performance Trial at Center, CO.

By Merlin Dillon, Area Extension Agent, Agronomy, San Luis Valley Research Center, Center, CO.

-----No Yield Harvest-----

Variety	Heading Date ¹	Plant Height	Lodging 8/05	Lodging 8/18
	(June)	Inches	%	%
Maverick	38.5	47.1*	0.0*	13.8*
Monico	35.8*	50.7	0.0*	15.0*
Monida	39.5	54.6	42.5	71.3
Triticale 2700	36.3*	62.7	0.0*	0.0*
Everleaf 126	61.3	53.1	0.0*	27.5
Average	42.3	53.6	8.5	25.5
LSD, 10%	1.24	1.50	18.6	18.5
CV, %	2.34	26.6	174	57.6

* Top statistical yield group; average of four replications.

¹ Heading date; days after June 1.

Site Information:

Previous Crop: Potato

Date Planted: April 24

Irrigation: center pivot

Herbicide: Bronate, 1.6 pt/ac

Nitrogen: 85+30 fertigation (lbs/acre)

Date Harvested: No yield harvest

Seed Rate: 120 lbs/acre

Row Spacing: 8-inch

Plot Size: 6 ft. x 25ft; 9 rows planted 8 inches apart

Note: Sprinkler problem stressed the crop; watered after 7 days instead of 3 day interval; stress was observable. No tall, late maturing tillers in oats.

Note#2: Not harvested for grain because of severe lodging at harvest time. Almost all varieties were lodged.

Comments: Planting was rather late for us; harvest was late also. Excellent growing conditions produced healthy, tall plants and good yield potential. Sprinkler problems and moisture stress did not seem to affect growth in this trial. Monico was earliest to heading; Everleaf 126 was 30 days later to heading than normal oat cultivars. Maverick was shorter than either Monico or Monida. Triticale was much taller than the oats.

Monida was the only one that showed lodging on August 5 and it also had the most lodging on August 18. Last year, Everleaf 126 had no lodging. This year it showed moderate lodging. Monico and Maverick lodged just about the same; both lodged much less than the standard variety, Monida.

Table 7. 2009 Hard Spring Wheat Protein Enhancement Trial

By Merlin Dillon, Area Extension Agronomist, San Luis Valley Research Center, Center, CO 81125.

Nitrogen Treatment ³	Grain Yield ¹	Bushel Weight	Heading Date ²	Grain Moisture	Grain Hardness	Grain Protein
Early Application = 215 #/ac + (+Boot + Heading) = Total #/ac	bu/ac	lbs/bu	(June)	%	%	%
0 + 0 = 215 #/ac	124.2	58.2*	28.3	16.8	55.1	11.4
50 + 0 = 265 #/ac	154.6*	58.0*	28.5	17.1	57.6	11.8
100 + 0 = 315 #/ac	150.0*	57.1*	28.5	16.8	57.8	12.5*
100 + 60 = 375 #/ac	156.6*	55.9	28.3	17.0	58.9	12.7*
Trial Average	146.4	57.3	28.4	16.9	57.3	12.1
LSD, 10%	19.9	1.49	N.S.	N.S.	N.S.	0.88
CV, %	10.5	2.0	2.4	5.5	5.24	5.60

¹ Yield corrected for 12% moisture and 60 lbs/bu

² Days after June 1.

³ Treatments varied the boot + heading nitrogen amounts only; early application was 85#/ac applied by cart plus 100 #/ac applied by hand plus 30 #/ac fertigation which totals 215 #/ac.

Site Information:

Previous Crop: Potato

Date Planted: April 25

Irrigation: center pivot

Herbicide: Bronate @ 1.6 pt/ac

Nitrogen: 215 + lbs/acre

Date Harvested: September 15

Seed Rate: 120 lbs/acre

Row Spacing: 8-inch

Plot Size: 6 ft. x 25ft; 9 rows planted 8 inches apart

Note: Sprinkler problems delayed irrigation from 3 days to 8 days (5 days stress) in late June, from June 19-27. Moisture stress was observable but this variety is very early maturing. It may have been early enough to avoid much damage. Yields were excellent.

Note #2: Light hail on July 30 caused about 15% damage.

Comments:

Our planting was late because of wet ground and waiting for fertilizer. Our harvest date was even later, especially considering that the Sept. 15 harvest still had 17% moisture. Excellent growing conditions produced healthy, tall plants and good yield potential. Yields averaged 146 bu/acre; this is excellent for hard red spring wheat. There was a 30 bu/acre yield advantage for a 50 #/ac N application at late boot. The higher rate (100 #/ac) did not improve yields further. Evidently, the 100 #/acre rate was not needed for grain yield. Addition of another 60 #/acre at heading also did not affect yield.

Differences in grain hardness were statistically non-significant. Still, added nitrogen tended to improve or increase the grain hardness. Added N at heading (Treatment 4) also tended to improve the grain hardness.

Grain protein differences were statistically significant at 10%. Protein content was not very high considering the high nitrogen rates applied. It is evident that the nitrogen was diluted by the high grain yield. The 0+0 treatment had the lowest protein at 11.4%. Adding 50 # N/acre at late boot brought the protein up to 11.8%. Adding 100 # N/acre instead of 50 # improved the protein content to 12.5%. Finally, adding an additional 60 #/acre nitrogen at heading improved the protein only very slightly to 12.7%. The biggest protein difference was between adding 100 # vs. 50 #/acre N at late boot. Evidently, this application was late enough in the crop maturity so that the N added was not used for grain yield but was used by the crop to improve the grain protein. Adding an additional 60 # N/acre at heading improved protein very little because the N from the late boot application was still available.