2011-12 Southern Sacramento Valley Small Grains Research Program

Hard Red Wheat Protein Enhancement by Midseason Urea Application

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Summary of Results and Conclusions

Three additional hard red wheat plot treatments were included within the Cultivar Assessment research program this season. These plots researched protein enhancement with additional nitrogen applications at 4 locations in the southern Sacramento Valley. The additional variety plots were Cal Rojo, WB-Rockland, and Summit 515. Each of these plots were subdivided into 5 nitrogen (N) treatment subplots. These N applications were in addition to whatever fertilizer the grower applied. This nitrogen, in the form of urea fertilizer, was applied at the jointing and flowering growth stages. Nitrogen treatments were: Control – no additional N; 30lbs/ac at jointing; 60lbs/ac at jointing; 30lbs/ac at jointing + 30lbs/ac at flowering; 30lbs/ac at jointing + 60lbs/ac at flowering. Results showed a small increase in plant height, yield and grain protein over the treatments and a slight decrease in test weight.

Introduction and Objectives

In the southern Sacramento Valley daily minimum temperatures decrease the closer you get to the southern "delta" region. Historically, grain protein levels decrease in response to these cooler temperatures. Confusing this response are drought and other stress related responses that increase protein, but also increase dockage. Debate within this cooler region has questioned the ability to offset this response with additional nitrogen applications. This research is an attempt to answer that question.

Materials and Methods

I conducted 4 factorial randomized block designed small grain fertility trials each replicated 3 times. Plot widths and lengths varied per location depending on grain drill used. Widths were 9, 11 or 13ft and plot lengths were 126 to 186 feet with fertility subplots 25ft in length. Total acreage of the 4 locations was 7.8 acres.

E & H Farms Small Grain Trial – Located three-quarters mile north of Sievers Rd. on the east side of Curry Rd. about 3.5 mile north of Dixon, CA. Soil: Brentwood clay loam; one irrigation; 15 varieties + 3 fertility plots; 3 replications; planted flat. Field in a tomato-grains-seed crop rotation. Plot width 9ft + 2ft border, length 126 ft. Grower applied nitrogen: Pre-plant 100lbs/ac anhydrous ammonium; top-dress 80lbs/ac urea. Total 118.8lbs N/ac applied.

Hunn, Merwin & Merwin Small Grain Trial – Located on east side of Jefferson Road, 0.1mile north of Central Rd, 2mi. west of Clarksburg, CA. Soil type: Omni silty clay; One sprinkler irrigation; 15 varieties + 3 fertility plots; 3 replications; planted flat. Field in a tomato–grains-alfalfa rotation. Plot width 13ft + 2ft border, length 186 ft. Grower applied nitrogen: Preplant 100 units nitrogen as aqua ammonia. Total 20lbs N/ac applied.

McCormack Ranches Small Grains Trial – Location on the south side of Montezuma Hills Road 2 miles east of Anderson Rd., west of Rio Vista, CA. Soil type: Clear Lake clay on flats and Diablo-Ayar on slopes; dryland hills no irrigation; 17 varieties + 3 fertility plots; 3 replications; planted flat. Field in a 2 year Sheep-fallow-grains rotation. Plot width 13ft + 2 ft border, length 155ft. Grower applied nitrogen: 85 units Aqua preplant, plus 41lbs/ac 11-52-0 at planting. Total 21.5lbs N/ac applied.

Rominger Brothers Small Grains Trial – Location Southwest corner of County Roads 29 and 89, north of Winters, CA. Soil type: Marvin silty clay loam & Tehama loam; no irrigation; 15 varieties + 3 fertility plots; 3 replications. Field in a tomato-wheat rotation; with 60" beds. Plot width 11ft + 2ft border, length 152 ft. Grower applied nitrogen: 125 units Aqua preplant. Total 25lbs N/ac applied.

Data collected at all sites: Plant population, days to heading from planting, head height, lodging, frost, foliar disease ratings for (stripe rust, leaf rust, barley yellow dwarf virus, septoria, powdery mildew), harvest grain moisture, test weight, protein, falling number, full grade conducted independently by National Quality Inspections, Inc. , and yield. Data analyzed using UC MSTATC factorial analysis of variance. Coefficient of Variation (CV) provided where appropriate.

Budget: $6,000 – split between Cultivar Assessment and Protein Enhancement trials.

Supplies – steaks, plot signs, paper, equipment, fertilizer:	$1,000
Transportation – fuel:	$1,000
Clerical support:	$4,000

Results

I used 3 hard red wheat varieties and 5 different rates of added nitrogen replicated 3 times at 4 locations to determine if under cooler minimum temperatures I could increase grain protein and yield. Results indicate that additional nitrogen significantly improved yield and protein, slightly increased plant height and slightly decreased test weight, Table 1. Plots were all harvested with large commercial combines so some mixing occurred between plots. I was surprised with the linearity of the yield results despite this mixing. Plant heights with the highest treatment of nitrogen increased one inch for each of the varieties when compared to the control plots. There appeared to be a significant interaction between the location and fertility. With much lower soil moisture and fertility at the dryland hills (McCormack) location I would expect this. According to Table 2 and depicted in Chart 1, when averaged over locations, Cal Rojo had the largest response to increased nitrogen with a 13.3% increase in yield (831lbs/ac) and a 7.2% increase in percent protein (0.9%) over the control levels, going from 12.3% to 13.2%. Rockland had a 9.5% increase in yield (629lbs/ac) and 4.5% gain percent protein (0.6%), going from 13.4% to 14%. Summit 515 increased yields 6.7% (463lbs/ac) and increased grain protein 4.8% (0.6%), going from 11.9% to 12.5%. Interestingly, there was a slight decrease in test weights for each of the varieties: -1.0% for Cal Rojo; -1.3% for Rockland and -0.4% for Summit 515, though not very consistent as seen in Chart 2.

Discussion, Conclusions and Recommendations

It sounds and looks good, but in reality I only, on average, increased yields by 641lbs/ac and increased grain protein by only 0.7% with a total addition of 90lbs/ac nitrogen. This is not cost effective at today's nitrogen prices. Additionally, it takes rain or irrigation to incorporate these mid-season nitrogen applications. With the weather becoming more unpredictable moisture wise and irrigation costs increasing it is getting harder to make these applications. I am encouraged that I can improve grain protein with nitrogen in the cooler night time environments of the southern Sacramento Valley. I noticed that for each of the varieties the increase in protein would have put it over a quality price increase threshold making it closer to being cost effective. Perhaps with the new protein genes under development growers in this area will be able to consistently get 13% proteins with a little added nitrogen.

Chart 1. 2012 Hard Red Wheat Protein Enhancement By Urea Application Summarized Over 4 Locations for Yield and Protein

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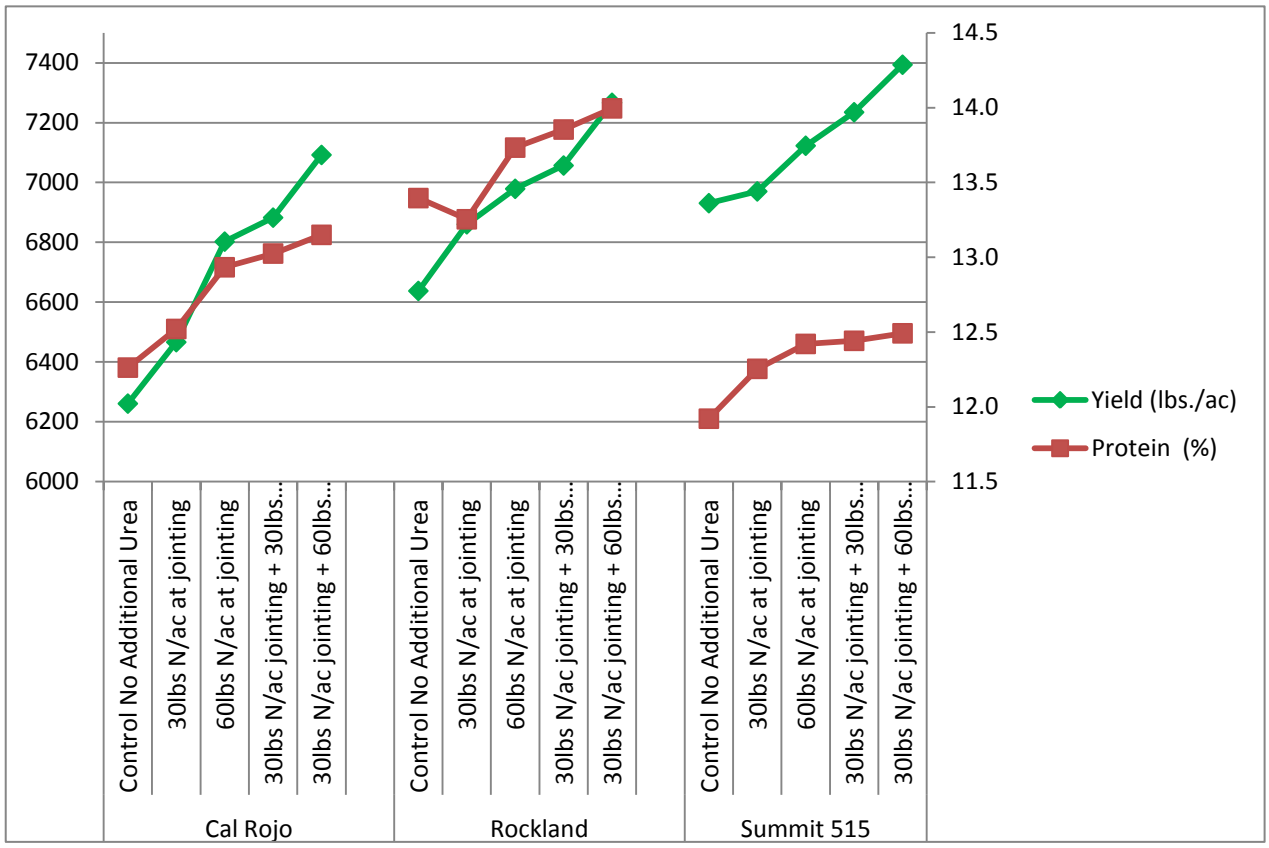

Chart 2. 2012 Hard Red Wheat Protein Enhancement By Urea Application Summarized Over 4 Locations for Grain Test Weight

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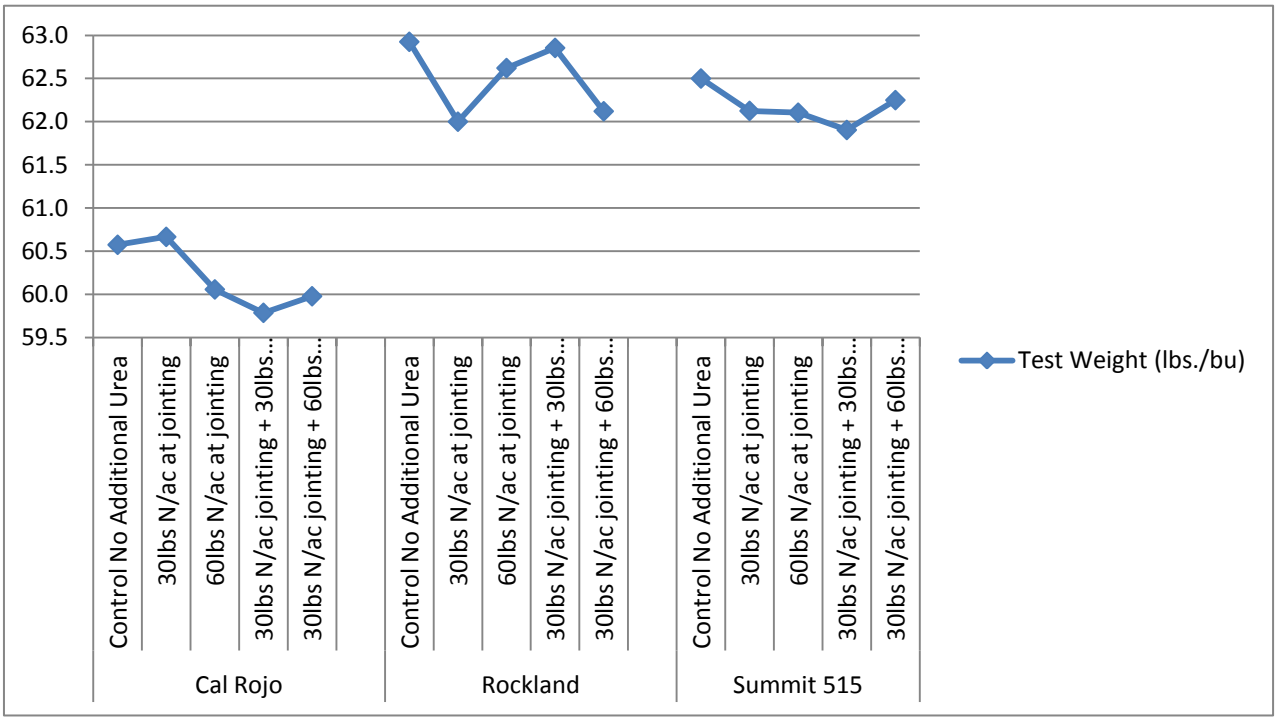

Table 1. 2012 Hard Red Wheat Protein Enhancement By Urea Application

Summarized Over 4 Locations

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Variety	Urea Fertility[1]	Plant Height (in)	Yield (lbs./ac)	Adams Grain Inc. NQI Grading Facility Test Weight (lbs./bu)	Protein (%)	(300 min.) Falling No. FN	Dockage DKG	Total Defects DEF
Cal Rojo	Control No Additional Urea	33	6261	60.6	12.3	402	0.6	4.2
	30lbs N/ac at jointing	33	6466	60.7	12.5	408	0.4	4.0
	60lbs N/ac at jointing	34	6802	60.1	12.9	422	0.7	4.6
	30lbs N/ac jointing + 30lbs flowering	33	6883	59.8	13.0	409	0.6	4.3
	30lbs N/ac jointing + 60lbs flowering	34	7092	60.0	13.2	410	0.6	4.6
Rockland	Control No Additional Urea	33	6637	62.9	13.4	443	0.4	3.6
	30lbs N/ac at jointing	33	6860	62.0	13.3	409	0.4	3.4
	60lbs N/ac at jointing	34	6979	62.6	13.7	420	0.4	3.4
	30lbs N/ac jointing + 30lbs flowering	34	7057	62.9	13.9	444	0.3	2.4
	30lbs N/ac jointing + 60lbs flowering	35	7267	62.1	14.0	414	0.5	3.2
Summit 515	Control No Additional Urea	36	6931	62.5	11.9	356	0.3	2.8
	30lbs N/ac at jointing	36	6970	62.1	12.3	348	0.4	3.6
	60lbs N/ac at jointing	36	7123	62.1	12.4	354	0.4	3.8
	30lbs N/ac jointing + 30lbs flowering	36	7235	61.9	12.4	361	0.4	3.7
	30lbs N/ac jointing + 60lbs flowering	37	7394	62.3	12.5	362	0.4	3.8
	Average	34	6930	61.6	12.9	398	0.5	3.7
	Coefficient of Variability C.V. (%)	1.46	1.86	1.14	2.14	7.9	48.7	39.6
	Significance by Location	**	**	**	**	**	**	**
	Significance by Replication		**		*			
	Significance by **Variety**	**	**	**	**	**	*	
	Location x Variety	**	**	**	*	**		
	Significance by **Fertility**	**	**	**	**			
	Location x Fertility	**	**	**	**			
	Variety x Fertility		**	**	*			
	Location x Variety x Fertility		**					

* Significant 95% to 98% of the time

** Significant 99% or more

NQI = National Quality Inspections, Inc.

Fertility[1] Urea applied over grower's standard nitrogen application

Location 1 Nitrogen applied by grower: 118.8lbs N/acre following processing tomatoes

Location 2 Nitrogen applied by grower: 20lbs N/acre following processing tomatoes

Location 3 Nitrogen applied by grower: 21.5lbs N/acre following 2 years fallow grazing

Location 4 Nitrogen applied by grower: 25lbs N/acre following processing tomatoes

Table 2. Percent Change Induced Through Nitrogen - Over Locations

Control compaired to highset Nitrogen treatment

Variety	Yield	Test Weight	Protein
Cal Rojo	13.3	-1.0	7.2
Rockland	9.5	-1.3	4.5
Summit 515	6.7	-0.4	4.8