GRAIN PROTEIN CONTENT AND COMPOSITION OF WINTER WHEAT CULTIVARS UNDER DIFFERENT LEVELS OF N AND WATER STRESS

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ABSTRACT

This study investigated the combined influences and interactions of N fertilization and moisture deficit during grain-fill on wheat grain protein content and grain protein composition of nine white winter wheat cultivars.

Grain was obtained from seven HWW wheat cultivars and two soft white winter (SWW) wheat cultivars grown under line-source irrigation systems at two Oregon locations during two years. The low N level treatment consisted in a single fertilization of 150 lb N/a in March, while the high N treatment received a second application of 150lb N/a in May. The 4 levels of moisture provided consisted in 100, 80, 50, and less than 50% of optimum.

Water deficit increased grain protein content and reduced grain yield, test weight, and kernel weight and diameter. Additional N also increased grain protein content for all genotypes. Reductions in test weight, grain weight and diameter, and kernel hardness were observed under high N-fertilization. High N-fertilization extended the grain-fill period, which resulted in greater water and heat stress. In regions where late season water stress is common, early maturing varieties are more likely to produce consistent grain quality.

Flour protein composition was characterized using size-exclusion HPLC. Changes in protein composition were linearly related to general increases in grain protein content. As protein content increased, the relative proportion of gliadins increased with higher slope than the glutenin fraction. Those results were observed either if the protein increase was related to increased N fertilization or reduced irrigation.

Significant N x irrigation interactions were observed for protein composition. However, biplot analyses showed that cultivars of similar protein quality and composition responded similarly to N and irrigation treatments. Crop management strategies will be important to reach desired targets for grain yield, flour quality, and finally end- product performance.

Table 1. Means and Duncan grouping for grain yield (t ha^{-1}), grain protein (g kg^{-1}), test weight (kg hl^{-1}), and grain hardness (HI), weight (mg) and diameter (mm) at Hermiston and Madras nurseries in 2002-03 and 2003-04; t/ha divided by .06725 = bu/a; kg/hl * 0.775 = lb/bu

		Yield	Grain protein	Test weight	Kernel properties		
					Hardness	Weight	Diameter
Irrigation level	I0	6.82 a	128.3 a	73.8 a	65.0 a	35.1 a	2.50 a
	I1	8.42 b	123.0 b	76.3 b	64.1 ab	37.0 b	2.60 b
	I2	10.02 c	121.0 b	77.8 c	63.2 b	39.7 c	2.73 c
	I3	9.99 c	116.4 c	78.2 c	60.8 c	41.8 d	2.82 d
N fertilization	N1	8.62 a	108.7 a	77.2 a	62.0 a	39.3 a	2.71 a
	N2	9.00 a	135.7 b	75.9 b	64.6 b	37.5 b	2.62 b

Within columns, different letters indicate significant differences ($p < 0.05$) between mean (Duncan test). Irrigation increased from I0 to I3. N-fertilization increased from N1 to N2.

Table 2. Means and Duncan grouping for flour protein content (g kg^{-1}), flour protein composition (%), flour yield (%), SDS sedimentation volume (cm^3), Mixograph properties, and polyphenol oxidase (PPO) activity from plants grown in Hermiston during 2002-03, and Madras during 2002-03 and 2003-04.

	Flour Protein	Protein Fraction		Flour yield	SDS	Mixograph			PPO
		Polymeric	Monomeric			Peak time	Stability	Tolerance	
Irrigation									
I1	109.8 a	36.1 a	47.9 a	61 a	38 a	3.51 a	-7.96 a	14.34 a	0.39 a
I2	106.3 a	36.1 a	47.5 ab	64 b	35 b	3.35 a	-8.23 a	13.97 a	0.39 a
I3	101.6 b	36.2 a	47.1 b	64 b	32 c	3.42 a	-8.09 a	12.85 a	0.41 b
N fertilization									
N1	94.2 a	35.9 a	46.4 a	63 a	30 a	3.69 a	-7.20 a	14.85 a	0.40 a
N2	117.7 b	36.3 b	48.6 b	62 a	40 b	3.16 b	-8.98 b	12.64 b	0.40 a

Within columns, different letters indicate significant differences ($p < 0.05$) between mean (Duncan test). Irrigation increased from I1 to I3. N-fertilization increased from N1 to N2.

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