ANNUAL REPORT

PROJECT NO: AP3664

TITLE: Adopting deficit irrigation practices in spring wheat production in southern Idaho

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ACCOMPLISHMENTS:

Three spring wheat varieties (Dayn, hard white; SY Coho, hard red; and Alturas, soft white) were planted in plots of 10 by 20 feet. Plots were maintained under well-watered conditions throughout the growing season (100% evapotranspiration (ET)) and under deficit irrigation at different growing stages. For the three deficit irrigation treatments, 50% ET was applied from tillering to stem elongation (50_T1), from booting to heading (50_T2), and from flowering to soft dough (50_T3), whereas the plots were irrigated at 100% ET during the other stages. The experiment was laid out in a split-plot design with four replicates in both 2018 and 2019. Irrigation treatment was the main plot, and variety was the split plot. All nutrients were supplied as needed, following the current University of Idaho guidelines for crop fertilization.

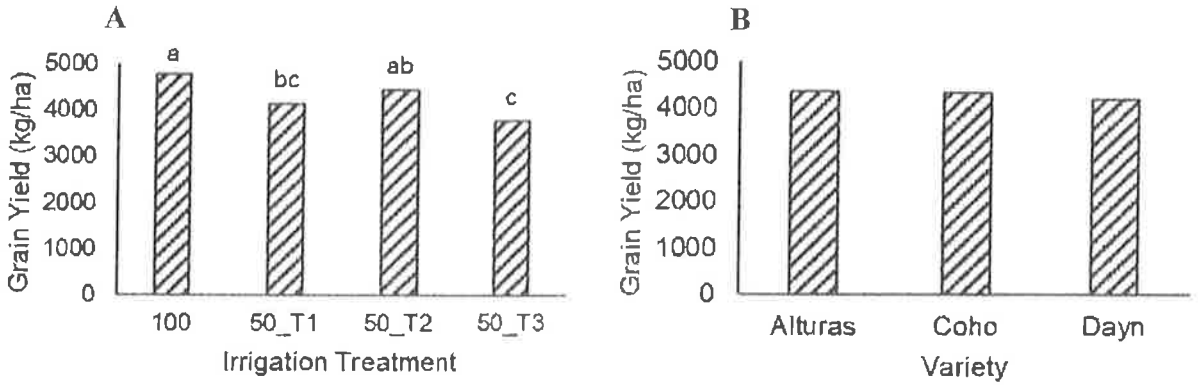

Figure 1 Grain yield (mean of 2018 and 2019) differed significantly among irrigation treatments (A), but was not different among varieties (B). Different letters indicate significant differences at a significance level of 0.05 (the same below).

Grain yield from deficit irrigation applied from flowering to soft dough (50_T3) and from tillering to stem elongation (50_T1) was significantly lower than 100% ET (100), but deficit irrigation from booting to heading (50_T2) did not cause severe yield loss compared with the 100% ET treatment (Figure 1A). Across all the irrigation treatments, varieties did not significantly differ from each other (Figure 1B).

End-use quality was analyzed in the Wheat Quality Laboratory using grain samples collected from each experimental plot in 2018 and 2019. Solvent retention capacity was measured

in four solvents, including sodium carbonate, lactic acid, sucrose, and water, which are related to starch damage, gluten strength, pentosan and gliadin, and water absorption, respectively. Baking quality was tested as cookie diameter for soft wheat (i.e., Alturas) and as loaf volume for hard wheat (i.e., SY Coho and Dayn).

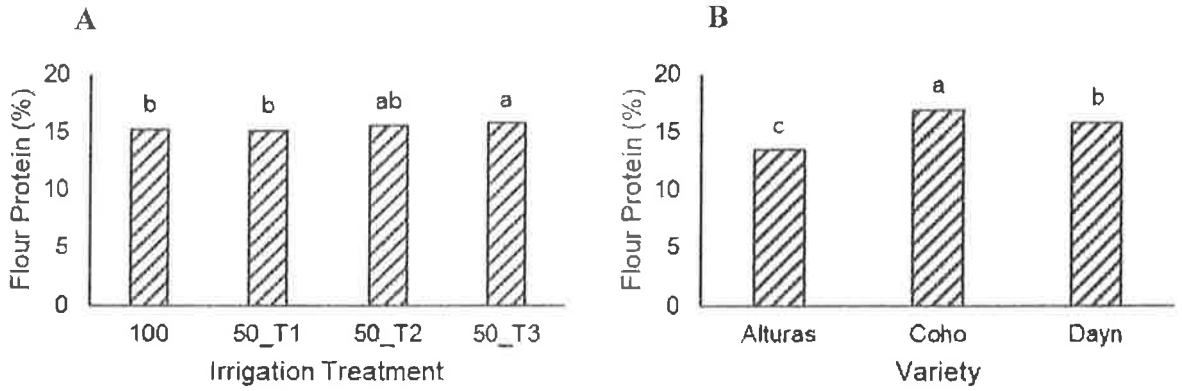

Figure 2. Flour protein (mean of 2018 and 2019) differed significantly among irrigation treatments (A) and varieties (B).

Table 1 End-use quality parameters of soft white spring wheat Alturas.

Treatment	Solvent retention capacity				Cookie diameter (cm)
	Water	Sodium carbonate	Lactic acid	Sucrose	
100	57.7 ab	71.1	125 ab	102.8 ab	8.85
50_T1	56.9 b	69.2	120 b	99.3 b	8.79
50_T2	58.2 ab	71.9	123 b	101.6 ab	8.78
50_T3	58.8 a	72.3	133 a	104.7 a	8.81

Table 2 End-use quality parameters of hard red spring wheat SY Coho.

Treatment	Solvent retention capacity				Mixograph peak time (min)	Mixograph peak height (cm)	Loaf volume (cm^3)
	Water	Sodium carbonate	Lactic acid	Sucrose			
100	62.8 ab	76.5	132 ab	100.7 a	3.1 ab	7.7	1328 a
50_T1	61.9 b	76.2	126 c	98.4 b	2.8 b	7.4	1228 b
50_T2	62.7 ab	76.9	130 bc	100.6 a	2.9 ab	7.8	1310 a
50_T3	63.1 a	77.9	137 a	101.6 a	3.3 a	7.8	1324 a

Flour protein under deficit irrigation from flowering to soft dough (50_T3) was greater than the well-watered treatment (100) and deficit irrigation from tillering to stem elongation (50_T1) (Figure 2A). Among the three varieties, SY Coho had the highest flour protein followed by Dayn and Alturas (Figure 2B). End-use quality parameters were affected differently by deficit irrigation treatments in three wheat varieties (Tables 1-3). For soft white spring wheat Alturas, drought stress from flowering to soft dough (50_T3) produced greater solvent retention capacity of water, lactic acid, and sucrose compared with deficit irrigation from tillering to stem elongation (50_T1) (Table 1). For hard red spring wheat SY Coho, solvent retention capacity of lactic acid and sucrose and loaf volume were reduced under deficit irrigation from tillering to stem elongation

(50_T1) compared with the 100% ET treatment (Table 2). For hard white spring wheat Dayn, solvent retention capacity of lactic acid and sucrose and mixograph peak time were greater under deficit irrigation from flowering to soft dough (50_T3) than drought stress from tillering to stem elongation (50_T1) (Table 3).

Table 3 End-use quality parameters of hard white spring wheat Dayn.

Treatment	Solvent retention capacity				Mixograph peak time (min)	Mixograph peak height (cm)	Loaf volume (cm^3)
	Water	Sodium carbonate	Lactic acid	Sucrose			
100	56.5	76.1	117 b	96.2 bc	2.9 ab	7.1	1229
50_T1	56.8	74.3	115 b	95.4 c	2.6 b	7.3	1238
50_T2	57.5	75.7	118 b	98.3 ab	2.7 ab	7.5	1274
50_T3	57.6	77.0	127 a	99.4 a	3.0 a	7.4	1261

PROJECTIONS:

During the study, we took biomass samples and measurements of photosynthetic rates for four times from each plot. Yield component parameters from in-season and mature samples are under processing, including biomass, number of kernels per spike, spike density, and thousand kernel weight. A greenhouse experiment with similar treatments as the field experiment was also finished in the spring and summer of 2019 with more intensive in-season measurements.

We have observed differences in grain yield and end-use quality parameters in response to deficit irrigation at different stages, as well as differences among varieties. Results from this study will provide references on adopting deficit irrigation in spring wheat production in southeastern Idaho, and recommendations can be provided on reduced irrigation input to maximize economic return in spring wheat production. A Masters' student, Jingya Yang is working on this project as her thesis, who is expected to graduate in 2020. Results of this research will be communicated to growers and researchers at different extension events and through extension publications.

PUBLICATIONS:

Yang, J., X. Liang. Effects of drought stress at different growth stages on source and sink interaction in wheat. ASA-CSSA-SSSA Annual Meetings. San Antonio, TX, November 10-13 2019.

Yang, J., X. Liang, R. Yang, H. Neibling, J. Marshall, K. O'Brien. End-use quality of spring wheat in response to drought stress at different growth stages. ASA-CSSA-SSSA Annual Meetings. San Antonio, TX, November 10-13 2019.

Liang, X. Effects of drought stress at different developmental stages on wheat yield and quality. Ashton Field Day, Ashton, ID July 18, 2019.

Liang, X. Effects of drought stress at different developmental stages on wheat yield and quality. Aberdeen Field Day, Aberdeen, ID July 17, 2019.