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Wyoming First Grains Project: Effect of Location, Irrigation and Nitrogen on Crop Growth, Yield, and Quality of Ancient Grains of Wheat in Wyoming

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Introduction

Crop diversity in Wyoming is limited by poor soil health, arid conditions, isolation from markets, and high evapotranspiration demands. First grains like einkorn, emmer, and spelt are early predecessor of modern wheat and more adaptable to marginal agricultural land. There has been rapid increase in the market demand of ancient grains due to their desirable characteristics like higher protein (Campbell, 1997), distinct nutrition, and unique taste. First grains are thought to be a viable alternative small grain for Wyoming.

Objectives

Identify agronomic management practices and fertility needs of spelt, emmer, and einkorn. Determine how fertility affects agronomic traits and grain quality under multiple Wyoming growing conditions and locations.

Materials and methods

This study was conducted at the Sheridan Research and Extension Center (ShREC) in 2019. The experiment was a randomized design with 3 replications. Spelt, emmer, einkorn, and modern wheat were grown under different nitrogen application rates in irrigated and dryland fields. Irrigated fields were planted on May 18th at a seeding rate of 100 lbs/a. Dryland fields were planted on May 18 at a seeding rate of 60 lbs/a. Nitrogen treatments of low, medium, and high (25, 50, 80 lbs nitrogen/a respectively) were applied to each crop before planting. Data on heading date and yield were taken. Crops were harvested at maturity with an Almaco small plot combine and hulled and dehulled yield was calculated. Percent yield loss when the hull was removed is calculated as $[1 - (\text{grain yield} / \text{hulled yield})]$.

Results and discussion

In spring 2019, ancient grains differed from each other and modern wheat in growth and maturity. Einkorn was the slowest maturing, heading out two weeks later than wheat, 10 days later than emmer, and 5 days later than spelt (Table 1). Wheat was harvested first, followed by emmer, then spelt, and then einkorn in dryland. The irrigated trials were lost to bird damage prior to harvest and no harvest or yield data was collected. Due to differences in crop growing period and pattern, growing these ancient grains might require some changes in agronomic management practices and alteration in crop rotation.

Table 1. Heading date (HD) and harvest date (CD) of first grains. NA indicates not available

	Dryland						Irrigated					
	25 lb/a N		50 lb/a N		80 lb/a N		25 lb/a N		50 lb/a N		80 lb/a N	
	HD	CD	HD	CD	HD	CD	HD	CD	HD	CD	HD	CD
Wheat	7/9	8/27	7/9	8/27	7/9	8/27	7/10	NA	7/10	NA	7/10	NA
Spelt	7/21	8/28	7/21	8/28	7/21	8/28	7/20	NA	7/20	NA	7/20	NA
Emmer	7/15	8/28	7/15	8/28	7/15	8/28	7/15	NA	7/15	NA	7/15	NA
Einkorn	7/25	9/6	7/25	9/6	7/25	9/6	7/26	NA	7/26	NA	7/26	NA

Hulled yield, naked grain yield, and percent yield loss to hull of each crop was not affected by nitrogen treatments under dryland conditions (Table 2). The lack of yield response to N suggests that either the optimum N was applied even at 25 lbs/a or that there was an error in application and the plots did have access to the applied N. Soil nitrogen analysis, yield from 2020 trials, and grain quality analysis will provide more information on the nitrogen balance in the trial. Percent yield loss to hull was higher for spelt than emmer (Table 2). When comparing yield of the different grains, the grain yield of modern wheat was higher than emmer and spelt; however, lower yield of ancient grains might be offset with their high market demand and price premium.

Table 2. Average grain yield (lbs/a) of first grains. Yields are reported for hulled (grain in the hull) and grain (grain only with the hull removed). Percent yield loss [$1 - (\text{grain yield}/\text{hulled yield})$] is reported for spelt and emmer. P-values for yield within each crop are given. NS means not significant, ND means no data, and NA means not applicable.

lbs/a N	Wheat			Spelt			Emmer			Einkorn		
	Hulled	Grain	Loss	Hulled	Grain	Loss	Hulled	Grain	Loss	Hulled	Grain	Loss
	Dryland											
25	NA	1019	NA	1313	800	39%	1390	921	34%	667	ND	ND
50	NA	1671	NA	1147	664	42%	1139	720	37%	503	ND	ND
80	NA	2115	NA	1413	821	42%	1365	954	30%	831	ND	ND
p-value		NS		NS	NS	NS	NS	NS	NS	NS		

The Wyoming first grains project will be continued through 2021. Future work includes dehulling of einkorn, grain quality analysis, and analysis of soil nitrogen and nitrogen use efficiency of each crop. Soil nitrogen and grain quality analysis will be used to determine nitrogen use efficiency of first grains. Studies have been repeated for the 2020 crop season. Future work will include studies on seeding rate to optimize yield of the first grains as well as market analysis for small and large acreage production.

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