University of Wyoming

College of Agriculture and Natural Resources

Wyoming Agricultural Experiment Station

2020 FIELD DAYS BULLETIN

Wyoming First Grain 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 predecessors 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 James C. Hageman Sustainable Agriculture Research Center (SAREC) 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. Both irrigated and dryland spring trials in SAREC were planted on May 6th, 2019. The irrigated seeding rate was 100 lbs/a and the dryland rate was 60 lbs/a. Nitrogen treatments of low, medium, and high (25, 50, 80 lbs nitrogen/acre for dryland, and 50, 80, 110 lbs nitrogen/acre for irrigated) were applied to each crop before planting. Data on heading date and yield were taken. Crops were harvested at maturity with a Kincaid small plot combine and hulled and dehulled yield was calculated. Percent yield loss when the hull was removed was calculated as [1-(grain yield/hulled yield)].

Results and discussion

In spring 2019, ancient grains differed from each other and modern wheat in growth pattern and maturity. Einkorn was the slowest to mature heading out about 2 weeks later than spelt and emmer in irrigated field and 18 days later in dryland field (Table 1). When the other crops were ripening, it was still green (Figure 1). Wheat was ready to harvest the earliest first, followed by emmer, then spelt, then einkorn (Table 1). Growth was slower in the dryland than under irrigation as seen by later heading and harvest dates (Table 1). Nitrogen treatment had no effect on crop heading or harvest date. 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 in 2019.

	Dryland						Irrigated					
	25 lb/a N		50 lb/a N		80 lb/a N		50 lb/a N		80 lb/a N		110 lb/a N	
	HD	CD	HD	CD	HD	CD	HD	CD	HD	CD	HD	CD
Wheat	7/5	8/20	7/5	8/20	7/5	8/20	6/28	8/18	6/28	8/18	6/28	8/18
Spelt	7/11	9/5	7/11	9/5	7/11	9/5	7/5	8/27	7/5	8/27	7/5	8/27
Emmer	7/11	8/23	7/11	8/23	7/11	8/23	7/5	8/23	7/5	8/23	7/5	8/23
Einkorn	7/24	9/6	7/24	9/6	7/24	9/6	7/23	9/06	7/23	9/06	7/23	9/06

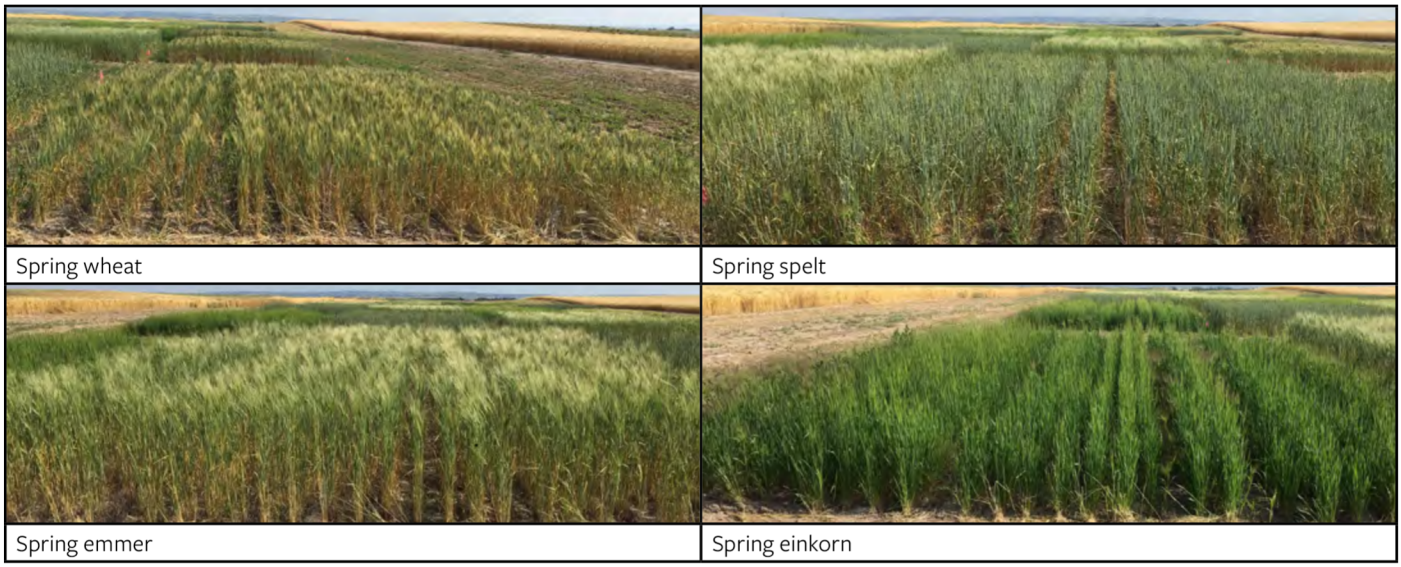

Figure 1. Field pictures of wheat, spelt, emmer, and einkorn growing in the SAREC dryland on August 2, 2019, showing maturity differences between the four crops.

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- (grain yield/hulled yield)] is reported for spelt and emmer as loss. P-values for yield within each crop are given. NS means not significant, ND means no data, and NA means not applicable.

	Wheat			Spelt			Emmer			Einkorn		
	Hulled	Grain	Loss	Hulled	Grain	Loss	Hulled	Grain	Loss	Hulled	Grain	Loss
lbs/a N	Dryland											
25	NA	801	NA	606	331	45%	1017	604	42%	243	ND	ND
50	NA	750	NA	526	320	39%	880	537	40%	243	ND	ND
80	NA	793	NA	552	343	38%	1156	719	38%	272	ND	ND
p-value		NS		NS	NS	NS	NS	NS	NS	NS		
	Irrigated											
50	NA	947	NA	1257	517	58%	861	505	41%	915	ND	ND
80	NA	1707	NA	1192	549	56%	751	497	35%	979	ND	ND
110	NA	1228	NA	1157	607	49%	908	610	33%	815	ND	ND
P-value		NS		NS	NS	NS	NS	NS	NS	NS		

Hulled yield, naked grain yield, and percent yield loss to hull of each crop was not affected by nitrogen treatment under irrigated or 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 not have access to the applied

N. Percent yield loss to hull was higher for spelt than emmer under irrigation. 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.

The Wyoming first grains project will be continued through 2021. Future work includes dehulling of einkorn, grain quality analysis, analysis of soil nitrogen and nitrogen use efficiency, and market analysis for each crop. Studies have been repeated for the 2020 crop season.

Acknowledgements
This project was funded by Western SARE Professional and Producer Grant, Northwest Wyoming Applied Research Grant Program, and Federal Hatch Funds. Special thanks to Mike Moore and Blaine Magnuson for all their work.

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Keywords: ancient grains, agronomy, nitrogen, irrigation

PARP: I2, II10