Intensive Wheat Management, a Research and Educational Opportunity for Kentucky

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Background and Introduction

The University of Kentucky Wheat Science Working Group along with the Kentucky Small Grain Utilization Committee, industry partners and wheat consultants in the 1990's greatly improved wheat production practices, yields, and profits through research, promotion, and educational programs. Wheat grain prices have dipped in the past but have recently rebounded to favorable prices and the question arises about maximizing yields and profits through intensive management practices. Specific questions and concerns that are being addressed include: 1. Do newer varieties with higher yield potential require or tolerate a greater nitrogen (N) rate to maximize yields?; 2. Does N management influence the potential for spring freeze damage and lodging potential?; 3. Is the use of a plant growth regulator (e.g. Palisade) needed when pushing N rates to maximize yields?; 4. Are current UK fertility recommendations sufficient to maximize wheat yields: 5. Is maximizing wheat yield an economically sustainable approach?

Approach (slight modifications from 2021 and 2022)

We will produce wheat in an intensive management system to answer these questions. We are proposing early planted wheat (e.g. first week of October or as early as conditions permit) using two different high yielding modern hybrids as determined by the UK Small Grains Variety Testing Program. The varieties used were Pioneer 26R59 and Agri-Max 454 and we will continue to use these varieties. We will use three fall N-rates (0, 30, and 60 lb N/A) and three spring rates (50, 100, and 150 lb N/A) to determine how N management influences wheat yield and freeze potential. A plant growth regulator will be applied to half of the treatments to determine if the modern hybrids can tolerate high N rates without lodging for the Variety*Fall N rate*Spring N rate*growth regulator studies. Soil fertility for P and K will be maintained at the high range to eliminate any potential yield loss to insufficient phosphorus, potassium or possibly sulfur. This research will be conducted in fields with high yield potential for wheat. We will follow corn in one field and soybean in another due to interest in this rotation as in the 2022-2023 season. Tissue samples (flag leaf) and grain samples will be collected and analyzed to determine if treatments influenced nutrient content of wheat.

Like in the early 1990's, education was key to providing information that led to increased wheat yields and profits to Kentucky wheat producers. In a similar fashion as the early 90's, we also propose an educational component to this research project. We will provide in-depth, hands-on training through the Kentucky Agriculture Training School (KATS) to extend the results of this research. The KATS offers training sessions for wheat, corn, soybean, forages, and other related topics to align with the Grain and Forage Center of Excellence. Summary from 2021 and 2022 Funding Cycles

Wheat was planted on productive Crider soils at the UKREC in 2021 and 2022. The experimental protocol was the same in both years. Two varieties (Pioneer 26R59 and Agri-Max 454) were used based on performance in the Small Grain Variety Testing Program. Three fall N rates (0, 30 and 60 lb N/A) and three spring N rates (50, 100 and 150 lb N/A). The addition of the plant growth regulator “Palisade” was applied to half of the plots. Normal agronomic practices were followed according to UK Cooperative Extension Recommendations. The 2022-2023 wheat crop followed either corn or soybean in the same design as used in 2021. Two additional studies were incorporated into this work in 2022 to understand a potential interaction of nitrogen (N) and sulfur (S) and if the addition of P or K in high testing soils improved wheat yield or quality. This data is still being analyzed.

Each field was monitored for weed, insect and disease pressure throughout the growing season and addressed as appropriate. Flag leaf samples and grain samples were collected for each plot. Yield was collected with a plot combine by harvesting the middle 5 feet of row for each individual plot.

Past results are summarized below briefly. Agri-Max 454 had similar or lower grain yield than Pioneer 26R59 both years. Yield results are reported in Table 1 for the 2021-2022 wheat crop. Agri-Max 454 consistently yielded lower than Pioneer 26R59 in the 2021-2022 season, which followed corn, and was thought to have suffered from greater foliar disease pressure. Both fall and spring N increased yield with increasing rates, however 150 lb/A spring N yielded the same as any other combination of fall N and spring N receiving 110 lb N/A or more in the 2021-2022 wheat crop (Table 1). Generally, the same trend was true with the 2022-2023 wheat crop that followed soybean. However, yield was not influenced in the 2022-2023 crop following corn by either variety, spring or fall N-rate or Palisade treatment (Table 3). The environmental conditions and application of Palisade towards the later side of recommended dates were not favorable and reduced yield in the 2021-2022 growing season. No difference for the use of Palisade was observed in the 2022-2023 growing season following either corn or soybean. No lodging was evident during either growing season.

Table 1. Wheat yield results for main effects and interactions for the 2021-2022 wheat crop.

		Yield (bu/a)	
Variety	<.0001		
	Var1	80.1	b
	Var2	69.6	a
Fall N	<.0001		
	0	70.3	a
	30	75.1	b
	60	79.2	c
Spring N	<.0001		
	50	70.9	a
	100	74.3	b
	150	79.4	c
Var*SprN	0.0671		
	Var1 50N	74.9	b
	Var1 100N	82.0	c
	Var1 150N	83.6	c
	Var2 50N	66.9	a
	Var2 100N	66.6	a
	Var2 150N	75.2	b
Palisade	<0001		
	No	78.0	b
	Yes	71.7	a
FallN*SprN	0.060		
	0N 50N	64.9	a
	0N 100N	66.9	ab
	0N 150N	79.0	c
	30N 50N	70.8	b
	30N 100N	76.6	c
	30N 150N	77.8	c
	60N 50N	76.9	c
	60N 100N	79.4	c
	60N 150N	81.3	c

Different letters within a treatment or interaction indicate statistical differences.

Var1 = Pioneer 26R59; Var2 = Agri-Max 454

Table 2. Wheat yield results for main effects and interactions for the 2022-2023 wheat crop following soybean.

		Yield (bu/a)	
Variety	<0.001		
	Var1	114.0	b
	Var2	100.6	a
Fall N	<0.001		
	0	101.2	a
	30	108.5	b
	60	112.4	c
Spring N	<0.001		
	50	70.9	a
	100	74.3	b
	150	79.4	c
Palisade	0.409		
	No	107.8	
	Yes	106.7	
FallN*SprN	0.082		
	0N 50N	94.4	a
	0N 100N	101.3	b
	0N 150N	107.7	c
	30N 50N	101.0	b
	30N 100N	108.5	c
	30N 150N	116.1	d
	60N 50N	106.8	c
	60N 100N	115.9	d
	60N 150N	113.6	d

Table 3. Wheat yield results for main effects and interactions for the 2022-2023 wheat crop following corn. (No significant differences were observed in this rotation)

		Yield (bu/a)	
Variety	<0.652		
	Var1	100.7	
	Var2	101.9	
Fall N	<0.42		
	0	102.4	
	30	102.5	
	60	98.9	
Spring N	<0.182		
	50	98.2	
	100	103.9	
	150	101.8	
Palisade	0.922		
	No	101.2	
	Yes	101.4	
FallN*SprN	0.644		
	0N 50N	98.9	
	0N 100N	105.3	
	0N 150N	103.1	
	30N 50N	101.8	
	30N 100N	106.4	
	30N 150N	99.5	
	60N 50N	93.9	
	60N 100N	100.1	
	60N 150N	102.7	