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Testing Efficacy of Plant Growth Regulator Products for Enhanced Winter Wheat Grain Yield and Quality

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Summary

Experimental plant growth regulator compounds are expected to improve wheat grain yield by extending the duration of green leaf area and altering remobilization of stored carbohydrates. In order to evaluate this, plant growth regulator materials supplied by a commercial third party were applied to Tatonka hard red winter wheat during the mid-grain fill development stage. Overall, crop productivity increased. Compared to the control treatment, two of the treatment combinations had increased grain yield (13%, machine harvest; 31%, hand harvest); increased above-ground biomass (AGB, 8%); and increased harvest index (HI, 22%). Yield components also increased, including seeds/a (21%) and seed mass (7%). Variation in chlorophyll content during the grain filling period was positively related to variation in these and other response variables.

Introduction

Plant growth regulators are integral to agronomic management of crops, such as cotton, and can modify development of cereal crops. Field studies demonstrate yield benefits of growth regulators applied to wheat. For example, lodging and plant height were reduced for irrigated wheat when two growth regulators (ethephon and chlormequat chloride) were applied at flag leaf stage (Ramburan and Greenfield, 2007). Flag leaf duration of winter wheat was extended and seed yield increased with application of 6-benzylamino-purine, a cytokinin plant growth regulator (Luo et al., 2018). The research objective of this study was to evaluate effects of proprietary plant growth regulators on productivity of winter wheat.

Procedures

Tatonka hard red winter wheat was drilled (70 lb/a., 7.5-in. row spacing) on September 27, 2019. The previous crop at this site was a biomass sorghum, harvested in fall 2018 and subsequently managed with minimum-tillage. Power Flex HL (Pyroxsulam, 2 oz/a) with Preference nonionic surfactant adjuvant (32 oz/100 gal) was applied on April 1, 2020. Solid set irrigation sprinklers were installed (30-ft. centers); irrigation (1.6 in.) was applied on May 23, 2020 (Feekes 10.4, 80% heading), then the system was removed.

Plots (10- × 50-ft) were established with three sampling locations within each plot; treatment assignments were randomized. Treatments were applied on June 11, 2020 (mid-grain fill) using TT11002 nozzles with a spray boom that had 20-in. spacing, 1.5-ft above crop canopy, and operating at 22 psi at 3 mph.

Flag leaf chlorophyll content was measured using a SPAD meter; readings were taken from five flag leaves at each three sampling locations on June 11, 2020 (Chl_1) and June 16, 2020 (Chl_2). Leaf chlorophyll content was calculated from Chl (μmol/m2) = 10 ^(M^0.265), where M is SPAD reading (Markwell et al., 1995). On June 23, 2020, triplicate samples (12-in. row lengths) were harvested and measured for AGB, grain mass, HI, and components of yield. Hand harvest occurred on June 23, 2020, and machine harvest was conducted using a plot combine on July 4, 2020.

Data were analyzed as randomized complete block experimental design, with covariate analysis.

Results

Hot conditions with some strong winds prevailed during the June grain filling period (Figure 1), delaying the application of treatments to June 11, 2020. The crop reached 80% heading (Feekes 10.4) on May 22, 2020, early flowering on May 26, 2020, and flowering (Feekes 10.5.3) on 6/1 2020.

Mean responses to experimental treatment means were adjusted for linear effects of significant covariates. In summary, relative to the control treatment (1), treatments 5 and 6 increased above-ground biomass; and grain yield (hand harvest) (Figure 2); harvest index; the yield components seeds/a; and seed mass. Treatment 5 resulted in greater yield (machine harvest), seeds per head, and increased the moisture content of above-ground biomass. No differences among experimental treatments were detected in chlorophyll content.

Variation in flag leaf chlorophyll during grain fill was positively related to variation in above-ground biomass, grain, harvest index, seeds per head, seeds/a, seed mass, and biomass moisture. Canopy extent at grain fill was positively related to variation in seeds per head and seeds/a. Grain N was negatively related to seeds/a.

Next Steps

This study is being conducted in Colby, KS, to repeat the field trial for a second growing season to confirm treatment responses.

References

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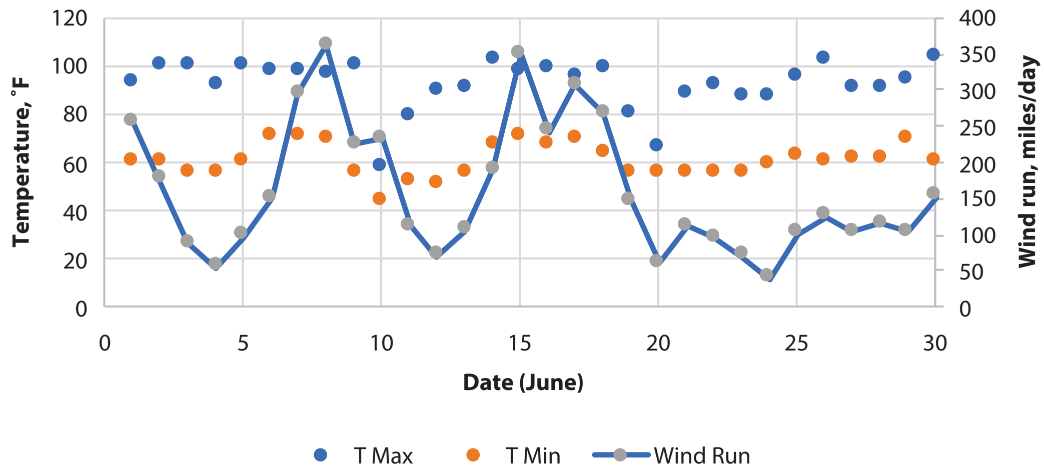
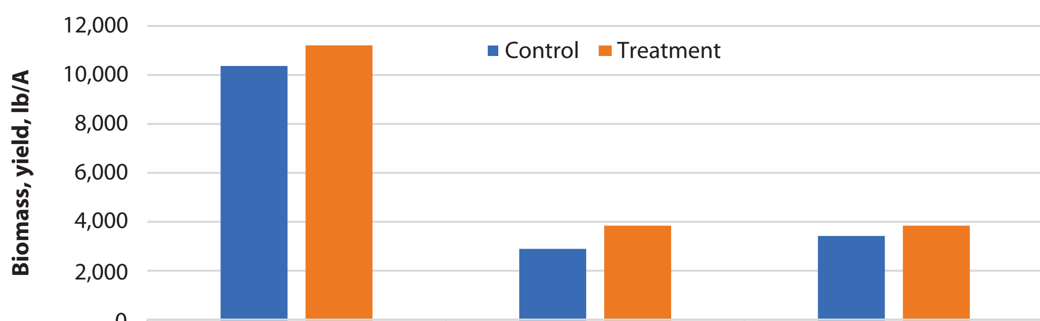


Figure 1. Temperature and wind conditions during the grain filling period at the Northwest Research-Extension Center, Colby, KS (June 2020).



	AGB	G_HH	G_CH
Control	10,357	2,911	3,418
Treatment	11,161	3,830	3,853

Wheat productivity

Figure 2. Effects of an experimental growth regulator treatment on productivity of winter wheat: Above-ground biomass (AGB), hand-harvested grain yield (G_HH) and combine-harvested grain yield (G-CH).