EFFECTS OF TRINEXAPAC-ETHYL ON KENTUCKY BLUEGRASS IN THE COLUMBIA BASIN OF OREGON

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Introduction

Oregon is one of the few states in the United States with significant Kentucky bluegrass (KBG) seed production, with more than 17,300 acres in production. The Columbia Basin of eastern Oregon is one of the state's major KBG seed production areas. In this area, KBG seed production occurs primarily on coarse-textured soils such as loamy fine sand and fine sandy loam.

KBG is susceptible to lodging because of a lack of stem strength and the prevalence of windy conditions during the reproductive stage. Lodging can result in significant yield loss and harvesting difficulties for growers. The plant growth regulator (PGR) trinexapac-ethyl (TE) is widely used to reduce lodging and increase seed yield in perennial ryegrass and tall fescue in western Oregon. Application of TE was found to increase seed yield by 45% in perennial ryegrass and by 40% in tall fescue (Chastain et al., 2014; Chastain et al., 2015). However, the literature on the use of PGRs in KBG seed production is limited. In one published study, the effects of PGRs on KBG seed production were inconsistent, with only certain cultivars showing increased seed yields (Butler et al., 2010). Therefore, there is a need for more in-depth research on the effect of PGRs on KBG seed yield across different KBG cultivars.

To fill the knowledge gap, a study was conducted to measure the effect of TE at various application rates on three KBG cultivars that differ in growth habit. By evaluating plant growth, lodging, flowering, and crop yield, the objective of this project was to identify the most effective TE application rates for KBG seed production. The overall goal is to improve our understanding of the relationship between cultivars, management practices, and utilization of PGRs.

Materials and Methods

A field trial was conducted from September 2018 to July 2019 at the Oregon State University Hermiston Agricultural Research and Extension Center on an Adkins sandy loam soil. Three KBG cultivars ('Mercury', 'Bluecoat', and 'Midnight') were selected to represent classes that differ in growth habit and seed yield potential. For example, 'Mercury' and 'Bluecoat' have taller tiller height and higher yield potential than 'Midnight'. The cultivars were planted on August 30 under a center pivot system. The sowing rate for 'Mercury' and 'Midnight' was 6 lb/acre, with the rate for 'Bluecoat' increased by 20% (7.2 lb/acre) to adjust for seed age difference. Each cultivar was planted with a cone planter into a block measuring 24 feet x 135 feet (four drill passes/block) oriented side by side.

Preplant fertilizer was applied and incorporated into the trial site at a rate (lb nutrient/acre) of 14N-40P-100K-20S-4Mg-1Zn-1B-73Cl. During the growing season, the trial site was top-dressed with regular urea on October 30 and April 3, delivering 145 and 150 lb N/acre, respectively. Nitrogen application rates were based on the N content in the top foot of soil.

Broadleaf weed and volunteer potatoes were controlled with the application of 4 oz/acre Callisto herbicide in mid-October. In April, the fungicide Tilt was sprayed at a rate of 4 oz/acre to control powdery mildew disease. Grass weeds (annual ryegrass and occasionally volunteer wheat) and mallow were hand weeded throughout the growing season.

In mid-April, within each KBG cultivar block, each drill pass was divided into five 25-foot-long plots with a 2.5-foot border on each end. As a result, each cultivar block was a randomized complete block experimental design with five treatments and four replicates. TE was applied with a backpack sprayer on April 22, when plants were at the early stem elongation stage (BBCH 32). TE rates were 0, 0.9, 1.9, 2.8, and 3.8 pint product/acre.

Following treatment, lodging score, stem height, and percent flowering were measured regularly throughout the growing season. Lodging was evaluated using a customized chart with a scoring system ranging from 1 to 9, where 1 represents the most serious lodging and 9 represents no lodging.

A small plot swather was used to windrow each cultivar at a high seed moisture content (24–28%) on July 2. Threshing was done with a small-plot combine in mid-July. The dirty and clean seed yields were determined for each treatment. The data were analyzed as a one-way ANOVA using Sigmaplot 13. When the F-test was significant, the means were separated using the Bonferroni test at the 5% level.

Results and Discussion

Lodging

Results from the study indicate that the application of TE significantly reduced the severity of lodging, with the higher application rates resulting in less lodging (Figure 1). A significant effect of TE for lodging control was observed during the period of June 4–June 21 for 'Bluecoat', from May 22 to June 21 for 'Mercury', and on June 4 for 'Midnight' ($P < 0.05$).

However, it appears that TE lost effectiveness at harvest time regardless of the application rate. This may be attributed to two factors. First, strong wind events may have resulted in high levels of lodging for the TE-treated plants. Second, the effect of TE may last for only a certain length of time, after which the crop may be able to resume normal growth, as indicated by stem heights measured in this study. One solution to the short-lived effect of TE might be a split application of TE at the two-node stage (BBCH 32) and at flag leaf emergence (BBCH 37–39). Research related to prolonging the effect of TE is needed.

Among the three cultivars, TE was more effective at controlling lodging in 'Mercury' and 'Bluecoat' and less effective for 'Midnight' (Figure 1). The lodging response difference may be attributed to the overall plant height growth potential of each cultivar. In this study, 'Midnight' exhibited a shorter plant height than did 'Bluecoat' and 'Mercury'.

Stem height

Our data indicate a significant reduction in stem height with increased TE application rate (Figure 2). Similar to the lodging score, the TE effect on stem height reduction diminished with time (Figure 2). For example, in 'Mercury', the significant differences in stem height reduction between TE application rates occurred in both May and June and disappeared at harvest time. For 'Bluecoat' and 'Midnight', the significant differences in stem height disappeared beginning June 21. Field observations indicate that flowering was delayed for approximately 1 week in all KBG cultivars at TE application rates ≥ 2.8 pt/acre (data not shown).

At harvest, uncleaned seeds and clean seed yield were determined for each treatment. It should be noted that during the cleaning procedure an unknown number of clean seeds are removed. The highest KBG clean seed yields for 'Bluecoat' and 'Mercury' were obtained with TE application rates of 1.9–2.8 pt/acre ($P < 0.05$) (Figure 3). Compared to other cultivars, the seed yield response to TE application in 'Midnight' was limited. The average internode length of 'Midnight' is much shorter than that of the other two cultivars, and the effect of TE in reducing internode elongation was limited. Among the three cultivars, the lowest seed production was measured in 'Midnight'.

It should be noted that seed yield in the study was much lower than that on commercial farms, possibly because strong wind events coincided with KBG harvest (swathing or combine harvest) and may have impacted seed yield due to an unknown amount of seed shatter. Additionally, field management practices might need to be improved.

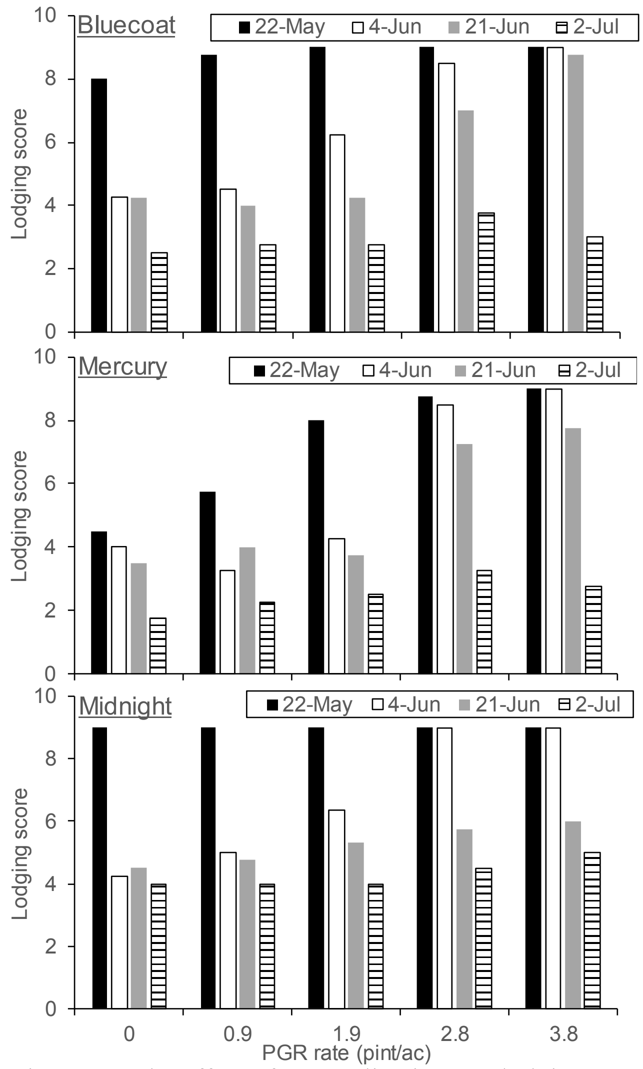

Figure 1. The effect of TE applications on lodging in Kentucky bluegrass. Lodging scores range from 1 to 9, with 1 representing the most serious lodging and 9 representing no lodging.

Results from the first-year field study suggest that the TE effect may vary with different cultivars. This finding is consistent with previous research demonstrating differential cultivar response to TE (Butler et al., 2010). The application of TE had a significant effect on lodging and stem height reduction on cultivars with greater plant height and yield potential. An additional year of data is needed in order to confirm the effect of TE and to refine TE application recommendations for KBG seed producers.

References

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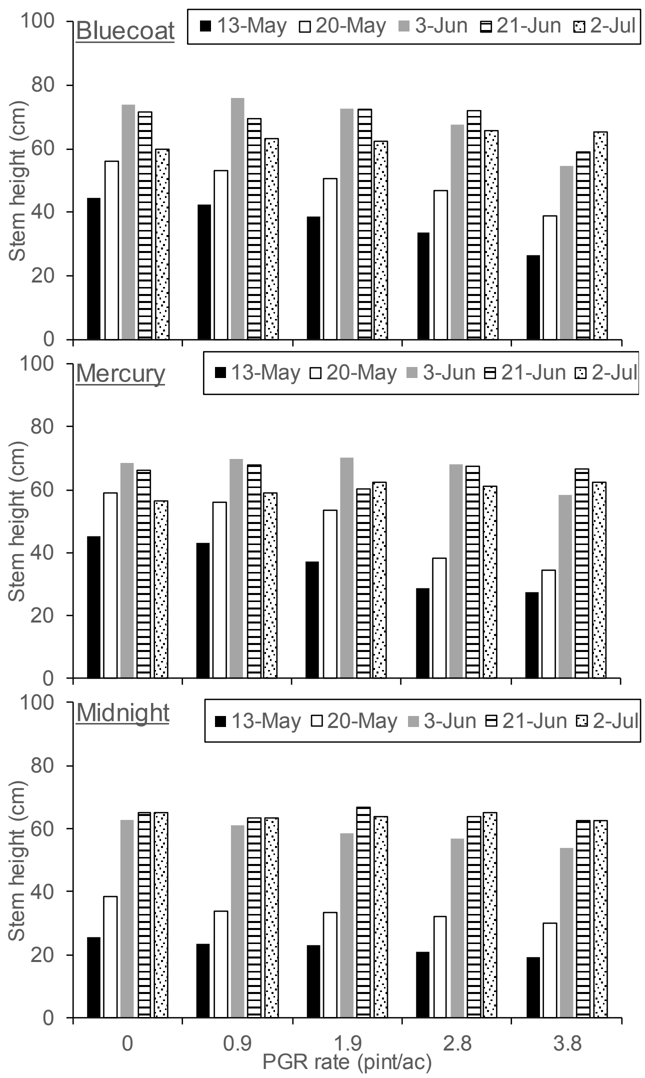

Figure 2. The effect of TE applications on stem height of Kentucky bluegrass.

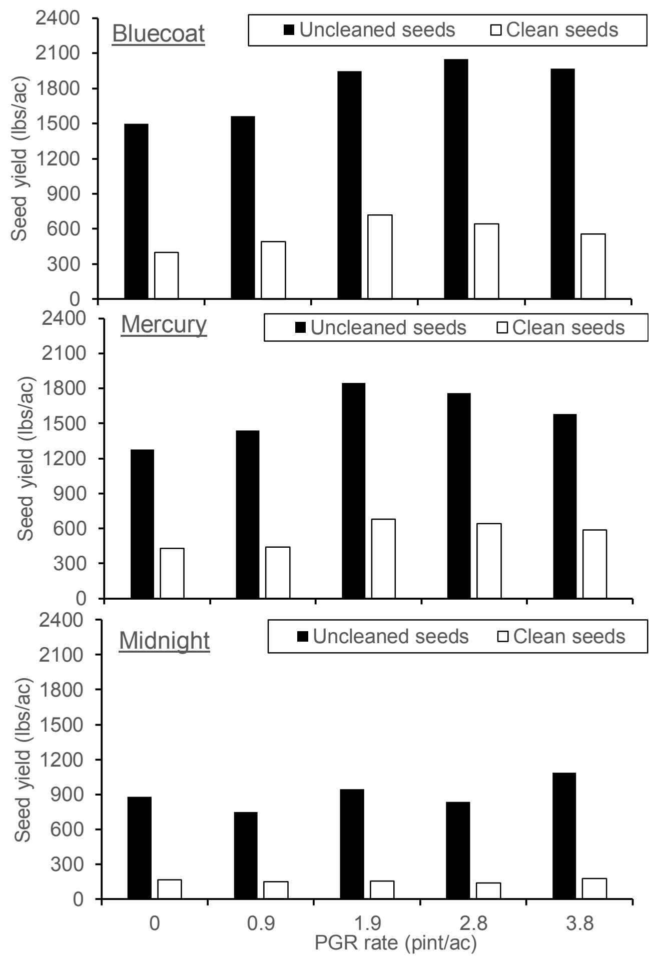

Figure 3. The effect of TE applications on seed yields of Kentucky bluegrass.