PLANT GROWTH REGULATOR COMBINATION EFFECTS ON TURF-TYPE AND FORAGE-TYPE TALL FESCUE SEED CROPS

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Introduction

Tall fescue is an important cool-season forage and turf grass and ranks among the most important seed crops in Oregon. Unfortunately, cool-season grasses produce only a fraction of their potential seed yield. Young et al. (1998) reported that tall fescue seed crops produced 37–53% of their potential yield, making them inefficient seed producers. While there are several reasons for low seed yield in tall fescue, lodging of the crop during flowering is a major contributing factor. Chastain et al. (2015) found that applications of trinexapac-ethyl (TE) increased tall fescue seed yield up to 40% over the untreated control and consistently reduced lodging.

There has been no previous research conducted in Oregon to indicate whether a combination of plant growth regulators (PGRs) will affect seed yield in tall fescue. Studies conducted in New Zealand with PGR combinations showed increases of up to 95% in perennial ryegrass seed yield (Chynoweth et al., 2014) and up to 86% in orchardgrass seed yield (Rolston et al., 2014). In New Zealand, forage-type cultivars make up a majority of the perennial ryegrass and tall fescue seed crops. In Oregon, those same species of seed crops consist mostly of turf-type cultivars.

The objectives of this study are: (1) to evaluate the effect of PGR combinations on lodging, above-ground biomass, plant height, and panicle length in turf- and forage-type tall fescue cultivars, and (2) to determine the effect of PGR combinations on seed yield, seed weight, and seed number.

Materials and Methods

The study compared two cultivars: 'Fawn' for the forage type and 'Spyder' for the turf type. 'Fawn' was chosen as the forage type due to its long production history (since 1964), and 'Spyder' was chosen as the turf type for its compact growth and ideal turf characteristics. Field trials were conducted at OSU's Hyslop Farm near Corvallis, OR, during the growing seasons of 2017 and 2018. Soil type at the site was Woodburn silt loam. The study design was a randomized complete block with a split-plot arrangement of treatments and four replications. Main plots were cultivars, and subplots were PGR treatments.

Plant growth regulators applied in this study included TE as Palisade and chlormequat chloride (CCC) as Cycocel. These stem-shortening PGRs were chosen because each acts at a different location in the gibberellin (GA) biosynthesis pathway (Rademacher, 2015). CCC is an onium-type compound and is not currently registered for use in Oregon grass seed crops. TE is an acylcyclohexanedione and is commonly applied in Oregon tall fescue seed crops for lodging control. Treatments evaluated in the study included:

- Untreated control
- 1.5 pt/acre TE (1X rate)
- 1.34 lb ai/acre CCC (1X rate)
- 0.75 pt/acre TE + 0.67 lb ai/acre CCC (½X + ½X)
- 1.5 pt/acre TE + 1.34 lb ai/acre CCC (1X + 1X)
- 1.5 pt/acre TE + 0.67 lb ai/acre CCC (1X + ½X)
- 0.75 pt/acre TE + 1.34 lb ai/acre CCC (½X + 1X)

PGRs were applied at BBCH 32 (two-node stage) with a bicycle-type boom sprayer. Biomass and plant height measurements were taken near peak anthesis (BBCH 65). Assessment of lodging was done during early to late anthesis (BBCH 60–69).

Results and Discussion

'Fawn' and 'Spyder' both experienced lodging in 2017 (Figure 1). TE applied as a stand-alone treatment provided significant control of lodging in both cultivars, while CCC alone did not (Figure 1). Lodging in 'Fawn' had already begun prior to the first measurement. Combinations with ½X TE were less effective in lodging control than those with 1X TE in both cultivars in 2017 (Figure 1) and in 'Fawn' in 2018 (Figure 2). Only the untreated control and the CCC alone treatment experienced lodging in 'Spyder' in 2018 (Figure 2).

Results of the Bartlett's test indicated that data could not be pooled across years. Each year's production results are presented separately. Seed yield was greater in 'Spyder' than in 'Fawn' in both years (Table 1 and Figure 3). In 2017 and 2018, CCC alone did not increase seed yields in 'Spyder' or 'Fawn' over the untreated control. An interaction of cultivar and PGR treatment was observed for tall fescue seed yield in 2018 (Figure 3) but not in 2017. Combinations

of ½X TE + ½X CCC and 1X TE + 1X CCC increased seed yield in 'Spyder' over the untreated control and either TE or CCC alone. Seed yields in the untreated control were not different than TE or CCC alone in 'Spyder' in 2018.

None of the TE and CCC combinations increased seed yield in 'Fawn' over TE alone (Figure 3). The seed yield in 'Fawn' was determined solely by the rate of TE, with the highest yields observed with 1X TE and intermediate yields observed with the ½X TE rate. The lowest seed yields in 'Fawn' were seen in the untreated control and CCC stand-alone treatment. Seed yield responses in both cultivars were largely attributable to the effects of PGR treatments on reducing lodging and resultant seed number increases from better pollination and improved seed set.

Seed number was higher in 'Spyder' than in 'Fawn' in both years (data not shown). The largest increases in seed number were observed with 1X TE + ½X CCC in 2017 and with 1X TE + 1X CCC in 2018. These treatments also had high seed yields. Seed weight was greater in 'Fawn' than in 'Spyder' (data not shown). In 2017, there was no difference in seed weight among PGR applications. The highest seed weight was observed with the 1X TE + 1X CCC rate in 2018.

Tiller height was reduced by TE alone but not by CCC alone in both 'Spyder' and 'Fawn' (data not shown). The greatest reduction in tiller height was observed with the 1X TE + 1X CCC treatment in 2017 and 2018. The forage type 'Fawn' produced 22% and 27% more biomass than the turf-type 'Spyder' in 2017 and 2018, respectively.

Conclusion

Results from this study indicate that PGR combinations may increase seed yield of tall fescue in western Oregon. TE + CCC combinations and CCC stand-alone treatments did not provide consistent seed yield increases, suggesting that increased seed yields are likely due to application of TE. Application of the 1X rate of TE (1.5 pt/acre) resulted in consistent seed yield increases. Results of this study do not support CCC as a viable PGR option for tall fescue seed production in Oregon, and efforts to register CCC may not be necessary unless additional research reveals such utility.

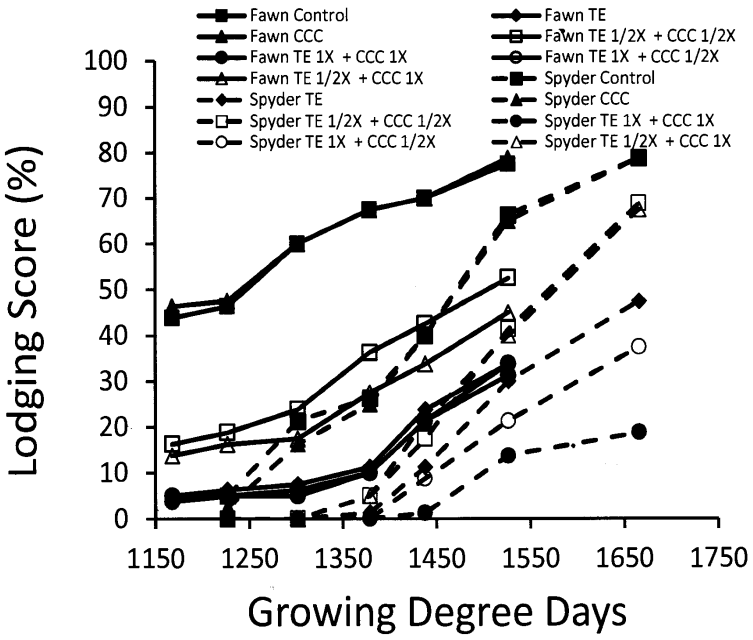

Figure 1. Effect of PGRs and PGR combinations on lodging in 'Spyder' (dashed lines) and 'Fawn' (solid lines), spring 2017. TE 1X = 1.5 pt/a; TE ½X = 0.75 pt/a; CCC 1X = 1.34 lb ai/a; CCC ½X = 0.67 lb ai/a.

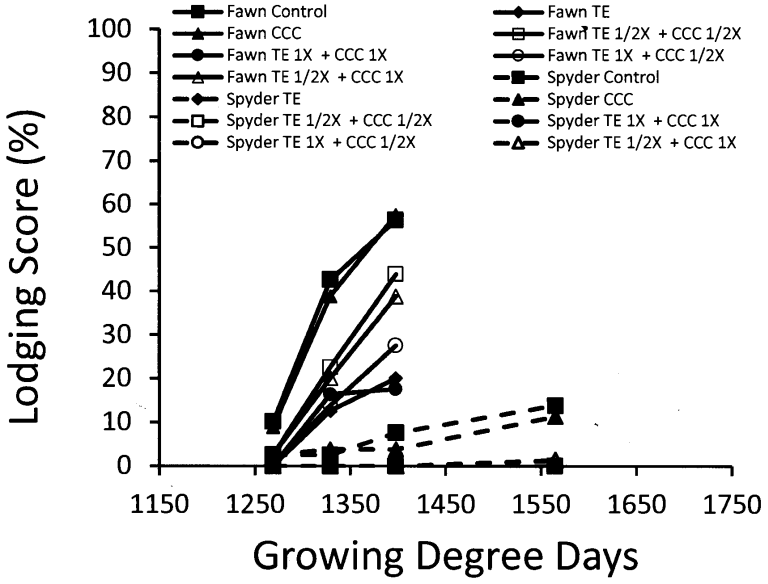

Figure 2. Effect of PGRs and PGR combinations on lodging in 'Spyder' (dashed lines) and 'Fawn' (solid lines), spring 2018. TE 1X = 1.5 pt/a; TE ½X = 0.75 pt/a; CCC 1X = 1.34 lb ai/a; CCC ½X = 0.67 lb ai/a.

References

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Table 1. Effects of cultivar and PGR combination treatments on seed yield in tall fescue, 2017.

Cultivar	Seed yield[1]
	(lb/a)
Fawn	917 b
Spyder	1,634 a
PGR combination[2]	
Control	1,111 d
1.5 pt/a TE	1,319 b
1.34 lb ai/a CCC	1,174 cd
0.75 pt/a TE + 0.67 lb ai/a CCC	1,256 bc
1.5 pt/a TE + 1.34 lb ai/a CCC	1,394 ab
1.5 pt/a TE + 0.67 lb ai/a CCC	1,505 a
0.75 pt/a TE + 1.34 lb ai/a CCC	1,170 cd

[1]Means followed by the same letter are not different by Fisher's protected LSD values ($P = 0.05$).
[2]TE = trinexapac-ethyl; CCC = chlormequat chloride

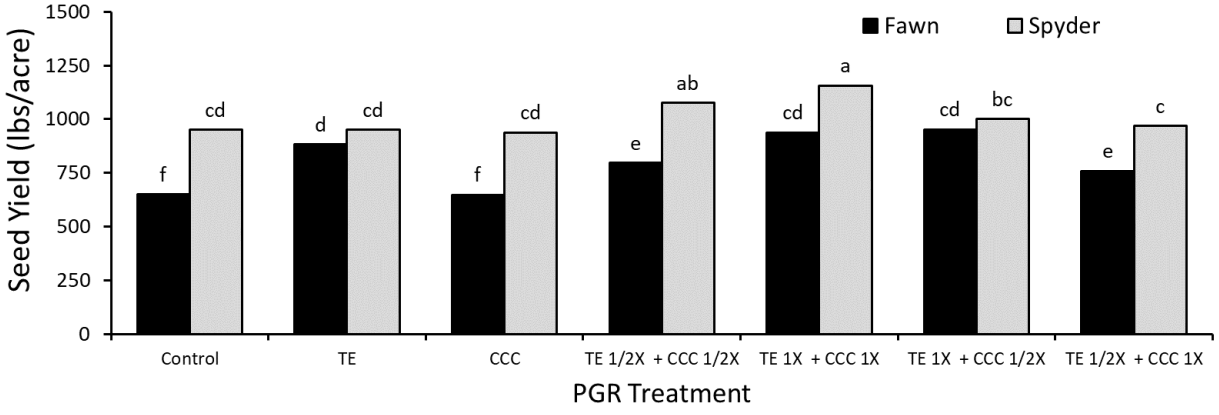

Figure 3. Interaction of cultivar and PGR treatment on seed yield of tall fescue, 2018. Means followed by the same letter are not different by Fisher's protected LSD values ($P = 0.05$). TE 1X = 1.5 pt/a; TE ½X = 0.75 pt/a; CCC 1X = 1.34 lb ai/a; CCC ½X = 0.67 lb ai/a.