EFFECTS OF PLANT GROWTH REGULATOR MIXTURES 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.

Use of trinexapac-ethyl (TE) plant growth regulator (PGR) in grasses grown for seed has been widely adopted in grass seed production around the globe. Chlormequat chloride (CCC) and paclobutrazol (PB) are not currently registered for use in grass seed crops in Oregon. All three PGRs inhibit gibberellic acid (GA) biosynthesis, each acting at different locations in the GA pathway. The PGRs fall into one of three categories of GA biosynthesis inhibitors: CCC is an onium-type compound, TE is a structural mimic of 2-oxoglutaric acid (acylcyclohexandione), and PB is a triazole with a nitrogen-containing heterocycle. Tall fescue seed yield was increased 40% over the untreated control with applications of TE to control lodging (Chastain et al., 2015). In New Zealand, combinations of TE, CCC, and PB increased seed yield by up to 95% in perennial ryegrass (Chynoweth et al., 2014) and up to 86% in orchardgrass (Rolston et al., 2014).

There has been no previous research conducted in Oregon to indicate whether a combination of PGRs will affect seed yield in tall fescue. In New Zealand, forage-type cultivars make up a majority of the perennial ryegrass and tall fescue seed crops, whereas in Oregon, tall fescue and perennial ryegrass 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 stem 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 included ‘Fawn’ forage-type and ‘Spyder’ turf-type tall fescue and was conducted in field trials at the OSU Hyslop Farm near Corvallis, OR, in spring 2017. The study will be repeated in spring 2018 at the same study site. Soil type at the study site is a Woodburn silt loam. Study design is a randomized complete block with four replications. Plot size was 11 feet x 50 feet. Treatments evaluated include:

- Untreated control
- 1.5 pt/a TE
- 1.34 lb ai/a CCC
- 0.75 pt/a TE + 0.67 lb ai/a CCC
- 1.5 pt/a TE + 1.34 lb ai/a CCC
- 1.5 pt/a TE + 0.67 lb ai/a CCC
- 0.75 pt/a TE + 1.34 lb ai/a CCC
- 1.5 pt/a TE + 1.34 lb ai/a CCC + 0.45 lb ai/a PB

Nitrogen was applied in March as a split application, at a total rate of 135 kg N/ha. PGRs were applied at BBCH 32 (two-node stage) with a bicycle-type boom sprayer.

Biomass measurements were taken near peak anthesis (BBCH 65). Crop height, length of stems, and assessment of lodging were done during late anthesis (BBCH 69).

Harvest timing was determined based on seed moisture content. The seed crop was harvested with a small-plot swather, and seed was threshed with a small-plot combine after seed moisture content was reduced to approximately 12%. Seed yield was determined on cleaned seed, and seed number was calculated using seed yield and seed weight. Samples were taken from the harvested seeds and were cleaned by the use of screens and blowers. An electronic seed counter counted two 1,000-seed samples, which were used to determine seed weight.

Analysis of variance (ANOVA) was used to test PGR and PGR mixture effects on seed yield and other characteristics of tall fescue seed production, and Fisher’s protected least significant difference (FPLSD) values were used to separate treatment means.

Results and Discussion

Above-ground biomass production was not affected by any PGR treatment within either cultivar (data not shown). However, as expected, the forage-type cultivar produced 25% more biomass than the turf-type cultivar. Tiller height was reduced by TE alone but not by CCC alone in both ‘Spyder’ and ‘Fawn’ cultivars (data not shown). Mixtures of 1.5 pt/a TE + 1.34 lb ai/a CCC and TE + CCC + PB reduced tiller height more than TE alone in ‘Spyder’ (data not shown). Only the TE + CCC + PB mixture in ‘Fawn’ reduced tiller height over TE alone.

Both cultivars experienced lodging in spring 2017, beginning earlier in ‘Fawn’ than in ‘Spyder’. Applications of TE alone provided significant control of lodging in both cultivars, while CCC alone did not (Figures 1 and 2). Lodging of the plants in ‘Fawn’ had already begun prior to the first measurement. Mixtures with 0.75 pt/a TE were less effective in lodging control than mixtures with 1.5 pt/a TE. The mixture with TE + CCC + PB provided maximum lodging control throughout the period in both cultivars.

Seed yield response to PGRs and PGR mixtures varied between the forage-type and turf-type cultivar (Table 1). Application of PGRs affected seed yield of both cultivars, when compared with the untreated control. In ‘Fawn’, the highest seed yields were evident in all treatments that contained 1.5 pt/a TE. The CCC alone treatment did not produce increased seed yields over the untreated control. Increased seed yields in ‘Fawn’ from treatments containing TE ranged from 28 to 51% over the control. In the turf-type cultivar ‘Spyder’, the highest seed yield was observed in the 1.5 pt/a TE + 0.67 lb ai/a CCC mixture. This PGR treatment increased seed yield by 29% over the untreated control but was no different in yield from the 1.5 pt/a TE +1.34 lb ai/a CCC mixture. No other PGRs or mixtures improved yield over the untreated control. Seed yield loss in lots treated with TE + CCC + PB (18%) was significantly lower than in the control.

Yield responses in both cultivars can largely be attributed to the effects of PGR treatments on reduced lodging and resultant seed number increases from better pollination and seed set (Table 2). The largest increases in seed number were observed in ‘Fawn’ with the TE + CCC + PB mixture, 1.5 pt/a TE + 0.67 lb ai/a CCC mixture, and TE alone. These treatments also had high seed yields. In ‘Spyder’, the 1.5 pt/a TE + 0.67 lb ai/a CCC mixture and the 1.5 pt/a TE + 1.34 lb ai/a CCC mixture had both high seed number and seed yield. The TE + CCC + PB mixture did not increase seed number over the control, and this treatment had seed yields that were significantly lower than the control. The TE alone, CCC alone, 0.75 pt/a TE + 1.34 lb ai/a CCC mixture, and the 0.75 pt/a TE + 0.67 lb ai/a CCC mixture all had seed number that were not different from the control.

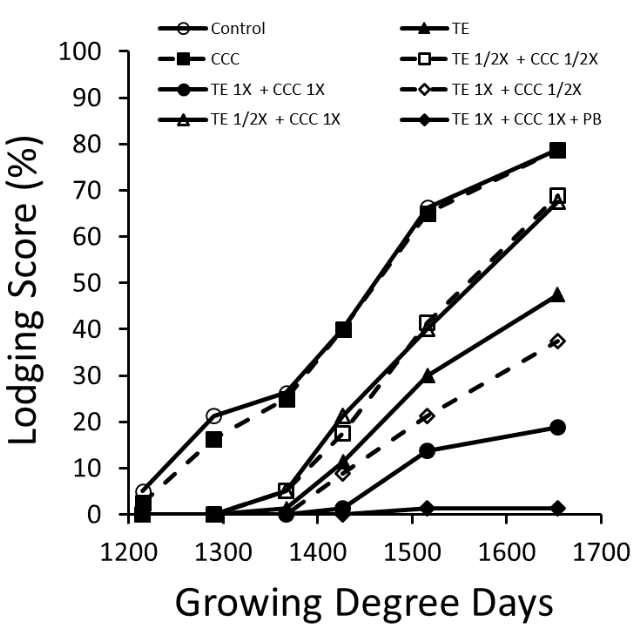

Figure 1. Effect of PGR and PGR mixtures on lodging in ‘Spyder’ turf-type tall fescue in spring 2017. TE 1X = 1.5 pt/a, TE 1/2X = 0.75 pt/a, CCC 1X = 1.34 lb ai/a, CCC 1/2X = 0.67 lb ai/a.

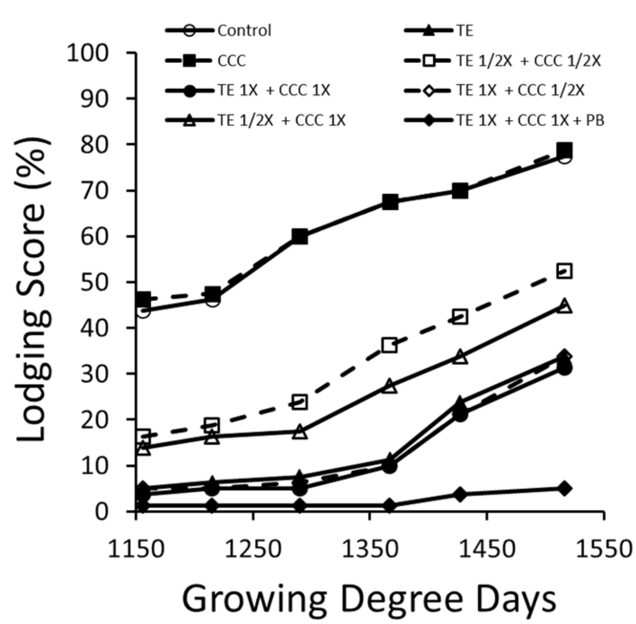

Figure 2. Effect of PGR and PGR mixtures on lodging in ‘Fawn’ forage-type tall fescue in spring 2017. TE 1X = 1.5 pt/a, TE 1/2X = 0.75 pt/a, CCC 1X = 1.34 lb ai/a, CCC 1/2X = 0.67 lb ai/a.

These treatments also produced seed yields equivalent to the control.

Seed weight was affected by PGR mixtures in 'Fawn' (Table 2). The 1.5 pt/a TE +1.34 lb ai/a CCC mixture increased seed weight over the control, whereas the TE + CCC + PB mixture reduced seed weight. Seed weight did not appear to have any effect on seed yields since the TE + CCC + PB mixture had low seed weight but also had high seed yield. There was no significant difference in seed weight among PGR treatments in 'Spyder'.

References

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Table 1. Seed yield response of 'Fawn' forage-type and 'Spyder' turf-type tall fescue cultivars to combinations of plant growth regulators (PGRs).

		Cultivar[1]	
PGR[2]	Rate	Fawn	Spyder
		(lb/a)	
Control	0	704 d	1,511 bc
TE	1.5 pt/a	1,011 ab	1,619 bc
CCC	1.34 lb ai/a	812 cd	1,532 bc
TE + CCC	0.75 pt/a + 0.67 lb ai/a	904 bc	1,603 bc
TE + CCC	1.5 pt/a + 1.34 lb ai/a	1,000 ab	1,781 ab
TE + CCC	1.5 pt/a + 0.67 lb ai/a	1,055 a	1,948 a
TE + CCC	0.75 pt/a + 1.34 lb ai/a	918 bc	1,416 cd
TE + CCC + PB	1.5 pt/a + 1.34 lb ai/a + 0.45 lb ai/a	1,063 a	1,235 d
LSD (*P* = 0.05)		45.22	16.95

[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; PB = paclobutrazol.

Table 2. Seed number and seed weight response of 'Fawn' forage-type and 'Spyder' turf-type tall fescue cultivars to combinations of plant growth regulators (PGRs).

		Seed number[1]		Seed weight[1]	
PGR[2]	Rate	Fawn	Spyder	Fawn	Spyder
		(no/m^2)		(mg)	
Control	0	27,779 e	75,009 cd	2.85 b	2.27 a
TE	1.5 pt/a	40,186 abc	81,221 bc	2.83 b	2.24 a
CCC	1.34 lb ai/a	32,442 de	76,267 cd	2.81 b	2.26 a
TE + CCC	0.75 pt/a + 0.67 lb ai/a	35,139 cd	79,884 bc	2.89 b	2.25 a
TE + CCC	1.5 pt/a + 1.34 lb ai/a	38,007 bcd	92,743 ab	2.95 a	2.16 a
TE + CCC	1.5 pt/a + 0.67 lb ai/a	40,865 ab	98,230 a	2.90 ab	2.23 a
TE + CCC	0.75 pt/a + 1.34 lb ai/a	36,370 bcd	73,612 cd	2.84 b	2.16 a
TE + CCC + PB	1.5 pt/a + 1.34 lb ai/a + 0.45 lb ai/a	44,278 a	62,524 d	2.70 c	2.22 a
LSD (*P* = 0.05)		2,006	4,892	0.035	0.031

[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; PB = paclobutrazol

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