

Tall Fescue (*Festuca arundinacea*) Seedhead Suppression with Plant Growth Regulators

Introduction

Plant growth regulators, or PGRs, are an effective tool utilized by vegetation managers in turf, urban forestry, and rights-of-way to reduce the impact that vegetation has on management cycles. Maintenance costs may decrease by reducing the number of mowings or trimmings needed to keep the vegetation clear of sensitive areas. PGRs can be classified as herbicides, since they control vegetation in some manner, and most herbicides, at very low rates, are growth regulators but with a narrow margin of safety. Products that are marketed as PGRs for turf include flurprimidol, mefluidide, and paclobutrazol. Traditional herbicides that include seedhead suppression, or “chemical mowing”, verbiage in their labels include metsulfuron, imazapic, and glyphosate.

PGRs are categorized into two groups; the type I PGRs and the type II PGRs. Type I PGRs suppress growth and development and inhibit cell division while the type II PGRs suppress growth only. Type II PGRs act as gibberellin biosynthesis inhibitors and suppress, not inhibit, cell elongation. Type II PGRs therefore do allow for the development of plant organs, although miniature in size compared to untreated vegetation. Type I PGRs and herbicides for turf include maleic hydrazide, mefluidide, glyphosate, chlorsulfuron, and metsulfuron. Type II PGRs for turf include flurprimidol, paclobutrazol, and triexepac-ethyl.

Highway rights-of-way managers use type I PGRs to inhibit seedhead development and growth of tall fescue in areas that would be otherwise time consuming, and thereby more costly, to mow. These areas would include steep embankments around cloverleafs and areas underneath permanent structures where grass cover is desirable. Timing of application of PGRs for seedhead suppression is critical as seedheads that have already developed in the spring will continue to grow after application. Future seedhead development will be inhibited by most chemicals but the window of application to receive the most net benefit for the application is relatively small (about 4 weeks in the spring or right at green up of the turf). Another concern of applying PGR's on turf is a discoloration of the vegetative growth; however, the vegetation will return to “normal” color as the growing season progresses. One added benefit is that PGRs, by inhibiting seedhead growth and development, may redirect the energy stores intended for seedheads into the roots and creating a stronger turf in the long run.

Two trials were installed to evaluate several PGRs and herbicides for seedhead suppression in tall fescue. Broadleaf weed control products were tested in combination with the PGRs and other herbicides to detect any differences in removing broadleaf weeds in turf. Discoloration of turf, length of seedhead suppression, and the ability of these products to suppress other grass species seedhead development (i.e. orchardgrass) were also evaluated.

Methods and Materials

Two identical trials were installed with the first at Princeton Research Station in Princeton, KY and the second at Spindletop Research Station in Lexington, KY. Thirty-eight treatments and one untreated control were evaluated in a randomized complete block design with three replications (block being replicates) (Table 1). Plots were 7' X 25' with 5' running checks between plots. Plots were treated with a CO₂ powered sprayer mounted on an ATV. The spray boom was mounted on one side of the ATV so treatments could be made without driving the ATV over the plot area and equipped with TeeJet 8004 flat fan nozzles. Treatments were

made at 20 GPA at both sites. Princeton applications were made on April 5th, 2004 and the Spindletop applications were made on April 27th, 2004.

Data collected included turf color using a 0-9 scale (0 = dead, 9 = fully green), percent cover by species, seedhead height, and categorical data on number of seedheads per plot. The categorical groupings for this variable were 0 = no seedheads, 1 = 1 – 5 seedheads, 2 = 6 – 15 seedheads, 3 = 16 – 30 seedheads, and 4 = > 30 seedheads per plot. Categorical data was collected to avoid having to count individual seedheads in each plot. The presence of orchardgrass and Kentucky bluegrass seedheads were noted for each plot at each measurement interval. Data for turf color, seedhead height, and number of seedheads per plot (categorical) were taken every two weeks from time of application up to 10 WAT. After 10 WAT, the presence of tall fescue, orchardgrass, (i.e. seedhead present or not) and turf color was recorded every other week up to 18 WAT. Percent cover by species was taken 1 WAT, 8 WAT, and 17 WAT at the Princeton site and 1 WAT, 9 WAT, and 18 WAT at the Spindletop site.

Data collected was analyzed using several different methodologies. Turf color was analyzed using analysis of variance and treatment means were compared at each time interval using Fisher's LSD method at $p = 0.05$. Seedhead height data was analyzed using the general linearized model procedure in SAS to produce least square means and treatment means were compared using the Tukey-Kramer method at $p = 0.05$. Percent cover by species was analyzed using analysis of covariance with cover at 1 WAT being the covariate. This allowed for the comparison of treatments for broadleaf weed control.

Seedhead count data, which was categorical, was tested for normality using the univariate procedure in SAS® and all categorical data failed to pass the requirements for normality (i.e. data having a normal, or Bell curve distribution). Thus, categorical data collected had to be analyzed using nonparametric techniques. Methods for nonparametric data analysis included the use of the rank procedure, the mixed procedure, and a SAS macro program designed to provide standard errors and relative group effects (Shah and Madden 2004). These specialized SAS programs provided ANOVA type statistics (i.e. the F statistic) to show presence of treatment effect at a given time interval. They also create rank least square means based on the observed categorical data. Rankings show the underlying pattern in the measured response. For example, there are several ways that a treatment in this study could have a mean categorical response of 1 (1 – 5 seedheads per plot). All three replications of the treatment may have been rated as 1 or one replication may have been rated a 3 and the other two a 0. The rank procedure examines the pattern of the data and its relation to both the *mean* and *median* response and assigns ranks accordingly. The least square mean ranks are then evaluated for treatment effect. This allows one to see the effect treatments have using categorical data.

Table 1: Treatment list for seedhead suppression trial

Treatment	Product	Rate per acre	Estimated cost per acre
1	Stronghold	8 fl oz	\$13.00
2	Stronghold	12 fl oz	\$19.00
3	Stronghold	16 fl oz	\$26.00
4	Stronghold + Telar	4 fl oz + 0.125 oz	\$9.00
5	Stronghold + Telar	6 fl oz + 0.125 oz	\$12.00
6	Stronghold + Telar	8 fl oz + 0.125 oz	\$16.00
7	Stronghold + Telar	4 fl oz + 0.25 oz	\$12.00
8	Stronghold + Telar	6 fl oz + 0.25 oz	\$15.00
9	Stronghold + Telar	8 fl oz + 0.25 oz	\$18.00
10	Stronghold + HiDep	8 fl oz + 32 fl oz	\$18.00
11	Stronghold + HiDep	12 fl oz + 32 fl oz	\$24.00
12	Stronghold + HiDep	16 fl oz + 32 fl oz	\$30.00
13	Stronghold + HiDep	8 fl oz + 64 fl oz	\$22.00
14	Stronghold + HiDep	12 fl oz + 64 fl oz	\$29.00
15	Stronghold + HiDep	16 fl oz + 64 fl oz	\$35.00
16	Stronghold + Escort	2 fl oz + 0.25 oz	\$8.00
17	Stronghold + Escort	3 fl oz + 0.25 oz	\$10.00
18	Stronghold + Escort	4 fl oz + 0.25 oz	\$11.00
19	Stronghold + Escort	2 fl oz + 0.5 oz	\$13.00
20	Stronghold + Escort	3 fl oz + 0.5 oz	\$14.00
21	Stronghold + Escort	4 fl oz + 0.5 oz	\$16.00
22	Plateau	1 fl oz	\$3.00
23	Plateau	2 fl oz	\$5.00
24	Plateau	3 fl oz	\$7.00
25	Plateau	4 fl oz	\$9.00
26	Plateau + Escort	1 fl oz + 0.25 oz	\$7.00
27	Plateau + Escort	2 fl oz + 0.25 oz	\$9.00
28	Plateau + Escort	3 fl oz + 0.25 oz	\$11.00
29	Plateau + Escort	4 fl oz + 0.25 oz	\$13.00
30	Plateau + Escort	1 fl oz + 0.5 oz	\$11.00
31	Plateau + Escort	2 fl oz + 0.5 oz	\$14.00
32	Plateau + Escort	3 fl oz + 0.5 oz	\$16.00
33	Plateau + Escort	4 fl oz + 0.5 oz	\$18.00
34	Escort	0.25 oz	\$5.00
35	Escort	0.33 oz	\$6.00
36	Escort	0.5 oz	\$9.00
37	RoundUp Pro	6 fl oz	\$2.00
38	RoundUp Pro	8 fl oz	\$3.00
40	Untreated		

Results

Princeton PGR trial results

The timing of applications of plant growth regulators for seedhead suppression in tall fescue stands is critical. The timing of the application for the Princeton trial appeared to be very accurate as initial seedhead growth inhibition was excellent for the majority of the treatments at 4 WAT (Table 2). Three Stronghold treatments, 2, 15, and 17, inhibited the development and growth of seedheads through 10 WAT. Several Plateau treatments (treatments 24, 25, 26, 28, 29, 31, and 33) successfully prevented seedhead growth through 10 WAT. No one Escort alone treatment or RoundUp Pro treatment could inhibit seedhead development through 10 WAT. A Stronghold + Escort treatment, 21, was able to prevent the growth of new seedheads after application as mean seedhead height declined to 0 cm at 6 WAT and maintained this through 10 WAT. A Plateau treatment, 23, was able to perform in the same manner. It is important to remember when reading this table that the important fact is the absence of seedheads and not the height of the seedheads.

Table 3 shows density of seedheads based on the categorical data analysis for time intervals with significant treatment effect. This table mimics Table 2 in that treatments with a mean seedhead height of 0 cm will have a mean density category of 0. Table 3 has been sorted by mean rank and its corresponding treatment effect. The **lower the rank** (and its corresponding treatment effect) **the better the treatment was in suppressing seedhead development and growth**. The purpose of this table is to give the reader an idea of the gradient of treatments from more effective to less effective.

As stated previously in the methods section, data collected on seedhead presence after 10 WAT only noted the presence or absence of tall fescue seedheads. Table 4 summarizes the presence of tall fescue seedheads in all plots. Ordinal means data can be interpreted as fractions; that is, an ordinal mean of 0.67 means 2/3^{rds} of the plots for that treatment released seedheads. Six treatments were effective in tall fescue seedhead suppression on all three replications at 17 WAT (Table 4). These included two Stronghold + Escort treatments (treatments 17 & 20), two Plateau treatments (treatments 24 & 25), and two Plateau + Escort treatments (treatments 29 & 33). Stronghold @ 12 oz was able to suppress all seedheads in all plots up to 15 WAT. Plateau @ 3 and 4 oz (treatments 24 and 25) suppressed tall fescue seedhead through the entire trial but at the expense of early discoloration (Table 5)

Vegetative color was severely affected by most all treatments at 4 WAT (Table 5). Only 2 treatments (1 and 30) had mean color ratings above 5 at 4 WAT. A mean color rating below 5 is considered operationally unacceptable. These discolorations were temporary as all treatments had color ratings above 5 by 10 WAT.

There was no significant difference in the percent cover of broadleaf weeds when evaluated throughout the trial. This is due to the abundance of cover of tall fescue (> 95 %) throughout the trial. The addition of Escort as a broadleaf weed control product at the rates tested does not appear to influence the efficacy of the PGR. Higher rates of Escort will damage tall fescue. The Stronghold + Telar and Stronghold + HiDep treatments were not as effective in seedhead suppression past 8 WAT as other Stronghold treatments. The Escort alone and RoundUp Pro treatments were not effective in tall fescue seedhead suppression at rates tested.

No one treatment tested here could effectively suppress orchardgrass seedheads.

Table 2: Adjusted mean seedhead height (cm) by treatment for Princeton PGR trial

Mixture	Treatment	4WAT		6WAT		8WAT		10WAT	
Stronghold	1	20.7	a-c	67.9	ab	79.8	ab	79.4	ab
	2	0	c	0	c	0	d	0	c
	3	0	c	61.9	a-c	74.9	a-c	31.4	a-c
Stronghold + Telar	4	0	c	42	a-d	49.6	a-d	58.4	a-c
	5	0	c	0	c	17.3	cd	42	a-c
	6	0	c	0	c	53.4	a-d	56.1	a-c
	7	20	bc	46.6	a-d	36.6	a-d	38	a-c
	8	0	c	0	c	37.8	a-d	47.6	a-c
	9	13.3	c	66.75	ab	66	a-c	70.7	ab
Stronghold + HiDep	10	0	c	30.3	b-d	60.8	a-d	60.3	a-c
	11	0	c	0	c	34.5	a-d	24.3	bc
	12	0	c	0	c	0	d	37	a-c
	13	0	c	0	c	57.3	a-d	60.8	a-c
	14	0	c	0	c	50.6	a-d	40.6	a-c
	15	0	c	0	c	0	d	0	c
Stronghold + Escort	16	0	c	30	b-d	77.1	a-c	76.6	ab
	17	0	c	0	c	0	d	0	c
	18	0	c	0	c	0	d	27.3	bc
	19	0	c	13.7	cd	0	d	23	bc
	20	0	c	24.5	b-d	35.7	a-d	42	a-c
	21	34	a-c	0	c	22.6	b-d	0	c
Plateau	22	0	c	0	c	0	d	27.7	bc
	23	34.2	ab	0	c	0	d	0	c
	24	0	c	0	c	0	d	0	c
	25	0	c	0	c	0	d	0	c
Plateau + Escort	26	0	c	0	c	0	d	0	c
	27	0	c	0	c	35.4	a-d	26.7	bc
	28	0	c	0	c	0	d	0	c
	29	0	c	0	c	0	d	0	c
	30	21.7	a-c	53.6	a-c	29	b-d	60	a-c
	31	0	c	0	c	0	d	0	c
	32	0	c	15.8	cd	21.8	b-d	0	c
	33	0	c	0	c	0	d	0	c
Escort	34	0	c	64.9	ab	80.6	ab	77.3	ab
	35	11.3	c	68.5	ab	57.5	a-d	65.6	ab
	36	0	c	55.9	a-c	67.7	a-c	65.5	ab
RoundUp Pro	37	0	c	67.1	ab	79.3	ab	80.9	ab
	38	59.3	ab	55.9	a-c	66	a-c	68.6	ab
Untreated	40	65.3	a	79.4	a	92.1	a	94.8	a

Tall Fescue (*Festuca arundinacea*) Seedhead Suppression with Plant Growth Regulators

Note: Treatment means followed by the same letter are not statistically different at $p = 0.05$ using Tukey-Kramer HSD

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Table 3: Tall fescue seedhead density rank means by treatment for Princeton PGR trial

6WAT				8WAT				10WAT			
Treatment	Ordinal Mean	Rank Mean	Treatment effect ¹	Treatment	Ordinal Mean	Rank Mean	Treatment effect ¹	Treatment	Ordinal Mean	Rank Mean	Treatment effect ¹
2	0.00	41.00	0.35 (0.02)	2	0.00	36.00	0.30 (0.04)	2	0.00	34.50	0.29 (0.04)
5	0.00	41.00	0.35 (0.02)	12	0.00	36.00	0.30 (0.04)	15	0.00	34.50	0.29 (0.04)
6	0.00	41.00	0.35 (0.02)	15	0.00	36.00	0.30 (0.04)	17	0.00	34.50	0.29 (0.04)
8	0.00	41.00	0.35 (0.02)	17	0.00	36.00	0.30 (0.04)	21	0.00	34.50	0.29 (0.04)
11	0.00	41.00	0.35 (0.02)	18	0.00	36.00	0.30 (0.04)	23	0.00	34.50	0.29 (0.04)
12	0.00	41.00	0.35 (0.02)	21	0.33	36.00	0.30 (0.04)	24	0.00	34.50	0.29 (0.04)
13	0.00	41.00	0.35 (0.02)	22	0.00	36.00	0.30 (0.04)	25	0.00	34.50	0.29 (0.04)
14	0.00	41.00	0.35 (0.02)	23	0.00	36.00	0.30 (0.04)	26	0.00	34.50	0.29 (0.04)
15	0.00	41.00	0.35 (0.02)	25	0.33	36.00	0.30 (0.04)	28	0.00	34.50	0.29 (0.04)
17	0.00	41.00	0.35 (0.02)	27	0.67	36.00	0.30 (0.04)	29	0.00	34.50	0.29 (0.04)
18	0.00	41.00	0.35 (0.02)	28	0.00	36.00	0.30 (0.04)	31	0.00	34.50	0.29 (0.04)
21	0.00	41.00	0.35 (0.02)	29	0.00	36.00	0.30 (0.04)	32	0.00	34.50	0.29 (0.04)
23	0.00	41.00	0.35 (0.02)	31	0.00	36.00	0.30 (0.04)	33	0.00	34.50	0.29 (0.04)
24	0.00	41.00	0.35 (0.02)	5	0.33	50.33	0.43 (1.69)	3	0.33	49.00	0.42 (1.72)
25	0.00	41.00	0.35 (0.02)	8	0.33	50.33	0.43 (1.69)	11	0.33	49.00	0.42 (1.72)
26	0.00	41.00	0.35 (0.02)	11	0.33	50.33	0.43 (1.69)	12	0.33	49.00	0.42 (1.72)
27	0.00	41.00	0.35 (0.02)	19	0.00	50.33	0.43 (1.69)	14	0.33	49.00	0.42 (1.72)
28	0.00	41.00	0.35 (0.02)	20	0.33	50.33	0.43 (1.69)	18	0.33	49.00	0.42 (1.72)
29	0.00	41.00	0.35 (0.02)	24	0.00	50.33	0.43 (1.69)	19	0.33	49.00	0.42 (1.72)
31	0.00	41.00	0.35 (0.02)	30	0.33	50.33	0.43 (1.69)	20	0.33	49.00	0.42 (1.72)
32	0.00	41.00	0.35 (0.02)	32	0.33	50.33	0.43 (1.69)	22	0.33	49.00	0.42 (1.72)
33	0.00	41.00	0.35 (0.02)	33	0.33	50.33	0.43 (1.69)	27	0.33	49.00	0.42 (1.72)
4	0.33	56.00	0.47 (1.82)	4	0.67	54.50	0.46 (2.80)	5	0.67	53.50	0.45 (2.95)
10	0.33	56.00	0.47 (1.82)	6	0.67	54.50	0.46 (2.80)	7	0.67	53.50	0.45 (2.95)
16	0.33	56.00	0.47 (1.82)	7	0.67	54.50	0.46 (2.80)	6	1.00	56.67	0.48 (4.03)
19	0.33	56.00	0.47 (1.82)	14	0.67	54.50	0.46 (2.80)	4	0.67	63.50	0.54 (1.73)
20	0.33	56.00	0.47 (1.82)	26	0.00	54.50	0.46 (2.80)	8	0.67	63.50	0.54 (1.73)
7	1.33	64.83	0.55 (4.66)	10	0.67	64.67	0.55 (1.70)	30	1.00	68.00	0.58 (2.41)
30	1.33	64.83	0.55 (4.66)	3	2.00	79.17	0.67 (4.03)	9	1.33	72.50	0.62 (2.95)
22	0.67	71.00	0.60 (1.82)	9	2.00	79.17	0.67 (4.03)	1	2.00	79.33	0.67 (0.27)
9	1.67	93.00	0.79 (0.11)	35	2.33	81.83	0.70 (4.38)	13	1.33	82.50	0.70 (0.19)
1	2.33	99.33	0.85 (0.09)	13	1.33	83.17	0.71 (0.18)	10	1.67	85.67	0.73 (0.48)
36	2.33	99.33	0.85 (0.09)	16	2.00	89.33	0.76 (0.87)	16	2.33	93.83	0.80 (0.76)
38	2.33	99.33	0.85 (0.09)	1	2.67	97.67	0.83 (0.30)	35	3.00	101.00	0.86 (0.03)
3	2.67	101.83	0.87 (0.22)	36	3.33	103.00	0.88 (0.11)	36	3.33	104.67	0.89 (0.11)
35	2.67	101.83	0.87 (0.22)	38	3.33	103.00	0.88 (0.11)	38	3.33	104.67	0.89 (0.11)
37	3.00	103.67	0.88 (0.61)	34	3.67	106.50	0.91 (0.10)	34	3.67	108.33	0.92 (0.10)
34	3.33	107.50	0.92 (0.07)	37	4.00	110.00	0.94 (0.02)	37	3.67	108.33	0.92 (0.10)
40	4.00	112.50	0.96 (0.01)	40	4.00	110.00	0.94 (0.02)	40	4.00	112.00	0.95 (0.01)

¹ Numbers in parentheses are the standard error of the rank means (lower is better)

Tall Fescue (*Festuca arundinacea*) Seedhead Suppression with Plant Growth Regulators

Table 4: Presence or absence of tall fescue seedheads by treatment at end of Princeton PGR trial

12WAT				15WAT				17WAT			
Treatment	Ordinal Mean	Rank Mean	Treatment effect ¹	Treatment	Ordinal Mean	Rank Mean	Treatment effect ¹	Treatment	Ordinal Mean	Rank Mean	Treatment effect ¹
2	0.00	28.50	0.24 (0.04)	2	0.00	32.50	0.27 (0.04)	17	0.00	30.00	0.25 (0.06)
15	0.00	28.50	0.24 (0.04)	11	0.00	32.50	0.27 (0.04)	20	0.00	30.00	0.25 (0.06)
18	0.00	28.50	0.24 (0.04)	18	0.00	32.50	0.27 (0.04)	24	0.00	30.00	0.25 (0.06)
24	0.00	28.50	0.24 (0.04)	21	0.00	32.50	0.27 (0.04)	25	0.00	30.00	0.25 (0.06)
25	0.00	28.50	0.24 (0.04)	24	0.00	32.50	0.27 (0.04)	29	0.00	30.00	0.25 (0.06)
26	0.00	28.50	0.24 (0.04)	25	0.00	32.50	0.27 (0.04)	33	0.00	30.00	0.25 (0.06)
29	0.00	28.50	0.24 (0.04)	28	0.00	32.50	0.27 (0.04)	2	0.33	49.50	0.42 (3.14)
31	0.00	28.50	0.24 (0.04)	31	0.00	32.50	0.27 (0.04)	8	0.33	49.50	0.42 (3.14)
32	0.00	28.50	0.24 (0.04)	32	0.00	32.50	0.27 (0.04)	11	0.33	49.50	0.42 (3.14)
8	0.33	48.00	0.41 (3.12)	33	0.00	32.50	0.27 (0.04)	12	0.33	49.50	0.42 (3.14)
12	0.33	48.00	0.41 (3.12)	1	0.33	52.00	0.44 (3.13)	14	0.33	49.50	0.42 (3.14)
13	0.33	48.00	0.41 (3.12)	5	0.33	52.00	0.44 (3.13)	15	0.33	49.50	0.42 (3.14)
14	0.33	48.00	0.41 (3.12)	8	0.33	52.00	0.44 (3.13)	16	0.33	49.50	0.42 (3.14)
17	0.33	48.00	0.41 (3.12)	9	0.33	52.00	0.44 (3.13)	18	0.33	49.50	0.42 (3.14)
21	0.33	48.00	0.41 (3.12)	13	0.33	52.00	0.44 (3.13)	22	0.33	49.50	0.42 (3.14)
23	0.33	48.00	0.41 (3.12)	14	0.33	52.00	0.44 (3.13)	23	0.33	49.50	0.42 (3.14)
27	0.33	48.00	0.41 (3.12)	15	0.33	52.00	0.44 (3.13)	26	0.33	49.50	0.42 (3.14)
30	0.33	48.00	0.41 (3.12)	17	0.33	52.00	0.44 (3.13)	31	0.33	49.50	0.42 (3.14)
33	0.33	48.00	0.41 (3.12)	19	0.33	52.00	0.44 (3.13)	32	0.33	49.50	0.42 (3.14)
4	0.67	67.50	0.57 (3.12)	20	0.33	52.00	0.44 (3.13)	1	0.67	69.00	0.59 (3.14)
5	0.67	67.50	0.57 (3.12)	23	0.33	52.00	0.44 (3.13)	3	0.67	69.00	0.59 (3.14)
9	0.67	67.50	0.57 (3.12)	26	0.33	52.00	0.44 (3.13)	4	0.67	69.00	0.59 (3.14)
10	0.67	67.50	0.57 (3.12)	27	0.33	52.00	0.44 (3.13)	5	0.67	69.00	0.59 (3.14)
19	0.67	67.50	0.57 (3.12)	29	0.33	52.00	0.44 (3.13)	9	0.67	69.00	0.59 (3.14)
20	0.67	67.50	0.57 (3.12)	3	0.67	71.50	0.61 (3.13)	10	0.67	69.00	0.59 (3.14)
22	0.67	67.50	0.57 (3.12)	4	0.67	71.50	0.61 (3.13)	13	0.67	69.00	0.59 (3.14)
28	0.67	67.50	0.57 (3.12)	12	0.67	71.50	0.61 (3.13)	19	0.67	69.00	0.59 (3.14)
37	0.67	87.00	0.74 (0.04)	22	0.67	71.50	0.61 (3.13)	21	0.67	69.00	0.59 (3.14)
1	1.00	87.00	0.74 (0.04)	30	0.67	71.50	0.61 (3.13)	27	0.67	69.00	0.59 (3.14)
3	1.00	87.00	0.74 (0.04)	37	0.67	71.50	0.61 (3.13)	28	0.67	69.00	0.59 (3.14)
6	1.00	87.00	0.74 (0.04)	6	1.00	91.00	0.77 (0.04)	30	0.67	69.00	0.59 (3.14)
7	1.00	87.00	0.74 (0.04)	7	1.00	91.00	0.77 (0.04)	35	0.67	69.00	0.59 (3.14)
11	1.00	87.00	0.74 (0.04)	10	1.00	91.00	0.77 (0.04)	36	0.67	69.00	0.59 (3.14)
16	1.00	87.00	0.74 (0.04)	16	1.00	91.00	0.77 (0.04)	37	0.67	69.00	0.59 (3.14)
34	1.00	87.00	0.74 (0.04)	34	1.00	91.00	0.77 (0.04)	6	1.00	88.50	0.75 (0.06)
35	1.00	87.00	0.74 (0.04)	35	1.00	91.00	0.77 (0.04)	7	1.00	88.50	0.75 (0.06)
36	1.00	87.00	0.74 (0.04)	36	1.00	91.00	0.77 (0.04)	34	1.00	88.50	0.75 (0.06)
38	1.00	87.00	0.74 (0.04)	38	1.00	91.00	0.77 (0.04)	38	1.00	88.50	0.75 (0.06)
40	1.00	87.00	0.74 (0.04)	40	1.00	91.00	0.77 (0.04)	40	1.00	88.50	0.75 (0.06)

¹ Numbers in parentheses are the standard error of the rank means (lower is better)

Table 5: Color ratings for Princeton PGR trial

Mixture	Treatment	1WAT*		4WAT*		6WAT*		8WAT*		10WAT*		12WAT		15WAT		17WAT	
		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating	
Stronghold	1	7.0	bc	7.0	b	6.7	bc	7.3	b-d	7.3	a-c	7.7	ab	7.7	a-c	7.0	a-c
	2	7.0	bc	4.0	e-g	6.0	b-e	7.0	b-e	6.7	b-d	7.3	ab	7.3	a-c	6.7	b-d
	3	7.3	ab	5.3	c-e	7.0	b	8.0	ab	7.0	b-d	7.0	b	8.0	ab	7.0	a-c
Stronghold + Telar	4	7.3	ab	3.7	fg	5.7	b-f	6.7	b-f	6.7	b-d	7.7	ab	7.0	bc	6.3	cd
	5	7.0	bc	3.7	fg	6.0	b-e	7.0	b-e	6.7	b-d	7.3	ab	6.7	c	6.3	cd
	6	7.0	bc	3.7	fg	4.3	e-h	6.7	b-f	7.3	a-c	7.3	ab	7.3	a-c	7.0	a-c
	7	7.0	bc	5.0	c-f	6.7	bc	6.7	b-f	6.7	b-d	7.3	ab	7.0	bc	6.7	b-d
	8	7.3	ab	4.7	c-g	5.0	c-h	6.0	d-h	6.3	c-e	7.0	b	7.0	bc	6.7	b-d
	9	7.0	bc	3.7	fg	5.3	b-g	6.0	d-h	6.3	c-e	8.0	a	7.3	a-c	6.3	cd
Stronghold + HiDep	10	6.7	c	5.0	c-f	6.0	b-e	7.0	b-e	7.0	b-d	7.3	ab	7.3	a-c	6.3	cd
	11	6.7	c	4.7	c-g	6.3	b-d	6.7	b-f	7.3	a-c	7.3	ab	8.0	ab	6.3	cd
	12	6.7	c	5.3	c-e	6.0	b-e	6.3	c-g	7.0	b-d	7.7	ab	7.0	bc	7.0	a-c
	13	6.0	d	4.7	c-g	6.7	bc	7.0	b-e	7.0	b-d	7.3	ab	7.3	a-c	6.7	b-d
	14	5.3	e	4.7	c-g	7.0	b	7.3	b-d	6.7	b-d	7.7	ab	6.7	c	6.7	b-d
	15	6.0	d	4.7	c-g	5.3	b-g	6.7	b-f	7.0	b-d	7.3	ab	7.0	bc	7.0	a-c
Stronghold + Escort	16	7.0	bc	4.0	e-g	4.7	d-h	6.7	b-f	7.0	b-d	8.0	a	7.7	a-c	7.0	a-c
	17	7.3	ab	3.7	fg	5.3	b-g	5.7	e-i	6.3	c-e	7.7	ab	7.0	bc	6.7	b-d
	18	7.0	bc	4.0	e-g	5.0	c-h	6.0	d-h	6.7	b-d	7.3	ab	7.3	a-c	6.7	b-d
	19	7.0	bc	4.7	c-g	3.7	gh	4.7	h-j	6.0	de	7.7	ab	7.3	a-c	6.7	b-d
	20	6.7	c	3.3	g	5.0	c-h	6.0	d-h	6.7	b-d	7.7	ab	7.3	a-c	6.0	d
	21	7.3	ab	4.7	c-g	4.0	f-h	4.0	j	5.3	e	7.0	b	7.0	bc	7.0	a-c
Plateau	22	7.0	bc	5.7	b-d	6.0	b-e	7.3	b-d	7.0	b-d	7.7	ab	7.0	bc	6.7	b-d
	23	7.0	bc	5.0	c-f	6.0	b-e	7.0	b-e	7.0	b-d	7.7	ab	7.3	a-c	6.7	b-d
	24	7.0	bc	3.7	fg	3.3	h	5.0	g-j	7.7	ab	7.7	ab	8.0	ab	6.7	b-d
	25	7.0	bc	4.7	c-g	5.7	b-f	5.7	e-i	6.7	b-d	7.0	b	7.0	bc	7.0	abc
Plateau + Escort	26	7.0	bc	4.7	c-g	5.3	b-g	6.7	b-f	6.3	c-e	7.7	ab	7.3	a-c	6.7	b-d
	27	7.3	ab	3.7	fg	4.3	e-h	5.0	g-j	7.0	b-d	7.0	b	7.3	a-c	7.0	a-c
	28	7.0	bc	4.0	e-g	4.3	e-h	4.0	j	5.3	e	7.3	ab	7.7	a-c	7.0	a-c
	29	7.0	bc	4.0	e-g	3.7	gh	4.3	i-j	6.0	de	7.3	ab	7.7	a-c	6.3	cd
	30	7.0	bc	6.0	bc	5.3	b-g	5.3	f-j	7.0	b-d	7.7	ab	8.0	ab	6.7	b-d
	31	6.7	c	3.7	fg	3.7	gh	4.7	h-j	6.3	c-e	8.0	a	7.7	a-c	6.7	b-d
	32	7.0	bc	3.3	g	3.3	h	4.3	ij	6.0	de	7.3	ab	7.7	a-c	7.0	a-c
	33	6.7	c	4.3	d-g	4.0	f-h	5.3	f-j	5.3	e	7.3	ab	7.3	a-c	6.0	d
	34	7.0	bc	4.7	c-g	6.0	b-e	6.0	d-h	7.0	b-d	8.0	a	7.3	a-c	6.3	cd
Escort	35	7.0	bc	5.0	c-f	7.0	b	7.3	b-d	7.7	ab	8.0	a	7.0	bc	6.7	b-d
	36	6.7	c	4.7	c-g	6.7	bc	7.3	b-d	7.0	b-d	8.0	a	7.7	a-c	7.0	a-c
	37	7.0	bc	5.0	c-f	6.7	bc	7.7	a-c	7.7	ab	7.7	ab	7.7	a-c	7.0	a-c
RoundUp Pro	38	7.0	bc	5.0	c-f	5.7	b-f	7.0	b-e	7.3	a-c	7.7	ab	7.3	a-c	7.3	ab
Untreated	40	7.7	a	9.0	a	9.0	a	9.0	a	8.3	a	8.0	a	8.3	a	7.7	a

Note: Treatment means followed by the same letter are not significantly different at $p = 0.05$ using Fisher's LSD.

Lexington PGR Trial Results

As previously stated, the timing of PGR applications is critical. The Lexington PGR applications were made approximately 3 weeks after the Princeton applications as full green up of tall fescue turf traditionally occurs later in central Kentucky than in western Kentucky. Unlike the Princeton PGR trial, only 2 treatments had prevented the growth of seedheads 1 WAT (Table 6). The presence of seedheads at 1WAT indicates that these seedheads were already formed at application but had yet to grow to be visible. This also indicates that the timing of the application was late. The ability of PGRs to inhibit the development of new seedheads after application is apparent in examining the 9 WAT height data as nine treatments had an average of 0 cm of seedhead growth at that time. These treatments included Stronghold tank mixtures (treatments 6,9,10,12), a Plateau treatment (treatment 22), and Plateau tank mixtures (treatments 26, 27, 31, 32).

There was an increase in the number of treatments that suppressed or reduced tall fescue seedheads from 4 WAT through 9 WAT (Table 7). This table is sorted by increasing rank means so as to show efficacy of treatments from best to worst. The number of treatments that had completely reduced the density of seedheads to 0 from 4 WAT to 9 WAT increased from one to nine. These data are concurrent with the data presented in Table 6. Treatments of RoundUp Pro and Escort alone were ineffective in preventing the development or reducing the density of tall fescue seedheads at 9 WAT which is similar to the results in the Princeton PGR trial. There is a general trend across all treatments of an increase in density reduction efficacy across time.

As with the Princeton PGR trial, seedhead data collected after 9-10 WAT were analyzed for presence or absence. No one treatment completely inhibited the development of tall fescue seedheads across the entire time of the trial. This is again due to the timing to the application. When examining the three data tables examining seedhead height (Table 6), seedhead density (Table 7), and seedhead presence (Table 8), there is considerable variation in the efficacy of all treatments.

Tall fescue vegetative color ratings at the Lexington PGR trial were considerably higher than those at the Princeton trial (Table 9). Color ratings at Lexington were never below the 5 level unlike the Princeton trial. This may be due to environmental conditions. The Princeton trial received approximately 5 inches of rain the month after application while the Lexington trial received approximately 9.5 inches of rain the month following application. Soil characteristics also varied between the two sites. The Princeton trial was located on a poorly drained soil with an argillic (clay) subsurface while the Lexington trial was located on a more fertile, well-drained loam. The differences in weather conditions between the two sites may have also influenced the results. Princeton weather data shows precipitation levels close to normal for the growing season while Lexington weather data shows precipitation levels to be well above normal for the entire growing season. This, as well as the timing of applications, may have caused the PGR applications at the Lexington sites to be less effective than those at the Princeton site.

There was no significant difference between treatments for broadleaf weed control. This is again due to the lack of considerable cover by broadleaf weeds. There was no treatment tested in the Lexington PGR trial that inhibited the seedhead growth of orchardgrass.

Future seedhead suppression research in 2005 will include Stronghold, Stronghold + Escort, Plateau, and Plateau + Escort Treatments.

Table 6: Adjusted mean seedhead height (cm) by treatment for Lexington PGR trial

Mixture	Treatment	1WAT		4WAT		6WAT		9WAT	
Stronghold	1	47.4	ab	73.4	a-c	75.7	a-d	58.5	a-d
	2	41	ab	48.7	a-e	33	b-e	23.3	b-d
	3	41.5	ab	33.6	a-e	33.2	b-e	19.7	c-d
Stronghold + Telar	4	24.3	ab	40.3	a-e	24.5	c-e	24.3	b-d
	5	35.6	ab	13.3	de	0	e	31.3	b-d
	6	0	b	30.5	c-e	28	c-e	0	d
	7	49	ab	55.6	a-e	50.3	a-e	56.8	a-d
	8	42.4	ab	60.1	a-d	21.7	de	54.8	a-d
Stronghold + HiDep	9	45.6	ab	48	a-e	0	e	0	d
	10	47.1	ab	51.6	a-e	0	e	0	d
	11	22.5	ab	27.5	c-e	45.3	a-e	54	a-d
	12	28.8	ab	38.5	a-e	46.7	a-e	0	d
	13	54.9	ab	48.2	a-e	38.4	b-e	32	b-d
	14	31	ab	0	e	29.5	b-e	41.5	a-d
Stronghold + Escort	15	51.2	ab	51.9	a-e	55	a-e	47	a-d
	16	50.7	ab	52.3	a-e	48.9	a-e	58.5	a-d
	17	32	ab	47.6	a-e	56.9	a-e	50.5	a-d
	18	33.3	ab	52.5	a-e	50.4	a-e	35	a-d
	19	54.9	ab	55.9	a-e	50.7	a-e	44.3	a-d
	20	45.7	ab	35.2	a-e	64.8	a-d	48	a-d
Plateau	21	18.7	ab	32.1	b-e	42	a-e	29.1	b-d
	22	50.7	ab	46.3	a-e	43.8	a-e	0	d
	23	61.7	ab	62.1	a-d	52.4	a-e	46	a-d
	24	47.8	ab	34.7	a-e	25.8	c-e	30	b-d
Plateau + Escort	25	53.8	ab	50	a-e	45.3	a-e	52.9	a-d
	26	0	b	40.1	a-e	38.6	a-e	0	d
	27	27.8	ab	36.7	a-e	0	e	0	d
	28	43.1	ab	58.1	a-d	53.9	a-e	54.6	a-d
	29	55.4	ab	53.6	a-e	51.2	a-e	54.3	a-d
	30	67.3	a	59.5	a-d	58.5	a-d	65.9	a-c
	31	35.2	ab	37.8	a-e	33.8	b-e	0	d
	32	51.3	ab	42.1	a-e	39.4	a-e	0	d
Escort	33	30.6	ab	43.9	a-e	37.3	b-e	40.3	a-d
	34	61.9	ab	89.7	ab	81.6	a-c	79.1	a-c
	35	42.5	ab	79.3	a-c	87.8	ab	84.5	ab
RoundUp Pro	36	42.4	ab	80.1	a-c	82.3	a-c	82.7	a-c
	37	49.3	ab	64.1	a-d	71.2	a-d	69.7	a-c
Untreated	38	25.3	ab	60.4	a-d	66.3	a-d	63.4	a-d
	40	66.1	a	91.3	a	98.3	a	96.1	a

Note: Treatment means followed by the same letter are not statistically different at $p = 0.05$ using Tukey-Kramer HSD

Tall Fescue (*Festuca arundinacea*) Seedhead Suppression with Plant Growth Regulators
 Table 7: Tall fescue seedhead density rank means by treatment for Lexington PGR

Treatment	4WAT			Trt	6WAT			Trt	9WAT		
	Ordinal Mean	Rank Mean	Treatment Effect ¹		Ordinal Mean	Rank Mean	Treatment Effect ¹		Ordinal Mean	Rank Mean	Treatment Effect ¹
14	0.00	17.50	0.15 (0.05)	5	0.00	25.50	0.21 (0.05)	6	0.00	30.00	0.25 (0.04)
5	0.33	30.17	0.26 (1.32)	9	0.00	25.50	0.21 (0.05)	9	0.00	30.00	0.25 (0.04)
6	0.33	30.17	0.26 (1.32)	10	0.00	25.50	0.21 (0.05)	10	0.00	30.00	0.25 (0.04)
11	0.33	30.17	0.26 (1.32)	27	0.00	25.50	0.21 (0.05)	12	0.00	30.00	0.25 (0.04)
20	0.33	30.17	0.26 (1.32)	2	0.33	38.83	0.33 (1.48)	22	0.00	30.00	0.25 (0.04)
21	0.33	30.17	0.26 (1.32)	3	0.33	38.83	0.33 (1.48)	26	0.00	30.00	0.25 (0.04)
26	0.67	40.00	0.34 (4.17)	4	0.33	38.83	0.33 (1.48)	27	0.00	30.00	0.25 (0.04)
32	0.67	40.00	0.34 (4.17)	6	0.33	38.83	0.33 (1.48)	31	0.00	30.00	0.25 (0.04)
2	0.67	42.83	0.36 (1.34)	8	0.33	38.83	0.33 (1.48)	32	0.00	30.00	0.25 (0.04)
3	0.67	42.83	0.36 (1.34)	13	0.33	38.83	0.33 (1.48)	25	1.00	34.67	0.55 (2.67)
4	0.67	42.83	0.36 (1.34)	14	0.33	38.83	0.33 (1.48)	2	0.33	44.33	0.37 (1.69)
9	0.67	42.83	0.36 (1.34)	24	0.33	38.83	0.33 (1.48)	3	0.33	44.33	0.37 (1.69)
12	0.67	42.83	0.36 (1.34)	31	0.33	38.83	0.33 (1.48)	4	0.33	44.33	0.37 (1.69)
22	0.67	42.83	0.36 (1.34)	32	0.67	46.17	0.39 (3.52)	5	0.33	44.33	0.37 (1.69)
24	0.67	42.83	0.36 (1.34)	25	1.00	49.83	0.42 (4.89)	13	0.33	44.33	0.37 (1.69)
27	0.67	42.83	0.36 (1.34)	26	1.00	49.83	0.42 (4.89)	18	0.33	44.33	0.37 (1.69)
31	0.67	42.83	0.36 (1.34)	11	0.67	52.17	0.44 (1.50)	21	0.33	44.33	0.37 (1.69)
33	0.67	42.83	0.36 (1.34)	18	0.67	52.17	0.44 (1.50)	23	0.33	44.33	0.37 (1.69)
1	1.33	47.83	0.41 (7.63)	21	0.67	52.17	0.44 (1.50)	24	0.33	44.33	0.37 (1.69)
23	1.00	52.67	0.45 (3.12)	22	0.67	52.17	0.44 (1.50)	15	0.67	50.33	0.43 (3.39)
25	1.00	52.67	0.45 (3.12)	33	0.67	52.17	0.44 (1.50)	1	1.33	56.50	0.48 (5.80)
7	1.00	55.50	0.47 (0.10)	12	1.00	59.50	0.50 (2.70)	8	0.67	58.67	0.50 (1.70)
10	1.00	55.50	0.47 (0.10)	23	1.00	59.50	0.50 (2.70)	11	0.67	58.67	0.50 (1.70)
13	1.67	60.50	0.52 (5.73)	29	1.00	59.50	0.50 (2.70)	14	0.67	58.67	0.50 (1.70)
30	1.33	62.50	0.53 (4.18)	15	1.33	63.17	0.54 (3.65)	20	0.67	58.67	0.50 (1.70)
8	1.33	65.33	0.55 (0.82)	28	1.33	63.17	0.54 (3.65)	33	0.67	58.67	0.50 (1.70)
18	1.33	65.33	0.55 (0.82)	20	1.00	65.50	0.56 (3.50)	17	1.00	64.67	0.55 (2.67)
29	1.33	65.33	0.55 (0.82)	16	1.33	66.83	0.57 (3.52)	28	1.00	64.67	0.55 (2.67)
15	1.67	66.33	0.56 (4.99)	19	1.33	66.83	0.57 (3.52)	19	1.67	70.83	0.60 (4.32)
28	1.67	69.17	0.59 (1.54)	30	1.33	66.83	0.57 (3.52)	30	1.67	73.17	0.62 (3.85)
19	2.00	85.00	0.72 (0.05)	1	1.67	67.00	0.57 (4.89)	7	1.33	79.00	0.67 (0.32)
16	2.33	88.83	0.76 (0.13)	7	1.67	80.17	0.68 (0.47)	29	2.00	85.17	0.72 (1.20)
17	2.33	88.83	0.76 (0.13)	17	2.00	83.83	0.71 (0.76)	16	2.00	91.00	0.77 (0.04)
38	4.00	100.50	0.85 (0.12)	38	2.67	94.83	0.81 (0.12)	38	3.00	98.50	0.84 (0.03)
34	4.00	108.50	0.92 (0.01)	37	3.67	106.17	0.90 (0.10)	37	3.33	102.17	0.87 (0.10)
35	4.00	108.50	0.92 (0.01)	34	4.00	110.00	0.94 (0.01)	34	4.00	109.50	0.93 (0.01)
36	4.00	108.50	0.92 (0.01)	35	4.00	110.00	0.94 (0.01)	35	4.00	109.50	0.93 (0.01)
37	4.00	108.50	0.92 (0.01)	36	4.00	110.00	0.94 (0.01)	36	4.00	109.50	0.93 (0.01)
40	4.00	108.50	0.92 (0.01)	40	4.00	110.00	0.94 (0.01)	40	4.00	109.50	0.93 (0.01)

¹ Numbers in parentheses are the standard error of the rank means (lower is better)

Table 8: Presence or absence of tall fescue seedheads by treatment at end of Lexington PRG trial

12WAT				14WAT				18WAT			
Trt	Ordinal Mean	Rank Mean	Treatment Effect ¹	Trt	Ordinal Mean	Rank Mean	Treatment Effect ¹	Trt	Ordinal Mean	Rank Mean	Treatment Effect ¹
9	0.00	29.00	0.24 (0.07)	1	0.00	33.50	0.28 (0.04)	1	0.00	31.00	0.26 (0.06)
34	0.00	29.00	0.24 (0.07)	5	0.00	33.50	0.28 (0.04)	8	0.00	31.00	0.26 (0.06)
1	0.33	48.50	0.41 (3.15)	12	0.00	33.50	0.28 (0.04)	12	0.00	31.00	0.26 (0.06)
3	0.33	48.50	0.41 (3.15)	17	0.00	33.50	0.28 (0.04)	13	0.00	31.00	0.26 (0.06)
6	0.33	48.50	0.41 (3.15)	21	0.00	33.50	0.28 (0.04)	16	0.00	31.00	0.26 (0.06)
8	0.33	48.50	0.41 (3.15)	22	0.00	33.50	0.28 (0.04)	25	0.00	31.00	0.26 (0.06)
10	0.33	48.50	0.41 (3.15)	23	0.00	33.50	0.28 (0.04)	7	0.33	50.50	0.43 (3.14)
13	0.33	48.50	0.41 (3.15)	24	0.00	33.50	0.28 (0.04)	9	0.33	50.50	0.43 (3.14)
15	0.33	48.50	0.41 (3.15)	26	0.00	33.50	0.28 (0.04)	10	0.33	50.50	0.43 (3.14)
17	0.33	48.50	0.41 (3.15)	31	0.00	33.50	0.28 (0.04)	11	0.33	50.50	0.43 (3.14)
24	0.33	48.50	0.41 (3.15)	3	0.33	53.00	0.45 (3.13)	14	0.33	50.50	0.43 (3.14)
25	0.33	48.50	0.41 (3.15)	4	0.33	53.00	0.45 (3.13)	17	0.33	50.50	0.43 (3.14)
26	0.33	48.50	0.41 (3.15)	7	0.33	53.00	0.45 (3.13)	18	0.33	50.50	0.43 (3.14)
29	0.33	48.50	0.41 (3.15)	9	0.33	53.00	0.45 (3.13)	19	0.33	50.50	0.43 (3.14)
30	0.33	48.50	0.41 (3.15)	10	0.33	53.00	0.45 (3.13)	20	0.33	50.50	0.43 (3.14)
32	0.33	48.50	0.41 (3.15)	13	0.33	53.00	0.45 (3.13)	22	0.33	50.50	0.43 (3.14)
35	0.33	48.50	0.41 (3.15)	15	0.33	53.00	0.45 (3.13)	23	0.33	50.50	0.43 (3.14)
37	0.33	48.50	0.41 (3.15)	25	0.33	53.00	0.45 (3.13)	26	0.33	50.50	0.43 (3.14)
38	0.33	48.50	0.41 (3.15)	28	0.33	53.00	0.45 (3.13)	27	0.33	50.50	0.43 (3.14)
2	0.67	68.00	0.58 (3.15)	29	0.33	53.00	0.45 (3.13)	29	0.33	50.50	0.43 (3.14)
5	0.67	68.00	0.58 (3.15)	30	0.33	53.00	0.45 (3.13)	30	0.33	50.50	0.43 (3.14)
7	0.67	68.00	0.58 (3.15)	32	0.33	53.00	0.45 (3.13)	31	0.33	50.50	0.43 (3.14)
11	0.67	68.00	0.58 (3.15)	33	0.33	53.00	0.45 (3.13)	33	0.33	50.50	0.43 (3.14)
12	0.67	68.00	0.58 (3.15)	38	0.33	53.00	0.45 (3.13)	2	0.67	70.00	0.59 (3.14)
14	0.67	68.00	0.58 (3.15)	2	0.67	72.50	0.62 (3.13)	3	0.67	70.00	0.59 (3.14)
16	0.67	68.00	0.58 (3.15)	11	0.67	72.50	0.62 (3.13)	4	0.67	70.00	0.59 (3.14)
18	0.67	68.00	0.58 (3.15)	16	0.67	72.50	0.62 (3.13)	6	0.67	70.00	0.59 (3.14)
19	0.67	68.00	0.58 (3.15)	18	0.67	72.50	0.62 (3.13)	15	0.67	70.00	0.59 (3.14)
20	0.67	68.00	0.58 (3.15)	19	0.67	72.50	0.62 (3.13)	21	0.67	70.00	0.59 (3.14)
21	0.67	68.00	0.58 (3.15)	20	0.67	72.50	0.62 (3.13)	24	0.67	70.00	0.59 (3.14)
31	0.67	68.00	0.58 (3.15)	36	0.67	72.50	0.62 (3.13)	28	0.67	70.00	0.59 (3.14)
33	0.67	68.00	0.58 (3.15)	37	0.67	72.50	0.62 (3.13)	32	0.67	70.00	0.59 (3.14)
4	1.00	87.50	0.74 (0.07)	6	1.00	92.00	0.78 (0.05)	5	1.00	89.50	0.76 (0.06)
22	1.00	87.50	0.74 (0.07)	8	1.00	92.00	0.78 (0.05)	34	1.00	89.50	0.76 (0.06)
23	1.00	87.50	0.74 (0.07)	14	1.00	92.00	0.78 (0.05)	35	1.00	89.50	0.76 (0.06)
27	1.00	87.50	0.74 (0.07)	27	1.00	92.00	0.78 (0.05)	36	1.00	89.50	0.76 (0.06)
28	1.00	87.50	0.74 (0.07)	34	1.00	92.00	0.78 (0.04)	37	1.00	89.50	0.76 (0.06)
36	1.00	87.50	0.74 (0.07)	35	1.00	92.00	0.78 (0.04)	38	1.00	89.50	0.76 (0.06)
40	1.00	87.50	0.74 (0.07)	40	1.00	92.00	0.78 (0.04)	40	1.00	89.50	0.76 (0.06)

¹ Numbers in parentheses are the standard error of the rank means (lower is better)

Tall Fescue (*Festuca arundinacea*) Seedhead Suppression with Plant Growth Regulators

Table 9: Color ratings for Lexington PGR trial

Mixture	Treatment	1WAT		4WAT*		6WAT*		9WAT*		12WAT		14WAT*		18WAT	
		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating		Color Rating	
Stronghold	1	8	a	7.3	cde	6.7	bcd	8	a	7.7	ab	7.3	bcd	7.7	ab
	2	8	a	7	def	6.7	bcd	7.3	abc	7	bc	7	cd	7.3	b
	3	8	a	7	def	6.3	cde	7	cb	7	bc	7.3	bcd	7.3	b
Stronghold + Telar	4	8	a	7	def	7	bc	7	cb	7	bc	8	ab	7.7	ab
	5	8	a	6.7	efg	6.3	cde	7	cb	7.7	ab	7	cd	7	b
	6	8	a	7	def	6.7	bcd	7.7	ab	7.7	a	7.3	bcd	7	b
	7	8	a	7	def	7	bc	7	cb	7.3	abc	7.3	bcd	7	b
	8	7.7	a	7.7	cd	7	bc	7	cb	7.7	ab	7	cd	7.7	ab
Stronghold + HiDep	9	7.7	a	7	def	6.3	cde	7.7	ab	7.3	abc	7	cd	7.7	ab
	10	8	a	7	def	6.7	bcd	7	cb	6.7	c	7.3	bcd	7.7	ab
	11	7.7	a	8	bc	7.3	b	7.3	abc	7	bc	7.3	bcd	7.3	b
	12	8	a	7.7	cd	6.7	bcd	7	cb	7	bc	7	cd	7	b
	13	8	a	7	def	7.3	b	7.3	abc	7	bc	7	cd	7	b
Stronghold + Escort	14	8	a	7	def	7	bc	7.3	abc	7	bc	6.7	d	7.7	ab
	15	7.7	a	7	def	6.7	bcd	7	cb	7	bc	7	cd	7.3	b
	16	8	a	7.3	cde	6.7	bcd	7	cb	7.3	abc	7.3	bcd	7.3	b
	17	8	a	7.3	cde	7	bc	8	a	6.7	c	7.3	bcd	7.3	b
	18	7.7	a	7	def	6.7	bcd	7	cb	7.3	abc	7	cd	7	b
Plateau	19	7.7	a	7	def	6.7	bcd	7.3	abc	7.7	ab	7	cd	7.7	ab
	20	7.7	a	6	g	5.3	fg	6.7	c	7.3	abc	7.7	abc	7.3	b
	21	7.7	a	7	def	6.3	cde	7.3	abc	7.7	ab	6.7	d	7.7	ab
Plateau	22	8	a	7	def	6	def	7.3	abc	7.3	abc	7.7	abc	7.3	b
	23	7.7	a	7.3	cde	5.7	efg	7.7	ab	7	bc	7.3	bcd	7	b
	24	7.7	a	6.7	efg	5.3	fg	7	cb	7.3	abc	7.3	bcd	7	b
	25	8	a	7	def	5	g	7.3	abc	8		8	ab	7.3	b
Plateau + Escort	26	8	a	7	def	6.3	cde	7.7	ab	7.3	abc	7.3	bcd	7.3	b
	27	8	a	7	def	6	def	7.3	abc	7	bc	7	cd	7	b
	28	7.7	a	7	def	5	g	7.7	ab	7.7	ab	7.7	abc	7.3	b
	29	8	a	6.7	efg	5	g	7.3	abc	7.7	ab	8	ab	7.3	b
	30	8	a	7	def	6.3	cde	7.3	abc	7	bc	7	cd	7	b
	31	7.7	a	6.3	fg	5.7	efg	7.7	ab	7.3	abc	7.3	bcd	7	b
	32	7.7	a	6.7	efg	5.3	fg	7.3	abc	7.7	ab	7.3	bcd	7.7	ab
	33	7.7	a	7	def	5	g	7	cb	7.7	ab	7.7	abc	7.3	b
Escort	34	8	a	8.7	ab	8.3	a	7.7	ab	7.3	abc	7.7	abc	7.7	ab
	35	7.7	a	8.7	ab	9	a	8	a	7.3	abc	8	ab	8.3	a
	36	8	a	9	a	8.3	a	8	a	6.7	c	8	ab	7.7	ab
RoundUp Pro	37	8	a	7.3	cde	6.7	bcd	7	cb	7.3	abc	7.7	abc	7.3	b
	38	7.7	a	6.7	efg	6.7	bcd	7	cb	7	bc	7	cd	7	b
Untreated	40	8	a	9	a	9	a	8	a	8	a	8.3	a	7.7	ab

Note: Treatment means followed by the same letter are not significantly different at $p = 0.05$ using Fisher's LSD.

