2016 Mowing x PGR Trial

Introduction

Tall fescue is a widely adapted grass species commonly used for roadsides and other unimproved turf areas. Frequent mowing is the most common management regime for departments of transportation but reduced mowing schedules are being used to cut costs. To maintain highway safety, the zone next to the roadway (clear zone) might be mowed three times per season while the remaining right of way (selective zone) is only mowed once per season. Plant Growth Regulators (PGRs) could potentially reduce mowing while maintaining safe highway conditions. PGRs are currently classified into six categories, Classes A – F, based on their mechanism of action. This trial includes examples of Class A, C, and D PGRs and was established to evaluate some PGR options for roadside management. Class A are late GA synthesis blockers, Class C are mitotic/cell division inhibitors, and Class D are herbicidal. This trial was established to examine the interaction between different PGRs and mowing management regimes.

Materials and Methods

This trial was established in 2016 at the Spindletop Research Farm in Lexington KY arranged as a split plot design with 3 mowing regimes, 16 PGR treatments, and three replications. Main plots were 20 ft wide and the mowing regimes were three times per season, once at the end of the season, and unmowed. Sub plots were 10 ft by 20 ft with running unsprayed checks (5 ft wide) between each of the plots. The treatments were five PGRs applied one to two weeks after each of the three mowings plus control. Each set of plots received only one PGR application.

Products tested were Embark 2S (mefluidide [Class C]) at 24 fl oz/A, Plateau (imazapic) (Class D) at 12 fl oz/A, Opensight (aminopyralid + metsulfuron methyl [Class D]) at 2.5 fl oz/A, Anuew (prohexadione calcium [Class A]) at 1 lb/A, and Perspective (aminocyclopyrachlor + clorsulfuron [Class D]) at 4.75 oz/A (Table 1). Plateau should have been applied at the recommended rate of 4 fl oz/A rather than 12 fl/oz A but the error was not noticed until after all the applications had been made. Growth regulator herbicides were included in the treatments, either as part of the product or added as 2,4-D to act as “safeners” to reduce the fescue “yellowing” after application. However, it should be noted that application of even low volatility 2,4-D formulations later in the season carry the risk of damage to sensitive plants nearby. All applications were at 25 gallons per acre and included a non-ionic surfactant (Activator 90) at 0.25% v/v. Application dates were 5/24/2016, 7/19/2016, and 10/6/2016. Mowing dates were 5/16/2016, 7/11/2016, and 9/21/2016.

Tall fescue color was assessed weekly by comparison to the running check strips. The color rating ranges from 0 (dead) to 9 (full green). The color of the check strips was set at 8. Seedhead and canopy heights were measured weekly as well. With the Plateau treatment application error, it was decided to analyze the data for each mowing regime separately rather than as the split plot design. Data were analyzed using ARM software and treatment means were compared using Fisher’s LSD at $p = 0.05$.

Results and Discussion

Plots were rated for color and height weekly after PGR / herbicide application which is a lot of data. The tables and figures in this report illustrate the treatment effects at similar times after treatment and trends over the season to provide information useful for managers. Tables 2 and 3 and Figures 1 to 4 present information on treatments within the three mowing per season regime. Table 4 has information about the one mowing per season regime. There were not many measurable treatment effects on the plots without mowing. Figure 5 illustrates the monthly precipitation for the 2016 season and how it was a wetter than average during the summer but drier than average in the fall.

Plateau, Opensight, and Perspective applied after the first mowing resulted in lower color ratings and shorter fescue 21 days after treatment (DAT) (Table 2). The Anuew treatment had shorter fescue with the same color as the control 21 DAT1 (Days after treatment after first mowing). Tall fescue color recovered and then was higher in the Plateau, Opensight, and Perspective treatments 48 and 64 DAT1. These Perspective plots "rebounded" and also had taller fescue 64 DAT1 (Table 2). Interestingly, the tall fescue in the Anuew plots were shorter 112 DAT1 (Table 3).

Similar results were observed with PGR applications after the second mowing. Plateau, Opensight, and Perspective gave lower color and shorter fescue (Table 2) and 20 DAT2 (Days after treatment after second mowing) (Table 3). Again, the color recovered and the Opensight and Perspective treatments actually had higher color than the control 56 DAT2 (Table 3). Embark, Plateau, Anuew, and Perspective resulted in shorter fescue than the control 56 DAT2. The Perspective plots still had higher color than the control 101 DAT2.

There was less response-to PGRs applied after the third mowing as the conditions were drier than average (Figure 5) and the growing season was ending. However, the Plateau and Perspective gave lower color than the control 22 DAT3 (Days after treatment after third mowing) (Table 3).

Turf color data are summarized in Figures 1 and 3 while fescue height data are summarized in Figures 2 and 4. These are the "biological" responses to the treatments and but they may not be practically significant (i.e., you may still need to mow anyway) but they are differences from the control.

Embark and Anuew had no effect on turf color when applied after the first mowing (Figure 1). Plateau (applied at too high a rate), Opensight, and Perspective applications resulted in lower color after the first mowing and it took from 30 to 42 DAT for color to recover. These three PGRs had higher color 48 DAT and the higher color persisted after the second mowing until 69 DAT (Figure 1). Embark did not affect fescue height while all the other treatments had shorter fescue than the control by 8 DAT (Figure 2). How long this growth reduction lasted varied between the treatments. Anuew gave the longest lasting tall fescue growth suppression, up to

112 and 120 DAT, without reducing color (Figure 2). The Plateau and Perspective had taller fescue for a few ratings after the second mowing (Figure 2) even beyond the time when the turf color had recovered (Figure 1).

A similar pattern was observed for the response of turf color after the second mowing (Figure 3). Anuew again had no effect on turf color while Embark resulted in lower color 28 and 34 DAT. Plateau, Opensight, and Perspective had consistently lower color 8 to 20 DAT (Figure 3) with color recovering sometime afterwards. All three of these treatments had higher color than the control 64 DAT and Perspective continued to have higher color after the third mowing up to 101 DAT (Figure 3). Plateau, Opensight, and Perspective had shorter fescue 8 DAT with the effect being intermittently significant up to the third mowing (Figure 4). The Embark and Anuew plots had shorter tall fescue at the 34 and 56 DAT ratings (Figure 4).

In the plots with only one mowing per season, there were no color differences 21 DAT1 for the first application timing (Table 4). The application was later than the application window for seedhead suppression. However, there were height reductions with the Plateau, Opensight, Anuew, and Perspective treatments. Lodging or "leaning" was observed with Opensight and there seemed to be less seedfill with the Perspective treatment (Table 4). At 28 DAT2 after the second application, lower color was observed on the fresh vegetative growth for the Plateau, Opensight, and Perspective plots. These same PGRs plus the Embark produced shorter fescue than the control (Table 4). Plateau, Opensight, and Perspective treatments resulted in lower tall fescue color when applied after the one seasonal mowing and 22 DAT3. These same treatments, plus Anuew, reduced fescue growth (Table 4).

In the three mowing per season regime, the effects of these PGR treatments extended over time, even beyond subsequent mowing. There was a recovery, even a "rebound", in color and growth after application of the Class D (herbicidal) PGR's (Plateau, Opensight, and Perspective). Tall fescue showed good resilience after these applications in a season with good moisture availability. The story may be different in a drought. The Class C (mitotic/cell division inhibitors) (Embark) and Class A (late GA synthesis blockers) (Anuew) PGR's showed little turf yellowing but also reduced fescue growth less. PGR's may have a role as part of an integrated vegetation management system.

Table 1. Herbicide Treatments, Active Ingredients and Application Rates.

Product (s)	Rate (per Acre)	Active Ingredient(s)	ai Rate (per Acre)
Embark 2S Formula 40	24 fl oz 2 qt	mefluidide 2,4-D amine	6 oz ae 1.84 lb ae
Plateau * Formula 40	12 fl oz 2 qt	imazapic 2,4-D amine	3 oz ae 1.84 lb ae
Opensight	2.5 oz	aminopyralid + metsulfuron methyl	1.3 oz ae + 0.24 oz
Anuew Formula 40	1 lb 2 qt	prohexadione calcium 2,4-D amine	4.4 oz 1.84 lb ae
Perspective	4.75 oz	aminocyclopyrachlor + chlorsulfuron	1.9 oz + 0.75 oz
Unsprayed Control			

All herbicide treatments contained the adjuvant, Activator 90 at 0.25% v/v.

* Rate should have been 4 fl oz per acre

Growth regulator herbicides included as “safeners”.

Table 2. Herbicide Treatments, Turf Color and Fescue Height for Plots with 3 Mowing Cycles per Year (Part 1)

Product (s)	Rate (per Acre)	Timing	June 14, 2016		July 11, 2016		July 27, 2016	
			Color (0-9)	Ht (in)	Color (0-9)	Ht (in)	Color (0-9)	Ht (in)
			21 DAT1[1]		48 DAT1		64 DAT1 (8 DAT2[2])	
Embark 2S	24 fl oz	after first mowing	7.8 ab[3]	16 ab	8.0 b	17	8.2 cd	13 bc
Formula 40	2 qt	after second mowing					7.8 de	12 cde
		after third mowing						
Plateau *	12 fl oz	after first mowing	6.5 d	11 cd	8.5 a	14	9.0 a	15 ab
Formula 40	2 qt	after second mowing					7.0 f	9 f
		after third mowing						
Opensight	2.5 oz	after first mowing	7.5 b	9 d	8.3 a	18	8.4 bc	12 cd
		after second mowing					7.5 e	10 ef
		after third mowing						
Anuew	1 lb	after first mowing	8.0 a	13 bc	8.0 b	16	8.0 d	12 cde
Formula 40	2 qt	after second mowing					8.0 d	12 cde
		after third mowing						
Perspective	4.75 oz	after first mowing	7.0 c	11 cd	8.5 a	15	8.7 ab	16 a
		after second mowing					7.5 e	11 def
		after third mowing						
Unsprayed Control			8.0 a	17 a	8.0 b	18	8.0 d	13 bc

* Rate should have been 4 fl oz per acre

[1] *DAT1 = Days after treatment after first mowing*

[2] *DAT2 = Days after application after second mowing*

[3] *Means within a column followed by the same letter are not different according to Fisher's LSD at P < 0.05.*

Table 3. Herbicide Treatments, Turf Color and Fescue Height for Plots with 3 Mowing Cycles per Year (Part 2)

Product (s)	Rate (per Acre)	Timing	August 8, 2016		September 13, 2016		October 28, 2016	
			Color (0-9)	Ht (in)	Color (0-9)	Ht (in)	Color (0-9)	Ht (in)
			76 DAT1[1] (20 DAT2[2])		112 DAT1 (56 DAT2)		157 DAT1 (22 DAT3[3])	
Embark 2S	24 fl oz	after first mowing	8.0 ab[4]	17 abc	8.0 c	18 bcd	8.0 b	12 abcd
Formula 40	2 qt	after second mowing	7.5 bc	14 cde	8.1 c	16 cd	8.0 b	11 bcd
		after third mowing					8.0 b	12 abcd
Plateau *	12 fl oz	after first mowing	8.3 a	19 a	8.0 c	20 ab	8.0 b	12 abcd
Formula 40	2 qt	after second mowing	5.3 e	10 f	8.1 bc	15 d	8.0 b	13 ab
		after third mowing					7.8 c	10 d
Opensight	2.5 oz	after first mowing	8.2 a	19 ab	8.0 c	19 abc	8.0 b	11 bcd
		after second mowing	7.0 cd	12 def	8.3 ab	18 bc	8.1 ab	12 abcd
		after third mowing					8.0 b	11 bcd
Anuew	1 lb	after first mowing	8.0 ab	17 abc	8.0 c	16 cd	8.0 b	11 cd
Formula 40	2 qt	after second mowing	8.0 ab	15 bcd	8.0 c	16 cd	8.0 b	12 abcd
		after third mowing					8.0 b	11 bcd
Perspective	4.75 oz	after first mowing	8.5 a	19 a	8.0 c	22 a	8.0 b	11 bcd
		after second mowing	6.8 d	12 ef	8.4 a	16 cd	8.2 a	13 a
		after third mowing					7.8 c	11 cd
Unsprayed Control			8.0 ab	17 abc	8.0 c	21 ab	8.0 b	12 abcd
								ns

* Rate should have been 4 fl oz per acre

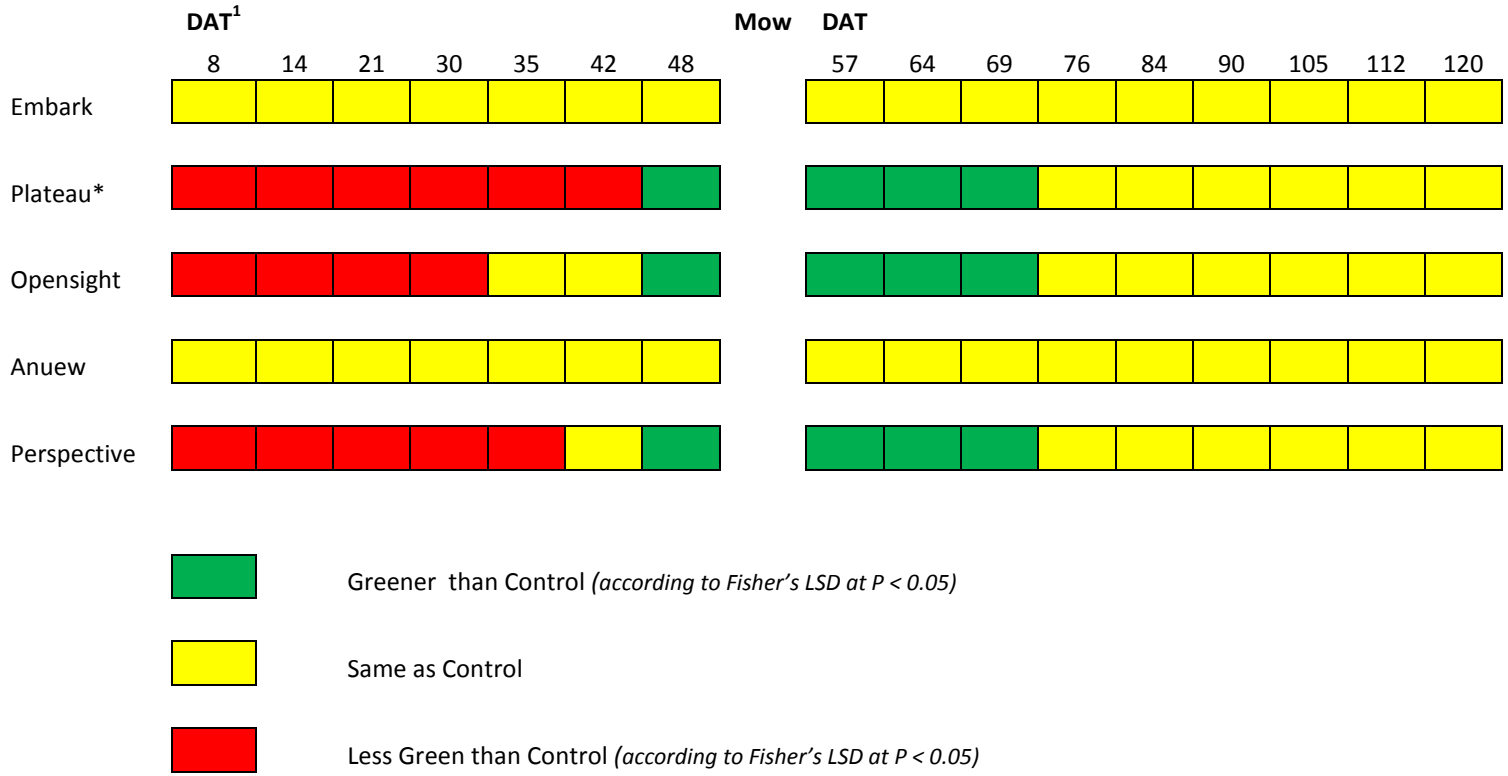
[1] *DAT1 = Days after treatment after first mowing*

[2] *DAT2 = Days after application after second mowing*

[3] *DAT3 = Days after application after third mowing*

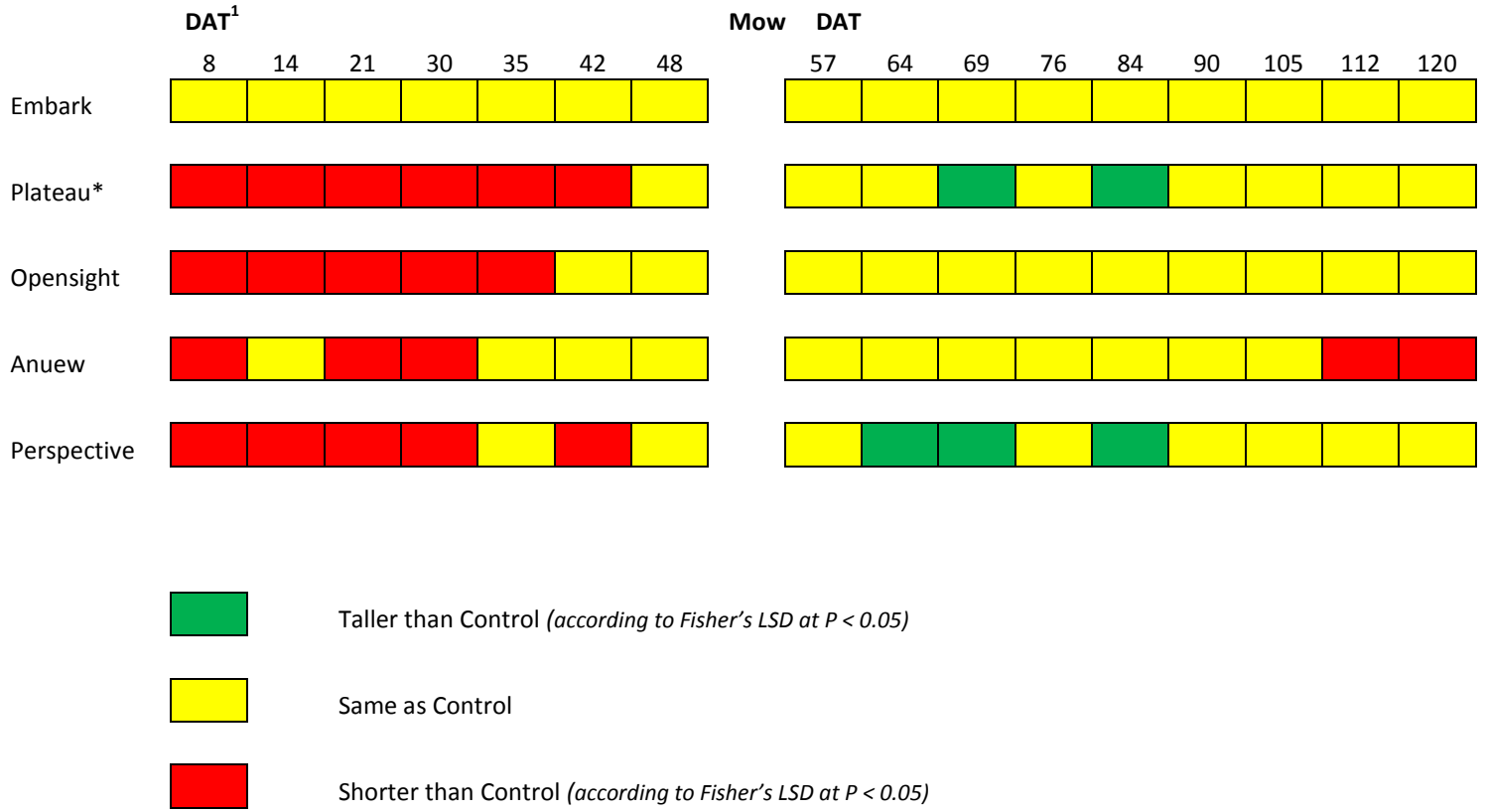
[4] *Means within a column followed by the same letter are not different according to Fisher's LSD at P < 0.05.*

Figure 1. Summary of Turf Color with Application after First Mowing for 3 Mowing Cycles per Year



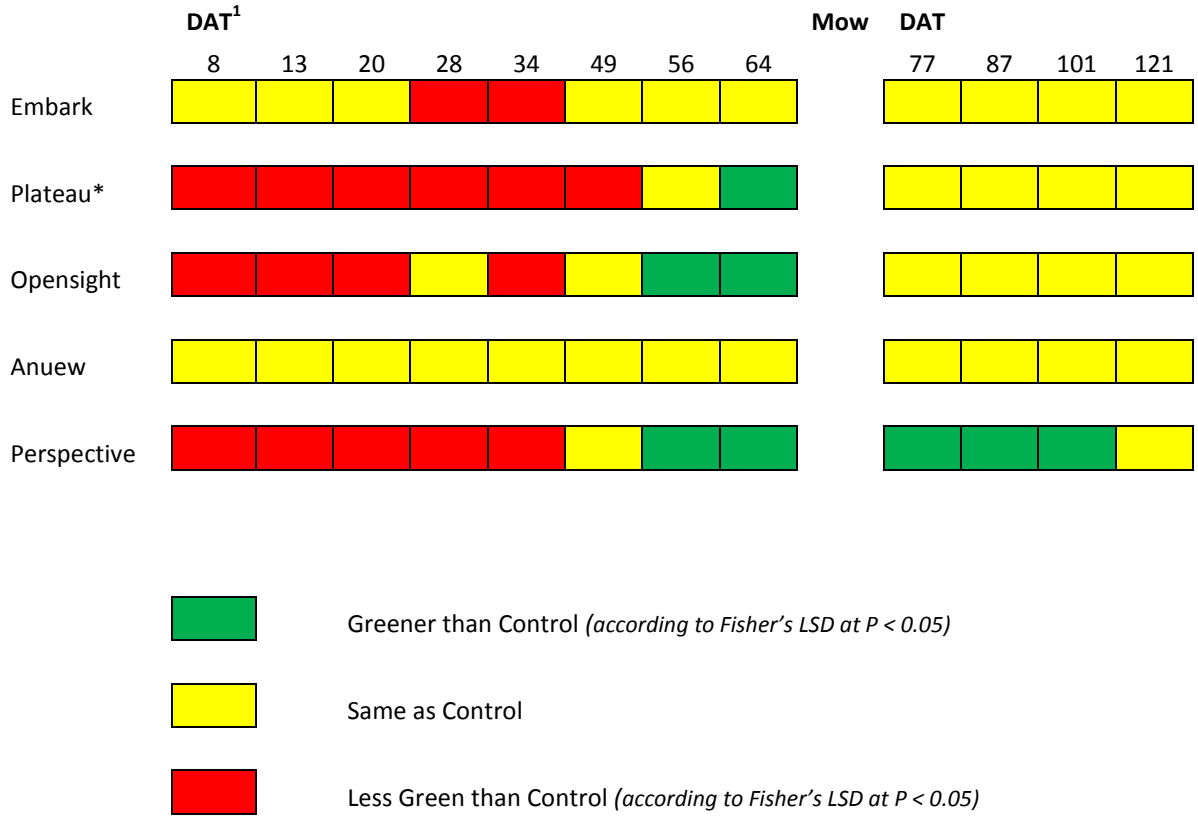
[1] *DAT = Days after treatment*

Figure 2. Summary of Fescue Height with Application after First Mowing for 3 Mowing Cycles per Year



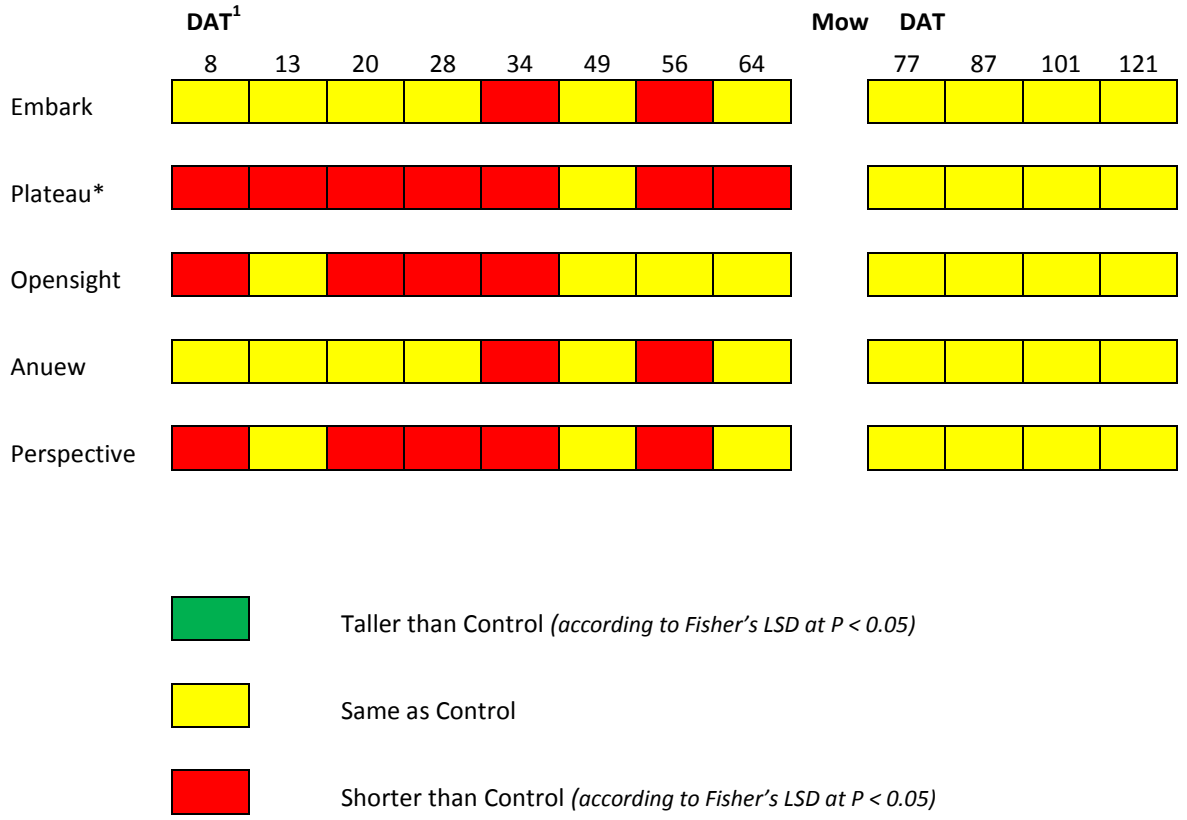
[1] *DAT = Days after treatment*

Figure 3. Summary of Turf Color with Application after Second Mowing for 3 Mowing Cycles per Year



[1] *DAT = Days after treatment*

Figure 4. Summary of Fescue Height with Application after Second Mowing for 3 Mowing Cycles per Year



[1] *DAT = Days after treatment*

Table 4. Herbicide Treatments, Turf Color and Fescue Height for Plots with 1 Mowing Cycles per Year

Product (s)	Rate (per Acre)	Timing	June 14, 2016			August 16, 2016		October 28, 2016	
			Color (0-9)	Ht (in)	Lodging (%)[4]	Color (0-9)	Ht (in)	Color (0-9)	Ht (in)
			21 DAT1[1]			84 DAT1 (28 DAT2[2])		157 DAT1 (22 DAT3[3])	
Embark 2S	24 fl oz	after first mowing	8.0	46 ab[5]	0 b	8.0 a	18 bcd	8.0 ab	14 abc
Formula 40	2 qt	after second mowing				7.7 ab	18 cd	8.0 ab	14 ab
		after third mowing						8.0 ab	14 ab
Plateau *	12 fl oz	after first mowing	8.0	44 bc	0 b	8.0 a	22 a	8.0 ab	14 ab
Formula 40	2 qt	after second mowing				5.0 c	16 d	8.1 a	15 ab
		after third mowing						7.7 d	13 d
Opensight	2.5 oz	after first mowing	8.0	44 bc	21 a	8.0 a	23 a	8.0 ab	14 bcd
		after second mowing				7.0 b	17 d	8.1 a	14 ab
		after third mowing						7.9 bc	14 bcd
Anuew	1 lb	after first mowing	8.0	44 bc	0 b	8.0 a	21 ab	8.0 ab	14 ab
Formula 40	2 qt	after second mowing				8.0 a	21 abc	8.0 ab	15 a
		after third mowing						8.0 ab	14 bcd
Perspective	4.75 oz	after first mowing	8.0	41 c	0 b[6]	8.0 a	21 a	8.0 ab	14 ab
		after second mowing				7.0 b	17 d	8.1 a	15 a
		after third mowing						7.8 c	13 cd
Unsprayed Control			8.0	49 a	0 b	8.0 a	23 a	8.0 ab	15 a

* Rate should have been 4 fl oz

[1] *DAT1 = Days after treatment after first mowing*

[2] *DAT2 = Days after application after second mowing*

[3] *DAT3 = Days after application after third mowing*

[4] *Lodging (%) range from 0% (erect and full height) to 100% (flat on ground)*

[5] *Means within a column followed by the same letter are not different according to Fisher's LSD at P < 0.05.*

[6] *Seedhead fill appeared to be less in these plots*

Figure 5: Monthly Precipitation and Deviations from Long Term Average (inches) for 2016 for Climate Division 3