

Noncrop and Invasive Vegetation Management Weed Science

2019 Annual Research Report



**UNIVERSITY
OF KENTUCKY**

**College of Agriculture
Department of Plant and Soil Sciences**

J.A. Omielan, G. Munshaw

**University of Kentucky
College of Agriculture
Department of Plant and Soil Sciences
Lexington, KY 40546-0312**

INFORMATION NOTE 2019 NCVN-1

Table of Contents

Forward	i
Acknowledgements	ii
Species List	iii
Herbicide List	iv
2019 Weather Summary	vi
2018 Cable Barrier Bareground Trial in Louisville (including 2019 assessment).....	1
2019 Cable Barrier Bareground Trial in Louisville	23
2018 PGR Options for Tall Fescue Management (2019 assessments).....	35
2018 Johnsongrass Control Trial in Bowling Green (including 2019 assessment).....	41
2019 Johnsongrass Control Trial at Georgetown	46
2019 Fescue Damage by Johnsongrass Control Options	50
2018 Poison Hemlock Control Trial near Richmond (including 2019 assessment).....	54
2018 Selective Broadleaf Control Trial near Richmond (including 2019 assessment).....	60
2019 Selective Broadleaf Control Trial near Richmond	64
Posters Presented at Meetings	68
Field Days / Workshops	69

Forward

The information provided in this document represents a collaborative effort between the Roadside Environment Branch of the Kentucky Transportation Cabinet and the Department of Plant and Soil Sciences in the College of Agriculture at the University of Kentucky. The main priority of this project was to collect and disseminate information to the KTC REB to increase the efficiency of operations aimed at roadside environment management.

This report contains a summary of research conducted during the 2019 season. This document is primarily for the use of the Kentucky Transportation Cabinet. Other use is allowable if proper credit is given to the authors.

Direct any questions, concerns, complaints, or praise regarding this publication to:

Dr. Joe Omielan
Research Scientist I

Dr. Gregg Munshaw
Associate Professor, Turf Science

University of Kentucky
College of Agriculture
Department of Plant and Soil Science
105 Plant Science Building
Lexington, KY 40546-0312
859-257-5020

Acknowledgements

The Kentucky Transportation Cabinet funded the majority of the research conducted during the 2019 season. A special recognition must go to P. David Cornett, Mike Smith, and others at the Central Office in Frankfort for supporting this research effort. Special acknowledgement must also go to the twelve district roadside environment managers and their crews for contribution of ideas and land to conduct part of this research.

Other personnel in the Weed Science and Turf Science groups who also aided in this project in terms of labor, equipment, and ideas include Charlie Slack, Sara Carter, Dr. J.D. Green, Ricky King, and Dr. Kenneth Cropper. Appreciation is also given to the farm crews at Spindletop Research Station for equipment and plot maintenance.

The research could not have been accomplished if not for the generous contributions of product. Contributors of product used include:

BASF Corporation
Bayer Crop Science
Dow AgroSciences
DuPont
Nufarm

We sincerely appreciate the effort and continued support of all our cooperators and look forward to future endeavors.

Species List

The following is a list of plant species discussed in the following document.

Scientific Name	Common Name
<i>Apocynum cannabinum</i>	Hemp Dogbane
<i>Capsella bursa-pastoris</i>	Shepherd's purse
<i>Chamaesyce maculate</i>	Prostrate spurge
<i>Cirsium arvense</i>	Canada Thistle
<i>Conium maculatum</i>	Poison Hemlock
<i>Cyndon dactylon</i> (L.) Pers.	Bermuda Grass
<i>Dactylis glomerata</i>	Orchardgrass
<i>Digitaria sanguinalis</i>	Large crabgrass
<i>Dipsacus fullonum</i>	Common Teasel
<i>Festuca arundinaceum</i> (Schreb.) S.J. Darbyshire	Tall Fescue
<i>Lactuca serriola</i>	Prickly Lettuce
<i>Medicago lupulina</i> L.	Black Medic
<i>Plantago lanceolata</i> L.	Buckhorn Plantain
<i>Poa pratensis</i> L.	Kentucky Bluegrass
<i>Setaria faberi</i> Herrm.	Giant Foxtail
<i>Setaria pumila</i> (Poir.) Roem. & Schult.	Yellow Foxtail
<i>Sorghum halepense</i> (L.) Pers.	Johnsongrass
<i>Trifolium pratense</i>	Red clover
<i>Trifolium repens</i>	White clover
<i>Vicia</i> sp.	Vetch

Herbicide List

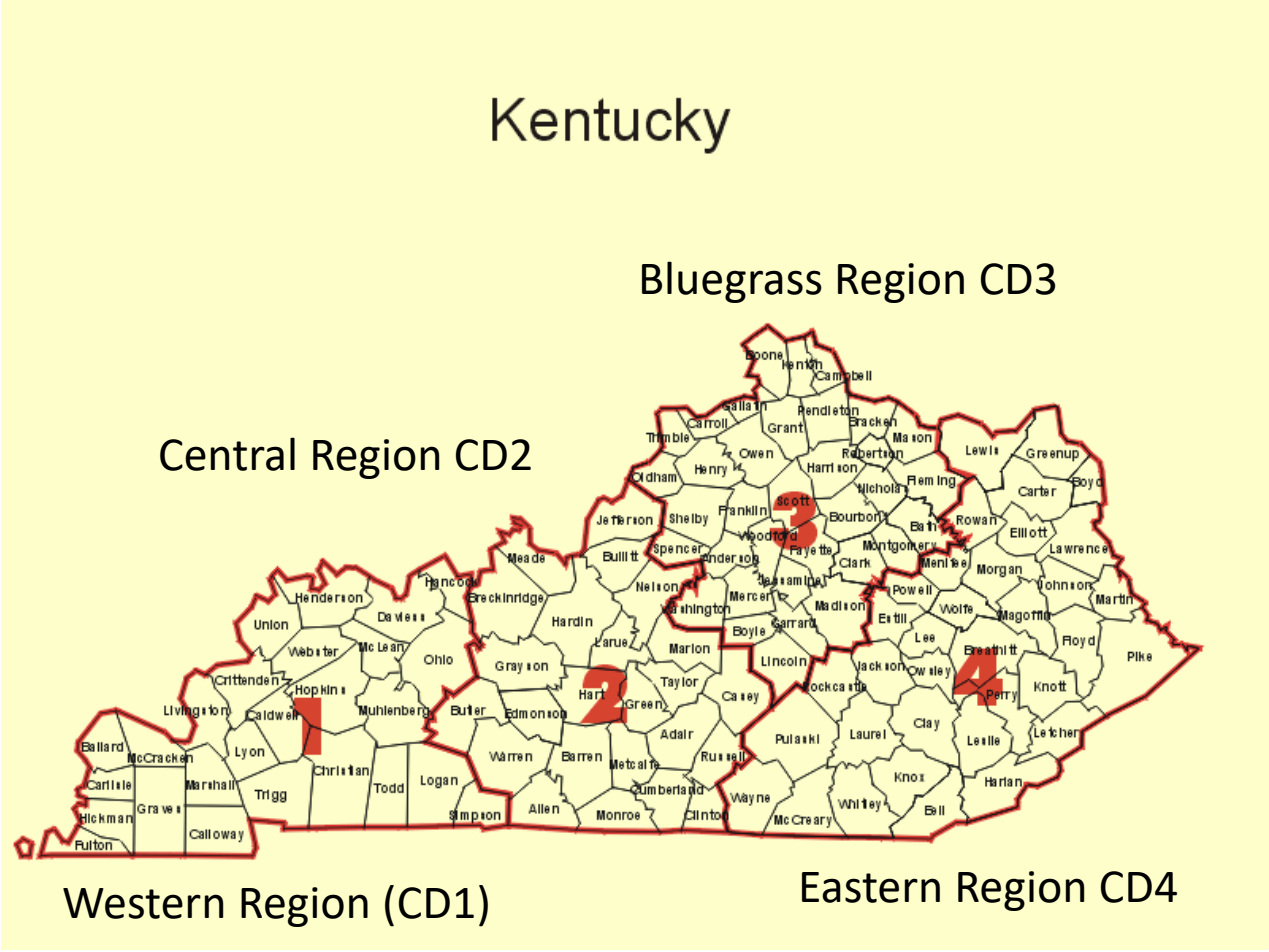
The following is a list of herbicides discussed in the following document.

Product	Active Ingredient(s)	Concentration	Manufacturer
Acclaim Extra	fenoxaprop	0.57 lb per gallon	Bayer
Aneuw	prohexadione calcium	27.5% w/w	Nufarm
Cleantraxx	penoxsulam + oxyfluorfen	0.083 lb + 3.93 lb per gallon	Dow AgroSciences
Clearcast	imazamox	1 lb ae per gallon	BASF
Detail	saflufenacil	2.85 lb per gallon	BASF
DMA 4	2,4-D	3.8 lb ae per gallon	Dow AgroSciences
Embark 2-S	mefluidide	2.0 lb ae per gallon	PBI Gordon
Escort XP	metsulfuron methyl	60% w/w	DuPont
Esplanade	indaziflam	1.67 lb per gallon	Bayer
Freelexx	2,4-D	3.8 lb ae per gallon	Dow AgroSciences
Fusilade II	fluazifop	2 lb per gallon	Syngenta
Fusion	fluazifop + fenoxaprop	2 lb + 0.56 lb per gallon	Syngenta
Garlon 3A	triclopyr	3 lb ae per gallon	Dow AgroSciences
Hyvar X	bromacil	80% w/w	DuPont
Journey	imazapic + glyphosate	0.75 lb ae + 1.5 lb ae per gallon	BASF
Method	aminocyclopyrachlor	2 lb ae per gallon	Bayer
Milestone VM	aminopyralid	2 lb ae per gallon	Dow AgroSciences
MSMA	monosodium acid methanearsonate	6 lb per gallon	Drexel
Opensight	aminopyralid + metsulfuron	0.525 lb ae + 0.0945 lb ae per gallon	Dow AgroSciences
Oust XP	sulfometuron	75% w/w	DuPont
Oust Extra	sulfometuron + metsulfuron	56.25% + 15% w/w	DuPont
Outrider	sulfosulfuron	75% w/w	Monsanto
Overdrive	diflufenzopyr + dicamba	0.2 lb ae + 0.5 lb ae per gallon	BASF
Perspective	aminocyclopyrachlor + chlorsulfuron	39.5% + 15.8% w/w	DuPont
Polaris AC Complete	imazapyr	4 lb ae per gallon	Nufarm
Plateau	imazapic	2 lb ae per gallon	BASF
Proclipse	prodiamine	65% w/w	Nufarm
Pyresta	2,4-D + pyraflufen-ethyl	3.5 lb ae + 0.0177 lb per gallon	Nichino America
Rodeo	glyphosate	4 lb ae per gallon	Dow AgroSciences

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

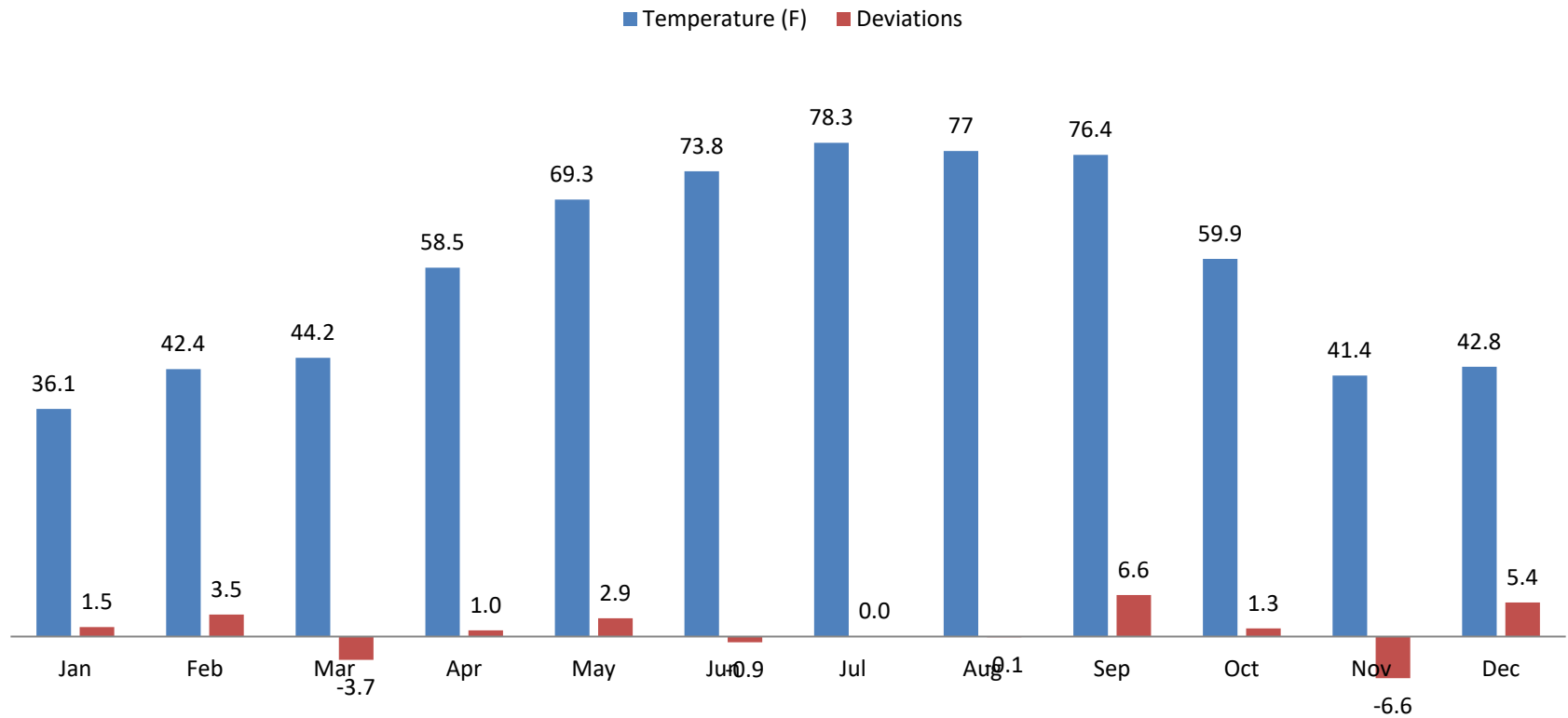
Roundup ProMax	glyphosate	4.5 lb ae per gallon	Monsanto
Sahara	diuron + imazapyr	62.22% + 7.78% w/w	BASF
Select Max	clethodim	0.97 lb per gallon	Valent
Solution Water Soluble	2,4-D	80.5% ae w/w	Nufarm
Streamline	aminocyclopyrachlor + metsulfuron methyl	39.5% + 12.6% w/w	DuPont
Vastlan	triclopyr	4 lb ae per gallon	Dow AgroSciences
Viewpoint	imazapyr + aminocyclopyrachlor + metsulfuron	31.6% + 22.8% + 7.3% w/w	DuPont

Map of Kentucky Climate Divisions



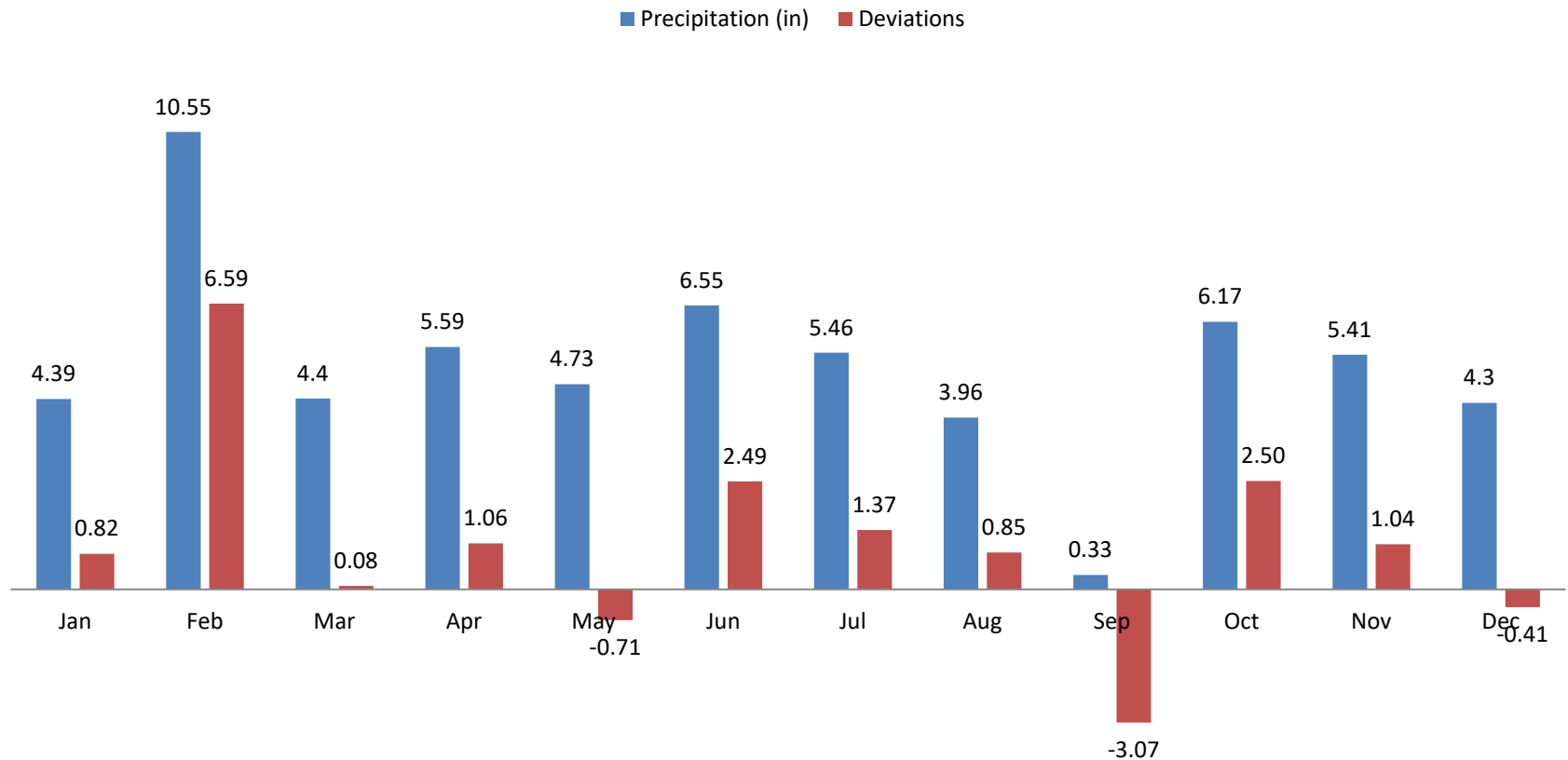
Western Region (CD1) Monthly Temperatures and Deviations from Normal (UKWAC)

Summary for 2019 (CD1)



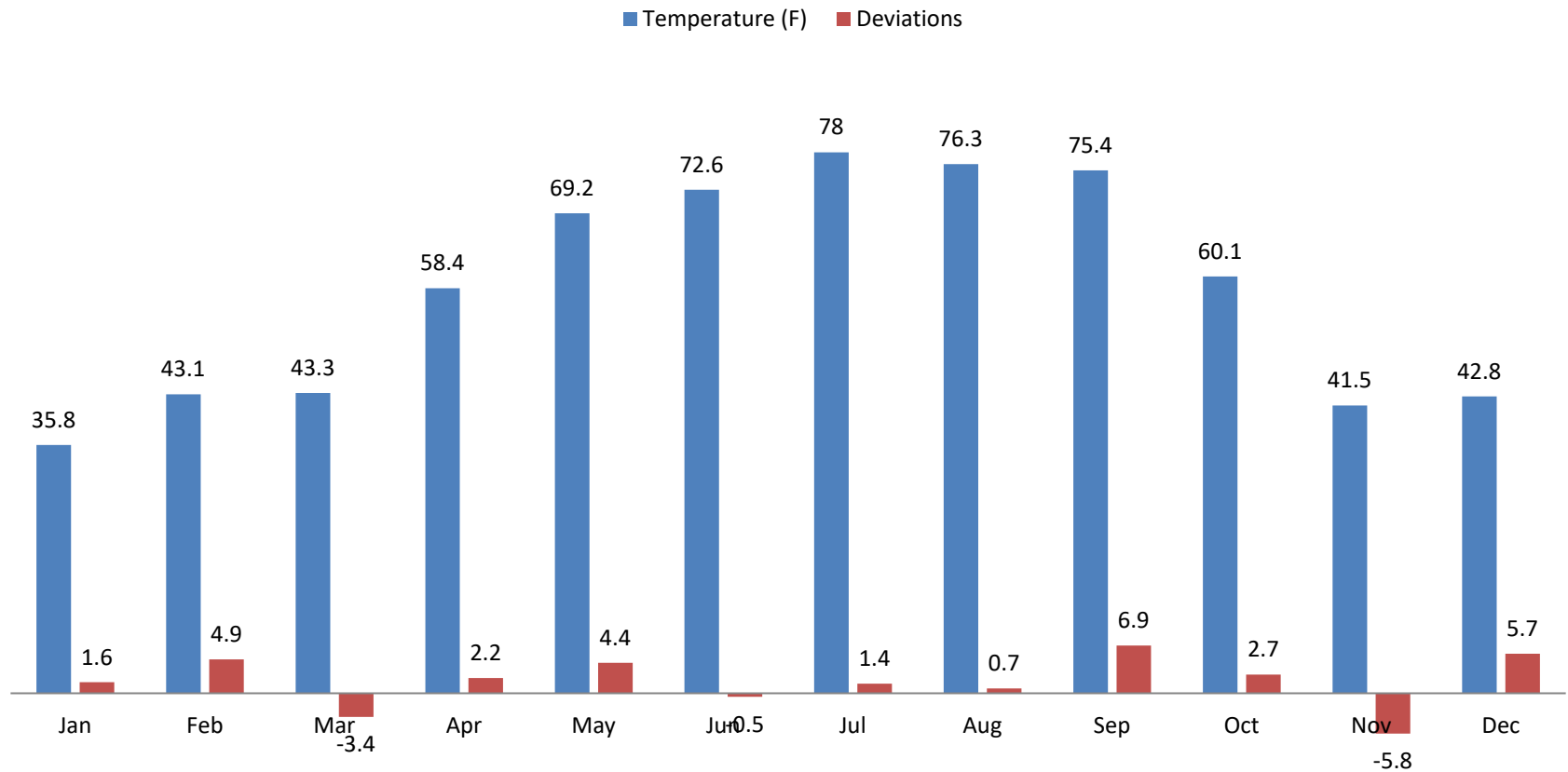
Western Region (CD1) Monthly Precipitation and Deviations from Normal (UKWAC)

Summary for 2019 (CD1)



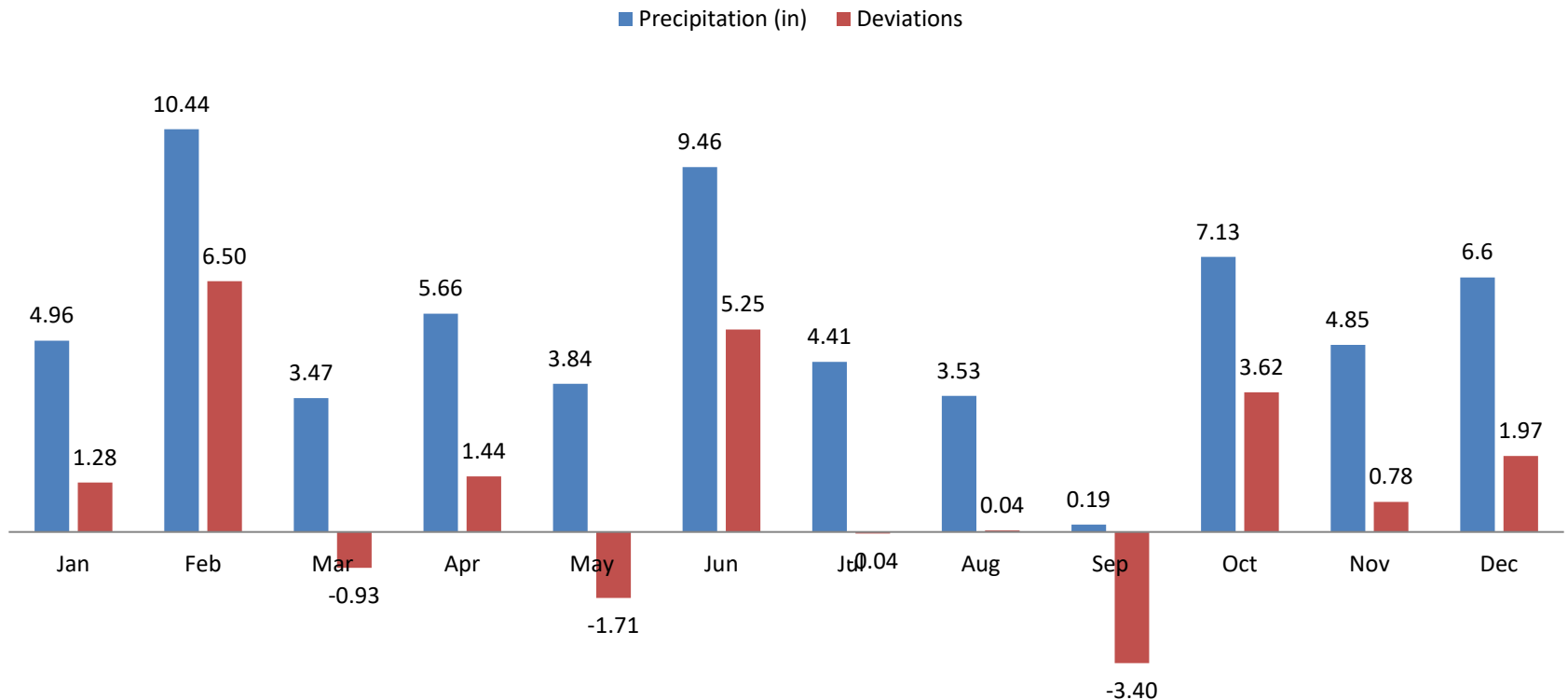
Central Region (CD2) Monthly Temperatures and Deviations from Normal (UKWAC)

Summary for 2019 (CD2)



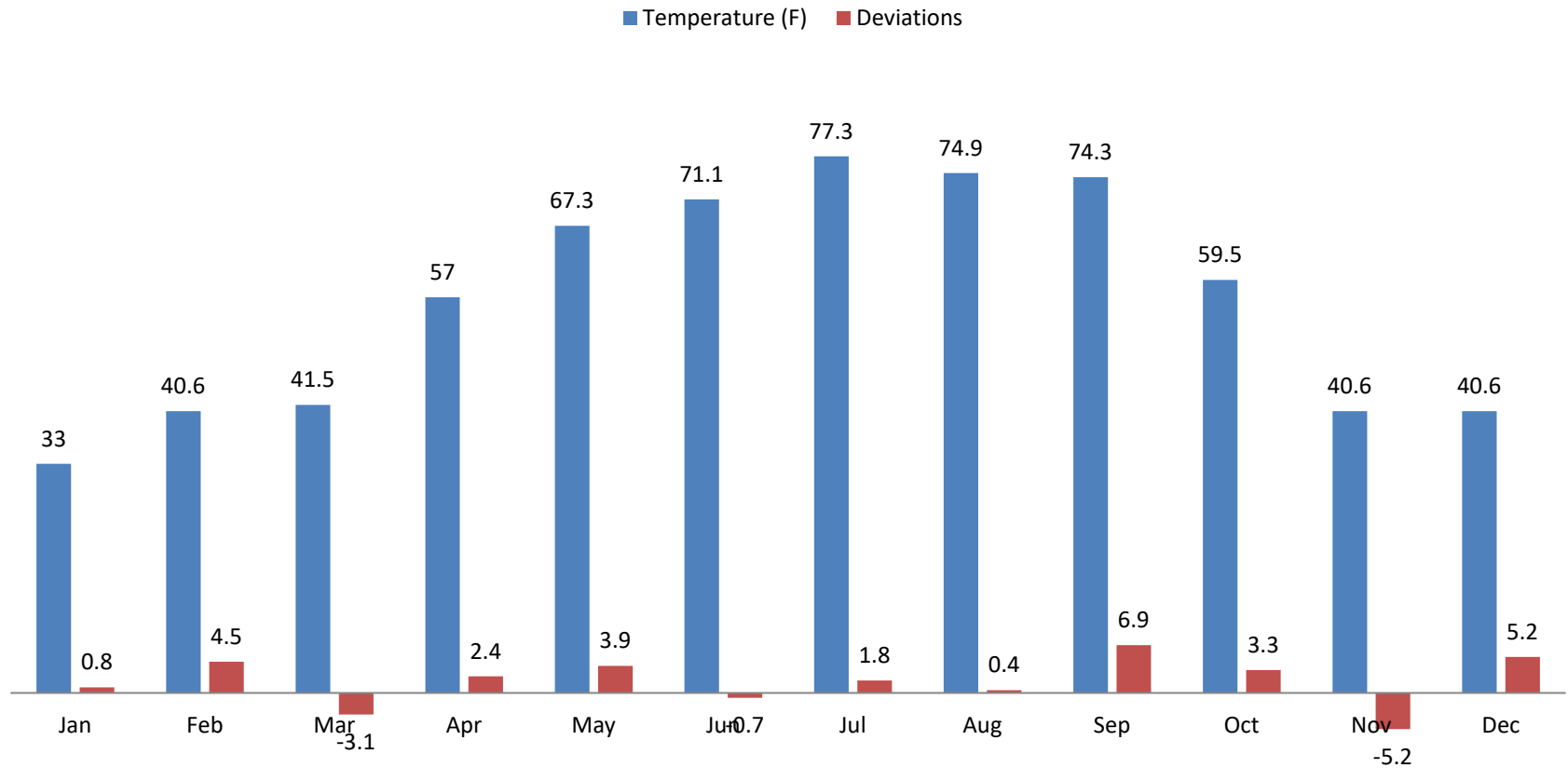
Central Region (CD2) Monthly Precipitation and Deviations from Normal (UKWAC)

Summary for 2019 (CD2)



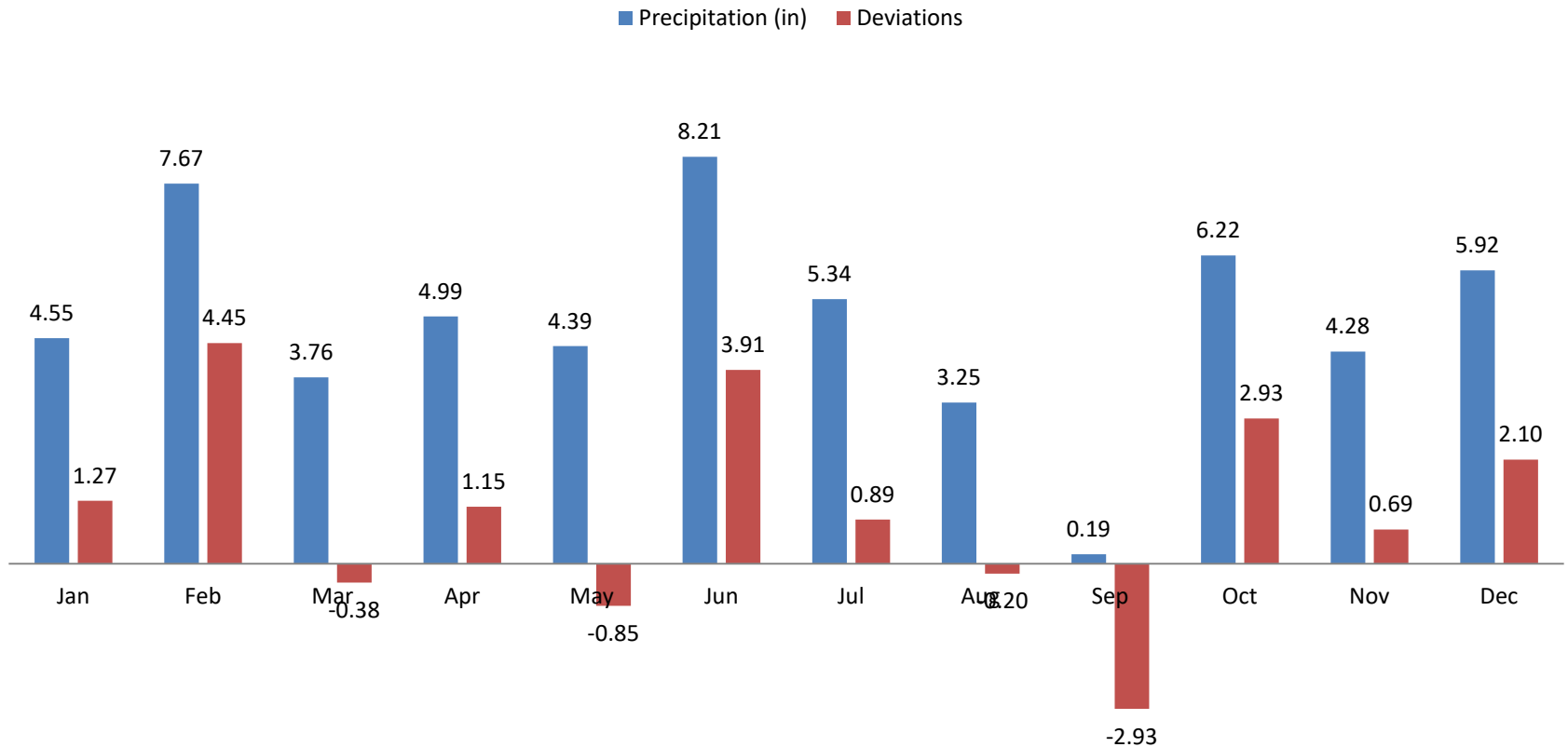
Bluegrass Region (CD3) Monthly Temperatures and Deviations from Normal (UKWAC)

Summary for 2019 (CD3)



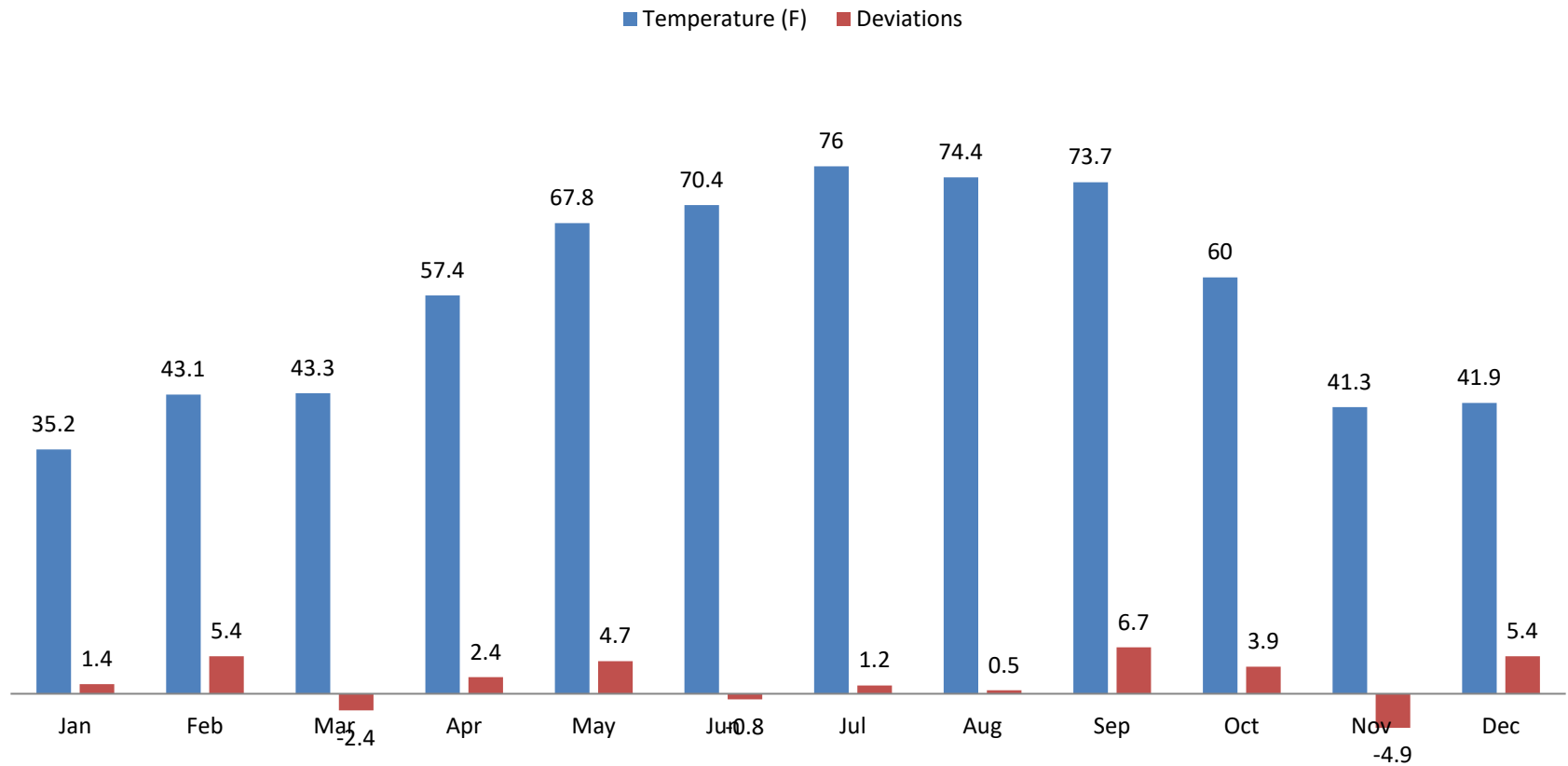
Bluegrass Region (CD3) Monthly Precipitation and Deviations from Normal (UKWAC)

Summary for 2019 (CD3)



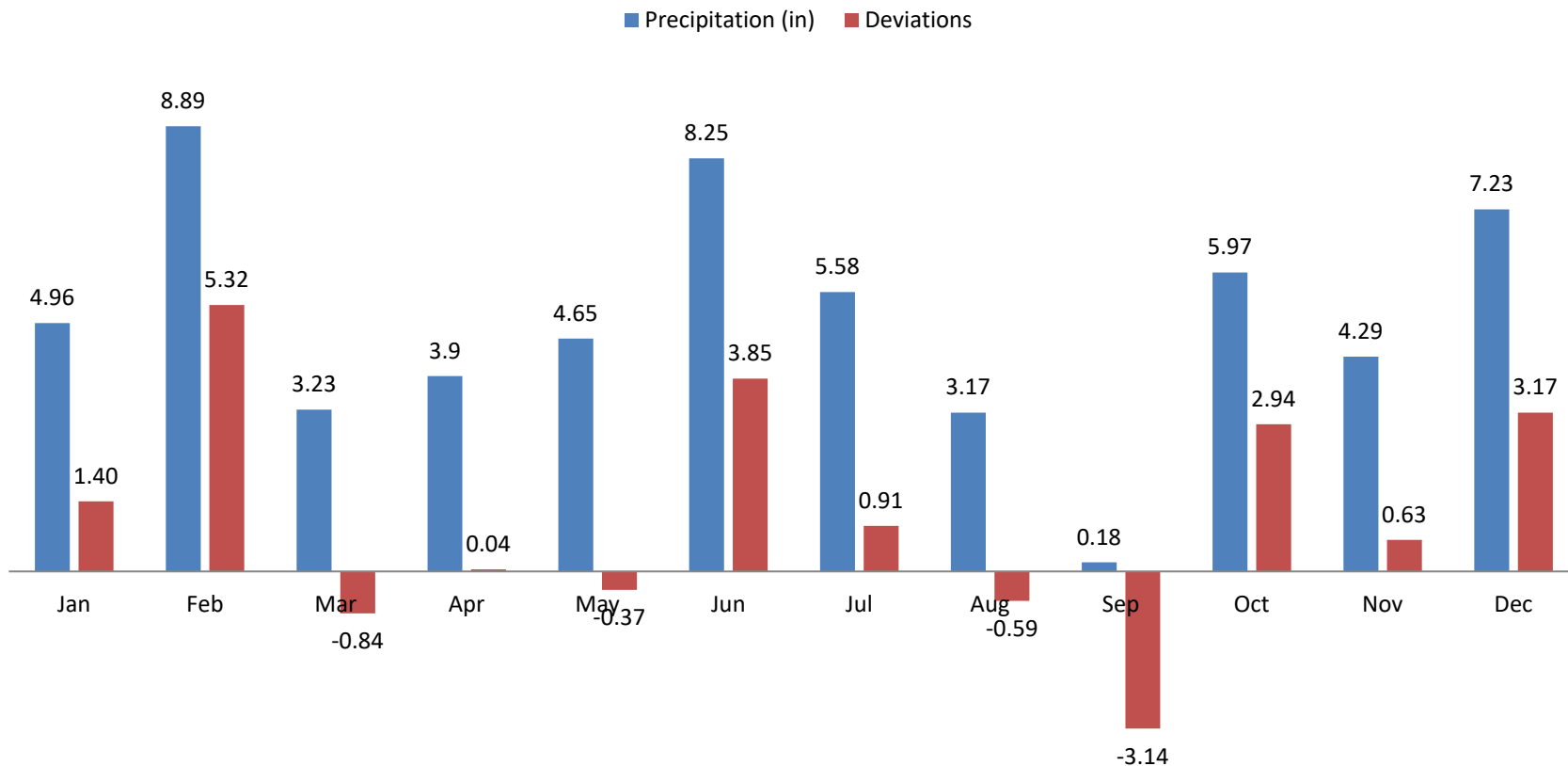
Eastern Region (CD4) Monthly Temperatures and Deviations from Normal (UKWAC)

Summary for 2019 (CD4)



Eastern Region (CD4) Monthly Precipitation and Deviations from Normal (UKWAC)

Summary for 2019 (CD4)



2018 Cable Barrier Bareground Trial in Louisville (including 2019 assessment)

Introduction

Median cable barriers are designed to protect drivers from crossover accidents on interstates and highways. However, the vegetation under and adjacent to them must be managed for safety and aesthetics. Usually, this means using herbicides to maintain a vegetation free (bare ground) zone underneath the barriers. Broad-spectrum soil applied preemergence residual herbicides, in combination with a broad-spectrum post emergence herbicide like glyphosate, are the mainstay for maintaining these bare ground zones. However, there may be turf adjacent to the bare ground zone that should be maintained. Ideally, the residual herbicides will last all season long (even into early the next spring) and not move off-site by leaching or erosion (movement of soil particles with adsorbed herbicide).

This trial was part of an ongoing effort to evaluate the vegetation control efficacy and desirable turf damage potential of a range of herbicide options when used for vegetation management under cable barriers.

Materials and Methods

The trial was established in the median of I-265 in Louisville, KY under and beside a cable barrier with a mixed stand of turf species. The 18 herbicide treatments and 3 replications were arranged in a randomized complete block design. Treatments were applied at 25 gallons per acre onto 6.5 ft wide by 20 ft long plots on May 23, 2018. All treatments, except Roundup ProMax alone (Treatment 1) included Activator 90 non-ionic surfactant at 0.25% v/v (Table 1a and 1b). Roundup ProMax (glyphosate) has no residual activity so other herbicides were included in the combination treatments to provide residual and pre-emergent control for the bare ground treatments. Different herbicide combinations also broadened the weed spectrum controlled and reduced the risk of developing problems with resistant weeds by using different Mechanisms of Action (MOA) groups (Table 1a and 1b). The trial included treatments which have been long term “standards” as well as newer products and combinations currently being used in KY. New treatments this year included Detail (saflufenacil) (Treatment 16) and one without glyphosate designed to control broadleaf weeds and suppressing grass growth behind guardrails (Treatment 17). Detail may be useful in areas with sensitive crops nearby as it is less likely to move off-target due to volatility but can be less persistent than other herbicides. It should be noted that the label recommends the use of MSO for accelerated burndown at 2 fl oz/ac in combination with glyphosate, however, Treatment 16 was applied with a non-ionic surfactant. The label also recommends the 6 fl oz/ac rate for residual control. This treatment combination will be included in next year’s trial.

The Louisville weather station reported 0.53 inches of rain over May 27 and 28 which should have activated the soil residual herbicide treatments. Additional rainfall was recorded from May 29 to June 1 (1.75 inches). These rainfall events may have contributed to the movement of some herbicide treatments from their application site and damaged adjacent turf (Figures 1 to 5). Species present at application included flowering Buckhorn plantain (7 inch canopy), flowering

tall fescue (24 inches to seedhead) plus Kentucky bluegrass which had mature seed heads (20 inches to seedhead).

Visual ratings of the proportion (%) of bare ground cover were taken 41 days after treatment (DAT) (7/3/2018) along with a rating of the extent of turf damage beyond the initial spray pattern, ranging from 0 (none) to 3 (severe). Visual assessments of the proportion (%) of bare ground, perennial grasses, annual grasses, and broadleaf weeds were taken 72 DAT (8/3/2018), 119 DAT (9/19/2018), and 153 DAT (10/23/2018) DAT. The last rating in 2018 was done after a hard freeze when many of the annual broadleaf plants, such as prostrate spurge, were killed. The last evaluation for this trial was conducted in the spring of 2019, 342 DAT (4/30/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

All treatments with glyphosate (Treatments 1 to 16) had more bareground (35 to 100%) than those that did not (Treatments 17 and 18) (3 to 12%) 41 DAT (Tables 2a and 2b). Most of the treatments with soil active herbicides were in the top grouping (Treatments 2 to 14) (83 to 100%) except for Treatments 15 and 16 (35 to 75%). A number of treatments had turf damage [>0.5 to <2.0] consistent with movement of herbicides beyond the initial spray pattern (Tables 2a and 2b). Treatments with similar damage ratings included Sahara (Treatment 2), Hyvar (Treatment 3), Oust XP (Treatments 4 and 9), Perspective + Proclipse (Treatment 6), Streamline + Esplanade + Plateau (Treatment 10), and two treatments with imazapyr (Treatments 7 and 8).

While most of the trial site had a mix of tall fescue and Kentucky bluegrass there were areas with fine fescues and bermudagrass. Their non-uniform distribution increased the plot by plot variability with some treatments. By 72 DAT some treatments had less bareground as perennial grasses recovered, annual grasses (mostly yellow foxtail), and broadleaves (mostly prostrate spurge) colonized the space (Tables 3a and 3b). Treatments in the top group for bareground (70 to 98%) included Sahara (Treatment 2), Hyvar (Treatment 3), Perspective + Proclipse (Treatment 6), Viewpoint + Esplanade (Treatment 7), AC Polaris Complete (Treatment 8), Esplanade + Oust (Treatment 9), Streamline + Esplanade + Plateau (Treatment 10), Method + Esplanade (Treatment 13) and Milestone + Esplanade (Treatment 14). Treatments with the lowest percentage of bareground were not different from control (2 to 13%) and included Roundup ProMax by itself (Treatment 1), Detail (Treatment 16), and Method + Plateau (Treatment 17). This last treatment did not have glyphosate applied and had the greatest perennial grass cover.

Later in the season (119 DAT) a greater percentage of annual grass and broadleaf cover was observed in more treatments. Treatments in the top group with high % bareground (58 to 85%) included Hyvar (Treatment 3), Viewpoint + Esplanade (Treatment 7), Oust + Esplanade (Treatment 9), Streamline + Esplanade + Plateau (Treatment 10), Method + Esplanade (Treatment 13), and Milestone + Esplanade (Treatment 14) (Tables 4a and 4b). Most the other treatments were not different from control (0 to 33%) except for Esplanade + Oust Extra (Treatment 15) (42%). Control plots were dominated by annual teff grass (90% cover). Detail (Treatment 16) had removed most of the perennial grass and had the most yellow foxtail cover

(43%) in the trial. The Cleantraxx treatments (11 and 12) did not have as much foxtail but did have the most prostrate spurge cover (69 to 72%) in the trial.

The last assessment in 2018, 153 DAT, was done after a hard freeze and many of the annuals were killed. The treatments with the greatest amount of bareground (60 to 88%) were the same as at the previous rating with the addition of the Cleantraxx treatments (11 and 12) after the natural death of much of the spurge cover (Tables 5a and 5b).

The last assessment for the trial was conducted in spring 2019, 342 DAT (Figure 6). Most of the herbicide treatments still displayed 42 to 73% bareground (Tables 6a and 6b). Treatments with the least bareground (0 to 30%) and similar to the control treatment included Oust (Treatment 4), Perspective + Esplanade (Treatment 5), Perspective + Proclipse (Treatment 6), Esplanade + Oust Extra (Treatment 15), Detail (Treatment 16), and the treatment without glyphosate (Method + Plateau) (Treatment 17). The treatments with the most grass cover (60 to 88%) were those without glyphosate, Method + Plateau (Treatment 17) and control (Treatment 18).

The vegetation under the cable barrier at this location gave a good test of how well some of these bare ground herbicides can perform over a season and into the next year (Figure 7). These trials will continue to provide information for roadside managers.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 1a. Herbicide Treatments, Active Ingredients, Application Rates, and Mechanism of Action (MOA) Groups for Cable Barrier Bareground Trial. (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)	MOA Groups
1	Roundup ProMax	1.3	QT/A	glyphosate	1.5 LB AE	9
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	glyphosate diuron + imazapyr	1.5 LB AE 6.2 LB + 12.4 OZ	9 7 + 2
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	glyphosate bromacil	1.5 LB AE 8 LB	9 5
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	glyphosate sulfometuron	1.5 LB AE 2.3 OZ	9 2
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	glyphosate aminocyclopyrachlor + chlorsulfuron indaziflam	1.5 LB AE 3.6 OZ + 1.4 OZ 0.7 OZ	9 4 + 2 29
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	glyphosate aminocyclopyrachlor + chlorsulfuron prodiamine	1.5 LB AE 3.6 OZ + 1.4 OZ 1.5 LB	9 4 + 2 3
7	Roundup ProMax Viewpoint Esplanade	1.3 18 3.5	QT/A OZ/A FL OZ/A	glyphosate aminocyclopyrachlor + imazapyr + metsulfuron indaziflam	1.5 LB AE 4.1 OZ + 5.7 OZ + 1.3 OZ 0.7 OZ	9 4 + 2 + 2 29
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	glyphosate imazapyr	1.5 LB AE 16 OZ AE	9 2
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	glyphosate indaziflam sulfometuron	1.5 LB AE 0.7 OZ 2.3 OZ	9 29 2
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	glyphosate aminocyclopyrachlor + metsulfuron indaziflam imazapic	1.5 LB AE 3.2 OZ + 1 OZ 1 OZ 1.3 OZ AE	9 4 + 2 29 2
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	glyphosate penoxsulam + oxyfluorfen aminopyralid	1.5 LB AE 0.5 OZ + 23.6 OZ 1.8 OZ AE	9 2 + 14 4
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	glyphosate penoxsulam + oxyfluorfen	1.5 LB AE 0.7 OZ + 35.4 OZ	9 2 + 14

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 1b. Herbicide Treatments, Active Ingredients, Application Rates, and Mechanism of Action (MOA) Groups for Cable Barrier Bareground Trial (Part 2 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)	MOA Groups
13	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE	4
	Esplanade	5	FL OZ/A	indaziflam	1 OZ	29
14	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Esplanade	6	FL OZ/A	indaziflam	1.3 OZ	29
	Milestone VM	7	FL OZ/A	aminopyralid	1.8 OZ AE	4
15	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Esplanade	3.5	FL OZ/A	indaziflam	0.7 OZ	29
	Oust Extra	1.5	OZ/A	sulfometuron + metsulfuron	0.8 OZ + 0.2 OZ	2 + 2
16	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Detail	2	FL OZ/A	saflufenacil	0.7 OZ	14
17	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE	4
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE	2
18	Nontreated Check					

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2a. Results for Cable Barrier Trial 41 DAT¹ (July 3, 2018) (Part 1 of 2)

				% Bareground	Turf Damage (0-3) ³
Trt. No.	Product Name*	Rate	ate Unit	41 DAT	
1	Roundup ProMax	1.3	QT/A	70 c ²	0.0 c
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	100 a	1.3 ab
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	100 a	1.3 ab
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	83 abc	1.0 abc
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	79 abc	0.3 bc
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	94 ab	0.7 abc
7	Roundup ProMax Viewpoint Esplanade	1.3 18 3.5	QT/A OZ/A FL OZ/A	98 a	1.0 abc
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	98 a	1.7 a
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	99 a	1.7 a
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	83 abc	0.7 abc
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	97 a	0.0 c
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	98 a	0.0 c

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment ² Means within a column followed by the same letter are not different according to Fisher's LSD at P < 0.05.

³ Turf damage based on a scale that ranged from 0 (none) to 3 (severe)

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2b. Results for Cable Barrier Trial 41 DAT¹ (July 3, 2018) (Part 2 of 2)

				% Bareground	Turf Damage (0-3) ³
Trt. No.	Product Name*	Rate	Rate Unit	41 DAT	
13	Rodeo	1.5	QT/A	91 ab ²	0.3 bc
	Method	12	FL OZ/A		
	Esplanade	5	FL OZ/A		
14	Rodeo	1.5	QT/A	87 abc	0.0 c
	Esplanade	6	FL OZ/A		
	Milestone VM	7	FL OZ/A		
15	Rodeo	1.5	QT/A	75 bc	0.3 bc
	Esplanade	3.5	FL OZ/A		
	Oust Extra	1.5	OZ/A		
16	Rodeo	1.5	QT/A	35 d	0.0 c
	Detail	2	FL OZ/A		
17	Method	12	FL OZ/A	12 e	0.0 c
	Plateau	3	FL OZ/A		
18	Nontreated Check			3 e	0.0 c

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

³ Turf damage based on a scale that ranged from 0 (none) to 3 (severe)

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 3a. Results for Cable Barrier Trial 72 DAT¹ (August 3, 2018) (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	72 DAT				
				% Bareground	% Annual Grass	% Perennial Grass	% Broadleaves	% Spurge
1	Roundup ProMax	1.3	QT/A	12 ef ²	22 c	0 d	65 a	63 a
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	97 a	1 d	0 d	2 fg	2 f
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	98 a	0 d	0 d	1 g	1 f
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	53 bcd	6 d	35 bc	6 fg	5 f
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	49 cd	5 d	45 ab	1 fg	1 f
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	75 abc	7 d	12 cd	6 fg	6 f
7	Roundup ProMax Viewpoint Esplanade	1.3 18 3.5	QT/A OZ/A FL OZ/A	96 a	2 d	0 d	2 fg	2 f
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	70 abc	4 d	0 d	26 de	24 de
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	93 a	2 d	0 d	5 fg	1 f
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	70 abc	2 d	26 bcd	2 fg	2 f
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	33 de	7 d	0 d	60 ab	60 ab
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	55 bcd	5 d	0 d	40 cd	38 cd

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 3b. Results for Cable Barrier Trial 72 DAT¹ (August 3, 2018) (Part 2 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	72 DAT				
				% Bareground	% Annual Grass	% Perennial Grass	% Broadleaves	% Spurge
13	Rodeo	1.5	QT/A	83 ab ²	3 d	11 cd	3 fg	3 f
	Method	12	FL OZ/A					
	Esplanade	5	FL OZ/A					
14	Rodeo	1.5	QT/A	72 abc	4 d	11 cd	12 efg	12 ef
	Esplanade	6	FL OZ/A					
	Milestone VM	7	FL OZ/A					
15	Rodeo	1.5	QT/A	53 bcd	2 d	35 bc	10 fg	5 f
	Esplanade	3.5	FL OZ/A					
	Oust Extra	1.5	OZ/A					
16	Rodeo	1.5	QT/A	8 ef	37 b	8 cd	47 bc	47 bc
	Detail	2	FL OZ/A					
17	Method	12	FL OZ/A	13 ef	7 d	71 a	9 fg	6 f
	Plateau	3	FL OZ/A					
18	Nontreated Check			2 f	60 a	23 bcd	17 ef	10 ef

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 4a. Results for Cable Barrier Trial 119 DAT¹ (September 19, 2018) (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	119 DAT					
				% Bareground	% Annual Grass	% Yellow Foxtail	% Perennial Grass	% Broadleaves	% Spurge
1	Roundup ProMax	1.3	QT/A	5 e ²	35 c	25 b	0 d	60 ab	28 bcdef
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	33 bcde	12 def	8 cde	0 d	55 abc	33 bc
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	60 abc	6 f	2 de	3 d	30 cde	29 bcde
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	22 de	28 cd	22 bc	37 abcd	13 def	9 cdefg
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	30 cde	12 def	12 bcde	57 ab	2 f	1 g
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	30 cde	25 cde	17 bcde	23 bcd	22 def	22 bcdefg
7	Roundup ProMax Viewpoint Esplanade	1.3 18 3.5	QT/A OZ/A FL OZ/A	85 a	6 f	6 cde	2 d	7 def	7 cdefg
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	20 de	20 cdef	13 bcde	0 d	60 ab	40 b
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	83 a	7 f	7 cde	0 d	9 def	1 g
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	58 abc	6 f	4 de	33 abcd	3 ef	3 efg
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	9 de	12 def	10 bcde	0 d	78 a	72 a
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	18 de	10 ef	8 cde	0 d	72 a	69 a

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 4b. Results for Cable Barrier Trial 119 DAT¹ (September 19, 2018) (Part 2 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	119 DAT					
				% Bareground	% Annual Grass	% Yellow Foxtail	% Perennial Grass	% Broadleaves	% Spurge
13	Rodeo	1.5	QT/A	82 a ²	5 f	2 e	12 cd	2 f	1 g
	Method	12	FL OZ/A						
	Esplanade	5	FL OZ/A						
14	Rodeo	1.5	QT/A	67 ab	3 f	1 e	6 cd	24 def	24 bcdefg
	Esplanade	6	FL OZ/A						
	Milestone VM	7	FL OZ/A						
15	Rodeo	1.5	QT/A	42 bcd	6 f	6 cde	43 abc	11 def	2 fg
	Esplanade	3.5	FL OZ/A						
	Oust Extra	1.5	OZ/A						
16	Rodeo	1.5	QT/A	5 e	53 b	43 a	8 cd	33 bcd	32 bcd
	Detail	2	FL OZ/A						
17	Method	12	FL OZ/A	3 e	20 cdef	8 cde	70 a	7 def	6 defg
	Plateau	3	FL OZ/A						
18	Nontreated Check			0 e	90 a	18 bcd	3 d	7 def	7 cdefg

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 5a. Results for Cable Barrier Trial 153 DAT¹ (October 23, 2018) (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	% Bareground	% Annual Grass	% Perennial Grass	% Broadleaves
				153 DAT			
1	Roundup ProMax	1.3	QT/A	38 bcde ²	50 b	0 d	12 cd
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	38 bcde	12 cd	0 d	50 ab
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	63 ab	8 cd	7 d	22 bcd
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	18 def	8 cd	52 ab	22 bcd
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	28 bcdef	7 cd	58 ab	3 d
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	35 bcdef	17 cd	28 bcd	20 cd
7	Roundup ProMax Viewpoint Esplanade	1.3 18 3.5	QT/A OZ/A FL OZ/A	83 a	8 cd	5 d	3 d
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	22 cdef	24 c	0 d	54 a
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	83 a	7 cd	1 d	9 cd
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	58 abc	6 cd	33 bcd	2 d
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	82 a	4 cd	2 d	12 cd
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	60 ab	3 d	1 d	37 abc

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 5b. Results for Cable Barrier Trial 153 DAT¹ (October 23, 2018) (Part 2 of 2)

				% Bareground	% Annual Grass	% Perennial Grass	% Broadleaves
Trt. No.	Product Name*	Rate	Rate Unit	153 DAT			
13	Rodeo	1.5	QT/A	85 a ²	3 d	10 cd	2 d
	Method	12	FL OZ/A				
	Esplanade	5	FL OZ/A				
14	Rodeo	1.5	QT/A	85 a	5 cd	10 cd	0 d
	Esplanade	6	FL OZ/A				
	Milestone VM	7	FL OZ/A				
15	Rodeo	1.5	QT/A	40 bcd	3 d	51 abc	6 d
	Esplanade	3.5	FL OZ/A				
	Oust Extra	1.5	OZ/A				
16	Rodeo	1.5	QT/A	15 def	52 b	22 bcd	12 cd
	Detail	2	FL OZ/A				
17	Method	12	FL OZ/A	2 ef	13 cd	84 a	1 d
	Plateau	3	FL OZ/A				
18	Nontreated Check			0 f	88 a	2 d	10 cd

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 6a. Results for Cable Barrier Trial 342 DAT¹ (April 30, 2019) (Part 1 of 2)

				% Bareground	% Grass	% Broadleaves
Trt. No.	Product Name*	Rate	Rate Unit	342 DAT		
1	Roundup ProMax	1.3	QT/A	42 abcd ²	18 defg	40 abcde
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	40 bcde	2 g	58 a
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	43 abcd	5 fg	52 abc
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	17 def	37 bcdef	47 abcd
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	18 def	52 bc	30 abcde
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	30 cdef	30 bcdefg	40 abcde
7	Roundup ProMax Viewpoint Esplanade	1.3 18 3.5	QT/A OZ/A FL OZ/A	73 a	7 efg	20 cde
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	42 abcd	2 g	58 ab
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	67 ab	2 g	32 abcde
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	43 abcd	38 bcde	18 de
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	63 ab	12 efg	25 bcde
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	63 ab	8 efg	28 abcde

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 6b. Results for Cable Barrier Trial 342 DAT¹ (April 30, 2019) (Part 2 of 2)

				% Bareground	% Grass	% Broadleaves
Trt. No.	Product Name*	Rate	Rate Unit	342 DAT		
13	Rodeo	1.5	QT/A	55 abc ²	28 bcdefg	17 de
	Method	12	FL OZ/A			
	Esplanade	5	FL OZ/A			
14	Rodeo	1.5	QT/A	63 ab	23 cdefg	14 e
	Esplanade	6	FL OZ/A			
	Milestone VM	7	FL OZ/A			
15	Rodeo	1.5	QT/A	27 cdef	45 bcd	28 abcde
	Esplanade	3.5	FL OZ/A			
	Oust Extra	1.5	OZ/A			
16	Rodeo	1.5	QT/A	8 ef	32 bcdefg	60 a
	Detail	2	FL OZ/A			
17	Method	12	FL OZ/A	2 f	88 a	10 e
	Plateau	3	FL OZ/A			
18	Nontreated Check			0 f	60 ab	40 abcde

*All herbicide treatments (except trt. #1) contained the adjuvant, Activator 90 at 0.25% v/v.

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 1: View of Plots in the Cable Barrier Trial on July 3, 2018 (41 Days After Treatment)

Note evidence of herbicide movement from where they were applied with damage to adjacent turf. The white line indicates the initial spray pattern. Treatment 1 (only Roundup ProMax) is the treatment at the bottom of the photo.



Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 2: View of Treatment 1 plot in the Cable Barrier Trial on July 3, 2018 (41 Days After Treatment)
Only Roundup ProMax was sprayed for this treatment and one can see the extent of the spray pattern.



Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 3: View of Treatment 2 and 1 plots the Cable Barrier Trial on July 3, 2018 (41 Days After Treatment)

Treatment 2 (Roundup ProMax + Sahara) was sprayed on the plot in the foreground. Note the turf damage beyond the initial spray pattern as seen on the plot closer to the truck which only had Roundup ProMax applied.



Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 4: View of Treatment 3, 2, and 1 Plots in the Cable Barrier Trial on July 3, 2018 (41 Days After Treatment)

Treatment 3 (Roundup ProMax + Hyvar) was sprayed on the plot in the foreground. The extent of the damage appears to be greater than the Treatment 2 plot. Note the turf damage beyond the initial spray pattern as seen on the plot closest to the truck, which only had Roundup ProMax applied.



Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 5: View of Treatment 4, 3, 2, and 1 Plots in the Cable Barrier Trial on July 3, 2018 (41 Days After Treatment)

Treatment 4 (Roundup ProMax + Oust) was sprayed on the plot in the foreground. Note the turf damage beyond the initial spray pattern as seen on the plot closest to the truck, which only had Roundup ProMax applied.



Figure 6: View of Plots in the Cable Barrier Trial on April 30, 2019 (342 Days After Treatment)
One can still see the sprayed plots with less vegetation than outside the plot area.



Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 7: View of one of the “Best” Plots in the Cable Barrier Trial on April 30, 2019 (342 Days After Treatment)
Treatment 9 (Roundup ProMax + Oust + Esplanade) was sprayed on the plot in the foreground 342 days before photo was taken.



2019 Cable Barrier Bareground Trial in Louisville

Introduction

Median cable barriers are designed to protect drivers from crossover accidents on interstates and highways. However, the vegetation under and adjacent to them must be managed for safety and aesthetics. Usually, this means using herbicides to maintain a vegetation free (bare ground) zone underneath the barriers. Broad-spectrum soil applied preemergence residual herbicides, in combination with a broad-spectrum post emergence herbicide like glyphosate, are the mainstay for maintaining these bare ground zones. However, there may be turf adjacent to the bare ground zone that should be maintained. Ideally, the residual herbicides will last all season long (even into early the next spring) and not move off-site by leaching or erosion (movement of soil particles with adsorbed herbicide).

This trial was part of an ongoing effort to evaluate the vegetation control efficacy of a range of herbicide options when used for vegetation management under cable barriers.

Materials and Methods

The trial was established in the median of I-265 in Louisville, KY under and beside a cable barrier with a mixed stand of turf species. The 20 herbicide treatments and 3 replications were arranged in a randomized complete block design. Treatments were applied at 25 gallons per acre onto 6.5 ft wide by 20 ft long plots on May 21, 2019. All treatments, except Roundup ProMax alone (Treatment 1) and Rodeo + Detail + MSO (Treatment 18) included Activator 90 non-ionic surfactant at 0.25% v/v (Table 1a and 1b). Roundup ProMax (glyphosate) has no residual activity so other herbicides were included in the combination treatments to provide residual and pre-emergent control for the bare ground treatments. Different herbicide combinations also broadened the weed spectrum controlled and reduced the risk of developing problems with resistant weeds by using different Mechanisms of Action (MOA) groups (Table 1a and 1b).

The trial included treatments which have been long term “standards” as well as newer products and combinations currently being used in KY. This year’s treatment list had a few changes from last year. One of our best performing treatments in 2018 was the combination of Viewpoint plus Esplanade but since it is more expensive this year Viewpoint alone was applied (Treatment 7). In 2018 one of the combinations recommended by industry reps was the combination of Method @ 12 fl oz plus Esplanade (Treatment 13) while in 2019 the recommendation was reduced to Method @ 6 fl oz to reduce the risk of damage from movement after application to sensitive crops, like tobacco (Treatments 14 & 15). The current recommendation also includes the addition of NuFilm IR to reduce the risk of movement from where the herbicide was applied (Treatment 15). New treatments this year also included Detail (saflufenacil) @ 6 fl oz (Treatment 18) and one without glyphosate designed to control broadleaf weeds and suppressing grass growth behind guardrails (Treatment 19). Detail may be useful in areas with sensitive crops nearby as it is less persistent than other herbicides.

The Louisville weather station reported 0.41 inches of rain May 26 which should have activated the soil residual herbicide treatments. Additional rainfall was recorded from May 29 to 30 (1.31 inches). Species present at application included flowering Buckhorn plantain (12 inches to

seedhead), flowering tall fescue (24 inches to seedhead), flowering Kentucky bluegrass (12 inches to seedhead) and flowering black medic (5 inches to seedhead).

Visual assessments of the proportion (%) of bare ground, grasses, and broadleaf weeds were taken 64 days after treatment (DAT) (7/24/2019). The trial area had recently been mowed and string trimmed by mistake. Assessments for (%) bareground, annual grasses, crabgrass, perennial grasses, broadleaf weeds, and prostrate spurge were done 114 DAT (9/12/2019) and 157 DAT (10/25/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

All the treatments with glyphosate (Treatments 1 to 18) had more bareground (27 to 96%) than those that did not (Treatments 19 and 20) (8%) 64 DAT (Tables 2a and 2b). The treatments with soil active herbicides that included Esplanade were in the top grouping with 89 to 96% bareground. These were Perspective + Esplanade (Treatment 5), Esplanade + Oust (Treatment 9), Streamline + Esplanade + Plateau (Treatment 10), Method + Esplanade (Treatments 13 – 15), Esplanade + Milestone (Treatment 16), and Esplanade + Oust Extra (Treatment 17). Turf damage beyond the spray pattern due to herbicide movement after application was not observed to the same extent as in 2018. Treatments without glyphosate (Treatments 19 and 20) had 82-83% grass cover.

By 114 DAT some treatments had less bareground as annual grasses (mostly yellow foxtail and crabgrass) and broadleaves (mostly prostrate spurge) colonized the space (Figure 1) (Tables 3a and 3b). Treatments in the top group for bareground (75 to 89%) were the same ones that included Esplanade listed above at 64 DAT. A number of treatments had the same percent bareground (10-23%) as the nontreated check. These included Roundup ProMax (Treatment 1), Perspective + Proclipse (Treatment 6), Viewpoint (Treatment 7), Polaris AC Complete (Treatment 8), Cleantraxx + Milestone (Treatment 11), Cleantraxx (Treatment 12), Detail (Treatment 18), and Method + Escort + Plateau (Treatment 19). The treatments with most annual grass cover (48-60%) included Roundup ProMax (Treatment 1), Polaris AC Complete (Treatment 8), and Detail (Treatment 18). Some treatments had higher levels of crabgrass cover (17-35%). These included Roundup ProMax (Treatment 1), Rodeo + Detail (Treatment 18), and two treatments containing imazapyr, Viewpoint (Treatment 7) and Polaris AC Complete (Treatment 8). A similar pattern was observed in a 2016 guardrail trial near Louisa with imazapyr herbicides and crabgrass. The treatments with the most broadleaf cover (42-70%) (mostly spurge) included Hyvar (treatment 3), Oust (Treatment 4), Perspective + Proclipse (Treatment 6), Cleantraxx + Milestone (Treatment 11) and Cleantraxx (Treatment 12). The two treatments without glyphosate (Treatments 19 and 20) had 52-62% perennial grass cover.

By the end of the season (157 DAT) the top treatments were still the same as at 64 DAT but had more vegetative cover but still had 70-83% bareground (Tables 4a and 4b). The study location (Bluegrass Region CD2) had a very dry September with 0.19" which is 3.40" less than the long term average. This may have reduced the growth of emerged vegetation and germination/emergence of new vegetation. Plots with the greatest annual grass (47-58%), particularly crabgrass cover (18-33%), stood out. These included Roundup ProMax (Treatment

1), Viewpoint (Treatment 7), Polaris AC Complete (Treatment 8), and Detail (Treatment 18). Plots with the most broadleaf cover (48-68%) (mostly prostrate spurge) were the same treatments as observed at 114 DAT. Treatments without glyphosate (Treatments 19 and 20) had 42-55% perennial grass cover.

The vegetation under the cable barrier at this location provided a good trial on the performance of bare ground herbicides over a season and into the next year. These plots will be reassessed in spring 2020, which will continue to provide information for roadside managers.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 1a. Herbicide Treatments, Active Ingredients, Application Rates, and Mechanism of Action (MOA) Groups for Cable Barrier Bareground Trial. (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)	MOA Groups
1	Roundup ProMax	1.3	QT/A	glyphosate	1.5 LB AE	9
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	glyphosate diuron + imazapyr	1.5 LB AE 6.2 LB + 12.4 OZ	9 7 + 2
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	glyphosate bromacil	1.5 LB AE 8 LB	9 5
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	glyphosate sulfometuron	1.5 LB AE 2.3 OZ	9 2
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	glyphosate aminocyclopyrachlor + chlorsulfuron indaziflam	1.5 LB AE 3.6 OZ + 1.4 OZ 0.7 OZ	9 4 + 2 29
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	glyphosate aminocyclopyrachlor + chlorsulfuron prodiamine	1.5 LB AE 3.6 OZ + 1.4 OZ 1.5 LB	9 4 + 2 3
7	Roundup ProMax Viewpoint	1.3 18	QT/A OZ/A	glyphosate aminocyclopyrachlor + imazapyr + metsulfuron	1.5 LB AE 4.1 OZ + 5.7 OZ + 1.3 OZ	9 4 + 2 + 2
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	glyphosate imazapyr	1.5 LB AE 16 OZ AE	9 2
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	glyphosate indaziflam sulfometuron	1.5 LB AE 0.7 OZ 2.3 OZ	9 29 2
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	glyphosate aminocyclopyrachlor + metsulfuron indaziflam imazapic	1.5 LB AE 3.2 OZ + 1 OZ 1 OZ 1.3 OZ AE	9 4 + 2 29 2
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	glyphosate penoxsulam + oxyfluorfen aminopyralid	1.5 LB AE 0.5 OZ + 23.6 OZ 1.8 OZ AE	9 2 + 14 4
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	glyphosate penoxsulam + oxyfluorfen	1.5 LB AE 0.7 OZ + 35.4 OZ	9 2 + 14

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.
Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 1b. Herbicide Treatments, Active Ingredients, Application Rates, and Mechanism of Action (MOA) Groups for Cable Barrier Bareground Trial (Part 2 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)	MOA Groups
13	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE	4
	Esplanade	5	FL OZ/A	indaziflam	1 OZ	29
14	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Method	6	FL OZ/A	aminocyclopyrachlor	1.5 OZ AE	4
	Esplanade	6	FL OZ/A	indaziflam	1.2 OZ	29
15	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Method	6	FL OZ/A	aminocyclopyrachlor	1.5 OZ AE	4
	Esplanade	6	FL OZ/A	indaziflam	1.2 OZ	29
	NuFilm IR	24	FL OZ/A	Pinolene		
16	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Esplanade	6	FL OZ/A	indaziflam	1.3 OZ	29
	Milestone VM	7	FL OZ/A	aminopyralid	1.8 OZ AE	4
17	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Esplanade	3.5	FL OZ/A	indaziflam	0.7 OZ	29
	Oust Extra	1.5	OZ/A	sulfometuron + metsulfuron	0.8 OZ + 0.2 OZ	2 + 2
18	Rodeo	1.5	QT/A	glyphosate	1.5 LB AE	9
	Detail	6	FL OZ/A	saflufenacil	2.1 OZ	14
19	Method	4	FL OZ/A	aminocyclopyrachlor	1 OZ AE	4
	Escort	0.33	OZ/A	metsulfuron	0.2 OZ	2
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE	2
20	Nontreated Check					

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.

Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2a. Results for Cable Barrier Trial 64 DAT¹ (July 24, 2019) (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	% Bareground	% Grass	% Broadleaves
				64 DAT		
1	Roundup ProMax	1.3	QT/A	27 f	43 c	30 bc
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	73 bc	5 f	22 bcde
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	50 de	13 def	37 ab
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	70 c	9 ef	21 bcdef
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	89 ab	8 ef	2 g
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	65 cd	9 ef	26 bcde
7	Roundup ProMax Viewpoint	1.3 18	QT/A OZ/A	40 ef	23 de	37 ab
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	40 ef	27 d	27 bcd
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	93 a	4 f	3 fg
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	96 a	2 f	1 g
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	40 ef	10 ef	53 a
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	52 de	15 def	37 ab

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.
Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2b. Results for Cable Barrier Trial 64 DAT¹ (July 24, 2019) (Part 2 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	% Bareground	% Grass	% Broadleaves
				64 DAT		
13	Rodeo	1.5	QT/A	92 a	8 ef	0 g
	Method	12	FL OZ/A			
	Esplanade	5	FL OZ/A			
14	Rodeo	1.5	QT/A	89 ab	10 ef	0 g
	Method	6	FL OZ/A			
	Esplanade	6	FL OZ/A			
15	Rodeo	1.5	QT/A	90 ab	10 ef	0 g
	Method	6	FL OZ/A			
	Esplanade	6	FL OZ/A			
	NuFilm IR	24	FL OZ/A			
16	Rodeo	1.5	QT/A	93 a	7 f	0 g
	Esplanade	6	FL OZ/A			
	Milestone VM	7	FL OZ/A			
17	Rodeo	1.5	QT/A	96 a	1 f	3 fg
	Esplanade	3.5	FL OZ/A			
	Oust Extra	1.5	OZ/A			
18	Rodeo	1.5	QT/A	28 f	65 b	13 cdefg
	Detail	6	FL OZ/A			
19	Method	4	FL OZ/A	8 g	83 a	8 efg
	Escort	0.33	OZ/A			
	Plateau	3	FL OZ/A			
20	Nontreated Check			8 g	82 a	10 defg

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.

Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 3a. Results for Cable Barrier Trial 114 DAT¹ (September 12, 2019) (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	%	% Annual	% Crabgrass	% Perennial	%	% Spurge
				Bareground	Grass		Grass	Broadleaves	
114 DAT									
1	Roundup ProMax	1.3	QT/A	22 cd	48 ab	17 abcd	0 c	27 cde	23 ef
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	40 b	10 cd	3 d	7 c	43 bc	42 cde
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	27 bc	15 cd	2 d	0 c	58 ab	57 abc
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	27 bc	21 cd	2 d	0 c	53 ab	45 bcd
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	81 a	4 d	0 d	3 c	13 de	8 f
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	23 cd	6 d	0 d	2 c	69 a	65 ab
7	Roundup ProMax Viewpoint	1.3 18	QT/A OZ/A	15 cd	42 b	25 abc	0 c	43 bc	43 cde
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	20 cd	50 ab	30 ab	0 c	30 cd	23 ef
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	75 a	9 cd	5 cd	0 c	16 de	13 f
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	80 a	4 d	0 d	1 c	14 de	14 f
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	12 cd	18 cd	5 cd	0 c	70 a	70 a
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	17 cd	23 c	10 bcd	0 c	61 ab	58 abc

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.
Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 3b. Results for Cable Barrier Trial 114 DAT¹ (September 12, 2019) (Part 2 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	% Bareground	% Annual Grass	% Crabgrass	% Perennial Grass	% Broadleaves	% Spurge
				114 DAT					
13	Rodeo	1.5	QT/A	80 a	6 cd	0 d	5 c	9 de	9 f
	Method	12	FL OZ/A						
	Esplanade	5	FL OZ/A						
14	Rodeo	1.5	QT/A	84 a	3 d	0 d	6 c	7 e	6 f
	Method	6	FL OZ/A						
	Esplanade	6	FL OZ/A						
15	Rodeo	1.5	QT/A	82 a	4 d	0 d	7 c	7 e	7 f
	Method	6	FL OZ/A						
	Esplanade	6	FL OZ/A						
	NuFilm IR	24	FL OZ/A						
16	Rodeo	1.5	QT/A	89 a	4 d	0 d	1 c	6 e	6 f
	Esplanade	6	FL OZ/A						
	Milestone VM	7	FL OZ/A						
17	Rodeo	1.5	QT/A	87 a	3 d	1 d	0 c	10 de	9 f
	Esplanade	3.5	FL OZ/A						
	Oust Extra	1.5	OZ/A						
18	Rodeo	1.5	QT/A	15 cd	60 a	35 a	0 c	25 cde	25 def
	Detail	6	FL OZ/A						
19	Method	4	FL OZ/A	12 cd	23 c	3 d	52 b	13 de	13 f
	Escort	0.33	OZ/A						
	Plateau	3	FL OZ/A						
20	Nontreated Check			10 d	14 cd	5 cd	62 a	14 de	10 f

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.

Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 4a. Results for Cable Barrier Trial 157 DAT¹ (October 25, 2019) (Part 1 of 2)

Trt. No.	Product Name*	Rate	Rate Unit	%	% Annual	% Crabgrass	% Perennial	%	% Spurge
				Bareground	Grass		Grass	Broadleaves	
157 DAT									
1	Roundup ProMax	1.3	QT/A	25 bcd	58 a	18 abc	1 b	16 fg	13 ef
2	Roundup ProMax Sahara	1.3 10	QT/A LB/A	35 b	11 de	2 c	12 b	42 bcde	40 bcd
3	Roundup ProMax Hyvar	1.3 10	QT/A LB/A	30 bc	20 cde	0 c	2 b	48 abcd	46 abc
4	Roundup ProMax Oust XP	1.3 3	QT/A OZ/A	28 bcd	19 cde	0 c	0 b	52 abc	41 bcd
5	Roundup ProMax Perspective Esplanade	1.3 9 3.5	QT/A OZ/A FL OZ/A	77 a	5 de	0 c	6 b	12 fg	6 f
6	Roundup ProMax Perspective Proclipse	1.3 9 2.3	QT/A OZ/A LB/A	23 bcd	7 de	0 c	3 b	67 ab	63 ab
7	Roundup ProMax Viewpoint	1.3 18	QT/A OZ/A	18 cde	47 ab	33 a	0 b	35 cdef	33 cde
8	Roundup ProMax Polaris AC Complete	1.3 2	QT/A PT/A	23 bcd	50 ab	30 a	0 b	27 defg	21 def
9	Roundup ProMax Esplanade Oust XP	1.3 3.5 3	QT/A FL OZ/A OZ/A	70 a	6 de	3 c	0 b	24 defg	14 ef
10	Roundup ProMax Streamline Esplanade Plateau	1.3 8 5 5	QT/A OZ/A FL OZ/A FL OZ/A	80 a	4 e	0 c	1 b	15 fg	15 ef
11	Rodeo Cleantraxx Milestone VM	1.5 3 7	QT/A PT/A FL OZ/A	17 cde	21 cde	3 c	1 b	61 ab	60 ab
12	Rodeo Cleantraxx	1.5 4.5	QT/A PT/A	13 de	18 cde	7 bc	0 b	68 a	66 a

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.
Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 4b. Results for Cable Barrier Trial 157 DAT¹ (October 25, 2019 (Part 2 of 2))

Trt. No.	Product Name*	Rate	Rate Unit	% Bareground	% Annual Grass	% Crabgrass	% Perennial Grass	% Broadleaves	% Spurge
				157 DAT					
13	Rodeo	1.5	QT/A	80 a	4 e	0 c	8 b	7 g	6 f
	Method	12	FL OZ/A						
	Esplanade	5	FL OZ/A						
14	Rodeo	1.5	QT/A	79 a	4 e	0 c	9 b	8 g	3 f
	Method	6	FL OZ/A						
	Esplanade	6	FL OZ/A						
15	Rodeo	1.5	QT/A	78 a	4 e	0 c	12 b	6 g	5 f
	Method	6	FL OZ/A						
	Esplanade	6	FL OZ/A						
	NuFilm IR	24	FL OZ/A						
16	Rodeo	1.5	QT/A	83 a	4 de	0 c	5 b	7 g	7 f
	Esplanade	6	FL OZ/A						
	Milestone VM	7	FL OZ/A						
17	Rodeo	1.5	QT/A	82 a	4 e	0 c	0 b	14 fg	12 ef
	Esplanade	3.5	FL OZ/A						
	Oust Extra	1.5	OZ/A						
18	Rodeo	1.5	QT/A	18 cde	52 ab	25 ab	3 b	27 defg	20 def
	Detail	6	FL OZ/A						
19	Method	4	FL OZ/A	7 e	32 bc	0 c	42 a	20 efg	13 ef
	Escort	0.33	OZ/A						
	Plateau	3	FL OZ/A						
20	Nontreated Check			5 e	25 cd	5 bc	55 a	15 fg	8 f

*All herbicide treatments (except trt. #1 & #18) contained the adjuvant, Activator 90 at 0.25% v/v.

Treatment 18 included MSO @ 1%

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Figure 1: View of Plots in the Cable Barrier Trial on September 12, 2019 (114 Days After Treatment)

One can see plots covered with annual grasses in the foreground along with a group of plots largely bareground closer to the truck..



2018 PGR Options for Tall Fescue Management (2019 Assessments)

Tall fescue is a widely adapted species and is a common roadside and other unimproved turf cool-season grass. Frequent mowing is the most common management regime for departments of transportation to reduce top growth. Plant Growth Regulators (PGRs) are potential tools to reduce turf growth and aid in keeping our roadways safe for travelers. 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. Seedhead suppression with PGRs is an effective means to reduce mowing for the first cycle. Generally PGRs are normally applied in the early spring. This trial was established to evaluate PGR options for roadside management including fall application of PGRs, which may benefit seedhead suppression the following spring.

Materials and Methods

A trial was established in 2018 at Spindletop Research Farm in Lexington KY arranged as a complete block design with 21 PGR treatments and three replications. Plots were 7 ft by 20 ft with running unsprayed checks (3 ft wide) between each of the plots. The treatments were five PGRs applied before the first mowing and one to two weeks after each of the three mowings plus control. Products tested were Embark 2S (mefluidide) [Class C], Plateau (imazapic) [Class D], Opensight (aminopyralid + metsulfuron methyl) [Class D], Anuew (prohexadione calcium) [Class A], and Perspective (aminocyclopyrachlor + clorsulfuron) [Class D] (Table 1). All applications were at 25 gallons per acre and included a non-ionic surfactant at 0.25% v/v. Application dates were 4/29/2018, 6/14/2018, 8/24/2018, and 10/19/2018 for the 2018 trial. Mowing dates were 5/29/2018, 8/10/2018, and 10/11/2018.

Plots from the fourth application date were assessed for seedhead height and seedhead density in 2019 at 199 days after application (DAT4) (5/6/2019), 213 DAT4 (5/20/2019), and 234 DAT4 (6/10/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

In the spring after a fall application of PGR treatments reductions in seedhead heights were observed for the Plateau, Opensight, and Perspective treatments at the first assessment date 199 DAT4 (Table 2) (Figure 1). Reductions in seedhead density were also observed for these treatments as well as with Embark at 199 DAT4 (Figure 2). At the next assessment date 213 DAT4, only the Plateau and Perspective treatments had reduced seedhead heights. The visual seedhead density assessments at this date were greater than at the last evaluation date 234 DAT4 for many of the treatments. This may be because flowering orchard grass was present making it difficult to assess the true extent of tall fescue heading as they were shorter than the orchard grass plants (data not shown). Despite this the Plateau, Opensight, and Perspective treatments

had the lowest seedhead densities 213 DAT. By the last assessment (234 DAT) there were no differences in heading height but all the treatments had lower heading densities than the unsprayed control. Anuew (Class A) was at 77% heading density while the other PGR treatments had greater seedhead suppression (18-25% seedhead density). The Class C treatment (Embark) and the Class D treatments (Plateau, Opensight, and Perspective) had similar effects.

Embark, Plateau, Opensight, and Perspective treatments may have reduced tall fescue heading enough to delay the first mowing but other grass species on the roadside may not have been affected equally by the PGR treatments. In a previous trial by our group (Omielan and Witt, 2012) fall application of a higher rate of Plateau (4 fl oz/ac) + 2,4-D [added as a safener] had similar reductions in tall fescue seedheads. The most consistent seedhead suppression was with spring application but fall applications may have the “benefit” of seedhead suppression perhaps as a result of fall herbicide applications used to control biennial weeds at the fall rosette stage. With Class D PGRs they may be applied primarily for growth regulation or for weed control, depending on the desired management outcome(s).

Literature Cited:

Omielan, J and Witt, W. 2011/2012 Fall Spring Tall Fescue Seedhead Suppression Trial (IVM 2012 Annual Research Report)

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Product (s)	Rate (per Acre)	Active Ingredient(s)	ai Rate (per Acre)
Embark 2S	24 fl oz	mefluidide	6 oz ae
Plateau	2 fl oz	imazapic	0.5 oz ae
Opensight	2.5 oz	aminopyralid + metsulfuron methyl	1.3 oz ae + 0.24 oz
Anuew	1 lb	prohexadione calcium	4.4 oz
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.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments, Fescue Heights and Heading Density after Fourth PGR Application the Following Spring

Product (s)	Rate (per Acre)	Timing	May 6, 2019		May 20, 2019		June 10, 2019	
			Ht (in)	Heading (%)	Ht (in)	Heading (%)	Ht (in)	Heading (%)
			199 DAT4 ¹		213 DAT4		234 DAT4	
Embark 2S	24 fl oz	after third mowing	20 abc ²	10 bc	38 ab	80 ab	42	23 c
Plateau	2 fl oz	after third mowing	17 c	4 c	29 c	35 c	41	18 c
Opensight	2.5 oz	after third mowing	16 c	4 c	39 ab	57 bc	38	25 c
Anuew	1 lb	after third mowing	22 ab	22 ab	35 abc	90 a	42	77 b
Perspective	4.75 oz	after third mowing	17 bc	6 bc	33 bc	58 abc	41	20 c
Unsprayed Control			23 a	28 a	40 a	90 a	45	100 a

¹ DAT4 = Days after treatment after third mowing (i.e. following fourth PGR application)

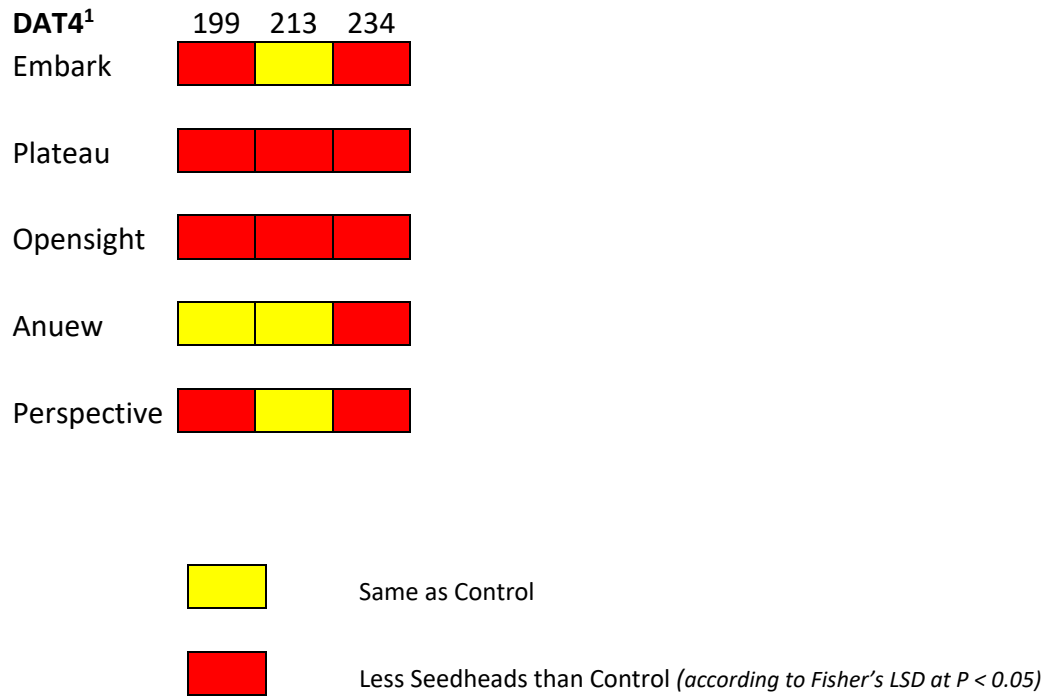
² Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

Figure 1. Summary of Fescue Height after Fourth PGR Application



¹ DAT4 = Days after treatment

Figure 2. Summary of Fescue Seedhead Density after Fourth PGR Application



¹ DAT4 = Days after treatment

2018 Johnsongrass Control Trial in Bowling Green (including 2019 Assessment)

Introduction

Johnsongrass (*Sorghum halepense*) is a perennial warm-season grass, listed as a noxious weed in Kentucky, that is a common problem on right-of-ways. There are a number of herbicides labeled and available to control johnsongrass on right-of-ways. However, some of these are nonselective or are selective for johnsongrass but can still damage desirable cool-season turf, such as tall fescue. One of the safer johnsongrass control herbicides to use on tall fescue is Fusion but a label change in 2012 made it unavailable for use on right-of-way sites. A range of herbicide options for johnsongrass control/suppression continued to be evaluated.

Materials and Methods

The objective was to evaluate early and late-season established trials at a site near Bowling Green, KY along the Natcher Parkway and Hwy 68 (Russellville Rd.) interchange. However, there was only enough area with a good stand of johnsongrass for one application timing. The area was mowed May 24, 2018 and the regrowth was treated June 8, 2018. The trial consisted of 18 treatments with 3 replications arranged in a randomized complete block design with 7 ft by 20 ft plots. Applications were made using a carrier volume of 30 gallons /acre. Johnsongrass vegetative growth was 32 inches tall and flowering plants (5% flowering) up to 43 inches tall at time of application. Johnsongrass control was assessed 25 days after treatment (DAT) (7/3/2018), 66 DAT (8/13/2018), 103 DAT (9/19/2018), 130 DAT (10/16/2018), and 390 DAT (7/3/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Table 1 lists the treatments, active ingredients and application rates. The previous 2011 Fusion label indicated rates for selective control of johnsongrass were 7 to 9 fl oz/A (Treatments 1 and 2). The labeled Fusilade II rates are 16 to 24 fl oz/A (Treatments 3 and 4). The Acclaim Extra label indicates 20 fl oz/A per acre to control seedling johnsongrass 12 to 24 inches tall (Treatment 5); 39 fl oz/A to control rhizome johnsongrass 24 to 60 inches tall (Treatment 6); and a combination of Acclaim Extra plus Fusilade II (7 and 14 fl oz/A, respectively), for improved turfgrass tolerance and to target rhizome johnsongrass 10 to 25 inches tall (Treatment 7). The Outrider label rates for selective johnsongrass control in tall fescue turf are 0.75 to 1 oz/A (Treatments 8 and 9). MSMA was applied alone (Treatment 10) and in combination with Outrider at 0.75 oz/A (Treatment 11). Clearcast (Treatment 12) has an aquatic label and may be used close to waterways. The high rate of Plateau (Treatment 13) can potentially damage tall fescue. Detail + Plateau was suggested as a combination (Treatment 14) for enhanced (faster) control of johnsongrass. The combination of Method + Detail + Plateau (Treatment 15) was designed to suppress johnsongrass growth, in areas such as behind guardrails. Roundup ProMax (Treatment 16) and Journey (Treatment 17) are non-selective herbicides.

Results and Discussion

By the time of the first rating 25 DAT some of the dead foliage had been dry for a while and there was already considerable regrowth on some plots (Table 2). Therefore, if earlier ratings had been taken the control for the MSMA plots (Treatment 10) would have been higher than 12% as the foliar damage was evident relatively quickly before the regrowth starts. The most effective group of treatments had 68 to 90% control. They included the high rate of Fusion (Treatment 2), both Fusilade II rates (Treatments 3 and 4), the Acclaim Extra + Fusilade II combination (Treatment 7), both rates of Outrider (Treatments 8 and 9), Clearcast (Treatment 12), both Plateau treatments (Treatments 13 and 14), Roundup (Treatment 16) and Journey (Treatment 17).

Control was observed at 78% with Roundup ProMax (Treatment 16) 25 DAT while it was 0% at subsequent assessment dates (Table 2). The regrowth was thicker and taller than the untreated control. There may not have been much glyphosate translocated to rhizome buds with this early season treatment timing, and subsequently dormant buds started growing after the existing culms were killed (McWhorter, 1972).

At 68 DAT the top group of treatments had 68 to 88% control and included the high rates of Fusion (Treatment 2) and Fusilade II (Treatment 4), the Acclaim Extra + Fusilade II combination (Treatment 7), both rates of Outrider (Treatments 8 and 9), both Plateau treatments (Treatments 13 and 14), and Journey (Treatment 17).

By 103 DAT some treatments had more regrowth and lower control ratings while some were slower acting and had higher % control (Table 2). The top group of treatments had 50 to 82% control and were the same as at 68 DAT but added the low rate of Fusion (Treatment 1), both rates of Acclaim Extra (Treatments 5 and 6), and the Outrider + MSMA combination (Treatment 11).

At the last rating of the 2018 season (130 DAT) 45 to 83% control was observed for the top group of treatments which were the same as at 103 DAT, except the low rate of Acclaim Extra (Treatment 5) was not high enough to be included with this group. The Method + Detail + Plateau combination (Treatment 15) did not have high control ratings but did reduce the growth of johnsongrass and might have utility in controlling growth in areas such as behind guardrails early in the season. The treatments showing aboveground control more quickly may not necessarily be the ones with the best long-term control.

Evaluations were also taken in 2019 at 390 DAT and the top group of treatments still provided 58 to 87% control. They included the high rates of Fusion (Treatment 2) and Fusilade II (Treatment 4), both rates of Acclaim Extra (Treatments 5 and 6), the Acclaim Extra + Fusilade II combination (Treatment 7), both rates of Outrider (Treatments 8 and 9), the Outrider + MSMA combination (Treatment 11), both Plateau treatments (Treatments 13 and 14), and Journey

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

(Treatment 17). Most of the treatments showing good control at the end of the 2018 season continued to have good control ratings the following summer.

Literature Cited:

McWhorter, C.G. 1972. Factors affecting johnsongrass rhizome production and germination. *Weed Sci.* 20: 41-45.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Fusion Activator 90	7 0.25	FL OZ/A % V/V	fluazifop + fenoxaprop	1.75 oz + 0.49 oz
2	Fusion Activator 90	9 0.25	FL OZ/A % V/V	fluazifop + fenoxaprop	2.25 oz + 0.63 oz
3	Fusilade II Activator 90	16 0.25	FL OZ/A % V/V	fluazifop	4 oz
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	fluazifop	6 oz
5	Acclaim Extra Activator 90	20 0.25	FL OZ/A % V/V	fenoxaprop	1.4 oz
6	Acclaim Extra Activator 90	39 0.25	FL OZ/A % V/V	fenoxaprop	2.78 oz
7	Acclaim Extra Fusilade II COC	7 14 1	FL OZ/A FL OZ/A % V/V	fenoxaprop fluazifop	0.5 oz 3.5 oz
8	Outrider Activator 90	0.75 0.25	OZ/A % V/V	sulfosulfuron	0.563 oz
9	Outrider Activator 90	1 0.25	OZ/A % V/V	sulfosulfuron	0.75 oz
10	MSMA	32	FL OZ/A	monosodium acid methanearsonate	24 oz
11	Outrider MSMA	0.75 32	OZ/A FL OZ/A	sulfosulfuron monosodium acid methanearsonate	0.563 oz 24 oz
12	Clearcast MSO	32 1	FL OZ/A % V/V	imazamox	4 oz ae
13	Plateau MSO	8 1	FL OZ/A % V/V	imazapic	2 oz ae
14	Detail Plateau MSO	1 8 1	FL OZ/A FL OZ/A % V/V	saflufenacil imazapic	0.36 oz 2 oz ae
15	Method Detail Plateau MSO	6 1 3 1	FL OZ/A FL OZ/A FL OZ/A % V/V	aminocyclopyrachlor saflufenacil imazapic	1.5 oz ae 0.36 oz 0.75 oz ae
16	Roundup ProMax	22	FL OZ/A	glyphosate	12.4 oz ae
17	Journey MSO	21.3 1	FL OZ/A % V/V	imazapic + glyphosate	2 oz ae + 4 oz ae
18	Nontreated Check				

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments and Visual Control 25, 66, 103, 130, and 390 Days After Treatment (DAT)²

Trt. No.	Product Name	Rate	Rate Unit	25 DAT (July 3, 2018)	66 DAT (Aug 13, 2018)	103 DAT (Sept 19, 2018)	130 DAT (Oct 16, 2018)	390 DAT (July 3, 2019)
1	Fusion Activator 90	7 0.25	FL OZ/A % V/V	37 efg ¹	50 bcde	72 a	62 abc	45 cd
2	Fusion Activator 90	9 0.25	FL OZ/A % V/V	72 abc	72 abcd	77 a	70 ab	82 ab
3	Fusilade II Activator 90	16 0.25	FL OZ/A % V/V	68 abcd	27 ef	32 bcd	47 abcd	50 bcd
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	87 a	73 abcd	78 a	80 ab	85 a
5	Acclaim Extra Activator 90	20 0.25	FL OZ/A % V/V	47 cdef	45 cde	52 abc	42 bcd	68 abc
6	Acclaim Extra Activator 90	39 0.25	FL OZ/A % V/V	58 bcde	50 bcde	78 a	65 ab	58 abcd
7	Acclaim Extra Fusilade II COC	7 14 1	FL OZ/A FL OZ/A % V/V	83 ab	68 abcd	82 a	82 ab	78 ab
8	Outrider Activator 90	0.75 0.25	OZ/A % V/V	87 a	72 abcd	80 a	75 ab	85 a
9	Outrider Activator 90	1 0.25	OZ/A % V/V	85 ab	83 ab	82 a	83 a	78 ab
10	MSMA	32	FL OZ/A	12 gh	18 ef	22 cd	42 bcd	50 bcd
11	Outrider MSMA	0.75 32	OZ/A FL OZ/A	30 fg	50 bcde	50 abc	45 abcd	72 abc
12	Clearcast MSO	32 1	FL OZ/A % V/V	88 a	38 de	18 cd	17 de	28 de
13	Plateau MSO	8 1	FL OZ/A % V/V	85 ab	72 abcd	53 abc	60 abc	60 abcd
14	Detail Plateau MSO	1 8 1	FL OZ/A FL OZ/A % V/V	90 a	78 abc	63 ab	55 abcd	58 abcd
15	Method Detail Plateau MSO	6 1 3 1	FL OZ/A FL OZ/A FL OZ/A % V/V	40 def	20 ef	30 bcd	22 cde	12 e
16	Roundup ProMax	22	FL OZ/A	78 ab	0 f	0 d	0 e	10 e
17	Journey MSO	21.3 1	FL OZ/A % V/V	86 a	88 a	73 a	63 ab	87 a
18	Nontreated Check			0 h	0 f	0 d	0 e	0 e

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

² Treatments applied June 8, 2018

2019 Johnsongrass Control Trial in Georgetown

Introduction

Johnsongrass (*Sorghum halepense*) is a perennial warm-season grass, listed as a noxious weed in Kentucky, that is a common problem on right-of-ways. There are a number of herbicides labeled and available to control johnsongrass on right-of-ways. However, some of these are nonselective or are selective for johnsongrass but can still damage desirable cool-season turf, such as tall fescue. One of the safer johnsongrass control herbicides to use on tall fescue is Fusion but a label change in 2012 made it unavailable for use on right-of-way sites. A range of herbicide options for johnsongrass control/suppression continued to be evaluated.

Materials and Methods

A field study was established on an area next to the Toyota plant near Georgetown, KY with a sizable stand of johnsongrass on August 5, 2019. The trial consisted of 18 treatments with 3 replications arranged in a randomized complete block design with 7 ft by 15 ft plots. Blank (unused) plots were included in each block due to variable distribution (very sparse areas) of johnsongrass plants. Applications were made using a carrier volume of 30 gallons /acre. The johnsongrass growth was 45 inches tall with 25% flowering plants at time of application. Johnsongrass control was assessed 30 days after treatment (DAT) (9/4/2019) and 77 DAT (10/21/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Table 1 lists the treatments, active ingredients and application rates. The previous 2011 Fusion label indicated rates for selective control of johnsongrass were 7 to 9 fl oz/A (Treatments 1 and 2). The labeled Fusilade II rates are 16 to 24 fl oz/A (Treatments 3 and 4). The Acclaim Extra label indicates 20 fl oz/A per acre to control seedling johnsongrass 12 to 24 inches tall (Treatment 5); 39 fl oz/A to control rhizome johnsongrass 24 to 60 inches tall (Treatment 6); and a combination of Acclaim Extra plus Fusilade II (7 to 14 fl oz/A), for improved turfgrass tolerance and to target rhizome johnsongrass 10 to 25 inches tall (Treatment 7). The Outrider label rates for selective johnsongrass control in tall fescue turf are 0.75 to 1 oz/A (Treatments 8 and 9). MSMA was applied alone (Treatment 10) and in combination with Outrider at 0.75 oz/A (Treatment 11). Clearcast (Treatment 12) has an aquatic label and may be used close to waterways. The high rate of Plateau (Treatment 13) can potentially damage tall fescue. Detail + Plateau was suggested as a combination (Treatment 14) for enhanced control of johnsongrass. The combination of Method + Detail + Plateau (Treatment 15) was designed to suppress johnsongrass growth, in areas such as behind guardrails. Roundup ProMax (Treatment 16) and Journey (Treatment 17) are non-selective herbicides.

Results and Discussion

At the first evaluation period 30 DAT limited control was observed for most treatments, less than observed in some previous trials. It should be noted that the johnsongrass plants were larger than the guidelines indicated on the label for obtaining control for some treatments. The most effective group of treatments had 53 to 75% control (Table 2). They included both rates of Fusion (Treatments 1 and 2), both Fusilade II rates (Treatments 3 and 4), both Acclaim Extra rates (Treatment 5 and 6), the Acclaim Extra + Fusilade II combination (Treatment 7), and both treatments with MSMA (Treatments 10 and 11).

In some years regrowth of johnsongrass plants after treatment will occur, but none was observed in this trial. This may be the result of little rainfall received during the month of September. The Bluegrass Region CD3 had 0.19" which was 2.93" less than the long term average. At the end of the season (77 DAT) more of the treatments were in the top grouping (63 to 85% control). They included both rates of Fusion (Treatments 1 and 2), the low rate of Fusilade II (Treatment 3), the high rate of Acclaim Extra (Treatment 6), the Acclaim Extra + Fusilade II combination (Treatment 7), both Outrider rates (Treatments 8 and 9), MSMA (Treatment 10), Clearcast (Treatment 12), both Plateau treatments (Treatments 13 and 14), Roundup (Treatment 16), and Journey (Treatment 17).

The Method + Detail + Plateau combination (Treatment 15) did not provide a high level of control, but did reduce the growth of johnsongrass which might have some utility in controlling growth in areas such as behind guardrails early in the season. The treatments showing aboveground control more quickly may not necessarily be the ones with the best long-term control. Future evaluations will be taken in spring 2020.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Fusion Activator 90	7 0.25	FL OZ/A % V/V	fluazifop + fenoxaprop	1.75 oz + 0.49 oz
2	Fusion Activator 90	9 0.25	FL OZ/A % V/V	fluazifop + fenoxaprop	2.25 oz + 0.63 oz
3	Fusilade II Activator 90	16 0.25	FL OZ/A % V/V	fluazifop	4 oz
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	fluazifop	6 oz
5	Acclaim Extra Activator 90	20 0.25	FL OZ/A % V/V	fenoxaprop	1.4 oz
6	Acclaim Extra Activator 90	39 0.25	FL OZ/A % V/V	fenoxaprop	2.78 oz
7	Acclaim Extra Fusilade II COC	7 14 1	FL OZ/A FL OZ/A % V/V	fenoxaprop fluazifop	0.5 oz 3.5 oz
8	Outrider Activator 90	0.75 0.25	OZ/A % V/V	sulfosulfuron	0.563 oz
9	Outrider Activator 90	1 0.25	OZ/A % V/V	sulfosulfuron	0.75 oz
10	MSMA	32	FL OZ/A	monosodium acid methanearsonate	24 oz
11	Outrider MSMA	0.75 32	OZ/A FL OZ/A	sulfosulfuron monosodium acid methanearsonate	0.563 oz 24 oz
12	Clearcast MSO	32 1	FL OZ/A % V/V	imazamox	4 oz ae
13	Plateau MSO	8 1	FL OZ/A % V/V	imazapic	2 oz ae
14	Detail Plateau MSO	1 8 1	FL OZ/A FL OZ/A % V/V	saflufenacil imazapic	0.36 oz 2 oz ae
15	Method Detail Plateau MSO	6 1 3 1	FL OZ/A FL OZ/A FL OZ/A % V/V	aminocyclopyrachlor saflufenacil imazapic	1.5 oz ae 0.36 oz 0.75 oz ae
16	Roundup ProMax	22	FL OZ/A	glyphosate	12.4 oz ae
17	Journey MSO	21.3 1	FL OZ/A % V/V	imazapic + glyphosate	2 oz ae + 4 oz ae
18	Nontreated Check				

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments and Visual Control 30, and 77 Days After Treatment (DAT)²

Trt. No.	Product Name	Rate	Rate Unit	30 DAT (Sept 4, 2019)	77 DAT (Oct 21, 2019)
1	Fusion Activator 90	7 0.25	FL OZ/A % V/V	57 abcde	68 abcd
2	Fusion Activator 90	9 0.25	FL OZ/A % V/V	65 abc	75 abc
3	Fusilade II Activator 90	16 0.25	FL OZ/A % V/V	58 abcde	63 abcd
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	57 abcde	62 bcd
5	Acclaim Extra Activator 90	20 0.25	FL OZ/A % V/V	73 a	57 cd
6	Acclaim Extra Activator 90	39 0.25	FL OZ/A % V/V	72 ab	78 abc
7	Acclaim Extra Fusilade II COC	7 14 1	FL OZ/A FL OZ/A % V/V	75 a	75 abc
8	Outrider Activator 90	0.75 0.25	OZ/A % V/V	22 hi	75 abc
9	Outrider Activator 90	1 0.25	OZ/A % V/V	48 bcdefg	77 abc
10	MSMA	32	FL OZ/A	53 abcdef	80 abc
11	Outrider MSMA	0.75 32	OZ/A FL OZ/A	63 abcd	45 d
12	Clearcast MSO	32 1	FL OZ/A % V/V	30 fgh	85 ab
13	Plateau MSO	8 1	FL OZ/A % V/V	38 efgh	85 ab
14	Detail Plateau MSO	1 8 1	FL OZ/A FL OZ/A % V/V	25 gh	65 abcd
15	Method Detail Plateau MSO	6 1 3 1	FL OZ/A FL OZ/A FL OZ/A % V/V	42 cdefgh	55 cd
16	Roundup ProMax	22	FL OZ/A	40 defgh	80 abc
17	Journey MSO	21.3 1	FL OZ/A % V/V	47 cdefg	88 a
18	Nontreated Check			0 i	0 e

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.
² Treatments applied August 5, 2019.

2019 Fescue Damage by Johnsongrass Control Options

Introduction

Johnsongrass (*Sorghum halepense*) is a perennial warm-season grass, listed as a noxious weed in Kentucky, that is a common problem on right-of-ways. There are a number of herbicides labeled and available to control johnsongrass on right-of-ways. However, some of these are nonselective or are selective for johnsongrass but can still damage desirable cool-season turf, such as tall fescue. One of the safer johnsongrass control herbicides to use on tall fescue is Fusion but a label change in 2012 made it unavailable for use on right-of-way sites. This trial is a continuation of the evaluation of a range of johnsongrass control/suppression options and how they affect tall fescue.

Materials and Methods

A field trial was established August 6, 2019 at the University of Kentucky Spindletop Research Farm near Lexington, KY on a tall fescue field when plants were approximately 10 inches tall. The trial consisted of 18 treatments with 3 replications each arranged in a randomized complete block design with 3.5 ft by 10 ft plots and 1.5 ft wide unsprayed buffers between each plot. Applications were made using 30 gallons per acre carrier volume. Tall fescue color was assessed by comparison to the running check strips. The color ratings were based on a scale ranging from 0 (dead) to 9 (full green). The color of the check strips was set at 8 on the scale. Plots were assessed 30 days after treatment (DAT) (9/5/2019), and 84 DAT (10/29/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Table 1 lists the treatments, active ingredients and application rates. The previous 2011 Fusion label indicated rates for selective control of johnsongrass were 7 to 9 fl oz/A (Treatments 1 and 2). The labeled Fusilade II rates are 16 to 24 fl oz/A (Treatments 3 and 4). The Acclaim Extra label indicates 20 fl oz/A per acre to control seedling johnsongrass 12 to 24 inches tall (Treatment 5); 39 fl oz/A to control rhizome johnsongrass 24 to 60 inches tall (Treatment 6); and a combination of Acclaim Extra plus Fusilade II (7 to 14 fl oz/A), for improved turfgrass tolerance and to control rhizome johnsongrass 10 to 25 inches tall (Treatment 7). The Outrider label rates for selective johnsongrass control in tall fescue turf are 0.75 to 1 oz/A (Treatments 8 and 9). MSMA was applied alone (Treatment 10) and in combination with Outrider at 0.75 oz/A (Treatment 11). Clearcast (Treatment 12) has an aquatic label and may be used close to waterways. The high rate of Plateau (Treatment 13) can potentially damage tall fescue. Detail + Plateau was suggested as a combination (Treatment 14) for enhanced control of johnsongrass. The combination of Method + Detail + Plateau (Treatment 15) was designed to suppress johnsongrass growth, in areas such as behind guardrails. Roundup ProMax (Treatment 16) and Journey (Treatment 17) are non-selective herbicides.

Results and Discussion

Some treatments indicated good safety on tall fescue with color ratings that were not different from the nontreated check, while others exhibited recovery of color by the end of the season following an initial display of discoloration (Table 2). Regrowth of tall fescue may have been reduced by the drought conditions in September. The Bluegrass Region CD3 had 0.19” which was 2.93” less than the long-term average. Treatments with color ratings unchanged from the control 30 DAT included both rates of Fusion (Treatments 1 and 2), both rates of Acclaim Extra (Treatments 5 and 6), the high rate of Outrider (Treatment 9), and MSMA by itself (Treatment 10) plus MSMA in combination with Outrider (Treatment 11). Treatments where color recovered by 84 DAT included the low rate of Fusilade II (Treatment 3), the combination of Acclaim Extra + Fusilade II (Treatment 7), and the low rate of Outrider (Treatment 8). Fescue color in plots treated with the the high rate of Fusilade II (Treatment 4), Clearcast (Treatment 12), all Plateau treatments (Treatments 13, 14, and 15), Roundup (Treatment 16), or Journey (Treatment 17) did not recover before the end of the season. These treatments would not be recommended if it is desirable to preserve existing tall fescue in the application area. Additional ratings of tall fescue density will be taken in spring 2020.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Fusion Activator 90	7 0.25	FL OZ/A % V/V	fluazifop + fenoxaprop	1.75 oz + 0.49 oz
2	Fusion Activator 90	9 0.25	FL OZ/A % V/V	fluazifop + fenoxaprop	2.25 oz + 0.63 oz
3	Fusilade II Activator 90	16 0.25	FL OZ/A % V/V	fluazifop	4 oz
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	fluazifop	6 oz
5	Acclaim Extra Activator 90	20 0.25	FL OZ/A % V/V	fenoxaprop	1.4 oz
6	Acclaim Extra Activator 90	39 0.25	FL OZ/A % V/V	fenoxaprop	2.78 oz
7	Acclaim Extra Fusilade II COC	7 14 1	FL OZ/A FL OZ/A % V/V	fenoxaprop fluazifop	0.5 oz 3.5 oz
8	Outrider Activator 90	0.75 0.25	OZ/A % V/V	sulfosulfuron	0.563 oz
9	Outrider Activator 90	1 0.25	OZ/A % V/V	sulfosulfuron	0.75 oz
10	MSMA	32	FL OZ/A	monosodium acid methanearsonate	24 oz
11	Outrider MSMA	0.75 32	OZ/A FL OZ/A	sulfosulfuron monosodium acid methanearsonate	0.563 oz 24 oz
12	Clearcast MSO	32 1	FL OZ/A % V/V	imazamox	4 oz ae
13	Plateau MSO	8 1	FL OZ/A % V/V	imazapic	2 oz ae
14	Detail Plateau MSO	1 8 1	FL OZ/A FL OZ/A % V/V	saflufenacil imazapic	0.36 oz 2 oz ae
15	Method Detail Plateau MSO	6 1 3 1	FL OZ/A FL OZ/A FL OZ/A % V/V	aminocyclopyrachlor saflufenacil imazapic	1.5 oz ae 0.36 oz 0.75 oz ae
16	Roundup ProMax	22	FL OZ/A	glyphosate	12.4 oz ae
17	Journey MSO	21.3 1	FL OZ/A % V/V	imazapic + glyphosate	2 oz ae + 4 oz ae
18	Nontreated Check				

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments and Tall Fescue Color Ratings 30, and 84 Days After Treatment (DAT)²

Trt. No.	Product Name	Rate	Rate Unit	30 DAT	84 DAT
1	Fusion Activator 90	7 0.25	FL OZ/A % V/V	8.0 a	7.8 ab
2	Fusion Activator 90	9 0.25	FL OZ/A % V/V	7.0 abc	8.0 a
3	Fusilade II Activator 90	16 0.25	FL OZ/A % V/V	6.3 cd	7.3 abc
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	5.0 e	7.0 c
5	Acclaim Extra Activator 90	20 0.25	FL OZ/A % V/V	7.0 abc	7.8 ab
6	Acclaim Extra Activator 90	39 0.25	FL OZ/A % V/V	7.7 ab	8.0 a
7	Acclaim Extra Fusilade II COC	7 14 1	FL OZ/A FL OZ/A % V/V	6.7 bcd	7.7 abc
8	Outrider Activator 90	0.75 0.25	OZ/A % V/V	6.7 bcd	7.3 abc
9	Outrider Activator 90	1 0.25	OZ/A % V/V	7.0 abc	7.2 bc
10	MSMA	32	FL OZ/A	8.0 a	7.7 abc
11	Outrider MSMA	0.75 32	OZ/A FL OZ/A	7.7 ab	7.5 abc
12	Clearcast MSO	32 1	FL OZ/A % V/V	2.3 g	1.8 h
13	Plateau MSO	8 1	FL OZ/A % V/V	2.7 fg	4.0 ef
14	Detail Plateau MSO	1 8 1	FL OZ/A FL OZ/A % V/V	3.7 f	4.7 e
15	Method Detail Plateau MSO	6 1 3 1	FL OZ/A FL OZ/A FL OZ/A % V/V	5.7 de	6.2 d
16	Roundup ProMax	22	FL OZ/A	3.7 f	3.7 f
17	Journey MSO	21.3 1	FL OZ/A % V/V	3.0 fg	2.7 g
18	Nontreated Check			8.0 a	8.0 a

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

² Treatments applied August 6, 2019. Tall fescue color ratings based on a scale from 0 (dead) to 9 (full green)

2018 Poison Hemlock Control Trial near Richmond (including 2019 Assessment)

Introduction

Poison hemlock (*Conium maculatum*) is classified as a biennial species that is potentially toxic, and listed as a noxious weed. It is a common problem on Kentucky right-of-ways. Infestations occur along roadsides, field margins, ditches, marshes, meadows, and low-lying areas, but this plant prefers shaded areas with moist soil. It can grow up to ten feet tall. The stems are ribbed and hollow with purplish streaks or splotches, which are characteristics for identification. Poison hemlock reproduces by seeds that fall near the plant and disperse via fur, birds, water, and, to a limited extent, wind. Most seeds fall from September through December, but they can fall as late as the end of February. The seeds typically germinate in the fall or late winter, but the plant usually does not bolt and produce flowers until the following spring, which is when they are most noticeable. The objective of this study was to evaluate herbicide control options including new formulations of 2,4-D, considered to have a lower volatility potential (i.e. Freelexx) and the new formulation of triclopyr (i.e. Vastlan).

Materials and Methods

The trial was established May 7, 2018 on an area mowed once a year along I-75 near Richmond, KY with a thick stand of poison hemlock. The trial consisted of 9 treatments with 3 replications arranged in a randomized complete block design with 7 ft by 25 ft plots. Applications were made using a spray carrier volume of 20 gallons per acre. Poison hemlock plants had bolted (32 to 48 inches tall) but not yet flowered at time of application. Canada thistle plants (average of 24 inches tall) and common teasel plants (average of 12 inches tall) were also present in most plots at application. Plots were assessed 9 days after treatment (DAT) (5/16/2018), 52 DAT (6/28/2018), and 374 DAT (5/16/2019). It was not possible to assess treatments later in the season as giant foxtail covered the treated plot area. Vetch also covered the control plot areas. Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

All herbicide treatments (Table 1) had an effect on the poison hemlock plants (Figure 1) 9 DAT. There were no differences in control between the DMA 4 and Freelexx 2,4-D formulations 9 or 52 DAT (Table 2). However, the older Garlon 3A was slower (33% control) than Vastlan (50% control) 9 DAT but had the same control at 52 DAT (97 to 98% control). Most poison hemlock plants were brown and dry 52 DAT but some green tissue still remained. Visual control was lower for the Milestone and Opensight than the other treatments. Method provided the best control (55%) on common teasel 9 DAT but it was not possible to evaluate common teasel on the

second rating date. The best early control ratings 9 DAT on Canada thistle (50 to 63% control) were with DMA 4, Milestone, Solution Water Soluble, and Opensight.

In 2019 an early spring assessment for the amount of aboveground vegetation for these three species was conducted (Table 3). Although the plant distribution had been variable in 2018, we hoped to distinguish patterns attributable to extended control in 2019 with soil residual herbicides, like Milestone, Method, and Opensight. However, there was considerable variability among plots (Table 3). Furthermore, at 374 DAT no teasel plants were observed within plots treated with Method.

A number of effective herbicide control options are available for poison hemlock. The new formulations of 2,4-D and triclopyr resulted in similar levels of control compared to the older formulations.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	DMA 4 IVM	4	PT/A	2,4-D [dimethylamine salt]	1.9 lb ae
2	Freelexx	4	PT/A	2,4-D [choline salt]	1.9 lb ae
3	Milestone	5	FL OZ/A	aminopyralid	1.25 oz ae
4	Method	15	FL OZ/A	aminocyclopyrachlor	3.75 oz ae
5	Solution Water Soluble	2.28	LB/A	2,4-D [dimethylamine salt]	1.84 lb ae
6	Garlon 3A	1.5	QT/A	Triclopyr [triethylamine salt]	18 oz ae
7	Vastlan	1.1	QT/A	Triclopyr [choline salt]	18 oz ae
8	Opensight	2.5	OZ/A	aminopyralid + metsulfuron	1.31 oz ae + 0.24 oz
9	Nontreated Check				

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

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments, Application Rates, and Visual Data²

Trt. No.	Product Name	Rate	Rate Unit	Poison Hemlock Control (%)	Common Teasel Control (%)	Canada Thistle Control (%)	Poison Hemlock Control (%)
				9 DAT (May 16, 2018)			52 DAT (June 28, 2018)
1	DMA 4	4	PT/A	52 ab ¹	10 cde	55 ab	98 a
2	Freelexx	4	PT/A	35 ab	10 cde	13 d	90 abc
3	Milestone	5	FL OZ/A	40 ab	30 b	50 abc	82 c
4	Method	15	FL OZ/A	68 a	55 a	25 bcd	98 a
5	Solution Water Soluble	2.28	LB/A	45 ab	20 bcd	63 a	91 abc
6	Garlon 3A	1.5	QT/A	33 bc	5 de	5 d	97 ab
7	Vastlan	1.1	QT/A	50 ab	13 cde	18 cd	98 ab
8	Opensight	2.5	OZ/A	40 ab	25 bc	58 ab	87 bc
9	Nontreated Check			0 c	0 e	0 d	0 d

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

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

² Treatments applied May 7, 2018

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 3. Herbicide Treatments, Application Rates, and Assessment Data. 2

				Poison Hemlock Amount (0-10) ³	Common Teasel Amount (0-10)	Canada Thistle Amount (0-10)
Trt. No.	Product Name	Rate	Rate Unit	374 DAT (May 16, 2019)		
1	DMA 4	4	PT/A	4.6 ab ¹	1.3 ab	1.7 ab
2	Freelexx	4	PT/A	4.6 ab	0.7 b	3.3 a
3	Milestone	5	FL OZ/A	4.3 ab	0.3 b	1.3 ab
4	Method	15	FL OZ/A	4.3 ab	0.0 b	0.3 b
5	Solution Water Soluble	2.28	LB/A	2.5 b	0.3 b	1.7 ab
6	Garlon 3A	1.5	QT/A	4.0 ab	2.7 a	2.0 ab
7	Vastlan	1.1	QT/A	5.3 ab	0.3 b	2.3 ab
8	Opensight	2.5	OZ/A	7.0 a	0.3 b	1.3 ab
9	Nontreated Check			7.3 a	0.7 b	2.0 ab

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

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

² Treatments applied May 7, 2018.

³ Visual assessment of coverage and volume of biomass

Figure 1: View of the Opensight and Control Plots 9 DAT (May 16, 2018)

The effects of the herbicide treatment are quite dramatic on the poison hemlock!



2018 Selective Broadleaf Control Trials near Richmond (including 2019 Assessment)

Introduction

One of the objectives of roadside vegetation management is selective control of broadleaf weeds, without damaging desirable grasses, such as tall fescue. Other objectives include brush control and grass growth regulation. A number of herbicides are currently available for use by roadside managers. Therefore, individual herbicides and product combinations were evaluated for control of various weed species.

Materials and Methods

A field trial was established June 29, 2018 on an area mowed periodically, following the first mowing of the season, along I-75 near Richmond, KY. The trial had 14 treatments with 3 replications arranged in a randomized complete block design with 7 ft by 20 ft plots.

Applications were made using a carrier volume of 25 gallons per acre. The area consisted of a mix of broadleaf weeds and some desirable grasses. Most plots contained Canada thistle (9 inches tall) as well as johnsongrass (20 inches tall). Some plots contained flowering buckhorn plantain (6 inch rosettes and 15 inch seedheads) as well as prickly lettuce (15 inches tall). A patch of hemp dogbane (15 inches tall) was also present.

Herbicide treatments and active ingredients are listed in Table 1. Many treatments were applied at the maximum annual rate which included Milestone (Treatment 1) and Opensight (Treatment 2). Perspective (Treatment 3) and Streamline (Treatment 4) were both applied at the maximum selective rate although both can be applied at higher rates for bareground. However, even the selective rate can result in turf yellowing and reduced growth. In some cases the reduced growth may be desirable. Method (Treatments 6, 7, and 8) is a new product with only the aminocyclopyrachlor component of Perspective and Streamline. Method at 7.2 fl oz per acre has the equivalent amount of aminocyclopyrachlor (1.8 oz ai/A) which is present in 4.5 oz per acre of either Perspective or Streamline. The labeling for Method indicates good plantain and brush control when applied from 10 to 18 fl oz per acre. Combinations of Milestone or Method + Plateau (Treatments 11 and 12) may provide grass growth reduction, as well as weed control. A higher rate of Method + Plateau (Treatment 13) has been recommended for grass growth regulation plus brush control behind guardrails.

Treatments were assessed 31 days after treatment (DAT) (7/30/2018), 68 DAT (9/5/2018), and 306 DAT (5/1/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

Initial control of a range of broadleaf weeds was observed (68 to 92%) 31 DAT (Table 2) for most treatments. The least amount of control (63 to 65%) was with the two lowest rates of

Method (Treatments 6 and 7). The greatest degree of grass damage (43 to 57%) was with the combinations of Plateau (Treatments 11, 12, and 13) and Streamline (Treatment 4). Some treatments displayed little to no grass damage which included Milestone (Treatment 1), Opensight (Treatment 2), Pyresta + ProClipse (Treatment 5), low rate of Method (Treatment 6), Overdrive + Vastlan (Treatment 9), and Freelexx + Vastlan (Treatment 10). The best control of Canada thistle observed at 31 DAT was with the high rate of Method (Treatment 8) and the combinations with Plateau (Treatments 11, 12, and 13). The highest level of johnsongrass control was achieved with the high rate of Method (Treatment 8) and the combinations with Plateau (Treatments 11, 12, and 13).

By the second evaluation timing 68 DAT the site was overtaken by giant foxtail. Johnsongrass was also present in most plots (Table 2). The treatments with the least amount of foxtail cover were the mid-rate of Method (Treatment 7) and the combinations with Plateau (Treatments 11, 12, and 13). In future trials plot flags should be temporarily removed so that the area can be on the same mowing schedule to evaluate the broadleaf weed control as under the standard mowing regime of three times per year.

In the spring the trial area was dominated by shepherd's purse (*Capsella bursa-pastoris*) which was senescing by the assessment date (306 DAT) (Table 2). The trial area contained a good stand of Canada thistle within many of the plots in 2018 at time of application but in 2019 the visual estimation of the amount of Canada thistle was quite variable (coefficient of variation: 86%). Regardless of the variability observed all herbicide treatments had fewer Canada thistle plants than the nontreated control.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Milestone VM	7	FL OZ/A	aminopyralid	1.8 OZ AE/A
2	Opensight	3.3	OZ/A	aminopyralid + metsulfuron	1.7 OZ AE + 0.3 OZ/A
3	Perspective	4.5	OZ/A	aminocyclopyrachlor + chlorsulfuron	1.8 OZ + 0.7 OZ/A
4	Streamline	4.5	OZ/A	aminocyclopyrachlor + metsulfuron	1.8 OZ + 0.6 OZ/A
5	Pyresta	24	FL OZ/A	2,4-D + pyraflufen-ethyl	0.66 LB AE + 0.05 OZ/A
	Proclipse	2	LB/A	prodiamine	1.3 LB/A
6	Method	4	FL OZ/A	aminocyclopyrachlor	1 OZ AE/A
7	Method	6	FL OZ/A	aminocyclopyrachlor	1.5 OZ AE/A
8	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE/A
9	Overdrive	5	OZ/A	diflufenzopyr + dicamba	1 OZ AE + 2.5 OZ AE/A
	Vastlan	16	FL OZ/A	triclopyr	8 OZ AE/A
10	Freelexx	48	FL OZ/A	2,4-D	22.8 OZ AE/A
	Vastlan	32	FL OZ/A	triclopyr	16 OZ AE/A
11	Milestone VM	6	FL OZ/A	aminopyralid	3 OZ AE/A
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE/A
12	Method	6	FL OZ/A	aminocyclopyrachlor	1.5 OZ AE/A
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE/A
13	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE/A
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE/A
14	Nontreated Check				

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

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments, Application Rates, and Evaluation Data.2

Trt. No.	Product Name	Rate	Rate Unit	Broadleaf Control (%)	Grass Damage (%)	Johnsongrass Control (%)	Canada Thistle Control (%)	Giant Foxtail Cover (%)	Johnsongrass Cover (%)	Canada Thistle Amount (0-10) ³
				31 DAT (July 30, 2018)				68 DAT (Sept 5, 2018)		306 DAT (May 1, 2019)
1	Milestone VM	7	FL OZ/A	72 abc ¹	13 cde	25 defg	88 ab	85 a	9	1.3 bc
2	Opensight	3.3	OZ/A	70 abc	3 de	35 def	92 a	75 ab	18	1.3 bc
3	Perspective	4.5	OZ/A	92 a	37 b	35 def	90 a	52 abc	13	0.5 c
4	Streamline	4.5	OZ/A	92 a	43 ab	40 cde	92 a	67 abc	17	0.3 c
5	Pyresta Proclipse	24 2	FL OZ/A LB/A	68 abc	3 de	10 fg	65 b	50 abc	22	1.8 bc
6	Method	4	FL OZ/A	63 c	15 cde	30 def	72 ab	88 a	10	0.3 c
7	Method	6	FL OZ/A	65 bc	18 cd	47 bcd	65 b	35 bc	33	2.3 bc
8	Method	12	FL OZ/A	90 a	28 bc	68 ab	93 a	47 abc	27	0.3 c
9	Overdrive Vastlan	5 16	OZ/A FL OZ/A	73 abc	15 cde	20 efg	77 ab	72 ab	20	0.8 bc
10	Freelexx Vastlan	48 32	FL OZ/A FL OZ/A	83 abc	0 e	15 efg	80 ab	63 abc	30	0.7 bc
11	Milestone VM Plateau	6 3	FL OZ/A FL OZ/A	72 abc	45 ab	65 abc	70 ab	27 c	37	2.7 b
12	Method Plateau	6 3	FL OZ/A FL OZ/A	73 abc	43 ab	80 a	73 ab	40 bc	17	1.7 bc
13	Method Plateau	12 3	FL OZ/A FL OZ/A	88 ab	57 a	80 a	91 a	40 bc	12	1.0 bc
14	Nontreated Check			0 d	0 e	0 g	0 c	48 abc	35	5.2 a

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

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

² Treatments applied June 29, 2018.

³ Visual assessment of coverage and volume of biomass

2019 Selective Broadleaf Control Trials near Richmond

Introduction

One of the objectives of roadside vegetation management is the selective control of broadleaf weeds, without damaging desirable grasses, such as tall fescue. Other objectives include brush control and grass growth regulation. A number of herbicides are currently available for use by roadside managers. Therefore, individual herbicides and product combinations were evaluated for control of various weed species.

Materials and Methods

A field trial was established June 14, 2019 on an area mowed periodically, following the first mowing of the season, along I-75 near Richmond, KY. The trial had 15 treatments with 3 replications arranged in a randomized complete block design with 7 ft by 20 ft plots.

Applications were made using a carrier volume of 25 gallons per acre. The area consisted of a mix of broadleaf weeds and some desirable grasses. Tall fescue was 9 inches tall and the undesirable johnsongrass was 22 inches tall at time of application. Most plots contained red clover (18 inches tall); as well as, flowering buckhorn plantain (19 inch tall seedheads). Other legumes included white clover (8 inches tall) and black medic (8 inches tall).

Herbicide treatments and active ingredients are listed in Table 1. Many treatments were applied at the maximum annual rate which included Milestone (Treatment 1) and Opensight (Treatment 2). Perspective (Treatment 3) and Streamline (Treatment 4) were both applied at the maximum selective rate although both can be applied at higher rates for bareground. However, even the selective rate can result in turf yellowing and reduced growth. In some cases the reduced growth may be desirable. Method (Treatments 6, 7, and 8) is a new product with only the aminocyclopyrachlor component of Perspective and Streamline. Method at 7.2 fl oz per acre has the equivalent amount of aminocyclopyrachlor (1.8 oz ai/A) which is present in 4.5 oz per acre of either Perspective or Streamline. The labeling for Method indicates good plantain and brush control when applied from 10 to 18 fl oz per acre. Combinations of Milestone or Method + Plateau (Treatments 12 and 13) may provide grass growth reduction, as well as weed control. A higher rate of Method + Plateau (Treatment 14) was been recommended for grass growth regulation plus brush control behind guardrails. The FreeLexx + Escort combination (Treatment 11) is designed for greater woody vegetation control.

Plots were assessed 48 days after treatment (DAT) (8/1/2019), 83 DAT (9/5/2019), and 131 DAT (10/23/2019). Data were analyzed using ARM research management software (GDM Solutions, Inc.) and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

Most red clover plants were brown, including those in the control plots by the first evaluation period 48 DAT. Growth of all plants was less than in nearby areas likely due to poorer soil; and

regrowth of plants like plantain was limited by the thin soil, as well as, the drought. The Bluegrass Region CD3 had 0.19” which was 2.93” less than the long-term average in September.

The predominant broadleaf weed 48 DAT was buckhorn plantain and most treatments provided 45 to 87% control (Table 2). However, Milestone (Treatment 1), Perspective (Treatment 3), and Milestone + Plateau (Treatment 12) had ratings similar to the untreated control. Overall broadleaf weed control ranged from 40 to 92% for all herbicide treatments which was better than for the untreated control. The greatest grass damage observed (13 to 17%) was with Method + Plateau treatments (Treatments 13 and 14).

At 83 DAT broadleaf plantain seedheads were largely brown and new rosette leaf growth was observed which resulted in somewhat lower control ratings for many treatments (Table 2). Milestone (Treatment 1), Milestone + Plateau (Treatment 12), and the low rate of Method + Plateau (Treatment 13) had ratings the same as the untreated control. Most treatments had visual ratings different from the control for overall broadleaf weed control (40 to 80%).

By the last assessment date of the season 131 DAT the dead/damaged plants were not evident but plantain regrowth was visible after receiving adequate rain. The amount of plantain cover (%) was assessed and it should be noted that the initial cover was not uniform. The only treatments with less plantain cover than the untreated control were Streamline (Treatment 4), Freelex + Vastlan (Treatment 10), and Freelex + Escort (Treatment 11). Additional assessments will be taken in spring 2020.

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

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

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Milestone VM	7	FL OZ/A	aminopyralid	1.8 OZ AE/A
2	Opensight	3.3	OZ/A	aminopyralid + metsulfuron	1.7 OZ AE + 0.3 OZ/A
3	Perspective	4.5	OZ/A	aminocyclopyrachlor + chlorsulfuron	1.8 OZ + 0.7 OZ/A
4	Streamline	4.5	OZ/A	aminocyclopyrachlor + metsulfuron	1.8 OZ + 0.6 OZ/A
5	Pyresta	24	FL OZ/A	2,4-D + pyraflufen-ethyl	0.66 LB AE + 0.05 OZ/A
	Proclipse	2	LB/A	prodiamine	1.3 LB/A
6	Method	4	FL OZ/A	aminocyclopyrachlor	1 OZ AE/A
7	Method	6	FL OZ/A	aminocyclopyrachlor	1.5 OZ AE/A
8	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE/A
9	Overdrive	5	OZ/A	diflufenzopyr + dicamba	1 OZ AE + 2.5 OZ AE/A
	Vastlan	16	FL OZ/A	triclopyr	8 OZ AE/A
10	Freelexx	48	FL OZ/A	2,4-D	22.8 OZ AE/A
	Vastlan	32	FL OZ/A	triclopyr	16 OZ AE/A
11	Freelexx	32	FL OZ/A	2,4-D	15.2 OZ AE/A
	Escort	1	OZ/A	metsulfuron	0.6 OZ/A
12	Milestone VM	6	FL OZ/A	aminopyralid	3 OZ AE/A
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE/A
13	Method	6	FL OZ/A	aminocyclopyrachlor	1.5 OZ AE/A
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE/A
14	Method	12	FL OZ/A	aminocyclopyrachlor	3 OZ AE/A
	Plateau	3	FL OZ/A	imazapic	0.75 OZ AE/A
15	Nontreated Check				

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

Non-Crop and Invasive Vegetation Management Weed Science
2019 Annual Research Report

Table 2. Herbicide Treatments, Application Rates, and Assessment Data.

Trt. No.	Product Name	Rate	Rate Unit	Broadleaf Control (%)	Buckhorn Plantain Control (%)	Grass Damage (%)	Broadleaf Control (%)	Buckhorn Plantain Control (%)	Buckhorn Plantain Cover (%)
				48 DAT (August 1, 2019)			83 DAT (Sept 23, 2019)		131 DAT (Oct 23, 2019)
1	Milestone VM	7	FL OZ/A	47 c	38 bcd	0 b	40 bcd	33 bcde	10 a
2	Opensight	3.3	OZ/A	67 abc	55 abc	3 b	48 abcd	47 abcd	5 abcd
3	Perspective	4.5	OZ/A	60 bc	37 bcd	0 b	52 abcd	48 abcd	5 abcd
4	Streamline	4.5	OZ/A	80 ab	70 ab	3 b	60 abc	58 abc	1 d
5	Pyresta	24	FL OZ/A	78 ab	87 a	0 b	78 a	87 a	8 ab
	Proclipse	2	LB/A						
6	Method	4	FL OZ/A	67 abc	67 ab	0 b	73 ab	50 abcd	6 abcd
7	Method	6	FL OZ/A	75 ab	65 abc	2 b	57 abcd	63 ab	3 bcd
8	Method	12	FL OZ/A	67 abc	70 ab	2 b	80 a	70 ab	2 cd
9	Overdrive	5	OZ/A	67 abc	72 ab	0 b	63 abc	50 abcd	5 abcd
	Vastlan	16	FL OZ/A						
10	Freelexx	48	FL OZ/A	92 a	85 a	0 b	67 abc	53 abcd	2 d
	Vastlan	32	FL OZ/A						
11	Freelexx	32	FL OZ/A	85 ab	78 ab	0 b	67 abc	58 abc	1 d
	Escort	1	OZ/A						
12	Milestone VM	6	FL OZ/A	40 c	23 cd	3 b	33 cde	18 cde	7 abcd
	Plateau	3	FL OZ/A						
13	Method	6	FL OZ/A	60 bc	45 abc	17 a	23 de	13 de	8 ab
	Plateau	3	FL OZ/A						
14	Method	12	FL OZ/A	67 abc	67 ab	13 a	50 abcd	47 abcd	3 bcd
	Plateau	3	FL OZ/A						
15	Nontreated Check			0 d	0 d	0 d	0 e	0 e	7 abc

¹ Means within a column followed by the same letter are not different according to Fisher's LSD at $P < 0.05$.

² Treatments applied June 14, 2019.

INTRODUCTION

One of the challenges of vegetation management on right-of-ways is the rapid growth of woody plants. While mechanical (mowing) and chemical options are available during the growing season to manage woody vegetation, dormant-stem herbicide applications are another option outside the growing season that extend the spray season. The herbicides are applied to brush vegetation while there are no leaves on the deciduous plants. The herbicide treatment is applied to the branches and trunks and the herbicide moves into the plant by penetrating the thin bark layer. The most effective timing is from about six weeks prior to bud break and up to the beginning of bud break. Applications must be made when the bark, stems, and branches are dry.

OBJECTIVE

Compare the efficacy of some herbicide combinations for controlling brush species.

MATERIALS & METHODS

A trial was established in an area of mixed brush regrowth near Nortonville in western Kentucky along the Western KY Parkway. Four treatments plus a control, listed in Table 1, were applied on March 8, 2016 before bud break at 468 L ha⁻¹ using a TeeJet® Boomless tip mounted on the rear of an ATV. Plots were 12 m long X 3.7 m wide and were arranged as a RCBD with 4 replications. The woody vegetation was 1.5 to 1.8 m high at application. The species in the plots included tulip poplar (*Liriodendron tulipifera* L.), sweet gum (*Liquidambar styraciflua* L.), winged elm (*Ulmus alata Michx.*), smooth sumac (*Rhus glabra* L.), devil's walking stick (*Aralia spinosa* L.), and blackberry (*Rubus* L.).

All the herbicide mixes included basal oil @ 18.7 L ha⁻¹ to help get the herbicide through the bark and surfactant @ 9.4 L ha⁻¹ to emulsify the oil with the water carrier. All the mixes also included different rates of Garlon 4 Ultra (triclopyr) which does not have residual soil activity. The components with some soil activity are the dicamba in BK800, aminopyralid in Milestone, aminocyclopyrachlor + imazapyr + metsulfuron in Viewpoint, and metsulfuron in Patriot (Table 1).

The small plots were rated visually 57 (5/3/2016), 72 (5/18/2016), 114 (6/29/2016), 205 (9/28/2016), and 422 (5/3/2017) days after treatment (DAT). Data collected were % woody stem leaf out and % herbaceous cover 57 DAT and % leaf out and % green cover from woody vegetation which was split into lower and upper canopy cover 72 DAT. For the 114 and 205 DAT ratings, % bareground, % herbaceous cover, and % woody lower and upper canopy cover (overlapping canopy at this point) data were collected. The following spring at the 422 DAT rating, % herbaceous cover, % woody lower and upper canopy cover plus % woody stem leafout data were collected. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at p = 0.05.

RESULTS & DISCUSSION

Table 1. Herbicide treatments, active ingredients and application rates.

Trt. No.	Product(s)	Rate per ha	Active Ingredient(s)	ai Application Rate (per ha)
1	BK800	14 L	2,4-D + 2,4-DP + dicamba	3.18 kg ae + 1.58 kg ae + 0.80 kg ae
	Garlon 4 Ultra	4.7 L	triclopyr	2.24 kg ae
2	Garlon 4 Ultra	18.7 L	triclopyr	8.97 kg ae
	Milestone	0.2 L	aminopyralid	126 g ae
3	Garlon 4 Ultra	9.4 L	triclopyr	4.48 kg ae
	Viewpoint	840 g	aminocyclopyrachlor + imazapyr + metsulfuron	189 g + 266 g + 63 oz
4	Patron 170	8 L	2,4-D + 2,4-DP	1.65 kg ae + 0.84 kg ae
	Garlon 4 Ultra	9.4 L	triclopyr	4.48 kg ae
	Patriot	210 g	metsulfuron	126 g ae
5	Untreated Control			

Table 2. Initial results in 2016.

Trt. No.	Product(s)	% Leaf Out 57 DAT ¹ (May 3, 2016)	% Herbaceous Cover	% Leaf Out	% Green Cover	Woody Vegetation Cover	
						% Lower Canopy 72 DAT (May 18, 2016)	% Upper Canopy
1	BK800	7 b ²	3	9 b	20 b	11 b	9 b
	Garlon 4 Ultra						
2	Garlon 4 Ultra	2 c	9	3 b	11 b	8 b	3 b
	Milestone						
3	Garlon 4 Ultra	5 bc	1	9 b	16 b	5 b	11 b
	Viewpoint						
4	Patron 170	3 bc	2	8 b	14 b	6 b	8 b
	Garlon 4 Ultra						
	Patriot						
5	Untreated Control	100 a	2	100 a	100 a	53 a	48 a

Table 3. Initial results in 2017.

Trt. No.	Product(s)	% Herbaceous Cover	Woody Vegetation Cover		
			% Lower Canopy	% Upper Canopy	% Woody Stem Leafout
422 DAT ¹ (May 3, 2017)					
1	BK800	41	56 a ²	30 ab	69 a
	Garlon 4 Ultra				
2	Garlon 4 Ultra	50	19 b	4 c	26 b
	Milestone				
3	Garlon 4 Ultra	49	39 ab	13 bc	69 a
	Viewpoint				
4	Patron 170	66	43 ab	25 bc	75 a
	Garlon 4 Ultra				
	Patriot				
5	Untreated Control	75	63 a	48 a	84 a

¹ DAT = Days after treatment

² Means within a column followed by the same letter are not different according to Fisher's LSD at P < 0.05

The spray coverage or, rather, the lack of coverage was evident in the plots after leaf out. This illustrated the importance of good coverage for the most efficacious control results. All the treatments gave good initial results in brush suppression but many of the plants still leafed out from buds outside the spray pattern and continued to grow (Table 2). Assessments the following season provided information on how many of these plants actually died and how efficacious the herbicide mixes (Table 3). The treatment that stood out was Garlon + Milestone (Treatment 2) which had less lower canopy cover and woody stem leafout than control. Many of these stems were dead and dry. It can take time for treatment differences to become evident with perennials.

2019 Roadside Environment Update

**Thursday March 28, 2019 at Weldon Suite (Good Barn on UK Campus)
1451 University Drive, Lexington, KY 40546**

Agenda

- 8:30 – 9:00 a.m. Coffee, Orange Juice & Donuts
- 9:00 – 9:10 a.m. Opening Remarks (David Cornett)
- 9:10 – 10:00 a.m. Summary and discussion of Research Trials (part 1) (information on guardrail (bareground chemistries) and johnsongrass control trials) (Cat. 3, 6, 10) (Dr. Joe Omielan)
- 10:00 – 10:30 a.m. Some alternatives to KY31 on Roadsides and Rest Areas (Cat. 3, 6, 10) (Dr. Gregg Munshaw)
- 10:30 – 10:40 a.m. Break
- 10:40 – 11:30 a.m. Update on Research on Pollinators in the Environment (General) (Adam Baker)
- 11:30 – 12:00 p.m. Summary and discussion of Research Trials (part 2) (information on PGR and broadleaf trials plus knapweed biocontrol update) (Cat. 3, 6, 10) (Dr. Joe Omielan)
- 12:00 – 1:00 p.m. Lunch (Box Lunches)
- 1:00 – 1:50 p.m. Update on Invasive Plants along Roadsides and in our Forests (General) (Dr. Ellen Crocker)
- 1:50 – 2:40 p.m. Update on Imported Fire Ants and other Insect Pests in KY (General) (Joe Collins and Dr. Janet Lensing)
- 2:40 – 3:30 p.m. Sprayer Systems: Basic Principles and New Technologies (General) (Dr. Tim Stombaugh)

Pesticide CEUs approved: General (4 CEU)
Cat. 3, 6, 10 (2 CEU)

Attendance: 29 KYTC, 4 UK

**Breakdown of KYTC attendance: Central Office (6), Dept. Environ. Analysis (1)
D3 (1), D4 (2), D5 (8), D6 (2), D7 (2), D8 (3), D9 (3), D11 (1)**

Vegetation Management for Highway Rights of Way Workshop
Tuesday July 23, 2019 at Spindletop Research Farm, Lexington KY
3250 Iron Works Pike, Lexington, KY 40511

Agenda

- 8:30 – 9:00 a.m. Registration (coffee and donuts)
- 9:00 – 10:00 a.m. Pesticide Spill Response (Dr. Ed McCracken) with the assistance of the D9 Crew and their spray truck.
- 10:00 – 11:00 a.m. Weed ID (Dr. Tim Phillips) (Group A) & Herbicide Injury Demo (Dr. Joe Omielan) (Group B)
- 11:00 – 12:00 p.m. Weed ID (Dr. Tim Phillips) (Group B) & Herbicide Injury Demo (Dr. Joe Omielan) (Group A)
- 12:00 – 12:45 p.m. Lunch
- 12:45 – 1:30 p.m. Updates on Pollinator Stakeholder Initiatives, Activities, Meetings, and Plots (Ellen Mullins)
- 1:30 – 2:30 p.m. Demonstration of Weed Wiper from GrassWorks Manufacturing (Linda Reed and Bobby Umberson)
- 2:30 – 3:30 p.m. Tour of Turf Research Center and Landscape Management (Dr. Gregg Munshaw and Kayla Marshall)

CEU's in this workshop: 3 General and 2 Specific (Categories 3, 5, 6, 10, 12) (approved)

Dr. Ed McCracken will provide information on how handle fuel spills at Rest Areas and how to respond to and clean up pesticide spills. The D9 Crew and their spray truck will demonstrate how to respond to a spill. (General)

Dr. Tim Phillips will provide information and practice in identifying crops, pollinator plants, invasive grasses, and weeds. (Cat. 3, 5, 6, 10, 12)

Dr. Joe Omielan will lead the group in an exercise examining herbicide injury symptoms on different crop species (Cat. 3, 5, 6, 10, 12)

Ellen Mullins will update us on some of the Pollinator Stakeholder initiatives, activities, meetings, and plots and how we can participate and assist. (General)

Dr. Gregg Munshaw will lead the tour of the Turf Research Center and discuss some of the current research activities, including the role of fertility management, while Kayla Marshall will discuss the examples of a pollinator garden and a bee bank. (General)

For more information contact Joe Omielan at 859-967-6205, e-mail joe.omielan@uky.edu

Attendance: 48 KYTC, 5 UK, 2 Industry

**Breakdown of KYTC attendance: Central Office (3), Dept. Environ. Analysis (2)
D2 (6), D3 (5), D4 (7), D6 (7), D7 (5), D8 (7), D9 (5), D11 (1)**

2019 KYTC Tree Management Workshop
**Wednesday September 11, 2019 at Boone County Extension Enrichment Center (1824 Patrick Dr.,
Burlington KY 41005) and Boone County Arboretum (9190 Camp Ernst Rd., Union KY 41091)**

Agenda

- 8:30 – 9:00 a.m. Registration along with coffee and donuts (at Enrichment Center)
- 9:00 – 10:00 a.m. Selection and Care of Healthy Trees (Dr. Bill Fountain, UK)
- 10:00 – 11:00 a.m. An Overview of the International Society of Arboriculture Tree Risk Assessment Qualification.
(Dr. Bill Fountain, UK)
- 11:00 – 11:45 a.m. Chainsaw Maintenance, Safety & Ergonomics (Cody Dunkin from Bryan Equipment)
- 11:45 – 12:30 p.m. Lunch (at Enrichment Center)
- 12:30 – 1:00 p.m. Video of Bobcat Forestry Head in action plus discussion and demonstration of Skytrim Mini (at
Enrichment Center)
- 1:00 – 4:00 p.m. Move to Shelter #2 at Arboretum for Tour and Outdoor Demonstrations (*please bring your
hard hats and other safety gear*)
- 1:15 – 1:45 p.m. Continuation of Cody’s Chainsaw Presentation/Demonstration (perhaps along
Woodland Trail)
- 1:45 – 4:00 p.m. Tour along Woodland Trail for discussion of Risk of Tree Failure, Landscape Trees
(alternatives to Ash and what to plant under utilities), Butterfly Garden
- Demonstrations of Skytrim by Owen Electric Cooperative (possibly), proper pruning,
possibly rigging and road side set up/safety by Bartlett Tree Experts (possibly), proper
tree planting (Arboretum staff).

Pesticide CEU’s for this workshop: 1 General, 1 Specific (Categories 3, 6, 10, 12) (approved)

Arborist CEU’s (5.75 CEUs) (approved).

Engineering PDH’s (6 Hours) (approved).

For more information contact Joe Omielan at 859-967-6205, e-mail joe.omielan@uky.edu

Topics to be covered in the Workshop

Selection and Care of Healthy Trees (Dr. Bill Fountain, UK)

- Bill will present information on tree ID (both native and non-natives used in landscapes). It's important to pick the right tree for the location, plant it properly, and maintain it with proper pruning while avoiding mower damage and other hazards. He'll also suggest trees that are attractive and good for pollinators.

An Overview of the International Society of Arboriculture Tree Risk Assessment Qualification. (Dr. Bill Fountain, UK)

- TRAQ is an ISA qualification program that trains arborists how to use the methodologies outlined in the ISA Best Management Practices for Tree Risk Assessment. This qualification promotes the safety of people and property by providing a standardized and systematic process for assessing tree risk. The results of a tree risk assessment can provide tree owners and risk managers with the information to make informed decisions to enhance tree benefits, health, and longevity. Bill will also present information about tree failure profiles and appraisal values of landscape trees.

Chainsaw Maintenance, Safety & Ergonomics (Cody Dunkin from Bryan Equipment)

- Cody will discuss the safety features of a saw and proper PPE as well as proper starting and handling and continue this outdoors at the Arboretum

We were unable to get the equipment trucked to the site but we'll have a video of the Bobcat Forestry Head in action plus discussion. We should have an example and demonstration of the Skytrim Mini from Progress Rail.

Outdoor Demonstrations and Hands-On Opportunities (*please bring your hard hats and other safety gear plus your chainsaws*):

Chainsaw Maintenance, Safety & Ergonomics (Cody Dunkin from Bryan Equipment)

- Cody will continue this outdoors at the Arboretum

- Tour along Woodland Trail for discussion of Risk of Tree Failure, Landscape Trees (alternatives to Ash and what to plant under utilities), Butterfly Garden

- Demonstrations of Skytrim by Owen Electric Cooperative (possibly), proper pruning, possibly rigging and road side set up/safety by Bartlett Tree Experts (possibly), proper tree planting (Arboretum staff).

Attendance: 39 KYTC, 2 UK, 4 Industry

Breakdown of KYTC attendance: Central Office (2)

D4 (5), D5 (4), D6 (13), D7 (2), D9 (13)