Noncrop and Invasive Vegetation Management Weed Science

2014 Annual Research Report

UNIVERSITY
OF KENTUCKY

College of Agriculture
Department of Plant and Soil Sciences

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INFORMATION NOTE 2014 NCVM-1

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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 2014 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.

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Acknowledgements

The Kentucky Transportation Cabinet funded the majority of the research conducted during the 2014 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 group who also aided in this project in terms of labor, equipment, and ideas include Charlie Slack, Sara Carter, Dr. J.D. Green, and Dr. Jim Martin. 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
Backed By Bayer
Dow AgroSciences
DuPont
Nufarm
Valent

External funding for research projects was received from Dow AgroSciences LLC. The financial support of these organizations is greatly appreciated.

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
Ambrosia trifida L.	Giant Ragweed
Euphorbia maculata L.	Spotted Spurge
Festuca arundinaceum (Schreb.) S.J. Darbyshire	Tall Fescue
Microstegium vimineum (Trin.) A. Camus	Japanese Stiltgrass
Oxalis sp.	Oxalis
Plantago lanceolata L.	Buckhorn Plantain
Poa pratensis L.	Kentucky Bluegrass
Pueraria montana (Lour.) Merr.	Kudzu
Sorghum halepense (L.) Pers.	Johnsongrass

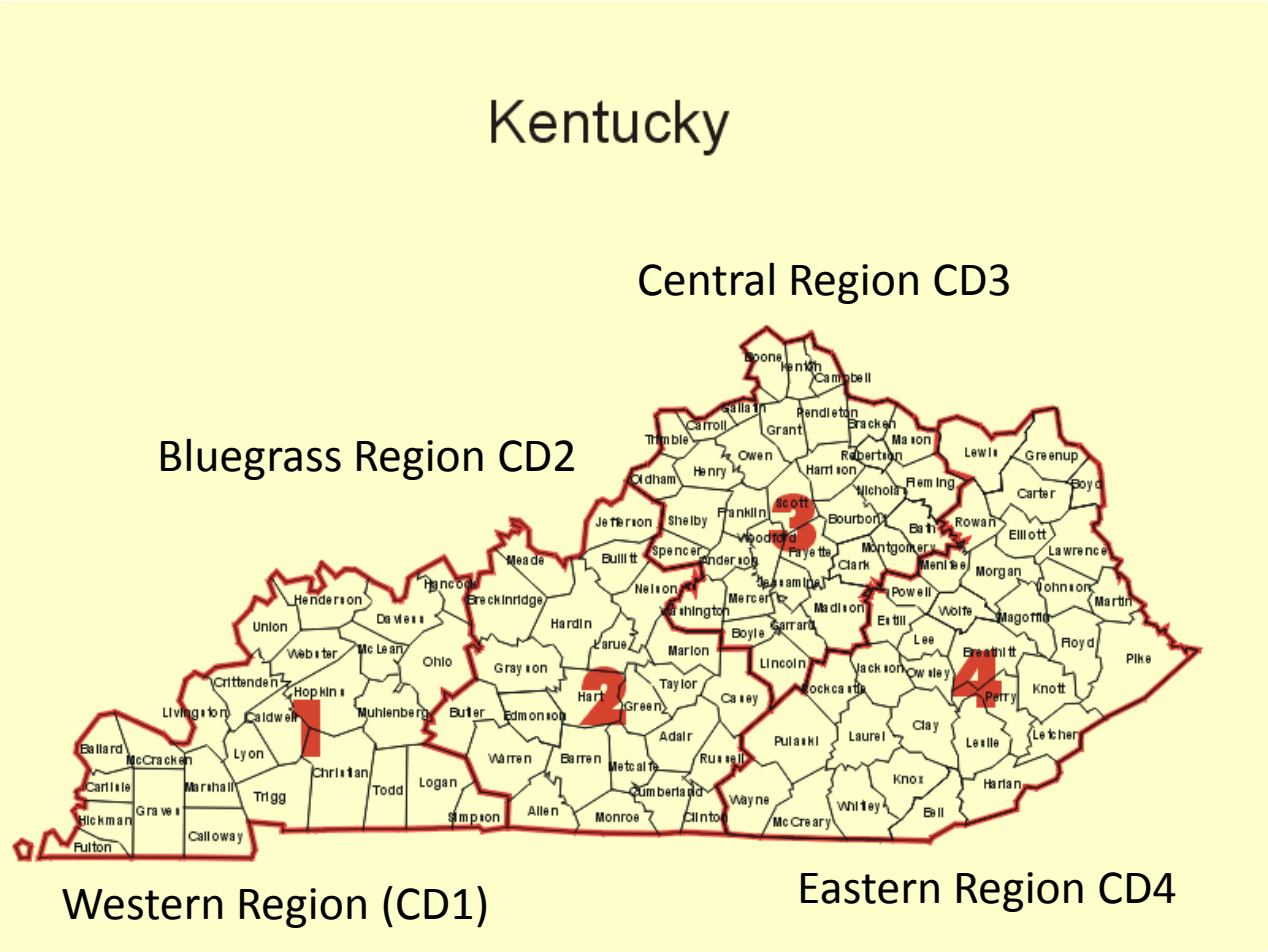
Herbicide List

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

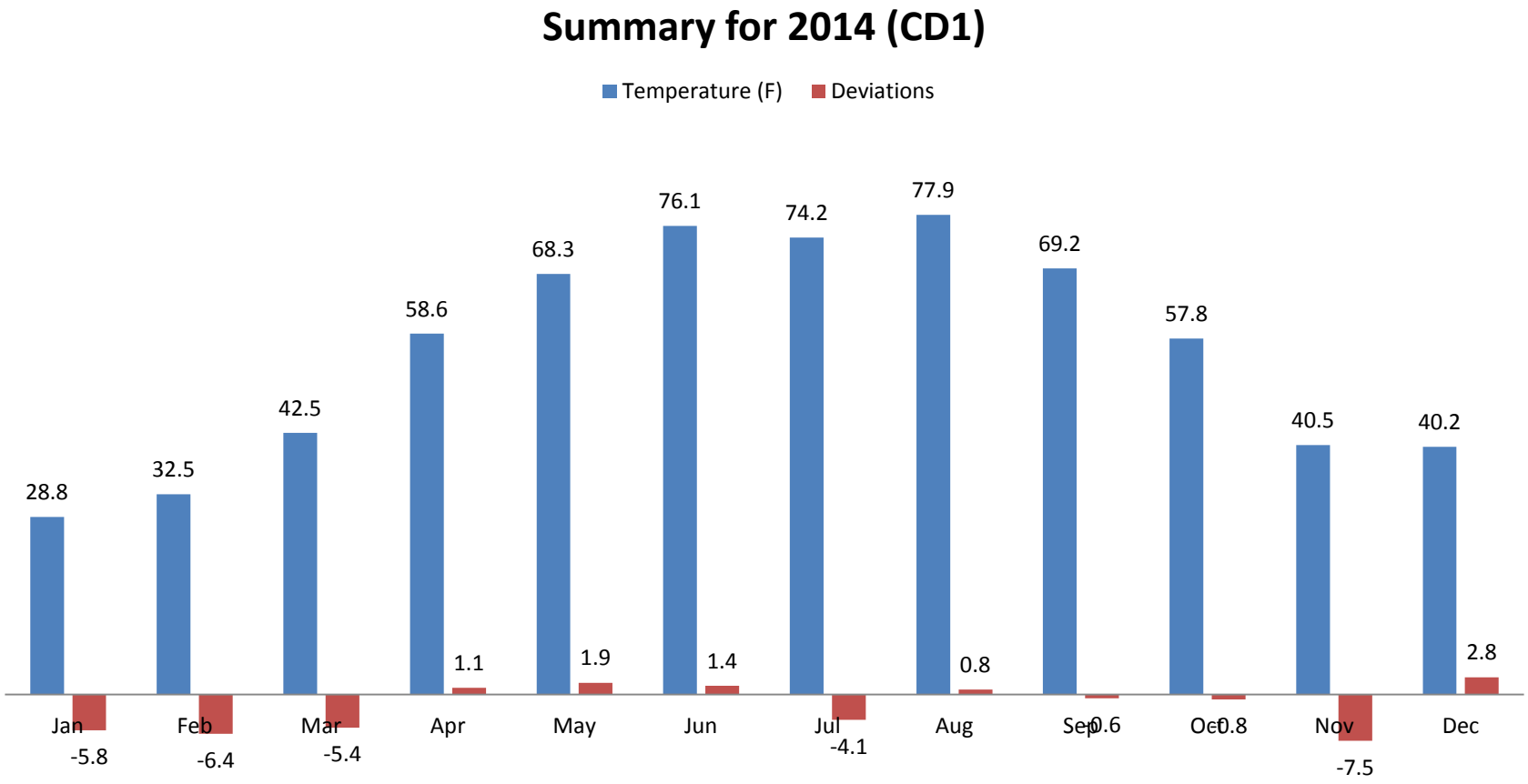
Product	Active Ingredient(s)	Concentration	Manufacturer
Acclaim Extra	fenoxaprop	0.57 lb per gallon	Bayer
BK 800	2,4-D + 2,4-DP + dicamba	1.89 lb ae + 0.94 lb ae + 0.47 lb ae per gallon	PBI Gordon
Clearcast	imazamox	1 lb ae per gallon	BASF
Endurance	prodiamine	65% w/w	Syngenta
Esplanade	indaziflam	1.67 lb per gallon	Bayer
Finale	glufosinate	1 lb per gallon	Bayer
Fusilade II	fluazifop	2 lb per gallon	Syngenta
Fusion	fluazifop + fenoxaprop	2 lb + 0.56 lb per gallon	Syngenta
Garlon 3A	triclopyr amine	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
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 Extra	sulfometuron + metsulfuron	56.25% + 15% w/w	DuPont
Oust XP	sulfometuron	75% w/w	DuPont
Outrider	sulfosulfuron	75% w/w	Monsanto
Pastora	nicosulfuron + metsulfuron	56.2% + 15% w/w	DuPont
Patron 170	2.4-D + 2,4-DP	1.71 lb ae + 0.87 lb ae per gallon	Nufarm
Payload	flumioxazin	51% w/w	Valent
Pendulum AquaCap	pendimethalin	3.8 lb per gallon	BASF
Perspective	aminocyclopyrachlor + chlorsulfuron	39.5% + 15.8% w/w	DuPont
Plateau	imazapic	2 lb ae per gallon	BASF
Polaris AC Complete	imazapyr	4 lb ae per gallon	Nufarm
Proclipse	prodiamine	65% w/w	Nufarm
Rodeo	glyphosate	4 lb ae per gallon	Dow AgroSciences
Roundup ProMax	glyphosate	4.5 lb ae per gallon	Monsanto
Sahara	diuron + imazapyr	62.22% + 7.78% w/w	BASF

Streamline	aminocyclopyrachlor + metsulfuron methyl	39.5% + 12.6% w/w	DuPont
Transline	clopyralid	3 lb ae per gallon	Dow AgroSciences
Viewpoint	imazapyr + aminocyclopyrachlor + metsulfuron	31.6% + 22.8% + 7.3% w/w	DuPont

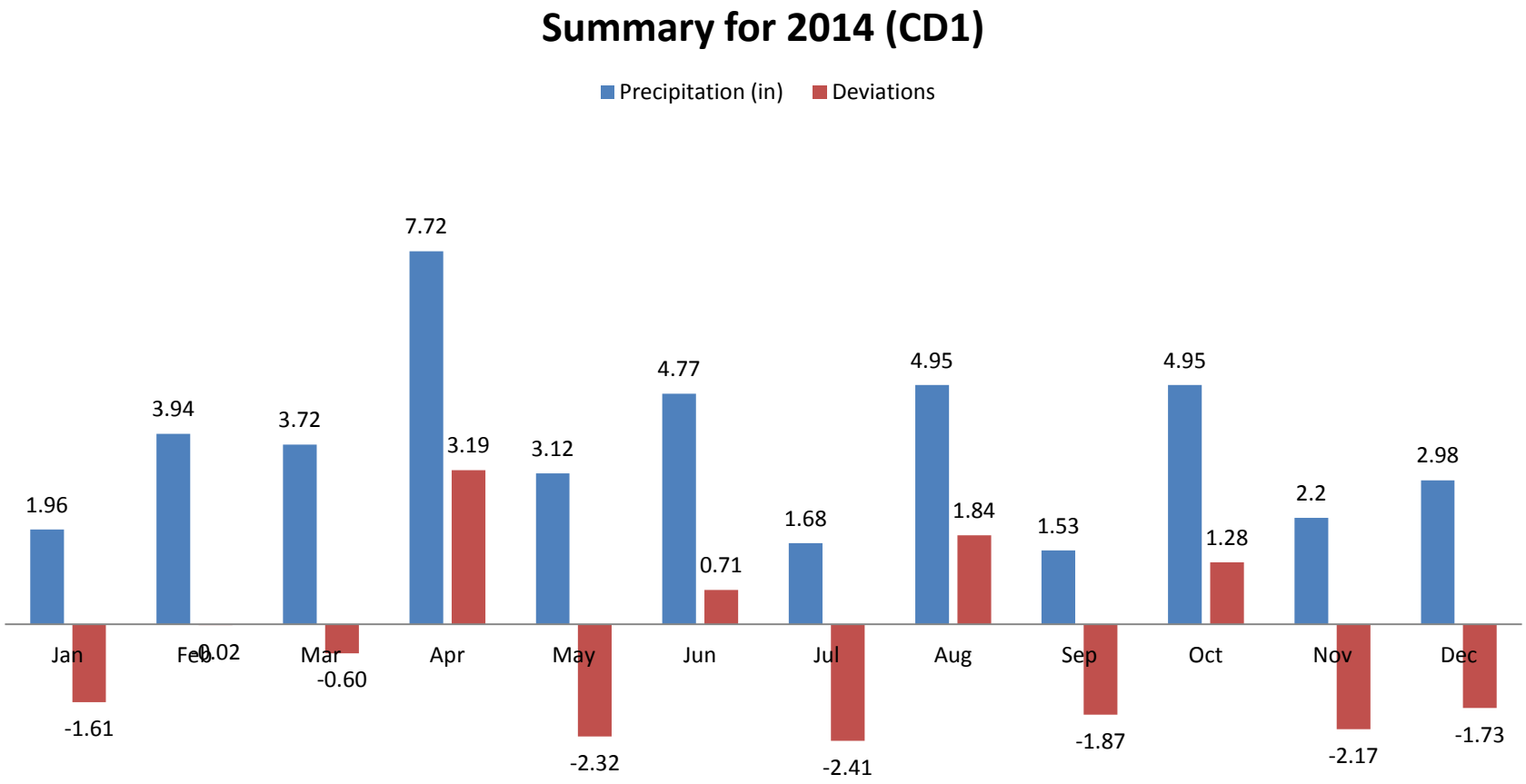
Map of Kentucky Climate Divisions



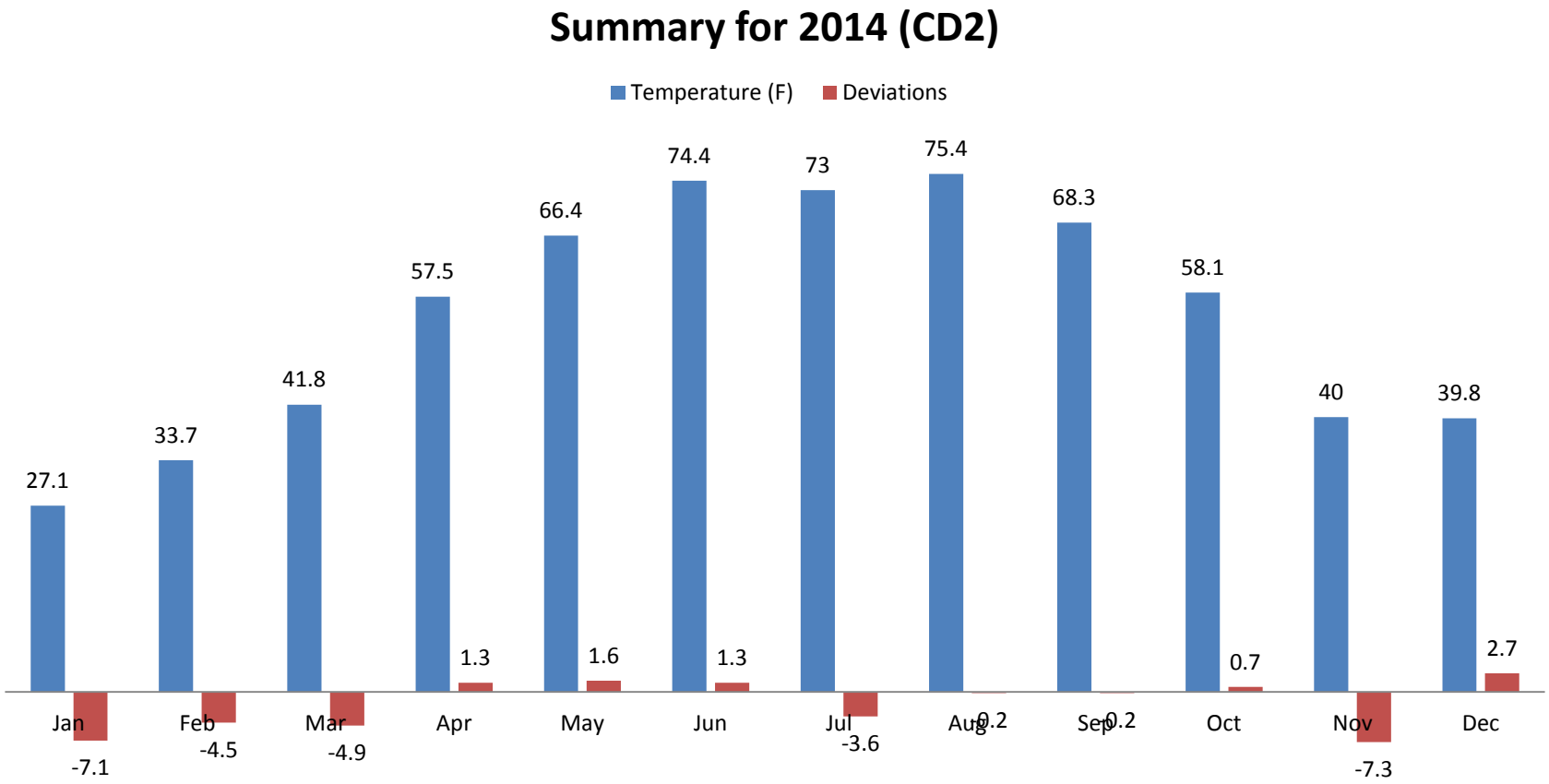
Western Region (CD1) Monthly Temperatures and Deviations from Normal (UKWAC)



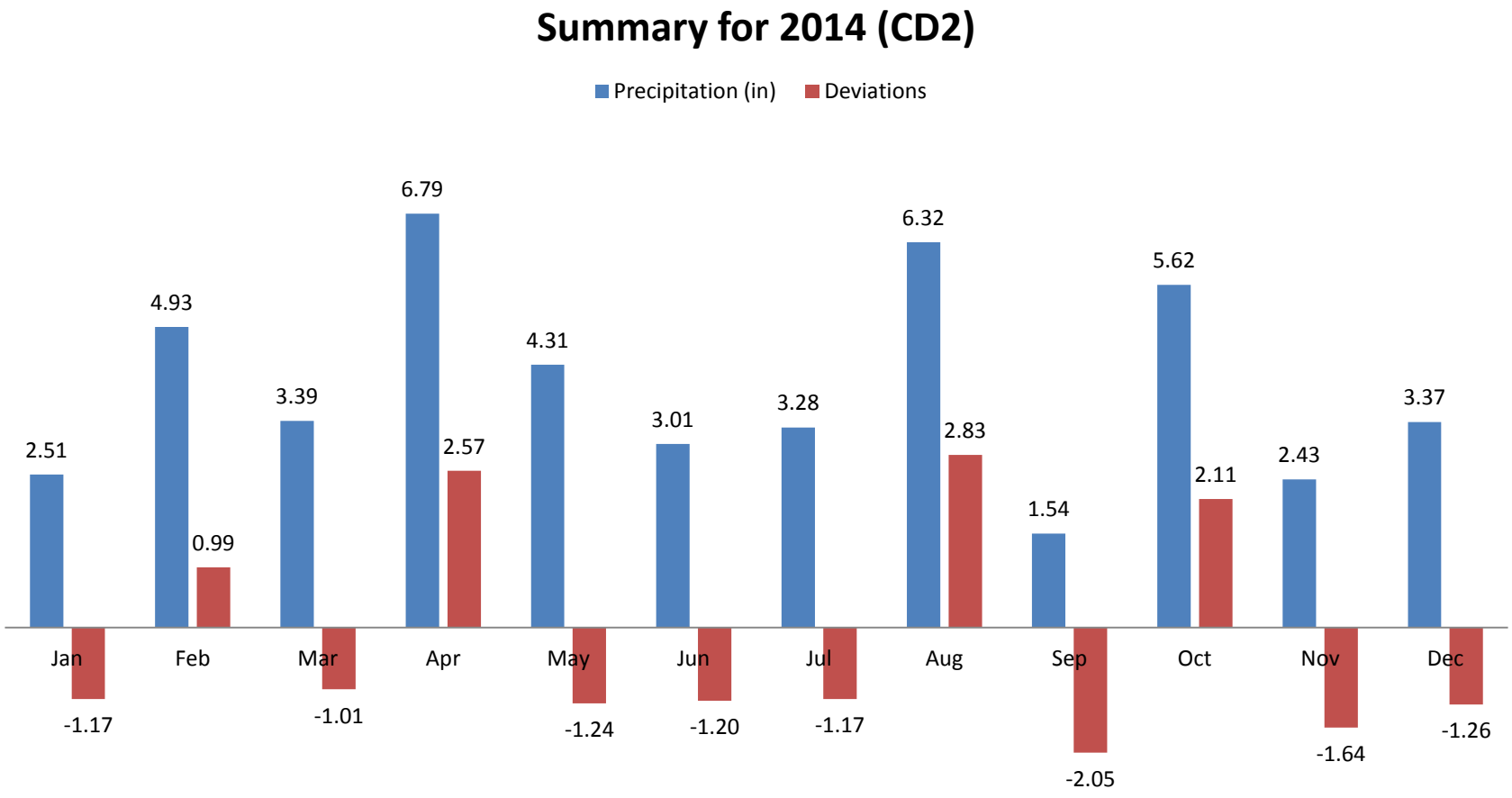
Western Region (CD1) Monthly Precipitation and Deviations from Normal (UKWAC)



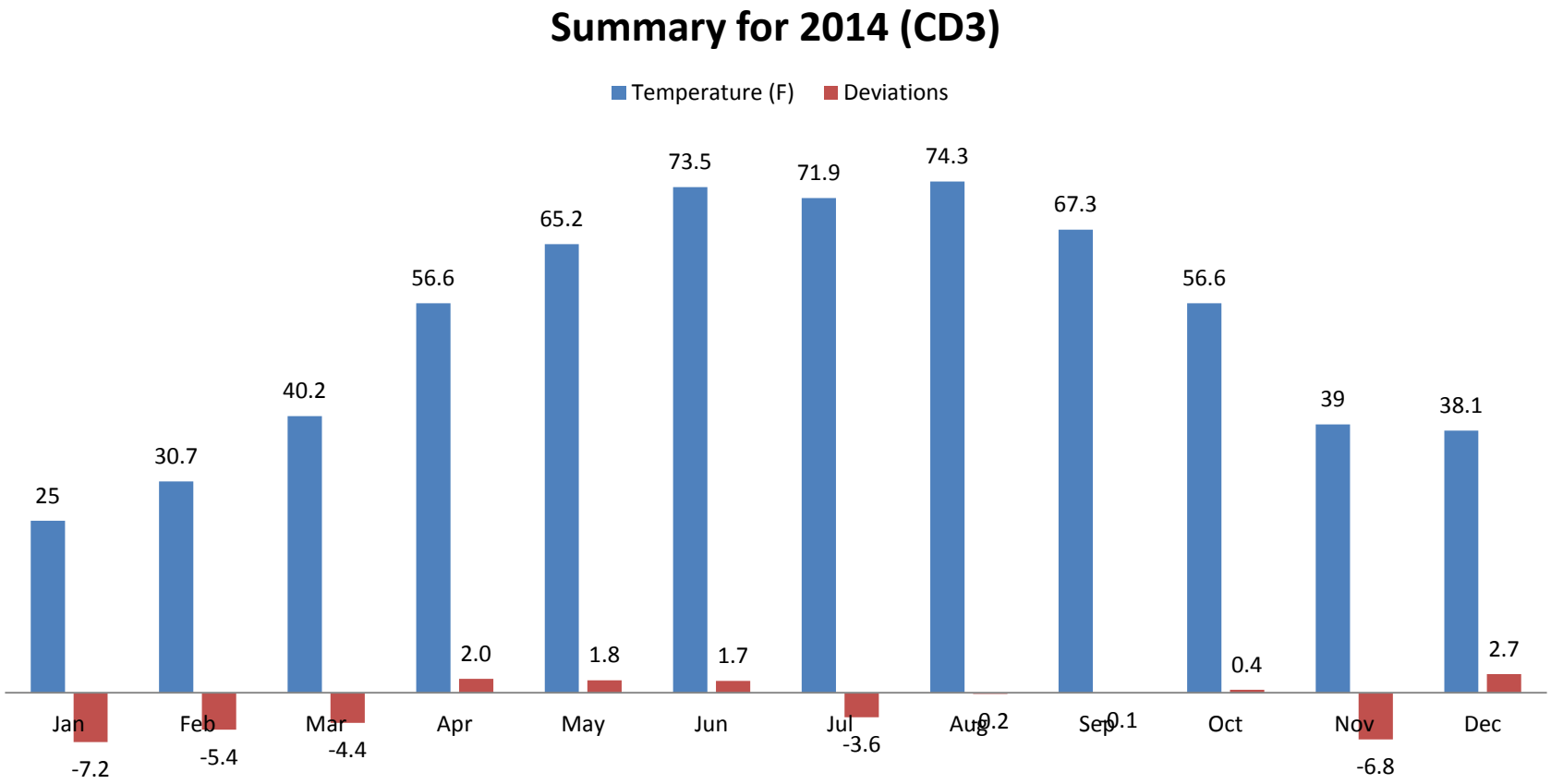
Central Region (CD2) Monthly Temperatures and Deviations from Normal (UKWAC)



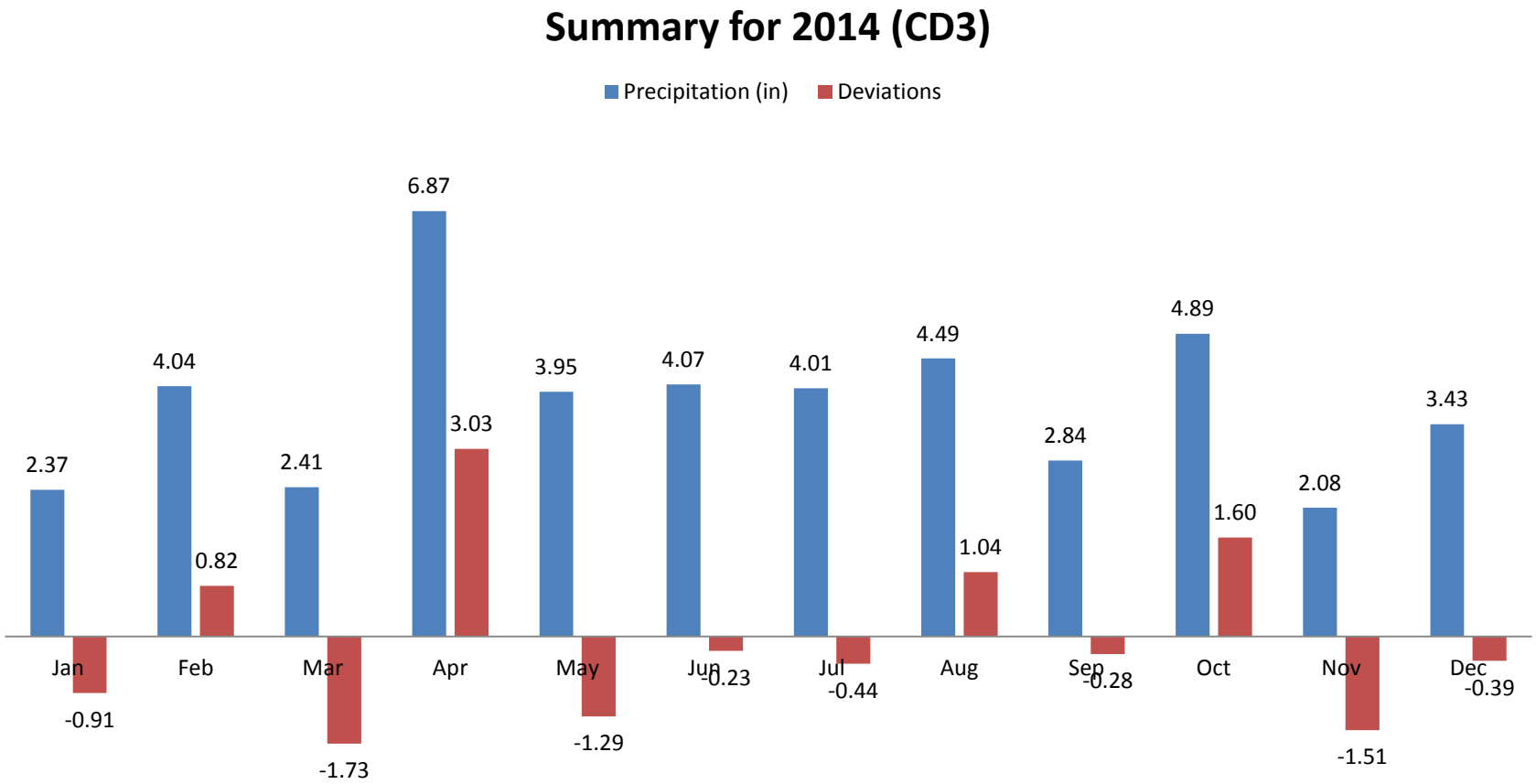
Central Region (CD2) Monthly Precipitation and Deviations from Normal (UKWAC)



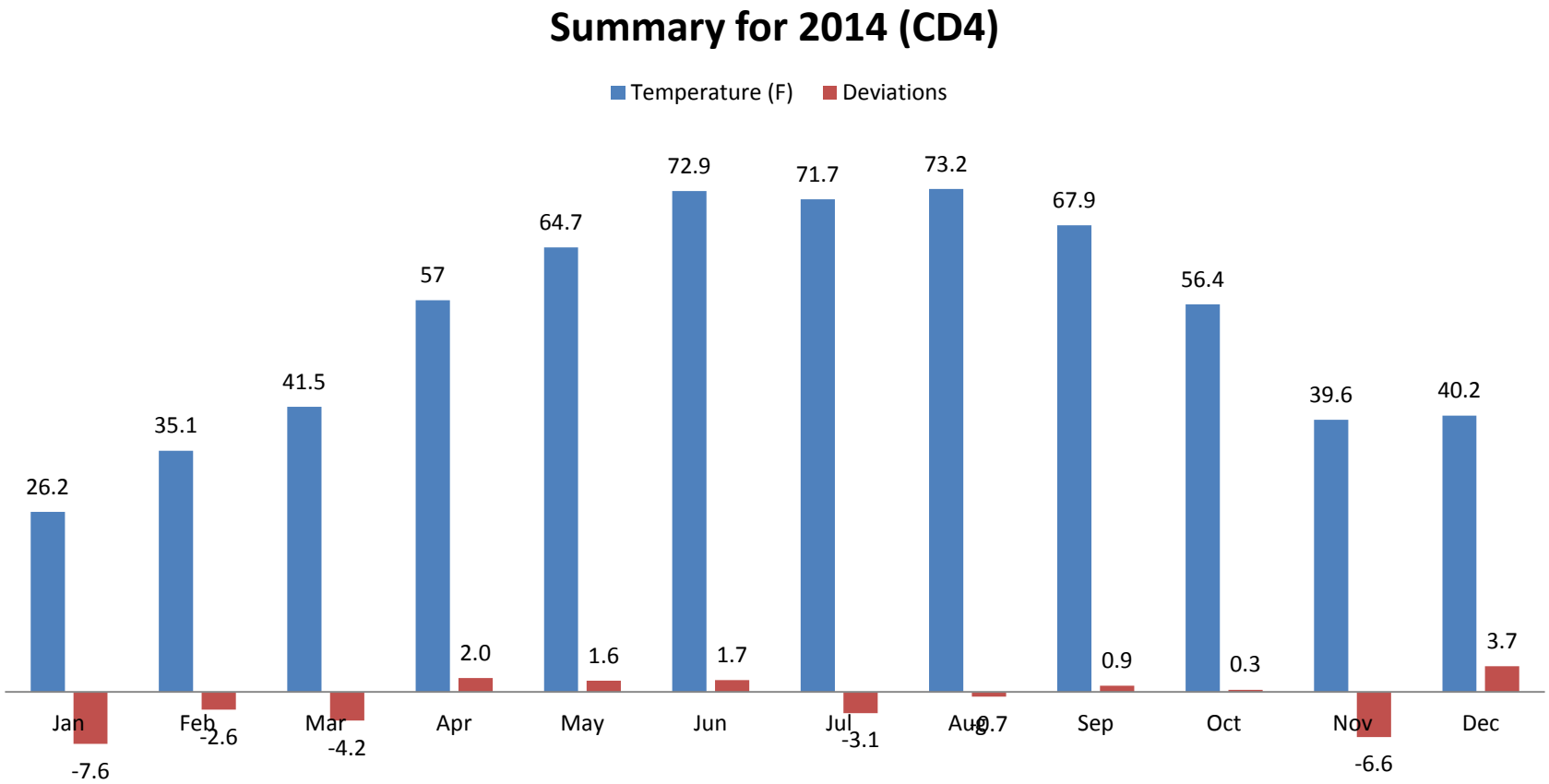
Bluegrass Region (CD3) Monthly Temperatures and Deviations from Normal (UKWAC)



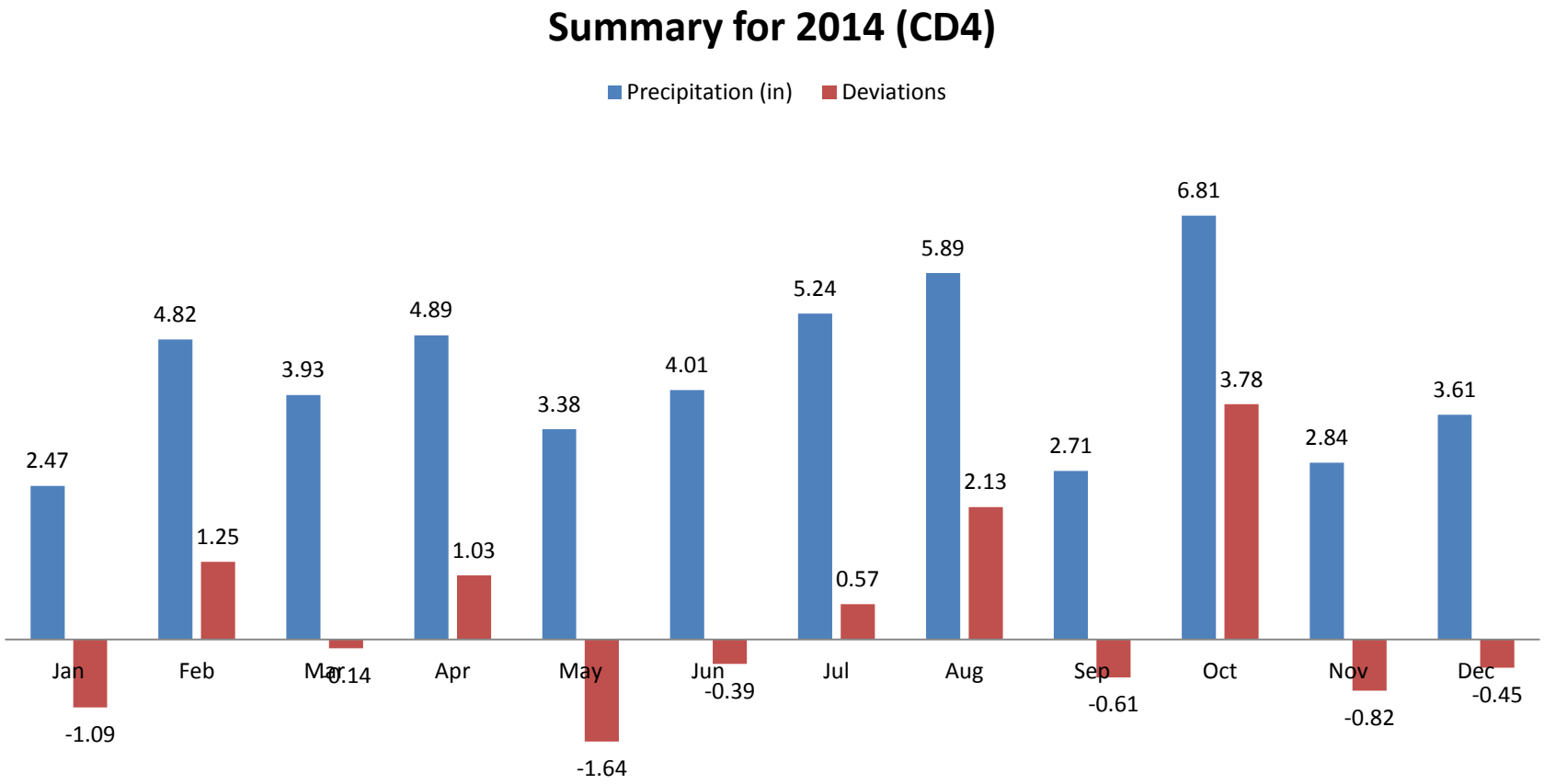
Bluegrass Region (CD3) Monthly Precipitation and Deviations from Normal (UKWAC)



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



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



2014 Cable Barrier 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 bareground zones. However, there may be turf adjacent to the bare ground zone that should not be damaged. In other cases, there may be desirable turf under the cable barriers that also should not be damaged. Ideally, the residual herbicides will last all season long and not move off-site by leaching or erosion (movement of soil particles with adsorbed herbicide).

Recently, a number of new products (Perspective, Viewpoint, Esplanade) have become available for bare ground vegetation management. Perspective is a combination of aminocyclopyrachlor and chlorsulfuron. Viewpoint is a combination of aminocyclopyrachlor, imazapyr and metsulfuron. Esplanade is indaziflam. The objective of this trial was to evaluate the efficacy and desirable turf damage potential of these and other herbicides when used for vegetation management under cable barriers.

Materials and Methods

The trial was established under and beside cable barrier, with tall fescue – Kentucky bluegrass turf underneath, in the median of I-265 in Louisville, KY. The 15 treatments and 3 replications were arranged in a randomized complete block design. Treatments were applied at 25 gallons / acre onto 6.5 ft wide by 20 ft long plots on May 8, 2014. All herbicide treatments, except Roundup ProMax alone (Trt. 1), included Activator 90 at 0.25% v/v (Table 1). Roundup ProMax (glyphosate) has no residual activity so other herbicides were included in the combinations with it to provide residual and pre-emergent control. The Pyresta + Proclipse combination (Trt. 14) did not include the non-selective glyphosate and might be an option to manage existing turf. The Louisville weather station reported 1.5 inches of rain on May 10, which would have activated the soil applied preemergence herbicide treatments. Broadleaf weeds present at application included Buckhorn plantain, spotted spurge, and oxalis, which was flowering. Heights of the tall fescue and the Kentucky bluegrass were 11 and 12 inches, respectively, and the Kentucky bluegrass was flowering.

The plan was to use string to mark the down slope edge of the sprayed area in each of the plots, based on the dead turf killed by the glyphosate, 20 days after treatment (DAT). Damaged turf beyond the string later in the season would indicate movement of herbicides with water or soil particles. However, the plot area was mowed a few days before the rating and it was difficult to mark the edge of the sprayed area accurately once the standing vegetation had been removed. Better communication with the mowing crews is required for future trials.

The proportion of brown vegetation (%) was visually rated 20 DAT (5/28/2014). Ratings of the proportion (%) of bare ground, broadleaf weeds, annual grasses and perennial grasses were taken

96 (8/12/2014) and 169 (10/24/2014) DAT. The plot area had been mowed recently before the 169 DAT rating. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at p = 0.05.

Results and Discussion

All plots treated with glyphosate had more brown vegetation than the Pyresta + ProClipse combination or the untreated plots 20 DAT (Table 2). Roundup ProMax alone (Trt. 1) and the Journey + Milestone combination (Trt. 7) had more broadleaf cover than the untreated check 96 DAT (Table 2). The season end rating (169 DAT) (Table 3) was done after the plots were mowed and much of the broadleaf cover was from spurge, which was below the mowers.

Treatments with the highest amount of bare ground at the end of the season (169 DAT) included Hyvar (Trt. 3) and Esplanade combined with Perspective (Trt. 9) or Oust (Trt. 13) (Table 3). These treatments had lower proportions of perennial grasses than other treatments too. The highest proportions of perennial grasses were found in the untreated plots and those with treatments that included prodiamine (Trts. 10 and 14) 169 DAT (Table 3). In many treatments, the removal of perennial grasses resulted in more broadleaves and annual grasses (Tables 2 and 3). The vegetation under the cable barrier in this location gave a good test of how well some of these bare ground herbicides can perform as well as one turf management herbicide mix. Future trials will evaluate more options for maintaining the turf as well as evaluating desirable turf damage from herbicide movement outside the treated zone.

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

Treatment	Product Name	Rate[1]	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
2	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Sahara	10	LB/A	diuron + imazapyr	6.2 lb + 12.4 oz
3	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Hyvar	10	LB/A	bromacil	8 lb
4	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Oust XP	3	OZ/A	sulfometuron	2.3 oz
5	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Payload	12	OZ/A	flumioxazin	6.1 oz
6	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Pendulum AquaCap	4	QT/A	pendimethalin	3.8 lb
	Milestone VM	7	FL OZ/A	aminopyralid	1.8 oz ae
7	Roundup ProMax	1	QT/A	glyphosate	1.1 lb ae
	Journey	1	QT/A	glyphosate + imazapic	0.4 lb ae + 3 oz ae
	Milestone VM	7	FL OZ/A	aminopyralid	1.8 oz ae
8	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Perspective	9	OZ/A	aminocyclopyrachlor + chlorsulfuron	3.6 oz + 1.4 oz
	Esplanade	3.5	FL OZ/A	indaziflam	0.7 oz
9	Razor Pro	2	QT/A	glyphosate	1.5 lb ae
	Perspective	5	OZ/A	aminocyclopyrachlor + chlorsulfuron	2 oz + 0.8 oz
	Esplanade	4	FL OZ/A	indaziflam	0.8 oz
10	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Perspective	9	OZ/A	aminocyclopyrachlor + chlorsulfuron	3.6 oz + 1.4 oz
	Endurance	2.3	LB/A	prodiamine	1.5 lb
11	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Viewpoint	18	OZ/A	aminocyclopyrachlor + imazapyr + metsulfuron	4.1 oz + 5.7 oz + 1.3 oz
12	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Polaris AC Complete	2	PT/A	imazapyr	16 oz ae
13	Roundup ProMax	1.3	QT/A	glyphosate	1.5 lb ae
	Esplanade	3.5	FL OZ/A	indaziflam	0.7 oz
	Oust XP	3	OZ/A	sulfometuron	2.3 oz
14	Pyresta	24	FL OZ/A	2,4-D + pyraflufen-ethyl	0.66 lb ae + 0.05 oz
	Proclipse	2	LB/A	prodiamine	1.3 lb
15	Untreated Check				

[1]*All herbicide treatments (except Roundup ProMax alone, Treatment 1) contained the adjuvant, Activator 90 at 0.25% v/v.*

Table 2. Herbicide treatments and results from 2014 (20 and 96 Days After Treatment (DAT)).

Trt.	Product Name	Rate[1]	Rate Unit	% Brown Vegetation	% Bare Ground	% Broadleaf Weeds	% Annual Grasses	% Perennial Grasses
				20 Days after Treatment	96 Days after Treatment			
1	Roundup ProMax	1.3	QT/A	73 *abc*[2]	12 *fg*	40 *a*	33 *ab*	15 *cd*
2	Roundup ProMax	1.3	QT/A	76 *abc*	58 *abcd*	12 *cd*	5 *fgh*	25 *cd*
	Sahara	10	LB/A					
3	Roundup ProMax	1.3	QT/A	96 *a*	88 *a*	10 *cd*	2 *h*	0 *d*
	Hyvar	10	LB/A					
4	Roundup ProMax	1.3	QT/A	75 *abc*	50 *bcde*	7 *cd*	33 *abc*	10 *cd*
	Oust XP	3	OZ/A					
5	Roundup ProMax	1.3	QT/A	97 *a*	33 *defg*	18 *bc*	43 *a*	2 *cd*
	Payload	12	OZ/A					
6	Roundup ProMax	1.3	QT/A	55 *c*	23 *efg*	19 *bc*	18 *bcdefgh*	40 *abc*
	Pendulum AquaCap	4	QT/A					
	Milestone VM	7	FL OZ/A					
7	Roundup ProMax	1	QT/A	79 *abc*	23 *efg*	32 *ab*	27 *abcdef*	18 *cd*
	Journey	1	QT/A					
	Milestone VM	7	FL OZ/A					
8	Roundup ProMax	1.3	QT/A	63 *bc*	40 *defg*	1 *d*	26 *abcdefg*	33 *bcd*
	Perspective	9	OZ/A					
	Esplanade	3.5	FL OZ/A					
9	Razor Pro	2	QT/A	96 *a*	55 *abcde*	8 *cd*	29 *abcde*	8 *cd*
	Perspective	5	OZ/A					
	Esplanade	4	FL OZ/A					
10	Roundup ProMax	1.3	QT/A	72 *abc*	45 *cdef*	8 *cd*	18 *bcdefgh*	28 *bcd*
	Perspective	9	OZ/A					
	Endurance	2.3	LB/A					
11	Roundup ProMax	1.3	QT/A	88 *ab*	53 *bcde*	13 *bc*	32 *abcd*	2 *d*
	Viewpoint	18	OZ/A					
12	Roundup ProMax	1.3	QT/A	95 *ab*	81 *ab*	6 *cd*	10 *defgh*	3 *cd*
	Polaris AC Complete	2	PT/A					
13	Roundup ProMax	1.3	QT/A	83 *abc*	78 *abc*	5 *cd*	3 *gh*	14 *cd*
	Esplanade	3.5	FL OZ/A					
	Oust XP	3	OZ/A					
14	Pyresta	24	FL OZ/A	0 *d*	7 *g*	12 *cd*	10 *cdefgh*	72 *a*
	Proclipse	2	LB/A					
15	Untreated Check			0 *d*	10 *g*	15 *cd*	8 *efgh*	63 *ab*

[1]All herbicide treatments (except Roundup ProMax alone, Treatment 1) contained the adjuvant, Activator 90 at 0.25% v/v
[2]Means within a column followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.

Table 3. Herbicide treatments and results from 2014.

Trt.	Product Name	Rate[1]	Rate Unit	% Bare Ground	% Broadleaf Weeds	% Annual Grasses	% Perennial Grasses
				169 Days after Treatment			
1	Roundup ProMax	1.3	QT/A	5 c[2]	38 ab	20 cd	36 cde
2	Roundup ProMax	1.3	QT/A	22 *bc*	35 *abc*	5 *d*	38 *cde*
	Sahara	10	LB/A				
3	Roundup ProMax	1.3	QT/A	45 *ab*	44 *a*	11 *d*	0 *e*
	Hyvar	10	LB/A				
4	Roundup ProMax	1.3	QT/A	32 *bc*	8 *cd*	24 *bcd*	35 *cde*
	Oust XP	3	OZ/A				
5	Roundup ProMax	1.3	QT/A	17 *bc*	8 *cd*	63 *a*	14 *de*
	Payload	12	OZ/A				
6	Roundup ProMax	1.3	QT/A	20 *bc*	17 *bcd*	24 *cd*	38 *cde*
	Pendulum AquaCap	4	QT/A				
	Milestone VM	7	FL OZ/A				
7	Roundup ProMax	1	QT/A	8 *c*	22 *abcd*	48 *ab*	22 *cde*
	Journey	1	QT/A				
	Milestone VM	7	FL OZ/A				
8	Roundup ProMax	1.3	QT/A	28 *bc*	0 *d*	27 *bcd*	45 *bcd*
	Perspective	9	OZ/A				
	Esplanade	3.5	FL OZ/A				
9	Razor Pro	2	QT/A	45 *ab*	8 *cd*	26 *bcd*	21 *cde*
	Perspective	5	OZ/A				
	Esplanade	4	FL OZ/A				
10	Roundup ProMax	1.3	QT/A	23 *bc*	3 *d*	13 *d*	60 *abc*
	Perspective	9	OZ/A				
	Endurance	2.3	LB/A				
11	Roundup ProMax	1.3	QT/A	20 *bc*	35 *abc*	45 *abc*	0 *e*
	Viewpoint	18	OZ/A				
12	Roundup ProMax	1.3	QT/A	23 *bc*	45 *a*	31 *bcd*	1 *e*
	Polaris AC Complete	2	PT/A				
13	Roundup ProMax	1.3	QT/A	70 *a*	1 *d*	11 *d*	18 *cde*
	Esplanade	3.5	FL OZ/A				
	Oust XP	3	OZ/A				
14	Pyresta	24	FL OZ/A	2 *c*	0 *d*	5 *d*	93 *a*
	Proclipse	2	LB/A				
15	Untreated Check			8 *c*	0 *d*	7 *d*	85 *ab*

[1]All herbicide treatments (except Roundup ProMax alone, Treatment 1) contained the adjuvant, Activator 90 at 0.25% v/v.
[2]Means within a column followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.

2014 Johnsongrass Control x Mowing Timing Trial

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. A key to achieving high levels of Johnsongrass control is translocation of the herbicide from the leaves to the rhizomes. However, routine mowing as part of roadside management could reduce Johnsongrass control by removing leaf material along with the herbicide applied to it before translocation occurs. A practical question for managers is how long after herbicide application do they need to wait before mowing without reducing herbicide efficacy on johnsongrass.

Materials and Methods

This study was initiated August 14, 2014 at an interchange near Bardstown KY. Four herbicide treatments (Outrider [sulfosulfuron] 0.25 oz/A, Fusilade II [fluazifop] 6 oz/A, Acclaim Extra [fenoxaprop] 2.8 oz/A, and Acclaim Extra plus Fusilade II [0.5 and 3.5 oz/A] were applied to 10 ft x 60 ft strips. Applications were made at 30 gallons per acre carrier volume and either a surfactant or crop oil concentrate (Table 1). The herbicide treatments were applied when johnsongrass plants were on average 36 inches tall with a range from 20 to 48 inches in height. Six mowing treatments, the same day as herbicide treatment, one day after herbicide treatment (AHT), 2 days AHT, one week AHT, two weeks AHT, or no mowing (Table 2) were performed as 10 ft x 40 ft strips across the herbicide treatments in a split block design, replicated three times. Mowing height was 4 inches. Visual assessments of percent johnsongrass control were done 34 (9/17/2014) and 70 (10/23/2014) days after herbicide treatment (DAT). Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

Differences in johnsongrass regrowth between herbicide treatments were visible by 14 DAT. There was also an interaction between herbicide treatments and mowing after treatment. These differences were more evident 34 DAT (Table 3). Outrider provided greater control (83%) than the other three herbicides when the johnsongrass was mowed the same day as treatment. Because Outrider can be taken up from the soil as well as the leaves, delaying mowing may not be as critical as for Acclaim and Fusilade II. These are only active through the leaves. In addition, it is possible the Outrider was translocated to the rhizomes more rapidly than Acclaim Extra or Fusilade II. However, Outrider provided less control than the other herbicide treatments 34 DAT when the johnsongrass was not mowed. Control with Acclaim Extra was the most sensitive to mowing. Only with a two-week delay before mowing was the control with Acclaim equivalent to no mowing 34 DAT. Control 34 DAT with Fusilade II or Fusilade II plus Acclaim Extra, on the other hand, was the same as the unmowed treatment if mowing was delayed only for one day.

Johnsongrass regrowth was visible in some of the treatment combinations 70 DAT and resulted in lower control ratings than 34 DAT, particularly plots for Acclaim Extra, Fusilade II and Acclaim Extra plus Fusilade II that were mowed the same day as treatment (Table 4). Interestingly, unmowed plots treated with Outrider had lower control that the mowed plots. However, there was no difference in control with Outrider between the mowing treatments. As at 34 DAT, mowing the same day as treatment did not reduce control with Outrider. Among the four herbicide treatments, the mowing delays needed for maximum control were as follows: Outrider, 0 days, Fusilade II and Fusilade II plus Acclaim Extra, 1 day, and Acclaim Extra two weeks. With an appropriate delay in mowing, all treatments could provide 88% or better control 70 DAT.

In summary, mowing timing after application did affect herbicide efficacy. Our initial results suggest that mowing 1 or 2 days after application will not reduce the efficacy of Outrider, Fusilade, or Acclaim + Fusilade. However, one should wait 2 weeks before mowing if Acclaim Extra alone was applied. Assessments of johnsongrass control from these treatments will be done again in 2015.

Table 1. Herbicide Treatments and Active Ingredients for Mowing x Johnsongrass Control Trial

Treatment	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Outrider	1	OZ/A	sulfosulfuron	0.25 oz
	Activator 90	0.25	% V/V		
2	Fusilade II	24	FL OZ/A	fluazifop	6 oz
	Activator 90	0.25	% V/V		
3	Acclaim Extra	39	FL OZ/A	fexoxaprop	2.8 oz
	Activator 90	0.25	% V/V		
4	Acclaim Extra	7	FL OZ/A	fexoxaprop	0.5 oz
	Fusilade II	14	FL OZ/A	fluazifop	3.5 oz
	COC	1	% V/V		

Table 2. Timing of Mowing Treatments

Treatment	Timing of Mowing Treatment
1	Same day as herbicide application
2	1 Day after herbicide application
3	2 Days after herbicide application
4	1 Week after herbicide application
5	2 Weeks after herbicide application
6	No Mowing

Table 3: Johnsongrass Control (%) 34 Days after Treatment

Mowing Time after Application	Outrider	Fusilade II	Acclaim Extra	Acclaim + Fusilade
Same day	83 *cd*[1]	39 *gh*	45 *g*	30 *h*
1 Day	97 *ab*	90 *abcd*	65 *f*	87 *bcd*
2 Days	98 *a*	91 *abcd*	68 *f*	91 *abcd*
1 Week	99 *a*	92 *abcd*	72 *ef*	93 *abc*
2 Weeks	99 *a*	95 *ab*	83 *cd*	93 *abc*
No Mowing	70 *f*	87 *bcd*	82 *de*	87 *bcd*

[1]*Means followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.*

Table 4: Johnsongrass Control (%) 70 Days after Treatment

Mowing Time afer Application	Outrider	Fusilade II	Acclaim Extra	Acclaim + Fusilade
Same day	88 *ab*[1]	0 *f*	17 *ef*	14 *ef*
1 Day	99 *a*	94 *a*	37 *de*	96 *a*
2 Days	100 *a*	97 *a*	47 *cd*	98 *a*
1 Week	100 *a*	97 *a*	67 *bc*	99 *a*
2 Weeks	100 *a*	100 *a*	94 *a*	99 *a*
No Mowing	93 *a*	99 *a*	92 *a*	97 *a*

[1]*Means followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.*

2014 Johnsongrass Control Trial in Princeton

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 (alternatives to Fusion) and how they affect tall fescue.

Materials and Methods

The trial was established August 22, 2014 at the Princeton Research and Education Center. The trial had 18 treatments with 3 replications arranged in a randomized complete block design with 5 ft by 20 ft plots. Application was at 30 gallons /acre. The johnsongrass was 17 to 32 inches tall with an overall average canopy height of 26 inches and about 40% of plants had emerged seedheads. The field was mostly a mixture of tall fescue and bluegrass. Johnsongrass control was assessed 25 (9/16/2014), 61 (10/22/2014), and 305 (6/23/2015) days after treatment (DAT). Tall fescue damage (0 = dead to 9 = fully green; with unsprayed plots set at 8.0) was assessed 25 and 61 DAT. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at $p = 0.05$.

Table 1 lists the treatments, active ingredients and application rates. The 2011 Fusion label rates for selective control of johnsongrass were 7 to 9 oz/A (Treatments 1 and 2). The labeled Fusilade II rates are 16 to 24 oz/A (Treatments 3 and 4). The Acclaim Extra label lists 20 oz/A per acre to control seedling johnsongrass 12 – 24 inches tall (Treatment 5); 39 oz/A to control rhizome johnsongrass 24 to 60 inches tall (Trt. 6); and a combination of Acclaim Extra plus Fusilade (0.5 plus 3.5 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). Roundup (Treatment 13) and Journey (Treatment 16) are non-selective. Clearcast (Treatment 14) has an aquatic label and may be used close to waterways. The high rate of Plateau used in Treatment 15 will severely damage tall fescue. Pastora (Treatment 17) is only labeled for warm season pastures. MSMA can still be used on rights-of-way was included in these trials, but not in the 2012 trials. Treatment 10 is MSMA applied alone and Treatment 11 is MSMA applied in combination with Outrider at 0.75 oz/A. Outrider is slow to show symptoms, so a combination of Outrider with Finale (Treatment 12) was included to speed johnsongrass injury. A lower rate of Finale (1 pt/A) was used than in 2013 (2 qt/A).

Results and Discussion

The growth of the johnsongrass at this site was not as vigorous as in other trials or roadside locations. All the treatments controlled johnsongrass to some extent 25, 61, and 305 DAT (Table

2). The most effective treatments 25 DAT were MSMA alone (88% control, Treatment 10) and with Outrider (77% control, Treatment 11), Roundup ProMax (87% control, Treatment 13), Journey (75% control, Treatment 16), and the high rate (39 oz/A) of Acclaim Extra (70% control, Treatment 6).

At 61 DAT, all the selective treatments (Fusion, Fusilade II, Acclaim Extra, Outrider, Clearcast, MSMA or combinations of some of these) with the exceptions of Plateau (68%) and Pastora (63%), provided 70% or better johnsongrass control (Table 2). The nonselective treatments of Roundup Promax, Journey, and Outrider plus Finale gave 78% or better johnsongrass control. At the final assessment date (305 DAT), the most effective selective treatments were Fusilade II (24 oz/A, Treatment 4), Acclaim Extra (39 oz/A, Treatment 6), Clearcast (Treatment 14), Outrider alone or with MSMA (Treatments 8, 9, and 11), and MSMA alone (Treatment 10). Control with the nonselective treatments of Roundup ProMax (92% control), Journey (82% control), and Outrider plus Finale (72 % control) were statistically equivalent.

The majority of the treatments caused yellowing or other damage to the tall fescue 25 DAT (Table 2). The greatest injury occurred with treatments containing glyphosate (Treatments 13 and 16). Acclaim Extra alone (Treatments 5 and 6) and MSMA alone (Treatment 10) had the least yellowing. In 2013, a higher rate of Finale (4 oz/A) was used compared to that in this trial (1 oz/A, Treatment12) and caused rapid injury to johnsongrass and other plants. This year there were no visible symptoms of glufosinate damage on any of the plants. By 61 DAT, tall fescue injured by the treatments had partially or fully recovered. Tall fescue treated with glyphosate (Treatments 13 and 16) or Clearcast (Treatment t. 14) had the most severe injury 61 DAT.

In summary, long term johnsongrass control was greater in this study compared to previous trials. Acclaim Extra, Outrider, and MSMA all provided good johnsongrass control the next year and minimal tall fescue damage two months after application. Fusilade II also gave good johnsongrass control but tall fescue injury was still evident from this treatment two months after application. Addition of Finale (1 pt/A) to Outrider did not improve johnsongrass control or increase tall fescue injury. Roundup Promax, Clearcast, and Journey all gave good to excellent johnsongrass control (82-92%) the year after treatment but were also, as expected, the most injurious to tall fescue. The damage to tall fescue by these treatments was severe and resulted in thin stands which allowed other weeds to dominate.

Table 1. Treatments and Active Ingredients for Johnsongrass Control Trial

Treatment	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	Outrider Finale Activator 90	0.75 1 0.25	OZ/A PT/A % V/V	sulfosulfuron glufosinate	0.563 oz 2 oz
13	Roundup ProMax	22	FL OZ/A	glyphosate	12.4 oz ae
14	Clearcast MSO	32 1	FL OZ/A % V/V	imazamox	4 oz ae
15	Plateau MSO	8 1	FL OZ/A % V/V	imazapic	2 oz ae
16	Journey MSO	21.3 1	FL OZ/A % V/V	imazapic + glyphosate	2 oz ae + 4 oz ae
17	Pastora Activator 90	1 0.25	OZ/A % V/V	nicosulfuron + metsulfuron	0.562 oz + 0.15 oz
18	Untreated Check				

Table 2: Results for Johnsongrass Control Trial

Treatment	Product Name	Rate	Rate Unit	% Johnsongrass Control			Fescue Color (0-9)[1]	
				25 DAT[2]	61 DAT	305 DAT	25 DAT	61 DAT
1	Fusion	7	FL OZ/A	50 *defgh*[3]	73 *cdef*	27 *e*	5.8 *bcd*	7.0 *abc*
	Activator 90	0.25	% V/V					
2	Fusion	9	FL OZ/A	53 *defg*	80 *abcde*	33 *e*	5.0 *de*	6.3 *bcd*
	Activator 90	0.25	% V/V					
3	Fusilade II	16	FL OZ/A	45 *efgh*	77 *bcde*	47 *de*	4.8 *de*	5.7 *de*
	Activator 90	0.25	% V/V					
4	Fusilade II	24	FL OZ/A	43 *efgh*	73 *cdef*	68 *abcd*	4.7 *de*	6.0 *cde*
	Activator 90	0.25	% V/V					
5	Acclaim Extra	20	FL OZ/A	57 *bcde*	78 *abcde*	33 *e*	7.2 *ab*	7.7 *a*
	Activator 90	0.25	% V/V					
6	Acclaim Extra	39	FL OZ/A	70 *abcd*	90 *a*	72 *abcd*	7.2 *ab*	8.0 *a*
	Activator 90	0.25	% V/V					
7	Acclaim Extra	7	FL OZ/A	50 *defgh*	73 *cdef*	48 *cde*	5.0 *de*	6.3 *bcd*
	Fusilade II	14	FL OZ/A					
	COC	1	% V/V					
8	Outrider	0.75	OZ/A	57 *bcde*	78 *abcde*	73 *abc*	5.3 *de*	7.3 *ab*
	Activator 90	0.25	% V/V					
9	Outrider	1	OZ/A	35 *fgh*	70 *def*	62 *bcd*	5.7 *cde*	7.0 *abc*
	Activator 90	0.25	% V/V					
10	MSMA	32	FL OZ/A	88 *a*	80 *abcde*	87 *ab*	7.0 *abc*	8.0 *a*
11	Outrider	0.75	OZ/A	77 *ab*	88 *ab*	80 *ab*	5.3 *de*	7.7 *a*
	MSMA	32	FL OZ/A					
12	Outrider	0.75	OZ/A	55 *cdef*	83 *abc*	72 *abcd*	5.3 *de*	7.7 *a*
	Finale	1	PT/A					
	Activator 90	0.25	% V/V					
13	Roundup ProMax	22	FL OZ/A	87 *a*	88 *ab*	92 *a*	1.0 *f*	3.3 *g*
14	Clearcast	32	FL OZ/A	43 *efgh*	78 *abcde*	82 *ab*	4.3 *e*	4.0 *fg*
	MSO	1	% V/V					
15	Plateau	8	FL OZ/A	33 *gh*	68 *ef*	52 *cde*	4.7 *de*	5.7 *de*
	MSO	1	% V/V					
16	Journey	21.3	FL OZ/A	75 *abc*	82 *abcd*	82 *ab*	2.3 *f*	3.3 *g*
	MSO	1	% V/V					
17	Pastora	1	OZ/A	32 *h*	63 *f*	33 *e*	5.0 *de*	5.0 *ef*
	Activator 90	0.25	% V/V					
18	Untreated Check			0 *i*	0 *g*	0 *f*	8.0 *a*	8.0 *a*

[1]0 = uninjured, 9 = dead plants

[2]Days after treatment

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

Japanese Stiltgrass Control Trial at Fort Knox

Introduction

Japanese stiltgrass (*Microstegium vimineum*) is an invasive sprawling, dense, mat-forming annual grass, native to Asia. It is very shade tolerant but will quickly take advantage of extra sunlight and is common in forest edges, roadsides, trail sides, and disturbed areas such as skid trails from timber harvest. It's a prolific seed producer and humans and machinery readily spread the seed. The seed remains viable in the soil for 3 years. Successful management of stiltgrass requires a combination of control of existing plants before they produce seed and new plants coming up from the seedbank. This trial examined the efficacy of some selective herbicide control options for stiltgrass.

Materials and Methods

The trial was established September 24, 2013 on a skid trail within the forested Hunt Area 19 on Fort Knox. The trial had 9 treatments with 3 replications arranged in a randomized complete block design with 5 ft by 20 ft plots. Application was at 20 gallons /acre. The height of the stiltgrass plants was 16 to 27 inches, with some seedheads emerged in the areas receiving more sunshine, at treatment. The early summer application was made on July 15, 2014 when the stiltgrass plants were 10 to 20 inches tall. Stiltgrass control was assessed 14 (10/8/2013), 294 (7/15/2014), and 393 (10/22/2014) days after treatment (DAT). Stiltgrass cover (%) was assessed (9/10/2015) 716 DAT. These assessments corresponded to 99 and 422 DAT for the early summer application (Treatment 8). Data on green vegetative cover (0-100%) were collected 294, 393 (99), and 716 (422) DAT. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at $p = 0.05$.

Table 1 lists the treatments, active ingredients and application rates. Treatments 1 to 7 were applied in fall 2013 while Treatment. 8 was applied in early summer 2014. All the treatments included products that had post-emergence and pre-emergence activity to control emerged stiltgrass and germinating seeds. The Fusilade II treatments would be the most selective with little damage to non-target broadleaf species. The expected period of pre-emergence activity varied among the treatments. The Pendulum AquaCap treatment (Treatment 8) was applied in early summer as its period of effectiveness is not as long as ProClipse (Treatments 5 and 7).

Results and Discussion

All of the fall applied treatments, except for Plateau (Treatment 1), controlled stiltgrass 96% or greater 294 DAT (Table 2). Control with Plateau at this point was 72%. This pattern persisted 393 DAT with all of the other treatments controlling stiltgrass better than Plateau (40% control). At this point, control with Fusilade II plus ProClipse (99%) was higher than with Milestone (78%) or Streamline (81%) but equivalent that from OustExtra (94%), Fusilade II alone (89%), Roundup ProMax plus Proclipse (97%), or Fusilade II plus Pendulum AquaCap (97%). Two years (716 DAT) after the initial application the stiltgrass cover was reduced more by the combination of Fusilade II with either ProClipse (7 % stiltgrass) or Pendulum AquaCap (8%

stiltgrass) with the exceptions of the OustExtra (33% stiltgrass) and Roundup ProMax plus Proclipse (25% stiltgrass) treatments.Treatments with

The Plateau, Fusilade II, and Fusilade II plus ProClipse (Treatments1, 4 and 5) treated plots had the most green vegetative cover of the herbicide treated plots 294 DAT. OustExtra and Fusilade II plus Pendulum Aquacap treated plots had significantly less green vegative cover at this rating day than all the other treatments except RoundUp ProMax plus ProClipse. One hundred days later (393 DAT), the OustExtra and Roundup ProMax plus ProClipse treatments resulted in lower green vegetative cover than the other treatments with the exceptions of Fusilade II plus ProClipse and Fusilade II plus Pendulum Aquacap.

There are a number of herbicide treatments tested in this study, with the exceptions of Plateau, Milestone VM, and Streamline, significantly reduced the stiltgrass population at this site more than 2 years after the initial applications. The inclusion of a preemergence herbicide, ProClipse or Pendulum AquaCap, with Fusilade II produced the best combination of stiltgrass population reduction without removing other plant species from the site.

Table 1. Treatments and Active Ingredients for Japanese Stiltgrass Control Trial

Treatment	Product Name	Rate	Rate Unit	Active Ingredient(s)	ai Rate (per acre)
1	Plateau Activator 90	4 0.25	FL OZ/A % V/V	imazapic	1 oz ae
2	OustExtra Activator 90	3 0.25	OZ/A % V/V	sulfometuron + metsulfuron	1.69 oz + 0.45 oz
3	Milestone VM Activator 90	6 0.25	FL OZ/A % V/V	aminopyralid	1.5 oz ae
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	fluazifop	6 oz
5	Fusilade II ProClipse Activator 90	24 2 0.25	FL OZ/A LB/A % V/V	fluazifop prodiamine	6 oz 20.8 oz
6	Streamline Activator 90	4.75 0.25	OZ/A % V/V	aminocyclopyrachlor + metsulfuron	1.88 oz + 0.60 0z
7	Roundup ProMax ProClipse Activator 90	22 2 0.25	FL OZ/A LB/A % V/V	glyphosate prodiamine	12.38 oz ae 20.8 oz
8	Fusilade II Pendulum AquaCap Activator 90	24 4.2 0.25	OZ/A QT/A % V/V	fluazifop pendimethalin	6 oz 63.8 oz
9	Untreated Check				

Table 2. Results for Japanese Stiltgrass Control Trial

Treatment	Product Name	Rate	Rate Unit	Application Timing	% Stiltgrass Control			% Stiltgrass Cover	% Green Vegetation		
					14 DAT[1]	294 DAT	393 DAT	716 DAT	294 DAT	393 DAT	716 DAT
1	Plateau Activator 90	4 0.25	FL OZ/A % V/V	Fall	13 *De*[2]	72 *b*	40 *d*	68 *ab*	57 *b*	75 *ab*	85 *ab*
2	OustExtra Activator 90	3 0.25	OZ/A % V/V	Fall	13 *de*	99 *a*	94 *abc*	33 *cde*	23 *c*	28 *e*	77 *bc*
3	Milestone VM Activator 90	6 0.25	FL OZ/A % V/V	Fall	33 *cd*	97 *a*	78 *c*	63 *abc*	35 *c*	63 *abc*	85 *ab*
4	Fusilade II Activator 90	24 0.25	FL OZ/A % V/V	Fall	40 *bc*	97 *a*	89 *abc*	48 *bcd*	60 *b*	57 *bcd*	82 *ab*
5	Fusilade II ProClipse Activator 90	24 2 0.25	FL OZ/A LB/A % V/V	Fall	25 *cd*	99 *a*	99 *a*	7 *e*	57 *b*	43 *cde*	75 *bc*
6	Streamline Activator 90	4.75 0.25	OZ/A % V/V	Fall	60 *b*	97 *a*	81 *bc*	70 *ab*	35 *c*	57 *bcd*	83 *ab*
7	Roundup ProMax ProClipse Activator 90	22 2 0.25	FL OZ/A LB/A % V/V	Fall	98 *a*	99 *a*	97 *ab*	25 *de*	22 *c*	30 *e*	67 *c*
8	Fusilade II Pendulum AquaCap Activator 90	24 4.2 0.25	OZ/A QT/A % V/V	Spring	0 *e*	0 *c*	97 *ab*	8 *e*	85 *a*	37 *de*	72 *bc*
9	Untreated Check				0[3] *e*	0[3] *c*	0 *e*	87 *a*	82 *a*	83 *a*	93 *a*

[1] DAT = Days after treatment
[2] Means within a column followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.
[3]Treatment 8 was unsprayed at 14 and 294 DAT. Assessments at 393 and 716 DAT were 99 and 422 days after application for this treatment.

2014 Kudzu Control Trial - Initial Results

Introduction

Kudzu (*Pueraria montana*) is an invasive deciduous twining, trailing, mat-forming, woody leguminous vine that forms dense infestations along forest edges, rights-of-way, old homesteads, and stream banks. It colonizes by vines rooting at nodes and spreads by seed dispersal. The plants have extensive root systems with large tuberous roots which can be 3 to 10 feet deep. Kudzu can dominate a site to the exclusion of other vegetation. Repeated herbicide applications along with other management measures are required to reduce the infestation. Picloram is used for kudzu control in many states but has not been used extensively in KY in recent years. This trial evaluated the efficacy of some potential alternate herbicide control options to picloram for kudzu control.

Materials and Methods

This study was initiated on June 24, 2014 by mowing a kudzu infested field near Beattyville KY. The abandoned tobacco field had been burned in March, 2014 and the dominant vegetation was a mix of kudzu and giant ragweed at the time of mowing. Plots that were 30 feet by 30 feet with 10 foot alleys separating them and were arranged in a 10 treatment randomized complete block design with three replications. On July 25, 2014, after kudzu regrowth, 9 herbicide treatments were applied in 30 gallons per acre carrier. The average kudzu canopy height was 14 inches with a range of 9 to 18 inches. Two of the treatments (Garlon 1.5 gal/A and Rodeo 4 qt/A) were reapplied on September 25, 2014. These same treatments will be reapplied in 2015 and final assessments taken in 2016.

Table 1 lists the treatments, active ingredients and application rates. All the treatments were applied at the maximum annual amount specified on the herbicide product label. Garlon 3A and Rodeo can be applied more than once per year so one treatment of each (Treatments 4 and 6) received half the maximum rate in July and again in September. Most treatments included a non-ionic surfactant (Activitor 90) at 0.5% v/v except for the Streamline treatment which included methylated seed oil (MSO) at 1% v/v. Visual assessments of percent kudzu control and green vegetative cover (0-100%) were done 32 (8/26/2014), and 62 (9/25/2014) days after initial treatment (DAT). Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at $p = 0.05$.

Results and Discussion

All the treatments, with the exceptions of Transline and Patron 170, controlled kudzu 98% or better 32 DAT (Table 2). Control with Transline and Patron 170 was still good 32 DAT, but only 92%. However by 62 DAT, control with Patron 170 declined to 72% while control with Transline was 96% (Table 2). Streamline, Garlon 3A (either as a single or split application), and Opensight all resulted in better control 99-100%) than Transline or Patron 170 62 DAT. Control with Rodeo (either as a single or split application, 99 and 98%, respectively) and BK 800 (98%) 62 DAT was higher than Patron 170 but not significantly different than the other treatments.

Transline and Patron 170 allowed for more regrowth of vegetation than the other treatments, 83 and 70% green vegetation cover, respectively, 32 DAT (Table 2). However, by 62 DAT, these treatments as well as the split Garlon treatment, both Rodeo treatments, and BK 800 had green vegetation cover equal to that of the untreated plots (Table 2). Streamline was the most injurious to other vegetation (13% green cover) followed by Opensight (63% green cover) and the single application (1.5 gal/A) of Garlon (80% green cover).

In summary, all the tested herbicides, Transline, Streamline, Garlon 3A, Rodeo, Opensight, BK 800, and Patron 170 provided excellent kudzu control two months after initial applications. With the exceptions of Streamline and, possibly, Opensight, the herbicides had minimal effect on other vegetation at the site 62 DAT. The treatments will be repeated in 2015 and final assessments will be made in 2016.

Table 1. Treatments and Active Ingredients for Kudzu Control Trial

Treatment	Product Names	Rate	Rate Unit	2014 Application Date	Active Ingredient(s)	ai Rate (per acre)
1	Transline	21	FL OZ/A	7/25	clopyralid	7.9 oz ae
	Activator 90	0.5	% V/V			
2	Sreamline	11.5	OZ/A	7/25	aminocylcopyrachlor + metsulfuron	4.5 oz + 1.4 oz
	COC	1	% V/V			
3	Garlon 3A	3	GAL/A	7/25	triclopyr	9 lb ae
	Activator 90	0.5	% V/V			
4	Garlon 3A	1.5	GAL/A	7/25	triclopyr	4.5 lb ae
	Activator 90	0.5	% V/V			
	Garlon 3A	1.5	GAL/A	9/25	triclopyr	4.5 lb ae
	Activator 90	0.5	% V/V			
5	Rodeo	8	QT/A	7/25	glyphosate	8 lb ae
	Activator 90	0.5	% V/V			
6	Rodeo	4	QT/A	7/25	glyphosate	4 lb ae
	Activator 90	0.5	% V/V			
	Rodeo	4	QT/A	9/25	glyphosate	4 lb ae
	Activator 90	0.5	% V/V			
7	Opensight	3.3	OZ/A	7/25	aminopyralid + metsulfuron	1.7 oz ae + 0.3 oz
	Activator 90	0.5	% V/V			
8	BK 800	2	GAL/A	7/25	2,4-D + 2,4-DP + dicamba	3.78 lb ae + 1.88 lb ae + 0.94 lb ae
	Activator 90	0.5	% V/V			
9	Patron 170	6.9	PT/A	7/25	2,4-D + 2,4-DP	1.47 lb ae + 0.75 lb ae
	Activator 90	0.5	% V/V			
10	Untreated Check					

Table 2: Results for Kudzu Control Trial

Treatment	Product Names	Rate	Rate Unit	2014 Application Date	% Kudzu Control		% Green Vegetation Cover	
					32 DAT[1]	62 DAT	32 DAT	62 DAT
1	Transline	21	FL OZ/A	7/25	92 *b*[2]	96 *b*	83 *ab*	100 *a*
	Activator 90	0.5	% V/V					
2	Sreamline	11.5	OZ/A	7/25	100 *a*	100 *a*	2 *e*	13 *d*
	COC	1	% V/V					
3	Garlon 3A	3	GAL/A	7/25	100 *a*	100 *a*	10 *de*	80 *b*
	Activator 90	0.5	% V/V					
4	Garlon 3A	1.5	GAL/A	7/25	98 *a*	100 *a*	38 *c*	97 *a*
	Activator 90	0.5	% V/V					
	Garlon 3A	1.5	GAL/A	9/25				
	Activator 90	0.5	% V/V					
5	Rodeo	8	QT/A	7/25	100 *a*	99 *ab*	25 *cde*	97 *a*
	Activator 90	0.5	% V/V					
6	Rodeo	4	QT/A	7/25	98 *a*	98 *ab*	30 *cd*	96 *a*
	Activator 90	0.5	% V/V					
	Rodeo	4	QT/A	9/25				
	Activator 90	0.5	% V/V					
7	Opensight	3.3	OZ/A	7/25	98 *a*	99 *a*	18 *cde*	63 *c*
	Activator 90	0.5	% V/V					
8	BK 800	2	GAL/A	7/25	99 *a*	98 *ab*	28 *cd*	98 *a*
	Activator 90	0.5	% V/V					
9	Patron 170	6.9	PT/A	7/25	92 *b*	72 *c*	70 *b*	100 *a*
	Activator 90	0.5	% V/V					
10	Untreated Check				0 *c*	0 *d*	100 *a*	100 *a*

[1] *DAT = Days after treatment*

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

Effect of Mowing Timing on Johnsongrass Herbicide Efficacy

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INTRODUCTION

Johnsongrass (*Sorghum halepense*) is a perennial warm season grass, listed as a noxious weed, and a common problem on right-of-way sites. There are a number of herbicides labeled and available to control johnsongrass and most rely on translocation from the leaves to the rhizomes for greatest efficacy. However, mowing is part of roadside management and one question is how long after herbicide application do we need to wait before mowing without reducing herbicide efficacy on johnsongrass control?

OBJECTIVE

The objective of this study was to:

1) Evaluate the effect of mowing timing on the efficacy of johnsongrass control herbicides

MATERIALS & METHODS

This study was initiated August 14, 2014 at an interchange near Bardstown KY. Four herbicide treatments were applied to 10 ft x 60 ft strips at 30 gal/ac (Table 1). Average johnsongrass height was 30 in. Six time of mowing treatments (Table 2) were applied as 10 ft x 40 ft strips across the herbicide treatments (Fig. 1 & 2A) in a split block design, replicated three times. The mowing height was 5 inches. The herbicide treatments were Outrider (sulfosulfuron), Fusilade II (fluazifop), Acclaim Extra (fenoxaprop), and Fusilade + Acclaim. The time of mowing treatments were as follows: no mowing, same day as herbicide application, as well as 1 day, 2 days, 1week, and 2 weeks after application.

Visual assessments of percent johnsongrass control were done 34 (9/17/2014) and 70 (10/23/2014) days after herbicide treatment (DAT). Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at p = 0.05.

RESULTS & DISCUSSION

Differences in johnsongrass regrowth among herbicide treatments with mowing within hours of application were visible 14 DAT (Fig. 2B). These differences were more evident 34 DAT (Table 3A) with Outrider providing greater control than other herbicide treatments with the same day mowing treatment. There may have been more soil uptake with Outrider than other herbicide treatments as well as faster translocation to the rhizomes. Acclaim Extra had less control than the other herbicide treatments at many of the shorter mowing intervals (Table 3A & B) (Fig. 3). An overview of the herbicide treatment strips in rep 1 (Fig. 4) illustrates the control ratings in Table 3A.

Johnsongrass regrowth was visible in some of the treatment combinations 70 DAT and resulted in lower control ratings (Table 3B). The control with Outrider with same day mowing was higher than the other herbicide treatments and in the same group as the top treatments. However, only the no mowing and 2 weeks combinations with Acclaim Extra were in this group.

Table 1. Herbicide treatments, application rates, and active ingredients used in this trial.

Trt. No.	Product(s)	Rate per acre	Active Ingredients
1	Outrider	1 oz	sulfosulfuron
	Activator 90	0.25% v/v	
2	Fusilade II	24 fl oz	fluazifop
	Activator 90	0.25% v/v	
3	Acclaim Extra	39 fl oz	fenoxaprop
	Activator 90	0.25% v/v	
4	Acclaim Extra	7 fl oz	fenoxaprop
	Fusilade II	14 fl oz	fluazifop
	COC	1%	

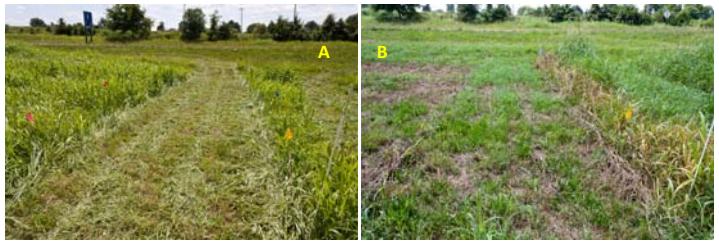

Figure 2. Mowed strip on day of application (**A**) and 2 weeks later (**B**).

Table 2. Timing of mowing treatments used in this trial.

Trt No.	Timing of Mowing Treatments
1	Same day as herbicide application
2	1 Day after
3	2 Days after
4	1 Week after
5	2 Weeks after
6	No mowing

Figure 1. Mowing on day of application (August 14, 2014).

Figure 3. Overview of Rep 1 plots 34 DAT. Red flags mark edge of block while yellow and blue flags mark center of herbicide strips.

Table 3. Herbicide x mowing treatment combinations and % johnsongrass control 34 DAT **(A)** and 70 DAT **(B)**.

(A) Mowing Time	Outrider	Fusilade II	Acclaim Extra	Acclaim + Fusilade
Same Day	83 *cd*	39 *gh*	45 *g*	30 *h*
1 Day After	97 *ab*	90 *abcd*	65 *f*	87 *bcd*
2 Days After	98 *a*	91 *abcd*	68 *f*	91 *abcd*
1 Week After	99 *a*	91 *abcd*	72 *ef*	93 *abc*
2 Weeks After	99 *a*	95 *ab*	83 *cd*	93 *abc*
No Mowing	70 *f*	87 *bcd*	82 *de*	87 *bcd*

(B) Mowing Time	Outrider	Fusilade II	Acclaim Extra	Acclaim + Fusilade
Same Day	88 *ab*	0 *f*	17 *ef*	14 *ef*
1 Day After	99 *a*	94 *a*	37 *de*	96 *a*
2 Days After	100 *a*	97 *a*	48 *cd*	98 *a*
1 Week After	100 *a*	97 *a*	67 *bc*	99 *a*
2 Weeks After	100 *a*	100 *a*	94 *a*	99 *a*
No Mowing	93 *a*	99 *a*	92 *a*	97 *a*

Means followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05..

Figure 4. Overview of herbicide treatment strips 34 DAT in Rep 1: Trt. 1 (**A**), Trt. 2 (**B**), Trt. 3 (**C**), Trt. 4 (**D**). Yellow and blue flags mark the center of the strips while red flags mark the edge of the rep.

SUMMARY

Mowing timing did affect herbicide efficacy. Initial results suggest that mowing 1 or 2 days after application will not reduce the efficacy of Outrider, Fusilade, or Acclaim + Fusilade. However, one should wait 2 weeks before mowing if Acclaim Extra was applied. Final assessments will be done in 2015.

Japanese Stiltgrass Control in Managed Woodlands

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INTRODUCTION

Japanese stiltgrass (*Microstegium vimineum*) is a sprawling, dense, mat-forming annual grass. It is very shade tolerant but will quickly take advantage of extra sunlight and is common in forest edges, roadsides, trailsides, and disturbed areas such as skid trails (timber harvest). It's a prolific seed producer, the seed is readily spread by humans and machinery, and the seed bank can remain viable for 3 years. It competes with and reduces regeneration of desirable species in managed woodlands (Fig. 1). Successful management of stiltgrass requires control of the plants before seed production and extended control of the plants coming up from the seedbank. What are some of the selective herbicide control options and how effective are they?

OBJECTIVE

The objective of this study was to:

1) evaluate the effectiveness of herbicide options in selective control of Japanese stiltgrass

MATERIALS & METHODS

The trial was established September 24, 2013 on a skid trail within the forested Hunt Area 19 on Fort Knox (Fig. 2). The trial had 9 treatments and 3 replications arranged in a randomized complete block design with 5 ft by 20 ft plots. Application was at 20 gallons /acre. The height of the stiltgrass plants was 16 to 27 inches, with some seedheads emerged in the areas receiving more sunshine. The early summer application was on July 15, 2014 when the stiltgrass plants were 10 to 20 inches tall. Stiltgrass control was assessed 14 (10/8/2013), 294 (7/15/2014), and 393 (10/22/2014) days after treatment (DAT). The last assessment was 99 DAT for the early summer application. Data on green vegetative cover (0-100%) were collected 294 and 393 (99) DAT. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at p = 0.05.

Table 1 lists the treatments, active ingredients and application rates. Treatments 1 to 7 were applied in fall 2013, while Trt. 8 was applied in early summer 2014. All the treatments included products that had post-emerge and pre-emerge activity to control emerged stiltgrass and germinating seeds. The Fusilade II treatments would be the most selective with little damage to non-target broadleaf species. The expected period of pre-emerge activity varied among the treatments. The Pendulum AquaCap treatment (Trt. 8) was applied in early summer as its period of effectiveness is not as long as ProClipse (Trt. 5 and 7).

RESULTS & DISCUSSION

Most of the treatments, except for Plateau (Trt. 1), had stiltgrass control greater than 96% 294 DAT (Table 2) (Fig. 3). However, the Plateau and Fusilade II (Trt. 4 and 5) treatments had the most green vegetative cover for the sprayed plots 294 DAT. The OustExtra (Trt. 2), Fusilade II (Trt. 4, 5, and 8), and ProClipse (Trt. 5 and 7) treatments still had the greatest control (89 – 97%) 393 DAT. However, the Plateau and Milestone treatments had the same proportion of green vegetative cover as the control plots 393 DAT while the lowest vegetative cover was with the OustExtra (Trt. 2), ProClipse (Trt 5 and 7), and Pendulum AquaCap (Trt. 8 at 99 DAT) treatments.

Figure 1. Dense stands of stiltgrass can be very competitive.

Figure 2. View of Japanese stiltgrass infested skid trail before trial establishment (Aug. 2013).

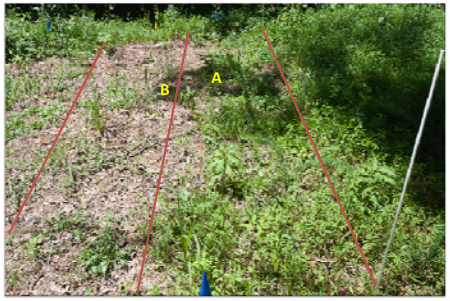

Figure 3. Plateau (A) and OustExtra (B) plots 294 DAT.

Table 1. Herbicide treatments, application rates, and active ingredients used in this trial.

Trt. No.	Product Name	Rate	Rate Unit	Active Ingredient(s)	AI Rate (per acre)	AI Rate (per hectare)
1	Plateau	4	FL OZ/A	imazapic	1 oz ae	70 g ae
2	OustExtra	3	OZ/A	sulfometuron + metsulfuron	1.69 oz + 0.45 oz	118 g + 32 g
3	Milestone VM	6	FL OZ/A	aminopyralid	1.5 oz ae	105 g ae
4	Fusilade II	24	FL OZ/A	fluazifop	6 oz	420 g
5	Fusilade II	24	FL OZ/A	fluazifop	6 oz	420 g
	ProClipse	2	LB/A	prodiamine	20.8 oz	1.45 kg
6	Streamline	4.75	OZ/A	aminocyclopyrachlor + metsulfuron	1.88 oz + 0.60 oz	132 g + 42 g
7	Roundup ProMax	22	FL OZ/A	glyphosate	12.38 oz ae	0.87 kg ae
	ProClipse	2	LB/A	prodiamine	20.8 oz	1.45 kg
8	Fusilade II	24	OZ/A	fluazifop	6 oz	420 g
	Pendulum AquaCap	4.2	QT/A	pendimethalin	63.8 oz	2.55 kg
9	Nontreated Check					

All treatments included Activator 90, a non-ionic surfactant, at 0.25% v/v.

Table 2. Herbicide treatments, stiltgrass control, and green vegetative cover in this trial.

Trt. No.	Product Name	Rate	Rate Unit	Application Timing	% Control						% Green Vegetation			
					14 DAT		294 DAT		393 DAT		294 DAT		393 DAT	
1	Plateau	4	FL OZ/A	Fall	13	*de*	72	*b*	40	*d*	57	*b*	75	*ab*
2	OustExtra	3	OZ/A	Fall	13	*de*	99	*a*	94	*abc*	23	*c*	28	*e*
3	Milestone VM	6	FL OZ/A	Fall	33	*cd*	97	*a*	78	*c*	35	*c*	63	*abc*
4	Fusilade II	24	FL OZ/A	Fall	40	*bc*	97	*a*	89	*abc*	60	*b*	57	*bcd*
5	Fusilade II	24	FL OZ/A	Fall	25	*cd*	99	*a*	99	*a*	57	*b*	43	*cde*
	ProClipse	2	LB/A											
6	Streamline	4.75	OZ/A	Fall	60	*b*	97	*a*	81	*bc*	35	*c*	57	*bcd*
7	Roundup ProMax	22	FL OZ/A	Fall	98	*a*	99	*a*	97	*ab*	22	*c*	30	*e*
	ProClipse	2	LB/A											
8*	Fusilade II	24	OZ/A	Summer	0	*e*	0	*c*	97	*ab*	85	*a*	37	*de*
	Pendulum AquaCap	4.2	QT/A											
9	Nontreated Check				0	*e*	0	*c*	0	*e*	82	*a*	83	*a*

All treatments included Activator 90, a non-ionic surfactant, at 0.25% v/v.
Means within a column followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.
* Treatment 8 was unsprayed at 14 and 294 DAT. Assessment at 393 DAT was 99 days after application for this treatment.

SUMMARY

There are a number of herbicide options which are selective and effective for stiltgrass control. Application of a glyphosate herbicide as a 0.5 to 2 percent solution in early summer or Fusilade or Plateau in summer for more selective control are among the recommended control procedures in Miller, et al. 2010. Final assessments will be done in 2015.

Literature Cited:

Miller, J.H., S.T. Manning, and S.F. Enloe. 2010. A management guide for invasive plants in southern forests. USDA Forest Service Southern Research Station. GTR SRS-131.

Kudzu Control Options: Initial Evaluation

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INTRODUCTION

Kudzu (*Pueraria montana*) is an invasive deciduous twining, trailing, mat-forming, woody leguminous vine that forms dense infestations along forest edges, rights-of-way, old homesteads, and stream banks. It colonizes by vines rooting at nodes and spreads by seed dispersal. The plants have extensive root systems with large tuberous roots which can be 3 to 10 feet deep. Kudzu can dominate a site to the exclusion of other vegetation. Repeated herbicide applications along with other management measures are required to reduce the infestation. Picloram is used for kudzu control in many states but has not been used extensively in KY in recent years. What are some of the other selective herbicide control options and how effective are they?

OBJECTIVE

The objective of this study was to:
1) Evaluate the efficacy of herbicide control options for kudzu control

MATERIALS & METHODS

This study was initiated in June, by mowing a kudzu infested field near Beattyville KY. Plots (9 m x 9 m) with 3 m alleys separating them were arranged in a 10 treatment randomized complete block design with 3 replications. After kudzu regrowth (35 cm canopy), 9 herbicide treatments were applied at 337 L/ha on July 25, 2014 and two repeat treatments were applied on September 25 (Table 1). These same treatments will be applied in 2015 and final assessments taken in 2016. Alleyways were mowed and treated with Milestone VM to prevent vine encroachment (Minogue et al., 2011).

Visual assessments of percent kudzu control and green vegetative cover (0-100%) were done 32 (8/26/2014), and 62 (9/25/2014) DAT (days after initial treatment). Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at p = 0.05.

RESULTS & DISCUSSION

All the treatments had kudzu control greater than 92% 32 DAT (Table 1 and Fig. 1). However by 62 DAT control with Patron 170 had declined to 72%. Green vegetative cover increased from 32 to 62 DAT and ranged from 63 to 100% for most treatments except for Streamline with only 13% green cover 62 DAT (Table 1 and Fig. 2).

SUMMARY

There are a number of herbicide options which are selective and effective in kudzu control. Final assessments will be done in 2016 after repeat applications in 2015.

Table 1. Herbicide treatments, application rates and timing, active ingredients used in this trial plus % kudzu control and % green vegetation cover.

Trt. No.	Product(s)	Rate per Ac	Application	Active Ingredient(s)	ai Rate per Ha	% Kudzu Control 32 DAT	% Kudzu Control 62 DAT	% Green Cover 32 DAT	% Green Cover 62 DAT
1	Transline Activator 90	21 fl oz 0.5% v/v	A	clopyralid	551 g ae	92 *b*	96 *b*	83 *ab*	100 *a*
2	Streamline COC	11.5 oz 1%	A	aminoclyclopyrachlor + metsulfuron	318 g + 101 g	100 *a*	100 *a*	2 *e*	13 *d*
3	Garlon 3A Activator 90	3 gal 0.5% v/v	A	triclopyr	10.1 kg ae	100 *a*	100 *a*	10 *de*	80 *b*
4	Garlon 3A Activator 90 Garlon 3A Activator 90	1.5 gal 0.5% v/v 1.5 gal 0.5% v/v	A B	triclopryr triclopyr	5 kg ae 5 kg ae	98 *a*	100 *a*	38 *c*	97 *a*
5	Rodeo Activator 90	8 qt 0.5% v/v	A	glyphosate	9 kg ae	100 *a*	99 *ab*	25 *cde*	97 *a*
6	Rodeo Activator 90 Rodeo Activator 90	4 qt 0.5% v/v 4 qt 0.5% v/v	A B	glyphosate glyphosate	4.5 kg ae 4.5 kg ae	98 *a*	98 *ab*	30 *cd*	96 *a*
7	Opensight Activator 90	3.3 oz 0.5% v/v	A	aminopyralid + metsulfuron	121 g ae + 22 g	98 *a*	99 *a*	18 *cde*	63 *c*
8	BK 800 Activator 90	2 gal 0.5% v/v	A	2,4-D + 2,4-DP + dicamba	4.2 kg ae + 2.1 kg ae + 1.1 kg ae	99 *a*	98 *ab*	28 *cd*	98 *a*
9	Patron 170 Activator 90	6.9 pt 0.5% v/v	A	2,4-D + 2,4-DP	1.7 kg ae + 0.8 kg ae	92 *b*	72 *c*	70 *b*	100 *a*
10	Unsprayed Control					0 *c*	0 *d*	100 *a*	100 *a*

Application A on 8/26/2014 and B on 9/25/2014.
DAT: Days after initial treatment.
Means followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05..

Figure 1. Overall view of trial (**A**), Control (**B**), Transline (**C**), and Streamline (**D**) plots 32 DAT (Aug. 26, 2014).

Figure 2. Overall view of trial (**A**), Control (**B**), Transline (**C**), and Streamline (**D**) plots 62 DAT (Sept. 25, 2014).

Literature Cited:
Minojue, P.J., S.F. Enloe, A. Osiecka, and D.K. Lauer. 2011 Comparison of aminocyclopyrachlor to common herbicides for kudzu (*Pueraria montana*) management. Invasive Plant Sci. Management. 4: 419-426.