EVALUATION OF NICOSULFURON, FLAZASULFURON AND MSMA FOR JOHNSONGRASS CONTROL IN BERMUDAGRASS ROADSIDES

ANNUAL REPORT FOR FY 2009

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METRIC CONVERSION PAGE

SI (METRIC) CONVERSION FACTORS

Approximate Conversions to SI Units

Symbol	When you know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	25.40	millimeters	Mm
ft	feet	0.3048	meters	M
yd	yards	0.9144	meters	M
mi	miles	1.609	kilometers	Km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.0929	square meters	m^2
yd^2	square yards	0.8361	square meters	m^2
ac	acres	0.4047	hectacres	Ha
mi^2	square miles	2.590	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	Ml
gal	gallon	3.785	liters	L
ft^3	cubic feet	0.0283	cubic meters	m^3
yd^3	cubic yards	0.7645	cubic meters	m^3
		MASS		
oz	ounces	28.35	grams	G
lb	pounds	0.4536	kilograms	Kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	degrees Fahrenheit	(°F-32)/1.8	degrees Celsius	°C
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.448	Newtons	N
lbf/in^2	poundforce per square inch	6.895	kilopascals	kPa

Approximate Conversions from SI Units

Symbol	When you know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.0394	inches	in
m	meters	3.281	feet	ft
m	meters	1.094	yards	yds
km	kilometers	0.6214	miles	mi
		AREA		
mm^2	square millimeters	0.00155	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.196	square yards	yd^2
ha	hectacres	2.471	acres	ac
km^2	square kilometers	0.3861	square miles	mi^2
		VOLUME		
mL	milliliters	0.0338	fluid ounces	fl oz
L	liters	0.2642	gallon	gal
m^3	cubic meters	35.315	cubic feet	ft^3
m^3	cubic meters	1.308	cubic yards	yd^3
		MASS		
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.1023	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	degrees Fahrenheit	9/5(°C)+32	degrees Celsius	°F
		FORCE and PRESSURE or STRESS		
N	Newtons	0.2248	poundforce	lbf
kPa	kilopascals	0.1450	poundforce per square inch	lbf/in^2

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1.0 INTRODUCTION

A low growing erosion resistant ground cover such as bermudagrass is required in the clear or safety zone of the roadside right of way. Johnsongrass (Sorghum halepense) frequently exceeds the 12 inch maximum vegetation height prescribed in the ODOT mowing manual. Additionally, when left unmowed or infrequently mowed, johnsongrass can often times out compete bermudagrass yet provides less suitable soil stabilization on roadsides.

While development of agrichemicals has slowed for agricultural crops, there is a sustained interest by the agrichemical manufacturers or marketers to expand herbicide label registrations on existing products into the industrial and roadside vegetation management market. The development of new herbicide products increases market competition and can result in reduce product prices to end users. New products are also needed to replace products which are loosing their registration. Recently the herbicide MSMA has failed the reregistration process conducted by the US Environmental Protection Agency (EPA) [1]. The phaseout of MSMA in the roadside and all markets other than in cotton production has begun. The phase out of MSMA has resulted in instability of availability of certain MSMA products. This report covers our research during the 2009 growing season concerning a preliminary evaluation of a promising herbicide Accent® (active ingredient nicosulfuron) in tank mixes with glyphosate and metsulfuron methyl for johnsongrass control. Additionally covered in this report is a rapid screening of currently labeled MSMA herbicide products for johnsongrass control that was necessary for inclusion on the ODOT Approved Herbicide and Adjuvant List. Also included in the trial with MSMA is continued screening of flazasulfuron and glyphosate tank mixes in anticipation of the eventual registration of flazasulfuron (Katana) for use in johnsongrass control in bermudagrass right of way.

1.1 OBJECTIVES

The objectives of this work were to evaluate nicosulfuron (Accent®), flazasulfuron (Katana™) and MSMA for johnsongrass control and phytotoxicity to common bermudagrass.

2.0 DEVELOPMENT OF NICOSULFURON (ACCENT®) AS A POTENTIAL JOHNSONGRASS CONTROL PRODUCT (STUDY 4-H-93-09)

2.1 MATERIALS AND METHODS FOR STUDY 4-H-93-09

This trial evaluated tank mixes of nicosulfuron, metsulfuron and glyphosate as compared to sulfosulfuron and glyphosate tank mixes for johnsongrass control and bermudagrass phytotoxicity. At the time of the trial and as of press time, no nicosulfuron products were registered for use in roadsides infested with johnsongrass. Herbicide treatments were applied on May 26 to an actively growing bermudagrass stand containing johnsongrass that ranged in height from 12-28 inches (average 19 inches). The application specifics of the trial are show in Table 1. Growing conditions were near ideal during this study with only a short temporary drought in late June/early July. This study received above average rainfall during the last half (late July-August) of the trial which produced aggressive late summer johnsongrass growth.

Table 1. Herbicide application specifics for experiment 4-H-93-09.

Application Factor	**Measurement**
Application Date:	May-26-2009
Time of Day:	9:10 a.m.
Application Method:	Broadcast spray
Application Timing:	Post emergence
Application Placement:	Foliar
Air Temperature:	74 F
Relative Humidity:	73 %
Wind Velocity:	About 1 mile per hour
Wind Direction:	North
Dew Presence (Y/N):	Yes
Soil Temperature:	About 72 F
Soil Moisture:	Suitable
Cloud Cover:	About 60 %
Appl. Equipment:	4-wheel ATV
Operating Pressure:	25 PSI
Nozzle Type:	Turbojet brand
Nozzle Size:	11002 type
Nozzle Spacing:	20 inches
Nozzles/Row:	3
Boom Height:	26 inches
Ground Speed, Unit:	2.4 miles per hour
Carrier:	Water
Spray Volume, Unit:	20 gallons per acre
Mix Size:	1.8 liters
Propellant:	CO2

2.2 RESULTS & DISCUSSION FOR STUDY 4-H-93-09

At 30 days-after-application (DAA) all treatments were producing excellent (96-98%) control of johnsongrass (Table 1). By 59 DAA all treatments were maintaining good to excellent (88-97%) control of johnsongrass. At 59 DAA bermudagrass treated with tank mixes containing Accent® herbicide were showing small amounts of johnsongrass regrowth, especially at the lowest tank mix rate.

Evaluations at 90 DAA are used to indicate the level of long-term johnsongrass control provided by a product. By 90 DAA the tank mix combination with Accent® herbicide at 0.56 oz. a.i./A was producing 54% control of johnsongrass. This was significantly lower control than that achieved by the tank mixes with the two higher use rates of Accent® and was below the minimum acceptable level of 80% for long-term johnsongrass control. At 90 DAA tank mixes with Accent® at 0.84 and 1.125 oz. a.i./A were producing 79% and 84% control of johnsongrass. We anticipate that the tank mix with Accent® at 1.125 oz. a.i./A combined with a mowing program would produce a very acceptable roadside turf. The “Standard treatment” used in this study was a tank mix that used 0.94 oz. a.i./A rate of Outrider® and was a higher than normal use rate of this product. Generally, ODOT uses Outrider® at 0.75 oz. a.i./A in a tank mix with glyphosate at 0.5 lb a.i./A. The standard treatment produced excellent (>90%) control of johnsongrass (94% or greater) throughout the duration of this study.

Bermudagrass phytotoxicity was also evaluated in this study. At 30 DAA all treatments were producing small amounts of injury on bermudagrass. The injury ranged from 7-12% at 30 DAA for all of the treatments. Injury at that time was in the form of slight yellowing and slight stunting. All of the injury produced at 30 DAA was very acceptable for roadsides. No bermudagrass phytotoxicity was noticed at later evaluation dates for any of the treatments. The Accent®/Escort XP®/Roundup Pro Concentrate® tank mix treatments in this study would be considered very safe on common bermudagrass grown on roadside.

Table 2. Comparison of multiple rates of nicosulfuron (Accent®) and metsulfuron methyl tank mixes versus Outrider® for johnsongrass control and bermudagrass safety.

				% Control of Johnsongrass			% Common bermudagrass Injury
Treat No.	Treatment Name	Rate	Rate Unit	Jun-25-2009 30 DAA	Jul-24-2009 59 DAA	Aug-24-2009 90 DAA	Jun-25-2009 30 DAA
1	Untreated Check	---	---	6	5	22	0
2	Accent® Escort XP® Roundup Pro Concentrate®	0.5625 0.15 0.5	oz ai/a oz ai/a lb ai/a	97 ab	88 C	54 c	7 b
3	Accent® Escort XP® Roundup Pro Concentrate®	0.84375 0.225 0.5	oz ai/a oz ai/a lb ai/a	96 b	92 B	79 b	12 a
4	Accent® Escort XP® Roundup Pro Concentrate®	1.125 0.3 0.5	oz ai/a oz ai/a lb ai/a	96 b	94 B	84 ab	10 ab
5	Outrider® Roundup Pro Concentrate®	0.94 0.5	oz ai/a lb ai/a	98 a	97 A	94 a	12 a
LSD at Probability = 0.10				2.0	2.1	9.7	3.9
Standard Deviation				1.2	1.3	5.9	2.4
Coefficient of variation				1.25	1.38	7.6	23.06
Replicate F value				3.658	2.307	0.777	1.515
Replicate Probability of a greater F value				0.1050	0.1951	0.5085	0.3059
Treatment F value				1.822	26.380	25.374	3.262
Treatment Probability of a greater F value				0.2601	0.0017	0.0019	0.1179

Footnotes: LSD = least significant difference test. Means sharing a common letter do not significantly differ at P = 0.10.

3.0 DEVELOPMENT OF FLAZASULFURON AND GENERIC MSMA PRODUCTS AS A POTENTIAL JOHNSONGRASS CONTROL PRODUCT (4-H-99-09)

3.1 MATERIALS AND METHODS FOR STUDY (4-H-99-09)

The objectives of this study were to evaluate two generic MSMA products and continue the evaluation of flazasulfuron (Katana™) combinations for their ability to successfully control johnsongrass in bermudagrass roadsides. The initial intent of this study was to compare two MSMA formulations (Weed-Hoe® 108 & Target® 6 Plus) to the currently approved Drexel MSMA 6 Plus in an effort to gain approval for the ODOT AHAL. However, the availability of the Drexel MSMA 6 Plus product has been a problem during the past year and OSU personnel were unable to secure a sample of this product to use in this study. A second purpose of this study was to continue with the development of flazasulfuron for johnsongrass control in preparation for both federal and state registrations of this new active ingredient. At the time of the trial and as of press time, no flazasulfuron (Katana™) products were registered for use in roadsides infested with johnsongrass. However, during 2009 the Katana™ label was expanded to include bermudagrass turf (not roadside right of way), which was highly encouraging.

Treatments were applied on May 26 to actively growing bermudagrass and johnsongrass that ranged in height from 12-28 inches (average 19 inches). The application specifics of the trial are show in Table 3. Growing conditions were near ideal during this study with only a short temporary drought in late June/early July.

3.2 RESULTS & DISCUSSION (4-H-93-09)

At 30 DAA (days-after-application) all of the treatments in this study were producing good to excellent control of johnsongrass (83-96%, Table 4.). Treatments of Weed-Hoe® 108 and Target® 6 Plus mixed with Outrider® were showing a significant increase in johnsongrass control over those treatments without Outrider®. All of the treatments including Outrider® and flazasulfuron were producing excellent control of johnsongrass (95-97%) at 30 DAA. At 59 DAA, as expected, both treatments of Weed-Hoe® 108 & Target® 6 Plus were producing poor control of johnsongrass. However, johnsongrass control from both of these formulations produced the expected short term johnsongrass control. The addition of Outrider® herbicide to both Weed-Hoe® 108 and Target® 6 Plus herbicide tank mixes continued to significantly increase both johnsongrass control and duration of control. Each of these treatment combinations would be expected to successfully produce season-long control of johnsongrass for any of the ODOT Field divisions when incorporated with a sound mowing program.

Treatments of flazasulfuron, at both rates, produced very good initial johnsongrass control at 30 DAA (95%) that was maintained through 90 DAA (93 & 90% control), respectively. Flazasulfuron treatment combinations evaluated in the past as well as in this years study show that this new active ingredient could provide good to excellent control of perennial johnsongrass while creating very little injury to common

bermudagrass. There was a small amount of initial bermudagrass phytotoxicity at 30 DAA from all of the treatments, however, the level of bermudagrass toxicity was very low (3-11%) and temporary, and would be more than acceptable for roadsides. No bermudagrass phytotoxicity was evident at later evaluations.

Table 3. Herbicide application specifics for experiment 4-H-99-09.

Application Factor	**Measurement**
Application Date:	May-26-2009
Time of Day:	9:30 a.m.
Application Method:	Broadcast spray
Application Timing:	Post emergence
Application Placement:	Foliar
Air Temperature:	73 F
Relative Humidity:	73 %
Wind Velocity:	About 1 mile per hour
Wind Direction:	North
Dew Presence (Y/N):	Yes
Soil Temperature:	About 72 F
Soil Moisture:	Suitable
Cloud Cover:	About 60 %
Appl. Equipment:	4-wheel ATV
Operating Pressure:	25 PSI
Soil Temperature:	About 72 F
Nozzle Type:	Turbojet brand
Nozzle Size:	11002 type
Nozzle Spacing:	20 inches
Nozzles/Row:	3
Boom Height:	26 inches
Ground Speed, Unit:	2.4 miles per hour
Carrier:	Water
Spray Volume, Unit:	20 gallons per acre
Mix Size:	1.8 liters
Propellant:	CO2

Table 4. Johnsongrass control from treatment combinations using MSMA and flazasulfuron.

				% Control of Johnsongrass						% Common Bermudagrass Injury	
Treat No.	**Treatment Name**	**Rate**	**Rate Unit**	**Jun-25-2009 30 DAA**		**Jul-24-2009 59 DAA**		**Aug-24-2009 90 DAA**		**Jun-25-2009 30 DAA**	
1	MSMA 6 Plus	3.0	lb ai/a								
2	Weed-Hoe® 108	3.0	lb ai/a	83	b	35	b	35	b	5	bc
3	Target® 6 Plus	3.0	lb ai/a	86	b	37	b	33	b	3	c
4	MSMA 6 Plus Outrider®	3.0 0.047	lb ai/a lb ai/a								
5	Weed-Hoe® 108 Outrider®	3.0 0.047	lb ai/a lb ai/a	95	a	83	a	83	a	6	b
6	Target® 6 Plus Outrider®	3.0 0.047	lb ai/a lb ai/a	96	a	90	a	88	a	6	b
7	flazasulfuron Roundup Pro Concentrate®	0.0234 0.5	lb ai/a lb ai/a	95	a	92	a	93	a	9	a
8	flazasulfuron Roundup Pro Concentrate®	0.047 0.5	lb ai/a lb ai/a	95	a	93	a	90	a	11	a
9	Untreated Check			5	c	5	c	23	b	0	d
Least significant difference (LSD) at probability = 0.10				6.1		13.4		18.5		2.4	
Standard deviation				4.2		9.2		12.7		1.6	
Coefficient of variation				5.27		14.81		20.02		28.65	
Replicate F value				0.175		0.400		0.241		0.452	
Replicate probability (P) of a greater F value				0.8417		0.6792		0.7898		0.6469	
Treatment F value				189.148		45.536		18.075		13.705	
Treatment probability of a greater F value				0.0001		0.0001		0.0001		0.0001	

Footnotes: LSD = least significant difference test. Means sharing a common letter do not significantly differ at P = 0.10.

4.0 RECOMMENDATIONS

Nicosulfuron (Accent®) herbicide results were very promising. Provided that a manufacturer or marketer of this active ingredient shows continuing interest in pursuing additional research or registration of the product for possible use on roadsides, we recommend that additional rate refinement work be undertaken on nicosulfuron.

Provided that the manufacturer of flazasulfuron (Katana^{TM}), ISK BioSciences, achieves both Federal and state registration of flazasulfuron and provided that the final herbicide formulation of this product has no tank mix compatibility issues, this product will be recommended for inclusion on the ODOT AHAL. No flazasulfuron containing products were labeled for use on rights of way as of press time. We had no information as to what the cost of flazasulfuron would be at press time.

As both the Target® 6 Plus from Luxemborg-Panol, LTD and the Weed-Hoe® 108 from Albaugh performed suitably under field testing and were found to not have any tank mix compatibility issues [2], we recommended that the 2.5 gallon container size of both products be placed on the *Revised 2009 Approved Herbicide and Adjuvant List*. Also, since MSMA is not a new active ingredient and preliminary testing of these two MSMA products provided suitable and expected short-term johnsongrass control, we do not recommend additional testing be performed on these two MSMA products.

5.0 IMPLEMENTATION OF RECOMMENDATIONS

The 2.5 gallon container size of Target® 6 Plus from Luxemborg-Panol, LTD and Weed-Hoe® 108 from Albaugh were placed on the *Revised 2009 Approved Herbicide and Adjuvant List* facilitating their being added to the state herbicide contract.

6.0 REFERENCES

1. Edwards, Debra. 2006. Revised Reregistration Eligibility Decision for MSMA, DSMA, CAMA, and Cacodylic Acid. US EPA Publication 736-R-06-021.

2. Evans, C.C., D.P. Montgomery and D.L. Martin. 2009. Evaluation of Herbicide Tank Mix Compatibility. Annual Report For FY 2009. Available on-line at: http://www.okladot.state.ok.us/hqdiv/p-r-div/spr-rip/library/2156-2157/2009annual.pdf. (verified 13 January 2010).