EVALUATION OF NEW AND GENERIC HERBICIDES FOR ODOT ROADSIDE VEGETATION MANAGEMENT PROGRAMS

ANNUAL REPORT FOR FY 2010

ODOT SPR ITEM NUMBER 2157

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DISCLAIMERS

METRIC CONVERSION PAGE

SI (METRIC) CONVERSION FACTORS

Symbol	When you know	Multiply by	To Find	Symbol	Symbol	When you know	Multiply by	To Find	Symbol
Approximate Conversions to SI Units					***Approximate Conversions from SI Units***				
		LENGTH					LENGTH		
in	inches	25.40	millimeters	Mm	mm	millimeters	0.0394	inches	in
ft	feet	0.3048	meters	M	m	meters	3.281	feet	ft
yd	yards	0.9144	meters	M	m	meters	1.094	yards	yds
mi	miles	1.609	kilometers	Km	km	kilometers	0.6214	miles	mi
		AREA					AREA		
in^2	square inches	645.2	square millimeters	mm^2	mm^2	square millimeters	0.00155	square inches	in^2
ft^2	square feet	0.0929	square meters	m^2	m^2	square meters	10.764	square feet	ft^2
yd^2	square yards	0.8361	square meters	m^2	m^2	square meters	1.196	square yards	yd^2
ac	acres	0.4047	hectacres	Ha	ha	hectacres	2.471	acres	ac
mi^2	square miles	2.590	square kilometers	km^2	km^2	square kilometers	0.3861	square miles	mi^2
		VOLUME					VOLUME		
fl oz	fluid ounces	29.57	milliliters	Ml	mL	milliliters	0.0338	fluid ounces	fl oz
gal	gallon	3.785	liters	L	L	liters	0.2642	gallon	gal
ft^3	cubic feet	0.0283	cubic meters	m^3	m^3	cubic meters	35.315	cubic feet	ft^3
yd^3	cubic yards	0.7645	cubic meters	m^3	m^3	cubic meters	1.308	cubic yards	yd^3
		MASS					MASS		
oz	ounces	28.35	grams	G	g	grams	0.0353	ounces	oz
lb	pounds	0.4536	kilograms	Kg	kg	kilograms	2.205	pounds	lb
T	short tons (2000 lb)	0.907	megagrams	Mg	Mg	megagrams	1.1023	short tons (2000 lb)	T
		TEMPERATURE (exact)					TEMPERATURE (exact)		
°F	degrees Fahrenheit	(°F-32)/1.8	degrees Celsius	°C	°C	degrees Fahrenheit	9/5(°C)+32	degrees Celsius	°F
		FORCE and PRESSURE or STRESS					FORCE and PRESSURE or STRESS		
lbf	poundforce	4.448	Newtons	N	N	Newtons	0.2248	poundforce	lbf
lbf/in^2	poundforce per square inch	6.895	kilopascals	kPa	kPa	kilopascals	0.1450	poundforce per square inch	lbf/in^2

TABLE OF CONTENTS

LIST OF TABLES

TABLE **PAGE**

1.0 INTRODUCTION

A low-growing erosion-resistant ground cover such as bermudagrass is very beneficial in the clear or safety zone of the roadside right of way. Johnsongrass (Sorghum halepense) and other roadside weeds frequently exceed maximum vegetation heights prescribed in the ODOT mowing manual. Additionally, when left unmowed or infrequently mowed, johnsongrass and other weeds can often out compete our beneficial roadside grasses yet provide less suitable soil stabilization on roadsides. In recent years, in the national effort to manage invasive non-native weed species, roadsides are often singled out as a primary source of initial non-native weed establishment. This is not necessarily a reflection of anyone's roadside management program, but more a reflection on the nature of managing a state highway system right-of-way and the challenges of interstate travel. National needs dictate that highway roadside vegetation managers have an obligation to stay aware of any new exotic, non-native weed species that may occur on their 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 reduced product prices to end users. This report covers our research during the 2010 growing season with the continued development of the new active ingredient aminocyclopyrachlor/DPX-MAT28 (Streamline® and Perspective® herbicides). These new blended herbicides should receive their initial federal labels in early 2011 and should provide increased kochia control for ODOT personnel across the state. New products are also needed to replace products which are losing their registration. Recently the herbicide MSMA has failed the reregistration process conducted by the US Environmental Protection Agency. The phase-out of MSMA in the roadside and all markets other than in cotton production has begun. Included in this report is the final development of a promising new herbicide DPX-V9360 plus DPX-T6376 (Pastora® herbicide, active ingredients nicosulfuron plus metsulfuron methyl). Pastora® herbicide will be one of the alternative herbicides to replace MSMA in 2011 and should provide good summer johnsongrass control as well as control of many summer annual grasses and broadleaf weeds. This report also includes the continued development of SL-160 (Katana® herbicide, active ingredient flazasulfuron) in anticipation of the eventual registration of flazasulfuron for use in johnsongrass control programs.

1.1 OBJECTIVES

The objectives of this research were to determine if any of the new products evaluated showed promise in allowing ODOT to manage vegetation problems more effectively, efficiently, or at less risk to the environment. This research also addresses the need to provide for a screening of older herbicide chemistries that have lost patent protection and become available as generic formulations ("same-as-formulations" to the original patented product). This research continues to focus on current specific problem areas that ODOT weed control programs experience statewide.

2.0 DEVELOPMENT OF AMINOCYCLOPYRACHLOR FOR PREEMERGENCE AND POSTEMERGENCE BROADLEAF WEED CONTROL (4-H-01-10)

2.1 MATERIALS AND METHODS FOR STUDY 4-H-01-10

This trial continues the development of aminocyclopyrachlor (experimental product DPX-MAT28), when mixed with other herbicides, for the ability to control both broadleaf and grassy weeds. This specific trial concentrates on the effectiveness of these treatments when applied early in the growing season as a preemergence to early postemergence application. Treatments were applied on April 8 to evaluate the ability of aminocyclopyrachlor to provide early postemergence control of winter annual weeds and preemergence control of summer annual weeds (Table 1). At treatment time winter annual weeds present were downy brome (Bromus tectorum) at 2-6" in height, wheat at 6-10", prickly lettuce (Lactuca serriola) at 4-8", corn gromwell (Lithospermum arvense) at 4-8" (beginning to flower) and Carolina geranium (Geranium carolinianum) at 2-4" tall. Preemergence evaluations were taken on the summer annual weed Palmer amaranth (Amaranthus palmeri) which had yet to emerge at treatment time. Early postemergence and preemergence percent control ratings were also made on large crabgrass (Digitaria sanguinalis) and common marestail (Hippuris vulgaris) which were just beginning to emerge and in a very early seedling stage of growth at treatment time (0.25-0.5" tall). Six days following application, approximately 0.5 - 0.7 inches of rainfall fell on this site activating the residual components of these treatments. Growing conditions were good during this study with the first month following treatment being somewhat dry followed by two months of moderate temperatures and above average moisture conditions. Visual ratings for control of winter annual weed species were collected at 29 days-after-application (DAA). Visual ratings for control of summer annual weed species were collected at 29, 61, 92, and 120 DAA.

2.2 RESULTS & DISCUSSION FOR STUDY 4-H-01-10

On July 9, at 91 DAT evaluations, it was documented that approximately 80-100% of the research area was treated, or received drift, from an illegal June 20 application of Roundup RT at 22 oz. prod./A. The application was made by the custom applicator of the adjacent farmer who made a 30-35 foot wide pass outside of his fence onto the roadside rights-of-way. The farmers name was Ray Pennington (application made by his custom applicator) who was farming the adjacent Roundup-Ready soybean field for Dan Wittwer (Wittwer Construction/Stillwater). The research area was properly signed and flagged. Unfortunately the application was made over the top of the research area. Both ODOT and Dupont were immediately notified of this unfortunate event. Because of the effects of this application it is in the opinion of OSU that the data collected at 92 and 120 DAA has been severely compromised. Therefore, for the purposes of this report only 29 and 61 DAA weed control data will be discussed.

At 29 DAA all treatments including Campaign® or Landmaster BW® and the treatment of MAT28 + Matrix® were providing 97-100% control of downy brome and wheat (Table 2.). At that time all other treatments were producing good to excellent control of downy brome (80-90%) and wheat (88-96%). At 29 DAA all treatments in this study provided 95-99% control of prickly lettuce, corn gromwell, and Carolina geranium. At 29 DAA all treatments were providing complete control of the summer annual common marestail (Table 3.). It should be noted that even the treatments of Campaign® or Landmaster BW® + ammonium sulfate were also providing complete control at this time which is a result of the early emergence and exposure of this summer annual weed to postemergent treatment. At 61 DAA all treatments of MAT28 were maintaining complete control of common marestail, however, treatments of Campaign® or Landmaster BW® + ammonium sulfate showed less weed control due to additional late spring weed germination. At 29 DAA large crabgrass remained in a very early seedling stage of growth due to the cool and wet growing conditions. At that time there did not appear to be any treatment affects to the large crabgrass. This is somewhat surprising considering that several of the active ingredients in this study are known to have postemergence and preemergence activity on annual grass species. At 61 DAA large crabgrass growth and development had significantly increased with the warmer temperatures. At 61 DAA treatments of MAT28 at 1.88 oz.a.i./A + Escort XP® 0.6 oz.a.i./A and MAT28 + Matrix® were providing moderate control of large crabgrass (60-63%), with all other treatments providing very poor control (3-18%). At 29 DAA, due to cool and wet conditions, there was only a small amount of Palmer amaranth growth and development at this study site. At this time there was very little if any control of Palmer amaranth or suppression from any of the treatments when compared to the untreated check. At 61 DAA Palmer amaranth growth had significantly increased in the untreated checks and all treatments of MAT28 were showing low to moderate levels of control of Palmer amaranth that ranged from 38-65%. The high rate of MAT28 + Escort XP® was producing better control of Palmer amaranth (57-65%) as compared to lower rates of this treatment or when in combination with Telar XP® or Matrix® (35-40%). The Palmer amaranth suppression from the MAT28 treatments is very similar to that produced from similar MAT28 treatments in the 2009 studies. The level of Palmer amaranth control and suppression from higher rates of MAT28 + Escort XP® while beneficial would not be an acceptable level of control (minimum 80%).

Table 1. Herbicide application specifics for experiment 4-H-01-10.

Application Factor	**Measurement**
Application Date:	Apr-8-2010
Time of Day:	9:00 a.m.
Application Method:	Broadcast spray
Application Timing:	Preemergence & Postemergence
Application Placement:	Soil & foliar
Air Temperature:	48 F
Relative Humidity:	63 %
Wind Velocity:	4 MPH
Wind Direction:	WNW
Dew Presence (Y/N):	No
Soil Temperature:	52 F
Soil Moisture:	Good
Cloud Cover:	50 %
Appl. Equipment:	4-wheel ATV
Operating Pressure:	25 PSI
Nozzle Type:	Turbojet
Nozzle Size:	8002VS
Nozzle Spacing, Unit:	20 inches
Nozzles/Row:	3
Boom Height:	16 inches
Ground Speed:	2.5 MPH
Carrier:	Water
Spray Volume:	20 gallons per acre
Mix Size:	1.8 liters
Propellant:	CO2

Table 2. Comparison of DPX-MAT28 treatment combinations for postemergence control of winter annual weeds.

Treatment Date: April 8, 2010				% Downy brome Control		% Wheat Control		% Prickly lettuce Control	% Corn gromwell Control	% Carolina geranium Control
Trt No.	Treatment Name	Rate	Rate Unit	29 DAA						
1	Untreated Check			0		0		0	0	0
2	Campaign® Ammonium Sulfate	32 17	fl oz/a lb/100 gal	100	a	100	a	98	98	97
3	Landmaster BW® Ammonium Sulfate	32 17	fl oz/a lb/100 gal	100	a	99	ab	99	99	96
4	DPX-MAT28 Telar XP® non-ionic surfactant	3.76 1 0.25	oz/a oz/a % v/v	85	bc	96	abc	98	99	96
5	Milestone VM® Escort XP® non-ionic surfactant	7.44 0.467 0.25	oz/a oz/a % v/v	80	c	88	d	99	99	98
6	DPX-MAT28 Escort XP® non-ionic surfactant	1.88 0.5 0.25	oz/a oz/a % v/v	88	b	95	c	99	99	97
7	DPX-MAT28 Escort XP® non-ionic surfactant	3.76 1 0.25	oz/a oz/a % v/v	90	b	96	bc	99	99	98
8	DPX-MAT28 Escort XP® Landmaster BW® Ammonium Sulfate	1.88 0.5 32 17	oz/a oz/a fl oz/a lb/100 gal	100	a	99	ab	99	99	95
9	DPX-MAT28 Escort XP® Landmaster BW® Ammonium Sulfate	3.76 1 32 17	oz/a oz/a fl oz/a lb/100 gal	100	a	99	ab	99	99	98
10	DPX-MAT28 Matrix® non-ionic surfactant	3.76 4 0.25	oz/a oz/a % v/v	98	a	97	abc	99	99	96
LSD (p=.10)				6.9		4.2		NS	NS	NS
Standard Deviation				4.9		2.9		1.1	0.8	3.0
CV				5.2		3.03		1.16	0.79	3.14
Replicate F				3.995		0.558		0.366	1.273	0.445
Replicate Prob(F)				0.0391		0.5834		0.6990	0.3069	0.6484
Treatment F				7.704		4.716		0.873	1.091	0.334
Treatment Prob(F)				0.0003		0.0041		0.5581	0.4174	0.9401

Footnotes: LSD = least significant difference test. Means sharing a common letter do not significantly differ at p = 0.10. NS = no significant differences present at p=0.10.

Table 3. Comparison of DPX-MAT28 treatment combinations for preemergence control of summer annual weeds.

Treatment Date: April 8, 2010				% Marestail Control	% Marestail Control		% Large crabgrass Control	% Large crabgrass Control		% Palmer amaranth Control	% Palmer amaranth Control	
Trt No.	Treatment Name	Rate	Rate Unit	29 DAA	61 DAA		29 DAA	61 DAA		29 DAA	61 DAA	
1	Untreated Check			0	0		0	0		0	0	
2	Campaign®	32	fl oz/a	100	93	b	0	12	c	0	3	c
	Ammonium Sulfate	17	lb/100 gal									
3	Landmaster BW®	32	fl oz/a	100	97	a	0	3	c	0	0	c
	Ammonium Sulfate	17	lb/100 gal									
4	DPX-MAT28	3.76	oz/a	100	100	a	0	18	bc	0	38	b
	Telar XP®	1	oz/a									
	non-ionic surfactant	0.25	% v/v									
5	Milestone VM®	7.44	oz/a	100	100	a	0	18	bc	0	13	c
	Escort XP®	0.467	oz/a									
	non-ionic surfactant	0.25	% v/v									
6	DPX-MAT28	1.88	oz/a	100	100	a	0	35	b	0	40	b
	Escort XP®	0.5	oz/a									
	non-ionic surfactant	0.25	% v/v									
7	DPX-MAT28	3.76	oz/a	100	100	a	0	63	a	0	65	a
	Escort XP®	1	oz/a									
	non-ionic surfactant	0.25	% v/v									
8	DPX-MAT28	1.88	oz/a	100	100	a	0	0	c	0	35	b
	Escort XP®	0.5	oz/a									
	Landmaster BW®	32	fl oz/a									
	Ammonium Sulfate	17	lb/100 gal									
9	DPX-MAT28	3.76	oz/a	100	100	a	0	35	b	0	57	a
	Escort XP®	1	oz/a									
	Landmaster BW®	32	fl oz/a									
	Ammonium Sulfate	17	lb/100 gal									
10	DPX-MAT28	3.76	oz/a	100	100	a	0	60	a	0	40	b
	Matrix®	4	oz/a									
	non-ionic surfactant	0.25	% v/v									
LSD (p=.10)				NS	3.4		NS	19.2		NS	15.8	
Standard Deviation				0.0	2.4		0.0	13.5		0.0	11.1	
CV				0.0	2.41		0.0	49.41		0.0	34.15	
Replicate F				0.000	1.584		0.000	3.977		0.000	0.234	
Replicate Prob(F)				1.0000	0.2356		1.0000	0.0396		1.0000	0.7937	
Treatment F				0.000	2.753		0.000	8.729		0.000	12.456	
Treatment Prob(F)				1.0000	0.0403		1.0000	0.0001		1.0000	0.0001	

Footnotes: LSD = least significant difference test. Means sharing a common letter do not significantly differ at p = 0.10. NS = no significant differences present at p=0.10.

3.0 DEVELOPMENT OF AMINOCYCLOPYRACHLOR FOR PREEMERGENCE AND POSTEMERGENCE BROADLEAF WEED CONTROL (4-H-02-10)

2.1 MATERIALS AND METHODS FOR STUDY 4-H-02-10

This trial continued research into the development of the aminocyclopyrachlor (DPX-MAT28) product... Treatments were applied on June 16 to evaluate the ability of selected combinations of aminocyclopyrachlor and tank-mix partners to provide postemergence control of summer annual grassy and broadleaf weeds (Table 4.). At the time of treatment summer annual weeds present were large crabgrass at 1-4" tall, marestail at 4-16", and Palmer amaranth at 1-8" tall. Visual ratings for percent control of summer annual weed species were collected at 30, 58, 89, and 120 days-after-application (DAA). Soil moisture conditions were very good at treatment time followed by a 1 inch rainfall 18 days after herbicide application. This was followed by approximately six weeks of very hot and droughty conditions.

On an unfortunate note, on July 9, while evaluating the adjacent study 4-H-01-10 (Preemergence Aminocyclopyrachlor Study), it was documented that approximately 75-100% of the research area of this trial was treated and/or received drift from an adjacent landowner herbicide application. Both Oklahoma Department of Transportation and Dupont were notified immediately of this observation. After a brief investigation it was found that the adjacent farmer (Ray Pennington/farming on behalf of Dan Wittwer) had a custom applicator apply RT Master III® at 22 fl.oz./A on a 30-35 foot wide pass outside of the fence onto the roadside rights-of-way. This illegal application was made over the top of research flags/signs and resulted in treatment of most of the research area. At this rate of glyphosate all annual weed species present in the plot area were controlled or severely damaged. Because of the effects of RT Master III® all of the early postemergence control data in this trial has been severely compromised. With the loss of this data extra efforts were made to salvage some preemergence weed control data by providing irrigation to this site in hopes of facilitating mid to late summer annual weed germination. In addition to normal rainfall, on August 4 ODOT/Grant County personnel, in cooperation with OSU personnel, applied approximately 0.7 inches of water over the top of this study. The water was applied using a clean ODOT spray rig utilizing a Boombuster® 437-R tip making multiple passes at very slow speeds. At this time new palmer amaranth and large crabgrass seedling plants were emerging in all of the untreated check plots. The research site was also irrigated on August 11 and August 30 using the same procedure as already mentioned.

Table 4. Herbicide application specifics for experiment 4-H-02-10.

Application Factor	**Measurement**
Application Date:	Jun-16-2010
Time of Day:	6:55 a.m.
Application Method:	Broadcast spray
Application Timing:	Postemergence & Preemergence
Application Placement:	Foliar
Air Temperature:	74 F
Relative Humidity:	84 %
Wind Velocity:	1 MPH
Wind Direction:	SE
Dew Presence (Y/N):	No
Soil Temperature:	76 F
Soil Moisture:	Good
Cloud Cover:	50 %
Appl. Equipment:	Bicycle sprayer
Operating Pressure:	26 PSI
Nozzle Type:	XR Teejet
Nozzle Size:	XR 8002VS
Nozzle Spacing, Unit:	20 inches
Nozzles/Row:	3
Boom Height:	30 inches
Ground Speed:	2.0 MPH
Carrier:	Water
Spray Volume:	20 gallons per acre
Mix Size:	1.8 liters
Propellant:	CO2

2.2 RESULTS & DISCUSSION FOR STUDY 4-H-02-10

Because of the compromised data at 30 & 58 DAA evaluation times discussion and conclusions concerning Palmer amaranth, large crabgrass, and marestail control data, will not be attempted. However, at later evaluation dates both Palmer amaranth and large crabgrass seedlings had emerged making late preemergence evaluations possible. At the 89 & 120 DAA evaluation times there was no preemergence control of Palmer amaranth or large crabgrass being provided by any of the treatments. During this time, following the initial burndown from the RT Master III® application, Palmer amaranth emergence was slow but steady. By late August Palmer amaranth and large crabgrass had emerged in all plots and was producing normal growth. With combination of the August irrigation plus rainfall, the Palmer amaranth and large crabgrass in this trial produced a large amount of late summer growth. This was likely due to removal of other competitive plants as a result of the adjacent landowner's RT Master III® treatment as well as lack of residual weed control provided by any of the herbicide treatments screened in this trial. This finding suggests that the primary mode of Palmer amaranth control provided by aminocyclopyrachlor is through foliar postemergence activity and not through residual root-absorbed preemergence activity.

4.0 DEVELOPMENT OF SL-160 & SL-950 FOR JOHNSONGRASS CONTROL (4-H-03-10)

4.1 MATERIALS AND METHODS FOR STUDY 4-H-03-10

This trial continued the development of SL-160 (flazasulfuron) herbicide. The objective was to evaluate the product applied alone or mixed with other herbicides for johnsongrass control. Treatments were applied on May 25 to actively growing bermudagrass and johnsongrass that ranged in height from 8-20 inches (average 15 inches) (Table 5). Johnsongrass was showing approximately 10-15 percent cool temperature stress (leaf purpling) at treatment time. Growing conditions were ideal during this study. Soil moisture was suitable for the first six weeks followed by moderate heat and drought stress during the final six weeks of the study. Percent johnsongrass control and common bermudagrass injury were visually evaluated at 13, 30, 59, and 92 days-after-application (DAA).

4.2 RESULTS & DISCUSSION FOR STUDY 4-H-03-10

AT 13 DAA all treatments were producing moderate levels of johnsongrass control (45-73%) as noted in Table 6. By 30 DAA all treatments were producing good to excellent johnsongrass control (78-92%) with the exception of SL-160 + NIS and SL-160 + Roundup Pro Concentrate®. At that time these treatments were producing little to no increase in johnsongrass control. The lack of johnsongrass response to the SL-160 + Roundup Pro Concentrate® treatment was unexpected as this treatment in several past trials has produced much better initial control of johnsongrass than was evident in this study. Treatments of SL-950, Outrider®, and Oust XP® combined with Roundup Pro Concentrate® were producing excellent johnsongrass control of 88-92% at 30 DAA. At 59 DAA all treatments of SL-950 and Outrider® continued to maintain acceptable levels (>80%) of johnsongrass control that ranged from 83-94%. At 59 DAA all treatments of SL-160 and Oust XP® were not providing acceptable levels of johnsongrass control. At 92 DAA johnsongrass control decreased for all treatments which is typical at this later evaluation date. At 92 DAA the only treatments that were maintaining acceptable levels of johnsongrass control were SL-950 and Outrider® alone, however the Outrider® plus Roundup Pro Concentrate® treatments produced 78% control which is very close to minimum acceptable level. Bermudagrass injury (phytotoxicity, stunting) was also evaluated in this study. Low levels of injury were evident on bermudagrass from all treatments in this study. However, it should be noted that all injury documented was acceptable for roadside weed control in bermudagrass in Oklahoma. At 13 DAA common bermudagrass injury ranged from 3-12% with treatments including Roundup Pro Concentrate® producing slightly more injury than treatments without the Roundup Pro Concentrate®. Bermudagrass injury peaked at the 30 DAA evaluations and ranged from 3-14% for all of the treatments. By 59 & 92 DAA all or nearly all bermudagrass phytotoxicity had diminished.

Table 5. Herbicide application specifics for experiment 4-H-03-10.

Application Factor	**Measurement**
Application Date:	May-25-2010
Time of Day:	9:58 a.m.
Application Method:	Broadcast spray
Application Timing:	Postemergence
Application Placement:	Foliar
Air Temperature:	78 F
Relative Humidity:	66 %
Wind Velocity:	5 MPH
Wind Direction:	SE
Dew Presence (Y/N):	No
Soil Temperature:	72 F
Soil Moisture:	Good
Cloud Cover:	50 %
Appl. Equipment:	4-wheel ATV
Operating Pressure:	27 PSI
Nozzle Type:	XR Teejet
Nozzle Size:	XR 8002VS
Nozzle Spacing, Unit:	20 inches
Nozzles/Row:	3
Boom Height:	30 inches
Ground Speed:	2.1 MPH
Carrier:	Water
Spray Volume:	20 gallons per acre
Mix Size:	1.8 liters
Propellant:	CO2

Table 6. Comparison of SL-160 & SL-950 treatment combinations for summer johnsongrass control.

Treatment Date: May 25, 2010				% Johnsongrass Control		% Johnsongrass Control		% Johnsongrass Control		% Johnsongrass Control	% Common bermudagrass Injury	% Common bermudagrass Injury		% Common bermudagrass Injury
Trt No.	Treatment Name	Rate	Rate Unit	13 DAA		30 DAA		59 DAA		92 DAA	13 DAA	30 DAA		59 DAA
1	Untreated Check			4		0		0		10	0	0		0
2	SL-160 non-ionic surfactant	0.047 0.418	lb ai/a lb ai/a	62		53	c	44	b	40	3	4	b	0
3	SL-160 Roundup Pro Conc. ®	0.047 0.5	lb ai/a lb ai/a	52		63	bc	53	b	41	7	3	b	0
4	SL-950 non-ionic surfactant	0.047 0.418	lb ai/a lb ai/a	45		81	a	94	a	85	7	10	a	2
5	SL-950 Roundup Pro Conc. ®	0.047 0.5	lb ai/a lb ai/a	65		88	a	83	a	64	11	11	a	3
6	Outrider® non-ionic surfactant	0.047 0.418	lb ai/a lb ai/a	53		88	a	87	a	89	6	10	a	0
7	Outrider® Roundup Pro Conc. ®	0.047 0.5	lb ai/a lb ai/a	73		92	a	90	a	78	9	8	ab	2
8	Oust XP® non-ionic surfactant	0.047 0.418	lb ai/a lb ai/a	48		78	ab	48	b	37	10	11	a	0
9	Oust XP® Roundup Pro Conc. ®	0.047 0.5	lb ai/a lb ai/a	60		86	a	66	ab	38	12	14	a	3
LSD (p=.10)				NS		17.4		28.4		NS	NS	5.8		NS
Standard Deviation				15.8		12.1		19.7		29.0	4.2	4.0		2.0
CV				27.53		15.31		27.89		49.14	51.09	45.66		171.56
Replicate F				0.140		0.194		1.139		0.822	0.312	7.295		4.566
Replicate Prob(F)				0.8703		0.8257		0.3480		0.4597	0.7370	0.0068		0.0297
Treatment F				1.042		3.855		3.176		1.837	1.448	2.671		1.379
Treatment Prob(F)				0.4465		0.0152		0.0313		0.1577	0.2628	0.0558		0.2877

Footnotes: LSD = least significant difference test. Means sharing a common letter do not significantly differ at p = 0.10. NS = no significant differences present at p=0.10.

5.0 DEVELOPMENT OF DPX-V9360 FOR JOHNSONGRASS CONTROL (4-H-04-10)

5.1 MATERIALS AND METHODS FOR STUDY 4-H-04-10

This trial continues the development of Pastora® herbicide (blended formulation of DPX-V9360 (nicosulfuron) + DPX-V6376 (metsulfuron methyl)) for the ability to provide johnsongrass control. Treatments were applied on May 25 to actively growing bermudagrass (Cynodon dactylon) and johnsongrass (Table 7). Johnsongrass (Sorghum halapense) ranged in height from 8-20 inches (average 14 inches).and 20% of the johnsongrass was showing cool temperature stress (leaf purpling) at treatment time. Growing conditions were ideal during this study. Suitable soil moisture was present for the first six weeks followed by moderate heat and drought stress during the final six weeks of the study. Percent johnsongrass control and common bermudagrass injury were visually evaluated at 13, 30, 59, and 92 days-after-application (DAA). At 13 DAT evaluations it became apparent that plot 204 (Treatment 3, Rep 2) had not been treated on 25 May. Therefore data from this plot was not included in our analysis .

5.2 RESULTS & DISCUSSION FOR STUDY 4-H-04-10

At 13 DAA all treatments were producing moderate to good levels of early johnsongrass control (64-79%) as noted in Table 8. By 30 DAA johnsongrass control had increased for all treatments. All treatments were producing very good to excellent johnsongrass control (89-94%) at that time. At 30 DAA there was very little separation of treatments or treatment rates with respect to johnsongrass control. At 59 DAA all treatments were maintaining very good to excellent johnsongrass control that was well above minimum acceptable levels (80%). At 59 DAA even the low rate of Pastora® + Roundup Pro Concentrate® was producing exceptional johnsongrass control at 96%. At 92 DAA johnsongrass control from all treatments of Pastora® + Roundup Pro Concentrate® were holding at 90-93% which is extremely close to the current industry standard of Outrider® + Roundup Pro Concentrate® (96%). At 92 DAA the other standard treatments of Oust XP® or Plateau® combined with Roundup Pro Concentrate® were showing the beginning signs of late season release of johnsongrass, however even these standard treatments were maintaining 86 & 87% johnsongrass control, respectively. The johnsongrass control from Pastora® treatments the last 3 years has been consistent. In summary of our last 3 years of work, Pastora® at 1 or 1.5 oz./A combined with Roundup Pro Concentrate® at 0.5 lb.ai./A produces slightly less control (3-5%) than the standard treatment of Outrider® + Roundup Pro Concentrate®. It provides slightly more control (5-10%) than standard treatments of Oust XP® or Plateau® when combined with Roundup Pro Concentrate®. Pastora® treatments should have an advantage in providing additional broadleaf weed control as compared to current standard treatments while having lower herbicide volatility.

At 13 DAA bermudagrass injury was evident from all treatments in this study. However, all injury documented throughout the duration of this study was acceptable for common bermudagrass release programs. The primary injury noticed was leaf phytotoxicity and growth suppression. At 13 DAA common bermudagrass injury ranged from 7-14% with very little difference amongst most herbicide treatments. By 30 DAA there was a small noticeable separation where the two lower rates of Pastora® + Roundup Pro Concentrate® and Outrider® + Roundup Pro Concentrate® were showing less injury (6-8%) than other treatments. The highest rate of Pastora® + Roundup Pro Concentrate® plus the standard treatments of Oust XP® and Plateau® + Roundup Pro Concentrate® were producing higher but acceptable common bermudagrass injury levels of 12-15%. By 59 DAA the highest rate of Pastora® + Roundup Pro Concentrate® and standard treatments of Oust XP® or Plateau® + Roundup Pro Concentrate® were producing a very small amount of noticeable common bermudagrass injury. Other treatments were producing no noticeable injury to common bermudagrass at 59 DAA. By 92 DAA no common bermudagrass injury was evident from any of the treatments in this study. The lower rates of Pastora® + Roundup Pro Concentrate® seem to produce very similar, low levels of common bermudagrass injury to that of Outrider® + Roundup Pro Concentrate® treatments. Many of today's roadside vegetation managers would consider this to be a valuable asset as there will be minimal growth regulation of common bermudagrass following the application. Standard treatments of Oust XP® or Plateau® plus Roundup Pro Concentrate® are well known for the 30-45 days of moderate common bermudagrass growth suppression they produce following treatment.

Table 7. Herbicide application specifics for experiment 4-H-04-10.

Application Factor	**Measurement**
Application Date:	May-25-2010
Time of Day:	10:50 a.m.
Application Method:	Broadcast spray
Application Timing:	Postemergence
Application Placement:	Foliar
Air Temperature:	83 F
Relative Humidity:	53 %
Wind Velocity:	4 MPH
Wind Direction:	E
Dew Presence (Y/N):	No
Soil Temperature:	72 F
Soil Moisture:	Good
Cloud Cover:	50 %
Appl. Equipment:	4-wheel ATV
Operating Pressure:	27 PSI
Nozzle Type:	XR Teejet
Nozzle Size:	XR 8002VS
Nozzle Spacing, Unit:	20 inches
Nozzles/Row:	3
Boom Height:	30 inches
Ground Speed:	2.1 MPH
Carrier:	Water
Spray Volume:	20 gallons per acre
Mix Size:	1.8 liters
Propellant:	CO2

Table 8. Comparison of DPX-V9360 & DPX-V6376 treatment combinations for summer johnsongrass control.

Treatment Date: May 25,2010				% Johnsongrass Control	% Johnsongrass Control	% Johnsongrass Control	% Johnsongrass Control	% Common bermudagrass Injury		% Common bermudagrass Injury		% Common bermudagrass Injury	
Trt No.	Treatment Name	Rate	Rate Unit	13 DAA	30 DAA	59 DAA	92 DAA	13 DAA		30 DAA		59 DAA	
1	DPX-V9360	0.75	oz wt/a	75	89	96	92	13	a	7	bc	0	c
	DPX-T6376	0.25	oz wt/a										
	Roundup Pro Conc. ®	13	fl oz/a										
2	DPX-V9360	1.13	oz wt/a	64	89	95	93	10	ab	6	bc	0	c
	DPX-T6376	0.375	oz wt/a										
	Roundup Pro Conc. ®	13	fl oz/a										
3	DPX-V9360	1.5	oz wt/a	73	90	89	90	14	a	15	a	7	a
	DPX-T6376	0.5	oz wt/a										
	Roundup Pro Conc. ®	13	fl oz/a										
4	Outrider®	1.0	oz wt/a	67	94	97	96	7	b	4	c	0	c
	Roundup Pro Conc. ®	13	fl oz/a										
5	Oust XP®	1.0	oz wt/a	79	93	92	86	13	a	12	ab	4	b
	Roundup Pro Conc. ®	13	fl oz/a										
6	Plateau®	4	fl oz/a	68	93	91	87	13	a	14	a	3	b
	Roundup Pro Conc. ®	10	fl oz/a										
7	Untreated Check			6	0	3	10	0		0		0	
LSD (p=.10)				NS	NS	NS	NS	4.1		5.7		2.8	
Standard Deviation				8.9	3.7	4.6	5.5	2.7		3.8		1.9	
CV				12.49	4.07	4.92	6.04	23.0		39.43		74.67	
Replicate F				3.309	5.491	0.272	1.921	1.170		4.340		3.186	
Replicate Prob(F)				0.0837	0.0276	0.7677	0.2019	0.3535		0.0479		0.0899	
Treatment F				1.193	1.077	1.620	1.342	2.930		4.095		7.888	
Treatment Prob(F)				0.3845	0.4335	0.2492	0.3299	0.0767		0.0324		0.0042	

Footnotes: LSD = least significant difference test. Means sharing a common letter do not significantly differ at p = 0.10.NS = no significant differences present at p=0.10.

6.0 RECOMMENDATIONS

After this year's successful side-by-side efficacy testing of Landmaster BW® to its discontinued counterpart Campaign®, we recommend that ODOT switch to Landmaster BW® in all future ODOT weed control programs. Successful compatibility testing was conducted on Landmaster BW® in the fall of 2009.

In late 2010, or early 2011, new Dupont herbicides that include the active ingredient aminocyclopyrachlor should receive their EPA registration and subsequent Oklahoma registration allowing their use on roadsides. At the time of this report these registrations, and subsequent labels, were not yet available. Recommendations at this time are to closely monitor the availability of the new labels (January/February 2011) and at that time final recommendations can be made to ODOT on the use of Streamline® (aminocyclopyrachlor + metsulfuron methyl) and Perspective® (aminocyclopyrachlor + chlorsulfuron) herbicides. Final recommendations on use rates, treatment combinations, application timings, and weeds controlled are scheduled for late winter/early spring of 2011. In the fall 2010 Compatibility Study both of these herbicides were found compatible with the liquid drift control product Detain II®. There is also a goal of trying to get these products on the ODOT herbicide contract by September of 2011. It is highly unlikely, with the various purchasing deadlines that these products will be under state contract before the 2011 spray season. However, it may be possible if a field division were motivated to use either of these products in 2011. They may be able to do a small contract on their own much quicker, making applications for the 2011 spray season window a possibility. Field divisions interested in using either Streamline® or Perspective® in 2011 should contact the OSU RVM team for further guidance. The use and benefits of these new herbicides will be covered in detail at the 2011 ODOT Continuing Education Workshops (February/March 2011).

The new Dupont herbicide, Pastora® (nicosulfuron + metsulfuron methyl), received its EPA registration and Oklahoma registration during the summer of 2010. This allows for its use on roadsides. Based on OSU research trials it is recommended that ODOT use Pastora® herbicide at a rate of 1.0 dry ounce of Pastora® product per acre combined with glyphosate at 0.5 pounds of active ingredient per acre. This is equivalent to 13 fl.oz. of Roundup Pro Concentrate® or 16 fl.oz. of most generic glyphosate products. Pastora® will primarily target summer johnsongrass and summer annual grasses and broadleaf weeds. This treatment should be applied at the same timing as glyphosate + Oust XP® treatments (refer to OSU publication E-958 for your respective Zone). If applied accurately this treatment will produce very little if any noticeable injury to common bermudagrass. The injury is comparable to the minimal amount seen by using Outrider® + glyphosate treatments. Pastora® is also projected to provide for good control of field sandbur control (although we have not screened for this) as well as many annual broadleaf weeds. This treatment will not control of kochia or pigweeds. At the time of this report the OSU RVM program has requested that ODOT pursue a contract addendum to try to add Pastora® herbicide to the state contract before the 2011 spray season of May/June 2011. While the timing of this addendum is out of the hands of OSU personnel, we are hopeful that an addendum will be in place by March of 2011. As such it would allow ODOT personnel to purchase Pastora® on contract. Last summer the retail price of Pastora® herbicide was approximately $10.50 per ounce of product. Our recommended use rate will be 1 dry ounce of Pastora® per acre. We are hoping that the future ODOT contract price will be lower than the summer 2010 price. Pastora® is a new treatment in the current arsenal of johnsongrass control recommendations. We expect there to be interest with some of the ODOT field divisions, especially because of its activity on field sandbur and increased summer broadleaf weed control. The use and benefits of Pastora® herbicide will be covered in detail at the February/March 2011 ODOT Continuing Education Workshops. We encourage field division personnel to contact OSU RVM personnel with any questions they have on its benefits and use.

With respect to SL-160, SL-950, we recommend staying in contact with the manufacturer and pursuing the development of these products as they have shown potential as possible beneficial roadside herbicides.