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

## ANNUAL REPORT FOR FY 2009

ODOT SPR ITEM NUMBER 2157

**Submitted to:**

Ginger McGovern, P.E.
Planning and Research Division Engineer
Oklahoma Department of Transportation
200 N.E. 21st Street
Oklahoma City, Oklahoma 73105


**Submitted by:**

Douglas Montgomery, M.S.
Craig Evans, M.S.
Dennis Martin, Ph.D., Principal Investigator
Oklahoma State University
Department of Horticulture & Landscape Architecture
358 Agricultural Hall
Stillwater, OK 74078


January 13, 2010

# DISCLAIMERS

Oklahoma State University, U. S. Department of Agriculture, State and Local governments cooperating. Oklahoma State University in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal and state laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices, or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources. 1/2010.

The contents of this report reflect the views of the author(s) who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the views of the Oklahoma Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation. While trade names may be used in this report, it is not intended as an endorsement of any machine, contractor, process, or product.

# METRIC CONVERSION PAGE

## SI (METRIC) CONVERSION FACTORS

| *Approximate Conversions to SI Units* | | | | | *Approximate Conversions from SI Units* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Symbol | When you know | Multiply by | To Find | Symbol | Symbol | When you know | Multiply by | To Find | Symbol |
| | | 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


**SECTION** **PAGE**

1.0 INTRODUCTION ..... 1

1.1 OBJECTIVES ..... 1

2.0 DEVELOPMENT OF NICOSULFURON AS A POTENTIAL JOHNSONGRASS CONTROL PRODUCT (4-H-93-09) ..... 2

2.1 MATERIALS AND METHODS FOR STUDY 4-H-93-09 ..... 2

2.2 RESULTS & DISCUSSION FOR STUDY 4-H-93-09 ..... 3

3.0 DEVELOPMENT OF FLAZASULFURON AND GENERIC MSMA PRODUCTS AS A POTENTIAL JOHNSONGRASS CONTROL PRODUCT (4-H-99-09) ..... 5

3.1 MATERIALS AND METHODS FOR STUDY (4-H-99-09) ..... 5

3.2 RESULTS & DISCUSSION (4-H-93-09) ..... 5

4.0 RECOMMENDATIONS ..... 8

5.0 IMPLIMENTATION OF RECOMMENDATIONS ..... 8

6.0 REFERENCES ..... 8


# LIST OF TABLES


**TABLE** **PAGE**

1. HERBICIDE APPLICATION SPECIFICS FOR EXPERIMENT 4-H-93-09 ..... 2

2. COMPARISON OF MULTIPLE RATES OF NICOSULFURON (ACCENT®) AND METSULFURON METHYL TANK MIXES VERSUS OUTRIDER® FOR JOHNSONGRASS CONTROL AND BERMUDAGRASS SAFETY ..... 4

3. HERBICIDE APPLICATION SPECIFICS FOR EXPERIMENT 4-H-99-09 ..... 6

4. JOHNSONGRASS CONTROL FROM TREATMENT COMBINATIONS USING MSMA AND FLAZASULFURON ..... 7

# 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® | 0.5625 | oz ai/a | 97 | ab | 88 | C | 54 | c | 7 | b |
| | Escort XP® | 0.15 | oz ai/a | | | | | | | | |
| | Roundup Pro Concentrate® | 0.5 | lb ai/a | | | | | | | | |
| 3 | Accent® | 0.84375 | oz ai/a | 96 | b | 92 | B | 79 | b | 12 | a |
| | Escort XP® | 0.225 | oz ai/a | | | | | | | | |
| | Roundup Pro Concentrate® | 0.5 | lb ai/a | | | | | | | | |
| 4 | Accent® | 1.125 | oz ai/a | 96 | b | 94 | B | 84 | ab | 10 | ab |
| | Escort XP® | 0.3 | oz ai/a | | | | | | | | |
| | Roundup Pro Concentrate® | 0.5 | lb ai/a | | | | | | | | |
| 5 | Outrider® | 0.94 | oz ai/a | 98 | a | 97 | A | 94 | a | 12 | a |
| | Roundup Pro Concentrate® | 0.5 | lb ai/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<br>Outrider® | 3.0<br>0.047 | lb ai/a<br>lb ai/a | | | | | | | | |
| 5 | Weed-Hoe® 108<br>Outrider® | 3.0<br>0.047 | lb ai/a<br>lb ai/a | 95 | a | 83 | a | 83 | a | 6 | b |
| 6 | Target® 6 Plus<br>Outrider® | 3.0<br>0.047 | lb ai/a<br>lb ai/a | 96 | a | 90 | a | 88 | a | 6 | b |
| 7 | flazasulfuron<br>Roundup Pro Concentrate® | 0.0234<br>0.5 | lb ai/a<br>lb ai/a | 95 | a | 92 | a | 93 | a | 9 | a |
| 8 | flazasulfuron<br>Roundup Pro Concentrate® | 0.047<br>0.5 | lb ai/a<br>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™), 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).