Final Report Concerning 2004 – 2006 Evaluations of New Herbicide Formulations For Potential Integration Into Existing ODOT Roadside Vegetation Management Programs

September 30, 2006

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Produced Under Section I of Project 2157:
REFINEMENT OF ROADSIDE VEGETATION MANAGEMENT PRACTICES IN OKLAHOMA

A Joint Project Between the Oklahoma Department of Transportation & the Oklahoma State University

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16 . ABSTRACT

In order for clear zone or safety zone vegetation to provide its maximum benefit, undesirable plants in the clear zone require annual management. A three year research project was conducted between the Oklahoma Department of Transportation (ODOT) and the Oklahoma State University to investigate herbicides and herbicide tank mixes that could supplement existing ODOT weed control programs. Constant screening of new and experimental herbicides insures that a knowledge base remains current and in place in order for ODOT to effectively respond to changes in herbicide availability and cost due to Governmental Regulatory action or changes due to the business activities of private industry corporations involved in the manufacture, marketing or sales of herbicide products.

Fifteen studies covering some eight topic areas were address in this three year research project. Rates below the current Federally labeled rate of 4 ounces of Overdrive herbicide (active ingredient diflufenzopyr + dicamba) were investigated for control of the noxious weed Scotch thistle. These low rates provided erratic and unacceptable control so no pursuit of a 2ee Oklahoma label exemption permit was recommended. Testing of certain potassium salt formulations of glyphosate herbicide revealed that these formulations could provide effective control of johnsongrass when used in combination with existing tank mix partners such as Outrider or Oust XP herbicide. Private industry will decide upon the availability of these formulations for roadside use in future years. Milestone VM herbicide has the potential to provide effective control of important broadleaf weeds both pre-and post-emergence in roadside turf. Quicksilver herbicide (active ingredient carfentrazone) did not provide additional benefit to or over existing standard broadleaf herbicide treatments in practice by ODOT. Katana herbicide (active ingredient flazasulfuron) when tank mixed with glyphosate herbicide can be used to provide Johnsongrass control equivalent to tank mixes with existing standard herbicides such as Outrider herbicide (active ingredient sulfosulfuron). Katana has not yet been labeled for use on non-crop roadside right of ways. The herbicide Sulfomax (active ingredient sulfometuron) appears to provide johnsongrass control efficacy equivalent to that provided by Oust XP (same active ingredient) when both herbicides are tank mixed with glyphosate. Sulfomax is not yet labeled for roadside turf. Provided that Federal as well as Oklahoma State labeling of several products occurs in combination with expected competitive bid process, many new, cost effective and efficacious products will be available to ODOT for weed control purposes in the future.

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The contents of this report reflect the views of the authors who are responsible for 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, their use is not intended as an endorsement of any machine, contractor, process or product.

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EXECUTIVE SUMMARY OF THE FINAL REPORT CONCERNING 2004 – 2006 EVALUATIONS OF NEW HERBICIDE FORMULATIONS FOR POTENTIAL INTEGRATION INTO EXISTING ODOT ROADSIDE VEGETATION MANAGEMENT PROGRAMS

In 2004, Joint Research Project 2157: *Refinement Of Roadside Vegetation Management Practices In Oklahoma* was initiated as a cooperative effort between the Oklahoma Department of Transportation (ODOT) and the Oklahoma State University (OSU). The objectives of this specific report appeared in Task # 1: *Evaluations of New Herbicide Formulations For Potential Integration Into Existing ODOT Roadside Vegetation Management Programs.* **The specific objective of this research was:**

(1) To evaluate new herbicide formulations for potential integration into existing ODOT roadside vegetation management programs.

During 2004-2006, a total of 15 herbicide screening experiments were conducted in ODOT Divisions 3, 4 and 5 to determine herbicide treatments/rates effective in the selective control of certain weeds. All trials contained three replications of treatment and were statistically analyzed and treatments were compared using the least significant difference test. Weed species included in trials were johnsongrass, scotch thistle, palmer amaranth, Kochia, prickly lettuce, Carolina geranium, cheat, common ragweed, crabgrass, downy brome, annual ryegrass, field bindweed, and marestail, There were a total of eight research thrust areas during this project. From this research, the RVM Research Team at OSU has developed the following seven statements/recommendations to ODOT.

1. Rates below the current Federally labeled rate of 4 ounces of Overdrive herbicide (active ingredient diflufenzopyr + dicamba) provide erratic and unacceptable control of Scotch thistle. Thus we do not suggest any pursuit of a 2ee Oklahoma label exemption permit allow such a low use rate which if effective would have saved money in treating for this particular noxious weed.

2. Testing of certain potassium salt formulations of glyphosate herbicide revealed that these formulations could provide effective control of johnsongrass when used in combination with existing tank mix partners such as Outrider or Oust XP herbicide. Monsanto Products Corporation will decide upon the availability of these formulations for roadside use in future years. Bid cost of the products at that time will determine if they are cost effective for ODOT at that time.

3. Milestone VM herbicide has the potential to provide effective control of important broadleaf weeds both pre-and post-emergence in roadside turf. Milestone fits a critically important pre-emergent as well as post-emergent need for ODOT.

4. Quicksilver herbicide (active ingredient carfentrazone) did not provide additional benefit to or over existing standard broadleaf herbicide treatments in practice by ODOT, so no change to the existing post-emergent broadleaf herbicide management programs in use by ODOT is necessary at this time.

5. Katana herbicide (active ingredient flazasulfuron) when tank mixed with glyphosate herbicide can be used to provide Johnsongrass control equivalent to tank mixes with existing standard herbicides such as Outrider herbicide (active ingredient sulfosulfuron) and Oust XP (active ingredient metsulfuron). Katana has not yet been labeled for use on non-crop roadside right of ways. Cost effectiveness cannot be stated at this time but data is in position for cost comparison once market availability of this product occurs.

6. The herbicide Sulfomax (active ingredient sulfometuron) appears to provide johnsongrass control efficacy equivalent to that provided by Oust XP (same active ingredient) when either herbicides is tank mixed with glyphosate. Sulfomax is not yet labeled for roadside turf. Provided that Federal as well as Oklahoma State labeling of products occurs in combination with expected competitive bid process, a new, cost effective and efficacious generic product will be available to ODOT for weed control purposes in the future.

7. Various experimental herbicide treatments have been tested and may become available to ODOT in the future. Confidentiality agreements are in place that prevents release of this data at this time. However, once products are commercialized, the performance data for these products can be released so that cost and efficacy comparison can be made by ODOT. ODOT suffers no negative impact from not having access to this data at this time because these products are not yet labeled for use as herbicides. All herbicides must always have both State and Federal labels in place as well as competitive bidding before cost comparisons and product selection recommendations can be made.

1.0 Introduction

The vegetation management programs practiced by the Oklahoma Department of Transportation (ODOT) are considered to be in their mature phase, in that permanent vegetation present in the clear zone is for the most part well established on most rights of way in Oklahoma (with a few exceptions). Our research principally concerns the continued development of weed management programs that allow ODOT to cost effectively manage weed problems in the clear zone portion of the right of way. Properly executed vegetation management programs result in aesthetically pleasing low growing vegetation that provides suitable sight distance and excellent soil stabilization of the soil and road surface with minimal off target environmental effects.

The intent of this Final Report is to summarize the herbicide product and weed control evaluations conducted under the 2004-2006 Joint Project 2157 between OSU and ODOT. Project 2157 concerns research on the *Refinement of Roadside Vegetation Management Practices in Oklahoma.*

It is our intent that this report be considerably less formal and more abbreviated than previous Final Research Reports generated by our program. We would like to remind the reader that detailed year-end research reports were generated concerning yearly research progress at the end of 2004 and again at the end of 2005.

The contents of this report are divided into three main areas: 1. a *Summary of Findings & Recommendations from our research* (Section 2.1 – 2.8), 2. *Materials & Methods* (Section 3.0) and 3. a detailed presentation of the *Results & Discussion* of each of the 15 weed control or product evaluation trials. These studies are grouped into 8 areas of similar work (Section 4.1 – 4.8). The *Summary* section is recommended for those wishing to merely have an overview of what was discovered in this research and what recommendations have been developed from our research. The more detailed *Materials & Methods* as well as *Results & Discussion* sections are recommended for those wishing to know more details about each research study that was conducted.

Each of our studies involved either commercially available and/or experimental phase products and treatments that could have a positive impact on ODOT roadside vegetation management programs. Beyond the findings of our research, the availability of herbicide products to ODOT will depend upon both Federal Environmental Protection Agency (EPA) and Oklahoma Dept. of Ag, Food and Forestry labeling of the products, specific non-crop right of way site intent (part of labeling), the product being placed on the ODOT Approved Herbicide & Adjuvant List and competitive bidding of contracts by private industry. Most of these factors lay outside the control or influence of our vegetation management research program.

All of the research presented in this report has been conducted using both industry and University weed control standard research techniques. All research studies were conducted on Oklahoma highway system roadsides and under the normal range of roadside conditions such that results could be expected to be similar to those that would be experienced by ODOT herbicide applicators. As with all herbicide research conducted under field conditions, there are many variables that can influence the effects of the treatments. The most extreme examples of these include varying soil types and the effects of drought. All data collected from treated plots was compared to nearby untreated plots. Data was collected in an unbiased fashion with respect to product and manufacturer as well.

2.0 Summary of Conclusions Regarding Weed Control Studies And Subsequent Recommendations

2.1 Development of Overdrive For Scotch Thistle Control.

It is recommended that ODOT personnel use Overdrive® (active ingredient diflufenzopyr and dicamba) at 4 oz. product/A combined with a non-ionic surfactant at 0.25% V/V to control scotch thistle (*Onopordum acanthium*) when the plant is in the rosette to early bolting stages of growth. The appropriate time of this application will vary depending on location but normally would occur in March through early April. This application can be made as a spot treatment or broadcast treatment depending on the thistle density and amount of area to be treated. This recommendation is based on the fact that our work showed Scotch thistle control to be erratic at the sub-Federal labeled rate of 2 oz. product/A. Therefore we do not recommend approaching the manufacturer to support the addition of scotch thistle to the existing Overdrive 2ee label. An Oklahoma 2ee permit allows the herbicide applicator to use a specific herbicide at rates lower than recommended on the Federal and standard State Label.

2.2. Development of New Glyphosate Formulations For Johnsongrass Control.

As a result of this preliminary research ODOT will be prepared to make an informed decision on what affects, if any, a change in the formulation of glyphosate will make on both ODOT herbicide programs and statewide herbicide contracts. This research has collected critical data on all new proposed Monsanto Products Company® glyphosate formulations that will likely be marketed in the near future. Our recommendation is based on whether or not Monsanto actually makes the change in the future to market one of the new potassium (K) salt formulations of glyphosate instead of the current isopropyl amine (IPA) salt formulation as in Roundup Pro Concentrate®. If Monsanto makes this change, OSU will request that Monsanto reveal their research codes used during these studies, allowing us to match new commercialized products to Monsanto's research codes used in our research. At this time, data collected indicates the new formulations of glyphosate are equal to current glyphosate formulations as far as johnsongrass control and safety to common bermudagrass are concerned.

2.3 Development of Milestone VM Herbicide For Broadleaf Weed Control.

This research has shown the new herbicide, Milestone VM® (active ingredient aminopyralid) will provide very good preemergence and postemergence control of roadside broadleaf weeds. It is our recommendation to approve Milestone VM for inclusion on the ODOT Approved Herbicide & Adjuvant List. Milestone VM technical data shows the product has a very good safety profile for both ODOT personnel and the environment. The full benefits, uses, and limitations of Milestone VM will continue to be researched by our program and others in industry but at this point we would recommend using Milestone VM +

glyphosate as a late winter treatment or Milestone VM mixed with traditional late winter Campaign + AMS treatments. Our recommended treatments and rates would be as follow: 1.) Milestone VM at 4 fluid ounces/Acre + glyphosate at 0.5 lb. ai./Acre, or, 2.) Milestone 4 fluid ounces/Acre + Campaign 32 fluid ounces/Acre + Ammonium sulfate at 17 pounds product/100 gallons of water. Both Milestone VM treatments will provide good postemergence control of existing winter broadleaf weeds and good preemergence control of later germinating summer annual broadleaf weeds. In Oklahoma, Milestone VM should be applied from late Feb. (south of I-40) through the end of March (north of I-40). Weed control data has shown Milestone VM, when applied at this timing, will provide preemergence control of summer annual broadleaf weeds for a minimum of 4 months. A side benefit of Milestone VM treatments is by controlling summer broadleaf weeds as a preemergence application (Feb.-March) should eliminate the need for postemergence summer broadleaf treatments of Vanquish or Overdrive(May or June). This will help reduce the potential of vapor drift injury to adjacent summer broadleaf crops. Milestone VM has some weak points; it will not control kochia and has little activity on grassy weeds. ODOT personnel interested in using Milestone VM should contact OSU personnel for more specific treatment recommendations. With the amount of good broadleaf weed control Milestone VM has shown and the fact it is providing residual weed control after applications there will likely be additional benefits in the future from this product.

2.4 Development of Overdrive Herbicide Combinations For Summer Broadleaf Weed Control.

There are no new Overdrive® (active ingredient diflufenzopyr and dicamba) herbicide recommendations or amendments to current recommendations regarding the use of Overdrive as a result of this research effort.

2.5 Development of a New Herbicide Active Ingredient For Spring And Summer Broadleaf Weed Control.

The new active ingredient evaluated in these 2006 research studies, manufactured by BASF, has shown a great deal of promise as a beneficial roadside weed control product. This is the first year OSU has looked at this product and it is likely 2 or more years away from commercialization. The manufacturer has been encouraged by OSU personnel to continue to develop this product in the roadside market. This product is currently being developed under a confidentially agreement with the manufacturer. OSU will retain all data from this research and will release the information to ODOT as soon as it is available under the terms of the confidentiality agreement between OSU and BASF.

2.6. Postemergence Broadleaf And Grassy Weed Control With Quicksilver.

In this single study, the product Quicksilver® (active ingredient carfentrazone), did not provide any significant benefit to standard treatments evaluated in the trial, therefore, no

recommendations will be made to ODOT for the use of Quicksilver or Quicksilver treatment combinations at this time.

2.7. Johnsongrass Control Using Flazasulfuron Treatment Combinations.

This study has been a continuation of studies over the last 5 years for the development of Katana® (active ingredient flazasulfuron) herbicide. This herbicide, which comes from the same sulfonyl urea family as Oust® and Outrider®, has provided consistent equivalent control of johnsongrass when substituted for Oust or Outrider in current standard treatments. Due to marketing decisions of the manufacturer, ISK BioSciences®, the product is yet to receive its Federal EPA label. Recommendations from OSU are pending based on whether or not Katana is labeled by its manufacturer or another company. We have no indication what the price of Katana herbicide will be since it has not been commercialized for the roadside market.

2.8. Johnsongrass Control Using Sulfomax Treatment Combinations.

This trial involved the testing of Sulfomax® (active ingredient sulfometuron) herbicide to see if it provided equivalent performance to the product Oust XP® (active ingredient sulfometuron). Sulfomax can be considered a generic form of Oust XP. In this single study the Sulfomax product performed the same as Oust XP. This study generated the necessary data to recommend to ODOT to place the Sulfomax product on its Approved Herbicide & Adjuvant List (AHAL). However, towards the end of data collection in our work the manufacturer decided they were not going to pursue an amendment to the Sulfomax label that would allow its lawful use on roadsides. The manufacturer was encouraged to reconsider and pursue a Sulfomax label amendment that would include roadside use.

3.0 Materials & Methods

In order to develop a Final Report of improved readability we have chosen to present a generalized materials and methods section that is applicable to all herbicide trials that we conducted. Minute details of each trial have already been report in the Year End 2004 and 2005 Research Report so we spare the reader those many details in this report. The generalized methods used in all of our studies follow.

All studies were conducted on common bermudagrass (*Cynodon dactylon*) roadside rights-of-way. The objectives of each study are reported in their respective Results & Discussion section. Additionally, the target weeds studied are reported in those same sections. Research Study name codes are assigned to each of our trials and those codes are listed in each respective section. Studies were named for record keeping purposes using the following code: A-B-C-D, where A= the ODOT Division number, B= H for herbicide or G for plant growth regulator, C=the cumulative number of that study, representing the total number of studies that were conducted in that ODOT division since our record keeping began in 1963, and D= the two digit code for the year of the study. For instance a study coded as 4-H-32-06 would be a study conducted in Division 4 involving herbicides that was the 32nd cumulative study conducted in that division by our program (since 1963) and that study was put out in 2006.

All trials were conducted using Randomized Complete Block field experiment designs and they contained 3 replications of treatment and at least one untreated check in each replication. Herbicide treated plots each measured 5 x 10 feet in dimension. We utilized either 80 degree or 110 degree flat fan spray nozzles mounted to a boom on an R&D brand $C0_2$ pressurized bicycle sprayer. Either 20 or 30 gallons of sprayer carrier rate was used in each trial.

Data were collected for percent weed control and damage (phytotoxicity) to bermudagrass usually at 1, 2 and 3 months after herbicide application. The amount of time that had passed since application will be at the top of the weed control or turf damage data column. The time will be labeled as the number of days since herbicide treatment (DAT). The specific weed to which the data applies is listed at the top of each column. Likewise, if injury or phytotoxicity to bermudagrass is being studied, that label will also appear above its respective data column.

All data was subject to a statistical analysis test called the Analysis of Variance procedure. The effect of the treatments was compared. When statistical differences were present at the 90% certainty level (probability =.10) a least significant difference (LSD) statistical test was also performed to compare the individual performance averages (called means) of each herbicide treatment. The reader can use the LSD value to compare the various means or simply refer to the statistical letter of the alphabet that follows each treatment mean. Means followed by the same letter are not statistically different from each other at the 90% certainty level. The 90% certainty levels means that the test is 90% certain that the difference witnessed is not likely due to simply pure chance but rather it is likely a real effect due to true differences in the performance of the herbicide treatments.

4.0 Herbicide Product and Weed Control Trial Results and Discussion

4.1 Development of Overdrive For Scotch Thistle Control

Trial Objectives: The objectives of these studies were to evaluate the effectiveness of Overdrive® herbicide for scotch thistle control and common bermudagrass tolerance.

Studies 4-H-55-04 & 5-H-60-05

Results & Discussion: Overdrive herbicide has proven to be very effective at low rates in controlling labeled thistle species. In previous research the 2 oz. prod. /A rate was very effective in controlling musk thistle. This finding prompted the request and subsequent Oklahoma 2ee state-issued label amendment to legalize the sub-label rate. Research has been conducted the past two years to expand the data base of the Overdrive 2 oz. rate to evaluate if it was also effective in controlling other state noxious weeds such as scotch thistle. In 2004 trials, the 2 oz. rate worked well in preventing scotch thistle from flowering. However, a few scotch thistles did not completely die in test plots. In this year's study, the sub-label Overdrive rate of 2 oz. prod. /A did not completely prevent scotch thistles from flowering. This treatment produced severe plant growth suppression at 56 days-after-application (DAT), but some of the thistles were able to produce small stunted seedheads. We do not know if any viable seed was produced in these seedheads but we assume the worst case scenario that seed was produced. To fully comply with the Oklahoma Noxious Weed Law, control methods must prevent seed production. The lowest federally labeled rate of 4 oz. prod. /A completely prevented seedheads while producing 82% control of scotch thistle (good control with a small amount of thistle leaves remaining green and/or yellow and severely stunted). Overdrive at 6 oz. prod. /A produced complete control of scotch thistle seedheads and 97% control of the thistle plants. With the 2005 data showing less control (inconsistent) than the previous year using the sub-labeled 2 oz. product rate, it is unlikely that the manufacturer of Overdrive (BASF) would entertain the idea of adding scotch thistle to the 2ee state-issued label. At this point we do not support approaching the manufacturer with such a request. It is not completely surprising that the sub-labeled rated of 2 oz. /A did not provide consistent high levels of scotch thistle control. In past research at OSU we have found scotch thistle to be more difficult to control than musk thistle. The Overdrive product does provide very good economical control of scotch thistle at the minimum labeled rate of 4 oz. prod. /A. We would encourage ODOT personnel to use Overdrive in both broadcast or handgun applications to control scotch thistle, a state noxious weed.

Table 1. Scotch Thistle Control With Overdrive Herbicide.

Date Treated: 4/15/04
Trial ID: 4-H-55-04 **Study Dir.: Doug Montgomery**
Location: Roger Mills County

Weed Code				Scotch thistle	Scotch thistle
Rating Data Type				control	control
Rating Unit				percent	percent
Rating Date				5/27/2004	6/16/2004
Evaluation Interval				27 DAT	61 DAT
Trt No.	Treatment Name	Product Rate	Product Rate Unit		
1	Untreated Check			0	0
2	Overdrive	2	OZ WT/A	50 b	90
	+ Surf King	0.25	% V/V		
3	Overdrive	4	OZ WT/A	70 ab	94.3
	+ Surf King	0.25	% V/V		
4	Overdrive	6	OZ WT/A	80 a	100
	+ Surf King	0.25	% V/V		
LSD (P=.10)				21.02	15.12
Standard Deviation				12.08	8.69
Coeff. Of Variation				18.11	9.16
Replicate Mean Square				3.486	2.856
Replicate Prob (F value)				0.1329	0.1697
Treatment Mean Square				4.8	1
Treatment Prob (F value)				0.0865	0.4444

Means followed by same letter do not significantly differ (P=.10, LSD).
Control treatments excluded from analysis.
Surf-King is a non-ionic surfactant.

Table 2. Scotch Thistle Control With Overdrive Herbicide.

Treated On: March 29, 2005
Trial ID: 5-H-60-05 **Study Dir.: Montgomery/Evans**
Location: Beckham County

Trt No.	Treatment Name	Rate	Rate Unit	Scotch thistle thistle count per plot 3/29/2005 0 DAT		Scotch thistle control percent 4/27/2005 28 DAT		Scotch thistle control percent 5/26/2005 56DAT	Scotch thistle seedheads per plot 4/27/2005 56 DAT
1	Untreated Check			6		0		17	31
2	Overdrive Surf King	2 0.25	oz. prod/A % V/V	9	a	32	b	57	12
3	Overdrive Surf King	4 0.25	oz. prod/A % V/V	6	ab	48	a	82	0
4	Overdrive Surf King	6 0.25	oz. prod/A % V/V	4	b	50	a	97	0
LSD (P=.10)				3.2		9.4		N.S.	N.S.
Standard Deviation				1.9		5.4		20.8	8.6
CV				28.8		12.46		26.57	210.34
Replicate F				1.581		2		1	1
Replicate Prob (F)				0.312		0.25		0.4444	0.4444
Treatment F				5.452		10.571		2.827	2.034
Treatment Prob (F)				0.072		0.0253		0.1717	0.2458

Means followed by same letter do not significantly differ (P=.10, LSD).
Controls were excluded from analysis.

4.2. Development of New Glyphosate Formulations For Johnsongrass Control.

Trial Objectives: The objectives of these studies were to evaluate the effectiveness of various formulations of glyphosate herbicide when combined with or without Outrider® herbicide for johnsongrass control and common bermudagrass tolerance.

Studies 4-H-53-04, 4-H-62-05, & 4-H-70-06

Results & Discussion: The glyphosate formulation studies that have been conducted the past 3 years are to prepare ODOT for a possible shift in availability of glyphosate containing products from Monsanto. There are many considerations that Monsanto is dealing with before they change the current isopropylamine salt formulation (IPA salt) currently marketed as Roundup Pro Concentrate to a potassium based salt formulation. While all of this research was not conducted under a confidentiality agreement between Monsanto and OSU, the products evaluated within each study involved the use of designated Monsanto product codes to ensure that University cooperators were operating blind with respect to product identity. Using product codes, which change annually, can be used to ensure that evaluators remain unbiased as well as allow the study designer to test competitor products without the evaluator being aware of the identity of the entries. In recent 2006 conversations with Monsanto research representatives, they still want to keep product codes confidential for each study. While OSU maintains all of the data from these studies, not being able to decode the products will affect our ability to make final conclusions and summaries. Our summaries will have to be made by year as we will be unable to draw conclusions over years. Monsanto assures us that when and if they market one of their new glyphosate formulations they will then reveal the codes used in this research. This will allow for final conclusions to be made by both OSU and ODOT as to the future of the newly selected glyphosate product.

Study 4-H-53-04 (Table. 3): Common bermudagrass injury was very low throughout all evaluations. At 7 DAT there was only minimal visual change to bermudagrass growth as compared to the untreated check. At 14 DAT bermudagrass injury, or growth suppression, increased slightly. It appeared that the treatments including the higher glyphosate rates, were producing a little more growth suppression than lower rates. At 28 DAT evaluations bermudagrass injury had lessened to 5-7% for all treatments. At 56 DAT there was no visible injury to common bermudagrass for any of the treatments.

At 7 DAT johnsongrass control from all low rates was ranging from 47-55% with control increasing to 57-75% for high rates. Johnsongrass control increased by 14 DAT for lower rates (67-74%) and higher rates (78-86%). AT 28 DAT control had dropped for most treatments with lower rates producing 54-69% and higher rates producing 61-81%. Control at 56 DAT was very similar to control at 28 DAT which means most treatments were maintaining their level of johnsongrass control. At this time only the MON 79527 was maintaining an acceptable 80% control level and MON 79688 close at 79%. All other treatments were producing unacceptable levels of johnsongrass control. By the final evaluations at 84 DAT the higher rate of MON 79527 continued to maintain 83% control along with the higher rate of MON 79688 which was close at 78%. Ranking their performance for johnsongrass control would be as follows:

MON 79527=MON 79688>MON 79503>MON 79528=MON 78754>MON79730

Study 4-H-62-05 (Table 4): Common bermudagrass injury was very low throughout all evaluations. At 7 DAT there was only minimal visual change to bermudagrass growth as compared to the untreated check. At 14 DAT bermudagrass injury, or growth suppression, increased slightly. It appeared that the treatments including the higher glyphosate rates, were producing a little more growth suppression than lower rates. At 28 DAT evaluations the peak of bermudagrass injury was noticed which ranged from 8-12% for treatments with the higher glyphosate rates versus 5-7% for the lower glyphosate rates. The injury for the higher glyphosate rates consisted mainly of growth suppression with very slight chlorosis. At 56 DAT there was no visible injury to common bermudagrass for any of the treatments.

At 7 DAT johnsongrass control from all treatments was ranging between 62-80% (which is very good for 7 days). All of the higher glyphosate rates had separated slightly from their lower rates, however only the higher rate of MON 79730 produced significantly more johnsongrass control than its lower rate treatment. At 14 DAT johnsongrass control had increased for all treatments and was ranging between 68-87%. At this point all of the higher glyphosate rate treatments were producing satisfactory control (>80%) of johnsongrass with the lower glyphosate rate treatments producing 4-16% less control. AT 28 DAT johnsongrass control had increased again for all treatments and was ranging between 73-93%. At this time only the low rate of MON 79786 was not producing satisfactory control (73%) of johnsongrass. At 28 DAT the lower glyphosate rate treatments were producing 4-17% less control than the higher glyphosate rates. AT 28 DAT all of the high glyphosate rate treatments were producing from 90-93% control of johnsongrass. At 56 DAT there was a slight decrease in johnsongrass control for some treatments with control ranging from 69-94%. At this time all treatments were producing satisfactory control except for the low glyphosate rate treatment of MON 79786 (69%). The experimental area received good rainfall in late June through early July which should have promoted mid-summer johnsongrass seedling germination and/or growth from rhizome johnsongrass that was not controlled by the herbicide treatments. There were subtle differences in johnsongrass control from the various glyphosate formulations in this study but a superior treatment is difficult to point out. There were more noticeable differences between low and high glyphosate rates within the same MON formulation than between MON formulations. Ranking their performance from best-to-worst johnsongrass control would be as follows:
MON 79786 = MON 78754 > MON 79730 > MON 79670 > MON 79748

Study 4-H-70-06 (Table. 5): Common bermudagrass injury was very low for all treatments at each of the four evaluation dates. There were slight differences in bermudagrass injury between the low and high rates of each glyphosate product at 5 DAT but no noticeable differences between glyphosate products at the same rate.

Johnsongrass control at 5 DAT from the low glyphosate rates ranged from 35-45% and increased to 58-67% by final 56 DAT evaluations. Johnsongrass control at 5 DAT from the high glyphosate rates ranged from 52-60% and increased to 73-83% by final 56 DAT evaluations. At the 28 DAT evaluations, there was the beginning of some separation between the different glyphosate products. The separation wasn't great but the normal rains in June helped the johnsongrass produce its normal vegetative growth during June. Starting in late June and through the July 56 DAT

evaluations the area had higher than normal temperatures and very little rainfall. What treatment separation may have been occurring in late June was masked somewhat by the hot, dry conditions. Under the environmental conditions of this trial we would rank the johnsongrass control from these 3 products as follows: MON 78754=MON 79859>MON 79862

Table 3. 2004 Glyphosate Formulation Study.

Date Treated: May-18-04
Trial ID: 4-H-53-04 **Study Dir.: Doug Montgomery/Craig Evans**
Location: Noble Co.

Weed/Crop Code Rating Data Type Rating Unit Rating Date Evaluation Interval				Johnsongrass control percent May-10-04 7 DAT		Johnsongrass control percent Jun-01-04 14 DAT		Johnsongrass control percent Jun-15-04 28 DAT		Johnsongrass control percent Jul-13-04 56 DAT		Johnsongrass control percent Aug-10-04 84 DAT		Bermuda injury percent May-10-04 7 DAT		Bermuda injury percent Jun-01-04 14 DAT		Bermuda injury percent Jun-15-04 28 DAT	
Trt No.	Treatment Name	Product Rate	Rate Unit																
1	MON 78754 +Outrider	0.29 1.33	Lb AE/A OZ WT/A	52	cd	68	d	68	b-e	68	bcd	60	b-f	2	b	7	a	5	a
2	MON 78754 +Outrider	0.377 1.33	Lb AE /A OZ WT/A	60	bcd	78	a-d	74	a-d	73	abc	58	c-f	5	a	8	a	5	a
3	MON 79688 +Outrider	0.29 1.33	Lb AE /A OZ WT/A	55	cd	74	cd	69	a-e	72	bcd	63	b-e	5	a	8	a	5	a
4	MON 79688 +Outrider	0.377 1.33	Lb AE /A OZ WT/A	63	abc	86	ab	80	ab	79	ab	78	ab	5	a	10	a	5	a
5	MON 79730 +Outrider	0.29 1.33	Lb AE /A OZ WT/A	52	cd	67	d	54	f	65	cd	48	def	5	a	8	a	5	a
6	MON 79730 +Outrider	0.377 1.33	Lb AE /A OZ WT/A	57	cd	69	d	61	def	65	cd	46	ef	5	a	8	a	7	a
7	MON 79503 +Outrider	0.29 1.33	Lb AE /A OZ WT/A	52	cd	76	bcd	67	b-f	78	ab	76	abc	5	a	7	a	5	a
8	MON 79503 +Outrider	0.377 1.33	Lb AE /A OZ WT/A	73	ab	84	abc	77	abc	73	abc	63	b-e	5	a	10	a	7	a
9	MON 79527 +Outrider	0.29 1.33	Lb AE /A OZ WT/A	47	d	67	d	64	c-f	69	bcd	62	b-e	5	a	7	a	5	a
10	MON 79527 +Outrider	0.377 1.33	Lb AE /A OZ WT/A	60	bcd	81	abc	81	a	83	a	83	a	5	a	10	a	7	a
11	MON 79528 +Outrider	0.29 1.33	Lb AE /A OZ WT/A	48	d	68	d	60	ef	61	d	42	f	5	a	7	a	5	a
12	MON 79528 +Outrider	0.377 1.33	Lb AE /A OZ WT/A	75	a	88	a	80	ab	73	abc	66	a-d	5	a	10	a	5	a
13	Untreated Check			0		0		0		0		0		0		0		0	
LSD (P=.10)				14.9		11.6		13.6		11.3		18.9		1.2		3.2		2.0	
Standard Deviation				10.6		8.3		9.7		8.1		13.4		0.8		2.3		1.4	
Coeff. Of Variation				18.28		10.95		13.88		11.25		21.63		17.65		27.63		26.65	
Replicate Mean Square				7.223		0.702		2.636		7.021		9.223		1		1.571		1	
Replicate Prob (F value)				0.0041		0.5069		0.0952		0.0046		0.0013		0.384		0.2302		0.384	
Treatment Mean Square				2.226		2.586		2.589		1.956		2.676		4		1.143		0.818	
Treatment Prob (F value)				0.0553		0.0295		0.0293		0.0897		0.0252		0.0027		0.3775		0.6237	

Table 4. 2005 Glyphosate Formulation Study.

Treated On: May 27, 2005
Trial ID: 4-H-62-05 **Study Dir.: Montgomery/Evans**
Location: Kay County

Weed Code				Bermuda	Bermuda	Bermuda	Johnsongrass	Johnsongrass	Johnsongrass	Johnsongrass	Johnsongrass	Marestail	Marestail	Marestail
Rating Data Type				injury	injury	injury	control	control	control	control	control	control	control	control
Rating Unit				percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
Rating Date				6/3/2005	6/10/2005	6/24/2005	6/3/2005	6/10/2005	6/24/2005	7/22/2005	8/19/2005	6/3/2005	6/10/2005	6/24/2005
Trt-Eval Interval				7 DAT	14 DAT	28 DAT	7 DAT	14 DAT	28 DAT	56 DAT	84 DAT	7 DAT	14 DAT	28 DAT
Trt No.	Treatment Name	Rate	Rate Unit											
1	MON 78754 (IPA salt)	0.29	LB AE/A	5 a	5 c	5 d	67 bc	75 cd	83 bcd	84 a	73 c	42 abc	75 abc	80 abc
	Outrider	1.0	OZ WT/A											
2	MON 78754 (IPA salt)	0.377	LB AE/A	5 a	8 ab	10 ab	75 ab	87 a	93 a	93 a	90 a	47 abc	88 abc	80 abc
	Outrider	1.0	OZ WT/A											
3	MON 79670 (K salt)	0.29	LB AE/A	5 a	5 c	5 d	68 bc	75 cd	80 de	83 a	79 abc	42 abc	78 abc	73 bc
	Outrider	1.0	OZ WT/A											
4	MON 79670 (K salt)	0.377	LB AE/A	5 a	7 bc	8 bc	70 abc	87 a	91 ab	89 a	89 a	47 abc	83 abc	80 abc
	Outrider	1.0	OZ WT/A											
5	MON 79730 (K salt)	0.29	LB AE/A	5 a	7 bc	7 cd	62 c	80 abc	89 abc	86 a	82 abc	30 c	89 abc	97 ab
	Outrider	1.0	OZ WT/A											
6	MON 79730 (K salt)	0.377	LB AE/A	5 a	10 a	12 a	80 a	87 a	93 a	90 a	89 a	45 abc	91 ab	80 abc
	Outrider	1.0	OZ WT/A											
7	MON 79748 (K salt)	0.29	LB AE/A	5 a	5 c	5 d	67 bc	78 bc	82 cde	84 a	76 bc	32 bc	66 c	78 abc
	Outrider	1.0	OZ WT/A											
8	MON 79748 (K salt)	0.377	LB AE/A	5 a	7 bc	10 ab	72 abc	82 abc	90 abc	89 a	85 ab	48 ab	96 a	93 ab
	Outrider	1.0	OZ WT/A											
9	MON 79786 (K salt)	0.29	LB AE/A	3 ab	5 c	7 cd	65 bc	68 d	73 e	69 b	70 c	38 abc	70 bc	60 c
	Outrider	1.0	OZ WT/A											
10	MON 79786 (K salt)	0.377	LB AE/A	5 a	7 bc	10 ab	75 ab	84 ab	90 abc	94 a	89 a	50 a	90 ab	100 a
	Outrider	1.0	OZ WT/A											
11	Untreated Check			2 b	0 d	0 e	0 d	0 e	0 f	0 c	0 d	0 d	0 d	0 d
LSD (P=.10)				1.7	2.3	2.5	10.8	8	8.6	11.8	11.9	17.5	23.1	25.4
Standard Deviation				1.2	1.6	1.8	7.6	5.7	6.1	8.4	8.4	12.4	16.3	18
CV				26.39	27.16	25.35	12.02	7.82	7.77	10.7	11.28	32.47	21.77	24.09
Replicate F				1.579	6.176	0.233	1.399	0.703	4.261	5.06	11.905	6.159	6.652	14.926
Replicate Prob (F)				0.2308	0.0082	0.7946	0.27	0.5071	0.0287	0.0167	0.0004	0.0087	0.0065	0.0001
Treatment F				2.421	7.353	10.279	24.246	57.095	57.834	30.679	28.016	3.954	7.976	6.851
Treatment Prob (F)				0.0443	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0049	0.0001	0.0002

Table 5. 2006 Glyphosate Formulation Study

Treated on: 5-31-06
Trial ID: 4-H-70-06 **Study Dir.: Montgomery/Evans**
Location: Kay County

Weed Code				Johnsongrass	Johnsongrass	Johnsongrass	Johnsongrass	Bermuda	Bermuda	Bermuda	Bermuda
Rating Data Type				control	control	control	control	injury	injury	injury	injury
Rating Unit				percent	percent	percent	percent	percent	percent	percent	percent
Rating Date				6/5/2006	6/12/2006	6/28/2006	7/26/2006	6/5/2006	6/12/2006	6/28/2006	7/26/2006
Trt-Eval Interval				5 DAT	12 DAT	28 DAT	56 DAT	5 DAT	12 DAT	28 DAT	56 DAT
Trt No.	Treatment Name	Product Rate	Rate Unit								
1	MON 78754	0.231	Lb AE /A	35 c	47 cd	48 b	63 a	5 bc	8 a	7 c	0 a
2	MON 78754	0.293	Lb AE /A	60 a	70 ab	83 a	83 a	12 a	8 a	12 a	0 a
3	MON 79859	0.231	Lb AE /A	45 bc	42 d	55 b	67 a	3 c	8 a	8 bc	0 a
4	MON 79859	0.293	Lb AE /A	53 ab	75 a	80 a	79 a	12 a	10 a	10 ab	0 a
5	MON 79862	0.231	Lb AE /A	37 c	42 d	43 b	58 a	5 bc	7 a	7 c	0 a
6	MON 79862	0.293	Lb AE /A	52 ab	60 bc	70 a	73 a	8 ab	8 a	8 bc	0 a
7	Untreated check			0	0	0	15	0	0	0	0
LSD (P=.10)				10.9	14.4	14.1	18.6	3.6	3.6	2.6	N.S.
Standard Deviation				7.4	9.7	9.5	12.6	2.4	2.4	1.7	.
CV				15.76	17.38	14.99	17.8	32.2	28.98	20.3	.
Replicate F				1.853	4.027	0.1	1.389	0.714	2.143	8.636	.
Replicate Prob (F)				0.2068	0.0521	0.9054	0.2936	0.5129	0.1681	0.0066	.
Treatment F				5.325	6.823	9.448	1.758	6.714	0.571	3.727	.
Treatment Prob (F)				0.0121	0.0051	0.0015	0.2093	0.0054	0.7211	0.0364	.

Means followed by same letter do not significantly differ (P=.10, LSD)

4.3 Development of Milestone VM Herbicide For Broadleaf Weed Control.

Trial Objectives: The objectives of these studies were to evaluate the effectiveness of a new herbicide Milestone VM® (active ingredient aminopyralid, experimental number DE-750) for preemergence and postemergence broadleaf weed control and common bermudagrass tolerance.

Studies 4-H-51-04, 4-H-56-04, 4-H-59-05, 4-H-66-05, & 4-H-69-06

Results & Discussion: Milestone VM herbicide, manufactured by Dow AgroSciences, has proven itself to be a very beneficial herbicide for controlling roadside broadleaf weeds. Milestone VM has both foliar and root (residual) uptake and is actively translocated in target weeds. Milestone VM has produced good activity when applied on actively growing broadleaf weeds (postemergence) and even better control when applied prior to broadleaf weed emergence (preemergence). The ability to produce both postemergence and preemergence broadleaf weed control is a big benefit as it will allow for a wider window of Milestone VM use. It was also proven in this research that common bermudagrass has very good tolerance to Milestone VM.

These studies have involved applying various Milestone VM treatment combinations during different applications timings, March and May. March timings would consist of postemergence applications to existing winter broadleaf weeds and preemergence applications to later germinating summer broadleaf weeds (4-H-51-04, 4-H-59-05, & 4-H-69-06). May timings would consist of strictly postemergence applications to existing summer broadleaf weeds (4-H-56-04, 4-H-66-05, & 4-H-69-06). Because of the activity of Milestone VM it allows for the flexibility of either applying in late winter/early spring (postemergence/preemergence) or in early summer (postemergence) while producing the same results. There are however advantages and disadvantages to each of these two timings. The preemergence/postemergence timing allows a distinct advantage in treating weedy roadside in March at which time many of the summer broadleaf agricultural crops have not been planted. Since crops such as cotton, soybeans, and peanuts have not been planted there is less potential for drift problems associated with spraying near these crops. The disadvantage with the preemergence/postemergence timing is ODOT personnel will need to know ahead of season what specific roadsides need to be treated as summer weeds will not be emerged. One of the advantages of the postemergence application of Milestone VM is weeds should be 1-6 inches tall so areas needing treatment are visible and can be easily targeted. The disadvantage with Milestone VM applied postemergence is the same with other summer broadleaf herbicide, vapor drift. While Milestone VM has a low vapor pressure, which should minimize its potential for volatilizing and moving off-target as vapor drift, it is still very much a concern as far as particle drift. Milestone VM particle drift which reaches off-target gardens, aquatic areas, or broadleaf agricultural crops will create injury to these areas. Since Milestone VM is an auxin –type herbicide it will produce injury similar to that of Vanquish and other auxin herbicides.

The full benefits, uses, and limitations of Milestone VM will continue to be researched but at this point we would recommend using Milestone VM + glyphosate as a late winter treatment or Milestone VM mixed with traditional late winter Campaign + AMS treatments. Our recommended treatments and rates would be one of the following: 1.) Milestone VM at 4 fluid ounces/Acre + glyphosate at 0.5 lb. ai./Acre, or, 2.) Milestone 4 fluid ounces/Acre + Campaign 32 fluid ounces/Acre + Ammonium sulfate at 17 pounds product/100 gallons of water. Both Milestone VM treatments will provide good postemergence control of existing winter broadleaf weeds and good preemergence control of later germinating summer annual broadleaf weeds. Milestone VM should be applied from late Feb. (south of I-40) through the end of March (north of I-40). Weed control data has shown Milestone VM, when

applied at this timing, will provide preemergence control of summer annual broadleaf weeds for a minimum of 4 months. Milestone VM should only be applied once per season at this rate. Milestone VM has little to no activity on grassy weeds so it will likely be necessary to mix some type of grass control herbicide (glyphosate) with this product. One of the biggest problems with Milestone VM, even though is has shown the ability to control many different broadleaf weeds, it will not control kochia. Areas where kochia is problem should stick to May/June applications of Vanquish herbicide. Vanquish will control the kochia as well as many of the other broadleaf weeds. We encourage ODOT personnel to call OSU personnel with their questions as to suggested broadleaf weed control treatments with regards to targeted weeds and adjacent sensitive crops.

Table 6. Preemergence And Postemergence Control Of Roadside Weeds With DE-750.

Date Treated: 3-19-04
Trial ID: 4-H-51-04 **Study Dir.: Montgomery**
Location: Garfield County

Trt No.	Treatment Name*	Product Rate	Product Rate Unit	Bermuda greenup percent 4/20/2004 32 DAT	Bermuda greenup percent 5/3/2004 45 DAT	Bermuda greenup percent 5/17/2004 56 DAT	Bermuda greenup percent 6/15/2004 85 DAT	Carolina geranium control percent 4/20/2004 32 DAT	Carolina geranium control percent 5/3/2004 45 DAT	Downy brome control percent 4/20/2004 32 DAT	Downy brome control percent 5/3/2004 45 DAT	Prickly lettuce control percent 4/20/2004 32 DAT	Prickly lettuce control percent 5/3/2004 45 DAT
1	DE-750	5	fl oz/a	33	78	70	72 ab	93 ab	98 ab	60 b	78 b	95 a	99 a
2	DE-750	7	fl oz/a	30	65	63	76 ab	88 bc	99 a	35 c	47 c	88 a	99 a
3	DE-750	5	fl oz/a	35	73	72	77 ab	92 abc	99 a	93 a	98 a	88 a	99 a
	Glypro Plus	8	fl oz/a										
	Outrider	1.33	oz wt/a										
4	DE-750	5	fl oz/a	33	80	75	83 a	95 a	99 a	85 a	82 ab	95 a	99 a
	Outrider	1.33	oz wt/a										
5	DE-750	5	fl oz/a	28	70	67	67 bc	93 ab	99 a	90 a	93 ab	95 a	99 a
	Glypro Plus	8	fl oz/a										
	Oust	0.33	oz wt/a										
6	DE-750	5	fl oz/a	20	63	62	78 ab	87 c	99 a	23 c	55 c	95 a	99 a
	Oust	0.33	oz wt/a										
7	DE-750	5	fl oz/a	32	73	63	71 abc	95 a	99 a	90 a	95 ab	95 a	99 a
	Campaign	32	fl oz/a										
	Ammonium sulfate	17	lb/100 gal										
8	Glypro Plus	8	fl oz/a	23	67	55	57 cd	27 e	60 c	92 a	98 a	63 b	83 b
	Outrider	1.33	oz wt/a										
9	Glypro Plus	8	fl oz/a	25	70	67	70 abc	63 d	91 b	88 a	88 ab	95 a	99 a
	Oust	0.33	oz wt/a										
10	Campaign	32	fl oz/a	18	68	53	67 bc	95 a	98 ab	95 a	95 ab	95 a	99 a
	Ammonium sulfate	17	lb/100 gal										
11	Untreated Check			27	68	53	48 d	0 f	0 d	0 d	0 d	0 c	0 c
LSD (P=.10)				N.S.	N.S.	N.S.	14.6	5.7	7.5	21.8	19.3	18	12
Standard Deviation				8.4	9.3	11.3	10.3	4	5.3	15.4	13.7	12.8	8.5
CV				30.21	13.24	17.85	14.88	5.35	6.23	22.6	18.18	15.53	9.64
Replicate F				0.81	2.402	10.732	7.535	1.308	0.071	0.518	0.941	0.877	1
Replicate Prob (F)				0.459	0.1161	0.0007	0.0036	0.2924	0.9312	0.6036	0.4069	0.4313	0.3855
Treatment F				1.337	0.94	1.299	2.811	195.411	99.138	14.306	14.751	15.323	36.526
Treatment Prob (F)				0.2776	0.5195	0.2956	0.0236	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

*Means followed by same letter do not significantly differ (P=.10, LSD). All treatments included Activator 90 at a rate 0.25% volume per volume.

Table 7. Preemergence Broadleaf Weed Control With DE-750.

Date Treated: 3-19-04
Trial ID: 4-H-51-04 **Study Dir.: Montgomery/Evans**
Location: Garfield County

Weed Code Rating Data Type Rating Unit Rating Date Trt-Eval Interval				Marestail control percent 5/3/2004 45 DAT	Marestail control percent 5/17/2004 56 DAT	Marestail control percent 6/15/2004 85 DAT	Field bindweed control percent 4/20/2004 32 DAT	Field bindweed control percent 5/3/2004 45 DAT	Field bindweed control percent 5/17/2004 56 DAT	Field bindweed control percent 6/15/2004 85 DAT	Palmer amaranth control percent 5/17/2004 56 DAT	Palmer amaranth control percent 6/15/2004 85 DAT
Trt No.	Treatment Name*	Product Rate	Product Rate Unit									
1	DE-750	5	fl oz/a	99 a	99 a	98 a	80 a	25 a	90 a	0 a	40 a	0 c
2	DE-750	7	fl oz/a	99 a	99 a	97 a	45 b	5 a	33 b	0 a	45 a	92 a
3	DE-750	5	fl oz/a	99 a	99 a	98 a	23 bcd	10 a	0 b	0 a	0 a	0 c
	Glypro Plus	8	fl oz/a									
	Outrider	1.33	oz wt/a									
4	DE-750	5	fl oz/a	99 a	99 a	98 a	35 bc	40 a	15 b	0 a	0 a	29 b
	Outrider	1.33	oz wt/a									
5	DE-750	5	fl oz/a	99 a	99 a	97 a	20 cd	0 a	20 b	0 a	0 a	19 bc
	Glypro Plus	8	fl oz/a									
	Oust	0.33	oz wt/a									
6	DE-750	5	fl oz/a	98 b	99 a	96 a	15 cd	0 a	3 b	0 a	40 a	22 bc
	Oust	0.33	oz wt/a									
7	DE-750	5	fl oz/a	99 a	99 a	97 a	15 cd	0 a	10 b	49 a	0 a	12 bc
	Campaign	32	fl oz/a									
	Ammonium sulfate	17	lb/100 gal									
8	Glypro Plus	8	fl oz/a	99 a	99 a	89 ab	5 d	0 a	3 b	0 a	0 a	0 c
	Outrider	1.33	oz wt/a									
9	Glypro Plus	8	fl oz/a	99 a	98 a	70 b	0 d	0 a	3 b	0 a	0 a	35 b
	Oust	0.33	oz wt/a									
10	Campaign	32	fl oz/a	99 a	76 b	40 c	0 d	0 a	3 b	0 a	0 a	0 c
	Ammonium sulfate	17	lb/100 gal									
11	Untreated Check			0 c	0 c	0 d	0 d	0 a	0 b	0 a	0 a	0 c
LSD (P=.10)				1	17	25.8	24.4	N.S.	35.6	N.S.	N.S.	25.3
Standard Deviation				0.7	12.1	18.3	12.9	21	18.8	19.9	32	17.5
CV				0.77	13.74	22.93	59.54	288.51	116.53	449.59	281.42	92.06
Replicate F				1	0.937	0.079	1.547	0.836	0.389	0.55	0.218	3.016
Replicate Prob (F)				0.3855	0.4084	0.9239	0.2536	0.3909	0.5527	0.592	0.6507	0.0839
Treatment F				5499.213	18.44	9.163	7.144	0.803	3.983	1.633	0.744	7.384
Treatment Prob (F)				0.0001	0.0001	0.0001	0.008	0.6362	0.0398	0.2166	0.6755	0.0007

Means followed by same letter do not significantly differ (P=.10, LSD). *All treatments included Activator 90 at a rate of 0.25% volume per volume.

Table 8. Postemergence Summer Weed Control With DE-750.

Date Treated: 5-24-04

Trial ID: 4-H-56-04 **Study Dir.: Montgomery/Evans**

Location: Garfield County

Weed Code				Marestail	Marestail	Marestail	Marestail	Kochia	Kochia	Kochia
Rating Data Type				control	control	control	control	control	control	control
Rating Unit				percent	percent	percent	percent	percent	percent	percent
Rating Date				6/6/2004	6/22/2004	7/20/2004	8/17/2004	6/6/2004	6/22/2004	7/20/2004
Trt-Eval Interval				14 DAT	28 DAT	56 DAT	84 DAT	14 DAT	28 DAT	56 DAT
Trt No.	Treatment Name	Product Rate	Product Rate Unit							
1	DE-750	4	fl oz/a	48 abc	47 ab	88 a	98 ab	45 b	33 b	95 a
	Vista	21	fl oz/a							
	Activator 90	0.25	% v/v							
2	DE-750	6	fl oz/a	54 a	48 ab	85 ab	97 ab	42 b	36 b	91 a
	Vista	21	fl oz/a							
	Activator 90	0.25	% v/v							
3	DE-750	4	fl oz/a	47 bcd	47 ab	90 a	96 ab	55 a	35 b	95 a
	Vista	32	fl oz/a							
	Activator 90	0.25	% v/v							
4	DE-750	6	fl oz/a	52 ab	55 a	92 a	100 a	43 b	40 b	95 a
	Vista	32	fl oz/a							
	Activator 90	0.25	% v/v							
5	DE-750	4	fl oz/a	48 abc	47 ab	91 a	98 ab	43 b	30 bc	95 a
	Garlon 3A	16	fl oz/a							
	Vista	10	fl oz/a							
	Activator 90	0.25	% v/v							
6	DE-750	6	fl oz/a	43 cd	53 a	88 a	98 ab	45 b	40 b	95 a
	Garlon 3A	16	fl oz/a							
	Vista	10	fl oz/a							
	Activator 90	0.25	% v/v							
7	Vanquish	16	fl oz/a	40 d	43 b	75 b	94 b	43 b	70 a	95 a
	Activator 90	0.25	% v/v							
8	Escort	0.5	oz wt/a	15 e	25 c	20 c	0 c	20 c	18 c	63 b
	Activator 90	0.25	% v/v							
9	Untreated check			0 f	0 d	0 d	0 c	0 d	0 d	0 c
LSD (P=.10)				6.9	9	10.8	5	8.9	13.9	26.8
Standard Deviation				4.8	6.3	7.5	3.5	6.2	9.7	18.7
CV				12.51	15.52	10.75	4.58	16.65	28.91	23.28
Replicate F				1.875	1.332	2.458	2.153	1.719	3.025	1.205
Replicate Prob (F)				0.1876	0.2935	0.1194	0.1506	0.2128	0.0788	0.327
Treatment F				44.018	23.078	63.989	461.096	21.765	11.062	8.705
Treatment Prob (F)				0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002

Table 9. Postemergence Broadleaf Weed Control And Common Bermudagrass Injury With DE-750 Tank Mixes.

Treated On: March 14, 2005
Trial ID: 4-H-59-05 **Study Dir.: Montgomery/Evans**
Location: Garfield County

Trt No.	Treatment Name	Rate	Rate Unit	Bermuda greenup percent 4/11/2005 28 DAT	Bermuda greenup percent 5/9/2005 56 DAT	Bermuda Injury Percent 6/7/2005 85 DAT	Common chickweed control percent 4/11/2005 28 DAT	Common chickweed control percent 5/9/2005 56 DAT	Common geranium control percent 4/11/2005 28 DAT	Common geranium control percent 5/9/2005 56 DAT	Black medic control percent 4/11/2005 28 DAT	Black medic control percent 5/9/2005 56 DAT	Black brome control percent 4/11/2005 28 DAT	Downy brome control percent 5/9/2005 56 DAT	Cheat control percent 5/9/2005 56 DAT	Annual ryegrass control percent 5/9/2005 56 DAT
1	DE-750	5	FL OZ/A	18 bc	79 ab	1 B	66 c	99 a	70 b	99 a	85 a	99 a	1 c	2 c	1 c	5 c
	Activator 90	0.25	% V/V													
2	DE-750	7	FL OZ/A	18 b	83 a	0 B	85 b	99 a	83 ab	99 a	93 a	95 a	7 c	42 b	40 b	23 bc
	Activator 90	0.25	% V/V													
3	DE-750	5	FL OZ/A	5 d	38 c	13 A	92 a	99 a	95 a	99 a	93 a	99 a	88 a	95 a	93 a	95 a
	Glypro Plus	8	FL OZ/A													
	Oust XP	0.33	OZ WT/A													
	Activator 90	0.25	% V/V													
4	DE-750	5	FL OZ/A	14 c	82 a	3 B	93 a	99 a	88 ab	99 a	95 a	99 a	70 b	75 a	73 a	60 ab
	Glypro Plus	8	FL OZ/A													
	Outrider	1.33	OZ WT/A													
	Activator 90	0.25	% V/V													
5	DE-750	5	FL OZ/A	15 bc	67 b	5 B	93 a	99 a	95 a	99 a	94 a	99 a	88 a	76 a	70 ab	48 b
	Campaign	32	FL OZ/A													
	Ammonium Sulfate	17	LB/100 GAL													
6	Campaign	32	FL OZ/A	23 a	80 ab	2 B	72 c	60 b	40 c	65 b	50 b	60 b	91 a	80 a	73 a	57 ab
	Ammonium Sulfate	17	LB/100 GAL													
7	Untreated Check			23	75	0	0	0	0	0	0	0	0	0	0	0
LSD (P=.10)				4.6	14.1	5.8	6.3	14	23.1	11.6	25.2	17.5	17.5	30.4	32.4	42.9
Standard Deviation				3.1	9.6	3.9	4.2	9.4	15.4	7.7	14.5	7.5	11.7	20.3	21.6	28.7
CV				18.67	13.4	97.42	5.08	10.1	19.63	8.3	17.05	8.12	20.4	32.98	37.03	59.75
Replicate F				11.409	2.235	0.527	3.09	0.934	2.216	0.917	0.407	0.6	1.135	0.467	0.354	1.238
Replicate Prob (F)				0.0021	0.1533	0.6076	0.0952	0.4279	0.1649	0.4342	0.6903	0.495	0.3634	0.6413	0.7114	0.3349
Treatment F				11.988	8.078	4.785	23.669	8.725	5.568	9.662	4.355	8.848	38.999	8.497	6.963	3.532
Treatment Prob (F)				0.0003	0.0016	0.0207	0.0001	0.0029	0.0131	0.002	0.0895	0.0513	0.0001	0.0032	0.0063	0.0482

Means followed by same letter do not significantly differ (P=.10, LSD).
Controls were excluded from analysis.

Table 10. Preemergence Broadleaf Weed Control With DE-750 Tank Mixes.

Treated On: March 14, 2005
Trial ID: 4-H-59-05 **Study Dir.: Montgomery/Evans**
Location: Garfield County

Trt No.	Treatment Name	Rate	Rate Unit	Common ragweed control percent 4/11/2005 28 DAT		Common ragweed control percent 5/9/2005 56 DAT		Common ragweed control percent 6/7/2005 85 DAT		Common ragweed control percent 7/20/2005 128 DAT		Marestail control percent 5/9/2005 56 DAT	Marestail control percent 6/7/2005 85 DAT		Marestail control percent 7/20/2005 128 DAT	
1	DE-750	5	FL OZ/A	88	ab	99	a	94	a	97	a	99	94	a	96	a
	Activator 90	0.25	% V/V													
2	DE-750	7	FL OZ/A	93	ab	99	a	97	a	96	a	99	97	a	98	a
	Activator 90	0.25	% V/V													
3	DE-750	5	FL OZ/A	93	ab	99	a	100	a	99	a	99	100	a	99	a
	Glypro Plus	8	FL OZ/A													
	Oust XP	0.33	OZ WT/A													
	Activator 90	0.25	% V/V													
4	DE-750	5	FL OZ/A	95	a	99	a	100	a	97	a	99	100	a	99	a
	Glypro Plus	8	FL OZ/A													
	Outrider	1.33	OZ WT/A													
	Activator 90	0.25	% V/V													
5	DE-750	5	FL OZ/A	94	a	99	a	100	a	99	a	99	100	a	99	a
	Campaign	32	FL OZ/A													
	Ammonium Sulfate	17	LB/100 GAL													
6	Campaign	32	FL OZ/A	0	c	7	b	38	b	0	b	71	68	b	76	b
	Ammonium Sulfate	17	LB/100 GAL													
7	Untreated Check			0		0		0		0		0	0		0	
LSD (P=.10)				6.6		7.4		9		4.5		N.S.	15.9		13.2	
Standard Deviation				4.4		4.9		6		3		12.8	10.6		8.8	
CV				5.71		5.89		6.79		3.71		13.52	11.37		9.35	
Replicate F				0.091		1.01		0.765		0.867		0.905	0.772		0.969	
Replicate Prob (F)				0.9142		0.4021		0.4933		0.4526		0.4386	0.4906		0.4158	
Treatment F				221.936		175.971		50.5		523.808		2.36	4.13		3.092	
Treatment Prob (F)				0.0001		0.0001		0.0001		0.0001		0.1243	0.0316		0.0674	

Means followed by same letter do not significantly differ (P=.10, LSD).
Controls were excluded from analysis.

Table 11. Postemergence Summer Broadleaf Weed Control With DE-750 Tank Mixes.

Treated On: May 10, 2005
Trial ID: 4-H-66-05 **Study Dir.: Montgomery/Evans**
Location: Garfield County

Trt No.	Treatment Name	Product Rate	Product Rate Unit	Bermuda injury percent 6/7/2005 28 DAT	Bermuda injury percent 7/6/2005 56 DAT	Kochia control percent 6/7/2005 28 DAT	Kochia control percent 7/6/2005 56 DAT	Kochia control percent 8/2/2005 84 DAT	Field bindweed control percent 6/7/2005 28 DAT	Field bindweed control percent 7/6/2005 56 DAT	Field bindweed control percent 8/2/2005 84 DAT
1	DE-750	5	FL OZ/A	2	0	38 d	20 c	0 d	65 b	78 b	40 b
	Activator 90	0.25	% V/V								
2	DE-750	5	FL OZ/A	5	0	68 bc	27 c	32 c	96 a	98 a	95 a
	Garlon 3A	32	FL OZ/A								
	Activator 90	0.25	% V/V								
3	DE-750	5	FL OZ/A	2	3	87 ab	77 ab	80 ab	95 a	93 a	92 a
	Garlon 3A	12.8	FL OZ/A								
	Vista	8.5	FL OZ/A								
	Activator 90	0.25	% V/V								
4	DE-750	5	FL OZ/A	0	0	60 c	57 b	67 b	96 a	97 a	95 a
	2,4-D	22.2	FL OZ/A								
	Activator 90	0.25	% V/V								
5	DE-750	5	FL OZ/A	13	0	83 ab	56 b	72 b	93 a	93 a	90 a
	Vanquish	8	FL OZ/A								
	Activator 90	0.25	% V/V								
6	Vanquish	16	FL OZ/A	7	0	94 a	93 a	96 a	96 a	96 a	80 a
	Activator 90	0.25	% V/V								
7	Untreated Check			3	0	0	0	0	0	0	45
LSD (P=.10)				9	3.5	20.6	25.5	19.5	7.8	9.4	18.5
Standard Deviation				6.1	2.4	13.9	17.2	13.2	5.3	6.4	12.5
CV				129.2	424.26	19.37	31.41	22.79	5.82	6.87	15.22
Replicate F				1.94	1	0.833	2.659	2.017	2.461	2.926	0.679
Replicate Prob (F)				0.1941	0.4019	0.4626	0.1186	0.1837	0.1352	0.0999	0.5292
Treatment F				1.918	1	6.655	8.015	21.747	16.963	4.237	8.73
Treatment Prob (F)				0.1781	0.4651	0.0056	0.0028	0.0001	0.0001	0.025	0.002

Means followed by same letter do not significantly differ (P=.10, LSD).
Controls were excluded from analysis.

Table 12. Preemergence And Postemergence Broadleaf Weed Control With Milestone VM.

Treated on: March 14 & May 16, 2006

Trial ID: 4-H-69-06 Study Dir.: Montgomery/Evans

Location: Garfield County

Weed Code					Common ragweed		Common ragweed		Common ragweed		Common ragweed		Common ragweed		Marestail		Marestail		Marestail		Marestail		Marestail	
Rating Data Type					control		control		control		control		control		control		control		control		control		control	
Rating Unit					percent		percent		percent		percent		percent		percent		percent		percent		percent		percent	
Rating Date					4/25/2006		5/9/2006		6/5/2006		7/5/2006				4/25/2006		5/9/2006		6/5/2006		7/5/2006			
Trt-Eval Interval					42 DAT		56 DAT		83 DAT		113 DAT				42 DAT		56 DAT		83 DAT		113 DAT			
Trt No.	Treatment Name	Product Rate	Product Rate Unit	Appl. Date																				
1	Milestone VM	4	fl oz/a	3/14/06	100	a	98	b	97	a	98	a			100	a	100	a	97	a	95	ab		
2	Milestone VM Milestone VM	4 3	fl oz/a fl oz/a	3/14/06 5/16/06	100	a	99	ab	99	a	99	a			100	a	100	a	100	a	99	a		
3	Milestone VM	7	fl oz/a	3/14/06	100	a	99	ab	100	a	99	a			100	a	100	a	100	a	99	a		
4	Milestone VM	5	fl oz/a	5/16/06	0	c	0	c	40	b	89	b			0	c	0	c	42	b	93	b		
5	Milestone VM Accord XRT	7 6	fl oz/a fl oz/a	3/14/06	100	a	99	ab	100	a	99	a			100	a	100	a	100	a	99	a		
6	Milestone VM Accord XRT	5 6	fl oz/a fl oz/a	3/14/06	100	a	99	a	100	a	99	a			100	a	100	a	100	a	99	a		
7	Accord XRT Oust XP	6 0.25	fl oz/a oz wt/a	3/14/06	7	b	0	c	7	c	7	c			7	b	33	b	7	c	0	c		
8	Oust XP	0.25	oz wt/a	3/14/06	0	c	0	c	7	c	0	c			0	c	0	c	0	d	0	c		
9	Milestone VM Campaign AMS	4 32 17	fl oz/a fl oz/a lb/100 gal	3/14/06	100	a	98	b	96	a	94	ab			100	a	100	a	98	a	98	ab		
10	Untreated Check				0		0		0		0				0		0		0		0			
LSD (P=.10)					5.5		1		8.8		7.6		.		5.5		27.4		6.2		5.8		.	
Standard Deviation					3.8		0.7		6.2		5.3		.		3.8		19.2		4.3		4.1		.	
CV					5.71		1.12		8.62		7.01		.		5.71		27.35		6.04		5.38		.	
Replicate F					1		1.931		0.047		0.213				1		1		1.839		0.296			
Replicate Prob (F)					0.3897		0.1773		0.9538		0.8103				0.3897		0.3897		0.1911		0.7477			
Treatment F					484.75		13565.864		135.804		180.844				484.75		16.75		298		333.387			
Treatment Prob (F)					0.0001		0.0001		0.0001		0.0001				0.0001		0.0001		0.0001		0.0001			

Means followed by same letter do not significantly differ (P=.10, LSD)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

All treatments, excluding treatment 9, included Activator 90 surfactant at 0.25% V/V.

Untreated treatment(s) 10 excluded from analysis.

4.4 Development of Overdrive Herbicide Combinations For Summer Broadleaf Weed Control.

Trial Objectives: The objectives of these studies were to evaluate Overdrive® herbicide tank mixtures for increased broadleaf weed control and common bermudagrass tolerance.

Studies 4-H-54-04, 4-H-63-05, & 4-H-64-05

Results & Discussion: These studies were a result of the continued development of Overdrive herbicide by BASF. The Overdrive product includes a unique mixture of dicamba + diflufenzypur that can produce very good control of problem broadleaf weeds at low rates. The increased activity of this product at low rates could yield beneficial tank mixtures. BASF is active in the development of both the Overdrive product and diflufenzypyr mixtures. Findings of this research could manifest itself in future label use amendments to Overdrive. Part of this research, which consisted of diflufenzypyr tank mixtures, was conducted under a confidentiality agreement with BASF and as of the writing of this report BASF has not and will not likely release this specific study data (4-H-64-05). OSU will still retain all data and information from this study.

The current recommendation for general summer broadleaf weed control is to apply Vanquish® at 1 pint/Acre with a non-ionic surfactant at 0.25% V/V. The Vanquish treatment, applied in early summer to 1-6 inch target weeds, provides good broad spectrum control of most troublesome broadleaf weed species. Overdrive at 4 fl. Oz. /A with a non-ionic surfactant at 0.25% V/V will also provide similar general broadleaf weed control as the standard Vanquish treatment, however treatment costs will be 10-15% higher. While many of the combination treatments in these studies provided for good to excellent broadleaf weed control so did the standard treatments. For a combination treatment to provide an advantage to ODOT it must either broaden the spectrum of weed control, reduce treatment costs, or provide for a more environmentally sound treatment as compared to current standards. In these studies none of the treatment combinations and rates of application provided any distinct advantages over today's current standard treatments. There is still potential for some of these treatment and rate combinations to provide advantages if rates could be lowered to provide for more economical treatments while maintaining weed control. The manufacturer has been encouraged to pursue further Overdrive and/or diflufenzypur developmental research with this in mind.

Table 13. Marestail and Amaranth Control in the Overdrive/Tank Mix Broadleaf Weed Control Study.

Date Treated: 5/26/04 Trial ID: 4-H-54-04

Location: Garfield Co. Study Dir.: Doug Montgomery/Craig Evans

Weed Code Rating Data Type Rating Unit Rating Date Evaluation Interval				Marestail control percent 6/8/2004 13 DAT	Marestail control percent 6/22/2004 27 DAT	P. amaranth Control Percent 6/8/2004 13 DAT	P. amaranth control percent 6/22/2004 27 DAT	P. amaranth control percent 7/20/2004 55 DAT	P. amaranth control percent 8/17/2004 84 DAT
Trt No.	Treatment Name	Product Rate	Product Rate Unit						
1	Untreated Check			0	0	0	0	0	0
2	Overdrive	4	OZ WT/A	27	28 e	43	48	72 bc	80 cde
3	Overdrive	6	OZ WT/A	25	42 b-e	47	43	82 abc	87 a-e
4	Overdrive	8	OZ WT/A	28	53 abc	47	60	85 ab	91 a-d
5	Overdrive + Escort	4 0.25	OZ WT/A OZ WT/A	25	58 ab	35	58	83 abc	92 a-d
6	Overdrive + Escort	4 0.5	OZ WT/A OZ WT/A	22	47 a-d	42	70	72 bc	79 de
7	Overdrive + Telar	4 0.25	OZ WT/A OZ WT/A	22	30 de	50	35	48 d	65 f
8	Overdrive + Telar	4 0.5	OZ WT/A OZ WT/A	30	38 cde	42	42	63 cd	78 ef
9	Overdrive + 2,4-D Amine	4 16	OZ WT/A FL OZ/A	25	38 cde	38	62	92 ab	97 ab
10	Overdrive + 2,4-D Amine	4 32	OZ WT/A FL OZ/A	28	37 cde	52	53	88 ab	93 abc
11	Overdrive + Microflo triclopyr 3A	4 8	OZ WT/A FL OZ/A	32	35 cde	43	55	86 ab	90 a-e
12	Overdrive + Microflo triclopyr 3A	4 16	OZ WT/A FL OZ/A	27	58 ab	37	63	74 abc	84 b-e
13	Overdrive + Vanquish	4 8	OZ WT/A FL OZ/A	33	57 ab	45	63	78 abc	95 ab
14	Overdrive + Vanquish	4 16	OZ WT/A FL OZ/A	33	63 a	58	73	94 a	98 a
LSD (P=.10)				8.7	18.3	13.4	22	21.4	13.3
Standard Deviation				6.2	12.9	9.6	15.7	15.3	9.5
Coeff. Of Variation				22.62	28.75	21.54	28.17	19.62	10.99
Replicate Mean Square				9.183	6.197	2.792	1.818	0.642	0.141
Replicate Prob (F value)				0.0016	0.0095	0.0812	0.184	0.5348	0.8695
Treatment Mean Square				1.172	2.443	1.337	1.544	2.029	2.899
Treatment Prob (F value)				0.3667	0.0452	0.2622	0.1761	0.0677	0.0128

Means followed by same letter do not significantly differ (P=.10, LSD).

Control treatments excluded from analysis.

Table 14. Broadleaf Weed Control With Overdrive Tank Mixes.

Treated On: May 20, 2005
Trial ID: 4-H-63-05 **Study Dir.: Montgomery/Evans**
Location: Garfield County

Weed Code				Bermuda	Bermuda	Kochia	Kochia	Kochia	Kochia	F. bindweed	F. bindweed	F. bindweed
Rating Data Type				injury	injury	control	control	control	control	control	control	control
Rating Unit				percent	percent	percent	percent	percent	percent	percent	percent	percent
Rating Date				6/3/2005	6/20/2005	6/3/2005	6/20/2005	7/20/2005	8/19/2005	6/3/2005	6/20/2005	7/20/2005
Trt-Eval Interval				14 DAT	31 DAT	14 DAT	31 DAT	61 DAT	91 DAT	14 DAT	31 DAT	61 DAT
Trt No.	Treatment# Name	Rate	Product Rate Unit									
1	Untreated Check			0 a	0 a	0 d	0 c	0 b	0 b	0 c	0 c	0 b
2	Vista	24	Fl OZ/A	3 a	2 a	48 c	91 ab	98 a	99 a	75 b	93 b	89 a
	Overdrive	4	WT OZ/A									
3	Vista	24	Fl OZ/A	3 a	3 a	67 a	95 a	99 a	96 a	93 a	99 a	93 a
	Overdrive	6	WT OZ/A									
4	Vista	16	Fl OZ/A	4 a	0 a	57 bc	88 ab	99 a	98 a	78 ab	91 b	88 a
	Overdrive	4	WT OZ/A									
5	Vista	16	Fl OZ/A	4 a	0 a	58 ab	92 ab	99 a	99 a	82 ab	93 ab	83 a
	Overdrive	6	WT OZ/A									
6	Vista	12	Fl OZ/A	8 a	2 a	52 bc	87 b	99 a	99 a	82 ab	93 ab	89 a
	Overdrive	4	WT OZ/A									
7	Vista	12	Fl OZ/A	10 a	5 a	53 bc	87 b	98 a	98 a	81 ab	95 ab	85 a
	Overdrive	6	WT OZ/A									
8	Vista	8	Fl OZ/A	3 a	0 a	53 bc	93 ab	99 a	96 a	75 b	95 ab	89 a
	Overdrive	4	WT OZ/A									
9	Vista	8	Fl OZ/A	5 a	2 a	53 bc	95 a	99 a	96 a	83 ab	95 ab	93 a
	Overdrive	6	WT OZ/A									
LSD (P=.10)				6	4.4	9.3	7.5	1.6	3.3	16.4	5.9	10.9
Standard Deviation				4.2	3.1	6.5	5.3	1.1	2.3	11.5	4.1	7.7
CV				91.94	209.21	13.24	6.51	1.28	2.69	15.99	4.93	9.75
Replicate F				2.601	0.675	6.597	0.771	0.471	0.878	6.806	0.99	6.84
Replicate Prob (F)				0.1052	0.5232	0.0081	0.479	0.633	0.4349	0.0073	0.3931	0.0071
Treatment F				1.364	0.964	25.945	100.578	2577.736	584.311	17.115	174.189	44.948
Treatment Prob (F)				0.2836	0.496	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.10, LSD).

*Each treatment contained methylated seed oil at a rate of 1.25% volume per volume.

4.5 Development Of New Herbicide Active Ingredients For Spring And Summer Broadleaf Weed Control.

Trial Objectives: The objectives of these studies were to evaluate the effectiveness of a new herbicide active ingredient for preemergence and postemergence broadleaf weed control and common bermudagrass tolerance.

(Studies 4-H-67-06 & 4-H-68-06)

Results & Discussion: Both studies were performed under a confidentiality agreement between OSU Roadside Vegetation Management personnel and BASF. Under the agreement, OSU cannot publish or share any data or study information until it is released by BASF. Agreements of this nature are standard operating procedure when an herbicide is in the early stages of development by the manufacturer. While OSU cannot share the data with ODOT at this point, OSU personnel will retain this data and at the earliest point possible will inform ODOT personnel of the performance of any and all products evaluated in this study that have any significance to ODOT vegetation management programs. Results from the new product were very positive; we have encouraged the company to pursue further development of this new active ingredient.

4.6 Postemergence Broadleaf And Grassy Weed Control With Quicksilver.

Trial Objectives: The objectives of this study were to evaluate the effectiveness of the new herbicide Quicksilver® (active ingredient carfentrazone) herbicide for control of various broadleaf and grassy weeds and common bermudagrass tolerance.

Study: 4-H-57-04

Results & Discussion: At the time of treatment there were small amounts of weeds that were beginning to show moisture stress in small distinct areas within the research area. The droughty conditions persisted from the day of treatment for approximately 2 more weeks at which point numerous rain events occurred. Basically this study was under minor drought stress in the first 2 weeks, moderate drought stress for the next 2 weeks, and no drought stress for the remaining last one-half of the studies duration. In our opinion this could be a reason why some of the treatments produced weed control results slower than expected.

The targeted weeds in this study were palmer amaranth, large crabgrass, and marestail. We were also looking closely at injury to common bermudagrass. At 2 DAT most of the treatments including Quicksilver were producing more injury to palmer amaranth than comparative treatments without Quicksilver. However, palmer amaranth control at this time was not acceptable (minimum of 80%) for any of the treatments. At 7 DAT palmer amaranth control had increased for all treatments except Quicksilver alone. Treatments including RPC+SFM 75, tank-mixed with either Vanquish or Quicksilver, were producing similar amounts of palmer amaranth control of 67-68%. Most other treatments showed slight increases in palmer amaranth control. At 13 DAT palmer amaranth control continued to increase for both treatments of RPC+SFM 75 tank mixed with either Vanquish or Quicksilver. The tank mixture of RPC+SFM 75+Vanquish was showing slightly better palmer amaranth control than its Quicksilver comparative treatment. It is important to mention that after the 13 DAT evaluations the experimental area received a couple of rainfall events that pulled the study out of the moderate drought that it was experiencing. At 27 DAT and 55 DAT all vegetation was actively growing and under no abnormal environmental stresses. At 27 DAT palmer amaranth control increased for all treatments except Quicksilver alone. This is no doubt due to increased weed growth/herbicide translocation due to adequate moisture. At 27 DAT treatments of RPC+SFM 75 combined with either Vanquish or Quicksilver, or treatments including Overdrive at 4 oz., and Vanquish were producing moderate to good control of palmer amaranth. At 55 DAT vegetation growth had completely resumed active growth and all treatments showed increases in palmer amaranth control. Treatments of RPC+SFM 75+Vanquish, Overdrive @ 4 oz., Quicksilver @ 2 oz.+ Overdrive @ 2 oz., Quicksilver @ 1 oz.+ Overdrive @ 4 oz., and Quicksilver+Vanquish were all producing good control of palmer amaranth. All other treatments, excluding Quicksilver alone, were producing moderate control at this time.

At 2 DAT no crabgrass control was evident for any of the treatments. At 7 DAT and 13 DAT treatments of RPC+SFM 75 tank mixed with either Vanquish or Quicksilver were producing 63% and 75% control of large crabgrass, respectively. No other treatments were having an affect on crabgrass at this time. At 27 DAT crabgrass control began to separate slightly between these two treatments with the Quicksilver tank mix producing slightly better control than the Vanquish mixture. This same trend was noticed at 55 DAT with the Quicksilver treatment producing significantly better crabgrass control than its comparative Vanquish treatment. Crabgrass control

for both of these treatments was moderate at 27 DAT and began to drop at 55 DAT to unacceptable levels.

At 7 DAT and 13 DAT the treatment of RPC+SFM 75+Vanquish treatment was producing significantly better control of marestail than all other treatments at 55 and 82%, respectively. Marestail control at 7 DAT and 13 DAT was very low for all other treatments but with the rainfall control increased at 27 DAT. AT 27 DAT treatments of RPC+SFM 75 tank mixed with either Vanquish or Quicksilver, or Quicksilver @ 2 oz. + Overdrive @ 2 oz. were producing moderate levels of marestail control. Marestail control was not available at 55 DAT as the large crabgrass, which was not controlled, reached heights of 14-18 inches and masked the lower growing suppressed marestail.

Common bermudagrass injury at 7 DAT was very slight ranging from 3-8% from all treatments. At 13 and 27 DAT both treatments of RPC+SFM 75 significantly increased common bermudagrass injury but the level of injury would be considered acceptable for roadside situations. No common bermudagrass injury was evident at later evaluations.

Table 15. Control of Palmer Amaranth and Crabgrass with Quicksilver Herbicide.

Date Treated: 5/26/04 **Trial ID: 4-H-57-04**
Location: Garfield Co. **Study Dir.: Doug Montgomery/Craig Evans**

Trt No.	Treatment Name	Product Rate	Product Rate Unit	P. amaranth Control percent 5/28/2004 2 DAT		P. amaranth Control Percent 6/2/2004 7 DAT		P. amaranth control percent 6/8/2004 13 DAT		P. amaranth control percent 6/22/2004 27 DAT		P. amaranth control percent 7/20/2004 55 DAT		P. amaranth control percent 8/17/2004 84DAT		crabgrass control percent 6/2/2004 7 DAT		crabgrass control percent 6/8/2004 13 DAT		crabgrass control percent 6/22/2004 27 DAT		crabgrass control percent 7/20/2004 55 DAT	
1	Roundup Pro Concentrate + SFM 75 + Vanquish	13 1 16	FL OZ/A OZ WT/A FL OZ/A	30	def	68	a	77	a	78	a	94	ab	95	a	63	a	75	a	67	b	48	b
2	Roundup Pro Concentrate + SFM 75 + QuickSilver	13 1 2	FL OZ/A OZ WT/A FL OZ/A	60	a	67	a	72	a	70	ab	76	ab	78	a	63	a	75	a	76	a	65	a
3	Overdrive + Surf King Surfactant	2 0.25	OZ WT/A % V/V	27	ef	37	de	27	cd	42	cd	73	b	70	a	0	b	0	b	0	c	0	c
4	Overdrive + Surf King Surfactant	4 0.25	OZ WT/A % V/V	20	f	37	de	32	bcd	54	bcd	88	ab	93	a	0	b	0	b	0	c	0	c
5	QuickSilver + Overdrive + Surf King Surfactant	2 2 0.25	FL OZ/A OZ WT/A % V/V	47	bc	54	b	33	bc	40	d	83	ab	87	a	2	b	0	b	0	c	0	c
6	QuickSilver + Overdrive + Surf King Surfactant	1 2 0.25	FL OZ/A OZ WT/A % V/V	37	cde	48	bc	35	bc	62	abc	74	ab	78	a	3	b	0	b	0	c	0	c
7	QuickSilver + Overdrive + Surf King Surfactant	1 4 0.25	FL OZ/A OZ WT/A % V/V	37	cde	52	b	47	b	78	a	94	ab	88	a	2	b	0	b	0	c	0	c
8	QuickSilver + Vanquish + Surf King Surfactant	1 16 0.25	FL OZ/A FL OZ/A % V/V	33	de	45	bcd	37	bc	83	a	95	a	93	a	0	b	0	b	0	c	0	c
9	QuickSilver + Surf King Surfactant	1 0.25	FL OZ/A % V/V	38	cd	35	e	15	d	7	e	10	c	17	b	3	b	0	b	0	c	0	c
10	QuickSilver + Surf King Surfactant	2 0.25	FL OZ/A % V/V	52	ab	40	cde	15	d	8	e	18	c	32	b	2	b	0	b	0	c	0	c
11	Untreated Check			0		0		0		0		0		10		0		0		0		0	
LSD (P=.10)				**10.1**		**9.8**		**18.1**		**21.8**		**20.5**		**26.4**		**6.6**		**5.9**		**8.6**		**11.6**	
Standard Deviation				**7.1**		**6.9**		**12.8**		**15.4**		**14.5**		**18.7**		**4.7**		**4.2**		**6.1**		**8.2**	
Coeff. Of Variation				**18.83**		**14.29**		**32.87**		**29.38**		**20.57**		**25.53**		**34**		**27.89**		**42.52**		**72.49**	
Replicate Mean Square				**8.251**		**2.273**		**7.192**		**3.205**		**2.599**		**4.773**		**1.101**		**1**		**1.091**		**1.123**	
Replicate Prob (F value)				**0.0029**		**0.1318**		**0.0051**		**0.0645**		**0.102**		**0.0217**		**0.3538**		**0.3874**		**0.3572**		**0.3469**	
Treatment Mean Square				**8.383**		**9.204**		**8.188**		**9.861**		**13.562**		**6.367**		**92.397**		**171.429**		**74.14**		**26.058**	
Treatment Prob (F value)				**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0004**		**0.0001**		**0.0001**		**0.0001**		**0.0001**	

Means followed by same letter do not significantly differ (P=.10, LSD).

Control treatments excluded from analysis.

Table 16. Marestail Control and Bermuda Injury With Quicksilver Herbicide.

Date Treated: 5/26/04 **Trial ID: 4-H-57-04**
Location: Garfield Co. **Study Dir.: Doug Montgomery/Craig Evans**

Trt No.	Treatment Name	Product Rate	Product Rate Unit	Marestail control percent 6/2/2004 7 DAT	Marestail control percent 6/8/2004 13 DAT	Bermuda injury percent 6/2/2004 7 DAT	Bermuda injury percent 6/8/2004 13 DAT	Bermuda injury percent 6/22/2004 27 DAT
1	Roundup Pro Concentrate	13	FL OZ/A	32	82 a	3 bc	10 a	13 b
	+ SFM 75	1	OZ WT/A					
	+ Vanquish	16	FL OZ/A					
2	Roundup Pro Concentrate	13	FL OZ/A	37	20 cd	8 a	10 a	17 a
	+ SFM 75	1	OZ WT/A					
	+ QuickSilver	2	FL OZ/A					
3	Overdrive	2	OZ WT/A	30	25 bc	3 bc	0 b	0 c
	+ Surf King Surfactant	0.25	% V/V					
4	Overdrive	4	OZ WT/A	34	22 cd	0 c	0 b	0 c
	+ Surf King Surfactant	0.25	% V/V					
5	QuickSilver	2	FL OZ/A	32	20 cd	5 ab	0 b	0 c
	+ Overdrive	2	OZ WT/A					
	+ Surf King Surfactant	0.25	% V/V					
6	QuickSilver	1	FL OZ/A	32	25 bc	3 bc	0 b	0 c
	+ Overdrive	2	OZ WT/A					
	+ Surf King Surfactant	0.25	% V/V					
7	QuickSilver	1	FL OZ/A	34	38 b	7 ab	0 b	0 c
	+ Overdrive	4	OZ WT/A					
	+ Surf King Surfactant	0.25	% V/V					
8	QuickSilver	1	FL OZ/A	28	38 b	7 ab	0 b	0 c
	+ Vanquish	16	FL OZ/A					
	+ Surf King Surfactant	0.25	% V/V					
9	QuickSilver	1	FL OZ/A	17	5 e	5 ab	0 b	0 c
	+ Surf King Surfactant	0.25	% V/V					
10	QuickSilver	2	FL OZ/A	18	10 de	7 ab	0 b	0 c
	+ Surf King Surfactant	0.25	% V/V					
11	Untreated Check			0	0	0	0	0
LSD (P=.10)				**18.2**	**13.4**	**3.5**	**2.2**	**3.7**
Standard Deviation				**12.7**	**9.5**	**2.5**	**1.6**	**2.6**
Coeff. Of Variation				**43.34**	**33.21**	**52.3**	**79.06**	**84.92**
Replicate Mean Square				**1.322**	**2.202**	**0.13**	**1**	**0.188**
Replicate Prob (F value)				**0.2942**	**0.1411**	**0.8785**	**0.3874**	**0.8305**
Treatment Mean Square				**0.831**	**15.375**	**2.739**	**21.333**	**18.942**
Treatment Prob (F value)				**0.5987**	**0.0001**	**0.0329**	**0.0001**	**0.0001**

Control treatments excluded from analysis.

4.7 Johnsongrass Control Using Flazasulfuron Treatment Combinations.

Trial Objectives: The objectives of this study were to evaluate the effectiveness of Katana® (active ingredient flazasulfuron) treatment combinations for johnsongrass control and common bermudagrass tolerance.

Study: 4-H-61-05

Results & Discussion: Treatments were applied on May 24 to johnsongrass (6-20" tall) and common bermudagrass (100% greenup) that was actively growing under ideal conditions. Environmental conditions were ideal throughout the duration of this trial.

Common bermudagrass injury at 31 days-after-application (DAT) ranged from 10-15% for all of the treatments. This level of injury is acceptable for roadside areas. Common bermudagrass injury was not present at later evaluations.

Johnsongrass control at 31 DAT ranged from 77-86% for all of the treatments. Each of the flazasulfuron tank mixes were producing similar johnsongrass control compared to that of the standards at 31 DAT. The level of johnsongrass control at 31 DAT would be acceptable (80% or greater) for each of these treatments. Johnsongrass control at 59 DAT dropped significantly for all treatments. Johnsongrass control at 59 DAT was unacceptable for all of the treatments in this trial. The standard treatments in this trial, as well as the flazasulfuron tank mixes, typically will maintain acceptable levels of johnsongrass for at least 2 months and usually through 3 month evaluations. With the break in johnsongrass control at 59 DAT, johnsongrass control continued to decrease up to the final 92 DAT evaluation.

All herbicide treatments in this study failed to provide the level of johnsongrass control that was expected. When weed control in a study is far from expected levels, it is important to investigate the study parameters to determine if any clerical or application errors occurred. After thorough investigation of this study, no errors were found.

In recent conversations with the manufacturer of Katana (ISK BioSciences), it appears the company may not pursue an EPA label for this product. However, they will likely sell the entire herbicide portfolio to another company that will pursue an EPA label and that is better equipped to market a new herbicide. ISK BioSciences has very few sales and market development personnel that work in the non-crop roadside vegetation management area. This is a practice that is becoming more and more commonplace in our weed control market segment. We will continue to monitor the labeling of Katana as it has performed similar to both Oust and Outrider in many OSU roadside weed control trials. If it is priced competitively it would be a strong candidate for ODOT summer weed control programs.

Table 17. Flazasulfuron Johnsongrass Control Study.

Treated On: May 24, 2005
Trial ID: 4-H-61-05 **Study Dir.: Montgomery/Evans**
Location: Kay County

Weed Code Rating Data Type Rating Unit Rating Date Trt-Eval Interval				Bermuda injury percent 6/24/2005 31 DAT		Johnsongrass control percent 6/24/2005 31 DAT		Johnsongrass control percent 7/22/2005 59 DAT		Johnsongrass control percent 8/24/2005 92 DAT	
Trt No.	Treatment Name	Rate	Rate Unit								
1	Untreated Check			0		0		0		0	
2	Roundup Pro Concentrate Oust XP	0.5 0.047	LB A/A LB A/A	13	a	83		45	b	27	c
3	Roundup Pro Concentrate Outrider	0.5 0.047	LB A/A LB A/A	10	b	82		68	a	56	a
4	Roundup Pro Concentrate Flazasulfuron	0.5 0.0234	LB A/A LB A/A	15	a	83		58	ab	45	ab
5	Roundup Pro Concentrate Flazasulfuron	0.5 0.035	LB A/A LB A/A	13	a	77		50	b	30	c
6	Roundup Pro Concentrate Flazasulfuron	0.5 0.047	LB A/A LB A/A	15	a	86		53	b	33	bc
LSD (P=.10) Standard Deviation CV Replicate F Replicate Prob (F) Treatment F Treatment Prob (F)				2.4 1.6 11.86 2.667 0.1296 5 0.0257		N.S. 7.5 9.13 0.905 0.4422 0.66 0.6367		13.8 9.1 16.51 0.242 0.7903 2.879 0.0949		13 8.5 22.37 4.966 0.0396 6.03 0.0154	

Means followed by same letter do not significantly differ (P=.10, LSD).
Controls were excluded from analysis.

4.8 Johnsongrass Control Using Sulfomax Treatment Combinations.

Trial Objectives: The objectives of this study were to evaluate the effectiveness of a new generic herbicide Sulfomax® (active ingredient sulfometuron) and treatment combinations for johnsongrass control and common bermudagrass tolerance.

Study: 4-H-65-05

Results & Discussion: Treatments were applied on May 24 to johnsongrass (6-18" tall) and common bermudagrass (100% greenup) that were actively growing. Environmental conditions were ideal throughout the duration of this trial.

Common bermudagrass injury at 31 days-after-application (DAT) was acceptable (<30%) for all treatments on roadside areas. Sulfomax, alone or tank-mixed, produced similar bermudagrass injury to the comparative standard treatments. No bermudagrass injury was present at later evaluation dates.

Johnsongrass control at 31, 59, and 92 DAT for both Sulfomax and Oust XP alone treatments was not acceptable and produced only a small amount of growth suppression (very little if any control was produced). Typically sulfometuron used alone for johnsongrass control would be at a rate of at least 2.0 oz. prod. /A to produce actual control of rhizome johnsongrass. At 31 DAT both tank-mix treatments were producing very good to excellent control of johnsongrass. At 59 DAT johnsongrass control dropped 12-17% for the tank-mixtures and fell slightly below the 80% (acceptable) level. Johnsongrass control continued to drop at 92 DAT to 62% for both tank-mixture treatments. Clear explanation as to why the johnsongrass control from the tank-mixture treatments dropped below the acceptable level so early and continued to drop is lacking. Typically these treatments would produce johnsongrass control levels at least 15-20% higher than what was evaluated through 92 DAT. Other nearby trials of similar nature also had less johnsongrass control from standard treatments than what was expected. Regardless, the Sulfomax product produced similar results whether applied alone or in combination with glyphosate when compared to similar Oust XP treatments.

The significance of this study is that the BASF product Sulfometuron Max is currently labeled for use in forestry production areas but not labeled for use on roadsides. The manufacturer is considering pursuing an amendment to the current EPA Sulfometuron Max label that would add roadsides as a use site or pursuing a stand alone labeled product Sulfomax. This in turn would bring another generic sulfometuron product to the market and provide additional herbicide pricing competition. In this study the Sulfomax product provided the same level of johnsongrass control as the comparative name brand Oust XP treatment. It would be our recommendation to ODOT to place the Sulfomax product on the AHAL if the manufacturer receives the amended EPA label or new product label and submits the necessary documents to qualify for the AHAL.

Table 18. Johnsongrass Control With Sulfomax Tank Mixes.

Treated On: May 24, 2005
Trial ID: 4-H-65-05 **Study Dir.: Montgomery/Evans**
Location: Kay County

Trt No.	Treatment Name	Rate	Product Rate Unit	Bermuda injury percent 6/24/2005 31 DAT		Bermuda injury percent 7/22/2005 59 DAT		Johnsongrass control percent 6/24/2005 31 DAT		Johnsongrass Control Percent 7/22/2005 59 DAT		Johnsongrass control percent 8/24/2005 92 DAT	
1	Untreated Check			0		0		0		0		0	
2	Sulfomax	1.0	WT OZ/A	8	c	0		7	b	13	b	10	b
	Surf King Surfactant	0.25	% V/V										
3	Oust XP	1.0	WT OZ/A	13	b	0		7	b	7	b	0	b
	Surf King Surfactant	0.25	% V/V										
4	Sulfomax	1.0	WT OZ/A	18	a	0		88	a	76	a	62	a
	Roundup Pro Concentrate	13	FL. OZ./A										
	Surf King Surfactant	0.25	% V/V										
5	Oust XP	1.0	WT OZ/A	20	a	0		92	a	75	a	62	a
	Roundup Pro Concentrate	13	FL. OZ./A										
	Surf King Surfactant	0.25	% V/V										
LSD (P=.10)				4		N.S.		12.4		11.8		14.9	
Standard Deviation				2.5		0		7.8		7.5		9.4	
CV				16.67		0		16.16		17.4		28.17	
Replicate F				1		0		0.891		2.688		0.591	
Replicate Prob (F)				0.4219		1		0.4584		0.1467		0.5833	
Treatment F				13.333		0		113.934		78.022		36.976	
Treatment Prob (F)				0.0046		1		0.0001		0.0001		0.0003	

Means followed by same letter do not significantly differ (P=.10, LSD).
Controls were excluded from analysis.