Noncrop and Industrial Vegetation Management Weed Science

2006 Annual Research Report

UNIVERSITY OF KENTUCKY
College of Agriculture
Department of Plant and Soil Sciences

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INFORMATION NOTE 2007 NCVM-1

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The information provided in this document represents a collaborative effort between the Roadside Environment Branch of the Kentucky Transportation Cabinet and the Department of Plant and Soil Sciences in the College of Agriculture at the University of Kentucky. The main priority of this project was to collect and disseminate information to the KTC REB to increase the efficiency of operations aimed at roadside environment management.

This report contains a summary of research conducted during 2006. This document is primarily for the use of the Kentucky Transportation Cabinet. Other use is allowable if proper credit is given to the authors.

Weather data was obtained from weather recorders located on site of the Princeton Agricultural Research Station in Princeton, KY (located in western Kentucky), the Spindletop Agricultural Research Station in Lexington, KY (located in central Kentucky), and a University of Kentucky operated weather station located in Jackson, KY (located in eastern Kentucky)

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Acknowledgements

The Kentucky Transportation Cabinet funded the research conducted during the 2006 season. A special recognition must go to P. David Cornett, Mike Smith, and others at the Central Office in Frankfort for supporting this research effort. Special acknowledgement must also go to the twelve district roadside environment managers and their crews for contribution of ideas and land to conduct part of this research.

This work was accomplished with the help of Garrick Howell, a student at UK, who aided in study initiation, data collection and mining, and plot maintenance. Personnel in the Weed Science group who also aided in this project in terms of labor, equipment, and ideas include Charlie Slack, Ted Hicks, Jack Zeleznik, Daisy Fryman, Andrew Iten, Dr. J.D. Green, and Dr. Jim Martin. Appreciation is also given to the farm crews at Spindletop Research Station for equipment and plot maintenance.

Appreciation is extended to Tom Hayes at East Kentucky Power RECC and Paul Merrick at South Kentucky RECC for land area to perform brush trials. Mike Reed, a county agent in Powell County, KY provided contacts and land to perform purple loosestrife research.

The research could not have been accomplished if not for the generous contributions of product. Contributors of product used include:

Allegare, LLC
BASF Corporation
CWC Chemical, Inc
Dow AgroSciences
DuPont
PBI Gordon
Townsend Chemical

External funding for research projects was also received from Allegare LLC, BASF Corporation, Dow AgroSciences LLC, DuPont Inc., and PBI Gordon Inc. The financial support of these organizations is greatly appreciated.

We sincerely appreciate the effort and continued support of all our cooperators and look forward to future endeavors.

Species List

The following is a list of plant species discussed in the following document.

Scientific Name	Common Name
Acer rubrum L.	Red maple
Carduus nutans L.	Musk thistle
Cercis canadensis L.	Redbud
Cichorium intybus L.	Chicory
Cirsium arvense (L.) Scop.	Canada thistle
Conium maculatum L.	Poison hemlock
Coronilla varia L.	Crown vetch
Daucus carota L.	Wild Carrot
Digitaria sanguinalis (L.) Scop.	Large crabgrass
Dipsacus fullonum L.	Common teasel
Festuca arundinacea Schreb.	Tall fescue
Kummerowia striata (Thunb.) Schindl.	Annual lespedeza
Liquidambar styraciflua L.	Sweetgum
Liriodendron tulipfera L.	Yellow-poplar
Lonicera maackii (Rupr.) Herder	Amur honeysuckle
Lythrum salicaria L.	Purple loosestrife
Micanthus sinensis Anderss.	Chinese silvergrass
Oxydendrum arboretum (L.) DC.	Sourwood
Phragmites australis (CAV.) Trin. *Ex* Steud.	Common reed
Poa pratensis L.	Kentucky bluegrass
Polygonum cuspidatum Sieb. & Zucc.	Japanese knotweed
Prunus serotina Ehrh.	Black cherry
Quercus alba L.	White oak
Quercus veluntina Lam.	Black oak
Rhus copallinum L.	Shining (winged) sumac
Rhus typhina (hirta) L.	Staghorn sumac
Robinia pseudoacacia L.	Black locust
Setaria glauca (L.) Beauv.	Yellow foxtail
Sorghum halepense (L.) Pers.	Johnsongrass
Tridens flavus L.	Purpletop

2006 Field Season Weather Data

Eastern Kentucky (Jackson Weather Station)

This weather data provided by the University of Kentucky Agricultural Weather Center (Phone (859)257-3000 Ext245) http://wwwagwx.ca.uky.edu/

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Jackson	03-01-2006	73	56	64								
Jackson	03-02-2006	71	50	60	T							
Jackson	03-03-2006	43	33	38	0.01							
Jackson	03-04-2006	45	24	34								
Jackson	03-05-2006	54	29	42	T							
Jackson	03-06-2006	42	39	40	0.14							
Jackson	03-07-2006	46	33	40	0.13							
Jackson	03-08-2006	58	38	48	T							
Jackson	03-09-2006	75	57	66								
Jackson	03-10-2006	69	55	62	0.23							
Jackson	03-11-2006	74	50	62	0.40							
Jackson	03-12-2006	71	54	62	0.26							
Jackson	03-13-2006	78	61	70	0.56							
Jackson	03-14-2006	52	37	44	0.49							
Jackson	03-15-2006	55	34	44								
Jackson	03-16-2006	67	39	53	T							
Jackson	03-17-2006	47	40	44	0.06							
Jackson	03-18-2006	50	30	40								
Jackson	03-19-2006	49	29	39								
Jackson	03-20-2006	43	35	39	0.06							
Jackson	03-21-2006	35	31	33	0.19							
Jackson	03-22-2006	38	23	30	T							
Jackson	03-23-2006	53	28	40								
Jackson	03-24-2006	45	36	40	0.05							
Jackson	03-25-2006	41	33	37	0.06							
Jackson	03-26-2006	47	33	40	0.02							
Jackson	03-27-2006	58	33	46								
Jackson	03-28-2006	61	48	54	0.03							
Jackson	03-29-2006	64	40	52								
Jackson	03-30-2006	77	46	62								
Jackson	03-31-2006	75	59	67	0.26							

Summary for Jackson for the period 3-1-2006 through 3-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Jackson	57	40	48	2.95							
(Deviation from normal)	+3	+6	+4	-1.39							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	04-01-2006	75	58	66	0.01							
Jackson	04-02-2006	81	46	64	T							
Jackson	04-03-2006	68	47	58	0.84							
Jackson	04-04-2006	61	39	50	0.07							
Jackson	04-05-2006	63	43	53								
Jackson	04-06-2006	63	46	54	0.17							
Jackson	04-07-2006	76	57	66	0.81							
Jackson	04-08-2006	54	41	48	0.78							
Jackson	04-09-2006	59	31	45								
Jackson	04-10-2006	72	42	57								
Jackson	04-11-2006	80	52	66								
Jackson	04-12-2006	81	61	71								
Jackson	04-13-2006	83	59	71	T							
Jackson	04-14-2006	87	62	74	0.02							
Jackson	04-15-2006	86	68	77								
Jackson	04-16-2006	84	67	76	T							
Jackson	04-17-2006	71	58	64	0.43							
Jackson	04-18-2006	75	48	62								
Jackson	04-19-2006	78	50	64	0.30							
Jackson	04-20-2006	73	56	64	0.01							
Jackson	04-21-2006	70	60	65	0.09							
Jackson	04-22-2006	76	59	68	0.23							
Jackson	04-23-2006	77	60	68								
Jackson	04-24-2006	73	55	64	0.32							
Jackson	04-25-2006	80	56	68	0.25							
Jackson	04-26-2006	53	46	50	0.01							
Jackson	04-27-2006	68	47	58	T							
Jackson	04-28-2006	73	47	60								
Jackson	04-29-2006	77	54	66								
Jackson	04-30-2006	75	57	66	0.02							

Summary for Jackson for the period 4-1-2006 through 4-30-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	73	52	63	4.36							
(Deviation from normal)	+8	+8	+8	+0.26							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Jackson	05-01-2006	74	53	64	0.22							
Jackson	05-02-2006	74	55	64	0.12							
Jackson	05-03-2006	75	53	64								
Jackson	05-04-2006	80	55	68								
Jackson	05-05-2006	73	61	67								
Jackson	05-06-2006	69	52	60								
Jackson	05-07-2006	72	49	60	0.22							
Jackson	05-08-2006	65	50	58								
Jackson	05-09-2006	77	50	64								
Jackson	05-10-2006	74	62	68	0.14							
Jackson	05-11-2006	60	48	54	0.42							
Jackson	05-12-2006	59	48	54	0.01							
Jackson	05-13-2006	71	48	60	T							
Jackson	05-14-2006	57	47	52	0.11							
Jackson	05-15-2006	57	47	52	0.12							
Jackson	05-16-2006	61	46	54	T							
Jackson	05-17-2006	68	47	58								
Jackson	05-18-2006	71	48	60	0.25							
Jackson	05-19-2006	72	42	57	T							
Jackson	05-20-2006	71	55	63	0.50							
Jackson	05-21-2006	78	47	62								
Jackson	05-22-2006	71	51	61	T							
Jackson	05-23-2006	72	47	60								
Jackson	05-24-2006	80	51	66								
Jackson	05-25-2006	82	59	70	0.15							
Jackson	05-26-2006	81	62	72	1.56							
Jackson	05-27-2006	83	65	74								
Jackson	05-28-2006	88	63	76								
Jackson	05-29-2006	89	64	76								
Jackson	05-30-2006	90	68	79								
Jackson	05-31-2006	91	68	80	0.01							

Summary for Jackson for the period 5-1-2006 through 5-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Jackson	74	54	64	3.83							
(Deviation from normal)	-2	-1	-2	-0.65							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Jackson	06-01-2006	85	63	74	T							
Jackson	06-02-2006	78	64	71	0.23							
Jackson	06-03-2006	77	54	66								
Jackson	06-04-2006	75	56	66	0.09							
Jackson	06-05-2006	75	53	64	T							
Jackson	06-06-2006	81	52	66								
Jackson	06-07-2006	80	57	68	T							
Jackson	06-08-2006	77	64	70								
Jackson	06-09-2006	83	59	71								
Jackson	06-10-2006	78	62	70								
Jackson	06-11-2006	82	58	70	0.19							
Jackson	06-12-2006	75	56	66	0.51							
Jackson	06-13-2006	79	54	66								
Jackson	06-14-2006	81	60	70								
Jackson	06-15-2006	81	60	70								
Jackson	06-16-2006	85	58	72								
Jackson	06-17-2006	88	64	76								
Jackson	06-18-2006	87	70	78								
Jackson	06-19-2006	83	64	74								
Jackson	06-20-2006	83	60	72	0.52							
Jackson	06-21-2006	89	67	78								
Jackson	06-22-2006	91	72	82								
Jackson	06-23-2006	83	66	74	0.99							
Jackson	06-24-2006	79	70	74	0.15							
Jackson	06-25-2006	73	69	71	0.32							
Jackson	06-26-2006	73	67	70	T							
Jackson	06-27-2006	83	65	74	T							
Jackson	06-28-2006	81	64	72								
Jackson	06-29-2006	83	61	72	0.01							
Jackson	06-30-2006	82	60	71								

Summary for Jackson for the period 6-1-2006 through 6-30-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Jackson	81	62	71	3.01							
(Deviation from normal)	-2	-0	-1	-0.81							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	07-01-2006	88	63	76								
Jackson	07-02-2006	91	70	80								
Jackson	07-03-2006	92	71	82								
Jackson	07-04-2006	88	69	78	1.24							
Jackson	07-05-2006	71	68	70	1.49							
Jackson	07-06-2006	75	57	66	0.17							
Jackson	07-07-2006	78	59	68								
Jackson	07-08-2006	81	59	70								
Jackson	07-09-2006	82	62	72	0.05							
Jackson	07-10-2006	86	66	76								
Jackson	07-11-2006	81	71	76	0.10							
Jackson	07-12-2006	88	74	81								
Jackson	07-13-2006	82	73	78	0.25							
Jackson	07-14-2006	89	71	80								
Jackson	07-15-2006	87	71	79	0.22							
Jackson	07-16-2006	90	67	78								
Jackson	07-17-2006	92	71	82								
Jackson	07-18-2006	92	73	82								
Jackson	07-19-2006	92	73	82								
Jackson	07-20-2006	92	73	82	T							
Jackson	07-21-2006	89	73	81	T							
Jackson	07-22-2006	79	68	74	0.25							
Jackson	07-23-2006	83	63	73								
Jackson	07-24-2006	87	63	75								
Jackson	07-25-2006	88	67	78								
Jackson	07-26-2006	90	68	79								
Jackson	07-27-2006	90	74	82	T							
Jackson	07-28-2006	90	75	82	0.01							
Jackson	07-29-2006	82	69	76	0.09							
Jackson	07-30-2006	89	70	80								
Jackson	07-31-2006	89	70	80								

Summary for Jackson for the period 7-1-2006 through 7-31-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	86	68	77	3.87							
(Deviation from normal)	+0	+4	+2	-1.38							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	08-01-2006	96	71	84								
Jackson	08-02-2006	97	74	86								
Jackson	08-03-2006	97	74	86								
Jackson	08-04-2006	90	73	82	0.06							
Jackson	08-05-2006	91	67	79								
Jackson	08-06-2006	94	74	84	T							
Jackson	08-07-2006	92	75	84	0.02							
Jackson	08-08-2006	87	74	80	T							
Jackson	08-09-2006	89	71	80	0.04							
Jackson	08-10-2006	92	72	82	0.03							
Jackson	08-11-2006	74	70	72	0.22							
Jackson	08-12-2006	81	68	74	T							
Jackson	08-13-2006	86	65	76								
Jackson	08-14-2006	89	71	80								
Jackson	08-15-2006	82	72	77	0.05							
Jackson	08-16-2006	90	64	77								
Jackson	08-17-2006	94	67	80								
Jackson	08-18-2006	89	69	79	T							
Jackson	08-19-2006	89	68	78	0.29							
Jackson	08-20-2006	75	67	71	1.27							
Jackson	08-21-2006	82	61	72								
Jackson	08-22-2006	82	63	72								
Jackson	08-23-2006	84	58	71								
Jackson	08-24-2006	86	59	72								
Jackson	08-25-2006	89	64	76								
Jackson	08-26-2006	87	70	78								
Jackson	08-27-2006	87	70	78	0.28							
Jackson	08-28-2006	86	72	79	0.47							
Jackson	08-29-2006	82	72	77	0.53							
Jackson	08-30-2006	80	69	74	0.18							
Jackson	08-31-2006	72	68	70	0.10							

Summary for Jackson for the period 8-1-2006 through 8-31-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	87	69	78	3.54							
(Deviation from normal)	+3	+6	+5	-0.47							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	09-01-2006	65	61	63	0.70							
Jackson	09-02-2006	65	56	60								
Jackson	09-03-2006	69	58	64								
Jackson	09-04-2006	76	57	66	0.14							
Jackson	09-05-2006	71	62	66	0.17							
Jackson	09-06-2006	75	59	67								
Jackson	09-07-2006	77	58	68								
Jackson	09-08-2006	79	56	68								
Jackson	09-09-2006	80	61	70								
Jackson	09-10-2006	81	64	72								
Jackson	09-11-2006	79	65	72	0.03							
Jackson	09-12-2006	76	64	70	T							
Jackson	09-13-2006	67	62	64	0.68							
Jackson	09-14-2006	69	51	60								
Jackson	09-15-2006	69	54	62								
Jackson	09-16-2006	76	54	65								
Jackson	09-17-2006	81	56	68								
Jackson	09-18-2006	82	62	72	0.64							
Jackson	09-19-2006	71	57	64	0.06							
Jackson	09-20-2006	55	48	52								
Jackson	09-21-2006	66	39	52								
Jackson	09-22-2006	69	54	62	0.72							
Jackson	09-23-2006	78	64	71	1.62							
Jackson	09-24-2006	71	62	66	0.47							
Jackson	09-25-2006	68	57	62								
Jackson	09-26-2006	70	47	58								
Jackson	09-27-2006	74	50	62								
Jackson	09-28-2006	58	50	54	0.82							
Jackson	09-29-2006	60	44	52								
Jackson	09-30-2006	68	48	58	0.13							

Summary for Jackson for the period 9-1-2006 through 9-30-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	72	56	64	6.18							
(Deviation from normal)	-6	+0	-3	+2.66							

2006 Field Season Weather Data
Central Kentucky (Spindletop Weather Station)

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Spindletop	03-01-2006	71	54	62		100	54	50	44	54	47	
Spindletop	03-02-2006	66	38	52		74	28	51	48	54	49	
Spindletop	03-03-2006	43	28	36		79	39	48	43	49	45	
Spindletop	03-04-2006	43	19	31		100	32	43	39	47	40	
Spindletop	03-05-2006	46	23	34	0.01	100	33	42	38	45	40	
Spindletop	03-06-2006	42	35	38	0.04	100	100	42	41	44	43	
Spindletop	03-07-2006	49	27	38		100	29	44	40	48	40	
Spindletop	03-08-2006	59	35	47		63	36	45	42	47	43	
Spindletop	03-09-2006	68	55	62	0.12	100	35	49	45	51	47	
Spindletop	03-10-2006	59	44	52		100	58	50	47	53	49	
Spindletop	03-11-2006	57	43	50	0.49	100	100	49	47	51	48	
Spindletop	03-12-2006	66	56	61	1.01	100	100	53	49	55	50	
Spindletop	03-13-2006	71	43	57	0.84	100	58	56	52	60	55	
Spindletop	03-14-2006	49	35	42		81	38	55	49	56	48	
Spindletop	03-15-2006	54	32	43		76	27	49	45	52	44	
Spindletop	03-16-2006	63	38	50		66	26	50	46	54	46	
Spindletop	03-17-2006	49	33	41		100	37	49	46	52	47	
Spindletop	03-18-2006	47	24	36		100	29	47	43	51	42	
Spindletop	03-19-2006	44	25	34		69	34	46	42	49	42	
Spindletop	03-20-2006	43	34	38		100	46	44	43	46	43	
Spindletop	03-21-2006	39	23	31	0.10	100	52	43	40	44	40	
Spindletop	03-22-2006	42	19	30	0.01	100	51	43	38	47	38	
Spindletop	03-23-2006	48	24	36		100	41	44	39	48	39	
Spindletop	03-24-2006	44	33	38	0.05	100	60	44	42	47	43	
Spindletop	03-25-2006	42	31	36	0.03	100	55	43	42	46	42	
Spindletop	03-26-2006	49	27	38		100	42	45	40	50	40	
Spindletop	03-27-2006	54	28	41		100	33	46	40	51	41	
Spindletop	03-28-2006	53	43	48	0.01	100	53	47	45	50	47	
Spindletop	03-29-2006	58	32	45		100	49	49	44	55	44	
Spindletop	03-30-2006	73	39	56		100	29	52	45	57	46	
Spindletop	03-31-2006	68	58	63	0.34	100	44	52	49	55	52	

Summary for Spindletop for the period 3-1-2006 through 3-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Spindletop	54	35	44	3.05	94	47	47	44	51	45	
(Deviation from normal)	-1	+1	+0	-1.35							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Spindletop	04-01-2006	67	46	56	0.02	100	55	55	51	61	53	
Spindletop	04-02-2006	75	41	58	0.22	100	44	55	50	60	51	
Spindletop	04-03-2006	63	41	52		100	57	55	51	58	52	
Spindletop	04-04-2006	58	37	48		100	29	53	49	56	49	
Spindletop	04-05-2006	61	38	50		65	27	53	48	57	47	
Spindletop	04-06-2006	57	43	50	0.40	100	45	51	49	53	50	
Spindletop	04-07-2006	73	56	64	0.24	100	59	55	50	60	52	
Spindletop	04-08-2006	55	35	45	0.01	100	44	55	51	58	52	
Spindletop	04-09-2006	54	29	42		100	38	53	48	58	47	
Spindletop	04-10-2006	69	33	51		100	24	54	48	60	49	
Spindletop	04-11-2006	75	47	61		60	31	56	50	61	52	
Spindletop	04-12-2006	74	61	68		76	36	57	53	62	56	
Spindletop	04-13-2006	79	59	69	0.02	100	31	62	56	68	58	
Spindletop	04-14-2006	83	62	72	0.03	100	37	63	58	68	61	
Spindletop	04-15-2006	82	65	74		83	50	65	60	70	62	
Spindletop	04-16-2006	77	63	70	0.07	100	52	64	61	70	64	
Spindletop	04-17-2006	67	50	58	0.42	100	67	63	61	67	64	
Spindletop	04-18-2006	71	43	57		100	44	62	58	68	58	
Spindletop	04-19-2006	74	51	62	0.27	100	36	63	58	70	60	
Spindletop	04-20-2006	70	51	60	0.08	100	52	61	58	65	61	
Spindletop	04-21-2006	64	58	61	0.67	100	100	61	59	63	61	
Spindletop	04-22-2006	73	55	64		100	45	64	60	70	61	
Spindletop	04-23-2006	72	54	63	0.03	100	36	64	60	69	62	
Spindletop	04-24-2006	74	55	64	0.01	100	33	65	61	71	63	
Spindletop	04-25-2006	74	47	60	0.21	100	74	63	60	67	62	
Spindletop	04-26-2006	59	41	50		100	53	61	59	64	59	
Spindletop	04-27-2006	66	39	52		97	29	61	57	67	57	
Spindletop	04-28-2006	70	42	56		100	32	62	56	69	58	
Spindletop	04-29-2006	67	52	60		82	46	61	58	65	60	
Spindletop	04-30-2006	66	52	59	0.82	100	53	60	58	63	60	

Summary for Spindletop for the period 4-1-2006 through 4-30-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Spindletop	69	48	59	3.52	95	45	59	55	64	57	
(Deviation from normal)	+4	+3	+3	-0.36							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Spindletop	05-01-2006	71	53	62		100	52	62	57	67	59	
Spindletop	05-02-2006	69	55	62	0.24	100	72	62	59	67	61	
Spindletop	05-03-2006	77	51	64		100	47	64	58	71	60	
Spindletop	05-04-2006	76	58	67		100	60	65	61	71	64	
Spindletop	05-05-2006	71	56	64		100	42	65	62	71	65	
Spindletop	05-06-2006	65	49	57		100	45	65	60	71	63	
Spindletop	05-07-2006	59	50	54	0.01	100	65	62	60	66	63	
Spindletop	05-08-2006	68	49	58		100	56	64	59	69	61	
Spindletop	05-09-2006	74	48	61		100	54	65	59	70	62	
Spindletop	05-10-2006	69	61	65	0.30	100	100	64	63	67	65	
Spindletop	05-11-2006	65	48	56	0.16	100	57	63	60	65	62	
Spindletop	05-12-2006	59	49	54	0.09	100	60	60	58	62	59	
Spindletop	05-13-2006 E	68	49	58	0.02	96	43	63	59			
Spindletop	05-14-2006	57	45	51	0.07	100	65	59	57	62	58	
Spindletop	05-15-2006	56	45	50	0.03	100	94	58	57	62	58	
Spindletop	05-16-2006	65	44	54	0.23	100	60	59	56	63	57	
Spindletop	05-17-2006	67	51	59		100	59	62	58	66	60	
Spindletop	05-18-2006	65	45	55	0.53	100	42	62	59	66	61	
Spindletop	05-19-2006	69	44	56	0.11	100	37	62	57	66	59	
Spindletop	05-20-2006	68	50	59		100	37	66	60	70	62	
Spindletop	05-21-2006	76	47	62		100	47	67	60	71	62	
Spindletop	05-22-2006	68	48	58		67	31	68	62	72	63	
Spindletop	05-23-2006	70	43	56		99	33	68	60	71	62	
Spindletop	05-24-2006	78	45	62	0.02	100	29	68	61	71	62	
Spindletop	05-25-2006	80	61	70	1.09	100	63	70	65	73	66	
Spindletop	05-26-2006	81	64	72	0.01	100	51	70	67	73	68	
Spindletop	05-27-2006	84	62	73		100	47	73	67	76	68	
Spindletop	05-28-2006	88	65	76		100	44	75	69	79	70	
Spindletop	05-29-2006	89	63	76		100	40	76	70	80	71	
Spindletop	05-30-2006	91	69	80		100	35	78	72	81	73	
Spindletop	05-31-2006	90	64	77	0.08	100	40	77	72	80	73	

Summary for Spindletop for the period 5-1-2006 through 5-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Spindletop	72	53	62	2.99	99	52	66	61	70	63	
(Deviation from normal)	-4	-2	-3	-1.48							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Spindletop	06-01-2006	80	66	73		100	66	75	73	77	74	
Spindletop	06-02-2006	72	58	65	0.23	100	100	73	70	74	71	
Spindletop	06-03-2006	78	52	65		100	46	73	67	77	68	
Spindletop	06-04-2006	74	56	65		100	45	72	68	76	69	
Spindletop	06-05-2006	75	49	62		100	34	72	66	77	67	
Spindletop	06-06-2006	82	53	68		100	31	72	66	76	67	
Spindletop	06-07-2006	75	61	68		100	51	70	68	72	69	
Spindletop	06-08-2006	76	59	68		100	58	71	67	74	68	
Spindletop	06-09-2006	82	59	70		100	36	72	67	77	68	
Spindletop	06-10-2006	72	58	65	0.31	100	65	71	68	74	69	
Spindletop	06-11-2006	67	58	62	0.41	100	100	69	67	72	69	
Spindletop	06-12-2006	72	58	65		100	46	71	67	76	68	
Spindletop	06-13-2006	75	54	64		100	49	72	66	76	68	
Spindletop	06-14-2006	79	58	68		100	43	73	67	77	69	
Spindletop	06-15-2006	80	60	70		100	38	74	68	78	69	
Spindletop	06-16-2006	84	60	72		97	32	74	68	78	69	
Spindletop	06-17-2006	88	63	76		86	49	75	69	79	71	
Spindletop	06-18-2006	82	68	75	0.26	100	50	73	71	76	73	
Spindletop	06-19-2006	83	62	72	0.15	100	58	75	71	79	72	
Spindletop	06-20-2006	87	62	74		100	42	76	71	81	72	
Spindletop	06-21-2006	89	70	80		100	50	78	73	81	74	
Spindletop	06-22-2006	91	68	80	0.22	100	50	79	74	83	76	
Spindletop	06-23-2006	81	67	74	0.13	100	61	76	74	79	75	
Spindletop	06-24-2006	76	67	72	0.02	100	100	75	73	77	75	
Spindletop	06-25-2006	77	65	71		100	61	75	72	78	74	
Spindletop	06-26-2006	79	63	71		100	71	74	71	77	73	
Spindletop	06-27-2006	83	62	72		100	42	76	71	80	73	
Spindletop	06-28-2006	82	62	72		100	44	75	70	80	72	
Spindletop	06-29-2006	81	61	71	0.09	100	43	75	71	80	73	
Spindletop	06-30-2006	82	59	70		100	36	75	69	79	72	

Summary for Spindletop for the period 6-1-2006 through 6-30-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Spindletop	79	61	70	1.82	99	53	74	69	77	71	
(Deviation from normal)	-3	-1	-2	-1.84							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Spindletop	07-01-2006	90	63	76		100	40	77	70	81	73	
Spindletop	07-02-2006	92	74	83		71	34	78	73	82	75	
Spindletop	07-03-2006	92	73	82		79	38	79	74	83	76	
Spindletop	07-04-2006	91	70	80	0.86	100	45	79	75	83	77	
Spindletop	07-05-2006	74	61	68	0.38	100	62	75	73	78	75	
Spindletop	07-06-2006	75	56	66		100	43	75	70	78	71	
Spindletop	07-07-2006	77	55	66		100	43	75	69	79	71	
Spindletop	07-08-2006	81	57	69		100	43	76	69	80	71	
Spindletop	07-09-2006	81	61	71		100	50	74	70	80	73	
Spindletop	07-10-2006	86	66	76		100	49	76	71	82	73	
Spindletop	07-11-2006	83	69	76	0.89	100	70	75	73	79	75	
Spindletop	07-12-2006	83	72	78	0.25	100	74	75	73	79	76	
Spindletop	07-13-2006	84	71	78	0.20	100	100	76	74	80	76	
Spindletop	07-14-2006	88	70	79	1.56	100	64	78	74	84	76	
Spindletop	07-15-2006	88	69	78		100	48	80	75	84	77	
Spindletop	07-16-2006	91	68	80		100	45	81	76	85	78	
Spindletop	07-17-2006	92	67	80		100	40	81	76	85	78	
Spindletop	07-18-2006	92	69	80		100	47	81	77	86	79	
Spindletop	07-19-2006	93	70	82		100	46	82	77	86	79	
Spindletop	07-20-2006	90	73	82		100	55	81	78	85	80	
Spindletop	07-21-2006	87	66	76	0.88	100	67	80	77	84	79	
Spindletop	07-22-2006	77	66	72	0.04	100	65	77	76	80	77	
Spindletop	07-23-2006	81	62	72		100	43	78	74	81	75	
Spindletop	07-24-2006	84	60	72		100	43	78	73	81	75	
Spindletop	07-25-2006	86	63	74		100	43	79	74	82	75	
Spindletop	07-26-2006	86	66	76		100	53	78	74	81	76	
Spindletop	07-27-2006	87	75	81		100	57	78	76	81	77	
Spindletop	07-28-2006	84	71	78	0.07	100	69	77	76	79	77	
Spindletop	07-29-2006	84	69	76		100	100	77	75	79	77	
Spindletop	07-30-2006	89	71	80		100	55	80	75	83	76	
Spindletop	07-31-2006	94	69	82		100	45	81	76	84	77	

Summary for Spindletop for the period 7-1-2006 through 7-31-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Spindletop	86	67	76	5.13	98	54	78	74	82	76	
(Deviation from normal)	+0	+2	+1	+0.13							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Spindletop	08-01-2006	92	74	83		100	52	82	77	84	79	
Spindletop	08-02-2006	93	75	84		100	51	82	78	84	80	
Spindletop	08-03-2006	93	77	85		100	42	81	78	85	80	
Spindletop	08-04-2006	83	68	76		100	45	81	78	83	80	
Spindletop	08-05-2006	88	63	76		100	42	79	74	84	77	
Spindletop	08-06-2006	93	71	82		100	47	81	76	84	78	
Spindletop	08-07-2006	93	75	84		100	45	81	77	85	80	
Spindletop	08-08-2006	84	72	78	0.39	100	66	80	77	82	80	
Spindletop	08-09-2006	82	70	76		100	100	78	76	81	78	
Spindletop	08-10-2006	92	69	80	1.23	100	56	80	76	83	78	
Spindletop	08-11-2006	73	69	71	0.16	100	100	76	75	79	77	
Spindletop	08-12-2006	82	64	73		100	58	77	74	79	75	
Spindletop	08-13-2006	85	64	74		100	60	77	74	80	76	
Spindletop	08-14-2006	84	69	76		100	62	77	75	79	77	
Spindletop	08-15-2006	81	65	73	0.09	100	46	77	75	79	77	
Spindletop	08-16-2006	84	58	71		100	42	76	72	78	73	
Spindletop	08-17-2006	89	63	76		100	56	77	72	79	74	
Spindletop	08-18-2006	88	70	79		100	70	78	74	79	76	
Spindletop	08-19-2006	83	71	77	0.23	100	100	77	75	79	77	
Spindletop	08-20-2006	81	65	73	0.48	100	76	76	74	78	76	
Spindletop	08-21-2006	82	59	70		100	51	75	72	77	74	
Spindletop	08-22-2006	82	60	71		100	42	75	71	77	73	
Spindletop	08-23-2006	87	59	73		100	38	75	70	77	72	
Spindletop	08-24-2006	88	59	74		100	38	75	70	77	72	
Spindletop	08-25-2006	89	64	76		100	44	75	71	77	73	
Spindletop	08-26-2006	88	71	80		100	55	76	72	78	75	
Spindletop	08-27-2006	88	72	80		100	64	77	74	80	76	
Spindletop	08-28-2006	81	72	76	0.48	100	100	76	75	78	77	
Spindletop	08-29-2006	85	70	78		100	64	77	74	78	76	
Spindletop	08-30-2006	75	68	72	0.17	100	100	75	74	77	76	
Spindletop	08-31-2006	77	67	72		100	100	74	73	76	75	

Summary for Spindletop for the period 8-1-2006 through 8-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Spindletop	85	68	76	3.23	100	62	78	74	80	76	
(Deviation from normal)	+1	+5	+3	-0.70							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Spindletop	09-01-2006	68	59	64	0.01	100	100	74	71	76	73	
Spindletop	09-02-2006	65	57	61		100	100	71	69	73	71	
Spindletop	09-03-2006	73	57	65		100	57	71	68	73	70	
Spindletop	09-04-2006	69	54	62		100	100	69	67	71	69	
Spindletop	09-05-2006	78	60	69		100	54	71	68	73	69	
Spindletop	09-06-2006	76	53	64		100	55	70	66	72	68	
Spindletop	09-07-2006	80	55	68		100	45	70	65	72	67	
Spindletop	09-08-2006	83	54	68		100	43	70	65	72	67	
Spindletop	09-09-2006	84	58	71		100	44	70	66	73	68	
Spindletop	09-10-2006	81	60	70	1.03	100	59	69	67	72	69	
Spindletop	09-11-2006	79	65	72	0.13	100	99	70	68	72	70	
Spindletop	09-12-2006	73	63	68	1.02	100	100	69	68	71	70	
Spindletop	09-13-2006	70	57	64	0.15	100	64	68	67	71	69	
Spindletop	09-14-2006	72	58	65	0.01	100	98	68	66	70	69	
Spindletop	09-15-2006	75	56	66		100	56	69	66	71	68	
Spindletop	09-16-2006	79	51	65		100	52	69	65	72	67	
Spindletop	09-17-2006	83	59	71		100	41	70	67	73	68	
Spindletop	09-18-2006	74	58	66	0.19	100	67	70	68	72	70	
Spindletop	09-19-2006	67	53	60		100	56	69	67	71	68	
Spindletop	09-20-2006	60	46	53		100	54	66	63	68	64	
Spindletop	09-21-2006	66	41	54		100	48	63	60	66	61	
Spindletop	09-22-2006	71	55	63	1.59	100	87	63	61	65	63	
Spindletop	09-23-2006	76	64	70	3.56	100	100	66	64	68	66	
Spindletop	09-24-2006	74	59	66	0.01	100	49	68	66	70	67	
Spindletop	09-25-2006	70	53	62		100	48	67	65	69	66	
Spindletop	09-26-2006	73	52	62		100	44	66	63	69	64	
Spindletop	09-27-2006	76	56	66	0.45	100	44	67	63	69	65	
Spindletop	09-28-2006	59	47	53	1.01	100	60	65	63	67	64	
Spindletop	09-29-2006	61	42	52	0.06	100	46	63	60	64	61	
Spindletop	09-30-2006	68	52	60	0.05	100	58	62	61	64	62	

Summary for Spindletop for the period 9-1-2006 through 9-30-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Spindletop	73	55	64	9.27	100	64	68	65	70	67	
(Deviation from normal)	-5	-0	-3	+6.07							

2006 Field Season Weather Data
Western Kentucky (Princeton Weather Station)

STATION	DATE		AIR TEMP			PRECIP	RH		SOIL TEMP GRASS		SOIL TEMP BARE		EVAP
			MX	MN	AV		MX	MN	MX	MN	MX	MN	
Princeton	03-01-2006	E	76	52	64		100	50	45	42			
Princeton	03-02-2006	E	76	52	64		100	20	50	47			
Princeton	03-03-2006	E	52	28	40		100	40	49	46			
Princeton	03-04-2006	E	52	26	39		100	40	44	43			
Princeton	03-05-2006	E	54	31	42		80	40	45	43			
Princeton	03-06-2006	E	61	41	51	0.05	100	30	44	44			
Princeton	03-07-2006	E	60	33	46		85	40	45	43			
Princeton	03-08-2006	E	66	46	56	0.02	100	40	45	44			
Princeton	03-09-2006	E	67	61	64	0.78	100	40	46	44			
Princeton	03-10-2006	E	63	61	62	1.48	100	40	48	47			
Princeton	03-11-2006	E	78	56	67	0.22	94	51	49	48			
Princeton	03-12-2006	E	80	62	71	0.18	100	55	53	49			
Princeton	03-13-2006	E	78	63	70	0.30	100	60	54	51			
Princeton	03-14-2006	E	69	35	52	0.01	90	30	53	51			
Princeton	03-15-2006	E	63	30	46		100	20	52	50			
Princeton	03-16-2006	E	69	46	58		45	30	52	51			
Princeton	03-17-2006	E	69	40	54		100	90	51	50			
Princeton	03-18-2006	E	53	33	43		92	36	48	46			
Princeton	03-19-2006	E	51	36	44		45	20	48	46			
Princeton	03-20-2006	E	45	34	40	0.47	100	40	48	45			
Princeton	03-21-2006	E	40	32	36	0.57	96	36	46	44			
Princeton	03-22-2006	E	45	22	34	0.03	100	35	46	42			
Princeton	03-23-2006	E	45	28	36		100	40	45	43			
Princeton	03-24-2006	E	46	28	37		100	50	45	44			
Princeton	03-25-2006	E	48	29	38		98	48	44	44			
Princeton	03-26-2006	E	53	24	38		48	22	46	23			
Princeton	03-27-2006	E	62	30	46		100	25	45	43			
Princeton	03-28-2006	E	61	48	54	T	100	50	49	47			
Princeton	03-29-2006	E	63	30	46		100	40	49	46			
Princeton	03-30-2006	E	80	40	60		80	30	50	47			
Princeton	03-31-2006	E	78	60	69	0.11	100	80	52	49			

Summary for Princeton for the period 3-1-2006 through 3-31-2006:

STATION	AIR TEMP			TOTAL PRECIP	RH		SOIL TEMP GRASS		SOIL TEMP BARE		TOTAL EVAP
	MX	MN	AV		MX	MN	MX	MN	MX	MN	
Princeton	61	40	51	4.22	92	41	48	45			
(Deviation from normal)	+1	+4	+3	-0.72							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Princeton	04-01-2006 E	75	48	62		100	30	56	52			
Princeton	04-02-2006 E	76	50	63	0.19	100	60	59	54			
Princeton	04-03-2006 E	65	51	58	0.01	100	65	59	56			
Princeton	04-04-2006 E	63	33	48		100	20	53	50			
Princeton	04-05-2006 E	72	34	53		100	20	56	51			
Princeton	04-06-2006 E	77	49	63	0.24	100	40	56	53			
Princeton	04-07-2006 E	77	64	70	0.07	100	40	57	54			
Princeton	04-08-2006 E	58	45	52	0.28	100	40	53	53			
Princeton	04-09-2006 E	63	34	48		95	39	55	51			
Princeton	04-10-2006 E	71	33	52		100	20	55	51			
Princeton	04-11-2006	79	49	64		80	30	64	52			
Princeton	04-12-2006	79	64	72		65	55	62	54			
Princeton	04-13-2006	86	58	72		100	40	69	54			
Princeton	04-14-2006	87	53	70		95	35	70	60			
Princeton	04-15-2006	86	63	74		100	75	65	61			
Princeton	04-16-2006	76	64	70	0.05	100	70	72	66			
Princeton	04-17-2006	78	60	69		100	55	72	62			
Princeton	04-18-2006	84	52	68		100	45	72	60			
Princeton	04-19-2006	87	57	72	0.08	100	50	74	60			
Princeton	04-20-2006	84	60	72	0.54	100	0	75	64			
Princeton	04-21-2006	72	60	66	1.62	100	70	66	63			
Princeton	04-22-2006	79	47	63		100	40	67	64			
Princeton	04-23-2006	73	57	65	0.05	100	40	66	64			
Princeton	04-24-2006	78	60	69	0.12	100	70	68	58			
Princeton	04-25-2006	78	59	68		100	60	69	62			
Princeton	04-26-2006	79	48	64	0.57	100	60	68	60			
Princeton	04-27-2006	71	36	54		100	20	65	53			
Princeton	04-28-2006	74	40	57		100	25	66	56			
Princeton	04-29-2006	73	55	64	0.12	100	70	65	55			
Princeton	04-30-2006	68	52	60	0.08	100	80	64	52			

Summary for Princeton for the period 4-1-2006 through 4-30-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Princeton	76	51	63	4.02	98	45	64	57			
(Deviation from normal)	+4	+5	+5	-0.78							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Princeton	05-01-2006	68	51	60	0.27	100	70	64	52			
Princeton	05-02-2006	74	56	65	0.45	100	85	63	57			
Princeton	05-03-2006	84	48	66		100	55	70	57			
Princeton	05-04-2006	84	46	65	0.23	100	64	71	64			
Princeton	05-05-2006	74	54	64	0.10	100	40	70	62			
Princeton	05-06-2006	72	49	60	T	100	35	69	51			
Princeton	05-07-2006	67	53	60	0.14	100	50	66	61			
Princeton	05-08-2006	74	44	59		100	40	71	58			
Princeton	05-09-2006	74	53	64	0.12	100	70	70	59			
Princeton	05-10-2006	73	61	67	1.04	100	85	65	60			
Princeton	05-11-2006	75	51	63	0.44	100	50	66	59			
Princeton	05-12-2006	61	52	56	0.23	90	45	63	55			
Princeton	05-13-2006	74	49	62		90	30	63	54			
Princeton	05-14-2006	60	49	54		100	50	62	54			
Princeton	05-15-2006	61	46	54	T	100	55	63	53			
Princeton	05-16-2006	68	47	58	0.48	100	60	62	54			
Princeton	05-17-2006	74	47	60	0.11	100	50	65	57			
Princeton	05-18-2006	75	53	64		100	25	70	60			
Princeton	05-19-2006	76	46	61	0.16	100	50	69	60			
Princeton	05-20-2006	73	56	64	0.04	100	60	66	62			
Princeton	05-21-2006	76	53	64	0.07	100	65	65	61			
Princeton	05-22-2006	75	57	66	T	100	30	72	62			
Princeton	05-23-2006	79	50	64		80	30	75	62			
Princeton	05-24-2006	87	52	70		100	50	75	64			
Princeton	05-25-2006	88	63	76	0.22	100	65	76	69			
Princeton	05-26-2006	89	65	77		100	50	77	69			
Princeton	05-27-2006	90	68	79		100	50	79	70			
Princeton	05-28-2006	92	68	80		94	38	74	47			
Princeton	05-29-2006	91	66	78		100	50	81	67			
Princeton	05-30-2006	88	65	76	1.20	100	60	77	70			
Princeton	05-31-2006	89	63	76	0.12	100	60	79	70			

Summary for Princeton for the period 5-1-2006 through 5-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Princeton	77	54	66	5.42	99	52	70	60			
(Deviation from normal)	-4	-2	-3	+0.46							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Princeton	06-01-2006	89	69	79	T	100	90	80	70			
Princeton	06-02-2006	78	65	72	0.12	100	75	77	73			
Princeton	06-03-2006	86	55	70		100	30	79	75			
Princeton	06-04-2006	85	57	71	0.45	100	45	78	75			
Princeton	06-05-2006	80	55	68		100	35	76	65			
Princeton	06-06-2006	81	55	68		100	35	76	67			
Princeton	06-07-2006	83	58	70		100	65	77	69			
Princeton	06-08-2006	86	64	75		100	35	75	70			
Princeton	06-09-2006	90	57	74		100	40	76	70			
Princeton	06-10-2006	92	67	80		100	40	78	72			
Princeton	06-11-2006	87	65	76		100	55	76	71			
Princeton	06-12-2006	74	64	69		100	60	78	67			
Princeton	06-13-2006	77	57	67		100	40	76	67			
Princeton	06-14-2006	84	66	75		100	30	78	67			
Princeton	06-15-2006	88	56	72		100	30	80	70			
Princeton	06-16-2006	91	67	79		60	30	81	71			
Princeton	06-17-2006	91	64	78	0.56	100	50	82	72			
Princeton	06-18-2006	79	67	73	1.50	100	50	80	71			
Princeton	06-19-2006	87	67	77	0.04	100	65	78	70			
Princeton	06-20-2006	92	69	80		100	50	80	70			
Princeton	06-21-2006	93	69	81		100	55	81	75			
Princeton	06-22-2006	97	67	82	0.16	100	60	80	76			
Princeton	06-23-2006	93	67	80	0.18	100	70	81	71			
Princeton	06-24-2006 E	86	70	78		98	80	75	74			
Princeton	06-25-2006	86	66	76		100	55	79	71			
Princeton	06-26-2006	85	63	74		100	40	79	73			
Princeton	06-27-2006	86	61	74	0.38	100	50	79	72			
Princeton	06-28-2006	85	59	72		100	40	78	71			
Princeton	06-29-2006	87	65	76		100	45	79	73			
Princeton	06-30-2006	90	66	78		100	35	80	74			

Summary for Princeton for the period 6-1-2006 through 6-30-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Princeton	86	63	75	3.39	99	49	78	71			
(Deviation from normal)	-1	-0	-0	-0.46							

STATION	DATE		AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Princeton	07-01-2006	E	93	69	81		100	40	80	75			
Princeton	07-02-2006		94	70	82		100	35	80	74			
Princeton	07-03-2006		93	71	82		100	45	80	75			
Princeton	07-04-2006		92	70	81	T	100	65	81	75			
Princeton	07-05-2006		81	69	75	0.13	100	70	75	71			
Princeton	07-06-2006		82	56	69		100	40	76	70			
Princeton	07-07-2006		82	56	69		100	40	76	70			
Princeton	07-08-2006	E	86	56	71		100	45	75	73			
Princeton	07-09-2006		85	63	74	T	100	45	75	71			
Princeton	07-10-2006		83	64	74	0.05	100	70	77	69			
Princeton	07-11-2006		86	73	80	0.11	100	90	78	69			
Princeton	07-12-2006		83	70	76	0.37	100	0	76	67			
Princeton	07-13-2006		91	71	81	1.05	100	70	78	69			
Princeton	07-14-2006		93	72	82	0.42	100	55	78	70			
Princeton	07-15-2006	E	93	71	82	0.20	98	61	78	77			
Princeton	07-16-2006		93	68	80		100	40	81	75			
Princeton	07-17-2006		94	69	82		90	35	82	76			
Princeton	07-18-2006		94	70	82		100	40	83	76			
Princeton	07-19-2006	E	96	71	84		100	40	83	76			
Princeton	07-20-2006		96	72	84		100	45	84	78			
Princeton	07-21-2006		96	77	86		100	60	84	79			
Princeton	07-22-2006	E	96	74	85	0.49	98	60	80	78			
Princeton	07-23-2006		90	61	76		100	40	85	79			
Princeton	07-24-2006		87	60	74		100	35	81	73			
Princeton	07-25-2006		88	61	74		93	46	81	77			
Princeton	07-26-2006		90	67	78		100	50	79	71			
Princeton	07-27-2006		89	74	82	0.03	100	60	78	73			
Princeton	07-28-2006		89	70	80	0.25	100	80	76	73			
Princeton	07-29-2006		89	67	78	0.68	100	90	75	72			
Princeton	07-30-2006		93	72	82		100	90	80	72			
Princeton	07-31-2006	E	95	74	84	0.01	100	90	80	72			

Summary for Princeton for the period 7-1-2006 through 7-31-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Princeton	90	68	79	3.79	99	54	79	73			
(Deviation from normal)	+1	+2	+1	-0.50							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Princeton	08-01-2006	93	75	84		100	50	81	76			
Princeton	08-02-2006	95	74	84		100	50	81	78			
Princeton	08-03-2006	95	74	84		100	55	81	77			
Princeton	08-04-2006	95	72	84	0.14	100	65	80	75			
Princeton	08-05-2006	95	66	80		95	45	80	74			
Princeton	08-06-2006	92	69	80		100	60	80	74			
Princeton	08-07-2006	95	74	84		100	50	80	75			
Princeton	08-08-2006	95	70	82		100	50	80	75			
Princeton	08-09-2006	96	72	84		100	50	80	75			
Princeton	08-10-2006	98	69	84		100	50	82	77			
Princeton	08-11-2006	97	71	84	0.72	100	60	82	76			
Princeton	08-12-2006	87	68	78	0.18	95	55	81	77			
Princeton	08-13-2006	88	65	76		95	45	79	74			
Princeton	08-14-2006	90	72	81	0.36	100	75	80	68			
Princeton	08-15-2006	92	70	81	0.30	100	45	78	73			
Princeton	08-16-2006	92	60	76		100	35	78	73			
Princeton	08-17-2006	92	64	78		95	45	78	72			
Princeton	08-18-2006	93	68	80		100	50	79	75			
Princeton	08-19-2006	95	73	84	0.31	100	45	80	76			
Princeton	08-20-2006	84	71	78	0.05	100	70	78	75			
Princeton	08-21-2006	85	70	78		100	70	78	75			
Princeton	08-22-2006	86	68	77		100	50	78	74			
Princeton	08-23-2006	88	66	77		100	50	78	74			
Princeton	08-24-2006	87	59	73		100	35	76	74			
Princeton	08-25-2006	92	61	76		100	40	76	72			
Princeton	08-26-2006	95	69	82		100	50	76	73			
Princeton	08-27-2006	94	71	82		100	85	77	73			
Princeton	08-28-2006	88	70	79	0.50	100	95	77	72			
Princeton	08-29-2006	88	71	80	T	100	80	76	70			
Princeton	08-30-2006	79	63	71	0.02	100	75	75	67			
Princeton	08-31-2006	80	63	72		100	75	73	70			

Summary for Princeton for the period 8-1-2006 through 8-31-2006:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Princeton	91	69	80	2.58	99	57	79	74			
(Deviation from normal)	+4	+4	+4	-1.43							

STATION	DATE	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	EVAP
Princeton	09-01-2006	81	65	73		100	50	73	69			
Princeton	09-02-2006	70	60	65		100	100	72	68			
Princeton	09-03-2006	78	58	68		95	45	73	68			
Princeton	09-04-2006	80	58	69		100	45	72	68			
Princeton	09-05-2006	77	53	65		100	65	71	66			
Princeton	09-06-2006	78	54	66		100	45	69	65			
Princeton	09-07-2006	84	53	68		100	30	69	65			
Princeton	09-08-2006	87	57	72		100	25	70	66			
Princeton	09-09-2006	88	59	74		95	30	70	64			
Princeton	09-10-2006	87	64	76	0.15	100	40	72	63			
Princeton	09-11-2006	86	63	74	0.02	100	60	71	68			
Princeton	09-12-2006	76	66	71	1.12	100	100	72	69			
Princeton	09-13-2006	72	58	65	0.57	100	60	68	65			
Princeton	09-14-2006	74	60	67		100	50	68	65			
Princeton	09-15-2006	80	55	68		95	40	68	64			
Princeton	09-16-2006	84	57	70		95	30	70	64			
Princeton	09-17-2006	88	59	74		95	70	70	66			
Princeton	09-18-2006	79	62	70	0.66	100	100	68	64			
Princeton	09-19-2006	72	49	60	0.02	100	40	68	63			
Princeton	09-20-2006	72	43	58		100	30	65	60			
Princeton	09-21-2006	71	45	58		100	35	64	60			
Princeton	09-22-2006	69	59	64	3.57	100	100	61	57			
Princeton	09-23-2006	79	65	72	3.35	100	95	61	56			
Princeton	09-24-2006	72	58	65	0.02	95	60	60	54			
Princeton	09-25-2006	74	48	61		100	35	64	57			
Princeton	09-26-2006	78	47	62		100	30	63	58			
Princeton	09-27-2006	83	47	65		100	40	64	55			
Princeton	09-28-2006	83	54	68	0.29	100	50	64	56			
Princeton	09-29-2006	83	40	62	0.03	100	30	64	59			
Princeton	09-30-2006	82	54	68		90	55	65	60			

Summary for Princeton for the period 9-1-2006 through 9-30-2006:

STATION	AIR TEMP MX	AIR TEMP MN	AIR TEMP AV	TOTAL PRECIP	RH MX	RH MN	SOIL TEMP GRASS MX	SOIL TEMP GRASS MN	SOIL TEMP BARE MX	SOIL TEMP BARE MN	TOTAL EVAP
Princeton	79	56	67	9.80	99	53	68	63			
(Deviation from normal)	-2	-2	-2	+6.47							

Bromacil, Diuron, and Flumioxazin Combinations for Total Vegetation Control

Introduction

Industrial vegetation managers constantly battle herbaceous vegetation in areas designated to be 'vegetation free' such as substations and underneath guardrails. Individual site characteristics can change over the course of time in terms of vegetation types, the potential for herbicide resistant biotypes, and off target damage due to lateral or subsurface herbicide movement. Managers need to have a wide array of herbicides at their disposal to confidently treat these areas to deal with changes in site characteristics and to prevent the introduction of herbicide resistant weeds due to the repeated application of the same chemistries.

Past research at the University of Kentucky for total vegetation control evaluated flumioxazin, diuron, sulfometuron, and bromacil in individual trials. Each of these products have specific characteristics that make them desirable options in certain situations. For example, flumioxazin is labeled for kochia control, sulfometuron provides pre and post emergent control of grass species such as johnsongrass, and bromacil provides a control option for glyphosate or ALS resistant marestail. A study was conducted in 2006 to compare these products for overall total vegetation control.

Methods and Materials

The trial was located at a retired storage facility at the intersection of I-75 and Ironworks Pike in Fayette County, KY. Fifteen herbicide treatments were installed in randomized complete block design with three replications (Table 1). Treatments were applied at 25 GPA using a CO_2 handheld sprayer and all treatments included Activator 90 surfactant at 0.25 % v/v and RoundUp Pro at 2 qt / ac for burndown of existing weed pressure. The untreated check (treatment 15) was treated with RoundUp Pro as well for comparison purposes. Vegetation included annual lespedeza, tall fescue, wild carrot, and chicory.

Data collected included: 1) percent bareground at application, 2) percent bareground and percent area by weedy species 60 days after treatment (DAT), 90 DAT, and 120 DAT. Analysis of variance (ANOVA) was performed on percent bareground at application with mean separation using Fisher's LSD to test for differences at application. A significant difference in percent bareground was present across treatments at initiation, and therefore, the remaining data points (i.e. 60, 90, 120 DAT) were analyzed using analysis of covariance (ANCOVA) with preapplication data as the covariate. This allowed for a more accurate treatment mean comparison.

Results

60 DAT

Treatments that included Oust at 3 oz or Krovar I alone at 10 or at 6 lbs / ac combined with Payload at 8 oz/ac were the only treatments to exceed 90% bareground at 60 DAT (Table 1). The Payload alone treatments resulted in bareground percentages ranging from 65 to 77 %. The addition of Oust at 3 oz and Telar at 1.5 oz to the Payload at 8 oz treatments resulted in > 95 % bareground. Authority at 8 oz per acre resulted in 70 % bareground.

90 DAT

Treatments of Payload alone dropped in control levels to < 50 %. The Payload-Oust-Telar tank mix still provided excellent levels of bareground. Krovar alone or combined with Payload or Oust-Telar continued to provide excellent control > 90 %. Karmex alone treatments provided satisfactory control levels ranging between 80 and 90 %.

120 DAT

Krovar alone at 10 lb/ac, all Karmex tank mixes, Krovar I tank mixes, and the Payload-Oust-Telar tank mix resulted in bareground levels > 90% at 120 DAT.

Overall Bareground

Payload alone, Authority, and the RoundUp Pro check treatments were all statistically significantly lower than all other treatments at 120 DAT. There were no significant differences between the remaining treatments at 120 DAT (Table 1). Krovar I alone at 10 lb / ac and Karmex combined with Oust and either Escort or Telar resulted in > 95% bareground from 90 DAT through the rest of the trial. Krovar at 10 lb / ac resulted in similar results at every evaluation period as Krovar @ 6 lb / ac + Oust and Telar at 3 and 1.5 oz /a c, respectively. The Payload-Oust-Telar combination maintained bareground levels > 90% at the end of the trial while Payload alone at 8 oz resulted in ~ 4 % bareground at the end of the trial.

Vegetation 120 DAT

Average percent cover by species was evaluated to determine if any patterns of noncontrol were present (Table 2). This data was not analyzed statistically due to spatial variation in the study area; data in Table 2 was simply averaged by treatment and included here for observational purposes only.

A trend seems apparent with the Payload alone treatments as annual lespedeza, yellow foxtail, and purpletop are present in these treatments 120 DAT. The Authority alone and the RoundUp Pro treatment also show this trend. Purpletop is a warm season perennial grass that does not compete well with other weeds. This may explain its presence in plots with high bareground percentages late into the summer as this site characteristic is ideal for late season germination.

Table 1: Percent Bareground

Treatment	Active Ingredient	Rate per acre	Initial*	60 DAT		90 DAT		120 DAT	
Payload	Flumioxazin	8 oz	45.33	77.46	ab	9.77	c	3.62	c
Payload	Flumioxazin	10 oz	29.50	73.89	ab	45.25	bc	42.93	b
Payload	Flumioxazin	12 oz	28.33	65.01	bc	20.11	c	9.73	bc
Krovar I	Bromacil + diuron	10 lb	18.33	93.75	a	99.09	a	97.02	a
Krovar I Payload	Bromacil + diuron Flumioxazin	6 lb 8 oz	22.00	91.84	ab	93.77	a	89.89	a
Payload Hyvar XL	Flumioxazin Bromacil	8 oz 6.4 qt	15.83	87.18	ab	85.88	a	85.34	a
Karmex80	Diuron	12 lb	24.50	89.75	ab	83.15	ab	89.24	a
Karmex80 Payload	Diuron Flumioxazin	10 lb 8 oz	35.00	87.79	ab	83.52	ab	86.49	a
Payload Oust XP Escort XP	Flumioxazin Sulfometuron Metsulfuron	8 oz 3 oz 1 oz	40	98.1	a	87.78	a	88.52	a
Karmex80 Oust XP Escort XP	Diuron Sulfometuron Metsulfuron	10 lb 3 oz 1 oz	24.50	97.25	a	98.82	a	97.9	a
Payload Oust XP Telar	Flumioxazin Sulfometuron Chlorsulfuron	8 oz 3 oz 1.5 oz	26.67	91.43	ab	92.8	a	92	a
Karmex80 Oust XP Telar	Diuron Sulfometuron Chlorsulfuron	10 lb 3 oz 1.5 oz	14.83	95.68	a	96.86	a	97.93	a
Krovar I Oust XP Telar	Bromacil + diuron Sulfometuron Chlorsulfuron	6 lb 3 oz 1.5 oz	18.33	96.25	a	94.93	a	97.02	a
Authority	Sulfentrazone	8 oz	31.67	70.25	abc	20.23	c	3.53	c
RoundUp Pro	Glyphosate	2 qt	14.83	43.68	c	8.21	c	5.17	c

Note: Means followed by the same letter are not statistically different using Tukey-Kramer's Test at p = 0.05.

* Initial bareground means are preapplication means presented for comparison purposes only and are not statistically analyzed

Table 2: Average Percent Cover of Live Vegetation 120 DAT

Treatment	Active Ingredient	Rate per acre	Annual Lespedeza	Chicory	Yellow Foxtail	Purpletop
Payload	Flumioxazin	8 oz	73	0	15	3
Payload	Flumioxazin	10 oz	7	0	17	27
Payload	Flumioxazin	12 oz	55	0	12	11
Krovar I	Bromacil + diuron	10 lb	0	1	1	0
Krovar I Payload	Bromacil + diuron Flumioxazin	6 lb 8 oz	0	4	4	2
Payload Hyvar XL	Flumioxazin Bromacil	8 oz 6.4 qt	0	11	0	1
Karmex80	Diuron	12 lb	4	1	0	3
Karmex80 Payload	Diuron Flumioxazin	10 lb 8 oz	0	8	0	0
Payload Oust XP Escort XP	Flumioxazin Sulfometuron Metsulfuron	8 oz 3 oz 1 oz	0	0	0	8
Karmex80 Oust XP Escort XP	Diuron Sulfometuron Metsulfuron	10 lb 3 oz 1 oz	3	1	0	2
Payload Oust XP Telar	Flumioxazin Sulfometuron Chlorsulfuron	8 oz 3 oz 1.5 oz	0	0	0	7
Karmex80 Oust XP Telar	Diuron Sulfometuron Chlorsulfuron	10 lb 3 oz 1.5 oz	0	3	0	2
Krovar I Oust XP Telar	Bromacil + diuron Sulfometuron Chlorsulfuron	6 lb 3 oz 1.5 oz	0	1	1	3
Authority	Sulfentrazone	8 oz	56	4	11	17
RoundUp Pro	Glyphosate	2 qt	30	0	53	3

Note: Means presented in Table 2 are for comparison purposes only and are not statistically analyzed.

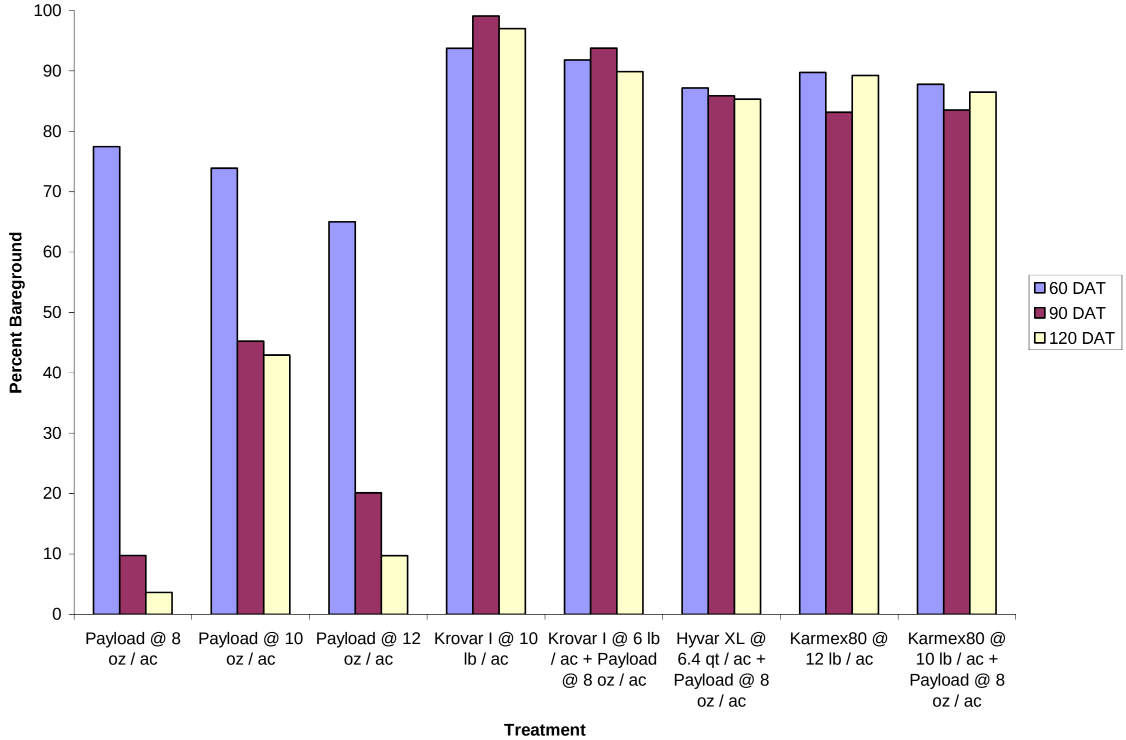

Figure 1: Least Square Means of Payload, Krovar I, Hyvar XL, and Karmex80 Tank Mixes

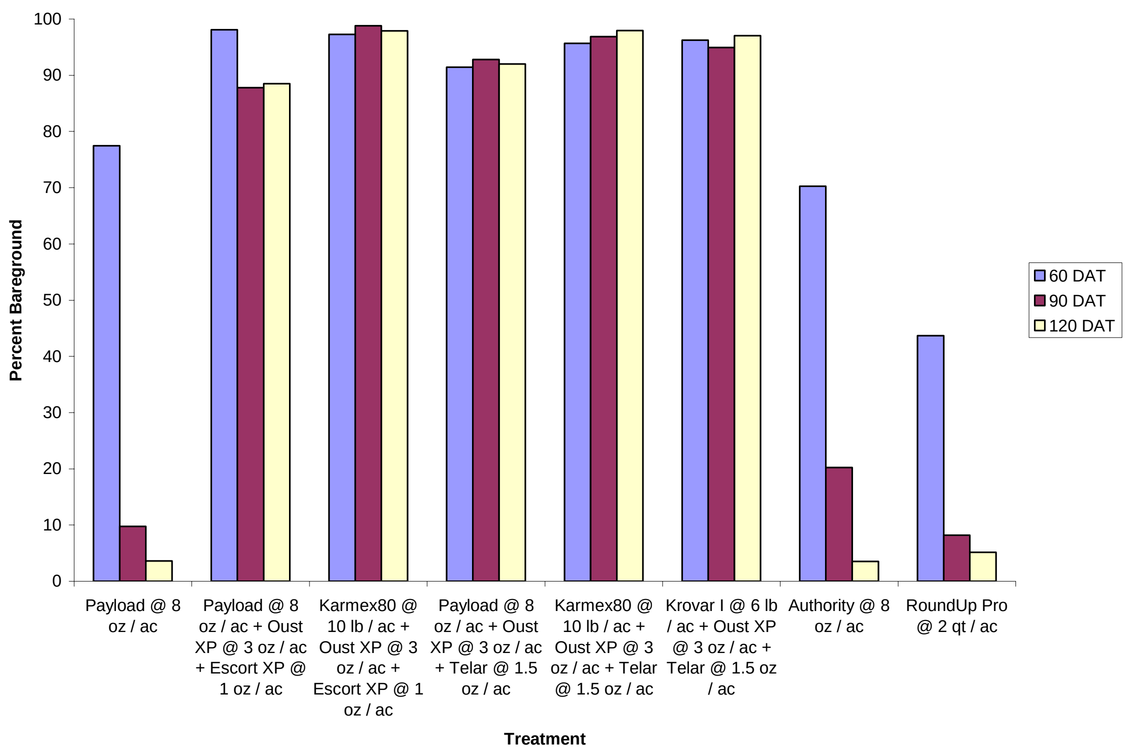

Figure 2: Least Square Means of Payload, Oust, Escort, Telar, Krovar I, and Karmex80 Tank Mixes

<u>Non-typical and Generic Products for Total Vegetation Management</u>

Introduction

Noncrop and industrial vegetation management has seen an influx of new products available both as new active ingredients and existing active ingredients offered by generic and niche product marketing. Milestone VM (a.i. aminopyralid), a relatively new product manufactured by Dow Agrosciences, is a growth regulator type herbicide used for broadleaf weed control. Aminopyralid provides some level of residual weed control for species such as musk thistle, Canada thistle, and marestail. Payload (a.i. flumioxazin), manufactured by Valent Professional Products, is a PPO herbicide labeled for preemergent uses for broadleaf and grass control on bareground sites. Diuron 80DF (a.i. diuron), manufactured by Vegetation Manager, is a photosynthesis inhibitor herbicide labeled for preemergent control of many annual and perennial grasses and herbaceous weeds. Casoron (a.i. dichlobenil), manufactured by Chemtura, is a meristimatic inhibitor herbicide labeled for preemergent perennial and annual grass and herbaceous weed control in nurseries and noncrop sites.

A trial was installed in May of 2006 comparing these products for total vegetation control in industrial sites.

Methods and Materials

Eight treatments were evaluated in a randomized complete block trial located at I-75 and Iron Works Pike in Fayette County, Kentucky. Plots were 5' X 20' with a 3' running check between plots. Herbicide applications were made with a CO_2 powered sprayed at 25 GPA on May 19, 2006. All treatments, including the check, included RoundUp Pro at 2 qt / ac to decrease weed pressure and also included Activator 90 surfactant at 0.25 % v/v. Vegetation at trial establishment included tall fescue, annual lespedeza, and bluegrass. Evaluations for percent bareground were made preapplication, 35 days after treatment (DAT), 77 DAT, and 111 DAT. Vegetation percent cover by species was measured 77 and 111 DAT.

Percent bareground preapplication was tested for significant difference to determine appropriate data analysis technique (i.e. ANOVA versus ANCOVA). No significant differences were detected with percent bareground at initiation so subsequent data analysis was performed using ANOVA with Fisher's LSD at $p = 0.05$ for treatment mean separation. Percent cover of vegetation 77 and 111 DAT were compared using simple averages and were not statistically analyzed. Information pertaining to vegetative cover by treatment will be presented here for comparison purposes only and possess no statistical inference.

Results and Discussion

35 DAT

Payload alone at 12 oz / ac resulted in 47 % bareground which was statistically similar to RoundUp Pro at 2 qt / ac at 23 % (Table 1). All other treatments had percent bareground above 70 % 35 DAT.

77 DAT

Statistical differences between treatments became more defined at this observation. Treatments that included imazapyr (Arsenal or Sahara) had bareground percentages above 95 %. The Casoron / Diuron 80DF tank mix provided 77 % bareground 77 DAT, a drop from the 90 % 35 DAT. All Payload / Milestone treatments resulted in unacceptable levels of percent bareground at this interval.

111 DAT

Treatments that included imazapyr (Arsenal or Sahara) again provided the highest levels of bareground at this interval. Sahara at 12 lb / ac resulted in 96 % bareground which was statistically similar to the 91 % seen in the Arsenal / Diuron 80DF tank mix. The Casoron / Diuron tank mix resulted in significantly lower bareground levels (73 %) than the imazapyr combinations at 111 DAT; however, the treatment did provide significantly higher levels of bareground than any Payload or Milestone treatment tested.

Overall

There was no significant difference between the Arsenal + Diuron80DF treatment and the Sahara treatment at any evaluation interval across the entire trial. The Arsenal / Diuron 80DF treatment did provide significantly higher control levels than the Casoron / Diuron 80DF treatment 77 and 111 DAT, indicating the effectiveness of imazapyr as a residual herbicide tank mix partner. The Payload / Milestone treatments tested never presented themselves as effective total vegetation control options. The Milestone alone treatment did provide significantly higher levels of bareground at 111 DAT than the Payload alone treatment, although both levels are considered operationally unacceptable as stand alone treatments. This result, however, does show potential benefit of using Milestone as a postemergent tank mix partner for applications made after the ideal application window for bareground applications (i.e. March-April).

Vegetation Summary

The following discussion will focus on vegetation 77 and 111 DAT. It must be stressed that the values presented here are averages and not analyzed statistically. The most common species living 111 DAT were annual lespedeza, yellow foxtail, and crabgrass. Species such as chicory, tall fescue, and dandelion were present; however, their frequency and distribution were too sporadic to effectively summarize.

The Payload alone treatment was ineffective in controlling annual lespedeza, which increased from 37 % cover 77 DAT to 63 % cover 111 DAT (Table 2). Yellow foxtail was present in all treatments at 77 DAT except those that included imazapyr. Frequency of yellow foxtail decreased through 111 DAT in all treatments. Crabgrass was not present 77 DAT; however, at 111 DAT crabgrass began occurring in most plots except those containing imazapyr.

Table 1: Summary Statistics for Non-typical Bareground Trial

Pest Name					Bareground	Bareground	Bareground	Bareground
Rating Date					19/May/2006	23/Jun/2006	4/Aug/2006	7/Sep/2006
Rating Data Type					AREA	AREA	AREA	AREA
Rating Unit					%	%	%	%
Days After First/Last Applic.					0 0	35 35	77 77	111 111
Trt-Eval Interval					0 DA-A	35 DA-A	77 DA-A	111 DA-A
ARM Action Codes						TA[5]		
Trt No.	Type	Treatment Name	Rate	Rate Unit	1	2	3	4
1	HERB	Payload	12	OZ/A	10 a	45 cd	5 d	1 d
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
2	HERB	Payload	12	OZ/A	5 a	75 bc	11 d	10 cd
	HERB	Milestone VM	4	FL OZ/A				
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
3	HERB	Payload	8	OZ/A	14 a	90 ab	30 c	22 c
	HERB	Milestone VM	4	FL OZ/A				
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
4	HERB	Milestone VM	4	FL OZ/A	5 a	75 bc	10 d	11 cd
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
5	HERB	Milestone VM	7	FL OZ/A	11 a	75 bc	14 d	22 c
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
6	HERB	Arsenal 2	15	OZ A/A	11 a	98 a	97 a	91 ab
	HERB	Diuron 80 DF	119.5	OZ A/A				
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
7	HERB	Sahara	12	LB/A	9 a	96 ab	96 a	96 a
	HERB	Roundup Pro	2	QT/A				
	ADJ	NIS	0.25	% V/V				
8	HERB	Casoron	3	LB/A	5 a	90 ab	77 b	73 b
	HERB	Diuron 80 DF	8	LB/A				
	HERB	Roundup Pro	2	QT/A				
9	CHK	Untreated Check			11 a	17 d	8 d	3 d
LSD (P=.05)					12.0	21.0t	16.4	18.1
Standard Deviation					6.9	12.1t	9.5	10.4
CV					77.21	19.99	24.63	28.66
Grand Mean					8.98	60.77t	38.54	36.43
Bartlett's X2					3.46	10.747	10.103	9.145
P(Bartlett's X2)					0.839	0.057	0.183	0.166
Replicate F					1.781	0.061	1.137	0.788
Replicate Prob(F)					0.2002	0.9412	0.3452	0.4718
Treatment F					0.663	6.708	51.817	41.166
Treatment Prob(F)					0.7165	0.0006	0.0001	0.0001
Means followed by same letter do not significantly differ (P=.05, LSD)								
t=Mean descriptions are reported in transformed data units, and are not de-transformed.								
Column 2: TA[5] = Arcsine square root percent([5])								

*Table 2: Average Percent Cover for Three Most Common Species**

Treatment	Annual Lespedeza		Yellow Foxtail		Crabgrass
	77 DAT	111 DAT	77 DAT	111 DAT	111 DAT
Payload @ 12 oz	37	63	24	10	0
Payload @ 12 oz + Milestone @ 4 fl oz	0	0	44	3	24
Payload @ 8 oz + Milestone @ 4 fl oz	7	0	21	10	24
Milestone @ 4 fl oz	0	7	46	7	12
Milestone @ 7 fl oz	0	0	40	24	38
Arsenal @ 60 fl oz + Diuron @ 9.3 lb / ac	0	0	0	0	0
Sahara @ 12 lb / ac	0	0	0	0	0
Casoron @ 3 lb / ac + Diuron @ 8 lb / ac	0	0	7	3	7
RoundUp Pro @ 2 qt / ac	43	58	3	1	0

**This data is not statistically analyzed and is for comparison purposes only.*

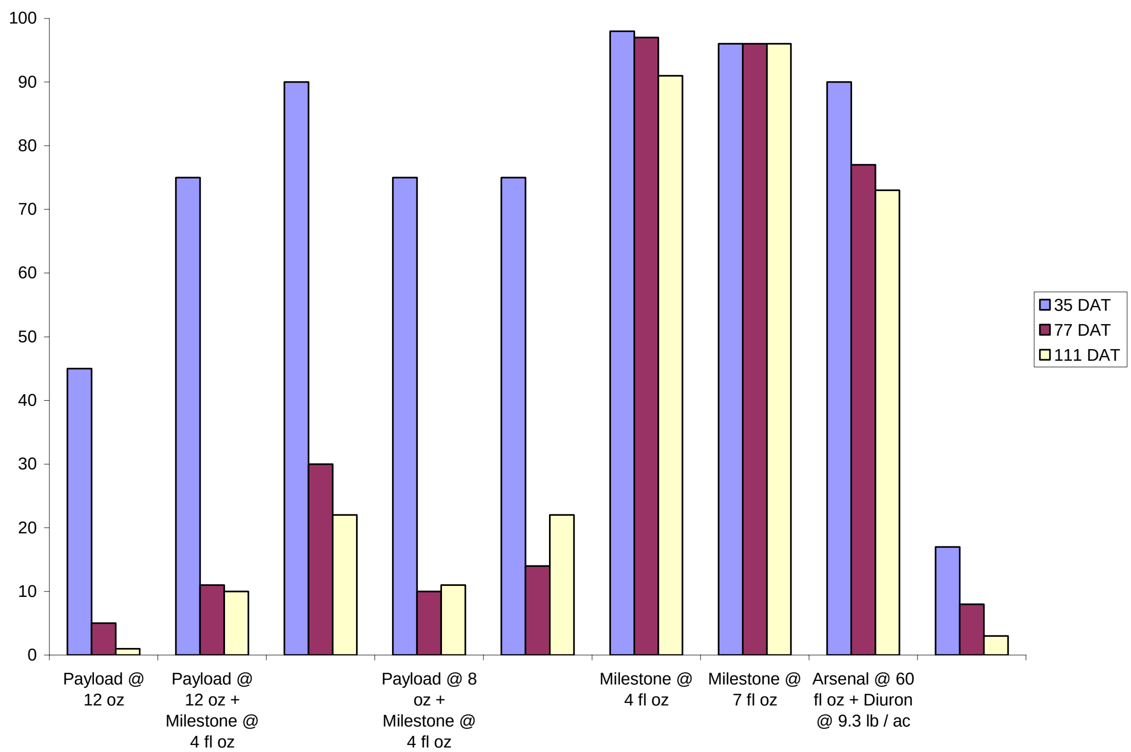

Figure 1: Mean Percent Bareground

Milestone VM® for Roadside Weed Control

Introduction

Milestone VM (active ingredient aminopyralid) is a relatively new compound for right-of-way vegetation management. First introduced in 2005, this compound has been researched mostly as a thistle control product (Canada and musk) by researchers at the University of Kentucky. As with any new product, more data can be compiled on general weed control as well as specific species problematic to industrial landowners (i.e. common teasel, poison hemlock, etc). Long term studies need to be installed as well to determine any residual activity that aminopyralid may have in reducing the regeneration potential for these species. Two trials were installed in 2006 to examine aminopyralid's ability to control 1) musk thistle and 2) musk thistle, common teasel, poison hemlock, and general broadleaf weed control. These two trials were permanently marked and GPS positions recorded to allow the determination of control levels the following growing season. The two trials were installed on the Gene Snyder Expressway (I-265) near Billtown Road (exit 19). Although both trials utilized the same treatments list, the methods and materials vary slightly between the two studies and will be discussed separately.

Musk Thistle Trial

Methods and Materials

The study area was in the cloverleaf area of exit 19 with an even distribution of musk thistle. Seven herbicide treatments were installed in a randomized complete block design with four replications (Table 1). Plots were 10' X 30' and treated at 20 GPA on April 13, 2006 using a CO_2 powered sprayer mounted on an ATV. Visual measurements of percent control were taken 27, 62, and 109 DAT. Musk thistle counts were taken 165 DAT using a 1 m^2 sampling square with three sub samples per plot. Data were analyzed using ARM and treatment means were separated using Fisher's LSD at $p = 0.05$.

Results

There were no statistically significant differences detected among treatments 27 DAT (Table 1). The does appear to be a difference in rate of burndown; however, as Milestone VM at 7 oz / ac resulted in 93 % control (or burndown) while the 2,4-D + Telar tank mix only resulted in 70 % burndown (although not statistically different). There were no differences detected for percent control or burndown between treatments at the 62 or 109 DAT. All treatments provided excellent control of musk thistle 109 DAT.

There were no significant differences in the number of musk thistle plants counted per square meter 165 DAT (Table 1). This trial will be re-evaluated in the summer of 2007 for plant parts per square meter and compared to the untreated area to determine the treatments efficacy in reducing musk thistle densities.

Table 1: Summary Statistics for Musk Thistle Control

Trt No.	Type	Treatment Name	Rate	Rate Unit	Percent Control 27 DAT	62 DAT	109 DAT	Musk Thistle Counts Per m^2
1	HERB	Milestone VM	5	fl oz/a	73.3 a	99 a	99 a	0.3 a
	ADJ	NIS	0.25	% v/v				
2	HERB	Milestone VM	5	fl oz/a	83.3 a	96.8 a	99 a	0.3 a
	HERB	Garlon 3A	32	fl oz/a				
	ADJ	NIS	0.25	% v/v				
3	HERB	Milestone VM	5	fl oz/a	89.5 a	99 a	99 a	0.1 a
	HERB	Garlon 3A	12	fl oz/a				
	HERB	Vista	8	fl oz/a				
	ADJ	NIS	0.25	% v/v				
4	HERB	Milestone VM	5	fl oz/a	90.8 a	99 a	99 a	0.0 a
	HERB	2,4-D Amine	32	fl oz/a				
	ADJ	NIS	0.25	% v/v				
5	HERB	Milestone VM	7	fl oz/a	93 a	99 a	99 a	0.2 a
	ADJ	NIS	0.25	% v/v				
6	HERB	2,4-D Amine	32	fl oz/a	70 a	99 a	99 a	0.2 a
	HERB	Telar	0.25	oz/a				
	ADJ	NIS	0.25	% v/v				
7	HERB	2,4-D Amine	64	fl oz/a	83.3 a	99 a	99 a	0.3 a
	ADJ	NIS	0.25	% v/v				
LSD (P=.05)					24.18	2.53	0.00	0.36
Standard Deviation					16.28	1.70	0.00	0.24
CV					19.54	1.72	0.0	144.75
Bartlett's X2					5.759	0.0	0.0	5.148
P(Bartlett's X2)					0.451	.	.	0.398
Replicate F					5.451	1.000	0.000	7.364
Replicate Prob(F)					0.0076	0.4155	1.0000	0.0020
Treatment F					1.172	1.000	0.000	0.636
Treatment Prob(F)					0.3637	0.4552	1.0000	0.6999

Means followed by same letter do not significantly differ (P=.05, LSD)

Common Teasel, Musk Thistle, Poison Hemlock, and General Weed Control

Methods and Materials

The study area was on a cut slope along the westbound lane of I-265 just east of exit 19. The same seven herbicide treatments tested above were tested in a randomized complete block design with four replications. Plots were linear, 10' by 30', and treated on May 5, 2006 using a TeeJet® BoomJet boomless tip on a CO_2 powered sprayer mounted on an ATV. All treatments included Activator 90 at 0.25 % v/v and were applied at 25 GPA. Vegetation present at installation included musk thistle, crown vetch, teasel, and poison hemlock.

Overall weed control and control by species was visually estimated 41 DAT and overall weed control was again evaluated 88 DAT. Data were analyzed using ARM and treatment means were separated using Fisher's LSD at p = 0.05.

Results

Treatments that included Milestone VM resulted in significantly higher control of musk thistle than 2,4-D alone at 64 fl oz / ac 41 DAT (Table 2). This result contradicts that of the trial reported above; however, treatments in that trial were applied one month earlier. This indicates the fast burndown effect that Milestone VM has as compared to that of 2,4-D when musk thistle plants are further along in the bolting / flowering process. The Milestone VM at 5 fl oz, Milestone VM at 5 fl oz + Garlon 3A at 32 fl oz, and Milestone VM at 5 fl oz + 2,4-D at 32 fl oz / ac were significantly higher than the 2,4-D + Telar tank mix and the 2,4-D alone treatments at the same evaluation.

There were no differences detected in crown vetch control with any treatment tested at 41 DAT. All treatments were effective in controlling crown vetch.

Only two treatments had poison hemlock densities high enough across all replications to include in analysis. Milestone VM at 5 fl oz + 2,4-D at 32 fl oz provided significantly higher burndown of poison hemlock than Milestone VM alone at 7 fl oz at 41 DAT.

The same trend exists between control levels with teasel as shown with musk thistle. Treatments that included Milestone VM had significantly higher control of teasel than 2,4-D alone at 64 fl oz at 41 DAT. All Milestone VM treatments except the Milestone VM + Garlon 3A tank mix resulted in higher burndown levels than the 2,4-D + Telar and 2,4-D alone treatments.

Overall weed control followed the same trends as control of musk thistle and teasel discussed above at 41 DAT. All treatment differences were removed; however, when evaluated 88 DAT. This indicates the quick visual symptomology of Milestone VM yet 2,4-D and Telar’s ability to provide equivalent control levels 2 months after treatment.

This trial will be re-evaluated in the summer of 2007 for control of musk thistle, poison hemlock, and teasel to determine the treatments efficacy in reducing weed species densities.

Table 2: Summary Statistics for Musk Thistle, Teasel, Poison Hemlock, and Overall Weed Control

Trt No.	Type	Treatment Name	Rate	Rate Unit	Percent Control					
					Musk Thistle	Crown Vetch	Teasel	Poison Hemlock	Overall	Overall
					41 DAT	41 DAT	41 DAT	41 DAT	41 DAT	88 DAT
1	HERB	Milestone VM	5	fl oz/a	90 a	87 a		99 a	88 ab	100 a
	ADJ	NIS	0.25	% v/v						
2	HERB	Milestone VM	5	fl oz/a	93 a	99 a		85 ab	91 a	100 a
	HERB	Garlon 3A	32	fl oz/a						
	ADJ	NIS	0.25	% v/v						
3	HERB	Milestone VM	5	fl oz/a	88 ab	99 a		90 a	90 a	100 a
	HERB	Garlon 3A	12	fl oz/a						
	HERB	Vista	8	fl oz/a						
	ADJ	NIS	0.25	% v/v						
4	HERB	Milestone VM	5	fl oz/a	91 a	99 a	70 a	89 a	89 ab	100 a
	HERB	2,4-D Amine	32	fl oz/a						
	ADJ	NIS	0.25	% v/v						
5	HERB	Milestone VM	7	fl oz/a	88 ab	99 a	60 b	90 a	87 abc	100 a
	ADJ	NIS	0.25	% v/v						
6	HERB	2,4-D Amine	32	fl oz/a	71.3 bc	87 a		68 bc	72 bc	100 a
	HERB	Telar	0.25	oz/a						
	ADJ	NIS	0.25	% v/v						
7	HERB	2,4-D Amine	64	fl oz/a	68.3c	99 a		58 c	70 c	100 a
	ADJ	NIS	0.25	% v/v						
LSD (P=.05)					17.51	23.22	0.00	18.24	17.865	0.00
Standard Deviation					11.37	14.24	0.00	9.13	12.020	0.00
CV					13.47	14.91	0.0	11.04	14.33	0.0
Bartlett's X2					6.322	0.168	0.0	1.481	12.308	0.0
P(Bartlett's X2)					0.388	0.682	.	0.83	0.055	.
Replicate F					0.384	0.767	0.000	0.035	0.090	0.000
Replicate Prob(F)					0.7666	0.5441	1.0000	0.9659	0.9647	1.0000
Treatment F					3.206	0.691	0.000	7.755	2.263	0.000
Treatment Prob(F)					0.0407	0.6648	1.0000	0.0125	0.0837	1.0000

Means followed by same letter do not significantly differ (P=.05, LSD)

<u>Control of Purple Loosestrife (*Lythrum salicaria* L.)</u>

Introduction

Purple loosestrife is a federally listed invasive terrestrial plant that occurs in wetland areas. Although listed as an aquatic invasive plant, this species is terrestrial and can occur on ditch banks, creek and river sides, and other areas where water is near. Purple loosestrife is aggressive, reproducing by seed and the more problematic reproductive sprouts. This aggressiveness can displace native vegetation, degrade wildlife habitat, and reduce the efficiency of drainage areas. Purple loosestrife was first reported in Canada and the New England areas of the United States and now occurs in most of the continental United States with the most severe infestations still occurring in New England (USDA 2005). In Kentucky, infestations are more common and intense in the eastern regions of the state with occurrences beginning to appear in the central and western parts.

Purple loosestrife can easily be spread by mowing. Plant parts may remain on equipment and be transported away from the original site. Also, due to the close proximity to water, cuttings may be spread by the water flow or flooding disturbances. Species of Lythrum, including purple loosestrife, may be purchased in the landscaping and ornamental industry, further increasing its spread.

Current control options include biological and chemical control. Chemical control options usually include glyphosate, imazapyr, and triclopyr. Studies have shown imazapyr, at rates ranging from 20 to 96 fl oz per acre of 2 # product, can maintain 90 % control 1 YAT (Knezevic et al 2004). The same trial showed glyphosate at 2 and 3 qt / ac resulted in 70 to 75 % control 2 YAT while triclopyr tested at 1.5 to 2.5 qt / ac resulted in quick burndown initially but failed to provide greater than 50 % control over 2 years.

A trial was installed in 2006 to compare glyphosate and triclopyr, alone and tank mixed with imazapyr, for purple loosestrife control. The trial also examined other non-aquatic herbicides for their potential for control.

Methods and Materials

The study site was located in a soybean field near the banks of the Red River in Powell County, Kentucky. Fifteen treatments and one untreated check were evaluated in a randomized complete block design with 10’ by 30’ plots and four replications (Table 1). Treatments were applied on May 23, 2006 using a CO_2 powered sprayer mounted on an ATV. Visual percent control evaluations were taken 72 and 127 DAT. Data were analyzed using ARM® software and treatment mean separations were performed using Fisher’s LSD at $p = 0.05$.

Results

Aquamaster at 1 qt / ac resulted in significantly lower control 72 DAT than any other Aquamaster treatment (Table 1). There appears to be an increase in efficacy when Habitat is added to the 1 qt of Aquamaster as that treatment provided 84 % control at the same evaluation period. Aquamaster at 2 qt alone or tank mixed with Habitat provided greater than 70 % control 72 DAT. These differences in control are not seen 127 DAT. Aquamaster at 2 qt / ac plus Habitat at 0.5 pt / ac resulted in the highest control at this interval than any other Aquamaster treatments; however, there were no significant differences detected between these treatments. Control levels for the Aquamaster treatments ranged from 64 to 78 % 127 DAT.

There were no significant differences detected between any of the Garlon 3A treatments tested 72 DAT (Table 1). Control levels ranged from 61 % to 68 % at this evaluation. Control levels for the high rate of Garlon 3A tested (4 pt / ac) decreased from 72 DAT to 127 DAT indicating that this rate may be too high and burning down the plant to fast to allow proper translocation for control of sprouts. Garlon 3A at 2 pt / ac provided significantly higher control 127 DAT (78 %) and the two treatments using 4 pt / ac. There was no difference detected between the Garlon 3A at 2 pt / ac (78 %) and the tank mix of Garlon 3A at 2 pt / ac and Habitat at 0.5 pt / ac (70 %) 127 DAT.

Habitat alone treatments resulted in acceptable control levels 72 DAT. There were no differences detected among the high rate (1 pt / ac) and the two low rates (0.5 pt / ac with either MSO or NIS as the surfactant) at this interval. Control levels ranged from 85 to 93 %. Differences between the Habitat treatments were exhibited 127 DAT. Habitat at 1 pt / ac + NIS (75 %) provided significantly higher control than Habitat at 0.5 pt / ac + NIS (43 %) at 127 DAT. There was no difference detected between the Habitat at 1 pt / ac and the Habitat at 0.5 pt / ac + MSO. There were also no differences detected between the two 0.5 pt / ac treatments and the two surfactants. There does seem to be some operational benefit, although not statistically significant, to using MSO with Habitat at 0.5 pt / ac (60 % at 127 DAT) than using NIS (43 % at 127 DAT).

There were no differences between ForeFront R & P at 2 pt / ac and Milestone VM at 5 oz / ac at either evaluation. ForeFront R & P provided 83 % control 72 DAT and decreased to 70 % control 127 DAT. Milestone VM resulted in 89 % control 72 DAT and decreased to 75 % control 127 DAT.

Vanquish provided the highest control levels of any treatment tested at both evaluation intervals. At 72 DAT, Vanquish applied at 4 pt / ac resulted in 94 % control and 85 % control 127 DAT.

Journey at 32 oz / ac was significantly lower in percent control (28 %) than all other treatments tested other than Aquamaster at 1 qt / ac 72 DAT. Control did increase to 60 % at 127 DAT. It is likely that the low amount of glyphosate in this treatment did not prove to be high enough to cause burn down.

Results of this trial need to be examined while understanding that purple loosestrife is a terrestrial plant that thrives in wet areas. Vanquish does not have an aquatic label and should not be used in such areas. The treatments that provided the highest control levels and also include aquatic verbiage in their labels would be the Aquamaster and Habitat. The label for Garlon 3A does include aquatic language in its label; however, great care and complete understanding of the label is needed to prevent any off label applications of this or any of the above mentioned products.

Table 1: Summary Statistics for Purple Loosestrife Control

Trt No.	Type	Treatment Name	Rate	Rate Unit	Percent Control 72 DAT	Percent Control 127 DAT
1	HERB ADJ	Aquamaster NIS	2 0.25	QT/A % V/V	71a-d	64a-d
2	HERB HERB ADJ	Aquamaster Habitat NIS	2 0.5 0.25	QT/A PT/A % V/V	80a-d	78ab
3	HERB ADJ	Aquamaster NIS	1 0.25	QT/A % V/V	35e	66abc
4	HERB HERB ADJ	Aquamaster Habitat NIS	1 0.5 0.25	QT/A PT/A % V/V	84a-d	68abc
5	HERB ADJ	Garlon 3A NIS	4 0.25	PT/A % V/V	63d	56bcd
6	HERB HERB ADJ	Garlon 3A Habitat NIS	4 0.5 0.25	PT/A PT/A % V/V	65cd	48cd
7	HERB ADJ	Garlon 3A NIS	2 0.25	PT/A % V/V	61d	78ab
8	HERB HERB ADJ	Garlon 3A Habitat NIS	2 0.5 0.25	PT/A PT/A % V/V	68bcd	70abc
9	HERB ADJ	Habitat NIS	1 0.25	PT/A % V/V	90ab	75ab
10	HERB ADJ	Habitat MSO	0.5 1.25	PT/A % V/V	93a	60cd
11	HERB ADJ	Habitat NIS	0.5 0.25	PT/A % V/V	85a-d	43d
12	HERB ADJ	ForeFront NIS	2 0.25	PT/A % V/V	83a-d	70abc
13	HERB ADJ	Milestone VM NIS	5 0.25	FL OZ/A % V/V	89abc	75ab
14	HERB ADJ	Vanquish NIS	4 0.25	PT/A % V/V	94a	85a
15	HERB ADJ	Journey NIS	32 0.25	FL OZ/A % V/V	28e	60bcd
16	CHK	Untreated Check			0	0

Note: Treatment means followed by the same letter are not significantly different using Fishers LSD at p = 0.05.

Literature Cited

Knezevic, S.Z., Smith, D., Klum, R., Doty, D., Kinkaid, D., Goodrich, M., and Stolcpart, R., 2004. Purple loosestrife (Lythrum salicaria) control with herbicides: single year application. Weed Tech. 18: 1255 - 1260.

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Comparison of 2,4-D + Edict, Milestone, Overdrive, and Transline for Canada Thistle (*Cirsium arvense* L.) Control

Introduction

Canada thistle is a problematic invasive weed species along Kentucky highways. Mowing infestations can increase densities as this perennial species can reproduce via seed as well as rhizomatous sprouts. Chemical control options in the past have included picloram, clopyralid, and dicamba with results being average to moderately good at best. Introduction of Milestone VM (a.i. aminopyralid) in 2006 provided another control option for this particular species. Edict (a.i. pyraflufen) has been introduced in the non-crop market from the cereal market as a possible tank mix partner to increase efficacy of compounds such as 2,4-D. A study was conducted in 2006 to compare industry standards to the new introductions for Canada thistle control.

Methods and Materials

The study was located at the UK Spindletop Research Farm in Lexington, KY. Six (6) chemical treatments and one (1) untreated check were evaluated in a randomized complete block design with four (4) replications (Table 1). Treatments included 2,4-D + Edict, Milestone VM, Overdrive (a.i. dicamba + diflufenzopyr), and Transline (a.i. clopyralid). The study was installed on May 15, 2006 in a tall fescue stand with an even distribution of Canada thistle. Canada thistle plants were either pre or post bolt with no visible flower parts on any plant. Application volume was 25 GPA and all treatments included Activator 90 surfactant at 0.25 % v/v. Visual percent control ratings were taken at 21, 44, 81, and 114 DAT.

Results and Discussion

Milestone VM provided higher levels of control at all evaluation dates than all other treatments (Table 1). Milestone VM at 7 fl oz / ac resulted in 75 % control at 21 DAT, increased to ~ 95 % control at 44 and 81 DAT, then decreased to 86 % control 114 DAT. Transline at 10.67 fl oz / ac (2/3 pt / ac) provided the second highest level of control at any given evaluation throughout the study with its highest level of control coming at 81 DAT.

Overdrive at 6 oz / ac provided marginal control with its highest level of suppression being 60 % at 81 DAT. Past research has shown Overdrive to be effective at controlling Canada thistle at this rate and at 4 oz / ac when tank mixed with Transline[1].

The addition of Edict at 1.4 fl oz / ac did not appear to increase efficacy of 2,4-D amine at either rate tested for Canada thistle control. 2,4-D alone at 1.5 qt / ac provided similar control levels to that of 2,4-D at 1.5 qt .ac + Edict at 1.4 fl oz / ac.

This trial will be evaluated in the late spring of 2007 for control of Canada thistle 1 year after treatment.

[1]*Blair, M.P. and Witt, W.W. 2004. Noncrop and Industrial Weed Science Annual Research Report.*

Table 1: Summary Statistics for 2006 Canada Thistle Trial

Trt No.	Type	Treatment Name	Rate	Rate Unit								
		Pest Type			W Weed		W Weed		W Weed		W Weed	
		Pest Code			CIRAR		CIRAR		CIRAR		CIRAR	
		Pest Name			Canada thistle		Canada thistle		Canada thistle		Canada thistle	
		Rating Date			5/Jun/2006		28/Jun/2006		4/Aug/2006		6/Sep/2006	
		Rating Data Type			CONTRO		CONTRO		CONTRO		CONTRO	
		Rating Unit			%		%		%		%	
		Days After First/Last Applic.			21 21		44 44		81 81		114 114	
		Trt-Eval Interval			21 DA-A		44 DA-A		81 DA-A		114 DA-A	
		ARM Action Codes					TA[2]					
					1		3		4		5	
1	HERB	2,4-D Amine	1	QT/A	44	cd	45	c	21	e	33	c
	HERB	Edict	1.4	OZ/A								
	ADJ	NIS	0.25	% V/V								
2	HERB	2,4-D Amine	1.5	QT/A	53	bc	63	bc	31	de	25	c
	HERB	Edict	1.4	OZ/A								
	ADJ	NIS	0.25	% V/V								
3	HERB	2,4-D Amine	1.5	QT/A	55	b	56	bc	44	cd	31	c
	ADJ	NIS	0.25	% V/V								
4	HERB	Milestone VM	7	FL OZ/A	75	a	96	a	95	a	86	a
	ADJ	NIS	0.25	% V/V								
5	HERB	Overdrive	6	OZ/A	40	d	45	c	60	bc	40	bc
	ADJ	NIS	0.25	% V/V								
6	HERB	Transline	10.67	FL OZ/A	55	b	68	b	80	ab	61	b
	ADJ	NIS	0.25	% V/V								
7	CHK	Untreated Check			0		0		0		0	
		LSD (P=.05)			10.0		12.0t		20.1		21.3	
		Standard Deviation			6.6		7.9t		13.3		14.1	
		CV			12.36		14.91		24.13		30.73	
		Grand Mean			53.54		53.27t		55.21		46.04	
		Bartlett's X2			3.744		6.765		0.531		2.732	
		P(Bartlett's X2)			0.442		0.239		0.97		0.604	
		Replicate F			1.418		0.185		0.648		0.213	
		Replicate Prob(F)			0.2764		0.9049		0.5964		0.8856	
		Treatment F			13.602		11.892		18.393		10.906	
		Treatment Prob(F)			0.0001		0.0001		0.0001		0.0001	

Means followed by same letter do not significantly differ (P=.05, LSD)
t=Mean descriptions are reported in transformed data units, and are not de-transformed.
Untreated treatment(s) 7 excluded from analysis.

Effect of Timing of Application with Imazapyr and Fosamine for Japanese Knotweed Control

Introduction

Japanese knotweed is a perennial herbaceous to semi-woody plant common in eastern and central Kentucky. This invasive plant has prolific reproduction capabilities from seed or rhizomatous sprouts with sprouts being more problematic. Dense stands of knotweed can form along roadsides decreasing line of sight and aesthetic value. Mowing of infestations will increase stand density and promote the spread and establishment of new stands via cutting transport and deposit.

The majority of Japanese knotweed roadside infestations in eastern Kentucky occur on two lane secondary roads where encroaching brush can compound the line of sight issue. It would be beneficial to have a control option for Japanese knotweed in a roadside setting that could provide a secondary benefit such as encroaching brush control. Krenite (a.i. fosamine) is the primary tool used for roadside brush control as it prevents unsightly brownout issues and is an excellent chemical side trimming option for several hardwood and coniferous species.

Chemical control options have included glyphosate and imazapyr. Research performed at the University of Kentucky in 2005 showed 95 % control of Japanese knotweed 1 YAT with 3 pt / ac of Habitat® (a.i. imazapyr) applied at 50 GPA in June (Blair and Witt 2006). Combinations of imazapyr and fosamine have been shown to provide greater than 90 % control of knotweed when applied late in the growing season (Hipkins and Witt 2003). A trial in 2006 to examined the effect that timing of imazapyr and fosamine applications for Japanese knotweed control.

Methods and Materials

The study area was located on a roadside in Perry County, KY. Plots were 30' long X 10' deep. The entire study area was evenly populated with Japanese knotweed approximately 5-8 feet tall at initiation. All applications were made with a CO_2 sprayed mounted on an ATV using a TeeJet® BoomJet nozzle at 50 GPA.

Seven herbicide treatments were installed in a randomized complete block design with three replications. All treatments included Activator surfactant at 0.25 % v/v. The trial consisted of two treatments (Habitat alone and Habitat tank mixed with Krenite) applied at three different times (May, July, and August) and one treatment (Aquamaster) applied once (Table 1). The original study design was for the same rates of the three timing treatments; however, a clerical error changed the trial for a Habitat / Krenite treatment at 1 % v/v and 4 % v/v respectively in May while the July and August treatments were applied at 1 % v/v and 1 % v/v respectively.

Data collected were visual percent control of Japanese knotweed at each application timing and at the end of the growing season. Data were analyzed using ANOVA with Fisher's LSD test at $p = 0.05$ for treatment mean separation. Treatments not applied (i.e. July and August) were removed from analysis at appropriate evaluation times.

Results

May Applications

There was no significant difference in the May applied treatments at 42 DAT (Table 1). Control (i.e. leaf necrosis) levels ranged form 15 % (Habitat alone) to 28 % (Habitat plus Krenite at 4 %). These control levels increased to 55 % and 72 % respectively at 97 DAT. The Aquamaster alone treatment increased control to 37 % at 97 DAT and this was significantly lower than the Habitat / Krenite tank mix. The Habitat at 1 % plus Krenite @ 4 % tank mix again provided significantly higher control than the Aquamaster treatment 134 DAT. The Habitat alone treatment resulted in 77 % control 134 DAT; this was statistically similar to the Habitat / Krenite tank mix and the Aquamaster alone treatments.

July Applications

There were no significant differences among the treatments applied in July when evaluated 36 DAT (Table 1). The Habitat alone treatment and the Habitat plus Krenite at 1 % tank mix treatment resulted in 28 and 32 % control respectively. These treatments increased control to 60 and 80 % control, respectively, when evaluated 72 DAT. There was no significant difference among the treatments applied in May when evaluated on August 21 (97 DAT) and treatments applied in July when evaluated on August 21 (36 DAT). When evaluated in September (134 DAT for the May applications and 72 DAT for the July applications), the Habitat and Krenite at 4 % tank mix applied in May (91 %) was significantly higher than Aquamaster treatment applied in May (55 %) and the Habitat alone treatment applied in July (60 %).

August Applications

The Habitat alone treatment applied in August (32 %) was significantly lower than the Habitat / Krenite tank mix applied in August (72 %) when evaluated 37 DAT. The Habitat / Krenite at 1 % tank mix applied in August resulted in statistically similar results as the Habitat / Krenite at 4 % tank mix when applied in May. The August applied tank mix also resulted in a higher control level at 37 DAT (72 %) than the May application of the 4 % tank mix when evaluated 42 DAT (28 %).

Summary

There appears to be some benefit to applying the Habitat / Krenite tank mix late in the season as compared to early in the season for rapid burndown of Japanese knotweed. The Habitat alone treatment applied in May did provide statistically similar results as the tank mixes applied in May, July, and August; however, the Habitat alone treatment applied in August resulted in significantly lower control that the tank mixes applied at all three timings. This is indicative to the slow burndown effect that imazapyr has shown in the past on most species.

The trial will be reevaluated 1 YAT to determine control levels of application timings.

Table 1: Summary Statistics for Japanese Knotweed Control

Trt No.	Type	Treatment Name	Rate	Rate Unit	Appl Description			
						42 DAT	97 DAT	134 DAT
1	HERB	Habitat	1	% V/V	MAY	15a	55a	77ab
	ADJ	NIS	0.25	% V/V	MAY			
2	HERB	Habitat	1	% V/V	MAY	28a	72a	91a
	HERB	Krenite	4	% V/V	MAY			
	ADJ	NIS	0.25	% V/V	MAY			
							36 DAT	72 DAT
3	HERB	Habitat	1	% V/V	JULY		28a	60bc
	ADJ	NIS	0.25	% V/V	JULY			
4	HERB	Habitat	1	% V/V	JULY		32a	80ab
	HERB	Krenite	1	% V/V	JULY			
	ADJ	NIS	0.25	% V/V	JULY			
								37 DAT
5	HERB	Habitat	1	% V/V	AUGUST			32c
	ADJ	NIS	0.25	% V/V	AUGUST			
6	HERB	Habitat	1	% V/V	AUGUST			72ab
	HERB	Krenite	1	% V/V	AUGUST			
	ADJ	NIS	0.25	% V/V	AUGUST			
						42 DAT	97 DAT	134 DAT
7	HERB	Aquamaster	2	% V/V	MAY	27a	37a	55bc
	ADJ	NIS	0.25	% V/V	MAY			
LSD (P=.05)						14.6	45.2	29.3
Standard Deviation						6.5	24.0	16.5
CV						27.66	53.7	24.72
Grand Mean						23.33	44.67	66.57
Bartlett's X2						0.332	6258	4.235
P(Bartlett's X2)						0.847	0.181	0.645
Replicate F						0.800	0.055	0.431
Replicate Prob(F)						0.5102	0.9468	0.6596
Treatment F						3.800	1.741	4.246
Treatment Prob(F)						0.1189	0.2338	0.0159

Means followed by same letter do not significantly differ (P=.05, LSD)

Literature Cited

Blair, M.P. and Witt, W.W. 2006. Evaluation of Imazapyr, Glyphosate, and Triclopyr for Japanese Knotweed (Polygonum cuspidatum Seib. & Zucc.) Control. In: *Noncrop and Industrial Vegetation Management Weed Science 2005 Annual Research Report. Information Note 2006 NCVM-1.*

Hipkins, P.L., and Witt, H.L. 2003 Noncrop and Turfgrass Weed Science Research. Information Note 2003-A.

Mefluidide, Sulfosulfuron, and MSMA Combinations for Johnsongrass Control

Introduction

Johnsongrass (*Sorghum halepense* L.) is a perennial warm season nonnative invasive grass that has been problematic in Kentucky, as well as most of the United States, since its introduction in the mid 1800's (NAL 2006). Control options for this species have been heavily investigated in the past and there is no deficiency of acceptable suppression and control options available. Current chemical options for eradication include sulfosulfuron (an ALS inhibiting herbicide) and ACCase (grass specific) herbicides such as clethodim, fluaziflop, fenoxaprop. The ACCase herbicides, however, will have a negative impact on desirable grass species that will be needed to maintain a vegetative cover for reclamation.

Monosodium methanearsonate (MSMA) is an herbicide commonly used in turf and has been researched extensively for johnsongrass control with results varying greatly. Research at the University of Kentucky at the Turf Research Center in 2000 realized no more than 35 % control of johnsongrass at 4.125 lb a.i / ac (88 fl oz of 6 lb product) (UK Turf 2000). Taylor and Coats (1999) had similar results in 1998 with 3.3 lb a.i / ac of MSMA resulting in only 36 % control 12 WAT. Research performed in the summer of 2004 showed greater than 80 % control of johnsongrass with 1.5 lb a.i / ac of MSMA (Blair and Witt 2005). Studies have shown benefit of adding MSMA to other herbicides at decreased rates to improve or maintain control levels. Arnold et al (2001) showed similar control levels greater than 80 % with 0.125 lb a.i / ac of imazapic alone and with 0.094 lb a.i. / ac imazapic tank mixed with 2 lb a.i / ac of MSMA. This inconsistency of efficacy may be due to the slow absorption rate of MSMA in johnsongrass as Mason et al (1979) showed that 50 % absorption occurs after 6 hours of rain fastness while up to 155 hours are needed for 90 % absorption.

Mefluidide is another herbicide that has been researched for johnsongrass control in the past. Commonly used as a plant growth regulator and seedhead suppressant and known as Embark ®, past research shows inconsistent results similar to that of MSMA.

A trial was installed in 2006 to evaluate the ability of mefluidide and MSMA tank mixes to control johnsongrass and compare the results to sulfosulfuron, one of the industry standards.

Methods and Materials

The trial was located at Spindletop Farm in Lexington, KY. The area was a managed mature johnsongrass field (primarily rhizomatous) that had been routinely mowed to prevent seedhead formation. Ten treatments were evaluated in a randomized complete block design with four replications (Table 1). All treatments included a nonionic surfactant at 0.25 % v/v. Plots were 10' X 30' and treated at 25 GPA using a CO_2 powered sprayer mounted on an ATV. Treatments were applied on June 9, 2006 as the johnsongrass was about to set seedheads. Data collected included percent johnsongrass vegetative control 14, 41, and 95 DAT as well as percent seedhead suppression 41 DAT. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at p = 0.05.

Results

Outrider at 0.5 and 1 oz per acre resulted in significantly higher control 14 DAT than any of the other treatments (48 and 46 % respectively) (Table 1). All of the Embark and MSMA treatments, whether alone or tank mixed, resulted in 30 % control or lower at 14 DAT.

The two Outrider treatments increased in control levels to 93 and 97 % at the 0.5 oz and 1 oz per acre rates respectively at 41 DAT. These control levels were again significantly higher than and of the Embark or MSMA treatments combinations at the same time interval. There were no significant differences between the Embark and MSMA treatments and no one treatment provided greater than 30 % control 41 DAT. In terms of seedhead suppression, however, all treatments provided greater than 80 % suppression 41 DAT.

The Embark / MSMA treatments provided no control of johnsongrass 95 DAT. The Outrider treatments decreased slightly in control from 41 DAT to 95 DAT to 80 and 94 % for the 0.5 oz and 1 oz treatments, respectively.

Literature Cited

Arnold, J.C., Coats, G.E., Taylor, J.M., and Hutto, K.C., 2001. *Evaluation of Plateau, Oasis, and Outrider for Control of Johnsongrass (Sorgum halepense) on Highway Rights-of-Way.* Proc. South. Weed. Sci. Soc. 54:126.

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Williams, D.W. et al., 2000. *Johnsongrass Control in Tall Fescue.* 1999-2000 Turfgrass Science Research Report. http://www.uky.edu/agturf/summ9900.htm.

Table 1: Summary Statistics for Johnsongrass Control

Trt No.	Type	Treatment Name	Rate	Rate Unit	Percent Control	Percent Seedhead Suppression	Percent Control	Percent Control
					14 DAT	41 DAT	41 DAT	95 DAT
1	HERB HERB ADJ	Embark MSMA NIS	16 32 0.25	FL OZ/A FL OZ/A % V/V	24bc	100a	25b	0c
2	HERB HERB ADJ	Embark MSMA NIS	8 32 0.25	FL OZ/A FL OZ/A % V/V	28b	99a	16b	0c
3	HERB HERB ADJ	Embark MSMA NIS	4 32 0.25	FL OZ/A FL OZ/A % V/V	30b	100a	30b	0c
4	HERB HERB ADJ	Embark MSMA NIS	2 32 0.25	FL OZ/A FL OZ/A % V/V	30b	100a	25b	0c
5	HERB HERB ADJ	Embark MSMA NIS	16 16 0.25	FL OZ/A FL OZ/A % V/V	23bc	96a	13b	0c
6	HERB HERB ADJ	Embark MSMA NIS	16 8 0.25	FL OZ/A FL OZ/A % V/V	20bc	80b	16b	0c
7	HERB ADJ	Outrider NIS	0.5 0.25	OZ/A % V/V	48a	100a	93a	80b
8	HERB ADJ	Outrider NIS	1 0.25	OZ/A % V/V	46a	100a	97a	94a
9	HERB ADJ	Embark NIS	16 0.25	FL OZ/A % V/V	11c	98a	25b	0c
10	HERB ADJ	MSMA NIS	32 0.25	FL OZ/A % V/V	18bc	100a	29b	0c

Note: Treatment means followed by the same letter are not statistically different using Fishers LSD at p = 0.05.

<u>Control of Common Reed (*Phragmites australis* Cav.)</u>

Introduction

Common reed, or phragmites, is a terrestrial plant that occurs in moist to flooded areas. This non-native species can tolerate a wide array of adverse conditions from stagnate to flowing water and salty to alkaline conditions. This plant was once recommended by federal agencies as a desirable species to use in constructed wetlands to filter water in landfills, reclaimed coal mines, and other industrial sites. Unfortunately, phragmites has the ability to reproduce prolifically through seed, cuttings, and rhizomatous sprouting which causes it to spread outside of its original planting and displace native vegetation, obstruct drainage areas, and degrade wildlife habitat. Control options in the past have been limited to glyphosate and imazapyr, labeled for aquatic use, due to this species propensity to grow near water. A trial was installed in 2006 to compare these two active ingredients and their ability to control phragmites.

Methods and Materials

The study was located in the clover leaf area of exit 58 of the westbound Western Kentucky Parkway in Muhlenberg County, Kentucky. Phragmites was growing in and around a drainage ditch and was approximately 10 – 12' tall at applications. Seven treatments were used in a randomized complete block design with three replications. Plots were linear and 30' long by 10' wide. Treatments were applied at 25 GPA on June 21, 2006 using a boomless tip and a CO_2 sprayer mounted on an ATV. Plots were evaluated for percent control or burndown 72 DAT and treatment means were separated using Fishers LSD at $p = 0.05$.

Results

Aquamaster at 2 qt / ac plus NIS at 0.25 % v/v provided 50 % burndown approximately 10 WAT (Table 1). There was no statistical difference between the use of MSO or NIS and Aquamaster at 2 or 4 qt / ac. Habitat at 2 pt / ac plus MSO at 1 % v/v resulted in 23 % burndown at the same interval. There were no significant differences detected between the use of MSO or NIS and Habitat at any rate tested. A high degree of variability was detected when these plots were evaluated at 72 DAT. Plots will be reevaluated in the spring of 2007 to obtain control levels 1 GSAT.

Phragmites control has been researched in the Weed Science group at the University of Kentucky for 2 years and treatments were applied in June in both years. Trials in 2007 will be installed in late spring to determine effect of timing of application.

Table 1: Phragmites Control 2006

Trt No.	Type	Treatment Name	Rate	Rate Unit	Percent Control 72 DAT	
1	HERB	Aquamaster	2	qt/a	50.0	a
	ADJ	NIS	0.25	% v/v		
2	HERB	Aquamaster	2	qt/a	15.0	ab
	ADJ	MSO	1	% v/v		
3	HERB	Aquamaster	4	qt/a	26.7	ab
	ADJ	MSO	1	% v/v		
4	HERB	Habitat	2	pt/a	6.7	b
	ADJ	NIS	0.25	% v/v		
5	HERB	Habitat	2	pt/a	23.3	ab
	ADJ	MSO	1	% v/v		
6	HERB	Habitat	4	pt/a	6.7	b
	ADJ	MSO	1	% v/v		
7	HERB	Habitat	6	pt/a	20.0	ab
	ADJ	MSO	1	% v/v		
LSD (P=.05)					41.54	
Standard Deviation					23.35	
CV					110.19	
Bartlett's X2					10.921	
P(Bartlett's X2)					0.091	
Replicate F					4.103	
Replicate Prob(F)					0.0439	
Treatment F					1.216	
Treatment Prob(F)					0.3627	

Means followed by same letter do not significantly differ (P=.05, LSD)

<u>Escort® Combinations for Woody Plant Control</u>

Introduction

Woody plant management is an important component to noncrop vegetation management. Utility managers strive for areas under power lines to be completely free of woody plants to allow uninterruption of service due to tree-line contact and to have clear access in rights-of-way for maintenance purposes. Power line rights-of-way that are clear of woody plants also make for excellent fire breaks to allow containment of forest fires. Roadside vegetation managers deal with woody plants in terms of safety for travelers and work crews. A roadside that is clear of woody vegetation will typically have better line of sight and fewer hazardous trees that can cause personal injury and property damage in the event of an accident.

Control options for woody plants range from mechanical, chemical, and cultural. Chemical control options include a wide array of herbicides, from those designed to control only a few species to those designed to control a wide spectrum. Application methods for chemical control vary as well, from individual stem treatments of basal bark or cut stump, low volume foliar backpack applications, and high volume broadcast foliar treatments. Site characteristics, such as stem density, stem height, accessibility, and species composition, will determine what combination of herbicide and application method will prove most effective.

Escort (a.i. metsulfuron) is a sulfonylurea herbicide in the ALS family commonly used for herbaceous weed control. The product has efficacy on a limited number of woody plants. Unlike a glyphosate tank mix application for woody plants, an Escort application will be selective to some desirable grasses leaving suitable ground cover. Escort provides excellent control of some woody legumes such as locust. A trial was installed in the summer of 2005 to compare Escort tanks mixes for control of several woody species including black locust and redbud.

Methods and Materials

The trial was located on a distribution line operated by South Kentucky Rural Electric Cooperative located near Somerset, KY. The line had been untreated for approximately 4-5 years and had a high density of hardwoods common to an Appalachian hardwood stand. Dominant species included red maple, yellow poplar, redbud, black locust, white oak, black oak, staghorn sumac, with an occasional conifer (mostly Virginia pine). Height of target stems ranged from 1’ to 10’. A randomized complete block study was installed with five treatments and three replications (Table 1). Plots were 15’ wide by 30’ long. Treatments were applied on July 7, 2006 using a CO_2 backpack and a Spraying Systems® handgun with and adjustable cone tip. Treatments were broadcasted at 100 GPA (high volume) due to the high density and stem height.

Data collected included overall control (defoliation) 8 WAT and control by species 1 YAT. Data were analyzed using ANOVA and treatment mean separation performed using Fisher’s LSD at p = 0.05.

Results

8WAT

There were no significant differences detected among treatments at 70 DAT (Table 1). The three-way tank mix of Escort / Garlon 3A / Krenite; however, did provide the highest operational level of overall control of 95 % 8 WAT. Escort alone at 2 oz / ac resulted in the lowest control at 8 WAT with 55 %.

1 YAT

Significant differences between treatments were present for overall control at 1 YAT. The three-way tank mix provided significantly higher overall control levels 1 YAT (92 %) than the Escort alone treatments and the Escort / Krenite tank mix (Table 1). The Escort alone treatment at 2 oz provided the lowest overall control levels 1 YAT (45 %) and was significantly lower than the treatments incorporating triclopyr (Garlon 3A).

There were no significant differences across treatments for red maple control 1 YAT; however, there was a great deal of variation across treatments. Control levels ranged from 75 % and 71 % (Escort at 3 oz and the three-way tank mix respectively) to 24 % (Escort / Krenite tank mix). There was a treatment effect present for redbud control. Treatments utilizing triclopyr were significantly higher than those not. Triclopyr tank mixes had control levels greater than 90 % while Escort alone treatments were less than 35 % and the Escort / Krenite combination was less than 55 %.

The triclopyr tank mixes provided the highest level of yellow-poplar control as well; however, no differences were detected across treatments for control of this species. Yellow-poplar control with Escort alone does increase from 40 to 70 % when the rate is increased form 2 to 3 oz per acre. The addition of Krenite to the low rate of Escort increased control form 40 to 80 %.

The same pattern was exhibited with control of staghorn sumac. Treatments including triclopyr provided higher levels of control. There was a significant difference between the Escort alone treatment at 2 oz / ac and the remaining treatments. All treatments were extremely effective in controlling black locust; however, there were not enough data points for the Escort / Garlon 3A tank mix to include in analysis.

Table 1: Summary Statistics for Somerset Brush Trial

Trt No.	Type	Treatment Name	Rate	Rate Unit	Appl Description	1		2		3		4		5		6		7	
		Pest Type				W Weed		W Weed		W Weed		W Weed		W Weed		W Weed		W Weed	
		Pest Code				BRUSH		BRUSH		ACRRB		CCSCA		LIRTU		RHUSS		ROBSS	
		Pest Name								Red maple		Eastern redbud		Yellow poplar		Sumach		Locust	
		Rating Date				15/Sep/2005		19/Jul/2006		19/Jul/2006		19/Jul/2006		19/Jul/2006		19/Jul/2006		19/Jul/2006	
		Rating Data Type				CONTRO		CONTRO		CONTRO		CONTRO		CONTRO		CONTRO		CONTRO	
		Rating Unit				%		%		%		%		%		%		%	
		Days After First/Last Applic.				70 70		377 377		377 377		377 377		377 377		377 377		377 377	
		Trt-Eval Interval				70 DA-A		377 DA-A		377 DA-A		377 DA-A		377 DA-A		377 DA-A		377 DA-A	
1	HERB	Escort	1.2	OZ A/A		55	a	45	c	48	a	29	b	40	a	5	b	100	a
	ADJ	NIS	3	PT/A															
2	HERB	Escort	1.8	OZ A/A		67	a	60	bc	75	a	27	b	70	a	74	a	100	a
	ADJ	NIS	3	PT/A															
3	HERB	Escort	1.2	OZ A/A		67	a	84	ab	49	a	100	a	98	a	100	a		
	HERB	Garlon 3A	24	OZ A/A															
	ADJ	NIS	3	PT/A															
4	HERB	Escort	1.2	OZ A/A		95	a	92	a	66	a	99	a	100	a	100	a	100	a
	HERB	Garlon 3A	24	OZ A/A															
	HERB	Krenite	96	OZ A/A															
	ADJ	NIS	3	PT/A															
5	HERB	Escort	1.2	OZ A/A		61	a	62	bc	27	a	55	ab	80	a	67	a	100	a
	HERB	Krenite	96	OZ A/A															
	ADJ	NIS	3	PT/A															
		LSD (P=.05)				42.7		26.8		54.9		48.8		272.5		52.4		0.0	
		Standard Deviation				22.7		14.2		24.2		21.5		26.3		20.2		0.0	
		CV				32.82		20.69		45.93		34.91		33.89		29.13		0.0	
		Grand Mean				69.07		68.78		52.7		61.7		77.5		69.17		100.0	
		Bartlett's X2				4.86		6.751		5.552		3.939		2.549		1.457		0.0	
		P(Bartlett's X2)				0.182		0.15		0.235		0.268		0.11		0.483		.	
		Replicate F				0.720		5.658		0.094		0.763		0.089		0.326		0.000	
		Replicate Prob(F)				0.5156		0.0294		0.9124		0.5239		0.9215		0.7443		1.0000	
		Treatment F				1.371		5.376		1.743		8.378		2.582		11.180		0.000	
		Treatment Prob(F)				0.3255		0.0212		0.3019		0.0317		0.4326		0.0379		1.0000	

Means followed by same letter do not significantly differ (P=.05, LSD)

Chinese Silvergrass and Japanese Knotweed Control 1 Year After Treatment

Control of Chinese Silvergrass (*Miscanthus sinensis* Anderss.)

Introduction

Chinese silvergrass, often times simply referred to as miscanthus, is a non-native bunchgrass that has become widespread in the eastern and southern parts of the United States. Occurrences are also being reported in Missouri, Illinois, Colorado, and California. Native to eastern Asia, this warm season grass species is used for bio-energy and paper pulp on Europe and Asia as well as erosion control and field hedges (Morisawa 1999). In the United States, *M. sinensis* is still widely sold as an ornamental with several varieties being imported and sold (Miller 2003).

The grass is a tall perennial that forms dense clumps. Leaves are upright, curly tipped with white midribs, approximately 2 centimeters wide, and can attain heights up to 1.5 – 2 meters. Plants flower in September through November and are pink to red at first turning brown to tan in the fall. Preferred habitats include sites with full sunlight and well drained soils. Reproduction by seed is not as common as sprouting from an extensive subterranean rhizomatous system. This characteristic allows Chinese silvergrass to form dense and extensive infestations along forest edges, roadsides, and other disturbed sites. Although not as aggressive as other invasive grasses, Chinese silvergrass is problematic in forest and roadside situations as leaves are extremely flammable and can be easily ignited.

Control options available appear to be limited. Mechanical control (mowing, burning, manual removal) does not appear to be effective as the entire root system will need to be removed to obtain complete control (Morisawa 1999). Mechanical control may also lead to the spread of the plant. Current chemical control recommendations are limited and include a foliar spray of a 2% glyphosate solution, a 1% imazapyr solution, or a combination of the two.

Chinese silvergrass has become established along Kentucky roadsides in the eastern regions of the state. These infestations are a concern due to line of sight issues, potential for fire, and mowing costs. A study was initiated in June 2005 to examine several herbicides available for grass control to evaluate their effectiveness on Chinese silvergrass.

Methods and Materials

The study was installed directly behind a guardrail on the eastbound lane of the Mountain Parkway in Wolfe County. Active ingredients tested included glyphosate, imazapyr, sulfosulfuron, clethodim, fluazifop + fenoxyprop, and imazapic (Table 1). Plots were 15’ X 10’ and arranged in a completely randomized block with 3 replications. Treatments were applied on June 21, 2005 at 20 GPA using a TeeJet® Boomless tip mounted on the rear of an ATV. Plots were evaluated for visual percent control at 31 and 61 DAT.

Table 1: Treatment list for Miscanthus trial in Eastern Kentucky

Treatment	Compounds	Active Ingredients	Rate per acre
1	Arsenal + RoundUp Pro	Imazapyr + glyphosate	2 pt + 1.5 qt
2	Arsenal	Imazapyr	2 pt
3	RoundUp Pro	Glyphosate	1.5 qt
4	Outrider	Sulfosulfuron	1.25 oz
5	Outrider	Sulfosulfuron	1.67 oz
6	Envoy	Clethodim	18 fl oz
7	Envoy	Clethodim	24 fl oz
8	Fusion	Fluazifop + fenoxyprop	7 fl oz
9	Fusion	Fluazifop + fenoxyprop	9 fl oz
10	Plateau	Imazapic	8 fl oz
11	Plateau	Imazapic	12 fl oz

Results

Treatments that included RoundUp Pro had statistically higher control rates than those that did not at all evaluation intervals (Table 2). The addition of RoundUp Pro to the Arsenal treatment dramatically increased control levels at 31 and 62 DAT and statistically increased control levels at 359 DAT. There was no significant increase in control levels with the Arsenal / RoundUp tank mix versus RoundUp alone.

Outrider failed to provide satisfactory control which is consistent with other warm season grass applications with this product. Outrider is labeled for cool season grass control, such as tall fescue, and had documented tolerance on warm season grasses, such as big bluestem. Envoy, a graminicide, provided higher control levels than Fusion, another type of graminicide, yet both products provided overall unsatisfactory control levels at the evaluation periods. Plateau provided extremely low levels of control in 2005. Outrider, Envoy, Fusion, and Plateau had no effect on Miscanthus 1 YAT.

Future work with Miscanthus will include the use of a MSO in combination with Arsenal to determine if MSO will increase herbicide efficacy. The study area used in 2005 will be retreated in 2006 to determine the effect of sequential applications of Round Up and Arsenal in increasing control levels from those reported here.

Table 2: Summary statistics for Miscanthus trial in Eastern Kentucky

Trt No.	Type	Treatment Name	Rate	Rate Unit	Visual Percent Control 31 DAT		62 DAT		359 DAT	
1	HERB HERB	Arsenal RoundUp Pro	2 1.5	PT/A QT/A	80	a	92	a	85	a
2	HERB ADJ	Arsenal NIS	2 0.25	PT/A % V/V	15	bc	17	cd	62	b
3	HERB	RoundUp Pro	1.5	QT/A	72	a	88	a	82	a
4	HERB ADJ	Outrider NIS	1.25 0.25	OZ/A % V/V	7	c	5	d	0	c
5	HERB ADJ	Outrider NIS	1.67 0.25	OZ/A % V/V	8	c	3	d	0	c
6	HERB ADJ	Envoy COC	18 1	FL OZ/A % V/V	18	bc	52	b	0	c
7	HERB ADJ	Envoy COC	24 1	FL OZ/A % V/V	30	b	50	b	0	c
8	HERB ADJ	Fusion COC	7 1	FL OZ/A % V/V	12	bc	35	bc	0	c
9	HERB ADJ	Fusion COC	9 1	FL OZ/A % V/V	18	bc	23	cd	0	c
10	HERB ADJ	Plateau NIS	8 0.25	FL OZ/A % V/V	5	c	12	d	0	c
11	HERB ADJ	Plateau NIS	12 0.25	FL OZ/A % V/V	8	c	8	d	0	c
12	CHK	Untreated Check			0		0		0	

Note: Treatment means followed by the same letter are not statistically different using Fishers LSD at p = 0.05.

Literature Cited

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Evaluation of Imazapyr, Glyphosate, and Triclopyr for Japanese Knotweed (*Polygonum cuspidatum* Sieb. & Zucc.) Control

Introduction

Japanese knotweed is a federally listed invasive perennial native to Asia (National Agricultural Library 2004). This herbaceous plant (sometime referred to as semi woody) was introduced into England in the early 1800s and was subsequently introduced into North America as an ornamental (Figueroa 1989, Uva et al 1997). This species has now spread across the Pacific Northwest, Midwest, and eastern United States (USDA NRCS 2004).

Japanese knotweed is problematic for land managers due to its aggressive nature and reproduction capabilities. The plant can establish itself on a wide array of site conditions but can establish and grow exceedingly well in areas of partial to high sunlight and moist well-drained soils such as roadsides, utility rights-of-way, and river and stream banks (McCormick 2000, Uva et al 1997). Stems are hollow and jointed, much like bamboo, and can reach heights up to 2 meters (approximately 10 feet). Plants form either male and female white flowers (dioecious) in late summer and form three sided seed like fruit. There is some confusion as whether or not seeds produced from plants naturalized in the United States are viable. Pure strains of Japanese, giant, or Himalayan knotweed are thought not to produce viable seed while hybrid varieties can produce viable seeds (Soll 2004). Japanese knotweed can also reproduce vegetatively from thick rhizomes that can reach 40 to 60 feet in length and annual growth of 8 feet is not uncommon (McCormick 2000). This vegetative reproduction can lead to the formation of dense colonies of Japanese knotweed that can out compete native species. Above ground portions usually die with a hard frost while the below ground rhizomes remain viable for growth the following year.

Individual plant parts created from mechanical mowing can remain viable and lead to the spread of this plant. Due to its habitat usually occurring near flowing water, flooding disturbances can transport plant parts to be deposited in uncolonized areas further compounding the problem. Homeowner mowing clippings and vehicle transport of plant parts have also lead to the spread of Japanese knotweed (Figueroa 1989).

Methods and Materials

A study was initiated in June of 2005 to evaluate herbicides labeled for use near and around aquatic areas. Treatments included glyphosate (formulated as Aquamaster®), imazapyr (formulated as Habitat®), and triclopyr (formulated as Garlon 3A®). The study was located along Bonnyman Road in Perry County, KY. Five treatments were installed in a completely randomized block design with three replications and applied at 50 GPA using a boomless tip mounted on a CO_2 sprayer on an ATV. All treatments included NIS at 0.25 % v/v. Plots were evaluated for percent control (estimated by burndown) at 21 and 58 DAT.

Results and Discussion

The combination of Aquamaster and Garlon 3A provided significantly higher control levels (88%) at 21 DAT than all other treatments (Table 1). Aquamaster at 5 qt / ac provided the next highest level of control (57 %) at the same evaluation interval. Habitat at 3 pt / ac was not effective (12 %) at 21 DAT. The Aquamaster / Garlon 3A tank mix resulted in high control levels (95 %) at 58 DAT and was statistically higher than all other treatments. There were no statistical differences among the remaining treatments at 58 DAT and these treatments did not exceed 42 % control.

The Habitat at 3 pt / ac treatment provided the highest level of control (95 %) 1 growing season after treatment (1 GSAT) (Table 1). The Habitat alone treatment also resulted in the lowest amount of variance in control levels 1 GSAT (Figure 1). This indicates the consistent level of control provided by Habitat at 3 pt / ac in this trial. Aquamaster alone and Aquamaster + Habitat provided the next highest levels of control (82 % and 77 % respectively) at the same evaluation interval. There were no significant differences between these three treatments 1 GSAT. Treatments using Renovate 3 resulted in extremely poor control levels 1 GSAT. This indicates triclopyr's ability to provide quick burndown of Japanese knotweed in the same growing season of application but its inability to provide long term control.

Table 1: Control of Japanese Knotweed

Trt No.	Type	Treatment Name	Rate	Rate Unit	Percent Control 31 DAT	58 DAT	58 DAT(t)	333 DAT
1	HERB HERB ADJ	Aquamaster Habitat NIS	5 4 0.25	QT/A FL OZ/A % V/V	40b	30b	30b	77a
2	HERB ADJ	Aquamaster NIS	5 0.25	QT/A % V/V	57b	42b	39b	82a
3	HERB ADJ	Habitat NIS	3 0.25	PT/A % V/V	12c	23b	23b	95a
4	HERB ADJ	Renovate 3 NIS	2 0.25	QT/A % V/V	40b	47b	42b	0b
5	HERB HERB ADJ	Aquamaster Renovate 3 NIS	5 2 0.25	QT/A QT/A % V/V	88a	95a	95a	10b
6	CHK	Untreated Check			0	0	0	0
LSD (P=.05)					20.6	26.3	0.3t	20.4
Standard Deviation					10.9	14.0	0.1t	10.8
CV					23.1	29.55	8.56	20.58
Grand Mean					47.33	47.27	1.62t	52.67
Bartlett's X2					8.894	10.379	9.488	0.78
P(Bartlett's X2)					0.064	0.035*	0.05	0.677

Means followed by same letter do not significantly differ (P=.05, LSD)
t=Mean descriptions are reported in transformed data units, and are not de-transformed.
Untreated treatment(s) 6 excluded from analysis.
Data Column 3: TL[Data Column 2] = LOG([Data Column 2]+ 1)

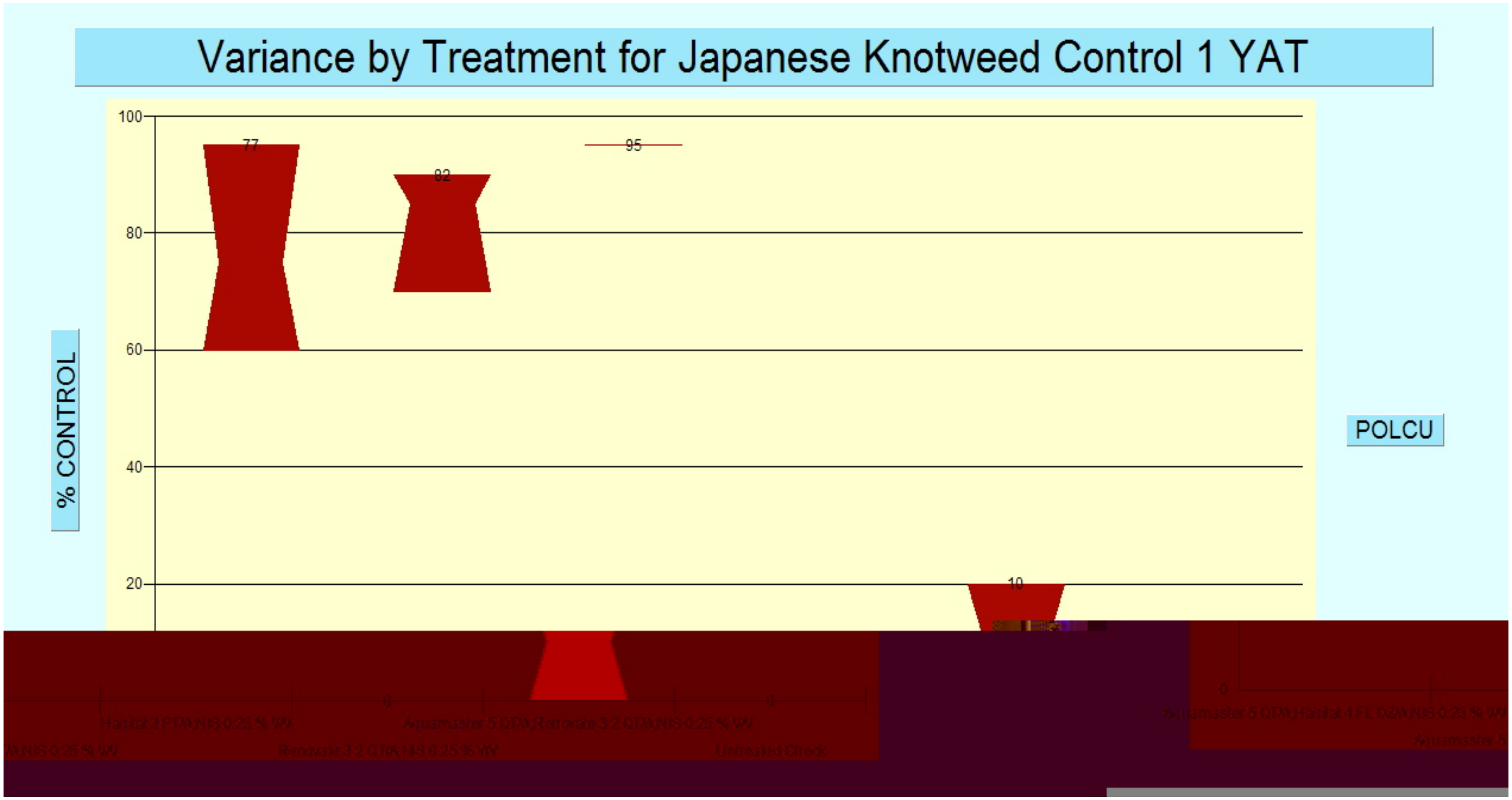

Figure 1: Treatment Variance for Japanese Knotweed Control 1 Growing Season after Treatment.
(Color bars represent the range of control levels for three replications of each treatment.)

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On-Going Trials Installed in 2006

Several trials were installed in 2006 with no data collected. The following is a brief summary of objectives, methods, and expected data collection for these trials.

Wet Blade ® Evaluation

The Wet Blade is an integrated mower that combines mowing capabilities and herbicide application in one pass. Herbicide is applied at high concentrations and low rates (2.5 GPA) by using centrifugal force to run herbicide along the bottom of the cutting blade and applying herbicide as it cuts. This piece of equipment was evaluated in 2005 as a demonstration and yielded poor results for reducing hardwood sprouts after cutting. We wanted to re-evaluate the Wet Blade in a replicated trial in 2006.

The trial was installed in Lewis County to evaluate the Wet Blade's effectiveness in application of cut stump treatments and compare several herbicide options. Five herbicide treatments and one untreated check were evaluated in a randomized complete block design with three replications (Table 1). Dominant woody species included sourwood, black cherry, winged sumac, and sweetgum. The site had been previously mowed and woody species were approximately 1-2 years old. All treatments listed below were mixed in water and DID NOT include a nonionic surfactant. Treatments were applied at 2.5 GPA on August 29, 2006. Plots will be evaluated in the summer of 2007 for number of sprouts and be compared to the mowed only plots.

Table 1: Treatment list for Wet Blade Trial

Treatment	Herbicide	Rates
1	Garlon 3A	25 % v/v
2	Garlon 3A	50 % v/v
3	Garlon 3A + Milestone VM	25 % v/v + 2 % v/v
4	Garlon 3A + HiDep	25 % v/v + 25 % v/v
5	Garlon 3A + Arsenal	25 % v/v + 2 % v/v
6	Mowed	

Bush Honeysuckle Control with Cut Stump and Foliar-Applied Herbicide Treatments

Bush honeysuckle is a problematic woody species in the central and northern regions of Kentucky. This species is a prolific sprouter and as stands are cut to increase line of sight for motorists the density of a stand will undoubtedly increase. As the most common treatment method for bush honeysuckle on Kentucky roadsides is mechanical removal with herbicide cut stump treatments, a trial was installed in northern Kentucky to evaluate cut stump herbicide options.

The trial is located at I-275 and Three Mile Road in Campbell County (near Northern Kentucky University). The original study was initially only examining cut stump treatments. Foliar treatments were added to the cut stump treatments after the site was initially cut due to the abundance of bush honeysuckle saplings present. Six treatments were installed in randomized complete block design with three replications and plots 15’ X 20’ (Table 2). All treatments were mixed in water with the exception of Garlon 4 which was blended with HyGrade mineral oil. Stumps were re-cut and all treatments applied on August 18, 2006. Plots will be evaluated in the summer of 2007 for sprout abundance and control.

Treatment	Herbicide	Rate	Application Method
1	Tordon RTU	100 %	Cut Stump
2	RoundUp Pro RoundUp Pro	25 % v/v 2 % v/v	Cut Stump Foliar
3	Arsenal Arsenal	20 % v/v 2 % v/v	Cut Stump Foliar
4	Garlon 4 Garlon 4	20 % v/v 20 % v/v	Cut Stump Basal Stem
5	Tordon RTU Garlon 3A + Escort	100 % 2 qt / ac + 0.5 oz / ac	Cut Stump Foliar
6	RoundUp Pro + Arsenal	49 % v/v + 1.5 % v/v	Cut Stump

Comparison of Fertilizer Formulation for Nitrogen Availability

Fertilizer formulations come in a wide array of concentrations of active ingredients (i.e nitrogen, phosphorus, and potassium). Although concentrations of active ingredients are different in some products, as long as a base rate is applied (lb of N per acre), turf species should have similar responses to different products.

A new commercial fertilizer is now available for industrial and lawn uses. Louisville Green®, manufactured by Louisville / Jefferson County Metropolitan Sewer District (MSD) in Louisville, KY, is a fertilizer composed of highly treated organic solids left over from wastewater treatment. This product is pelletized and is 5-3-0 fertilizer (5 % N, 3 % P, 0 % K). End-users of this product have noticed that there is the potential for 2 sequential applications of Louisville Green as a fertilizer 6 weeks apart to deter deer from the site of application. The KTC, in cooperation with the KDFW, are conducting a study along sections of Kentucky highways that have a high incident of deer-vehicle incursions. The study will determine if Louisville Green can alter deer travel patterns along highways to prevent collisions. Since this product is purported to have fertilizing capabilities, a trial was installed in Lexington, KY comparing commercially available fertilizers and Louisville Green and their effect on cool season grasses.

Three treatments and one untreated check were installed in a randomized complete block design with four replications (Table 3). Plots were 10’ by 30’ and treatments were applied with hand spreader. All fertilizers were applied at 1 lb N per 1000 sq ft. The Louisville Green treatment was a sequential application (one application mid fall 2006 and another winter 2006) with total application rate equaling 1 lb N per 1000 sq ft. Dry weight samples of cool season grasses will be taken in the summer of

2007 to determine if any difference exists between the 3 fertilizers and concentrations of active N.

Table 3: Fertilizers Tested in 2006

Trt	Fertilizer	Concentration of N	Rate
1	Ammonium Nitrate	33.5 %	1 lb N per 1000 ft^2
2	Louisville Green	5 %	1 lb N per 1000 ft^2
3	Triple 19	19 %	1 lb N per 1000 ft^2
4	Untreated		