Noncrop and Industrial Vegetation Management Weed Science

2005 Annual Research Report

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

M.P. Blair and W.W. Witt

University of Kentucky
College of Agriculture
Department of Plant and Soil Sciences
Lexington, KY 40546-0312

INFORMATION NOTE 2006 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 2005. This document is primarily for the use of the Kentucky Transportation Cabinet. Other use is allowable given proper credit 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)

Any questions, concerns, complaints, or praise regarding this publication should be directed to:

Mitch Blair
Vegetation Management Research Specialist

Dr. William Witt
Professor, Weed Science

University of Kentucky
College of Agriculture
Department of Plant and Soil Science
108 Plant Science Building
Lexington, KY 40546-0312
859.257.5020

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Appreciation is extended to Brett Wilson and Hopkins County Coal along with Paul Merrick and South Kentucky RECC for providing land area to perform serecia lespedeza and brush research, respectively.

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
Riverdale / NuFarm Inc
Townsend Chemical

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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
Ambrosia artemisiifolia L.	Common ragweed
Ambrosia trifida L.	Giant ragweed
Carduus nutans L.	Musk thistle
Conyza canadensis (L.) Cronq.	Marestail
Festuca arundinacea Schreb.	Tall fescue
Lespedeza cuneata Dumont	Serecia lespedeza
Lespedeza procumbens Michaux.	Decumbent lespedeza
Lonicera maackii (Rupr.) Herder	Amur honeysuckle
Lonicera morrowii Gray	Morrow's honeysuckle
Lonicera tatarica L.	Tatarian honeysuckle
Lythrum salicaria L.	Purple loosestrife
Micanthus sinensis Anderss.	Chinese silvergrass
Phragmites australis (CAV.) Trin. *Ex* Steud.	Common reed
Plantago lanceolate L.	Buckhorn plantain
Polygonum cuspidatum Sieb. & Zucc.	Japanese knotweed
Setaria glauca (L.) Beauv.	Yellow foxtail
Trifolium pretense L.	Red clover
Trifolium repens L.	White clover

2005 Field Season Weather Data
Eastern Kentucky

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	03-01-2005	29	23	26	0.09							
Jackson	03-02-2005	36	21	28	0.01							
Jackson	03-03-2005	41	20	30								
Jackson	03-04-2005	56	28	42	T							
Jackson	03-05-2005	47	38	42	0.17							
Jackson	03-06-2005	59	35	47								
Jackson	03-07-2005	63	46	54	T							
Jackson	03-08-2005	32	27	30	0.68							
Jackson	03-09-2005	41	21	31	T							
Jackson	03-10-2005	41	24	32								
Jackson	03-11-2005	38	32	35	0.20							
Jackson	03-12-2005	52	30	41	0.18							
Jackson	03-13-2005	40	33	36	0.05							
Jackson	03-14-2005	48	27	38	0.01							
Jackson	03-15-2005	51	27	39								
Jackson	03-16-2005	42	31	36	0.01							
Jackson	03-17-2005	53	33	43	0.01							
Jackson	03-18-2005	61	32	46								
Jackson	03-19-2005	56	42	49	0.04							
Jackson	03-20-2005	54	35	44	0.01							
Jackson	03-21-2005	57	33	45								
Jackson	03-22-2005	63	35	49	0.01							
Jackson	03-23-2005	66	50	58	0.43							
Jackson	03-24-2005	45	37	41	T							
Jackson	03-25-2005	62	40	51	0.05							
Jackson	03-26-2005	66	41	54								
Jackson	03-27-2005	60	46	53	0.09							
Jackson	03-28-2005	57	47	52	1.25							
Jackson	03-29-2005	69	42	56	0.07							
Jackson	03-30-2005	82	52	67								
Jackson	03-31-2005	73	57	65	0.13							

Summary for Jackson for the period 3-1-2005 through 3-31-2005:

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	53	35	44	3.49							
(Deviation from normal)	-1	+1	-0	-0.85							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	04-01-2005	55	51	53	0.44							
Jackson	04-02-2005	41	38	40	1.54							
Jackson	04-03-2005	61	37	49	0.02							
Jackson	04-04-2005	75	46	60								
Jackson	04-05-2005	82	56	69								
Jackson	04-06-2005	81	63	72								
Jackson	04-07-2005	69	65	67	0.03							
Jackson	04-08-2005	71	56	64								
Jackson	04-09-2005	79	51	65								
Jackson	04-10-2005	83	59	71								
Jackson	04-11-2005	83	61	72								
Jackson	04-12-2005	67	56	62	0.23							
Jackson	04-13-2005	57	50	54	0.58							
Jackson	04-14-2005	68	42	55	0.03							
Jackson	04-15-2005	73	46	60								
Jackson	04-16-2005	73	48	60								
Jackson	04-17-2005	78	46	62								
Jackson	04-18-2005	81	54	68								
Jackson	04-19-2005	81	56	68								
Jackson	04-20-2005	81	59	70								
Jackson	04-21-2005	79	59	69	0.13							
Jackson	04-22-2005	75	56	66	0.01							
Jackson	04-23-2005	44	39	42	0.38							
Jackson	04-24-2005	45	32	38	0.20							
Jackson	04-25-2005	64	42	53								
Jackson	04-26-2005	59	49	54	0.17							
Jackson	04-27-2005	58	44	51	0.17							
Jackson	04-28-2005	61	39	50	0.14							
Jackson	04-29-2005	64	47	56	0.93							
Jackson	04-30-2005	58	50	54	2.47							

Summary for Jackson for the period 4-1-2005 through 4-30-2005:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	68	50	59	7.47							
(Deviation from normal)	+3	+5	+4	+3.37							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	05-01-2005	61	42	52								
Jackson	05-02-2005	56	43	50								
Jackson	05-03-2005	56	34	45								
Jackson	05-04-2005	64	36	50								
Jackson	05-05-2005	70	47	58								
Jackson	05-06-2005	73	50	62								
Jackson	05-07-2005	77	47	62								
Jackson	05-08-2005	80	56	68								
Jackson	05-09-2005	84	57	70								
Jackson	05-10-2005	79	63	71								
Jackson	05-11-2005	86	59	72								
Jackson	05-12-2005	82	62	72								
Jackson	05-13-2005	88	59	74	0.01							
Jackson	05-14-2005	81	64	72	0.10							
Jackson	05-15-2005	70	53	62	0.01							
Jackson	05-16-2005	62	43	52								
Jackson	05-17-2005	74	46	60								
Jackson	05-18-2005	81	53	67								
Jackson	05-19-2005	83	57	70	0.19							
Jackson	05-20-2005	73	58	66	0.85							
Jackson	05-21-2005	72	52	62	0.37							
Jackson	05-22-2005	75	50	62								
Jackson	05-23-2005	77	59	68	0.95							
Jackson	05-24-2005	63	54	58	0.01							
Jackson	05-25-2005	66	48	57								
Jackson	05-26-2005	77	49	63								
Jackson	05-27-2005	78	58	68								
Jackson	05-28-2005	75	55	65	0.01							
Jackson	05-29-2005	78	55	66								
Jackson	05-30-2005	79	56	68								
Jackson	05-31-2005	77	55	66								

Summary for Jackson for the period 5-1-2005 through 5-31-2005:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	74	52	63	2.50							
(Deviation from normal)	-2	-3	-2	-1.98							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Jackson	06-01-2005	75	59	67	0.08							
Jackson	06-02-2005	73	57	65	0.20							
Jackson	06-03-2005	74	61	68	0.52							
Jackson	06-04-2005	84	64	74								
Jackson	06-05-2005	88	65	76								
Jackson	06-06-2005	91	71	81								
Jackson	06-07-2005	81	66	74	0.02							
Jackson	06-08-2005	85	69	77	0.03							
Jackson	06-09-2005	85	69	77	T							
Jackson	06-10-2005	89	71	80								
Jackson	06-11-2005	80	68	74	1.27							
Jackson	06-12-2005	88	69	78	T							
Jackson	06-13-2005	83	70	76	0.07							
Jackson	06-14-2005	88	69	78	0.05							
Jackson	06-15-2005	83	64	74	T							
Jackson	06-16-2005	77	63	70								
Jackson	06-17-2005	78	55	66								
Jackson	06-18-2005	79	60	70								
Jackson	06-19-2005	82	59	70								
Jackson	06-20-2005	81	60	70								
Jackson	06-21-2005	81	60	70	0.24							
Jackson	06-22-2005	85	62	74								
Jackson	06-23-2005	87	60	74								
Jackson	06-24-2005	90	63	76								
Jackson	06-25-2005	91	67	79								
Jackson	06-26-2005	90	70	80								
Jackson	06-27-2005	86	71	78	0.05							
Jackson	06-28-2005	88	69	78	0.19							
Jackson	06-29-2005	89	69	79								
Jackson	06-30-2005	91	68	80	0.06							

Summary for Jackson for the period 6-1-2005 through 6-30-2005:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Jackson	84	65	74	2.78							
(Deviation from normal)	+1	+3	+2	-1.04							

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	07-01-2005	88	67	78	1.11							
Jackson	07-02-2005	85	65	75								
Jackson	07-03-2005	85	67	76	0.09							
Jackson	07-04-2005	88	69	78								
Jackson	07-05-2005	83	68	76	T							
Jackson	07-06-2005	82	69	76	0.10							
Jackson	07-07-2005	74	66	70	0.39							
Jackson	07-08-2005	84	60	72								
Jackson	07-09-2005	87	65	76								
Jackson	07-10-2005	87	68	78								
Jackson	07-11-2005	82	72	77	0.17							
Jackson	07-12-2005	85	75	80								
Jackson	07-13-2005	71	69	70	0.54							
Jackson	07-14-2005	78	68	73	0.78							
Jackson	07-15-2005	84	71	78	T							
Jackson	07-16-2005	83	72	78	0.03							
Jackson	07-17-2005	86	72	79	0.05							
Jackson	07-18-2005	86	72	79	0.16							
Jackson	07-19-2005	82	72	77	0.19							
Jackson	07-20-2005	88	71	80								
Jackson	07-21-2005	89	72	80	0.15							
Jackson	07-22-2005	86	71	78								
Jackson	07-23-2005	88	70	79								
Jackson	07-24-2005	90	68	79								
Jackson	07-25-2005	93	71	82								
Jackson	07-26-2005	94	75	84								
Jackson	07-27-2005	91	71	81	0.30							
Jackson	07-28-2005	78	68	73	0.02							
Jackson	07-29-2005	85	67	76								
Jackson	07-30-2005	86	67	76								
Jackson	07-31-2005	89	68	78								

Summary for Jackson for the period 7-1-2005 through 7-31-2005:

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	85	69	77	4.08							
(Deviation from normal)	-1	+5	+2	-1.17							

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	08-01-2005	89	67	78								
Jackson	08-02-2005	92	68	80								
Jackson	08-03-2005	94	70	82								
Jackson	08-04-2005	95	68	82								
Jackson	08-05-2005	93	70	82								
Jackson	08-06-2005	91	67	79								
Jackson	08-07-2005	87	68	78								
Jackson	08-08-2005	76	68	72	0.01							
Jackson	08-09-2005	89	64	76								
Jackson	08-10-2005	94	68	81								
Jackson	08-11-2005	93	69	81								
Jackson	08-12-2005	97	71	84								
Jackson	08-13-2005	95	69	82	0.65							
Jackson	08-14-2005	93	69	81								
Jackson	08-15-2005	92	69	80								
Jackson	08-16-2005	86	70	78	0.87							
Jackson	08-17-2005	83	71	77	0.25							
Jackson	08-18-2005	84	72	78	0.07							
Jackson	08-19-2005	92	74	83	0.05							
Jackson	08-20-2005	94	74	84	0.63							
Jackson	08-21-2005	89	72	80	0.01							
Jackson	08-22-2005	84	67	76								
Jackson	08-23-2005	84	64	74								
Jackson	08-24-2005	84	60	72								
Jackson	08-25-2005	89	64	76								
Jackson	08-26-2005	76	71	74	0.41							
Jackson	08-27-2005	83	70	76	0.66							
Jackson	08-28-2005	87	69	78								
Jackson	08-29-2005	78	69	74	0.14							
Jackson	08-30-2005	81	71	76	0.09							
Jackson	08-31-2005	79	67	73	0.08							

Summary for Jackson for the period 8-1-2005 through 8-31-2005:

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	88	69	78	3.92							
(Deviation from normal)	+4	+6	+5	-0.09							

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	09-01-2005	83	61	72								
Jackson	09-02-2005	84	64	74								
Jackson	09-03-2005	81	58	70								
Jackson	09-04-2005	80	61	70								
Jackson	09-05-2005	84	59	72								
Jackson	09-06-2005	82	61	72								
Jackson	09-07-2005	84	59	72								
Jackson	09-08-2005	84	59	72								
Jackson	09-09-2005	84	60	72								
Jackson	09-10-2005	88	63	76								
Jackson	09-11-2005	89	64	76								
Jackson	09-12-2005	86	64	75								
Jackson	09-13-2005	86	63	74								
Jackson	09-14-2005	87	62	74								
Jackson	09-15-2005	89	65	77								
Jackson	09-16-2005	83	69	76	T							
Jackson	09-17-2005	81	64	72	T							
Jackson	09-18-2005	83	62	72								
Jackson	09-19-2005	91	62	76								
Jackson	09-20-2005	85	65	75	T							
Jackson	09-21-2005	88	64	76								
Jackson	09-22-2005	91	69	80								
Jackson	09-23-2005	91	68	80								
Jackson	09-24-2005	93	69	81								
Jackson	09-25-2005	88	72	80	T							
Jackson	09-26-2005	74	67	70	0.27							
Jackson	09-27-2005	76	60	68								
Jackson	09-28-2005	85	58	72								
Jackson	09-29-2005	68	57	62	0.24							
Jackson	09-30-2005	76	48	62								

Summary for Jackson for the period 9-1-2005 through 9-30-2005:

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	84	63	73	0.51							
(Deviation from normal)	+6	+7	+7	-3.01							

2005 Field Season Weather Data
Central Kentucky

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	03-01-2005	31	23	27		100	82	40	37	40	37	
Spindletop	03-02-2005	36	19	28		100	47	38	36	39	36	
Spindletop	03-03-2005	39	15	27		89	37	39	35	42	35	
Spindletop	03-04-2005	55	27	41		80	56	42	36	45	36	
Spindletop	03-05-2005	46	38	42	0.06	100	81	41	40	43	40	
Spindletop	03-06-2005	58	32	45		100	37	45	38	48	38	
Spindletop	03-07-2005	56	38	47	0.40	100	53	45	42	47	42	
Spindletop	03-08-2005	37	24	30	0.02	100	57	45	39	45	39	
Spindletop	03-09-2005	38	19	28		100	42	40	36	41	36	
Spindletop	03-10-2005	38	21	30		96	34	38	36	38	36	
Spindletop	03-11-2005	39	31	35	0.07	100	61	38	37	38	36	
Spindletop	03-12-2005	45	30	38	0.05	100	37	39	36	41	36	
Spindletop	03-13-2005	39	28	34		100	54	40	37	43	37	
Spindletop	03-14-2005	45	13	29	0.04	100	38	44	38	47	36	
Spindletop	03-15-2005	47	26	36		75	37	44	38	47	37	
Spindletop	03-16-2005	42	32	37		57	30	43	40	43	39	
Spindletop	03-17-2005	53	34	44		70	27	47	40	50	38	
Spindletop	03-18-2005	58	34	46		69	24	48	41	51	39	
Spindletop	03-19-2005	50	39	44	0.38	100	44	45	43	47	43	
Spindletop	03-20-2005	50	34	42		100	56	47	42	51	41	
Spindletop	03-21-2005	50	30	40		100	45	48	42	52	40	
Spindletop	03-22-2005	53	32	42	0.05	100	47	45	42	46	40	
Spindletop	03-23-2005	50	37	44	0.06	100	100	47	44	49	45	
Spindletop	03-24-2005	42	33	38		100	100	45	43	47	43	
Spindletop	03-25-2005	57	40	48	0.13	100	75	49	44	53	44	
Spindletop	03-26-2005	54	38	46		100	89	50	46	54	45	
Spindletop	03-27-2005	51	42	46	1.03	100	100	48	46	48	46	
Spindletop	03-28-2005	53	44	48	0.47	100	100	48	47	50	47	
Spindletop	03-29-2005	69	36	52		100	32	53	45	59	43	
Spindletop	03-30-2005	78	46	62		79	23	55	49	59	48	
Spindletop	03-31-2005	68	50	59	0.03	100	32	57	53	60	54	

Summary for Spindletop for the period 3-1-2005 through 3-31-2005:

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	49	32	41	2.79	94	54	45	41	47	40	
(Deviation from normal)	-5	-2	-3	-1.61							

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	04-01-2005	51	42	46	0.44	100	63	54	49	53	48	
Spindletop	04-02-2005	46	39	42	0.12	100	58	49	46	48	45	
Spindletop	04-03-2005	62	37	50		66	33	50	44	54	41	
Spindletop	04-04-2005	73	41	57		78	36	55	47	61	45	
Spindletop	04-05-2005	76	51	64		65	27	57	51	61	50	
Spindletop	04-06-2005	75	56	66		80	29	57	53	62	53	
Spindletop	04-07-2005	66	58	62	0.04	100	80	57	55	61	56	
Spindletop	04-08-2005	68	50	59	0.01	100	33	58	55	64	56	
Spindletop	04-09-2005	74	43	58		79	47	59	53	67	52	
Spindletop	04-10-2005	81	52	66		100	35	62	56	72	56	
Spindletop	04-11-2005	78	60	69		95	46	63	59	72	61	
Spindletop	04-12-2005	65	56	60	0.17	100	46	62	59	66	60	
Spindletop	04-13-2005	56	46	51	0.33	100	52	59	56	60	55	
Spindletop	04-14-2005	65	38	52		68	30	57	53	64	49	
Spindletop	04-15-2005	68	40	54		65	30	57	53	65	51	
Spindletop	04-16-2005	70	44	57		61	30	58	54	67	52	
Spindletop	04-17-2005	77	46	62		64	29	59	54	69	54	
Spindletop	04-18-2005	77	55	66		68	35	60	56	72	57	
Spindletop	04-19-2005	77	54	66		75	41	61	57	73	59	
Spindletop	04-20-2005	77	56	66		68	40	61	58	74	61	
Spindletop	04-21-2005	69	52	60	0.04	100	56	61	59	71	62	
Spindletop	04-22-2005	71	53	62	0.38	100	65	61	59	68	62	
Spindletop	04-23-2005	53	35	44	0.17	100	100	59	52	62	50	
Spindletop	04-24-2005	47	33	40	0.01	100	50	52	49	50	46	
Spindletop	04-25-2005	63	41	52		69	31	53	49	59	46	
Spindletop	04-26-2005	59	43	51	0.45	100	48	53	51	55	52	
Spindletop	04-27-2005	54	41	48	0.01	100	48	54	51	57	49	
Spindletop	04-28-2005	59	40	50	0.14	100	47	53	50	55	48	
Spindletop	04-29-2005	60	48	54	0.86	100	100	54	52	57	52	
Spindletop	04-30-2005	57	44	50	0.13	100	70	55	54	56	54	

Summary for Spindletop for the period 4-1-2005 through 4-30-2005:

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	66	46	56	3.30	87	48	57	53	62	53	
(Deviation from normal)	+0	+2	+1	-0.58							

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	05-01-2005	60	38	49		100	33	56	50	59	48	
Spindletop	05-02-2005	53	41	47		71	39	56	52	57	51	
Spindletop	05-03-2005	55	34	44		100	34	56	50	58	48	
Spindletop	05-04-2005	61	36	48		100	32	57	50	62	48	
Spindletop	05-05-2005	69	41	55		77	36	59	52	65	51	
Spindletop	05-06-2005	70	44	57		100	32	63	55	70	55	
Spindletop	05-07-2005	76	48	62		74	40	62	56	70	56	
Spindletop	05-08-2005	80	54	67		100	43	66	59	75	60	
Spindletop	05-09-2005	82	58	70		85	41	67	61	75	63	
Spindletop	05-10-2005 E	79	60	70		99	53	67	63			
Spindletop	05-11-2005	85	60	72		100	41	69	62	79	65	
Spindletop	05-12-2005	74	58	66		100	75	68	65	78	68	
Spindletop	05-13-2005	85	57	71		100	43	69	64	79	66	
Spindletop	05-14-2005	72	55	64	0.63	100	65	67	65	73	66	
Spindletop	05-15-2005	63	45	54		100	50	65	62	70	61	
Spindletop	05-16-2005	63	41	52		100	49	63	58	67	57	
Spindletop	05-17-2005	68	42	55		100	40	65	57	72	56	
Spindletop	05-18-2005	77	46	62		97	46	68	59	76	59	
Spindletop	05-19-2005	79	56	68	0.98	100	57	67	63	73	64	
Spindletop	05-20-2005	73	58	66	0.01	100	62	68	64	73	64	
Spindletop	05-21-2005	71	51	61		100	40	70	64	75	62	
Spindletop	05-22-2005	74	49	62	0.14	100	41	68	63	74	62	
Spindletop	05-23-2005	78	57	68		100	36	68	65	75	64	
Spindletop	05-24-2005	65	51	58		100	49	67	63	71	62	
Spindletop	05-25-2005	68	48	58		100	50	67	62	73	61	
Spindletop	05-26-2005	75	48	62		100	45	69	61	78	61	
Spindletop	05-27-2005	76	58	67		100	31	70	64	80	66	
Spindletop	05-28-2005	75	54	64	0.02	100	37	70	65	79	67	
Spindletop	05-29-2005	77	52	64		100	30	71	64	81	65	
Spindletop	05-30-2005	73	56	64		100	56	69	64	76	67	
Spindletop	05-31-2005	76	49	62		100	41	71	64	80	65	

Summary for Spindletop for the period 5-1-2005 through 5-31-2005:

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	50	61	1.78	97	44	66	60	72	60	
(Deviation from normal)	-4	-5	-4	-2.69							

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	06-01-2005	79	57	68	0.01	100	46	69	65	77	68	
Spindletop	06-02-2005	69	58	64	0.01	100	100	67	65	71	67	
Spindletop	06-03-2005	77	62	70	0.07	100	100	69	65	75	67	
Spindletop	06-04-2005	84	60	72		100	49	73	67	82	68	
Spindletop	06-05-2005	91	66	78		100	44	75	68	86	71	
Spindletop	06-06-2005	92	71	82		100	39	76	71	89	75	
Spindletop	06-07-2005	85	66	76		100	54	76	71	86	75	
Spindletop	06-08-2005	88	68	78		100	46	77	71	88	75	
Spindletop	06-09-2005	90	69	80		100	43	78	72	88	77	
Spindletop	06-10-2005	87	71	79	0.94	100	52	78	73	86	78	
Spindletop	06-11-2005	78	71	74	0.01	100	100	75	73	79	76	
Spindletop	06-12-2005	85	68	76	0.14	100	61	76	73	81	74	
Spindletop	06-13-2005	85	72	78		100	56	77	73	83	75	
Spindletop	06-14-2005	89	69	79	0.10	100	51	77	74	84	75	
Spindletop	06-15-2005	82	65	74		100	42	75	72	82	72	
Spindletop	06-16-2005	77	59	68		100	36	74	70	84	71	
Spindletop	06-17-2005	78	53	66		100	33	72	67	81	69	
Spindletop	06-18-2005	75	60	68		81	49	72	68	80	71	
Spindletop	06-19-2005	79	56	68		100	46	73	67	83	69	
Spindletop	06-20-2005	80	55	68		100	39	73	67	83	70	
Spindletop	06-21-2005	82	57	70		100	36	74	68	83	72	
Spindletop	06-22-2005	88	67	78		77	28	76	69	87	73	
Spindletop	06-23-2005	89	58	74		100	25	77	69	88	73	
Spindletop	06-24-2005	93	64	78		67	20	79	70	90	74	
Spindletop	06-25-2005	95	64	80		100	26	79	72	89	76	
Spindletop	06-26-2005	93	66	80		100	29	80	74	89	77	
Spindletop	06-27-2005	89	72	80		78	46	77	75	82	79	
Spindletop	06-28-2005 E	91	70	80	T	90	30	79	75	85	78	
Spindletop	06-29-2005 E	90	70	80	0.05	100	40	79	75	85	78	
Spindletop	06-30-2005	94	70	82	T	92	38	81	74	82	71	

Summary for Spindletop for the period 6-1-2005 through 6-30-2005:

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	64	75	1.33	96	47	75	70	84	73	
(Deviation from normal)	+2	+2	+2	-2.33							

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	07-01-2005	89	67	78	0.01	94	38	80	75	81	71	
Spindletop	07-02-2005	87	62	74		89	35	79	72	81	69	
Spindletop	07-03-2005	92	64	78	0.08	86	37	80	73	80	69	
Spindletop	07-04-2005 E	93	70	82		90	40	80	78	88	85	
Spindletop	07-05-2005	83	71	77		100	59	80	75	85	78	
Spindletop	07-06-2005	87	67	77		100	38	80	74	86	77	
Spindletop	07-07-2005	83	67	75		100	50	79	75	84	77	
Spindletop	07-08-2005	88	63	76		100	32	81	73	87	75	
Spindletop	07-09-2005	89	63	76		100	21	83	73	90	76	
Spindletop	07-10-2005	91	62	76		76	24	83	74	89	76	
Spindletop	07-11-2005	81	70	76	0.02	100	56	79	76	82	78	
Spindletop	07-12-2005	78	68	73	0.20	100	71	76	74	78	76	
Spindletop	07-13-2005	72	66	69	0.63	100	100	74	73	75	74	
Spindletop	07-14-2005	78	67	72	0.12	100	100	76	72	78	73	
Spindletop	07-15-2005	83	67	75		100	100	78	74	81	75	
Spindletop	07-16-2005	82	72	77	0.02	100	100	79	75	81	76	
Spindletop	07-17-2005	83	71	77	0.27	100	91	80	76	82	76	
Spindletop	07-18-2005	87	71	79	0.10	100	59	81	76	84	76	
Spindletop	07-19-2005	86	69	78	1.85	100	61	81	77	84	78	
Spindletop	07-20-2005	88	70	79		100	65	82	76	85	76	
Spindletop	07-21-2005	90	72	81		100	50	83	77	87	78	
Spindletop	07-22-2005	85	70	78		100	56	82	78	86	79	
Spindletop	07-23-2005	89	69	79		100	44	83	77	88	78	
Spindletop	07-24-2005	90	71	80		100	52	83	78	88	78	
Spindletop	07-25-2005	93	73	83		100	51	84	79	90	80	
Spindletop	07-26-2005	92	77	84		100	45	84	80	91	82	
Spindletop	07-27-2005	83	66	74		100	78	82	79	86	81	
Spindletop	07-28-2005	84	65	74		100	42	82	76	88	78	
Spindletop	07-29-2005	87	61	74		100	36	80	75	87	77	
Spindletop	07-30-2005	87	64	76		100	27	81	75	88	77	
Spindletop	07-31-2005	90	63	76		100	28	82	75	89	77	

Summary for Spindletop for the period 7-1-2005 through 7-31-2005:

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	86	68	77	3.30	98	54	81	75	85	77	
(Deviation from normal)	+0	+3	+2	-1.70							

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	08-01-2005	92	65	78		100	28	82	75	90	78	
Spindletop	08-02-2005	94	65	80		100	29	83	75	90	79	
Spindletop	08-03-2005	96	68	82		100	23	83	76	91	79	
Spindletop	08-04-2005	97	70	84		100	23	84	76	91	80	
Spindletop	08-05-2005	92	70	81		100	40	81	78	87	81	
Spindletop	08-06-2005	86	68	77		100	56	81	76	86	79	
Spindletop	08-07-2005	91	67	79		100	40	82	76	88	79	
Spindletop	08-08-2005	86	65	76		100	46	81	75	86	78	
Spindletop	08-09-2005	91	64	78		100	32	82	75	89	77	
Spindletop	08-10-2005	95	64	80		100	27	83	75	91	78	
Spindletop	08-11-2005	96	71	84		100	32	84	77	91	80	
Spindletop	08-12-2005	97	73	85		100	28	85	78	92	81	
Spindletop	08-13-2005	96	72	84	0.03	100	34	83	79	89	82	
Spindletop	08-14-2005	92	68	80		100	36	82	77	88	78	
Spindletop	08-15-2005	88	69	78		100	47	82	77	88	80	
Spindletop	08-16-2005	78	72	75	0.75	100	100	79	77	83	80	
Spindletop	08-17-2005	85	67	76		100	53	80	76	82	77	
Spindletop	08-18-2005	83	70	76		100	86	79	76	83	77	
Spindletop	08-19-2005	92	70	81	0.24	100	56	81	76	87	77	
Spindletop	08-20-2005	95	74	84		100	44	83	78	89	79	
Spindletop	08-21-2005	90	68	79		100	32	82	77	90	78	
Spindletop	08-22-2005	88	64	76		100	42	79	75	87	76	
Spindletop	08-23-2005	82	62	72		100	40	80	74	86	75	
Spindletop	08-24-2005	85	59	72		100	30	80	73	86	74	
Spindletop	08-25-2005	91	58	74		100	29	80	72	88	74	
Spindletop	08-26-2005	82	73	78	0.11	100	83	78	76	82	79	
Spindletop	08-27-2005	84	72	78	0.02	100	59	78	75	82	77	
Spindletop	08-28-2005	82	68	75	0.21	100	70	76	74	79	76	
Spindletop	08-29-2005	72	68	70	0.23	100	100	74	73	76	74	
Spindletop	08-30-2005	73	70	72	1.58	100	100	74	73	75	74	
Spindletop	08-31-2005	80	65	72	0.17	100	49	75	72	79	73	

Summary for Spindletop for the period 8-1-2005 through 8-31-2005:

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	88	68	78	3.34	100	48	81	76	86	78	
(Deviation from normal)	+4	+5	+5	-0.59							

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	09-01-2005	84	61	72		100	44	76	70	81	71	
Spindletop	09-02-2005	83	65	74		100	29	76	72	81	74	
Spindletop	09-03-2005	80	58	69		100	41	75	70	79	71	
Spindletop	09-04-2005	79	59	69		100	39	75	70	78	71	
Spindletop	09-05-2005	83	55	69		100	44	74	69	79	69	
Spindletop	09-06-2005	84	60	72		100	42	75	70	80	70	
Spindletop	09-07-2005	83	56	70		100	40	74	69	80	70	
Spindletop	09-08-2005	83	57	70		100	45	74	68	80	70	
Spindletop	09-09-2005	87	63	75		100	47	75	70	80	72	
Spindletop	09-10-2005	86	62	74		100	38	75	70	81	72	
Spindletop	09-11-2005	87	62	74		100	32	75	70	82	72	
Spindletop	09-12-2005	86	58	72		100	36	75	69	82	72	
Spindletop	09-13-2005	86	61	74		100	32	75	70	82	73	
Spindletop	09-14-2005	82	62	72		100	57	74	69	79	72	
Spindletop	09-15-2005	88	63	76		100	44	75	70	81	72	
Spindletop	09-16-2005	83	66	74	0.07	100	60	75	72	81	75	
Spindletop	09-17-2005	76	63	70		100	58	73	71	78	74	
Spindletop	09-18-2005	81	60	70		100	46	74	69	79	71	
Spindletop	09-19-2005	89	59	74	0.27	100	32	75	68	81	70	
Spindletop	09-20-2005	80	65	72	0.39	100	54	74	71	80	73	
Spindletop	09-21-2005	86	60	73		100	43	74	69	81	71	
Spindletop	09-22-2005	87	60	74		100	52	74	69	80	71	
Spindletop	09-23-2005	88	70	79		100	49	75	71	81	73	
Spindletop	09-24-2005	89	68	78		100	43	76	72	81	74	
Spindletop	09-25-2005	82	71	76		100	50	74	72	77	74	
Spindletop	09-26-2005	76	62	69	0.18	100	79	72	71	76	73	
Spindletop	09-27-2005	76	56	66		100	48	71	68	77	69	
Spindletop	09-28-2005	83	54	68		100	42	70	65	75	66	
Spindletop	09-29-2005	75	48	62	0.08	100	42	70	65	74	67	
Spindletop	09-30-2005	73	42	58		100	30	66	60	72	61	

Summary for Spindletop for the period 9-1-2005 through 9-30-2005:

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	83	60	72	0.99	100	45	74	69	79	71	
(Deviation from normal)	+5	+5	+5	-2.21							

2005 Field Season Weather Data
Western Kentucky

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	03-01-2005	36	24	30		88	51	45	40			
Princeton	03-02-2005	48	17	32		100	23	42	38			
Princeton	03-03-2005	53	23	38		94	26	46	40			
Princeton	03-04-2005	64	33	48		98	42	49	43			
Princeton	03-05-2005	63	41	52		90	50	49	44			
Princeton	03-06-2005	64	27	46		100	30	51	46			
Princeton	03-07-2005	62	40	51	0.52	100	40	50	43			
Princeton	03-08-2005	53	31	42	0.10	100	33	51	45			
Princeton	03-09-2005	47	24	36		100	36	48	42			
Princeton	03-10-2005	50	20	35		100	32	44	40			
Princeton	03-11-2005	50	35	42	T	100	38	44	44			
Princeton	03-12-2005	71	41	56		62	22	52	43			
Princeton	03-13-2005	60	30	45		80	50	51	43			
Princeton	03-14-2005	52	23	38		100	19	55	40			
Princeton	03-15-2005	49	29	39		63	29	50	41			
Princeton	03-16-2005	48	38	43		74	29	46	43			
Princeton	03-17-2005	59	33	46		64	20	53	45			
Princeton	03-18-2005	60	35	48		98	35	51	45			
Princeton	03-19-2005	65	42	54		90	30	52	46			
Princeton	03-20-2005	60	28	44		100	30	53	46			
Princeton	03-21-2005	63	35	49		100	25	46	44			
Princeton	03-22-2005	62	41	52	0.16	100	30	59	52			
Princeton	03-23-2005	58	44	51	0.02	100	94	59	52			
Princeton	03-24-2005	48	40	44		100	85	50	50			
Princeton	03-25-2005	70	43	56	0.04	100	40	50	49			
Princeton	03-26-2005	70	46	58		100	65	60	50			
Princeton	03-27-2005	52	43	48	1.08	100	100	58	48			
Princeton	03-28-2005	62	38	50	1.98	100	40	59	49			
Princeton	03-29-2005	75	36	56		100	30	63	49			
Princeton	03-30-2005	75	56	66		66	20	61	55			
Princeton	03-31-2005	75	47	61	0.21	100	16	65	56			

Summary for Princeton for the period 3-1-2005 through 3-31-2005:

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	59	35	47	4.11	92	39	52	46			
(Deviation from normal)	-2	-1	-1	-0.83							

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	04-01-2005	71	49	60	0.38	100	30	67	56			
Princeton	04-02-2005	59	38	48	0.11	100	35	65	55			
Princeton	04-03-2005	69	39	54		85	30	66	55			
Princeton	04-04-2005	77	55	66		62	28	60	49			
Princeton	04-05-2005	78	53	66		68	39	64	56			
Princeton	04-06-2005	78	57	68	0.11	100	50	67	60			
Princeton	04-07-2005	64	57	60	1.31	100	100	61	60			
Princeton	04-08-2005	70	51	60	0.03	100	54	65	59			
Princeton	04-09-2005	79	46	62		100	55	71	61			
Princeton	04-10-2005	82	59	70		100	40	73	62			
Princeton	04-11-2005	78	65	72	T	100	50	65	56			
Princeton	04-12-2005	72	60	66	0.26	100	40	69	64			
Princeton	04-13-2005	69	50	60		100	69	69	63			
Princeton	04-14-2005	68	42	55		100	28	66	55			
Princeton	04-15-2005	71	45	58		80	20	69	56			
Princeton	04-16-2005	79	41	60		100	20	70	57			
Princeton	04-17-2005	80	47	64		100	24	74	57			
Princeton	04-18-2005	80	50	65		100	27	78	63			
Princeton	04-19-2005	80	51	66		100	29	73	65			
Princeton	04-20-2005	80	55	68		90	40	73	64			
Princeton	04-21-2005	83	57	70		100	40	71	68			
Princeton	04-22-2005	83	57	70	0.87	100	28	80	70			
Princeton	04-23-2005	78	40	59	0.04	100	80	75	60			
Princeton	04-24-2005 E	57	32	44		100	30	74	59			
Princeton	04-25-2005	64	35	50		100	26	63	50			
Princeton	04-26-2005	63	49	56	0.32	100	44	61	59			
Princeton	04-27-2005	64	40	52		100	39	62	53			
Princeton	04-28-2005	58	42	50	0.29	100	80	60	57			
Princeton	04-29-2005	63	51	57	0.21	100	70	60	56			
Princeton	04-30-2005	62	48	55	0.68	100	40	60	55			

Summary for Princeton for the period 4-1-2005 through 4-30-2005:

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	72	49	60	4.61	96	43	68	59			
(Deviation from normal)	+1	+2	+2	-0.19							

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	05-01-2005		66	35	50		100	25	67	65			
Princeton	05-02-2005		63	43	53		100	30	69	66			
Princeton	05-03-2005		61	35	48		100	30	69	66			
Princeton	05-04-2005		67	35	51		100	20	70	68			
Princeton	05-05-2005		70	39	54		100	20	71	70			
Princeton	05-06-2005		76	39	58		100	25	74	71			
Princeton	05-07-2005		80	46	63		100	30	75	72			
Princeton	05-08-2005		82	52	67		100	35	76	72			
Princeton	05-09-2005		82	59	70		100	75	77	74			
Princeton	05-10-2005		84	59	72		100	55	79	76			
Princeton	05-11-2005		88	63	76		100	40	80	77			
Princeton	05-12-2005		89	65	77		100	35	81	79			
Princeton	05-13-2005		91	65	78		100	30	82	79			
Princeton	05-14-2005		86	63	74	0.85	100	70	80	78			
Princeton	05-15-2005		72	54	63		100	40	80	79			
Princeton	05-16-2005	E	69	43	56		97	49	66	63			
Princeton	05-17-2005		75	42	58		100	35	83	80			
Princeton	05-18-2005		83	47	65		100	40	82	80			
Princeton	05-19-2005		84	50	67		100	55	81	80			
Princeton	05-20-2005	E	84	63	74	0.69	100	75	66	64			
Princeton	05-21-2005	E	73	58	66		97	65	65	64			
Princeton	05-22-2005		83	56	70		100	58	80	80			
Princeton	05-23-2005		83	59	71		100	35	81	80			
Princeton	05-24-2005		83	56	70		100	55	82	80			
Princeton	05-25-2005		73	50	62		100	40	82	80			
Princeton	05-26-2005		73	50	62		100	40	82	80			
Princeton	05-27-2005		82	52	67		100	25	82	81			
Princeton	05-28-2005		82	56	69		100	30	85	84			
Princeton	05-29-2005		80	56	68		100	50	84	84			
Princeton	05-30-2005		83	53	68		100	30	86	84			
Princeton	05-31-2005		81	59	70		100	40	84	83			

Summary for Princeton for the period 5-1-2005 through 5-31-2005:

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	78	52	65	1.54	100	41	77	75			
(Deviation from normal)	-2	-5	-3	-3.42							

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	06-01-2005	E	77	61	69	0.17	100	68	66	64			
Princeton	06-02-2005		70	61	66	0.81	100	100	85	83			
Princeton	06-03-2005		75	65	70	0.09	100	80	85	83			
Princeton	06-04-2005		88	59	74		100	55	86	84			
Princeton	06-05-2005		90	72	81		100	55	87	84			
Princeton	06-06-2005		90	72	81		55	50	87	85			
Princeton	06-07-2005		90	64	77		100	55	84	78			
Princeton	06-08-2005		89	67	78	0.03	100	57	86	76			
Princeton	06-09-2005		90	68	79	0.07	100	55	85	80			
Princeton	06-10-2005		90	72	81		90	80	85	79			
Princeton	06-11-2005		87	71	79	0.13	100	75	84	78			
Princeton	06-12-2005		74	64	69	1.66	100	100	83	76			
Princeton	06-13-2005		89	67	78		100	65	80	72			
Princeton	06-14-2005		90	75	82		100	55	81	73			
Princeton	06-15-2005	E	89	62	76		100	40	76	72			
Princeton	06-16-2005	E	86	60	73		100	47	72	70			
Princeton	06-17-2005	E	83	56	70		100	35	70	68			
Princeton	06-18-2005	E	79	58	68		99	48	72	70			
Princeton	06-19-2005	E	82	57	70		100	40	74	70			
Princeton	06-20-2005	E	83	59	71		100	40	71	69			
Princeton	06-21-2005	E	87	57	72		100	35	74	69			
Princeton	06-22-2005	E	90	62	76		100	40	74	71			
Princeton	06-23-2005		91	66	78		100	55	90	80			
Princeton	06-24-2005		94	66	80		100	35	89	79			
Princeton	06-25-2005		92	66	79		100	30	89	79			
Princeton	06-26-2005		92	67	80	0.03	100	30	86	79			
Princeton	06-27-2005	E	90	68	79	0.10	100	40	85	80			
Princeton	06-28-2005		92	68	80		100	55	87	78			
Princeton	06-29-2005		93	69	81		100	45	89	80			
Princeton	06-30-2005		96	71	84		100	40	84	80			

Summary for Princeton for the period 6-1-2005 through 6-30-2005:

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	87	65	76	3.09	98	54	82	76			
(Deviation from normal)	-0	+2	+1	-0.76							

STATION	DATE	AIR TEMP MX	MN	AV	PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	EVAP
Princeton	07-01-2005	95	70	82		100	50	85	83			
Princeton	07-02-2005	87	65	76	0.07	100	30	88	82			
Princeton	07-03-2005	89	62	76		100	30	88	83			
Princeton	07-04-2005	94	63	78		100	45	89	83			
Princeton	07-05-2005	91	69	80	0.25	100	50	87	78			
Princeton	07-06-2005	88	66	77		100	35	85	76			
Princeton	07-07-2005	90	65	78		100	40	88	78			
Princeton	07-08-2005	91	64	78		100	40	89	77			
Princeton	07-09-2005	94	67	80		100	35	90	76			
Princeton	07-10-2005	93	69	81		70	50	89	77			
Princeton	07-11-2005	90	68	79	0.65	100	100	90	78			
Princeton	07-12-2005	74	62	68	0.68	100	100	82	76			
Princeton	07-13-2005	76	66	71	0.33	100	100	80	76			
Princeton	07-14-2005	85	71	78	0.25	100	80	80	75			
Princeton	07-15-2005	87	68	78	T	100	85	81	78			
Princeton	07-16-2005	86	70	78	0.03	100	80	82	79			
Princeton	07-17-2005 E	86	71	78	0.13	100	67	75	74			
Princeton	07-18-2005	88	74	81		100	75	85	78			
Princeton	07-19-2005	92	73	82		100	60	85	78			
Princeton	07-20-2005	93	72	82		100	55	88	80			
Princeton	07-21-2005	95	74	84		100	80	90	82			
Princeton	07-22-2005	95	71	83		100	60	90	82			
Princeton	07-23-2005	95	73	84		100	60	90	83			
Princeton	07-24-2005	95	70	82		100	50	91	82			
Princeton	07-25-2005	96	75	86		100	50	92	87			
Princeton	07-26-2005	96	76	86		100	50	92	85			
Princeton	07-27-2005 E	80	73	76		100	75	81	80			
Princeton	07-28-2005	80	73	76		100	75	95	86			
Princeton	07-29-2005 E	85	59	72		83	46	78	74			
Princeton	07-30-2005 E	89	63	76		100	30	78	75			
Princeton	07-31-2005 E	92	64	78		100	35	80	76			

Summary for Princeton for the period 7-1-2005 through 7-31-2005:

STATION	AIR TEMP MX	MN	AV	TOTAL PRECIP	RH MX	MN	SOIL TEMP GRASS MX	MN	BARE MX	MN	TOTAL EVAP
Princeton	89	69	79	2.39	98	59	86	79			
(Deviation from normal)	-0	+2	+1	-1.90							

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	08-01-2005	E	92	66	79		86	48	80	76			
Princeton	08-02-2005	E	93	67	80		76	46	79	77			
Princeton	08-03-2005	E	96	67	82	0.11	100	30	80	75			
Princeton	08-04-2005	E	94	67	80		87	43	80	77			
Princeton	08-05-2005		97	69	83		100	30	93	85			
Princeton	08-06-2005		92	70	81		100	60	91	83			
Princeton	08-07-2005		93	70	82	0.06	100	100	90	83			
Princeton	08-08-2005		92	66	79		100	50	90	80			
Princeton	08-09-2005		94	63	78		100	40	92	80			
Princeton	08-10-2005		98	67	82		100	30	95	82			
Princeton	08-11-2005		98	69	84		100	30	95	85			
Princeton	08-12-2005		99	72	86		100	35	95	83			
Princeton	08-13-2005		100	74	87		100	30	96	84			
Princeton	08-14-2005		95	71	83		100	40	96	85			
Princeton	08-15-2005		88	65	76	0.39	100	65	94	82			
Princeton	08-16-2005		90	70	80	0.51	100	75	92	88			
Princeton	08-17-2005		89	71	80	0.49	100	65	89	82			
Princeton	08-18-2005		91	72	82	0.31	100	85	89	73			
Princeton	08-19-2005	E	96	76	86		86	61	80	77			
Princeton	08-20-2005	E	96	74	85	0.55	100	59	80	78			
Princeton	08-21-2005	E	93	72	82		100	52	80	78			
Princeton	08-22-2005		88	70	79	0.05	100	40	88	83			
Princeton	08-23-2005		88	69	78		100	50	88	81			
Princeton	08-24-2005		90	65	78		100	40	89	81			
Princeton	08-25-2005		95	67	81		100	45	90	81			
Princeton	08-26-2005		95	69	82	4.60	100	45	88	80			
Princeton	08-27-2005		83	70	76	1.00	100	90	89	80			
Princeton	08-28-2005		85	69	77	0.06	100	70	88	81			
Princeton	08-29-2005		77	70	74	0.25	100	65	90	81			
Princeton	08-30-2005		73	69	71	3.10	100	100	88	76			
Princeton	08-31-2005		83	60	72	0.06	100	40	89	77			

Summary for Princeton for the period 8-1-2005 through 8-31-2005:

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	91	69	80	11.54	98	54	88	80			
(Deviation from normal)	+4	+5	+4	+7.53							

SOIL TEMP
AIR TEMP RH GRASS BARE

STATION	DATE	MX	MN	AV	PRECIP	MX	MN	MX	MN	MX	MN	EVAP
Princeton	09-01-2005	89	61	75		100	45	86	75			
Princeton	09-02-2005	89	57	73		100	40	87	76			
Princeton	09-03-2005	90	56	73		100	45	87	77			
Princeton	09-04-2005	91	57	74		100	40	87	75			
Princeton	09-05-2005	85	60	72		100	85	85	73			
Princeton	09-06-2005	87	62	74		100	45	84	75			
Princeton	09-07-2005	86	61	74		100	40	85	74			
Princeton	09-08-2005	87	60	74		100	50	82	75			
Princeton	09-09-2005	89	64	76		100	45	82	78			
Princeton	09-10-2005	91	66	78		100	45	85	80			
Princeton	09-11-2005	90	63	76		100	40	83	78			
Princeton	09-12-2005	88	62	75		100	40	82	75			
Princeton	09-13-2005	88	61	74		100	40	81	75			
Princeton	09-14-2005	88	65	76		100	50	82	76			
Princeton	09-15-2005	81	64	72	0.22	100	90	82	75			
Princeton	09-16-2005	79	70	74		100	80	83	75			
Princeton	09-17-2005	76	71	74		100	80	82	73			
Princeton	09-18-2005	77	50	64		100	70	82	71			
Princeton	09-19-2005	89	60	74		100	40	82	70			
Princeton	09-20-2005	89	66	78	0.16	100	60	81	69			
Princeton	09-21-2005	91	66	78		100	40	82	71			
Princeton	09-22-2005	92	66	79		100	50	83	70			
Princeton	09-23-2005	91	69	80		100	45	82	70			
Princeton	09-24-2005	90	69	80		100	85	82	71			
Princeton	09-25-2005	80	71	76	1.08	100	95	80	69			
Princeton	09-26-2005	82	65	74	0.42	100	40	81	70			
Princeton	09-27-2005	83	61	72		100	50	80	72			
Princeton	09-28-2005	84	56	70		100	45	80	72			
Princeton	09-29-2005	67	49	58	0.29	100	40	75	71			
Princeton	09-30-2005	72	41	56		100	35	74	70			

Summary for Princeton for the period 9-1-2005 through 9-30-2005:

	AIR TEMP			TOTAL	RH		SOIL TEMP GRASS		SOIL TEMP BARE		TOTAL
STATION	MX	MN	AV	PRECIP	MX	MN	MX	MN	MX	MN	EVAP
Princeton	85	62	74	2.17	100	53	82	73			
(Deviation from normal)	+4	+4	+4	-1.							

Total Vegetation Control for Industrial Sites
Second Year Results

Introduction

Total vegetation control is required for several types of industrial sites, including power substations, roadside vegetative free zones, storage lots, pipeline facilities, etc. Maintenance and safety issues are prevalent in these sites as the presence of vegetation can have several detrimental effects. Power substations and pipeline yards need to be vegetative free to remove fire fuel load and decrease the possibility of vegetation causing equipment failure and increased maintenance costs. Highway roadsides need to have a vegetative free zone underneath guardrails and in vehicle recovery zones for several reasons. Vegetation existing at pavements edge can block drainage resulting in standing water. These areas will also pose safety and maintenance concerns if vegetated due to fire concerns from accidents and littering of ignited material (i.e. cigarettes) and the effects vegetation will have in increasing the amount of cracks in the pavement and increasing freeze – thaw potential.

Applications of broad spectrum residual herbicides have become the mainstay for bareground maintenance operations. Preemergent type herbicides work by inhibiting the germination of seeds present in the soil / strata or being translocated via the roots and/or seed shoots. Examples of these types of herbicides are those containing prodiamine, pendimethalin, bromacil, and diuron. If actively growing weeds are present, it is necessary to combine the preemergent compound with a postemergent herbicide such as glyphosate or imazapyr. Many compounds offer both pre and post emergent activity. Examples of these include flumioxazin, diuron, and sulfumeturon. There is a balance in choosing the most effective compounds to create the desired results while minimizing off target damage and cost per acre.

A study was initiated in April of 2004 to examine the ability of several 'bareground' products and combinations with other herbicides for duration of control. The entire study was reapplied on the same plots in April of 2005 to determine the effect of sequential applications on duration of total vegetation control and effectiveness of site reclamation.

Methods and Materials

The study was initiated in April of 2005 to compare flumioxazin, pendimethalin, and diuron as bareground products for length of control. The study site was a retired storage area along Interstate 75 in central Kentucky. The study site had areas completely covered with herbaceous vegetation while other areas still completely void of vegetation from the previous years application. The substrate was a compacted gravel base with little to no soil present with essentially no slope differences within and between the study blocks. Twenty seven chemical treatments and one untreated control were screened in a completely randomized block design with three replications (Table 1).

Table 1: Treatment list for bareground trial (Note: Prices based on 2004 estimates)

Treatment	Compound	Active Ingredient(s)	Rate per acre	Cost per acre
1	Payload + Arsenal	flumioxazin + imazapyr	8 oz + 12 fl oz	$71.00
2	Payload + Arsenal	flumioxazin + imazapyr	8 oz + 16 fl oz	$77.00
3	Payload + Arsenal	flumioxazin + imazapyr	8 oz + 32 fl oz	$106.00
4	Payload + Arsenal	flumioxazin + imazapyr	10 oz + 12 fl oz	$82.00
5	Payload + Arsenal	flumioxazin + imazapyr	10 oz + 16 fl oz	$89.00
6	Payload + Arsenal	flumioxazin + imazapyr	10 oz + 32 fl oz	$118.00
7	Payload + Arsenal	flumioxazin + imazapyr	12 oz + 12 fl oz	$94.00
8	Payload + Arsenal	flumioxazin + imazapyr	12 oz + 16 fl oz	$101.00
9	Payload + Arsenal	flumioxazin + imazapyr	12 oz + 32 fl oz	$130.00
10	Payload	flumioxazin	8 oz	$49.00
11	Payload	flumioxazin	10 oz	$61.00
12	Payload	flumioxazin	12 oz	$73.00
13	Payload + Oust	flumioxazin + sulfumeturon	8 oz + 3 oz	$81.00
14	Payload + Oust	flumioxazin + sulfumeturon	10 oz + 3 oz	$93.00
15	Payload + Oust	flumioxazin + sulfumeturon	12 oz + 3 oz	$105.00
16	Payload + RoundUp Pro	flumioxazin + glyphosate	8 oz + 64 fl oz	$71.00
17	Payload + RoundUp Pro	flumioxazin + glyphosate	10 oz + 64 fl oz	$83.00
18	Payload + RoundUp Pro	flumioxazin + glyphosate	12 oz + 64 fl oz	$95.00
19	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	64 fl oz + 12 fl oz	$46.00
20	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	64 fl oz + 16 fl oz	$53.00
21	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	128 fl oz + 12 fl oz	$70.00
22	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	128 fl oz + 16 fl oz	$77.00
23	Sahara	diuron + imazapyr	12 lb	$107.00
24	Sahara	diuron + imazapyr	16 lb	$143.00
25	Sahara + RoundUp Pro	diuron + imazapyr + glyphosate	12 lb + 64 fl oz	$130.00
26	Sahara + RoundUp Pro	diuron + imazapyr + glyphosate	16 lb + 64 fl oz	$165.00
27	Endurance + Arsenal	prodiamine + imazapyr	2 lb + 12 fl oz	$83.00
28	Untreated			

Predominant vegetation at the second year initiation included decumbent lespedeza, white and red clover, and tall fescue. Plots were 3.3’ X 20’ with 5’ running checks in between plots. Applications were made on April 20th, 2004 using a CO_2 powered sprayer equipped with 2 TeeJet 8008 SS flat fan nozzles at 50 GPA. All treatments included a nonionic surfactant at 0.25 % v/v. Costs per acre are approximate and are for comparison purposes only.

Data collected in the first trial included pre-application measurement of cover by species, percent cover of dead vegetation, and percent cover bareground. Follow up measurements were taken at approximately two week intervals after treatment. Data were analyzed using analysis of covariance (pre-application data as the covariate) in SAS software and adjusted treatment means were compared at each time interval using Tukey's Honest Significant Difference (HSD) method at $p = 0.05$.

The second application was performed on April 15th, 2005 with the same methodology as the first trial. Data collected was performed on a less intense schedule than the first trial and was collected at 3, 10, 15, and 21 WAT (weeks after treatment). Data analysis was performed with the same methodology as the first year's data set.

Results and Discussion

Results discussed here will focus on the results of the 2005 application as compared to the 2004 application. Complete results from the 2004 application discussing site reclamation with one application can be found in Noncrop and Industrial Vegetation Management Weed Science 2004 Annual Research Report (Information Note 2005 NCVM-1). Results presented here will statistically compare treatment means with the 2005 year and discuss differences and similarities with the 2004 trial.

Second Year Results

All treatments, including the untreated, had relatively high levels of percent bareground (> 65%) at 3WAT (Table 2). The levels of bareground achieved at this time interval is higher than that at a similar time period in the first year (Table 3). This shows the effectiveness of these treatments to provide increased levels of control at early stages of evaluation after sequential applications.

There were no statistically significant differences in any of the Payload / Arsenal tank mixes at any evaluation interval during the second year trial (Table 2). The highest levels of control generally occurred at 10 WAT, with the exception of Payload @ 10 oz + Arsenal @ 16 fl oz, which occurred at 3 WAT, and Payload @ 10 oz + Arsenal @ 32 fl oz, which occurred at 15 WAT; however, these differences should not be considered operationally significant. A trend does exist that shows increased levels of control with the high rate of Arsenal (32 fl oz) regardless of the rate of Payload. Second year results generally showed operationally higher levels of control at the end of the trial as compared to the end of the first year trial (Figure 1). This can be attributed to the effect of the 2004 application in reducing weed pressure and difference in precipitation amounts between the two years as rainfall levels in 2004 were above normal while rainfall levels in 2005 were below normal.

Two rates of Payload alone, 8 and 10 oz, had effective levels of control (> 85 %) at 3 WAT (Table 2). Similar to the first year results, these control levels began to decrease between the 3 and 10 WAT evaluations and continued to decline throughout the trial. The Payload / Oust tank mixes produced similar results in the second year as in the first year. Levels of control were far superior to that of the Payload alone treatments through the entire second year. Levels of control with the Payload / Oust tank mixes were relatively higher at the end of the second year as compared to the end of the first year (Figure 2). Payload / RoundUp tank mixes provided effective levels of control at 3 WAT in the second year (> 90 %); however, declined to unacceptable levels at the end of the second year (Figure 2). Results with the Payload / RoundUp tank mixes at the end of the second growing season were similar to those at the end of the first growing season (Figure 2).

Pendulum Aquacap treatments showed acceptable levels of control at 3WAT; however, control levels began to decrease between the 3 and 10 WAT evaluations. The high rate of Pendulum Aquacap (128 fl oz) tank mixed with RoundUp at 64 fl oz showed acceptable levels of percent bareground (> 90 %) at 15 WAT yet these control levels dropped sharply (69 %) at 21 WAT (Table 2). Results of the Pendulum Aquacap treatments at the end of the second year were consistent with the results of the same treatments at the end of the first year (Figure 3).

Sahara treatments performed very well and had control levels greater than 90% for all treatments through 15 WAT (Table 2). These treatments maintained somewhat acceptable levels of control (> 85 %) through 21 WAT. There were no significant differences between any of the Sahara treatments during the entire second year. Results at the end of the second growing season were comparable to those at the end of the first growing season (Figure 3).

Table 2: Least Square Means for Second Year Application of Bareground Trial

TRT	3WAT*	$HSD_{0.05}$ 23.93	10WAT*	$HSD_{0.05}$ 28.72	15WAT*	$HSD_{0.05}$ 36.71	21WAT*	$HSD_{0.05}$ 36.75
1	92.43	abc	97.84	a	88.88	ab	81.28	a-d
2	90.39	abc	98.64	a	82.83	ab	67.64	a-d
3	92.77	abc	96.04	ab	94.79	ab	85.48	a-d
4	85.27	abc	92.84	abc	85.21	ab	70.11	a-d
5	95.71	a	93.85	ab	80.69	abc	71.44	a-d
6	90.08	abc	95.21	ab	97.18	a	84.73	a-d
7	92.77	abc	96.04	ab	89.79	ab	66.31	a-d
8	84.11	abc	91.04	a-d	88.63	ab	70.97	a-d
9	92.51	abc	97.51	ab	92.51	ab	85.17	a-d
10	86.73	abc	63.11	de	76.27	abc	62.14	a-d
11	93.28	a	78.49	a-e	69.74	abc	56.14	cd
12	68.85	c	68.94	b-e	60.26	bc	60.16	a-d
13	94.81	a	96.67	ab	81.55	abc	95.59	a
14	93.86	a	96.37	ab	97.34	a	94.92	a
15	95.91	a	97.01	ab	97.43	a	96.37	a
16	92.97	ab	78.54	a-e	80.41	abc	58.22	bcd
17	95.01	a	92.51	abc	86.33	ab	60.01	a-d
18	99.11	a	92.99	abc	81.74	ab	74.47	a-d
19	91.45	abc	89.13	a-d	82.71	ab	60.68	a-d
20	91.99	abc	94.85	ab	84.15	ab	69.31	a-d
21	73.13	bc	64.51	cde	59.83	bc	54.03	d
22	82.24	abc	94.87	ab	92.31	ab	69.36	a-d
23	92.26	abc	95.89	ab	91.11	ab	88.78	a-d
24	91.17	abc	95.55	ab	97.23	a	86.84	a-d
25	94.49	a	97.35	ab	97.47	a	92.14	abc
26	94.49	a	97.35	ab	97.47	a	94.64	ab
27	82.45	abc	89.85	a-d	84.31	ab	72.83	a-d
28	69.24	bc	49.97	e	44.98	c	17.03	e

Note: An asterisk (*) denotes significant treatments effect at p = 0.05 at corresponding evaluation interval.

Table 3: Least Square Means for First Year Application of Bareground Trial

Trt	2WAT*	$HSD_{0.05}$ 55.25	10WAT*	$HSD_{0.05}$ 40.33	14WAT*	$HSD_{0.05}$ 66.18	18WAT*	$HSD_{0.05}$ 61.5
1	52.9	a	88.6	abc	85	ab	63.1	a
2	30	a	84.1	abc	57.9	ab	47.9	a
3	51.3	a	91.4	ab	84.3	ab	72.3	a
4	45.6	a	82.8	abc	83.1	ab	71.7	a
5	27.7	a	63.2	abcde	67	ab	50	a
6	58.8	a	89.4	ab	83.8	ab	71.5	a
7	40.6	a	85.2	abc	78.1	ab	53.9	a
8	45.9	a	77.6	abcd	73.3	ab	58.7	a
9	53.9	a	97.2	ab	86.3	ab	64.4	a
10	21	a	39.8	de	50.7	ab	48.6	a
11	47.1	a	80	abc	80.6	ab	71.8	a
12	48.2	a	46	cde	50	ab	50.4	a
13	43.3	a	90.7	ab	88.1	ab	71.8	a
14	44.6	a	96.1	ab	91.4	ab	87.5	a
15	33.1	a	98.4	a	98.2	a	89.7	a
16	54.5	a	68.8	abcde	82.8	ab	60.4	a
17	42.3	a	72	abcd	66.1	ab	42.5	a
18	46.9	a	84	abc	84.4	ab	83.8	a
19	34.6	a	57.4	bcde	63.3	ab	62.9	a
20	27.6	a	83.7	abc	77.9	ab	69.1	a
21	33.6	a	75.7	abcd	76.3	ab	62.6	a
22	35.7	a	79.1	abcd	74.4	ab	64.8	a
23	37.5	a	97.3	a	93.1	ab	82.7	a
24	57.7	a	95.9	ab	95.7	a	89.7	a
25	48.9	a	100	a	97	a	88.1	a
26	49	a	100	a	99.7	a	91.6	a
27	32.3	a	65.9	abcde	50.1	ab	59.4	a
28	20.5	a	32	e	45.2	b	55.3	a

Note: An asterisk (*) denotes significant treatments effect at $p = 0.05$ at corresponding evaluation interval.

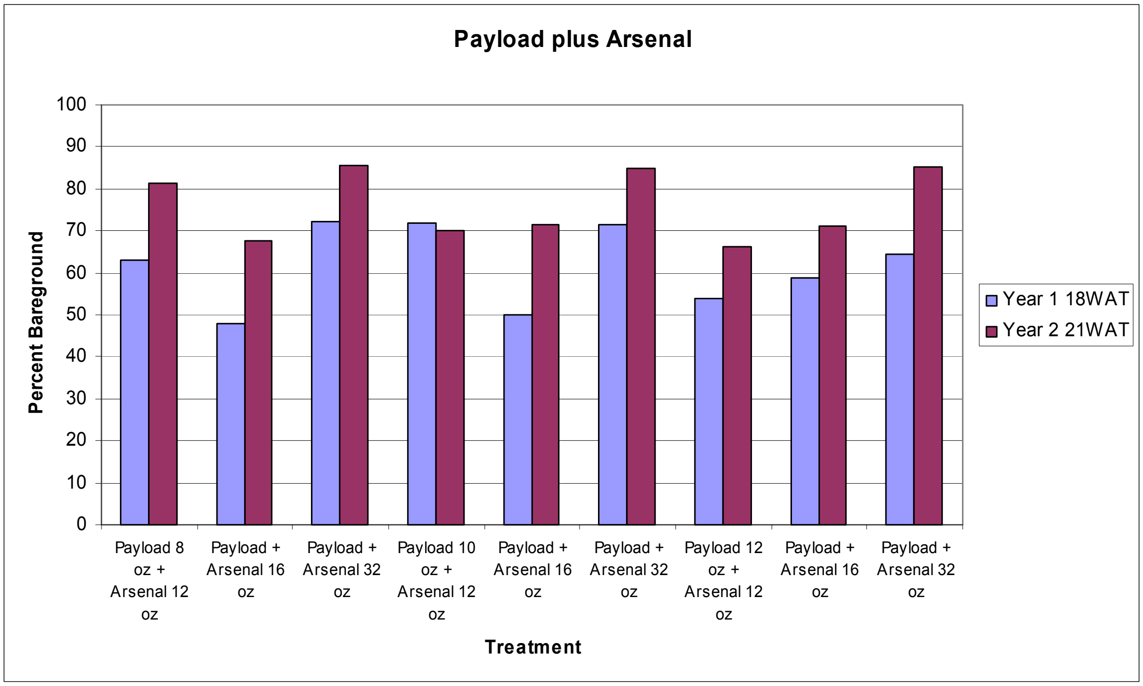

Figure 1: Least Square Means for First and Second Year Trials at End of Evaluation for Payload / Arsenal Tank Mixes

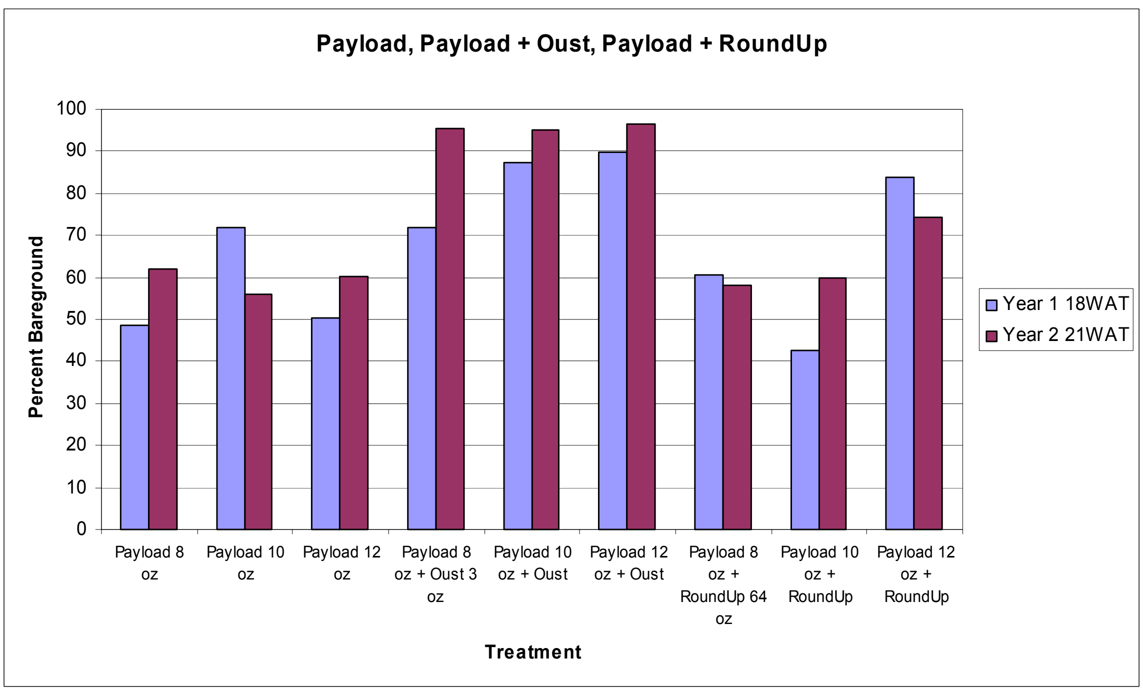

Figure 2: Least Square Means for First and Second Year Trials at End of Evaluation for Payload / Oust, Payload / RoundUp Tank Mixes and Payload Alone

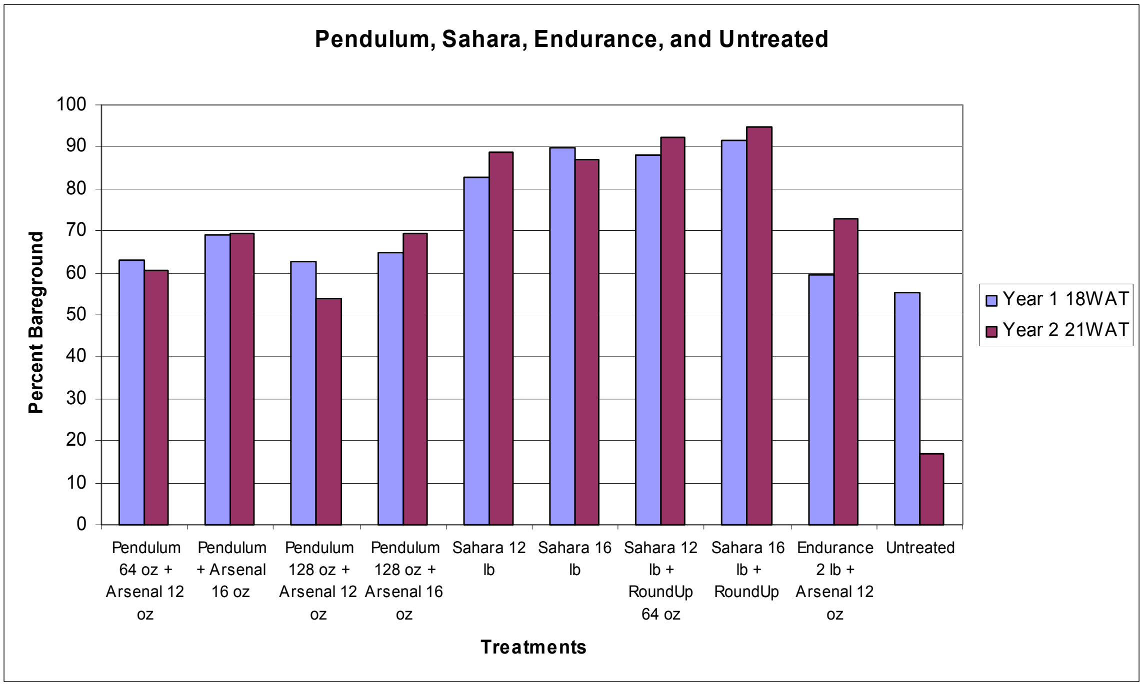

Figure 3: Least Square Means for First and Second Year Trials at End of Evaluation for Pendulum Aquacap, Sahara, Endurance, and Untreated

Combinations of Diuron, Flumioxazin, Glyphosate, and Sulfentrazone for Total Vegetation Control

Introduction

Industrial vegetation managers often require that certain areas remain free of vegetation. Areas may include roadside shoulders and guardrails, power substations, and pipeline yards. The reasons for vegetation free areas range from safety concerns to maintenance issues. Herbicides traditionally used for these types of applications are typically preemergent type herbicides; with little to no post activity; however some may have effective amounts of post activity. There are concerns that the products used, such as sulfumeturon or diuron, may cause off target damage through lateral movement or desirable species uptake. These herbicides are usually applied at high per acre rates as well. Existing chemistries, such as imazapic, can be applied at lower per acre rates. Imazapic, an ALS inhibitor herbicide, has soil residual activity, little to no movement in the soil, and little to no activity on woody plants, all of which are desirable characteristics for a 'bareground' herbicide. A study was initiated in May of 2005 to evaluate Journey, a formulated blend of imazapic and glyphosate, for its ability to provide broad spectrum control of vegetation in bareground situations.

Methods and Materials

The study was installed on May 10, 2005 at the retired KTC storage lot at Ironworks Pike and I – 75 in Lexington, KY. Eleven chemical treatments and one untreated check were replicated three times in 5' X 20' plots arranged in a randomized complete block design (Table 1). Predominant vegetation included buckhorn plantain, white clover, common ragweed, and tall fescue. Treatments were applied using a hand-held CO_2 sprayer at 20 GPA and included a nonionic surfactant at 0.25 % v/v. All plots were treated with 1.25 % v/v solution (equivalent to 32 fl oz / ac) of RoundUp Pro one hour after application to provide burndown of initial weed pressure. Plots were evaluated before application to obtain percent cover by species and percent bareground. Plots were then evaluated at 60, 90, and 120 DAT for the same information. Data was analyzed using analysis of covariance, with preapplication values as the covariate, due to the presence of a statistical difference in percent bareground values at initiation. Treatment means were compared using Tukey-Kramer's Test at $p = 0.05$.

Results

The Payload alone treatment and the Authority alone treatment were not as operationally and statistically effective as those that included Journey, Oust, and Karmex (Table 2). These two treatments never reached bareground levels greater than 85 % and dropped to unacceptable control levels at the end of the trial (120 DAT). All other herbicide treatments maintained high levels of control (> 90 %) at the end of the trial. This indicates the benefit of adding imazapic to Payload or Authority to obtain operationally successful control levels. Although there were no statistically significant differences between the Authority alone, Payload alone, and Journey + Authority treatments at 120 DAT, the Authority alone and Payload alone treatments were significantly lower than all other herbicide treatments at 120 DAT.

The Karmex alone and Oust alone treatments were the only stand alone tested that produce excellent control levels through the entire study. The addition of Journey to Karmex did allow for the high levels of control to be consistently maintained through the trial; however, the two treatments were not statistically different at any time. Journey tank mixes with Karmex and Payload resulted in excellent control levels (> 95 %) at 120 DAT.

Table 1: Treatment list for Journey Bareground Trial

Treatment	Product	Active Ingredient(s)	Rate per acre
1	Untreated		
2	Authority	Sulfentrazone	8 oz
3	Payload	Flumioxazin	10 oz
4	Karmex 80WP	Diuron	8 lb
6	Oust	Sulfometuron	3 oz
7	Journey + Authority	Imazapic + glyphosate + sulfentrazone	32 fl oz + 8 oz
8	Journey + Payload	Imazapic + glyphosate + flumioxazin	32 fl oz + 10 oz
9	Journey + Karmex 80WP	Imazapic + glyphosate + diuron	32 fl oz + 8 lb

Table 2: Least Square Means of Percent Bareground for Journey Trial

Treatment	Product	60 DAT	$HSD_{0.05}$ = 12.66	90 DAT	$HSD_{0.05}$ = 23.75	120 DAT	$HSD_{0.05}$ = 34.04
1	Untreated	59.46	c	50.92	c	43.74	c
2	Authority	82.45	b	73.71	bc	57.83	bc
3	Payload	82.81	b	80.27	ab	50.31	c
4	Karmex 80WP	97.31	a	95.3	ab	94.55	a
6	Oust	96.95	a	98.42	a	96.24	a
7	Journey + Authority	94.81	ab	91.66	ab	90.87	ab
8	Journey + Payload	95.49	a	94.18	ab	96.12	a
9	Journey + Karmex 80WP	97.66	a	97.23	ab	97.87	a

Note: Treatment means followed by the same letter are not statistically different at the given time interval using Tukey's HSD at p = 0.05.

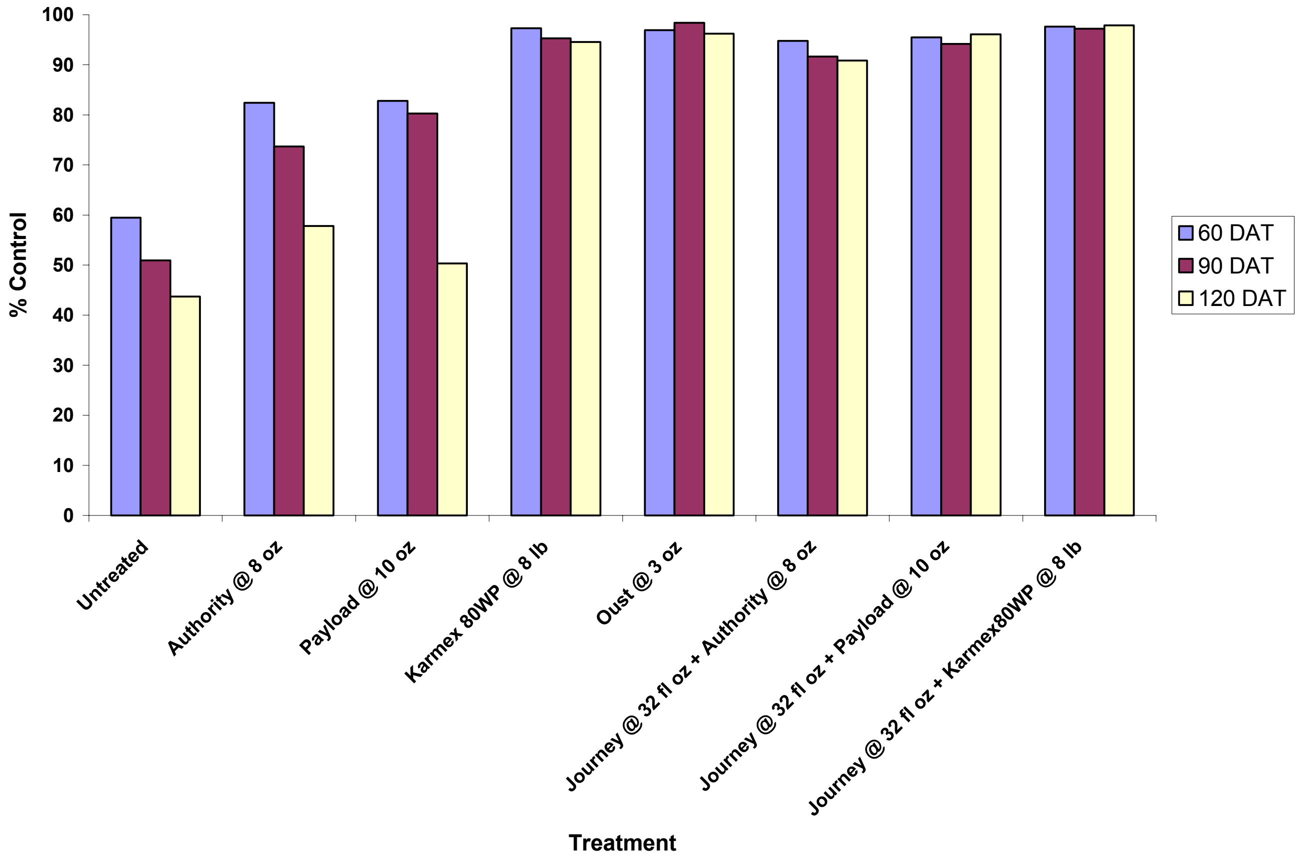

Figure 1: Treatment Mean Comparisons of Percent Bareground

Evaluation of Westar® and Krovar® to Control Marestail (*Conyza canadensis* (L.) Cronq.) in Bareground Situations

Introduction

Several herbaceous species can be problematic for vegetation managers involved in total vegetation management. Marestail, sometimes referred to as horseweed, can be problematic due to several of its physiological characteristics. Considered a winter or summer annual, germination characteristics of marestail can allow it to have the growth habit of a biennial. Germination of marestail seed can occur from fall through late summer. Seeds germinating in late summer may not be controlled by residual herbicide applications applied in the early spring if the available amount of active ingredient of herbicide has dissipated over the growing season. Seeds that germinate in late summer will overwinter in the rosette form and bolt early the following growing season and require a post application of herbicide to control.

Resistance of marestail to some herbicides can also lead to decreased control. Unfortunately, resistance to a specific mode of action is difficult to confirm. Glyphosate resistant biotypes are believed to occur in western and central Kentucky in production agriculture situations. It is also suspected that marestail may be developing resistance to ALS herbicides and certain biotypes are developing ‘multiple resistance’ to both glyphosate and ALS herbicides. The lack of control due to the germination characteristics described above may lead to a vegetation manager to assume resistance; however, this may not necessarily be the case.

In terms of total vegetation control scenarios, managers need to find treatments that include multiple modes of action, provide long lasting residual control to allow for one application per growing season, and consider rotating chemistries every few years to further prevent the development of resistance of marestail to glyphosate and ALS herbicides. A trial was initiated in May of 2005 to evaluate Westar (a.i. hexazinone and sulfometuron) and Krovar (a.i. bromacil and diuron) and their ability of provide total vegetation and marestail control.

Methods and Materials

The trial was located at the West Kentucky Research and Extension Center in Princeton, KY. The site had a history of traditional row crop research with appropriate soil characteristics. There is a suspicion that the area has ALS resistant biotypes of marestail present; however, this was never documented with laboratory tests. Dominant vegetation at initiation included marestail, yellow foxtail, and giant ragweed with marestail being the most dominant. The study was installed as a randomized complete block with three replications. Plots were 10’ X 30’, utilized a 2.5’ running check between plots, and were treated with a CO_2 handheld sprayer at 20 GPA. All herbicide treatments included a nonionic surfactant at 0.25 % v/v. Eleven herbicide treatments and one untreated check (Table 1) were evaluated for total vegetation control and marestail control at 63 and 125 DAT. Control data was analyzed using ANOVA and treatment means were separated using Fisher’s LSD at p = 0.05.

Results

The Payload alone treatment was significantly lower (63 %) than all other treatments tested for marestail control at 63 DAT (Table 1). Control values for this treatment increased at the 125 DAT interval and there were no significant differences across all treatments for marestail control at this evaluation interval. A rate effect was observed for the Westar alone treatments; as rate increased levels of bareground increased from 60 % to 95 % at 63 DAT. These control levels were not sustained; however, and control levels dropped below operationally acceptable levels for all Westar alone treatments at 125 DAT. The Krovar alone treatment provided satisfactory bareground levels at 63 DAT (92 %) and maintains effective levels of bareground through 125 DAT (90 %). The addition of Krovar to Westar did increase levels of bareground to operationally acceptable levels and above that of Krovar alone; however, there were no significant differences between any treatments that included Krovar at any evaluation interval. The Payload alone treatment never obtained operationally successful levels of total vegetation control and the Oust alone treatment, even though it provided satisfactory levels of bareground at 63 DAT (85 %), failed to maintain high levels of control at 125 DAT (43 %).

It is still unclear if the site was dominated by ALS resistant marestail. The site had been treated with FirstRate® (a.i. cloransulam methyl), an ALS herbicide, in the past and poor control levels were realized. Effective control levels were seen in this trial with Oust (a.i. sulfometuron), another type of ALS herbicide. This trial did show the effectiveness of another type of chemistry, the photosynthesis inhibitors bromacil and diuron (Krovar), to provide satisfactory levels of marestail control. This provides for an alternative chemistry for vegetation managers to prevent the establishment of marestail resistance while managing for total vegetation control.

Table 1: Treatment list and marestail and total vegetation control values

Treatment	Product(s)	Rate per acre	Percent Control Marestail		Total Vegetation Control	
			63 DAT	125 DAT	63 DAT	125 DAT
1	Westar	0.5 lb	97a	98a	60c	23ef
2	Westar	1 lb	98a	99a	78b	40de
3	Westar	1.5 lb	98a	99a	85ab	55cd
4	Westar	2 lb	98a	99a	95ab	72bc
5	Krovar I	6 lb	97a	99a	92ab	90ab
6	Westar + Krovar I	1 lb + 6 lb	98a	99a	93ab	96a
7	Westar + Krovar I	2 lb + 6 lb	98a	99a	98a	99a
8	Westar + Krovar I	1 lb + 8 lb	98a	99a	97a	99a
9	Westar + Krovar I	2 lb + 8 lb	100a	99a	95ab	99a
10	Payload	0.5 lb	63b	98a	30d	17f
11	Oust	0.125 lb	95a	96a	85ab	43de
12	Untreated		0	0	0	0
$LSD_{0.05}$			13.9	3.2	17.7	21.0

Note: Treatment means followed by the same letter are not statistically different using Fisher's LSD at p = 0.05. Untreated means were removed from analysis.

Purple Loosestrife (*Lythrum salicaria* L) Identification and Control

Introduction

Purple loosestrife is a federally listed invasive perennial that typically occurs in wetland areas. This aggressive species has the potential to quickly replace native vegetation, degrade wildlife habitat, and obstruct drainage areas. Native to Europe, it is believed that purple loosestrife first arrived in North America through the ballast water of sailing ships. Occurrences have been reported in provinces of Canada and most of the continental United States (excluding Arizona, New Mexico, Louisiana, Florida, Georgia, and South Carolina) (USDA 2005). Purple loosestrife may possibly still be sold as an ornamental even though it is listed as a noxious weed in many states. Synonyms include purple lythrum and bouquet-violet (Uva et al 1997).

Identification

Purple loosestrife is an erect, multi-branched perennial that can obtain 1 – 2 meters in height. Juvenile plants tend to emerge from root buds or root crowns but may also develop from seed germination. Mature plants have square, sometimes six-sided, stems with leaves in opposite or whorled arrangement. Leaves are lanceolate to linear with entire margins and can be up to 10 cm in length. Root systems are thick and fleshy and develop a large woody crown as it matures (Uva et al 1997).

Flowers develop from July to September and are showy purple to lavender in long (10 – 40 cm) terminal spikes. Plants may produce up to 3,000 flowers which are insect pollinated (SE-EEPC 2006). Seeds are contained in capsules that are produced after pollination. Each capsule contains an average of 120 seeds and a plant may contain up to 900 capsules at one time (SE-EPPC 2006). A single plant has the potential to produce up to 2 million seeds in one year (Uva et al 1997). Seeds are wind dispersed but may also be transported via water and mud flow. Seeds can germinate over a wide range on temperature and environmental conditions (Young and Clements 2001), are long-lived, and can even remain viable up to 20 months in completely submerged conditions (SE-EPPC 2006).

Reproduction by seed germination is viable; however, sprouting from root buds or cuttings can dramatically increase the size of infestations. Mowing can displace stem fragments that can root to form new plants. Mowing can also create favorable conditions for increased stem density from existing root crown sprouts. Infestations will die back at the end of the season resulting in red foliage and dead stalks that persist throughout the winter.

The preferred habitat of purple loosestrife is wetland areas. It is considered an aquatic to semi-aquatic weed occurring in shallow water areas such as marshes, river banks, wet pastures, roadside ditches, and lake a reservoir shores. Plants grow best in moist soil conditions with full sunlight but can persist in areas with as much as 50 % shade (SE-EPPC 2006).

Control Options

Mechanical Control

Mechanical control methods, such as mowing and hand removal, are not deemed to be effective and may actually increase the size of a current infestation. Mowing will increase sprouting potential and may transport cuttings to areas currently uninfested to compound the problem. Hand removal may be appropriate in extremely small infestations; however, it is necessary to remove the entire plant, including the root system. Proper disposal of plant parts includes burning and transporting to an approved landfill. Transporting plant parts needs to be performed with care as this may lead to new infestations. Establishment of native vegetation in areas where infestations have been removed will reduce the potential of new seedlings through competition.

Biological Control

Biological control options for purple loosestrife have been researched extensively. *Galerucella calmariensis* L. and *Galerucella pusilla* Duftschmid are two types of leaf eating beetles that have been approved for biological control of purple loosestrife in the United States. Studies have shown that these two species of beetles are host specific to Lythrum species (Blossey et al 1994). The young larva feed on developing plant tissue while adult beetles will feed on almost any above-ground plant part. Native to Europe, these species where introduced in 1992 in a 5 – 15 year program to control purple loosestrife in the mid-Atlantic states and the program has since moved to the Midwest along with Colorado and Montana (Blossey et al 1994). Establishment of populations great enough to impact purple loosestrife may take up to 10 years; however, estimates are that once established North American populations of purple loosestrife will be reduced up to 90 % (Blossey et al 1994).

Hylobius transversovittatus Goeze, a nonnative root feeding weevil, has also been researched as a potential biological control agent for purple loosestrife (McAvoy et al 2004). Research is ongoing as to the impact this species will have in controlling purple loosestrife and its ability to establish great enough populations to justify its use.

Chemical Control

Chemical control of purple loosestrife can be achieved with the use of approved herbicides. Recommendations from non-profit and invasive plant management organizations (i.e. The Nature Conservancy, Southeast Exotic Plant Pest Council, etc) commonly include the use of an aquatic glyphosate as a foliar spray of 2 %. Glyphosate is a nonselective herbicide and may not leave desirable species in the treated area. The use of a selective herbicide, such as imazapyr or triclopyr, would be preferred to allow desirable grasses to survive herbicide applications and outcompete loosestrife regrowth.

Knezevic et al (2004) examined the ability for several selective herbicides along with glyphosate in their ability to control purple loosestrife for multiple years with one application along with the response of desirable vegetation. At 1 YAT, all treatments of imazapyr, ranging from 20 to 96 fl oz of product, and metsulfuron, tested at 0.0125 and 0.25 oz of product, maintained greater than 90 % control of purple loosestrife. At 2 YAT, two rates of imazapyr, 64 and 96 fl oz, and the two rates of metsulfuron maintained 90 % control or greater. The imazapyr treatments did have a negative effect on desirable vegetation as the two high rates resulted in only 68 and 40 % vegetative cover, respectively. The metsulfuron treatments allowed for 100 % vegetative cover 2 YAT. Two rate of glyphosate tested, 64 and 96 fl oz, resulted in 70 to 75 % control, respectively, 2 YAT but allowed for 100 % vegetative cover. Triclopyr, tested at 1.5 and 2.5 qt, provided quick burndown at 10 WAT; however, the level of control decreased below 50 % over the next two years. The results of this study indicate that it is possible to eradicate purple loosestrife and, if used in with an integrated approach of replanting desirable species, one may be able to reclamate an infested site.

Research at the University of Kentucky

A trial was installed in central Kentucky to examine the ability for three herbicides, glyphosate, imazapyr, and triclopyr, all of which have an aquatic label, in controlling purple loosestrife. The study was located in the westbound cloverleaf in Interstate 64 at exit 35 near Shelbyville, KY. Purple loosestrife infestations were concentrated along and in a drainage way and due to area restrictions, only three treatments were installed in a randomized complete block design with three replications. The trial was installed on August 5th, 2005. Treatments were applied at 20 GPA and all treatments included NIS at 0.25% v/v. Treatments included imazapyr (formulated as Habitat®), triclopyr (Renovate 3®), and glyphosate (Aquamaster®). Plots were rated for percent control 6 WAT. This was the only evaluation made in the current growing season due to the time of year. Table 1 summarizes rates used and control levels by treatment.

There was no statistical difference across all treatments at the evaluation interval. 4 The triclopyr treatment did result in a higher level of control at 6 WAT (95 %) which may have operational implications. Triclopyr may be a desirable treatment if control levels are operationally acceptable since damage to desirable grasses would be minimal and may allow for the reduction of purple loosestrife regrowth through competition.

Table 1: Control of purple loosestrife 6 WAT

Trt No.	Type	Treatment Name	Rate	Rate Unit	42 DAT	
1	HERB	Habitat	1	pt/a	83	a
	ADJ	NIS	0.25	% v/v		
2	HERB	Renovate 3	4	pt/a	95	a
	ADJ	NIS	0.25	% v/v		
3	HERB	Aquamaster	4	pt/a	88	a
	ADJ	NIS	0.25	% v/v		

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Chemical 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.

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Identification and Control of Common Reed (*Phragmites australis* (CAV.) Trin. *ex* Steud.)

Introduction

Common reed, often referred to as phragmites, is a perennial invasive terrestrial grass that occurs across the United States. Although widely distributed across Europe, it is unclear as to the exact origin and method of introduction of this species. Categorized as a facultative wetland and obligate wetland species (USFWS 1996), phragmites can occur in a variety of moist to wet environments. The species can tolerate stagnate and flowing water, salt and alkaline conditions, and is commonly found in roadside ditches, marshes, and other wet area (Uva et al 1997). Individual stems can become very large (2 – 4 m in height) and form large monotypic stands. Stems are hollow, round, and become thicker towards the base of the plant. Leaves are fairly long (20 – 60 cm), flat, hairless, and have rough or sharp margins. Plants flower by mid summer in plume-like panicles with feathery spikelets that are purple at emergence and turn light brown with age. Plants rarely produce viable seed and reproduce mainly vegetatively through rhizomatous sprouting. This aids in its invasibility and spread as it is easily moved across sites through disturbances such as mowing, flooding, and road construction. Infestations of phragmites can be problematic in terms of degrading aquatic and terrestrial wildlife habitat and preventing roadside ditches and other waterway channels form operating efficiently.

Control options for phragmites are somewhat limited due to its usual proximity to aquatic environments. Miller (2004) recommends a 4 % glyphosate solution or a 1 % imazapyr solution applied as a foliar spray to control giant reed (*Arundo donax*), a species very similar to common reed. These herbicides are available for use for aquatic situations. These applications may cause unwanted damage to desirable grasses and forbs in the understory. This may be problematic since common reed can not readily establish itself in vegetated soil. Revegetation practices should be addressed when managing common reed infestations. Applying glyphosate or imazapyr through unconventional methods, such as 'wicking' or 'wiping' herbicide applicators may allow for effective control of common reed while allowing desirable vegetation to survive and compete against common reed regrowth. Kay et al (1999) realized effective control 1 YAT (1.2 live shoots / m^2 versus 29.3 live shoots / m^2 in the untreated) with imazapyr at 6 pt / ac when applied through a Weed Sweep, a type of cut – wipe herbicide applicator. Glyphosate, applied at 6 pt / ac, was ineffective in reducing live shoot counts 1 YAT (33.9 live shoots / m^2).

A trial was installed in June of 2005 to examine the efficacy of glyphosate, formulated as Aquamaster®, and imazapyr, formulated as Habitat®, for their ability to control phragmites.

Methods and Materials

The study was located on the eastbound shoulder of the Western Kentucky Parkway in Hopkins County, KY between mile points 44 and 45. Five herbicide treatments and one untreated control were evaluated in a completely randomized block design with three replications (Table 1). Treatments were applied on June 16th, 2005 using a Teejet XP BoomJet® boomless tip. Plots were 12' X 25' and treated at 20 GPA. Percent control was visually estimated at 53 and 79 DAT. Since the plots were along the shoulder and in the mowing zone the treated areas were mowed approximately 2 – 3 WAT and again at approximately 8 WAT.

Results

The low rate of glyphosate tested (4 pt / ac) resulted in significantly lower control levels compared to the low rate of imazapyr tested (4 pt / ac) at 53 DAT. Imazapyr at 4 pt / ac provided the highest level of control (85 %) at 53 DAT (Table 1). There were no significant differences between treatments in control levels as the trial progressed through 79 DAT as all treatments had control levels between 73 % and 78 %.

The effect of the mowing on the ability of the herbicide to completely translocate though the plant and control regrowth is not yet known. The mowing of the plots also may have affected the variance in the data collected during the same growing season. The study will be reinstalled in the summer of 2006.

There was a visual effect present in the difference in the glyphosate and imazapyr treatments and the amount of damage to the understory. Tall fescue was severely damage in plots containing glyphosate while minimal damage was observed in the imazapyr alone treatments. This should be considered when making management recommendations.

Table 2: Treatment list and control levels of common reed

Treatment	Product(s)	Rate per acre	Percent Control	
			53 DAT	79 DAT
1	Aquamaster + NIS	4 pt + 0.25 % v/v	53 b	73 a
2	Aquamaster + NIS	6 pt + 0.25 % v/v	73 ab	77 a
3	Habitat + NIS	4 pt + 0.25 % v/v	85 a	78 a
4	Habitat + MSO	6 pt + 32 fl oz	70 ab	75 a
5	Aquamaster + Habitat + NIS	4 pt + 1 pt + 0.25 % v/v	72 ab	78 a
6	Untreated		0	0
$LSD_{0.05}$			29.0	

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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 3: 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)

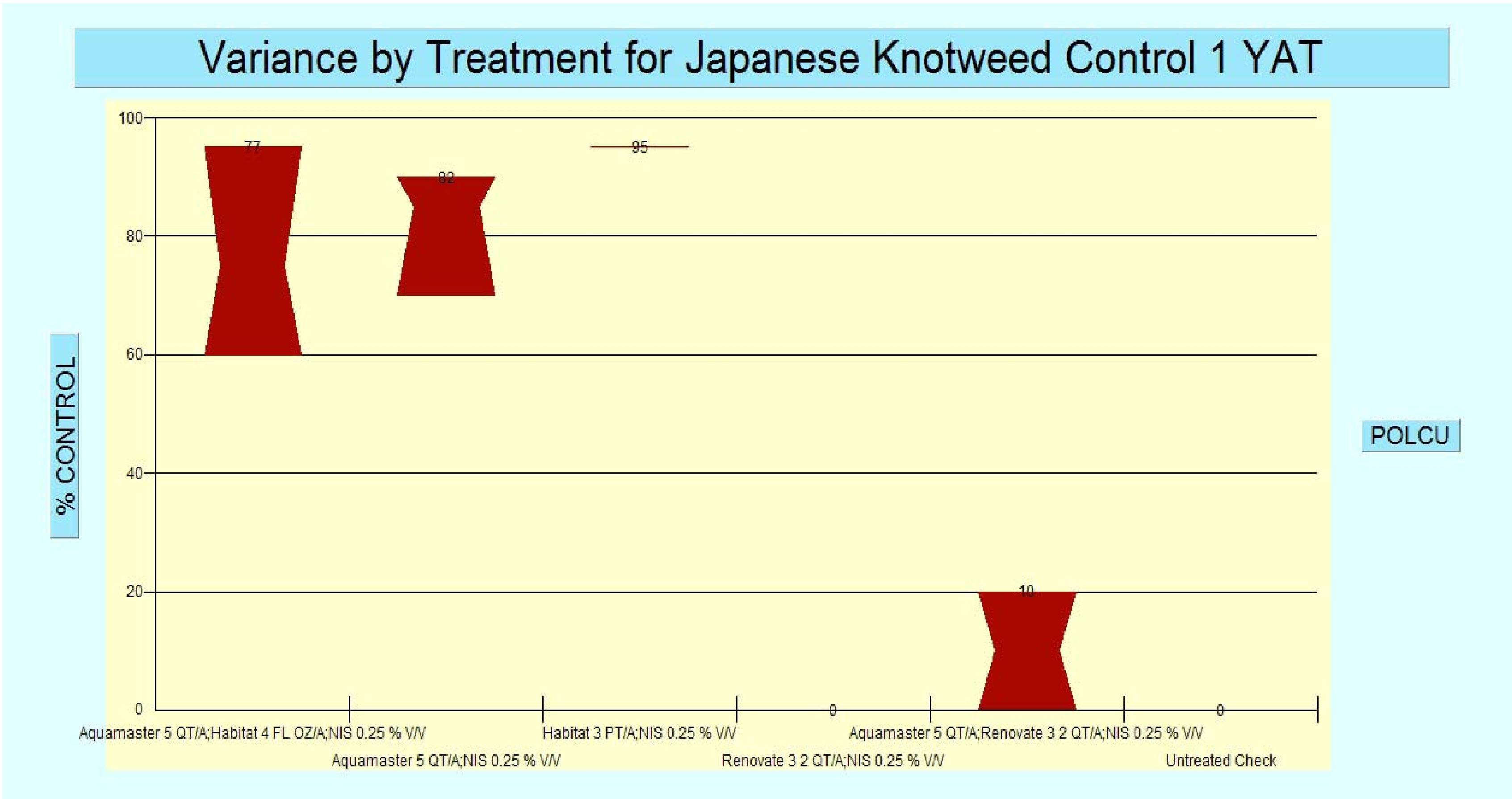

Figure 1: Treatment Variance for Japanese Knotweed Control 1 Growing Season after Treatment.
(Color bars represent the range of control levels for three replications of each treatment.)

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Identification and Control of Serecia Lespedeza (*Lespedeza cuneata* (Dum. – Cours.))

Introduction

Serecia lespedeza, otherwise known as Chinese lespedeza, is a perennial leguminous forb native to Asia. Introduced in the late 1800s as a potential forage species, it was later used as a reclamation species planted on acidic and low fertility soils (Koger 2003). Government programs also supported the use of serecia lespedeza as a soil stabilizer and food source for wildlife plantings (mainly quail). Infestations occur across the southeastern United States from Oklahoma and Texas to Virginia, the Carolinas, to Florida.

Serecia lespedeza is an upright forb and can reach heights up to 6 feet (Miller 2004). Stems are angular, herbaceous to semi woody, and are grey-green in color with pubescence. Leaves are trifoliate, alternate in arrangement, and appear in clusters. Flowers appear from July to September in the upper leaf axils and are white in color with purple markings. Seeds occur in round single seeded legume pods October through March. Typical seed yields range from 205 to 1015 lbs / ac (Farris et al 2004) and these seeds can remain viable for decades (Miller 2004). Along with this prolific seed production, serecia lespedeza has the ability to reproduce vegetatively from crown bud regrowth after disturbance, further aiding in its invasibility. Serecia lespedeza can occur in wide array of sites including roadsides, forest openings, dry upland sites, and moist savannahs. Serecia lespedeza is flood tolerant and somewhat intolerant to shade.

Recommendations for control include herbicide applications of triclopyr, metsulfuron methyl, and clopyralid. Prescribed burning and mowing amy increase herbicide efficacy. Miller (2004) recommends foliar sprays of triclopyr ester as a 2 % solution, metsulfuron methyl at 0.75 oz per acre, clopyralid as a 0.2 % solution, hexazinone as a 2 % solution, or glyphosate as a 2 % solution. Cargill et al (2002) found effective control 2 months after treatment (MAT) with 1 and 1.5 pts of Garlon 4 per acre (92 and 98 % control respectively). Fluroxypyr (Vista®) realized 94 % and 98 % control when tested at 1 and 1.3 pts per acre at the same evaluation interval. These levels of control where maintained at 3 MAT.

Overdrive® is a granular herbicide labeled for use in noncrop and rights-of-way areas. It is a combination of dicamba (0.5 lb ae / lb of product and diflufenzopyr (0.2 lb ae / lb of product). A study was initiated in the summer of 2005 to examine Overdrive in combination with Vista for serecia lespedeza control. Specifically, treatments were designed to test the ability of Overdrive to control serecia lespedeza in combination of low rates of Vista.

Methods and Materials

The study was located on a reclaimed coal mine on the property of Hopkins County Coal in Hopkins County, KY. Serecia lespedeza was the dominant species with approximately 95 % cover in the study area. Height of lespedeza ranged from 1.5' to 4' at application. The trial was installed as a randomized complete block design with three replications and 13 treatments (including an untreated control) (Table 1). Plots were 10' by 20' with a majority of the cover (> 90%) in each plot being serecia lespedeza. Treatments included Vista at 24, 16, 12, and 8 fl oz / ac alone and in combination of either 4 or 6 oz of Overdrive per acre. Applications were made at 20 GPA using a CO_2 powered boom sprayer mounted on an ATV and all treatments included methylated seed oil (MSO) at 32 fl oz / ac. Treatments were applied on June 16, 2005 and rated at 19, 35, 53, and 89 DAT for percent control.

Results

There were no significant differences between any treatment at the first evaluation interval (19 DAT) and control levels ranged from 37 % (treatment 4) and 50 % (treatment 5) at this evaluation interval (Table 1). The highest control levels realized at the 35 DAT interval were seen with the treatments incorporating the high rate of Vista (24 fl oz) and Vista alone at 16 fl oz. This trend continued through all following evaluation dates and is shown visually in Figure 1. The highest level of control at 53 DAT came from the high rate of Vista (24 fl oz) tank mixed with the high rate of Overdrive (6 oz) although this treatment was not significantly different than any other treatment except for Vista @ 12 fl oz + Overdrive @ 6 oz. The Vista alone at 16 fl oz provide high control levels (91 %) at 89 DAT; however' was only significantly higher than the Vista @ 12 fl oz + Overdrive @ 6 oz and the Vista @ 8 fl oz + Overdrive 6 oz treatments. There was no significant difference between this treatment and either the Vista alone at 8 fl oz or the Vista at 8 fl oz + Overdrive at 4 oz at 89 DAT. This indicates the potential of Overdrive to increase the efficacy of Vista at low rates in controlling serecia lespedeza; however, the difference in control levels between the high and low rates of Vista both with and without Overdrive may be operationally unacceptable.

The study site was dominated by a dense serecia lespedeza infestation and represents a 'worse case scenario'. The treatments examined here may be more efficacious controlling less dense populations.

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Table 4: Treatment list and percent control of serecia lespedeza

Treatment	Product(s)	Rate per acre	19 DAT	35 DAT	53 DAT	89DAT
1	**Vista**	**24 fl oz**	**45a**	**80a**	**87ab**	**80abc**
2	**Vista + Overdrive**	**24 fl oz + 4 oz**	**43a**	**78a**	**88ab**	**87ab**
3	**Vista + Overdrive**	**24 fl oz + 6 oz**	**45a**	**82a**	**92a**	**88ab**
4	**Vista**	**16 fl oz**	**37a**	**78a**	**90ab**	**91a**
5	**Vista + Overdrive**	**16 fl oz + 4 oz**	**50a**	**75ab**	**78ab**	**73abc**
6	**Vista + Overdrive**	**16 fl oz + 6 oz**	**47a**	**67ab**	**78ab**	**72abc**
7	**Vista**	**12 fl oz**	**47a**	**72ab**	**78ab**	**73abc**
8	**Vista + Overdrive**	**12 fl oz + 4 oz**	**47a**	**75ab**	**83ab**	**80abc**
9	**Vista + Overdrive**	**12 fl oz + 6 oz**	**48a**	**70ab**	**73b**	**65c**
10	**Vista**	**8 fl oz**	**42a**	**62b**	**75ab**	**80abc**
11	**Vista + Overdrive**	**8 fl oz + 4 oz**	**43a**	**77ab**	**85ab**	**77abc**
12	**Vista + Overdrive**	**8 fl oz + 6 oz**	**48a**	**67ab**	**75ab**	**70bc**
13	**Control**		**0**	**0**	**0**	**0**
$\mathbf{LSD_{0.05}}$			**16.7**	**16.1**	**17.4**	**20.2**

Note: Treatment means followed by the same letter are not significantly different using Fisher's LSD at p = 0.05. Control treatment removed from analysis.

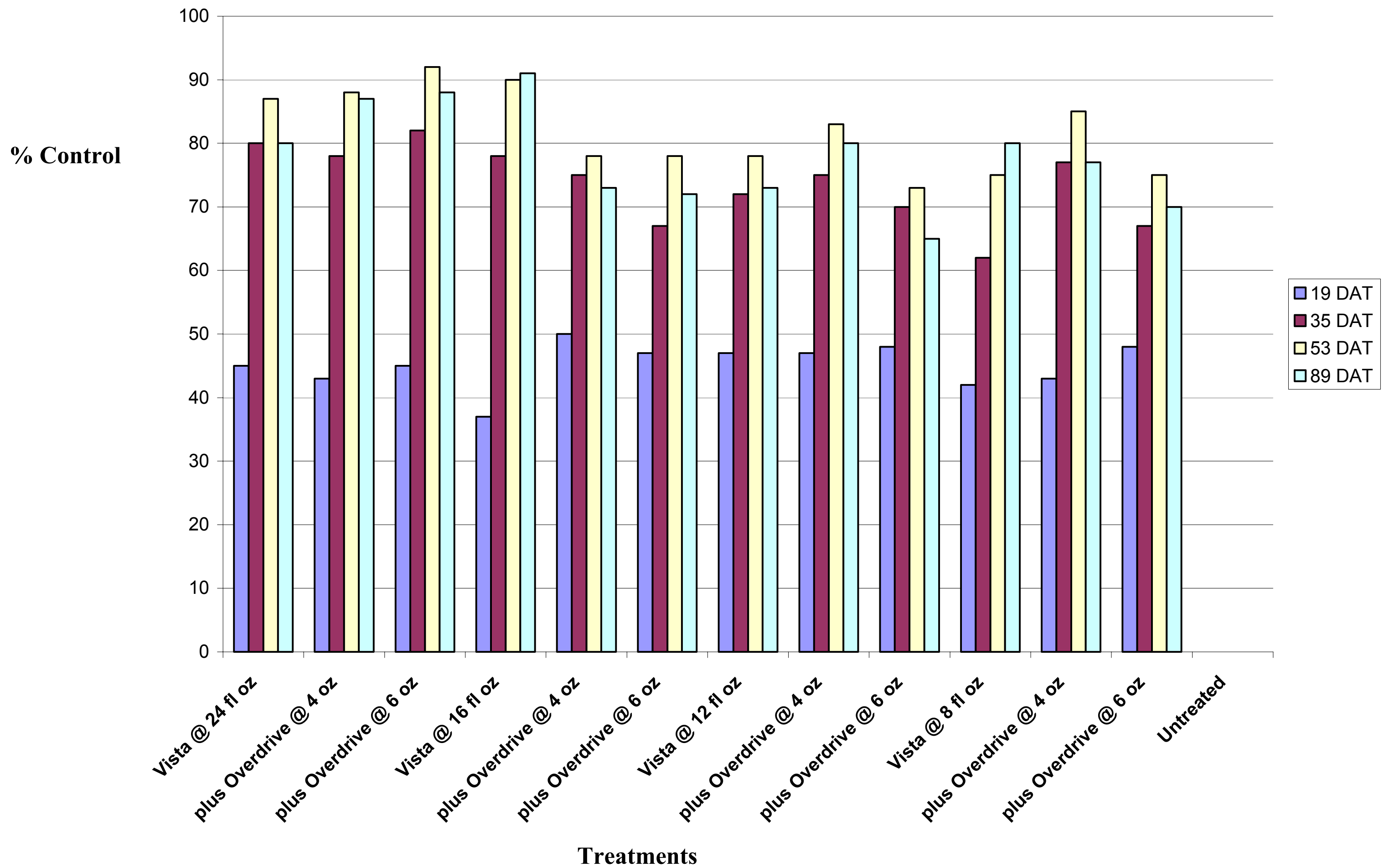

Figure 1: Control levels for Serecia Lespedeza

Dormant Stem Herbicide Applications for Bush Honeysuckle Control

Introduction

Bush honeysuckle is an inclusive term used to describe several species of an invasive woody shrub. These species include Amur honeysuckle (*Lonicera maackii* (Rupr.) Herder), Morrow's honeysuckle (*Lonicera morrowii* Gray), and Tatarian honeysuckle (*Lonicera tatarica* L.). These three species were introduced from Eurasia in the 17 and 1800s and planted as ornamentals. Their spread to rural and forested areas is due to their planting as wildlife food sources and seed dispersal by animals (mostly birds). These deciduous woody shrubs are multi-stemmed, shade tolerant, prolific seed producers, and have the ability to sprout from rootstocks after disturbance. These characteristics aid in its invasibility and ability to dominate a site and create monocultures.

Traditional herbicide screening literature on these species is minimal. Hartman and McCarthy (2004) reported 98% and 94% mortality one year after treatment by utilizing individual stem injections of glyphosate with an EZ-ject and a cut stump treatment of 50% solution of glyphosate, respectively. Literature from conservancy and invasive plant groups commonly recommends foliar sprays of a 1 to 2 % solution of glyphosate and cut stump treatments of a 20 % glyphosate solution. Miller (2004) recommends a 2 % solution of glyphosate as a foliar spray, a 20 % solution of triclopyr ester mixed with basal oil as a individual stem basal treatment, and either a 20 % glyphosate solution or a 10 % imazapyr solution as a cut stump treatment as control options.

Dormant stem herbicide applications may provide operationally effective control of bush honeysuckle while providing several benefits. These treatments may be performed during the winter months allowing crews to remain productive. Unlike individual stem basal treatments, dormant stem applications may be a broadcast treatment and therefore increase the productivity of crews (i.e. acres or plants treated). Public visibility and complaints may be reduced as the effect of brownout would be reduced. Off target damage to desirable species (either woody or herbaceous) may be reduced if the application is performed during the dormant season of these desirables and if selective chemistry is used. These types of herbicide treatments can be cost prohibitive; however, so it would be beneficial to know if plant size (i.e. height or number of stems per rootstock) affected herbicide efficacy to allow for site specific applications. A study was initiated in March 2005 to investigate the ability of broadcast herbicide treatments to dormant stems to provide effective control of Amur honeysuckle. Specifically, the study evaluated 1) the ability of several herbicide treatments to control bush honeysuckle and 2) determine if any relationship existed between either height of target plant or number of stems from a rootstock of a target plant and control levels from dormant stem herbicide treatments.

Methods and Materials

Five treatments were evaluated in a completely randomized design with three replications located in Lexington, KY. Treatments included BK800 (a.i. 2,4 – D, 2,4 – DP ester and dicamba acid) at 3 % v/v plus crop oil concentrate (COC) at 2.5 % v/v, Garlon 4 (a.i. triclopyr ester) at 1.5 % v/v plus COC at 2.5 % v/v, BK 800 at 1 % v/v plus Garlon 4 at 1.5 % v/v plus COC at 2.5 % v/v, BK800 at 3 % v/v plus Garlon 4 at 1.5 % v/v plus COC at 2.5 % v/v, and COC alone at 2.5 % v/v. Each plot included ten bush honeysuckle rootstocks, which were labeled and numbered, and estimated height and number of stems per rootstock were recorded before application. Treatments were applied in early March 2005 while plants were still dormant using a hand gun and entire stems were treated to the point of runoff. Plots were evaluated for percent control (estimated by amount of leafout) at 60 and 120 DAT. Treatment means were compared using Fishers LSD at $p = 0.05$. Simple linear regressions were performed in SAS® by each treatment using height and number of stems as individual regressors to predict control levels at $p = 0.05$ for significant models.

Results

The BK 800 at 3 % v/v plus Garlon 4 at 1.5 % v/v treatment provided significantly higher control levels (85 %) than BK 800 alone (71 %) at 60 DAT. There were no significant difference between the BK 800 and Garlon 4 tank mixes (79 % for BK 800 at 1 % tank mix) and the Garlon 4 alone treatment (78 %) at 60 DAT. The BK800 alone treatment was significantly lower (71 %) than all other treatments at 60 DAT. There was no observable effect at 60 DAT of treating stems with a COC / water mix. There were no significant differences between the BK 800 at 3 % plus Garlon 4 at 1.5 % (89 %), Garlon 4 at 1.5 % (83 %), BK 800 at 1 % plus Garlon 4 at 1.5 % (83 %), and BK 800 at 3 % (81 %) at 120 DAT. Treating bush honeysuckle with COC at 2.5 % resulted in 14 % control at 120 DAT.

Only two significant models could be produced to predict control levels at 120 DAT of the 10 models tested (2 variables X 5 treatments). The BK 800 at 3 % plus Garlon 4 at 1.5 % treatment could be predicted using stem height at 120 DAT ($y = 107.23x - 2.52$, $p = 0.0233$, $R^2 = 0.1705$) (Figure 1). Even though the model was significant it is of little operational use due to its low coefficient of determination (R^2). The second model produced used the number of stems to predict the effect of COC at 2.5 % 60 DAT. This is of little operational value as well since there were low control levels using COC alone at 120 DAT. The lack of significant models may be the result of variability present in the control data; however, it is more likely that there is no significant relationship between the two physiological variables measured, the herbicides used, the application technique screened here and the level of control produced for any treatment tested.

Evaluation of this trial 1 year after treatment (YAT) resulted in no statistically significant difference between any of the herbicide treatments (Table 1). The only difference between treatments 1 YAT occurred between the COC alone treatment, which resulted in no control 1 YAT, and all other treatments. Control levels of all herbicide treatments are deemed ineffective. Models tested for prediction of response yielded no effective results using either height or number of stems for any herbicide treatment one year after application.

Table 1: Percent control of bush honeysuckle

Treatment	Percent Control		
	60 DAT	120 DAT	1 YAT
BK 800 @ 3%	**70.97 b**	**81.13 a**	**46.33 a**
Garlon 4 @ 1.5 % plus	**77.8 ab**	**83.30 a**	**38.33 a**
BK 800 @ 1 % plus Garlon 4 @ 1.5 %	**79.13 ab**	**83.00 a**	**58.87 a**
BK 800 @ 3 % plus Garlon 4 @ 1.5 %	**84.43 a**	**88.56 a**	**48.17 a**
COC @ 2.5 %	**0 c**	**14.00 b**	**0 b**

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

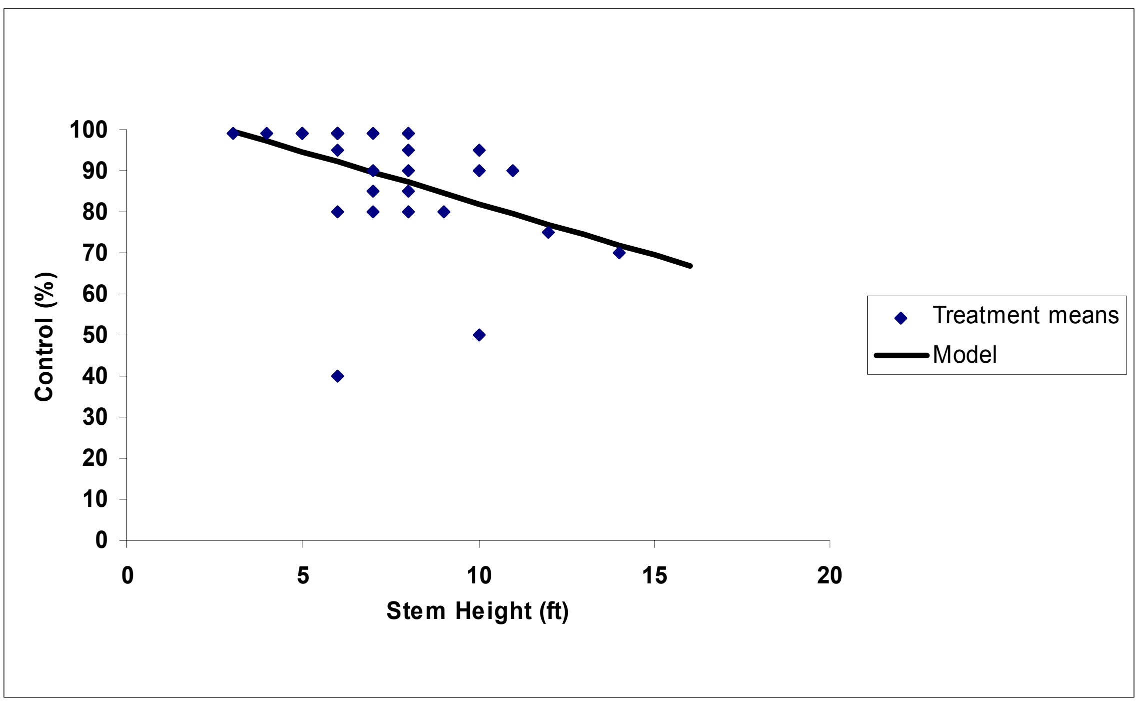

Figure 1: Prediction of Control 120 DAT with BK 800 (3%) + Garlon 4 (1.5%) using Stem Height
Model: $y = -2.52x + 107.23$; $R^2 = 0.1705$, $p = 0.0233$

Literature Cited

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