

**MASSACHUSETTS
WEED SCIENCE RESEARCH RESULTS
2009**

VOLUME 28



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UNIVERSITY OF MASSACHUSETTS AMHERST**

PREFACE

The purpose of this report is to inform cooperators in industry, colleagues at other institutions, and other persons interested in weed control, of the results of our research projects conducted in 2009. This information is our annual summary of ongoing field research in Weed Science at the University of Massachusetts, Amherst. Interpretation of the data may be modified by additional experiments. In spite of careful proofreading, there may be some typing or compilation errors in this report. Should you find an obvious error, please bring it to the attention of the author.

Information herein does not constitute a recommendation or endorsement of any product. Current recommendations for weed control in various crop commodities are available from the University of Massachusetts Extension.

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Prof. Prasanta C. Bhowmik
Amherst, MA
December 31, 2009

**MASSACHUSETTS
WEED SCIENCE RESEARCH RESULTS - 2009**

Weed management research in turfgrass environments was conducted by Prof. Prasanta C. Bhowmik at the Joseph Troll Turfgrass Research Center, South Deerfield, MA. Other personnel in weed science research were:

Graduate Research Assistants

Dipayan Sarkar
Susanna Phoboo

Our field research program is partially funded by grant-in-aid support from industries. The following contributors are gratefully acknowledged for their support of our weed science projects in 2008.

The James Underwood Crockett Agricultural Technology Growth Fund
Industrial, Turf & Ornamentals-Monsanto
Syngenta Crop Protection
BASF
Cutting Edge
The Scotts Company

Appreciation is also extended to others who provided seeds, supplies, equipments, and/or services for these studies. Special thanks to Michael Barton for their collaboration on field trial at the golf course, Burning Tree Country Club. Also, thanks to Thom Griffin for his cooperation and help for the entire season.

2009 RESEARCH PROJECTS

Research Projects

Tolerance of turfgrass cultivars: Our studies continue to establish the tolerance of Kentucky bluegrass cultivars under NTEP (172 cultivars) to mesotrione, sulfosulfuron and primisulfuron. We will continue to evaluate new products for their safety to NTEP perennial ryegrass cultivars.

Environmental stress studies: Creeping bentgrass in the cool-season environment undergoes cold acclimation phase in the fall. Often this leads to damages to creeping bentgrass on putting greens or fairways. This project is being designed to understand the cold acclimation phase of creeping bentgrass and phenolic antioxidants in relation to cold temperature, day length and other environmental factors. The role of proline-linked pentose phosphate pathway for phenolic antioxidant production in creeping bentgrass under abiotic stress will be examined. This information on cold acclimation of bentgrass may lead to the development of new cold stress resistant cultivars through genetic manipulation.

Use directions for herbicide treatments. Much of our field research is aimed at gaining information on various phases of herbicide application that will influence specific label directions for herbicide use in various turfgrass species. New herbicides are being evaluated for their efficacy, turfgrass safety, and residual control of weeds under Massachusetts conditions. Herbicide formulations, additives, and antidotes have been included for various turfgrass studies. This is extremely important to the user groups in Massachusetts for weed management under diverse ecological systems. Also, this information leads to Weed Control Recommendation Guide to Turfgrass for New England States.

Development of low maintenance strategies with growth regulators: Use of growth regulators along with various cultural practices may enhance our weed management practices in turfgrass areas, including golf courses. Spring and fall treatments of growth regulators have been examined for their effectiveness in *Poa annua* control in putting greens. Safety of these growth regulators is being examined carefully in relation to bentgrass growth and development over a period of several years.

Ecological study of chiraito (*Swertia chirayita*): This research aims to study the ecophysiology of chiraito in relation to its environment. It will help in understanding the environmental conditions that affect its phenology and phenotypic characters as well as its phytochemicals. Secondary metabolites will be isolated and characterized for its role in medicinal value to humans as well as to the invasion of this species to different environments.

Biology and management of moss: Several trials on controlling garden moss were conducted in 2009. Other research is underway to document the biology and invasion of moss under turfgrass environments. Cultural and soil factors will be evaluated for its invasion. Also, studies will be conducted to evaluate various organic products in moss control.

TURFGRASS DATA COLLECTION METHODS

A. TURFGRASS

I. WEED CONTROL STUDIES. Visual ratings were estimated on weed control throughout the growing season based on a scale of 0 to 100%.

PERCENT WEED CONTROL: Zero percent control meaning the treatment did not affect the weeds in question and the weeds were still present, as in the untreated check plot. One 100% control meaning the treatment was effective and completely controlled the species in question.

WEED COUNTS: Weed counts represent the number of plants or shoots or tillers per unit area or per plot, based on randomly placed 400 cm² quadrats in each plot.

II. TOLERANCE STUDIES.

PERCENT TURF INJURY: Turfgrass injury was rated on a scale of 0 to 100%, 0% injury meaning no injury to the turfgrass, and 100% injury meaning the turfgrass is completely dead.

QUALITY AND COLOR. Visual ratings were estimated throughout the growing season. Turf quality and color were rated on a scale of 1 to 9. In our studies, a rating of 6 is commercially acceptable for both turf color and quality.

TURF QUALITY: Turf quality was rated on a scale of 1 to 9, where 1 means dead turfgrass with bare ground, while 9 means a thick, lush stand of turfgrass.

TURF COLOR: Rating of 1 means dead turfgrass with brown color and bare ground, while 9 means a desirable turfgrass with dark green color.

III. GROWTH REGULATOR STUDIES. Various methods were used to determine the effectiveness of various growth regulator treatments.

1. Number of seed heads per unit area (cm² or in²)
2. Percent seed head reductions or suppression
3. Percent top growth reduction, (turf height measurement from clippings)
4. Clippings weight (fresh weight of clippings taken at 2 week intervals)

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Use of Growth Regulators in Turfgrass Management

Prasanta C. Bhowmik, Stockbridge Hall, Department of Plant, Soil, and Insect Sciences, University of Massachusetts Amherst

Plant growth regulators (PGRs) or turfgrass growth retardants (TGRs) are increasingly being used on golf courses to suppress seedheads and vegetative growth of desirable turfgrasses, and to enhance turfgrass quality. It is also being used to manage annual bluegrass (*Poa annua*) growth and development. Depending upon the turfgrass species and maintenance program, PGRs may reduce mowing costs, prevent scalping, increase turf density and decrease the need to mow steep slopes. Traditionally, PGRs were used for tall fescue (*Festuca arundinacea*) seedhead reduction in low maintenance areas such as highway roadsides, airports, and golf course roughs. In recent years, new products have been registered for use in most high maintenance turfgrasses, including golf courses.

The use of a PGR is often determined by the type of turfgrass area and level of maintenance. For example, trinexapac-ethyl (Primo MAXX), flurprimidol (Cutless), and paclobutrazol (Scotts TGR) may be used on putting greens. Mefluidie (Embark), amidochlor (Limit), and ethephon (Proxy) are used for seedhead reduction in low input turfgrass areas. The PGR label should always be followed for information concerning turfgrass species and their applications.

Turfgrass Growth Suppression

In general, Type I PGRs (cell division inhibitor) quickly (five to seven days) suppress vegetative growth, but usually provide a shorter period of growth suppression than Type II PGRs (gibberellin biosynthesis inhibitors). However, unlike gibberellin biosynthesis inhibitors, cell division inhibitors are highly effective in suppressing seedhead development. The growth suppression activity of gibberellin biosynthesis inhibitors is often not immediately evident. Compared to cell division inhibitors, paclobutrazol and flurprimidol are slower (10 to 14 days) in suppressing turfgrass growth, but their duration of activity is usually longer, lasting from four to eight weeks, depending on application rate. However, trinexapac-ethyl has been shown to reduce bentgrass clipping weights by 20 to 50% over a two to six week period. Depending upon application rates and schedules, trinexapac-ethyl also provides long term (four to eight weeks) growth suppression. Another key difference is that while gibberellin biosynthesis inhibitors decrease seedhead stalk height, they have little effect on the actual formation of seedheads. In recent years, Type I and Type II PGRs have been reclassified as Class A, B, C, D and E as presented in Table 1.

Timing of Application

Timing of application with PGRs is critical to achieve desired results. For seedhead suppression, the PGR must be applied before seedhead formation and emergence. **Applications made after seedhead emergence will not be effective.** For Kentucky bluegrass, the appropriate PGR should be applied to actively-growing turfgrasses after full spring green-up and several mowings (about 10 to 14 days following mowing usually from late April to mid May). The PGR treatment should be applied or just prior to new seedhead appearance. If PGRs are being used on creeping bentgrass golf greens, applications should be made during periods of active growth. Applications can be repeated if additional growth regulation is needed.

Turfgrass Quality

PGRs differ substantially in turfgrass safety. Use of products from Class D PGRs is generally recommended on low maintenance turfgrass due to the high potential of phytotoxicity and the poor quality of turfgrass that results. Class C PGRs are used in low maintenance areas where the primary objective is the control of seedheads. These products are used primarily on low-medium maintenance turfgrass areas because phytotoxicity (yellowing) can be a problem.

Classes A and B are the two most common PGRs for turfgrass due mainly to the length of suppression and turfgrass safety. Class A PGRs are noted as being the safest on all turfgrass species as they inhibit only gibberellic acid GA_1 . The early blockage of GA exhibited by the Class B products prevents the biosynthesis of further GAs which can lead to injury on environmentally stressed turfgrass.

Trinexapac-ethyl (Primo MAXX)

Primo MAXX (Class A) should be applied to actively growing turfgrass. Primo MAXX (1EC) at 3 to 6 fl. oz/A may be used on bentgrass. Repeat applications may be applied as needed or approximately three to six week apart to maintain turfgrass suppression. Application volume should be adequate to ensure thorough and even coverage of the turfgrass leaves and penetration to the crowns. Application can be made with 20 to 50 gal/A water, using flat fan nozzles.

***Poa annua* (Annual bluegrass) management**

Different grasses vary in their sensitivity to Primo MAXX. *Poa annua* is more sensitive to it than creeping bentgrass. It can be used to reduce the competitiveness of *Poa annua* in bentgrass greens. Primo MAXX can be integrated into existing *Poa annua* control programs. Low rates applied during peak growth periods may enable a slow transition in the golf green turf composition, resulting in higher percentage of bentgrass.

Other PGRs for *Poa annua* management

Mefluidide (Embark 2S, Embark Lite 0.2S). Apply at 0.05 to 0.125 lb. ai/acre (Embark 2S - 0.5 pt/A; Embark Lite - 2 to 5 pt/A) to suppress annual bluegrass seedhead development. Mefluidide must be applied before seedheads emerge. April time frame (actual timing of application depends upon location and climatic conditions) can be a good time for PGR application. Do not apply to turf within four growing months after seeding, and do not reseed within seven days after application. Treated turf may appear less dense and temporarily discolored. Iron applications may lessen discoloration. Mefluidide formulations are not recommended for use on golf course putting greens.

Paclobutrazol (TGR Turf Enhancer 2SC). Apply at 6.4 to 48 fl. oz/A (0.1 to 0.75 lb. ai/acre) in early spring after growth of desired grasses has resumed (greenup) and after one to two mowing. Paclobutrazol is root absorbed and 0.25 inch rainfall or irrigation water should be applied within 24 hours of application. Spring applications of paclobutrazol may also be used over a period of years to suppress the growth of perennial biotypes of annual bluegrass in creeping bentgrass greens. Repeat applications may be made three to four weeks apart. Do not use if *Poa annua* populations exceed 70%.

Flurprimidol (Cutless 50WP). Apply at 0.25 to 0.5 lb/A (0.12 to 0.25 lb. ai/acre) to actively-growing creeping bentgrass in the spring after third or fourth mowings. Repeat, if necessary, at 3 to 6 week intervals, but do not exceed 2 lb. product/A per growing season. Delay overseeding two weeks after application. Flurprimidol is not as effective as paclobutrazol in suppressing the growth of perennial biotypes of annual bluegrass.

Table 1. Characteristics of various plant growth regulators (PGR) used in turfgrass management.

Class	PGR Common name	Trade name	Absorption site	Mode of action	Comments
Class A Type II PGR	Trinexapac-ethyl	Primo, Primo-MAXX	Foliar	Interfere with gibberellin biosynthesis	Inhibits synthesis of GA late in its biosynthetic pathway. Initial growth response is slower compared to cell division inhibitors, but duration of activity is usually longer (4 to 6 weeks).
Class B Type II PGR	Flurprimidol	Cutless	Root	Interfere with gibberellin biosynthesis	Inhibits gibberellin biosynthetic in the early stages of this pathway. Initial growth response is slower compared to cell division inhibitors, but duration of activity is usually longer (4 to 6 weeks).
	Paclbutrazol	TGR, Turf Enhancer	Root	Interfere with gibberellin biosynthesis	Inhibits gibberellin biosynthetic in the early stages of this pathway. Response is similar to Cutless
Class C Type I PGR	Mefluidide Amidochlor	Embark, Embark Lite Limit	Foliar Root	Inhibit cell division Inhibit cell division	Mitotic inhibitors. Inhibit both vegetative growth and seedhead development. Growth inhibition is rapid, occurring within 4 to 10 days, and lasting 3 to 4 weeks. Inhibit seedheads and vegetative growth. Growth inhibition may last up to 6 weeks.
Class D	Ethofumesate Chlorosulfuron Sulfometuron	Prograss Telar Oust	Foliar	Inhibit amino acid synthesis or fatty acid biosynthesis	Herbicidal mode of action at sub-lethal dose. Inhibit growth and development of turfgrasses. Suppress seedhead formation.
Class E	Ethephon	Proxy	Foliar	Inhibit elongation of stems and roots	Promotes ethylene production and inhibit stem and root elongation

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF PRIMO MAXX ON BENTGRASS QUALITY ON A PUTTING GREEN

Trial ID: 0902TG2 Protocol ID: 0902TG2
 Location: SDF-TRC Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and D. Sarkar

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts-Amherst
Location: Joe Troll Turf Research Center, South Deerfield, MA
Investigator: P. C. Bhowmik and D. Sarkar

Site and Design

Plot Width, Unit: 4 FT
Plot Length, Unit: 10 FT
Plot Area, Unit: 40 FT²
Replications: 4 **Study Design:** RACOB L Randomized Complete Block (RCB)

Application Description

	A	B	C	D
Application Date:	May-20-09	Jun-1-09	Jun-13-09	Jul-3-09
Time of Day:	AM	Noon	Noon	AM
Application Method:	SPRAY	SPRAY	SPRAY	SPRAY
Air Temperature, Unit:	72 F	66.5 F	82.5 F	75.3 F
% Relative Humidity:	33	25.8	24.3	37.1
Wind Velocity, Unit:	0 MPH	2 MPH	0 MPH	0 MPH
Soil Temperature, Unit:	58 F	65.1 F	81.8 F	76.2 F
% Cloud Cover:		0	0	0

Application Equipment

	A	B	C	D
Appl. Equipment:	BACKPACK			
Equipment Type:	SPRBAC			
Operating Pressure, Unit:	22			
Nozzle Type:	TEEJET			
Nozzle Size:	1104 VS			
Nozzle Spacing, Unit:	20 IN			
Spray Volume, Unit:	50 gal/ac			
Mix Size, Unit:	0.456			

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EFFECTS OF PRIMO MAXX ON BENTGRASS QUALITY ON A PUTTING GREEN

Trial ID: 0902TG2 Protocol ID: 0902TG2
 Location: SDF-TRC Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code		AGSST	AGSST	AGSST	AGSST
BBCH Scale		BGRM	BGRM	BGRM	BGRM
Crop Scientific Name		Agrostis stolo>	Agrostis stolo>	Agrostis stolo>	Agrostis stolo>
Crop Name		Creeping bentg>	Creeping bentg>	Creeping bentg>	Creeping bentg>
Rating Date		May-27-09	May-27-09	Jun-4-09	Jun-4-09
Rating Type		PHYGEN	QUALITY	PHYGEN	QUALITY
Rating Unit		1-9 scal	1-9 scal	1-9 scal	1-9 scal
Number of Subsamples		1	1	1	1
Days After First/Last Applic.		7 7	7 7	15 3	15 3
Trt Treatment	Rate	Appl			
No. Name	Rate Unit	Code	1	2	3
1 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	7.88 a	8.75 a	9.0 a
2 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.50 a	8.88 a	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B			
3 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.75 a	8.88 a	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B			
PRIMO MAXX	0.138 fl oz/1000 ft2 C	C			
4 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.25 a	8.75 a	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B			
PRIMO MAXX	0.138 fl oz/1000 ft2 C	C			
PRIMO MAXX	0.138 fl oz/1000 ft2 D	D			
5 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.50 a	8.75 a	9.0 a
PROXY	5.0 fl oz/1000 ft2 A	A			
6 UNTREATED CHECK			8.00 a	8.75 a	9.0 a
LSD (P=.05)			1.539	0.502	0.00
Standard Deviation			1.022	0.333	0.00
CV			12.29	3.79	0.0
Bartlett's X2			1.816	2.208	0.0
P(Bartlett's X2)			0.874	0.82	
Replicate F			0.329	0.625	0.000
Replicate Prob(F)			0.8042	0.6098	1.0000
Treatment F			0.425	0.150	0.000
Treatment Prob(F)			0.8241	0.9769	1.0000

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Crop Code
 AGSST, BGRM, Agrostis stolonifera, = US
Rating Type
 PHYGEN = phytotoxicity - general / injury

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF PRIMO MAXX ON BENTGRASS QUALITY ON A PUTTING GREEN

Trial ID: 0902TG2 Protocol ID: 0902TG2
 Location: SDF-TRC Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code		AGSST	AGSST	AGSST	AGSST
BBCH Scale		BGRM	BGRM	BGRM	BGRM
Crop Scientific Name		Agrostis stolo>	Agrostis stolo>	Agrostis stolo>	Agrostis stolo>
Crop Name		Creeping bentg>	Creeping bentg>	Creeping bentg>	Creeping bentg>
Rating Date		Jun-24-09	Jun-24-09	Jul-1-09	Jul-1-09
Rating Type		PHYGEN	QUALITY	PHYGEN	QUALITY
Rating Unit		1-9 scal	1-9 scal	1-9 scal	1-9 scal
Number of Subsamples		1	1	1	1
Days After First/Last Applic.		35 11	35 11	42 18	42 18
Trt Treatment	Rate	Appl			
No. Name	Rate Unit	Code	5	6	7
1 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	9.00 a	8.75 a	9.0 a
2 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.63 a	8.75 a	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B			
3 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.88 a	38.74 a	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B			
PRIMO MAXX	0.138 fl oz/1000 ft2 C	C			
4 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.84 a	8.75 a	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B			
PRIMO MAXX	0.138 fl oz/1000 ft2 C	C			
PRIMO MAXX	0.138 fl oz/1000 ft2 D	D			
5 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	8.88 a	8.88 a	9.0 a
PROXY	5.0 fl oz/1000 ft2 A	A			
6 UNTREATED CHECK			9.00 a	8.75 a	9.0 a
LSD (P=.05)			0.245	27.208	0.00
Standard Deviation			0.161	17.939	0.00
CV			1.82	130.28	0.0
Bartlett's X2			0.067	107.815	0.0
P(Bartlett's X2)			0.996	0.001*	
Replicate F			4.696	0.991	0.000
Replicate Prob(F)			0.0180	0.4257	1.0000
Treatment F			2.914	1.860	0.000
Treatment Prob(F)			0.0523	0.1655	1.0000

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

<u>Crop Code</u>	AGSST, BGRM, Agrostis stolonifera, = US
<u>Rating Type</u>	PHYGEN = phytotoxicity - general / injury

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF PRIMO MAXX ON BENTGRASS QUALITY ON A PUTTING GREEN

Trial ID: 0902TG2 Protocol ID: 0902TG2
 Location: SDF-TRC Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code		AGSST	AGSST
BBCH Scale		BGRM	BGRM
Crop Scientific Name		Agrostis stolo>	Agrostis stolo>
Crop Name		Creeping bentg>	Creeping bentg>
Rating Date		Aug-14-09	Aug-14-09
Rating Type		PHYGEN	QUALITY
Rating Unit		1-9 Scal	1-9 scal
Number of Subsamples		1	1
Days After First/Last Applic.		86 42	86 42
Trt Treatment	Rate	Appl	
No. Name	Rate Unit	Code	
1 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	9
2 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	10
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B	
3 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 C	C	
4 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 B	B	9.0 a
PRIMO MAXX	0.138 fl oz/1000 ft2 C	C	
PRIMO MAXX	0.138 fl oz/1000 ft2 D	D	
5 PRIMO MAXX	0.138 fl oz/1000 ft2 A	A	9.0 a
PROXY	5.0 fl oz/1000 ft2 A	A	9.0 a
6 UNTREATED CHECK			9.0 a
LSD (P=.05)		0.00	0.00
Standard Deviation		0.00	0.00
CV		0.0	0.0
Bartlett's X2		0.0	0.0
P(Bartlett's X2)			
Replicate F		0.000	0.000
Replicate Prob(F)		1.0000	1.0000
Treatment F		0.000	0.000
Treatment Prob(F)		1.0000	1.0000

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Crop Code
 AGSST, BGRM, Agrostis stolonifera, = US
 Rating Type
 PHYGEN = phytotoxicity - general / injury

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF ADJUVANTS ON THE PERFORMANCE OF DRIVE XLR8 IN LARGE CRABGRASS CONTROL

Trial ID: 0903TG3 Protocol ID: 0903TG3
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and K. Miller

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts-Amherst
Investigator: P. C. Bhowmik and K. Miller
Location: Joe Troll Turf Research Center, South Deerfield, MA

Crop Description

Crop 1: TURF Kentucky bluegrass

Pest Description

Pest 1 Type: W **Code:** DIGSA *Digitaria sanguinalis*
Common Name: Large crabgrass

Site and Design

Plot Width, Unit: 3.5 FT **Site Type:** TURREE turf - research
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3

Study Design: RACOB L Randomized Complete Block (RCB)
Untreated Arrangement: INCLUDED single control randomized in each block

Application Description

	A
Application Date:	Jun-10-09
Time of Day:	10:00 AM
Application Method:	SPRAY
Application Timing:	EAPOWE
Application Placement:	BROFOL
Air Temperature, Unit:	70.2 F
% Relative Humidity:	30.0
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	75.2 F
% Cloud Cover:	0

Crop Stage At Each Application

	A
Crop 1 Code, BBCH Scale:	TURF

Pest Stage At Each Application

	A
Pest 1 Code, Type, Scale:	DIGSA W
Stage Majority, Percent:	90

Application Equipment

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF ADJUVANTS ON THE PERFORMANCE OF DRIVE XLR8 IN LARGE CRABGRASS CONTROL

Trial ID: 0903TG3 Protocol ID: 0903TG3
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

A	
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22
Nozzle Type:	TEEJET
Nozzle Size:	1104 VS
Nozzle Spacing, Unit:	20 IN
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF ADJUVANTS ON THE PERFORMANCE OF DRIVE XLR8 IN LARGE CRABGRASS CONTROL

Trial ID: 0903TG3 Protocol ID: 0903TG3
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed	W Weed
Pest Code		DIGSA	DIGSA	DIGSA	DIGSA
Pest Scientific Name		Digitaria sang>	Digitaria sang>	Digitaria sang>	Digitaria sang>
Pest Name		Large crabgrass	Large crabgrass	Large crabgrass	Large crabgrass
Rating Date		Jun-16-09	Jun-23-09	Jul-1-09	Jul-14-09
Rating Type		CONTROL	CONTROL	CONTROL	CONTROL
Rating Unit		%	%	%	%
Number of Subsamples		1	1	1	1
Days After First/Last Applic.		6 6	13 13	21 21	34 34
Trt-Eval Interval		6 DA-A	13 DA-A	21 DA-A	34 DA-A
Trt Treatment	Rate				
No. Name	Rate Unit	1	2	3	4
1 DRIVE XLR8	1.5 oz/1000 ft2	66.7 a	78.3 a	75.0 a	66.7 a
2 DRIVE XLR8	1.5 oz/1000 ft2	78.3 a	95.0 a	92.7 a	76.7 a
MSO	1 % v/v				
3 DRIVE XLR8	1.5 oz/1000 ft2	78.3 a	90.0 a	90.0 a	89.3 a
COC	1 % v/v				
4 DRIVE XLR8	1.5 oz/1000 ft2	68.3 a	73.3 a	72.7 a	58.3 a
X-77	0.25 % v/v				
5 DRIVE XLR8	1.5 oz/1000 ft2	75.0 a	92.0 a	95.3 a	92.0 a
NIS	0.25 % v/v				
6 UNTREATED CHECK		0.0 b	0.0 b	0.0 b	0.0 b
LSD (P=.05)		14.25	16.84	22.03	33.40
Standard Deviation		7.84	9.26	12.11	18.36
CV		12.82	12.96	17.07	28.76
Bartlett's X2		6.923	2.347	6.456	3.903
P(Bartlett's X2)		0.074	0.503	0.168	0.419
Replicate F		2.059	2.287	2.666	1.570
Replicate Prob(F)		0.1783	0.1521	0.1180	0.2553
Treatment F		44.995	45.335	26.527	10.185
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0011

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF ADJUVANTS ON THE PERFORMANCE OF DRIVE XLR8 IN LARGE CRABGRASS CONTROL

Trial ID: 0903TG3 Protocol ID: 0903TG3
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed			
Pest Code	DIGSA			
Pest Scientific Name	Digitaria sang>			
Pest Name	Large crabgrass			
Rating Date	Sep-3-09			
Rating Type	CONTROL			
Rating Unit	%			
Number of Subsamples	1			
Days After First/Last Applic.	85 85			
Trt-Eval Interval	85 DA-A			
Trt No.	Treatment Name	Rate	Unit	
				5
1	DRIVE XLR8	1.5 oz/1000 ft2		65.0 a
2	DRIVE XLR8 MSO	1.5 oz/1000 ft2 1 % v/v		75.0 a
3	DRIVE XLR8 COC	1.5 oz/1000 ft2 1 % v/v		85.0 a
4	DRIVE XLR8 X-77	1.5 oz/1000 ft2 0.25 % v/v		55.0 a
5	DRIVE XLR8 NIS	1.5 oz/1000 ft2 0.25 % v/v		90.0 a
6	UNTREATED CHECK			0.0 b
LSD (P=.05)				35.89
Standard Deviation				19.73
CV				31.99
Bartlett's X2				4.526
P(Bartlett's X2)				0.339
Replicate F				1.360
Replicate Prob(F)				0.3004
Treatment F				8.300
Treatment Prob(F)				0.0025

Pest Type
 W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
 DIGSA, Digitaria sanguinalis, = US
Rating Unit
 % = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and S. McCann

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik and S. McCann
Location: Joe Troll Turf Research Center, South Deerfield, MA

Crop Description

Crop 1: TURF Kentucky bluegrass

Pest Description

Pest 1 Type: W **Code:** DIGSA *Digitaria sanguinalis*
Common Name: Large crabgrass

Site and Design

Plot Width, Unit: 3.5 FT **Site Type:** TURREE turf - research
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3

Study Design: RACOB L Randomized Complete Block (RCB)
Untreated Arrangement: INCLUDED single control randomized in each block

Application Description

	A	B	C	D
Application Date:	Jun-1-09	Jul-3-09	Aug-4-09	
Time of Day:	Noon	AM	Noon	
Application Method:	SPRAY	SPRAY	SPRAY	
Application Timing:	EAPOWE	EAPOWE	EAPOWE	
Application Placement:	BROFOL	BROFOL	BROFOL	
Air Temperature, Unit:	66.5 F	75.3 F	88.0 F	
% Relative Humidity:	25.8	37.1	38.0	
Wind Velocity, Unit:	5 MPH	0 MPH	2 MPH	
Soil Temperature, Unit:	65.1 F	76.2 F	82.0 F	
% Cloud Cover:	0	0	0	

Crop Stage At Each Application

	A	B	C	D
Crop 1 Code, BBCH Scale:	TURF	TURF	TURF	TURF

Pest Stage At Each Application

	A	B	C	D
Pest 1 Code, Type, Scale:	DIGSA W	DIGSA W	DIGSA W	DIGSA W

Application Equipment

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MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

		B	C	D
Equipment Type:	SPRBAC			
Nozzle Type:	TEEJET			
Nozzle Size:	1104 VS			
Nozzle Spacing, Unit:	20 IN			
Boom Height, Unit:	20 IN			
Carrier:	WATER			
Spray Volume, Unit:	50 GAL/AC			
Mix Size, Unit:	0.4562 Liters			

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code		POAPR	POAPR	POAPR			
BBCH Scale		BGRM	BGRM	BGRM			
Crop Scientific Name		Poa pratensis	Poa pratensis	Poa pratensis			
Crop Name		Kentucky blueg>	Kentucky blueg>	Kentucky blueg>			
Rating Date		Jun-8-09	Jun-16-09	Jun-23-09			
Rating Type		PHYTO	PHYTO	PHYTO			
Rating Unit		Percent	Percent	Percent			
Number of Subsamples		1	1	1			
Days After First/Last Applic.		7 7	15 15	22 22			
Trt-Eval Interval		7 DA-A	15 DA-A	22 DA-A			
Trt No.	Treatment Name	Rate	Unit	Appl Code	1	2	3
1	CERTAINTY	0.75	oz wt/a	A	13.3 a	18.3 a	15.0 a
	NIS	0.25	% v/v	A			
	CERTAINTY	0.75	oz wt/a	B	16.7 a	13.3 a	11.7 a
	NIS	0.25	% v/v	B			
3	CERTAINTY	0.50	oz wt/a	A	11.7 a	3.3 b	6.7 b
	NIS	0.25	% v/v	A			
	CERTAINTY	0.50	oz wt/a	B	13.3 a	15.0 a	16.7 a
	NIS	0.25	% v/v	B			
	CERTAINTY	0.50	oz wt/a	C	13.3 a	5.0 b	3.3 bc
	NIS	0.25	% v/v	C			
	CERTAINTY	0.50	oz wt/a	D	13.3 a	5.0 b	3.3 bc
	NIS	0.25	% v/v	D			

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code	POAPR	POAPR	POAPR
BBCH Scale	BGRM	BGRM	BGRM
Crop Scientific Name	Poa pratensis	Poa pratensis	Poa pratensis
Crop Name	Kentucky blueg>	Kentucky blueg>	Kentucky blueg>
Rating Date	Jun-8-09	Jun-16-09	Jun-23-09
Rating Type	PHYTO	PHYTO	PHYTO
Rating Unit	Percent	Percent	Percent
Number of Subsamples	1	1	1
Days After First/Last Applic.	7 7	15 15	22 22
Trt-Eval Interval	7 DA-A	15 DA-A	22 DA-A
Trt No.	1	2	3
Treatment Name	6 UNTREATED		
Rate	0.0 b	0.0 b	0.0 c
Unit			
Code			
LSD (P=.05)	7.55	7.05	4.60
Standard Deviation	4.15	3.87	2.53
CV	36.44	42.25	28.44
Bartlett's X2	2.064	0.923	0.0
P(Bartlett's X2)	0.724	0.921	
Replicate F	0.323	3.333	0.217
Replicate Prob(F)	0.7315	0.0778	0.8083
Treatment F	5.887	10.833	20.696
Treatment Prob(F)	0.0086	0.0009	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Crop Code

POAPR, BGRM, Poa pratensis, = US

Rating Unit

Percent = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code		POAPR	POAPR	POAPR		
BBCH Scale		BGRM	BGRM	BGRM		
Crop Scientific Name		Poa pratensis	Poa pratensis	Poa pratensis		
Crop Name		Kentucky blueg>	Kentucky blueg>	Kentucky blueg>		
Rating Date		Jul-1-09	Jul-8-09	Jul-8-09		
Rating Type		PHYTO	PHYTO	COLOR		
Rating Unit		Percent	Percent	1-9 SCAL		
Number of Subsamples		1	1	1		
Days After First/Last Applic.		30 30	37 5	37 5		
Trt-Eval Interval		30 DA-A	37 DA-A	37 DA-A		
Trt No.	Treatment Name	Rate	Appl Code	4	5	6
		Rate Unit				
1	CERTAINTY	0.75 oz wt/a	A	0.0 a	3.3 a	8.00 b
	NIS	0.25 % v/v	A			
	CERTAINTY	0.75 oz wt/a	B			
	NIS	0.25 % v/v	B			
2	CERTAINTY	0.50 oz wt/a	A	0.0 a	5.0 a	8.00 b
	NIS	0.25 % v/v	A			
	CERTAINTY	0.50 oz wt/a	B			
	NIS	0.25 % v/v	B			
3	CERTAINTY	0.50 oz wt/a	A	0.0 a	5.0 a	8.00 b
	NIS	0.25 % v/v	A			
	CERTAINTY	0.50 oz wt/a	B			
	NIS	0.25 % v/v	B			
	CERTAINTY	0.50 oz wt/a	C			
	NIS	0.25 % v/v	C			
4	CERTAINTY	0.50 oz wt/a	A	0.0 a	5.0 a	8.00 b
	NIS	0.25 % v/v	A			
	CERTAINTY	0.50 oz wt/a	B			
	NIS	0.25 % v/v	B			
	CERTAINTY	0.50 oz wt/a	C			
	NIS	0.25 % v/v	C			
	CERTAINTY	0.50 oz wt/a	D			
	NIS	0.25 % v/v	D			
5	CERTAINTY	0.25 oz wt/a	A	0.0 a	5.0 a	8.17 b
	NIS	0.25 % v/v	A			
	CERTAINTY	0.25 oz wt/a	B			
	NIS	0.25 % v/v	B			
	CERTAINTY	0.25 oz wt/a	C			
	NIS	0.25 % v/v	C			
	CERTAINTY	0.25 oz wt/a	D			
	NIS	0.25 % v/v	D			

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code	POAPR	POAPR	POAPR
BBCH Scale	BGRM	BGRM	BGRM
Crop Scientific Name	Poa pratensis	Poa pratensis	Poa pratensis
Crop Name	Kentucky blueg>	Kentucky blueg>	Kentucky blueg>
Rating Date	Jul-1-09	Jul-8-09	Jul-8-09
Rating Type	PHYTO	PHYTO	COLOR
Rating Unit	Percent	Percent	1-9 SCAL
Number of Subsamples	1	1	1
Days After First/Last Applic.	30 30	37 5	37 5
Trt-Eval Interval	30 DA-A	37 DA-A	37 DA-A
Trt Treatment	Rate	Appl	
No. Name	Rate Unit	Code	
6 UNTREATED	0.0 a	5	6
		0.0 b	9.00 a
LSD (P=.05)	0.00	2.14	0.214
Standard Deviation	0.00	1.18	0.118
CV	0.0	30.3	1.44
Bartlett's X2	0.0	0.0	0.0
P(Bartlett's X2)	.	.	.
Replicate F	0.000	1.000	1.000
Replicate Prob(F)	1.0000	0.4019	0.4019
Treatment F	0.000	8.800	34.600
Treatment Prob(F)	1.0000	0.0020	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Crop Code
 POAPR, BGRM, Poa pratensis, = US
Rating Type
 COLOR = color
Rating Unit
 Percent = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code	POAPR	POAPR	POAPR																																																																																																																																																																																																						
BBCH Scale	BGRM	BGRM	BGRM																																																																																																																																																																																																						
Crop Scientific Name	Poa pratensis	Poa pratensis	Poa pratensis																																																																																																																																																																																																						
Crop Name	Kentucky blueg>	Kentucky blueg>	Kentucky blueg>																																																																																																																																																																																																						
Rating Date	Jul-14-09	Jul-14-09	Jul-17-09																																																																																																																																																																																																						
Rating Type	PHYTO	COLOR	PHYTO																																																																																																																																																																																																						
Rating Unit	Percent	1-9 SCAL	Percent																																																																																																																																																																																																						
Number of Subsamples	1	1	1																																																																																																																																																																																																						
Days After First/Last Applic.	43 11	43 11	46 14																																																																																																																																																																																																						
Trt-Eval Interval	43 DA-A	43 DA-A	46 DA-A																																																																																																																																																																																																						
Trt No.	Treatment Name	Rate	Appl Unit	Code	7	8	9																																																																																																																																																																																																		
1	CERTAINTY	0.75 oz wt/a	A		6.7 a	8.50 a	8.3 a																																																																																																																																																																																																		
	NIS	0.25 % v/v	A						CERTAINTY	0.75 oz wt/a	B					NIS	0.25 % v/v	B					2	CERTAINTY	0.50 oz wt/a	A		3.3 a	8.83 a	8.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B					3	CERTAINTY	0.50 oz wt/a	A		0.0 a	9.00 a	3.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C					4	CERTAINTY	0.50 oz wt/a	A		1.7 a	9.00 a	5.0 a	NIS	0.25 % v/v	A			CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.50 oz wt/a	D					NIS	0.25 % v/v	D					5	CERTAINTY	0.25 oz wt/a	A		6.7 a	8.33 a	3.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.25 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.25 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.25 oz wt/a	D					NIS	0.25 % v/v	D
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2	CERTAINTY	0.50 oz wt/a	A		3.3 a	8.83 a	8.3 a																																																																																																																																																																																																		
	NIS	0.25 % v/v	A						CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B					3	CERTAINTY	0.50 oz wt/a	A		0.0 a	9.00 a	3.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C					4	CERTAINTY	0.50 oz wt/a	A		1.7 a	9.00 a	5.0 a	NIS	0.25 % v/v	A			CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.50 oz wt/a	D					NIS	0.25 % v/v	D					5	CERTAINTY	0.25 oz wt/a	A		6.7 a	8.33 a	3.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.25 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.25 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.25 oz wt/a	D					NIS	0.25 % v/v	D																											
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3	CERTAINTY	0.50 oz wt/a	A		0.0 a	9.00 a	3.3 a																																																																																																																																																																																																		
	NIS	0.25 % v/v	A						CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C					4	CERTAINTY	0.50 oz wt/a	A		1.7 a	9.00 a	5.0 a	NIS	0.25 % v/v	A			CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.50 oz wt/a	D					NIS	0.25 % v/v	D					5	CERTAINTY	0.25 oz wt/a	A		6.7 a	8.33 a	3.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.25 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.25 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.25 oz wt/a	D					NIS	0.25 % v/v	D																																																						
	CERTAINTY	0.50 oz wt/a	B																																																																																																																																																																																																						
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4	CERTAINTY	0.50 oz wt/a	A		1.7 a	9.00 a	5.0 a																																																																																																																																																																																																		
	NIS	0.25 % v/v	A						CERTAINTY	0.50 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.50 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.50 oz wt/a	D					NIS	0.25 % v/v	D					5	CERTAINTY	0.25 oz wt/a	A		6.7 a	8.33 a	3.3 a	NIS	0.25 % v/v	A			CERTAINTY	0.25 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.25 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.25 oz wt/a	D					NIS	0.25 % v/v	D																																																																																																
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	NIS	0.25 % v/v	D																																																																																																																																																																																																						
5	CERTAINTY	0.25 oz wt/a	A		6.7 a	8.33 a	3.3 a																																																																																																																																																																																																		
	NIS	0.25 % v/v	A						CERTAINTY	0.25 oz wt/a	B					NIS	0.25 % v/v	B						CERTAINTY	0.25 oz wt/a	C					NIS	0.25 % v/v	C						CERTAINTY	0.25 oz wt/a	D					NIS	0.25 % v/v	D																																																																																																																																																									
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UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code	POAPR	POAPR	POAPR
BBCH Scale	BGRM	BGRM	BGRM
Crop Scientific Name	Poa pratensis	Poa pratensis	Poa pratensis
Crop Name	Kentucky blueg>	Kentucky blueg>	Kentucky blueg>
Rating Date	Jul-14-09	Jul-14-09	Jul-17-09
Rating Type	PHYTO	COLOR	PHYTO
Rating Unit	Percent	1-9 SCAL	Percent
Number of Subsamples	1	1	1
Days After First/Last Applic.	43 11	43 11	46 14
Trt-Eval Interval	43 DA-A	43 DA-A	46 DA-A
Trt Treatment	Rate	Appl	
No. Name	Rate	Unit	Code
6 UNTREATED	0.0 a		
		7	
		8	
		9	
LSD (P=.05)	8.08	0.636	6.14
Standard Deviation	4.44	0.350	3.37
CV	145.34	3.98	71.47
Bartlett's X2	1.007	0.852	1.599
P(Bartlett's X2)	0.80	0.653	0.809
Replicate F	0.493	0.455	4.512
Replicate Prob(F)	0.6249	0.6472	0.0401
Treatment F	1.423	2.091	2.756
Treatment Prob(F)	0.2965	0.1502	0.0810

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Crop Code

POAPR, BGRM, Poa pratensis, = US

Rating Type

COLOR = color

Rating Unit

Percent = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

				POAPR	POAPR
				BGRM	BGRM
				Poa pratensis	Poa pratensis
				Kentucky blueg>	Kentucky blueg>
				Jul-22-09	Jul-14-09
				PHYTO	COLOR
				Percent	1-9 SCAL
				1	1
				51 19	43 11
				51 DA-A	43 DA-A
Trt No.	Treatment Name	Rate	Appl Unit Code	10	11
1	CERTAINTY	0.75 oz wt/a	A	5.0 a	8.50 a
	NIS	0.25 % v/v	A		
	CERTAINTY	0.75 oz wt/a	B	3.3 a	8.67 a
	NIS	0.25 % v/v	B		
2	CERTAINTY	0.50 oz wt/a	A	1.7 a	9.00 a
	NIS	0.25 % v/v	A		
	CERTAINTY	0.50 oz wt/a	B	3.3 a	8.83 a
	NIS	0.25 % v/v	B		
	CERTAINTY	0.50 oz wt/a	C	1.7 a	8.83 a
	NIS	0.25 % v/v	C		
	CERTAINTY	0.50 oz wt/a	D	1.7 a	8.83 a
	NIS	0.25 % v/v	D		
3	CERTAINTY	0.50 oz wt/a	A	1.7 a	8.83 a
	NIS	0.25 % v/v	A		
	CERTAINTY	0.50 oz wt/a	B	1.7 a	8.83 a
	NIS	0.25 % v/v	B		
	CERTAINTY	0.50 oz wt/a	C	1.7 a	8.83 a
	NIS	0.25 % v/v	C		
	CERTAINTY	0.50 oz wt/a	D	1.7 a	8.83 a
	NIS	0.25 % v/v	D		
4	CERTAINTY	0.25 oz wt/a	A	1.7 a	8.83 a
	NIS	0.25 % v/v	A		
	CERTAINTY	0.25 oz wt/a	B	1.7 a	8.83 a
	NIS	0.25 % v/v	B		
	CERTAINTY	0.25 oz wt/a	C	1.7 a	8.83 a
	NIS	0.25 % v/v	C		
	CERTAINTY	0.25 oz wt/a	D	1.7 a	8.83 a
	NIS	0.25 % v/v	D		

UNIVERSITY OF MASSACHUSETTS-AMHERST

MAINTENANCE OF KENTUCKY BLUEGRASS STANDS WITH LOW RATES OF CERTAINTY

Trial ID: 0904TG4 Protocol ID: 0904TG4
 Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
 Project ID: 0904TG4 Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Crop Code	POAPR	POAPR
BBCH Scale	BGRM	BGRM
Crop Scientific Name	Poa pratensis	Poa pratensis
Crop Name	Kentucky blueg>	Kentucky blueg>
Rating Date	Jul-22-09	Jul-14-09
Rating Type	PHYTO	COLOR
Rating Unit	Percent	1-9 SCAL
Number of Subsamples	1	1
Days After First/Last Applic.	51 19	43 11
Trt-Eval Interval	51 DA-A	43 DA-A
Trt Treatment		
No. Name	10	11
Rate Unit		
Code		
6 UNTREATED	0.0 a	9.00 a
LSD (P=.05)	3.32	0.359
Standard Deviation	1.83	0.197
CV	73.03	2.24
Bartlett's X2	0.0	0.0
P(Bartlett's X2)	.	.
Replicate F	5.000	1.429
Replicate Prob(F)	0.0313	0.2846
Treatment F	2.750	2.929
Treatment Prob(F)	0.0814	0.0697

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Crop Code
 POAPR, BGRM, Poa pratensis, = US
 Rating Type
 COLOR = color
 Rating Unit
 Percent = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 0905TG5 Protocol ID: 0905TG5
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik, D. Sarkar and D. Barton

Initiation Date: Jun-1-09

Trial Location

City: Greenwich
State/Prov.: CT

Objectives:

To establish the rate response of false green kyllinga to various products

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik, D. Sarkar and D. Barton
Location: Burning Tree Country Club, Greenwich, CT

Pest Description

Pest 1 Type: W **Code:** KYLGR Kyllinga gracillima
Common Name: Pasture spikesedge
Description: A perennial species

Establishment Method/Description: Natural population in fairways

Site and Design

Plot Width, Unit: 3.5 FT **Site Type:** TUGCFA turf - golf course fairway
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3 **Study Design:** RACOBL Randomized Complete Block (RCB)

Trial Initiation Comments:

Natural population of false green kyllinga in fairways

Application Description

A	
Application Date:	Jun-3-09
Time of Day:	Noon
Application Method:	SPRAY
Application Timing:	POSPOS
Air Temperature, Unit:	70 F
% Relative Humidity:	28.7
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	69.4 F
Soil Moisture:	30FC
% Cloud Cover:	70

Pest Stage At Each Application

A	
Pest 1 Code, Type, Scale:	KYLGR W

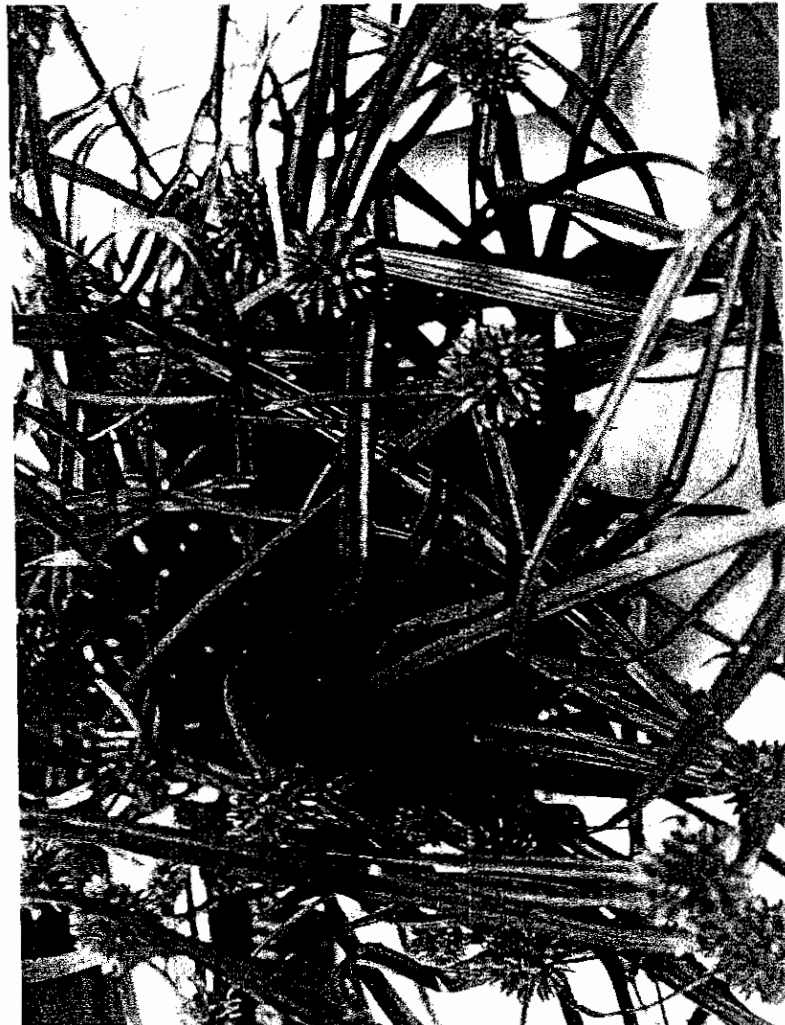
UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 0905TG5 Protocol ID: 0905TG5
Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Application Equipment

	A
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22
Nozzle Type:	TEEJET
Nozzle Size:	.1104 VS
Nozzle Spacing, Unit:	20 IN
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456



UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 0905TG5 Protocol ID: 0905TG5
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed			
Pest Code	KYLGR	KYLGR	KYLGR			
Pest Scientific Name	Kyllinga graci>	Kyllinga graci>	Kyllinga graci>			
Pest Name	Pasture spikes>	Pasture spikes>	Pasture spikes>			
Rating Date	Jun-15-09	Jul-2-09	Jul-9-09			
Rating Type	CONTROL	CONTROL	CONTROL			
Rating Unit	%	%	%			
Number of Subsamples	1	1	1			
Days After First/Last Applic.	12 12	29 29	36 36			
Trt-Eval Interval	12 DA-A	29 DA-A	36 DA-A			
Trt No.	Treatment Name	Rate	Unit	1	3	5
1	CERTAINTY	0.5	oz wt/a	20.0 a	78.3 a	87.7 a
2	CERTAINTY	1.0	oz wt/a	23.3 a	75.0 a	88.3 a
3	CERTAINTY	1.5	oz wt/a	26.7 a	68.3 a	82.7 a
4	SEDGEHAMMER	0.031	lb ai/a	18.3 a	35.0 ab	41.7 abc
5	SEDGEHAMMER	0.0625	lb ai/a	21.7 a	71.7 a	81.7 a
6	SEDGEHAMMER	0.125	lb ai/a	26.7 a	73.3 a	83.3 a
7	SUNRICE	0.125	lb ai/a	26.7 a	58.3 a	74.3 a
8	SUNRICE	0.250	lb ai/a	25.0 a	77.7 a	87.7 a
9	SUNRICE	0.375	lb ai/a	26.7 a	80.0 a	85.0 a
10	TENACITY	2.5	fl oz/a	21.7 a	30.0 ab	53.3 ab
11	TENACITY	5.0	fl oz/a	18.3 a	58.3 a	63.3 a
12	TENACITY	7.5	fl oz/a	15.0 a	23.3 ab	15.0 bc
13	UNTREATED			13.3 a	0.0 b	0.0 c
LSD (P=.05)				21.02	32.70	35.59
Standard Deviation				12.47	19.41	21.12
CV				57.24	34.59	32.53
Bartlett's X2				9.154	18.469	23.69
P(Bartlett's X2)				0.69	0.071	0.014*
Replicate F				0.424	2.406	1.399
Replicate Prob(F)				0.6590	0.1116	0.2661
Treatment F				0.406	5.267	5.827
Treatment Prob(F)				0.9470	0.0003	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Pest Type

W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop

Pest Code

KYLGR, *Kyllinga gracillima*, = US

Rating Unit

% = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 0905TG5 Protocol ID: 0905TG5
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed	
Pest Code		KYLGR	KYLGR	KYLGR	
Pest Scientific Name		Kyllinga graci>	Kyllinga graci>	Kyllinga graci>	
Pest Name		Pasture spikes>	Pasture spikes>	Pasture spikes>	
Rating Date		Jul-21-09	Aug-7-09	Sep-4-09	
Rating Type		CONTROL	CONTROL	CONTROL	
Rating Unit		%	%	%	
Number of Subsamples		1	1	1	
Days After First/Last Applic.		48 48	65 65	93 93	
Trt-Eval Interval		48 DA-A	65 DA-A	65 DA-A	
Trt No.	Treatment Name	Rate	7	9	11
		Rate Unit			
1	CERTAINTY	0.5 oz wt/a	87.7 a	69.3 abc	68.0 a
2	CERTAINTY	1.0 oz wt/a	97.7 a	82.7 ab	76.0 a
3	CERTAINTY	1.5 oz wt/a	95.3 a	91.0 a	78.7 a
4	SEDGEHAMMER	0.031 lb ai/a	36.7 bc	26.7 a-d	10.0 a
5	SEDGEHAMMER	0.0625 lb ai/a	78.3 a	68.3 abc	56.7 a
6	SEDGEHAMMER	0.125 lb ai/a	90.0 a	67.7 abc	50.0 a
7	SUNRICE	0.125 lb ai/a	85.0 a	61.7 abc	46.7 a
8	SUNRICE	0.250 lb ai/a	92.7 a	56.0 a-d	56.0 a
9	SUNRICE	0.375 lb ai/a	96.0 a	69.3 abc	56.0 a
10	TENACITY	2.5 fl oz/a	60.0 abc	21.7 bcd	6.7 a
11	TENACITY	5.0 fl oz/a	70.0 ab	31.7 a-d	10.0 a
12	TENACITY	7.5 fl oz/a	28.3 c	6.7 cd	0.0 a
13	UNTREATED		0.0 d	0.0 d	0.0 a
LSD (P=.05)			28.22	39.35	44.81
Standard Deviation			16.75	23.35	26.59
CV			23.73	46.51	67.16
Bartlett's X2			20.078	7.612	7.688
P(Bartlett's X2)			0.044*	0.748	0.659
Replicate F			1.773	7.529	6.966
Replicate Prob(F)			0.1913	0.0029	0.0041
Treatment F			10.202	4.758	3.755
Treatment Prob(F)			0.0001	0.0006	0.0028

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Pest Type

W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop

Pest Code

KYLGR, *Kyllinga gracillima*, = US

Rating Unit

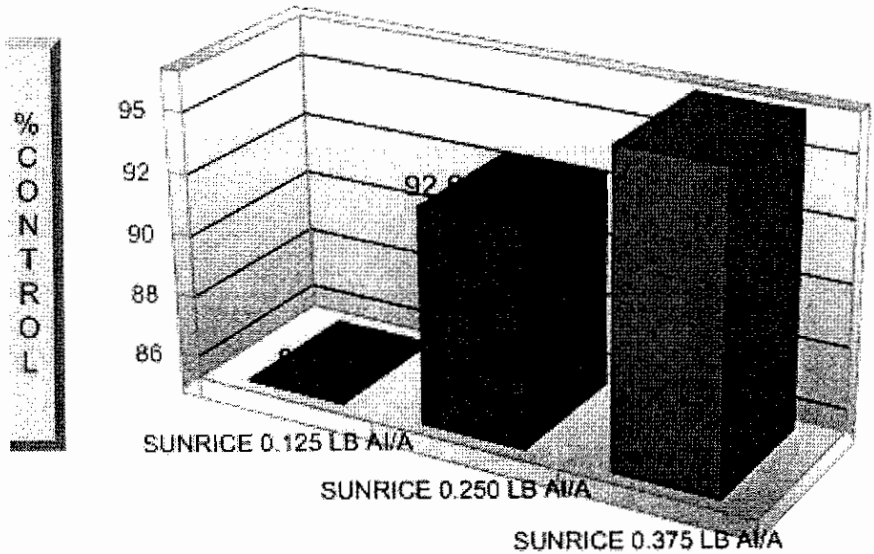
% = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFICACY OF VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 0905TG5 Protocol ID: 0905TG5
Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

PERCENT CONTROL OF FALSE GREEN KYLLINGA - SUNRICE (48 DAA)

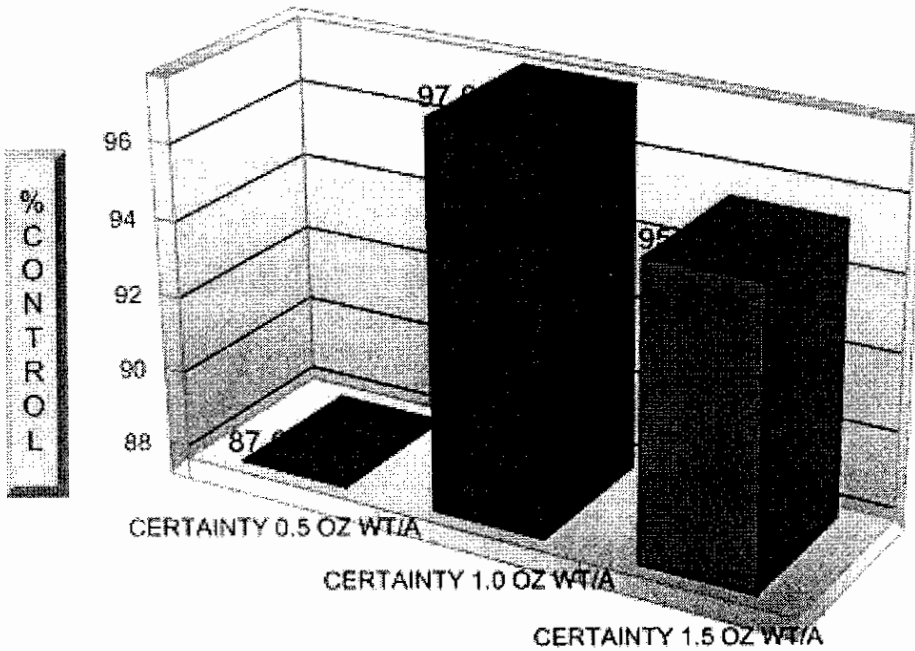


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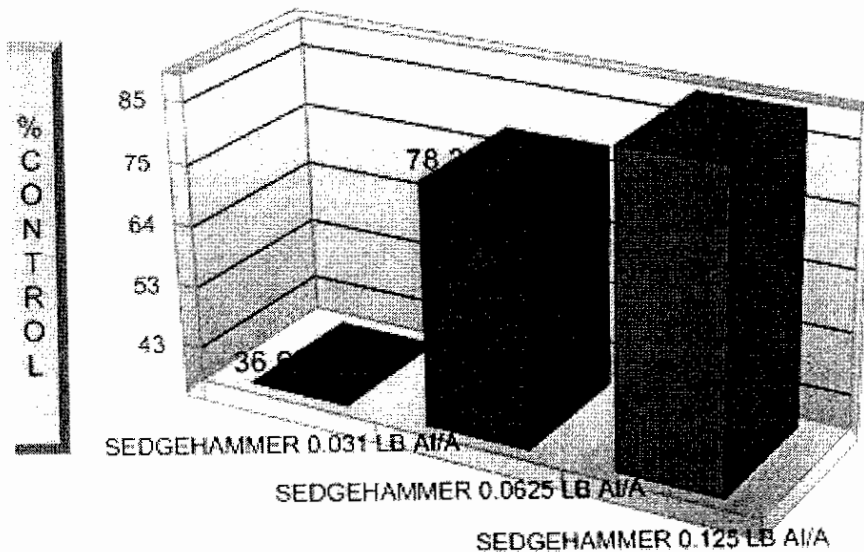
EFFICACY OF VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 0905TG5 Protocol ID: 0905TG5
Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

PERCENT CONTROL OF FALSE GREEN KYLLINGA - CERTAINTY (48 DAA)



PERCENT CONTROL OF FALSE GREEN KYLLINGA - SEDGEHAMMER (48 DAA)



UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF VOLUMES OF APPLICATION ON THE PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0906TG6M Protocol ID: 0906TG6M
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik Title: Professor
 Investigator: P. C. Bhowmik and M. Barton

Trial Location

City: Greenwich
 State/Prov.: CT

Objectives:

To determine the effects of two volumes of application on the effectiveness of various products in false green kyllings control.

Personnel

Study Director: Dr. Prasanta C. Bhowmik Title: Professor
 Affiliation: University of Massachusetts Amherst
 Investigator: P. C. Bhowmik and M. Barton
 Location: Burning Tree Country Club, Greenwich, CT

Pest Description

Pest 1 Type: W Code: KYLGR Kyllinga gracillima
 Common Name: Pasture spikesedge
 Description: A perennial species

Site and Design

Plot Width, Unit: 3.5 FT Site Type: TUGCFA turf - golf course fairway
 Plot Length, Unit: 10 FT
 Plot Area, Unit: 35 FT²
 Replications: 3 Study Design: SPLPLO Split-Plot

Trial Initiation Comments:

A heavy population of false green kyllinga in fairway turfgrass

Application Description

Application Description	
	A
Application Date:	Jun-3-09
Time of Day:	10:00 AM
Application Method:	SPRAY
Application Timing:	POSPOS
Air Temperature, Unit:	70.0 F
% Relative Humidity:	28.7
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	69.6 F
% Cloud Cover:	70

Pest Stage At Each Application

Pest Stage At Each Application	
	A
Pest 1 Code, Type, Scale:	KYLGR W

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF VOLUMES OF APPLICATION ON THE PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0906TG6M Protocol ID: 0906TG6M
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Application Equipment	
	A
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22
Nozzle Type:	TEEJET
Nozzle Size:	1104 VS
Nozzle Spacing, Unit:	20 IN
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF VOLUMES OF APPLICATION ON THE PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0906TG6M Protocol ID: 0906TG6M
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed
Pest Code		KYLGR	KYLGR	KYLGR
Pest Scientific Name		Kyllinga graci>	Kyllinga graci>	Kyllinga graci>
Pest Name		Pasture spikes>	Pasture spikes>	Pasture spikes>
Rating Date		Jun-15-09	Jul-2-09	Jul-9-09
Rating Type		CONTROL	CONTROL	CONTROL
Rating Unit		%	%	%
Number of Subsamples		1	1	1
Days After First/Last Applic.		12 12	29 29	36 36
Trt-Eval Interval		12 DA-A	29 DA-A	36 DA-A
Trt No.	Treatment Name	Rate	Unit	
				1 2 3
1	CERTAINTY APPL. VOL. 50 GPA	0.5 oz wt/a		26.7 a 40.0 b 53.3 b
2	CERTAINTY APPL. VOL. 100 GPA	0.5 oz wt/a		30.0 a 60.0 ab 63.3 ab
3	CERTAINTY APPL. VOL. 50 GPA	1.0 oz wt/a		26.7 a 55.0 ab 68.3 ab
4	CERTAINTY APPL. VOL. 100 GPA	1.0 oz wt/a		26.7 a 40.0 b 60.0 ab
5	SUNRICE APPL. VOL. 50 GPA	0.125 lb ai/a		26.7 a 61.7 ab 65.0 ab
6	SUNRICE APPL. VOL. 100 GPA	0.125 lb ai/a		26.7 a 50.0 ab 68.3 ab
7	SUNRICE APPL. VOL. 50 GPA	0.250 lb ai/a		25.0 a 71.7 a 75.0 a
8	SUNRICE APPL. VOL. 100 GPA	0.250 lb ai/a		26.7 a 68.3 a 75.0 a
9	SEDGEHAMMER APPL. VOL. 50 GPA	0.031 lb ai/a		25.0 a 53.3 ab 56.7 ab
10	SEDGEHAMMER APPL. VOL. 100 GPA	0.031 lb ai/a		25.0 a 46.7 ab 55.0 b
11	SEDGEHAMMER APPL. VOL. 50 GPA	0.0625 lb ai/a		21.7 a 58.3 ab 68.3 ab
12	SEDGEHAMMER APPL. VOL. 100 GPA	0.0625 lb ai/a		25.0 a 50.0 ab 61.7 ab
13	UNTREATED APPL. VOL. 50 GPA			0.0 b 0.0 c 0.0 c
14	UNTREATED APPL. VOL. 100 GPA			0.0 b 0.0 c 0.0 c
15	MONUMENT APPL. VOL. 50 GPA	0.0179 lb ai/a		0.0 b 20.0 c 53.3 b
16	MONUMENT APPL. VOL. 100 GPA	0.0179 lb ai/a		0.0 b 18.3 c 55.0 b
17	MONUMENT APPL. VOL. 50 GPA	0.0360 lb ai/a		0.0 b 15.0 c 60.0 ab

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF VOLUMES OF APPLICATION ON THE PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0906TG6M Protocol ID: 0906TG6M
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed
Pest Code	KYLGR	KYLGR	KYLGR
Pest Scientific Name	Kyllinga gracilima	Kyllinga gracilima	Kyllinga gracilima
Pest Name	Pasture spikes	Pasture spikes	Pasture spikes
Rating Date	Jun-15-09	Jul-2-09	Jul-9-09
Rating Type	CONTROL	CONTROL	CONTROL
Rating Unit	%	%	%
Number of Subsamples	1	1	1
Days After First/Last Applic.	12 12	29 29	36 36
Trt-Eval Interval	12 DA-A	29 DA-A	36 DA-A
Trt Treatment			
No. Name	1	2	3
Rate Unit			
18 MONUMENT APPL. VOL. 100 GPA	0.0 b	16.7 c	60.0 ab
LSD (P=.05)	7.83	15.79	10.44
Standard Deviation	4.56	9.20	6.09
CV	26.36	22.85	10.97
Bartlett's X2	9.477	14.974	21.385
P(Bartlett's X2)	0.578	0.453	0.092
Replicate F	8.089	4.639	14.788
Replicate Prob(F)	0.0031	0.0237	0.0002
Treatment F	23.207	18.529	36.577
Treatment Prob(F)	0.0001	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

Mean separations are based on the complete error term.

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

Pest Type

W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop

Pest Code

KYLGR, *Kyllinga gracillima*, = US

Rating Unit

% = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF VOLUMES OF APPLICATION ON THE PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0906TG6M Protocol ID: 0906TG6M
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed		
Pest Code		KYLGR	KYLGR	KYLGR		
Pest Scientific Name		Kyllinga graci>	Kyllinga graci>	Kyllinga graci>		
Pest Name		Pasture spikes>	Pasture spikes>	Pasture spikes>		
Rating Date		Jul-21-09	Aug-7-09	Sep-4-09		
Rating Type		CONTROL	CONTROL	CONTROL		
Rating Unit		%	%	%		
Number of Subsamples		1	1	1		
Days After First/Last Applic.		48 48	65 65	93 93		
Trt-Eval Interval		48 DA-A	65 DA-A	93 DA-A		
Trt No.	Treatment Name	Rate	Unit			
1	CERTAINTY APPL. VOL. 50 GPA	0.5 oz wt/a		75.3 bc	21.7 d	15.0 d
2	CERTAINTY APPL. VOL. 100 GPA	0.5 oz wt/a		84.3 ab	21.7 d	15.0 d
3	CERTAINTY APPL. VOL. 50 GPA	1.0 oz wt/a		97.0 a	28.3 d	16.7 d
4	CERTAINTY APPL. VOL. 100 GPA	1.0 oz wt/a		87.7 ab	51.7 c	36.7 c
5	SUNRICE APPL. VOL. 50 GPA	0.125 lb ai/a		91.7 ab	56.7 c	46.7 bc
6	SUNRICE APPL. VOL. 100 GPA	0.125 lb ai/a		91.7 ab	70.0 bc	58.3 b
7	SUNRICE APPL. VOL. 50 GPA	0.250 lb ai/a		94.3 a	82.7 ab	82.7 a
8	SUNRICE APPL. VOL. 100 GPA	0.250 lb ai/a		97.0 a	91.7 ab	82.7 a
9	SEDGEHAMMER APPL. VOL. 50 GPA	0.031 lb ai/a		77.7 abc	20.0 d	6.7 d
10	SEDGEHAMMER APPL. VOL. 100 GPA	0.031 lb ai/a		66.7 c	28.3 d	16.7 d
11	SEDGEHAMMER APPL. VOL. 50 GPA	0.0625 lb ai/a		85.0 ab	21.7 d	20.0 d
12	SEDGEHAMMER APPL. VOL. 100 GPA	0.0625 lb ai/a		83.3 ab	23.3 d	13.3 d
13	UNTREATED APPL. VOL. 50 GPA			0.0 d	0.0 d	0.0 d
14	UNTREATED APPL. VOL. 100 GPA			0.0 d	0.0 d	0.0 d
15	MONUMENT APPL. VOL. 50 GPA	0.0179 lb ai/a		96.0 a	100.0 a	100.0 a
16	MONUMENT APPL. VOL. 100 GPA	0.0179 lb ai/a		96.0 a	100.0 a	100.0 a
17	MONUMENT APPL. VOL. 50 GPA	0.0360 lb ai/a		96.0 a	100.0 a	100.0 a

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF VOLUMES OF APPLICATION ON THE PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0906TG6M Protocol ID: 0906TG6M
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed
Pest Code	KYLGR	KYLGR	KYLGR
Pest Scientific Name	Kyllinga gracilima	Kyllinga gracilima	Kyllinga gracilima
Pest Name	Pasture spikes	Pasture spikes	Pasture spikes
Rating Date	Jul-21-09	Aug-7-09	Sep-4-09
Rating Type	CONTROL	CONTROL	CONTROL
Rating Unit	%	%	%
Number of Subsamples	1	1	1
Days After First/Last Applic.	48 48	65 65	93 93
Trt-Eval Interval	48 DA-A	65 DA-A	93 DA-A
Trt No.	4	5	6
Treatment Name	18 MONUMENT APPL. VOL. 100 GPA		
Rate	0.0360 lb ai/a		
Unit			
Mean	95.0 a	100.0 a	100.0 a
LSD (P=.05)	10.89	18.71	13.96
Standard Deviation	6.35	10.91	8.14
CV	8.08	21.39	18.07
Bartlett's X2	54.175	20.933	6.54
P(Bartlett's X2)	0.001*	0.034*	0.835
Replicate F	37.620	4.913	16.825
Replicate Prob(F)	0.0001	0.0198	0.0001
Treatment F	66.297	34.402	68.613
Treatment Prob(F)	0.0001	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean separations are based on the complete error term.
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Pest Type
 W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
 KYLGR, *Kyllinga gracillima*, = US
Rating Unit
 % = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0907TG7 Protocol ID: 0907TG7
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and M. Barton

Initiation Date: Jun-1-09

Trial Location

City: Greenwich
State/Prov.: CT

Objectives:

To determine the effects of early and late applications of several products in controlling false green kyllinga.

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik and M. Barton
Location: Burning Tree Country Club, Greenwich, CT

Pest Description

Pest 1 Type: W **Code:** KYLGR *Kyllinga gracillima*
Common Name: Pasture spikesedge

Site and Design

Plot Width, Unit: 3.5 FT **Site Type:** TUGCFA turf - golf course fairway
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3 **Study Design:** SPLPLO Split-Plot

Trial Initiation Comments:

Uniform natural population of false green kyllinga

Application Description

	A	B
Application Date:	Jun-3-09	Jun-25-09
Time of Day:	10:30 AM	10:30 AM
Application Method:	SPRAY	SPRAY
Application Timing:	POEMCR	LATE POST
Air Temperature, Unit:	70.0 F	83.4 F
% Relative Humidity:	28.7	37.0
Wind Velocity, Unit:	2 MPH	2 MPH
Soil Temperature, Unit:	69.6 F	26.0
% Cloud Cover:	70.0	80.0

Pest Stage At Each Application

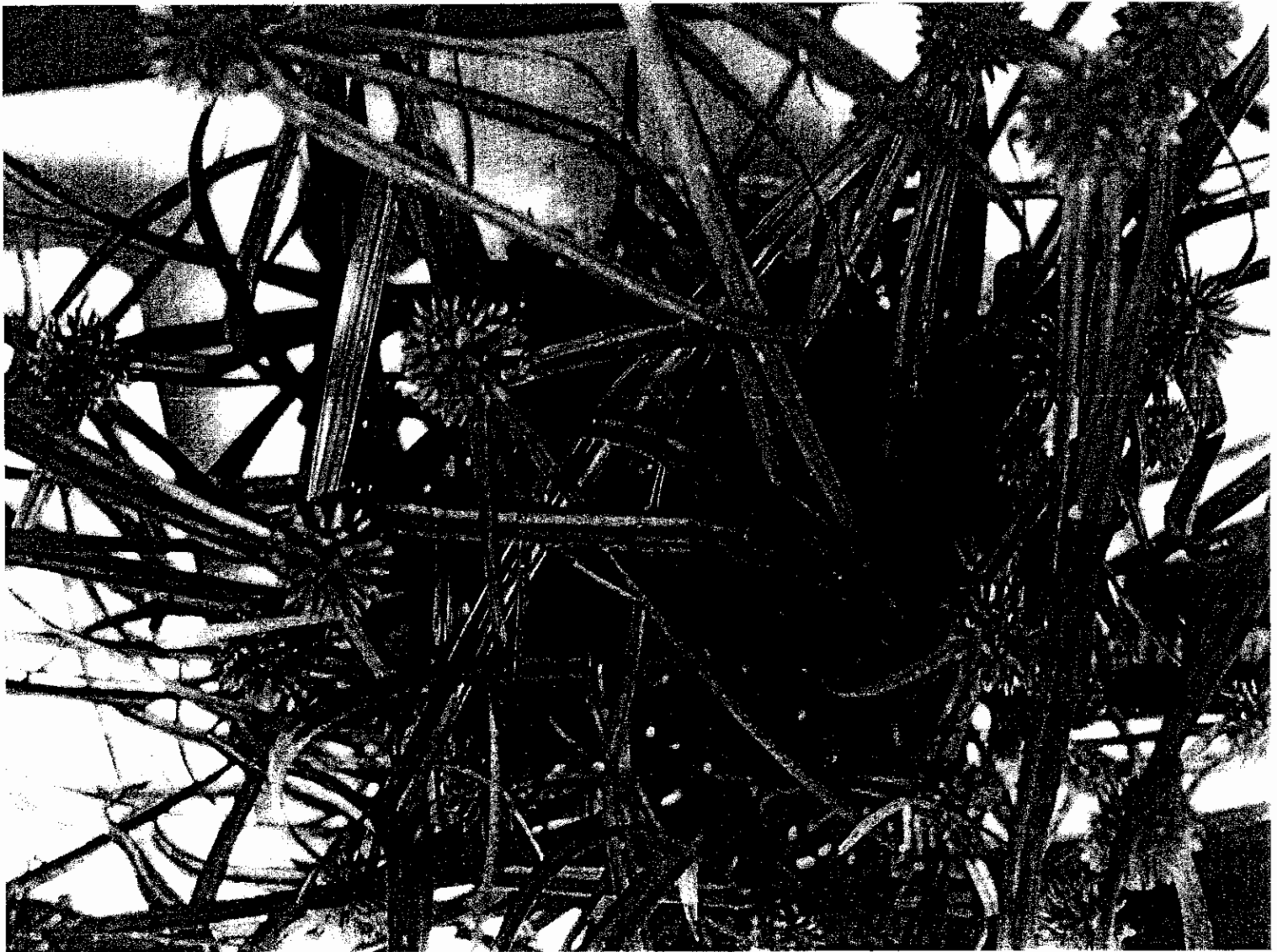
	A	B
Pest 1 Code, Type, Scale:	KYLGR W	KYLGR W

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0907TG7 Protocol ID: 0907TG7
 Location: Greenwich, CT Study Director: Prof. P. C. Bbhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Application Equipment		
	A	B
Appl. Equipment:	BACKPACK	
Equipment Type:	SPRBAC	
Operating Pressure, Unit:	22	
Nozzle Type:	TEEJET	
Nozzle Size:	1104 VS	
Spray Volume, Unit:	50 gal/ac	
Mix Size, Unit:	0.456	



UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0907TG7 Protocol ID: 0907TG7
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed
Pest Code		KYLGR	KYLGR	KYLGR
Pest Scientific Name		Kyllinga graci>	Kyllinga graci>	Kyllinga graci>
Pest Name		Pasture spikes>	Pasture spikes>	Pasture spikes>
Rating Date		Jun-15-09	Jul-2-09	Jul-9-09
Rating Type		CONTROL	CONTROL	CONTROL
Rating Unit		%	%	%
Number of Subsamples		1	1	1
Days After First/Last Applic.		12 12	29 7	36 14
Trt-Eval Interval		-10 DA-B	7 DA-B	14 DA-B
Trt Treatment	Rate	Rate	Appl	
No. Name	Unit	Unit	Code	
1 CERTAINTY EARLY POST	0.5 oz wt/a		A	21.7 ab
2 CERTAINTY LATE POST	0.5 oz wt/a		B	35.0 a
3 CERTAINTY EARLY POST	1.0 oz wt/a		A	73.3 a
4 CERTAINTY LATE POST	1.0 oz wt/a		B	25.0 a
5 SEDGEHAMMER EARLY POST	0.0625 lb ai/a		A	31.7 a
6 SEDGEHAMMER LATE POST	0.0625 lb ai/a		B	41.7 a
7 SEDGEHAMMER EARLY POST	0.094 lb ai/a		A	28.3 a
8 SEDGEHAMMER LATE POST	0.094 lb ai/a		B	58.3 a
9 SUNRICE EARLY POST	0.250 lb ai/a		A	18.3 b
10 SUNRICE LATE POST	0.250 lb ai/a		B	36.7 a
11 SUNRICE EARLY POST	0.500 lb ai/a		A	20.0 a
12 SUNRICE LATE POST	0.500 lb ai/a		B	60.0 a
13 UNTREATED EARLY POST			A	23.3 ab
14 UNTREATED LATE POST			B	35.0 a
LSD (P=.05)		8.11		35.67
Standard Deviation		4.63		20.37
CV		25.54		73.43
Bartlett's X2		5.049		11.241
P(Bartlett's X2)		0.41		0.423
Replicate F		3.646		0.948
Replicate Prob(F)		0.0531		0.4109
Treatment F		19.604		1.547
Treatment Prob(F)		0.0001		0.2141

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0907TG7 Protocol ID: 0907TG7
 Location: Greenwich, CT Study Director: Prof. P. C. Bbhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed				
Pest Code	KYLGR	KYLGR	KYLGR				
Pest Scientific Name	Kyllinga graci>	Kyllinga graci>	Kyllinga graci>				
Pest Name	Pasture spikes>	Pasture spikes>	Pasture spikes>				
Rating Date	Jul-21-09	Aug-7-09	Sep-4-09				
Rating Type	CONTROL	CONTROL	CONTROL				
Rating Unit	%	%	%				
Number of Subsamples	1	1	1				
Days After First/Last Applic.	48 26	65 43	93 71				
Trt-Eval Interval	26 DA-B	43 DA-B					
Trt No.	Treatment Name	Rate	Unit	Appl Code	4	5	6
1	CERTAINTY EARLY POST	0.5 oz wt/a		A	96.0 a	96.0 a	91.7 a
2	CERTAINTY LATE POST	0.5 oz wt/a		B	96.7 a	89.3 a	71.7 ab
3	CERTAINTY EARLY POST	1.0 oz wt/a		A	66.7 a	92.7 a	68.3 ab
4	CERTAINTY LATE POST	1.0 oz wt/a		B	91.7 a	98.7 a	97.7 a
5	SEDGEHAMMER EARLY POST	0.0625 lb ai/a		A	93.3 a	60.0 a	41.0 abc
6	SEDGEHAMMER LATE POST	0.0625 lb ai/a		B	93.3 a	60.0 a	26.7 bc
7	SEDGEHAMMER EARLY POST	0.094 lb ai/a		A	95.0 a	68.3 a	48.3 abc
8	SEDGEHAMMER LATE POST	0.094 lb ai/a		B	95.0 a	79.3 a	60.0 ab
9	SUNRICE EARLY POST	0.250 lb ai/a		A	95.0 a	95.0 a	87.0 a
10	SUNRICE LATE POST	0.250 lb ai/a		B	91.7 a	80.0 a	76.0 ab
11	SUNRICE EARLY POST	0.500 lb ai/a		A	73.3 a	94.3 a	92.0 a
12	SUNRICE LATE POST	0.500 lb ai/a		B	96.7 a	88.3 a	91.7 a
13	UNTREATED EARLY POST			A	0.0 b	0.0 b	0.0 c
14	UNTREATED LATE POST			B	0.0 b	0.0 b	0.0 c
LSD (P=.05)					30.67	22.75	35.76
Standard Deviation					17.51	12.99	20.42
CV					22.61	18.15	33.55
Bartlett's X2					37.906	19.407	21.429
P(Bartlett's X2)					0.001*	0.054	0.029*
Replicate F					4.080	2.404	3.118
Replicate Prob(F)					0.0402	0.1266	0.0759
Treatment F					11.323	19.275	7.993
Treatment Prob(F)					0.0001	0.0001	0.0002

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

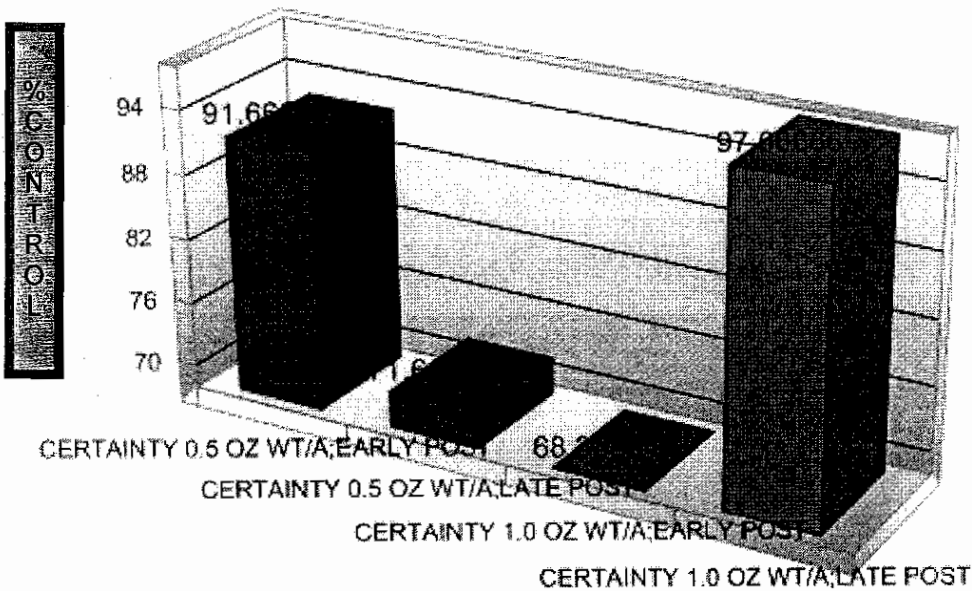
UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0907TG7 Protocol ID: 0907TG7
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Mean separations are based on the complete error term.
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Pest Type
 W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
 KYLGR, Kyllinga gracillima, = US
Rating Unit
 % = percent

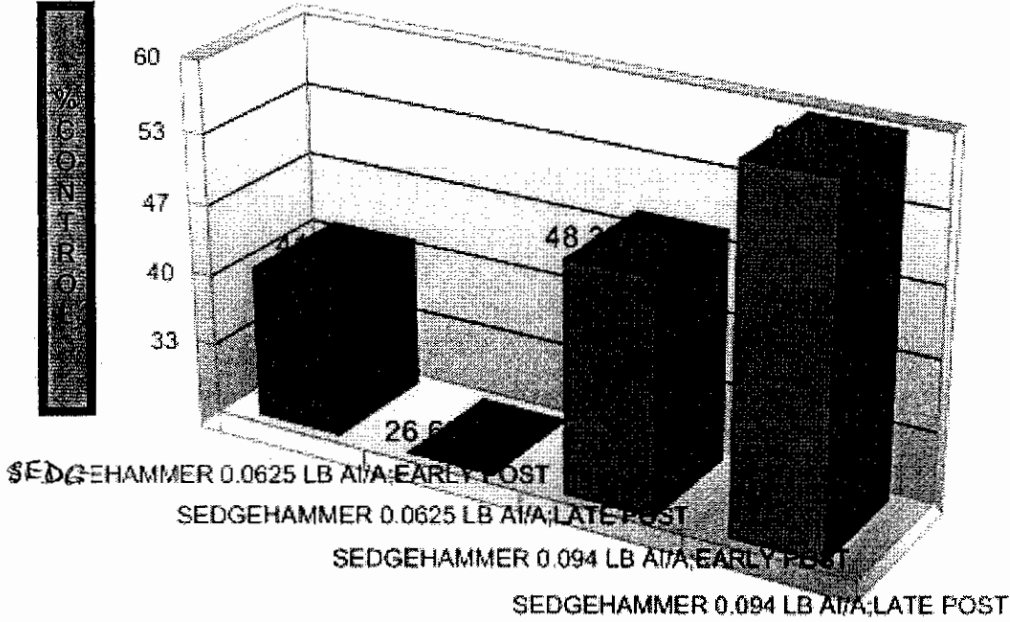


**TIMINGS OF CERTAINTY APPLICATION
 IN FALSE GREEN KYLLINGA CONTROL
 (Sept., 2009)**

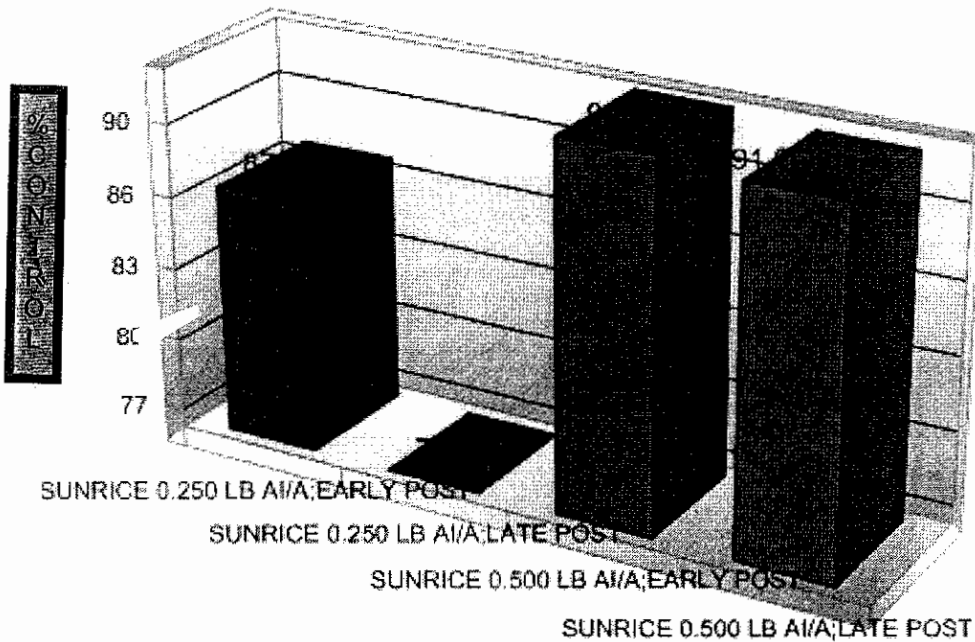
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EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 0907TG7 Protocol ID: 0907TG7
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK



**TIMINGS OF SEDGEHAMMER APPLICATION
 IN FALSE GREEN KYLLINGA CONTROL
 (Sept., 2009)**



**TIMINGS OF SUNRICE APPLICATION IN
 FALSE GREEN KYLLINGA CONTROL
 (September, 2009)**

UNIVERSITY OF MASSACHUSETTS-AMHERST

COMPARISON OF VARIOUS COMMERCIAL PRODUCTS IN GARDEN MOSS CONTROL

Trial ID: 0908TG8 Protocol ID: 0908TG8
 Location: Home lawn Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik
 Investigator: P. C. Bhowmik and S. Phoboo

Title: Professor

Personnel

Study Director: Dr. Prasanta C. Bhowmik Title: Professor
 Affiliation: University of Massachusetts Amherst
 Investigator: P. C. Bhowmik and S. Phoboo
 Location: Home lawn area, Amherst

Pest Description

Pest 1 Type: W Code: WEED
 Common Name: Garden moss

Site and Design

Plot Width, Unit: 3.5 FT
 Plot Length, Unit: 5 FT
 Plot Area, Unit: 17.5 FT²
 Replications: 3 Study Design: RACOB L Randomized Complete Block (RCB)

Application Description

Application Description	
	A
Application Date:	Jul-10-09
Time of Day:	10:00 AM
Application Method:	SPRAY
Application Timing:	NCPOPE
Application Placement:	BROFOL
Air Temperature, Unit:	73.5 F
% Relative Humidity:	45.7
Wind Velocity, Unit:	0 MPH
Soil Temperature, Unit:	66.9 F
% Cloud Cover:	0

Pest Stage At Each Application

Pest Stage At Each Application	
	A
Pest 1 Code, Type, Scale:	WEED W

UNIVERSITY OF MASSACHUSETTS-AMHERST

COMPARISON OF VARIOUS COMMERCIAL PRODUCTS IN GARDEN MOSS CONTROL

Trial ID: 0908TG8 Protocol ID: 0908TG8
 Location: Home lawn Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed	W Weed	
Pest Code		BRQAR	BRQAR	BRQAR	BRQAR	
Pest Scientific Name		Bryum argenteum	Bryum argenteum	Bryum argenteum	Bryum argenteum	
Pest Name		Silver moss	Silver moss	Silver moss	Silver moss	
Crop Name		No crop	No crop	No crop	No crop	
Rating Date		Jul-12-09	Jul-15-09	Aug-14-09	Sep-18-09	
Rating Type		CONTROL	CONTROL	CONTROL	CONTROL	
Rating Unit		%	%	%	%	
Number of Subsamples		1	1	1	1	
Days After First/Last Applic.		2 2	5 5	35 35	70 70	
Trt-Eval Interval		2 DA-A	2 DA-A	2 DA-A	2 DA-A	
Trt No.	Treatment Name	Rate	1	2	3	4
		Rate Unit				
1	MOSS OUT	32 oz/1000 ft ²	73.3 a	85.0 a	76.7 a	68.3 a
2	MOSS OUT	48 oz/1000 ft ²	73.3 a	83.3 a	80.0 a	75.0 a
3	MOSS-A ACID FORM	32 oz/1000 ft ²	53.3 b	68.3 b	53.3 bc	43.3 b
4	MOSS-A ACID FORM	48 oz/1000 ft ²	55.0 b	70.0 b	66.7 ab	40.0 b
5	QUICKSILVER	6.0 fl oz/a	8.3 c	25.0 c	38.3 cd	35.0 bc
6	QUICKSILVER	9.0 fl oz/a	10.0 c	25.0 c	26.7 d	26.7 c
7	UNTREATED		0.0 c	0.0 d	0.0 e	0.0 d
LSD (P=.05)			8.90	8.27	16.83	9.38
Standard Deviation			5.00	4.65	9.46	5.27
CV			12.8	9.13	19.38	12.8
Bartlett's X ²			0.983	3.176	7.338	2.942
P(Bartlett's X ²)			0.964	0.529	0.197	0.709
Replicate F			0.333	2.862	0.053	3.900
Replicate Prob(F)			0.7230	0.0963	0.9484	0.0496
Treatment F			122.429	157.578	28.333	68.971
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Pest Type
 W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
 BRQAR, Bryum argenteum, = US
Rating Unit
 % = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN GARDEN MOSS CONTROL

Trial ID: 0909TG9 Protocol ID: 0909TG9
 Location: Home garden Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and D. Sarkar

Trial Location

City: Amherst
State/Prov.: MA

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik and D. Sarkar
Location: Home garden, Amherst, MA

Pest Description

Common Name: Silver moss

Site and Design

Plot Width, Unit: 3.5 FT
Plot Length, Unit: 5 FT
Plot Area, Unit: 17.5 FT²
Replications: 3 **Study Design:** RACOB L Randomized Complete Block (RCB)

Application Description

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Application Date:	Jul-10-09	Aug-14-09																						
Time of Day:	10:00 AM	Noon																						
Application Method:	SPRAY	SPRAY																						
Application Timing:	NCPOPE	NCPOPE																						
Application Placement:	BROFOL	BROFOL																						
Air Temperature, Unit:	73.5 F	78.5 F																						
% Relative Humidity:	45.7	48.7																						
Wind Velocity, Unit:	0 MPH	2 MPH																						
Soil Temperature, Unit:	66.9 F	72.8 F																						
% Cloud Cover:	0	0																						

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN GARDEN MOSS CONTROL

Trial ID: 0909TG9 Protocol ID: 0909TG9
 Location: Home garden Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed	W Weed		
Pest Code	BRQAR	BRQAR	BRQAR	BRQAR		
Pest Scientific Name	Bryum argenteum	Bryum argenteum	Bryum argenteum	Bryum argenteum		
Pest Name	Silver moss	Silver moss	Silver moss	Silver moss		
Crop Name	No crop	No crop	No crop	No crop		
Rating Date	Jul-12-09	Jul-15-09	Aug-14-09	Sep-18-09		
Rating Type	CONTROL	CONTROL	CONTROL	70		
Rating Unit	%	%	%	70		
Number of Subsamples	1	1	1	5		
Days After First/Last Applic.	2 2	5 5	35 35	70 35		
Trt Treatment	Rate	Appl				
No. Name	Rate Unit	Code	1	2	3	4
1 MOSS OUT	32.0 fl oz/1000 ft2	JUNE	70.0 a	71.7 a	71.7 ab	65.0 ab
2 MOSS OUT	32.0 fl oz/1000 ft2	JUNE	70.0 a	73.3 a	75.0 a	85.0 a
MOSS OUT	32.0 fl oz/1000 ft2	JULY				
3 MOSS-B NEUTR	32.0 fl oz/1000 ft2	JUNE	41.7 abc	46.7 ab	20.0 bc	15.0 cd
4 MOSS-B NEUTR	32.0 fl oz/1000 ft2	JUNE	53.3 ab	70.0 a	33.3 abc	41.7 bcd
MOSS-B NEUTR	32.0 fl oz/1000 ft2	JULY				
5 QUICKSILVER	6.0 fl oz/a	JUNE	13.3 bc	31.7 ab	45.0 abc	23.3 bcd
6 QUICKSILVER	6.0 fl oz/a	JUNE	11.7 bc	20.0 ab	36.7 abc	53.3 abc
QUICKSILVER	6.0 fl oz/a	JULY				
7 AVENGER	32 fl oz/1000 ft2	JUNE	33.3 abc	51.7 ab	40.0 abc	38.3 bcd
8 AVENGER	32 fl oz/1000 ft2	JUNE	33.3 abc	43.3 ab	23.3 abc	46.7 a-d
AVENGER	32 fl oz/1000 ft2	JULY				
9 UNTREATED			1.7 c	6.7 b	6.7 c	6.7 d
LSD (P=.05)			30.97	37.04	32.97	28.69
Standard Deviation			17.89	21.40	19.05	16.57
CV			49.04	46.41	48.74	39.77
Bartlett's X2			21.545	14.157	10.743	6.791
P(Bartlett's X2)			0.003*	0.048*	0.217	0.559
Replicate F			1.010	0.752	3.142	7.656
Replicate Prob(F)			0.3864	0.4873	0.0706	0.0046
Treatment F			5.790	3.644	4.228	6.645
Treatment Prob(F)			0.0014	0.0133	0.0069	0.0007

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Pest Type
 W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
 BRQAR, Bryum argenteum, = US
Rating Unit
 % = percent

UNIVERSITY OF MASSACHUSETTS-AMHERST

POST EMERGENCE CONTROL OF POA ANNUA

Trial ID: 0910TG10-M Protocol ID: 0910TG10-M
 Location: TRC-SDF Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and T. Griffin

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik and T. Griffin
Location: Joe Troll Turf Research Center, South Deerfield, MA

Pest Description

Pest 1 Type: W **Code:** POAAN Poa annua
Common Name: Annual bluegrass

Site and Design

Plot Width, Unit: 3.5 FT
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3 **Study Design:** RACOB L Randomized Complete Block (RCB)

Application Description

	A	B
Application Date:	Jun-8-09	Jun-10-09
Time of Day:	11:: AM	10:00 AM
Application Method:	SPRAY	SPRAY
Application Timing:	EAPOWE	EAPOWE
Application Placement:	BROFOL	BROFOL
Air Temperature, Unit:	71.4 F	70.2 F
% Relative Humidity:	19.1	30.0
Wind Velocity, Unit:	5 MPH	5 MPH
Soil Temperature, Unit:	71.7 F	75.2 F
% Cloud Cover:		0

Pest Stage At Each Application

	A	B
Pest 1 Code, Type, Scale:	POAAN W	POAAN W

Application Equipment

	A	B
Appl. Equipment:	BACKPACK	
Equipment Type:	SPRBAC	
Operating Pressure, Unit:	22	
Nozzle Type:	TEEJET	
Nozzle Size:	1104 VS	
Spray Volume, Unit:	50	gal/ac
Mix Size, Unit:	0.456	

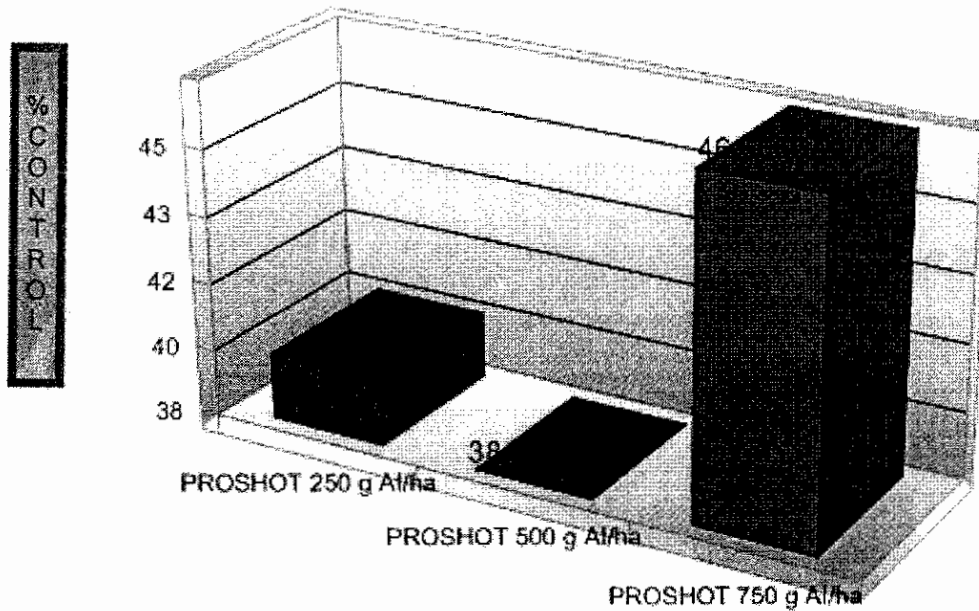
UNIVERSITY OF MASSACHUSETTS-AMHERST

POST EMERGENCE CONTROL OF POA ANNUA

Trial ID: 0910TG10-M Protocol ID: 0910TG10-M
Location: TRC-SDF Study Director:
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

POST CONTROL OF POA ANNUA - PROSHOT - JUNE 23



UNIVERSITY OF MASSACHUSETTS-AMHERST

POST EMERGENCE CONTROL OF POA ANNUA

Trial ID: 0910TG10-M Protocol ID: 0910TG10-M
 Location: TRC-SDF Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed
Pest Code		POAAN	POAAN	POAAN
Pest Scientific Name		Poa annua	Poa annua	Poa annua
Pest Name		Annual bluegra>	Annual bluegra>	Annual bluegra>
Crop Code		AGSST	AGSST	AGSST
BBCH Scale		BGRM	BGRM	BGRM
Crop Scientific Name		Agrostis stolo>	Agrostis stolo>	Agrostis stolo>
Crop Name		Creeping bentg>	Creeping bentg>	Creeping bentg>
Rating Date		Jun-23-09	Jul-1-09	Jul-17-09
Rating Type		CONTROL	CONTROL	CONTROL
Rating Unit		Percent	Percent	Percent
Number of Subsamples		1	1	1
Days After First/Last Applic.		15 13	23 21	39 37
Trt Treatment	Rate			
No. Name	Rate Unit	2	3	4
1 SUNRICE	0.125 lb ai/a	38.3 a	46.7 a	75.0 a
X-77	0.25 % v/v			
2 SUNRICE	0.188 lb ai/a	41.7 a	56.7 a	73.3 a
X-77	0.25 % v/v			
3 SUNRICE	0.250 lb ai/a	40.0 a	68.3 a	75.0 a
X-77	0.25 % v/v			
4 PROGRASS	0.25 lb ai/a	38.3 a	58.3 a	73.3 a
X-77	0.25 % v/v			
5 PROGRASS	0.50 lb ai/a	45.0 a	50.0 a	78.3 a
X-77	0.25 % v/v			
6 PROGRASS	0.75 lb ai/a	46.7 a	55.0 a	76.7 a
X-77	0.25 % v/v			
7 EXC 4142	0.05 lb ai/a	50.0 a	65.0 a	73.3 a
EZA 10347	0.25 % v/v			
8 EXC 4142	0.075 lb ai/a	48.3 a	60.0 a	70.0 a
EZA 10347	0.25 % v/v			
9 EXC 4142	0.100 lb ai/a	38.3 a	58.3 a	76.7 a
EZA 10347	0.25 % v/v			
10 ECHELON	0.375 lb ai/a	43.3 a	51.7 a	70.0 a
11 ECHELON	0.75 lb ai/a	46.7 a	63.3 a	71.7 a
12 ECHELON	1.00 lb ai/a	41.7 a	53.3 a	78.3 a
13 UNTREATED		0.0 b	0.0 b	0.0 b
14 PROSHOT	250 g ai/ha	40.0 a	50.0 a	78.3 a
15 PROSHOT	500 g ai/ha	38.3 a	43.3 a	80.0 a
16 PROSHOT	750 g ai/ha	46.7 a	53.3 a	78.3 a
LSD (P=.05)		18.53	14.47	9.21
Standard Deviation		11.12	8.68	5.52
CV		27.65	16.66	7.83
Bartlett's X2		5.755	6.506	6.699
P(Bartlett's X2)		0.972	0.952	0.877
Replicate F		17.908	46.853	0.017
Replicate Prob(F)		0.0001	0.0001	0.9831
Treatment F		3.164	9.450	35.703
Treatment Prob(F)		0.0035	0.0001	0.0001

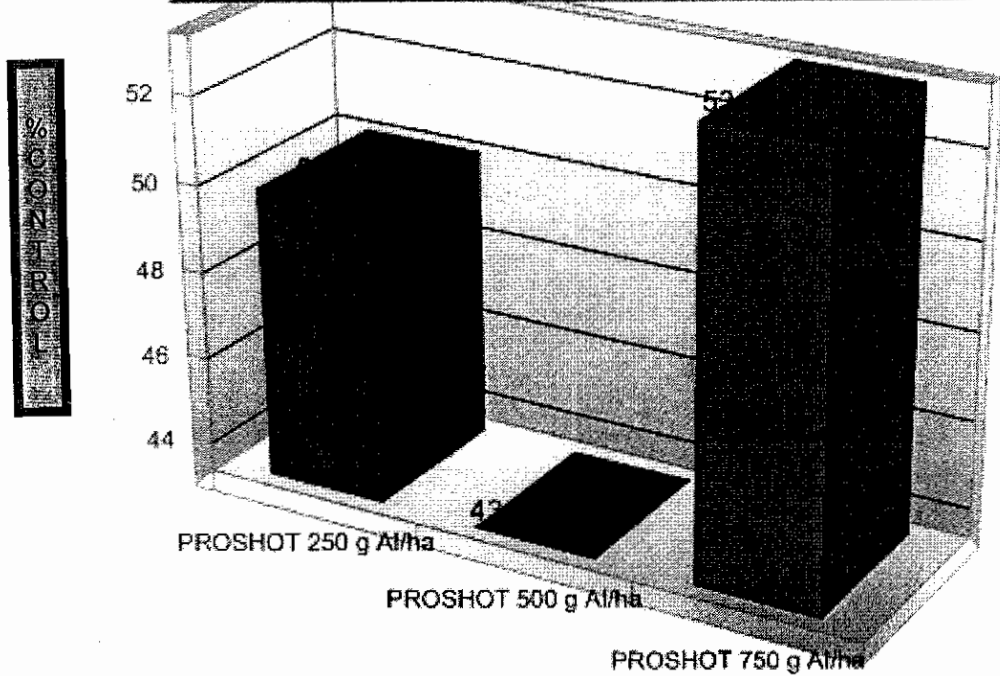
UNIVERSITY OF MASSACHUSETTS-AMHERST

POST EMERGENCE CONTROL OF POA ANNUA

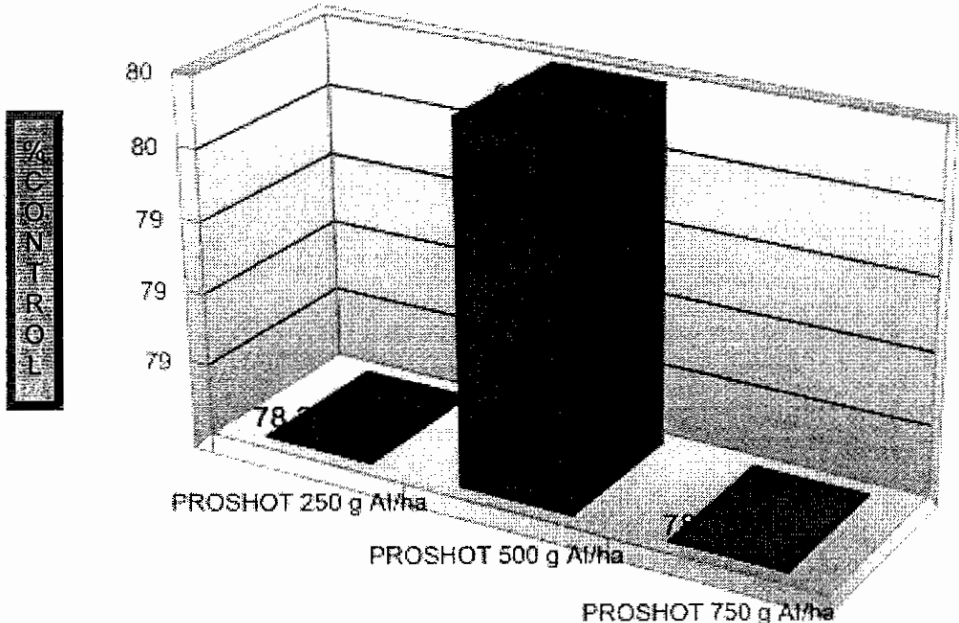
Trial ID: 0910TG10-M Protocol ID: 0910TG10-M
 Location: TRC-SDF Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

POST CONTROL OF POA ANNUA - PROSHOT - JULY 1



POST CONTROL OF POA ANNUA - PROSHOT - JULY 17



UNIVERSITY OF MASSACHUSETTS-AMHERST

POSTEMERGENCE CONTROL OF YELLOW NUTSEDGE

Trial ID: 0911TG11 Protocol ID: 0911TG11
 Location: Hickory Ridge CC Study Director: Prof. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information
Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and R. Ruzsala

Personnel
Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik and R. Ruzsala
Location: Hickory Ridge Country Club, Amherst

Site and Design

Plot Width, Unit: 3.5 FT
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3 **Study Design:** RACOB L Randomized Complete Block (RCB)

Moisture and Weather Conditions

Overall Moisture Conditions: EXCELL excellent

Application Description

	A
Application Date:	Jul-6-09
Time of Day:	1:30 PM
Application Method:	SPRAY
Application Timing:	LAPOWE
Air Temperature, Unit:	86.6 F
% Relative Humidity:	26.3
Wind Velocity, Unit:	0
Soil Temperature, Unit:	78.8 F

Application Equipment

	A
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22
Nozzle Type:	TEEJET
Nozzle Size:	1104 VS
Nozzle Spacing, Unit:	20 IN
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456

UNIVERSITY OF MASSACHUSETTS-AMHERST

POSTEMERGENCE CONTROL OF YELLOW NUTSEDGE

Trial ID: 0911TG11 Protocol ID: 0911TG11
 Location: Hickory Ridge CC Study Director: Prof. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed		W Weed		
Pest Code		CYPES		CYPES		
Pest Scientific Name		Cyperus esculentus		Cyperus esculentus		
Pest Name		Yellow nutsedge		Yellow nutsedge		
Crop Code	AGSPL		AGSPL			
BBCH Scale	BGRM		BGRM			
Crop Scientific Name	Agrostis palus		Agrostis palus			
Crop Name	Bent grass		Bent grass			
Part Rated	SHOOT	SHOOT	SHOOT	SHOOT		
Rating Date	Jul-15-09	Jul-15-09	Aug-4-09	Aug-4-09		
Rating Type	PHYTO	CONTROL	PHYTO	CONTROL		
Rating Unit	Percent	Percent	Percent	Percent		
Number of Subsamples	1	1	1	1		
Days After First/Last Applic.	9 9	9 9	29 29	29 29		
Trt-Eval Interval	9 DA-A	9 DA-A	9 DA-A	9 DA-A		
Trt No.	Treatment Name	Rate Unit	1	2	3	4
1	CERTAINTY	0.5 oz wt/1000 ft ²	10.0 b	66.7 a	0.0 d	87.7 ab
2	CERTAINTY	1.0 oz wt/1000 ft ²	10.0 b	45.0 ab	0.0 d	95.3 a
3	CERTAINTY	1.5 oz wt/1000 ft ²	23.3 b	38.3 ab	0.0 d	82.7 abc
4	SEDGEHAMMER	0.031 lb ai/a	0.0 b	41.7 ab	0.0 d	78.3 abc
5	SEDGEHAMMER	0.0625 lb ai/a	0.0 b	40.0 ab	0.0 d	75.0 abc
6	SEDGEHAMMER	0.125 lb ai/a	10.0 b	48.3 ab	0.0 d	83.3 abc
7	SUNRICE	0.125 lb ai/a	0.0 b	46.7 ab	0.0 d	85.0 abc
8	SUNRICE	0.250 lb ai/a	0.0 b	51.7 ab	0.0 d	75.0 abc
9	SUNRICE	0.375 lb ai/a	0.0 b	51.7 ab	0.0 d	85.0 abc
10	TENACITY	1.5 oz/1000 ft ²	0.0 b	25.0 b	0.0 d	53.3 bcd
11	TENACITY	3.0 oz/1000 ft ²	0.0 b	26.7 b	0.0 d	45.0 d
12	TENACITY	4.5 oz/1000 ft ²	48.3 a	26.7 b	51.7 c	51.7 cd
13	MONUMENT	0.0134 lb ai/a	65.0 a	50.0 ab	83.3 b	100.0 a
14	MONUMENT	0.0268 lb ai/a	60.0 a	35.0 ab	86.7 b	100.0 a
15	MONUMENT	0.0410 lb ai/a	63.3 a	43.3 ab	100.0 a	100.0 a
16	UNTREATED CHECK		0.0 b	0.0 c	0.0 d	0.0 e
LSD (P=.05)			18.61	19.84	8.50	21.10
Standard Deviation			11.16	11.90	5.10	12.65
CV			61.58	29.9	25.37	16.91
Bartlett's X2			5.436	21.903	0.874	13.453
P(Bartlett's X2)			0.607	0.081	0.646	0.265
Replicate F			2.860	3.779	1.342	0.408
Replicate Prob(F)			0.0730	0.0344	0.2766	0.6684
Treatment F			15.669	4.865	158.867	12.898
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

<p><u>Pest Type</u> W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop</p> <p><u>Pest Code</u> CYPES, Cyperus esculentus, = US</p> <p><u>Crop Code</u></p>	<p><u>AGSPL, BGRM, Agrostis palustris, = US</u></p> <p><u>Part Rated</u> SHOOT = shoot</p> <p><u>Rating Unit</u> Percent = percent</p>
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UNIVERSITY OF MASSACHUSETTS-AMHERST

POSTEMERGENCE CONTROL OF YELLOW NUTSEDGE

Trial ID: 0911TG11 Protocol ID: 0911TG11
 Location: Hickory Ridge CC Study Director: Prof. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type			W Weed
Pest Code			CYPES
Pest Scientific Name			Cyperus esculen>
Pest Name			Yellow nutsedge
Crop Code		AGSPL	
BBCH Scale		BGRM	
Crop Scientific Name		Agrostis palus>	
Crop Name		Bent grass	
Part Rated		SHOOT	SHOOT
Rating Date		Sep-18-09	Sep-18-09
Rating Type		PHYTO	CONTROL
Rating Unit		Percent	Percent
Number of Subsamples		1	1
Days After First/Last Applic.		74 74	74 74
Trt-Eval Interval		9 DA-A	9 DA-A
Trt No.	Treatment Name	Rate Unit	
		5	6
1	CERTAINTY	0.5 oz wt/1000 ft2	79.3 a
2	CERTAINTY	1.0 oz wt/1000 ft2	88.3 a
3	CERTAINTY	1.5 oz wt/1000 ft2	70.0 a
4	SEDGEHAMMER	0.031 lb ai/a	88.3 a
5	SEDGEHAMMER	0.0625 lb ai/a	90.0 a
6	SEDGEHAMMER	0.125 lb ai/a	93.3 a
7	SUNRICE	0.125 lb ai/a	86.7 a
8	SUNRICE	0.250 lb ai/a	85.0 a
9	SUNRICE	0.375 lb ai/a	81.7 a
10	TENACITY	1.5 oz/1000 ft2	63.3 a
11	TENACITY	3.0 oz/1000 ft2	71.7 a
12	TENACITY	4.5 oz/1000 ft2	63.3 a
13	MONUMENT	0.0134 lb ai/a	75.0 a
14	MONUMENT	0.0268 lb ai/a	78.3 a
15	MONUMENT	0.0410 lb ai/a	88.3 a
16	UNTREATED CHECK		0.0 b
LSD (P=.05)		14.18	23.22
Standard Deviation		8.51	13.93
CV		46.66	18.53
Bartlett's X2		1.413	15.43
P(Bartlett's X2)		0.702	0.281
Replicate F		0.202	1.471
Replicate Prob(F)		0.8186	0.2457
Treatment F		50.879	7.567
Treatment Prob(F)		0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

<p><u>Pest Type</u> W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop</p> <p><u>Pest Code</u> CYPES, Cyperus esculentus, = US</p> <p><u>Crop Code</u></p>	<p>AGSPL, BGRM, Agrostis palustris, = US</p> <p><u>Part Rated</u> SHOOT = shoot</p> <p><u>Rating Unit</u> Percent = percent</p>
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UNIVERSITY OF MASSACHUSETTS-AMHERST

TOLERANCE OF NTEP KENTUCKY BLUEGRASS CULTIVARS TO SULFOSULFURON

Trial ID: 0912TG12 Protocol ID: 0912TG12
 Location: TRC-SDF Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. Bhowmik, S. Ebdon and T. Griffin

Objectives:

To determine the tolerance of various Kentucky bluegrass cultivars to CERTAINTY

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. Bhowmik, S. Ebdon and T. Griffin
Location: Joe Troll Turf Research Center, South Deerfield, MA

Crop Description

Crop 1: POAPR Poa pratensis Kentucky bluegrass
Variety: 173 Entries
BBCH Scale: BGRM

Site and Design

Plot Width, Unit: 1.66 FT
Plot Length, Unit: 75 FT
Plot Area, Unit: 124.5 FT²
Replications: 3 **Study Design:** RACOBL Randomized Complete Block (RCB)

Comment: Sulfosulfuron (Certainty) was applied at 1.5 oz /A to Kentucky bluegrass cultivars.

Application Description

A	
Application Date:	Jul-14-09
Application Method:	SPRAY
Application Timing:	POST
Air Temperature, Unit:	75.5 F
% Relative Humidity:	34.5
Wind Velocity, Unit:	0 MPH
Soil Temperature, Unit:	71.9 F
% Cloud Cover:	0

Crop Stage At Each Application

A	
Crop 1 Code, BBCH Scale:	POAPR BGRM

UNIVERSITY OF MASSACHUSETTS-AMHERST

TOLERANCE OF NTEP KENTUCKY BLUEGRASS CULTIVARS TO SULFOSULFURON

Trial ID: 0912TG12 Protocol ID: 0912TG12
 Location: TRC-SDF Study Director:
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Application Equipment

A	
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22
Nozzle Type:	TEEJET
Nozzle Size:	1104 VS
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456

UNIVERSITY OF MASSACHUSETTS-AMHERST

TOLERANCE OF NTEP KENTUCKY BLUEGRASS CULTIVARS TO SULFOSULFURON

Trial ID: 0912TG12
Location: TRC-SDF
Project ID:

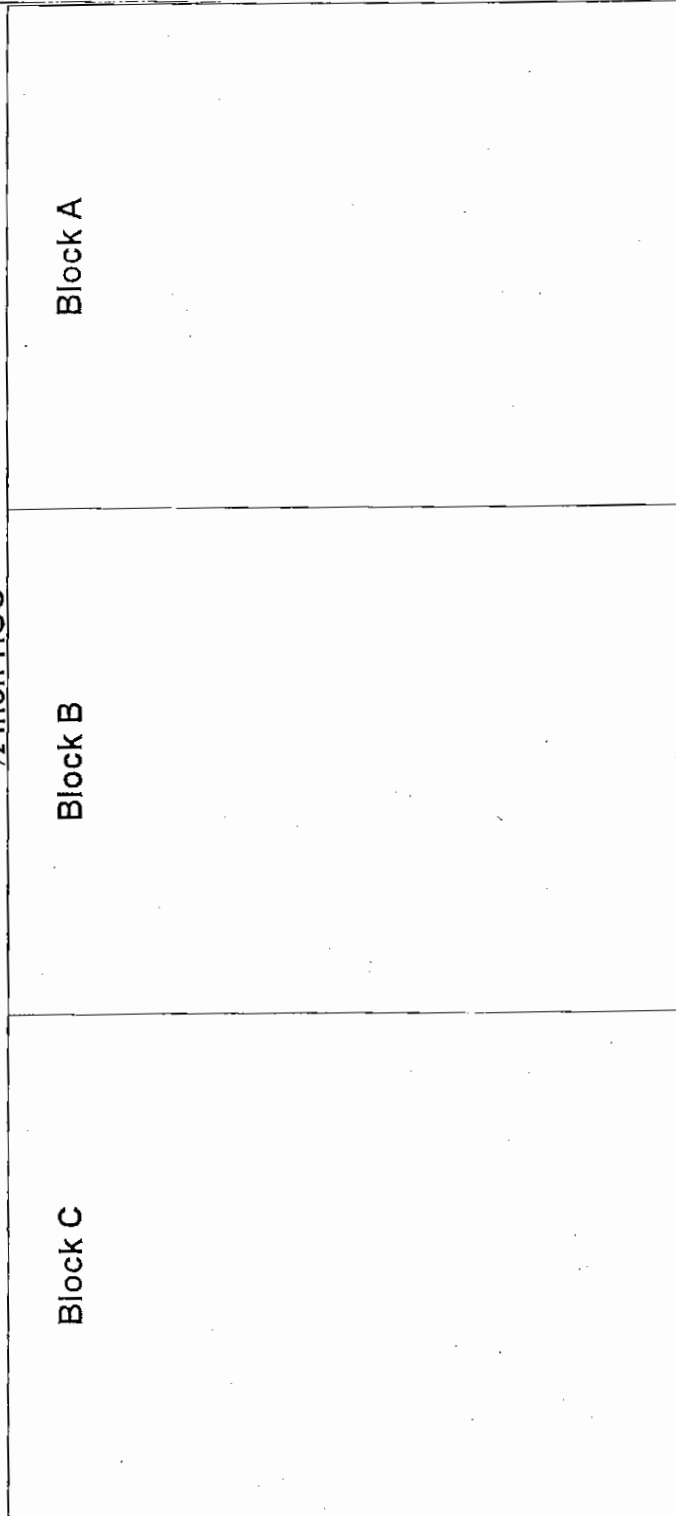
Protocol ID: 0912TG12
Study Director:
Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

RIVER ROAD

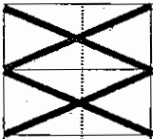
TURF- FARM FENCE

2000 NATIONAL TURFGRASS EVALUATION PROGRAM KENTUCKY BLUEGRASS VARIETY TRIAL

1/2 inch HOC



2000 NATIONAL TURFGRASS EVALUATION PROGRAM KENTUCKY BLUEGRASS VARIETY TRIAL

BLOCK A														PLOT PLAN														ENTRY NUMBER																					
109	141	21	93	7	57	6	85	52	46	119	78	112	146	70	59	68	49	40	159	97	19	170																											
																								87	53	131	151	121	114	133	64	105	167	162	65	81	145	71	39	152	139	67	77	149	168	96	9	172	
																									156	164	113	60	115	84	14	104	76	143	36	29	158	20	122	24	38	98	32	80	56	124	22	31	1
																									127	106	8	45	123	16	129	91	150	153	15	63	171	83	54	13	2	75	116	140	89	88	144	50	35
																									107	73	69	117	138	128	154	137	130	155	37	169	79	125	99	120	33	110	28	148	157	142	5	58	161
																									25	27	135	90	126	30	18	4	173	163	66	160	92	166	12	74	48	42	47	95	86	147	72	17	111
																									23	51	136	100	108	62	3	82	55	118	94	10	11	43	41	34	103	134	102	132	101	165	26	44	61

1/2 inch HOC

1/2 inch HOC

1/2 inch HOC

1/2 inch HOC

6 ft

3 ft

2000 NATIONAL TURFGRASS EVALUATION PROGRAM KENTUCKY BLUEGRASS VARIETY TRIAL

		BLOCK B											PLOT PLAN											ENTRY NUMBER								
		143	39	18	60	137	110	48	125	171	84	111	69	47	159	144	122	100	57	85	81	145	26	6	XXXXXXXXXX							
		92	134	82	106	28	115	52	22	162	124	66	44	108	139	126	41	43	95	97	90	67	71	16	73	121						
		1	155	136	31	87	50	62	21	158	10	150	9	152	109	91	129	45	147	29	154	5	33	96	79	88						
		51	113	12	80	30	77	59	138	20	169	74	8	112	119	127	146	2	103	148	98	170	68	94	63	15						
		11	114	173	166	168	167	157	14	165	132	17	172	27	86	107	70	133	130	163	78	46	61	135	118	140						
		76	32	153	128	142	53	64	42	120	117	104	65	164	93	35	24	89	40	49	102	116	161	13	54	38						
		105	141	151	156	34	3	23	160	75	123	149	37	56	36	55	83	25	19	72	58	131	7	101	99	4						

1/2 inch HOC

1/2 inch HOC

1/2 inch HOC

1/2 inch HOC

6 ft

3 ft

2000 NATIONAL TURFGRASS EVALUATION PROGRAM KENTUCKY BLUEGRASS VARIETY TRIAL

BLOCK C										PLOT PLAN										ENTRY NUMBER												
48	9	2	47	72	19	126	133	63	168	87	145	93	154	17	41	43	40	7	97	116	163	86	XXXXXXXXXX									
96	132	157	122	68	58	123	38	98	166	36	110	138	70	170	6	131	102	53	3	5	164	12	108	160								
54	119	121	78	144	91	83	27	14	18	172	77	23	153	59	150	8	20	140	85	115	136	49	118	95								
134	31	173	1	105	159	113	39	10	76	158	69	169	24	149	90	13	141	84	34	165	106	33	66	99								
65	127	61	71	22	21	112	100	28	82	151	62	117	103	46	56	167	155	25	4	73	161	81	120	146								
94	171	107	143	92	64	45	55	52	79	11	37	32	137	35	101	128	51	75	130	89	109	104	42	88								
29	74	114	129	142	125	152	139	111	15	135	57	67	162	148	60	26	147	156	30	16	80	50	44	124								

1/2 inch HOC

1/2 inch HOC

1/2 inch HOC

1/2 inch HOC

6 ft

3 ft

2009 Certainty™ Tolerance to Kentucky bluegrass cultivars (2000 NTEP Trial)

Table 1. Injury ratings of Kentucky bluegrass taken 1, 2 and 3 week after treatment (WAT)

Entry Number Name‡	Injury Rating (1 to 9, 9=No Injury)			
	1 WAT	2WAT	3WAT	Average
169. Serene*	8.67	8.67	7.67	8.33
8. Eagleton*	7.33	7.33	8.00	7.56
150. Langara*	8.00	7.00	7.67	7.56
167. Baronie*	8.00	7.33	6.33	7.22
157. A96-742	7.00	7.00	7.33	7.11
27. PST-108-79	7.67	7.00	6.33	7.00
29. PST-161	7.00	6.67	7.33	7.00
30. Bluemax*	7.67	7.00	6.33	7.00
62. BH-00-6002	7.00	7.33	6.67	7.00
159. BAR-Pp-0468	7.33	6.67	7.00	7.00
4. Limerick	7.33	7.00	6.33	6.89
53. Alpine*	7.67	6.67	6.33	6.89
140. Nu Destiny*	7.33	6.33	7.00	6.89
149. Moon Shadow*	7.00	6.67	7.00	6.89
171. Blackstone*	7.33	6.00	7.33	6.89
63. Fairfax*	7.33	6.33	6.67	6.78
84. Boutique*	7.67	6.33	6.33	6.78
158. A97-857	7.00	6.67	6.67	6.78
58. Envicta*	6.67	6.33	7.00	6.67
72. Chateau*	7.33	6.33	6.33	6.67
107. SR-2284*	7.33	6.00	6.67	6.67
120. A98-365	7.00	6.33	6.67	6.67
39. A97-1432	7.67	6.33	5.67	6.56
93. Bordeaux*	7.67	6.33	5.67	6.56
130. Ginney*	7.33	6.00	6.33	6.56
133. J-2885	7.00	6.33	6.33	6.56
145. Rambo*	7.00	5.67	7.00	6.56
168. Unique*	7.00	6.00	6.67	6.56
170. Moonlight*	7.33	6.33	6.00	6.56
33. Midnight II*	7.00	6.00	6.33	6.44
69. Marquis*	7.00	6.33	6.00	6.44
79. Allure*	7.67	6.33	5.33	6.44
80. A97-1330	7.00	6.33	6.00	6.44
87. Showcase*	7.00	6.00	6.33	6.44
101. DLF-76-9032	6.67	6.67	6.00	6.44
85. Blue Sapphire*	7.33	6.00	5.67	6.33
102. DLF-76-9034	7.00	6.00	6.00	6.33
137. Excursion*	6.67	6.33	6.00	6.33
138. Freedom III*	6.67	6.33	6.00	6.33
155. Bluestone*	6.33	6.00	6.67	6.33
2. Baron*	6.33	5.67	6.67	6.22
14. Pp H 7907	7.00	6.00	5.67	6.22
22. Glenmont*	7.00	6.00	5.67	6.22
28. Voyager II*	6.67	6.00	6.00	6.22

2009 Certainty™ Tolerance to Kentucky bluegrass cultivars (2000 NTEP Trial)

Table 1. Injury ratings of Kentucky bluegrass taken 1, 2 and 3 week after treatment (WAT)

Entry Number Name‡	Injury Rating (1 to 9, 9=No Injury)			
	1 WAT	2WAT	3WAT	Average
31. Brilliant*	7.00	5.67	6.00	6.22
48. H92-203	6.67	6.00	6.00	6.22
59. Goldrush*	6.67	6.00	6.00	6.22
73. Ba-00-6001	6.67	6.00	6.00	6.22
78. Julius*	5.67	6.33	6.67	6.22
83. Brooklawn*	6.67	6.00	6.00	6.22
86. NA-K992	7.00	6.00	5.67	6.22
89. Kingfisher*	6.67	6.00	6.00	6.22
96. Durham*	7.33	6.00	5.33	6.22
108. Diva*	7.00	6.33	5.33	6.22
113. A98-407	6.67	6.00	6.00	6.22
117. Goldstar*	6.67	6.00	6.00	6.22
128. Perfection*	6.67	6.33	5.67	6.22
139. EverGlade*	6.67	6.00	6.00	6.22
1. Midnight*	6.33	5.67	6.33	6.11
7. Boomerang*	6.67	5.67	6.00	6.11
35. Blacksburg II*	6.33	6.33	5.67	6.11
42. Arrow*	7.00	6.00	5.33	6.11
43. Moonshine*	7.00	6.00	5.33	6.11
50. B5-144	6.67	6.33	5.33	6.11
57. Quantum leap*	7.00	5.67	5.67	6.11
66. Baronette*	6.33	6.00	6.00	6.11
67. Raven*	6.33	5.67	6.33	6.11
70. Ba-84-140	6.67	6.00	5.67	6.11
76. A97-1409	7.00	5.67	5.67	6.11
97. Skye*	7.00	6.00	5.33	6.11
118. Royce*	7.00	6.00	5.33	6.11
131. Courtyard*	6.67	6.00	5.67	6.11
19. Wildwood*	6.67	5.67	5.67	6.00
23. Coventry*	6.67	6.33	5.00	6.00
36. Mallard*	6.33	5.67	6.00	6.00
52. PST-H6-150	7.00	5.67	5.33	6.00
64. Abbey*	6.67	5.67	5.67	6.00
104. DLF-96-9037	7.00	5.67	5.33	6.00
114. A98-1028	6.00	6.00	6.00	6.00
135. Everest*	6.67	5.67	5.67	6.00
164. Baritone*	6.33	6.00	5.67	6.00
166. Barzan*	6.33	6.00	5.67	6.00
172. Rita*	6.67	6.33	5.00	6.00
10. Cheetah*	6.00	5.67	6.00	5.89
16. Royale*	6.67	6.00	5.00	5.89
17. Shamrock*	6.33	6.00	5.33	5.89
18. Wellington*	6.67	6.00	5.00	5.89
45. B5-43	6.33	6.33	5.00	5.89
68. Ba-83-113	6.00	6.00	5.67	5.89

2009 Certainty™ Tolerance to Kentucky bluegrass cultivars (2000 NTEP Trial)

Table 1. Injury ratings of Kentucky bluegrass taken 1, 2 and 3 week after treatment (WAT)

Entry Number Name‡	Injury Rating (1 to 9, 9=No Injury)			
	1 WAT	2WAT	3WAT	Average
110. 99AN-53	6.33	5.33	6.00	5.89
111. Mongoose*	6.67	5.67	5.33	5.89
125. Odyssey*	6.33	5.33	6.00	5.89
129. Tsunami*	6.33	5.67	5.67	5.89
3. Lily	5.67	6.00	5.67	5.78
6. Bedazzled*	6.67	5.33	5.33	5.78
13. Pp H 7832	6.00	6.00	5.33	5.78
21. Lakeshore*	6.00	6.00	5.33	5.78
38. Apollo*	6.67	5.67	5.00	5.78
91. SRX-27921	6.33	6.00	5.00	5.78
106. SRX-2114	6.33	6.00	5.00	5.78
115. A98-183	6.00	5.67	5.67	5.78
132. Alexa*	6.33	5.67	5.33	5.78
141. Barrister*	6.00	5.67	5.67	5.78
143. Rugby II*	6.33	5.67	5.33	5.78
144. Award*	5.67	6.00	5.67	5.78
146. Freedom II*	6.00	5.67	5.67	5.78
148. G0-9LM9	6.33	5.33	5.67	5.78
153. PST-B3-170	6.67	6.00	4.67	5.78
12. Pp H 7929	5.67	6.00	5.33	5.67
25. PST-B5-125	6.33	6.00	4.67	5.67
47. Blue-tastic*	6.00	5.67	5.33	5.67
71. Ba-82-288	6.00	5.67	5.33	5.67
82. Julia*	5.67	6.00	5.33	5.67
123. Impact*	6.00	5.67	5.33	5.67
127. NuGlade*	6.00	5.33	5.67	5.67
152. PST-H5-35	6.00	5.67	5.33	5.67
165. Bariris*	5.67	6.00	5.33	5.67
20. Hallmark*	7.00	5.67	4.00	5.56
34. PST York Harbor	6.33	5.33	5.00	5.56
44. Dynamo*	6.00	5.67	5.00	5.56
46. B5-45	6.00	5.67	5.00	5.56
49. Casablanca*	6.00	5.33	5.33	5.56
51. PST-B4-246	6.33	6.00	4.33	5.56
94. Cabernet*	6.00	5.33	5.33	5.56
99. Unknown	5.67	5.33	5.67	5.56
112. Jefferson*	6.00	5.67	5.00	5.56
121. Kenblue*	5.67	5.67	5.33	5.56
134. Blue Velvet*	6.00	5.33	5.33	5.56
161. BAR-Pp-0568	6.67	5.67	4.33	5.56
37. Blue Ridge*	5.00	5.67	5.67	5.44
61. Ascot*	6.00	5.33	5.00	5.44
77. A96-451	6.33	5.33	4.67	5.44
88. Arcadia*	5.33	5.67	5.33	5.44
92. Sonoma*	6.00	5.67	4.67	5.44

2009 Certainty™ Tolerance to Kentucky bluegrass cultivars (2000 NTEP Trial)

Table 1. Injury ratings of Kentucky bluegrass taken 1, 2 and 3 week after treatment (WAT)

Entry Number Name‡	Injury Rating (1 to 9, 9=No Injury)			
	1 WAT	2WAT	3WAT	Average
124. Total Eclipse*	6.33	5.00	5.00	5.44
160. BAR-Pp-0471	6.00	5.33	5.00	5.44
162. BAR-Pp-0573	6.33	5.33	4.67	5.44
5. Bodacious*	6.00	5.33	4.67	5.33
11. Pp H 6366	5.33	5.33	5.33	5.33
15. Monte Carlo*	6.00	5.33	4.67	5.33
41. Mercury*	6.00	5.00	5.00	5.33
100. Blue Knight*	6.00	5.00	5.00	5.33
103. DLF-96-9036	5.67	5.33	5.00	5.33
136. Awesome*	6.00	5.33	4.67	5.33
142. Beyond*	5.33	5.33	5.33	5.33
147. Liberator*	6.00	5.33	4.67	5.33
151. A96-739	5.67	5.33	5.00	5.33
56. Limousine*	5.33	5.00	5.33	5.22
90. SRX-26351	5.67	5.33	4.67	5.22
119. A98-139	5.33	5.33	5.00	5.22
26. PST-604	5.33	5.33	4.67	5.11
40. HV 238	5.67	5.33	4.00	5.00
74. CVB-20631	5.00	4.67	5.33	5.00
81. H92-558	5.33	5.00	4.67	5.00
98. Jewel*	5.67	5.00	4.33	5.00
109. SRX-QG245	5.00	5.33	4.67	5.00
154. B4-128A	5.33	5.00	4.67	5.00
163. Bartitia*	5.33	5.00	4.67	5.00
156. Washington*	5.33	5.33	4.00	4.89
24. Avalanche*	5.67	5.00	3.67	4.78
32. PST-222	5.00	5.00	4.33	4.78
54. Pich 453	4.67	5.00	4.67	4.78
122. Princeton 105*	5.67	5.00	3.67	4.78
126. Chicago II*	4.67	5.00	4.67	4.78
173. North Star*	5.00	5.00	4.33	4.78
9. HV 140	5.00	4.67	4.33	4.67
65. BH-00-6003	5.00	4.33	4.67	4.67
105. SI-A96-386	5.33	4.67	4.00	4.67
116. Champlain*	5.67	5.00	3.33	4.67
55. Rampart*	4.67	4.67	4.33	4.56
60. Misty*	4.67	4.33	4.33	4.44
75. Chelsea*	5.00	4.67	3.67	4.44
95. Champagne*	4.67	4.00	3.33	4.00
LSD (0.05)§	1.23	1.00	1.44	1.01
Range	4.67 to 8.67	4.00 to 8.67	3.33 to 8.00	4.00 to 8.33

†1 to 9 scale, 9 = no injury. *Commercially available.

‡See entry listing and plot plan for field trial location of corresponding entry.

§Any two cultivars that differ in value exceeding LSD are statistically significant.

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF CARFENTRAZONE AND SULFENTRAZONE ON FALSE GREEN KYLLINGA

Trial ID: 0913TG13 Protocol ID: 0913TG13
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik, S. Phoboo and M. Barton

Trial Location

City: Greenwich
State/Prov.: CT

Objectives:

To determine the effects of two contact herbicides in controlling false green kyllinga

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik, S. Phoboo and M. Barton
Location: Burning Tree Country Club, Greenwich, CT

Pest Description

Pest 1 Type: W **Code:** KYLGR *Kyllinga gracillima*
Common Name: Pasture spikesedge/false green kyllinga

Site and Design

Plot Width, Unit: 3.5 FT **Site Type:** TUGCFA turf - golf course fairway
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3 **Study Design:** RAOBL Randomized Complete Block (RCB)

Trial Initiation Comments:

Natural uniform infestation of false green kyllinga in fairways

Application Description

A	
Application Date:	Jun-25-09
Time of Day:	10:30 AM
Application Method:	SPRAY
Application Timing:	LATE POST
Air Temperature, Unit:	83.4 F
% Relative Humidity:	37.0
Wind Velocity, Unit:	2 MPH
Soil Temperature, Unit:	26.0
% Cloud Cover:	80.0

Pest Stage At Each Application

A

Pest 1 Code, Type, Scale: KYLGR W

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF CARFENTRAZONE AND SULFENTRAZONE ON FALSE GREEN KYLLINGA

Trial ID: 0913TG13 Protocol ID: 0913TG13
 Location: Greewich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Application Equipment

A	
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22 PSI
Nozzle Type:	TEEJET
Nozzle Size:	1104 VS
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456 Liters

UNIVERSITY OF MASSACHUSETTS-AMHERST

EFFECTS OF CARFENTRAZONE AND SULFENTRAZONE ON FALSE GREEN KYLLINGA

Trial ID: 0913TG13 Protocol ID: 0913TG13
 Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed	W Weed	W Weed	
Pest Code	KYLGR	KYLGR	KYLGR	KYLGR	KYLGR	
Pest Scientific Name	Kyllinga graci>	Kyllinga graci>	Kyllinga graci>	Kyllinga graci>	Kyllinga graci>	
Pest Name	Pasture spikes>	Pasture spikes>	Pasture spikes>	Pasture spikes>	Pasture spikes>	
Rating Date	Jul-2-09	Jul-9-09	Jul-21-09	Jul-31-09	Sep-10-09	
Rating Type	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL	
Rating Unit	%	%	%	%	%	
Number of Subsamples	1	1	1	1	1	
Days After First/Last Applic.	7 7	14 14	26 26	36 36	77 77	
Trt-Eval Interval	7 DA-A	14 DA-A	26 DA-A	36 DA-A	42 DA-A	
Trt Treatment	Rate					
No. Name	Rate Unit	1	2	3	4	5
1 UNTREATED		0.0 d	0.0 d	0.0 c	0.0 c	0.0 b
2 QUICKSILVER	1.0 fl oz/a	0.0 d	0.0 d	0.0 c	0.0 c	10.0 b
3 QUICKSILVER	1.5 fl oz/a	10.0 d	8.3 d	5.0 c	0.0 c	0.0 b
4 QUICKSILVER	3.0 fl oz/a	11.7 d	8.3 d	5.0 c	0.0 c	0.0 b
5 DISMISS	4.0 fl oz/a	45.0 bc	41.7 bc	26.7 bc	16.7 c	41.7 ab
6 DISMISS	8.0 fl oz/a	78.3 a	76.7 a	89.3 a	51.7 ab	36.7 ab
7 DISMISS	12.0 fl oz/a	81.7 a	78.3 a	94.3 a	80.0 a	71.7 a
8 ECHELON	4.0 fl oz/a	18.3 cd	13.3 d	8.3 c	10.0 c	6.7 b
9 ECHELON	8.0 fl oz/a	23.3 cd	23.3 cd	10.0 c	10.0 c	13.3 b
10 ECHELON	12.0 fl oz/a	56.7 ab	55.0 ab	51.7 b	23.3 bc	16.7 b
LSD (P=.05)		22.16	20.10	28.10	28.56	32.32
Standard Deviation		12.92	11.72	16.38	16.65	18.84
CV		39.76	38.42	56.41	86.86	95.79
Bartlett's X2		9.625	8.232	13.779	2.974	7.649
P(Bartlett's X2)		0.211	0.313	0.055	0.704	0.265
Replicate F		0.584	0.346	0.032	1.464	0.580
Replicate Prob(F)		0.5679	0.7122	0.9687	0.2575	0.5700
Treatment F		17.163	20.230	14.974	7.720	4.648
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0027

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Pest Type

W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop

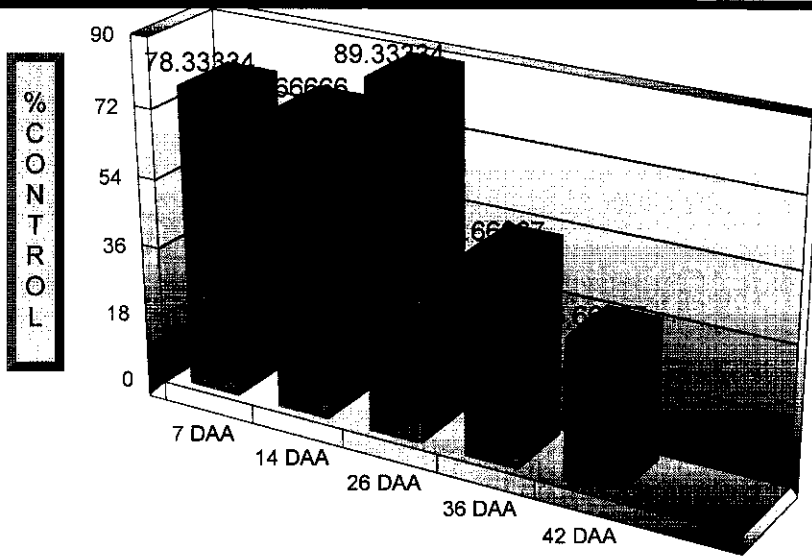
Pest Code

KYLGR, *Kyllinga gracillima*, = US

Rating Unit

% = percent

CONTROL OF FALSE GREEN KYLLINGA OVER TIME -
DISMISS (8 FL OZ/A)



UNIVERSITY OF MASSACHUSETTS-AMHERST**BROADLEAF WEED CONTROL IN TALL FESCUE**

Trial ID: 0914TG14 Protocol ID: 0914TG14
 Location: TRC-SDF Study Director: Prof. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

General Trial Information

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Investigator: P. C. Bhowmik and T. Griffin

Personnel

Study Director: Dr. Prasanta C. Bhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik and T. Griffin
Location: Joe Troll Turf Research Center, South Deerfield, MA

Site and Design

Plot Width, Unit: 3.5 FT
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT²
Replications: 3 **Study Design:** RACOBL Randomized Complete Block (RCB)

Application Description

A	
Application Date:	Jul-6-09
Time of Day:	Noon
Application Method:	SPRAY
Application Timing:	POSPOS
Air Temperature, Unit:	82.5 F
% Relative Humidity:	32.2
Wind Velocity, Unit:	3 MPH
Soil Temperature, Unit:	77.7 F
Soil Moisture:	100FC
% Cloud Cover:	5

Application Equipment

A	
Appl. Equipment:	BACKPACK
Equipment Type:	SPRBAC
Operating Pressure, Unit:	22
Nozzle Type:	TEEJET
Nozzle Size:	1104 VS
Nozzle Spacing, Unit:	20 IN
Spray Volume, Unit:	50 gal/ac
Mix Size, Unit:	0.456

UNIVERSITY OF MASSACHUSETTS-AMHERST

BROADLEAF WEED CONTROL IN TALL FESCUE

Trial ID: 0914TG14 Protocol ID: 0914TG14
 Location: TRC-SDF Study Director: Prof. Bhowmik
 Project ID: Investigator: PRASANTA C. BHOWMIK
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed
Pest Code		TRIFE	TRIFE	TRIFE
Pest Scientific Name		Trifolium repen	Trifolium repen	Trifolium repen
Pest Name		White Clover	White Clover	White Clover
Rating Date		Jul-14-09	Jul-22-09	Aug-14-09
Rating Type		CONTROL	CONTROL	CONTROL
Rating Unit		Percent	Percent	Percent
Number of Subsamples		1	1	1
Days After First/Last Applic.		8 8	16 16	39 39
Trt-Eval Interval		8 DA-A	8 DA-A	8 DA-A
Trt Treatment	Rate			
No. Name	Rate Unit	1	2	3
1 DISMISS	4.0 fl oz/a	51.7 a	31.7 ab	43.3 abc
2 DISMISS	8.0 fl oz/a	56.7 a	51.7 ab	51.7 abc
3 QUICKSILVER	1.5 fl oz/a	50.0 a	71.7 a	80.0 a
4 QUICKSILVER	3.0 fl oz/a	60.0 a	68.3 a	65.0 ab
5 ECHELON	4.0 fl oz/a	40.0 a	23.3 ab	60.0 ab
6 ECHELON	8.0 fl oz/a	38.3 a	23.3 ab	16.7 bc
7 KIXOR	0.5 oz wt/a	71.7 a	46.7 ab	76.0 a
8 KIXOR	1.0 oz wt/a	80.0 a	88.3 a	95.3 a
9 WEED-BE-GONE	3.0 pt/a	53.3 a	87.7 a	94.3 a
10 MILLENIUM ULTRA	3.0 pt/a	70.0 a	87.7 a	98.0 a
11 UNTREATED CHECK		0.0 b	0.0 b	0.0 c
LSD (P=.05)		30.51	43.39	38.77
Standard Deviation		17.91	25.47	22.76
CV		34.47	48.28	36.8
Bartlett's X2		4.356	15.118	14.64
P(Bartlett's X2)		0.886	0.088	0.067
Replicate F		4.776	1.734	1.391
Replicate Prob(F)		0.0202	0.2020	0.2720
Treatment F		4.320	4.300	5.988
Treatment Prob(F)		0.0026	0.0027	0.0003

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

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

Pest Type

W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop

Rating Unit

Percent = percent

Turfgrass and Weed Code Index

Turfgrass

Creeping bentgrass	AGSPL
Kentucky bluegrass	POAPR
Perennial ryegrass	LOLPE
Tall fescue	FESAR

Weeds

Annual bluegrass	POAN
Common chickweed	STEME
Mouse-ear chickweed	CERVU
White clover	TRIRE
Large crabgrass	DIGSA
Common dandelion	TAROF
Yellow foxtail	SETLU
False green kyllinga	KYLGR
Common plantain	PLAMA

Herbicides Used in 2009 Trials

Trade names	Chemical names	Page no.
CERTAINTY	Sulfosulfuron	15, 25, 31, 37, 50, 59
DISMISS	Sulfentrazone	65, 68
DRIVE XLR8	Quinchlorac	11
ECHELON	Sulfentrazone + prodiamine	47, 65, 68
EXC 4142	Experimental	47
F 7120	Spartan	
KIXOR	BAS 800H	68
MILLENEUM ULTRA	2,4-D + clopyralid + dicamba	68
MONUMENT	Trifloxysulfuron	31, 50
MOSS OUT	Ferric sulphate	42, 44
MOSS A- (acid)		42
MOSS B- (neutral)		44
PRIMO MAXX	Trienaxapac-ethyl	1, 6
PROGRESS	Ethofumesate	47
PROSHOT	Methiozolin	47
PROXY	Ethephon	6
QUICK SILVER	Carfentrazone	42, 44, 65, 68
SEDGEHAMMER	Halosulfuron	25, 31, 37, 50
SUNRICE	Ethoxysulfuron	25, 31, 37, 47, 50
TENACITY	Mesotrione	25, 50
WEED B GON	2,4-D + mecoprop + dicamba	68
COC	Crop oil conc.	11
NIS	Non-ionic surfactant	11, 15
MSO	Methylated seed oil	11
X-77	Non-ionic surfactant	11

**Joseph Troll Turfgrass Research
Center
South Deerfield, MA**

Weather Station: ET106



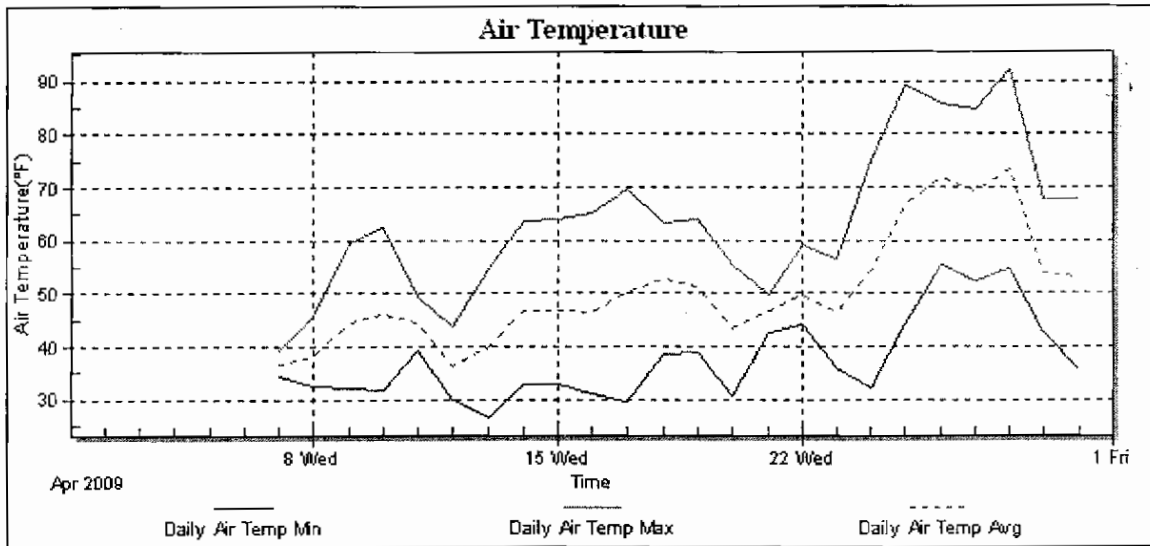
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:50 PM

Report Period: April 2009



Date	Air Temp Min (°F)	Air Temp Max (°F)	Air Temp Avg (°F)
4/7/2009	34.34	39.25	36.80
4/8/2009	32.72	46.72	38.13
4/9/2009	32.01	59.52	44.44
4/10/2009	31.71	62.62	45.98
4/11/2009	39.43	49.35	44.80
4/12/2009	29.91	43.62	36.28
4/13/2009	26.38	54.61	40.06
4/14/2009	32.90	63.64	46.89
4/15/2009	33.02	64.06	46.66
4/16/2009	30.93	65.08	46.41
4/17/2009	29.62	69.73	50.53
4/18/2009	38.60	63.18	52.84
4/19/2009	39.07	64.18	51.33
4/20/2009	30.81	55.58	43.49
4/21/2009	42.66	49.84	46.89
4/22/2009	44.10	58.98	49.00
4/23/2009	36.02	56.59	46.29
4/24/2009	32.25	75.04	54.49
4/25/2009	44.33	89.08	66.94
4/26/2009	55.35	85.80	71.78
4/27/2009	52.34	84.83	69.17
4/28/2009	54.73	92.25	73.36
4/29/2009	42.55	67.64	54.04
4/30/2009	35.61	67.71	53.12
Low	26.38	39.25	36.28
High	55.35	92.25	73.36
Average	37.56	63.66	50.42
Std Dev	7.87	13.78	10.22
Total	N/A	N/A	N/A

Air Temperature - April, 2009



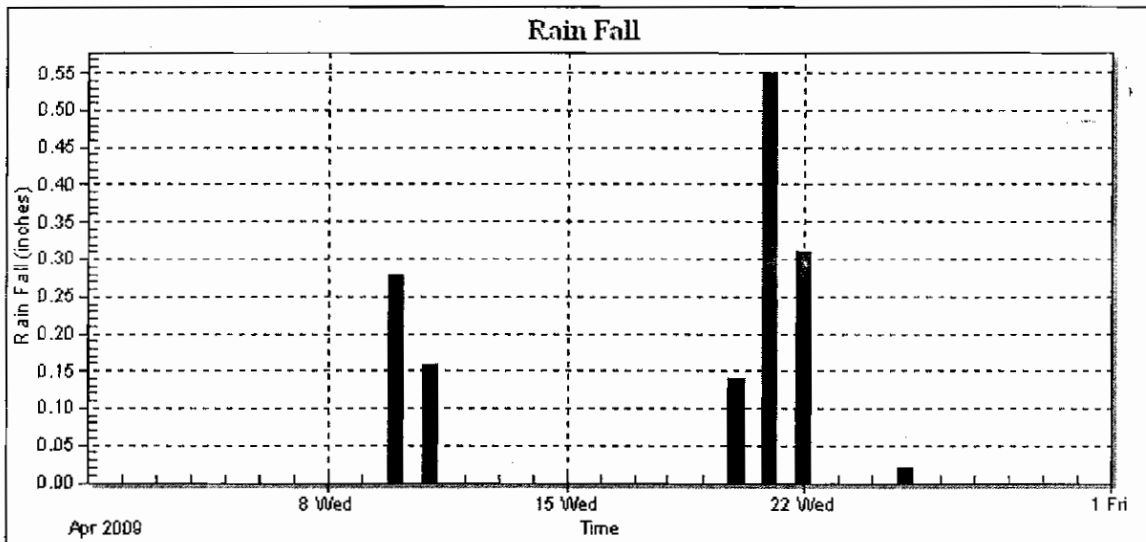
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:50 PM

Report Period: April 2009



Date	Rain Fall (inches)
4/7/2009	0.00
4/8/2009	0.00
4/9/2009	0.00
4/10/2009	0.28
4/11/2009	0.16
4/12/2009	0.00
4/13/2009	0.00
4/14/2009	0.00
4/15/2009	0.00
4/16/2009	0.00
4/17/2009	0.00
4/18/2009	0.00
4/19/2009	0.00
4/20/2009	0.14
4/21/2009	0.55
4/22/2009	0.31
4/23/2009	0.00
4/24/2009	0.00
4/25/2009	0.02
4/26/2009	0.00
4/27/2009	0.00
4/28/2009	0.00
4/29/2009	0.00
4/30/2009	0.00
Low	0.00
High	0.55
Average	0.06
Std Dev	0.13
Total	1.46

Rainfall - April, 2009



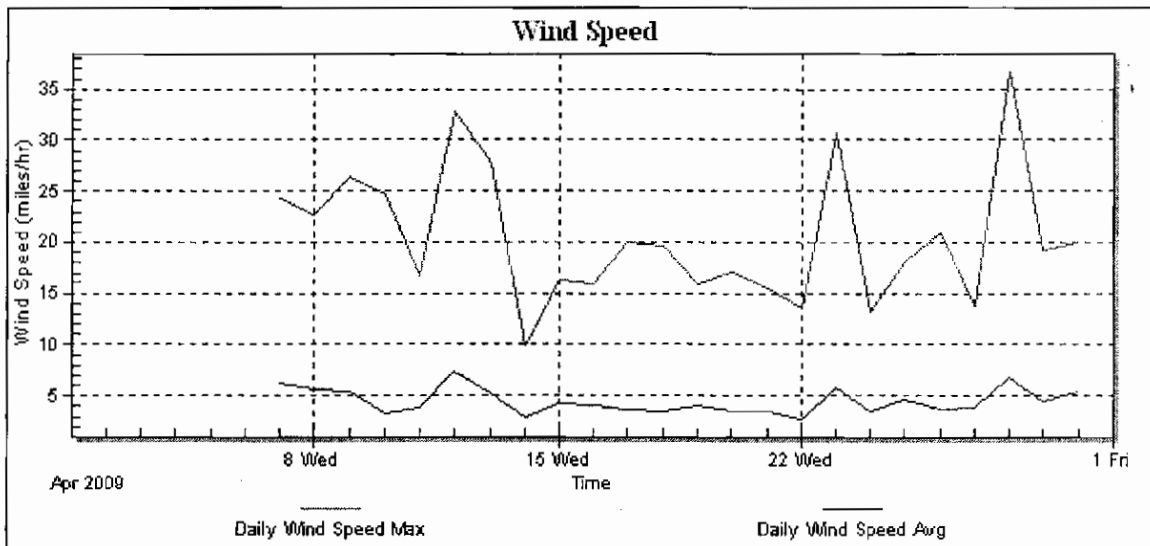
Weather Station: ET106

Location:

Report Type: 1 Month

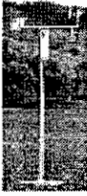
Created: Thursday, March 11, 2010 1:50 PM

Report Period: April 2009



Date	Wind Speed Max (miles/hr)	Wind Speed Avg (miles/hr)
4/7/2009	24.23	6.17
4/8/2009	22.80	5.56
4/9/2009	26.37	5.44
4/10/2009	24.58	3.18
4/11/2009	16.71	3.96
4/12/2009	32.79	7.38
4/13/2009	27.81	5.17
4/14/2009	9.92	2.91
4/15/2009	16.35	4.25
4/16/2009	15.99	4.00
4/17/2009	19.93	3.78
4/18/2009	19.57	3.46
4/19/2009	15.99	4.13
4/20/2009	17.07	3.55
4/21/2009	15.64	3.39
4/22/2009	13.50	2.63
4/23/2009	30.65	5.88
4/24/2009	13.14	3.49
4/25/2009	18.14	4.62
4/26/2009	21.01	3.65
4/27/2009	13.86	3.93
4/28/2009	36.73	6.79
4/29/2009	19.22	4.50
4/30/2009	19.93	5.37
Low	9.92	2.63
High	36.73	7.38
Average	20.50	4.47
Std Dev	6.51	1.22
Total	N/A	N/A

Weed Speed - April, 2009



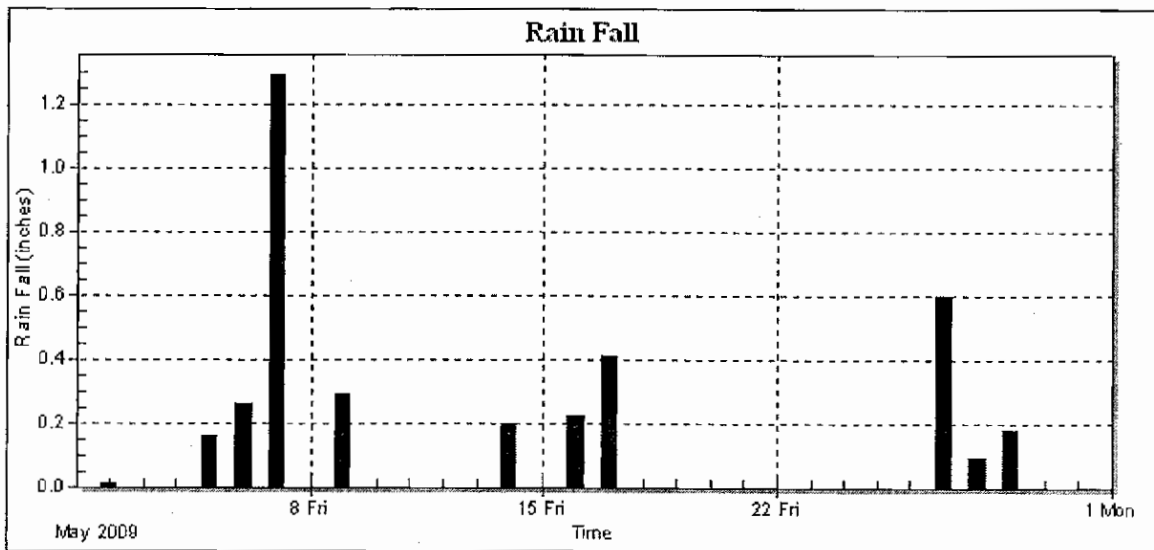
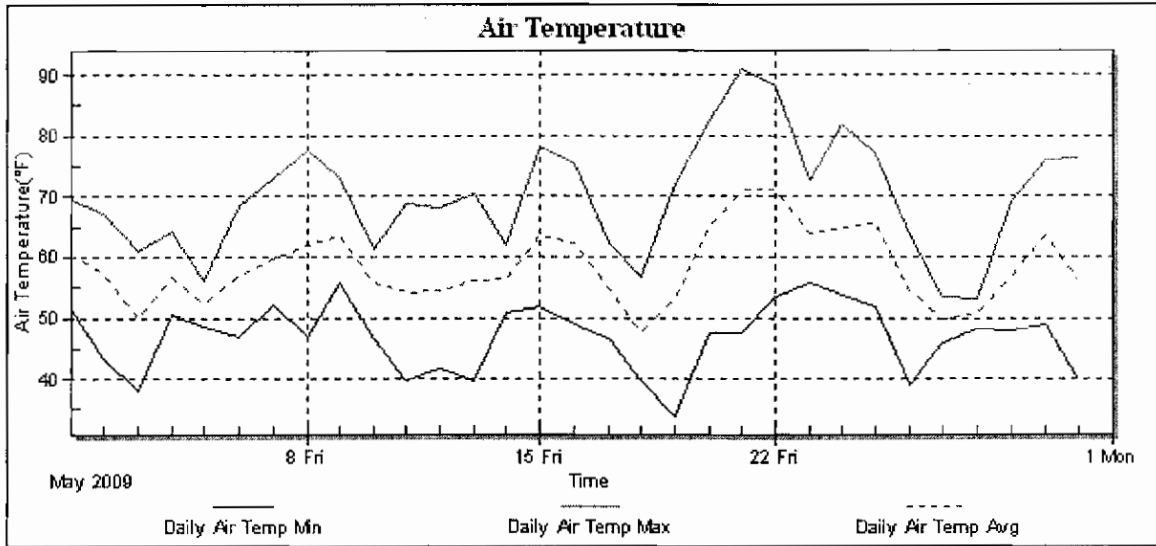
Weather Station: ET106

Location:

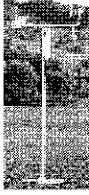
Report Type: 1 Month

Created: Thursday, March 11, 2010 1:53 PM

Report Period: May 2009



Air Temperature and Rainfall - May, 2009



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:53 PM

Report Period: May 2009

Date	Air Temp Min (°F)	Air Temp Max (°F)	Air Temp Avg (°F)
5/1/2009	51.33	69.44	60.24
5/2/2009	43.32	67.05	57.26
5/3/2009	37.94	60.89	49.99
5/4/2009	50.43	64.36	56.57
5/5/2009	48.51	56.17	52.02
5/6/2009	46.85	68.41	56.91
5/7/2009	52.23	73.20	59.52
5/8/2009	46.90	77.67	61.86
5/9/2009	55.81	73.20	63.58
5/10/2009	46.72	61.14	55.74
5/11/2009	39.73	68.83	54.14
5/12/2009	41.59	68.14	54.41
5/13/2009	39.85	70.56	56.17
5/14/2009	50.92	61.79	56.37
5/15/2009	51.76	78.15	63.69
5/16/2009	48.70	75.34	62.11
5/17/2009	46.60	62.33	54.85
5/18/2009	39.67	56.64	47.74
5/19/2009	33.68	71.89	53.26
5/20/2009	47.75	82.58	65.21
5/21/2009	47.68	91.11	71.05
5/22/2009	53.29	88.00	71.25
5/23/2009	55.63	72.59	63.99
5/24/2009	53.78	82.04	64.79
5/25/2009	51.87	76.91	65.62
5/26/2009	39.07	63.46	54.27
5/27/2009	46.06	53.55	50.03
5/28/2009	48.16	53.06	50.75
5/29/2009	47.88	69.12	56.62
5/30/2009	48.76	76.12	63.61
5/31/2009	39.90	76.48	55.99
Low	33.68	53.06	47.74
High	55.81	91.11	71.25
Average	46.85	70.01	58.37
Std Dev	5.51	9.32	5.91
Total	N/A	N/A	N/A



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:53 PM

Report Period: May 2009

Date	Rain Fall (inches)
5/1/2009	0.00
5/2/2009	0.01
5/3/2009	0.00
5/4/2009	0.00
5/5/2009	0.16
5/6/2009	0.26
5/7/2009	1.29
5/8/2009	0.00
5/9/2009	0.29
5/10/2009	0.00
5/11/2009	0.00
5/12/2009	0.00
5/13/2009	0.00
5/14/2009	0.20
5/15/2009	0.00
5/16/2009	0.22
5/17/2009	0.41
5/18/2009	0.00
5/19/2009	0.00
5/20/2009	0.00
5/21/2009	0.00
5/22/2009	0.00
5/23/2009	0.00
5/24/2009	0.00
5/25/2009	0.00
5/26/2009	0.00
5/27/2009	0.60
5/28/2009	0.09
5/29/2009	0.18
5/30/2009	0.00
5/31/2009	0.00
Low	0.00
High	1.29
Average	0.12
Std Dev	0.26
Total	3.71



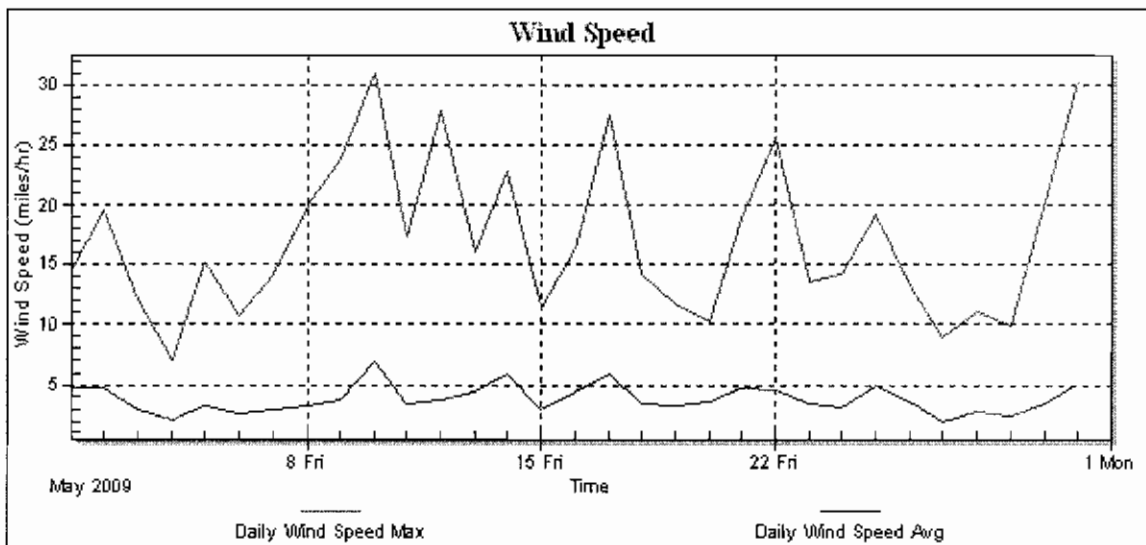
Weather Station: ET106

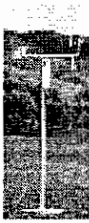
Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:53 PM

Report Period: May 2009





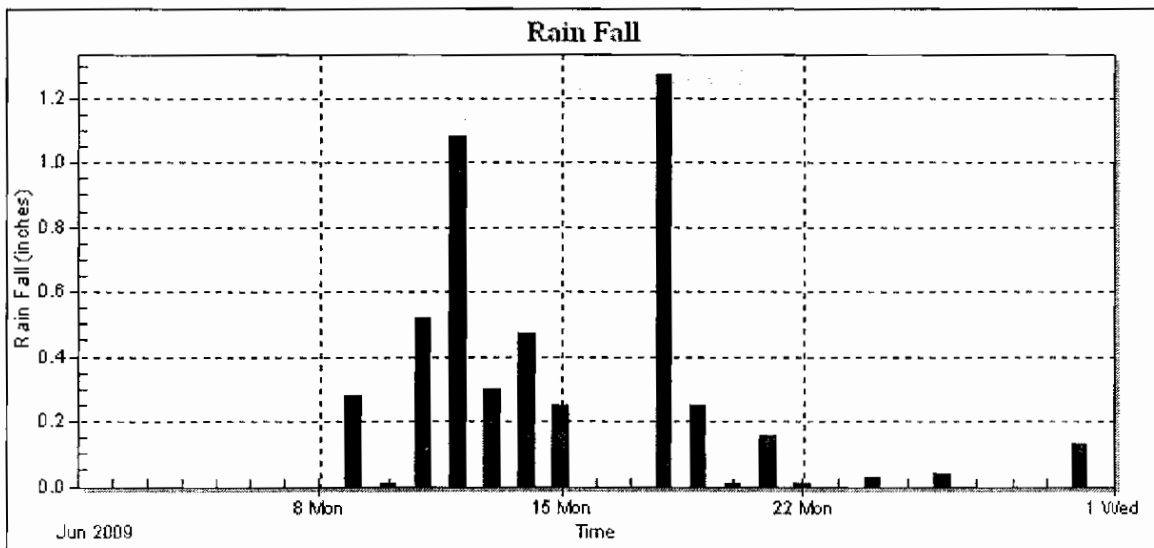
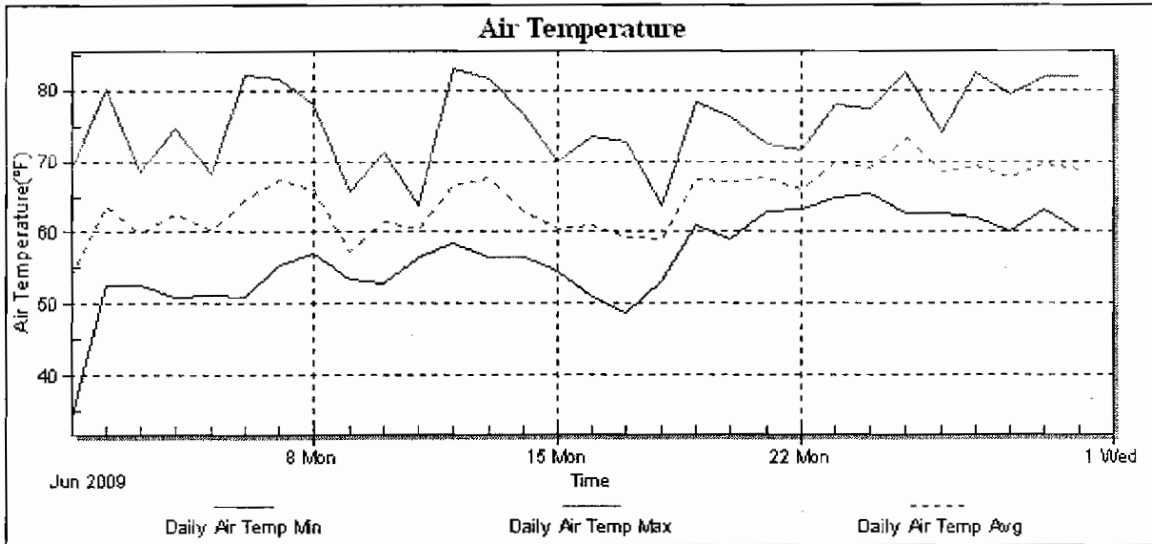
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:55 PM

Report Period: June 2009



Air Temperature and Rainfall - June, 2009



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:55 PM

Report Period: June 2009

Date	Air Temp Min (°F)	Air Temp Max (°F)	Air Temp Avg (°F)
6/1/2009	34.04	69.08	54.04
6/2/2009	52.52	80.29	63.89
6/3/2009	52.70	68.59	59.94
6/4/2009	50.79	74.57	62.58
6/5/2009	51.10	68.36	59.98
6/6/2009	50.79	82.22	64.62
6/7/2009	55.35	81.63	67.38
6/8/2009	57.18	77.95	65.99
6/9/2009	53.47	65.68	57.25
6/10/2009	52.93	71.28	61.52
6/11/2009	56.59	63.88	60.52
6/12/2009	58.51	83.08	66.59
6/13/2009	56.53	81.79	67.76
6/14/2009	56.59	76.48	62.84
6/15/2009	54.68	69.78	60.41
6/16/2009	50.92	73.49	61.06
6/17/2009	48.70	72.84	59.31
6/18/2009	53.19	63.64	59.17
6/19/2009	61.07	78.39	67.42
6/20/2009	59.16	76.42	67.20
6/21/2009	62.92	72.43	67.57
6/22/2009	63.28	71.64	66.10
6/23/2009	64.83	77.86	69.85
6/24/2009	65.50	77.38	68.94
6/25/2009	62.67	82.51	73.24
6/26/2009	62.74	74.23	68.56
6/27/2009	62.08	82.40	69.39
6/28/2009	60.24	79.34	67.80
6/29/2009	63.34	81.91	69.76
6/30/2009	60.24	81.91	68.68
Low	34.04	63.64	54.04
High	65.50	83.08	73.24
Average	58.49	75.37	64.65
Std Dev	6.35	5.84	4.44
Total	N/A	N/A	N/A



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:55 PM

Report Period: June 2009

Date	Rain Fall (inches)
6/1/2009	0.00
6/2/2009	0.00
6/3/2009	0.00
6/4/2009	0.00
6/5/2009	0.00
6/6/2009	0.00
6/7/2009	0.00
6/8/2009	0.00
6/9/2009	0.28
6/10/2009	0.01
6/11/2009	0.52
6/12/2009	1.08
6/13/2009	0.30
6/14/2009	0.47
6/15/2009	0.25
6/16/2009	0.00
6/17/2009	0.00
6/18/2009	1.27
6/19/2009	0.25
6/20/2009	0.01
6/21/2009	0.16
6/22/2009	0.01
6/23/2009	0.00
6/24/2009	0.03
6/25/2009	0.00
6/26/2009	0.04
6/27/2009	0.00
6/28/2009	0.00
6/29/2009	0.00
6/30/2009	0.13
Low	0.00
High	1.27
Average	0.16
Std Dev	0.31
Total	4.81



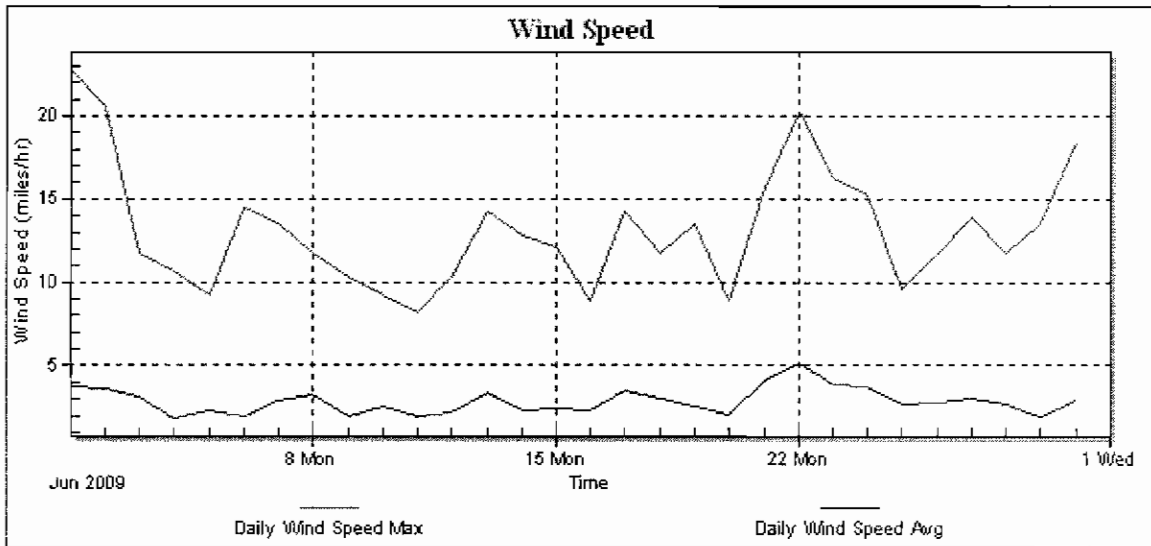
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:55 PM

Report Period: June 2009





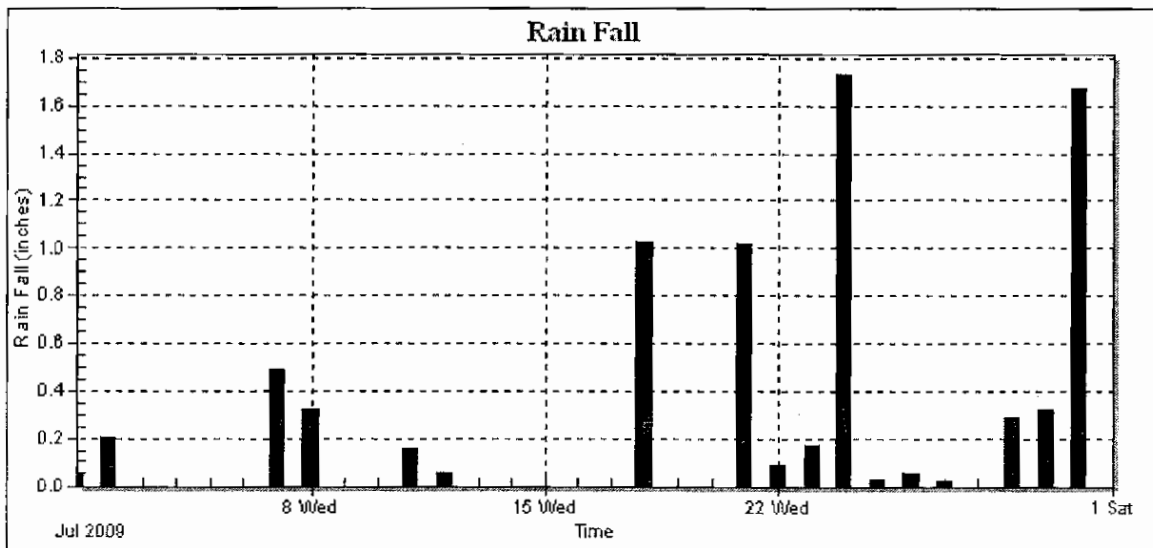
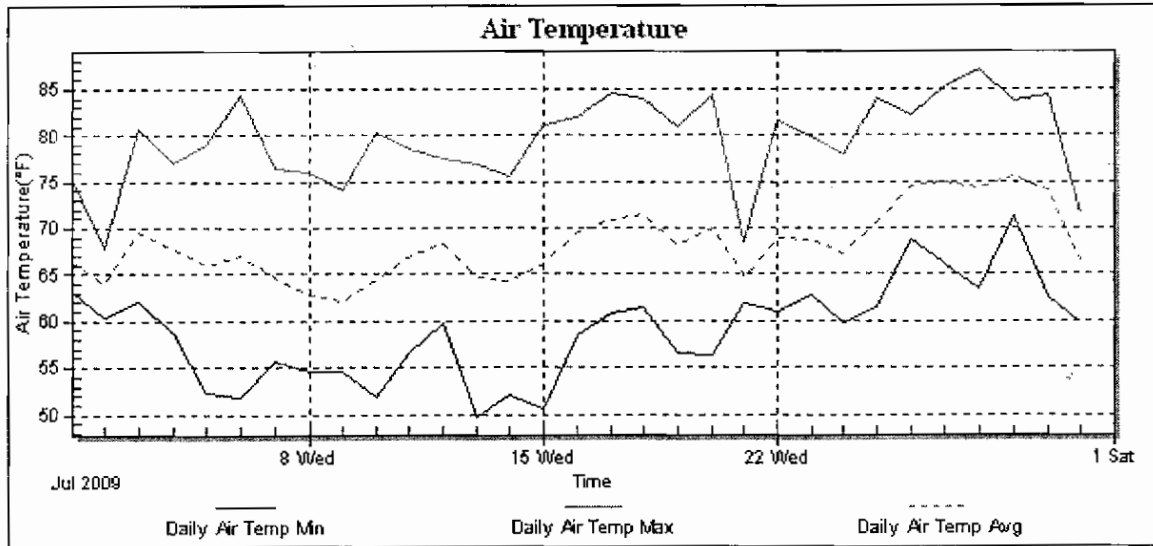
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:57 PM

Report Period: July 2009



Air Temperature and Rainfall - July 2009



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:57 PM

Report Period: July 2009

Date	Air Temp Min (°F)	Air Temp Max (°F)	Air Temp Avg (°F)
7/1/2009	63.16	75.36	66.28
7/2/2009	60.42	67.77	64.03
7/3/2009	62.08	80.65	69.50
7/4/2009	58.69	76.96	67.73
7/5/2009	52.18	78.93	65.97
7/6/2009	51.78	84.36	67.04
7/7/2009	55.63	76.50	64.68
7/8/2009	54.63	76.01	62.79
7/9/2009	54.63	74.08	62.06
7/10/2009	51.87	80.37	64.32
7/11/2009	56.53	78.62	67.12
7/12/2009	59.81	77.49	68.39
7/13/2009	49.59	76.89	64.71
7/14/2009	52.00	75.47	64.26
7/15/2009	50.81	81.09	66.17
7/16/2009	58.39	81.97	69.53
7/17/2009	60.71	84.54	70.91
7/18/2009	61.43	83.93	71.58
7/19/2009	56.64	81.01	68.08
7/20/2009	56.28	84.42	69.96
7/21/2009	61.86	68.54	64.56
7/22/2009	60.96	81.63	69.03
7/23/2009	62.62	79.88	68.68
7/24/2009	59.65	77.92	67.27
7/25/2009	61.38	83.88	70.66
7/26/2009	68.67	82.09	74.42
7/27/2009	66.09	85.08	74.97
7/28/2009	63.46	87.15	74.23
7/29/2009	71.29	83.71	75.60
7/30/2009	62.51	84.25	74.12
7/31/2009	59.65	71.53	66.26
Low	49.59	67.77	62.06
High	71.29	87.15	75.60
Average	58.88	79.42	68.23
Std Dev	5.15	4.73	3.66
Total	N/A	N/A	N/A



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:57 PM

Report Period: July 2009

Date	Rain Fall (inches)
7/1/2009	0.05
7/2/2009	0.21
7/3/2009	0.00
7/4/2009	0.00
7/5/2009	0.00
7/6/2009	0.00
7/7/2009	0.40
7/8/2009	0.32
7/9/2009	0.00
7/10/2009	0.00
7/11/2009	0.16
7/12/2009	0.05
7/13/2009	0.00
7/14/2009	0.00
7/15/2009	0.00
7/16/2009	0.00
7/17/2009	0.00
7/18/2009	1.03
7/19/2009	0.00
7/20/2009	0.00
7/21/2009	1.02
7/22/2009	0.09
7/23/2009	0.17
7/24/2009	1.73
7/25/2009	0.03
7/26/2009	0.05
7/27/2009	0.02
7/28/2009	0.00
7/29/2009	0.29
7/30/2009	0.32
7/31/2009	1.67
Low	0.00
High	1.73
Average	0.25
Std Dev	0.46
Total	7.70



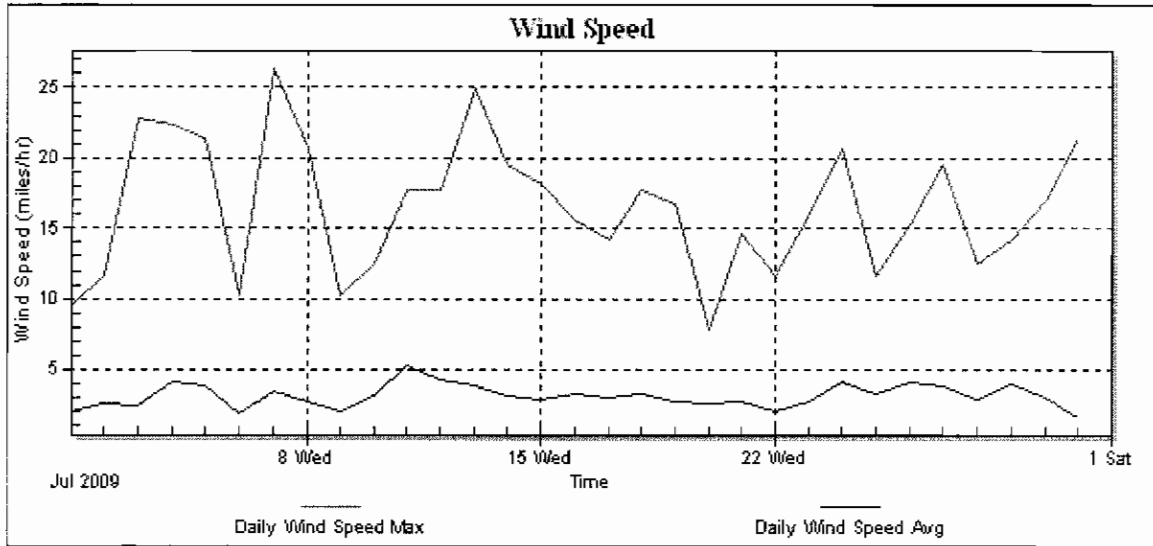
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:57 PM

Report Period: July 2009





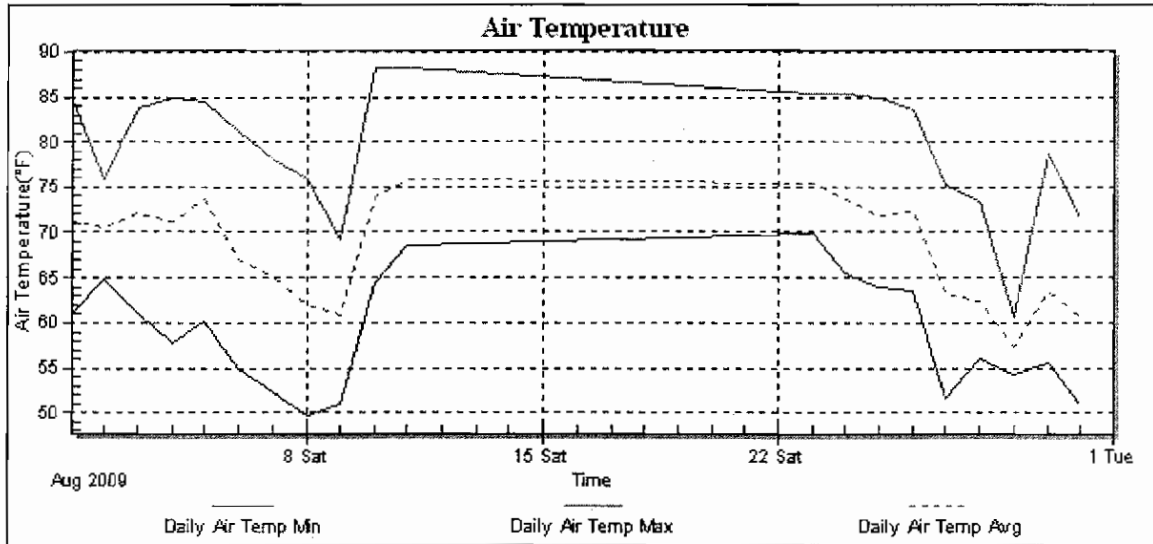
Weather Station: ET106

Location:

Report Type: 1 Month

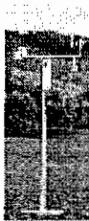
Created: Thursday, March 11, 2010 1:58 PM

Report Period: August 2009



Date	Air Temp Min (°F)	Air Temp Max (°F)	Air Temp Avg (°F)
8/1/2009	61.02	84.60	71.27
8/2/2009	64.78	75.78	70.49
8/3/2009	61.02	83.88	72.20
8/4/2009	57.79	85.01	71.27
8/5/2009	60.24	84.49	73.59
8/6/2009	54.99	81.14	66.93
8/7/2009	52.23	78.08	64.98
8/8/2009	49.53	75.78	61.97
8/9/2009	51.04	69.31	60.88
8/10/2009	64.42	88.11	73.95
8/11/2009	68.67	88.25	75.97
8/23/2009	69.98	85.37	75.36
8/24/2009	65.55	85.26	73.88
8/25/2009	63.93	84.90	71.90
8/26/2009	63.46	83.48	72.38
8/27/2009	51.84	75.11	63.38
8/28/2009	55.92	73.33	62.48
8/29/2009	54.14	60.73	57.36
8/30/2009	55.58	78.75	63.45
8/31/2009	51.04	71.58	60.88
Low	49.53	60.73	57.36
High	69.98	88.25	75.97
Average	58.85	79.65	68.21
Std Dev	6.13	6.97	5.62
Total	N/A	N/A	N/A

Air Temperature - August, 2009



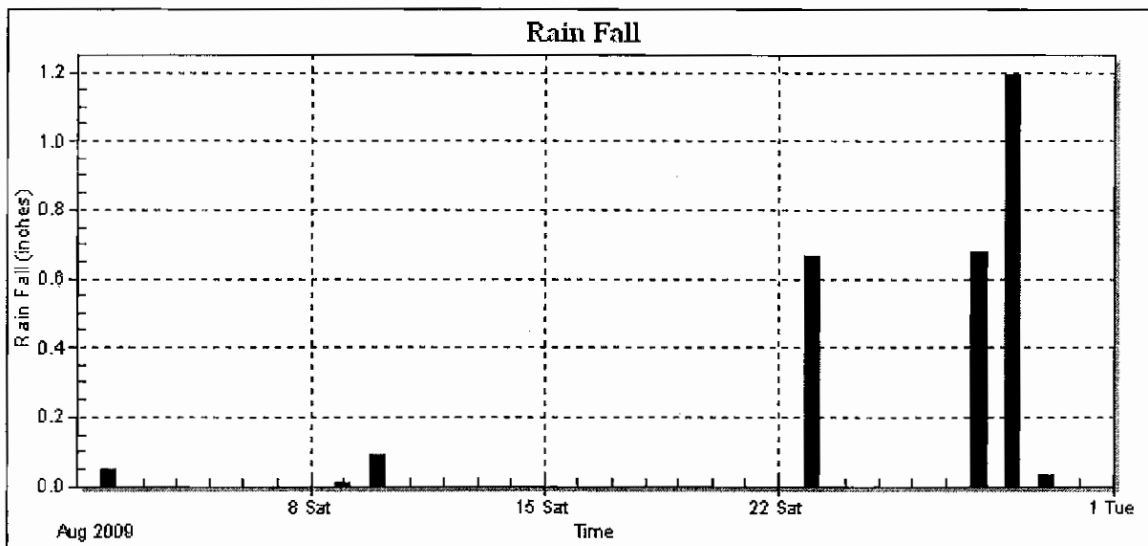
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:58 PM

Report Period: August 2009



Date	Rain Fall (inches)
8/1/2009	0.00
8/2/2009	0.05
8/3/2009	0.00
8/4/2009	0.00
8/5/2009	0.00
8/6/2009	0.00
8/7/2009	0.00
8/8/2009	0.00
8/9/2009	0.01
8/10/2009	0.09
8/11/2009	0.00
8/12/2009	0.00
8/13/2009	0.00
8/14/2009	0.00
8/15/2009	0.00
8/16/2009	0.00
8/17/2009	0.00
8/18/2009	0.00
8/19/2009	0.00
8/20/2009	0.00
8/21/2009	0.00
8/22/2009	0.00
8/23/2009	0.67
8/24/2009	0.00
8/25/2009	0.00
8/26/2009	0.00
8/27/2009	0.00
8/28/2009	0.68
8/29/2009	1.19
8/30/2009	0.03
8/31/2009	0.00
Low	0.00
High	1.19
Average	0.14
Std Dev	0.31
Total	2.72

Rainfall - August, 2009



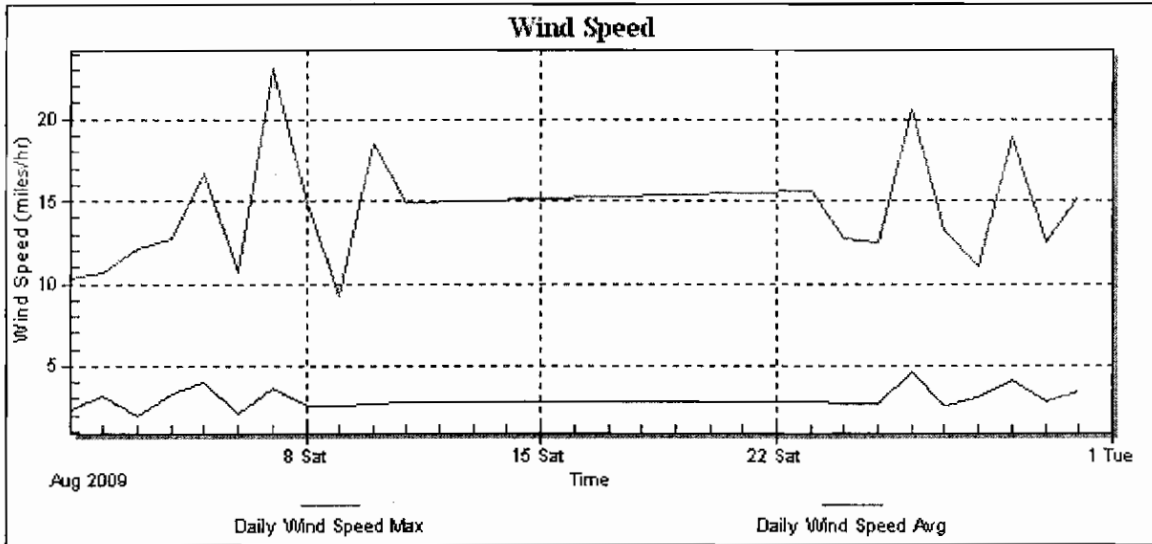
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 1:58 PM

Report Period: August 2009



Date	Wind Speed Max (miles/hr)	Wind Speed Avg (miles/hr)
8/1/2009	10.28	2.26
8/2/2009	10.64	3.15
8/3/2009	12.07	1.89
8/4/2009	12.78	3.31
8/5/2009	16.71	3.97
8/6/2009	10.64	2.06
8/7/2009	23.15	3.63
8/8/2009	14.93	2.54
8/9/2009	9.21	2.60
8/10/2009	18.50	2.67
8/11/2009	14.93	2.78
8/23/2009	15.64	2.81
8/24/2009	12.78	2.66
8/25/2009	12.42	2.64
8/26/2009	20.65	4.61
8/27/2009	13.14	2.60
8/28/2009	10.99	3.04
8/29/2009	18.86	4.17
8/30/2009	12.42	2.76
8/31/2009	15.29	3.35
Low	9.21	1.89
High	23.15	4.61
Average	14.30	2.98
Std Dev	3.64	0.68
Total	N/A	N/A

Wind Speed - August, 2009



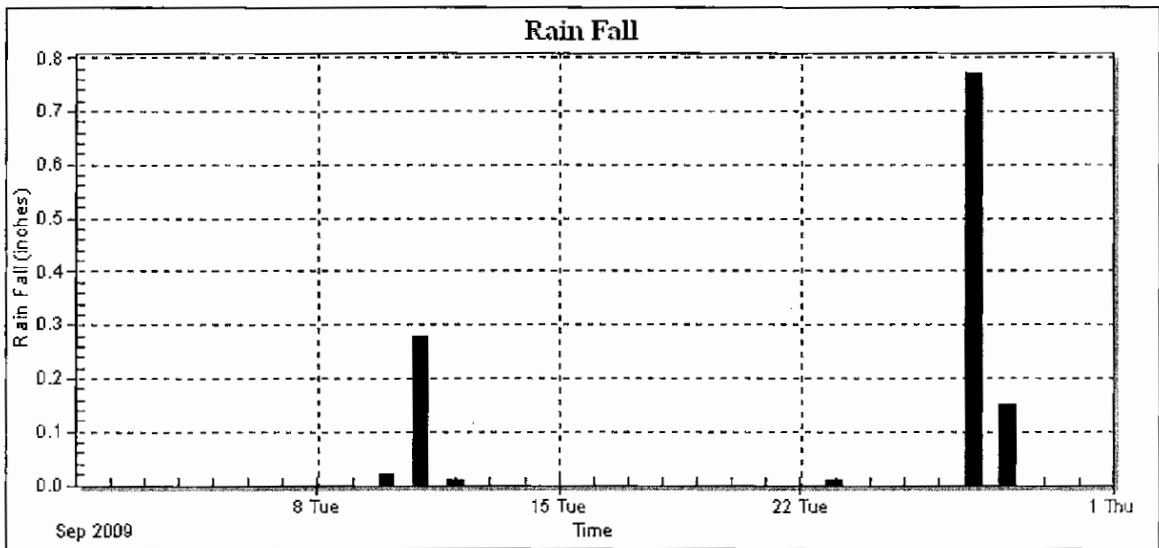
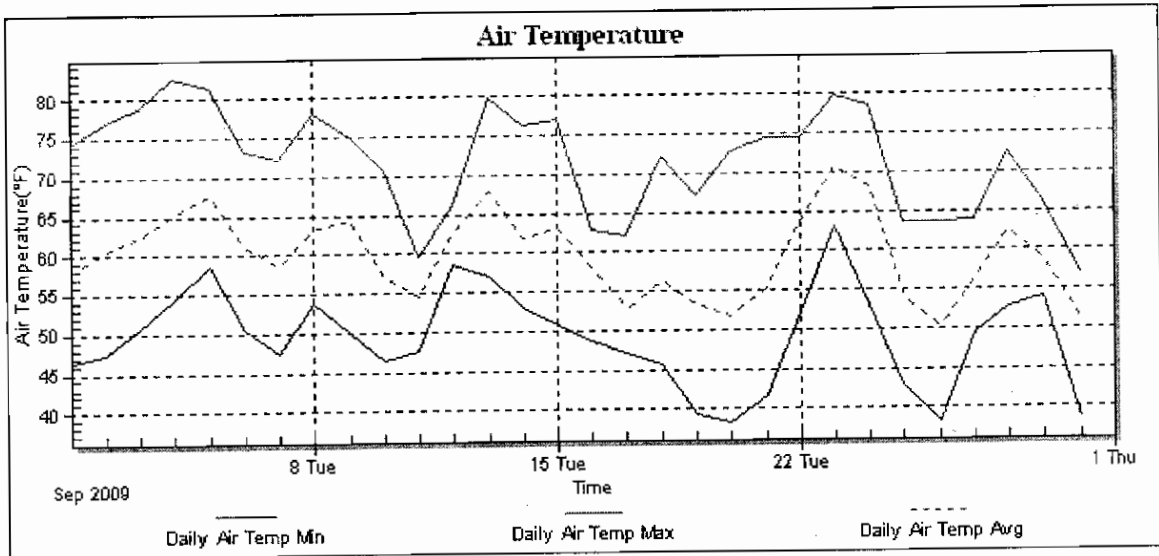
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 2:00 PM

Report Period: September 2009



Air Temperature and Rainfall - September, 2009



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 2:00 PM

Report Period: September 2009

Date	Air Temp Min (°F)	Air Temp Max (°F)	Air Temp Avg (°F)
9/1/2009	46.49	74.26	57.75
9/2/2009	47.39	77.14	60.46
9/3/2009	50.79	78.80	62.37
9/4/2009	54.32	82.63	65.13
9/5/2009	58.57	81.37	67.65
9/6/2009	50.43	73.20	61.18
9/7/2009	47.44	72.18	58.54
9/8/2009	53.83	78.04	63.02
9/9/2009	49.84	75.06	64.26
9/10/2009	46.42	70.63	57.09
9/11/2009	47.70	59.59	54.38
9/12/2009	58.57	66.22	62.51
9/13/2009	57.00	79.88	67.92
9/14/2009	53.02	76.19	61.71
9/15/2009	50.68	77.02	63.05
9/16/2009	48.81	62.98	57.99
9/17/2009	47.21	62.02	52.68
9/18/2009	45.72	72.25	56.34
9/19/2009	39.38	67.28	53.30
9/20/2009	38.30	72.61	51.72
9/21/2009	41.46	74.41	55.40
9/22/2009	52.30	74.59	63.77
9/23/2009	63.21	79.75	70.69
9/24/2009	52.95	78.64	68.26
9/25/2009	42.80	63.52	53.96
9/26/2009	38.18	63.46	50.31
9/27/2009	49.48	63.93	56.17
9/28/2009	52.72	72.43	62.54
9/29/2009	53.96	66.22	58.93
9/30/2009	38.66	58.91	51.20
Low	38.18	56.91	50.31
High	63.21	82.63	70.69
Average	49.26	71.77	59.68
Std Dev	6.18	6.86	5.41
Total	N/A	N/A	N/A



Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 2:00 PM

Report Period: September 2009

Date	Rain Fall (inches)
9/1/2009	0.00
9/2/2009	0.00
9/3/2009	0.00
9/4/2009	0.00
9/5/2009	0.00
9/6/2009	0.00
9/7/2009	0.00
9/8/2009	0.00
9/9/2009	0.00
9/10/2009	0.02
9/11/2009	0.28
9/12/2009	0.01
9/13/2009	0.00
9/14/2009	0.00
9/15/2009	0.00
9/16/2009	0.00
9/17/2009	0.00
9/18/2009	0.00
9/19/2009	0.00
9/20/2009	0.00
9/21/2009	0.00
9/22/2009	0.00
9/23/2009	0.01
9/24/2009	0.00
9/25/2009	0.00
9/26/2009	0.00
9/27/2009	0.77
9/28/2009	0.15
9/29/2009	0.00
9/30/2009	0.00
Low	0.00
High	0.77
Average	0.04
Std Dev	0.15
Total	1.24



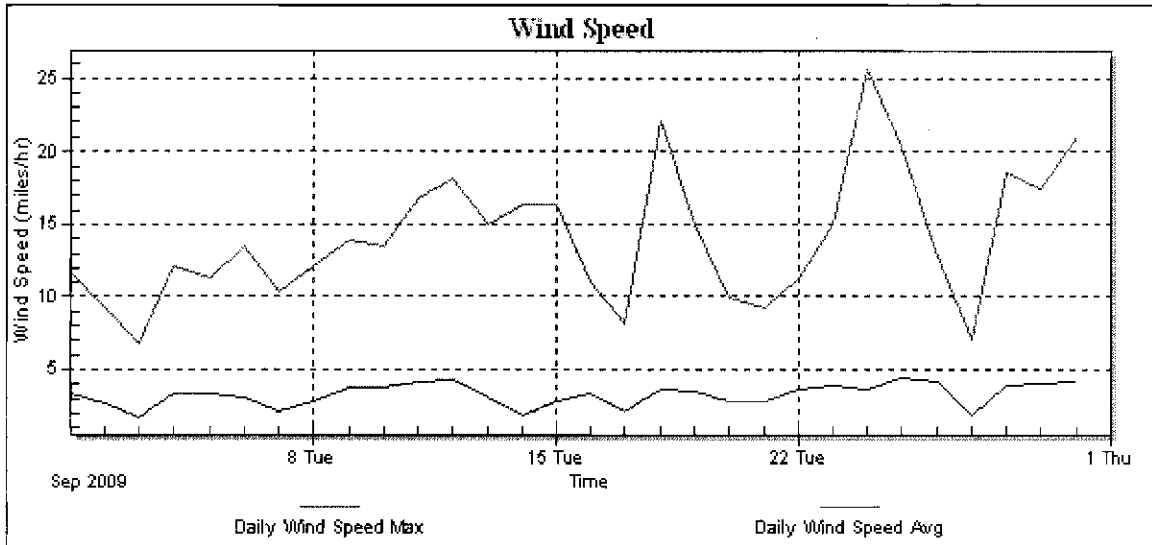
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, March 11, 2010 2:00 PM

Report Period: September 2009



2009 Publications

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Bhowmik, P. C. and D. Sarkar. 2008. Spread and management of quarantine and invasive weeds. Biennial National Conference of the Indian Society of Weed Science, Patna, Bihar, India, February 27-29, 2008. (Accepted).

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Bhowmik, P. C. and N. Tharayil. 2009. Importance of preferential sorption of phenolic acids to soil on allelopathic activity. Proceedings of the First Asian Allelopathy Society Conference, Guangzhou, China, December 18-21, 2009.

National

Bhowmik, P. C., D. Lycan and D. Sarkar. 2009. Safety of mesotrione to new seedlings of turfgrass species. 49th. Annual Meeting of the Weed Science Society of America, February 9-12, 2009, Orlando, FL. Electronic Abstract

Poster

Triebwasser, D., N. Tharayil, R. M. Callaway and P. C. Bhowmik. 2009. Diurnal rhythm of catechin exudation by invasive *Centaurea maculosa*. 49th. Annual Meeting of the Weed Science Society of America, February 9-12, 2009, Orlando, FL. Electronic Abstract

Regional

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International

Invited speaker at the First Asian Allelopathy Society Conference, December 18-21, 2009 in Guangzhou, China.

Topic: Experimental methods of allelopathy: Plant bioassays.

Bhowmik, P. C. and N. Tharayil. 2009. Importance of preferential sorption of phenolic acids to soil on allelopathic activity. Proceedings of the First Asian Allelopathy Society Conference, Guangzhou, China, December 18-21, 2009.

National

Bhowmik, P. C. and D. Sarkar. 2009. Potential use of mesotrione in turfgrass systems. ASA-CSSA-SSSA Annual Meeting, November 1-5, Pittsburg, PA. Abstract no.

Bhowmik, P. C., D. Lycan and D. Sarkar. 2009. Safety of mesotrione to new seedlings of turfgrass species. 2009 Joint Southern Weed Science Society and Weed Science Society of America Meeting, February 5-5-13, Orlando, FL

Sarkar, D., P. Bhowmik and K. Shetty. 2008. Stimulation of proline-linked antioxidant response system in cool-season turfgrasses under UV-B radiation. Joint Meeting of GSA and ASA-CSSA-SSSA, October 5-9, 2008, Houston, TX. Abstract no. 561-4.

Northeast Regional:

Bhowmik, P. C. and D. Sarkar. 2009. Biology of *Kyllinga* species. The 63rd. Annual Meeting of the Northeastern Weed Science Society, January 5-8, 2009, Baltimore, MD

Invited speaker:

At the Ecological Landscaping Association Conference, February 27, 2009, Springfield, MA. Title: Weeds as Indicator Species (over 80 participants)

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Bhowmik, P. C., S. Ebdon and D. Sarkar. 2008. Tolerance of Kentucky bluegrass cultivars to sulfosulfuron – NTEP cultivar trial. Massachusetts Weed Science Research Results – 2008. Vol. 27:55-57

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Bhowmik, P. C. D. Sarkar. 2008. Comparison of Avenger Moss products in moss control. Massachusetts Weed Science Research Results – 2008. Vol. 27:63-65

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Bhowmik, P. C., D. Sarkar and K. Miller. 2008. Postemergence control of large crabgrass. Massachusetts Weed Science Research Results – 2008. Vol. 27:15-18

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Diurnal Rhythm of Catechin Exudation by Invasive *Centaurea maculosa*

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Abstract

Allelopathy, the production of secondary metabolites at phytotoxic concentrations, has been proposed as a mechanism of invasion of few exotic plant species. Catechin is a phytochemical flavanoid implicated in the allelopathic interactions of *Centaurea maculosa*. However, catechin is highly unstable compound and hence is not accumulated in growth medium at phytotoxic concentrations.

Investigating the mechanism of stability of catechin, we hypothesized that a pulsed release of catechin, by temporarily overwhelming the degradation capacity, could result in its accumulation in the growth medium.

We tested the hypothesis by quantifying the diurnal rhythm of catechin release of *C. maculosa* in a hydroponic system. Catechin concentration was maximum 6-8 hours after exposure to sunlight and there was no accumulation of catechin overnight, indicating a possible diurnal rhythm in the exudation of the compound by *C. maculosa*. Catechin was found to further undergo degradation reaction resulting in a transient abundance of pyrocatechol in our system. Catechol due to its chelating property could increase the resource foraging ability of *C. maculosa*.

Our results indicate the pulsed release could result in transient accumulation of catechin in growth medium.

Introduction

Invasive plants rely upon unique traits and interactions to gain competitive advantage over native species. Allelopathy, the production of secondary metabolites at phytotoxic concentrations that inhibit neighboring species, has been proposed as mechanism of invasion of few exotic species.

Centaurea maculosa, spotted knapweed, is a nonnative and economically destructive invasive weed inhabiting >4 Mha in North America (1). Catechin is a phytochemical flavanoid implicated in the allelopathic interactions of *Centaurea maculosa*. Catechin also prevents conspecific seedling establishment, thus preventing intra-specific competition (2).

Because of the high reactivity, attributed to the five hydroxyl groups, catechin is unstable in aqueous solutions and is oxidized by dissolved oxygen. At alkaline pH catechin undergoes nucleophilic addition reaction to form catecholic acid derivatives and quinones, whereas acidic pH conditions result in the formation of dimers from radical coupling. Due to this highly reactive nature of catechin, its persistence in a highly heterogeneous environment is always questionable.

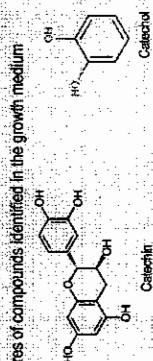
Investigating the mechanism of stability of catechin, we hypothesized that a pulsed release of catechin, by temporarily overwhelming the degradation capacity, could result in its accumulation in the growth medium.

Methods

We tested the hypothesis by quantifying the diurnal rhythm of catechin release of *C. maculosa* in a hydroponic system.

Three week old plants were transplanted in batches of twelve to opaque polypropylene containers and maintained under full sunlight in the greenhouse. The catechin concentration was quantified at various time intervals in accordance with the difference in duration of light exposure. Analytical method for catechin quantification was optimized as follows: the growth solutions were filter-sterilized and was further concentrated and purified on a polymeric solid phase extraction column. The compound was quantified with an HPLC using a diode array detector and a fluorescence detector. Identification of compounds was done using a quadrupole ion-trap tandem mass spectrometer with an electrospray ionization interface (ESI-MS/MS).

Compound structure



Results

- ↗ In fluorescence detection, excitation-emission wavelength of 205-315 was ten times more sensitive than the previously reported excitation-emission of 280-315, and the limit of detection for fluorescence detector was 0.1 ng.
- ↗ Fluorescence at Ex-Em 205-315 showed more specificity.
- ↗ Catechin exudation was highest when plants were exposed to full sunlight (2000 $\mu\text{mol m}^{-2} \text{s}^{-1}$) compared to artificial light (400 $\mu\text{mol m}^{-2} \text{s}^{-1}$).
- ↗ Catechin was maximum 6-8 hours after exposure to sunlight.
- ↗ There was no accumulation of catechin overnight.
- ↗ Catechin was found to further undergo degradation reaction resulting in a transient abundance of catechol in our system.

Fluorescence spectrum

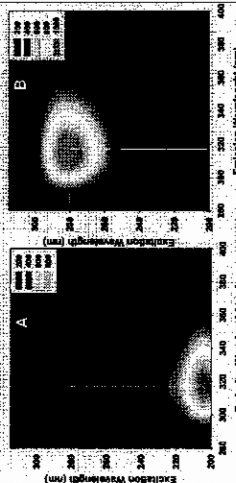


Fig. Fluorescence spectrum of catechin (A) and its degradation product (B) showing an increased sensitivity of excitation-emission wavelength of 205-315 compared to 280-315. Though the Ex-Em of 280-315 is common to both catechin and its degradation products, the Ex-Em of 205-315 is highly specific to catechin.

Mass spectrum

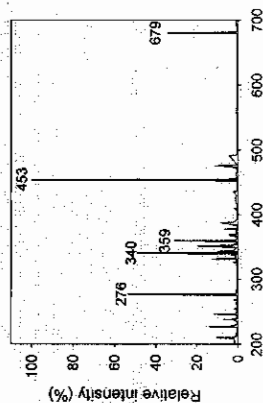


Fig. Mass spectrum of the polymerization compound formed.

Chromatogram of compounds detected

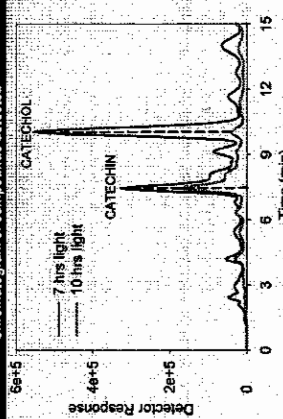


Fig. LC-fluorescence chromatograms of major compounds present in the *C. maculosa* growth medium.

Table 1. Pattern of root-exudation as affected by diurnal light rhythms

Time (hrs)	Catechol (ppm)	Catechin (ppm)
5	0.84 ± 0.3	0.51 ± 0.2
7	1.84 ± 0.2	2.97 ± 0.4
10	1.00 ± 0.4	0.54 ± 0.2
24	0	0

Discussion & Conclusion

Catechin exudation was limited and transient. However the pulsatile release of catechin corresponding to the diurnal rhythm of light intensity could result in temporary accumulation of catechin under natural conditions.

Pyrocatechol, which has not been previously reported as being exuded by *C. maculosa*, was present in the medium. Addition of pure catechin standard to the growth medium suggests that the catechol is being formed through the degradation of catechin. The occurrence of catechol supports our earlier finding that catechin is able to mobilize metals in soil matrix due to the chelation ability of its o-hydroxy moiety (3). This degradation could significantly increase the nutrient acquisition efficiency of this plant in its alkaline invaded ranges (4).

Further the catechin was found to undergo polymerization reaction resulting in the formation of high molecular weight compounds. Our results indicate that the pulsed release could result in transient accumulation of catechin in growth medium.

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