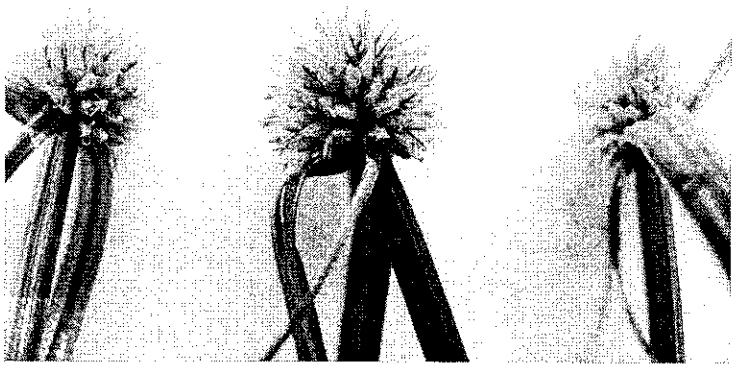
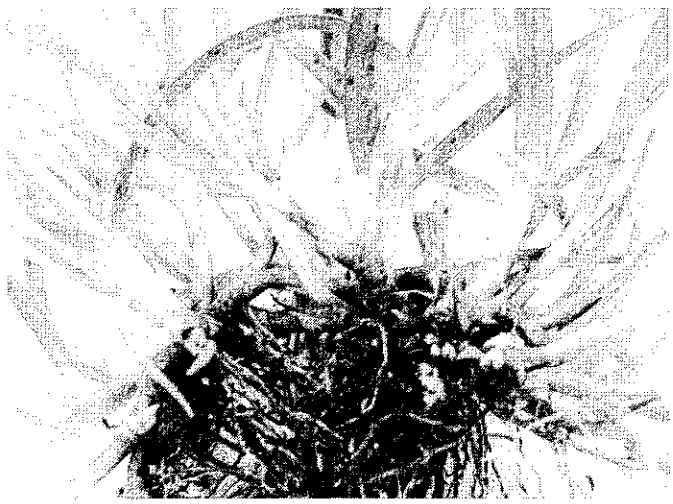
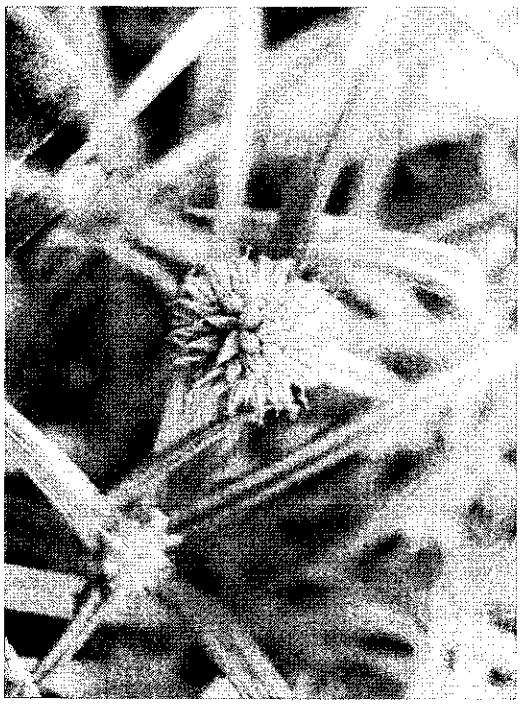
MASSACHUSETTS TURFGRASS WEED SCIENCE RESEARCH RESULTS - 2010

VOLUME 29







Prasanta C. Bhowmik

Department of Plant, Soil, and Insect Sciences
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 2010. This information is our annual summary of ongoing field research in Turfgrass 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.

Prof. Prasanta C. Bhowmik
Amherst, MA
December 31, 2010

MASSACHUSETTS
TURFGRASS WEED SCIENCE RESEARCH - 2010

Weed management research in turfgrass environments was conducted by Prof. Prasanta C. Bhowmik at the Joseph Troll Turfgrass Research Center, South Deerfield, MA. In addition, some of the trials were conducted at various golf courses.

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 turfgrass weed science projects in 2010.

BASF
DuPont Chemical Company

Appreciation is also extended to others who provided seeds, supplies, equipments, and/or services for these studies. Special thanks to Michael Barton and his staff for their collaboration for field trials at the Burning Tree Country Club golf course. Also, thanks to Thom Griffin for his cooperation and help for the entire season at the Joseph Troll Turfgrass Research Center, South Deerfield, MA.

2010 TURFGRASS RESEARCH PROJECTS

Turfgrass Environments

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

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.

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.

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.

Non Turfgrass – Research Projects

Ecological study of chiraito (*Swertia chirayita*): This research aims to study the ecophysiology of chirayita 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.

TURFGRASS
DATA COLLECTION METHODS

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 cm^2 quadrats in each plot.

II. Tolerance Studies

PERCENT TURFGRASS 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 growth regulator treatments.

1. Number of seed heads per unit area (cm^2 or in^2)
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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What's New in Broadleaf Weed Control

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

Weeds invade cool-season turfgrass environments such as bentgrass, Kentucky bluegrass, perennial ryegrass, tall fescue, and other mixed species areas, and they persist under various management conditions. Weed control is the cornerstone of most turfgrass and landscape management programs. Producing a dense, healthy stand of turfgrass is one way to suppress annual and some perennial weeds. The proper mowing height and frequency, fertilization and irrigation are part of the management program that should be practiced throughout the growing season.

Regardless of the type of turfgrass you manage, it is important to understand weed control principles, so that the decisions you make are economical, environmentally sound and produce good results. Turfgrass managers should be familiar with the following steps for a successful weed control program: (a) Knowing the specific weed problems: (grass vs broadleaf weeds), life cycle of the weeds (annual v/s perennial), (b) Selection of the right herbicide: in relation to effective weed control and turfgrass tolerance.

Some of the common broadleaf weeds are heal-all, common speedwell, shepherd's purse, black medic, white clover, ground ivy, dandelion, prostrate knotweed, plantain(s), hawkweed(s), henbit, yellow wood sorrel, red sorrel, mouse-ear chick weed, common chickweed, spurge(s), violet, and others (see the following pages). The management of these weeds can be challenging because of the weed complex that occurs. A successful integrated weed management program incorporates both cultural practices (mowing height, frequency of irrigation and fertilization) and various chemical control strategies. Cutting height has a significant effect on weed invasion and its establishment under varied conditions. Higher the cutting height, lower the incidence of many weed species.

Postemergence control of broadleaf weeds is a common practice especially it is important under IPM programs. Postemergence treatments are desirable in early spring or early fall for broadleaf weeds. The timing of postemergence application in relation to weed growth stage is very important in effective weed control. Products such as Confront, Millenium Ultra, PowerZone, TZONE, SpeedZone, Spotlight, Trimec Classic, and TurflonD are recommended for effective postemergence control of the above-mentioned broadleaf species.

Presented at the University of Massachusetts Turf Research Field Day, Wednesday, June 16, 2010

Formulations of these products are as important as the timing of application in controlling these species. Ester and amine formulations have different activity due to different properties in controlling various weeds. Amines are soluble in water; esters are oil soluble. Esters are generally better herbicides than the corresponding amine product. Esters tend to penetrate into the leaf more effectively than do amines. The reason that esters are not used exclusively is that they are slightly volatile. This volatility can result in non-target injury to susceptible plants in the landscape. Amines are non-volatile but not as effective as the esters. Thus, you may use an amine to avoid the risk of injury that comes when you use an ester. Amines should always be used in the spring when plant material is breaking dormancy, actively growing, and very susceptible to these broadleaf herbicides. Esters can be used in the summer when weeds are starting to harden off and are less susceptible to the herbicide and in the fall when non-target plants are hardening off for the winter and are much less susceptible to injury from volatile broadleaf herbicides.

Some of these compounds will be included in research trials. Effectiveness of these compounds will be discussed at the Field Day.

Commonly Used Postemergence Broadleaf Weed Control Products

Trade names	Common names	Comments
Many	2,4-D	Old product for BL weed control
Many	MCPP	Old product for BL weed control
Vanquish, Banvel	Dicamba	Old product for BL weed control
Many	Dichloroprop	Old product for BL weed control
Dismiss	Sulfentrazone	Fast acting
Imprelis	Aminoclyclopyrachlor	New product
Kixor	Saflufenacil	New product
Lontrel	Clopyralid	Excellent on legume species
Quicksilver	Carfentrazone	Fast acting
Spotlight	Fluroxypyr	Target: BL weeds. Not for bentgrass greens or tees
	Pyraflufen-ethyl	New product, fast acting
Turflon	Triclopyr	Excellent on clover, black medic, ground ivy, violet, plantains, docks, yarrow
Combination Products		
Confront	Clopyralid + triclopyr	Excellent on clover, dandelion, hawkweed, ground ivy, plantains, speedwell, wood sorrel, chickweed
TurflonD	2,4-D + triclopyr	Good activity on ground ivy, violet
Escalade 2	2,4-D + fluroxypyr + Dicamba	Good for tough-to-control weeds: violet, ground ivy, black medic, oxalis, clover, spurge and speed wells. Excellent on button weed
Momentum Force	2,4-D + MCPA + dicamba	Target: BL weed species
Millenium Ultra	2,4-D + clopyralid + dicamba	Excellent on clover, dandelion, plantains, chickweed, oxalis, thistle. Do not use on bentgrass tees and greens
Q4	Quinclorac + sulfentrazone + 2,4-D + dicamba	Fast acting. Good on grass and BL weeds. Dandelion, clover, plantains, hawkweeds, poison ivy
Q4 Plus	Quinclorac + sulfentrazone + 2,4-D + dicamba	Fast acting. Good on grass and BL weeds. Dandelion, clover, plantains, hawkweeds, poison ivy
TZone	Triclopyr + sulfentrazone + 2,4-D + dicamba	Fast acting. Good for tough-to-control weeds: violet, ground ivy, black medic, oxalis, clover, spurge and speed wells. **Only for bentgrass fairways**
SpeedZone	2,4-D + carfentrazone + MCPP + dicamba	Fast acting. BL weeds
4 Speed	2,4-D + Mecoprop + dicamba + pyraflufen-ethyl	New product
4 Speed XT	2,4-D + triclopyr + dicamba + pyraflufen-ethyl	New product. Good on violets, ground ivy, plantains, clover, dandelion
Trimec Bent	2,4-D + MCPA + dicamba	**BL weed control options for bentgrass greens, tees, fairways and aprons**
Trimec Classic	2,4-D + MCPP + dicamba	Old competitive product

Common Broadleaf Weeds
In Cool-Season Turfgrass Systems

Common Name	Scientific Name
Annuals	
Carpetweed	*Mollugo verticilata*
Common Chickweed	*Stellaria media*
Henbit	*Lamium amplexicaule*
Prostrate Knotweed	*Polygonum aviculare*
Common Purslane	*Portulac oleracea*
Field speedwell	*Veronica agrestis*
Prostrate Spurge	*Euphorbia maculata*
Shepherd's purse	*Capsella bursa-pastoris*
Perennials	
Mouseear Chickweed	*Cerestium vulgatum*
White Clover	*Trifolium repens*
Common Dandelion	*Taraxcum officinale*
Curley Dock	*Rumex crispus*
Wild Garlic	*Allium vineale*
Hawkweed (Orange/Yellow)	*Hieracleum spp.*
Heal All	*Prunella vulgaris*
Ground Ivy	*Glechoma hederacea*
Poison Ivy	*Rhus radicans*
Black Medic	*Medicago lupina*
Broadleaf Plantain	*Plantago major*
Buckhorn Plantain	*Plantago lanceolata*
Common Speedwell	*Veronica officinalis*
Slender Speedwell	*Veronica filliformis*
Red Sorrel	*Rumex acetosella*
Canada Thistle	*Cirsium arvense*
Violet	*Viola arvensis*
Yarrow	*Achillea millefolium*
Yellow Wood Sorrel	*Oxalia stricta*

UNIVERSITY OF MASSACHUSETTS-AMHERST

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

Trial ID: 1051TG1A Protocol ID: 1051TG1
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
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT2
Replications: 3
Site Type: TURREE turf - research
Study Design: RACOBL Randomized Complete Block (RCB)
Untreated Arrangement: INCLUDED single control randomized in each block

Application Description

	A
Application Date:	Jun-8-10
Time of Day:	10:00 AM
Application Method:	SPRAY
Application Timing:	EAPOWE
Application Placement:	BROFOL
Air Temperature, Unit:	74.4 F
% Relative Humidity:	21.9
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	68.0 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

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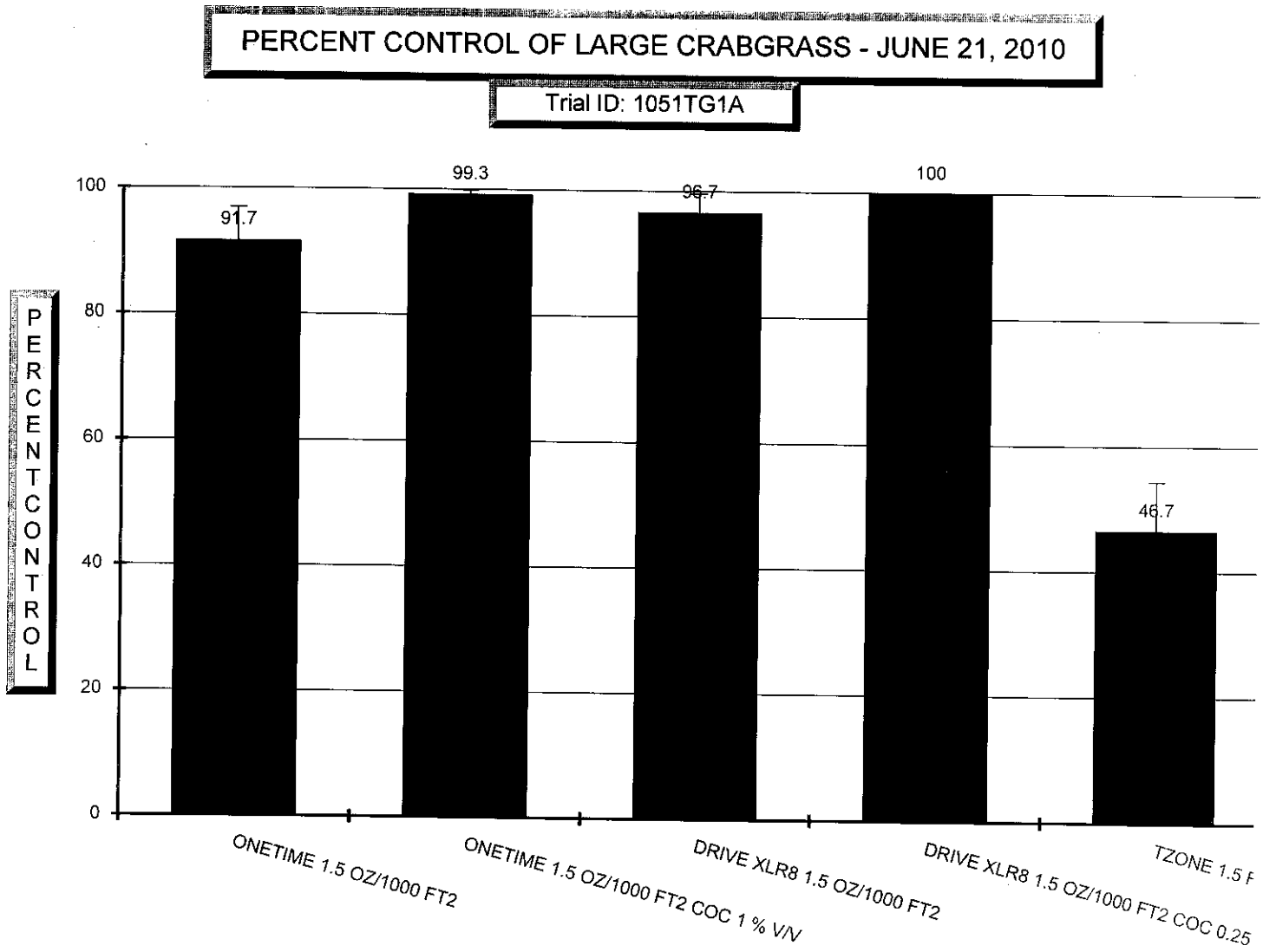
EFFICACY OF ADJUVANTS ON THE PERFORMANCE OF DRIVE XLR8 AND ONETIME IN LARGE CRABGRASS CONTROL

Trial ID: 1051TG1A Protocol ID: 1051TG1
Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
Project ID: 0903TG3 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



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

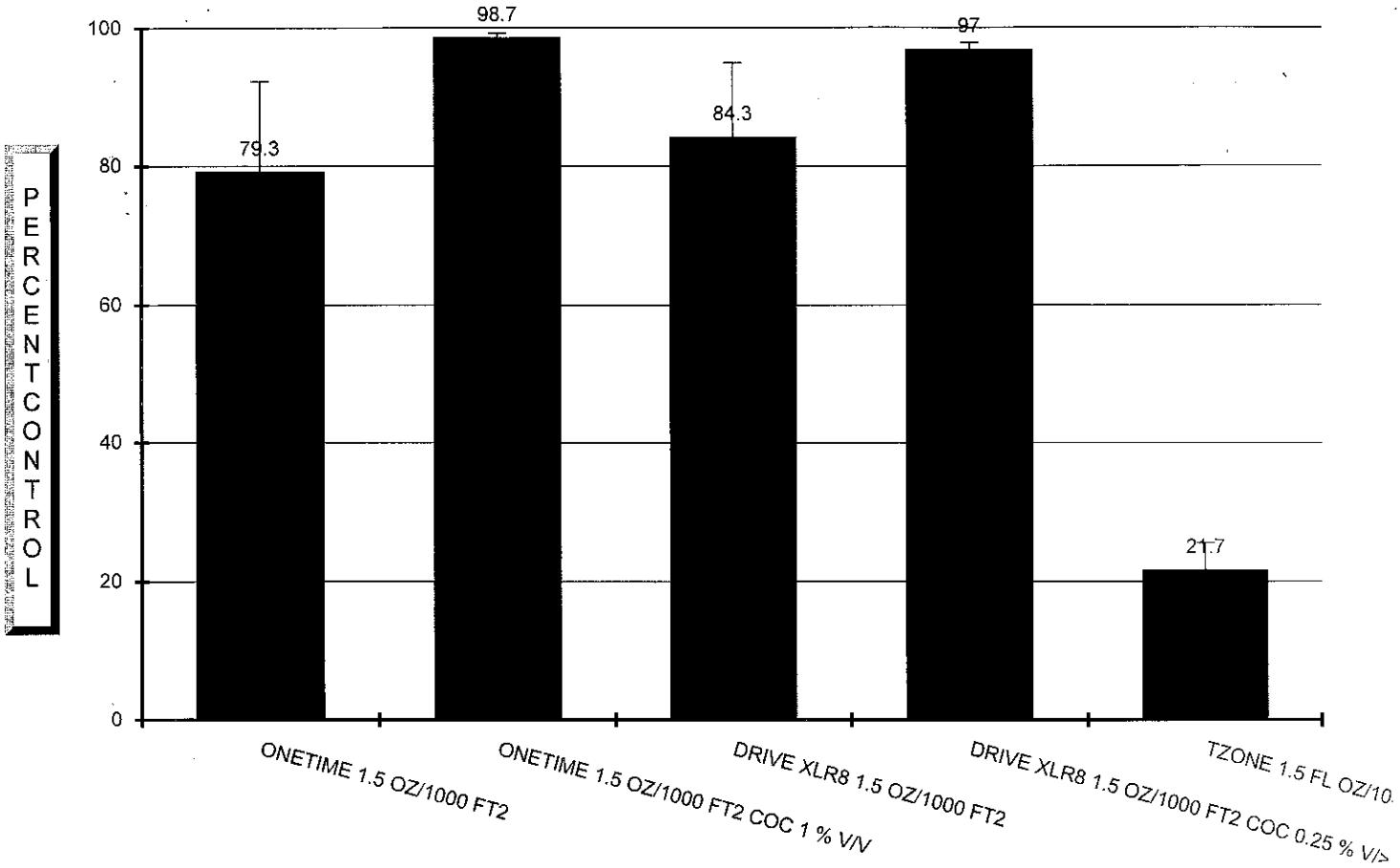
Pest Type		W Weed	W Weed	W Weed	W Weed
Pest Code		DIGSA	DIGSA	DIGSA	DIGSA
Pest Scientific Name		Digitaria sang>	Digitaria sang>	Digitaria sang>	Digitaria sang>
Pest Name		Large crabgrass	Large crabgrass	Large crabgrass	Large crabgrass
Rating Date		Jun-14-10	Jun-21-10	Jul-12-10	Jul-23-10
Rating Type		CONTROL	CONTROL	CONTROL	CONTROL
Rating Unit		%	%	%	%
Number of Subsamples		1	1	1	1
Days After First/Last Applic.		6 6	13 13	34 34	45 45
Trt-Eval Interval		6 DA-A	13 DA-A	21 DA-A	34 DA-A
Trt No.	Treatment Name / Rate Unit	1	2	3	4
1	ONETIME / 1.5 oz/1000 ft2	82.7 a	91.7 a	79.3 a	79.3 a
2	ONETIME COC / 1.5 oz/1000 ft2 1 % v/v	99.3 a	99.3 a	98.7 a	98.7 a
3	DRIVE XLR8 / 1.5 oz/1000 ft2	86.0 a	96.7 a	84.3 a	84.3 a
4	DRIVE XLR8 COC / 1.5 oz/1000 ft2 0.25 % v/v	99.3 a	100.0 a	97.0 a	97.0 a
5	TZONE / 1.5 fl oz/1000 ft2	33.3 b	46.7 b	21.7 b	21.7 b
6	UNTREATED CHECK	0.0 c	0.0 c	0.0 b	0.0 b
LSD (P=.05)		20.21	15.26	22.76	22.76
Standard Deviation		11.11	8.39	12.51	12.51
CV		16.64	11.59	19.7	19.7
Bartlett's X2		14.508	7.689	16.289	16.289
P(Bartlett's X2)		0.006*	0.053	0.003*	0.003*
Replicate F		1.039	0.346	2.475	2.475
Replicate Prob(F)		0.3891	0.7153	0.1339	0.1339
Treatment F		40.444	71.186	33.823	33.823
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
DIGSA, Digitaria sanguinalis, = US
Rating Unit
% = percent

PERCENT CONTROL OF LARGE CRABGRASS - JULY 23, 2010

Trial ID: 1051TG1A



UNIVERSITY OF MASSACHUSETTS-AMHERST

PERFORMANCE OF DRIVE XLR8 AND OTHER PRODUCTS IN BROADLEAF WEED CONTROL

Trial ID: 1051TG1B Protocol ID: 1051TG1
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
Plot Length, Unit: 10 FT
Plot Area, Unit: 35 FT2
Replications: 3
Site Type: TURREE turf - research
Study Design: RACOBL Randomized Complete Block (RCB)
Untreated Arrangement: INCLUDED single control randomized in each block

Application Description

	A
Application Date:	Jun-8-10
Time of Day:	10:00 AM
Application Method:	SPRAY
Application Timing:	EAPOWE
Application Placement:	BROFOL
Air Temperature, Unit:	74.4 F
% Relative Humidity:	21.9
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	68.0 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

UNIVERSITY OF MASSACHUSETTS-AMHERST

PERFORMANCE OF DRIVE XLR8 AND OTHER PRODUCTS IN BROADLEAF WEED CONTROL

Trial ID: 1051TG1B
Location: TRC-SDF
Project ID: 0903TG3
Protocol ID: 1051TG1
Study Director: Prof. P. C. Bhowmik
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

PERFORMANCE OF DRIVE XLR8 AND OTHER PRODUCTS IN BROADLEAF WEED CONTROL

Trial ID: 1051TG1B Protocol ID: 1051TG1
Location: TRC-SDF Study Director: Prof. P. C. Bhowmik
Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate / Rate Unit	W Weed TRFRE Trifolium repe> White clover Jun-21-10 CONTROL % 1 13 13 6 DA-A	W Weed STEME Stellaria media Common chickwe> Jun-21-10 CONTROL % 1 13 13 13 DA-A	W Weed DIGSA Digitaria sang> Large crabgrass Jun-21-10 CONTROL % 1 13 13 34 DA-A
1	ONETIME	1.5 oz/1000 ft2	94.3 a	92.7 a	87.7 a
2	ONETIME COC	1.5 oz/1000 ft2 1 % v/v	95.0 a	98.3 a	96.0 a
3	DRIVE XLR8	1.5 oz/1000 ft2	90.0 a	95.3 a	92.7 a
4	DRIVE XLR8 COC	1.5 oz/1000 ft2 0.25 % v/v	91.7 a	86.7 a	88.3 a
5	TZONE	1.5 fl oz/1000 ft2	89.3 a	86.0 a	26.7 b
6	UNTREATED CHECK		0.0 b	0.0 b	0.0 b
	LSD (P=.05)		11.31	13.90	37.21
	Standard Deviation		6.22	7.64	20.46
	CV		8.1	9.99	31.36
	Bartlett's X2		4.677	3.837	16.925
	P(Bartlett's X2)		0.197	0.428	0.002*
	Replicate F		0.329	0.009	0.562
	Replicate Prob(F)		0.7271	0.9915	0.5872
	Treatment F		110.037	73.384	12.157
	Treatment Prob(F)		0.0001	0.0001	0.0005

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
TRFRE, Trifolium repens, = US
STEME, Stellaria media, = US
DIGSA, Digitaria sanguinalis, = US
Rating Unit
% = percent

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

UNIVERSITY OF MASSACHUSETTS-AMHERST

PERFORMANCE OF DRIVE XLR8 AND OTHER PRODUCTS IN BROADLEAF WEED CONTROL

Trial ID: 1051TG1B
Location: TRC-SDF
Project ID: 0903TG3
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Study Director: Prof. P. C. Bhowmik
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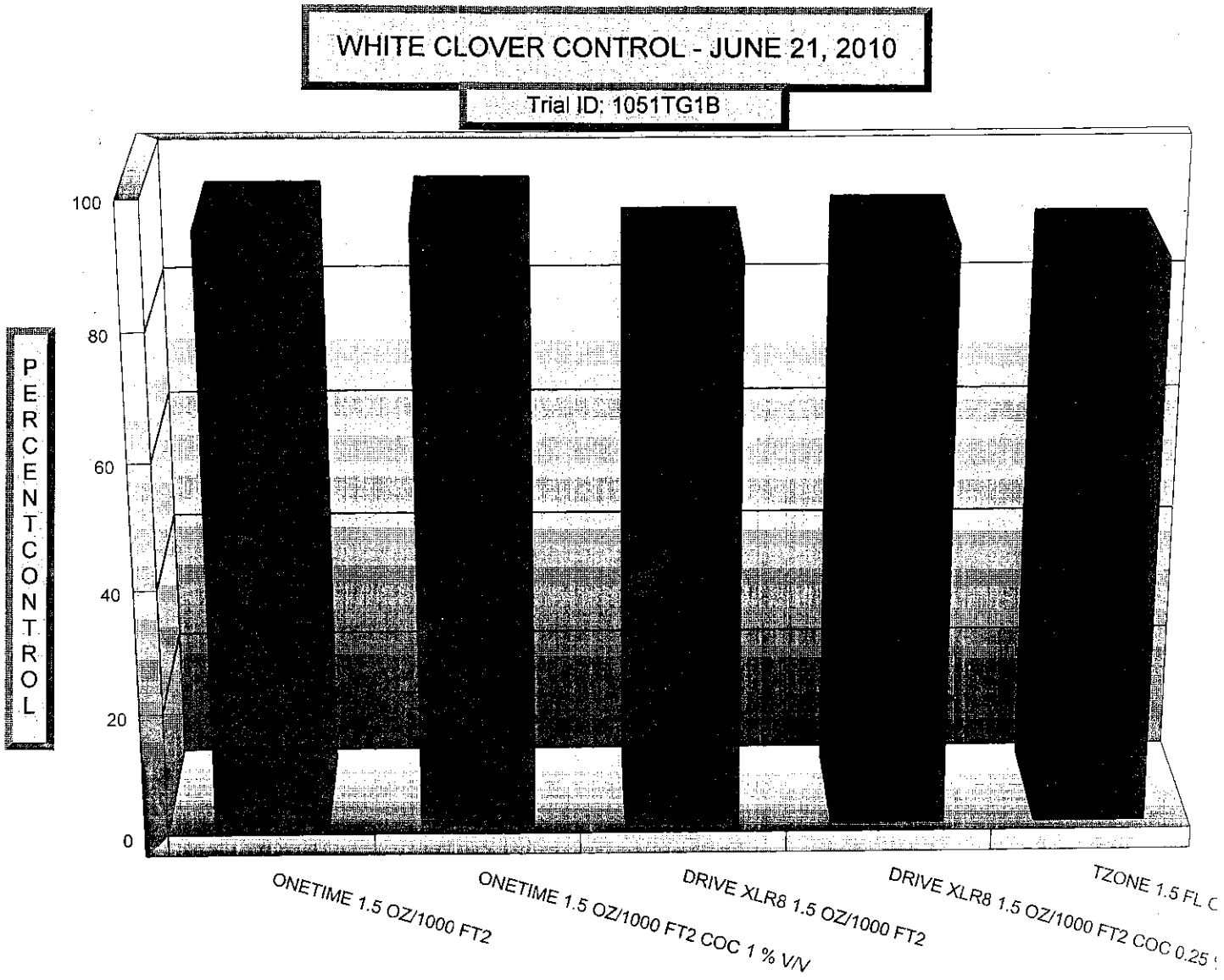
Sponsor Contact:



UNIVERSITY OF MASSACHUSETTS-AMHERST

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
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: 4 **Study Design:** RACOBL Randomized Complete Block (RCB)

Application Description

	A
Application Date:	May-28-10
Time of Day:	Noon
Application Method:	SPRAY
Application Timing:	POSPOS
Air Temperature, Unit:	80.6 F
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	86.0 F
% 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:	0.608

UNIVERSITY OF MASSACHUSETTS-AMHERST

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	1	2	5
	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			Jun-1-10	Jun-7-10	Jun-14-10
	Rating Type			CONTROL	CONTROL	CONTROL
	Rating Unit			Percent	Percent	Percent
	Number of Subsamples			1	1	1
	Days After First/Last Applic.			4 4	10 10	17 17
	Trt-Eval Interval			8 DA-A	8 DA-A	10 DA-A
1	IMPRELIS - 112	3.0	fl oz/a	32.5 b	92.0 a	80.3 a
2	IMPRELIS - 112	4.5	fl oz/a	40.0 b	97.8 a	80.0 a
3	IMPRELIS - 112	6.0	fl oz/a	36.3 b	97.8 a	83.8 a
4	TRIMEC BENT	4.0	pt/a	26.3 b	85.0 a	70.0 a
5	ESCALADE 2	3.0	pt/a	28.8 b	90.0 a	73.8 a
6	DPX-MAT28-138	150.0	lb/a	27.5 b	89.5 a	70.8 a
7	DPX-MAT28-138	200.0	lb/a	26.3 b	92.5 a	74.5 a
8	DPX-MAT28-131	150.0	lb/a	23.8 b	91.3 a	74.5 a
9	DPX-MAT28-131	200.0	lb/a	23.8 b	92.5 a	73.8 a
10	MOMENTUM FORCE	156.8	lb/a	21.3 b	90.8 a	60.3 a
11	UNTREATED CHECK			0.0 c	0.0 c	0.0 b
12	TRIMEC-CLASSIC	4.0	pt/a	62.5 a	62.5 b	82.5 a
	LSD (P=.05)			11.55	14.05	25.44
	Standard Deviation			8.00	9.73	17.62
	CV			27.53	11.9	25.66
	Bartlett's X2			11.466	16.199	5.579
	P(Bartlett's X2)			0.245	0.094	0.849
	Replicate F			0.225	1.381	26.300
	Replicate Prob(F)			0.8783	0.2656	0.0001
	Treatment F			12.958	31.537	6.553
	Treatment Prob(F)			0.0001	0.0001	0.0001

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Rating Unit
Percent = percent

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

UNIVERSITY OF MASSACHUSETTS-AMHERST

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit			
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				Jun-21-10	Jun-28-10	Jul-29-10
Rating Type				CONTROL	CONTROL	CONTROL
Rating Unit				Percent	Percent	%
Number of Subsamples				1	1	1
Days After First/Last Applic.				24 24	31 31	62 62
Trt-Eval Interval				17 DA-A	31 DA-A	62 DA-A
1	IMPRELIS - 112	3.0	fl oz/a	100.0 a	100.0 a	100.0 a
2	IMPRELIS - 112	4.5	fl oz/a	96.3 a	96.3 a	96.3 a
3	IMPRELIS - 112	6.0	fl oz/a	88.8 a	88.8 a	88.8 a
4	TRIMEC BENT	4.0	pt/a	98.3 a	98.3 a	98.3 a
5	ESCALADE 2	3.0	pt/a	99.0 a	99.0 a	99.0 a
6	DPX-MAT28-138	150.0	lb/a	100.0 a	100.0 a	100.0 a
7	DPX-MAT28-138	200.0	lb/a	98.8 a	98.8 a	98.8 a
8	DPX-MAT28-131	150.0	lb/a	100.0 a	100.0 a	100.0 a
9	DPX-MAT28-131	200.0	lb/a	95.0 a	95.0 a	95.0 a
10	MOMENTUM FORCE	156.8	lb/a	99.5 a	99.5 a	99.5 a
11	UNTREATED CHECK			0.0 b	0.0 b	0.0 b
12	TRIMEC-CLASSIC	4.0	pt/a	95.8 a	95.8 a	95.8 a
LSD (P=.05)				8.11	8.11	8.11
Standard Deviation				5.62	5.62	5.62
CV				6.29	6.29	6.29
Bartlett's X2				29.256	29.256	29.256
P(Bartlett's X2)				0.001*	0.001*	0.001*
Replicate F				1.546	1.546	1.546
Replicate Prob(F)				0.2211	0.2211	0.2211
Treatment F				101.582	101.582	101.582
Treatment Prob(F)				0.0001	0.0001	0.0001

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Rating Unit
Percent = percent
% = percent

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

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	3	6	9
	Pest Type			W Weed	W Weed	W Weed
	Pest Code			CERVU	CERVU	CERVU
	Pest Scientific Name			Cerastium font>	Cerastium font>	Cerastium font>
	Pest Name			Mouse-ear chic>	Mouse-ear chic>	Mouse-ear chic>
	Rating Date			Jun-7-10	Jun-14-10	Jun-21-10
	Rating Type			CONTROL	CONTROL	CONTROL
	Rating Unit			Percent	Percent	Percent
	Number of Subsamples			1	1	1
	Days After First/Last Applic.			10 10	17 17	24 24
	Trt-Eval Interval			8 DA-A	10 DA-A	17 DA-A
1	IMPRELIS - 112	3.0	fl oz/a	92.0 a	97.0 a	100.0 a
2	IMPRELIS - 112	4.5	fl oz/a	97.0 a	98.3 a	96.3 a
3	IMPRELIS - 112	6.0	fl oz/a	97.8 a	97.0 a	93.8 a
4	TRIMEC BENT	4.0	pt/a	87.5 a	90.0 a	99.0 a
5	ESCALADE 2	3.0	pt/a	90.3 a	89.5 a	99.5 a
6	DPX-MAT28-138	150.0	lb/a	95.8 a	95.8 a	100.0 a
7	DPX-MAT28-138	200.0	lb/a	94.0 a	96.5 a	99.5 a
8	DPX-MAT28-131	150.0	lb/a	93.3 a	97.8 a	100.0 a
9	DPX-MAT28-131	200.0	lb/a	93.3 a	97.8 a	97.5 a
10	MOMENTUM FORCE	156.8	lb/a	90.8 a	80.8 a	99.5 a
11	UNTREATED CHECK			0.0 c	0.0 b	0.0 b
12	TRIMEC-CLASSIC	4.0	pt/a	70.0 b	81.3 a	95.8 a
	LSD (P=.05)			12.32	16.01	5.71
	Standard Deviation			8.53	11.09	3.95
	CV			10.22	13.03	4.39
	Bartlett's X2			13.508	59.174	29.469
	P(Bartlett's X2)			0.197	0.001*	0.001*
	Replicate F			1.170	0.311	1.420
	Replicate Prob(F)			0.3361	0.8172	0.2545
	Treatment F			40.848	24.660	206.966
	Treatment Prob(F)			0.0001	0.0001	0.0001

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
CERVU, Cerastium fontanum vulgare, = US
Rating Unit
Percent = percent

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

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	13	17
	Pest Type			W Weed	W Weed
	Pest Code			CERVU	CERVU
	Pest Scientific Name			Cerastium font>	Cerastium font>
	Pest Name			Mouse-ear chic>	Mouse-ear chic>
	Rating Date			Jun-28-10	Jul-29-10
	Rating Type			CONTROL	CONTROL
	Rating Unit			Percent	%
	Number of Subsamples			1	1
	Days After First/Last Applic.			31 31	62 62
	Trt-Eval Interval			31 DA-A	62 DA-A
1	IMPRELIS - 112	3.0	fl oz/a	100.0 a	100.0 a
2	IMPRELIS - 112	4.5	fl oz/a	96.3 a	96.3 a
3	IMPRELIS - 112	6.0	fl oz/a	93.8 a	93.8 a
4	TRIMEC BENT	4.0	pt/a	99.0 a	99.0 a
5	ESCALADE 2	3.0	pt/a	99.5 a	99.5 a
6	DPX-MAT28-138	150.0	lb/a	100.0 a	100.0 a
7	DPX-MAT28-138	200.0	lb/a	99.5 a	99.5 a
8	DPX-MAT28-131	150.0	lb/a	100.0 a	100.0 a
9	DPX-MAT28-131	200.0	lb/a	97.5 a	97.5 a
10	MOMENTUM FORCE	156.8	lb/a	99.5 a	99.5 a
11	UNTREATED CHECK			0.0 b	0.0 b
12	TRIMEC-CLASSIC	4.0	pt/a	95.8 a	95.8 a
	LSD (P=.05)			5.71	5.71
	Standard Deviation			3.95	3.95
	CV			4.39	4.39
	Bartlett's X2			29.469	29.469
	P(Bartlett's X2)			0.001*	0.001*
	Replicate F			1.420	1.420
	Replicate Prob(F)			0.2545	0.2545
	Treatment F			206.966	206.966
	Treatment Prob(F)			0.0001	0.0001

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
CERVU, Cerastium fontanum vulgare, = US
Rating Unit
Percent = percent
% = percent

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

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	W Weed TAROF Taraxacum offi> Common dandeli> Jun-7-10 CONTROL % 1 10 10 10 DA-A	W Weed TAROF Taraxacum offi> Common dandeli> Jun-14-10 CONTROL % 1 17 17 10 DA-A	W Weed TAROF Taraxacum offi> Common dandeli> Jun-21-10 CONTROL % 1 24 24 17 DA-A
	Pest Type			W Weed	W Weed	W Weed
	Pest Code			TAROF	TAROF	TAROF
	Pest Scientific Name			Taraxacum offi>	Taraxacum offi>	Taraxacum offi>
	Pest Name			Common dandeli>	Common dandeli>	Common dandeli>
	Rating Date			Jun-7-10	Jun-14-10	Jun-21-10
	Rating Type			CONTROL	CONTROL	CONTROL
	Rating Unit			%	%	%
	Number of Subsamples			1	1	1
	Days After First/Last Applic.			10 10	17 17	24 24
	Trt-Eval Interval			10 DA-A	10 DA-A	17 DA-A
1	IMPRELIS - 112	3.0	fl oz/a	90.0 a	95.3 a	100.0 a
2	IMPRELIS - 112	4.5	fl oz/a	95.3 a	94.5 a	97.5 a
3	IMPRELIS - 112	6.0	fl oz/a	91.5 a	95.8 a	92.5 a
4	TRIMEC BENT	4.0	pt/a	80.0 a	80.0 a	98.3 a
5	ESCALADE 2	3.0	pt/a	89.5 a	89.5 a	98.3 a
6	DPX-MAT28-138	150.0	lb/a	92.0 a	91.5 a	100.0 a
7	DPX-MAT28-138	200.0	lb/a	85.8 a	88.3 a	98.8 a
8	DPX-MAT28-131	150.0	lb/a	78.8 a	80.8 a	100.0 a
9	DPX-MAT28-131	200.0	lb/a	87.0 a	94.5 a	95.0 a
10	MOMENTUM FORCE	156.8	lb/a	85.8 a	85.3 a	98.8 a
11	UNTREATED CHECK			0.0 c	0.0 c	0.0 b
12	TRIMEC-CLASSIC	4.0	pt/a	50.7 b	57.5 b	90.8 a
	LSD (P=.05)			18.31	18.17	8.81
	Standard Deviation			12.68	12.59	6.10
	CV			16.43	15.85	6.84
	Bartlett's X2			12.059	28.063	21.443
	P(Bartlett's X2)			0.281	0.002*	0.003*
	Replicate F			2.711	1.643	1.608
	Replicate Prob(F)			0.0614	0.1984	0.2062
	Treatment F			18.046	18.642	85.673
	Treatment Prob(F)			0.0001	0.0001	0.0001

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
TAROF, Taraxacum officinale, = US
Rating Unit
% = percent

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

BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	W Weed TAROF Taraxacum offi> Common dandeli> Jun-28-10 CONTROL % 1 31 31 31 DA-A 14	W Weed TAROF Taraxacum offi> Common dandeli> Jul-29-10 CONTROL % 1 62 62 62 DA-A 18
1	IMPRELIS - 112	3.0	fl oz/a	100.0 a	100.0 a
2	IMPRELIS - 112	4.5	fl oz/a	97.5 a	97.5 a
3	IMPRELIS - 112	6.0	fl oz/a	92.5 a	92.5 a
4	TRIMEC BENT	4.0	pt/a	98.3 a	98.3 a
5	ESCALADE 2	3.0	pt/a	98.3 a	98.3 a
6	DPX-MAT28-138	150.0	lb/a	100.0 a	100.0 a
7	DPX-MAT28-138	200.0	lb/a	98.8 a	98.8 a
8	DPX-MAT28-131	150.0	lb/a	100.0 a	100.0 a
9	DPX-MAT28-131	200.0	lb/a	95.0 a	95.0 a
10	MOMENTUM FORCE	156.8	lb/a	98.8 a	98.8 a
11	UNTREATED CHECK			0.0 b	0.0 b
12	TRIMEC-CLASSIC	4.0	pt/a	92.0 a	90.8 a
LSD (P=.05)				8.59	8.81
Standard Deviation				5.95	6.10
CV				6.66	6.84
Bartlett's X2				21.021	21.443
P(Bartlett's X2)				0.004*	0.003*
Replicate F				1.435	1.608
Replicate Prob(F)				0.2503	0.2062
Treatment F				90.234	85.673
Treatment Prob(F)				0.0001	0.0001

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
TAROF, Taraxacum officinale, = US
Rating Unit
% = percent

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

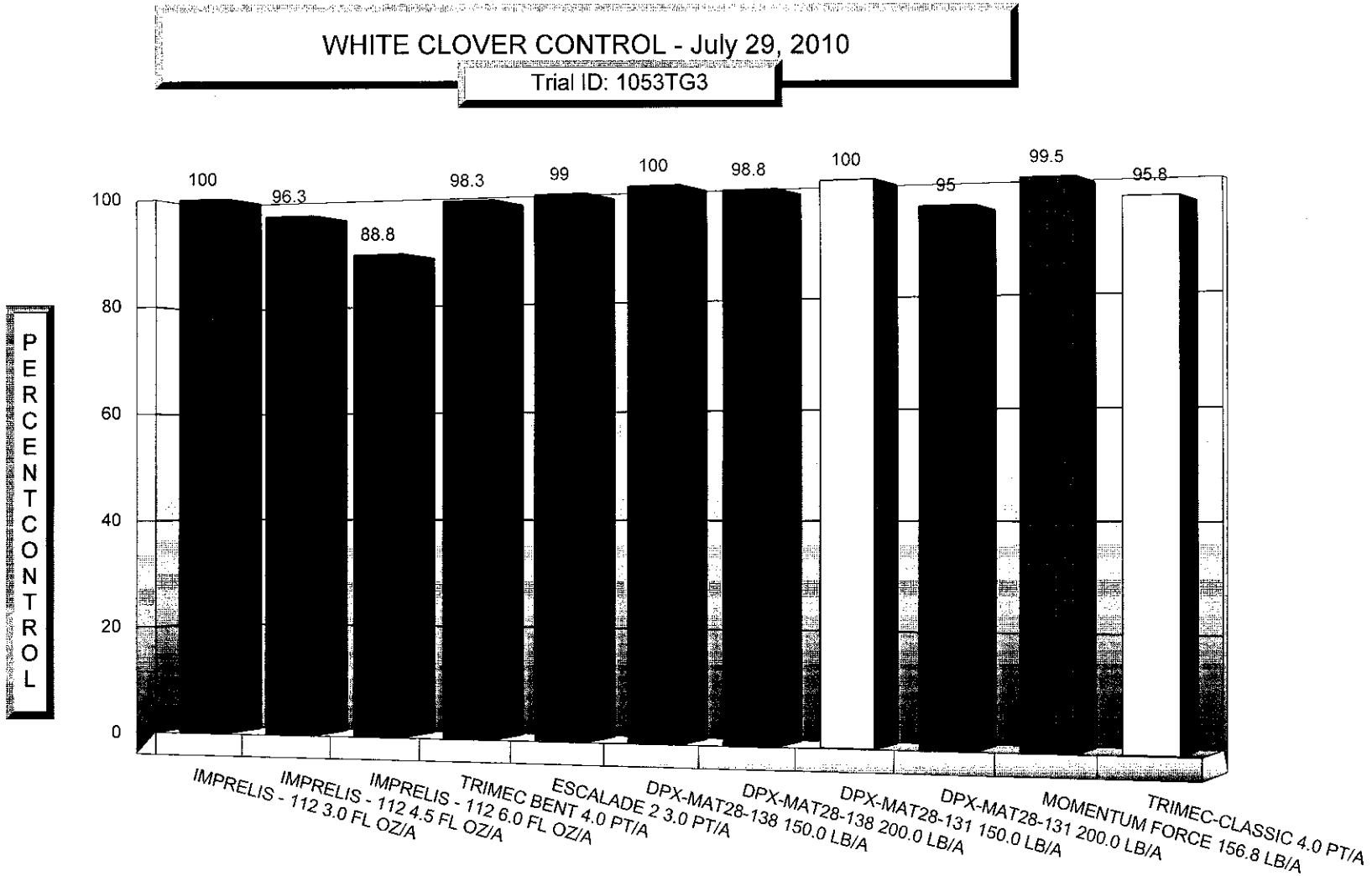
BROADLEAF WEED CONTROL IN COOL-SEASON TURFGRASS

Trial ID: 1053TG3 Protocol ID: 1053TG3
Location: TRC-SDF Study Director: Prof. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	11	15	19
Pest Type				W Weed	W Weed	W Weed
Pest Code				OXAST	DIGSA	DIGSA
Pest Scientific Name				Oxalis stricta	Digitaria sang>	Digitaria sang>
Pest Name				Common yellow >	Large crabgrass	Large crabgrass
Rating Date				Jun-21-10	Jun-28-10	Jul-29-10
Rating Type				CONTROL	CONTROL	CONTROL
Rating Unit				%	%	%
Number of Subsamples				1	1	1
Days After First/Last Applic.				24 24	31 31	62 62
Trt-Eval Interval				24 DA-A	31 DA-A	62 DA-A
1	IMPRELIS - 112	3.0	fl oz/a	100.0 a	97.0 a	97.0 a
2	IMPRELIS - 112	4.5	fl oz/a	96.3 a	95.0 a	95.0 a
3	IMPRELIS - 112	6.0	fl oz/a	72.5 a	99.5 a	99.5 a
4	TRIMEC BENT	4.0	pt/a	75.0 a	40.0 b	40.0 b
5	ESCALADE 2	3.0	pt/a	100.0 a	90.8 a	90.8 a
6	DPX-MAT28-138	150.0	lb/a	97.5 a	97.3 a	97.3 a
7	DPX-MAT28-138	200.0	lb/a	91.3 a	96.3 a	96.3 a
8	DPX-MAT28-131	150.0	lb/a	99.5 a	99.5 a	99.5 a
9	DPX-MAT28-131	200.0	lb/a	95.0 a	99.5 a	99.5 a
10	MOMENTUM FORCE	156.8	lb/a	72.5 a	89.5 a	89.5 a
11	UNTREATED CHECK			0.0 b	0.0 c	0.0 c
12	TRIMEC-CLASSIC	4.0	pt/a	24.5 b	10.0 c	7.5 c
LSD (P=.05)				37.19	20.55	20.74
Standard Deviation				25.76	14.23	14.36
CV				33.45	18.68	18.91
Bartlett's X2				47.874	83.219	81.515
P(Bartlett's X2)				0.001*	0.001*	0.001*
Replicate F				3.756	1.102	1.079
Replicate Prob(F)				0.0200	0.3622	0.3716
Treatment F				6.365	27.200	27.287
Treatment Prob(F)				0.0001	0.0001	0.0001

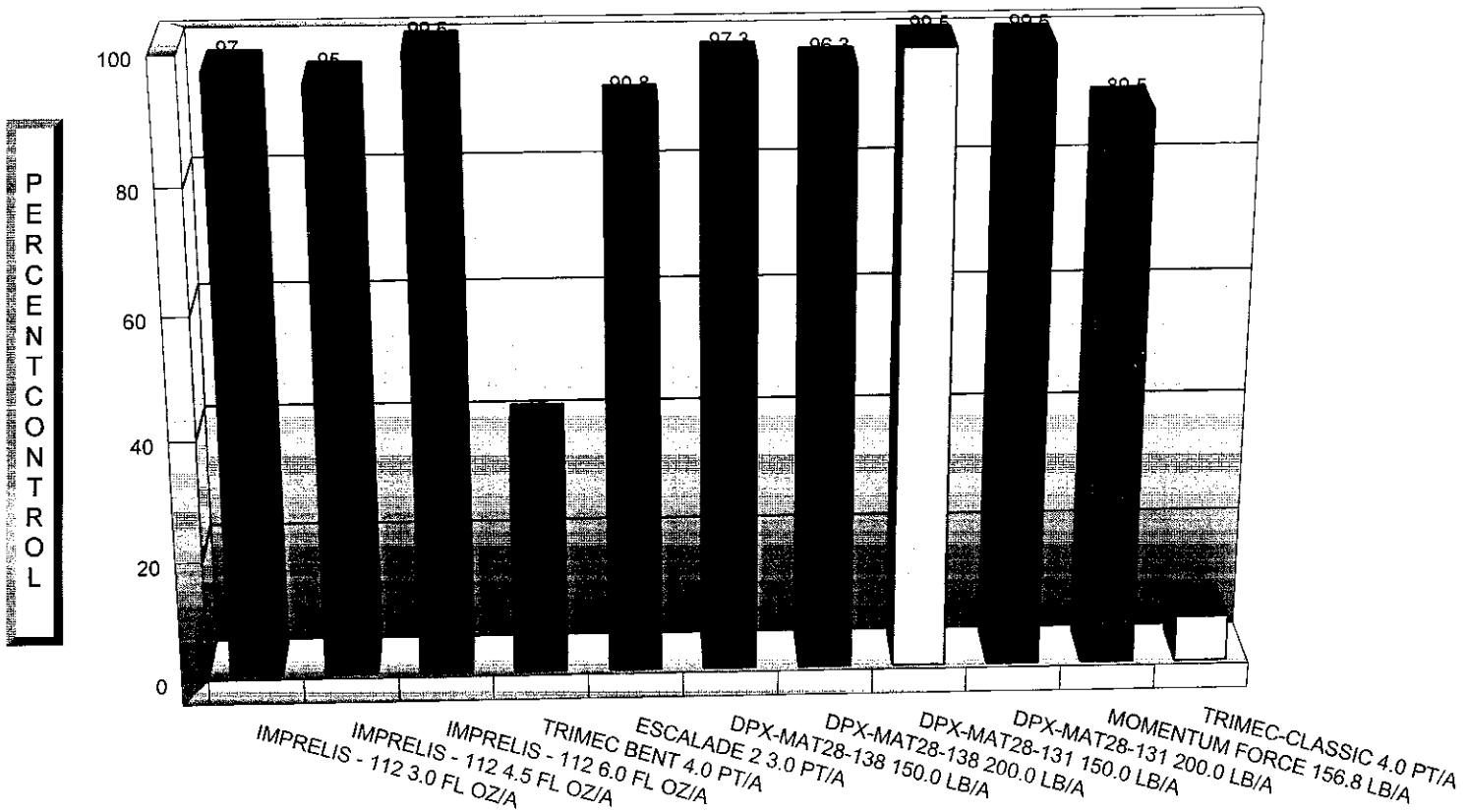
Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
OXAST, Oxalis stricta, = US
DIGSA, Digitaria sanguinalis, = US
Rating Unit
% = percent

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.


WHITE CLOVER CONTROL - July 29, 2010
Trial ID: 1053TG3
PERCENTCONTROL
100
80
60
40
20
0
100
96.3
88.8
98.3
99
100
98.8
100
95
99.5
95.8
IMPRELIS - 112 3.0 FL OZ/A
IMPRELIS - 112 4.5 FL OZ/A
IMPRELIS - 112 6.0 FL OZ/A
TRIMEC BENT 4.0 PT/A
ESCALADE 2 3.0 PT/A
DPX-MAT28-138 150.0 LB/A
DPX-MAT28-138 200.0 LB/A
DPX-MAT28-131 150.0 LB/A
DPX-MAT28-131 200.0 LB/A
MOMENTUM FORCE 156.8 LB/A
TRIMEC-CLASSIC 4.0 PT/A

COMMON DANDELION CONTROL - JULY 29, 2010

Trial ID: 1053TG3



UNIVERSITY OF MASSACHUSETTS-AMHERST

POSTEMERGENCE CONTROL OF POA ANNUA - COOL-SEASON TURFGRASS

Trial ID: 1055TG5M Protocol ID: 1055TG5M
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

Crop Description

Crop 1: AGSST Agrostis stolonifera Creeping bentgrass
BBCH Scale: BGRM

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:** RACOBL Randomized Complete Block (RCB)

Trial Initiation Comments:
Trial site consisted of natural population of Poa annua. All treatments were applied with a non-ionic surfactant (NIS) at 0.25% (v/v).

Application Description

	A	B
Application Date:	May-17-10	
Time of Day:	11:: AM	
Application Method:	SPRAY	
Application Timing:	POSPOS	
Air Temperature, Unit:	80.4 F	
Wind Velocity, Unit:	5 MPH	
Soil Temperature, Unit:	60.8 F	
% Cloud Cover:	0	0

Crop Stage At Each Application

	A	B
Crop 1 Code, BBCH Scale:	AGSST BGRM	AGSST BGRM

Pest Stage At Each Application

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

UNIVERSITY OF MASSACHUSETTS-AMHERST

POSTEMERGENCE CONTROL OF POA ANNUA - COOL-SEASON TURFGRASS

Trial ID: 1055TG5M Protocol ID: 1055TG5M
Location: TRC-SDF Study Director:
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

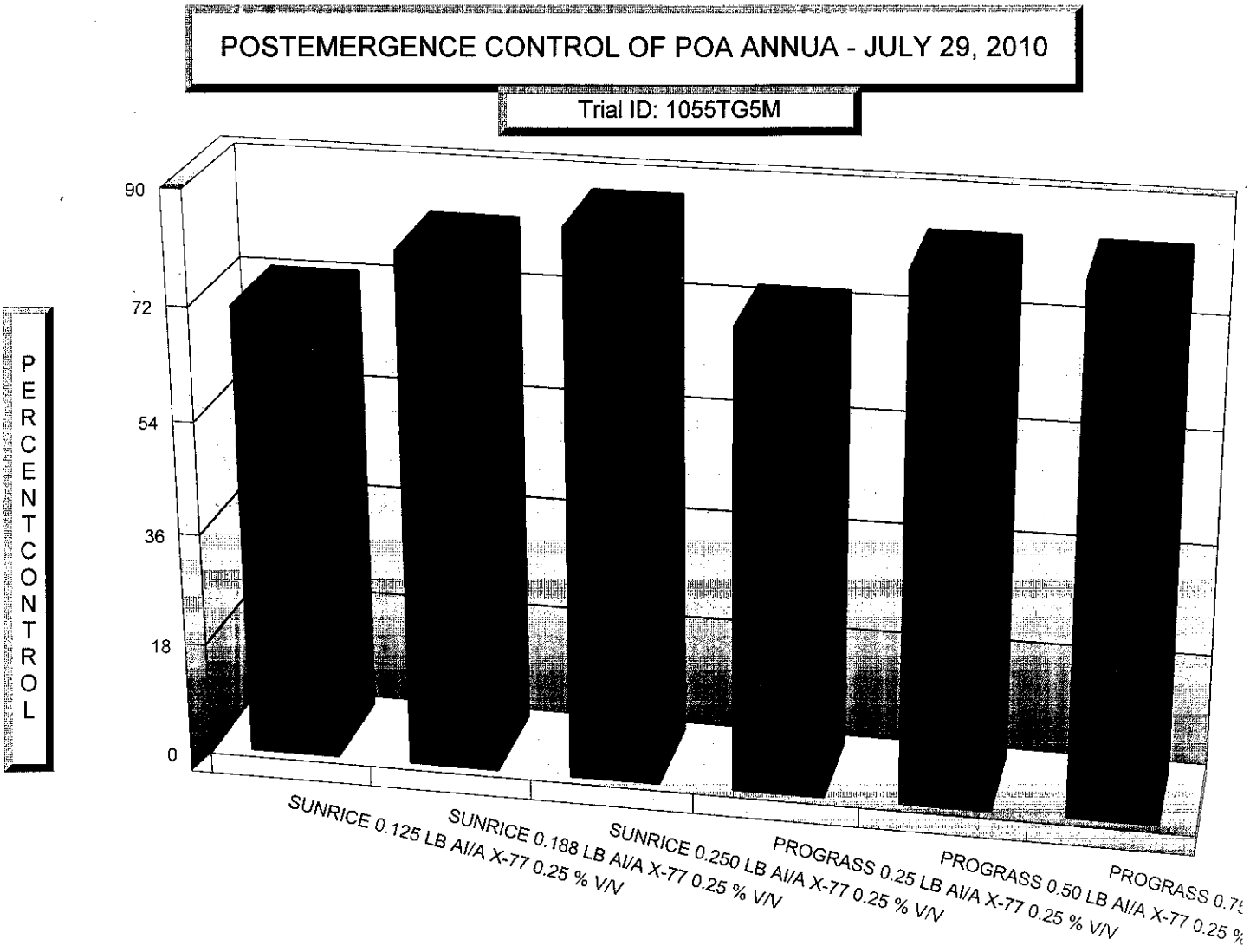
POST EMERGENCE CONTROL OF POA ANNUA - COOL-SEASON TURFGRASS

Trial ID: 1055TG5 Protocol ID: 1055TG5
Location: TRC-SDF Study Director:
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	1	2	3	4
Pest Type				W Weed	W Weed	W Weed	W Weed
Pest Code				POAAN	POAAN	POAAN	POAAN
Pest Scientific Name				Poa annua	Poa annua	Poa annua	Poa annua
Pest Name				Annual bluegra>	Annual bluegra>	Annual bluegra>	Annual bluegra>
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-26-10	Jun-17-10	Jul-8-10	Jul-29-10
Rating Type				CONTROL	CONTROL	CONTROL	CONTROL
Rating Unit				Percent	Percent	Percent	Percent
Number of Subsamples				1	1	1	1
Days After First/Last Applic.				9 9	31 31	52 52	73 73
Trt-Eval Interval				9 DA-A	31 DA-A	52 DA-A	73 DA-A
1	SUNRICE	0.125	lb ai/a	38.3 a	46.7 a	75.0 a	71.7 e
	X-77	0.25	% v/v				
2	SUNRICE	0.188	lb ai/a	41.7 a	56.7 a	73.3 a	81.7 a-e
	X-77	0.25	% v/v				
3	SUNRICE	0.250	lb ai/a	40.0 a	68.3 a	75.0 a	86.7 ab
	X-77	0.25	% v/v				
4	PROGRASS	0.25	lb ai/a	38.3 a	58.3 a	73.3 a	73.3 de
	X-77	0.25	% v/v				
5	PROGRASS	0.50	lb ai/a	45.0 a	50.0 a	78.3 a	83.3 a-d
	X-77	0.25	% v/v				
6	PROGRASS	0.75	lb ai/a	46.7 a	55.0 a	76.7 a	83.3 a-d
	X-77	0.25	% v/v				
7	ECHELON	0.375	lb ai/a	43.3 a	51.7 a	70.0 a	76.7 b-e
8	ECHELON	0.75	lb ai/a	46.7 a	63.3 a	71.7 a	85.0 abc
9	ECHELON	1.00	lb ai/a	41.7 a	53.3 a	78.3 a	88.3 a
10	PROSHOT	1.45	pt/a	40.0 a	50.0 a	78.3 a	75.0 cde
11	PROSHOT	1.45	pt/a	38.3 a	43.3 a	80.0 a	76.7 b-e
	PROSHOT	1.45	pt/a				
12	PROSHOT	2.90	pt/a	46.7 a	53.3 a	78.3 a	86.7 ab
13	UNTREATED			0.0 b	0.0 b	0.0 b	0.0 f
LSD (P=.05)				19.26	14.31	9.62	6.85
Standard Deviation				11.43	8.49	5.71	4.06
CV				29.32	16.98	8.17	5.45
Bartlett's X2				4.888	6.315	5.211	5.687
P(Bartlett's X2)				0.936	0.852	0.877	0.893
Replicate F				12.511	37.227	0.020	0.621
Replicate Prob(F)				0.0002	0.0001	0.9805	0.5456
Treatment F				3.389	11.209	41.407	96.544
Treatment Prob(F)				0.0053	0.0001	0.0001	0.0001

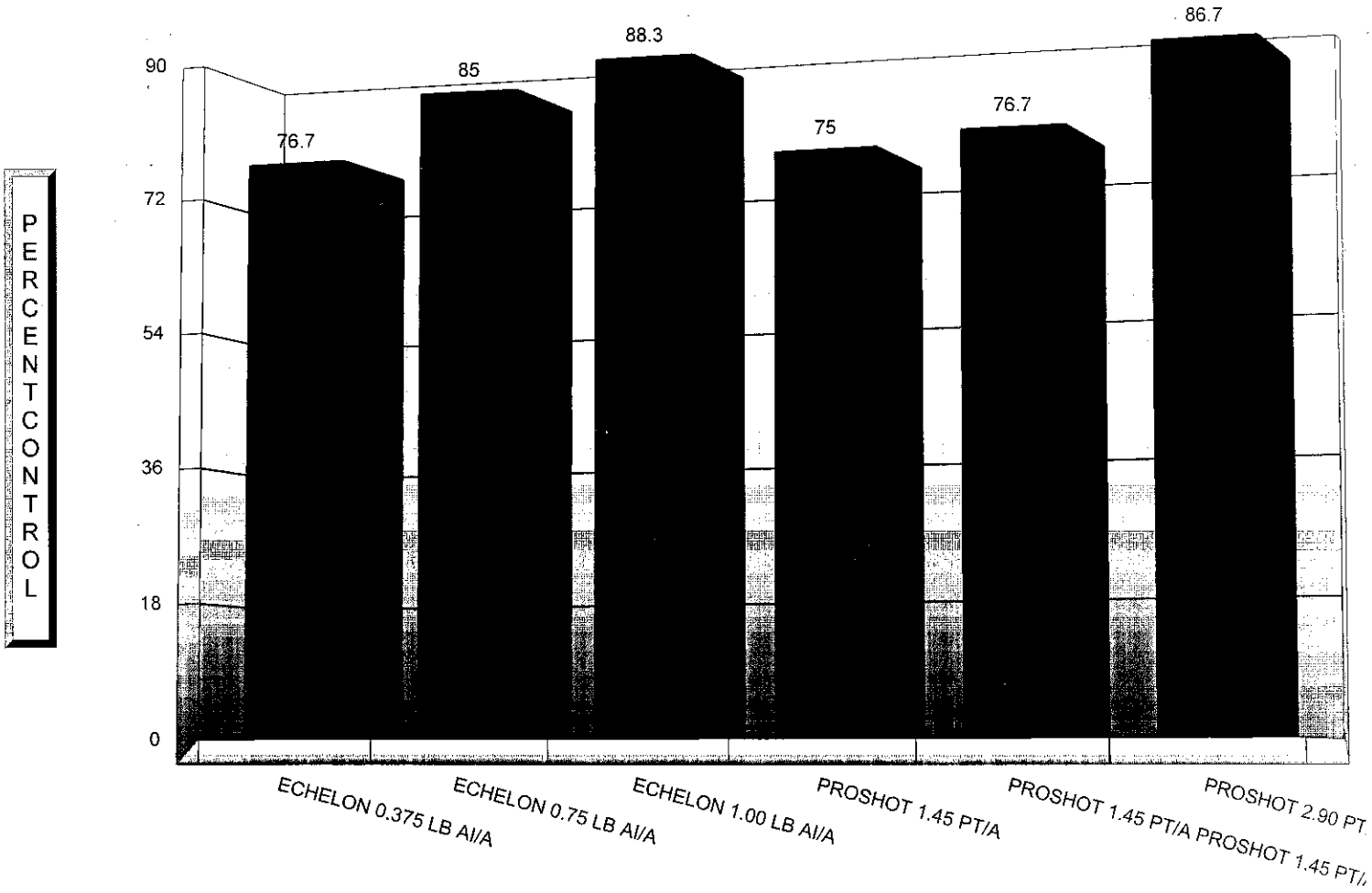
Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop

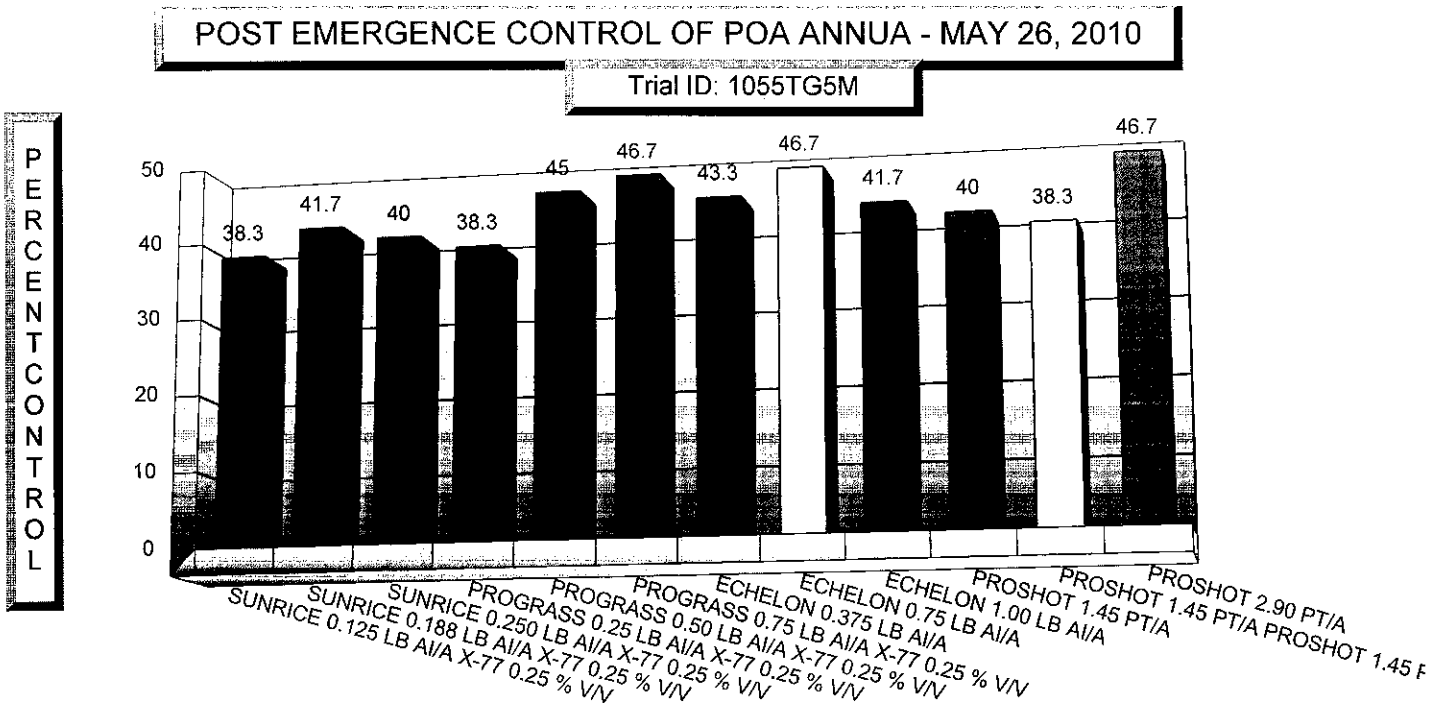
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.


POSTEMERGENCE CONTROL OF POA ANNUA - JULY 29, 2010
Trial ID: 1055TG5M
PERCENTCONTROL
90
72
54
36
18
0
SUNRICE 0.125 LB AI/A X-77 0.25 % V/V
SUNRICE 0.188 LB AI/A X-77 0.25 % V/V
SUNRICE 0.250 LB AI/A X-77 0.25 % V/V
PROGRASS 0.25 LB AI/A X-77 0.25 % V/V
PROGRASS 0.50 LB AI/A X-77 0.25 %

POST EMERGENCE CONTROL OF POA ANNUA - JULY 29, 2010

Trial ID: 1055TG5M




POST EMERGENCE CONTROL OF POA ANNUA - MAY 26, 2010
Trial ID: 1055TG5M
PERCENTCONTROL
50
40
30
20
10
0
38.3
41.7
40
38.3
45
46.7
43.3
46.7
41.7
40
38.3
46.7
SUNRICE 0.125 LB AI/A X-77 0.25 % V/V
SUNRICE 0.188 LB AI/A X-77 0.25 % V/V
SUNRICE 0.250 LB AI/A X-77 0.25 % V/V
PROGRASS 0.25 LB AI/A X-77 0.25 % V/V
PROGRASS 0.50 LB AI/A X-77 0.25 % V/V
PROGRASS 0.75 LB AI/A X-77 0.25 % V/V
ECHELON 0.375 LB AI/A
ECHELON 0.75 LB AI/A
ECHELON 1.00 LB AI/A
PROSHOT 1.45 PT/A
PROSHOT 1.45 PT/A PROSHOT 1.45 F
PROSHOT 2.90 PT/A

UNIVERSITY OF MASSACHUSETTS-AMHERST

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

Trial ID: 1059-TG9 Protocol ID: 1059-TG9
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, M. Barton and A. Kufel

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, M. Barton and A. Kufel
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 rough areas

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 rough
A non-ionic surfactant (NIS) at 0.25% (v/v) was added to each of the treatments.

Application Description

	A
Application Date:	Jun-2-10
Time of Day:	10:0 AM
Application Method:	SPRAY
Application Timing:	POSPOS
Air Temperature, Unit:	84.3 F
% Relative Humidity:	27.6
Wind Velocity, Unit:	0 MPH
Soil Temperature, Unit:	89.6 F
% Cloud Cover:	0

UNIVERSITY OF MASSACHUSETTS-AMHERST

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

Trial ID: 1059-TG9
Location: Greenwich, CT
Project ID:
Protocol ID: 1059-TG9
Study Director: Prof. P. C. Bhowmik
Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Pest Stage At Each Application

	A
Pest 1 Code, Type, Scale:	KYLGR W

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: 1059-TG9 Protocol ID: 1059-TG9
Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	1	2	3	4
	Pest Type			W Weed	W Weed	W Weed	W Weed
	Pest Code			KYLGR	AGSPL	KYLGR	AGSPL
	Pest Scientific Name			Kyllinga graci>	Agrostis palus>	Kyllinga graci>	Agrostis palus>
	Pest Name			Pasture spikes>	Bent grass	Pasture spikes>	Bent grass
	Rating Date			Jun-9-10	Jun-9-10	Jun-18-10	Jun-18-10
	Rating Type			CONTROL	PHYDIS	CONTROL	PHYDIS
	Rating Unit					%	%
	Number of Subsamples			1	1	1	1
	Days After First/Last Applic.			7 7	7 7	16 16	16 16
	Trt-Eval Interval			7 DA-A	7 DA-A	12 DA-A	12 DA-A
1	CERTAINTY	0.5	oz wt/a	10.0 d	0.0 c	71.7 a	13.3 a
2	CERTAINTY	1.0	oz wt/a	15.0 bc	3.3 c	85.0 a	10.0 a
3	CERTAINTY	1.5	oz wt/a	20.0 a	0.0 c	83.3 a	25.0 a
4	SEDGEHAMMER	0.031	lb ai/a	15.0 bc	0.0 c	78.3 a	0.0 a
5	SEDGEHAMMER	0.0625	lb ai/a	20.0 a	0.0 c	80.0 a	0.0 a
6	SEDGEHAMMER	0.125	lb ai/a	18.3 ab	0.0 c	75.0 a	6.7 a
7	SUNRICE	0.125	lb ai/a	16.7 ab	0.0 c	76.7 a	8.3 a
8	SUNRICE	0.250	lb ai/a	18.3 ab	0.0 c	73.3 a	3.3 a
9	SUNRICE	0.375	lb ai/a	20.0 a	0.0 c	71.7 a	6.7 a
10	TENACITY	2.5	fl oz/a	10.0 d	61.7 ab	75.0 a	20.0 a
11	TENACITY	5.0	fl oz/a	11.7 cd	53.3 b	68.3 a	20.0 a
12	TENACITY	7.5	fl oz/a	11.7 cd	73.3 a	80.0 a	35.0 a
13	UNTREATED			0.0 e	0.0 c	0.0 b	0.0 a
	LSD (P=.05)			3.12	14.39	14.37	23.40
	Standard Deviation			1.85	8.54	8.53	13.89
	CV			12.88	57.92	12.07	121.7
	Bartlett's X2			0.0	4.698	14.188	9.193
	P(Bartlett's X2)			.	0.195	0.165	0.42
	Replicate F			0.188	2.171	3.233	1.958
	Replicate Prob(F)			0.8302	0.1359	0.0571	0.1631
	Treatment F			28.656	31.578	19.520	1.821
	Treatment Prob(F)			0.0001	0.0001	0.0001	0.1022

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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 VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 1059-TG9 Protocol ID: 1059-TG9
Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	5	6	7	8
	Pest Type			W Weed	W Weed	W Weed	W Weed
	Pest Code			KYLGR	AGSPL	KYLGR	AGSPL
	Pest Scientific Name			Kyllinga graci>	Agrostis palus>	Kyllinga graci>	Agrostis palus>
	Pest Name			Pasture spikes>	Bent grass	Pasture spikes>	Bent grass
	Rating Date			Jun-29-10	Jun-29-10	Jul-7-10	Jul-7-10
	Rating Type			CONTROL	PHYDIS	CONTROL	PHYDIS
	Rating Unit			%	%	%	%
	Number of Subsamples			1	1	1	1
	Days After First/Last Applic.			27 27	27 27	35 35	35 35
	Trt-Eval Interval			29 DA-A	29 DA-A	36 DA-A	48 DA-A
1	CERTAINTY	0.5	oz wt/a	85.0 a	10.0 a	98.0 a	28.3 a
2	CERTAINTY	1.0	oz wt/a	87.7 a	3.3 a	95.3 a	6.7 a
3	CERTAINTY	1.5	oz wt/a	89.3 a	8.3 a	96.0 a	11.7 a
4	SEDGEHAMMER	0.031	lb ai/a	81.7 a	0.0 a	96.0 a	0.0 a
5	SEDGEHAMMER	0.0625	lb ai/a	85.0 a	0.0 a	97.0 a	0.0 a
6	SEDGEHAMMER	0.125	lb ai/a	83.3 a	8.3 a	96.0 a	5.0 a
7	SUNRICE	0.125	lb ai/a	89.3 a	6.7 a	97.0 a	13.3 a
8	SUNRICE	0.250	lb ai/a	87.7 a	5.0 a	98.0 a	11.7 a
9	SUNRICE	0.375	lb ai/a	85.0 a	10.0 a	96.0 a	6.7 a
10	TENACITY	2.5	fl oz/a	88.3 a	6.7 a	90.0 a	10.0 a
11	TENACITY	5.0	fl oz/a	80.0 a	3.3 a	78.3 a	6.7 a
12	TENACITY	7.5	fl oz/a	86.0 a	15.0 a	78.3 a	15.0 a
13	UNTREATED			0.0 b	3.3 a	0.0 b	0.0 a
	LSD (P=.05)			10.15	13.55	12.11	21.73
	Standard Deviation			6.02	8.04	7.19	12.89
	CV			7.61	130.65	8.37	145.75
	Bartlett's X2			3.234	6.315	31.034	7.832
	P(Bartlett's X2)			0.987	0.788	0.001*	0.551
	Replicate F			18.161	9.402	2.155	6.698
	Replicate Prob(F)			0.0001	0.0010	0.1378	0.0049
	Treatment F			47.418	0.846	41.374	1.081
	Treatment Prob(F)			0.0001	0.6063	0.0001	0.4168

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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 VARIOUS RATES OF SEVERAL PRODUCTS IN CONTROLLING FALSE GREEN KYLLINGA

Trial ID: 1059-TG9 Protocol ID: 1059-TG9
Location: Greenwich, CT Study Director: Prof. P. C. Bhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

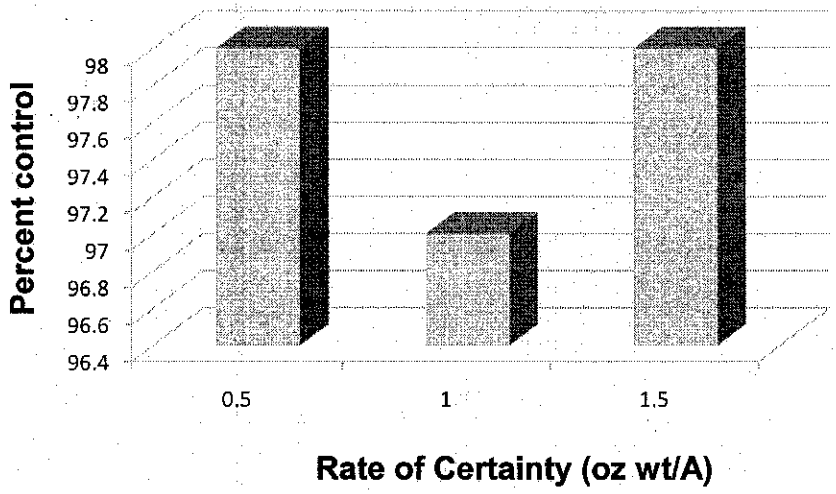
Trt No.	Treatment Name	Rate	Rate Unit	W Weed KYLGR Kyllinga graci> Pasture spikes>	W Weed AGSPL Agrostis palus> Bent grass
	Pest Type			W Weed	W Weed
	Pest Code			KYLGR	AGSPL
	Pest Scientific Name			Kyllinga graci>	Agrostis palus>
	Pest Name			Pasture spikes>	Bent grass
	Rating Date			Jul-21-10	Jul-21-10
	Rating Type			CONTROL	PHYDIS
	Rating Unit			%	%
	Number of Subsamples			1	1
	Days After First/Last Applic.			49 49	49 49
	Trt-Eval Interval			48 DA-A	48 DA-A
1	CERTAINTY	0.5	oz wt/a	98.0 a	1.7 a
2	CERTAINTY	1.0	oz wt/a	97.0 a	0.0 a
3	CERTAINTY	1.5	oz wt/a	98.7 a	0.0 a
4	SEDGEHAMMER	0.031	lb ai/a	97.7 a	0.0 a
5	SEDGEHAMMER	0.0625	lb ai/a	100.0 a	0.0 a
6	SEDGEHAMMER	0.125	lb ai/a	98.0 a	0.0 a
7	SUNRICE	0.125	lb ai/a	97.7 a	0.0 a
8	SUNRICE	0.250	lb ai/a	98.7 a	0.0 a
9	SUNRICE	0.375	lb ai/a	98.7 a	0.0 a
10	TENACITY	2.5	fl oz/a	88.3 a	0.0 a
11	TENACITY	5.0	fl oz/a	69.3 a	0.0 a
12	TENACITY	7.5	fl oz/a	66.7 a	0.0 a
13	UNTREATED			0.0 b	0.0 a
	LSD (P=.05)			24.88	1.35
	Standard Deviation			14.77	0.80
	CV			17.31	624.5
	Bartlett's X2			48.575	0.0
	P(Bartlett's X2)			0.001*	.
	Replicate F			2.575	1.000
	Replicate Prob(F)			0.0971	0.3827
	Treatment F			10.784	1.000
	Treatment Prob(F)			0.0001	0.4777

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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.

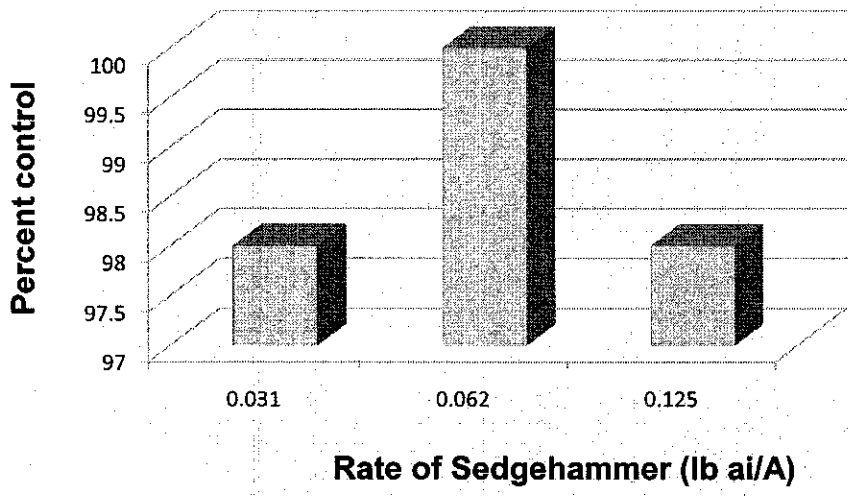
Percent Control of False Green Kyllinga (48 DAA)

Burning Tree Country Club, Greenwich, CT - 2010



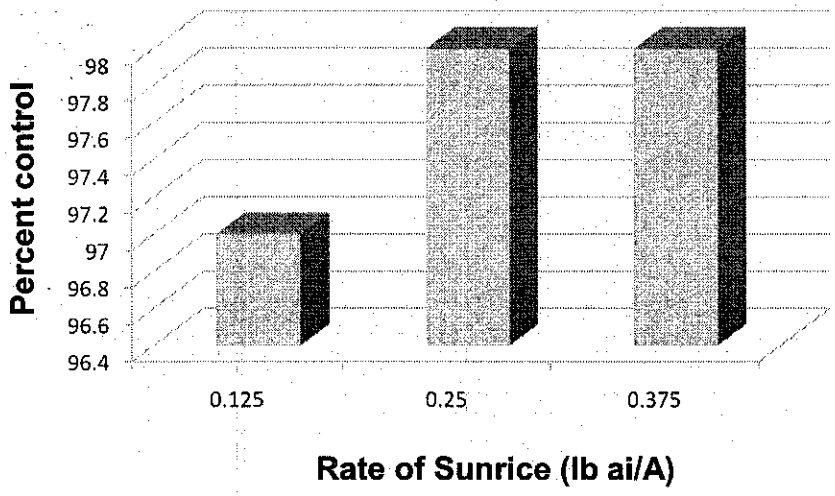
Percent Control of False Green Kyllinga (48 DAA)

Burning Tree Country Club, Greenwich, CT - 2010



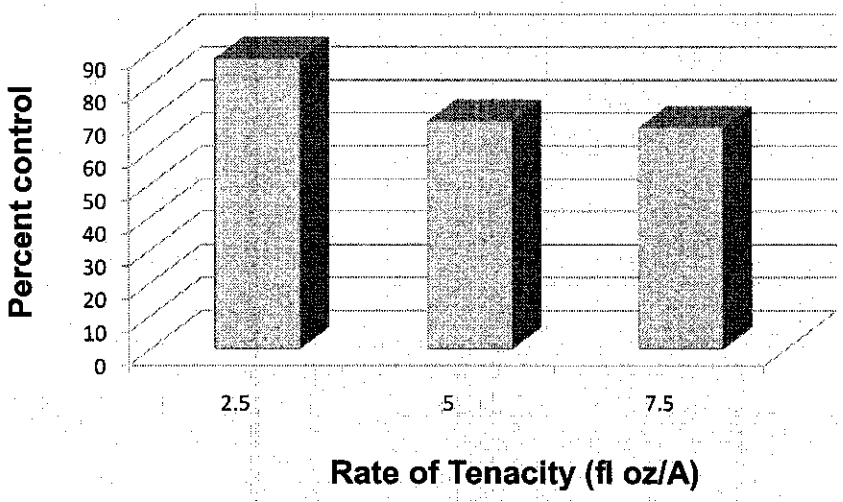
Percent Control of False Green Kyllinga (48 DAA)

Burning Tree Country Club, Greenwich, CT - 2010



Percent Control of False Green Kyllinga (48 DAA)

Burning Tree Country Club, Greenwich, CT - 2010



UNIVERSITY OF MASSACHUSETTS-AMHERST

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

Trial ID: 1060TG10 Protocol ID: 1060TG10
Location: Greenwich, CT Study Director: Prof. P. C. Bbhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

General Trial Information

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

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. Bbhowmik **Title:** Professor
Affiliation: University of Massachusetts Amherst
Investigator: P. C. Bhowmik, M. Barton and A. Kufel
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:
Trial site in rough areas consisted of uniform natural populatinm of false green kyllinga. A non-ionic surfactant (NIS) at 0.25% (v/v) was added to all treatments.

Application Description

	A	B
Application Date:	Jun-2-10	Jun-22-10
Time of Day:	10:30 AM	10:00 AM
Application Method:	SPRAY	SPRAY
Application Timing:	POEMCR	LATE POST
Air Temperature, Unit:	84.3 F	88.8 F
% Relative Humidity:	27.6	23.5
Wind Velocity, Unit:	0 MPH	0 MPH
Soil Temperature, Unit:	89.6 F	84.2 F
% Cloud Cover:	0	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: 1060TG10
Location: Greenwich, CT
Project ID:

Protocol ID: 1060TG10
Study Director: Prof. P. C. Bbhowmik
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: 1060TG10 Protocol ID: 1060TG10
Location: Greenwich, CT Study Director: Prof. P. C. Bbhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	Appl Code	1	2	3	4
	Pest Type				W Weed	W Weed	W Weed	W Weed
	Pest Code				KYLGR	AGSPL	KYLGR	AGSPL
	Pest Scientific Name				Kyllinga graci>	Agrostis palus>	Kyllinga graci>	Agrostis palus>
	Pest Name				Pasture spikes>	Bent grass	Pasture spikes>	Bent grass
	Rating Date				Jun-9-10	Jun-9-10	Jun-29-10	Jun-29-10
	Rating Type				CONTROL	PHYDIS	CONTROL	PHYDIS
	Rating Unit				%	%	%	%
	Number of Subsamples				1	1	1	1
	Days After First/Last Applic.				7 7	7 7	27 7	27 7
	Trt-Eval Interval				-10 DA-B	7 DA-B	14 DA-B	
1	CERTAINTY EARLY POST	0.5	oz wt/a	A	0.0 a	23.3 a	90.0 a	10.0 a
2	CERTAINTY LATE POST	0.5	oz wt/a	B	0.0 a	0.0 c	0.0 b	21.7 a
3	CERTAINTY EARLY POST	1.0	oz wt/a	A	0.0 a	18.3 ab	91.7 a	8.3 a
4	CERTAINTY LATE POST	1.0	oz wt/a	B	0.0 a	0.0 c	0.0 b	13.3 a
5	SEDGEHAMMER EARLY POST	0.0625	lb ai/a	A	0.0 a	3.3 c	91.7 a	0.0 a
6	SEDGEHAMMER LATE POST	0.0625	lb ai/a	B	0.0 a	0.0 c	0.0 b	11.7 a
7	SEDGEHAMMER EARLY POST	0.094	lb ai/a	A	0.0 a	6.7 bc	90.0 a	6.7 a
8	SEDGEHAMMER LATE POST	0.094	lb ai/a	B	0.0 a	0.0 c	0.0 b	10.0 a
9	SUNRICE EARLY POST	0.250	lb ai/a	A	0.0 a	11.7 bc	93.3 a	0.0 a
10	SUNRICE LATE POST	0.250	lb ai/a	B	0.0 a	0.0 c	30.0 b	25.0 a
11	SUNRICE EARLY POST	0.500	lb ai/a	A	0.0 a	8.3 bc	93.3 a	0.0 a
12	SUNRICE LATE POST	0.500	lb ai/a	B	0.0 a	0.0 c	0.0 b	8.3 a
13	UNTREATED EARLY POST			A	0.0 a	0.0 c	0.0 b	0.0 a

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.

UNIVERSITY OF MASSACHUSETTS-AMHERST

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

Trial ID: 1060TG10 Protocol ID: 1060TG10
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	W Weed
Pest Code				KYLGR	AGSPL	KYLGR	AGSPL
Pest Scientific Name				Kyllinga graci>	Agrostis palus>	Kyllinga graci>	Agrostis palus>
Pest Name				Pasture spikes>	Bent grass	Pasture spikes>	Bent grass
Rating Date				Jun-9-10	Jun-9-10	Jun-29-10	Jun-29-10
Rating Type				CONTROL	PHYDIS	CONTROL	PHYDIS
Rating Unit				%	%	%	%
Number of Subsamples				1	1	1	1
Days After First/Last Applic.				7 7	7 7	27 7	27 7
Trt-Eval Interval				-10 DA-B	7 DA-B	14 DA-B	
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code	1	2	3	4
14	UNTREATED LATE POST			B	0.0 a	0.0 c	0.0 b	0.0 a
LSD (P=.05)					0.00	9.36	26.20	19.63
Standard Deviation					0.00	5.35	14.96	11.21
CV					0.0	104.42	36.11	136.43
Bartlett's X2					0.0	7.231	30.381	9.888
P(Bartlett's X2)					.	0.204	0.001*	0.273
Replicate F					0.000	1.271	0.886	4.735
Replicate Prob(F)					1.0000	0.3111	0.4343	0.0269
Treatment F					0.000	6.258	28.148	1.556
Treatment Prob(F)					1.0000	0.0008	0.0001	0.2110

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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.

UNIVERSITY OF MASSACHUSETTS-AMHERST

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

Trial ID: 1060TG10 Protocol ID: 1060TG10
Location: Greenwich, CT Study Director: Prof. P. C. Bbhowmik
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	Appl Code	5	6	7	8
	Pest Type				W Weed	W Weed	W Weed	W Weed
	Pest Code				KYLGR	AGSPL	KYLGR	AGSPL
	Pest Scientific Name				Kyllinga graci>	Agrostis palus>	Kyllinga graci>	Agrostis palus>
	Pest Name				Pasture spikes>	Bent grass	Pasture spikes>	Bent grass
	Rating Date				Jul-7-10	Jul-7-10	Jul-21-10	Jul-21-10
	Rating Type				CONTROL	PHYDIS	CONTROL	PHYDIS
	Rating Unit				%	%		
	Number of Subsamples				1	1	1	1
	Days After First/Last Applic.				35 15	35 15	49 29	49 29
	Trt-Eval Interval				26 DA-B	43 DA-B		
1	CERTAINTY EARLY POST	0.5	oz wt/a	A	95.3 a	6.7 a	97.7 a	0.0 a
2	CERTAINTY LATE POST	0.5	oz wt/a	B	92.7 a	13.3 a	96.7 a	0.0 a
3	CERTAINTY EARLY POST	1.0	oz wt/a	A	95.0 a	8.3 a	98.0 a	0.0 a
4	CERTAINTY LATE POST	1.0	oz wt/a	B	94.3 a	11.7 a	98.7 a	0.0 a
5	SEDGEHAMMER EARLY POST	0.0625	lb ai/a	A	93.3 a	6.7 a	98.7 a	0.0 a
6	SEDGEHAMMER LATE POST	0.0625	lb ai/a	B	94.3 a	3.3 a	97.0 a	0.0 a
7	SEDGEHAMMER EARLY POST	0.094	lb ai/a	A	94.3 a	6.7 a	98.7 a	0.0 a
8	SEDGEHAMMER LATE POST	0.094	lb ai/a	B	96.0 a	15.0 a	97.7 a	0.0 a
9	SUNRICE EARLY POST	0.250	lb ai/a	A	97.0 a	6.7 a	98.0 a	0.0 a
10	SUNRICE LATE POST	0.250	lb ai/a	B	97.0 a	16.7 a	98.3 a	0.0 a
11	SUNRICE EARLY POST	0.500	lb ai/a	A	96.0 a	5.0 a	97.7 a	0.0 a
12	SUNRICE LATE POST	0.500	lb ai/a	B	97.0 a	5.0 a	100.0 a	0.0 a
13	UNTREATED EARLY POST			A	0.0 b	0.0 a	0.0 b	0.0 a

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.

UNIVERSITY OF MASSACHUSETTS-AMHERST

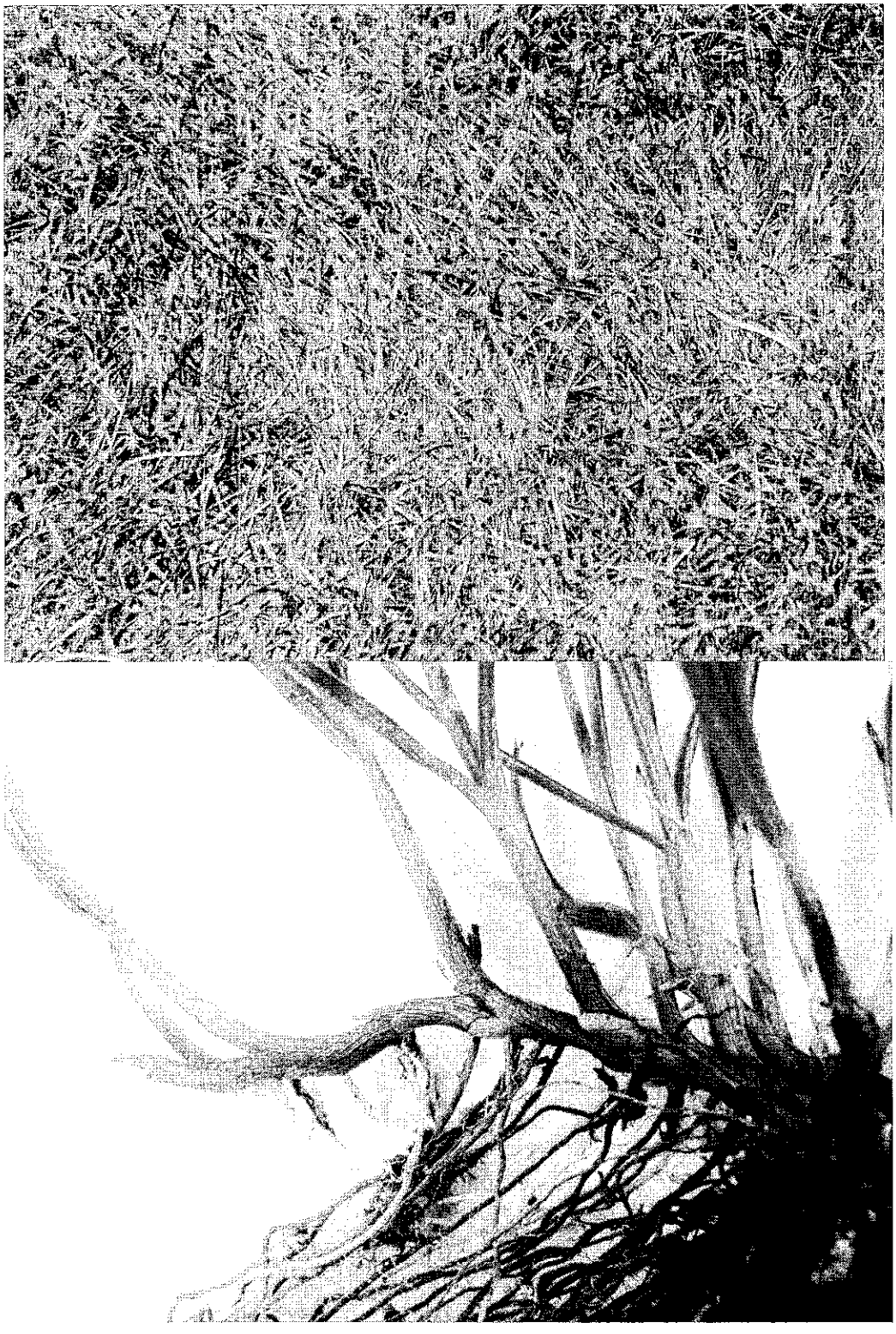
EFFECTS OF TIMINGS OF APPLICATION OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL

Trial ID: 1060TG10 Protocol ID: 1060TG10
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	W Weed
Pest Code				KYLGR	AGSPL	KYLGR	AGSPL
Pest Scientific Name				Kyllinga graci>	Agrostis palus>	Kyllinga graci>	Agrostis palus>
Pest Name				Pasture spikes>	Bent grass	Pasture spikes>	Bent grass
Rating Date				Jul-7-10	Jul-7-10	Jul-21-10	Jul-21-10
Rating Type				CONTROL	PHYDIS	CONTROL	PHYDIS
Rating Unit				%	%		
Number of Subsamples				1	1	1	1
Days After First/Last Applic.				35 15	35 15	49 29	49 29
Trt-Eval Interval				26 DA-B	43 DA-B		
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code	5	6	7	8
14	UNTREATED LATE POST			B	0.0 b	0.0 a	0.0 b	0.0 a
LSD (P=.05)					3.38	18.18	2.74	0.00
Standard Deviation					1.93	10.38	1.57	0.00
CV					2.36	138.4	1.86	0.0
Bartlett's X2					6.556	15.023	4.098	0.0
P(Bartlett's X2)					0.767	0.181	0.848	.
Replicate F					10.006	2.204	3.874	0.000
Replicate Prob(F)					0.0020	0.1471	0.0458	1.0000
Treatment F					966.624	0.723	1552.697	0.000
Treatment Prob(F)					0.0001	0.7175	0.0001	1.0000

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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.



UNIVERSITY OF MASSACHUSETTS-AMHERST

PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL UNDER FAIRWAY MOWING HEIGHT CONDITIONS

Trial ID: 1061TG11A Protocol ID: 1061TG11
Location: BTCC 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 M. Barton

Trial Location

City: Greenwich
State/Prov.: CT

Objectives:
To examine the tolerance of creeping bentgrass under faiway conditions

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

Crop Description

Crop 1: TURF Kentucky bluegrass

Pest Description

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

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: 2 **Study Design:** RACOBL Randomized Complete Block (RCB)
Untreated Arrangement: INCLUDED single control randomized in each block

Trial Initiation Comments:
Trial site under fairway mowing height conditions consisted of natural population of false green kyllinga. A non-ionic surfactant (NIS) at 0.25% (v/v) was added to all treatments.

Application Description

	A
Application Date:	Jun-22-10
Time of Day:	10:00 AM
Application Method:	SPRAY
Application Timing:	EAPOWE
Application Placement:	BROFOL
Air Temperature, Unit:	88.8 F
% Relative Humidity:	23.5
Wind Velocity, Unit:	0 MPH
Soil Temperature, Unit:	84.2 F
% Cloud Cover:	0

UNIVERSITY OF MASSACHUSETTS-AMHERST

PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL UNDER FAIRWAY MOWING HEIGHT CONDITIONS

Trial ID: 1061TG11A
Location: BTCC
Project ID: 0903TG3
Protocol ID: 1061TG11
Study Director: Prof. P. C. Bhowmik
Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Crop Stage At Each Application

	A
Crop 1 Code, BBCH Scale:	TURF

Pest Stage At Each Application

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

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

PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL UNDER FAIRWAY MOWING HEIGHT CONDITIONS

Trial ID: 1061TG11A Protocol ID: 1061TG11
Location: BTCC Study Director: Prof. P. C. Bhowmik
Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	1	2	3	4
	Pest Type			W Weed	W Weed	W Weed	W Weed
	Pest Code			KYLGR	KYLGR	AGSPL	AGSPL
	Pest Scientific Name			Kyllinga graci>	Kyllinga graci>	Agrostis palus>	Agrostis palus>
	Pest Name			Pasture spikes>	Pasture spikes>	Bent grass	Bent grass
	Description			Fairway	Rough	Fairway	Rough
	Rating Date			Jun-29-10	Jun-29-10	Jun-29-10	Jun-29-10
	Rating Type			CONTROL	CONTROL	PHYDIS	PHYDIS
	Rating Unit			%	%	%	%
	Number of Subsamples			1	1	1	1
	Days After First/Last Applic.			7 7	7 7	7 7	7 7
	Trt-Eval Interval			6 DA-A	13 DA-A	21 DA-A	34 DA-A
1	CERTAINTY	0.5	oz wt/a	12.5 a	12.5 a	15.0 a	0.0 a
2	CERTAINTY	1.0	oz wt/a	20.0 a	25.0 a	27.5 a	0.0 a
3	SEDGEHAMMER	0.031	lb ai/a	25.0 a	12.5 a	7.5 a	5.0 a
4	SEDGEHAMMER	0.062	lb ai/a	22.5 a	20.0 a	17.5 a	0.0 a
5	UNTREATED CHECK			10.0 a	7.5 a	7.5 a	0.0 a
	LSD (P=.05)			35.79	32.10	55.35	8.78
	Standard Deviation			12.89	11.57	19.94	3.16
	CV			71.63	74.61	132.92	316.23
	Bartlett's X2			0.202	1.947	0.852	0.0
	P(Bartlett's X2)			0.977	0.745	0.931	.
	Replicate F			0.962	0.019	0.025	1.000
	Replicate Prob(F)			0.3821	0.8979	0.8817	0.3739
	Treatment F			0.504	0.720	0.346	1.000
	Treatment Prob(F)			0.7385	0.6212	0.8358	0.5000

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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

PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL UNDER FAIRWAY MOWING HEIGHT CONDITIONS

Trial ID: 1061TG11A Protocol ID: 1061TG11
Location: BTCC Study Director: Prof. P. C. Bhowmik
Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	5	6	7	8
Pest Type				W Weed	W Weed	W Weed	W Weed
Pest Code				KYLGR	KYLGR	AGSPL	AGSPL
Pest Scientific Name				Kyllinga graci>	Kyllinga graci>	Agrostis palus>	Agrostis palus>
Pest Name				Pasture spikes>	Pasture spikes>	Bent grass	Bent grass
Description				Faiway	Rough	Fairway	Rough
Rating Date				Jul-7-10	Jul-7-10	Jul-7-10	Jul-7-10
Rating Type				CONTROL	CONTROL	PHYDIS	PHYDIS
Rating Unit				%	%	%	%
Number of Subsamples				1	1	1	1
Days After First/Last Applic.				15 15	15 15	15 15	15 15
Trt-Eval Interval				85 DA-A	15 DA-A	15 DA-A	15 DA-A
1	CERTAINTY	0.5	oz wt/a	30.0 a	35.0 a	0.0 a	5.0 a
2	CERTAINTY	1.0	oz wt/a	52.5 a	67.5 a	0.0 a	5.0 a
3	SEDGEHAMMER	0.031	lb ai/a	47.5 a	50.0 a	0.0 a	0.0 a
4	SEDGEHAMMER	0.062	lb ai/a	50.0 a	50.0 a	0.0 a	0.0 a
5	UNTREATED CHECK			30.0 a	35.0 a	0.0 a	0.0 a
LSD (P=.05)				83.57	100.19	0.00	10.75
Standard Deviation				30.10	36.09	0.00	3.87
CV				71.68	75.98	0.0	193.65
Bartlett's X2				5.756	2.449	0.0	0.0
P(Bartlett's X2)				0.124	0.485	.	.
Replicate F				0.000	0.002	0.000	2.667
Replicate Prob(F)				1.0000	0.9672	1.0000	0.1778
Treatment F				0.272	0.278	0.000	1.000
Treatment Prob(F)				0.8825	0.8784	1.0000	0.5000

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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

PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL UNDER FAIRWAY MOWING HEIGHT CONDITIONS

Trial ID: 1061TG11A Protocol ID: 1061TG11
Location: BTCC Study Director: Prof. P. C. Bhowmik
Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Trt No.	Treatment Name	Rate	Rate Unit	9	10	11	12
	Pest Type			W Weed	W Weed	W Weed	W Weed
	Pest Code			KYLGR	KYLGR	AGSPL	AGSPL
	Pest Scientific Name			Kyllinga graci>	Kyllinga graci>	Agrostis palus>	Agrostis palus>
	Pest Name			Pasture spikes>	Pasture spikes>	Bent grass	Bent grass
	Description			Fairway	Rough	Fairway	Rough
	Rating Date			Jul-21-10	Jul-21-10	Jul-21-10	Jul-21-10
	Rating Type			CONTROL	CONTROL	PHYDIS	PHYDIS
	Rating Unit			%	%	%	%
	Number of Subsamples			1	1	1	1
	Days After First/Last Applic.			29 29	29 29	29 29	29 29
	Trt-Eval Interval			29 DA-A	29 DA-A	29 DA-A	29 DA-A
1	CERTAINTY	0.5	oz wt/a	90.0 a	85.0 a	25.0 a	0.0 a
2	CERTAINTY	1.0	oz wt/a	91.5 a	87.5 a	35.0 a	0.0 a
3	SEDGEHAMMER	0.031	lb ai/a	87.5 a	82.5 a	0.0 a	0.0 a
4	SEDGEHAMMER	0.062	lb ai/a	91.5 a	90.0 a	0.0 a	0.0 a
5	UNTREATED CHECK			0.0 b	0.0 b	0.0 a	0.0 a
	LSD (P=.05)			12.83	15.52	65.98	0.00
	Standard Deviation			4.62	5.59	23.77	0.00
	CV			6.41	8.1	198.08	0.0
	Bartlett's X2			0.772	0.714	0.101	0.0
	P(Bartlett's X2)			0.68	0.87	0.751	.
	Replicate F			4.501	0.000	2.549	0.000
	Replicate Prob(F)			0.1012	1.0000	0.1856	1.0000
	Treatment F			152.429	95.720	1.000	0.000
	Treatment Prob(F)			0.0001	0.0003	0.5000	1.0000

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
KYLGR, Kyllinga gracillima, = US
AGSPL, Agrostis palustris, = US
Rating Type
PHYDIS = phytotoxicity - discoloration
Rating Unit
% = percent

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

PERFORMANCE OF VARIOUS PRODUCTS IN FALSE GREEN KYLLINGA CONTROL UNDER FAIRWAY MOWING HEIGHT CONDITIONS

Trial ID: 1061TG11A Protocol ID: 1061TG11
Location: BTCC Study Director: Prof. P. C. Bhowmik
Project ID: 0903TG3 Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

Pest Type		W Weed	W Weed
Pest Code		POAAN	POAAN
Pest Scientific Name		Poa annua	Poa annua
Pest Name		Annual bluegra>	Annual bluegra>
Description		Fairway	Fairway
Rating Date		Jul-7-10	Jul-21-10
Rating Type		CONTROL	CONTROL
Rating Unit		%	%
Number of Subsamples		1	1
Days After First/Last Applic.		15 15	29 29
Trt-Eval Interval		15 DA-A	29 DA-A
Trt No.	Treatment Name	Rate Rate Unit	13	14
1	CERTAINTY	0.5 oz wt/a	0.0	77.5 a
2	CERTAINTY	1.0 oz wt/a	30.0	45.0 a
3	SEDGEHAMMER	0.031 lb ai/a	40.0	37.5 a
4	SEDGEHAMMER	0.062 lb ai/a	40.0	0.0 a
5	UNTREATED CHECK		30.0	0.0 a
LSD (P=.05)				115.00
Standard Deviation				41.43
CV				129.46
Bartlett's X2				3.767
P(Bartlett's X2)				0.152
Replicate F				0.006
Replicate Prob(F)				0.9428
Treatment F				1.258
Treatment Prob(F)				0.4147

Pest Type
W, Weed, G-BYRW7, G-WedStg = Weed or volunteer crop
Pest Code
POAAN, Poa annua, = US
Rating Unit
% = percent

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

TOLERANCE OF NTEP PERENNIAL RYEGRASS CULTIVARS TO SULFOSULFURON

Trial ID: 1064TG14 Protocol ID: 1064TG14
Location: TRC-SDF Study Director:
Project ID: Investigator: PRASANTA C. BHOWMIK
Sponsor Contact:

General Trial Information

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

Objectives:
To determine the tolerance of various perennial ryegrass cultivars to sufosulfuron (Certainty).

Personnel

Study Director: 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: LOLPE Lolium perenne Perennial ryegrass
Variety: 120 Entries
BBCH Scale: BGRM

Site and Design

Plot Width, Unit: 3 FT
Plot Length, Unit: 60 FT
Plot Area, Unit: 180 FT2
Replications: 3 **Study Design:** RACOBL Randomized Complete Block (RCB)

Comment: Sulfosulfuron (Certainty) was applied at 1.5 oz /A to perennial ryegrass cultivars. This NTEP perennial ryegrass site was established in 2004.

Application Description

	A
Application Date:	Jun-30-10
Time of Day:	AM
Application Method:	SPRAY
Application Timing:	POST
Air Temperature, Unit:	83.5 F
% Relative Humidity:	13.5
Wind Velocity, Unit:	5 MPH
Soil Temperature, Unit:	73.4 F
% Cloud Cover:	0

Crop Stage At Each Application

	A
Crop 1 Code, BBCH Scale:	LOLPE BGRM

UNIVERSITY OF MASSACHUSETTS-AMHERST

TOLERANCE OF NTEP PERENNIAL RYEGRASS CULTIVARS TO SULFOSULFURON

Trial ID: 1064TG14 Protocol ID: 1064TG14
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

Table 1. 2004 NTEP Perennial Ryegrass Test: 2010 Injury to Certainty

Entry Number Name‡	Injury† (2WAT)
109. D04-1667	6
83. Quicksilver*	7
117. DP-17-9499	7
13. Halo*	9
74. DCM	9
93. Harrier*	9
118. Galatti	9
24. SP4	10
36. Pick RB-1	10
81. Silver Dollar*	11
30. Revenge GLX*	12
31. Monterey 3*	12
34. 1G2	12
35. Mach I*	12
78. RAD-PR8	12
103. AC2	12
120. DP 17-9788	12
7. Protégé GLR*	13
68. Pick-02-R	13
90. SRX 4682	13
22. ASP6001*	14
55. La Quinta*	14
67. Fiesta 4*	14
86. Barlennium*	14
2. Panther*	15
16. L44	15
21. ASP6004*	15
58. Manhattan 5*	15
106. D04-LP05	15
114. Premier*	15
41. All*Star3*	16
49. Buena Vista*	16
69. Firebolt*	16
79. Brightstar SLT*	16
104. Pleasure Supreme*	16
33. MMV	17
47. Cabo II*	17
52. Secretariat II*	17
65. 04-BRE	17
98. Panther GLS*	17
5. Affinity*	18
11. Presidio*	18
18. ASP6002*	18

Table 1. 2004 NTEP Perennial Ryegrass Test: 2010 Injury to Certainty

Entry Number Name‡	Injury† (2WAT)
40. Attribute*	18
59. PST-2BLK	18
85. Pinnacle II*	18
108. D04-11T	18
6. Paragon GLR*	19
28. Accent II*	19
44. Primary*	19
50. Fusion*	19
51. Charismatic*	19
64. 04-BEN	19
76. PS-2	19
3. Pacesetter*	20
4. Pizzazz*	20
32. DP1*	20
70. PM 101	20
92. SR 4600*	20
94. PM 102	20
60. PST-2MNG	21
95. Headstart 2*	21
105. E-99*	21
20. ASP6006*	22
26. Phenom*	22
38. Regal 5*	22
43. Keystone 2*	22
82. Gray star*	22
89. BAR Lp 4920	22
14. VB99	23
29. Top Gun II*	23
97. Repell GLS*	23
113. APR 1670	23
10. TR47	25
23. Wild Dance 2*	25
25. SNR	25
84. Premier II*	25
111. Pentium*	25
46. Stellar GL*	26
48. Kokomo*	26
57. PST-217	26
96. MS2	26
99. GL-2	26
110. Inspire*	26
115. Pinnacle*	26
27. Delaware XL*	27
62. PST-2GSM	27
72. Apple GL*	27

Table 1. 2004 NTEP Perennial Ryegrass Test: 2010 Injury to Certainty

Entry Number Name‡	Injury† (2WAT)
101. Palmer IV*	27
102. Line Drive GLS*	27
54. Goalkeeper II*	28
71. Dart*	28
75. AF	28
80. Citation Fore*	28
12. GPR	30
87. Bar Lp 4317	30
19. ASP6005*	31
37. LCK	31
91. SRX 4692	31
100. RNS*	31
107. D04-UP	32
45. Derby Xtreme*	33
53. Caddieshack II*	33
73. Homerun*	33
77. Palmer III*	33
112. APR 1648	33
119. Pianist	33
1. LPR 02203	34
17. APS6003*	34
42. Amazing GS*	34
56. Overdrive*	34
61. PST-2AG	34
88. BAR Lp 4420	34
15. VB77	35
63. PST-2LAN	35
66. Sunshine 2*	35
8. Exacta II GLSR*	36
39. Palace*	36
9. ES45	39
116. Linn*	49
LSD§	17
Range	6 to 49

†Injury to Certainty measured as chlorophyll index of check plot relative to treated as 100*[1- (treated/check)]. Certainty applied 30 June, 2010.
§Any two cultivars that differ in value exceeding LSD (0.05) are statistically significant.
*Commercially available in 2010.

RIVER ROAD

TURF- FARM FENCE

2004 NATIONAL TURFGRASS EVALUATION PROGRAM PERENNIAL RYEGRASS VARIETY TRIAL

Block C	Block B	Block A

2010 - Turfgrass and Weed Code Index

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

Weed species	Code
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

Herbicide Index – 2010 Experiments

Trade names	Chemical names	Page no.
CERTAINTY	Sulfosulfuron	31, 38, 45, 49
DPX-MAT28-138	aminocyclopyrachlor + MAT28 (GF-S)	14
DPX-MAT28-131	aminocyclopyrachlor + MAT28 (GF-E)	14
DRIVE XLR8	Quinchlorac	7, 11
ECHELON	Sulfentrazone + prodiamine	25
ESCALADE 2	2,4-D + fluorxypyr + dicamba	3, 14
EMPRELIS 112	aminocyclopyrachlor	14
MILLENEUM ULTRA	2,4-D + clopyralid + dicamba	3
MONUMENT FORCE	2,4-D (E) + 2,4-D (A) + MCPP + dicamba	3, 14
ONETIME	BAS 790 00H	7, 11
PROGRESS	Ethofumesate	25
PROSHOT	Methioxyzolin	25
Q4	Quinclorac + sulfentrazone + 2,4-D + dicamba	3
Q4 PLUS	2,4-D + quinclorac + dicamba + sulfentrazone	3
SEDGEHAMMER	Halosulfuron	31, 38, 45
SUNRICE	Ethoxysulfuron	25, 31, 38
TENACITY	Mesotrione	31
TRIMEC BENT	2,4-D + MCPP + dicamba	3, 14
TRIMEC CLASSIC	,4-D + MCPP + dicamba	3, 14
TZONE	Triclopyr + sulfentrazone + 2,4-D + dicamba	3, 7, 11
COC	Crop oil conc.	7, 11
NIS (X-77)	Non-ionic surfactant	25, 31, 36, 45

2010
Weather Data
South Deerfield, MA

Joseph Troll Turfgrass Research Center
South Deerfield, MA

Weather Station: ET106

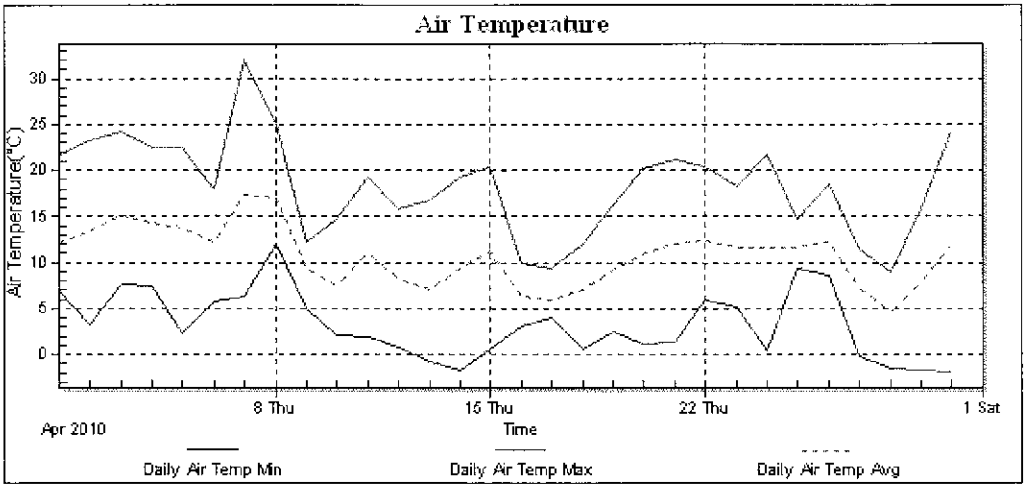
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:27 AM

Report Period: April 2010



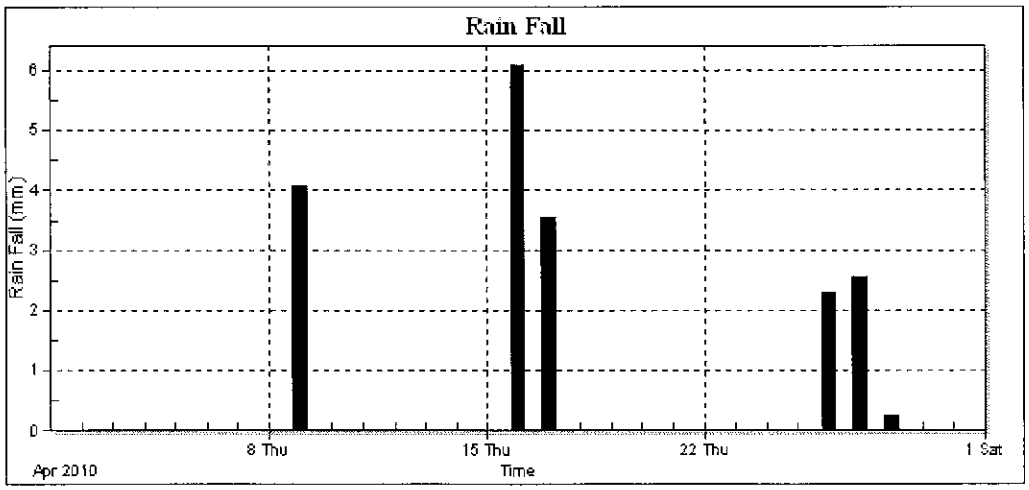
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:27 AM

Report Period: April 2010



Air Temperature and Rainfall - April, 2010

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:27 AM
Report Period: April 2010

Date	Air Temp Min (°C)	Air Temp Max (°C)	Air Temp Avg (°C)
4/1/2010	6.85	21.82	12.21
4/2/2010	3.33	23.32	13.31
4/3/2010	7.62	24.25	15.08
4/4/2010	7.52	22.59	14.35
4/5/2010	2.30	22.56	13.75
4/6/2010	5.69	17.88	12.19
4/7/2010	6.39	32.01	17.31
4/8/2010	12.07	26.24	17.00
4/9/2010	4.92	12.23	9.28
4/10/2010	2.20	14.76	7.47
4/11/2010	1.87	19.27	11.00
4/12/2010	0.74	15.76	8.18
4/13/2010	-0.75	16.78	7.09
4/14/2010	-1.62	19.23	9.33
4/15/2010	0.87	20.50	11.22
4/16/2010	3.06	9.94	6.35
4/17/2010	4.06	9.28	5.87
4/18/2010	0.60	11.93	7.07
4/19/2010	2.57	16.18	9.11
4/20/2010	1.17	20.27	11.06
4/21/2010	1.27	21.09	11.94
4/22/2010	5.86	20.47	12.49
4/23/2010	5.19	18.28	11.59
4/24/2010	0.41	21.76	11.69
4/25/2010	9.28	14.72	11.61
4/26/2010	8.55	18.48	12.17
4/27/2010	-0.23	11.43	7.30
4/28/2010	-1.46	8.98	4.60
4/29/2010	-1.69	15.92	7.93
4/30/2010	-1.86	24.21	11.78
Low	-1.86	8.98	4.60
High	12.07	32.01	17.31
Average	3.22	18.37	10.71
Std Dev	3.59	5.24	3.14
Total	N/A	N/A	N/A

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:27 AM
Report Period: April 2010

Date	Rain Fall (mm)
4/1/2010	0.00
4/2/2010	0.00
4/3/2010	0.00
4/4/2010	0.00
4/5/2010	0.00
4/6/2010	0.00
4/7/2010	0.00
4/8/2010	0.00
4/9/2010	4.06
4/10/2010	0.00
4/11/2010	0.00
4/12/2010	0.00
4/13/2010	0.00
4/14/2010	0.00
4/15/2010	0.00
4/16/2010	6.10
4/17/2010	3.56
4/18/2010	0.00
4/19/2010	0.00
4/20/2010	0.00
4/21/2010	0.00
4/22/2010	0.00
4/23/2010	0.00
4/24/2010	0.00
4/25/2010	0.00
4/26/2010	2.29
4/27/2010	2.54
4/28/2010	0.25
4/29/2010	0.00
4/30/2010	0.00
Low	0.00
High	6.10
Average	0.63
Std Dev	1.49
Total	18.80

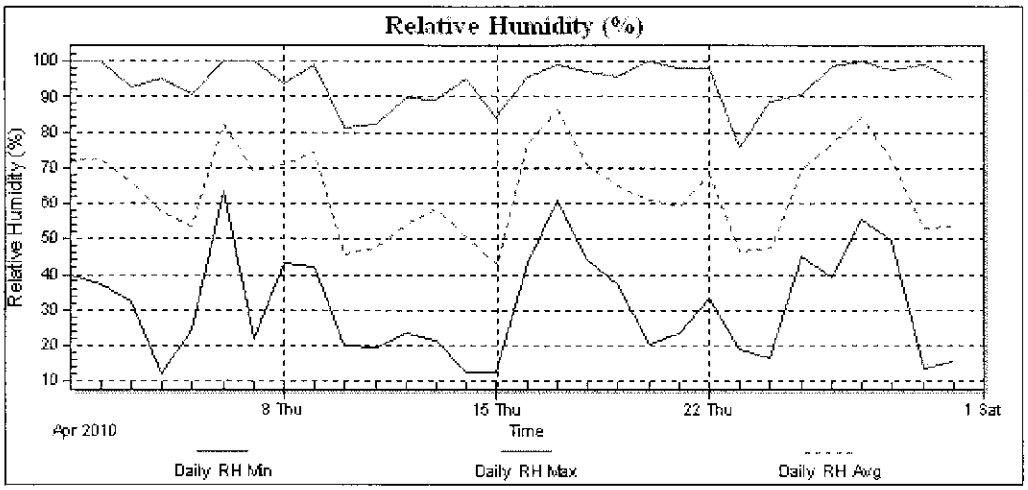
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:27 AM

Report Period: April 2010



Date	RH Min	RH Max	RH Avg
4/1/2010	39.66	100.00	72.35
4/2/2010	37.52	100.00	72.49
4/3/2010	32.46	92.40	65.96
4/4/2010	12.13	95.20	57.48
4/5/2010	24.43	90.90	53.80
4/6/2010	63.42	100.00	82.37
4/7/2010	22.18	100.00	68.96
4/8/2010	43.19	93.80	70.79
4/9/2010	42.45	98.90	74.18
4/10/2010	20.01	81.10	45.55
4/11/2010	19.23	82.40	47.75
4/12/2010	23.31	89.80	54.26
4/13/2010	21.47	89.40	58.57
4/14/2010	12.44	95.30	50.51
4/15/2010	12.73	84.40	42.61
4/16/2010	43.08	95.40	77.05
4/17/2010	61.07	99.10	86.14
4/18/2010	44.13	96.90	70.76
4/19/2010	37.18	95.40	64.76
4/20/2010	20.20	100.00	61.12
4/21/2010	23.23	98.10	59.05
4/22/2010	33.57	98.30	68.18
4/23/2010	19.14	75.90	46.60
4/24/2010	16.60	88.90	47.47
4/25/2010	45.14	90.70	69.37
4/26/2010	39.04	98.70	77.06
4/27/2010	55.62	100.00	84.44
4/28/2010	49.88	97.60	72.17
4/29/2010	13.60	99.20	52.94
4/30/2010	15.50	95.00	53.46
Low	12.13	75.90	42.61
High	63.42	100.00	86.14
Average	31.45	94.09	63.61
Std Dev	14.80	6.29	12.14
Total	N/A	N/A	1908.22

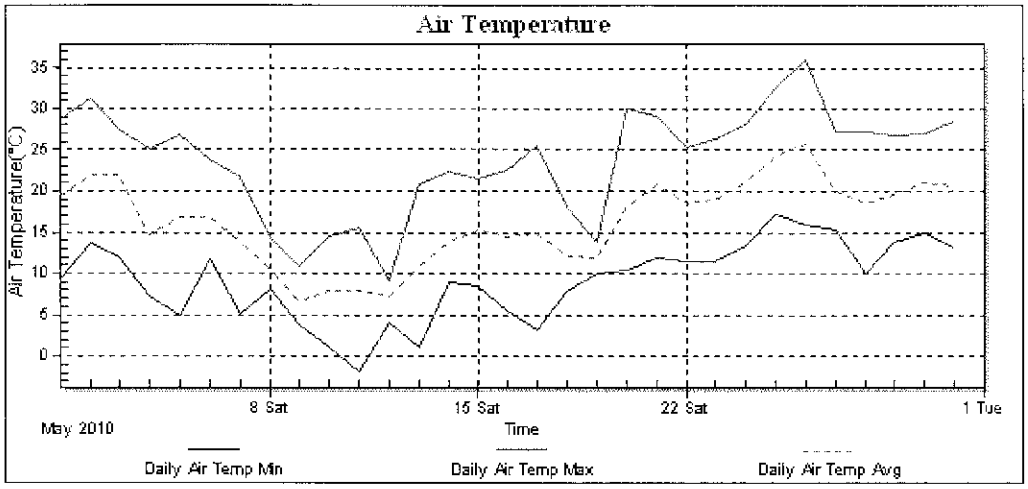
Weather Station: ET106

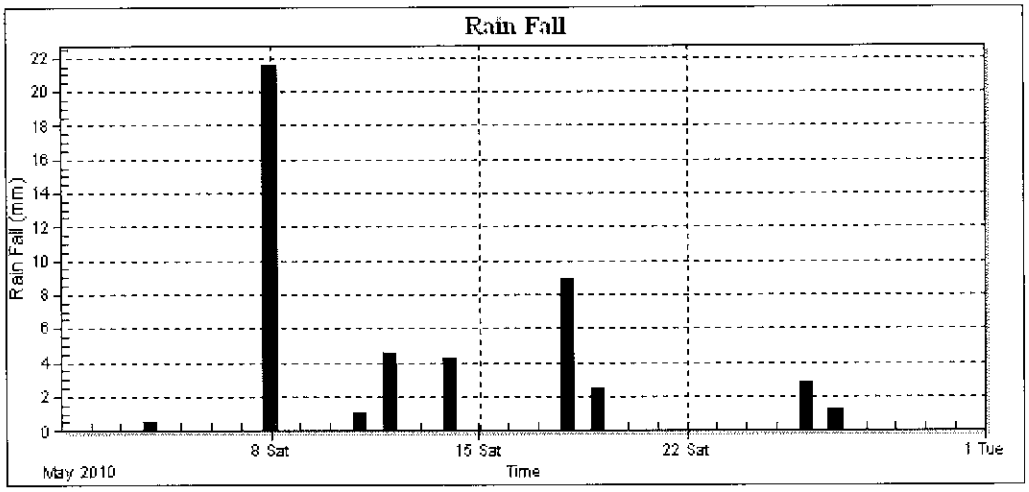
Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:29 AM

Report Period: May 2010





Air Temperature and Rainfall - May, 2010

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:29 AM
Report Period: May 2010

Date	Air Temp Min (°C)	Air Temp Max (°C)	Air Temp Avg (°C)
5/1/2010	9.38	28.75	19.41
5/2/2010	13.53	31.31	22.04
5/3/2010	11.83	27.47	21.91
5/4/2010	7.32	25.11	14.70
5/5/2010	4.83	26.87	16.77
5/6/2010	11.77	23.85	16.87
5/7/2010	5.13	21.76	13.84
5/8/2010	8.11	14.26	10.49
5/9/2010	3.83	10.88	6.71
5/10/2010	1.04	14.39	7.92
5/11/2010	-1.86	15.62	7.98
5/12/2010	4.06	9.11	7.15
5/13/2010	1.07	20.80	10.90
5/14/2010	9.01	22.42	13.88
5/15/2010	8.52	21.49	16.44
5/16/2010	5.53	22.46	14.39
5/17/2010	3.20	25.53	14.92
5/18/2010	7.81	18.08	12.25
5/19/2010	10.04	13.83	12.01
5/20/2010	10.41	29.95	18.12
5/21/2010	11.97	29.12	20.85
5/22/2010	11.44	25.33	18.43
5/23/2010	11.54	26.37	18.89
5/24/2010	13.33	28.16	21.00
5/25/2010	17.15	32.54	24.18
5/26/2010	15.95	35.92	25.81
5/27/2010	15.42	27.17	20.00
5/28/2010	10.11	27.13	18.54
5/29/2010	13.86	26.80	19.54
5/30/2010	14.79	26.93	21.04
5/31/2010	13.27	28.40	20.64
Low	-1.86	9.11	6.71
High	17.15	35.92	25.81
Average	9.14	23.80	16.34
Std Dev	4.72	6.41	5.04
Total	N/A	N/A	N/A

Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:29 AM

Report Period: May 2010

Date	Rain Fall (mm)
5/1/2010	0.00
5/2/2010	0.00
5/3/2010	0.00
5/4/2010	0.51
5/5/2010	0.00
5/6/2010	0.00
5/7/2010	0.00
5/8/2010	21.59
5/9/2010	0.00
5/10/2010	0.00
5/11/2010	1.02
5/12/2010	4.57
5/13/2010	0.00
5/14/2010	4.32
5/15/2010	0.00
5/16/2010	0.00
5/17/2010	0.00
5/18/2010	8.89
5/19/2010	2.54
5/20/2010	0.00
5/21/2010	0.00
5/22/2010	0.00
5/23/2010	0.00
5/24/2010	0.00
5/25/2010	0.00
5/26/2010	2.79
5/27/2010	1.27
5/28/2010	0.00
5/29/2010	0.00
5/30/2010	0.00
5/31/2010	0.00
Low	0.00
High	21.59
Average	1.53
Std Dev	4.13
Total	47.50

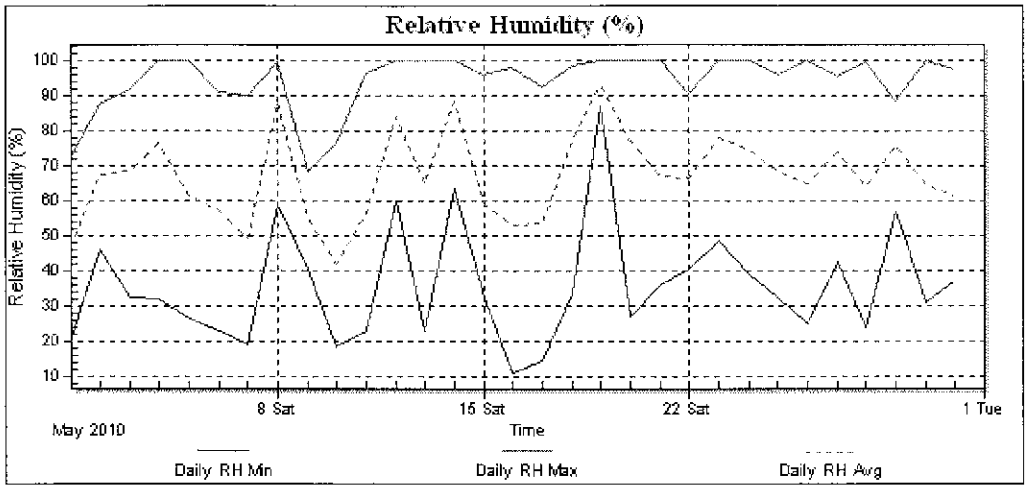
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:29 AM

Report Period: May 2010



Date	RH Min	RH Max	RH Avg
5/1/2010	21.10	73.20	47.23
5/2/2010	46.17	87.70	67.38
5/3/2010	32.35	92.20	68.66
5/4/2010	32.29	100.00	76.69
5/5/2010	26.69	100.00	61.53
5/6/2010	22.89	91.30	57.18
5/7/2010	19.06	90.20	49.28
5/8/2010	58.93	99.80	88.24
5/9/2010	40.53	68.39	55.24
5/10/2010	18.62	76.70	42.00
5/11/2010	23.07	96.80	56.60
5/12/2010	60.06	100.00	84.22
5/13/2010	23.33	100.00	65.15
5/14/2010	63.79	100.00	88.53
5/15/2010	32.40	98.10	59.09
5/16/2010	11.20	98.20	52.95
5/17/2010	14.56	92.70	53.49
5/18/2010	33.67	98.50	77.20
5/19/2010	87.10	100.00	93.33
5/20/2010	27.28	100.00	77.05
5/21/2010	36.18	100.00	67.38
5/22/2010	40.59	90.50	66.63
5/23/2010	48.81	100.00	78.07
5/24/2010	39.31	100.00	74.84
5/25/2010	32.51	96.10	68.44
5/26/2010	25.14	100.00	64.95
5/27/2010	42.41	95.40	73.97
5/28/2010	24.05	99.80	64.20
5/29/2010	57.07	88.70	75.95
5/30/2010	31.22	100.00	64.75
5/31/2010	37.12	97.60	61.59
Low	11.20	68.39	42.00
High	87.10	100.00	93.33
Average	35.79	94.51	67.15
Std Dev	16.25	8.14	12.33
Total	N/A	N/A	2081.79

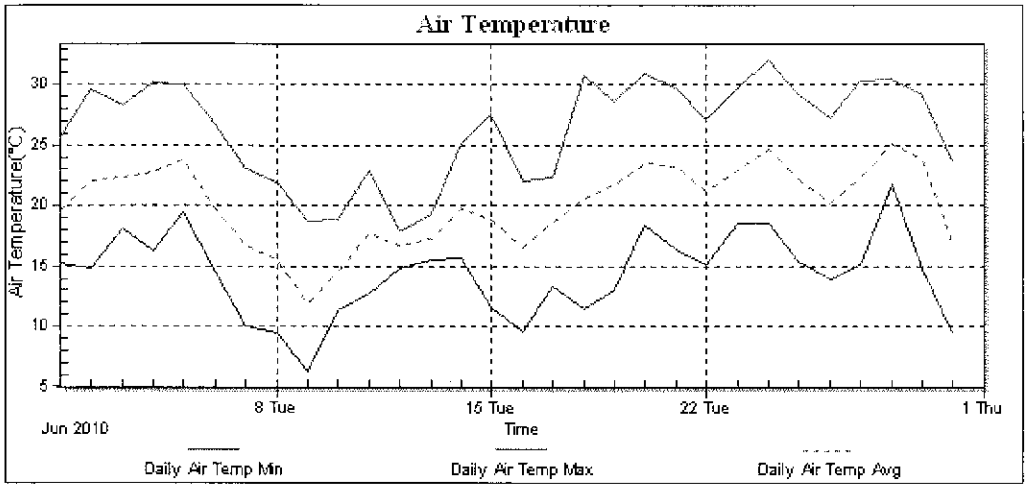
Weather Station: ET106

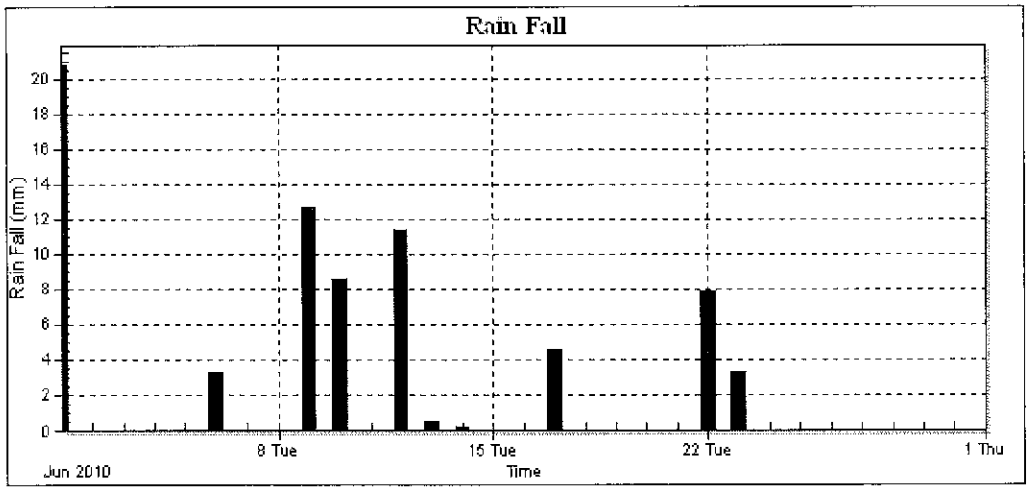
Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:30 AM

Report Period: June 2010





Air Temperature and Rainfall - June, 2010

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:30 AM
Report Period: June 2010

Date	Air Temp Min (°C)	Air Temp Max (°C)	Air Temp Avg (°C)
6/1/2010	15.29	25.63	19.61
6/2/2010	14.83	29.52	22.06
6/3/2010	18.18	28.27	22.27
6/4/2010	16.22	30.11	22.84
6/5/2010	19.44	29.99	23.83
6/6/2010	14.53	26.67	19.69
6/7/2010	10.07	23.02	16.64
6/8/2010	9.41	21.86	15.57
6/9/2010	6.25	18.71	11.87
6/10/2010	11.38	18.88	14.46
6/11/2010	12.80	22.92	17.67
6/12/2010	14.86	17.78	16.65
6/13/2010	15.52	19.34	17.25
6/14/2010	15.72	25.11	19.75
6/15/2010	11.64	27.57	18.86
6/16/2010	9.64	21.99	16.52
6/17/2010	13.33	22.39	18.54
6/18/2010	11.41	30.81	20.81
6/19/2010	13.03	28.62	21.62
6/20/2010	18.44	30.84	23.44
6/21/2010	16.32	29.71	23.23
6/22/2010	15.03	27.10	21.14
6/23/2010	18.54	29.68	22.90
6/24/2010	18.54	32.04	24.67
6/25/2010	15.33	29.15	22.25
6/26/2010	13.96	27.30	20.18
6/27/2010	15.06	30.31	22.37
6/28/2010	21.82	30.46	25.11
6/29/2010	14.85	29.19	23.82
6/30/2010	9.45	23.62	17.00
Low	6.25	17.78	11.87
High	21.82	32.04	25.11
Average	14.36	26.29	20.09
Std Dev	3.40	4.15	3.25
Total	N/A	N/A	N/A

Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:30 AM

Report Period: June 2010

Date	Rain Fall (mm)
6/1/2010	20.83
6/2/2010	0.00
6/3/2010	0.00
6/4/2010	0.00
6/5/2010	0.00
6/6/2010	3.30
6/7/2010	0.00
6/8/2010	0.00
6/9/2010	12.70
6/10/2010	8.64
6/11/2010	0.00
6/12/2010	11.43
6/13/2010	0.51
6/14/2010	0.25
6/15/2010	0.00
6/16/2010	0.00
6/17/2010	4.57
6/18/2010	0.00
6/19/2010	0.00
6/20/2010	0.00
6/21/2010	0.00
6/22/2010	7.87
6/23/2010	3.30
6/24/2010	0.00
6/25/2010	0.00
6/26/2010	0.00
6/27/2010	0.00
6/28/2010	0.00
6/29/2010	0.00
6/30/2010	0.00
Low	0.00
High	20.83
Average	2.45
Std Dev	4.92
Total	73.40

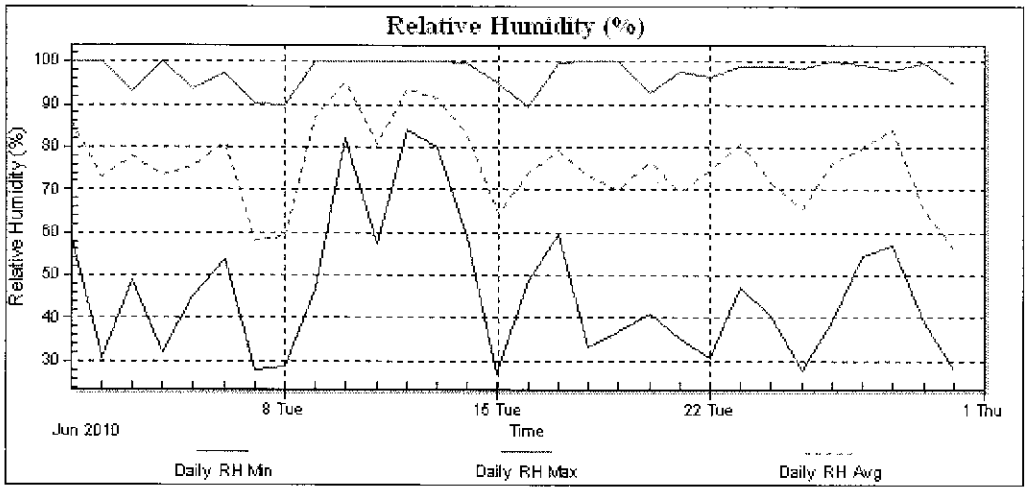
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:30 AM

Report Period: June 2010



Date	RH Min	RH Max	RH Avg
6/1/2010	59.11	100.00	86.75
6/2/2010	30.85	100.00	73.18
6/3/2010	48.98	93.30	77.75
6/4/2010	31.84	100.00	73.29
6/5/2010	45.07	93.40	75.66
6/6/2010	53.61	97.40	81.28
6/7/2010	27.93	90.40	58.17
6/8/2010	28.70	89.70	59.07
6/9/2010	46.91	100.00	87.04
6/10/2010	82.10	100.00	95.26
6/11/2010	57.49	100.00	80.89
6/12/2010	84.10	100.00	93.62
6/13/2010	79.80	100.00	91.38
6/14/2010	58.91	99.60	82.82
6/15/2010	27.15	95.20	64.37
6/16/2010	49.00	89.40	73.92
6/17/2010	59.62	99.80	79.38
6/18/2010	33.37	100.00	73.33
6/19/2010	36.82	100.00	69.78
6/20/2010	41.07	92.50	76.51
6/21/2010	35.34	97.70	69.30
6/22/2010	30.79	96.50	74.55
6/23/2010	47.17	98.80	80.92
6/24/2010	40.83	98.90	71.56
6/25/2010	27.89	98.60	65.69
6/26/2010	39.21	100.00	76.17
6/27/2010	64.62	99.10	79.87
6/28/2010	57.17	98.00	84.25
6/29/2010	39.01	99.60	65.27
6/30/2010	27.96	94.80	56.10
Low	27.15	89.40	56.10
High	84.10	100.00	95.26
Average	46.08	97.42	75.87
Std Dev	15.95	3.37	9.74
Total	N/A	N/A	2276.13

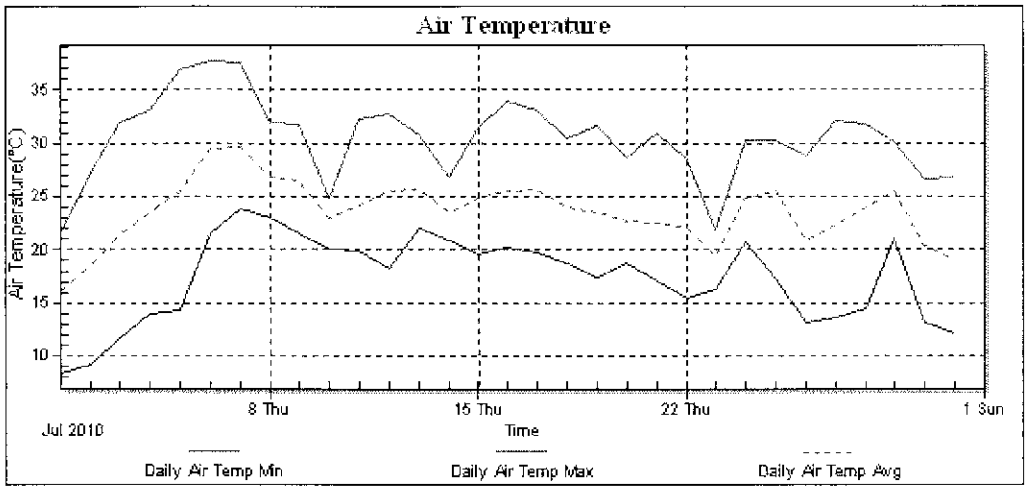
Weather Station: ET106

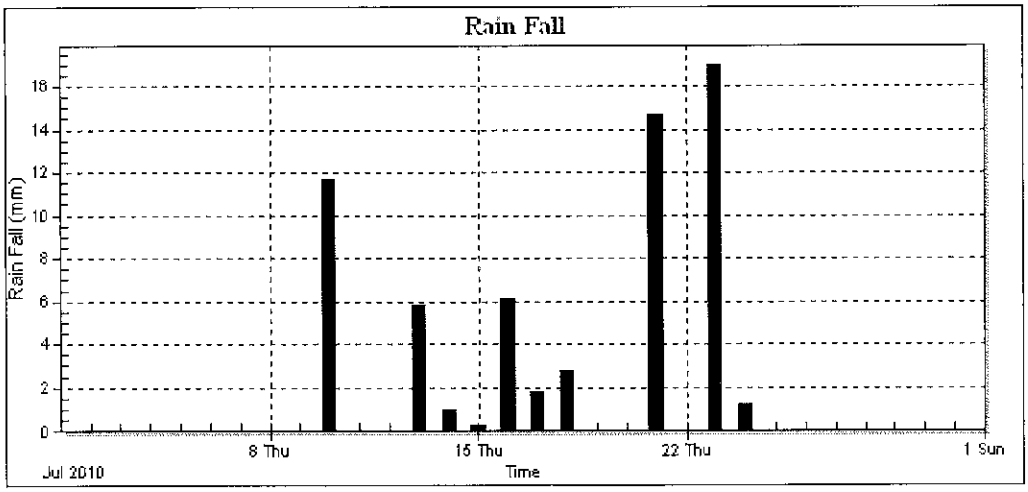
Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:31 AM

Report Period: July 2010





Air Temperature and Rainfall - July 2010

Weather Station: ET106

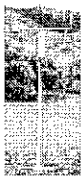
Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:31 AM
Report Period: July 2010

Date	Air Temp Min (°C)	Air Temp Max (°C)	Air Temp Avg (°C)
7/1/2010	8.38	21.50	16.08
7/2/2010	9.18	27.36	18.60
7/3/2010	11.61	31.97	21.43
7/4/2010	13.96	33.14	23.50
7/5/2010	14.33	36.88	25.51
7/6/2010	21.56	37.68	29.46
7/7/2010	23.92	37.51	29.60
7/8/2010	23.06	31.91	26.86
7/9/2010	21.62	31.81	26.56
7/10/2010	20.10	24.88	22.98
7/11/2010	19.84	32.21	24.26
7/12/2010	18.24	32.84	25.42
7/13/2010	22.09	30.84	25.62
7/14/2010	20.87	26.81	23.48
7/15/2010	19.54	31.24	24.81
7/16/2010	20.24	33.93	25.43
7/17/2010	19.71	33.07	25.65
7/18/2010	18.68	30.48	24.01
7/19/2010	17.35	31.67	23.60
7/20/2010	18.68	28.57	22.78
7/21/2010	17.15	30.88	22.50
7/22/2010	15.43	28.53	22.04
7/23/2010	16.32	21.93	19.43
7/24/2010	20.70	30.26	24.84
7/25/2010	17.34	30.29	25.43
7/26/2010	13.10	28.75	20.91
7/27/2010	13.63	32.11	22.33
7/28/2010	14.43	31.74	23.99
7/29/2010	21.03	30.18	25.52
7/30/2010	13.14	26.67	20.36
7/31/2010	12.17	26.87	19.13
Low	8.38	21.50	16.08
High	23.92	37.68	29.60
Average	17.34	30.47	23.62
Std Dev	4.01	3.75	2.93
Total	N/A	N/A	N/A

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:31 AM
Report Period: July 2010

Date	Rain Fall (mm)
7/1/2010	0.00
7/2/2010	0.00
7/3/2010	0.00
7/4/2010	0.00
7/5/2010	0.00
7/6/2010	0.00
7/7/2010	0.00
7/8/2010	0.00
7/9/2010	0.00
7/10/2010	11.68
7/11/2010	0.00
7/12/2010	0.00
7/13/2010	5.84
7/14/2010	1.02
7/15/2010	0.25
7/16/2010	6.10
7/17/2010	1.78
7/18/2010	2.79
7/19/2010	0.00
7/20/2010	0.00
7/21/2010	14.73
7/22/2010	0.00
7/23/2010	17.02
7/24/2010	1.27
7/25/2010	0.00
7/26/2010	0.00
7/27/2010	0.00
7/28/2010	0.00
7/29/2010	0.00
7/30/2010	0.00
7/31/2010	0.00
Low	0.00
High	17.02
Average	2.02
Std Dev	4.41
Total	62.48



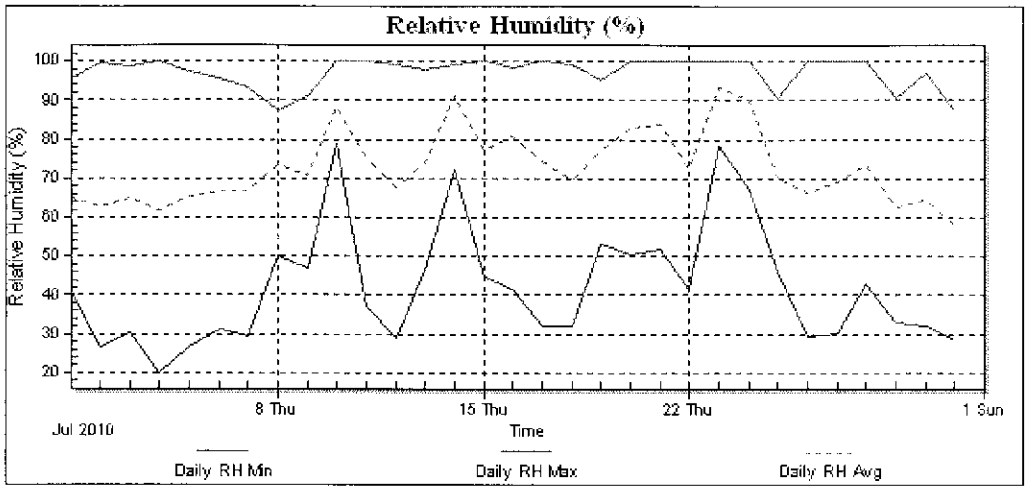
Weather Station: ET106

Location:

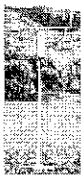
Report Type: 1 Month

Created: Thursday, February 03, 2011 11:31 AM

Report Period: July 2010



Date	RH Min	RH Max	RH Avg
7/1/2010	41.07	95.50	64.90
7/2/2010	26.59	99.50	62.89
7/3/2010	30.51	98.90	65.09
7/4/2010	20.02	100.00	61.83
7/5/2010	26.84	97.40	66.66
7/6/2010	31.23	95.70	66.80
7/7/2010	29.40	93.30	66.86
7/8/2010	50.29	87.30	73.47
7/9/2010	46.83	91.00	70.75
7/10/2010	78.80	100.00	88.18
7/11/2010	37.04	100.00	76.49
7/12/2010	28.81	99.40	67.56
7/13/2010	46.56	97.70	74.10
7/14/2010	72.30	99.30	91.27
7/15/2010	44.77	100.00	76.97
7/16/2010	41.79	98.10	80.75
7/17/2010	32.27	100.00	74.32
7/18/2010	32.17	99.20	69.33
7/19/2010	53.02	95.10	77.02
7/20/2010	50.67	100.00	82.84
7/21/2010	51.71	100.00	83.73
7/22/2010	41.58	100.00	72.82
7/23/2010	78.30	100.00	93.55
7/24/2010	67.36	100.00	89.99
7/25/2010	46.30	90.70	69.84
7/26/2010	29.61	100.00	66.26
7/27/2010	30.11	100.00	69.11
7/28/2010	42.67	100.00	73.59
7/29/2010	32.91	90.70	62.61
7/30/2010	32.15	97.00	64.38
7/31/2010	28.55	87.60	58.33
Low	20.02	87.30	58.33
High	78.80	100.00	93.55
Average	42.01	97.21	72.91
Std Dev	15.10	3.86	9.14
Total	N/A	N/A	2260.29



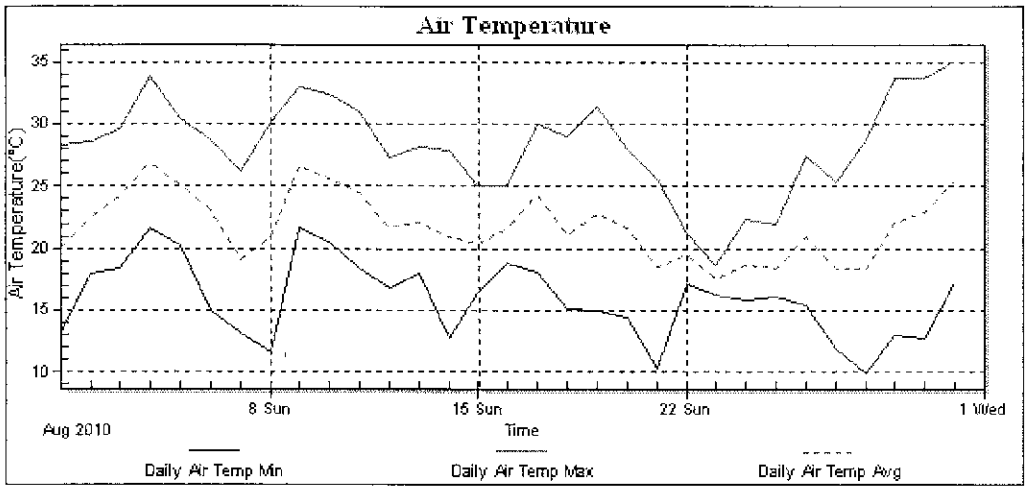
Weather Station: ET106

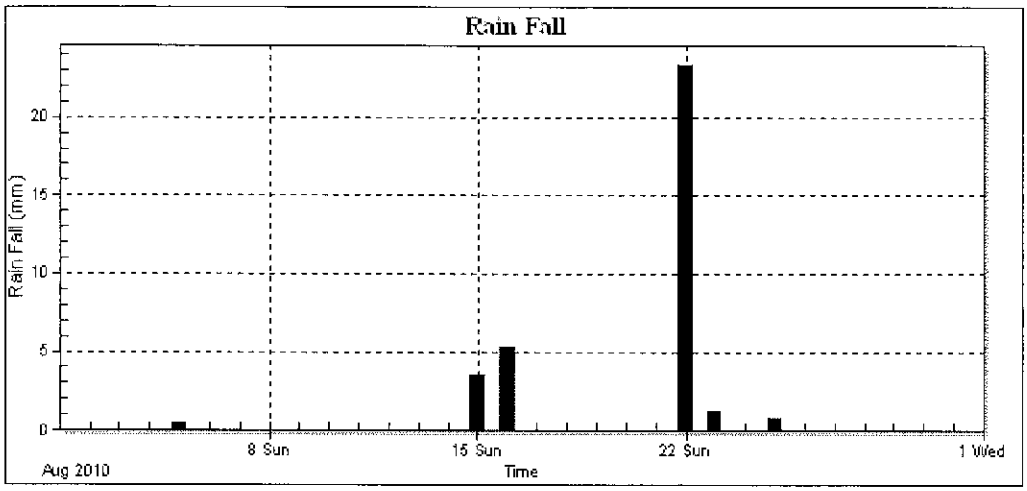
Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:32 AM

Report Period: August 2010





Air Temperature and Rainfall - August, 2010

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:32 AM
Report Period: August 2010

Date	Air Temp Min (°C)	Air Temp Max (°C)	Air Temp Avg (°C)
8/1/2010	13.14	28.30	20.15
8/2/2010	18.01	28.56	22.47
8/3/2010	18.41	29.52	24.21
8/4/2010	21.66	33.86	26.87
8/5/2010	20.17	30.44	24.98
8/6/2010	14.96	28.73	23.01
8/7/2010	13.23	26.17	19.10
8/8/2010	11.58	30.09	21.02
8/9/2010	21.60	33.01	26.65
8/10/2010	20.47	32.34	25.55
8/11/2010	18.41	31.04	24.42
8/12/2010	16.79	27.30	21.69
8/13/2010	17.98	28.12	22.13
8/14/2010	12.73	27.90	20.87
8/15/2010	16.42	25.11	20.34
8/16/2010	18.84	24.98	21.61
8/17/2010	18.14	30.02	24.35
8/18/2010	15.19	29.05	21.12
8/19/2010	14.99	31.41	22.72
8/20/2010	14.49	28.00	21.63
8/21/2010	10.28	25.61	18.51
8/22/2010	17.15	21.27	19.62
8/23/2010	16.28	18.74	17.51
8/24/2010	15.82	22.39	18.65
8/25/2010	16.19	21.92	18.46
8/26/2010	15.46	27.50	20.97
8/27/2010	11.90	25.30	18.34
8/28/2010	9.94	28.72	18.38
8/29/2010	12.97	33.64	22.06
8/30/2010	12.67	33.64	22.90
8/31/2010	17.25	35.06	25.46
Low	9.94	18.74	17.51
High	21.66	35.06	26.87
Average	16.91	28.31	21.80
Std Dev	3.08	3.86	2.57
Total	N/A	N/A	N/A

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:32 AM
Report Period: August 2010

Date	Rain Fall (mm)
8/1/2010	0.00
8/2/2010	0.00
8/3/2010	0.00
8/4/2010	0.00
8/5/2010	0.51
8/6/2010	0.00
8/7/2010	0.00
8/8/2010	0.00
8/9/2010	0.00
8/10/2010	0.00
8/11/2010	0.00
8/12/2010	0.00
8/13/2010	0.00
8/14/2010	0.00
8/15/2010	3.56
8/16/2010	5.33
8/17/2010	0.00
8/18/2010	0.00
8/19/2010	0.00
8/20/2010	0.00
8/21/2010	0.00
8/22/2010	23.37
8/23/2010	1.27
8/24/2010	0.00
8/25/2010	0.76
8/26/2010	0.00
8/27/2010	0.00
8/28/2010	0.00
8/29/2010	0.00
8/30/2010	0.00
8/31/2010	0.00
Low	0.00
High	23.37
Average	1.12
Std Dev	4.21
Total	34.80

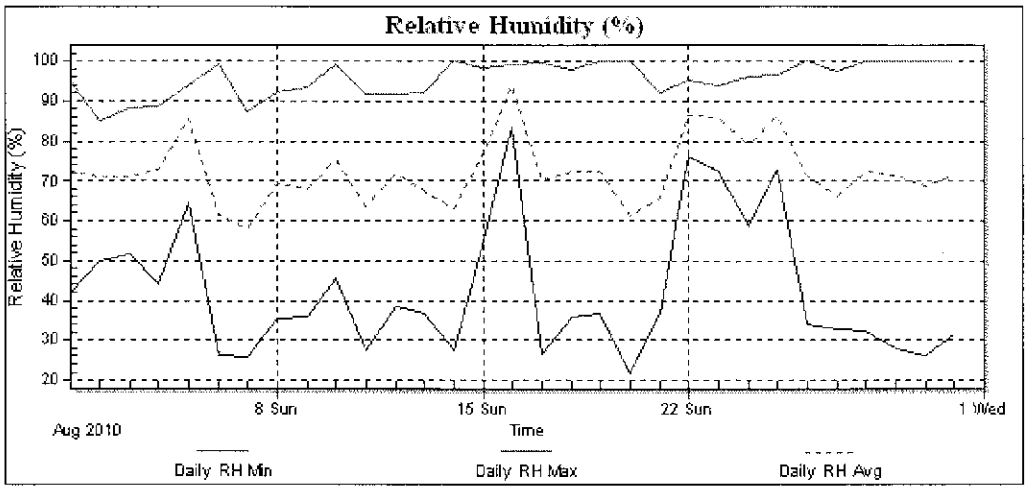
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:32 AM

Report Period: August 2010



Date	RH Min	RH Max	RH Avg
8/1/2010	41.84	94.90	72.19
8/2/2010	49.97	85.00	70.82
8/3/2010	51.53	88.20	70.88
8/4/2010	44.26	88.60	72.60
8/5/2010	64.38	94.10	85.70
8/6/2010	26.19	99.10	61.27
8/7/2010	25.62	87.20	58.00
8/8/2010	35.24	92.30	69.37
8/9/2010	35.70	93.50	67.82
8/10/2010	45.36	99.40	75.33
8/11/2010	27.71	91.70	63.49
8/12/2010	38.48	91.70	72.09
8/13/2010	36.71	92.00	67.60
8/14/2010	27.35	99.90	63.04
8/15/2010	55.31	98.50	77.03
8/16/2010	83.40	99.30	93.83
8/17/2010	26.82	99.60	70.20
8/18/2010	35.74	97.90	72.52
8/19/2010	36.57	100.00	72.40
8/20/2010	21.86	100.00	61.57
8/21/2010	36.69	92.20	65.84
8/22/2010	76.30	95.10	86.52
8/23/2010	72.40	93.80	85.84
8/24/2010	58.59	96.10	78.77
8/25/2010	72.60	96.40	86.26
8/26/2010	33.95	100.00	71.45
8/27/2010	32.65	97.40	66.05
8/28/2010	32.18	100.00	72.53
8/29/2010	28.11	100.00	71.64
8/30/2010	26.31	100.00	69.03
8/31/2010	31.40	100.00	71.46
Low	21.86	85.00	58.00
High	83.40	100.00	93.83
Average	42.30	95.61	72.36
Std Dev	16.53	4.37	8.14
Total	N/A	N/A	2243.13

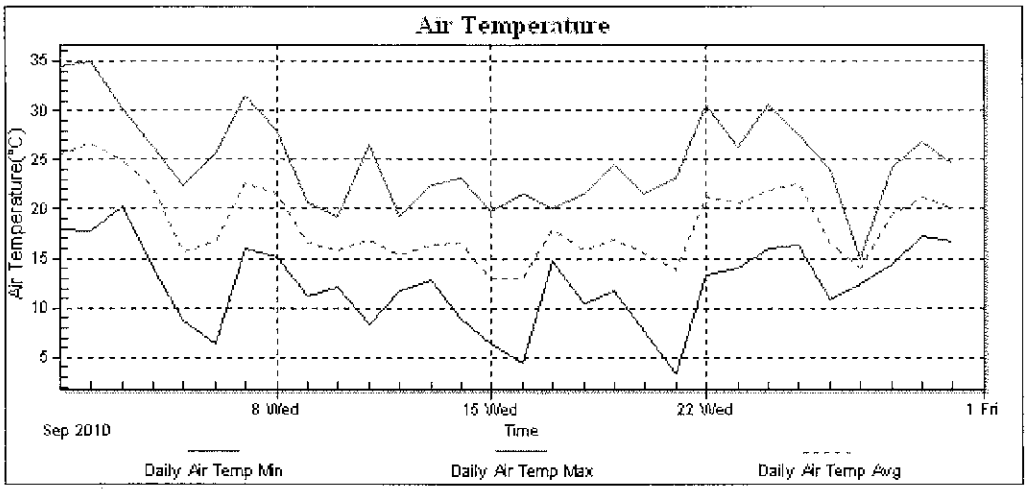
Weather Station: ET106

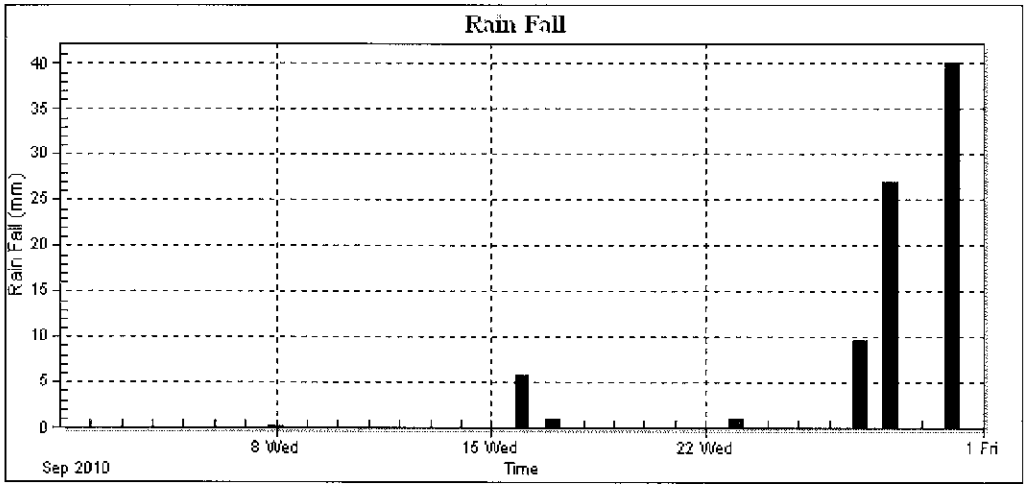
Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:33 AM

Report Period: September 2010





Air Temperature and Rainfall - September, 2010

Weather Station: ET106

Location:
Report Type: 1 Month
Created: Thursday, February 03, 2011 11:33 AM
Report Period: September 2010

Date	Air Temp Min (°C)	Air Temp Max (°C)	Air Temp Avg (°C)
9/1/2010	17.91	34.46	25.51
9/2/2010	17.81	34.99	26.63
9/3/2010	20.31	30.26	24.89
9/4/2010	14.09	26.30	22.21
9/5/2010	8.62	22.46	15.68
9/6/2010	8.42	25.63	16.74
9/7/2010	15.95	31.47	22.59
9/8/2010	15.03	27.90	21.58
9/9/2010	11.21	20.53	16.46
9/10/2010	12.07	19.18	15.80
9/11/2010	8.35	26.40	16.90
9/12/2010	11.77	19.21	15.32
9/13/2010	12.77	22.36	16.45
9/14/2010	8.88	23.09	16.46
9/15/2010	6.39	19.77	13.00
9/16/2010	4.36	21.52	12.98
9/17/2010	14.76	20.10	17.92
9/18/2010	10.64	21.59	16.75
9/19/2010	11.80	24.46	16.87
9/20/2010	7.55	21.59	15.51
9/21/2010	3.40	23.06	13.95
9/22/2010	13.37	30.58	21.09
9/23/2010	13.96	26.30	20.57
9/24/2010	16.02	30.56	21.79
9/25/2010	16.35	27.60	22.64
9/26/2010	10.88	23.92	16.51
9/27/2010	12.53	14.89	13.97
9/28/2010	14.43	24.16	19.33
9/29/2010	17.25	26.83	21.20
9/30/2010	16.65	24.49	20.17
Low	3.40	14.89	12.98
High	20.31	34.99	26.63
Average	12.38	24.86	18.55
Std Dev	4.16	4.63	3.72
Total	N/A	N/A	N/A

Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:33 AM

Report Period: September 2010

Date	Rain Fall (mm)
9/1/2010	0.00
9/2/2010	0.00
9/3/2010	0.00
9/4/2010	0.00
9/5/2010	0.00
9/6/2010	0.00
9/7/2010	0.00
9/8/2010	0.25
9/9/2010	0.00
9/10/2010	0.00
9/11/2010	0.00
9/12/2010	0.00
9/13/2010	0.00
9/14/2010	0.00
9/15/2010	0.00
9/16/2010	5.84
9/17/2010	1.02
9/18/2010	0.00
9/19/2010	0.00
9/20/2010	0.00
9/21/2010	0.00
9/22/2010	0.00
9/23/2010	1.02
9/24/2010	0.00
9/25/2010	0.00
9/26/2010	0.00
9/27/2010	9.65
9/28/2010	26.92
9/29/2010	0.00
9/30/2010	40.13
Low	0.00
High	40.13
Average	2.83
Std Dev	8.61
Total	84.83

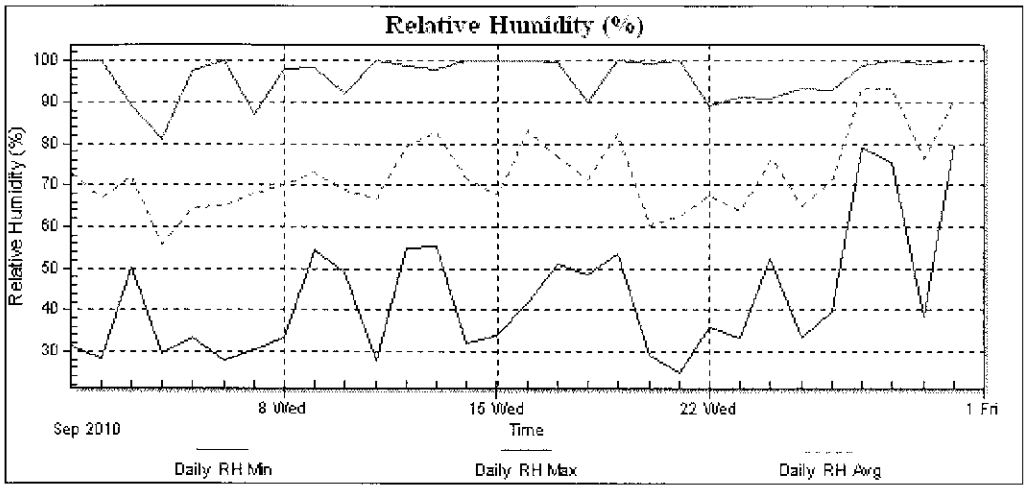
Weather Station: ET106

Location:

Report Type: 1 Month

Created: Thursday, February 03, 2011 11:33 AM

Report Period: September 2010



Date	RH Min	RH Max	RH Avg
9/1/2010	30.97	100.00	72.86
9/2/2010	28.21	99.90	66.66
9/3/2010	50.17	88.90	71.95
9/4/2010	29.62	81.00	55.82
9/5/2010	33.36	97.60	64.47
9/6/2010	27.92	100.00	65.01
9/7/2010	30.38	87.00	67.88
9/8/2010	33.12	97.80	70.03
9/9/2010	54.53	98.20	72.87
9/10/2010	49.04	92.10	68.98
9/11/2010	27.69	100.00	66.57
9/12/2010	55.01	98.90	79.24
9/13/2010	55.46	97.90	82.56
9/14/2010	32.16	100.00	71.67
9/15/2010	33.93	100.00	67.59
9/16/2010	41.73	100.00	83.17
9/17/2010	51.17	99.60	76.83
9/18/2010	48.39	89.80	71.26
9/19/2010	53.42	100.00	82.44
9/20/2010	29.10	99.10	60.23
9/21/2010	24.93	100.00	62.60
9/22/2010	35.70	89.20	67.53
9/23/2010	33.45	91.30	63.77
9/24/2010	52.33	90.80	76.24
9/25/2010	33.39	93.20	66.19
9/26/2010	39.66	92.70	70.72
9/27/2010	78.70	98.90	93.23
9/28/2010	75.60	99.90	93.34
9/29/2010	38.55	99.20	76.61
9/30/2010	79.80	100.00	90.55
Low	24.93	81.00	55.82
High	79.80	100.00	93.34
Average	42.92	96.10	72.59
Std Dev	15.11	5.04	9.20
Total	N/A	N/A	2177.57

2010

Publications

2010
Peer Reviewed Manuscripts Published

Cheplick, S., Y. Kwon, P. C. Bhowmik and K. Setty. 2010. Phenolic-linked variation in strawberry cultivars for potential dietary management of hyperglycemia and related complication of hypertension. Bioresource Technology 101:404-413

Ghosh, S., H. Hashayekhi, P. C. Bhowmik and B. Xing. 2010. Colloidal stability of Al_2O_3 nanoparticles as affected by coating of structurally different humic acids. Langmuir 26(2)873-879

Sarkar, D., P. C. Bhowmik, K. Shetty. 2010. Effects of marine peptide and chitosan oligosaccharide on high and low phenolic creeping bentgrass clonal lines and improvement of antioxidant enzyme response. Agronomy Journal 102:981-989

2010
Research Abstracts Published in Proceedings

International

Bhowmik, P.C. and J. Ebdon. 2010. Tolerance of Kentucky bluegrass cultivars to sulfosulfuron. International Meeting of Agronomy Society of America, Crop Science Society of America and Soil Science Society of America, October 31- November 4, 2010. Long Beach, CA. Abstract no.234, C_5-77-3
Available: http://a-c-s.confex.com/crops/2010am/webprogram/Paper60838.html

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New England Region

Invited Speaker

Bhowmik, P.C. 2010. Weeds: Indicator species for landscapes and other environments. 18th. Annual Turfgrass Conference & Show, Vermont Greenscape Association Inc., Lebanon, VT, December 7, 2010.

2010
Presentations at International, National, and Regional Conferences

International

Bhowmik, P. C. 2010. Biology and control of *Kyllinga gracillima* in turfgrass environments. 2010 Second European Turfgrass Society Conference, April 11-14, 2010, Angers, France.

Bhowmik, P. C. 2010. Characteristics of invasive plant species: Its importance to ornamental horticulture. 28th. International Horticultural Congress, August 22-27, 2010, Lisbon Congress Center, Lisbon, Portugal.

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Bhowmik, P.C. 2010. Leader in Group Discussions at the 33rd. Annual Fulbright Association Conference, Buenos Aires, Argentina, November 4-7, 2010,

National

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New England Regional

Invited speaker:
Bhowmik, P.C. 2010. Weeds: Indicator species for landscapes and other environments. 18th. Annual Turfgrass Conference & Show, Vermont Greenscape Association Inc., Lebanon, VT, December 7, 2010.

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2010

Poster Presentations

Biology and control of *Kyllinga gracillima* in Turfgrass Environments

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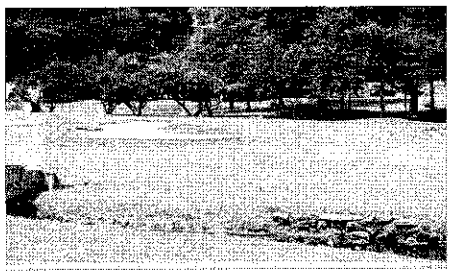
-90-

Introduction

The genus *Kyllinga* from the Cyperaceae family consists of 40 to 45 different weedy species commonly known as "spikesedge" (Tucker, 1987). The genus *Kyllinga* is widely distributed in the tropical, subtropical, and warm temperate regions around the world (Holm et al., 1979; Tucker, 1987). In the United States, 5 to 6 species of *Kyllinga* are known as problem weeds in turfgrass, pastures and roadside environments. All these species are apparently introduced into the United States from Asia during early 19th century. These species are commonly found as a weed in turfgrass environments.

Kyllinga stands are extremely persistent, and are difficult to control. Limited control information is available. The objectives were to evaluate several herbicides for their effectiveness in Kyllinga control.

Heavy infestation of *Kyllinga gracillima*



Plant Characteristics

Plants are either low rhizomatous perennials or annuals with triangular stems, and with 1 to 5 grass-like basal leaves. Leaf blades are V-shaped with prominent midribs and finely toothed margins. They produce 2 to 4 spreading terminal inflorescence with cylindrical, spherical, or dome-shaped spikes or heads (Table 1). The number of spikelets per spike varies from 15 to 150, and they are surrounded by a tiny scale like bracteole. All *kyllinga* species produce viable seeds. Achenes are laterally compressed, narrowly ovoid to oblong, or ellipsoid with finely punctuate surface.

Common Kyllinga Species

There are three common types of kyllinga found as a weed in the United States. Green kyllinga (*Kyllinga brevifolia* Rottb.) is the most commonly found in turfgrass environment among all kyllinga species (Figure 1). A closely related perennial species is false green kyllinga (*Kyllinga gracillima* Miq.) (Figure 2). Green and false green kyllinga are difficult to differentiate based on vegetative characteristic as both species are rhizomatous and of similar seed heads. They can only be distinguished by time of flowering and seed morphology. Another important perennial species found in the United States is fragrant kyllinga (*Kyllinga odorata* Vahl.) (Figure 3).

Materials & Methods

Field trials were conducted in a golf course rough, heavily infested with *Kyllinga gracillima* (KG). Sulfosulfuron (35, 70 and 105 g ai ha^{-1}), halosulfuron (35, 70 and 140 g ai ha^{-1}), ethoxysulfuron (140, 280 and 420 g ai ha^{-1}), and mesotrione (90, 180 or 270 g ai ha^{-1}) were evaluated, including timing of application (early and late) and volume of application (473 and 946 L ha^{-1}). Treatments were replicated three times in a randomized block design. All treatments were applied with X-77 at 0.25 % (v/v) on June 3 and June 25, 2009, respectively.

Results

For discussion purposes, weed control greater than 70% was considered acceptable. Sulfosulfuron, halosulfuron and ethoxysulfuron controlled KG by over 80% (Table 2). Early or late application of sulfosulfuron, ethoxysulfuron or halosulfuron provided 80 to 90% control of KG. Volume of application did not influence the efficacy of any of these treatments. Mesotrione treatments gave only 60 to 70% control of KG, which was not considered acceptable.

Morphological differences of Kyllinga species

Morphological characteristics	Green kyllinga *Kyllinga brevifolia*	False green kyllinga *gracillima*	Fragrant kyllinga *Kyllinga odorata*
Life cycle	Perennial	Perennial	Perennial
Rhizomes	Present	Present	Absent
Culms	15-40 cm tall	12-48 cm tall	5-30 cm tall
Inflorescence	1-3 heads	Single head	1-3 heads
Bracts	Spreading	Spreading	Strongly reflexed
Spikelets	Green	Green	White

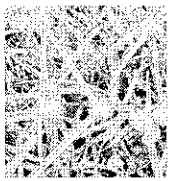


Figure 1. *Kyllinga brevifolia*

Figure 2. *Kyllinga gracillima*

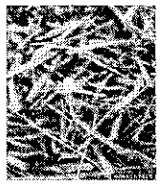
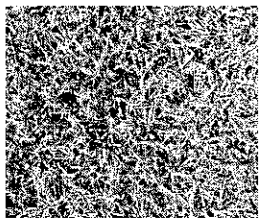
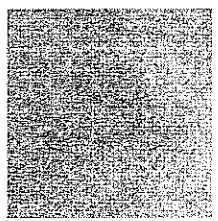


Figure 3. *Kyllinga odorata*

Impacts

In recent years, kyllinga species have become more prevalent in golf courses, and they are spreading rapidly (Bhowmik and Sarkar, 2009; Yelverton, 1996). The whole plant or fragments of the perennial kyllinga species spread as contaminants in transported turfgrass sods and sprigs. Frequent irrigation, and higher mowing frequency without removal of clippings around golf course greens, enhances vegetative reproduction of kyllinga species. In golf courses it creates a major problem in putting greens because of its fast growth. Seeds and rhizomes are spread by mowing, foot traffic, and cultivation. This allows the production of new plants and become an invasive species.





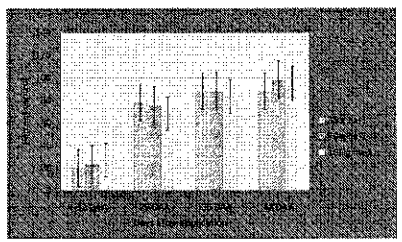


Figure 4. Control of *Kyllinga gracillima* with sulfosulfuron

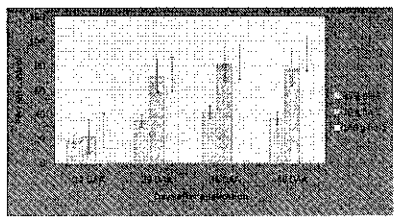


Figure 5. Control of *Kyllinga gracillima* with halosulfuron

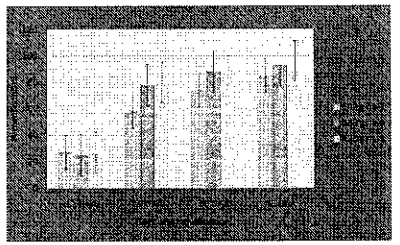


Figure 6. Control of *Kyllinga gracillima* with ethoxysulfuron

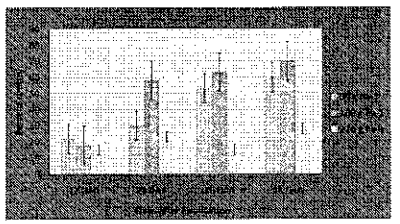


Figure 7. Control of *Kyllinga gracillima* with mesotrione

Conclusions

- The genus *Kyllinga* is introduced into the United States from Asia.
- It spreads quickly to form dense monoculture stands. Populations rely solely on vegetative regeneration of rhizomes.
- This species is spreading more and more towards New England states and southern states
- Stands are extremely persistent, and are difficult to control.
- Sulfosulfuron, halosulfuron and ethoxysulfuron controlled KG by over 80%.
- Timing of application or volume of application did not affect the efficacy of these treatments.
- This species has a potential to become an invasive species.

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Tolerance of Kentucky Bluegrass Cultivars to Sulfosulfuron

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Introduction & Objectives

Introduction

Sulfosulfuron [1-(4,6-dimethoxypyrimidin-2-yl)-3-[(2-ethanesulfonyl-imidazo[1,2-a]pyridine-3-yr)sulfonylurea] is a sulfonylurea herbicide that is labeled for use in cool-season and warm-season turfgrass species. This herbicide controls susceptible weed species by inhibiting the production of three essential amino acids used in protein biosynthesis. Sulfosulfuron is effective in controlling many of the broadleaf weeds found in turfgrass environments. Limited information is available on the tolerance of Kentucky bluegrass cultivars to sulfosulfuron.

Study Objectives

Our objective was to identify the response of various Kentucky bluegrass cultivars to sulfosulfuron.

Materials & Methods

Test Site

The National Turfgrass Evaluation Program trial at the University of Massachusetts Amherst was used to evaluate the herbicide tolerance of 172 cultivars of Kentucky bluegrass. These plots were established in 2000, and maintained with 196 kg N ha^{-1} yr^{-1}. Plots were 0.9 by 1.8 m in size. This trial was a split-block design with three blocks having cultivars as the main plot and two mowing heights (1.25 and 3.125 cm) as sub-plot. Experimental area was mown twice a week with clippings returned.

Sulfosulfuron

Sulfosulfuron was applied POST to Kentucky bluegrass at the rate of 75 g ai/ha on July 21, 2009 (Figure 1). Treatments were applied using a CO2-backpack sprayer with Teejet XR 1104 VS nozzles at 152 kPa using a spray volume of 467 L/ha. Turfgrass injury was visually estimated on a scale of 1 to 9, 1 = dead turfgrass, while 9 = healthy green turfgrass. Injury ratings were made 1, 2, and 3 weeks after treatment (WAT).

Results & Discussion

Height of Cut (HOC)

Little or no injury observed on 1.25 cm HOC (Figure 1), therefore injury data are reported for 3.125 cm HOC only.

Cultivar

In general, Kentucky bluegrass exhibited a wide range of tolerance to sulfosulfuron (Table 1). Injury was significantly greater at 2 WAT, but no interaction was observed between cultivar and injury rating period. 'Serene' and 'Langara' Kentucky bluegrass exhibited little injury following sulfosulfuron treatments at 1 WAT and injury was statistically equal to the untreated check (Table 1). Injury ratings ranged from 4.67 ('Champagne' and 'Misty') to 8.67 ('Serene') at 1 WAT (Figure 2). Injury following sulfosulfuron was significantly greater at 2 WAT. 'Serene' was the only entry to provide an injury rating greater than 8.0, which was equal to the untreated check. Injury ratings ranged from 4.0 ('Champagne') to 8.67 ('Serene') at 2 WAT.

Figure 1. Kentucky bluegrass test before (left) and after (right) sulfosulfuron treatment.

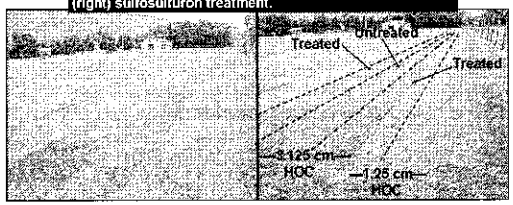
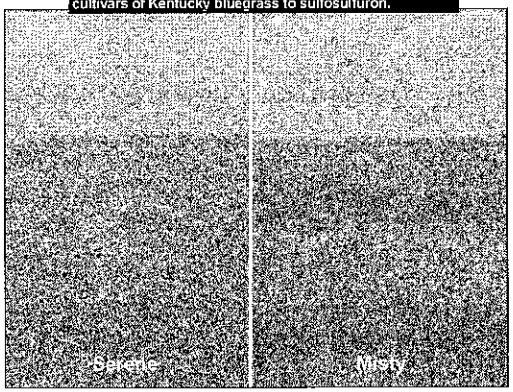


Figure 2. Differential tolerance of 'Serene' and "Misty' cultivars of Kentucky bluegrass to sulfosulfuron.



Conclusions

- Little or no injury was observed on 1.25 cm height of cut.
- 'Serene' and 'Langara' Kentucky bluegrass exhibited little injury following sulfosulfuron treatments at 1 WAT.
- Injury ratings ranged from 4.67 ('Champagne' and 'Misty') to 8.67 ('Serene') at 1 WAT.

Literature Cited

Bhowmik, P. C., J. S. Ebdon and T. Griffin. 2009. Tolerance of NTEP Kentucky bluegrass cultivars to sulfosulfuron. Massachusetts Weed Science Research Results – 2009. Vol. 28:53-62.

Table 1. Kentucky bluegrass tolerance to sulfosulfuron.

Entry Name	Injury Rating (1 to 9, 1=No Injury)			
	1 WAT	2 WAT	3 WAT	Average
Serene*	8.67	8.67	7.67	8.33
Sapphire*	7.33	7.33	6.00	7.00
Langara*	8.00	7.00	7.67	7.56
Venona*	8.00	7.33	6.67	7.33
ARG-142	7.00	7.00	7.33	7.11
PST-10B/79	7.67	7.00	6.33	7.00
PST-161	7.00	6.67	7.33	7.00
Bluenext*	7.67	6.00	6.33	7.00
BH&M-602	7.00	7.33	6.67	7.00
BAR-Pp-0413	7.33	6.67	7.00	7.00
Langara	7.33	7.00	6.67	6.67
Apollo*	7.67	6.67	6.33	6.89
NuDestiny*	7.33	6.33	7.00	6.89
Moon Shadow*	7.00	6.67	7.00	6.89
Blackstone*	7.33	6.00	7.33	6.89
Perfect*	7.33	6.33	6.67	6.78
Rambler*	7.67	6.33	6.33	6.78
A97-457	7.00	6.67	6.67	6.78
Envicta*	6.67	6.33	7.00	6.67
Chateau*	7.33	6.33	6.33	6.67
SR-7254*	7.33	6.00	6.67	6.67
A93-385	7.00	6.33	6.67	6.67
A97-1433	7.67	6.33	5.67	6.56
Bluestar*	7.67	6.33	5.67	6.56
Envoy*	7.33	6.00	5.33	6.56
A2-685	7.00	6.33	6.33	6.56
Rambo*	7.00	5.67	7.00	6.56
Unique*	7.00	6.00	6.67	6.56
Moonlight*	7.33	6.33	6.00	6.56
Midnight II*	7.00	6.00	6.33	6.44
Marquis*	7.00	6.33	6.00	6.44
Alive*	7.67	6.33	5.33	6.44
A97-1332	7.00	6.33	6.00	6.44
Shamrock*	7.00	6.00	6.33	6.44
DLF-76-1072	6.67	6.67	6.00	6.44
Blue Sapphire*	7.33	6.00	5.67	6.33
DLF-76-0834	7.00	6.00	6.00	6.33
Columbia*	6.67	6.33	6.00	6.33
Freedom III*	6.67	6.33	6.00	6.33
Bluestone*	6.33	6.00	6.67	6.33
Bimini*	6.33	6.67	6.67	6.22
Pp H-2007	7.00	6.00	5.67	6.22
Glennmore*	7.00	6.00	5.67	6.22
Voyager II*	6.67	6.00	6.00	6.22
Brilliant*	7.00	5.67	6.00	6.22
V92-253	6.67	6.00	6.00	6.22
Midnight*	6.67	6.00	6.00	6.22
BH-96-601	6.67	6.00	6.00	6.22
Julius*	6.67	6.33	5.67	6.22
Brooklawn*	6.67	6.00	6.00	6.22
NM-902	7.00	6.00	5.67	6.22
Kingfisher*	6.67	6.00	6.00	6.22
Dynamo*	7.33	6.00	5.33	6.22
Diva*	7.00	6.33	5.33	6.22
A96-457	6.67	6.00	6.00	6.22
Goldrush*	6.67	6.00	5.67	6.22
Perfection*	6.67	6.33	5.67	6.22
Everclear*	6.67	6.00	6.00	6.22
Midnight*	6.33	5.67	6.33	6.11
Boomerang*	6.67	5.67	6.00	6.11
Blazerunner*	6.33	6.33	5.67	6.11
Arrow*	7.00	6.00	5.33	6.11
Nemesis*	7.00	6.00	5.33	6.11
SR-144	6.67	6.33	5.33	6.11
Quantumleaf*	7.00	5.67	5.67	6.11
Bedazzled*	6.33	6.00	6.00	6.11
Raven*	6.33	5.67	6.33	6.11
Bo-84-140	6.67	6.00	5.67	6.11
A97-1469	7.00	5.67	5.67	6.11
Bryte*	7.00	6.00	5.33	6.11
Royce*	7.00	6.00	5.33	6.11
Everlyne*	6.67	6.00	5.67	6.11
Wildwood*	6.67	5.67	5.67	6.00
Everway*	6.67	5.33	6.00	6.00
Mallard*	6.33	5.67	6.00	6.00
PST-H6-150	7.00	5.67	5.33	6.00
Abbey*	6.67	5.67	5.67	6.00
DLF-Q6-0107	7.00	5.67	5.33	5.89
XB-1029	6.00	6.00	5.67	5.89
Evolve*	6.67	5.67	5.67	5.89
Bariome*	6.33	6.00	5.67	5.89
Barron*	6.33	6.00	5.67	5.89
Mia*	6.67	6.33	5.00	5.89
Chariot*	6.00	5.67	6.00	5.89
Royale*	6.67	6.00	5.00	5.89
Shamrex*	6.33	6.00	5.33	5.89
Wellington*	6.67	6.00	5.00	5.89
BS-43	6.33	6.33	5.00	5.89
Bo-83-113	6.00	6.00	5.67	5.89
93-M-33	6.33	6.33	5.00	5.89
Mongoose*	6.67	5.67	5.33	5.89
Odyssey*	6.33	6.33	5.00	5.89
Touareg*	6.33	6.67	5.67	5.89
Lily	5.67	6.00	5.67	5.78
Radiated*	6.67	5.33	5.33	5.78
Pp H-7872	6.00	5.00	5.33	5.78
Lakeshore*	6.00	5.00	5.33	5.78
Apollo*	6.67	5.67	5.00	5.78
SRX-27921	6.33	5.00	5.00	5.78
SRX-2014	6.33	5.00	5.00	5.78
ABS-103	6.00	5.67	5.67	5.78
Alive*	6.33	5.67	5.33	5.78
Bermuda*	6.00	5.67	5.67	5.78
Rugby II	6.33	5.67	5.33	5.78
Award*	5.67	6.00	5.67	5.78
Freedom*	6.00	5.67	5.67	5.78
SR-SLM8	6.33	5.33	5.67	5.78
PST-B3-170	6.67	6.00	4.67	5.78
Pp H-7920	5.67	6.00	5.33	5.67
PST-R5-125	6.33	6.00	4.67	5.67
Bellatrista*	6.00	5.67	5.33	5.67
Bo-87-298	6.00	5.67	5.33	5.67
Aaas*	5.67	6.00	5.33	5.67
Impact*	6.00	5.67	5.33	5.67
Midlands*	6.00	5.33	5.67	5.67
PST-H6-35	6.00	5.67	5.33	5.67
Barrio*	5.67	6.00	5.33	5.67
Hallmark*	7.00	5.67	4.00	5.56
PST-Trim Harbor	6.33	5.33	5.00	5.56
Dynamo*	6.00	5.67	5.00	5.56
B5-45	5.00	5.67	5.00	5.56
Casablanca*	5.00	5.33	5.33	5.56
PST-B4-241	6.33	6.00	4.33	5.56
Columbia*	5.00	5.33	5.33	5.56
Unknown	5.67	5.33	5.67	5.56
Jefferson*	6.00	5.67	5.00	5.56
Everlast*	5.67	5.67	5.33	5.56
Blue Velvet*	6.00	5.33	5.33	5.56
BAR-Pp-0568	6.67	5.67	4.33	5.56
Blue Ridge*	5.00	5.67	5.67	5.44
Aaas*	6.00	5.33	5.00	5.44
ABS-451	6.33	5.33	4.67	5.44
Arcadia*	5.33	5.67	5.33	5.44
Seaside*	6.00	5.67	4.67	5.44
Total Eclipse*	6.33	5.00	5.00	5.44
BAR-Pp-0471	6.00	5.33	5.00	5.44
BAR-Pp-0572	6.33	5.33	4.67	5.44
Bellissima*	6.00	5.33	4.67	5.33
Pp H-6396	5.33	5.33	5.33	5.33
Moxie Girl*	6.00	5.33	4.67	5.33
Mercury*	6.00	5.00	5.00	5.33
Blue Knight	6.00	5.00	5.00	5.33
DLF-H6-9038	5.67	5.33	5.00	5.33
Awesome*	6.00	5.33	4.67	5.33
Beyond*	5.33	5.33	5.33	5.33
Liberator*	5.00	5.33	4.67	5.33
ABS-739	5.67	5.33	5.00	5.33
Lancelina*	5.33	5.00	5.33	5.22
SRX-24161	5.67	5.33	4.67	5.22
ABS-124	5.33	5.33	5.00	5.22
PST-B4	5.33	5.33	4.67	5.11
HV 238	5.67	5.33	4.00	5.00
CVS-20631	5.00	4.67	5.33	5.00
HS-555	5.33	5.00	4.67	5.00
Javier*	5.67	5.00	4.33	5.00
SRX-00245	5.00	5.33	4.67	5.00
B4-128A	5.33	5.00	4.67	5.00
Bandar*	5.33	5.00	4.67	5.00
Winterhaven*	5.33	5.33	4.00	4.89
Aerobrushe*	5.67	5.00	3.67	4.78
PST-223	5.00	5.00	4.33	4.78
PQA-472	4.67	5.00	4.67	4.78
Patriotism RS*	5.67	5.00	3.67	4.78
Chicago F	4.67	5.00	4.67	4.78
Nuttx-Star*	5.00	5.00	4.33	4.78
HV-148	5.00	4.67	4.33	4.67
BAR-Ka-0403	5.00	5.33	4.67	4.67
SHAR-716	5.33	4.67	4.00	4.67
Champion*	5.67	5.00	3.33	4.67
Rampart*	4.67	4.67	4.33	4.56
Misty*	4.67	4.33	4.33	4.44
Shelter*	5.00	4.67	3.67	4.44
Champagne*	4.67	4.00	3.33	4.00
LSD (0.05)	1.23	1.20	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

*Commercially available.

2010 International Annual Meetings
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October 31 to November 4, Long Beach, CA

Ingress of *Poa Annua* into Perennial Ryegrass Stands

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Introduction & Objectives

Introduction

Annual bluegrass (*Poa annua* L.) is an opportunistic grassy weed that invades turfgrass stands under thinning caused by traffic, disease and other biotic and abiotic stresses (Gibeault and Goetze, 1973; Mitich, 1998). Annual bluegrass (ABG) forms a weak sod that provides poor footing for athletic fields and golf courses. Good density is important to minimizing the ingress of ABG. To that end planting of adapted species and genotypes are one of several strategies for maintaining turfgrass function. Limited information is available on the resistance to ABG of new perennial ryegrass (*Lolium perenne* L.) genotypes.

Study Objectives

The objective of this study was to assess the ingress of ABG into 120 genotypes of perennial ryegrass over a 5-year period as part of the 2004 National Turfgrass Evaluation Program (NTEP) test.

Materials & Methods

Test Site

The National Turfgrass Evaluation Program trial at the University of Massachusetts Amherst was established in 2004 and maintained with 196 kg N ha^{-1} yr^{-1}. Plots were 0.9 by 1.8 m in size and arranged as a randomized complete block design with three replicates. Experimental area was mown twice a week at 3.175 cm with clippings returned. Percent ABG was assessed visually in the fall of each year beginning in 2006 until 2009. Encroachment of ABG was assessed in relationship to other factors such as Pythium blight (*Pythium aphanidermatum*) incidence (July, 2005), wear tolerance (September, 2005), and percent fall cover (October, 2005). Disease and wear tolerance were assessed using a 1 to 9 rating scale (9= no disease or wear injury, 6=minimum acceptable). Wear was applied using a differential slip wear machine (D.S.1).

Data Analysis

Percent ABG was analyzed using additive main effect and multiplicative interaction (AMMI) analysis, which has demonstrated gains in accuracy within a single trial over ordinary ANOVA (Ebdon and Gauch, 2002).

The AMMI model is, $Y_{ger} = \mu + \alpha_g + \beta_e + {}^{N}\Sigma_{n=1}\lambda_n \varsigma_{gn} \eta_{en} + \rho_{ge} + \varepsilon_{ger}$

where Y_{ger} is the ABG rating of genotype g in environment e (year) for replicate r, μ is the grand mean, α_g are genotype mean deviations, β_e are the environment mean deviations, N is the number of interaction principal component (IPC) axes retained in the model, λ_n is the singular value for IPC axis n, ς_{gn} are the genotype singular vector values for IPC axis n, η_{en} are the environment singular vector values for IPC axis n, ρ_{ge} are the AMMI residuals, and ε_{ger} is the error term.

The goal of the analysis is to summarize the interaction SS using a few IPC axes (typically, N = 1 to 3), leaving a reduced model with AMMI residuals (ρ_{ge}) containing mostly noise. Several models were compared (see Ebdon and Gauch, 2002) for evaluating predictive accuracy. The models evaluated included the additive two-way model (AMMI0), which retains none of the interaction axes, AMMI1 to AMMIN models, which combine the additive main effects and the interaction estimated from 1 to N IPC axis with the remaining IPC axes discarded, and also the full model (AMMIF), i. e., the empirical cell means model (means averaged over replicates, or raw data), equivalent to ordinary means for genotype-year combinations from ANOVA.

The predictive values from each model were compared to the validation set by computing the sum of squared differences, dividing this by the number of validation observations and finally taking the square root to give the root mean square predictive difference (RMS PD). This cross validation/data splitting procedure was repeated 1,000 times and results averaged. The model having the best predictive accuracy (smallest RMS PD) was selected.

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Results & Discussion

Model Accuracy

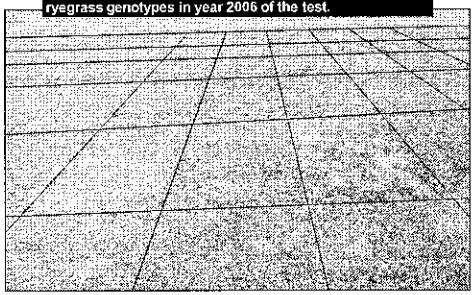
AMMI0 model (additive model, genotype and year main effect means) was identified as the optimum model for accuracy in predicting ABG ingress in future years (Table 1). AMM0 exhibited the smallest RMS PD (10.5459) based on 480,000 validations and had a AMMI gain factor of 6.31. Compared to AMMIF (i. e., genotype-year means averaged over replications), one replication using AMM0 would require 6.31 replications using AMMIF to achieve the same accuracy. G x Y interaction was principally noise so partitioning of interaction SS using AMMI revealed that AMMI reduced models were not statistically significant (AMMI1 and AMMI2) (Table 2). So, genotype means averaged over year shown in Table 3 were optimal in accuracy in predicting ABG cover. As such, all data shown in Table 3 is ordered by percent ABG ingress according to genotype main effects means averaged over year.

ABG Cover by Genotype and Year

ABG ingress into perennial ryegrass stands increased with age of the turf from a low in 2006 (12.6%) to its highest level in 2009 (17.6%) (Table 3). Significant genetic diversity in ABG cover was observed in all years of the test after the establishment year in 2005 (Figure 1, Table 3). Fall cover (density) in October, pythium blight in July, and the ability of perennial ryegrass to tolerate wear in the 1st full year of the test (2005) were closely associated with ABG cover. ABG cover decreased with greater perennial ryegrass fall cover (r=–0.678, p≤0.001), greater wear tolerance (r=–0.365, p≤0.001) and greater tolerance to pythium blight disease (r=–0.251, p=0.006).

Commercially available entries including 'Citation Fore' and 'Line Drive GLS' averaged less than 5% ABG along with experimental entries 'D04-1667', 'LCK' and 'DP 17-9788'.

Figure 1. Annual bluegrass encroachment into perennial ryegrass genotypes in year 2006 of the test.



Conclusions

- AMMI analysis of ABG ingress into perennial ryegrass identified AMMI0 (main effect means for genotype) was 6.31 times more accurate in predicting ABG in future years than genotype by year means (AMMIF).
- 'Citation Fore ' and 'Line Drive GLS' were most resistant to ABG (≤ 5%).
- Greater fall cover, better wear tolerance and superior disease resistance in the 1st full year of the test reduced ABG invasion.

Literature Cited

Ebdon, J. S., and H. G. Gauch. 2002. Additive main effect and multiplicative interaction analysis of NTEP trials: I. Interpretation of genotype x environment interaction. Crop Sci. 42:489–496.

Gibeault, V. A., and N. R. Goetze. 1973. Annual meadow-grass. *J. Sports Turf Res. Inst.* 48:48-53.

Mitich, L. W. 1998. Annual bluegrass (*Poa annua* L.). *Weed Tech.* 12:414-416.

Table 1. Root mean square predictive difference (RMS PD) for % *Poa annua* ingress into 120 genotypes of perennial ryegrass over 4 year period.

Model	df	RMSPD	AMMI gain†	Free observations§
AMMI0	122	10.54590*	6.31	9086
AMMI1	243	11.41464	1.98	2851
AMMI2	362	12.07537	1.24	1786
AMMIF	479	12.48881	1.00	0

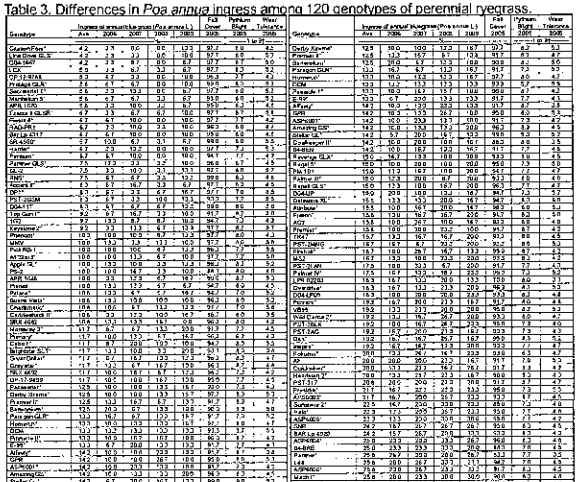
†Gain in replications with model compared with 1 replication using AMMIF.

§Number of free observations compared with AMMIF based on 480 treatments and 3 replicates.

Table 2. AMMI analysis of % *Poa annua* in 120 genotypes over 4 years.

Source	df	SS	MS	F ratio
Block	2	10501	152.9	
Treatment	479	120017	250.6	2.68***
Genotype (G)	119	87000	731.1	7.83***
Year (Y)	3	4598	1532.8	16.40***
G x Y	357	28418	79.6	0.85
AMMI1	121	13808	114.1	1.22
AMMI2	119	7822	65.7	0.70
Error	958	89432	93.4	

Table 3. Differences in *Poa annua* ingress among 120 genotypes of perennial ryegrass.



*Commercially available.

† Rating scale, 9=no disease or injury from wear. Wear was applied using slip wear.

Acknowledgment

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