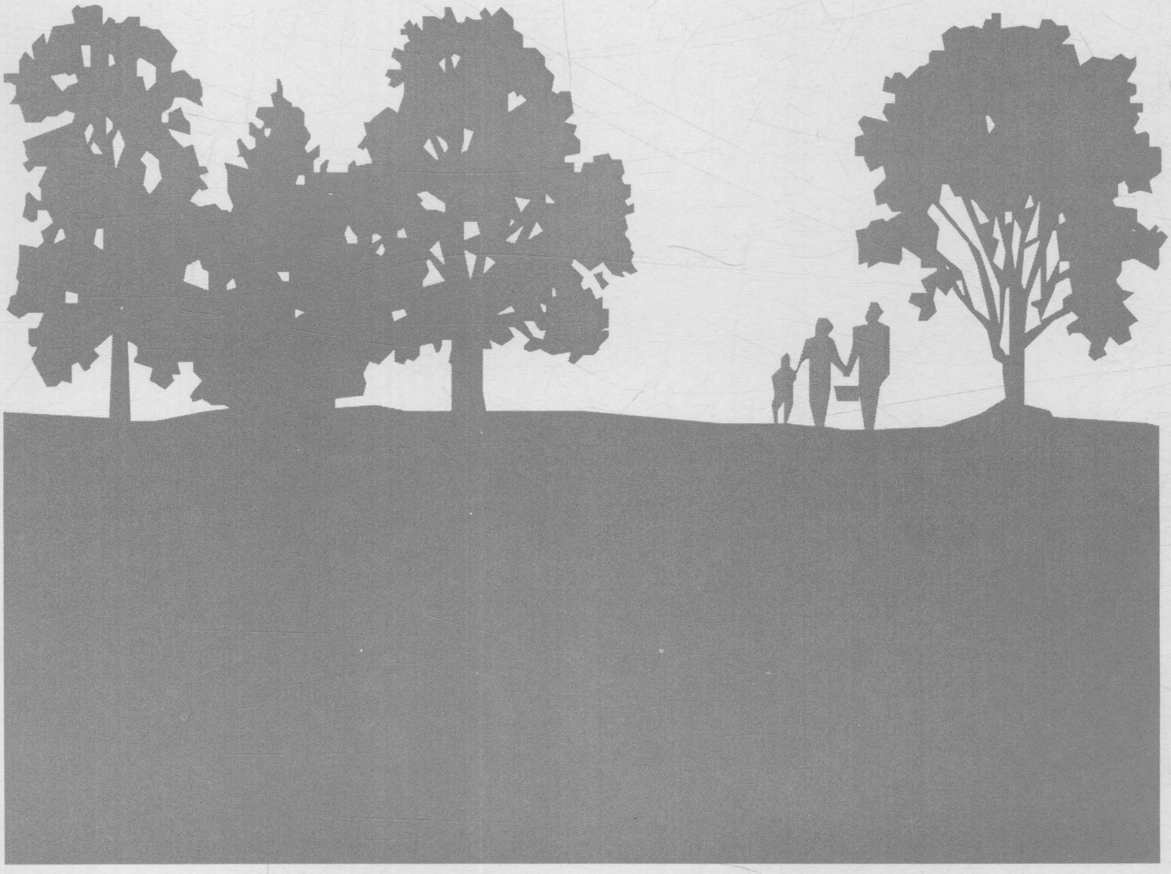
1994 Turfgrass Research Report



THE OHIO STATE UNIVERSITY

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Special Circular 148

Ohio Agricultural Research and Development Center
Wooster, Ohio 44691

OARDC
Thomas L. Payne
Director

The Ohio State University
Ohio Agricultural Research and Development Center
Wooster, Ohio 44691

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This booklet presents the 1994 Turfgrass Research Report from The Ohio State University and the Ohio Agricultural Research and Development Center. We hope this information provides insight into our diverse 1994 research effort. The reports herein are not to be reprinted without permission from the authors.

Jill Taylor, Editor

The Ohio State University
Turfgrass Research Personnel

Mr. Mark Belcher
Research Assistant
Entomology

Mr. Greg Bell
Graduate Student
Horticulture and Crop Science

Ms. Barbara Bloetscher
Research Assistant
Horticulture and Crop Science

Dr. Karl Danneberger
Associate Professor
Horticulture and Crop Science

Mr. Rob Golembiewski
Graduate Student
Horticulture and Crop Science

Ms. Marcella Grebus
Graduate Student
Plant Pathology

Dr. Harry Hoitink
Professor
Plant Pathology

Dr. Ed McCoy
Associate Professor
Natural Resources

Ms. Carol Musselman
Technical Assistant
Plant Pathology

Dr. Harry Niemczyk
Professor Emeritis
Entomology

Dr. William Pound
Senior Research Associate
Horticulture and Crop Science

Mr. Kevin Power
Research Associate
Entomology

Mr. Douglas Richmond
Graduate Student
Entomology

Mr. Joe Rimelspach
Research Assistant
Plant Pathology

Dr. John Street
Associate Professor
Horticulture and Crop Science

Ms. Renee Stewart
Research Assistant
Horticulture and Crop Science

Dr. David Shetlar
Assistant Professor
Entomology

Dr. Patty Sweeney
Research Associate
Horticulture and Crop Science

Ms. Jill Taylor
Research Assoc. and Field Mgr.
Horticulture and Crop Science

Turfgrass Research Support

The following companies, associations and foundations have generously supported turfgrass research at The Ohio State University, through the Ohio Agricultural Research and Development Center and Ohio State University Extension for the 1994 year. Their support has allowed the Ohio State University Turfgrass program to grow, resulting in information beneficial to the turfgrass industry.

Agridyne
AgriEvo
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Biosys
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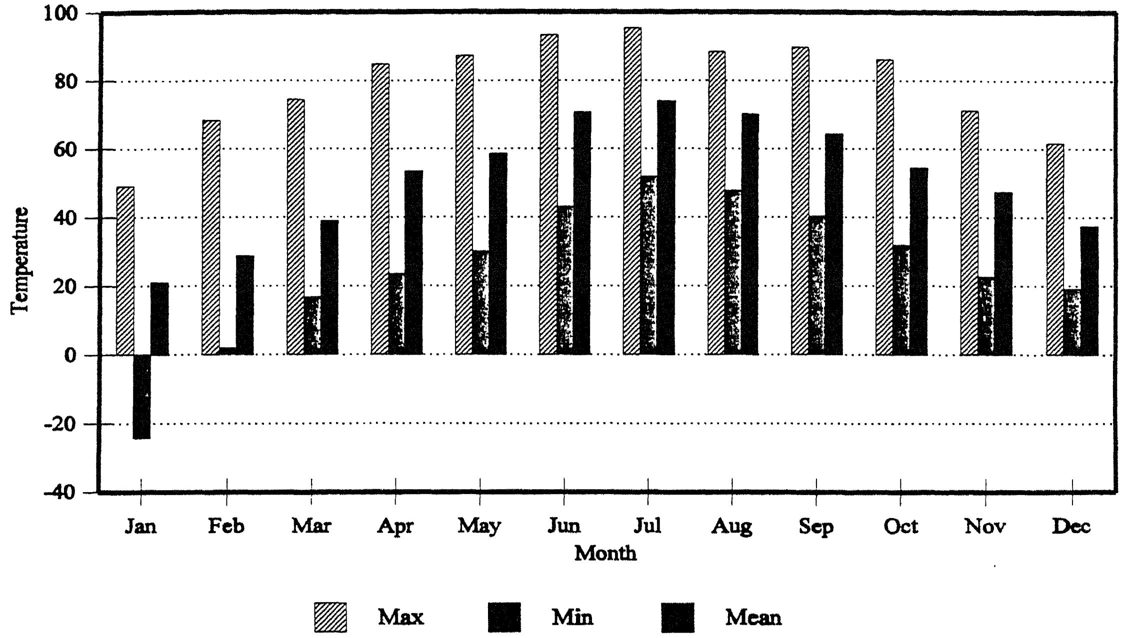
Tiger Machinery
Turfco, Inc.
Turf Seed
United Horticultural Supply
Valent USA
W. R. Grace
Zeneca

1994 Air Temperatures

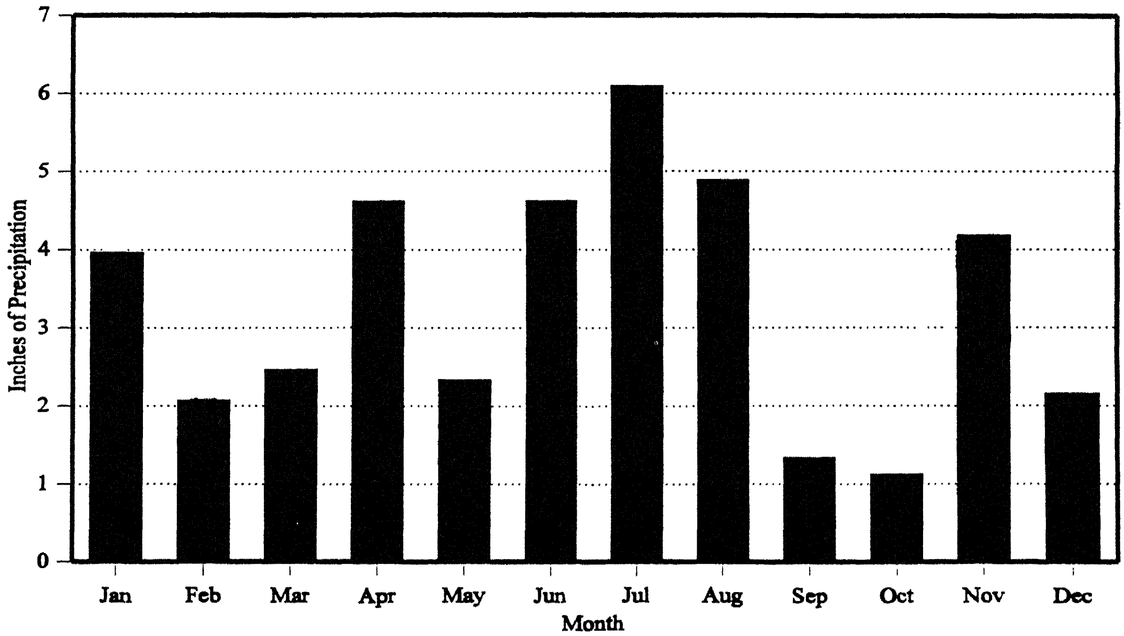
Columbus, Ohio



Maximum (Max), Minimum (Min) and Mean Temperatures in °F

1994 Monthly Precipitation

Columbus, Ohio



Total 1994 Precipitation = 39.91 inches

Turfgrass Weed Control

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Moss Control on Bentgrass Greens Evaluation

Jill Taylor
Horticulture and Crop Science

Introduction

Moss infestation on turf is widely attributed to poor turfgrass vigor. Underlying factors include low fertility, poor drainage, soil compaction, wet shaded conditions and poor air circulation. These factors do not promote a healthy vigorous turf that prevents moss infestation.

There are thousands of moss species. Mosses have a wide variation in adaptation to environmental conditions. Not much is known about their specific physiologies or their control in turf. It is widely accepted that mosses disseminate primarily by spores and have root-like filaments that attach to soil particles.

In the past, eradication of moss from golf course greens has been variable. Control, if successful, was temporary unless the underlying adverse environmental conditions were corrected. Treatments traditionally used have been iron, mercury compounds and lime. Some herbicides and fungicides have shown non-target control of moss, but are not recommended on greens due to turfgrass injury.

If moss does establish, control should be started immediately. Physical removal of a small moss establishment would be a wise first step, as moss can multiply rapidly if left unchecked. Proper fertility levels should be maintained. Due to the varied nature of hundreds of moss species, and of construction and maintenance of bentgrass greens, no chemical control management is absolute.

Discussion/Summary

Moss has established on several USGA bentgrass greens at The Ohio State University Turfgrass Research Center over the past several years. At least three different species were found on one green alone. These species are common and are known to establish in a wide variety of surfaces ranging from rocky sandy soils to sidewalk cracks and roofs.

For the past two years, several products and compounds have been applied monthly to two of our moss-infested bentgrass greens. Two of these products are labeled for moss control in turf. In 1993, no additional fertilizer was applied to these greens, other than any fertilizer contained in the treatments. Some moss reduction was noted in treatments containing fertilizer, apparently by increasing the turfgrass vigor and "shading out" the moss.

In 1994, about one pound of quickly available nitrogen fertilizer in 0.25 pound monthly increments was applied to these greens, in addition to treatments. Turf vigor improved on all treated plots, and all treatments had moss reduction compared to the check treatment.

Visually rating moss "control" in test plots is somewhat difficult. While some of the chemical treatments cause moss to change color (darker green or black), this is not a sure indicator moss will die. It appears that if moss changes color to tan/red or yellow, moss kill is imminent. However, there is no guarantee new moss will not establish.

In 1994, we experimented with using a vertical slicing machine on half of our moss test plots. While mosses were physically cut and showed signs of browning and drying out, new vigorous moss growth appeared a few days later in the slits.

Fertilizer products alone promote a vigorous turf to shade out mosses. However, moss may reestablish from soil borne or wind-borne spores when soil is exposed after loss of vigor. Adequate, but not high, levels of nitrogen are recommended.

Products containing fertilizer plus iron have reduced moss cover. However, increases in the fertilizer portion of this combination (from 0.1 to 0.6 lb ai N/1000 ft^2) reduced moss cover even more. Increased rates of lime (from 3 to 10 lb/1000 ft^2) reduced moss cover. Clorox bleach used at rates up to 16 oz/1000 ft^2 had some effect on moss reduction. Further testing is needed to confirm these preliminary findings.

Preemergent Spotted Spurge Broadleaf Weed Control Evaluation

William Pound and Renee Stewart
Horticulture and Crop Science

Introduction

Barricade 65 WG (common chemical name prodiamine) was recently registered as a preemergent annual weed control product for use in turfgrass. Many of the research studies conducted with prodiamine have been directed at quantifying the annual grass weed control capabilities of this active ingredient. Research is now needed to quantify the preemergent annual broadleaf weed control capabilities of this compound as numerous annual dicot weeds also routinely invade most turfgrass areas during the late spring/early summer period. A few of these weeds include yellow wood sorrel, knotweed, purslane, spotted spurge, etc. The purpose of this evaluation was to quantify the preemergent broadleaf weed control properties of prodiamine (as Barricade®65 WG) on spotted spurge (*Euphorbia supina*).

Discussion/Summary

This evaluation was initiated on April 29, 1994, at the Ohio State University Turfgrass Research Center in an area of low turfgrass density (50 to 70% cover) which had experienced significant spotted spurge encroachment in previous years. Because of the random establishment nature of this weed, four replications were included in the statistical design. In the initial treatments, Barricade 65 WG was applied at 0.49, 0.65, 0.75 and 1.15 lb ai/A. Gallery 75® DF was also included in the evaluation at the 0.75 lb ai/A rate. Per the protocol, two of the treatments received sequential 60-day retreatments.

On October 3, 1994, spotted spurge plant counts were made on each plot in the evaluation. Statistical analyses were performed on these data and are provided. As in the 1993 spotted spurge control evaluation, the results failed to show any statistically significant differences between any of the treatments. The results of the last two years of research on this subject definitively show that neither Barricade, Pendimethalin nor Gallery, applied as single spring treatments, is capable of providing 100% season long control of spotted spurge on this test site. Most likely, control is limited to various degrees of suppression of this annual broadleaf weed.

Once again, the lack of significant control in this year's trial is related to the lack of spotted spurge pressure in the check areas due largely to the intense establishment pressure from crabgrass. The untreated check plots contained very heavy crabgrass population, approaching 100% cover. Plots which were treated with Barricade had little crabgrass establishment and generally less than 65% vegetative cover. The impact of dense crabgrass establishment in check areas provided formidable competition to the germinating spotted spurge seedlings and most likely restricted its development. The results of spotted spurge weed counts made in the Gallery treatments are not consistent with the results of previous studies with Gallery in which weed counts have shown this herbicide to significantly inhibit the establishment of a variety of broadleaf weeds. These previous studies were long term endeavors which provided significant findings only after broadleaf weed establishment occurred within the untreated areas.

An alternative site has been identified for a 1995 evaluation. This site experienced very heavy spotted spurge density in 1994 with minimal encroachment from annual grass weeds such as crabgrass. On this site a study was initiated on November 4, 1994, and included fall applications of preemergent herbicides. Late winter/early spring treatments are planned for early March of next year. Another revision of the previous evaluations will include at least one mid-summer weed plant count. Many of the spotted spurge plants counted in this year's trial (October 3 reading) were small and undeveloped suggesting these weeds possibly germinated late in the growing season after the threshold concentration of the herbicides dropped below the critical soil concentration needed for the control of the seedling spotted spurge plants. With such data, the overall efficacy of the herbicides will be determined as well as comparisons in residual efficacy.

The results of trials the last two years provide additional confirmation that the maintenance of vegetative cover, either desirable turfgrass or annual grass weeds, is an important cultural control of annual broadleaf weeds.

Preemergent Spotted Spurge Broadleaf Weed Control Evaluation

List of Treatments

Treatments	Form.	Rate (lb ai/A)	Timing
1. Barricade	65 WG	0.49	PRE
2. Barricade	65 WG	0.65	PRE
3. Barricade	65 WG	0.75	PRE
4. Barricade	65 WG	1.15	PRE
5. Gallery	75 DF	0.75	PRE
6. Barricade+	65 WG	0.65	PRE
Gallery	75 DF	0.75	PRE
7. Barricade+	65 WG	0.49	PRE
Barricade	65 WG	0.25	SEQ
8. Barricade+	65 WG	0.75	PRE
Barricade	65 WG	0.38	SEQ
9. Check	—	—	—

Table 1. Spotted Spurge plants per plot

Treatments	Form.	Rate (lb ai/A)	Spotted Spurge Plants/Plots
1. Barricade	65 WG	0.49	7.3
2. Barricade	65 WG	0.65	4.0
3. Barricade	65 WG	0.75	4.3
4. Barricade	65 WG	1.15	5.3
5. Gallery	75 DF	0.75	7.3
6. Barricade+	65 WG	0.65	4.3
Gallery	75 DF	0.75	—
7. Barricade+	65 WG	0.49	10.0
Barricade	65 WG	0.25	—
8. Barricade+	65 WG	0.75	3.7
Barricade	65 WG	0.38	—
9. Check	—	—	8.3
		LSD (0.05)	6.48

Finale/Roundup Herbicide Demonstration Evaluation

William Pound and Renee Stewart
Horticulture and Crop Science

Introduction

The chemical company AgrEvo has recently commercialized the compound glufosinate, a new non-selective herbicide, under the trade name Finale®. Since 1990, four years of evaluations have been conducted at the Ohio State University's Turfgrass Research Center, quantifying the turfgrass uses/benefits of glufosinate. The purpose of the 1994 evaluation was to compare the performance of glufosinate to glyphosate as a non-selective herbicide.

Discussion/Summary

A study was initiated on August 3, 1994, comparing the performance of glufosinate at a 4.0 oz/gal rate to glyphosate at a 2.7 oz/gal rate. Three separate applications were made on three separate sets of plots. The application dates were August 3, 12 and 15, 1994. This procedure allowed a static display to be featured at the 1994 Ohio State University turfgrass research field day on August 17 exhibiting the performance features of glufosinate at 2, 5 and 14 DAT versus the activity of glyphosate under a similar treatment schedule.

Results of this evaluation showed significant initial discoloration was expressed 4 days sooner in the glufosinate-treated plots versus the glyphosate-treated plots. At only 2 DAT, the glufosinate-treated plots displayed 40% discoloration. The corresponding degree of discoloration was not expressed until 6 DAT in the glyphosate-treated plots. Discoloration of 90%+ can be expected to result at least 6 days sooner from glufosinate versus glyphosate applications.

In addition to the speed of vegetation control, glufosinate has performed well in our trials as a trimmer/edger product. Line integrity allows this product to be a preferred product option for edging along fences, around trees, ornamental beds, etc. Most other edger products on the market create rough, uneven lines which distract from the precision and aesthetics of the applications.

The results of this investigation suggest continued development is warranted as this compound offers some unique herbicidal benefits in the manicuring of commercial and residential turfgrass areas.

Table 1. Finale/Roundup Evaluation—% Turfgrass Discoloration

Treatment (rate)	2 DAT[a] (48 HAT)	3 DAT (72 HAT)	5 DAT (120 HAT)	6 DAT (144 HAT)	14 DAT (336 HAT)	15 DAT (360 HAT)
Roundup® (2.7 oz/gal)	5[b]	15	35	40	100	100
Finale® (4.0 oz/gal)	40	70	90	95	100	100
Check	0	0	0	0	0	0

[a]DAT=Days After Treatment; HAT=Hours After Treatment
[b]Percent turfgrass discoloration 1-100. (100=100% brown)

Turflon Solvent Evaluation

William Pound and Renee Stewart
Horticulture and Crop Science

Introduction

The DowElanco product, Turflon® Ester, is currently formulated in a solvent system containing petroleum distillates. An effort is currently underway to evaluate alternative solvents which preserve the triclopyr's chemical stability, yet maintain comparable efficacy and selective tolerance on the desirable turfgrasses.

Discussion/Summary

Two alternative solvent system evaluations were conducted in this year's testing program. The first evaluation tested and compared the efficacy of two rates (0.5 and 1.0 lb ai/A) of four alternative solvents (NAF-99, NAF-100, NAF-101 and NAF-102) to the current Turflon Ester commercial formulation on four common broadleaf weed species. In general, the results of that evaluation concluded the experimental formulations provided comparable efficacy to the current Turflon product on the weeds present.

On July 5, 1994, a second study was initiated on high quality Kentucky bluegrass to quantify the injury/phytotoxicity potentials of the alternative solvent-based formulations on the desirable turfgrass. Turfgrass color and injury data were collected 7, 15 and 28 DAT.

Applications of triclopyr-containing products can have a significant impact on turfgrass coloration. In comparison with the untreated check, significantly lighter green turfgrass resulted following applications of 1.0 lb ai/A, as recorded 20 DAT. In comparison with the current formulation, none of the alternative solvents significantly impacted turfgrass coloration on any of the three reading dates.

The injury data show varying degrees of phytotoxicity (expressed as reduced growth rates, discoloration, etc.) accompanied both the 0.5 and 1.0 lb ai/A rates of the Turflon Ester and all four alternative solvent experimentals. The highest incidence of statistically significant turfgrass injury was observed at the 1.0 lb rates of Turflon Ester, NAF-99 and NAF-100, with no significant differences recorded between the three formulations. This injury was most severe 5 DAT with significant injury still present 20 DAT. No significant turf injury was observed from either rate of the NAF-101 or NAF-102 formulations on any of the three reading dates.

In summary, the results of this evaluation indicate, in comparison to the current formulation, the alternative triclopyr solvent formulations do not significantly impact turfgrass coloration. These results also indicate applications of the NAF-99 and NAF-100 formulations will result in turfgrass injury levels comparable to similar rates of the current Turflon Ester formulation and that the NAF-101 and NAF-102 formulations may be slightly less injurious to the desirable turfgrass.

Table 1. Turflon solvent evaluation—color and phytotoxicity

Treatment	Rate (lb ai/acre)	Turf Color[a]			Turf Phyto.[b]		
		7/12	7/20	8/02	7/12	7/20	8/02
1. Turflon Ester	0.5	6.8	7.3	7.3	0.83	0.43	0.17
2. Turflon Ester	1.0	6.8	7.0	7.2	1.17	0.83	0.33
3. NAF-99	0.5	7.0	7.5	7.3	0.50	0.47	0.17
4. NAF-99	1.0	6.7	7.0	7.2	1.17	1.07	0.50
5. NAF-100	0.5	6.8	7.5	7.3	0.83	0.13	0.33
6. NAF-100	1.0	6.7	7.0	7.2	1.17	0.80	0.50
7. NAF-101	0.5	7.0	7.5	7.3	0.50	0.13	0.33
8. NAF-101	1.0	7.0	7.0	7.3	0.50	0.43	0.33
9. NAF-102	0.5	6.8	7.3	7.3	0.17	0.13	0.17
10. NAF-102	1.0	6.7	7.2	7.3	0.67	0.33	0.17
11. Check	--	6.7	7.5	7.2	0.17	0.00	0.00
	LSD (0.05)	0.49	0.36	0.47	0.61	0.49	0.38

[a]Turfgrass color ratings 1-10. (10=greenest)
[b]Turfgrass phytotoxicity ratings 1-10. (10=brown)

General Turfgrass Broadleaf Weed Control Evaluation

William Pound and Renee Stewart
Horticulture and Crop Science

Discussion/Summary

The 1994 General Broadleaf Weed Control Evaluation was initiated on May 27, 1994, on a heavy weed populated turfgrass area located in Worthington, Ohio. The broadleaf weed population consisted primarily of dandelion (*Taraxacum officinale*), buckhorn plantain (*Plantago lanceolata*), broadleaf plantain (*Plantago rugelii*) and white clover (*Trifolium repens*). The weather summaries for the six-week period subsequent to the applications featured slightly below normal temperatures and precipitation at the test location. Favorable daytime temperatures and adequate moisture to support plant growth resulted in active growth of all broadleaf weeds, as well as the desirable turfgrass, and provided ideal conditions under which to critically evaluate broadleaf weed control formulations.

Data were collected 2, 4 and 6 weeks after treatment (WAT). The formulations tested included a variety of spray-applied active ingredients formulated in amine, ester, emulsifiable concentrate and dry concentrate formulations. Additionally, five granular treatments were also included in this year's evaluation. During the past five years in which these evaluations have been performed, the efficacious responses attributed to the active ingredients reached a maximum 6 WAT. Therefore, the 6 WAT data were analyzed and the results are provided.

All five granular products tested were combination products of Confront (triclopyr+clopyralid) formulated on a fertilizer carrier. The results indicate the degree of control/efficacy of these granular formulated products to be comparable to similar rates of Confront applied in liquid spray form on the four weeds tested in this evaluation.

A total of 27 spray-applied treatments were evaluated. Buctril (2.0 pt/A) provided the least efficacy across the weeds tested. These results are consistent with previous studies evaluated on perennial weeds. Buctril is a contact herbicide possessing no systemic translocation to underground plant parts. This herbicide did provide some temporary thinning of the weed populations but little overall, long-term control.

DowElanco is currently evaluating various solvent systems for a potential replacement for the current solvents used in the formulation of Turflon Ester. Both the 0.5 and 1.0 lb ai/A rates of NAF-99, 100, 101 and 102 were evaluated and compared to the commercial Turflon Ester formulation. All experimental formulations provided comparable control to the current Turflon Ester formulation on dandelions, common plantain and white clover. Significantly less control was achieved, at both active ingredient rates of NAF-101 and 102, on buckhorn plantain when compared to the Turflon Ester. Additional testing of these two formulations is suggested on buckhorn plantain to confirm or refute the findings of this single evaluation. The addition of 2,4-D (1.00 lb ai/A) to the Turflon Ester significantly increased the speed of control and overall, the degree of efficacy.

As in previous years' studies, many of the Riverdale Chemical formulations provided some of the best performances in the evaluation. With the exception of RCTV11-94 and RCTD11-94 formulations, all Riverdale formulations provided excellent control on dandelion, buckhorn plantain and white clover. The most difficult weed to control in this evaluation was common/broadleaf plantain. This weed is commonly found in turfgrass areas around Ohio and routinely creates formidable challenges for most broadleaf weed control programs. In this year's evaluation, the degree of control was less than in previous years with the most efficacious herbicides providing 70 to 93% control. Most turfgrass managers realize repeat applications are often needed to eradicate broadleaf plantain from turfgrass areas.

For an applied assessment of efficacy of the individual treatments, consideration should be given to comparisons to industry standards. For many years now, many turfgrass managers have viewed the three-way combination products (2,4-D, MCPP+dicamba) as those standards. For individuals wishing to make such comparisons, PBI Gordon's Trimec (3.0 pt/A rate) and LESCO's Three-Way were included in this evaluation.

Results of this evaluation show that a number of acceptable broadleaf weed control products are commercially available for use on turfgrass and an additional number of promising experimental formulations and combination products are currently under development.

Table 1. Broadleaf Weed Control on Dandelion and Buckhorn Plantain

			% Dandelion Control			% Buckhorn Plan. Control		
Cooperator	Product	Rate	6/09	6/24	7/08	6/09	6/24	7/08
Scotts	S-4779	2.5 lb/M	43	80	87	45	70	77
Scotts	S-4779	3.0 lb/M	50	80	89	53	73	82
Scotts	S-4953	3.1 lb/M	48	85	89	48	86	83
Scotts	S-4953	3.7 lb/M	47	85	88	52	88	84
DowElanco	Confront+ Fertilizer	4.0 lb/M	50	85	90	47	80	87
Rhone-Poulenc	Buctril	2.0 pt/A	20	25	12	30	25	10
DowElanco	Confront	0.38 lb/A	53	82	83	58	77	77
DowElanco	Confront	0.75 lb/A	58	87	92	60	80	87
DowElanco	Turfln Est	0.50 lb/A	47	73	73	45	65	52
DowElanco	Turfln Est	1.00 lb/A	58	88	86	53	85	77
DowElanco	Turfln Est +2,4-D	1.00 lb/A 1.00 lb/A	67	98	100	67	95	99
DowElanco	NAF-99	0.50 lb/A	50	82	82	52	75	65
DowElanco	NAF-99	1.00 lb/A	57	87	88	60	78	75
DowElanco	NAF-100	0.50 lb/A	55	82	72	50	72	55
DowElanco	NAF-100	1.00 lb/A	59	88	88	60	68	71
DowElanco	NAF-101	0.50 lb/A	50	65	77	45	48	33
DowElanco	NAF-101	1.00 lb/A	60	75	85	52	62	63
DowElanco	NAF-102	0.50 lb/A	43	55	73	37	45	32
DowElanco	NAF-102	1.00 lb/A	50	72	83	52	52	55
Riverdale	Tri-Power Dry	2.34 lb/A	50	85	95	47	78	92
Riverdale	Tri-Power	48.0 oz/A	52	88	97	52	80	95
Riverdale	Dissolve	2.50 lb/A	52	87	98	55	83	95
Riverdale	RCTV11-94	7.6 oz/A	47	42	33	40	28	23
Riverdale	RCTD11-94	9.4 oz/A	43	62	30	40	40	29
Riverdale	RCATD-94	37.0 oz/A	48	83	92	49	77	93
Riverdale	RCAPT-94	42.7 oz/A	52	83	93	51	82	83
Riverdale	RCADPTE-94	52.3 oz/A	58	87	94	53	85	90
Riverdale	RCADPT-94	41.8 oz/A	60	88	94	57	85	90
Riverdale	RCADPD-94	41.8 oz/A	57	88	95	55	88	93
Riverdale	RCDPAD-94	41.8 oz/A	57	89	94	57	85	90
Standard	Trimec	3.0 pt/A	53	87	95	52	85	94
Standard	Three-Way	3.2 pt/A	57	91	95	53	88	93
Check	——	— —	0	0	0	0	0	0

LSD Value (0.05) =6.03 for the 7/08/94 Dandelion evaluation
LSD Value (0.05) for the 7/08/94 Buckhorn Plantain evaluation=7.92

Table 2. Broadleaf Weed Control on Broadleaf Plantain and White Clover

Cooperator	Product	Rate	% Brdlf Plan. Control 6/09	6/24	7/08	% White Clover Control 6/09	6/24	7/08
Scotts	S-4779	2.5 lb/M	30	30	21	53	92	100
Scotts	S-4779	3.0 lb/M	38	32	35	58	91	99
Scotts	S-4953	3.1 lb/M	30	50	32	53	95	100
Scotts	S-4953	3.7 lb/M	33	49	39	55	94	100
DowElanco	Confront+ Fertilizer	4.0 lb/M	33	35	38	60	97	100
Rhone-Poulenc	Buctril	2.0 pt/A	20	0	0	33	28	25
DowElanco	Confront	0.38 lb/A	28	30	27	57	93	98
DowElanco	Confront	0.75 lb/A	45	42	40	62	98	100
DowElanco	Turfln Est	0.50 lb/A	37	28	27	53	82	90
DowElanco	Turfln Est	1.00 lb/A	45	38	42	50	93	98
DowElanco	Turfln Est +2,4-D	1.00 lb/A 1.00 lb/A	55	85	93	68	99	100
DowElanco	NAF- 99	0.50 lb/A	40	21	27	60	93	93
DowElanco	NAF-99	1.00 lb/A	48	43	40	62	96	98
DowElanco	NAF-100	0.50 lb/A	N/A	N/A	N/A	55	93	94
DowElanco	NAF-100	1.00 lb/A	46	40	39	58	95	98
DowElanco	NAF-101	0.50 lb/A	39	24	25	52	82	87
DowElanco	NAF-101	1.00 lb/A	45	40	36	62	93	96
DowElanco	NAF-102	0.50 lb/A	39	26	22	47	85	88
DowElanco	NAF-102	1.00 lb/A	44	38	36	55	91	92
Riverdale	Tri-Power Dry	2.34 lb/A	6	60	84	50	96	100
Riverdale	Tri-Power	48.0 oz/A	42	54	82	58	95	100
Riverdale	Dissolve	2.50 lb/A	43	58	79	57	97	100
Riverdale	RCTV11-94	17.6 oz/A	25	19	17	50	68	78
Riverdale	RCTD11-94	9.4 oz/A	N/A	N/A	N/A	48	77	74
Riverdale	RCATD-94	37.0 oz/A	32	46	52	52	92	99
Riverdale	RCAPT-94	42.7 oz/A	33	43	54	53	94	100
Riverdale	RCADPTE-94	52.3 oz/A	32	40	61	55	96	100
Riverdale	RCADPT-94	41.8 oz/A	41	49	52	58	96	100
Riverdale	RCADPD-94	41.8 oz/A	46	52	70	57	97	100
Riverdale	RCDPAD-94	41.8 oz/A	47	51	69	60	96	100
Standard	Trimec	3.0 pt/A	45	50	67	53	95	100
Standard	Three-Way	3.2 pt/A	42	49	70	57	96	100
Check	—	— —	0	0	0	0	0	0

LSD Value (0.05) for the 7/08/94 Broadleaf Plantain evaluation=7.53
LSD Value (0.05) for the 7/08/94 White Clover evaluation =5.04

N/A—The plots did not contain sufficient numbers of weeds of this species to assess herbicide efficacy.

Postemergence Herbicide Efficacy on Crabgrass

John Street and Renee Stewart
Horticulture and Crop Science

Introduction

Postemergence crabgrass (*Digitaria* spp.) control for many years was primarily limited to the organic arsenicals (MSMA/DSMA). The organic arsenicals normally require repeat applications for effective postemergence crabgrass control and can cause some phytotoxicity/injury to desirable turfgrasses. Within the last few years, "Acclaim" has shown good efficacy for postemergence crabgrass control; however, some discoloration and stunting of Kentucky bluegrass may occur, and efficacy drops under droughty (dry) soil conditions. Dimension ® and Drive ® are the most recent postemergence crabgrass control herbicides under research evaluation.

Discussion/Summary

Various herbicides and rates were evaluated for post-emergence crabgrass control on an established stand of Kentucky bluegrass (see Table 1). Herbicides were applied to crabgrass at the 3-5 leaf to 1 tiller stage on July 13, 1994. All liquid applications were made with a CO_2-pressurized sprayer at 88 gpa. Rainfall occurred within 24 hours of herbicide application. Granular applications were applied by hand to wet/moist turfgrass/crabgrass foliage. The postemergence area was verticut in two directions in mid-April and overseeded with one pound of crabgrass seed per 1,000 ft^2. The stand was maintained at a mowing height of 0.75 inches until two weeks prior to herbicide treatment. A mowing height of 1¾ inches was maintained for the remainder of the research study. An annual total of three lbs. of nitrogen per 1,000 ft^2 was applied during the growing season. Irrigation was provided as needed to prevent wilt. Treatments were monitored for crabgrass control (percent crabgrass cover) at periodic intervals after herbicide application (see Table 1).

"Acclaim" in previous Ohio State University research has exhibited good efficacy for postemergence crabgrass control. Efficacy from "Acclaim" on crabgrass has been good up to the 3-4 tiller stage where soil moisture is adequate, but drops dramatically under droughty (dry) soil conditions, and when used in combination with phenoxy herbicides like 2,4-D. Erratic performance under droughty conditions reduces its reliability. Adequate foliar coverage is essential for best results. This entails (1) mowing prior to treatment to open the turf canopy for maximum spray contact on crabgrass foliage, and (2) sufficient spray volume to assure good foliar coverage. Some stunting and discoloration of Kentucky bluegrass may occur especially in the early season when bluegrass is growing rapidly.

"Acclaim" provided excellent postemergence crabgrass control at labeled rates in 1994 (see Table 1). "Acclaim" 1EC at 0.12 lb ai/A provided only fair control of crabgrass. Acclaim 1EC rates of 0.18 and 0.25 lb ai/A provided excellent control. Rainfall within 24 hours of application most likely reduced the efficacy of the 0.12 lb ai/A rate. Acclaim rate of activity in our previous Ohio State University research has been described as moderate, killing crabgrass in two to three weeks. Crabgrass knockdown and kill were slightly more rapid this year, occurring in one to two weeks.

The new isomer of "Acclaim" (an EW formulation) was tested in 1994 at rates ranging from 0.06 to 0.125 lb ai/A. The isomer rates are significantly lower than the standard Acclaim 1EC rates. The isomer (see Table 1) provided good crabgrass efficacy at the 0.06 lb ai/A rate and excellent control at the 0.09 to 0.125 lb ai/A rates. The rate of activity of the Acclaim isomer was similar to the standard Acclaim 1EC with crabgrass kill taking only one to two weeks. The inclusion of Coron and AgriPlex with either the Acclaim 1EC or isomer did not reduce efficacy, but instead aided in reducing the discoloration typically observed with either formulation of Acclaim.

Dimension is a relatively new herbicide released into the marketplace that exhibits both preemergence and postemergence herbicide activity on crabgrass. Dimension has proved to be an excellent preemergence herbicide. Postemergence activity of Dimension is slow with total kill ranging from three weeks (untillered crabgrass) to five weeks (early tillered crabgrass) (see Table 1). Dimension does, however, stunt crabgrass in ten to fourteen days making its presence in the turfgrass canopy less noticeable. The crabgrass is initially hidden within the canopy and then eventually dies over a three- to five-week period. During the stunting phase, crabgrass initially turns yellow and then a purple color.

Combinations of Dimension with MSMA (Daconate) have been shown to enhance the rate of kill and improve efficacy. In previous Ohio State University research, Dimension 1EC rates of 0.25, 0.38, and 0.50 lb ai/A in combination with 1.0, 0.5, and 0.25 lb ai/A rates of Daconate, respectively, have proved effective in enhancing the efficacy and rate of activity of Dimension. Dimension in combination with MSMA (Daconate) is not extremely effective beyond the three to four tiller stage. It will cause stunting, but kill may not occur.

In 1994, Ohio State University research with Dimension focused on evaluating the efficacy of lower rates for postemergence crabgrass control. Lower rates of Dimension have proven effective in our Ohio State University research for preemergence crabgrass control. Dimension rates of 0.125 to 0.50 lb ai/A were tested with the granular (GR), fertilizer granule (FG), and emulsifiable concentrate (EC) formulations. It required a Dimension rate of between 0.38 to 0.50 lb ai/A for acceptable postemergence crabgrass control. This rate is consistent with our 1993 findings. In 1993, the GR, FG, and EC formulations performed similarly. In 1994, the EC and FG formulations provided better efficacy than the GR formulation. All formulations required five- to six-weeks for complete crabgrass kill. Stunting and a hidden canopy effect occurred within two- to three-weeks after herbicide treatment.

Drive (BASF 514) has proved to be an excellent postemergence crabgrass herbicide. It also has good postemergence efficacy on foxtail and several broadleaf weeds. In previous Ohio State University research, Drive activity at rates ranging from 0.25 to 0.75 lb ai/A has proved very rapid, typically killing crabgrass in seven- to ten-days. Drive has provided excellent efficacy on mature crabgrass at the 0.50 to 0.75 lb ai/A rates. Drive efficacy does not appear to be as sensitive to soil moisture as Acclaim. Drive provided excellent postemergence control of crabgrass at 0.5 lb ai/A within seven- to ten-days after herbicide application in 1994 (see Table 1).

Herbicides ranked according to rate of postemergence herbicide activity are Drive > Acclaim > Dimension.

Table 1. Effect of Postemergence Herbicides on Crabgrass Efficacy on Kentucky Bluegrass

Treatment[a]	Formulation	lb. (ai/A)	Crabgrass Cover[b] 7-16	8-5	8-16	8-30
Dimension (Anderson) 19-3-6	0.072 FG	0.125	66.7	70.0	66.7	76.7
Dimension (Anderson) 19-3-6	0.072 FG	0.190	68.3	66.7	70.0	73.3
Dimension (Anderson) 19-3-6	0.072 FG	0.250	53.3	53.3	43.3	50.0
Dimension (Anderson) 19-3-6	0.072 FG	0.300	46.7	33.3	31.7	40.0
Dimension (Anderson) 19-3-6	0.072 FG	0.380	30.0	18.3	11.7	10.0
Dimension (Anderson) 19-3-6	0.072 FG	0.500	21.7	3.3	0.7	1.3
Dimension (Rohm & Haas)	0.25 GR	0.125	60.0	60.0	63.3	70.0
Dimension (Rohm & Haas)	0.25 GR	0.190	61.7	63.3	63.3	60.0
Dimension (Rohm & Haas)	0.25 GR	0.250	63.3	63.3	63.3	50.0
Dimension (Rohm & Haas)	0.25 GR	0.300	66.7	66.7	50.0	30.0
Dimension (Rohm & Haas)	0.25 GR	0.380	70.0	63.3	36.7	25.0
Dimension (Rohm & Haas)	0.25 GR	0.500	70.0	63.3	28.3	20.0
Dimension (Rohm & Haas)	1 EC	0.125	63.3	60.0	40.0	30.0
Dimension (Rohm & Haas)	1 EC	0.190	66.7	56.7	30.0	10.0
Dimension (Rohm & Haas)	1 EC	0.250	66.7	53.3	25.0	5.0
Dimension (Rohm & Haas)	1 EC	0.300	66.7	50.0	21.7	5.0
Dimension (Rohm & Haas)	1 EC	0.380	66.7	46.7	18.3	0.0
Dimension (Rohm & Haas)	1 EC	0.500	66.7	43.3	10.0	0.0
Acclaim	1 EC	0.12	10.0	8.3	8.3	10.0
Acclaim	1 EC	0.18	5.0	0.0	0.0	0.0
Acclaim	1 EC	0.25	5.0	0.0	0.0	0.0
Acclaim+Coron[c]	1 EC	0.18	3.0	0.0	0.0	0.0
Acclaim+AgriPlex[c]	1 EC	0.18	3.0	0.0	0.0	0.0
Acclaim Isomer	EW 360	0.06	10.0	2.0	1.7	5.0
Acclaim Isomer	EW 360	0.09	5.0	0.0	0.0	0.0
Acclaim Isomer	EW 360	0.12	54.0	0.0	0.0	0.0
Acclaim Isomer+Coron[c]	EW 360	0.12	56.7	0.0	0.0	0.0
Acclaim Isomer+AgriPlex[c]	EW 360	0.12	56.7	0.0	0.0	0.0
Drive	75 DF	0.50	5.0	0.0	0.0	0.0
Dimension	1 EC	0.38	56.7	11.7	0.0	0.0
+Daconate 6		0.50				
Check	——	——	66.7	73.3	76.7	83.3
		LSD (0.05)	9.65	9.40	7.30	7.95

[a]Herbicides were applied on July 13, 1994, to crabgrass at the 3-5 leaf to 1 tiller stages.
[b]Crabgrass ratings are based on percent crabgrass cover.
[c]Coron was applied at 0.50 lb N/1,000 ft² and AgriPlex at 1 fl oz/1,000 ft².

Preemergence Herbicide Efficacy on Crabgrass

John Street, Jill Taylor and Renee Stewart
Horticulture and Crop Science

Introduction

The evaluation of preemergence herbicides (*Digitaria* sp.) control on established turfgrass is a continuing process. Periodic evaluations are necessary to determine the suitability of new materials for use on various turfgrass species. Periodic evaluations are also helpful in observing and explaining variability in performance which occurs among preëmergence herbicides. Herbicide efficacy, reliability, and safety/phytotoxicity are all important in recommending a preemergence herbicide for usage on various turfgrass species.

Discussion/Summary

Preemergence herbicides were monitored for crabgrass efficacy and safety/phytotoxicity on Kentucky bluegrass. Preemergence experimental herbicides Ronstar 3.0 and Pre M 3.0 were applied on April 13, 1994. All other herbicides were initially applied on April 21, 1994. Sequential or split applications were made on June 15, 1994. Preemergence herbicides, application rates, and crabgrass control are listed in Table 1. The Kentucky bluegrass stand had been maintained at a mowing height of 1.5 inches prior to initiation of herbicide treatments on April 13. On May 10, 1993, the mowing height was lowered to 0.75 inches for the remainder of the study to encourage crabgrass pressure. An annual total of 3.0 lb N/1000 ft² was applied during the growing season. Irrigation was applied as needed to prevent wilt. Granular herbicides were distributed by hand. Liquid applications were made with a CO_2-pressurized sprayer at 88 gpa. Plots measured 3 x 8 feet and each treatment was replicated three times in a randomized complete block design. Crabgrass was overseeded at a rate of 1 lb per 1,000 ft² one week prior to herbicide application. Treatments were monitored for crabgrass infestation periodically throughout the growing season (see Table 1) and safety/phytotoxicity (see Table 2).

Dimension (dithiopyr) and Barricade (prodiamine) were monitored for a second year in a separate study for safety/phytotoxicity on creeping bentgrass cultivars. Dimension and Barricade rates of 0.5 and 1.0 lb ai/A were used. Herbicide treatments were applied on April 26, 1994. Safety/phytotoxicity was monitored throughout the growing season using a visual scale of one to nine with "nine" representing no injury and "one" representing severe injury.

The first crabgrass control rating was made on July 6 (see Table 1). Crabgrass in untreated plots averaged 20% at this time. Most herbicides and rates were exhibiting good to excellent efficacy on July 6. The Pre Exp 1 showed a significant break in control on July 6.

On August 1, most herbicides and rates again exhibited good to excellent herbicide efficacy. Herbicides/rates exhibiting a significant break in control on August 1 were Pre Exp 1, Pre Exp 2, Scotts S-240 (single), and Dimension FG (0.063 lb ai/A). Crabgrass control provided by this latter group of herbicides would have been considered unacceptable. Other herbicides exhibiting a slight break in control by September 1 were Pre Exp 3, Barricade FG (0.38 lb ai/A), and Dimension FG (0.94 lb ai/A). Dimension FG provided excellent crabgrass control at rates of 0.125 lb ai/A and greater. The Dimension EC (0.25 lb ai/A) provided excellent season-long control. Barricade FG and WG provided excellent control at 0.5 lb ai/A and greater.

The only herbicides that produced any visual phytotoxicity symptoms were the Pre Exps 1 and 2. Both herbicides caused a brilliant yellow coloration of Kentucky bluegrass foliage. Dandelions in the plots were even discolored. The discoloration was greater at the higher rate. The discoloration occurred at one week after application and lasted for 4-6 weeks depending on rate. The discoloration would have been unacceptable under quality turfgrass situations. No thinning or other phytotoxicity was evident.

Dimension EC and Barricade WG were also evaluated for their safety/phytotoxicity on high cut creeping bentgrass cultivars. Dimension at the 0.5 and 1.0 ai/A rates did not cause any significant phytotoxicity on any of the creeping bentgrass cultivars at the 0.5 ai/A rate. Some cultivars exhibited stress at the 1.0 ai/A rate. The Penn cultivars exhibited good tolerance. Dimension did cause all cultivars to exhibit a more blue-gray coloration. This coloration was most noticeable with the lighter green cultivars like Emerald. Cultivars tested included Pënncross, Penneagle, Pennlinks, Providence, Cobra, Emerald, SR 1019, Prominent, National, SR 1020 and Putter. There were no noticeable interactive effects of Dimension/Barricade related to post-treatment irrigation and sterol-inhibitor fungicide applications on Penncross creeping bentgrass. Both herbicides caused Penncross to turn a blue-gray green color.

Table 1. Effect of Preemergence Herbicides on Crabgrass Efficacy on Kentucky Bluegrass

Treatment[a]	Formulation	Rate (lb ai/A)	Crabgrass Cover (%)[b] 7-6	8-1	9-1
Pre Exp 1	75 WG	0.18	15.0	46.7	50.0
Pre Exp 1	75 WG	0.36	7.3	21.7	25.0
Pre Exp 2	0.37 G	0.18	5.7	25.0	31.7
Pre Exp 2	0.37 G	0.36	0.0	5.0	8.3
Pre Exp 3	1 G	1.0	1.3	4.0	7.3
Pre Exp 3	1 G	2.0	1.3	7.3	13.3
Ronstar	2 G	3.0	0.0	0.0	0.7
Pre M	60 WG	3.0	0.0	0.0	0.7
Team 27-3-8	1.15 FG	1.5+1.5 (split)	0.3	2.0	2.0
Team 27-3-8	1.15 FG	2.0	0.0	0.0	0.0
Team 27-3-8	1.15 FG	3.0	0.0	0.0	0.0
Prodiamine 19-4-6	0.22 G	0.5	0.0	0.0	0.0
Prodiamine 19-4-6	0.22 G	0.75	0.0	0.0	0.0
Prodiamine 19-4-6	0.22 G	1.0	0.0	0.0	0.0
Pendimethalin 28-3-4	1.21 G	1.5+1.5 (split)	0.0	0.0	0.0
Pendimethalin 28-3-4	1.21 G	1.5	0.0	0.0	0.0
Pendimethalin 28-3-4	1.21 G	3.0	0.0	0.0	0.0
Team (Pursell) 28-3-6	1.30 GR	1.5+1.5 (split)	0.0	0.7	0.7
Team (Pursell) 28-3-6	1.30 GR	2.0	0.0	0.0	0.0
Team (Pursell) 28-3-6	1.30 GR	3.0	0.0	0.0	0.0
Barricade (Andersons) 20-3-10	0.287 FG	0.38	0.0	5.0	8.3
Barricade (Andersons) 20-3-10	0.287 FG	0.50	0.3	2.3	6.7
Barricade (Andersons) 20-3-10	0.287 FG	0.65	0.3	0.7	1.3
Scotts S-5013	G	1.5+3.0	0.0	0.0	0.0
Scotts S-5013	G	0.75+1.5[c]	0.0	0.0	0.0
Scotts S-5010	G	1.0+0.125	0.0	0.0	0.0
Scotts S-5010	G	0.5+0.0625[c]	0.0	0.0	0.0
Scotts S-4067	G	1.0+0.75	0.0	0.0	0.0
Scotts S-4067	G	0.5+0.375[c]	0.0	0.0	0.0
Scotts S-2460	G	1.5+6.0	0.0	16.7	23.3
Scotts S-2460	G	0.75+3.0[c]	0.0	0.0	0.0
Barricade	65 WG	0.49	0.0	0.0	0.0
Barricade	65 WG	0.65	0.0	0.0	0.0
Dimension (Andersons) 19-3-6	0.072 FG	0.063	4.0	21.7	25.0
Dimension (Andersons) 19-3-6	0.072 FG	0.094	1.3	4.0	4.0
Dimension (Andersons) 19-3-6	0.072 FG	0.125	0.0	0.0	0.0
Dimension (Andersons) 19-3-6	0.072 FG	0.190	0.0	0.0	1.7
Dimension (Andersons) 19-3-6	0.072 FG	0.250	0.0	0.0	0.0
Dimension	1 EC	0.25	0.0	0.0	0.0
Dimension	1 EC	0.25+0.125(Split)	0.0	0.0	0.0
Dimension	1 EC	0.38	0.0	0.0	0.0
Check	——	——	20.0	50.0	55.0
LSD (0.05)			2.98	9.03	9.58

[a]Initial herbicide treatment was applied on April 13, 1994, for Pre Exps, Ronstar 3.0, and Pre M 3.0; and April 21, 1994, for all other treatments. Sequential or split applications were applied on June 15, 1994.
[b]Percent crabgrass is a visual estimate of percent crabgrass in plots.
[c] S-5-13 (Oxadiazon+Butralin), S-5010 (Oxadiazon + Dithiopyr),·S-4067 (Oxadiazon+Pendimethalin), and S-2460 (Oxadiazon+Bensulide) were applied at half rates on April 13 and June 15, 1994.

Table 2. Effect of Preemergence Herbicides on Phytotoxicity on Kentucky Bluegrass

Treatment[a]	Formulation	Rate (lb ai/A)	Phytotoxicity[b] 5-1	5-10	5-17	5-23
Pre Exp 1	75 WG	0.18	5	8	9	9
Pre Exp 1	75 WG	0.36	5	7	8	9
Pre Exp 2	0.37 G	0.18	7	9	9	9
Pre Exp 2	0.37 G	0.36	6	8	9	9
Pre Exp 3	1 G	1.0	9	9	9	9
Pre Exp 3	1 G	2.0	9	9	9	9
Ronstar	2 G	3.0	9	9	9	9
Pre M	60 WG	3.0	9	9	9	9
Team 27-3-8	1.15 FG	1.5+1.5 (split)	9	9	9	9
Team 27-3-8	1.15 FG	2.0	9	9	9	9
Team 27-3-8	1.15 FG	3.0	9	9	9	9
Prodiamine 19-4-6	0.22 G	0.5	9	9	9	9
Prodiamine 19-4-6	0.22 G	0.75	9	9	9	9
Prodiamine 19-4-6	0.22 G	1.0	9	9	9	9
Pendimethalin 28-3-4	1.21 G	1.5+1.5 (split)	9	9	9	9
Pendimethalin 28-3-4	1.21 G	1.5	9	9	9	9
Pendimethalin 28-3-4	1.21 G	3.0	9	9	9	9
Team (Pursell) 28-3-6	1.30 GR	1.5+1.5 (split)	9	9	9	9
Team (Pursell) 28-3-6	1.30 GR	2.0	9	9	9	9
Team (Pursell) 28-3-6	1.30 GR	3.0	9	9	9	9
Barricade (Andersons) 20-3-10	0.287 FG	0.38	9	9	9	9
Barricade (Andersons) 20-3-10	0.287 FG	0.50	9	9	9	9
Barricade (Andersons) 20-3-10	0.287 FG	0.65	9	9	9	9
Scotts S-5013	——	1.5+3.0	9	9	9	9
Scotts S-5013	——	0.75+1.5[c]	9	9	9	9
Scotts S-5010	——	1.0+0.125	9	9	9	9
Scotts S-5010	——	0.5+0.0625[c]	9	9	9	9
Scotts S-4067	——	1.0+0.75	9	9	9	9
Scotts S-4067	——	0.5+0.375[c]	9	9	9	9
Scotts S-2460	——	1.5+6.0	9	9	9	9
Scotts S-2460	——	0.75+3.0[c]	9	9	9	9
Barricade	65 WG	0.49	9	9	9	9
Barricade	65 WG	0.65	9	9	9	9
Dimension (Andersons) 19-3-6	0.072 FG	0.063	9	9	9	9
Dimension (Andersons) 19-3-6	0.072 FG	0.094	9	9	9	9
Dimension (Andersons) 19-3-6	0.072 FG	0.125	9	9	9	9
Dimension (Andersons) 19-3-6	0.072 FG	0.190	9	9	9	9
Dimension (Andersons) 19-3-6	0.072 FG	0.250	9	9	9	9
Dimension	1 EC	0.25	9	9	9	9
Dimension	1 EC	0.25+0.125 (Split)	9	9	9	9
Dimension	1 EC	0.38	9	9	9	9
Check	——	——	9	9	9	9

[a]Initial herbicide treatment was applied on April 13, 1994, for Pre Exps, Ronstar 3.0, and Pre M 3.0; and April 21, 1994, for all other treatments. Sequential or split applications were applied on June 15, 1994.
[b]Phytotoxicity is a visual reading.
[c]S-5-13 (Oxadiazon+Butralin), S-5010 (Oxadiazon+Dithiopyr), S-4067 (Oxadiazon+Pendimethalin), and S-2460 (Oxadiazon+Bensulide) were applied at half rates on April 13 and June 15, 1994.

Turfgrass Disease Control

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Leaf Spot Control Study

Joe Rimelspach, Karl Danneberger and Jill Taylor
Plant Pathology; Horticulture and Crop Science

Discussion/Summary

A fungicide control study for leaf spot (*Drechslera poae*) was initiated April 26, 1994, on a common Kentucky bluegrass turf located at the Ohio State University Turfgrass Research Center. The turf was maintained at 2-inch height of cut and watered when necessary. Fungicides were applied with a CO_2 sprayer with 8010 nozzles at 40 psi. The plots measured 3 x 8 feet and all treatments were replicated three times. Percent area infected was based on the sampling of 100 leaf blades per plot. Leaf spots were scored as either present or absent on a leaf. Treatments were made curatively. The treatment application dates were the following:

	Application Interval		
Date	14-day	21-day	28-day
April 26	X	X	X
May 10	X		
May 17		X	
May 24	X		X

Strong leaf spot pressure occurred in all treatments. Although most of the products were not statistically different, overall control appeared to be best with ASC67098-Z, Daconil, RH-0611 and Chipco 26019.

Table 1. Percent Leaf Spot Present on June 6, 1994

Treatment	Rate (oz/M)[b]	Interval (days)	% Leaf Spot[a] 6/6
ASC-67098-Z	3.6	14	17.3 a
Daconil 825 SDG	3.8	14	18.7 a
Daconil 2787 4.17F	6.0	14	22.7 ab
RH-0611	10.0	14	25.3 ab
Chipco 26019 FLO	4.0	21	26.7 ab
Fore	4.0	14	26.7 ab
Chipco 26019 WDG	2.0	21	28.0 ab
EXP 10452A	1.5	21	28.0 ab
Urea 46-0-0	1.0 lb/M	28	28.0 ab
Fore	8.0	14	29.3 ab
EXP 10452A	2.0	21	32.0 ab
Curalan	2.7 lbs ai/A	21	33.3 ab
Eagle WSP	0.6	1	33.3 ab
Control	——	——	45.3 b

[a]Percent based on infected leaves out of 100 sampled.
[b]M=1000 ft^2.
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Dollar Spot Control Study

Karl Danneberger, Joe Rimelspach and Jill Taylor
Horticulture and Crop Science; Plant Pathology

Discussion/Summary

A dollar spot (*Sclerotinia homoeocarpa*) control study was initiated on June 21, 1994, on a "Penncross" creeping bentgrass turf at the Ohio State University Turfgrass Research Center, Columbus. The turf was maintained under putting green conditions and mowed at 3/16 of an inch. The fungicide treatments were made with a CO_2 sprayer with 8010 nozzles at 40 psi. Granular products were applied by hand. The plots measured 5 x 6 feet and all treatments were replicated three times. The application dates for products applied on a 7-, 14-, 21-, 28-, or 42-day interval were:

	Application Interval				
Date	7-day	14-day	21-day	28-day	42-day
June 21	X	X	X	X	X
June 28	X				
July 5	X	X			
July 14	X		X		
July 20	X	X		X	
July 26	X				
August 2	X	X	X		X
August 9	X				
August 19	X	X		X	
August 23	X		X		
August 30	X	X			

Dollar spot pressure was good but not as severe as in past years. However, some general trends and observations were evident in this year's study. The chlorothalonil products (Daconil 2787 and Thalonil 90 DF) gave excellent dollar spot control on a 7-day schedule but failed to provide acceptable control at 14 days. The sterol inhibiting fungicides (Banner, Bayleton, Rubigan) provided excellent dollar spot control on 14- or 21-day intervals with sporadic control on 28-day intervals. Sentinel continued to perform well providing excellent dollar spot control on both a 28- and 42-day interval. However, in plots treated with Sentinel at 0.25 oz/1000 ft^2, a slight discoloration (blue color) and coarser leaf texture was noted. Chipco 26019 performed well at the 14-day interval. Aliette+Fore combination provided little control of dollar spot which would be expected since neither product shows efficacy on dollar spot. S-6044 gave excellent dollar spot control, and the overall density of the plots was rated the highest. However, the amount of growth that occurred may be excessive for most golf course superintendents.

Table 1. **Severity of dollar spot as expressed as a percent infected area on September 6**

Treatment	Rate (oz/M)[a]	Interval (days)	Disease (%)
Control	——	——	50.0 a
Control	——	——	36.7 b
Aliette+Fore	4+8	14	35.0 b
Fore FL	6.4	7	31.7 b
Daconil 2787 4.17F	6	14	20.0 c
TRA0028 4F	6.0	14	18.3 cd
Thalonil 90 DF	3.5	14	13.3 def
Bayleton	0.5	28	8.3 def
Fluazinam 500 F	1.0	21	8.3 def
Daconil 825 SDG	3.8	14	5.0 ef
Fluazinam 500 F	0.5	14	5.0 ef
EXP10361	5 lb ai/A	14	5.0 ef
S-4404	1X	14	5.0 ef
Bayleton+Prostar	1+2	21	4.0 ef
Bayleton+Prostar	1+2	28	4.0 ef
Rubigan 50 W	0.25	14	3.3 ef
Banner+Prostar	1+2	28	3.3 ef
EXP10452	0.5	14	3.3 ef
ASC-67098-Z	3.6	21	3.3 ef
Chipco 26019 WDG	1.5	14	3.0 ef
Sentinel 40 WG	0.17	28	1.7 f
RH-0611	10	14	1.7 f
Bayleton+Dac.2787	0.5+3.0	14	1.7 f
TRA0028 4F	6.0	7	1.7 f
Chipco 26019 WDG	2.0	14	0.7 f
Daconil 2787 4.17F	6	7	0.0 f
Curalan DF	2.7lb ai/A	14	0.0 f
Sentinel 40 WG	0.25	28	0.0 f
Sentinel 40 WG	0.25	42	0.0 f
EXP10452	0.75	14	0.0 f
EXP10452	1.5	14	0.0 f
EXP10452	2.0	14	0.0 f
Bayleton	0.5	14	0.0 f
Bayleton	1.0	14	0.0 f
Bayleton+Prostar	0.5+2.0	14	0.0 f
Thalonil 90 DF	3.5	7	0.0 f
Banner	1.0	14	0.0 f
Banner+Daconil 2787	1+4	21	0.0 f
Banner+Daconil 2787	1+4	28	0.0 f
Banner+Prostar	1+2	21	0.0 f
Eagle WSP	0.6	14	0.0 f
Eagle WSP	0.6	21	0.0 f
S-4404	2X	14	0.0 f
S-6044	1X	14	0.0 f
S-4404	2X	21	0.0 f
		LSD (0.05)	11.5

[a] M=1000 ft^2.
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Brown Patch Control Study

Karl Danneberger, Joe Rimelspach and Jill Taylor
Horticulture and Crop Science; Plant Pathology

Discussion/Summary

A fungicide efficacy trial for brown patch (*Rhizoctonia solani*) control was initiated on June 21, 1994, at the Ohio State University Turfgrass Research Center. "Penncross" creeping bentgrass was maintained at putting green height (3/16 of an inch) for this study. Fungicides were applied with a CO_2 sprayer with 8010 nozzles to plots measuring 5 x 6 feet. Granular applications were made by hand. All treatments were replicated three times and applied preventatively. The application dates were the following:

	Application Interval				
Date	7-day	14-day	21-day	28-day	42-day
June 21	X	X	X	X	X
June 28	X				
July 5	X	X			
July 14	X			X	
July 20	X	X			X
July 26	X				
August 2	X	X	X		X

Brown patch pressure was relatively high and uniform across the plot area providing the best test we have had in the last few years. Of the two dates brown patch was evaluated, the August 4 date provided the highest degree of infection (Table 2). Daconil, Thalonil, and Fore on 7-day schedule provided excellent brown patch control. Chipco 26019 and EXP10452 provided excellent control on a 14-day schedule. Prostar in combination with Bayleton or Banner provided consistent control on a 14-day schedule but was less effective on a 21-day schedule. Sentinel did not give the brown patch control as in past years but still provided good brown patch control. The combination Aliette+Fore on a 14-day schedule did not provide acceptable control, probably due to the fact that we do not get control for more than 7 days with Fore.

Table 1. Evaluation of fungicides for Brown Patch control July 20, 1994

Treatment	Rate (oz/M)[a]	Interval (days)	% Disease (7/20)
Control	——	——	26.7[a]
Bayleton	0.5	28	15.0 b
EXP10452	0.5	14	13.3 bc
Banner+Dac. 2787	1+4	28	13.3 bc
Sentinel 40 WG	0.17	28	11.7 bcd
Aliette+Fore	4+8	14	6.7 bcde
Rubigan 50 W	0.25	14	5.0 cde
Eagle WSP	0.6	14	5.0 cde
S-4404	2X	14	5.0 cde
Banner	1.0	14	3.7 de
S-4404	1X	14	3.3 de
TRA0028 4F	6.0	14	3.3 de
Chipco 26019 WDG	1.5	14	3.3 de
Sentinel 40 WG	0.25	28	1.7 e
Banner+Prostar	1+2	28	1.7 e
Fluazinam 500 F	0.5	14	1.7 e
Fluazinam 500 F	1.0	21	1.7 e
EXP10452	0.75	14	1.7 e
Daconil 2787 4.17F	6	14	0.0 e
Daconil 2787 4.17F	6	7	0.0 e
Daconil 825 SDG	3.8	14	0.0 e
ASC-67098-Z	3.6	21	0.0 e
Curalan DF	2.7lb ai/A	14	0.0 e
Sentinel 40 WG	0.25	42	0.0 e
Chipco 26019 WDG	2.0	14	0.0 e
EXP10452	1.5	14	0.0 e
EXP10452	2.0	14	0.0 e
EXP10361	5 lb ai/A	14	0.0 e
Bayleton	0.5	14	0.0 e
Bayleton	1.0	14	0.0 e
Bayleton+Dac. 2787	0.5+3.0	14	0.0 e
Bayleton+Prostar	0.5+2.0	14	0.0 e
Bayleton+Prostar	1+2	21	0.0 e
Bayleton+Prostar	1+2	28	0.0 e
Thalonil 90 DF	3.5	7	0.0 e
Thalonil 90 DF	3.5	14	0.0 e
TRA0028 4F	6.0	7	0.0 e
Banner+Dac. 2787	1+4	21	0.0 e
Banner+Prostar	1+2	21	0.0 e
Eagle WSP	0.6	21	0.0 e
RH-0611	10	14	0.0 e
Fore FL	6.4	7	0.0 e
S-6044	1X	14	0.0 e
S-4404	2X	21	0.0 e
		LSD (0.05)	9.7

[a] M=1000 ft^2.
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Table 2. Evaluation of fungicides for Brown Patch control August 4, 1994

Treatment	Rate (oz/M)[a]	Interval (days)	% Disease (8/4)
Control	——	——	35.0 a
Fluazinam 500 F	1.0	21	30.0 ab
Sentinel 40 WG	0.25	42	23.3 abc
Sentinel 40 WG	0.17	28	21.7 abcd
EXP10452	0.5	14	20.0 abcde
Banner+Dac. 2787	1+4	28	20.0 abcdef
Bayleton	0.5	28	15.0 bcdefg
Bayleton	0.5	14	15.0 bcdefg
S-6044	1X	14	13.3 bcdefg
Daconil 2787 4.17F	6	14	13.3 bcdefg
EXP10452	0.75	14	11.7 cdefg
TRA0028 4F	6.0	14	11.7 cdefg
Bayleton	1.0	14	11.7 cdefg
Aliette+Fore	4+8	14	11.7 cdefg
Fluazinam 500 F	0.5	14	10.0 cdefg
S-4404	2X	14	10.0 cdefg
EXP10361	5 lb ai/A	14	8.3 cdefg
EXP10452	2.0	14	8.3 cdefg
Eagle WSP	0.6	14	6.7 defg
Daconil 825 SDG	3.8	14	6.7 defg
Curalan DF	2.7lb ai/A	14	6.7 defg
Eagle WSP	0.6	21	5.0 efg
Thalonil 90 DF	3.5	14	5.0 efg
S-4404	2X	21	5.0 efg
Bayleton+Prostar	1+2	28	5.0 efg
Rubigan 50 W	0.25	14	5.0 efg
S-4404	1X	14	5.0 efg
Bayleton+Prostar	1+2	21	3.3 fg
Chipco 26019 WDG	1.5	14	3.3 fg
Bayleton+Dac. 2787	0.5+3.0	14	3.3 g
Sentinel 40 WG	0.25	28	3.3 g
Banner+Prostar	1+2	28	1.7 g
TRA0028 4F	6.0	7	1.7 g
Banner	1.0	14	1.7 g
Banner+Prostar	1+2	21	1.7 g
Daconil 2787 4.17F	6	7	0.0 g
ASC-67098-Z	3.6	21	0.0 g
Chipco 26019 WDG	2.0	14	0.0 g
EXP10452	1.5	14	0.0 g
Bayleton+Prostar	0.5+2.0	14	0.0 g
Thalonil 90 DF	3.5	7	0.0 g
Banner+Dac. 2787	1+4	21	0.0 g
RH-0611	10	14	0.0 g
Fore FL	6.4	7	0.0 g
		LSD (0.05)	17.1

[a] M=1000 ft^2.
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Anthracnose Control Study

Karl Danneberger, Joe Rimelspach and Jill Taylor
Horticulture and Crop Science; Plant Pathology

Discussion/Summary

An anthracnose fungicide study was initiated on July 27, 1994. The location was an annual bluegrass—Kentucky bluegrass mixed turf mowed at ½ inch at the Ohio State University Turfgrass Research Center, Columbus. Liquid applications were made with a CO_2 sprayer with 8010 nozzles at 40 psi. Granular applications were made by hand. The plots measured 5 x 6 feet and all treatments were replicated three times. The treatments were made curatively. The treatment schedule was the following:

Date	Application Interval 14-day	21-day
July 27	X	X
August 10	X	
August 22		X

Anthracnose severity was minimal during 1994. A relatively cool wet July and August discouraged the development of this disease. Sentinel, Eagle, Fluazinam, S4404, and S-6044 did show promise for controlling anthracnose.

Table 1. Evaluation of fungicides for control of Anthracnose

Treatment	Rate (oz/M)[a]	Interval (days)	% Disease (8/29)
Control	——	——	9.0 a
Daconil 2787 4.17F	6.0	14	5.0 ab
Sentinel	0.33	42	3.3 b
Bayleton+Prostar	0.5+2	14	3.3 b
S- 4404	1X	14	2.3 b
Bayleton	0.5	14	1.7 b
Eagle	0.6	21	1.7 b
RH-0611	6.0	14	1.7 b
Daconil 2787 825 SDG	3.8	14	1.7 b
Fluazinum	0.5	14	1.7 b
ASC-67098-Z	3.6	21	1.7 b
S-4404	2X	14	0.0 b
S-6044	1X	14	0.0 b
Eagle	0.6	14	0.0 b
Sentinel	0.25	42	0.0 b
Sentinel	0.33	28	0.0 b
Sentinel	0.25	28	0.0 b
Bayleton+Daconil 2787	0.5+3	14	0.0 b
Fluazinum	1.0	21	0.0 b
		LSD (0.05)	5.0

[a] M=1000 ft^2.
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Summer Patch Control Study

Joe Rimelspach, Karl Danneberger and Jill Taylor
Plant Pathology; Horticulture and Crop Science

Discussion/Summary

A summer patch (*Magnaporthe poae*) control study was conducted at Little Turtle Country Club in New Albany, Ohio. The treatments were applied to an annual bluegrass fairway that had a previous history of summer patch. Fungicide treatments were applied with a CO_2 sprayer with 8010 nozzles at 40 psi. The plots measured 9 x 6 feet and all treatments were replicated three times. The amount (percent) of summer patch in the plots was evaluated on July 8. The application dates were as follows:

	Application Interval			
Date	14-day	21-day	28-day	42-day
April 29	X	X	X	X
June 7	X	X	X	
June 17				X
July 8	X	X		X
July 22				X
August 2	X	X	X	X

A relatively cool summer resulted in sporadic and low disease development in the plots. In applying the fungicides, a 14-day application was missed in June which may have accounted for some loss in efficacy in some of the products. In general, Sentinel, Eagle, Banner, and Fluazinam performed well. Sentinel at the 0.66 oz product/1000 ft^2 rate resulted in severe phytotoxicity to the turf by the August 2 application date. Sentinel at 0.33 oz product/1000 ft^2 rate resulted in some of the turf turning a "light blue."

Table 1. Evaluation of fungicides for control of Summer Patch

Treatment	Rate (oz/M)[a]	Interval (days)	% Disease (7/8/94)
Sentinel 40 WG	0.33	42	33.3 a
Bayleton	4.0	28	20.0 ab
Fluazinam 500F	1.0	21	16.7 ab
Banner 1.1 EC	2.0	28	16.7 ab
Control	——	——	13.3 ab
ASC-67098-Z	3.6	21	6.7 b
Eagle WSP	1.2	14	3.3 b
Banner+Hydroflo	2.0+2	28	3.3 b
RH-0611	10.0	14	3.3 b
Fluazinam 500F	0.5	14	3.3 b
Sentinel 40 WG	0.25	28	0.0 b
Sentinel 40 WG	0.25	42	0.0 b
Sentinel 40 WG	0.33	28	0.0 b
Sentinel 40 WG	0.66	28	0.0 b
Eagle WSP	0.6	14	0.0 b
Banner 1.1 EC	4.0	28	0.0 b

[a]M=1000 ft^2.
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Yellow Tuft Control Study

Karl Danneberger, Joe Rimelspach and Jill Taylor
Horticulture and Crop Science; Plant Pathology

Discussion/Summary

A yellow tuft (*Sclerophthora macrospora*), also known as Downy Mildew, control study was initiated on a "Penncross" creeping bentgrass turf maintained at 3/16 of an inch (putting green situation) at the Ohio State University Turfgrass Research Center, Columbus. The fungicide treatments were made with a CO_2 sprayer with 8010 nozzles at 40 psi. The plots measured 5 x 6 feet and all treatments were replicated three times. The fungicides were applied preventatively on a 14-day schedule with the initial application being July 27 with subsequent applications on August 10 and August 24.

Considerable variation occurred in the yellow tuft control study. Consistent control over the two evaluation dates was somewhat lacking. In general, Subdue provided better control than Aliette or Banol. Better control of yellow tuft was achieved when Subdue, Aliette or Banol was combined with Daconil 2787. The best control was achieved with a combination of Subdue and Daconil 2787.

Table 1. Evaluation of fungicides for Yellow Tuft control

Treatments	Rate (oz/M)[a]	Interval (days)	Disease (%) (8/18)	Disease (%) (9/6)
Aliette+Daconil 2787	8+3	14	20.0 a	9.0 cde
Daconil 2787	3	14	18.3 ab	16.7 abcd
Banol	2	14	16.7 abc	26.7 ab
Control	——	——	13.3 abcd	16.7 abcd
Aliette WDG+Fore WP	4+8	14	13.3 abcd	10.0 cde
Banol	4	14	9.0 abcd	28.3 a
Aliette+Daconil 2787	4+3	14	9.0 abcd	15.0 bcd
Aliette+Daconil 2787	8+6	14	8.3 abcd	5.0 de
Aliette WDG	4	14	8.3 abcd	21.7 abc
Daconil 2787	6	14	8.0 abcd	6.7 e
Aliette+Daconil 2787	4+6	14	6.7 abcd	5.0 de
Aliette WDG	8	14	6.7 abcd	7.3 de
Banol+Daconil 2787	2+6	14	5.0 bcd	11.7 cde
Subdue 2E	2	14	4.0 cd	6.7 de
Banol+Daconil 2787	2+3	14	3.3 cd	0.7 e
Subdue 2E	4	14	1.7 d	0.0 e
Subdue+Daconil 2787	2+6	14	0.7 d	1.7 e
Subdue+Daconil 2787	2+3	14	0.0 d	8.3 de
		LSD (0.05)	13.4	13.0

[a] M=1000 ft^2
Means separated according to Duncan's Multiple Range Test. (P=0.05)

Red Thread Control Study, Columbus

Joe Rimelspach, Karl Danneberger and Jill Taylor
Plant Pathology; Horticulture and Crop Science

Discussion/Summary

A fungicide control study for red thread (*Laetisaria fuciformis*) was initiated April 26, 1994, on a common Kentucky bluegrass turf located at the Ohio State University Turfgrass Research Center. The turf was maintained at 2-inch height of cut and watered when necessary. Fungicides were applied with a CO_2 sprayer with 8010 nozzles at 40 psi. The plots measured 3 x 8 feet and all treatments were replicated three times. The number of 2-inch or greater red thread spots were counted in each plot. Treatments were made curatively. The treatment application dates were the following:

	Application Interval		
Date	14-day	21-day	28-day
April 26	X	X	X
May 10	X		
May 17		X	
May 24	X		X
June 7	X	X	

Good control of red thread was achieved with the experimentals ASC-67098-Z and EXP10452A and the fungicides Daconil and Chipco 26019.

Table 1. Evaluation of fungicide efficacy on Red Thread

Treatment	Rate (oz/M)[b]	Interval (days)	Red Thread[a] (6/3)
ASC-67098-Z	3.6	14	0.0 a
Daconil 2787 4.17F	6.0	14	1.0 ab
EXP 10452A	2.0	21	1.3 ab
Daconil 825 SDG	3.8	14	1.7 ab
Chipco 26019 WDG	2.0	21	2.0 ab
RH-0611	10.0	14	2.3 ab
Urea	1.0 lb/M	28	2.3 ab
EXP 10452A	1.5	21	3.3 ab
Chipco 26019 FLO	4.0	21	3.3 ab
Eagle WSP	0.6	21	4.0 abc
Control	——	——	7.3 abc
Fore	4.0	14	7.7 abc
Fore	8.0	14	8.7 bc
Curalan	2.7 lb ai/A	21	11.3 c

[a]Number of 2 inch or greater red thread spots per plot.
[b]M=1000 ft^2
Means separated according to Duncan's Multiple Range Test. ($P=0.05$)

Red Thread Control Study, Delaware

Joe Rimelspach, Bobby Joyner, Joe Green and Jerry Sullivan
OSU Plant Pathology; TruGreen ♦ Chemlawn Research and Development Center

Introduction

This study was conducted at the TruGreen ♦ Chemlawn Research and Development Center, Delaware, Ohio, on a two-year-old stand of Kentucky bluegrass consisting of 'Julia,' 'Merit,' 'Schamrock' and 'Touchdown.' The soil is Blount Siltloam, with a pH of 6.2. Turf was maintained at a 2-inch cutting height, with clippings returned, and irrigated as needed to avoid water stress.

Individual plots measuring 4 ft and 8 ft were arranged in a randomized complete-block design with three replications. Treatments were applied with a $C0_2$-powered plot sprayer with hand-held boom and 8005 LP nozzles at 23 psi at tank, 87 gal water per acre. Dry products were applied with a shaker jar by hand. A single treatment application was made on May 5. Ratings were taken on June 24 and June 30.

Discussion/Summary

All plots had minor infection of red thread present at the time of application. Chipco 26019WDG, Chipco 26019F and Bayleton gave good results with Sentinel providing excellent control. In all plots there was considerable Dollar Spot (*Lanzia and Moellerodiscus*) present at the time of both the June rating, in combination with the red thread. Casual observations indicated that high levels of dollar spot were present in the Chipco 2G019WDG, Chipco 2G019WG and ProStar treatment, and to a lesser degree in the Lesco G and Bayleton plots on June 30. At the present, Sentinel is only labeled for golf course and sod production use.

Table 1. Disease Severity Ratings on Kentucky Bluegrass

Treatment and rate/1000ft[2]	Disease Severity Ratings[1]		
	May 5[2]	June 24[3]	June 30[3]
Sentinel 40WG 0.25 oz	1.1 a	0.0 c	0.0 c
Chipco 26019WDG 50WP 2.0 oz	1.0 a	0.3 bc	10.0 bc
Chipco 26019F 2F 4.0 oz	1.8 a	0.3 bc	10.0 bc
Bayleton 25WG 1.0 oz	2.3 a	0.3 bc	10.0 bc
Banner F 1.1F 2.0 oz	1.7 a	8.3 abc	30.0 ab
Fluazinam 500 4F 1.0 oz	2.3 a	10.0 abc	40.0 a
ProStar 50WP 2.0 oz	2.3 a	13.3 abc	36.7 a
Lesco G 1G 24 oz	1.5 a	20.0 abc	30.0 ab
Scotts Fung. VII 0.59G 20.8 oz	1.5 a	13.3 abc	53.3 a
Rubigan AS IAS 2.0 oz	1.8 a	20.0 ab	50.0 a
Untreated	1.5 a	25.0 a	50.0 a
LSD (0.05)	1.9	19.7	24.9

[1]Disease severity (Red Thread) evaluated on a visual scale of 0-100 where 0= no disease, 100=100% of plot area infected.
[2]Initial disease present at time of application.
[3]A combination of Red Thread and Dollar Spot was present on all plots in June. Disease ratings reflect the percent turf infected by both diseases together.

Susceptibility of Bentgrass Cultivars to Fore+Aliette Combinations

Karl Danneberger and Jill Taylor
Horticulture and Crop Science

Discussion/Summary

A study was initiated on September 2, 1994, to evaluate the effect of multiple applications of the combination Fore and Aliette on various bentgrass cultivars. Twenty-four bentgrass cultivars located at the Ohio State University Turfgrass Research Center, Columbus, were used for this study. The cultivars were established in 1989 on a high clay soil mix and maintained at fairway height (0.5 inch). Each cultivar plot measured 10 x 5 feet. The cultivars were replicated three times in a randomized complete-block design. A Fore/Aliette (8+4 oz product/1000 ft^2) combination was applied to half of each cultivar plot on September 2, 9, 16, 23, and 30, 1994. Phytotoxicity and quality ratings were made October 3, 1994.

No phytotoxicity from the Fore/Aliette treatment was observed. Treated plots were of higher quality (greener, denser) than the untreated plots. (See Table 1.)

Table 1. The effect of multiple applications of Fore/Aliette on 24 bentgrass cultivars

	Quality[a]	
Cultivar	Treated	Untreated
BR 1518 (dryland bentgrass)	8.5	7.5
Carmen	9.0	8.0
Tracenta (colonial bentgrass)	7.5	6.3
Putter	9.0	8.0
SR1020	9.0	8.0
Providence	9.0	8.0
Bardot (colonial bentgrass)	6.7	6.0
Penncross	9.0	8.0
Pennlinks	9.0	8.0
Egmont (browntop bentgrass)	7.7	6.5
Normarc 101	9.0	8.0
Forbes 89-12	9.0	8.0
WVAB 89-0-15	9.0	8.0
National	9.0	8.0
88 CBE	9.0	8.0
88 CBL	9.0	8.0
Cobra	9.0	8.0
Emerald	9.0	8.0
Allure (colonial bentgrass)	7.2	6.7
Penneagle	9.0	8.0
Prominent	7.5	6.8
SR1019	9.0	8.0
Penncross	9.0	8.0
Southshore	9.0	8.0

[a]Quality rating 1-9; 9=best; 6=marginal.

Suppression of Turf Diseases with Biocontrol Agent-Fortified Compost-Amended Topdressings

Marcella Grebus, Carol Musselman, Joe Rimelspach and Harry Hoitink
Plant Pathology

Introduction

Compost Production The topdressing was prepared with materials produced by Kurtz Bros., Inc. from composted biosolids (Technagro ™). The Technagro™ was prepared from a blend of primary and secondary activated municipal sludge, sawdust, shredded hardwood bark and recycled biosolids compost (1:0.4:0.5:1, v/v) in an aerated trench process at the Kurtz Bros., Inc., Akron facility, and then stored in curing piles.

The compost was collected during the spring of 1994 from the center of a 6-8 month old curing pile turned the previous week. Temperatures in this pile were sufficiently high (50 to 60°C) so that thorough recolonization by mesophilic organisms had not occurred.

Topdressing Formulation Topdressings typically are formulated to contain 50% organic matter. Sand is frequently used to reduce thatch formation (Shildrick, 1985). The organic materials used in this work had an ash content of >50%. Thus, sand amendment was not required.

Topdressing Application The topdressing and fungicide were applied to stands of creeping bentgrass cv. Penncross, located at Range 1-South on the Ohio State University Turfgrass Research Center in Columbus. These turf stands have been established for at least 5 years.

On May 4, August 9, and September 30, 1994, the prepared topdressing was applied to creeping bentgrass to a depth of 1/8" (=7150 kg dry wt/HA; 0.64kg dry wt/m³; 130 lb dry wt/1000ft²). A wooden frame (3'x10'x1') was used to ensure separation of treatments. The topdressing was rubbed in by hand and then irrigated. The fungicide Daconil (chlorothalonil) was applied every week as a spray at a rate of 6.0 oz product/1000 ft². A plot plan describing the layout of the topdressing and fungicide treatments and replications is presented in Figure 1.

Site Maintenance To maintain fertility on creeping bentgrass 0.5 lb N/1000 ft² (0.01 kg/ha) was applied once during the spring (1994) and once late during the summer (1994). The once daily irrigation (9 min. in the early morning) was increased to three times per day when weather conditions were hot and dry to promote conditions favoring disease development. Creeping bentgrass was mowed to a height of 0.5" three times weekly. Clippings were returned.

Data Collection

Turf Quality The impact of the topdressing on turf "quality," i.e., overall greenness, health, vigor and appearance was rated throughout the season based on a scale of 0 to 9 (0=chlorotic; 9=darkest green). Means were calculated from six readings per treatment (n=6).

Disease Severity Plots were inspected for disease symptoms on a daily basis after inoculation. Lesion diameter was estimated to the nearest 1.25 cm, with ten inoculation sites per replicate. Disease severity early during the season was described using mean lesion diameter. Late during the summer, when symptoms were severe in the untreated check also, disease severity among treatments was compared by estimating percent diseased area (%) according to Nelson and Craft (1992).

Experimental Design and Statistical Analyses A randomized complete block experimental design was used, with 6 replicate blocks. One-way analysis of variance (ANOVA) was performed using MINITAB® statistical software (MINITAB Inc., State College, PA). Separations of means were based on LSD=0.05.

Discussion/Summary

During the 1993 season, Technagro™ fortified with the biocontrol agents *Trichoderma hamatum* 382 and *Flavobacterium balustinum* $299R_2$ provided a slight degree of control of dollar spot on creeping bentgrass relative to chlorothalonil, a standard fungicide used against this disease under commercial conditions (Table 1). All other topdressings, including the natural

Technagro™ treatment had no effect on disease severity. Positive fertility effects were observed with the Technagro™ composted yard waste and composted leaf topdressings. Inoculation with biocontrol agents did not affect fertility.

Throughout the 1994 season, Technagro™ fortified with the biocontrol agents *Trichoderma hamatum* 382 and *Flavobacterium balustinum* $299R_2$ provided a significant degree of control against dollar spot. Disease control, however, was not as good as that obtained with chlorothalonil (Table 2), a fungicide widely used in practice for control of this disease.

Turf quality was significantly improved by Technagro™ (Table 3). Dollar spot lesions on turf treated with Technagro™ recovered more rapidly than the untreated control during weather conditions not favorable to disease development.

Table 1. Efficacy of various organic topdressings fortified with the biocontrol agents *Trichoderma hamatum* 382 and *Flavobacterium balustinum* 299 R_2 for control of dollar spot on Penncross creeping bentgrass as compared to a fungicide (chlorothalonil) control

	Dollar Spot Severity[1]	
Treatment[2]	Fortified Topdressing[3]	Natural Topdressing
Technagro™	0.7[4]	1.2
Composted Yard Waste	1.1	1.1
Composted Leaves	1.1	1.3
Light Peat	1.0	1.0
Fungicide (chlorothalonil)	1.1	
Inoculated Control		1.3
LSD (0.05)		0.3

[1]*Sclerotinia homeocarpa* (isolates S38 and S83) inoculum (whole grain) applied on June 3, 1993.
[2]Topdressings applied on May 19, 1993, at a rate of 7150 kg dry wt/HA (0.125 in. depth). Chlorothalonil applied weekly after inoculation as a topical spray (6 oz. product/1000 ft²).
[3]Topdressings fortified with biocontrol agents.
[4]Mean lesion size (diameter in inches) based on 4 blocks of 10 replicates of each isolate (n=80) per treatment.

Table 2. Efficacy of a biocontrol agent-fortified composted biosolids topdressing (Technagro™) versus the fungicide chlorothalonil for control of dollar spot on Penncross creeping bentgrass during the 1994 season

	Dollar Spot Severity[1]		
Treatment[2]	7/8/94	9/23/94	10/14/94
Technagro™	15[3]	7	30
Fungicide Control (chlorothalonil)	2	0	4
Inoculated Control	32	22	45
LSD (0.05)	13	4	10

[1]Percent turf surface area showing dollar spot symptoms.
[2]Technagro™ applied at a rate of 7150 kg dry wt/HA (0.125 in. depth) on May 4, August 9 and October 30, 1994. Chlorothalonil applied weekly as a topical spray at a rate of 6 oz product/1000 ft².
[3]Mean value of 6 blocks of 1 replicate per treatment (n=6).

Table 3. Turf quality rating of Penncross creeping bentgrass topdressed with a biocontrol agent-fortified composted biosolids topdressing (Technagro™) versus the fungicide chlorothalonil for control of dollar spot during the 1994 season

	Turf Quality[1]			
Treatment[2]	7/8/94	9/23/94	0/14/94	10/25/94
Technagro™	5.2[3]	4.3	6.1	4.0
Fungicide (Daconil)	7.7	7.5	7.8	7.3
Untreated Check	4.3	3.3	4.1	3.1
LSD (0.05)	1.1	0.9	0.8	0.7

[1]Quality ratings 0-9, using the following scale: 0=chlorotic, ≥6=acceptable, 9=highest quality.
[2]Technagro™ applied at a rate of 7150 kg dry wt/HA (0.125 in. depth) on May 4, August 9 and October 30, 1994. Chlorothalonil applied weekly as a topical spray at a rate of 6 oz product/1000 ft².
[3]Mean value of 6 blocks of 1 replicate per treatment (n=6).

Evaluation of Fungicides for Resistance to Dollar Spot (*Sclerotinia homoecarpa*) on Creeping Bentgrass

Joe Rimelspach, Jill Taylor and Karl Danneberger
Plant Pathology; Horticulture and Crop Science

Introduction

This study was conducted on a private golf course in northwestern Ohio on a fairway of Creeping Bentgrass where there was concern about possible resistance to sterol inhibitor fungicides in the management of Dollar Spot. The fairway had been converted from Kentucky Bluegrass/Ryegrass to Bentgrass, starting in 1981 with overseeding of 'Penncross' and 'Penneagle,' and mowed at 7/16 inches. Soil was a native clay loam with a pH of 7.0 and maintained with an annual fertilizer program of 3 lb N/1000 ft^2.

Individual plots measured 6 ft. x 5 ft. and were arranged in a randomized complete-block design with three replications. Treatments were applied with a $C0_2$-powered plot sprayer with hand held boom and 8004 nozzles at 40 psi, 2.5 gal per 1,000 ft^2. Dry products were applied by hand. Applications were made on June 28, July 19, August 10 and September 2. Ratings of disease severity were taken on August 10, September 2, and September 28.

Discussion/Summary

No disease activity was present at the start of the applications. Disease activity started in late July and was moderate until August when severe infection occurred. Three sterol inhibitor fungicides (Fenarimol, Triademefon and Propiconazole) were all applied at the same rate (1 oz product/1000 ft^2) for comparison. There appeared to be no Dollar Spot resistance to this group of fungicides. There was clear evidence of resistance to the benzimidazole material, with disease equal or more severe in the Cleary's 3336 plots than the untreated control. The combination of Banner and Daconil gave excellent disease management. Daconil at 10 oz, Bayleton, Sentinel and Banner all gave good results under the design of this study. Note that all ratings were made three weeks or longer after applications.

Table 1. Disease severity ratings of various fungicides

Treatment and Rate/1000 ft[2]	Disease Severity Ratings[1] Aug 10	Sept. 2	Sept. 28
Cleary's 3336WP 2 oz	1.7 bcd	22.3 ab	43.3 a
Urea (0.5 lb N)+Daconil 2787 4.17F 10 oz[2]	0.3 cd	6.0 cde	35.0 ab
Control (No Treatment)	3.0 ab	13.0 abcd	31.7 abc
Myclobutanil G S-4404 2.6 oz	1.0 bcd	10.0 bcde	19.0 bcd
Myclobutanil S-6044 1.5 oz	2.7 abc	9.7 cde	15.7 cde
Rubigan A.S. 1 oz	1.3 bcd	15.0 abc	9.0 de
Fluazinam 500F 1 oz	0.0 d	22.7 a	5.0 de
Eagle WSP 0.6 oz	0.0 d	2.3 de	3.3 de
Daconil 2787 4.17F 6 oz	4.7 a	6.3 cde	2.3 de
Chipco 26019F 4 oz	0.3 cd	10.3 abcde	1.7 de
Daconil 2787 4.17F 10 oz	0.0 d	3.0 cde	0.3 e
Banner 1.1EC 2 oz+Daconil 2787 4.17F 6 oz	0.0 d	0.0 e	0.0 e
Bayleton 25 1 oz	0.0 d	0.7 de	0.0 e
Sentinel 40WG 0.17 oz	1.0 bcd	2.0 de	0.0 e
Banner 1.1 EC 1 oz	0.0 d	1.3 de	0.0 e
LSD (0.05)	2.6	12.3	17.8

[1]Disease Severity evaluated on a visual scale of 0-100 where 0=no disease and 100=100% of plot area infected.
[2]Only two applications of this treatment were made, June 28 and Aug 10.

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Turfgrass Insect Control

Application of an Insect Growth Regulator and Insecticide on Baits for Control of Ant Mounds in Turfgrass

David Shetlar, Harry Niemczyk and Kevin Power
Entomology

Discussion/Summary

The experiment was located on Fairway No. 1 of Green Hills Golf Course at Clyde, Ohio. Treatments were applied April 28 to plots arranged in a randomized complete-block design replicated four times. Plots were 10 ft. by 10 ft. with 2-ft. alleyways and 3-ft. between ranges. Hydremethylon treatments were applied with a shaker jar. Application of Dursban bait was with a drop spreader and 50W with a CO_2 sprayer, 35 psi and XR8006VS Teejet nozzles which delivered a volume of 1 gal./1000ft^2. The area received no post-treatment irrigation.

Field conditions at the time of treatment were as follows:

(1) Ants—Lasius neoniger (Emery) 12.6 mounds/yd^2.
(2) Turf—50%Kentucky bluegrass and 50% annual bluegrass; height 1½ in; thatch 0.75 in, dense.
(3) Soil—Moist, 51° F at 1 in. and 54° F at 3 in. deep, no soil analysis.
(4) Weather—Misting to clearing, 50° F, wind gusting 5 to 18 mph.

Efficacy data were obtained May 13, May 19, May 31, June 9, and August 1 (15,21,31,40,94 DAT) by counting the number of active mounds in two square-yard areas in each plot. Analysis of variance was done on plot totals and means separated by LSD test (p=0.5).

All of the treatments significantly reduced mound building 15 DAT. Although not significant, Hydremethylon 0.88G and Dursban bait had fewer mounds 21 DAT. Frequent rains made it difficult to identify active mounds 31 DAT. At 40 DAT the Dursban formulations gave significant reduction of mounds. There was no significant control 94 DAT but the check had the most active mounds.

Possibly the plots were too small to negate influence of the untreated alleyways. Perhaps sampling the middle area of larger plots would suppress mound building from nests in the alleyways and yield more meaningful data.

There were no signs of phytotoxicity from any of the treatments.

Table 1. Reduction in ant mounds following application of an insect growth regulator and an insecticide on a golf course fairway, Clyde, Ohio, 1994

	Rate		Average ant mounds/yd^2 (% Control)[b]			
Treatment[a]	lb.AI/A	15 DAT	21 DAT	31 DAT	40 DAT	94 DAT
Hydremethylon 0.88G	0.07	0.5(94)b	6.0(00)a	4.1(13)a	13.3(00)a	2.5(53)a
Hydremethylon 0.73G	0.06	1.0(89)b	8.5(42)a	3.4(29)a	5.8(55)ab	4.0(26)a
Dursban 1% bait	1.10	1.0(89)b	6.5(19)a	2.3(53)a	0.5(96)b	1.3(77)a
Dursban 50W	1.00	2.5(72)b	9.0(14)a	2.1(55)a	1.8(86)b	1.9(65)a
Check	——	9.0 a	10.5 a	4.8 a	12.8 a	5.4 a

[a]Treated April 28, replicated 4x, no post-treatment irrigation.
[b]Data based on two yd^2 samples from each plot.
Means followed by the same letter are not significantly different (LSD p=0.05).

Application of Insecticides for Control of Black Turfgrass Ataenius Larvae in Turfgrass

David Shetlar, Harry Niemczyk and Kevin Power
Entomology

Discussion/Summary

Treatments were applied June 23 to plots 10 ft. by 10 ft. arranged in a randomized complete-block design replicated four times. The experiment was located on Fairway No. 16 of Rawiga Country Club golf course at Seville, Ohio. The organophosphate liquid treatments were applied with a CO_2 sprayer, 35 psi and XR8008VS Teejet nozzles which delivered a volume of 1 gal./1000ft^2. Pyrethoid treatments were applied at 2 gal./1000ft^2 spray volume with a CO_2 sprayer, 35 psi and 8010LP Teejet nozzles. Orthene 15G granules were applied with a shaker jar, and the 5G was applied with a 24-inch Gandy Turf Tender drop spreader. The entire experimental area received 3/8 inch irrigation after all treatments were applied, but before spray treatments had dried on the grass blades.

Field conditions at the time of treatment were as follows:

(1) BT Ataenius—ca. >60/ft^2; eggs, first, and second instars present.
(2) Turf—70 percent bentgrass and 30 percent annual bluegrass; height 5/8 in; thatch 0.75 in, dense.
(3) Soil—Moist, 74°F at 1 in. and 72°F at 3 in. deep, no soil analysis.
(4) Weather—Sunny, 81°F, no wind.

Efficacy data were obtained July 7 (14 DAT) by counting the number of live BTA larvae and in six 4¼ in. in diameter x 2-in. deep samples from each plot. Analysis of variance was done on plot totals and means separated by LSD test (p=0.5).

All treatments gave significant control of the population. There are no significant differences among the treatments, but Orthene 75SP at 5.0, Orthene 5G at 8.0, and Dylox at 6.0 lb.A.I./A. gave best control.

There were no signs of phytotoxicity from any of the treatments.

Table 1. The effect in insecticide applications on control of black turfgrass ataenius larvae in turfgrass, Seville, Ohio, 1994

Treatment[a]	Rate lb.A.I./A	BTA larvae/ft^2 14 DAT[b]	% Control
Orthene 75SP	4.00	17.3 b	87
Orthene 75SP	5.00	6.3 b	95
Orthene 15G	5.00	34.7 b	73
Orthene 15G	8.00	27.1 b	79
Orthene 5G	5.00	16.1 b	88
Orthene 5G	8.00	9.3 b	93
Dylox 80S	6.00	7.2 b	95
Scimitar 10CS	0.06	35.9 b	72
Scimitar 10CS+Silwet	0.06	31.7 b	75
Scimitar 10WP	0.06	25.0 b	81
Scimitar 10WP+Silwet	0.06	33.0 b	75
Check	——	129.0 a	——

[a]Applied June 23, to plots 10x10 ft. replicated 4x.
[b]Data taken July 7, based on six samples 4¼ in. in diameter from each plot. Means followed by the same letter are not significantly different (LSD p=0.05).

Evaluation of Biorationals and Biologicals for Control of Black Cutworm (*Agrotis ipsilon* Hufnagel) and Sod Webworm (Pyralidae, Crambinae) Larvae in Bentgrass, 1994.

David Shetlar, Harry Niemczyk and Kevin Power
Entomology

Discussion/Summary

The study was located on the bentgrass nursery of Westfield Country Club, Westfield Center, Ohio (Medina Co.). The nursery was nearly 100% creeping bentgrass, *Agrostis palustris* Hudson, mowed at 7/16 inch. Insecticides were applied July 11 to plots 4 x 8 ft. (1.2 x 2.4 m) arranged in a randomized complete-block design and replicated 4 times. Treatment plots were not separated but each set of four plots was separated with a 3-ft. alley. Granular insecticides were applied using a drop spreader, and liquids were applied using a CO_2 sprayer with Teejet XR8006VX nozzles at 30 psi (2.11 kg/cm^2) pressure that delivered a volume of 1.0 gal/1000 ft^2 (407 liter/ha). Treatments were not irrigated.

Field conditions at time of treatment were as follows:

(1) BCW—soap flushes in the area the previous week revealed numerous medium to large larvae.
(2) Turf—100% bentgrass, level, dense, grass height—7/16 inch, heavy dew present: thatch—loose, moist, 1/4 to 3/8 inch (6-9 mm) or less.
(3) Soil—moist, sandy loam, 76ºF (24.4ºC) at 1.0 inch, 75ºF (23.9ºC) at 3.0 inch (no soil analysis).
(4) Weather—mostly sunny, 76º to 82ºF (24.4 to 27.8ºC), 0 to 7 mph (0-11.7 km/ht) wind.

Efficacy data taken July 15 (4 DAT) and July 25 (14 DAT) were based on the number of BCW and SWW larvae flushed in a 1 yd^2 (0.84 m^2) area using a soap irritant drench of 15 ml Joy dishwashing detergent in 2 gal (7.6 liter) water.

The standard insecticide Sevin as well as the experimentals RH-5992 and RH-0345 controlled the caterpillar populations at 7 DAT but the other products needed 14 days to achieve their maximum control.

BCW and SWW numbers were greatly reduced in all plots at the 14 DAT, probably due to the lack of untreated alleys and surrounding turf.

Table 1. Effectiveness of a single application of insecticides, biorationals and biologicals applied to creeping bentgrass for control of black cutworm (BCW) and sod webworm (SWW) larvae, Westfield Country Club, Ohio, 1994

	Rate	Ave # larvae/yd² at 4 DAT[b]			Ave # larvae/yd² at 14 DAT[c]		
Treatment[a]	lb (AI)/acre	BCW	SWW	BCW+SWW	BCW	SWW	BCW+SWW
NTN 33893 75WP	0.30	0.50	1.50	2.00 bcd	2.25	1.00	3.25 b
Sevin 80WP	4.00	0.50	0.00	0.00 cd	0.50	0.00	0.50 c
Sevin 3.5G	6.00	0.25	0.00	0.25 cd	0.00	0.00	0.00 c
RH-0345 2F[d]	0.50	2.25	0.00	2.25 bcd	0.00	0.00	0.00 c
RH-0345 2F[d]	1.00	0.00	0.00	0.00 d	0.00	0.00	0.00 c
RH-5992 2F[d]	0.06	0.25	0.00	0.25 cd	1.50	0.00	1.50 bc
RH-5992 2F[d]	0.125	0.00	0.25	0.25 cd	0.25	0.00	0.25 c
HP-88 nematode	$0.5x10^9$	3.75	2.00	5.75 b	2.00	1.00	3.00 b
Exhibit nemas	$1.0x10^9$	4.50	1.75	6.25 b	2.00	1.00	3.00 b
Turplex 3%EC	5gm/a	0.75	3.75	4.50 bc	1.50	0.75	2.25 bc
Turplex 3%EC	10gm/a	1.00	4.50	5.50 b	1.50	0.00	1.50 bc
Check	——	9.00	7.50	16.50 a	4.50	2.25	6.75 a
LSD $P< 0.05$	2.84	2.94	4.49	0.28	0.56	0.51	

[a]Application July 11, volume 1.0 gal/ 1000 ft², four replicates.
[b]Data taken July 18, based on one yd² area per plot drenched with soap irritant.
[c]Data taken July 25.
[d]Latron added to tank mix.

Evaluation of Pyrethroids and Other Insecticides for Control of Black Cutworm (*Agrotis ipsilon* Hufnagel) and Sod Webworm (Pyralidae, Crambinae) Larvae in Bentgrass, 1994

David Shetlar, Harry Niemczyk and Kevin Power
Entomology

Discussion/Summary

The study was located on the bentgrass nursery of Westfield Country Club, Westfield Center, Ohio (Medina Co.). The nursery was nearly 100 percent creeping bentgrass, *Agrostis palustris* Hudson, mowed at 7/16 inch. Insecticides were applied July 11 to plots 4 x 8 ft. (1.2 x 2.4 m) arranged in a randomized complete-block design and replicated 4 times. Treatment plots were not separated but blocks were separated with a 3-ft. alley. Treatments were applied using a CO_2 sprayer with Teejet XR8006VX nozzles at 30 psi (2.11 kg/cm^2) pressure that delivered a volume of 1.0 gal/1000 ft^2 (407 liter/ha). Treatments were not irrigated.

Field conditions at time of treatment were as follows:

(1) BCW—soap flushes in the area the previous week revealed numerous medium to large larvae.
(2) Turf—100 percent bentgrass, level, dense, grass height—7/16 inch, heavy dew present: thatch—loose, moist, 1/4 to 3/8 inch (6-9 mm) or less.
(3) Soil—Moist, sandy loam, 76°F (24.4°C) at 1.0 inch, 75°F (23.9°C) at 3.0 inch (no soil analysis).
(4) Weather—mostly sunny, 76° to 82° F (24.4° to 27.8° C), 0 to 7 mph (0-11.7 km/ht) wind.

Efficacy data taken July 15 (4 DAT) and July 25 (14 DAT) were based on the number of BCW and SWW larvae flushed in a 1 yd^2 (0.84 m^2) area using a soap irritant drench of 15 ml Joy dishwashing detergent in 2 gal (7.6 liter) water.

All the pyrethroids significantly reduced the caterpillar populations at 4 DAT as did the other standard insecticides. Turplex did not achieve its best control level until the 14 DAT sampling period.

BCW and SWW numbers were very low in all plots at the 14 DAT, probably due to the lack of untreated alleys and surrounding turf.

Table 1. Effectiveness of a single application of insecticides applied to creeping bentgrass for control of black cutworms (BCW) and sod webworm (SWW) larvae, Westfield Country Club, Ohio, 1994

Treatment[a]	Rate lb (AI)/acre	Ave # larvae/yd² at 4 DAT[b] BCW	SWW	BCW+SWW	Ave # larvae/yd² at 14 DAT[c] BCW	SWW	BCW+SWW
Talstar 0.66F	0.013	0.00	0.00	0.00 c	0.25	0.00	0.25 b
Talstar 0.66F	0.027	0.25	0.00	0.25 c	0.00	0.00	0.00 b
Talstar 0.66F	0.054	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Talstar 0.66F	0.10	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Talstar 10WP	0.013	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Talstar 10WP	0.027	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Talstar 10WP	0.054	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Talstar 10WP	0.10	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Bifenthrin 1EC	0.013	0.00	0.25	0.25 c	0.00	0.00	0.00 b
Bifenthrin 1EC	0.027	0.00	0.25	0.25 c	0.00	0.00	0.00 b
Bifenthrin 1EC	0.054	0.00	0.25	0.25 c	0.00	0.00	0.00 b
Bifenthrin 1EC	0.10	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Astro 3.2EC	0.87	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Dursban TI 4EC	1.0	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Tempo 20WP	0.10	0.25	0.25	0.50 c	0.00	0.00	0.00 b
Scimitar 10WP	0.03	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Scimitar 10WP	0.06	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Sevin 80S	4.0	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Triumph 4E	1.0	0.00	0.00	0.00 c	0.00	0.00	0.00 b
Orthene 75SP	5.0	0.00	0.00	0.00 c	0.25	0.00	0.00 b
Turplex 3%EC	0.044	0.50	2.75	3.25 b	0.00	0.00	0.00 b
Check	——	6.25	6.50	12.75 a	1.50	3.25	4.75 a
	LSD P<0.05	0.84	1.31	1.82	0.28	0.56	0.51

[a] Application July 11, volume 1.0 gal/ 1000 ft², four replicates.
[b] Data taken July 15, based on one yd² area per plot drenched with soap irritant.
[c] Data taken July 25.

Surface and Subsurface Applied Insecticides for Control of White Grubs in Turfgrass

David Shetlar, Harry Niemczyk and Kevin Power
Entomology

Discussion/Summary

Treatments were applied August 17 to plots 8 ft. by 10 ft. arranged in a randomized complete-block design replicated four times. The experiment was located on Fairway No. 4 of Valley View Golf Course, Akron, Ohio. The surface treatments were applied with a pressurized CO_2 sprayer, 8010 Teejet nozzles, and 30 psi at 3.1 gal./1000 ft^2 and a 2-ft. Gandy drop spreader for granules. Subsurface granular treatments were placed with a Cushman-Ryan subsurface applicator prototype which cut 11¼-in. slits two inches apart approximately 1/2 in. deep. The MYX-910L plots received 12 gal. (1/4 in.) water by hand irrigation immediately after each was treated. The entire experimental area received 1/4 in. irrigation using the golf course system after all treatments were applied.

Field conditions at time of treatments were as follows:

(1) White grubs—ca. 20/ft^2; 5% Japanese beetle 80% 1st and 20% 2nd instars; 50% masked chafers 60% 1st and 40% 2nd instar larvae.
(2) Turf—40% Kentucky bluegrass, 40% bentgrass, and 20% annual bluegrass; no thatch; reps 1-3 1¼ in. and rep 4 2 in. height.
(3) Soil—Moist, 82°F. at 1 inch and 77°F. at 3 inches deep. No soil analysis.
(4) Weather—Sunny, 81°F., no wind.

Efficacy data were obtained September 27 (41 DAT) by counting the number of live larvae in four samples 7 x 7 inches by approximately 3 inches deep. Plot totals were subjected to ANOVA and means separated by LSD test (p=0.5).

At the time data were obtained the population was predominately (85%) Japanese beetle larvae. All treatments gave significant control of the grubs. Subsurface-applied Mocap at 2.5 lb.A.I./A. was significantly more efficacious than other Mocap treatments. MYX-910L yielded good control at all rates as did Triumph and Crusade.

The viscosity of MYX-910L tank mixes at the two high rates (26&52 gal/A) affected the spray pattern. The 52 gal/A mix severely deteriorated the pattern so the spray boom was raised to 48 in. above the plots to compensate.

There were no signs of phytotoxicity from any of the materials and no excess damage to the turfgrass from the application equipment.

Table 1. Efficacy of surface and subsurface insecticide applications for control of white grubs in turfgrass, Valley View Golf Course, Akron, Ohio, 1994

Treatment[a]	Rate	Application equipment	$\bar{x}$ larvae/ft² 41 DAT[b]	% Control
Mocap 10G	2.0 lb AI/A	Cush/Ryan Prototype	18.9 c	62
Mocap 10G	2.5 lb AI/A	Cush/Ryan Prototype	4.4 fg	91
Mocap 10G	2.5 lb AI/A	Conventional Drop Spreader	17.5 cd	64
Mocap 10G	5.0 lb AI/A	Conventional Drop Spreader	16.0 cd	67
Sevin 3.5G	8.0 lb AI/A	Conventional Drop Spreader	15.4 cde	68
Sevin 80WSP	8.0 lb AI/A	Conventional Boom Sprayer	7.0 defg	86
MYX-910L	6.5 gal/A	Conventional Boom Sprayer	12.7 cdefg	74
MYX-910L	13 gal/A	Conventional Boom Sprayer	14.5 cdef	70
MYX-910L	26 gal/A	Conventional Boom Sprayer	4.8 fg	90
MYX-910L	52 gal/A	Conventional Boom Sprayer	2.2 g	96
Triumph 4E	2.0 lb AI/A	Conventional Boom Sprayer	3.5 g	93
Crusade 5G	4.0 lb AI/A	Conventional Drop Spreader	5.1 efg	90
Force 1.5G	0.16 lb AI/A	Conventional Drop Spreader	17.6 c	64
Scimitar 10CS	30.5 ml/A	Conventional Boom Sprayer	35.4 b	27
Check	—	—	48.8 a	—

[a]Applied August 17, to plots 8x10ft replicated 4x. Post-treatment irrigation 1/4in.
[b]Data taken September 27, based on five 7x7in samples from each plot.
Means followed by the same letter are not significantly different (LSD p=0.05).

Influence of Application Time on the Efficacy of Insect Growth Regulators for Control of White Grubs in Turfgrass

David Shetlar, Harry Niemczyk and Kevin Power
Entomology

Discussion/Summary

Treatments were applied August 11 and September 6 to plots 4 ft. by 10 ft. arranged in a randomized complete-block design replicated three times. The experiment was located in the par 3 Fairway No. 4 of Atwood Lake Resort, Delroy, Ohio. Liquid treatments were applied with a CO_2 sprayer, Teejet XR8010 nozzles, and 30 psi. delivering 3 gal/1000^2. The granules were applied with a shaker jar. At each application date, the entire experimental area received ¼ inch irrigation after all treatments were applied.

Field conditions at the time of the August 11 treatments were as follows:

(1) White grubs—100% masked chafers; 8-10ft^2; 30% 1st, 70% 2nd instars.
(2) Turf—40% bentgrass, 20% Kentucky Bluegrass, and 40% annual bluegrass; grass height 1-2 in.; no thatch.
(3) Soil—Moist; 75°F at 1 in. and 74°F at 3 in. deep, soil analysis not available at this writing.
(4) Weather—Cloudy and rain, 67°F.; no wind.

Field conditions at the time of the September 6 treatments were as follows:

(1) White grubs—2nd and 3rd instars present; no pre-treatment count or identification.
(2) Turf—40% bentgrass, 20% Kentucky Bluegrass, and 40% annual bluegrass; grass height 1-2 in.; no thatch.
(3) Soil—Moist; 65°F at 1 in. and 67°F at 3 in. deep, soil analysis not available at this time.
(4) Weather—Sunny; 64°F; no wind.

Efficacy data were obtained September 28 (47 and 21 DAT) by counting the number of live larvae in five samples 7 x 7 in. from each plot. Analysis of variance was done on plot totals and means separated by LSD test at p=0.05.

Results are shown in table 1. Though not significantly different, RH-0345BB 2.5G gave control of Japanese beetle comparable to Triumph® when applied September 9, 1994 and better control of masked chafer larvae.

There were no signs of phytotoxicity from any of the treatments.

Table 1. Table 1. Application of insect growth regulators targeted at early and later instar masked chafer (MC) and Japanese beetle (JB) larvae in turfgrass, Atwood Lake Resort Golf Course, Delroy, Ohio, 1994

Treatment[a]	Rate lb.A.I/A.	Application Date	Average JB/ft2[b]	% Control	Average MC/ft2[b]	% Control
RH-0345A 2.5G	1.5	8-11	0.0 d	98	0.0 b	100
RH-0345A 2.5G	3.0	8-11	0.0 d	100	0.0 b	100
RH-0345B 2.5G	1.5	8-11	2.2 bcd	83	30.6 b	90
RH-0345B 2.5G	3.0	8-11	0.0 d	100	0.0 b	100
RH-0345 2F	1.0	8-11	0.4 d	97	0.0 b	100
RH-0345 2F	1.5	8-11	0.0 d	100	0.0 b	100
RH-0345 2F	2.0	8-11	0.0 d	100	0.0 b	100
RH-0345 2F	3.0	8-11	0.0 d	100	0.0 b	100
RH-0345AA 2.5G	2.0	8-11	0.4 d	97	0.0 b	100
RH-0345BB 2.5G	2.0	8-11	0.0 d	100	0.0 b	100
Merit 75WP	0.3	8-11	0.0 d	100	0.0 b	100
RH-0345 2F	1.0	9-6	6.7 bc	48	5.5 a	7
RH-0345AA 2.5G	2.0	9-6	6.9 b	47	2.1 b	59
RH-0345BB 2.5G	2.0	9-6	2.5 bcd	81	0.6 b	90
Triumph 4E	2.0	9-6	1.0 cd	92	1.8 b	69
Merit 75WP	0.3	9-6	5.7 bcd	56	1.8 b	69
Check	——	——	12.9 a	——	5.9 a	——

[a]Applied to plots 4x10 ft. replicated three times. Post-treatment irrigation 1/4 in.
[b]Data taken September 27 (47 & 21 dat), based on five 7x7in. samples taken from each plot.
Means followed by the same letter are not significantly different (LSD p=0.05).

Subsurface Placement of Controlled Release Chlorpyrifos Granules for Extended Control of Japanese Beetle Larvae in Turfgrass: Third Report

Harry Niemczyk and David Shetlar
Entomology

Introduction

The objective of these experiments was to subsurface place SusCon Green (SCG), a slow-release granular form of chlorpyrifos, in the zone inhabited by Japanese beetle (JB) larvae in turfgrass for long-term (three years) control. The site of our first experiment was selected in 1992 at the College of Wooster golf course, Wooster, Ohio, on a fairway with a history of reoccurring JB grub populations. The site did not produce larvae in any of the three years in which data was taken from the untreated controls in the study. In 1993 another test site at the Ohio Agricultural Research and Development Center, Wooster, Ohio, was selected that facilitated caging of mated JB adults to ensure oviposition in the study plots. This method used in our second experiment has yielded efficacy data for the second year.

Discussion/Summary

SCG treatments were applied May 26, 1993, to plots 4 x 22.5 ft. arranged in a randomized complete-block design replicated four times. The SCG granules were placed with a Cushman Ryan subsurface applicator prototype which cut 11, 1/4 inch slits two inches apart depositing the granules approximately 3/4 inch deep into the soil. The standard, a surface treatment Dursban 0.97G, was applied August 29, 1994, with a two-foot Gandy drop spreader and received 1/4 inch of irrigation immediately after application. The subsurface placed granules received no irrigation, but the entire area was irrigated 19 hours post-treatment to promote healing of the slits made by the applicator.

Five PVC cylinders eight inches inside diameter were inserted into each plot. JB adults were collected using Elisco Cone traps and JB feeding lures. Beetles were held overnight at 70°F, then July 13, 30 beetles (measured volumetrically) consisting of 67% females were placed in each cylinder and the cylinder was covered with 20 mesh nylon screen. The beetles were caged for two weeks, received an apple slice dipped in brewers yeast, then a plain apple slice every two days for the duration of the caging.

Field conditions at the time of the SCG treatments May 26, 1993 were as follows:

(1) JB—no larvae present.
(2) Turf—100% Kentucky Bluegrass; no thatch; 1.75 in. height; dry.
(3) Soil—Moist; 77°F at 1 in. and 72°F at 3 in. deep, no soil analysis.
(4 Weather—Sunny, 72°F, 0-5 mph wind.

Field conditions at the time of the Dursban surface treatment August 29, 1994, were as follows:

(1) JB—first and second instars present.
(2) Turf—100% Kentucky Bluegrass; no thatch; 1.25 in. height; dry.
(3) Soil—Moist; 63°F at 1 in. and 66°F at 3 in. deep, no soil analysis.
(4) Weather—Cloudy, 67°F, 0-5 mph wind.

Efficacy data were obtained September 27 (29 and 506 DAT) by counting the number of live larvae in the five cylinder locations eight inches in diameter from each plot. Analysis of variance was done on cylinder totals and LSD tests at p=0.05 and p=0.10.

There was no statistical difference in any of the treatments at p=0.05 even though all reduced the larval population (table 1). SCG at 4.0 and 6.0 lb.A.I./A., and Dursban are different from the check at the 90% confidence level.(tables 1&2). Mammals removed some of the cylinder screens at four to six days after caging. Thirty beetles were replaced in each of those cylinders six days after caging. Some cylinder screens were removed again by mammals at 12 days after caging but beetles were not replaced. Table 2 shows the data where counts from disturbed cages have been omitted. Cages damaged by mammals may have influenced the results, but Table 2 does not demonstrate any. Nor does inspection of the data from disturbed and undisturbed cages show influence within any particular plot (Table 3).

There were no signs of phytotoxicity from any of the treatments.

Table 1. Subsurface placement of Suscon Green for the long-term control of Japanese beetle larvae in turfgrass, OARDC Main Campus, Wooster, Ohio

Rate	Date		Nº of	$\bar{x}$larvae/ft^2[c]	%
Treatment	lb.A.I/A	Applied	Cages	29&506 DAT	Control
Suscon 10G[a]	2.0	5/26/93	20	14.0 ab	22
Suscon 10G[a]	4.0	5/26/93	20	10.2 b	43
Suscon 10G[a]	6.0	5/26/93	20	11.5 b	36
Dursban 0.97G[b]	4.0	8/29/94	20	10.7 b	40
Check	——	——	20	17.9 a	——

[a]Plots 22.5x4 ft. replicated 4x. No post-treatment irrigation.
[b]Plots 22.5x4 ft. replicated 4x. Post-treatment irrigation ¼ in.
[c]30 JB adults (67% ♀) caged July 13, 1994, 14 days. Larval data taken September 27, 1994, based on 5 8-in. circle samples (cage location) from each plot.
Means followed by the same letter are not significantly different **(LSD p=0.10)**. No differences at p=0.05.

Table 2. Results of subsurface placement of Suscon Green for control of Japanese beetle larvae *where data from damaged cages have been omitted*, OARDC Main Campus, Wooster, Ohio, 1994

Treatment	Rate lb.A.I/A	Date Applied	Nº of Cages	$\bar{x}$larvae/ft^2[c] 29&506 DAT	% Control
Suscon 10G[a]	2.0	5/26/93	14	14.3 ab	24
Suscon 10G[a]	4.0	5/26/93	20	10.4 b	44
Suscon 10G[a]	6.0	5/26/93	20	11.4 b	39
Dursban 0.97G[b]	4.0	8/29/94	17	11.1 b	41
Check	——	——	18	11.8 a	——

[a]Plots 22.5x4 ft. replicated 4x. No post-treatment irrigation.
[b]Plots 22.5x4 ft. replicated 4x. Post-treatment irrigation ¼ in.
[c]30 JB adults (67% ♀) caged July 13, 1994, 14 days. Larval data taken September 27, 1994, based on 8 in. circle samples (cage location) from each plot.
Means followed by the same letter are not significantly different **(LSD p=0.10)**. No differences at p=0.05.

Table 3. Resulting cylinder grub counts from disturbed (D) and undisturbed (U) caged Japanese beetle adults on treated plots, Wooster, Ohio, 1994

			Total grubs/cylinder D=disturbed 7/19 7/25				
Treatment	Plot	Rep	1-cage	2-cage	3-cage	4-cage	5-cage
SusCon 6.0	1	1	2UU	0UD	0UD	0UD	2DD
SusCon 2.0	2	1	1DD	3DD	3UD	5DD	2UD
Control	3	1	12DU	7UD	9UD	7DD	14UD
SusCon 4.0	4	1	6UD	3UU	10UD	6UU	0UU
Dursban 4.0	5	1	0DD	0DD	1UU	9UU	7UU
SusCon 2.0	1	2	4UD	3UU	7UU	4UU	5UD
Control	2	2	7UD	2UU	8UU	10DU	14UU
Dursban 2.0	3	2	4UU	3UU	1UU	3UU	9UU
SusCon 6.0	4	2	1UU	0UU	1UU	1UU	2UU
SusCon 4.0	5	2	2UU	2UU	2UU	2UU	2UU
SusCon 6.0	1	3	8UD	10UD	3UU	13UU	6UU
Dursban 4.0	2	3	5DD	6UU	8DU	7UU	7UU
SusCon 4.0	3	3	3UU	7DU	5DU	6UU	3DU
Control	4	3	2DU	0DD	3DU	3UU	5DU
Suscon 2.0	5	3	5DD	8DU	7DD	7DD	8DU
Dursban 4.0	1	4	0UU	0UU	1UU	0UU	0UU
SusCon 2.0	2	4	4UU	6UU	2UU	10UU	4UU
Suscon 4.0	3	4	3DU	5UU	2UU	2UU	2UU
SusCon 6.0	4	4	1DU	10UU	6UD	5UD	9UU
Control	5	4	6UU	7UU	2UD	4UD	4UD

Evaluation of Turplex 3% EC for Control of Black Cutworm Larvae on the Greens of Shadow Creek Golf Course, N. Las Vegas, Nevada

Harry Niemczyk
Entomology

Introduction

Turplex® was to be applied to at least 18 course greens, plus whatever adjacent turf surfaces are normally treated for cutworm-bird damage control. A 14-day treatment schedule was to be followed. The cooperating superintendent was expected to inspect the treated greens from time to time to evaluate and record their status for cutworm presence, damage and/or bird activity. As long as damage ratings indicated no significant damage was evident, the 14-day treatment schedule was to be followed. If significant damage appeared before the next scheduled application, Turplex® was to be applied to stop damage. If, at anytime, the superintendent believed the program was not adequately controlling damage, other material may be applied to stop damage. Return to the 14-day program was requested after any other insecticide application.

Discussion/Summary

Examination of the observation records showed that except for two occasions, June 3 and August 27 to September 3, when the level of cutworm damage became intolerable, Turplex® provided excellent control. The reason(s) for the resurgence of cutworms on these two occasions is unclear. Except for a few specimens of sod webworm larvae, samples collected by the superintendent were black cutworm.

In general, the golf course superintendent was very satisfied with the results obtained. Turplex® provided an effective alternative to the usual 4-5 applications of Dursban normally required to keep cutworm damage under control.

Table 1. Record of treatment application for control of cutworm damage, Shadow Creek Golf Course, Las Vegas, Nevada, 1994

Material	Application Date	Interval Between Applications	Cutworm Damage Rating[a]
Turplex	4/11/94	—	0
"	5/2-3/94	22	0
"	5/18/94	16	2
"	5/27/94	9	3
Dursban	6/3/94	7	5
Turplex	6/13/94	10	0
"	6/27/94	14	0
"	7/11-12/94	14	0
"	7/25/94	14	0
"	8/9/94	15	1
"	8/23/94	14	2
"	9/2/94	10	3
Dursban	9/8/94	6	3
"	10/13/94	35	1

[a]Cutworm damage Rating—0=None; 1=Little; 2=Some; 3=Moderate; 4=Significant; 5=Severe.

Turfgrass Fertility

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Nitrogen Source and Rate Effect on Kentucky Bluegrass

John Street and Renee Stewart
Horticulture and Crop Science

Introduction

Good turfgrass growth is dependent on an adequate supply of all the essential nutrients, as well as other environmental and cultural factors. Of the essential nutrients, nitrogen is the element that receives the most attention in turfgrass fertilization programs. One reason for emphasis on nitrogen is that turfgrasses give a good color and growth response to nitrogen. The color and growth response from nitrogen is usually more dominant than any other element. The behavior of nitrogen, in both the plant and the soil, places it in the unique position of being the "growth control" element. Supplies of other nutrients are kept at adequate levels and the manager regulates growth and color by adding or withholding nitrogen. Thus, fertilization strategies for turfgrass are primarily designed around nitrogen.

A number of nitrogen-containing fertilizers are presently available in the marketplace for turfgrass fertilization: water soluble or quickly available and water insoluble or slowly available. These nitrogen fertilizers vary considerably in their chemical and physical properties. Slowly-available sources such as ureaformaldehyde (UF), milorganite, isobutylidene diurea (IBDU), methylene ureas, and sulfur-coated ureas have been available for years. Several new slowly-available sources have more recently emerged into the market place. These are the polymer-coated ureas and polymer-coated, sulfur-coated ureas. Polymer-coated urea is by definition a coated slow-release fertilizer consisting of fertilizer urea particles coated with a polymer plastic resin. The polymer-coated sulfur-coated ureas are sulfur-coated urea particles coated with a polymer plastic (resin). Coating thickness of the sulfur and/or plastic (resin) plays a major role in the release characteristics of these latter sources.

Discussion/Summary

The effect of several nitrogen sources and rates (Table 1) on turfgrass quality and yield was compared throughout the 1994 growing season. All the one and two pound per 1,000 square feet nitrogen rates were applied on May 25 and September 12, 1994. Polyon (12%) was applied only once on May 25, 1994, at four pounds of actual nitrogen per 1,000 square feet. Each treatment was replicated three times in a completely randomized block design using 3 x 8 feet plots. Mowing was performed at a two-inch height and clippings were collected throughout the season on a ten- to twelve-day interval schedule (Tables 2-3). Clipping yield was based on one complete swath across the center of each plot with a 22-inch Lawn-Boy rotary mower. Clippings were bagged, dried at 60 degrees C for 72 hours, and then weighed to provide dry matter yields (Tables 2-3). Turfgrass quality ratings were taken on a scale of 1 through 9 with 1 representing poorest and 9 representing best (Table 1). Irrigation was performed as needed to prevent wilt.

Turfgrass Quality Turfgrass quality ratings for the 1994 growing season are provided in Table 1. Turfgrass quality responses among the nitrogen sources were very similar to 1993. Unfertilized turfgrass consistently showed poorer quality than the fertilized turfgrass throughout the growing season (Table 1). In the 1 to 9 rating scheme, 6 is considered marginally acceptable and anything below 6 is unacceptable. Urea provided the best initial quality responses during the first few weeks after application in both the spring and the fall. Some residual responses were evident from several of the slow-release nitrogen sources from nitrogen applied in the fall of 1993. All slow-release nitrogen sources provided a delay in turfgrass response for the first seven to ten days after fertilizer application. Poly S and Poly Plus overall performed similarly throughout the growing season. Residual responses from Poly S and Poly Plus were acceptable for eight to ten weeks and twelve to fourteen weeks at the one pound and two pound N rates, respectively. Polyon (4%) provided a significantly better quality response than Polyon (8%) at the one pound N rate. The Polyon (8%) exhibited good spring green-up responses from fall applied nitrogen (1993). In contrast to 1993, residual responses from the May 25, 1994, application were similar between Polyon (4%) and Polyon (8%). The sulfur-coated urea sources exhibited a slightly better initial response than the Polyon sources at equivalent rates. Intermediate responses from Poly S and Poly Plus were slightly better than the sulfur-coated ureas. In turn, intermediate responses from the Polyon sources were slightly better than the PCSCUs. In general, intermediate and residual responses from all the latter sources were far superior at the two pound N rate compared to the one pound N rate. Clearly, the Polyon (4%) outperformed the Polyon (8%) in the fall. The SCUs and PCSCUs performed very similarly in the fall.

Turfgrass Clipping Yields Dry matter yields taken at ten- to twelve-day intervals throughout the growing season are provided in Tables 2-3. The unfertilized turfgrass consistently provided the lowest yields throughout the growing season. In general, dry matter yield trends reflect trends in turfgrass quality.

Table 1. Nitrogen Fertilizer Source and Rate Effect on Kentucky Bluegrass Quality

			Turfgrass Quality Rating[a]															
Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	5-19	6-1	6-13	6-24	7-5	7-15	8-1	8-16	8-31	9-13	9-21	10-3	10-12	10-24	11-4	11-20
Polyon (4%)[d]	44-0-0	1	5.5	5.2	6.0	7.0	7.5	7.5	7.5	6.3	5.3	5.5	5.7	6.5	6.5	7.0	7.0	6.0
		2	6.0	5.5	7.5	8.5	9.0	9.0	8.5	7.5	7.0	6.3	6.7	8.0	8.0	8.5	8.0	6.5
Polyon (8%)	42-0-0	1	6.2	5.0	6.0	6.5	7.3	7.0	7.0	6.0	5.2	5.0	4.3	5.0	5.5	6.0	6.5	6.0
		2	6.7	5.0	7.5	8.0	9.0	8.5	8.5	7.5	7.0	6.3	6.7	8.0	8.0	8.5	8.0	6.5
Poly-S Scotts	40-0-0	1	5.0	5.7	6.3	6.5	7.0	7.0	6.8	6.0	5.2	5.0	6.3	6.5	6.5	6.5	6.0	5.3
		2	6.0	6.5	8.0	8.0	8.5	8.0	8.0	7.3	6.2	6.0	7.5	8.5	8.0	8.0	7.2	6.0
Poly Plus	39-0-0	1	5.0	5.5	6.0	6.5	7.0	7.0	6.5	6.0	5.2	5.0	6.3	7.0	6.5	6.5	6.0	5.3
Lesco		2	6.0	6.5	7.5	8.0	8.5	8.0	8.0	7.3	6.2	6.0	7.5	8.5	8.0	8.0	7.0	6.0
Pursell SCU	39-0-0	1	5.0	5.5	6.0	6.5	6.7	6.5	6.5	6.0	5.2	5.0	6.0	7.0	6.5	6.5	6.0	5.5
		2	6.0	6.5	7.0	7.5	8.5	8.0	8.0	7.0	6.2	6.0	7.5	8.5	8.0	8.0	7.0	6.0
Anderson SCU	37-0-0	1	5.2	5.5	6.0	6.5	6.7	6.5	6.5	6.0	5.2	5.2	6.0	7.0	6.5	6.5	6.0	5.2
		2	6.0	6.5	7.0	7.5	8.5	8.0	8.0	7.0	6.2	6.0	7.5	8.5	8.0	8.0	7.0	6.0
Lesco SCU	37-0-0	1	5.2	5.5	6.0	6.5	6.7	6.5	6.5	5.7	5.2	5.0	6.0	7.0	6.5	6.5	6.0	5.5
		2	6.0	6.5	7.5	7.5	8.5	8.0	8.0	7.0	6.5	6.0	7.5	8.5	8.0	8.0	7.2	6.2
IBDU	31-0-0	1	6.0	5.0	5.0	6.5	7.0	7.2	7.0	6.0	5.5	5.3	5.5	6.0	6.0	7.0	6.5	6.0
		2	6.5	5.5	6.0	7.5	8.5	9.0	8.8	7.5	6.7	6.2	6.2	7.0	7.0	8.2	8.0	7.0
Once	34-0-7	1	5.5	5.5	6.0	6.5	7.3	7.0	7.0	6.0	5.5	5.5	6.0	6.5	6.5	7.0	6.5	6.0
		2	6.5	6.5	7.0	7.5	9.0	8.5	8.5	7.5	7.0	6.0	7.0	8.0	7.7	8.5	8.0	6.5
Nutralene	40-0-0	1	5.0	5.5	6.0	6.5	7.0	6.5	6.5	5.5	5.0	5.0	6.0	6.5	6.2	6.5	6.0	5.2
		2	6.0	6.3	7.0	7.5	8.5	8.0	8.0	6.8	6.0	5.7	7.5	8.0	7.5	7.5	7.0	6.0
Nature Safe	10-3-3	1	5.0	4.0	5.0	6.0	6.8	6.0	6.2	5.0	5.0	4.2	5.0	6.3	6.0	5.7	5.0	4.7
		2	5.5	5.0	6.0	7.5	8.3	7.5	7.5	6.5	5.5	5.0	6.0	7.8	7.5	7.5	6.5	5.5
Urea	46-0-0	1	4.0	6.5	7.0	7.0	7.0	6.0	6.0	5.0	4.0	3.3	7.0	7.5	7.0	7.0	5.8	5.0
		2	5.2	7.5	8.5	8.5	8.5	7.0	7.0	5.5	5.0	4.2	8.0	9.0	8.5	8.5	6.8	6.0
Pursell (12%)	40-0-0	4	6.0	5.0	5.0	5.0	8.3	9.0	9.0	9.0	8.5	7.5	7.0	6.8	7.3	6.5	6.2	5.5
Check	——	—	3.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	2.7	2.7	2.7	3.0	2.0	2.0	2.0
		LSD (0.05)	0.21	0.16	0.09	0.19	0.25	0.09	0.16	0.21	0.25	0.32	0.35	0.26	0.23	0.14	0.21	0.28

[a]Quality ratings were made on a scale of one to nine with nine representing best and one representing poorest.
[b]Fertilizer applications were made on May 25 and September 12, 1994.
[c]lb N/M represents pounds of Nitrogen per 1,000 square feet.
[d]4,8, and 12% represent coating thickness with polymer (polyurethane).

Table 2. Nitrogen Fertilizer Source and Rate Effect on Clipping Yield of Kentucky Bluegrass

Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	Clipping Yield (grams)[a] 4-28	5-10	5-20	6-6	6-16	6-28	7-8	7-20	8-1	8-12	8-23	9-2
Polyon (4%)[d]	44-0-0	1	39.3	34.0	26.7	16.7	14.7	47.3	38.0	2.0	46.0	29.3	20.7	10.7
		2	81.3	61.3	46.0	24.0	32.7	76.0	58.0	43.3	57.3	40.0	22.7	15.3
Polyon (8%)	42-0-0	1	40.0	41.3	34.7	14.0	9.3	27.3	37.3	30.7	46.0	32.0	22.0	14.0
		2	86.0	64.0	44.0	15.3	14.0	50.0	56.0	52.7	69.3	46.7	32.0	20.7
Poly-S Scotts	40-0-0	1	22.0	23.3	22.0	18.7	16.0	28.7	34.0	26.7	42.0	25.3	14.0	10.0
		2	48.7	42.0	34.0	40.7	44.0	55.3	46.7	34.0	48.0	36.0	22.7	11.3
Poly Plus Lesco	39-0-0	1	19.3	20.7	18.7	16.0	14.7	22.7	26.0	21.3	37.3	26.0	18.7	10.0
		2	48.0	46.0	34.0	30.0	31.3	46.0	42.7	42.0	52.7	39.3	24.7	15.3
Pursell SCU	39-0-0	1	27.3	26.7	24.7	12.7	14.7	19.3	24.7	20.0	34.7	23.3	13.3	10.7
		2	39.3	40.7	31.3	20.0	18.7	42.0	44.7	39.3	56.7	37.3	22.7	18.0
Anderson SCU	37-0-0	1	21.3	22.0	21.3	10.7	12.7	17.3	22.0	22.0	32.0	23.3	21.3	9.3
		2	33.3	28.0	32.7	17.3	18.7	35.3	39.3	36.7	48.0	32.0	24.0	14.0
Lesco SCU	37-0-0	1	18.0	21.3	22.7	10.0	4.7	12.7	24.7	17.3	30.0	20.7	16.0	9.3
		2	53.3	52.7	42.0	24.7	26.0	45.3	46.7	41.3	56.0	34.0	30.0	18.7
IBDU	31-0-0	1	34.7	33.3	32.0	15.3	8.0	20.7	29.3	28.7	41.3	27.3	21.3	10.7
		2	62.7	52.0	41.3	17.3	12.7	36.7	47.3	52.7	68.7	46.7	31.3	15.3
Once	34-0-7	1	30.7	32.7	28.7	12.7	11.3	21.3	30.0	28.0	43.3	30.0	22.0	10.7
		2	56.0	50.0	40.0	22.0	19.3	45.3	54.7	52.7	66.0	46.0	29.3	18.0
Nutralene	40-0-0	1	16.7	19.3	19.3	12.7	12.0	24.0	24.0	22.0	31.3	22.7	18.0	8.0
		2	28.0	26.7	25.3	20.0	26.7	42.0	40.7	29.3	44.7	31.3	22.0	12.7
Nature Safe	10-3-3	1	20.7	19.3	19.3	12.7	6.7	22.7	24.0	20.7	31.3	23.3	20.0	12.7
		2	36.0	30.7	25.3	10.7	15.3	45.3	42.7	30.0	36.0	30.0	22.7	11.3
Urea	46-0-0	1	22.0	20.7	16.7	16.7	16.0	26.0	25.3	19.3	28.7	20.7	18.0	8.0
		2	33.3	31.3	23.3	30.0	38.0	52.0	40.0	30.0	39.0	26.0	20.7	10.7
Pursell (12%)	40-0-0	4	34.7	28.7	27.3	8.0	4.0	15.3	31.3	41.3	64.7	44.0	36.7	22.7
Check	——	—	8.0	5.3	7.3	5.3	4.0	2.0	4.0	4.7	8.7	8.0	8.7	5.3
		LSD (0.05)	18.6	13.0	9.0	6.8	9.4	10.8	8.8	9.8	10.5	8.4	7.4	6.2

[a]Clipping yields were made by taking a swath down the center of each plot with a Lawn-Boy rotary mower.
[b]Fertilizer applications were made on May 25 and September 12, 1994.
[c]lb N/M represents pounds of Nitrogen per 1,000 square feet.
[d]4,8, and 12% represent coating thickness with polymer (polyurethane).

Table 3. Nitrogen Fertilizer Source and Rate Effect on Clipping Yield of Kentucky Bluegrass

Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	Clipping Yield (grams)[a] 9-13	9-22	10-4	10-13	10-24	11-7	11-21
Polyon (4%)[d]	44-0-0	1	12.7	8.0	11.3	10.0	8.7	8.7	2.7
		2	13.3	10.0	18.0	18.7	18.0	13.3	5.3
Polyon (8%)	42-0-0	1	15.3	4.7	8.7	8.0	8.0	7.3	2.7
		2	18.0	5.3	8.7	8.7	10.0	10.7	4.7
Poly-S Scotts	40-0-0	1	10.7	9.3	16.0	9.3	6.7	6.0	2.7
		2	8.7	21.3	30.0	16.0	14.0	10.0	4.0
Poly Plus Lesco	39-0-0	1	10.7	9.3	17.3	8.7	6.0	4.0	2.0
		2	16.0	24.0	34.0	17.3	12.7	9.3	2.7
Pursell SCU	39-0-0	1	11.3	10.0	16.7	7.3	4.7	4.7	2.0
		2	14.7	22.7	30.7	16.7	11.3	9.3	3.3
Anderson SCU	37-0-0	1	12.0	13.3	16.7	8.7	4.7	5.3	2.7
		2	12.7	19.3	25.3	14.0	8.0	7.3	2.0
Lesco SCU	37-0-0	1	11.3	10.7	14.0	8.0	4.0	3.3	2.0
		2	15.3	22.7	30.7	16.7	13.3	8.7	3.3
IBDU	31-0-0	1	12.0	8.0	9.3	6.7	6.0	7.3	3.3
		2	12.7	7.3	14.0	8.7	8.7	9.3	4.7
Once	34-0-7	1	10.7	6.7	10.0	9.3	7.3	8.7	4.0
		2	14.0	12.0	14.7	10.7	12.7	12.0	4.7
Nutralene	40-0-0	1	8.7	8.0	13.3	5.3	5.3	6.0	2.0
		2	12.7	20.0	25.3	10.7	9.3	4.7	2.0
Nature Safe	10-3-3	1	17.3	12.0	18.0	8.7	6.0	6.7	2.0
		2	12.7	13.3	27.3	14.0	12.7	8.7	2.0
Urea	46-0-0	1	10.0	13.3	18.7	9.3	5.3	4.7	2.0
		2	10.7	10.3	27.3	13.3	8.7	5.3	2.0
Pursell (12%)	40-0-0	4	19.3	10.7	11.3	6.7	5.3	5.3	2.7
Check	——	—	6.0	4.7	4.7	2.7	2.7	2.0	2.0
		LSD (0.05)	5.3	5.6	6.5	3.9	3.2	2.9	1.8

[a]Clipping yields were made by taking a swath down the center of each plot with a Lawn-Boy rotary mower.
[b]Fertilizer applications were made on May 25 and September 12, 1994.
[c]lb N/M represents pounds of Nitrogen per 1,000 square feet.
[d]4,8, and 12% represent coating thickness with polymer (polyurethane).

Polymer-Coated Nitrogen Source Effect on Kentucky Bluegrass

John Street and Renee Stewart
Horticulture and Crop Science

Introduction

Good turfgrass growth is dependent on an adequate supply of all the essential nutrients, as well as other environmental and cultural factors. Of the essential nutrients, nitrogen is the element that receives the most attention in turfgrass fertilization programs. One reason for emphasis on nitrogen is that turfgrasses give a good color and growth response to nitrogen. The color and growth response from nitrogen is usually more dominant than any other element. The behavior of nitrogen, in both the plant and the soil, places it in the unique position of being the "growth control" element. Supplies of other nutrients are kept at adequate levels and the manager regulates growth and color by adding or withholding nitrogen. Thus, fertilization strategies for turfgrass are primarily designed around nitrogen.

A number of nitrogen containing fertilizers are presently available in the marketplace for turfgrass fertilization: water soluble or quickly available and water insoluble or slowly available. These nitrogen fertilizers vary considerably in their chemical and physical properties. Slowly-available sources such as ureaformaldehyde (UF), milorganite, isobutylidene diurea (IBDU), methylene ureas, and sulfur-coated ureas have been available for years. Several new slowly-available sources have more recently emerged into the market place. These are the polymer-coated ureas and polymer-coated, sulfur-coated ureas. Polymer-coated urea is by definition a coated slow-release fertilizer consisting of fertilizer urea particles coated with a polymer plastic resin. The polymer-coated sulfur-coated urea are sulfur-coated urea particles coated with a polymer plastic (resin). Coating thickness of the sulfur and/or plastic (resin) plays a major role in the release characteristics of these latter sources.

Discussion/Summary

The effect of several nitrogen sources and rates (Tables 1-4) on turfgrass quality and yield were compared throughout the 1994 growing season. All the one and two pound per 1,000 square feet nitrogen rates were applied on May 14 and September 14, 1994. Each treatment was replicated three times in a completely randomized block design using 3 x 8 feet plots. Mowing was performed at a two-inch height and clippings were collected throughout the season on a ten- to twelve-day interval schedule (Tables 5-6). Clipping yield was based on one complete swath across the center of each plot with a 22-inch Lawn-Boy rotary mower. Clippings were bagged, dried at 60 degrees C for 72 hours, and then weighed to provide dry matter yields (Tables 5-6). Turfgrass quality ratings were taken on a scale of 1 to 9, with 1 representing poorest and 9 representing best (Tables 1-4). Irrigation was performed as needed to prevent wilt.

Turfgrass Quality and Clipping Yields Turfgrass quality ratings for the 1994 growing season are provided in Tables 1-4. In the 1 to 9 rating scale, 6 is considered marginally acceptable and anything below 6 is unacceptable. Dry matter yields taken at ten- to twelve-day intervals throughout the growing season are provided in Tables 4-6.

Table 1. Nitrogen Source Effect on Seasonal Quality of Kentucky Bluegrass

			Turfgrass Quality Rating[a]										
Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	6-1	6-12	6-21	7-1	7-13	7-26	8-4	8-15	8-25	9-6	9-13
UHS 2002 (60d)	25-5-10	1	6.0	6.0	6.5	7.0	7.0	6.8	7.0	7.5	6.0	5.0	5.0
		2	7.0	7.5	7.5	8.5	8.0	8.0	7.5	8.3	7.0	5.5	5.0
UHS 2003 (90d)	25-5-10	1	5.5	6.0	6.0	7.5	7.5	7.3	7.0	7.0	6.0	5.0	5.0
		2	6.5	7.5	7.5	9.0	9.0	8.8	8.2	8.0	7.0	5.8	5.5
UHS 2004 (120d)	25-5-10	1	5.0	5.5	6.0	7.0	7.3	7.5	7.3	7.0	6.2	5.5	5.0
		2	6.0	7.0	7.3	8.5	8.5	9.0	8.5	8.0	7.3	6.2	6.0
Urea	46-0-0	1	6.5	6.5	7.0	7.0	6.0	6.3	6.0	6.0	5.3	5.0	4.0
		2	7.5	8.0	8.5	8.0	7.2	7.5	7.3	7.5	6.7	5.3	4.0
Nutralene	40-0-0	1	5.5	6.0	6.0	7.0	7.0	7.5	7.5	7.0	6.0	5.3	5.0
		2	6.5	7.0	7.2	8.5	8.0	8.5	8.5	8.0	7.2	6.0	6.0
Sulfur Kote II	39-0-0	1	6.0	6.0	6.0	7.0	6.5	7.5	7.0	7.0	6.0	5.0	5.0
		2	7.0	7.5	7.5	8.5	8.0	8.5	8.0	8.0	7.0	6.0	6.0
Poly PLus	39-0-0	1	5.5	6.0	6.0	7.0	6.5	7.7	7.2	7.5	6.0	5.2	5.0
		2	6.5	7.5	7.5	8.0	8.0	8.7	8.5	8.5	7.5	6.0	6.0
CIL SCU	37-0-0	1	6.0	6.0	6.0	7.0	7.0	7.5	7.0	7.0	6.0	5.3	5.0
		2	7.0	7.5	7.5	8.2	8.2	8.7	8.2	8.0	7.2	6.0	5.8
Poly S	40-0-0	1	6.5	6.5	6.5	7.0	7.0	7.5	7.0	7.0	6.0	5.0	5.0
		2	7.5	8.0	8.2	8.0	8.0	8.5	8.0	8.0	7.2	6.0	5.8
		LSD (0.05)	0.22	0.12	0.16	0.26	0.27	0.40	0.25	0.25	0.37	0.27	0.33

[a]Quality ratings were taken on a scale of 1 to 9 with 9 representing best and 1 representing poorest.
[b]Fertilizer treatments were made on May 24 and September 14, 1994.
[c]lb N/M represents pounds of nitrogen per 1,000 square feet.

Table 2. Nitrogen Source Effect on Seasonal Quality of Kentucky Bluegrass

Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	Turfgrass Quality Rating[a] 6-1	6-12	6-21	7-1	7-13	7-26	8-4	8-15	8-25	9-6	9-13
Polyon	42-0-0	1	5.0	6.0	7.0	7.5	7.5	8.0	7.5	7.0	6.0	5.3	5.0
		2	5.5	7.5	8.5	9.0	9.0	9.0	8.7	8.5	7.5	6.2	5.8
Nature Safe	10-3-6	1	5.0	5.5	6.0	6.5	6.5	6.8	6.0	5.7	5.3	5.0	4.3
		2	5.5	6.5	7.0	8.0	7.5	7.8	7.2	7.5	6.5	5.5	5.0
UHS 2002 (60d)	41-0-0	1	5.0	5.5	6.5	7.2	7.5	8.0	7.7	7.5	6.5	5.5	5.0
		2	5.5	6.5	7.5	9.0	9.0	9.0	8.7	8.5	7.5	6.5	6.0
UHS 2003 (90d)	41-0-0	1	5.0	5.5	6.0	7.0	7.0	8.0	7.5	7.5	6.3	6.0	5.0
		2	5.5	6.5	7.0	8.5	8.5	9.0	8.5	8.5	7.5	6.5	6.0
UHS 2004 (120d)	41-0-0	1	5.0	5.0	5.7	7.2	7.5	8.5	7.8	7.5	6.	6.0	5.0
		2	5.0	6.0	7.0	8.3	9.0	9.0	9.0	8.5	7.5	6.5	6.0
MBN	30-0-0	1	6.5	7.0	7.0	7.0	6.5	6.5	6.5	6.5	5.0	5.0	5.0
		2	7.5	8.5	8.5	8.5	7.5	7.5	7.5	7.5	6.0	5.5	5.5
Coron	28-0-0	1	6.8	7.0	7.0	7.0	6.5	6.5	6.5	6.5	5.0	5.0	5.0
		2	7.2	8.5	8.5	8.5	7.5	7.5	7.5	7.5	6.0	5.5	5.5
Check	——	—	4.0	4.2	3.0	3.0	3.3	3.7	4.0	4.7	4.7	4.0	3.7
		LSD (0.05)	0.22	0.12	0.16	0.26	0.27	0.40	0.25	0.25	0.37	0.27	0.33

[a]Quality ratings were taken on a scale of 1 to 9 with 9 representing best and 1 representing poorest.
[b]Fertilizer treatments were made on May 24 and September 14, 1994.
[c]lb N/M represents pounds of nitrogen per 1,000 square feet.

Table 3. Nitrogen Source Effect on Seasonal Quality of Kentucky Bluegrass

Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	Turfgrass Quality Rating[a] 9-22	10-5	10-19	10-31	11-18	12-11
UHS 2002 (60d)	5-5-10	1	6.0	6.5	7.0	6.5	6.0	4.0
		2	7.0	7.5	8.0	7.5	7.0	5.0
UHS 2003 (90d)	25-5-10	1	5.3	6.0	6.5	6.5	6.0	4.0
		2	6.0	7.0	7.5	7.5	7.0	5.0
UHS 2004 (120d)	25-5-10	1	5.0	6.0	6.2	6.5	6.2	4.0
		2	6.0	7.0	7.2	7.5	7.5	5.7
Urea	46-0-0	1	7.5	7.3	7.0	7.0	6.0	3.3
		2	8.5	8.5	8.5	8.0	7.2	4.7
Nutralene	40-0-0	1	6.5	6.5	6.8	6.5	6.0	3.7
		2	7.7	8.0	7.8	7.5	7.0	5.0
Sulfur Kote II	39-0-0	1	6.5	7.0	7.0	6.5	6.0	4.0
		2	8.0	8.5	8.5	8.0	7.5	5.2
Poly PLus	39-0-0	1	6.5	7.0	7.0	6.5	6.0	4.0
		2	8.0	8.5	8.5	8.0	7.5	5.2
CIL SCU	37-0-0	1	6.5	7.0	6.8	6.5	6.0	4.0
		2	7.8	8.3	8.2	7.7	7.2	5.0
Poly S	40-0-0	1	6.7	7.0	7.0	6.5	6.0	4.0
		2	8.0	8.2	8.0	7.5	7.0	5.0
		LSD (0.05)	0.32	0.22	0.36	0.31	0.23	0.41

[a]Quality ratings were taken on a scale of 1 to 9 with 9 representing best and 1 representing poorest.
[b]Fertilizer treatments were made on May 24 and September 14, 1994.
[c]lb N/M represents pounds of nitrogen per 1,000 square feet.

Table 4. Nitrogen Source Effect on Seasonal Quality of Kentucky Bluegrass

Source	Fertilizer[b] Analysis	Rate[c] (lbs N/M)	Turfgrass Quality Rating[a] 9-22	10-5	10-19	10-31	11-18	12-11
Polyon	42-0-0	1	5.2	6.5	7.0	6.5	6.5	5.0
		2	5.8	8.0	8.5	8.0	8.0	6.0
Nature Safe	10-3-6	1	5.2	6.0	6.0	5.3	5.3	3.3
		2	6.0	7.5	7.5	7.0	6.5	5.0
UHS 2002 (60d)	41-0-0	1	5.5	6.0	6.7	6.7	6.2	4.3
		2	6.0	7.0	7.7	8.0	7.7	6.0
UHS 2003 (90d)	41-0-0	1	5.3	6.0	6.3	6.5	6.2	4.0
		2	5.8	6.8	7.3	7.7	7.7	6.0
UHS 2004 (120d)	41-0-0	1	5.2	5.5	5.8	6.5	6.0	4.0
		2	5.7	6.0	6.8	7.7	7.5	6.0
MBN	30-0-0	1	6.0	7.2	7.0	6.7	6.0	5.0
		2	7.5	8.5	8.0	7.7	7.5	6.0
Coron	28-0-0	1	6.5	7.2	6.5	6.5	6.0	5.0
		2	7.5	8.3	7.5	7.5	7.0	6.0
Check	——	—	3.7	4.0	3.3	2.7	2.0	2.0
		—	3.7	4.0	3.3	2.7	2.0	2.0
		LSD (0.05)	0.32	0.22	0.36	0.31	0.23	0.41

[a]Quality ratings were taken on a scale of 1 to 9 with 9 representing best and 1 representing poorest.
[b]Fertilizer treatments were made on May 24 and September 14, 1994.
[c]lb N/M represents pounds of nitrogen per 1,000 square feet.

Table 5. Kentucky Bluegrass Clipping Yields as Affected by Various Nitrogen Fertilizers

Fertilizer[b] Source	Rate[c] Analysis	(lbs N/M)	Clipping Yield (grams)[a] 6-3	6-13	6-23	7-5	7-15	7-26	8-4	8-15	8-26	9-6	9-27	10-7	10-20	11-2	11-22
UHS 2002	25-5-10	1	20	11	18	34	26	32	26	24	18	18	30	15	7	6	4
		2	26	28	38	59	35	41	35	27	21	7	37	22	14	8	7
UHS 2003	25-5-10	1	17	12	21	40	28	33	22	24	17	14	19	10	5	4	3
		2	28	35	52	78	49	58	40	35	25	20	36	21	11	8	7
UHS 2004	25-5-10	1	11	12	24	41	32	41	30	26	19	15	19	10	4	4	2
		2	15	24	42	71	46	55	42	35	24	22	30	17	11	8	7
Urea	46-0-0	1	20	18	23	38	24	35	27	24	17	10	32	17	7	5	3
		2	34	39	42	58	36	42	33	31	22	19	51	31	19	10	6
Nurtralene	40-0-0	1	17	10	19	33	26	31	25	25	20	18	32	13	5	4	3
		2	22	18	27	46	31	41	32	29	21	21	51	24	14	8	6
Sulfur Kotell	39-0-0	1	15	14	13	27	17	26	21	20	16	12	37	15	6	6	2
PC SCU		2	21	7	3	45	28	36	30	25	21	24	54	30	17	10	9
Poly Plus	39-0-0	1	12	10	15	25	15	25	24	20	16	16	36	15	8	5	3
PC SCU		2	15	16	24	38	30	38	29	27	21	24	49	24	19	9	5
CIL	37-0-0	1	13	11	14	29	21	32	23	23	19	15	28	13	8	4	2
		2	35	31	46	57	40	46	32	31	20	19	4	23	12	9	6
		LSD (0.05)	11.3	23.6	19.1	12.9	10.1	14.0	9.2	7.4	7.1	8.1	15.2	7.6	6.9	5.4	4.6

[a]Clipping yields were made by taking a swath down the center of each plot with a Lawn-Boy rotary mower.
[b]Fertilizer applications were made on May 24 and September 14, 1994.
[c]lb N/M represents pounds of nitrogen per 1,000 square feet.

Table 6. Kentucky Bluegrass Clipping Yields as Affected by Various Nitrogen Fertilizers

Fertilizer[b]	Rate[c]		Clipping Yield (grams)[a]														
Source	Analysis	(lbs N/M)	6-3	6-13	6-23	7-5	7-15	7-26	8-4	8-15	8-26	9-6	9-27	10-7	10-20	11-2	11-22
Poly S	39-0-0	1	29	19	24	38	26	32	25	22	15	9	25	14	8	3	3
		2	30	39	42	56	34	38	30	26	20	13	42	24	13	8	6
Polyon	42-0-0	1	16	14	31	45	28	36	25	25	19	12	16	12	9	5	5
		2	14	22	50	64	39	44	35	33	22	18	21	18	15	12	10
Nature Safe	10-3-3	1	7	6	21	36	23	29	25	22	15	10	17	10	6	6	2
		2	8	11	34	58	34	38	27	28	18	14	25	19	14	9	6
UHS 2002	41-0-0	1	9	6	18	37	28	32	26	22	18	11	13	7	4	4	2
		2	16	12	29	59	46	50	39	33	24	20	23	12	11	7	5
UHS 2003	41-0-0	1	12	8	16	37	27	32	26	24	20	16	22	10	7	6	3
		2	12	7	29	56	41	47	34	32	24	20	29	14	14	11	8
UHS 2004	41-0-0	1	14	7	11	30	20	31	26	21	15	14	16	7	3	3	2
		2	13	6	24	52	41	44	35	30	23	19	20	10	6	8	5
Morral NBN	30-0-0	1	15	34	32	32	19	26	20	21	15	19	31	13	5	4	2
		2	30	56	52	54	23	31	27	21	18	19	26	25	19	13	8
Coron	28-0-0	1	15	32	26	39	22	32	25	19	15	18	30	17	9	8	3
		2	30	34	47	47	25	31	20	20	20	20	28	23	19	13	11
Check	——	—	10	3	4	13	11	14	18	12	11	7	13	5	2	3	2
	——	—	11	4	3	14	9	16	17	14	10	13	15	6	2	3	2
		LSD (0.05)	11.3	23.6	19.1	12.9	10.1	14.0	9.2	7.4	7.1	8.1	15.2	7.6	6.9	5.4	4.6

[a]Clipping yields were made by taking a swath down the center of each plot with a Lawn-Boy rotary mower.
[b]Fertilizer applications were made on May 24 and September 14, 1994.
[c]lb N/M represents pounds of nitrogen per 1,000 square feet.

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Turfgrass Species and Cultivars

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Evaluation of Turfgrass Species and Cultivars for Shade

Jill Taylor
Horticulture and Crop Science

Introduction

Recommending a single turfgrass species or mixture to thrive in a particular shaded site is challenging. Shaded areas, in general, can vary in sunlight availability, soil type and moisture-holding capacity, drainage and air circulation.

Some single species have shown success as monostands. Mixtures of certain species have also shown success, allowing natural niche establishment and survival. When mixtures are seeded to a shaded site, those species that adapt best to that site over time will often become the major species component of the original seeded mixture.

A shade trial was established at the Ohio State University Turfgrass Research Center on Sept. 30, 1992. Major seed producers provided entries to be considered for shaded areas. The thirty-eight entries include monostands of bluegrass, ryegrass, tall fescue, Poa trivialis and fine fescue as well as five seed mixtures.

The area for trial establishment varies from deep shade to partial sun, with little air movement. Entries in the trial were placed in a randomized block design with the blocks placed across the shade variability. One inch of topsoil was added prior to seeding the entries by hand at the recommended rates.

In the establishment year for this trial (autumn 1992-autumn 1993), actual nitrogen applied was 2 pounds. Also, a split plot fertilizer application was applied in September 1993, and autumn species color response was recorded.

Irrigation was provided autumn 1992 through spring 1993 to encourage growth. Supplemental irrigation was provided four times in summer 1993 to prevent severe stress to the trial.

In the second year (autumn 1993-autumn 1994), no fertilizer was applied. No supplemental irrigation was provided. Except for one application of a contact fungicide to control brown patch on tall fescues in June 1994, no other inputs were used.

Ratings taken in 1993 were percent cover, quality, color, stress and disease. Ratings for 1994 include winter color, color, percent cover, quality and texture.

A list of seed producers supplying entries to this trial and establishment year data and discussion can be found in the *1993 Ohio State University Turfgrass Research Report.*

Components of the mixes used in this trial are:

Lesco Shade Mix: 35% Shadow chewings fescue, 35% Shademaster creeping red fescue, 15% Commander ryegrass, 10% Spartan hard fescue, and 5% Julia Ky. bluegrass.

Scott's Shady Area: 50% Banner chewings fescue, 30% Ovation ryegrass, 12% Bristol Ky. bluegrass and 8% Coventry Ky. bluegrass.

Loft's Ecology Mix: 70% Reliant hard fescue, and 30% Jamestown II chewings fescue.

TurfSeed Polo Mix: 80% ryegrass, 5% bluegrass, 7.5% Shademaster creeping fescue, and 7.5% Aurora hard fescue.

Scott's Perfect Choice Shade: 50% Brigade hard fescue, 25% Bristol Ky. bluegrass 25%, and 25% Banner chewings fescue.

Discussion/Summary

This report summarizes establishment and second-year data. Data will be taken over several years to provide more information on what species or mixtures persist over time in shaded areas. Table 1 provides 1994 cultivar data, including winter color, spring color, cover, texture and quality.

A shade trial species summary by rating catagory is as follows:

Percent Cover In the establishment year, best germination and cover were achieved by ryegrasses, followed by fine fescues, tall fescues, *Poa trivialis* and mixtures. Poorest in germination and cover were the bluegrasses.

In the second year, ryegrass still had the best cover, followed by mixes, tall fescue and *Poa trivialis*. Kentucky bluegrasses had some lateral growth but rated poorly in cover (less than 40%).

Summer Stress Most adaptable to summer stress were tall fescues, followed by fine fescues, bluegrasses and mixtures. *Poa trivialis* had good quality during wet soil conditions, but poor quality and loss of cover during dry soil conditions.

Disease In the establishment year, least susceptible to disease were the tall fescues, and most susceptible were ryegrasses and *Poa trivialis* (rust), followed to a lesser degree by bluegrasses and fine fescues (leaf spot). The mixtures varied in disease incidence, but those with ryegrass as a major component appeared the most affected. In the second year of the trial, tall fescues were highly infected with brown patch resulting in loss of cover. Loss may have been complete without an application of a contact fungicide. Recovery was good.

Summer Quality In 1993, good quality was recorded for most grasses. Bluegrasses received low ratings due to poor cover, and fine fescues due to poor color. *Poa trivialis*, which scored high in quality in 1993, fell in 1994 due to poor color and loss of cover (summer stress). In 1994, fine fescues and mixes scored higher in cover and quality. Tall fescues, which have good summer color, scored lower due to loss of cover (disease), and texture.

Color Best in spring color were tall fescues, followed by bluegrasses, ryegrasses and fine fescues. Best in summer color were the tall fescues and ryegrasses. Best in autumn color were tall fescues; poorest were the fine fescues. Best in autumn color fertilizer response were the bluegrasses. Best in winter color were bluegrasses and ryegrasses. Winter color of tall fescues was fair-poor.

Table 1. Ohio Shade Trial Ratings 1994

	W. Color 3/31/94	Color 5/10/94	% Cover 5/10/94	Texture 5/18/94	Quality 6/18/94
Perennial ryegrasses					
Citation II	6.8[a]	8.2[a]	76.7	3.5[b]	7.7[c]
Brightstar	6.9	8.2	75.0	3.4	7.0
Alliance	7.0	7.8	71.7	3.3	6.2
Kentucky bluegrasses					
WWKB-92	8.0	8.0	10.0	2.5	3.0
SKB-712	7.5	8.0	20.0	2.5	2.5
Coventry	6.8	8.0	31.7	2.8	5.0
Bristol	7.5	8.2	28.3	2.7	3.8
4 ACES	5.0	8.5	26.7	2.9	5.0
Blacksburg	6.8	8.3	16.7	2.9	3.3
Poa trivialis					
Laser	5.8	7.0	58.3	3.6	5.9
Fine fescues					
SCF-E Chewings	6.8	6.8	73.3	4.9	7.7
RUCF-92 Chewings	6.3	7.4	79.0	4.8	7.4
Jamestown II Chewings	6.2	6.8	60.0	4.5	6.3
Molinda Chewings	6.2	6.5	60.0	4.9	7.5
Banner Chewings	6.5	6.3	56.7	4.8	5.7
SCR-92 Creeping Red	6.6	7.0	61.7	4.8	6.4
SMWE-92 Creeping Red	7.5	7.5	60.0	4.3	8.0
Shadow Fine Fescue	6.8	7.0	73.3	4.5	7.2
Shademaster Red	6.7	7.5	68.3	4.5	6.3
Aurora Hard Fescue	6.1	4.2	66.7	4.8	7.2
Reliant Hard Fescue	6.9	6.7	73.3	4.8	6.5
Brigade Hard Fescue	6.3	6.6	45.0	5.0	6.0
Bighorn Sheep Fescue	5.7	6.8	41.7	4.8	4.2
Tall fescues					
Tomahawk	5.9	8.8	85.0	2.3	7.8
Tribute	6.3	8.3	73.3	1.6	5.8
Rebel Jr.	6.3	8.8	63.3	1.3	6.3
PSFL-92	6.1	8.3	76.7	1.8	6.3
Aztec	5.6	8.5	58.3	1.4	5.7
LDTF II-92	5.8	8.3	62.3	1.4	6.3
Mowless	5.9	8.5	58.3	1.6	5.7
Rebel 3D	6.0	8.2	48.3	2.0	4.2
Silverado	5.8	8.7	55.0	1.3	6.0
SFL	7.1	8.8	38.3	1.9	4.0
Shade mixtures					
Shade Mix	7.2	7.6	70.0	4.3	7.7
Shady Area	6.8	7.3	66.7	3.6	6.3
Ecology Mix	5.8	6.3	76.7	2.5	7.4
Polo Mix	6.9	7.8	70.0	3.7	6.7
Perfect Choice	6.0	6.8	83.3	4.9	6.9

[a]Mean color 1-9, 9=greenest, 6=some green, marginally acceptable, 5-1=poor color, 1=poorest color, brown or dead.
[b] Mean texture 1-5, 5=finest (as in fine fescue), 1=coarsest (as in K-31 Tall Fescue).
[c] Mean quality 1-9, 9=best, 6=marginally acceptable quality, 1=poorest.

Regional Low Input Sustainable Turf Study

Jill Taylor
Horticulture and Crop Science

Introduction

The Ohio State University Turfgrass Research Center is among a dozen universities participating in a Low Input Sustainable Turf (LIST) study entitled, "Effect of clipping frequency under low input turf management on species broadly adapted to the North Central United States." Chief researcher is Dr. Ken Diesburg, Southern Illinois University, Carbondale.

Results from this study will serve to identify appropriate low input turf species and their proper mowing management for a persistent, uniform turf. Practical target areas for low input sustainable turf are golf course roughs, institutional acreage, parks and recreational areas, highway right-of-ways and low management home lawns.

A recent NCR-10 Alternative Species project, directed by Dr. Nick Christians, Iowa State University, identified four broadly adapted persistent species. They are sheep fescue, tall fescue, colonial bentgrass and redtop. These species, as well as buffalograss, common Kentucky bluegrass, hard fescue and zoysia, comprise the current LIST study.

Discussion/Summary

In Ohio, fourteen entries were planted in October 1992 on an adequately drained site in full sun. Each entry (48 square feet) is contained in a randomized complete block design with three replications.

Each entry is split into three mowing frequencies:

- Alternate Weekly (AW)
- Monthly (M)
- Twice Yearly (2X/Y)

The plots were visually rated three times per year for quality, percent cover and weed encroachment.

Mowing under the twice yearly schedule occured in June and in September after seed production. Mowing is performed with a rotary mower at 3.5 inches height of cut. Clippings are returned.

Irrigation was provided for establishment for the remainder of the 1992 growing season. As dictated by the study, the buffalograss and zoysia entries were seeded in June 1993, and irrigation was again provided for the entire study until August 1.

A starter fertilizer was applied at 0.5 pound nitrogen per 1000 square feet at planting time(s). A sulfur-coated urea was applied once yearly in September/October. No other inputs are used.

Percent Cover Mean percent cover data ranged from 50% to 96% by September 1993. Highest in density by September 1993 (85% or higher) were the hard fescues and creeping red fescue. Lowest in density by September 1993 (less than 72%) were colonial bentgrasses (90161 and Exeter) and VNS and Barricuda redtops.

Sharp's Improved Buffalograss provided a good cover (80%) by September 1993 after its June 1993 seeding. Sunrise Chinese common Zoysia, also seeded in June, was slower to establish, providing only a 50% cover by September.

Ratings were recorded comparing percent cover versus mowing frequency (AW, M, 2X/Y). Comparisons were made within and between the species at LSD=0.05.

By September 1993, there were few significant differences within the species in percent cover, regardless of mowing frequency. VNS redtop and K-31 tall fescue with endophyte had significantly lower density with the (2X/Y) schedule vs. (AW) and (M).

By August 1994, percent cover had increased in all species and mowing frequencies. (See Table 1.) Within the species, there were no significant differences in percent cover vs. mowing frequency except, again, for VNS redtop and K-31 tall fescue with endophyte. These species had significantly lower density at the (2X/Y) schedule.

Species with less than 80% cover after two years were 90161 bentgrass (2X/Y), Barricuda redtop (M) and VNS redtop (M) and (2X/Y). Highest in percent cover (90% or higher) were: the hard fescues and sheep fescues (all mowing schedules); Cindy creeping red fescue (AW) and (M); K-31 tall fescues with and without endophyte (AW) and S. Dakota common bluegrass (AW).

Table 1. LIST Mean Percent Cover vs. Mowing Frequency, August 10, 1994

Species	Alt. Week	Month	2X/ year
HF 9032 Hard Fescue	97.0[a]	97.7	97.7
Exeter Colonial Bentgrass	88.3	80.0	81.7
Reliant Hard Fescue	98.3	100.0	97.7
South Dakota Common Ky. Bg.	90.7	86.7	81.7
Barricuda Redtop	86.7	78.3	81.7
K-31 Tall Fescue	90.0	85.7	85.0
VNS Redtop	81.7	75.0	66.7
VNS Sheep Fescue	99.0	98.3	96.7
K-31 Tall Fescue (with endo.)	90.0	87.7	80.0
Sharps Improved Buffalograss	83.3	85.0	87.7
Sunrise Chinese Common Zoysia	81.7	80.0	81.7
Cindy Creeping Red Fescue	94.3	96.0	88.3
Valda Hard Fescue	100.0	97.7	91.7
90161 Colonial bentgrass	80.0	81.7	76.7
LSD (0.05)=8.688			

[a]Mean percent cover 1-100

Percent Weeds In 1993, mean percent weeds ratings ranged from 9-44%. Between the species, buffalograss and zoysia had significantly higher percent weeds, probably due to the later (Spring 1993) seeding date. There were no significant differences within the species between mowing frequency vs. percent weeds.

In 1994, there were no significant differences within the species in percent weeds vs. mowing frequency except for Exeter colonial bentgrass, which had significantly more weeds at the (2X/Y) schedule vs. (AW) or (M). (See Table 3)

Between the species, lowest in percent weeds in August 1994 (3-10%) were Buffalograss (all mowing schedules); Reliant Hard fescue (M) and (AW); Valda and HF 9032 hard fescues (2X/Y) and K-31 tall fescue with endophyte (2X/Y).

Highest in percent weeds (38-51%) were Barricuda redtop, 90161 and Exeter colonial bentgrasses, all at the (2X/Y) schedules.

Quality Mean quality ratings vs. mowing frequency were taken on a scale of 1-9, with 9=best quality, 6=marginally acceptable and 1=dead or dormant. By September 1993, quality averages ranged from 2.7 to 7.5. None of the species rated high in quality (8 or above). Species rating 7.0 to 7.5 were: the HF 9032 hard fescue (M) and (2X/Y); Reliant and Valda hard fescues (2X/Y); buffalograss (M) and (2X/Y); and zoysia (all schedules). Species rating in the marginally acceptable range were Barricuda and VNS redtops, and Exeter and 90161 colonial bentgrasses, at all mowing schedules.

By August 1994, quality averages ranged from 3.0 to 8.7. (See Table 3). Within the species, quality was significantly lower for South Dakota common bluegrass (2X/Y); K-31 tall fescue (2X/Y); VNS redtop (2X/Y); and zoysia (2X/Y).

Highest in quality between the species (rating 8.0-8.7) were Reliant hard fescue (all mowing frequencies); HF 9032 and Valda hard fescues and VNS sheep fescue (M).

Species rating low and unacceptable at all mowing schedules were Exeter and 90161 Colonial bentgrasses; Barricuda and VNS redtops and Cindy creeping red fescue.

Marginally acceptable in quality were K-31 tall fescue (AW) and (M); K-31 tall fescue with endophyte (AW) and (2X/Y); buffalograss (AW) and zoysia (M).

During the first year of this study (1992-1993), supplemental irrigation at seeding times may have altered some of the mowing frequency effects on quality, weed encroachment and percent cover. The establishment year for zoysia and buffalograss was 1993. Irrigation was not an input in the second year of this study.

A few observations in regard to mowing frequency (AW, M, 2X/Y, or all three) can made from the 1994 data:

1. Reliant hard fescue was the highest rated at the monthly and alternate week mowing schedules.
2. Highest in percent cover (90% or more) were the hard fescues and sheep fescues (all mowing schedules); creeping red fescue (AW) and (M); K-31 and K-31 with endophyte (AW); and South Dakota common bluegrass (AW). Lowest (less than 80% cover) were the redtops (M) and (2X/Y) and the bentgrasses (2X/Y).
3. Highest in quality were Reliant hard fescue (all), Valda and HF 9032 hard fescues (M) and sheep fescue (M). Lowest in quality were the bentgrasses, redtops and creeping red fescue (all).
4. Lowest in weed encroachment were Reliant hard fescue (M) and (AW); Valda hard fescue (2X/Y); K-31 tall fescue with endophyte (2X/Y) and buffalograss (all). Highest in weed encroachment were Barricuda redtop and the bentgrasses at (2X/Y).

Table 2. LIST Mean Percent Weeds vs. Mowing Frequency, August 10, 1994

Species	Alt. Week	Month	2X/ year
HF 9032 Hard Fescue	16.7a	12.3	8.3
Exeter Colonial Bentgrass	21.7	26.7	51.7
Reliant Hard Fescue	3.7	8.7	11.7
South Dakota common Ky. Bg.	20.0	21.7	26.7
Barricuda Redtop	16.7	21.7	38.3
K-31 Tall Fescue	20.0	28.3	16.7
VNS Redtop	21.7	21.7	35.0
VNS Sheep Fescue	20.0	15.0	12.3
K-31 Tall Fescue (with endo.)	16.0	11.7	10.0
Sharps Improved Buffalograss	10.0	8.3	9.0
Sunrise Chinese common Zoysia	22.3	19.3	28.3
Cindy Creeping Red Fescue	32.7	26.0	13.7
Valda Hard Fescue	15.0	17.3	4.0
90161 Colonial bentgrass	26.0	25.0	38.3
LSD (0.05)=18.84			

[a]Mean percent weeds 1-100.

Table 3. LIST Mean Quality vs. Mowing Frequency, August 10, 1994

Species	Alt. Week	Month	2X/ year
HF 9032 Hard Fescue	7.5[a]	8.3	7.8
Exeter Colonial Bentgrass	4.2	4.3	3.7
Reliant Hard Fescue	8.5	8.7	8.0
South Dakota common Ky. Bg.	7.0	7.0	5.5
Barricuda Redtop	4.3	4.7	3.7
K-31 Tall Fescue	6.9	6.3	5.5
VNS Redtop	4.1	4.3	3.0
VNS Sheep Fescue	7.1	8.0	7.4
K-31 Tall Fescue (with endo.)	6.5	7.0	6.1
Sharps Improved Buffalograss	6.7	5.6	5.5
Sunrise Chinese common Zoysia	5.6	6.7	5.0
Cindy Creeping Red Fescue	5.0	5.1	5.5
Valda Hard Fescue	7.7	8.2	7.2
90161 Colonial bentgrass	3.7	4.5	4.3
LSD (0.05)=1.058			

[a]Mean quality 1-9, 9=best, 6=marginal, least acceptable, 1=poorest. Quality ratings based on density, uniformity and color.

1990 NTEP Perennial Ryegrass Test

Jill Taylor
Horticulture and Crop Science

Introduction

Due to space limitations, the Ohio State University Turfgrass Research Center did not participate in the 1990 National Turfgrass Evaluation Program (NTEP) Perennial Ryegrass Test. However, as space became available, most entries from the test were seeded July 24, 1993. This data was not submitted to NTEP, but was taken to support cultivar recommendations until the 1994 NTEP Ryegrass Test became available and was established Aug. 31, 1994.

A list of the entries appears in the following data tables. NTEP entries randomly omitted from this test were: Stallion, Rodeo II, APM, Pennfine, Palmer II, Repell, Toronto, and Mom Lp 3179.

The trial was hand-seeded in a randomized design on native soil in an irrigated area. Each plot was 20 square feet with three replications. Straw mulch was applied. Nitrogen applied in 1993 was 1.75 pounds. The area was maintained at 2.5 inches height of cut with a rotary mower.

Discussion/Summary

Included in this report are 1993 percent cover and color ratings (Tables 1 and 2) and 1994 spring color, quality and disease ratings (Tables 3, 4 and 5).

Table 1 gives mean percent cover ratings taken three months after the summer seeding. Percent cover ranged from 20 to 100 percent. Those entries with less than 90 percent cover were:

Assure	Prizm	PST-23C	Duet
Brightstar	Evening Shade	Pick 9100	Saturn
Fiesta II	Bar Lp 086FL	Elite	Bar Lp 852
Cartel	Barrage	Surprise	Taya

Mean color ratings from 1993 (Table 2) ranged from 6.7 to 9.0, with 9=best, greenest color possible. Entries with a color rating less than 8.0 were:

Mom Lp 3182	Lindsay	Regal	Elite
Legacy	Citation II	ZW42-176	Riviera
Linn	Bar Lp 852	Pleasure	Goalie
Entrar	Saturn	Danilo	Cartel
Surprise	Mom Lp 3111	Taya	

Incidence of rust disease is indicated on Table 2 by an asterisk. Those entries affected by rust in 1993 were:

Lowgrow	Prelude II	Seville	856
PST-20G	Mom Lp 3184	Target	KOOS 90-2
Derby Supreme	Meteor	Pick EEC	Mulligan
Stallion Slct.	Charger	Delaware Dwf	Caliente
Topeka	Pennant	Commander	Buccaneer
Mom Lp 3182	Regal	Legacy	Citation II
ZW42-176	Riviera	Bar Lp 852	Pleasure
Goalie	Entrar	Saturn	Cartel
Mom Lp 3111			

In April 1994, mean spring color ratings ranged from 5.0 to 7.8. (See Table 3.) Entries with color rating less than 6.5 were:

Taya	Surprise	Riviera	Barrage
Elite	Loretta	Cartel	Meteor
Troubadour	EEG 358		

Incidence of rust disease was also noted on Table 3. No chemical control was applied. Those entries affected by rust in April through June 1994 were:

Riviera	Surprise	Mulligan	Caliente
Cartel	Target	ZW 42-176	Premier
Advent	Mom Lp 3184	PR 9108	Unknown
BAR Lp 086Fl	Lindsay	Mom Lp 3179	Statesman
Citation II	89-666	Sherwood	ZPS-2EZ
Nomad	Gettysburg	Saturn	

Table 4 gives mean quality ratings from July 1994. Quality considers color, density, texture, disease and growth habit and is based on a 9 point scale with 9=best quality, 6=marginally acceptable and 5-1=poor quality. Quality ranged from 2.0 to 7.8. Those entries with quality ratings of less than 6.0 were:

Bar Lp 852	Nighthawk	Palmer II	Barrage
Surprise	Taya	Cartel	CLP 144

Mean dollar spot ratings were also recorded in July 1994 on a 5 point scale, with 5=severe infestation, unacceptable to 1=slight infestation, acceptable, and 0=no dollar spot present. Those entries with poor resistance to dollar spot, rating 3.0 to 5.0, were:

Seville	Barrage++	Cutless	Danaro
Nighthawk	Cutter	LowGrow	PR 9119
Gator	CLP 144	Morning Star	856
Unknown	Palmer II	Cowboy II	Linn
OFI-D4			

This trial has been renovated and replaced by the 1994 NTEP Ryegrass Test in August 1994.

Table 1. 1990 NTEP Ryegrass Test—Mean Percent Cover October 11, 1993

Entry	% Cov.	Entry	% Cov.	Entry	% Cov.
Topeka	100.0	Meteor	95.0	Troubadour	90.0
Calypso	100.0	Del. Dwf.	95.0	PST-23C	88.3
89-666	100.0	Advent	95.0	Prizm	88.3
Caliente	100.0	ZW 42-176	95.0	Assure	88.3
Envy	100.0	PST 290	95.0	Prizmq	88.3
7Express	100.0	PST-2FF	95.0	Duet	87.3
PST-PST-2ROR	100.0	Target	95.0	Saturn	86.7
Pebble Beach	100.0	Allegro	95.0	Fiesta II	86.7
SR 4200	100.0	Affinity	95.0	Pick 9100	86.7
Morning Star	100.0	Accolade	95.0	BarLp086FL	85.7
Equal	100.0	PST-2B3	95.0	BarLp852	85.7
Cutless	100.0	Unknown	95.0	Elite	85.0
WVPB 89-92	100.0	Goalie	95.0	Cartel	78.3
Premier	100.0	PST-28M	95.0	Barrage	75.0
Mom Lp 3147	100.0	PR 9109	95.0	Surprise	21.7
Repell II	100.0	Dandy	95.0	Taya	20.0
Quickstart	100.0	Barrage II	95.3		
PR 9108	100.0	Commander	93.3		
Manhattan II	99.0	MomLp3182	93.3		
Citation II	98.3	Loretta	93.3		
N-33	98.3	Danaro	93.3		
Danilo	98.3	Pennant	93.3		
MVF 89-90	98.3	CLP 39	93.3		
Stallion Select	98.3	Pick EEC	93.3		
Nomad	98.3	Lindsay	93.3		
PR 8820	98.3	Cowboy II	93.3		
Mulligan	98.3	Pick DKM	91.7		
MVF 89-88	96.7	OFI-D4	91.7		
PST-20G	96.7	ZPS-2EZ	91.7		
Riviera	96.7	PatriotII	91.7		
Statesman	96.7	MomLp3185	91.7		
Pinnacle	96.7	NightHawk	91.7		
Yorktown III	96.7	Koos-90-2	91.7		
Prelude II	96.7	Pleasure	91.7		
Regal	96.7	856	91.7		
Gator	96.7	Dimension	91.7		
PR 9118	96.7	PR 9121	91.7		
Seville	96.7	Gettysburg	90.0		
C-21	96.7	PR 9119	90.0		
Lowgrow	96.7	Sherwood	90.0		
OFI-F7	96.7	Ovation	90.0		
Mom Lp 3111	96.7	Competitor	90.0		
HE 311	96.7	Entrar	90.0		
Linn	96.7	Navajo	90.0		
Mom Lp 3184	96.7	CLP 144	90.0		
Buccaneer	96.7	Cutter	90.0		
Legacy	96.7	Charger	90.0		
Derby Supreme	96.7	WVPB8987A	90.0		
Achiever	96.7	EEG 358	90.0		

Table 2. 1990 NTEP Ryegrass Test—Mean Color October 13, 1993

Entry	Color	Entry	Color	Entry	Color
N-33	9.0[a]	Pick DKM	8.4	Legacy	7.8*
WVPV 89-92	9.0	Patriot II	8.4	MomLp3182	7.8*
PST-2FF	9.0	Barrage++	8.4	Lindsay	7.8
Gator	8.9	Prizm	8.4	Regal	7.8*
Affinity	8.8	Barrage	8.4	Elite	7.8
Achiever	8.8	Target	8.3*	CitationII	7.7*
PST-2ROR	8.8	C-21	8.3	ZW42-176	7.7*
Navajo	8.8	Unknown	8.3	Riviera	7.7*
Dimension	8.8	PR 9121	8.3	Linn	7.7
PR 9119	8.8	Pinnacle	8.3	BarLp 852	7.7*
Allegro	8.8	Cutter	8.3	Pleasure	7.7*
Lowgrow	8.7*	KOOS 90-2	8.3*	Goalie	7.6*
Dandy	8.7	Accolade	8.3	Entrar	7.5*
Pebble Beach	8.7	Manhattan II	8.3	Saturn	7.5*
Mom Lp 3147	8.7	Quickstart	8.3	Danilo	7.5
Morning Star	8.7	Calypso	8.3	Cartel	7.5*
HE 311	8.7	Derby Supreme	8.3*	Surprise	7.3
PR 8820	8.7	Evening Shade	8.3	MomLp3111	7.2*
Express	8.7	CLP 39	8.3	Taya	6.7
EEG 358	8.7	Gettysburg	8.3		
Cowboy II	8.7	PST-23C	8.3		
Repell II	8.7	Pick EEC	8.2*		
MVF 89-88	8.7	Bar Lp 086FL	8.2		
OFI-F7	8.7	Mom Lp 3185	8.2		
ZPS-2EZ	8.7	OFI-D4	8.2		
Statesman	8.7	PST-290	8.2		
Envy	8.7	Troubadour	8.2		
Prelude II	8.6*	Mulligan	8.2*		
Cutless	8.6	WVPB-89-87A	8.2		
Ovation	8.6	Stallion Slct.	8.2*		
Equal	8.6	Brightstar	8.2		
Pick 9100	8.5	PST-2B3	8.2		
Nighthawk	8.5	Delaware Dwf.	8.2*		
Danaro	8.5	Sherwood	8.2		
Advent	8.5	89-666	8.2		
Assure	8.5	SR 4200	8.2		
Seville	8.5*	Charger	8.2*		
PR 9109	8.5	Loretta	8.2		
856	8.5*	Meteor	8.2*		
PR 9118	8.5	Premier	8.1		
Duet	8.5	Competitor	8.1		
PST-28M	8.5	Caliente	8.1*		
PR 9108	8.5	Topeka	8.1*		
CLP 144	8.5	Nomad	8.0*		
PST-20G	8.5*	Fiesta II	8.0		
MVF 89-90	8.5	Buccaneer	8.0*		
Mom Lp 3184	8.4*	Pennant	8.0*		
Yorktown III	8.4	Commander	8.0*		

[a]Mean color 1-9, 9=greenest; 5=some green color; 1=poorest color. (*)Asterisk indicates rust disease in 1 or 2 replicates.

Table 3. 1990 NTEP Rye Test—Spring Color and Disease Incidence

Entry	Color	Entry	Color	Entry	Color
Riviera	6.4a*	Competitor	7.1	PR 9109	7.2
Calypso	7.1	PR 9121	7.1	Mulligan	7.5*
Seville	7.3	PR 9119	6.9	Target	7.3*
Caliente	7.3*	PR 9108	7.3*	Goalie	6.9
ZW 42-176	7.0*	PR 8820	7.1	Advent	7.3*
BarLp 852	6.6	Cutless	6.8	Unknown	7.2*
Barrage	6.3	Derby Supreme	7.4	Palmer II	7.5
Barrage++	6.8	Regal	7.4	YktownIII	6.9
Commander	7.1	Gator	7.8	PreludeII	7.5
Assure	7.5	Lindsay	7.1*	Cowboy II	7.7
Legacy	7.1	Achiever	7.8	Repell II	7.4
Dandy	7.0	Pick DKM	7.5	EEG 358	6.0
Danilo	6.6	Pick 9100	7.2	Equal	7.6
Danaro	7.4	Express	7.5	Eve.Shade	7.5
MomLp3147	7.3	Troubadour	6.3	MomLp3111	6.7
MomLp3184	6.9*	Entrar	6.6	MomLp3179	6.7*
Elite	6.1	CLP 144	7.2	HE 311	7.6
Allegro	6.9	Morning Star	7.7	MomLp3182	7.3
Taya	5.0	N-33	7.6	Linn	7.0
Loretta	6.2	Dimension	7.6	Duet	6.9
Ovation	7.2	Charger	6.6	Pennant	7.0
WVPB89-92	7.2	Citation II	6.7*	OFI-D4	6.7
Buccaneer	7.2	ZPS-2EZ	7.4*	OFI-F7	7.2
Koos 90-2	7.2	Manhattan II	7.1	89-666	7.1*
Pleasure	7.4	Prizm	7.0	MomLp3185	6.9
Del.Dwarf	7.3	Navajo	7.3	Pick EEC	7.1
B.Lp086FL	7.0*	PST-28M	7.7	Nomad	6.8*
Topeka	7.0	PST-290	7.1		
Statesman	7.5*	PST-2ROR	7.0		
Accolade	7.6	PST-23C	7.2		
Nighthawk	7.7	PST-2FF	7.5		
Affinity	7.3	Quickstart	7.5		
Sherwood	7.0*	PST-2B3	7.2		
Gettysburg	7.4*	Envy	7.8		
Pebb.Beach	7.5	PST-20G	6.9		
WVPB8987A	7.2	Brightstar	6.5		
Fiesta II	7.1	Saturn	6.9*		
Cutter	7.3	856	7.3		
Lowgrow	7.0	C-21	6.7		
CLP 39	6.7	MVF 89-88	7.3		
Surprise	5.3*	MVF 89-90	7.4		
Cartel	6.2*	Stallion Slct.	6.9		
Meteor	6.4	PR 9118	6.9		
Premier	7.1*	SR 4200	7.6		
Pinnacle	7.2	Patriot II	6.9		

[a]Spring color (4/13/94) 1-9, with 9=best, darkest green, 5=marginal, some green color, 4-1=poor, 1=brown, dormant or dead.
*(Asterisk) indicates rust disease in 2 or 3 replicates.

Table 4. 1990 NTEP Rye Test—Mean Quality Ratings July 22, 1994

Entry	Quality	Entry	Quality	Entry	Quality
Riviera	7.1[a]	Competitor	6.5	PR 9109	7.1
Calypso	7.1	PR 9121	6.3	Mulligan	7.5
Seville	7.0	PR 9119	6.4	Target	7.0
Caliente	6.9	PR 9108	6.5	Goalie	6.8
ZW 42-176	6.5	PR 8820	6.6	Advent	7.2
BarLp 852	5.9	Cutless	6.0	Unknown	7.3
Barrage	2.0	Derby Supreme	7.0	Palmer II	5.6
Barrage++	6.6	Regal	6.2	YktownIII	6.5
Commander	6.9	Gator	6.1	PreludeII	7.1
Assure	7.2	Lindsay	6.8	Cowboy II	7.4
Legacy	6.5	Achiever	6.8	Repell II	6.6
Dandy	6.6	Pick DKM	6.8	EEG 358	7.1
Danilo	6.9	Pick 9100	6.8	Equal	6.8
Danaro	6.4	Express	8.1	Eve.Shade	6.1
MomLp3147	6.9	Troubadour	6.6	MomLp3111	7.6
MomLp3184	6.8	Entrar	7.2	MomLp3179	7.5
Elite	6.7	CLP 144	5.8	HE 311	7.0
Allegro	6.8	Morning Star	6.7	MomLp3182	6.4
Taya	2.0	N-33	6.8	Linn	6.1
Loretta	6.4	Dimension	6.6	Duet	7.0
Ovation	6.6	Charger	6.8	Pennant	7.0
WVPB89-92	6.8	Citation II	7.2	OFI-D4	6.7
Buccaneer	6.9	ZPS-2EZ	6.7	OFI-F7	7.3
Koos 90-2	6.8	Manhattan II	6.9	89-666	7.1
Pleasure	7.2	Prizm	6.5	MomLp3185	6.8
Del.Dwarf	6.7	Navajo	6.6	Pick EEC	6.9
B.Lp086FL	7.6	PST-28M	7.1	Nomad	7.1
Topeka	6.4	PST-290	6.2		
Statesman	7.5	PST-2ROR	7.8		
Accolade	7.4	PST-23C	7.0		
Nighthawk	5.9	PST-2FF	7.4		
Affinity	6.7	Quickstart	7.0		
Sherwood	7.5	PST-2B3	6.5		
Gettysburg	6.4	Envy	6.8		
Pebb.Beach	6.8	PST-20G	6.4		
WVPB8987A	6.3	Brightstar	6.5		
Fiesta II	6.8	Saturn	6.9		
Cutter	6.8	856	6.8		
Lowgrow	6.2	C-21	7.0		
CLP 39	6.6	MVF 89-88	6.9		
Surprise	2.0	MVF 89-90	6.2		
Cartel	5.0	Stallion Slct.	7.1		
Meteor	6.7	PR 9118	6.9		
Premier	7.6	SR 4200	6.4		
Pinnacle	7.2	Patriot II	7.7		

[a]Mean quality ratings 1-9, with 9=best quality, 6=marginally acceptable quality, and 1=poorest quality.

Table 5. 1990 NTEP Rye Test—Mean Dollar Spot Ratings July 22, 1994

Entry	D. Spot	Entry	D.Spot	Entry	D.Spot
Riviera	1.2[a]	Competitor	1.2	PR 9109	1.8
Calypso	2.3	PR 9121	2.0	Mulligan	1.2
Seville	3.2	PR 9119	4.3	Target	1.7
Caliente	1.3	PR 9108	2.3	Goalie	1.7
ZW 42-176	1.8	PR 8820	2.8	Advent	1.2
BarLp 852	1.5	Cutless	3.5	Unknown	3.0
Barrage	2.7	Derby Supreme	1.8	Palmer II	4.0
Barrage++	3.0	Regal	2.3	YktownIII	1.2
Commander	1.0	Gator	4.3	PreludeII	1.2
Assure	1.0	Lindsay	1.3	Cowboy II	3.0
Legacy	1.7	Achiever	1.8	Repell II	0.8
Dandy	2.8	Pick DKM	2.7	EEG 358	2.0
Danilo	2.3	Pick 9100	1.0	Equal	2.7
Danaro	3.5	Express	0.7	Eve.Shade	2.8
MomLp3147	2.7	Troubadour	1.8	MomLp3111	1.7
MomLp3184	2.7	Entrar	1.8	MomLp3179	2.2
Elite	2.8	CLP 144	3.5	HE 311	1.8
Allegro	1.7	Morning Star	3.0	MomLp3182	2.0
Taya	0.8	N-33	1.8	Linn	3.0
Loretta	2.5	Dimension	1.7	Duet	1.7
Ovation	2.5	Charger	1.5	Pennant	1.3
WVPB89-92	2.2	Citation II	1.8	OFI-D4	3.0
Buccaneer	2.5	ZPS-2EZ	0.8	OFI-F7	1.5
Koos 90-2	2.7	Manhattan II	2.3	89-666	2.0
Pleasure	1.5	Prizm	1.5	MomLp3185	2.2
Del.Dwarf	2.2	Navajo	1.7	Pick EEC	1.8
B.Lp086FL	1.7	PST-28M	1.8	Nomad	1.3
Topeka	2.5	PST-290	2.7		
Statesman	2.0	PST-2ROR	1.0		
Accolade	1.7	PST-23C	1.3		
Nighthawk	4.3	PST-2FF	0.8		
Affinity	2.3	Quickstart	1.7		
Sherwood	0.7	PST-2B3	2.2		
Gettysburg	1.5	Envy	1.3		
Pebb.Beach	0.8	PST-20G	1.7		
WVPB8987A	1.7	Brightstar	0.8		
Fiesta II	2.3	Saturn	0.8		
Cutter	4.3	856	4.2		
Lowgrow	4.3	C-21	2.2		
CLP 39	3.2	MVF 89-88	2.0		
Surprise	1.0	MVF 89-90	2.3		
Cartel	2.0	Stallion Slct.	1.3		
Meteor	2.3	PR 9118	1.2		
Premier	1.3	SR 4200	2.2		
Pinnacle	1.3	Patriot II	1.3		

[a]Mean Dollar Spot ratings 0-5, with 5=severe infestation, 1=slight infestation, acceptable quality, and 0=no dollar spot present.

1994 NTEP Perennial Ryegrass Test

Jill Taylor
Horticulture and Crop Science

Introduction

The 1994 NTEP Perennial Ryegrass Test was established Aug. 31, 1994, at the Ohio State University Turfgrass Research Center. Ninety-six entries were hand-seeded at 60 grams/25 square feet (5.2 pounds/1000 ft^2) in a randomized complete-block design with three replications.

The site is on irrigated, natural soil in full sun, and is maintained at 2.5 inches height of cut with a rotary mower. Nitrogen applied in 1994 was 1.75 pounds.

Discussion/Summary

The entries and their sponsors are listed in Table 1, along with late autumn 1994 mean color ratings. Mean color ratings are on a nine point scale, with 9=greenest possible, 6=some green color, marginally acceptable, 5-1=poor color and 1=poorest color, brown or dead. Color ranged from 6.8 to 8.1. Entries rated highest (7.8 to 8.1) were: LRF-94-MPRH, MB44, MB46, Laredo and PST-2M3.

Data from this three-year NTEP trial is submitted annually to the NTEP and appears as Ohio Data in the NTEP *National Test Report*. Future data includes color, quality and disease incidence.

Table 1. 1994 NTEP Perennial Ryegrass Test—Color Ratings November 29, 1994

Entry	Sponsor	Color	Entry	Sponsor	Color
1. Elf	Bailey Seed & J.W. Jenks Co.	7.6[a]	51. LRF-94-C7	Lofts Seed, Inc.	7.6
2. Dancer	Int'l Marketing Service	7.6	52. LRF-94-B6	Lofts Seed, Inc.	7.6
3. BAR Er 5813	Barenbrug Holland	7.2	53. Pick PR 84-91	Pickseed West, Inc.	7.1
4. DSV NA 9401	Deutsche Saatveredelung	6.8	54. Pick 928	Pickseed West, Inc.	7.6
5. DSV NA 9402	Deutsche Saatveredelung	7.1	55. Assure	LESCO, Inc.	7.4
6. Achiever	O.M. Scott & Sons	7.3	56. Advantage	LESCO, Inc.	7.1
7. APR 066	Advanta Seeds West, Inc.	7.1	57. LESCO-TWF	LESCO, Inc.	7.1
8. APR 106	Advanta Seeds West, Inc.	7.1	58. Williamsburg	LESCO, Inc.	7.1
9. APR 124	Advanta Seeds West, Inc.	7.5	59. Riviera II	Roberts Seed Co.	7.3
10. APR 131	Advanta Seeds West, Inc.	7.1	60. BAR USA 94-II	Barenbrug USA	7.6
11. Precision	Advanta Seeds West, Inc.	7.3	61. Koos 93-3	J.R. Koos & Sons	7.5
12. Calypso II	Roberts Seed Co.	7.5	62. Linn	Standard Entry	7.1
13. Laredo	Turf Merchants, Inc.	8.0	63. Stallion Slct.	Finelawn Research, Inc.	7.2
14. Accent	Medalist America	7.2	64. ZPS-PR1	Zajac Performance Seeds	7.2
15. MED 5071	Medalist America	7.3	65. Figaro	DLF/Trifolium	7.1
16. J-1703	Jacklin Seed Co.	7.3	66. DLP 1305	DLF/Trifolium	7.1
17. J-1706	Jacklin Seed Co.	7.3	67. Nine-O-One	Cascade Int'l Seed Co.	7.6
18. Edge	Pickseed West, Inc.	7.1	68. SRX 4010	Seed Research of OR, Inc.	7.6
19. Cutter	Pickseed West, Inc.	7.3	69. SR 4200	Seed Research of OR, Inc.	7.5
20. Express	Pickseed West, Inc.	7.1	70. SRX 4400	Seed Research of OR, Inc.	7.3
21. Esquire	Willamette Seed Co.	7.2	71. Omni	Royal Seeds of Salem, OR	7.1
22. Vivid	Willamette Seed Co.	7.1	72. Night Hawk	Forbes Seed & Grain, Inc.	7.6
23. WX3-91	Willamette Seed Co.	7.3	73. WVPB 92-4	Willamette Val. Plt. Breeders	7.1
24. WX3-93	Willamette Seed Co.	7.2	74. Koos 93-6	J. R. Koos & Sons	7.4
25. PST-2FE	Pure-Seed Testing, Inc.	7.3	75. PS-D-9	ProSeeds Marketing	7.3
26. PST-2R3	Pure-Seed Testing, Inc.	7.6	76. LRF-94-MPRH	Lofts Seed, Inc.	7.8
27. PST-2DLM	Pure-Seed Testing, Inc.	7.5	77. Pick Lp 102-92	Pickseed West, Inc.	7.2
28. PST-GH-94	Pure-Seed Testing, Inc.	7.4	78. CAS-LP23	Cascade Int'l Seed Co.	7.4
29. PST-2DGR	Pure-Seed Testing, Inc.	7.5	79. RPBD	Grasslands West	7.3
30. PST-2M3	Turf Seed, Inc.	8.1	80. PST-2CB	Turf-Seed, Inc.	7.2
31. PST-28M	Pure-Seed Testing, Inc.	6.8	81. Pennfine	Standard Entry	6.9
32. PST-2ET	Turf-Seed, Inc.	7.6	82. Morning Star	Pennington Seed, Inc.	7.1
33. Manhattan III	Manhattan Rye Growers Assoc.	7.3	83. Saturn	Standard Entry	7.1
34. Prizm	Zajac Performance Seeds	7.2	84. Imagine	Olsen-Fennell Seed Co.	7.3
35. Navajo	Turf Seed, Inc.	7.5	85. Pegasus	Olsen-Fennell Seed Co.	7.4
36. ZPS-2ST	Turf-Seed & Zajac Perf. Seeds	7.3	86. TMI-EXFLP94	Turf Merchants, Inc.	7.1
37. ZPS-2DR-94	Turf-Seed & Zajac Perf. Seeds	7.3	87. Nobility	Ampac Seed Co.	7.6
38. PSI-E-1	Production Service Int'l Inc.	7.4	88. Divine	McCarthy/Burlingham Res. Farm	7.3
39. WVPB-93-KFK	Willamette Val. Plt. Breeders	7.5	89. MB 1-5	McCarthy/Burlingham Res. Farm	7.4
40. WVPB-PR-C-2	Willamette Val. Plt. Breeders	7.3	90. MB 41	McCarthy/Burlingham Res. Farm	7.3
41. MVF-4-1	Mid-Valley Farms	7.2	91. MB 42	McCarthy/Burlingham Res. Farm	7.7
42. PC-93-1	Pratum Co-op	7.2	92. MB 43	McCarthy/Burlingham Res. Farm	7.4
43. PST-2FF	Roberts Seed Co.	7.5	93. MB 44	McCarthy/Burlingham Res. Farm	7.8
44. Quickstart	Turf-Seed, Inc.	7.2	94. MB 45	McCarthy/Burlingham Res. Farm	7.6
45. ZPS-2NV	Zajac Performance Seeds	7.3	95. MB 46	McCarthy/Burlingham Res. Farm	7.8
46. Brightstar	Turf-Seed, Inc.	7.7	96. MB 47	McCarthy/Burlingham Res. Farm	7.7
47. ISI-MHB	International Seeds, Inc.	7.1	97. OFI-DM	Olsen-Fennel Seeds, Inc.	7.9
48. ISI-R2	International Seeds, Inc.	7.5	98. OFI-ET	Olsen-Fennel Seeds, Inc.	7.3
49. Top Hat	International Seeds, Inc.	7.6	99. OFI-ICE	Olsen-Fennel Seeds, Inc.	7.3
50. LRF-94-C8	Lofts Seed, Inc.	7.4			

[a]Mean late Autumn color 1-9, with 9=greenest 6=marginal, 1=brown, poor

1993 NTEP Bentgrass Test (Fairway/Tee)

Jill Taylor
Horticulture and Crop Science

Introduction

The 1993 NTEP Bentgrass Test (Fairway/Tee) was established Sept. 23, 1993, at the Ohio State University Turfgrass Research Center. Twenty-one entries were hand-seeded at 6 grams/24 square feet (0.55 pounds/1000 feet square) in a randomized complete-block design with three replications.

Five Colonial bentgrasses are included in the test.

The site is in full sun on natural clay loam and is maintained at one-half inch height of cut to simulate fairway/tee conditions. Actual nitrogen applied in 1994 was 4.5 pounds/1000 feet square.

Discussion/Summary

Percent cover ranged from 45 to 78% six weeks after seeding. (See Table 1.) However, these seedlings did not survive the severe winter of 1993-94. Mean percent cover data of these winter-killed plots was taken April 21, 1994, and also appears in Table 1.

These plots were then chemically killed and reseeded May 17, 1994. A second (initial) mean percent cover rating was taken June 14, 1994, and appears in the third data column of Table 1.

All cultivars had excellent first year cover. Cultivars that were more aggressive initially are 18th Green, BAR Ws 42102, Cato, PRO/CUP, Crenshaw, Southshore, Penncross, DF-1, G-2 and G-6.

Other ratings recorded in 1994 are color (see Table 2) and quality and texture (see Table 3).

Cultivars that had the darkest green color in the test are SR 7100, 18th Green, BAR Ws 42102, Trueline, Providence, Cato, PRO/CUP, Crenshaw, Southshore, G-6, Penneagle, Lopez, Tendez and ISI-At-90162. Cultivars that had the best late-autumn color retention were SR 7100, Tendez, Exeter and ISI-At-90162, all colonial types.

The cultivars had very good to excellent quality ratings. Among the cultivars in August, BAR Ws 42102, PRO/CUP, Southshore and G-6 scored highest in quality.

Texture ratings for all cultivars were excellent (scoring high) for bentgrass. Cultivars scoring highest are BAR As 493, Seaside, Exeter, Crenshaw, SR 7100, DF-1, Tendez and ISI-At-90162.

Data from this three-year NTEP Test are submitted annually to the NTEP and appears as Ohio data in the *NTEP National Test Report.*

Table 1. 1993 NTEP Bentgrass Test—1994 Mean Percent Cover

Entry	11/5/93	4/21/94	6/14/94	7/14/94	8/10/94
18th Green	70.0[a]	16.7[b]	68.3[a]	88.3	96.7
BAR As 493	63.3	16.7	53.3	73.3	91.0
BAR Ws 42102	60.0	33.3	78.3	91.7	98.3
Trueline	65.0	21.7	60.0	73.3	96.0
Providence	60.0	16.7	61.7	81.7	97.7
Seaside	60.0	21.7	73.3	83.3	94.3
Cato	46.7	13.3	68.3	86.7	100.0
Exeter	65.0	18.3	60.0	70.0	88.3
PRO/CUP	68.3	31.7	61.7	85.0	97.7
Crenshaw	66.7	26.7	66.7	85.0	98.3
Southshore	45.0	11.7	75.0	90.0	98.7
SR 7100	78.3	13.3	58.3	80.0	96.0
Penncross	55.0	18.3	61.7	86.7	96.7
DF-1	68.3	20.0	75.0	85.0	97.7
G-2	53.3	20.0	55.0	86.7	95.3
G-6	71.7	26.7	58.3	87.3	98.3
Penneagle	68.3	33.3	53.3	81.7	97.7
Lopez	70.0	26.7	55.0	79.3	96.7
Tendez	50.0	11.7	45.0	78.3	91.7
ISI-At-90162	53.3	11.7	51.7	73.3	90.0
OM-At-90163	56.7	16.7	61.7	79.0	93.3

[a]Mean percent cover 1-100.
[b]April rating followed winter kill of plots. Next, plots were chemically killed and reseeded on May 17, 1994.

Table 2. 1993 NTEP Bentgrass Test—1994 Mean Color Ratings

Entry	Species	7/14/94	8/10/94	2/14/94
18th Green	Creeping	7.0[a]	7.7	5.2
BAR As 493	Creeping	7.2	7.3	6.6
BAR Ws 42102	Creeping	7.2	7.8	5.9
Trueline	Creeping	7.1	7.8	5.5
Providence	Creeping	7.0	7.7	5.9
Seaside	Creeping	7.0	7.3	6.2
Cato	Creeping	7.2	7.7	5.7
Exeter	Colonial	5.8	7.2	6.8
PRO/CUP	Creeping	7.0	7.8	6.3
Crenshaw	Creeping	6.7	8.1	6.0
Southshore	Creeping	6.8	7.7	5.9
SR 7100	Colonial	7.3	7.3	6.9
Penncross	Creeping	7.2	7.4	6.2
DF-1	Creeping	6.8	7.5	5.6
G-2	Creeping	7.0	7.5	6.3
G-6	Creeping	7.2	7.7	6.3
Penneagle	Creeping	7.0	7.9	6.0
Lopez	Creeping	7.2	8.0	6.2
Tendez	Colonial	7.7	7.7	6.8
ISI-At-90162	Colonial	7.7	7.7	6.7
OM-At-90163	Colonial	7.2	7.3	6.1

[a]Mean Color 1-9, with 9=greenest, 6=some green color, marginally acceptable, and 1=brown, dormant or dead.

Table 3. 1993 NTEP Bentgrass Test—Mean Quality (Q) and Texture (T) Ratings

Entry	Q.7/14/94	Q.8/10/94	Q.9/28/94	T.8/10/94
18th Green	7.8[a]	8.1	7.8	8.1[b]
BAR As 493	6.7	7.7	6.6	8.6
BAR Ws 42102	7.6	8.7	7.8	8.1
Trueline	7.2	7.9	7.1	8.2
Providence	7.3	8.2	6.9	8.0
Seaside	6.8	7.6	7.1	8.8
Cato	7.8	8.1	7.4	8.2
Exeter	5.6	7.5	6.0	8.5
PRO/CUP	7.3	8.5	7.6	8.4
Crenshaw	7.7	8.2	7.5	8.5
Southshore	7.6	8.7	7.8	8.1
SR 7100	7.2	8.0	6.2	8.5
Penncross	7.6	8.4	6.8	8.4
DF-1	7.6	8.2	7.2	8.6
G-2	7.4	8.3	7.6	8.4
G-6	7.7	8.6	7.7	8.1
Penneagle	7.5	8.2	7.4	8.1
Lopez	7.2	7.8	7.3	8.3
Tendez	7.2	8.4	6.2	8.5
ISI-At-90162	7.3	8.0	6.2	8.7
OM-At-90163	7.4	7.9	6.3	8.3

[a]Mean quality ratings 1-9, with 9=best quality, 6=marginally acceptable quality, and 1=poorest quality. Quality considers color, texture, density, disease susceptibility and growth habit.
[b]Mean texture ratings 1-9, with 9=finest texture (i.e., as with fine fescues), and 1=coarsest texture (i.e., as with K-31 Tall Fescue).

1993 NTEP Fineleaf Fescue Test

Jill Taylor
Horticulture and Crop Science

Introduction

The 1993 NTEP Fineleaf Fescue Test was established September 1993 in full sun at the Ohio State University Turfgrass Research Center. Sixty entries were hand seeded at 50 grams/25 square feet (4.4 pounds/1000 square feet) in a randomized complete block design with three replications. A starter fertilizer was applied at a rate of one pound N/1000 square feet. Soil type is silt loam.

Fineleaf fescues represented in this trial are chewings, strong creeping, hard and sheep fescues.

Discussion/Summary

Table 1 gives mean percent cover ratings from November 1993, June 1994 and November 1994. Initial plot density six weeks after seeding ranged from 25 to 50%. This data, based on varietal comparisons, did not reveal any seedling vigor consistency of one fineleaf fescue species over another.

Cover by June 1994 was excellent, ranging from 86 to 98%. Some of the species slower to achieve full plot density were of the chewings and strong creeping varieties.

A decimating infestation of brown patch disease (*Rhizoctonia solani*) occured in July 1994, causing loss of cover for all species. A curative fungicide was applied. Plot density improved monthly but had not fully recovered by the end of 1994. In Table 1, a percent cover rating from November 29, 1994, illustrates the differing rates of recovery. Varieties with good recovery (75%+cover) by this date were:

Strong creeping varieties: Aruba, PST-4ST, Shademaster II, Jasper, and Flyer.

Sheep varieties: FO 143.

Hard varieties: SR 3100, Spartan, MED 32, MB 83-93, Discovery, Pamela, Brigade, Reliant II, Scaldis and Ecostar.

Chewings varieties: none

Some chewings varieties showed better recovery than others. Those with 40 to 60% recovery were:

Brittany, MB 61-93, Jamestown II, Pick 4-91W, Bridgeport and SR 5100.

Varieties with slow recovery (40% or less cover) on November 29, 1994, were:

Strong creeping varieties: BAR Frr 4ZBD, WX3-FFG6, Bar UR 204 and common creeping.

Sheep varieties: 67135.

Hard varieties: none

Chewings varieties: PRO 92/20, Shadow (E), NJ F-93, Cascade and MB 63-93.

Chewings varieties with less than 10% cover were: Victory (E), MB 66-93, Molinda, Darwin, Medina, MB 65-93, Tiffany, Jamestown, ISI-FC-62, and PST-44D.

Various other ratings were taken throughout 1994, including quality, color and disease (rust, brown patch). Table 2 provides mean quality ratings from June and July 1994. To add more specific information to this table, the June ratings note specific observed limitations in quality (i.e., density, color, disease or growth habit) that led to the quality ratings assigned to each variety.

The July mean quality ratings were taken after the brown patch infestation. These ratings, taken from the remaining live grass, indicate the varying degrees of quality reduction among the species. The hard fescues were the only species in the acceptable quality range (6.0 or above) on this date.

This NTEP study is to continue at least two more years. Future ratings include density, quality, color and texture. However, due to the loss and slow recovery of plot density in 1994, especially the chewings varieties, the Ohio Fineleaf Fescue Test may be terminated in 1995 at the discretion of the NTEP Project Leader.

Table 1. 1993 NTEP Fineleaf Fescue Test—Mean Percent Cover

Entry	Species	Mean Percent Cover 11/15/93	6/14/94	11/29/94
Aruba	Strong Creeping	50.0[a]	95.3	75.0[b]
ISI-FC-62	Chewings	48.3	90.0	15.0
Jamestown	Chewings	48.3	92.7	11.7
Brittany	Chewings	48.3	95.0	50.0
MB 61-93	Chewings	46.7	93.3	60.0
MB 64-93	Chewings	46.7	96.0	41.7
BAR UR 204	Strong Creeping	45.0	94.3	31.7
FO 143	Sheep	45.0	95.7	91.0
SR 3100	Hard	45.0	97.0	84.3
WX3-FFG6	Strong Creeping	45.0	97.7	35.0
Jasper (E)	Strong Creeping	45.0	96.7	70.0
Flyer	Strong Creeping	45.0	96.0	78.3
Shadow (E)	Chewings	45.0	93.7	33.3
PRO 92/24	Hard	43.3	98.0	55.0
Spartan	Hard	43.3	97.7	90.0
Tiffany	Chewings	43.3	93.3	16.7
Jamestown II	Chewings	43.3	94.3	46.7
Banner II	Chewings	43.3	97.0	41.7
MB 65-93	Chewings	43.3	96.0	15.0
CAS-FR13	Strong Creeping	43.3	94.3	50.0
TMI-3CE	Chewings	43.3	95.3	40.0
MED 32	Hard	43.3	92.7	88.3
BAR Frr 4ZBD	Strong Creeping	41.7	95.3	26.7
ZPS-MG	Chewings	41.7	96.0	46.7
MB 83-93	Hard	41.7	98.0	80.0
MB 81-93	Hard	41.7	96.0	50.0
Discovery	Hard	41.7	96.0	85.0
PST-44D	Chewings	41.7	97.0	20.0
WX3-FF54	Chewings	40.0	94.3	48.3
Ecostar	Hard	40.0	96.7	92.7
NJ F-93	Chewings	40.0	92.7	38.3
67135	Sheep	40.0	94.3	6.7
Dawson	Slender Creeping	40.0	96.0	33.3
PST-4ST	Strong Creeping	40.0	95.0	82.7
Pick 4-91W	Chewings	40.0	97.0	65.0
Cascade	Chewings	38.3	96.7	16.7
Medina	Chewings	38.3	91.0	7.3
Pamela	Hard	38.3	92.7	78.3
PRO 92/20	Chewings	38.3	90.0	30.0
ZPS-4BN	Strong Creeping	38.3	86.7	68.3
Seabreeze	Slender Creeping	38.3	98.0	43.3
MB 82-93	Hard	38.3	94.7	78.3
Common creep.	Strong Creeping	38.3	86.7	25.0
MB 63-93	Chewings	36.7	97.0	31.7
Darwin	Chewings	36.7	90.0	0.0
Nordic	Hard	36.7	98.0	78.3
Brigade	Hard	36.7	94.3	83.3
Reliant II	Hard	36.7	93.3	80.0
Rondo	Strong Creeping	36.7	92.7	50.0

Continued on next page

Table 1. 1993 NTEP Fineleaf Fescue Test—Mean Percent Cover, (continued)

Entry	Species	Mean Percent Cover 11/15/93	6/14/94	11/29/94
PST-4DT	Strong Creeping	36.7	88.3	65.0
Victory (E)	Chewings	36.7	96.7	6.7
WVPB-STCR-101	Strong Creeping	36.7	95.3	65.0
MB 66-93	Chewings	36.7	93.3	11.7
Aurora w/endo.	Hard	36.7	92.7	78.3
Molinda	Chewings	35.0	88.3	18.3
PST-4VB Endo	Strong Creeping	33.3	88.3	76.7
Bridgeport	Chewings	33.3	93.3	55.0
Shademaster II	Strong Creeping	33.3	90.0	86.7
SR 5100	Chewings	28.3	88.3	66.7
Scaldis	Hard	25.0	97.0	83.3

[a]Mean percent cover 1-100 Plots seeded 9/93
[b]Cover reduced by severe infestation of brown patch disease in July

Table 2. 1993 NTEP Fineleaf Fescue Test—Mean Quality Ratings

Entry	Species	Mean Quality 6/21/94	Mean Quality 7/21/94[a]
Aruba	Strong Creeping	7.3cd[bc]	5.9
ISI-FC-62	Chewings	7.4rd	2.7
Jamestown	Chewings	7.2cd	4.8
Brittany	Chewings	7.6rd	4.9
MB 61-93	Chewings	7.6d	4.3
MB 64-93	Chewings	7.9rd	4.9
BAR UR 204	Strong Creeping	7.0rd	4.2
FO 143	Sheep	7.0d	7.0
SR 3100	Hard	7.9cg	6.7
WX3-FFG6	Strong Creeping	7.6d	4.3
Jasper (E)	Strong Creeping	8.2	4.8
Flyer	Strong Creeping	7.7d	4.8
Shadow (E)	Chewings	7.5d	4.5
PRO 92/24	Hard	8.0	4.0
Spartan	Hard	8.0cd	7.1
Tiffany	Chewings	7.0cd	3.7
Jamestown II	Chewings	7.5rd	4.8
Banner II	Chewings	7.5rd	4.9
MB 65-93	Chewings	7.6d	4.1
CAS-FR13	Strong Creeping	7.8rcd	4.0
TMI-3CE	Chewings	7.8rd	3.0
MED 32	Hard	7.8d	6.6
BAR Frr 4ZBD	Strong Creeping	7.8d	4.3
ZPS-MG	Chewings	7.5r	4.3
MB 83-93	Hard	8.1d	6.8
MB 81-93	Hard	8.0d	4.8
Discovery	Hard	7.9d	6.0
PST-44D	Chewings	8.0	4.5
WX3-FF54	Chewings	7.8rd	3.9
Ecostar	Hard	7.4cd	6.5
NJ F-93	Chewings	7.6r	4.6
67135	Sheep	5.5g	3.2
Dawson	Slender Creeping	7.9	3.2
PST-4ST	Strong Creeping	8.0d	5.4
Pick 4-91W	Chewings	8.2	4.2
Cascade	Chewings	7.6d	2.3
Medina	Chewings	6.4rd	2.0
Pamela	Hard	7.7d	5.4
PRO 92/20	Chewings	7.3rd	3.5
ZPS-4BN	Strong Creeping	7.7d	4.0
Seabreeze	Slender Creeping	8.3	4.8
MB 82-93	Hard	8.1d	5.6
Common creep.	Strong Creeping	6.5d	3.0
MB 63-93	Chewings	7.5d	5.3
Darwin	Chewings	7.6d	3.7
Nordic	Hard	8.2	5.8
Brigade	Hard	7.6d	6.8
Reliant II	Hard	7.7cd	5.9
Rondo	Strong Creeping	7.6dr	3.7
PST-4DT	Strong Creeping	7.2dr	5.6
Victory (E)	Chewings	7.8d	2.2
WVPB-STCR-101	Strong Creeping	8.0d	4.6
MB 66-93	Chewings	7.7d	3.2
Aurora w/endo.	Hard	7.8d	6.6
Molinda	Chewings	6.7rd	3.0
PST-4VB Endo	Strong Creeping	7.7d	5.7
Bridgeport	Chewings	7.7	4.8
Shademaster II	Strong Creeping	7.3rd	5.6
SR 5100	Chewings	7.1cd	4.8
Scaldis	Hard	8.0c	6.8

[a]7/21/94 rating taken after severe brown patch infestation.
[b]Mean quality 1-9 with 9=best, 6=marginal, and 1=poorest, dead.
[c]Notations, in varying degrees, of limiting quality: r=infected by rust disease, d=poor plot density, c=poor color, and g=poor growth habit and mowability.

Bermudagrass Management Study

John Street and Jill Taylor
Horticulture and Crop Science

Introduction

Bermudagrass is a warm-season turfgrass species touted for its excellent heat and drought tolerance. It also forms a dense, durable sod due to high tillering and an extensive stolon and rhizome system. The major limitation to Bermudagrass use in the north is a lack of winter/cold hardiness. Several cultivars of Bermudagrass have been more recently developed with improved (claimed) winter hardiness. "Sundevil" Bermudagrass (Medalist America) has been observed to survive winters as far north as Chicago, Illinois.

Discussion/Summary

The objectives of this research were to evaluate "Sundevil" Bermudagrass for quality and winter survival as influenced by nitrogen and potassium fertilization. Bermudagrass was seeded on June 6, 1993, at 1.5 pounds per 1,000 square feet. Mowing height was initiated at 1.5 inches with a Jacobson triplex reel mower. On July 29, 1993, the mowing height was lowered to a 1-inch maintenance height using a Cushman front line rotary mower. Mowing was performed twice weekly during the growing season. Nitrogen treatments were 0, 2, and 4 pounds per 1,000 square feet. Potassium treatments were 0, 4, and 8 pounds of K2O per 1,000 square feet. The experimental design was randomized complete-split plot design resulting in all combinations of nitrogen and potassium rates. Nitrogen and potassium rates were split into four equal applications. Fertilizer applications were initially applied on September 15, 1993. In 1994, treatments were applied on May 2, June 17, August 3 and September 9.

Nutralene (40-0-0) and muriate of potash (0-0-61) were used as the nitrogen and potassium sources, respectively. Color ratings were at approximately two-week intervals throughout the growing season until dormancy occurred in the autumn. Color ratings were based on a scale of 1 to 9 with 1 representing poorest (brown, dormant), 6 representing marginally acceptable, and 9 representing best (greenest). Percent cover ratings were taken at periodic intervals throughout the growing season in 1994 (see Table 1). At the end of the 1993 season, the entire Bermudagrass area exhibited 90%+ cover.

Bermudagrass color/quality ratings are provided in Tables 2 and 3. The initial nitrogen and potassium fertilizations occurred on September 15, 1993. Color/quality of Bermudagrass increased with increasing nitrogen fertilization. The addition of potassium (0 compared to 4 and 8 lbs.) provided enhanced color/quality on some dates. There appeared to be minimal difference in color/quality between the 4 and 8 lb. K2O per 1,000 square feet rates.

Bermudagrass winter survival is measured by percent cover ratings during the 1994 growing season (see Table 1). Prior to dormancy in 1993, Bermudagrass cover in all treatments was 90%+. Nitrogen fertilization alone had no effect on winter survival of Bermudagrass. Nitrogen fertilization did enhance the recovery rate of Bermudagrass. There was a corresponding increase in Bermudagrass survival with increasing potassium rates. This is well illustrated by the percent mean cover ratings in May and June. There also appeared to be a positive nitrogen-potassium interaction on Bermudagrass winter survival.

Table 1. Bermudagrass Percent Cover as Influenced by Nitrogen & Potassium Fertilization

				Mean Percent Cover 1994[a]					
Fertility Level[b]	5/10	5/25	6/9	6/22	7/6	7/20	8/8	8/22	9/8
0 K, 0 N	4	5	7	27	33	33	30	30	30
0 K, 2 N	1	4	10	23	27	27	37	60	60
0 K, 4 N	2	8	10	25	33	33	40	48	48
4 K, 0 N	6	18	45	60	62	62	68	58	58
4 K, 2 N	7	23	43	55	62	62	57	82	82
4 K, 4 N	15	42	55	68	70	70	85	83	83
8 K, 0 N	42	42	65	82	80	80	80	83	83
8 K, 2 N	40	47	83	88	83	83	93	95	95
8 K, 4 N	65	75	87	89	93	93	98	93	93

[a]Mean Percent Cover 1-100. Percent cover was 90% + in 1993.
[b]Fertility level in pounds/1000 feet square/year in 4 timely applications.

Table 2. Bermudagrass Color as Influenced by Nitrogen & Potassium Fertilization

	Mean Color 1993[a]				
Fertility Level	9/22	10/6	10/20	1/4	11/18
0 K, 0 N[b]	6.3	5.0	6.1	5.0	1.0
0 K, 2 N	6.8	5.6	6.6	6.3	1.0
0 K, 4 N	7.3	6.5	7.0	6.9	1.0
4 K, 0 N	6.3	4.7	6.0	5.4	1.0
4 K, 2 N	7.2	6.7	6.7	6.3	1.0
4 K, 4 N	7.8	6.5	7.1	7.3	1.0
8 K, 0 N	6.3	5.7	6.1	5.0	1.0
8 K, 2 N	7.2	6.5	6.3	6.1	1.0
8 K, 4 N	8.0	6.5	7.0	7.2	1.0

	Mean Color 1994[a]							
Fertility Level	8/8	9/8	9/19	10/15	10/26	11/10	11/23	12/14
0 K, 0 N[b]	6.2	7.0	6.8	5.7	3.7	1.7	1.3	1.0
0 K, 2 N	7.0	7.2	7.7	6.3	6.3	3.3	2.5	1.0
0 K, 4 N	7.2	7.5	8.0	7.5	6.3	5.0	3.8	1.0
4 K, 0 N	6.0	6.6	7.7	5.0	3.0	2.7	2.0	1.0
4 K, 2 N	7.4	7.5	7.0	7.0	6.8	3.7	2.8	1.0
4 K, 4 N	7.8	7.8	8.0	8.0	7.0	4.2	3.2	1.0
8 K, 0 N	6.2	6.8	6.9	5.3	4.7	4.3	3.2	1.0
8 K, 2 N	7.2	7.7	8.0	7.0	6.3	5.0	3.8	1.0
8 K, 4 N	8.0	8.1	8.0	8.0	7.3	6.0	4.5	1.0

[a]Mean color 1-9, with 9=greenest, 6=some green color, marginally acceptable, 5-1=poor color, 1=poorest color, brown, dormant or dead.
[b]Fertility level in pounds/1000 feet square/year in 4 timely applications.

Turfgrass Culture and Management

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Duration of Rolling as Measured by Ball Roll

Karl Danneberger, Jill Taylor and Jobin Morrow
Horticulture and Crop Science

Introduction

Previous studies have shown that rolling putting greens increases ball roll. Generally, the increase in ball roll is transient, lasting less than 24 hours in most cases. This study was initiated to measure the longevity of increased ball roll using various rolling devices.

Discussion/Summary

The rolling study was conducted at the Ohio State University Turfgrass Research Center, Columbus, between October 10 and November 7, 1994. The study was conducted on a "Penncross" creeping bentgrass turf mowed at 3/16 of an inch and maintained under putting green conditions. Two rolling units were used in the mowing study. One unit was the "Vibrator Roller" from Turfline, Inc., which consisted of the rolling units mounted on a Toro Greensmaster mower and the second unit was a Smithco Tournament Roller. The plots measured 7 x 15 feet and each rolling treatment was done once in a single direction. An untreated plot (not receiving a rolling) was included as a control. Prior to the rolling treatments, all plots were mowed at 3/16 of an inch. Rolling treatments were conducted twice weekly during the period from October 10 through November 7. A stimpmeter was used to measure ball roll. The three treatments were replicated three times in a completely randomized design. Treatment effects were statistically analyzed on a one-way ANOVA (MSTAT, Michigan State University, East Lansing, MI).

Data reported in the following tables are representative of the data gathered during the period of the study. Rolling greens significantly increased ball roll (Table 1). The increase in ball roll from rolling lasted at least 8 hours. Further studies revealed that the increase in ball roll was maintained for 48 hours after rolling (Table 2). The 48-hour duration is longer than previously reported. However, given the time of the year where little turfgrass growth was occurring (minimal amount of clippings were being removed when the area was mowed), the lack of growth may have been a major factor in the sustained ball roll. No difference in water infiltration using an Infiltrometer (Turf-Tec International, Miami, Florida) was detected at the completion of the study. The use of the rollers resulted in no apparent wear damage during this study when used a maximum of twice weekly.

Table 1. Ball roll 8 hours after the rolling treatment

	Ball roll (inches)	
Treatment	October 20, 1994	October 25, 1994
Turfline Vibrator	130.3	130.0
Smithco Roller	128.0	134.7
Control	100.7	109.3
LSD (0.05)	16.8	12.4

Table 2. Ball roll 48 hours after the rolling treatment

Treatment	Ball roll (inches)
Turfline Vibrator	126.3[a]
Smithco Roller	131.0
Control	114.7
LSD (0.05)	13.6

[a]The rolling treatment was done on October 25 *and* rolling measurement was taken on October 27.

Golf Ball Roll as Influenced by Soft Spike and Traditional Metal Spike Golf Shoes

Karl Danneberger and Jobin Morrow
Horticulture and Crop Science

Introduction

According to a USGA study, the average golfer takes 28 paces per green and the average golf shoe has 12 spikes; 28 paces times 24 spikes yields 672 impressions per player per green; 672 impressions times 18 greens equals 12,096 impressions per round per player. Assuming a course receives its daily average of 200 rounds, the greens receive 2,419,200 impressions every day, which comes to more than 72.5 million spike marks each month.

In theory, a golf ball rolling across a green pocked with spike marks would not roll as far as a ball on an unmarked green. This is due to the fact that each time the ball strikes a spike mark, it briefly loses contact with the putting surface. Over a distance of several feet, these subtle bounces may cause a significant reduction in ball roll.

Softspikes[R] have recently been gaining acceptance with golf course superintendents and golfers as a viable alternative to traditional metal spikes. This experiment was conducted to determine if use of soft spikes in lieu of traditional metal spikes would have a significant effect on ball roll.

Discussion/Summary

During the Autumn of 1994, a study was initiated at the Ohio State University Turfgrass Research Center, Columbus, to compare the effects of soft versus metal spikes on ball roll. The study was conducted on a creeping bentgrass (*Agrostis palustris* Huds. cv. Penncross) turf maintained at 3/16 of an inch. The treatments included soft spikes (Softspikes, Alexandria, VA), metal spikes (Footjoy[R]), and an untreated control.

Each treatment consisted of walking with the soft or metal spikes for 10 minutes within a plot measuring 2 x 12 feet. The control did not receive a walking treatment. A single person, 5 feet 11 inches in height and weighing 160 pounds, was used as the walker throughout the study. The shoes used in the study were size 10 Footjoys[R]. Upon completion of the walking, a stimpmeter was used to measure the distance a golf ball rolled. The treatments were conducted four times between October 20 and November 7 between the hours of 1 and 3 p.m. Each treatment was replicated three times in a completely randomized design.

Three out of the four reading dates showed a significant (P=0.05) increase in ball roll with the soft spikes compared to both the metal spikes and the control (Table 1). The initial readings taken on October 20 showed no difference in ball roll between the soft and metal spikes; however, both were significantly (P=0.05) greater than the control.

Table 1. Comparison of golf spikes on ball roll.

	Stimpmeter measurements of roll (inches)			
Treatment	10/20	10/25	11/4	11/7
Soft spikes	118.7	124.0	122.0	119.7
Metal spikes	109.0	109.0	113.3	111.7
Control	96.3	95.0	105.0	97.3
LSD (0.05)	12.3	11.2	6.2	5.2

The control was consistently the shortest ball roll treatment. This may seem counter-intuitive; however, the control plots were not walked upon, while the soft and metal spike treatments received intensive traffic from the walking. In essence, the walking served as a light "rolling." As a result, the metal spiked treatment, even with the spike marks, rolled further than the control which did not receive the "rolling."

Although the comparison between soft and metal spikes on a putting green setting was somewhat "amplified" by confining the research to a small plot area, the significance of the data cannot be dismissed. Softspikes are more likely to result in increased ball roll in situations where greens become excessively "spiked-up" by use of traditional metal spikes. Greens that receive excessive play or are smaller in size are more likely to see the effects of slower ball roll caused by spike marks and are therefore the most likely candidates to experience an increase in green speed with use of Softspikes.

Two potential benefits of using Softspikes were observed while conducting the experiment. First was the striking visual difference between the soft and metal spike treatments. The metal spiked plots looked literally "chewed up" after the ten minutes of walking; in contrast, the soft spiked plots looked healthy and could barely be distinguished from the control plots. Second, we observed a noticeable difference in the "trueness" of ball roll between the soft and metal spiked treatments, especially as ball speed declined. In the soft spike plots, the ball rolled true, even as the ball slowed; while in the metal spiked plots the ball was more apt to vary in its course, especially as ball speed decreased.

This study was conducted during the latter part of October and the beginning of November. If the study had been conducted in the spring or in the middle of the summer when growth patterns are different, the data may vary. Although further studies need to be conducted, we would expect similar data trends to occur.

**Trade name and company name of equipment used in this study are included for the benefit of the reader and does not imply any endorsement or preferential treatment of the product by The Ohio State University.

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Turfgrass Plant Growth Regulations

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Primo/Banner Interaction Study

Bill Pound, Renee Stewart and Joe Rimelspach
Horticulture and Crop Science; Plant Pathology

Introduction

Primo®, a Ciba product, was recently registered as a growth regulator for use on high maintenance turfgrass. As the marketing and commercialization efforts continue to develop, one of the potential primary markets for this product is on golf course sites. In the last 10 to 15 years, the use of creeping bentgrass on golf courses in the cool season turfgrass regions of the United States has expanded to include not only upscale private courses, but also many of the lower budget private and public courses. In addition to the high maintenance demands of creeping bentgrass, the increased susceptibility to turfgrass diseases, especially Dollar Spot, creates an additional concern. As the use of Primo is expanded on these courses, the concern of diseases on the creeping bentgrass, as well as the potential interactions of Primo with various fungicides, exists. The purpose of this trial was to quantify the impact of Primo on the incidence of Dollar Spot and assess the interaction of tank mixing this growth regulator with the fungicide, Banner.

Discussion/Summary

The study was initiated on June 27, 1994. Treatments were applied, per the protocol, every 14 or 28 days. Beginning Sept. 1, 1994, Dollar Spot disease severity data were collected. All disease data were collected by Joe Rimelspach, Turfgrass Extension Pathologist, The Ohio State University. A total of six readings were made with the final data collection conducted on Oct. 13.

Results of this investigation show Primo applied alone had no significant influence on the incidence of Dollar Spot (Table 1). Disease severity, expressed as percent diseased turfgrass, ranged from 21.7 to 26.3%. Disease severity in the untreated check areas ranged from 20.0 to 30.7 during this same period. Banner, applied alone or in combination with Primo, provided 95 to 100% control through this 44-day period. The addition of Primo to the Banner applications did not result in any antagonism on the efficacy of the Banner. Although no data were collected on turfgrass coloration or quality, casual observations indicated tank mixes with Banner did not negatively impact the color or quality enhancement benefits expressed on the creeping bentgrass from the use of Primo.

A nitrogen treatment (0.25 lb/M) was also evaluated. Data collected from the first and second reading indicate nitrogen had no significant impact on Dollar Spot. The four readings collected from Sept. 15 to Oct. 13 show significantly less diseased turfgrass in the nitrogen treatments vs. the untreated check areas (Table 1). Presumably, the buildup of nitrogen from repeat applications, combined with favorable growing conditions in early September, enabled the turfgrass to increase the growth rate and reduce the percentage of diseased turfgrass.

The results of this trial indicate the addition of Primo to Banner will not negatively impact the performance of this fungicide when used on creeping bentgrass in a Dollar Spot disease management program. Additionally, casual observations indicate the use of Banner will not reduce or negate the color or quality enhancement benefits expressed on creeping bentgrass following the use of Primo.

Treatment List

	Treatments	Oz Product/ 1000 sq.ft.	Schedule
1.	Untreated Check	0	——
2.	Primo	0.25	28 days
3.	Primo+Banner	0.25+0.50	28 and 14 days
4.	Primo+Banner	0.125+0.50	14 days
5.	Primo+Banner	0.25+0.50	28 days
6.	Banner	0.50	14 days
7.	Fertilized Check 4.0	(0.25 lb. as Coron)	14 days

Table 1. Percent Dollar Spot Disease Ratings

	Treatments	9/01	9/08	9/15	9/23	10/07	10/13
1.	Untreated Check	20.0	24.0	29.0	30.7	30.7	27.3
2.	Primo	21.7	25.0	25.7	26.3	26.3	26.3
3.	Primo+Banner	0.0	0.0	0.0	0.0	0.0	0.0
4.	Primo+Banner	0.0	0.0	0.0	0.0	0.0	0.0
5.	Primo+Banner	0.0	0.0	1.0	4.7	4.7	2.7
6.	Banner	0.0	0.0	0.0	0.0	0.0	0.0
7.	Fertilized Check	13.3	17.3	18.3	18.3	18.3	16.7
	LSD (0.05)	8.86	8.01	6.48	5.94	5.94	5.82

Primo Growth Regulator Evaluation on Creeping Bentgrass

William Pound and Renee Stewart
Horticulture and Crop Science

Introduction

The growth regulator Primo is the latest growth regulator product introduced for use on high maintenance turfgrass. Studies conducted at The Ohio State University from 1991-1993 quantified the benefits this growth regulator offers when used on highly maintained Kentucky bluegrass. An evaluation initiated in 1993 further showed significant benefits could also be achieved from the use of Primo on creeping bentgrass. The purpose of the 1994 study was to quantify the color and growth reduction benefits of Primo on fairway height creeping bentgrass.

Discussion/Summary

The study was initiated on May 2, 1994. Beginning with the early May application, treatments were repeated every 30 to 35 days ending with the October 3, 1994, treatment. Data were collected every 6 to 9 days and included turfgrass coloration (Table 1), fresh weight yields (Table 3) and turfgrass discoloration.

Results of this investigation show the addition of low rates of Primo (0.125 to 0.25 fl.oz./1000 sq.ft.) in combination with nitrogen (0.50 to 1.00 lb./1000 sq.ft) to significantly enhance turfgrass coloration. The addition of 0.125 fl.oz. of Primo to 0.5 lb. of nitrogen improved the average monthly turfgrass color ratings by 0.2 to 1.3 units greater than the standard 0.5 lb. nitrogen treatment (Table 2). The use of the higher Primo rate (0.25 fl. oz.) further enhanced this coloration by resulting in improved monthly color ratings by 0.6 to 1.9 units on the 0.50 lb. nitrogen treatments and 1.2 to 2.3 units on the 1.0 lb. nitrogen treatments (Table 2). No significant turfgrass discoloration was observed due to applications of Primo.

In addition to the enhancement in turfgrass coloration, Primo applications reduced clipping production of the creeping bentgrass. Both the 0.125 and 0.25 fl.oz. rates in combination with 0.5 lb. of nitrogen reduced clipping yields. These reductions ranged from 12.6 to 17.6% when compared with the 0.5 lb. nitrogen check. Less fresh weight reductions were realized when those same Primo rates (0.125 and 0.25 fl.oz.) were applied in combination with 1.0 lb. of nitrogen. These yield reductions ranged from 5.8% (0.125 fl.oz) to 7.6% (0.25 fl.oz). Previous studies on Kentucky bluegrass showed the growth suppression benefits of the growth regulator could be diminished with the addition of nitrogen. Presumably, the addition of nitrogen can override the growth reduction capabilities of Primo on creeping bentgrass as well.

In summary, the addition of Primo to nitrogen applications on creeping bentgrass will result in a dramatic enhancement in turfgrass coloration. The application of Primo will also result in reduced growth rates on the creeping bentgrass with the addition of nitrogen exhibiting the ability to override growth regulation.

Treatment List

	Treatment	Primo oz/1000 ft²	Nitrogen lbs/1000 ft²/app.
1.	Fert. Check	——	0.5
2.	Fert. Check	——	1.0
3.	Primo+Fert.	0.125	0.5
4.	Primo+Fert.	0.250	0.5
5.	Primo+Fert.	0.125	1.0
6.	Primo+Fert.	0.250	1.0

Table 1. Turfgrass Color Ratings On Creeping Bentgrass

Treatment	Turfgrass Color Ratings[a]													
	5/13	5/24	6/01	6/08	6/14	6/21	6/30	7/06	7/13	7/20	7/26	8/01	8/08	8/15
Fert. 0.5 lb	6.2	6.0	5.7	6.0	6.2	6.2	5.7	5.7	6.5	6.5	6.0	5.5	6.0	6.2
Fert. 1.0 lb	7.0	7.0	6.3	7.2	7.3	7.0	6.3	6.2	6.8	6.3	6.3	6.0	6.0	7.2
Fert. 0.5 lb+Primo 0.125oz	6.3	6.3	6.5	6.5	7.5	7.8	7.4	6.8	7.3	7.7	7.5	7.5	6.5	6.7
Fert. 0.5 lb+Primo 0.25 oz	6.7	6.8	7.7	6.7	7.5	8.0	7.7	7.2	7.5	8.0	7.7	8.0	6.7	7.0
Fert. 1.0 lb+Primo 0.125 oz	7.2	7.8	7.3	7.3	8.5	8.5	7.5	7.5	7.6	7.9	7.7	7.3	7.5	8.0
Fert. 1.0 lb+Primo 0.25 oz	8.0	8.7	8.2	7.8	8.8	9.0	8.3	7.3	8.0	8.3	8.2	7.8	7.5	8.5

Treatment	Turfgrass Color Ratings—continued								
	8/22	8/29	9/06	9/13	9/19	9/28	10/06	10/12	10/24
Fert. 0.5 lb	5.7	5.7	5.3	5.8	5.7	5.2	5.7	6.3	6.7
Fert. 1.0 lb	6.8	6.3	6.0	7.0	6.6	6.2	6.2	7.3	8.1
Fert. 0.5 lb+Primo 0.125 oz	7.5	7.5	6.5	6.7	7.2	7.2	6.8	7.3	7.7
Fert. 0.5 lb+Primo 0.25 oz	7.7	7.8	7.2	6.8	7.7	7.7	7.0	7.7	8.2
Fert. 1.0 lb+Primo 0.125 oz	8.5	8.2	7.8	8.2	8.5	8.5	7.8	8.6	9.1
Fert. 1.0 lb+Primo 0.25 oz	9.0	8.8	8.7	8.5	9.0	9.0	8.3	8.8	9.7

[a]Turfgrass color ratings 1-10. (10=Best)

Table 2. Average Monthly Turfgrass Color Ratings On Creeping Bentgrass

Treatment	Average Monthly Turfgrass Color Ratings[a]					
	May	June	July	August	Sept.	Oct.
Fert. 0.5 lb	6.1	6.0	6.2	5.8	5.5	6.2
Fert. 1.0 lb	7.0	6.9	6.4	6.5	6.5	7.2
Fert. 0.5 lb+Primo 0.125 oz	6.3	7.3	7.3	7.1	6.9	7.3
Fert. 0.5 lb+Primo 0.25 oz	6.7	7.5	7.6	7.4	7.4	7.6
Fert. 1.0 lb+Primo 0.125 oz	7.5	8.0	7.7	7.9	8.3	8.5
Fert. 1.0 lb+Primo 0.25 oz	8.3	8.5	8.0	8.3	8.8	8.9

No turfgrass discoloration was observed due to applications of Primo.
[a] Turfgrass color ratings 1-10. (10=Best)

Table 3. Fresh Weight Yields On Creeping Bentgrass

Treatment	Fresh Weights Collections (grams)[a]														
	5/05	5/12	5/18	5/25	6/01	6/09	6/16	6/22	6/30	7/08	7/15	7/22	8/01	8/08	8/15
Fert. 0.5 lb	135	191	107	118	96	106	125	145	247	204	195	184	267	156	175
Fert. 1.0 lb	138	238	131	155	107	171	233	245	307	253	233	219	303	195	293
Fert. 0.5 lb+Primo 0.125 oz	116	110	63	67	90	71	89	148	278	229	136	148	295	171	129
Fert. 0.5 lb+Primo 0.25 oz	111	100	48	53	83	55	61	123	294	229	103	135	335	181	97
Fert. 1.0 lb+Primo 0.125 oz	121	160	84	110	108	117	151	213	385	286	167	194	390	211	256
Fert. 1.0 lb+Primo 0.25 oz	117	130	56	96	133	96	112	204	355	283	151	211	474	228	199

Fresh Weight Collections (grams)—continued

Treatment	8/22	8/29	9/06	9/14	9/20	9/29	10/06	10/14	10/25	Totals	% Reduction vs. Same Fert.Checks	
Fert.0.5 lb	121	121	155	233	171	122	87	69	89	3619	Check	——
Fert.1.0 lb	182	168	174	411	268	177	107	135	179	5022	——	Check
Fert.0.5 lb+Primo 0.125 oz	106	159	161	173	125	129	77	49	44	3163	12.6	——
Fert.0.5 lb+Primo 0.25 oz	97	159	177	153	99	116	82	49	41	2981	17.6	——
Fert.1.0 lb+Primo 0.125 oz	210	224	228	310	258	205	131	102	111	4732	——	5.8%
Fert.1.0 lb+Primo 0.25 oz	206	247	234	315	227	196	135	110	123	4638	—	7.6%

a"Primo" growth regulator evaluation on Penncross creeping bentgrass.

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Turfgrass Biotechnology

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Restriction of Arbitrary Amplification Fragments of *Poa annua* L.

Patty Sweeney and Karl Danneberger
Horticulture and Crop Science

Introduction

Restriction digestion of arbitrarily primed amplification fragments has been suggested as a way to generate co-dominant markers using arbitrarily amplified DNA.

Random amplified polymorphic DNA (RAPD) markers exhibit dominance (heterozygous genotypes are identical to homozygous dominant genotypes) and allele frequency estimates cannot be made until progeny are evaluated. Allele frequency estimates are useful in studying population genetics and breeding systems. These kinds of studies require the evaluation of large numbers of individuals so progeny testing to determine the genotype of each individual is not feasible.

Restriction fragment length polymorphisms (RFLP) exhibit co-dominance (each genotype is expressed as a different phenotype), and it is possible to estimate allele frequencies directly from the analysis of an individual. However, large amounts of plant tissue and a time-consuming procedure to extract ultra pure DNA are required to generate RFLP markers. Thus, the use of RFLP markers in population genetic studies, especially in turfgrass species where only small amounts of tissue from an individual are available, is not feasible.

Restricted amplification fragment length polymorphic (RAFLP) markers should be similar to RFLP (co-dominant, evaluate restriction site changes) and RAPD markers (small tissue requirements, fast, inexpensive). RAFLP markers should be useful in studying turfgrass population genetics, but the feasibility of generating and using these markers has not been evaluated.

Discussion/Summary

The object was to determine the suitability of RAFLP as genetic markers by evaluating: 1) restriction and amplification in the same buffer rather than separate buffers for each, 2) the suitability of amplification products for restriction, 3) the number of restrictions generated by each primer/restriction enzyme combination and 4) the number of segregating (polymorphic) restriction sites.

Six (*Hinc II, Hind III, Kpn I, Pst I, Apa I* and *Sma I*) of 7 restriction enzymes we tested worked well in the amplification buffer evaluated, but one, *EcoR I*, produced nonspecific restriction in the buffer and was not used in further evaluations.

We tested 186 primers for amplification of *Poa annua* DNA. Amplification products were separated via electrophoresis on agarose gels and visualized under ultraviolet light. Seventy primers produced numerous bands of similar intensity throughout the gel. Specific restriction products of these multiple amplification fragments could not be determined, so these 70 primers, as well as 61 that produced little or no amplification, were not tested further. Fifty-three primers produced 1 to 5 distinct fragments and were used in restrictions.

When the 53 primers were used in combination with the 6 restriction enzymes, we observed 140 restrictions. To be useful as a co-dominant marker, however, all three genotypes must be easy to identify. Many restrictions did not allow identification of all genotypes and thus were not considered useful.

Hinc II often restricted multiple fragments in a single lane. When this occurred, the identification of individual restriction products was obscured. This was probably due to the degenerate nature of the restriction site. Such degenerate restriction increases the probability of restriction in any fragment and reduces the observation of the whole uncut fragment. Therefore, observation of heterozygotes (one of the pair cut and the other intact) would be decreased. Estimates that are based on heterozygosity, such as degree of outcrossing, would be skewed. These aspects of *Hinc II* limit its usefulness as a restriction enzyme in genetic studies so the 58 restrictions by Hinc II were excluded. Eleven other multiple restrictions were also excluded since specific products could not be determined.

Restriction products, necessary for the identification of heterozygotes, were missing in two cases. Three restrictions were in fragments that were polymorphic and in six restrictions, a second fragment of similar molecular weight obscured identification of some genotypes. These 11 restrictions were not considered useful for genetic studies.

Eleven restrictions were initially considered heterozygous. Six of these restrictions did not segregate when 12 individuals were evaluated. Since *Poa annua* is reported to have low outcrossing rates, it is unlikely that these loci were heterozygous in all 12 individuals. It is more probable that two similarly sized fragments were amplified, but only one of the fragments contained the restriction site. The other five tentative heterozygotes segregated, but the homozygous uncut genotype was never or rarely observed. Again, *Poa annua's* low outcrossing rate makes it much more probable to observe homozygous genotypes than the numerous heterozygous we observed. These five restrictions may represent polymorphic loci. However, the amplification of two different fragments of the same molecular weight, one that is always cut by the restriction enzyme, another that is not cut but is polymorphic, could result in the same pattern.

In addition to the tentative heterozygous loci, we observed 49 restriction loci that we considered useful. We have evaluated 32 of these and found 2 that appear to be segregating.

The protocol generated consistent RAFLP markers. Six restriction enzymes worked in the amplification buffer tested, simplifying the procedure. Fifty-three of the 186 primers evaluated produced clear amplification fragments that were suitable for restriction. Excluding the *Hinc II* restrictions, the 53 primers used in combination with 5 restriction enzymes resulted in 82 restrictions. Not all restrictions were useful for genetic studies since genotypes could not be unambiguously distinguished.

Our data indicated that the production of co-dominant amplification markers was feasible. Like RAPD markers, the RAFLP markers require little DNA for extraction, making the protocol adaptable to species where tissue is limited. Although we needed to screen a number of restriction loci to find useful polymorphic loci, the procedure requires no previous knowledge of DNA sequences and is fast once appropriate markers are identified. RAFLP markers should be more powerful than RAPD markers in genetic studies and should be especially useful in species that have previously had few genetic markers.

THE OHIO STATE UNIVERSITY
OARDC

**Ohio Agricultural Research
and Development Center
1680 Madison Ave.
Wooster, OH 44691-4096**