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2002 Turfgrass Research Report

In Cooperation With The

Pennsylvania Turfgrass Council

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CULTIVAR DEVELOPMENT AND ATHLETIC FIELD STUDIES

TOPDRESSING STUDY

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No endorsement is intended for products mentioned, nor is lack of endorsement meant for products not mentioned. The authors and the Pennsylvania State University assume no liability resulting from the use of pesticide applications detailed in this report.

I have the honor to present to you the enclosed report of the work of the Center for Turfgrass Science, Penn State University, University Park, PA for the year 2002.

Respectfully,
Aaron Lathrop,
Editor

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Effects of Plastic Covering and Rate of Basamid® Granular on *Poa annua* Seedling Emergence in Putting Greens

P.J. Landschoot and B.S. Park
Dept. of Crop and Soil Sciences

Funding Sources: BASF Corp. and The Pennsylvania Turfgrass Council

Introduction

Renovation and species conversion of golf course putting greens is becoming more common in the northern United States. Preliminary studies have revealed that Basamid® Granular (dazomet) provides varying degrees of preemergence control of *Poa annua* when applied to the surface of established turf. Although Basamid is labeled for putting green renovation, only preliminary research information is available on its ability to inhibit *P. annua* seedling emergence when surface-applied to greens. The purpose of this study was to determine the effects of plastic covering and rate of surface-applied Basamid on *P. annua* seedling emergence in putting greens.

Materials and Methods

This experiment was conducted during 2000 and 2001 at the Joseph Valentine Turfgrass Research Center in University Park, PA on a twenty-year-old mixed stand of creeping bentgrass (*Agrostis stolonifera*) 'Penneagle' (approximately 30%) and *P. annua* (approximately 70%). The soil is a sandy loam with a pH of 8.0, 38.0 lb P/A, a cation exchange capacity of 13.0 meq/100 g of soil, and 0.7 meq exchangeable K/100 g of soil. The stand was fertilized with Nutralene Chip 40-0-0 (J. R. Simplot Company, Boise ID) at 1.0 lb N/1000 ft^2 in the spring of 2000 and 2001. Prior to the start of the experiment, the turf was irrigated to prevent drought stress and mowed with a greens mower six times per week at a height of 0.125 inch. Clippings were removed from the site. No herbicides (other than treatments) were applied to the site during 2000 or 2001.

Roundup PRO® (glyphosate) was applied to the test area prior to treatment applications (11 July 2000 and 10 July 2001) in 2.0 gal water/1000 ft^2 at 30 psi using a CO_2-powered boom sprayer equipped with 8004 flat fan nozzles. On 25 July 2000 and 20 July 2001, the test area was core-aerated using a John Deere Aercore 800 (Deere & Company, Moline IL). The unit cored to a depth of approximately 2.5 inches using 0.6 inch-diameter tines positioned on 2.0-inch centers. The cores were removed from the site. On 26 July 2000 and 21 July 2001, the core aeration holes were filled using a topdressing mix consisting of 80% sand : 20% peat (v:v). Following topdressing (3 Aug 2000 and 23 July 2001), a Ryan Mataway (Cushman Inc., Lincoln, NE) walk-behind vertical mowing unit was used to scarify the surface. Each test area (2000 and 2001) was scarified one time in one direction. The unit was equipped with vertical blades 1.0 inch apart and blades penetrated the soil to a depth of 0.25 inch. On 3 Aug 2000 and 23 July 2001, the perimeters of plots that were to be covered with plastic were excavated using an Olathe

Model 28 Trencher (Olathe Manufacturing Inc., Industrial Airport, KS). Each trench was approximately 6.0 inches deep and 4.0 inches wide.

The treatments used in this experiment included Basamid applied to the turf surface at 350, 306, 263, and 175 lb/A and covered with clear plastic sheets (4.0 mil thick); Basamid applied to the turf surface at 350, 306, 263, and 175 lb/A and not covered; a plastic-covered non-treated control; and a non-covered non-treated control. Treatments were arranged as a 5 x 2 factorial. The experimental design was a randomized complete block design with three replications. Plot size was 4.0 by 6.0 ft and each plot was surrounded by a 1.0 ft border.

Basamid treatments were applied by hand using shaker jars on 5 Aug 2000 and on 25 July 2001. Following the 2000 and 2001 applications, approximately 0.5 inch of water was applied through an automatic irrigation system to the entire test area. During both tests, water was applied incrementally over about 60 minutes to allow infiltration into the soil and to prevent surface ponding and runoff. Immediately after watering, plastic sheets were placed over the four covered Basamid treatments and one covered non-treated control. To minimize loss of phytotoxic gases resulting from dazomet degradation (Fritch and Huber, 1995), the perimeter of each plastic sheet was placed in the trenches and backfilled with sterilized sand. On 12 Aug 2000 and 1 Aug 2001 [seven days after treatment (DAT) with Basamid] the plastic sheets were removed from all covered plots.

After the initial irrigation, a post-treatment irrigation regime was employed. The objective of this regime was to keep the soil surface moist between the date of application and the date in which seedlings were counted. This was done to create an environment conducive for *P. annua* seeds to germinate and to create a "water-seal", as directed by the product label for Basamid Granular (BASF AG, Ludwigshafen, Germany). The post-treatment irrigation regime consisted of 2-3 irrigation cycles per day with approximately 0.1 inch of water applied per cycle.

On 30 Aug 2000 (25 DAT) and 20 Aug 2001 (26 DAT), *P. annua* seedlings were counted in all plots. Counts were made by centering a 4.0 by 6.0 ft grid (24.0 ft^2) over each 4.0 by 6.0 ft plot and counting all seedlings within the grid. Seedling counts were subjected to a square root transformation prior to statistical analysis. Transformed seedling counts were subjected to analysis of variance and means were separated using Fisher's Protected Least Significant Difference test at the 0.05 level of significance. The non-transformed seedling counts are presented in Table 2, but the statistical analyses are based on transformed data.

Results

Analysis of variance of data collected in 2000 and 2001 (Table 1) indicate that the main effects of treatment and plastic covering were highly significant. All Basamid treatments reduced the number of emerged *P. annua* seedlings compared to controls during both years of this experiment. Covering Basamid treatments with plastic sheets reduced the number of emerged *P. annua* seedlings compared to non-covered treatments in 2000 and 2001.

Analysis of variance (Table 1) shows that a highly significant treatment x plastic covering interaction occurred for data collected during 2000 but not 2001. The interaction indicates that numbers of *P. annua* seedlings decreased as the rate of Basamid increased for non-covered treatments in 2000. There were no differences among Basamid rates with respect to seedling numbers for plastic-covered treatments in 2000 and 2001. When covered with plastic, Basamid applied at 350, 303, and 263 lbs/A provided 100% control of *P. annua* seedling emergence in 2000 and 2001. When not covered, the 350 lb/A rate of Basamid provided 98% control of *P. annua* seedling emergence in 2000 and 2001. The non-covered 175 lb/A rate of Basamid gave only 76.7% control of *P. annua* seedling emergence in 2000; however it produced 91.9% control in 2001. No significant differences in *P. annua* seedling numbers were detected among the 350, 306, and 263 lb/A rates of Basamid in either year of the experiment.

Table 1. Analysis of variance for transformed counts of *P. annua* seedlings that emerged in putting green turf treated with Basamid or not treated.

		Mean squares of *P. annua* seedlings	
Source	df	2000	2001
Replication	2	10.78 NS	29.81 NS
Treatment (T)	4	2512.00 ***	1909.87 ***
Plastic covering (P)	1	792.56 ***	595.08 **
T x P	4	110.16 **	6.71 NS
Error	18	15.41	47.89
Corrected total	29	-----	-----

NS, **, *** Nonsignificant or significant at P ≤ 0.01, or 0.001.

Table 2. Mean *Poa annua* seedlings (observed counts) from fairway turf treated with different rates of Basamid.

		P. annua seedlings			
	Rate	2000		2001	
Treatment	(lb product/A)	No plastic†	Plastic	No plastic	Plastic
Basamid	350	67 c‡	0 b	43 b	0 b
Basamid	306	101 c	0 b	96 b	0 b
Basamid	263	127 c	0 b	126 b	0 b
Basamid	175	620 b	0 b	216 b	22 b
Control	----	2664 a	2681 a	2678 a	1616 a

† No plastic indicates that field plots were not covered with plastic following Basamid application, plastic indicates that field plots were covered with plastic sheets for seven days following Basamid application.
‡ Column numbers followed by the same letter are not significantly different as determined by Fisher's Protected Least Significant Difference test at $P = 0.05$ on transformed data.

Conclusion

Surface applications of Basamid on turf that was heavily infested with *P. annua* seed reduced or eliminated emergence of *P. annua* seedlings. Complete control of *P. annua* seedling emergence was not achieved in either year when Basamid applications were not covered with plastic. However, when applied to putting green turf in late summer of 2000 and 2001 at 350, 303, or 263 lbs product/A, watered in with approximately 0.5 inch of water, and covered with plastic for 7 days, Basamid provided 100% control of *P. annua* seedling emergence. Results of this study indicate that Basamid has the potential to be an effective renovation herbicide and fumigant for putting green renovation in the northeastern United States.

Development of a Web-Accessible Turfgrass Case Library

A. J. Turgeon

In attempting to address technical problems encountered in the management of golf turf, one often relies on earlier experiences—one's own or others—in which success was achieved from specific courses of action. These experiences, including statements of the problem, actions taken, and results obtained, can be captured in historical case reports and organized in a database on a Web server for easy access. Employing historical cases in this way has been termed case-based reasoning (CBR) and is widely used by physicians for diagnostic purposes.

Beneficiaries include all turfgrass managers dealing with real-world turfgrass problems, and all turfgrass students learning problem-solving skills from simulated problems.

In prior years, accomplishments included the design and construction of an SQL version of the keyword-accessible database and the accumulation of 39 historical cases through a cooperative arrangement with the United States Golf Association Green Section. The database was installed on the CAS server and specific cases were linked to instructional modules to create a "just-in-time learning" resource.
This year, an arrangement was established with the Golf Course Superintendents Association of America to encourage submissions of new cases by GCSAA members from around the world. We also worked with the College's ICT personnel to make critical improvements in the Library for more efficient management of cases received from the field.

You can log onto the Web site at: http://turfgrass.cas.psu.edu/caselibrary/ and access cases resident within Penn State's Turfgrass Case Library.

Accessing Information

The first step in accessing relevant cases is to choose the turfgrass species at the problem site by clicking on the pull-down menu listing the species' common name. If there are two principal species at the site, such as creeping bentgrass and annual bluegrass, use both pull-down menus to make your selections, as shown below:

Choose one or two turf species:

creeping bentgrass ▼ annual bluegrass ▼

For the second step, choose one or two turf types from the pull-down list, including green, tee, fairway, rough, bunker, and general golf course. In the example below, we have chosen **GREEN**.

Choose one or two turf types:

green ▼ ▼

The third step is to choose the problem type. For example, if your problem is due to shade, disease, winter injury, or drainage, choose one of these from the pull-down menu. You can use the second window to identify a second problem or to provide a more detailed characterization. For example, if your problem is poor drainage due to layers within the soil profile, choose **DRAINAGE** in the left window and **LAYERING** in the right window:

Choose one or two problems you would like to look at:

drainage ▼ layering ▼

Finally, click on the button labeled **ACCESS THE CASE LIBRARY** to bring up cases dealing with creeping bentgrass-annual bluegrass greens that have drainage problems due to layering within the soil profile.

Access the Case Library

This will bring up only those cases resident in the Library in which these conditions exist. Notice that four cases are listed with brief descriptions.

Select

Failing putting green at Southern Dutchess Country Club
Improper rootzone mix can result in compacted soil.

Poor quality putting greens at the Cottonwood Creek Golf Course
Partial reconstruction of putting greens can save money while improving play.

Select

Core aerification of greens prior to rain at South Hills Country Club
Deep-tine aerification prior to rain decreases salinity and increases drainage.

Poor drainage within greens at Aronimink Golf Club
Deep hand-drilling with sand topdressing poured into the holes created better drainage.

Select

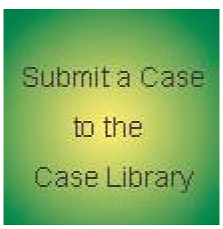
Choose one of these cases by clicking in the circle just to the left of the case title, then click on one of the nearby **SELECT** buttons to access that particular case. The case brought up will have the following information: a title, location, turfgrass species, turf type, description of the problem, actions taken to correct the problem, the rationale for these actions, expected results, actual results of the actions taken, comments on whether the problem was solved, and if there were any unexpected results. Some cases also have information on other actions that might have been taken and why they were not taken (See example: Failing Putting Green at Southern Dutchess CC).

Cause-and-effect relationships between actions taken and results obtained constitute the core of the cases within the Turfgrass Case Library. While the scientific bases for those relationships are not explained within the case itself, they can be accessed through hyperlinks connecting the cases to instructional modules dealing with relevant subject matter. For example, in the Southern Dutchess CC case, notice that several words in the case description are underlined, identifying them as hyperlinked words. When you click on these words, you will bring up instructional modules on soils, cultivation, and topdressing. These are learning resources through which you can develop a richer understanding of the concepts and processes inherent in these cause-and-effect relationships. Thus, by combining cases (problem-based learning resources) and instructional modules (knowledge-based learning resources), we have at our disposal "just-in-time learning" resources that can be accessed whenever one encounters a new problem for which good solutions are being sought AND a better understanding of the relevant science is desired.

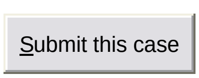
Contributing Information

Currently, the Turfgrass Case Library has about 40 cases. These were developed in cooperation with USGA Green Section personnel. In order to have broad utility, the Turfgrass Case Library must have hundreds of cases covering all of the significant problems encountered by turfgrass managers from around the world. ***Contributions of additional cases must come from you.***

If you have a case that you believe would be a valuable contribution to the Library, you can submit it by simply clicking on the green button marked "Submit a Case to the Case Library."



This will bring up the submission page on which you can provide detailed information in the boxes under each of the titles discussed earlier. After typing in the information into each of the boxes, you can formally submit the case by clicking on the "Submit this case" button.



Be sure to include your e-mail address, as additional information may be required before the case can be included in the Library. Once included, links between the case and appropriate instructional modules will be made to enhance its utility as a learning resource.

While it's too early to assess the actual impact of this project, the potential impact within the turfgrass industry is enormous and, depending on patterns of usage and evolutionary development over the next several years, this could serve as a model for similar efforts throughout the College.

Turfgrass Case Library

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Title: Failing Putting Green at Southern Dutchess CC

Geographic location: Beacon, NY

Turf species at the problem location: creeping bentgrass

Turf type: putting green

Brief description of the problem: Weak turf, evidenced by a thinned canopy and poor rooting, offered poor playability at the newly constructed 5th putting green at Southern Dutchess Country Club. The severely compacted rootzone made it nearly impossible to change hole locations on the putting green. Water infiltration was extremely limited, compounding the turf management problem. The few trees surrounding the green site were pruned and the putting green was core aerified and topdressed several times. The putting green had been reconstructed 2 years previously in an effort to improve putting quality and expand the amount of useable cupping area. A golf course architect was not involved nor was an experienced golf course construction contractor. As a result, the design and construction of the new green was terrible. The contractor who constructed the green used a rootzone mix consisting of 17 percent gravel, 12 percent very coarse sand, 16 percent coarse sand, 21 percent medium sand, 5 percent fine sand, 4 percent very fine sand, 11 percent silt, and 14 percent clay. As can be imagined, this mixture locked up like concrete.

What actions were taken to correct the problem? USGA Green Section agronomist Matt Nelson was called in to analyze the problem. The two recommendations offered were to reconstruct the green to the USGA guidelines for putting green construction or replace the rootzone through long-term conventional and deep aerification. Reconstruction using an architect and, at the least, a qualified golf course construction contractor experienced with the construction of USGA spec greens was the best option.

What was the rationale for these actions? The existing rootzone material was better suited for use as a road base than as a medium for turfgrass growth. The lack of non-capillary porosity, very limited water infiltration and extreme compaction of the rootzone suggested any remedial action to correct this problem would likely be fruitless. The membership was also weary of poor playing conditions and did not seem receptive to long term cultivation programs that, at best, **might** solve the problem.

What results were expected? With a suitable rootzone, it is expected that the cultivation of acceptable turfgrass should be attainable with appropriate management, good construction, and an adequate establishment period.

What other actions could be taken? Considering that the growing environment was quite good, irrigation water quality was fine, and reasonable management techniques were being employed, it seems doubtful that anything short of total reconstruction would have corrected the problem in an appropriate time frame.

Why was it decided not to do these things? Corrective measures using cultivation to replace the rootzone material over time would have taken far too long and caused substantial interference to playing quality.

What were the results of the action taken? Reconstruction ensued.

Did it solve the problem? Grow-in will occur during the 1999 season. Replacing the poor rootzone with one complying with USGA specifications should solve the soil problem.

Were there any unexpected results? Not yet.

To return to list of cases please use the Back button.
Make new selections

ANNUAL BLUEGRASS WEEVIL MANAGEMENT WITH CONVENTIONAL FORMULATIONS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This experiment was conducted on a golf course fairway in Bedford County to assess the performance of five formulations against a natural adult population. The fairway consisted primarily of annual bluegrass (50%) and perennial ryegrass (50%). Applications were made when flowering dogwood and shadblow were in full bloom and adults were active on golf course greens. Treatment plots were 5 x 6 ft, arranged in a RCB design and replicated three times. Liquid formulations were applied at the rate of 2 gal/1,000 ft^2 (227 ml water per 30 ft sq) using a CO_2 compressed air sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom operating at 28 psi. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time (1 May), the following soil and environmental conditions existed: air temp, 55° F; soil temp at l inch depth, 53° F; soil temp at 2 inch depth, 51° F; RH, 45%; amt of thatch, 0.5 inch; water pH, 7; particle analysis, 24.9% sand, 51.3% silt, 23.8% clay; textural class, silt loam; soil pH, 5.7; % soil water content (% by weight), 31.3; CEC, 15.9; % organic matter, 5.6; soil and thatch condition, moist; application time, late morning; and clear sunny skies. Each replicate was irrigated in with 0.1 inch of water immediately after treatment. Post-treatment counts were made on 10 Jun. Annual bluegrass weevil control was evaluated by removing two 4 inch cup cutter sod samples from each replicate and recording the total no. of weevil life stages (larva, pupa) per sample. Totals were then converted to a ft^2 count and a WD was performed on the data.

Adults were actively observed on golf course fairways, greens, and roughs before treatment. Five treatments provided significant control. No phytotoxicity was noted.

Treatment/ formulation[a]	Rate lb (AI)/acre	Avg no. annual bluegrass weevil life stages/ft^2 10 Jun	(% Control)
Untreated Check		159.1 a	
DeltaGard T & O 5SC	0.13	15.3 bc	(90.4)
Insecticide			
Tempo 20WP	0.135	26.8 b	(83.1)
Talstar PL G	0.2	1.9 c	(98.8)
Conserve SC	0.406	32.6 b	(79.5)
Scimitar GC	0.06875	1.9 c	(98.8)

Means followed by the same letter are not significantly different (P = 0.05, WD).
Data transformed to arcsine square root percent prior to ANOVA/WD. Untransformed means are presented in the table.
[a] Select formulations may not be labeled for golf course turfgrass.

MID - LATE SUMMER AND EARLY FALL EVALUATION OF REGISTERED AND EXPERIMENTAL FORMULATIONS TO SUPPRESS JAPANESE BEETLE AND NORTHERN MASKED CHAFER GRUBS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This study was undertaken to determine product effectiveness to control a mixed white grub population on a turfgrass area maintained at University Park. The turfgrass area consisted of Kentucky bluegrass (100%). Treatment plots were 6 x 9 ft, arranged in a RCB design and replicated three times. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time one (31 Jul) the following soil and environmental conditions existed: air temp, 68° F; soil temp at l inch depth, 68° F; soil temp at 2 inch, 70° F; RH, 90%; amt of thatch, 0.125 – 0.25 inch; water pH, 7.0; application time, early morning; soil moist; thatch wet; and sunny skies. Immediately after application the experimental area was irrigated in with 0.3 inch of water. The experimental area was irrigated on a regular basis until data was recorded. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 15.7%; silt, 69.6%; clay, 14.7%; soil percent water content (percent by wt), 23.4; organic matter, 4.3%; CEC, 11.5; and soil pH, 6.7. At treatment time two (12 Aug) the following soil and environmental conditions existed: air temp, 63° F; soil temp at l inch depth, 62° F; soil temp at 2 inch, 64° F; RH, 95%; amt of thatch, 0.125 – 0.25 inch; water pH, 7.0; application time, early morning; soil moist; thatch wet; and hazy skies. Immediately after application the experimental area was irrigated in with 0.1 inch of water. The experimental area was irrigated on a regular basis until data was recorded. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 15.2%; silt, 66.5%; clay, 18.3%; soil percent water content (percent by wt), 25.8; organic matter, 4.5%; CEC, 12.1; and soil pH, 6.5. At treatment time three (26 Aug) the following soil and environmental conditions existed: air temp, 78° F; soil temp at l inch depth, 77° F; soil temp at 2 inch, 76° F; RH, 60%; amt of thatch, 0.125 – 0.25 inch; water pH, 7.0; application time, late morning; soil wet; thatch wet; second instar NMC grubs present; and clear skies. Immediately after application the experimental area was irrigated in with 0.1 inch of water. The experimental area was irrigated on a regular basis until data was recorded. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 14.9%; silt, 74.1%; clay, 11.0%; soil percent water content (percent by wt), 25.2; organic matter, 4.4%; CEC, 12.6; and soil pH, 6.5. At treatment time four (17 Sep) the following soil and environmental conditions existed: air temp, 58° F; soil temp at l inch depth, 61° F; soil temp at 2 inch, 62° F; RH, 70%; amt of thatch, 0.125 – 0.25 inch; water pH, 7.0; application time, early morning; soil moist; thatch moist; second and third instar NMC grubs present; and clear skies. Immediately after application the experimental area was irrigated in with 0.3 inch of water. The experimental area was irrigated on a regular basis until data was recorded. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 19.7%; silt, 70.7%; clay, 9.6%; soil percent water content (percent by wt), 23.2; organic matter, 4.1%; CEC, 11.8; and soil pH, 6.7. Three sq ft soil samples were randomly removed from each replicate on 7 Oct and the total no. of Japanese beetle (JB) and Northern masked chafer (NMC) grubs was recorded. Data was analyzed using WD.

On April 25 the experimental area was infested with 20.7 third instar NMC scarab grubs per ft^2. The first adult NMC was collected on 24 Jun 2002. Peak NMC adult flight was recorded from ca. June 24 through 15 Jul. The last NMC adult was collected on 31 Jul. Drought conditions had a negative impact on scarab grub populations compared to those numbers recorded during the spring of 2002. All treatments provided significant reduction when both grub species were combined and for NMC grubs. Four treatments provided significant reduction of JB grubs. No phytotoxicity was noted.

Treatment/ formulation	Rate lbs (AI)/acre	Avg no. grubs/ft^2 7 Oct JB	NMC	BOTH[a]
Merit 0.5G[b]	0.3	0.3 ab	0.2 c	0.6 d
DAS011053 6.2G[b]	6.2	0.0 b	0.3 c	0.3 d
DAS011053 6.2G[c]	6.2	0.3 ab	0.1 c	0.4 d
DAS11053 6.2G[d]	6.2	0.7 ab	0.6 c	1.2 bcd
DAS11053 6.2G[e]	6.2	0.4 ab	1.6 bc	2.0 bc
DAS11053 6.2G[b]	7.4	0.1 b	0.0 c	0.1 d
DAS011053 6.2G[c]	7.4	0.1 b	1.0 bc	1.1 cd
Dylox 6.2G[d]	8.1	0.2 b	2.3 b	2.6 b
Untreated check		1.3 a	6.0 a	7.3 a

Means followed by the same letter are not significantly different (P = 0.05; WD).
[a] Combination of JB and NMC grubs.
[b] Treatments applied on 31 Jul.
[c] Treatments applied on 12 Aug.
[d] Treatments applied on 26 Aug.
[e] Treatments applied on 17 Sep.

BLACK CUTWORM LARVAL SUPPRESSION WITH CONVENTIONAL FORMULATIONS ON CREEPING BENTGRASS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This experiment was completed on a bentgrass green maintained at the Penn State Valentine Turfgrass Research Center at University Park to determine the effectiveness of treatments against second and early third instar BCW larvae. Treatment plots were 6 x 8 ft, arranged in a RCB design and replicated four times. A one foot barrier was established between each replicate and block. Liquid formulations were applied by using a CO_2 sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom operating at 28 psi, and applied in 363 ml water/48 ft^2 or delivering 2.0 gal/1000 ft^2. At treatment time (7 Aug), the following soil and environmental conditions existed: air temp, 52° F; soil temp at l inch depth, 53° F; soil temp at 2 inch depth, 56° F; RH, 95%; amt of thatch, 0.0625 inch; soil textural class, sandy loam; soil particle size analysis: 58.1% sand, 32.4% silt, 9.5% clay; percent water content (percent by wt), 19.2; organic matter, 3.2%; water pH, 7.0; soil pH, 6.7; CEC, 11.4; time of application, early morning; thatch and soil, wet; and clear skies. The entire experimental area received 2.36 inches of irrigation from 7 Aug through 15 Aug. Drought conditions required extensive irrigation to maintain the bentgrass. Eight inch diam by six inch long white PVC cylinders were placed in each replicate and secured in place. Each cylinder was covered with white meshed shade cloth. One cylinder was placed in each replicate and ten late second to early third instar black cutworm larvae were added to each cylinder on 8 Aug. Efficacy data was recorded on 15 Aug by counting the no. of BCW larvae flushed to the surface within one eight inch PVC cylinder per replicate by using a soap irritant drench. Data was analyzed by using WD.

All treatments provided significant reduction of BCW. No phytotoxicity was noted.

Treatment/ formulation[a]	Rate lb (AI)/acre	Avg No. Fresh BCW Larvae Flushed To Surface/8 inch Cylinder 15 Aug
Untreated Check		6.0 a
Conserve SC	0.40625	3.3 b
Mach 2 Liquid	1.0	3.5 b
DeltaGard GC	0.06	0.0 d
5SC Insecticide		
Scimitar CS	0.06875	0.0 d
Talstar L & T F	0.05	0.0 d
Tempo 20WP	0.096	0.0 d
Dursban Pro	1.0	0.5 c

Means followed by the same letter are not significantly different (P = 0.05, WD). Data transformed to an arcsine square root percent prior to ANOVA/WD. Untransformed means are presented in the table.

[a] Select formulations may not be labeled for golf course turfgrass.

CURATIVE SUPPRESSION OF WHITE GRUBS WITH APPLICATIONS OF INSECTICIDE FORMULATIONS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This experiment was conducted on turfgrass maintained at Penn State's Valentine Turfgrass Research Center which was infested with a natural population of white grubs to determine the effectiveness of formulations applied at different intervals. The turfgrass area consisted primarily of Kentucky bluegrass (100%). Treatment plots were 9 x 6 ft, arranged in a RCB block design and replicated three times. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time one (17 Sep) the following soil and environmental conditions existed: air temp, 57° F; soil temp at l inch depth, 61° F; soil temp at 2 inch, 62° F; RH, 70%; amt of thatch, 0.125 – 0.25 inch; percent water content (percent by wt), 24.8; soil textural class, silt loam; soil particle size analysis: 17.0% sand, 71.3% silt, 11.7% clay; organic matter, 3.5%; CEC, 10.1; and soil pH, 6.4; soil moist; thatch moist; water pH, 7.0; application time, early morning; and clear skies. Immediately after application treatments were irrigated in with 0.3 inch of water. Second and third instar NMC grubs were present in the soil on 17 Sep. The experimental area was irrigated on a regular basis following treatment. Three ft^2 sod samples were randomly taken from each replicate 22 Oct, and the total no. of scarab white grubs/ft^2 was recorded according to species. Data was analyzed using WD.

The experimental area was previously infested in the spring of 2002 with populations of NMC and a few JB grubs. Pre-treatment counts recorded on 5 Sep averaged 23.0 second and third instar NMC grubs per ft^2. JB grubs populations were minimal. The predominant white grub species present was NMC and six treatments provided significant reduction of NMC grubs. The first adult NMC was collected on 24 Jun 2002. Peak NMC adult flight was recorded from ca. June 24 through 15 Jul. The last NMC adult was collected on 31 Jul. No treatments provided significant reduction of JB grubs. No phytotoxicity was noted.

		Avg no. white grubs/ft^2		
		JB Grubs	NMC Grubs	Tt[a]
Treatment/ formulation	Rate lb (AI)/acre	22 Oct	22 Oct	22 Oct
Untreated Check		0.0 a	18.6 a	18.6 a
Imidacloprid 0.2GR-B	0.25	0.0 a	0.9 d	0.9 de
GrubEx	1.5	0.0 a	0.4 d	0.4 e
Spectracide Bug Stop Insect Control Granules (0.25% permethrin)	0.272	0.1 a	17.1 a	17.2 a
Spectracide Triazicide Soil And Turf Insect Killer Granules (0.04% lambda-cyhalothrin)	0.0523	0.2 a	9.1 b	9.3 b
Dylox 6.2G	8.1	0.1 a	2.7 d	2.8 d
Garden Tech Sevin Lawn Insect Granules (2% carbaryl)	7.84	0.1 a	6.6 c	6.7 c
Cyfluthrin 0.1GR	0.131	0.1 a	10.6 b	10.7 b

Means followed by the same letter are not significantly different (P = 0.05; WD).
[a] Combination of JB and NMC white grubs.

APPLICATION OF INSECTICIDE FORMULATIONS TO PREVENTIVELY SUPPRESS WHITE GRUBS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This study was undertaken to determine product effectiveness to control a NMC white grub population on a turfgrass area maintained at Penn State's Valentine Turfgrass Research Center at University Park. The turfgrass area consisted of perennial ryegrass (100%). Treatment plots were 6 x 8 ft, arranged in a RCB design and replicated three times. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time (22 Jul) the following soil and environmental conditions existed: air temp, 72° F; soil temp at l inch depth, 71° F; soil temp at 2 inch, 70° F; RH, 90%; amt of thatch, 0.0625-0.125 inch; water pH, 7.0; application time, early morning; soil and thatch moist; and clear skies. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 19.1%; silt, 60.2%; clay, 20.7%; soil percent water content (percent by wt), 19.6; organic matter, 3.4%; CEC, 11.8; and soil pH, 5.3. Treatments were irrigated in immediately after treatment with 0.5 inch of water. Throughout the summer the experimental area was irrigated on a regular basis because of severe drought conditions. Irrigation and rainfall total recorded from 22 Jul through 18 Sep was 16.04 inches. Three sq ft soil samples were randomly removed from each replicate on 18 Sep and the total no. of NMC and JB grubs was recorded. Data was analyzed using WD.

The area selected for the experiment had been infested with a natural population of NMC during the spring of 2002. NMC was the predominant white grub species present throughout the research area. Pre-treatment counts recorded on 25 Apr averaged 13.4 NMC third instar grubs/ft^2. Adult NMC's were monitored with a black light trap maintained at the Valentine Turfgrass Research Center. The first adult NMC was collected on 24 Jun 2002. Peak NMC adult flight was recorded from ca. June 24 through 15 Jul. The last NMC adult was collected on 31 Jul. Nine treatments provided significant suppression of NMC grubs. No treatments provided significant reduction of JB grubs but populations were minimal. No phytotoxicity was noted.

		Avg no. white grubs/ft^2		
		JB Grubs	NMC Grubs[a]	Tt[a b]
Treatment/ formulation	Rate lb (AI)/acre	18 Sep	18 Sep	18 Sep
Untreated Check		0.0 a	12.3 a	12.3 a
Imidacloprid 0.2GR-A	0.25	0.1 a	0.0 d	0.1 d
Imidacloprid 0.2GR-B	0.25	0.0 a	0.2 d	0.2 d
Imidacloprid 0.2GR-C	0.25	0.0 a	0.1 d	0.1 d
Imidacloprid 0.2GR-B	0.196	0.0 a	0.2 d	0.2 d
GrubEx	1.5	0.2 a	0.0 d	0.2 d
Spectracide Bug Stop	0.272	0.7 a	7.7 b	8.3 b
Insect Control Granules				
(0.25% permethrin)				
Spectracide Triazicide Soil	0.0523	0.3 a	6.0 b	6.3 bc
And Turf Insect Killer Granules				
(0.04% lambda-cyhalothrin)				
Dylox 6.2G	8.1	0.3 a	2.9 c	3.2 c
Garden Tech Sevin	7.84	1.1 a	6.7 b	7.8 b
Lawn Insect Granules (2% carbaryl)				
Cyfluthrin 0.1GR	0.131	1.0 a	9.0 ab	10.0 ab

Means followed by the same letter are not significantly different (P = 0.05; WD).
[a] Data transformed to an arcsine square root percent prior to ANOVA/WD. Untransformed means are presented in the table.
[b] Combination of JB and NMC white grubs.

TIMING STUDY SUPPRESSION OF WHITE GRUBS WITH APPLICATIONS OF MACH 2 AND MERIT, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This experiment was conducted on a golf course rough located in Beaver Falls which was infested with a natural population of white grubs to determine the effectiveness of conventional formulations. The turfgrass area consisted primarily of perennial ryegrass (50%) and annual bluegrass (50%). Treatment plots were 8 x 6 ft, arranged in a RCB block design and replicated three times. Liquid formulations were applied by using a CO_2 sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom, operating at 28 psi, and applied in 726 ml of water/48 ft^2 or delivering 4.0 gal/1000 ft^2. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time one (6 May) the following soil and environmental conditions existed: air temp, 62° F; soil temp at l inch depth, 58° F; soil temp at 2 inch, 59° F; RH, 68%; amt of thatch, 0.125 inch; percent water content (percent by wt), 26.2; soil textural class, silt loam; soil particle size analysis: 14.9% sand, 72.4% silt, 12.7% clay; organic matter, 3.9%; CEC, 11.5; and soil pH,4.8; soil moist; thatch moist; water pH, 7.0; application time, mid-morning; and cloudy skies. Immediately after application treatments were hand irrigated in with 0.18 inch of water. At treatment time two (4 Jun) the following soil and environmental conditions existed: air temp, 70° F; soil temp at l inch depth, 68° F; soil temp at 2 inch, 66° F; RH, 85%; amt of thatch, 0.125 inch; percent water content (percent by wt), 27.7; soil textural class, silt loam; soil particle size analysis: 31.2% sand, 64.6% silt, 4.2% clay; organic matter, 4.6%; CEC, 9.6; and soil pH, 5.0; soil moist; thatch moist; water pH, 7.0; application time, mid-morning; and sunny skies. Immediately after application treatments were hand irrigated in with 0.14 inch of water. At treatment time three (10 Jul) the following soil and environmental conditions existed: air temp, 73° F; soil temp at l inch depth, 70° F; soil temp at 2 inch, 69° F; RH, 90%; amt of thatch, 0.125 inch; percent water content (percent by wt), 14.4; soil textural class, silt loam; soil particle size analysis: 13.5% sand, 74.2% silt, 12.3% clay; organic matter, 5.3%; CEC, 13.8; and soil pH, 4.9; soil dry; thatch dry; water pH, 7.0; application time, early-morning; NMC eggs were present in soil samples; and cloudy skies. Immediately after application the experimental area was irrigated in with 0.5 inch of water. At treatment time four (1 Aug) the following soil and environmental conditions existed: air temp, 69° F; soil temp at l inch depth, 68° F; soil temp at 2 inch, 70° F; RH, 85%; amt of thatch, 0.125 inch; percent water content (percent by wt), 10.0; soil textural class, silt loam; soil particle size analysis: 18.9% sand, 69.6% silt, 11.5% clay; organic matter, 5.2%; CEC, 14.6; and soil pH, 4.8; soil dry; thatch dry; water pH, 7.0; application time, early-morning; NMC eggs and first instar larvae were present in soil samples; and partly cloudy skies. Immediately after application the experimental area was irrigated in with 0.6 inch of water. The experimental area was irrigated on a regular basis throughout the summer months twice a week with ca. 0.5 inch total irrigation applied on a weekly basis. The area was under a water restriction emergency because of severe drought conditions. Climatology data for Beaver Falls (*i.e.,* via Pittsburgh) was recorded as follows: 6 May – 31 May, 4.39 inches; 1 Jun – 30 Jun, 2.63 inches; 1 Jul – 31 Jul, 1.66 inches; 1 Aug – 31 Aug, 2.90 inches; 1 Sep – 30 Sep, 3.24 inches; and 1 Oct – 3 Oct, 0.11 inch. Post-treatment counts were made on 3 Oct. Three ft^2 sod samples were randomly taken from each replicate, and the total no. of scarab white grubs/ft^2 was recorded according to species. Data was analyzed using WD.

The experimental area was previously infested in the spring of 2002 with populations of NMC and a few JB grubs. Pre-treatment counts recorded on 6 May averaged 20.1 third instar NMC grubs per ft^2. White grub populations were negatively impacted by the extreme drought and emergency water restrictions placed on township residents. Post-treatment grub counts were lower than expected because of extreme drought conditions. Seven treatments provided significant control of JB grubs but populations were minimal. The predominant white grub species present was NMC and six treatments provided significant reduction of NMC grubs. Eight treatments provided significant control of all white grubs present. No phytotoxicity was noted.

		Avg no. white grubs/ft^2		
		JB Grubs	NMC Grubs	Tt[a]
Treatment/ formulation	Rate lb (AI)/acre	03 Oct	03 Oct	03 Oct
Mach 2 Liquid[b]	2.0	0.0 b	0.1 b	0.1 b
Mach 2 Liquid[c]	2.0	0.0 b	0.4 b	0.4 b
Mach 2 Liquid[d]	2.0	0.0 b	0.0 b	0.0 b
Mach 2 Liquid[e]	2.0	0.1 ab	0.0 b	0.1 b
Mach 2 1.5G[b]	2.0	0.0 b	0.2 b	0.2 b
Mach 2 1.5G[c]	2.0	0.0 b	0.2 b	0.2 b
Mach 2 1.5G[d]	2.0	0.4 ab	1.9 ab	2.3 ab
Mach 2 1.5G[e]	2.0	0.0 b	1.1 ab	1.1 b
Merit 75WP[c]	0.3	0.0 b	1.3 ab	1.3 b
Untreated Check		1.1 a	7.4 a	8.6 a

Means followed by the same letter are not significantly different (P = 0.05; WD). Data transformed to an arcsine square root percent prior to ANOVA/WD. Untransformed means are presented in the table.

[a] Total number of JB and NMC white grubs.
[b] Treatments applied on 6 May.
[c] Treatments applied on 4 Jun.
[d] Treatments applied on 10 Jul.
[e] Treatments applied on 1 Aug.

APPLICATION OF MACH 2 AND MERIT FORMULATIONS TO PREVENTIVELY SUPPRESS SCARAB GRUBS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This study was undertaken to determine product effectiveness to control a mixed white grub population on a turfgrass area maintained at Penn State's Valentine Turfgrass Research Center at University Park. The turfgrass area consisted of Kentucky bluegrass (100%). Treatment plots were 6 x 9 ft, arranged in a RCB design and replicated three times. Liquid formulations were applied by using a CO_2 sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom, operating at 28 psi, and applied in 817 ml of water/54 ft^2 or delivering 4.0 gal/1000 ft^2. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time (1 Jul) the following soil and environmental conditions existed: air temp, 70° F; soil temp at l inch depth, 70° F; soil temp at 2 inch, 70° F; RH, 88%; amt of thatch, 0.0625 inch; water pH, 7.0; application time, early morning; soil and thatch moist; and clear skies. Immediately after application the experimental area was irrigated in with 0.3 inch of water. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 15.7%; silt, 68.6%; clay, 15.7%; soil percent water content (percent by wt), 22.7; organic matter, 4.1%; CEC, 10.0; and soil pH, 6.3. Treatments were irrigated in with 0.3 inch of water immediately after application. Throughout the summer the experimental area was irrigated on a regular basis because of severe drought conditions. Three sq ft soil samples were randomly removed from each replicate on 24 Sep and the total no. of NMC grubs was recorded. Data was analyzed using WD.

The area selected for the experiment had been infested with a natural population of NMC during the spring of 2002. A few JB grubs were present but NMC was the predominant white grub species present throughout the research area. Pre-treatment counts recorded on 30 May averaged 14.8 NMC third instar grubs/ft^2. Adult NMC's were monitored with a black light trap maintained at the Valentine Turfgrass Research Center. The first adult NMC was collected on 24 Jun 2002. Peak NMC adult flight was recorded from ca. June 24 through 15 Jul. The last NMC adult was collected on 31 Jul. All treatments provided significant suppression of NMC and JB grubs. No phytotoxicity was noted.

Treatment/ formulation	Rate lb (AI)/acre	Avg no. grubs/ft^2 24 Sep JB	NMC [a]	BOTH[a b]
Mach 2 Liquid	2.0	0.2 b	0.3 b	0.6 b
Mach 2 1.5G	2.0	0.1 b	0.1 b	0.2 b
Mach 2 1.33 G	2.0	0.2 b	1.0 b	1.2 b
Merit 75WP	0.3	0.0 b	0.0 b	0.0 b
Untreated Check		1.0 a	24.6 a	25.6 a

Means followed by the same letter are not significantly different (P = 0.05; WD).
[a] Data transformed to an arcsine square root percent prior to ANOVA/WD.
Untransformed means are presented in the table.
[b] Combination of NMC and JB scarab grubs.

APPLICATION OF INSECTICIDE FORMULATIONS TO PREVENTIVELY SUPPRESS WHITE GRUBS WITH VARYING IRRIGATION STRATEGIES, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This study was undertaken to determine product effectiveness to control a NMC white grub population on a turfgrass area maintained at Penn State's Valentine Turfgrass Research Center at University Park. The turfgrass area consisted of perennial ryegrass (100%). Treatment plots were 6 x 9 ft, arranged in a RCB design and replicated three times. Liquid formulations were applied by using a CO_2 sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom, operating at 28 psi, and applied in 817 ml of water/54 ft^2 or delivering 4.0 gal/1000 ft^2. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time (1 Jul) the following soil and environmental conditions existed: air temp, 67° F; soil temp at l inch depth, 68° F; soil temp at 2 inch, 68° F; RH, 85%; amt of thatch, 0.0625-0.125 inch; water pH, 7.0; application time, early morning; soil and thatch moist; and clear skies. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 17.7%; silt, 63.7%; clay, 18.6%; soil percent water content (percent by wt), 22.0; organic matter, 4.1%; CEC, 9.6; and soil pH, 6.1. Treatments were irrigated in according to Table Two's pre (30 Jun) and post-irrigation (1 Jul) schedules. No other irrigation occurred until 05 Jul when the entire experimental area received 1.0 inch of water at 11 AM. Fungicide treatments were applied on 02 Jul (red thread and pythium) and 03 Jul (dollar spot) at 2.0 gal per 1,000 sq ft. The latter treatments were applied because severe drought conditions favored disease development. Throughout the summer the experimental area was irrigated on a regular basis because of severe drought conditions. However, the latter practice did not start until the original irrigation protocol had been completed on 05 Jul. Three sq ft soil samples were randomly removed from each replicate on 17 Sep and the total no. of NMC grubs was recorded. Data was analyzed using WD.

The area selected for the experiment had been infested with a natural population of NMC during the spring of 2002. NMC was the predominant white grub species present throughout the research area. Pre-treatment counts recorded on 25 Apr averaged 13.8 NMC third instar grubs/ft^2. Adult NMC's were monitored with a black light trap maintained at the Valentine Turfgrass Research Center. The first adult NMC was collected on 24 Jun 2002. Peak NMC adult flight was recorded from ca. June 24 through 15 Jul. The last NMC adult was collected on 31 Jul. All treatments provided significant suppression of NMC grubs. No phytotoxicity was noted.

Table 1. Application results with Mach 2 and Merit via pre-irrigation and post-irrigation schedules to suppress NMC grubs.

		Avg no. grubs/ft^2
		17 Sep
Treatment/ formulation	Rate lb (AI)/acre	NMC
Mach 2 Liquid[a]	2.0	0.0 f
Mach 2 Liquid[b]	2.0	0.4 cde
Mach 2 Liquid [c]	2.0	0.0 f
Mach 2 Liquid [d]	2.0	0.7 cde
Mach 2 1.5 Granule[a]	2.0	0.1 ef
Mach 2 1.5% Granule[b]	2.0	0.3 def
Mach 2 1.5 Granule [c]	2.0	0.0 f
Mach 2 1.5 Granule [d]	2.0	0.6 cd
Merit 75WP[a]	0.3	1.0 bc
Merit 75WP [c]	0.3	1.6 b
Untreated Check [c]		10.0 a

Means followed by the same letter are not significantly different (P = 0.05; WD). Data transformed to an arcsine square root percent prior to ANOVA/WD. Untransformed means are presented in the table.

[a] Treatments received **no** pre-irrigation or post-irrigation.
[b] Treatments received pre-irrigation but **no** post-irrigation.
[c] Treatments received **no** pre-irrigation but did receive post-irrigation.
[d] Treatments received **both** pre-irrigation and post-irrigation.

Table 2. Pre-irrigation and post-irrigation records.

Date	Amount Irrigation	Time of Day
30 June 2002	0.5 inch - Pre	7:00 AM – 7:30 AM (hand-watered with hose)
01 July 2002	0.5 inch - Post	12:05 PM – 12:30 PM (hand-watered with hose)
05 July 2002 (Entire area irrigated after four days had elapsed from 01 July.)	1.0 inch – four day interval	11 AM (automatic)

LATE SUMMER EVALUATION OF REGISTERED FORMULATIONS TO SUPPRESS WHITE GRUBS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This study was undertaken to determine product effectiveness to control a mixed white grub population on a turfgrass area maintained at University Park. The turfgrass area consisted of Kentucky bluegrass (100%). Treatment plots were 6 x 9 ft, arranged in a RCB design and replicated three times. Liquid formulations were applied by using a CO_2 sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom, operating at 28 psi, and applied in 817 ml of water/54 ft^2 or delivering 4.0 gal/1000 ft^2. Granular formulations were applied with a hand-held shaker and mixed with fine top dressing sand to facilitate product distribution. At treatment time (28 Aug) the following soil and environmental conditions existed: air temp, 62° F; soil temp at l inch depth, 62° F; soil temp at 2 inch, 64° F; RH, 80%; amt of thatch, 0.125 – 0.375 inch; water pH, 7.0; application time, early morning; soil moist; thatch moist; and cloudy skies. Immediately after application the experimental area was irrigated in with 0.3 inch of water. The experimental area was irrigated on a regular basis until data was recorded. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 16.3%; silt, 71.5%; clay, 12.2%; soil percent water content (percent by wt), 25.1; organic matter, 4.3%; CEC, 12.3; and soil pH, 5.9. Three sq ft soil samples were randomly removed from each replicate on 8 Oct and the total no. of Japanese beetle (JB) and Northern masked chafer (NMC) grubs was recorded. Data was analyzed using WD.

Prior to treatment the area was infested with 28.7 second instar NMC scarab grubs per ft^2. The first adult NMC was collected on 24 Jun 2002. Peak NMC adult flight was recorded from ca. June 24 through 15 Jul. The last NMC adult was collected on 31 Jul. All treatments provided significant reduction of NMC grubs and two treatments provided significant reduction of JB. Very few JB grubs were present. All treatments provided significant reduction when both grub species were combined. No phytotoxicity was noted.

		Avg no. grubs/ft^2		
			8 Oct	
Treatment/ formulation	Rate lb (AI)/acre	JB	NMC	BOTH[a]
Untreated check		1.7 a	31.4 a	33.1 a
Sevin SL	4.0	1.3 ab	11.7 b	13.0 b
Sevin SL	8.1	0.6 b	3.9 c	4.4 c
Dylox 6.2G	8.1	0.4 b	4.1 c	4.6 c

Means followed by the same letter are not significantly different (P = 0.05; WD).
[a] Combination of JB and NMC grubs. Data transformed using arcsine square root percent before ANOVA/WD. Means in the table are untransformed.

BLACK CUTWORM LARVAL SUPPRESSION WITH CONVENTIONAL FORMULATIONS ON CREEPING BENTGRASS, 2002

By Paul R. Heller and Robert Walker, Department of Entomology, Penn State

This experiment was completed on a bentgrass green maintained at the Penn State Valentine Turfgrass Research Center at University Park to determine the effectiveness of treatments against second and early third instar BCW larvae. Treatment plots were 6 x 9 ft, arranged in a RCB design and replicated three times. A one foot barrier was established between each replicate and block. Liquid formulations were applied by using a CO_2 sprayer with four 8002VS TeeJet nozzles mounted on a 6 ft boom operating at 28 psi, and applied in 408 ml water/54 ft^2 or delivering 2.0 gal/1000 ft^2. At treatment time (22 Jul), the following soil and environmental conditions existed: air temp, 70° F; soil temp at l inch depth, 68° F; soil temp at 2 inch depth, 68° F; RH, 90%; amt of thatch, 0.5 inch; soil textural class, loam; soil particle size analysis: 45.0% sand, 42.2% silt, 12.8% clay; percent water content (percent by wt), 17.8; organic matter, 2.9%; water pH, 7.0; soil pH, 6.4; CEC, 11.2; time of application, early morning; thatch and soil, moist; and clear skies. The entire experimental area received 1.61 inches of irrigation from 22 Jul through 26 Jul; 3.99 inches of irrigation from 27 Jul through 12 Aug; and 4.3 inches of irrigation from 12 Aug through 26 Aug. Drought conditions required extensive irrigation to maintain the bentgrass. Eight inch diam by six inch long white PVC cylinders were placed in each replicate and secured in place. Each cylinder was covered with white meshed shade cloth. One cylinder was placed in each replicate and ten late second to early third instar black cutworm larvae were added to each cylinder on three introduction dates, respectively 23 Jul, 6 Aug, and 20 Aug. Efficacy data was recorded on 26 Jul, 12 Aug, and 26 Aug by counting the no. of BCW larvae flushed to the surface within one eight inch PVC cylinder per replicate by using a soap irritant drench. Data was analyzed by using WD and an Abbott's transformation.

All treatments provided significant reduction of BCW on 26 Jul. One treatment provided significant reduction on 12 Aug. No significant differences were recorded on 26 Aug. Irrigation may have affected the residual activity of respective products. No phytoxicity was noted.

Treatment/ formulation[a]	Rate lb (AI)/acre	Mean No. of Fresh BCW Larvae Flushed To Surface/8 inch Cylinder		
		26 Jul[b]	12 Aug[b]	26 Aug[b]
Untreated Check		6.7 a (0.0)	8.7 a (0.0)	9.0 a (0.0)
DeltaGard GC 5SC Insecticide	0.03	0.0 d (100.0)	7.3 ab (15.7)	6.3 a (28.6)
DeltaGard GC 5SC Insecticide	0.06	0.0 d (100.0)	5.3 b (38.4)	5.3 a (41.1)
Talstar L & T F	0.05	0.0 d (100.0)	7.0 ab (19.4)	5.3 a (40.2)
Dursban Pro	1.0	0.7 cd (91.7)	6.3 ab (25.9)	7.7 a (13.9)
Conserve SC	0.406	3.3 b (47.2)	8.3 ab (3.2)	6.7 a (28.3)

Means followed by the same letter are not significantly different (P = 0.05; WD).
[a] Select formulations may not be labeled for use on golf course turfgrass.
[b] ( ) Represents an Abbotts transformation.

Effects of Fungicides for Control of Anthracnose on a Putting Green, 2002

W. Uddin, M. D. Soika, E. L. Soika, J. Shelton, and B. Turosky
Department of Plant Pathology

Introduction

Anthracnose *(Colletotrichum graminicola)* can cause serious injury on putting greens; particularly those comprised of high populations of annual bluegrass *(Poa annua)*. The use of fungicides is a significant part of a turf manager's strategy in the management of Anthracnose. This study assessed the effects of various products, rates, and application timings for controlling Anthracnose infection on *Poa annua*.

Materials and Methods

The experiment was carried out on a mixed-stand of annual bluegrass and creeping bentgrass maintained under golf course greens-management conditions, mowed at 0.125-inch cutting height six times per week. The soil was a modified sandy clay loam with a soil pH of 7.0. On 18 Apr, the site was aerified (0.5 in. hollow tines) and topdressed. The test area was fertilized on 12 Apr with 1.0 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft, and on 8 May with 0.5 lb nitrogen (Contec 31-3-10) per 1000 sq ft. On 22 May Trimec Bentgrass Formula 1.33EC (1.0 fl oz per 1000 sq ft) was applied for control of broadleaf weeds. Treatment plots, 3 ft x 6 ft, were arranged in a randomized complete block design with three replications. Treatments were applied with a CO_2-powered boom sprayer, equipped with TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were made on 8 and 22 May, 5 and 20 Jun, and 4, 17 and 31 Jul, unless otherwise noted in the table. Disease severity was evaluated on 6 and 20 Jun, 5 Jul, and 1 Aug. Data were subjected to analysis of variance, and the mean values were separated using the Waller-Duncan k-ratio test (P=0.05).

Results and Discussion

Disease severity was variable in this study. Depending upon the rating date, 17-35 of the 39 treatments did not separate statistically from the untreated check. In the last three disease ratings, one or more treatments were more severely injured from Anthracnose basal rot than was the untreated check. By 1 Aug, only the two Triton + Signature mixtures, Signature alone, the Spectro + Alliance combination, and the Lynx + Compass tank mix were providing disease control that was greater than 90%. The Triton + Signature (14-day interval) mixture provided the most consistent disease inhibition throughout the study.

Table. Effects of fungicides for control of Anthracnose on a putting green, 2002.

Treatment, formulation, and rate per 1000 sq ft	Disease Severity[z] 6 Jun	20 Jun	5 Jul	1 Aug
Banner MAXX 1.3MEC 1.0 fl oz	6.7 abc[y]	4.3 b-e[y]	6.0 ab[y]	8.0 a[y]
Bayleton 50WP 0.5 oz	6.3 a-d	5.3 a-d	6.0 ab	7.3 ab
Eagle 40WP 0.6 oz	5.3 b-f	6.0 ab	6.7 a	6.3 abc
Macro-Sorb Foliar L 2.0 fl oz +Quelant-Ca L 2.0 fl oz +Heritage 50WG 0.2 oz	5.3 b-f	3.3 d-g	4.7 a-e	5.7 a-d
Heritage 50WG 0.2 oz	7.0 ab	5.7 abc	5.3 abc	5.3 a-e
Heritage 50WG 0.4 oz	6.7 abc	5.3 a-d	4.3 b-f	5.3 a-e
Macro-Sorb Foliar L 2.0 fl oz	3.7 d-j	4.0 b-f	4.0 b-g	5.3 a-e
Macro-Sorb Foliar L 2.0 fl oz + Heritage 50WG 0.2 oz	5.3 b-f	3.3 d-g	4.0 b-g	5.3 a-e
Banner MAXX 1.3MEC 2.0 fl oz	3.0 e-k	4.3 b-e	3.0 d-i	5.0 a-f
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz	5.7 a-e	3.0 efg	5.0 a-d	4.7 b-g
Heritage 50WG 0.3 oz[x]	6.3 a-d	3.3 d-g	4.3 b-f	4.3 b-h
Insignia 20WG 0.5 oz	4.0 c-i	2.3 e-i	3.7 c-h	4.3 b-h
Insignia 20WG 0.5 oz ROTATE Concorde 82.5DF 3.2 oz[w]	2.3 g-k	2.0 f-i	2.3 f-j	4.3 b-h
Macro-Sorb Foliar L 2.0 fl oz + 3336 50WP 4.0 oz	3.7 d-j	2.7 e-h	4.3 b-f	4.3 b-h
Macro-Sorb Foliar L 2.0 fl oz +Quelant-Ca L 2.0 fl oz +3336 50WP 4.0 oz	3.3 e-j	2.3 e-i	3.7 c-h	4.3 b-h
Compass 50WG 0.15 oz	8.3 a	6.7 a	5.0 a-d	4.0 c-h
Compass 50WG 0.25 oz	3.7 d-j	2.3 e-i	3.7 c-h	4.0 c-h
3336 50WP 4.0 oz	4.0 c-i	3.3 d-g	2.3 f-j	4.0 c-h
Untreated Check	6.7 abc	3.3 d-g	4.0 b-g	4.0 c-h
Syngenta solution (14-day interval) 1. Heritage 50WG 0.4 oz + Banner MAXX 1.3MEC 1.0 fl oz 2. Banner MAXX 1.3MEC 1.0 fl oz+Daconil Ultrex 82.5WG 1.8 oz 3. 3336 50WP 4.0 oz + Daconil Ultrex 82.5WG 1.8 oz 4. 3336 50WP 4.0 oz + Daconil Ultrex 82.5WG 1.8 oz 5. Daconil Ultrex 82.5WG 1.8 oz 6. Heritage 50WG 0.4 oz + Daconil Ultrex 82.5WG 3.2 oz 7. Subdue MAXX 2MEC 1.0 fl oz+Daconil Ultrex 82.5WG 1.8 oz	3.3 e-j	2.7 e-h	3.7 c-h	3.7 c-i
TopPro Iprodione Pro 2SC 4.0 fl oz	5.0 b-g	3.3 d-g	4.7 a-e	3.7 c-i
3336 50WP 6.0 oz + Alliance L 3.0 fl oz[v]	2.7 f-k	2.0 f-i	2.3 f-j	3.3 c-j
Endorse 2.5WP 4.0 oz	4.3 b-h	3.3 d-g	4.0 b-g	3.3 c-j
Insignia 20WG 0.9 oz[u]	3.3 e-j	2.0 f-i	4.0 b-g	3.0 d-j
Lynx 45WP 0.556 oz	3.0 e-k	3.0 efg	4.7 a-e	3.0 d-j
Macro-Sorb Foliar L 2.0 fl oz + Quelant Minors L 2.0 fl oz	4.0 c-i	2.7 e-h	3.3 c-h	2.9 d-j

Treatment, formulation, and rate per 1000 sq ft	Disease Severity[z] 6 Jun	20 Jun	5 Jul	1 Aug
CPR (4-0-1) L 6.0 fl oz +Nutri-Rational N (19-1-6) L 3.0 fl oz +Nutri-Rational P (6-12-6) L 3.0 fl oz +Nutri-Rational K (2-0-16) L 3.0 fl oz +Nutri-Rational Si(3-0-10) L 3.0 fl oz	1.0 jk	4.0 b-f	1.0 ij	2.7 d-j
Endorse 2.5WP 6.0 oz	2.7 f-k	3.3 d-g	2.7 e-i	2.7 d-j
3336 50WP 6.0 oz[v]	5.0 b-g	2.0 f-i	4.0 b-g	2.4 e-j
CPR (4-0-1) L 6.0 fl oz	2.0 h-k	2.3 e-i	4.0 b-g	2.3 e-j
Triton 1.67SC 1.0 fl oz	6.3 a-d	5.3 a-d	3.3 c-h	2.0 f-j
Daconil Ultrex 82.5WG 3.2 oz +Banner MAXX 1.3MEC 1.0 fl oz	1.3 ijk	2.3 e-i	2.3 f-j	2.0 f-j
Spectro 90WG 4.0 oz	0.3 k	1.7 ghi	2.3 f-j	1.7 g-j
TADS 12529 70WG 0.3 oz + Signature 80WG 4.0 oz[x]	3.0 e-k	0.7 hi	4.0 b-g	1.3 hij
Daconil Ultrex 82.5 WG 3.2 oz	3.0 e-k	3.7 c-g	3.3 c-h	1.3 hij
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz	2.7 f-k	4.0 b-f	2.3 f-j	0.7 ij
Spectro 90WG 4.0 oz + Alliance L 3.0 fl oz	2.0 h-k	2.0 f-i	1.7 hij	0.7 ij
Signature 80WG 4.0 oz[x]	3.3 e-j	0.3 i	3.3 c-h	0.3 j
Triton 1.67SC 1.0 fl oz + Signature 80WG 4.0 oz[x]	3.7 d-j	0.3 i	2.0 g-j	0.3 j
Triton 1.67SC 1.0 fl oz + Signature 80WG 4.0 oz	0.3 k	0.7 hi	0.3 j	0.3 j

[z]Disease severity index 0-10; 0=asymptomatic, and 10=>90% annual bluegrass symptomatic, mean of three replications.

[y]Means within each column followed by different letters are significantly different (P=0.05) according to the Waller-Duncan k-ratio test.

[x]Treatment applied on a 21-day interval (8 and 30 May, 20 Jun, 11 and 31 Jul).

[w]Treatment applications rotated on a 14-day interval; Insignia applied 8 May, 5 Jun, 4 and 31 Jul; and Concorde applied 22 May, 20 Jun, and 17 Jul.

[v]Treatment applied curatively (after symptom development) twice on a 21-day interval (22 May and 13 Jun).

[u]Treatment applied on a 28-day interval (8 May, 5 Jun, 4 and 31 Jul).

Evaluation of Fungicides for Control of Dollar Spot on a Putting Green, 2002

W. Uddin, M. D. Soika, E. L. Soika, J. Shelton, and B. Turosky
Department of Plant Pathology

Introduction

The use of fungicides for managing dollar spot (*Sclerotinia homoeocarpa*) on golf courses is a commonly used practice to maintain high quality playing surfaces. This study was conducted at the Joseph Valentine Turfgrass Research Center, University Park, PA, on a mixed stand of creeping bentgrass (*Agrostis Palustris*, 'Penncross') and annual bluegrass (*Poa annua*). The study included various fungicides, rates, and/or application intervals to investigate control strategies and fungicide efficacy.

Materials and Methods

The experiment was carried out on a mixed-stand of creeping bentgrass and annual bluegrass maintained under golf course greens-management conditions, mowed at 0.125-inch cutting height. The soil was a modified sandy clay loam with a soil pH of 7.0. On 18 Apr, the site was aerified (0.5 in. hollow tines) and topdressed. The test site was fertilized on 12 Apr with 1.0 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft, and 8 and 23 May with 1.0 lb nitrogen (Contec 31-3-10) and 0.5 lb nitrogen (Lebanon 28-7-14) per 1000 sq ft. On 22 May Trimec Bentgrass Formula 1.33EC (1.0 fl oz per 1000 sq ft) was applied for control of broadleaf weeds. Treatment plots, 3 ft x 6 ft, were arranged in a randomized complete block design with three replications. Treatments were applied with a CO_2-powered boom sprayer, equipped with TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were made on 4 and 18 Jun, and 2 and 16, and 30 Jul, except as noted in the table. The experimental turf area was inoculated on 12 Jun by hand-broadcasting *S. homoeocarpa*-infested ryegrains, at a density of 20-30 grains per sq ft. A pool of five isolates of *S. homoeocarpa* was used in the inoculation. Disease incidence was evaluated once per week throughout the study. Data were subjected to analysis of variance, and the mean values were separated by the Waller-Duncan k-ratio test ($P \leq 0.05$). Data from 11 and 22 Jul, and 6 Aug are presented.

Results and Discussion

Dollar spot severity was high during the study period. All treatments provided control that was significantly different from the untreated check throughout the season. By the 6 Aug rating, 10 treatments were completely clean of dollar spot symptoms. The 2.0 fl oz rates of Banner MAXX and Chipco Triton, each applied on a 14-day interval, provided complete control of dollar spot throughout the experiment. Phytotoxicity was observed from both combination treatments of Banner MAXX + Heritage + Primo MAXX, the effects of which were gone within two weeks after application.

Table. Evaluation of fungicides for control of dollar spot on a putting green, 2002.

Treatment, formulation, and rate per 1000 sq ft	Infection centers per sq ft[z] 11 Jul	22 Jul	6 Aug
Untreated Check	23.2 a[y]	20.7 a[y]	28.6 a[y]
3336 50WP 4.0 oz	11.8 bc	15.3 b	23.3 b
Heritage 50WG 0.4 oz	15.8 b	16.7 b	22.9 b
Curalan 50WG 1.0 oz[x]	9.4 cde	8.3 de	17.6 c
Compass 50WG 0.15 oz	11.8 bc	11.7 c	16.8 c
Compass 50WG 0.25 oz	9.9 cd	9.6 cd	15.0 cd
Daconil Ultrex 82.5WG 1.82 oz	6.2 d-g	1.6 g	14.8 cd
Curalan 50WG 1.0 oz + Liberate L 0.5% v/v[x]	4.9 f-k	5.8 ef	14.3 cde
Chipco 26GT 2SC 3.0 fl oz[w]	6.4 d-g	0.2 g	12.7 def
Daconil Ultrex 82.5WG 1.82 oz + Liberate L 0.5% v/v	2.7 g-n	0.9 g	12.7 def
TopPro TMI Combo 4SC 4.2 fl oz[w]	5.0 f-j	1.8 g	12.6 def
Bayleton 50WP 0.5 oz[x]	5.2 e-h	6.8 de	12.1 d-g
TopPro TMI Combo 4SC 2.1 fl oz	5.8 d-g	3.0 fg	11.4 d-h
Chipco 26GT 2SC 3.0 fl oz + Liberate L 0.5% v/v[w]	4.4 f-m	0.7 g	10.7 e-i
Fluid Fungicide 4SC 4.2 fl oz[w]	4.7 f-l	0.3 g	9.2 f-j
Honor 50WG 0.2 oz[x]	7.7 c-f	0.9 g	8.6 g-k
Banner MAXX 1.3MEC 1.0 fl oz[w]	1.0 h-n	2.0 g	8.1 h-k
+Heritage 50WG 0.2 oz			
+Primo MAXX 1MEC 0.25 fl oz			
Fluid Fungicide 4SC 2.1 fl oz	2.2 g-n	0.8 g	7.3 ijk
Insignia 20WG 0.9 oz	4.0 f-n	1.4 g	5.7 jkl
Dow Program (14-day interval)	5.1 f-i	0.6 g	5.0 klm
1. Eagle 40WP 0.6 oz + Fore 80WP 6.0 oz			
2. Fore 80WP 8.0 oz			
3. Eagle 40WP 0.6 oz + ProStar 70WP 1.5 oz			
4. Fore 80WP 6.0 oz + Chipco 26GT 2SC 3.0 fl oz			
5. Heritage 50WG 0.2 oz			
Spectro 90WG 4.0 oz	0.1 n	0.0 g	3.3 lmn
Chipco 26GT 2SC 4.0 fl oz	3.6 f-n	0.2 g	2.7 lmn
Eagle 40WP 1.2 oz[x]	3.0 g-n	1.1 g	2.6 lmn
Banner MAXX 1.3MEC 2.0 fl oz[x]	1.3 h-n	1.7 g	2.1 lmn
Emerald 70WG 0.13 oz ROTATE Insignia 20WG 0.9 oz[v]	0.8 j-n	0.1 g	1.6 mn
TopPro Iprodione Pro 2SC 4.0 fl oz	0.0 n	0.0 g	1.6 mn
Emerald 70WG 0.18 oz[x]	3.2 g-n	0.8 g	1.3 mn
Banner MAXX 1.3MEC 2.0 fl oz[x]	1.1 h-n	0.0 g	1.0 n
+Heritage 50WG 0.2 oz			
+Primo MAXX 1MEC 0.25 fl oz			

Treatment, formulation, and rate per 1000 sq ft	Infection centers per sq ft[z] 11 Jul	22 Jul	6 Aug
Chipco Triton 1.67SC 0.75 fl oz	0.7 k-n	0.1 g	0.8 n
TopPro Propiconazole 1.3MEC 2.0 fl oz[x]	1.0 h-n	0.4 g	0.6 n
TopPro Propiconazole 1.3MEC 1.0 fl oz	0.0 n	0.0 g	0.1 n
Emerald 70WG 0.18 oz[w]	0.9 i-n	0.0 g	0.0 n
Banner MAXX 1.3MEC 1.0 fl oz	0.0 n	0.9 g	0.0 n
Bayleton 50WP 0.5 oz	0.6 lmn	0.2 g	0.0 n
Emerald 70WG 0.13 oz	0.3 mn	0.4 g	0.0 n
Honor 50WG 0.2 oz	0.2 mn	0.1 g	0.0 n
Chipco Triton 1.67SC 1.0 fl oz	0.3 mn	0.0 g	0.0 n
Lynx 45WP 0.556 oz	0.1 n	0.0 g	0.0 n
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz	0.1 n	0.0 g	0.0 n
Chipco Triton 1.67SC 2.0 fl oz	0.0 n	0.0 g	0.0 n
Banner MAXX 1.3MEC 2.0 fl oz	0.0 n	0.0 g	0.0 n

[z]Number of infection centers per sq ft, three subsamples per plot, mean of three replications.
[y]Means within column followed by different letters are significantly different (P=0.05) according to the Waller-Duncan k-ratio test.
[x]Treatment applied on a 28-day interval (4 Jun, 2 and 30 Jul).
[w]Treatment applied on a 21-day interval (4 and 25 Jun, 16 Jul).
[v]Treatment applications rotated on a 14-day interval (Emerald applied 4 Jun, 2 and 30 Jul; Insignia applied 18 Jun and 16 Jul).

Evaluation of Fungicides for Control of Gray Leaf Spot on Perennial Ryegrass, 2002

W. Uddin, M. D. Soika, E. L. Soika, J. Shelton, and B. Turosky
Department of Plant Pathology

Introduction

Gray leaf spot (*Pyricularia grisea*) is an important disease on perennial ryegrass (*Lolium perenne*) golf course fairways in the Mid-Atlantic and the Mid-West regions of the United States. This study was located at the Pennsylvania State University on perennial ryegrass. The objective was to evaluate various fungicides, rates, application timings, and fungicide combinations for their effectiveness in suppressing gray leaf spot.

Materials and Methods

The study was conducted on 'Pennfine' perennial ryegrass at the Valentine Turfgrass Research Center. The site was maintained under golf course fairway management conditions; mowed three times per week at 0.75-inch cutting height. The soil was a Hagerstown silt loam with a pH of 6.8. The test site was fertilized with 1.0 lb nitrogen per 1000 sq ft on 25 Apr (Lebanon 11-3-22) and 20 May (IBDU 31-0-0), and 0.5 lb nitrogen (IBDU 31-0-0) per 1000 sq ft on 5 Jun. Confront 3SL and Weedone 3.7SL were applied 16 May at the rates of 0.75 and 0.5 fl oz respectively per 1000 sq ft for control of broadleaf weeds. Treatment plots, 3 ft x 6 ft, were arranged in a randomized complete block design with four replications. Treatments were applied with a CO_2-powered boom sprayer equipped with TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Treatments were applied on 31 Jul, unless otherwise specified in the table. The experiment was inoculated on 11 Aug by spraying a spore suspension of *P. grisea*. The experiment was lightly irrigated and covered (11-14 Aug) with a 6-mil polyethylene sheet to maintain leaf wetness and reduce radiational cooling during the night The cover was removed between 10:00 a.m. and 4:00 p.m. daily during this period. Test plots were not mowed after 9 Aug. Disease severity was evaluated on 16, 20, 26, and 30 Aug. Data were subjected to analysis of variance, and mean values were separated using the Waller-Duncan k-ratio test (P=0.05).

Results and Discussion

On 16 Aug (5 days after inoculation) 15 treatments were asymptomatic, and 10 treatments were =5% infected, while infection in the untreated check was 68%. By 20 Aug (9 days after inoculation) 14, 21, and 28-day treatments had been applied 20, 27, and 34 days (respectively) prior. 28 treatments were providing gray leaf spot control that was statistically equal to the best treatments in the study, 14 of which were only 3-5% infected. Spectro, the 0.2 oz (21-day) and 0.25 oz (21-day) rates of Compass, Insignia (0.5 oz) alone and in combination with Concorde, and three of the four BAS 516 treatments were showing complete suppression of Gray leaf spot. Although 17 treatments were significantly different from the untreated check on 26 Aug, no treatments were providing acceptable disease control. Phytotoxicity was observed on all plots treated with Cuprofix.

Table. Evaluation of fungicides for control of gray leaf spot on perennial ryegrass, 2002.

	Disease Severity[z]			
Treatment, formulation, and rate per 1000 sq ft	16 Aug	20 Aug	26 Aug	30 Aug
FNX-100 4.7 L 12.0 fl oz[y]	6.0 ab[x]	7.8 a[x]	8.5 a[x]	10.0 a[x]
Endorse 2.5WP 4.0 oz	6.0 ab	7.3 a	8.5 a	10.0 a
Banner MAXX 1.3 MEC 1.0 fl oz	5.3 bc	7.3 a	8.0 abc	10.0 a
Untreated Check	6.8 a	6.5 ab	8.0 abc	10.0 a
Macro-Sorb Foliar L 2.0 fl oz	6.3 ab	6.0 abc	8.3 ab	10.0 a
Cuprofix 30MZ 42WG 4.0 oz	5.3 bc	5.3 bcd	7.5 a-e	9.8 ab
Endorse 2.5WP 6.0 oz	5.0 bc	4.8 bcd	7.8 a-d	10.0 a
Lynx 45WP 0.556 oz[d]	4.3 cd	4.8 bcd	7.5 a-e	9.8 ab
Cuprofix 30MZ 42WG 8.0 oz	4.5 cd	4.5 cde	7.5 a-e	10.0 a
Bayleton 50WP 0.5 oz[w]	3.3 d	3.5 def	7.3 a-f	9.5 abc
Daconil Weatherstik 6F 2.125 fl oz	1.8 e	2.8 efg	6.0 f-i	9.8 ab
Magellan 4.32L 4.1 fl oz +Daconil Weatherstik 6F 2.125 fl oz	1.8 e	2.0 fgh	6.0 f-i	10.0 a
Compass 50WG 0.15 oz[w]	1.3 ef	1.8 f-i	7.0 b-g	9.8 ab
Daconil Ultrex 82.5WG 3.67 oz	0.5 ef	1.5 ghi	4.3 jkl	9.0 bcd
Fore 80WP 6.0 oz	1.3 ef	1.5 ghi	6.5 d-h	8.8 cde
3336 4F 4.0 fl oz[w]	0.5 ef	1.3 ghi	7.0 b-g	9.5 abc
Heritage 50WG 0.4 oz[v]	1.3 ef	1.3 ghi	7.3 a-f	9.3 a-d
Macro-Sorb Foliar L 2.0 fl oz + Compass 50WG 0.15 oz	0.0 f	1.0 ghi	5.8 ghi	9.5 abc
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz[w]	0.0 f	0.5 hi	7.5 a-e	10.0 a
3336 50WP 4.0 oz	0.3 f	0.5 hi	7.5 a-e	9.8 ab
Magellan 4.32 L 4.1 fl oz + 3336 4F 4.0 fl oz[w]	0.0 f	0.5 hi	7.8 a-d	9.8 ab
Macro-Sorb Foliar L 2.0 fl oz + Compass 50WG 0.15 oz[w]	0.3 f	0.5 hi	7.0 b-g	9.5 abc
Compass 50WG 0.15 oz	0.3 f	0.5 hi	6.8 c-g	9.5 abc
Compass 50WG 0.2 oz	0.3 f	0.5 hi	6.8 c-g	9.5 abc
Insignia 20WG 0.9 oz[v]	0.0 f	0.5 hi	6.3 e-h	9.3 a-d
Heritage 50WG 0.4 oz[w]	0.3 f	0.5 hi	6.0 f-i	9.3 a-d
Insignia 20WG 0.5 oz ROTATE TP T-Methyl 4.5L 3.5 fl oz[u]	0.0 f	0.5 hi	7.0 b-g	8.8 cde
BAS 516 28WP 1.093 oz[v]	0.3 f	0.3 hi	7.5 a-e	9.5 abc
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz[w]	0.0 f	0.3 hi	6.8 c-g	9.5 abc
Heritage 50WG 0.2 oz	0.5 ef	0.3 hi	7.5 a-e	9.3 a-d
Compass 50WG 0.25 oz	0.0 f	0.3 hi	4.8 ijk	8.8 cde
Insignia 20WG 0.5 oz + Pentathlon DF 75WG 8.0 oz	0.0 f	0.3 hi	2.8 m	8.0 ef

Treatment, formulation, and rate per 1000 sq ft	Disease Severity[a] 16 Aug	20 Aug	26 Aug	30 Aug
BAS 516 26.25WP 1.033 oz[y]	0.0 f	0.0 i	6.3 e-h	9.8 ab
Compass 50WG 0.25 oz[w]	0.0 f	0.0 i	6.0 f-i	9.8 ab
Spectro 90WG 5.0 oz	0.0 f	0.0 i	5.3 hij	9.5 abc
Compass 50WG 0.20 oz[w]	0.3 f	0.0 i	6.0 f-i	9.3 a-d
Insignia 20WG 0.5 oz	0.0 f	0.0 i	3.3 lm	8.8 cde
BAS 516 26.25WP 0.554 oz	0.0 f	0.0 i	4.8 ijk	8.8 cde
BAS 516 28WP 0.582 oz	0.0 f	0.0 i	3.3 lm	8.5 de
Insignia 20WG 0.5 oz + Concorde DF 82.5WG 3.2 oz	0.0 f	0.0 i	3.5 klm	7.5 f

[z]Disease severity index 0-10; 0=asymptomatic, and 10=>90% turf area symptomatic, mean of four replications.
[y]Treatment applied 25 and 31 Jul.
[x]Means within each column followed by different letters are significantly different (P=0.05) according to the Waller-Duncan k-ratio test.
[w]Treatment applied 24 Jul (18 days prior to inoculation).
[v]Treatment applied 17 Jul (25 days prior to inoculation).
[u]Insignia applied 17 Jul; TP T-Methyl applied 31 Jul.

Phytotoxicity Evaluation of Acclaim Extra on Fairway Height Creeping Bentgrass

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature stand of "Penneagle" creeping bentgrass (*Agrostis stolonifera*) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to asses the phytotoxic effect of multiple applications of Acclaim Extra on fairway height "Penneagle" creeping bentgrass.

Methods and Materials

This study was a randomized complete block design with three replications. All treatments were applied on June 4, June 19, July 1, July 16, and July 31, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained similar to that of a golf course fairway with respect to irrigation, fertilization and mowing. The test area was maintained at 0.5 inch using a reel mower that collected the clippings three times per week.

On May 14, 2002 0.5 lbs N/M was applied to the test site using a three foot drop spreader. The nitrogen source was Lebanon Country Club 13-25-12. A tank mix of Bravo Ultrex (2.6 oz/M), Chipco GT (2oz/M), and Bayleton 50 (0.11 oz/M) was applied to the test site on June 4, 2002 as dollar spot had been identified on the test site. On June 19, 2002 Cleary's 3336 (3 oz/M) and Fungo (2 oz/M) were tank mixed and applied to the test site to control dollar spot again. In order to control cutworms found in the test site Scimitar was applied on June 20, 2002 at a rate of 10 oz/A. Dollar spot was again identified and Banner Maxx (2 oz/M) was applied to the test site on July 2, 2002. Two preventive fungicide applications of a tank mix of Bravo Ultrex (2.6 oz/M), Chipco GT (2oz/M), and Bayleton 50 (0.11 oz/M) were applied to the test site on July 21 and Aug 6, 2002. On Aug 5, 2002 Scimitar (10 oz/A) was applied to control cutworms that had been identified on the test site. All applications were made with a Toro Multi Pro 5500 with 11, ¼ TT J10-VS flood jet nozzles spaced at 20 inches and calibrated to deliver two gpm.

Results and Discussion

Both rates (label and 2X) of Acclaim Extra caused unacceptable phytotoxicity on "Penneagle" creeping bentgrass on June 28, July 3, and July 26 (Table 1). Turf treated with the 2X rate was found to have unacceptable phytotoxicity ratings on all dates except July 18 (Table 1). It appears that caution should be exercised when making sequential applications of Acclaim Extra on "Penneagle" creeping bentgrass even when using the label rate.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Phytotoxicity ratings of fairway height "Penneagle" creeping bentgrass treated with Acclaim Extra on a scale of 0-10 where 0 = worst, 7= acceptable, and 10 = no phytotoxicity taken in 2002.

Treatment	Form	Rate Oz/M	6-14	6-21	6-28	7-3	7-12
ACCLAIM EXTRA	0.57EW	0.08	9.0	8.7	6.0	6.5	9.2
CHECK			10.0	9.7	9.7	10.0	10.0
ACCLAIM EXTRA	0.57EW	0.16	6.0	6.0	4.7	5.7	6.5

Table 1 (Continued). Phytotoxicity ratings of fairway height "Penneagle" creeping bentgrass treated with Acclaim Extra on a scale of 0-10 where 0 = worst, 7= acceptable, and 10 = no phytotoxicity taken in 2002.

Treatment	Form	Rate Oz/M	7-18	7-26	7-31	8-8	8-22
ACCLAIM EXTRA	0.57EW	0.08	9.0	6.0	7.0	9.5	9.0
CHECK			10.0	10.0	10.0	10.0	10.0
ACCLAIM EXTRA	0.57EW	0.16	7.0	4.0	5.7	5.8	6.0

Evaluations of Pitch Mark Recovery on a Putting Green

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature stand of creeping bentgrass and *Poa annua* turfgrass that simulated a putting green at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the rate of turfgrass recovery from simulated pitch marks on a putting green.

Methods and Materials

The study was a randomized complete block design with three replications. Treatments were applied five times (June 4, June 19, July 1, July 16, and July 31, 2002) using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi.

On July 18, 2002 pitch marks that simulated a golf ball hitting a putting green were made. A golf ball was cut in half and mounted on a wooden shaft. This half ball was then driven into the putting green until it was completely buried. The compacted turfgrass within the divot was removed leaving a hole approximately 40 millimeters in diameter. This hole was then filled with an 80/20 topdressing mixture to the surface. Each test plot had six pitch marks that were measured on July 18, 2002 and every day until the study concluded on Aug 16, 2002.

The test site was maintained at 0.125 inch with a reel mower with clippings removed. The test site was maintained to simulate a golf course putting.

Results and Discussion

The data for four of the six pitch marks for each plot were used for statistical analysis (the high and low values for each plot were not used due to variation resulting form disease and other factors). Statistical separation only occurred once throughout the duration of the study (August 16) (Table 1). Turf treated with Primo Maxx at 0.063 (half the label rate) plus MacroSorb Foliar at 2 oz/M had slightly less pitch mark closure than the other treatments on August 16. However, this treatment still had a pitch mark closure value of 93%. Therefore, no practical significance in this difference was considered. Of interest however, is that turf treated with Primo Maxx alone at the label rate reached the 100% pitch mark closure point sooner than any other turf in the study.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Percent reduction of pitch mark size in a creeping bentgrass/*Poa annua* putting green in 2002.

Treatment	Form	Rate (oz/M)	7-19	7-20	7-21	7-22	7-23	7-24	7-25	7-26	7-27
			(-------	-------	-------	% Reduction	-------	-------	-------	-------	-------)
PRIMO MAXX	1MEC	0.125	8.7a[1]	20.3a	23.8a	20.7a	29.7a	28.6a	31.2a	31.9a	32.0a
MACROSORB FOLIAR	L	2									
PRIMO MAXX	1MEC	0.125	4.9a	17.2a	19.1a	20.0a	25.9a	25.0a	31.3a	27.6a	28.3a
UREA	46G	0.15 LB A/A									
PRIMO MAXX	1MEC	0.125	4.7a	20.1a	22.2a	22.7a	29.4a	27.7a	34.5a	34.3a	33.6a
CHECK			7.3a	17.7a	21.1a	22.2a	27.4a	27.1a	30.8a	30.9a	32.5a
MACROSORB FOLIAR	L	2	5.5a	18.2a	18.0a	18.2a	23.6a	24.6a	29.3a	30.7a	29.8a
UREA	46G	0.15 LB A/A	6.3a	17.9a	22.1a	22.9a	27.1a	27.7a	30.1a	30.3a	29.9a
PRIMO MAXX	1MEC	0.063	4.0a	14.8a	17.3a	17.8a	23.0a	23.1a	29.1a	29.5a	27.3a
MACROSORB FOLIAR	L	2									

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT)

Table 1(Continued). Percent reduction of pitch mark size in a creeping bentgrass/*Poa annua* putting green in 2002.

Treatment	Form	Rate (oz/M)	7-28	7-29	7-30	7-31	8-01	8-02	8-03	8-04	8-05
			(-------	-------	-------	% Reduction	-------	-------	-------	-------	-------)
PRIMO MAXX	1MEC	0.125	33.4a[1]	32.5a	36.3a	45.2a	48.4a	49.1a	54.9a	54.6a	57.5a
MACROSORB FOLIAR	L	2									
PRIMO MAXX	1MEC	0.125	31.9a	30.3a	35.2a	49.4a	50.2a	52.8a	57.4a	57.6a	58.6a
UREA	46G	0.15 LB A/A									
PRIMO MAXX	1MEC	0.125	31.0a	33.8a	39.6a	53.8a	57.4a	56.8a	61.3a	60.1a	63.0a
CHECK			29.4a	31.5a	37.0a	43.3a	47.9a	49.6a	52.8a	53.2a	54.8a
MACROSORB FOLIAR	L	2	26.7a	29.4a	34.3a	41.3a	46.4a	48.3a	53.2a	51.8a	54.6a
UREA	46G	0.15 LB A/A	30.0a	31.0a	37.7a	46.1a	48.9a	49.2a	51.9a	53.7a	56.1a
PRIMO MAXX	1MEC	0.063	29.2a	29.9a	33.5a	41.7a	44.5a	46. 5a	51.0a	50.3a	54.4a
MACROSORB FOLIAR	L	2									

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT)

Table 1(Continued). Percent reduction of pitch mark size in a creeping bentgrass/*Poa annua* putting green in 2002.

Treatment	Form	Rate (oz/M)	8-06	8-07	8-08	8-09	8-10	8-11	8-12	8-13	8-14
			(---% Reduction								---)
PRIMO MAXX	1MEC	0.125	62.1a[1]	63.5a	70.0a	70.4a	78.9a	78.3a	85.0a	84.8a	88.3a
MACROSORB FOLIAR	L	2									
PRIMO MAXX	1MEC	0.125	66.2a	67.4a	72.0a	71.4a	81.6a	79.7a	88.8a	90.6a	92.5a
UREA	46G	0.15 LB A/A									
PRIMO MAXX	1MEC	0.125	74.6a	79.4a	83.3a	88.4a	94.7a	92.8a	97.8a	98.8a	99.2a
CHECK			60.2a	65.3a	68.0a	69.1a	79.0a	80.8a	87.4a	87.5a	94.6a
MACROSORB FOLIAR	L	2	61.0a	64.2a	68.0a	64.6a	74.4a	76.8a	86.7a	85.8a	89.5a
UREA	46G	0.15 LB A/A	59.7a	62.9a	69.1a	64.2a	75.7a	74.7a	84.9a	85.8a	87.5a
PRIMO MAXX	1MEC	0.063	58.6a	60.6a	63.7a	65.3a	76.4a	79.1a	89.3a	85.8a	87.5a
MACROSORB FOLIAR	L	2									

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT)

Table 1(Continued). Percent reduction of pitch mark size in a creeping bentgrass/*Poa annua* putting green in 2002.

Treatment	Form	Rate (oz/M)	8-15	8-16
			(------% Reduction	-------)
PRIMO MAXX	1MEC	0.125	90.0a[1]	98.2a
MACROSORB FOLIAR	L	2		
PRIMO MAXX	1MEC	0.125	91.1a	100.0a
UREA	46G	0.15 LB A/A		
PRIMO MAXX	1MEC	0.125	100.0a	100.0a
CHECK			87.8a	100.0a
MACROSORB FOLIAR	L	2	89.7a	100.0a
UREA	46G	0.15 LB A/A	88.9a	98.8a
PRIMO MAXX	1MEC	0.063	95.3a	92.8b
MACROSORB FOLIAR	L	2		

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT)

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Perennial Ryegrass Establishment

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mixed stand that was formerly tall fescue, fine fescue, perennial ryegrass, creeping bentgrass and Kentucky bluegrass at the Landscape Management Research Center, Penn State University, University Park, PA. The objective of the study was to evaluate products for the enhancement of seedbed establishment into a renovated site.

Methods and Materials

The study was a randomized block design with three replications with a plot size of three feet by ten feet. The site was treated with Roundup Pro applied on May 22, 2002 at 5 lbs ai/A using a ten foot CO_2 powered boom sprayer calibrated to deliver 40 GPA using 6, flat fan, 11002 nozzles at 60 psi.

On June 3, 2002 the Roundup Pro treated site was prepared using a 48 in. Blecavator to cultivate the soil to a depth of six inches. The site was raked to remove debris and smooth the area. The test site was seeded with "Futura 3000" perennial ryegrass (32.91% Cutter, 32.80% Edge and 32.58% Sunshine perennial ryegrass) using a three foot drop spreader calibrated to deliver 2.5 lbs/M in two directions and rolled. All treatments were applied on June 3, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 GPA using two, flat fan, 11004 nozzles at 40 psi. Granular treatments were applied with a shaker jar. Tupersan 50WP was applied to the test site at 10 lbs/A using a ten foot CO_2 powered boom sprayer calibrated to deliver 40 GPA using 6, flat fan, 11002 nozzles at 60 psi.

On May 6, 2002 a soil test conducted by the Agricultural Analytical Services Laboratory, Pennsylvania State University, University Park PA of the test site revealed a pH of 7.3 (within the optimum range), phosphorus of 20 ppm (below the optimum range) and potassium of 111 ppm (below the optimum range). The test site had a CEC of 8.5 and 3.4% organic matter.

The seedbed was maintained using appropriate practices for irrigation and mowing until the final rating on July 15, 2002.

Results and Discussion

The only significant difference that occurred was on the June 10 rating date (Table 1). At this time, Awaken treated plots had less cover than the plots treated with Radicular and fertilizer. After this date, no treatment separation occurred. Some minor trends can be seen in the data, but they were inconsistent. Since the soil test indicated low phosphorus and potassium, it could be assumed that a starter fertilizer would provide considerable benefit in seedling establishment rate. Interestingly, the Radicular and the combination of Superbio and Awaken treatments provided establishment rates comparable to the starter fertilizer treatment. This provision of comparable establishment rate was achieved without the nutrient supplying capability of the starter fertilizer.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Ratings of percent turfgrass cover of a perennial ryegrass seedbed taken in 2002.

Treatment	Form	Rate	6-10	6-17	6-24	7-01	7-08	7-15
			(---% Turf Cover---)					
AWAKEN	L	2.0 QT/A	8.3b[1]	56.7a	66.7a	73.3a	83.3a	91.3a
AWAKEN SUPERBIO T&O	L L	2.0 QT/A 1.0 GAL/A	13.3ab	73.3a	81.7a	85.0a	86.7a	96.0a
CHECK			15.0ab	63.3a	71.7a	83.3a	90.0a	96.3a
SUPERBIO T&O	L	1.0 GAL/A	15.0ab	63.3a	73.3a	80.0a	90.0a	97.7a
8-32-16 FERT	8G	1 LB N/M	20.0a	66.7a	86.7a	91.7a	94.7a	99.0a
RADICULAR	L	4 OZ/M	18.3a	63.3a	75.0a	83.3a	88.3a	97.7a

1 - Means followed by same letter do not significantly differ (P=0.05 Duncan's New MRT)

Post Emergence Control of Ground Ivy and Broadleaf Weeds

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature mixed stand of perennial ryegrass, Kentucky bluegrass, and fine fescue on a home lawn in Julian, PA. The objective of the study was to determine the efficacy of broadleaf weed herbicides for the control of ground ivy. Although there were many types of broadleaf weeds in the stand they were not uniform enough to evaluate control on a species by species basis. The term "other weed" (used in this report) thus refers to buckhorn plantain, common plantain, dog fennel, slender speedwell, wild violet, wild strawberry, oxalis, white clover, dandelion, hawkweed, mouse ear chickweed, thymeleaf speedwell, healall, wild carrot, and yarrow that were present at the time of the herbicide application.

Methods and Materials

The study was a randomized complete block design with three replications. All of the treatments were applied on June 10, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. Ratings were taken on June 10, July 8, and Aug 5, 2002. Each plot was rated for ground ivy cover and other weed cover prior to treatment.

The site was mowed at two inches with a rotary mower with clippings returned. The site was not irrigated.

Results and Discussion

Ground ivy control was highly variable from treatment to treatment (Table 1). Sprayed formulations provided better control than granular materials. Speed Zone, Drive plus 2,4-D and MSO, Confront and Trimec Classic tended to provide the best and most lasting control of ground ivy (Table 1).

Control of the other weeds on the site was also variable, but the sprayed formulations again were typically more efficacious than the granular formulations (Table 2).

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table1. Rating of percent change of ground ivy population.

Treatment	Form	Rate	7-8-02	8-5-02
LEBANON TURF HERBICIDE	0.68G	157 LB/A	8.9c[1]	22.2b
CHECK			-6.7c	-13.3b
DRIVE	75DF	0.75 LB A/A	100.0a	100.0a
2,4-D	3.8L	1.0 LB A/A		
MSO	L	1 % V/V		
SPEED ZONE	L	3 PT/A	84.3ab	85.0a
POWER ZONE	L	3.5 PT/A	94.5a	75.8a
CONFRONT	3SL	0.75 LB A/A	97.2a	100.0a
TRIMEC CLASSIC	L	4 PT/A	100.0a	100.0a

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT). Positive numbers are a decrease in population and negative numbers are an increase in population.

Table 2. Rating of percent change of other weed populations.

Treatment	Form	Rate	7-8-02	8-5-02
LEBANON TURF HERBICIDE	0.68G	157 LB/A	22.2cd[1]	35.5b
CHECK			0.0d	-4.2c
DRIVE	75DF	0.75 LB A/A	66.5ab	71.4a
2,4-D	3.8L	1.0 LB A/A		
MSO	L	1 % V/V		
SPEED ZONE	L	3 PT/A	75.2a	82.9a
POWER ZONE	L	3.5 PT/A	73.1ab	78.7a
CONFRONT	3SL	0.75 LB A/A	72.3ab	81.2a
TRIMEC CLASSIC	L	4 PT/A	66.7ab	80.4a

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT). Positive numbers are a decrease in population and negative numbers are an increase in population.

Evaluation of Plant Growth Regulators and Bio-stimulants on Green Height Creeping Bentgrass/*Poa annua*

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature stand of creeping bentgrass (*Agrostis stolonifera*) and *Poa annua* at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the efficacy of plant growth regulators and bio-stimulants by color ratings and determinations of plant height and foliar yield.

Methods and Materials

This study was a randomized complete block design with three replications. All treatments were applied on June 5, June 19, July 2, July 16, July 31, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained similar to that of a golf course putting green with respect to irrigation, fertilization and mowing. Turfgrass height was measured using a Turfcheck 1 prism. After the June 5 application date Coron was substituted for ammonium sulfate as a nitrogen source.

A soil test was conducted on the test site on April 10, 2002 by the Agricultural Analytical Services Laboratory, Penn State University, University Park PA. The soil test revealed a soil pH of 6.1, phosphorus concentration of 61 ppm, and potassium concentration of 115 ppm. The soil test report recommended the site receive 2 lb K_2O/M for optimum growing conditions. Therefore, 1 lb K_2O/M was applied to the site on April 24 and May 7, 2002 from an 0-0-60 basic fertilizer using a three foot drop spreader. On May 7, 2002 1 lb P_2O_5/M was applied using a three foot drop spreader from a 0-46-0 basic fertilizer.

On April 10, 2002 1.5 lbs N/M was applied to the test site using a three foot drop spreader. The nitrogen source was IBDU 31-0-0 (Par Ex IBDU greens grade) with an analysis of 27% water insoluble nitrogen and 4% urea nitrogen.

The soil of the test site was also evaluated for particle size using the pipette method. The test revealed this particle size percent by weight; gravel (>2mm) 1.6, very coarse sand (2 - 1mm) 3.6, coarse sand (1 - 0.5mm) 25.1, medium sand (0.5 - 0.25mm) 33.3, fine sand (0.25 - 0.15mm) 12.4, very fine sand (0.15 - 0.05mm) 3.8, silt (0.05 – 0.002mm) 14.7, and clay (< 0.002mm) 5.7.

A tank mix of Bravo Ultrex (2.6 oz/M), Chipco GT (2oz/M), and Bayleton 50 (0.11 oz/M) was applied on June 4, 2002 as dollar spot had been identified on the test site. On June 19, 2002 Cleary's 3336 (3 oz/M) and Fungo (2 oz/M) were tank mixed and applied to the test site to control dollar spot again. In order to control cutworms found in the test site, Scimitar was applied on June 20, 2002 at a rate of 10 oz/A. Dollar spot was again identified and Banner Maxx (2 oz/M) was applied to the test site on July 2, 2002.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Two preventive fungicide applications of a tank mix of Bravo Ultrex (2.6 oz/M), Chipco GT (2oz/M), and Bayleton 50 (0.11 oz/M) were applied to the test site on July 21 and Aug 6, 2002. On Aug 5, 2002 Scimitar (10 oz/A) was applied to control cut worms that had been identified on the test site. All applications were made with a Toro Multi Pro 5500 with 11, ¼ TT J10-VS flood jet nozzles spaced at 20 inches and calibrated to deliver two gpm.

Results and Discussion

At no time did color ratings reveal that treated turf was in an unacceptable condition (Table 1). However, on June 10, turf treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron tended to have poorer color than untreated turf. Throughout the course of the study, there was a consistent tendency for turf that was treated with all materials to have color better than the untreated control.

On some dates, significant differences were found for height measurements (Table 2). For example, on June 10, turf treated with Primo Maxx, Astron, and Coron; Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron; Primo Maxx, MacroSorb Foliar, and Coron; Primo Maxx and Coron; Primo Maxx and Gary's Green 18-3-4; and Primo Maxx, Gary's Green 18-3-4, and Gary's Green PK Plus 3-21-18 had lower height than untreated turf. However, by June 24 turf treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One and Coron was found to have a height higher than untreated turf. On July 8, turf treated with Primo Maxx was shorter than untreated turf and turf that had received Coron and Gary's Green 18-3-4 with Primo Maxx. On July 16, only turf treated with Primo Maxx was shorter than the untreated turf. The other two dates on which a treated turf was found to have a height difference from the untreated turf was on August 12. On this date, turf treated with Primo Maxx plus Coron was shorter than the untreated turf. However, on August 19 the reverse response was found.

With exception of turf treated with Coron or that treated with Primo Maxx and Gary's Green 18-3-4, all other treated turf had lower clipping yields than untreated turf on June 10, 17, and 24 (Table 3). By July 1, only turf treated with Primo Maxx; Primo Maxx, Astron and Coron; Primo Maxx and Coron; and Primo Maxx, Gary's Green 18-3-4 plus Gary's PK Plus 3-21-18 had lower clipping yields. On July 8, only turf treated with Coron alone and that treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One and Coron had clipping yields similar to the untreated check, all other treatments caused significantly lower clipping yields. On July 16, no treatments caused significantly lower yields than untreated turf, however, turf treated wit Primo Maxx alone had less yield than turf treated with Coron alone. On July 22, only turf treated with Coron alone and Primo Maxx with Gary's Green 18-3-4 plus Gary's PK Plus 3-21-8 had yields similar to the untreated turf, all other treated turf had lower yields than the untreated turf. On Aug 5, turf treated with Primo Maxx had less clipping yield than the untreated turf. In addition, turf treated with Primo Maxx, produced less yield than turf treated with Primo Maxx, Astron, and Coron; Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron; Primo Maxx, MacroSorb Foliar, and Coron; and Coron alone. On August 12, only turf treated with Primo Maxx had less yield than untreated turf. By August 19, turf treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron; Primo Maxx, MacroSorb Foliar, and Coron; Primo Maxx plus Coron; and Primo Maxx, Gary's Green 18-3-4, and Gary's Green PK Plus 3-21-18, had yields that were significantly higher than untreated turf.

For the first application of treatments (applied on June 5), ammonium sulfate 21-0-0 was used at a rate of 0.125 lb N/M as a nitrogen source. On June 6, severe discoloration was observed (Table 4). Therefore, Coron was used as the nitrogen source for the remainder of the study.

Table 1. Color ratings on a scale of 0-10 where 0 = brown, 7= acceptable, and 10 = dark green of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	06-10	06-17	06-24	07-01
PRIMO MAXX	1MEC	0.125	8.6	9.5	9.7	9.0
PRIMO MAXX	1MEC	0.125	8.0	9.5	9.7	9.3
ASTRON	L	1.5				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	7.3	9.8	9.8	9.2
KICK	L	2				
POTENT-SEA	L	2				
N-HANCE	L	2				
BASE ONE	L	2				
CORON	2.9L	0.125 LB A/M				
CHECK			9.0	9.3	9.3	8.8
PRIMO MAXX	1MEC	0.125	8.7	9.8	9.5	9.2
MACROSORB FOLIAR	L	2				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	8.2	9.7	9.5	9.2
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	9.7	9.5	10.0	9.2
GARY'S GREEN 18-3-4	L	6				
PRIMO MAXX	1MEC	0.125	9.5	9.7	9.8	9.3
GARY'S GREEN 18-3-4	L	4				
GARY'S PK PLUS 3-21-18	L	4				
CORON	2.9L	0.125 LB A/M	9.3	9.3	9.3	9.0

Table 1 (Continued). Color ratings on a scale of 0-10 where 0 = brown, 7= acceptable, and 10 = dark green of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	07-08	07-16	07-22	07-30
PRIMO MAXX	1MEC	0.125	9.0	9.2	9.2	8.7
PRIMO MAXX	1MEC	0.125	9.2	9.3	9.5	8.5
ASTRON	L	1.5				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	9.3	9.3	9.5	9.0
KICK	L	2				
POTENT-SEA	L	2				
N-HANCE	L	2				
BASE ONE	L	2				
CORON	2.9L	0.125 LB A/M				
CHECK			9.3	9.0	9.0	8.2
PRIMO MAXX	1MEC	0.125	9.5	9.5	9.7	8.8
MACROSORB FOLIAR	L	2				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	9.3	9.5	9.3	8.3
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	9.3	9.5	9.7	9.2
GARY'S GREEN 18-3-4	L	6				
PRIMO MAXX	1MEC	0.125	9.5	9.3	9.5	9.2
GARY'S GREEN 18-3-4	L	4				
GARY'S PK PLUS 3-21-18	L	4				
CORON	2.9L	0.125 LB A/M	9.3	9.0	9.2	8.2

Table 1 (Continued). Color ratings on a scale of 0-10 where 0 = brown, 7= acceptable, and 10 = dark green of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	08-05	8-12	8-19
PRIMO MAXX	1MEC	0.125	8.7	9.3	9.7
PRIMO MAXX	1MEC	0.125	9.3	9.8	9.2
ASTRON	L	1.5			
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	9.5	9.8	9.7
KICK	L	2			
POTENT-SEA	L	2			
N-HANCE	L	2			
BASE ONE	L	2			
CORON	2.9L	0.125 LB A/M			
CHECK			8.2	9.2	8.8
PRIMO MAXX	1MEC	0.125	9.3	10.0	9.5
MACROSORB FOLIAR	L	2			
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	9.3	9.8	9.5
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	9.8	9.8	9.7
GARY'S GREEN 18-3-4	L	6			
PRIMO MAXX	1MEC	0.125	9.7	9.8	9.8
GARY'S GREEN 18-3-4	L	4			
GARY'S PK PLUS 3-21-18	L	4			
CORON	2.9L	0.125 LB A/M	9.0	9.3	9.2

Table 2. Height ratings (in inches) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	6-10	06-17	06-24	07-01
PRIMO MAXX	1MEC	0.125	0.117abc[1]	0.228a	0.094bc	0.122a
PRIMO MAXX	1MEC	0.125	0.111bc	0.094b	0.089c	0.133a
ASTRON	L	1.5				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	0.108c	0.108ab	0.131a	0.133 a
KICK	L	2				
POTENT-SEA	L	2				
N-HANCE	L	2				
BASE ONE	L	2				
CORON	2.9L	0.125 LB A/M				
CHECK			0.147a	0.125ab	0.100bc	0.133a
PRIMO MAXX	1MEC	0.125	0.103c	0.111ab	0.114abc	0.169a
MACROSORB FOLIAR	L	2				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	0.097c	0.103b	0.111abc	0.150a
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	0.111bc	0.109ab	0.100bc	0.150a
GARY'S GREEN 18-3-4	L	6				
PRIMO MAXX	1MEC	0.125	0.103c	0.103b	0.097bc	0.131a
GARY'S GREEN 18-3-4	L	4				
GARY'S PK PLUS 3-21-18	L	4				
CORON	2.9L	0.125 LB A/M	0.142ab	0.139ab	0.122ab	0.136a

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 2 (Continued). Height ratings (in inches) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	**Form**	**Rate Oz/M**	**07-8**	**07-16**	**07-22**	**07-30**
PRIMO MAXX	1MEC	0.125	0.072c[1]	0.083b	0.111a	0.150ab
PRIMO MAXX	1MEC	0.125	0.092bc	0.094ab	0.111a	0.131ab
ASTRON	L	1.5				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	0.089bc	0.111ab	0.122a	0.158a
KICK	L	2				
POTENT-SEA	L	2				
N-HANCE	L	2				
BASE ONE	L	2				
CORON	2.9L	0.125 LB A/M				
CHECK			0.108ab	0.131a	0.128a	0.139ab
PRIMO MAXX	1MEC	0.125	0.086bc	0.106ab	0.117a	0.139ab
MACROSORB FOLIAR	L	2				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	0.094bc	0.103ab	0.122a	0.142ab
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	0.106ab	0.108ab	0.111a	0.122b
GARY'S GREEN 18-3-4	L	6				
PRIMO MAXX	1MEC	0.125	0.086bc	0.100ab	0.119a	0.125ab
GARY'S GREEN 18-3-4	L	4				
GARY'S PK PLUS 3-21-18	L	4				
CORON	2.9L	0.125 LB A/M	0.125a	0.108ab	0.128a	0.153ab

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 2 (Continued). Height ratings (in inches) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	08-05	8-12	8-19
PRIMO MAXX	1MEC	0.125	0.100a[1]	0.094ab	0.144ab
PRIMO MAXX	1MEC	0.125	0.108a	0.100ab	0.150ab
ASTRON	L	1.5			
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	0.111a	0.106a	0.139ab
KICK	L	2			
POTENT-SEA	L	2			
N-HANCE	L	2			
BASE ONE	L	2			
CORON	2.9L	0.125 LB A/M			
CHECK			0.108a	0.106a	0.106b
PRIMO MAXX	1MEC	0.125	0.094a	0.097ab	0.150ab
MACROSORB FOLIAR	L	2			
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	0.094a	0.089b	0.161a
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	0.100a	0.100ab	0.150ab
GARY'S GREEN 18-3-4	L	6			
PRIMO MAXX	1MEC	0.125	0.106a	0.100ab	0.150ab
GARY'S GREEN 18-3-4	L	4			
GARY'S PK PLUS 3-21-18	L	4			
CORON	2.9L	0.125 LB A/M	0.100a	0.097ab	0.144ab

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 3. Fresh clipping weight ratings (in grams) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	**Form**	**Rate Oz/M**	**06-10**	**06-17**	**06-24**	**07-1**
PRIMO MAXX	1MEC	0.125	113.4bc[1]	94.4bc	61.1bc	66.5b
PRIMO MAXX	1MEC	0.125	106.0bc	84.0c	60.0bc	67.7b
ASTRON	L	1.5				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	91.8c	80.3c	64.0bc	77.6ab
KICK	L	2				
POTENT-SEA	L	2				
N-HANCE	L	2				
BASE ONE	L	2				
CORON	2.9L	0.125 LB A/M				
CHECK			155.9a	126.9a	82.4a	83.1a
PRIMO MAXX	1MEC	0.125	95.7c	89.3c	62.9bc	73.0ab
MACROSORB FOLIAR	L	2				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	85.5c	82.3c	56.6c	67.3b
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	122.0abc	107.8abc	70.5ab	74.4ab
GARY'S GREEN 18-3-4	L	6				
PRIMO MAXX	1MEC	0.125	104.2bc	90.1c	61.5bc	68.8b
GARY'S GREEN 18-3-4	L	4				
GARY'S PK PLUS 3-21-18	L	4				
CORON	2.9L	0.125 LB A/M	142.0ab	120.8ab	78.3a	83.6a

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 3 (Continued). Fresh clipping weight ratings (in grams) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	07-8	07-16	07-22	07-30
PRIMO MAXX	1MEC	0.125	42.0c[1]	57.2b	71.7d	78.9b
PRIMO MAXX	1MEC	0.125	44.6c	65.0ab	81.6cd	83.4ab
ASTRON	L	1.5				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	50.1bc	69.4ab	78.6cd	82.2ab
KICK	L	2				
POTENT-SEA	L	2				
N-HANCE	L	2				
BASE ONE	L	2				
CORON	2.9L	0.125 LB A/M				
CHECK			57.0ab	69.3ab	91.4ab	82.2ab
PRIMO MAXX	1MEC	0.125	45.2c	68.5ab	79.8cd	88.0a
MACROSORB FOLIAR	L	2				
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	42.9c	63.5ab	79.4cd	82.0ab
CORON	2.9L	0.125 LB A/M				
PRIMO MAXX	1MEC	0.125	47.3c	67.4ab	81.3cd	90.0a
GARY'S GREEN 18-3-4	L	6				
PRIMO MAXX	1MEC	0.125	44.5c	65.3ab	84.5bc	86.9ab
GARY'S GREEN 18-3-4	L	4				
GARY'S PK PLUS 3-21-18	L	4				
CORON	2.9L	0.125 LB A/M	57.9a	72.1a	99.0a	84.6ab

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 3 (Continued). Fresh clipping weight ratings (in grams) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	08-5	8-12	8-19
PRIMO MAXX	1MEC	0.125	34.6c[1]	47.0e	67.4b
PRIMO MAXX	1MEC	0.125	42.3ab	48.5cde	77.8ab
ASTRON	L	1.5			
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	44.5ab	57.2a	79.8a
KICK	L	2			
POTENT-SEA	L	2			
N-HANCE	L	2			
BASE ONE	L	2			
CORON	2.9L	0.125 LB A/M			
CHECK			45.6ab	54.1a-d	68.8b
PRIMO MAXX	1MEC	0.125	42.5ab	56.1ab	80.2a
MACROSORB FOLIAR	L	2			
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	38.4bc	49.7b-e	80.2a
CORON	2.9L	0.125 LB A/M			
PRIMO MAXX	1MEC	0.125	40.6abc	51.0a-e	75.0ab
GARY'S GREEN 18-3-4	L	6			
PRIMO MAXX	1MEC	0.125	39.5bc	48.0de	79.3a
GARY'S GREEN 18-3-4	L	4			
GARY'S PK PLUS 3-21-18	L	4			
CORON	2.9L	0.125 LB A/M	47.5a	55.1abc	67.8b

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 4. Discoloration ratings on a scale of 0-10 where 0 = worst, 7= acceptable, and 10 = best of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	Discoloration 06-6
PRIMO MAXX	1MEC	0.125	8.2
PRIMO MAXX	1MEC	0.125	5.2
ASTRON	L	1.5	
CORON	2.9L	0.125 LB A/M	
PRIMO MAXX	1MEC	0.125	4.7
KICK	L	2	
POTENT-SEA	L	2	
N-HANCE	L	2	
BASE ONE	L	2	
CORON	2.9L	0.125 LB A/M	
CHECK			9.3
PRIMO MAXX	1MEC	0.125	6.0
MACROSORB FOLIAR	L	2	
CORON	2.9L	0.125 LB A/M	
PRIMO MAXX	1MEC	0.125	5.0
CORON	2.9L	0.125 LB A/M	
PRIMO MAXX	1MEC	0.125	9.7
GARY'S GREEN 18-3-4	L	6	
PRIMO MAXX	1MEC	0.125	8.0
GARY'S GREEN 18-3-4	L	4	
GARY'S PK PLUS 3-21-18	L	4	
CORON	2.9L	0.125 LB A/M	6.0

Post Emergence Control of Broadleaf Weeds and Phytotoxicity Evaluation

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

Broadleaf weed control and phytotoxicity evaluations were conducted on different stands of mature perennial ryegrass (*Lolium perenne* L.) and fairway height creeping bentgrass (*Agrostis stolonifera*) respectively, at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objectives of the study were to determine the efficacy of broadleaf weed herbicides for the control of dandelion, common plantain, and white clover in perennial ryegrass and the phytotoxicity of these compounds on fairway height creeping bentgrass.

Methods and Materials

Both studies were a randomized complete block design with three replications. All of the treatments were applied on June 7, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi.

The perennial ryegrass was mowed at one inch with a rotary mower and the creeping bentgrass was mowed with a reel mower at one half inch with clippings returned on both sites.

Results and Discussion

No significant phytotoxicity was observed on the June 8 rating date (24 hours after application) (Table 1). However, on the June 10 rating date (three days after application) phytotoxicity was evident on bentgrass treated with all treatments. Although phytotoxicity was evident, only bentgrass treated with Speed Zone at the high rate, Power Zone, Trimec Classic, EH 1349 at the high rate, and NB 30165 had phytotoxicity ratings that were below acceptable. By the June 14 rating, only Power Zone at the low rate and Trimec Southern treated turf had acceptable phytotoxicity ratings. On June 21, most of the injured turf had recovered to acceptable ratings with the exception of that which was treated with Speed Zone at the high rate. Interestingly, on the June 28 rating date Speed Zone at the high rate continued to cause unacceptable phytotoxicity ratings, but turf treated with Speed Zone St. Augustine at the high rate, Trimec Classic and EH 1349 also caused unacceptable phytotoxicity ratings (Table 2). Only Speed Zone at the high rate caused unacceptable phytotoxicity on any rating after June 28 (July 2).

With regard to the control of dandelion, white clover, and common plantain in the perennial ryegrass trial, all treatments resulted in excellent control of white clover and common plantain (Tables 3 and 4). However, the control of dandelion was highly variable across the treatments. On the July 16 rating date, no treatment controlled dandelion better than 63.9%. By the July 29 rating date, only the Speed Zone at the low rate and Speed Zone St. Augustine at the low rate had relatively poor dandelion control compared to the rest of the treatments (Table 4).

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Evaluations of fairway height creeping bentgrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(-----------Phytotoxicity----------) 6-8-02	6-10-02	6-14-02
SPEED ZONE	L	3 PT/A	9.0	7.3	6.3
SPEED ZONE	L	5 PT/A	9.0	6.7	5.8
SPEED ZONE ST AUGUSTINE	L	4 PT/A	9.2	7.5	7.5
SPEED ZONE ST AUGUSTINE	L	6 PT/A	9.0	7.7	6.5
CHECK			9.7	9.3	10.0
POWER ZONE	L	3.5 PT/A	8.8	6.7	6.2
TRIMEC CLASSIC	L	4 PT/A	9.2	6.7	6.2
EH1349	L	4 PT/A	9.0	7.2	6.2
EH1349	L	6 PT/A	8.5	6.0	5.5
TRIMEC SOUTHERN	L	2 PT/A	8.5	7.5	7.5
NB30165	L	4 QT/A	9.0	6.7	6.3
TRIMEC BENTGRASS FORMULA	L	4 PT/A	9.0	7.0	6.5

Table 2. Evaluations of fairway height creeping bentgrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(------Phytotoxicity-------------) 6-21-02	6-28-02	7-2-02	7-18-02
SPEED ZONE	L	3 PT/A	8.2	7.3	8.7	8.8
SPEED ZONE	L	5 PT/A	6.0	6.2	6.7	8.2
SPEED ZONE ST AUGUSTINE	L	4 PT/A	8.0	7.3	7.5	8.7
SPEED ZONE ST AUGUSTINE	L	6 PT/A	7.2	6.8	8.2	8.2
CHECK			9.3	8.3	8.5	8.3
POWER ZONE	L	3.5 PT/A	7.7	7.5	8.3	7.7
TRIMEC CLASSIC	L	4 PT/A	7.7	6.3	8.0	8.5
EH1349	L	4 PT/A	7.2	7.0	7.2	7.8
EH1349	L	6 PT/A	7.0	5.8	7.0	7.5
TRIMEC SOUTHERN	L	2 PT/A	7.8	7.8	8.0	6.8
NB30165	L	4 QT/A	7.7	8.2	8.3	7.7
TRIMEC BENTGRASS FORMULA	L	4 PT/A	7.2	7.0	7.5	9.0

Table 3. Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on July 16, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
SPEED ZONE	L	3 PT/A	25.0abc[1]	100.0a	100.0a
SPEED ZONE	L	5 PT/A	48.3ab	100.0a	100.0a
SPEED ZONE ST AUGUSTINE	L	4 PT/A	22.2abc	94.4a	100.0a
SPEED ZONE ST AUGUSTINE	L	6 PT/A	11.1bc	99.3a	93.3a
CHECK			0.0c	0.0b	0.0b
POWER ZONE	L	3.5 PT/A	21.7abc	98.3a	93.3a
TRIMEC CLASSIC	L	4 PT/A	63.9a	100.0a	100.0a
EH1349	L	4 PT/A	50.0ab	100.0a	100.0a
EH1349	L	6 PT/A	63.9a	100.0a	100.0a
TRIMEC SOUTHERN	L	2 PT/A	63.9a	97.8a	100.0a
NB30165	L	4 QT/A	47.2ab	100.0a	100.0a
TRIMEC BENTGRASS FORMULA	L	4 PT/A	56.9ab	96.7a	100.0a

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Table 4. Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on July 29, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
SPEED ZONE	L	3 PT/A	65.0ab	100.0a	100.0a
SPEED ZONE	L	5 PT/A	90.3a	100.0a	100.0a
SPEED ZONE ST AUGUSTINE	L	4 PT/A	58.3b	100.0a	66.7ab
SPEED ZONE ST AUGUSTINE	L	6 PT/A	67.8ab	100.0a	100.0a
CHECK			27.8c	15.6b	33.3b
POWER ZONE	L	3.5 PT/A	71.7ab	100.0a	100.0a
TRIMEC CLASSIC	L	4 PT/A	91.7a	100.0a	100.0a
EH1349	L	4 PT/A	81.7ab	100.0a	100.0a
EH1349	L	6 PT/A	86.1ab	100.0a	100.0a
TRIMEC SOUTHERN	L	2 PT/A	83.3ab	100.0a	100.0a
NB30165	L	4 QT/A	93.1a	100.0a	100.0a
TRIMEC BENTGRASS FORMULA	L	4 PT/A	86.1ab	100.0a	100.0a

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Evaluation of Plant Growth Regulators on Creeping Bentgrass

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature stand of creeping bentgrass (*Agrostis stolonifera*) and *Poa annua* at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the efficacy of plant growth regulators by color ratings and determinations of plant height and foliar yield, and to compare different formulations of Primo.

Methods and Materials

This study was a randomized complete block design with three replications. All treatments were applied on June 5 and July 2, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained similar to that of a golf course fairway with respect to irrigation, fertilization and mowing. Turfgrass height was measured using a Turfcheck 1 prism.

Results and Discussion

No turf color differences were found for the three Primo formulations when applied alone, except for a 7.2 rating on June 24 for the 1EC formulation (Table 1). Additions of MacroSorb Foliar at 2 oz/M or urea at 0.2 lbs N/M did not significantly affect color ratings of turf treated with the three different Primo formulations. There was a trend for turf treated with Proxy alone, or with MacroSorb Foliar or urea additions, to have consistently lower color ratings than untreated turf (Table 1). This trend was not as consistent nor pronounced when Primo Maxx and Proxy treatments were combined with and without additions of MacroSorb Foliar or urea. Turf treated with BAS 125 11W plus MSO had lower color ratings early in the evaluation period (an unacceptable rating of 6 occurred on June 24).

On June 17, twelve days after initial applications, turf treated with Primo WSB, Primo 1EC plus urea, and BAS 125 11W plus MSO was shorter than untreated turf (Table 2). On June 24, turf treated with Primo Maxx at 0.25 plus MacroSorb Foliar and BAS 125 11W plus MSO was shorter than untreated turf. No height differences were found on July 1. On July 8, no treatments were found to significantly suppress height compared to untreated turf, but turf treated with Primo Maxx at 0.25, Primo 1EC at 0.25 and Primo WSB at 0.125 plus MacroSorb Foliar at 2 oz/M, Primo Maxx and Proxy, Primo Maxx plus Proxy plus urea, and BAS 125 11W plus MSO was found to be shorter than turf treated with Proxy at 5 oz/M plus urea at 0.2 lbs N/M. On July 16, only turf treated with Primo Maxx at 0.25 plus Proxy at 5 oz/M plus MacroSorb Foliar at 2 oz/M was measured to be significantly shorter than untreated turf (Table 2).

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[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Turf treated with this combination was also found to be significantly shorter than turf treated with Proxy at 5 oz/M and with Proxy at 5 oz/M plus MacroSorb Foliar at 2 oz/M. On July 22, turf treated with Primo WSB at 0.125 oz/M, Primo Maxx at 0.25 plus MacroSorb Foliar at 2 oz/M, Primo Maxx at 0.25 plus Proxy at 5 oz/M and BAS 125 11W plus MSO was measured to be shorter than untreated turf. No treated turf was found to be shorter than untreated turf on any of the remaining height measurement dates for the duration of the experiment. However, on August 12, turf treated with Proxy plus urea was found to be significantly taller than untreated turf. On August 19, turf treated with Primo 1EC plus urea was found to be taller than untreated turf. The phenomenon of turf treated with some PGR ultimately growing faster than untreated turf, once the PGR suppression has subsided has been referred to as a “rebound effect”.

All treatments, with the exception of Proxy with and without MacroSorb Foliar and Primo Maxx at 0.25 oz/M plus Proxy at 5 oz/M significantly reduced foliar yield compared to untreated turf on June 17 (Table 3). On June 24, turf treated with Primo 1EC and MacroSorb Foliar, Primo Maxx plus Proxy with either MacroSorb Foliar or urea, and BAS 125 11W plus MSO had less yield than untreated turf. On July 7, only turf treated with Primo WSB alone, Proxy alone and with MacroSorb Foliar or urea did not have less yield than untreated turf. On July 8, only turf treated with Primo 1EC plus urea and Proxy with either MacroSorb Foliar or urea did not have yield less than untreated turf. On July 16 and July 22, only turf treated with Proxy alone and in combination with either MacroSorb Foliar or urea did not significantly reduce foliar yield. On July 30 and August 5, no treated turf was found to significantly reduce yield compared to untreated turf. However, on August 5, turf treated with Primo 1EC plus urea produced significantly more yield than that treated with Primo Maxx in combination with Proxy and MacroSorb Foliar and turf treated with BAS 125 11W plus MSO. This increased growth is indication that “rebound effect” had occurred. On August 12, the only significant differences in yield were found for turf treated with Primo Maxx and Primo WSB alone and Primo WSB plus MacroSorb Foliar which had less yield than turf that had been treated with Primo 1EC plus urea.

On August 8, ratings were taken for a scalping incident that occurred on that day (Table 4). Scalping occurred, in part, due to one missed mowing cycle. All turf that was treated with Proxy alone or in combination with MacroSorb Foliar, urea, and Primo exhibited scalping injury. Turf treated with Proxy in combination with urea was the most severely injured.

Table 1. Color ratings on a scale of 0-10 where 0 = brown, 7= acceptable, and 10 = dark green of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	06-10	06-17	06-24	07-01
PRIMO MAXX	1MEC	0.25	8.7	8.3	8.2	8.7
PRIMO	1EC	0.25	8.3	8.0	7.2	8.5
PRIMO WSB	25WP	0.125	8.3	8.3	8.2	8.5
CHECK			8.2	8.8	9.0	8.8
PRIMO MAXX MACROSORB FOLIAR	1MEC L	0.25 2	8.0	7.8	7.8	8.0
PRIMO MACROSORB FOLIAR	1EC L	0.25 2	8.5	8.3	7.8	8.3
PRIMO WSB MACROSORB FOLIAR	25WP L	0.125 2	8.2	8.2	8.0	8.3
PRIMO MAXX UREA	1MEC 46G	0.25 0.2 LB A/M	8.3	8.3	8.7	8.7
PRIMO UREA	1EC 46G	0.25 0.2 LB A/M	8.7	8.7	8.8	8.7
PRIMO WSB UREA	25WP 46G	0.125 0.2 LB A/M	8.5	8.8	9.2	8.8
PROXY	2SL	5	7.8	7.5	8.0	7.8
PROXY MACROSORB FOLIAR	2SL L	5 2	8.5	7.5	8.0	7.9
PROXY UREA	2SL 46G	5 0.2 LB A/M	8.0	7.5	8.0	7.8
PRIMO MAXX PROXY	1MEC 2SL	0.25 5	7.8	7.5	7.8	7.8
PRIMO MAXX PROXY MACROSORB FOLIAR	1MEC 2SL L	0.25 5 2	7.7	7.8	7.8	7.8
PRIMO MAXX PROXY UREA	1MEC 2SL 46G	0.25 5 0.2 LB A/M	8.2	8.2	8.3	8.3
BAS 125 11 W MSO	27.5WG L	0.5 LB A/A 1 % V/V	8.0	7.0	6.0	8.0

Table 1 (Continued). Color ratings on a scale of 0-10 where 0 = brown, 7= acceptable, and 10 = dark green of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	08-05	8-12	8-19
PRIMO MAXX	1MEC	0.25	10.0	9.8	10.0
PRIMO	1EC	0.25	9.5	9.5	10.0
PRIMO WSB	25WP	0.125	9.3	9.8	9.5
CHECK			9.2	9.5	9.8
PRIMO MAXX MACROSORB FOLIAR	1MEC L	0.25 2	9.5	9.8	9.8
PRIMO MACROSORB FOLIAR	1EC L	0.25 2	10.0	9.8	10.0
PRIMO WSB MACROSORB FOLIAR	25WP L	0.125 2	9.7	10.0	9.8
PRIMO MAXX UREA	1MEC 46G	0.25 0.2 LB A/M	9.8	9.7	10.0
PRIMO UREA	1EC 46G	0.25 0.2 LB A/M	9.7	9.5	9.8
PRIMO WSB UREA	25WP 46G	0.125 0.2 LB A/M	10.0	10.0	10.0
PROXY	2SL	5	8.3	8.3	8.8
PROXY MACROSORB FOLIAR	2SL L	5 2	8.2	8.8	9.2
PROXY UREA	2SL 46G	5 0.2 LB A/M	8.0	8.2	9.2
PRIMO MAXX PROXY	1MEC 2SL	0.25 5	9.0	9.3	10.0
PRIMO MAXX PROXY MACROSORB FOLIAR	1MEC 2SL L	0.25 5 2	8.7	8.7	9.5
PRIMO MAXX PROXY UREA	1MEC 2SL 46G	0.25 5 0.2 LB A/M	8.5	9.3	9.7
BAS 125 11 W MSO	27.5WG L	0.5 LB A/A 1 % V/V	10.0	9.8	9.8

Table 2. Height ratings (in inches) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	**Form**	**Rate Oz/M**	**06-17**	**06-24**	**07-01**	**07-08**
PRIMO MAXX	1MEC	0.25	0.29abc[1]	0.28bcd	0.32a	0.25b
PRIMO	1EC	0.25	0.27a-d	0.25bcd	0.30a	0.25ab
PRIMO WSB	25WP	0.125	0.22cd	0.27bcd	0.32a	0.28ab
CHECK			0.29ab	0.30abc	0.29a	0.27ab
PRIMO MAXX	1MEC	0.25	0.24a-d	0.23d	0.26a	0.25ab
MACROSORB FOLIAR	L	2				
PRIMO	1EC	0.25	0.24a-d	0.28bcd	0.28a	0.24b
MACROSORB FOLIAR	L	2				
PRIMO WSB	25WP	0.125	0.24a-d	0.24cd	0.27a	0.24b
MACROSORB FOLIAR	L	2				
PRIMO MAXX	1MEC	0.25	0.27a-d	0.27bcd	0.30a	0.26ab
UREA	46G	0.2 LB A/M				
PRIMO	1EC	0.25	0.22cd	0.28bcd	0.27a	0.26ab
UREA	46G	0.2 LB A/M				
PRIMO WSB	25WP	0.125	0.28a-d	0.28bcd	0.30a	0.27ab
UREA	46G	0.2 LB A/M				
PROXY	2SL	5	0.30ab	0.34a	0.29a	0.28ab
PROXY	2SL	5	0.29abc	0.31abc	0.28a	0.28ab
MACROSORB FOLIAR	L	2				
PROXY	2SL	5	0.31a	0.31ab	0.30a	0.32a
UREA	46G	0.2 LB A/M				
PRIMO MAXX	1MEC	0.25	0.25a-d	0.29a-d	0.29a	0.25b
PROXY	2SL	5				
PRIMO MAXX	1MEC	0.25	0.26a-d	0.26bcd	0.27a	0.26ab
PROXY	2SL	5				
MACROSORB FOLIAR	L	2				
PRIMO MAXX	1MEC	0.25	0.23bcd	0.26bcd	0.26a	0.24b
PROXY	2SL	5				
UREA	46G	0.2 LB A/M				
BAS 125 11 W	27.5WG	0.5 LB A/A	0.21d	0.23d	0.28a	0.23b
MSO	L	1 % V/V				

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 2 (Continued). Height ratings (in inches) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	07-16	07-22	07-30	08-05
PRIMO MAXX	1MEC	0.25	0.22a-d[1]	0.29abc	0.33ab	0.34a
PRIMO	1EC	0.25	0.22a-d	0.29abc	0.30b	0.34a
PRIMO WSB	25WP	0.125	0.22a-d	0.28bc	0.33ab	0.33a
CHECK			0.24abc	0.35a	0.35ab	0.36a
PRIMO MAXX	1MEC	0.25	0.21a-d	0.28bc	0.34ab	0.34a
MACROSORB FOLIAR	L	2				
PRIMO	1EC	0.25	0.22a-d	0.30abc	0.31b	0.33a
MACROSORB FOLIAR	L	2				
PRIMO WSB	25WP	0.125	0.19bcd	0.29abc	0.36ab	0.35a
MACROSORB FOLIAR	L	2				
PRIMO MAXX	1MEC	0.25	0.22a-d	0.32ab	0.33ab	0.37a
UREA	46G	0.2 LB A/M				
PRIMO	1EC	0.25	0.23a-d	0.30abc	0.35ab	0.38a
UREA	46G	0.2 LB A/M				
PRIMO WSB	25WP	0.125	0.22a-d	0.33ab	0.35ab	0.32a
UREA	46G	0.2 LB A/M				
PROXY	2SL	5	0.26a	0.34ab	0.37ab	0.39a
PROXY	2SL	5	0.25ab	0.32ab	0.39a	0.38a
MACROSORB FOLIAR	L	2				
PROXY	2SL	5	0.21a-d	0.35[a]	0.38a	0.39a
UREA	46G	0.2 LB A/M				
PRIMO MAXX	1MEC	0.25	0.20bcd	0.28bc	0.36ab	0.36a
PROXY	2SL	5				
PRIMO MAXX	1MEC	0.25	0.17d	0.30abc	0.38a	0.39a
PROXY	2SL	5				
MACROSORB FOLIAR	L	2				
PRIMO MAXX	1MEC	0.25	0.19cd	0.31abc	0.37ab	0.38a
PROXY	2SL	5				
UREA	46G	0.2 LB A/M				
BAS 125 11 W	27.5WG	0.5 LB A/A	0.20bcd	0.25c	0.33ab	0.35a
MSO	L	1 % V/V				

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 2 (Continued). Height ratings (in inches) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	8-12	08-19
PRIMO MAXX	1MEC	0.25	0.36bcd[1]	0.32ab
PRIMO	1EC	0.25	0.39a-d	0.32ab
PRIMO WSB	25WP	0.125	0.36bcd	0.34ab
CHECK			0.37bcd	0.32b
PRIMO MAXX MACROSORB FOLIAR	1MEC L	0.25 2	0.38a-d	0.38ab
PRIMO MACROSORB FOLIAR	1EC L	0.25 2	0.35bcd	0.35ab
PRIMO WSB MACROSORB FOLIAR	25WP L	0.125 2	0.34cd	0.36ab
PRIMO MAXX UREA	1MEC 46G	0.25 0.2 LB A/M	0.36bcd	0.35ab
PRIMO UREA	1EC 46G	0.25 0.2 LB A/M	0.32d	0.40a
PRIMO WSB UREA	25WP 46G	0.125 0.2 LB A/M	0.42ab	0.37ab
PROXY	2SL	5	0.38a-d	0.38ab
PROXY MACROSORB FOLIAR	2SL L	5 2	0.34cd	0.37ab
PROXY UREA	2SL 46G	5 0.2 LB A/M	0.44a	0.38ab
PRIMO MAXX PROXY	1MEC 2SL	0.25 5	0.36bcd	0.37ab
PRIMO MAXX PROXY MACROSORB FOLIAR	1MEC 2SL L	0.25 5 2	0.36bcd	0.38ab
PRIMO MAXX PROXY UREA	1MEC 2SL 46G	0.25 5 0.2 LB A/M	0.41abc	0.37ab
BAS 125 11 W MSO	27.5WG L	0.5 LB A/A 1 % V/V	0.40abc	0.39ab

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 3. Fresh clipping weight ratings (in grams) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	06-17	06-24	07-01	07-08
PRIMO MAXX	1MEC	0.25	3.7d-g[1]	6.3cde	4.2bc	3.2d
PRIMO	1EC	0.25	3.2efg	6.9cde	5.4bc	4.4cd
PRIMO WSB	25WP	0.125	4.9b-f	9.1b-e	5.7abc	4.3cd
CHECK			8.3a	11.8bc	8.9a	6.6b
PRIMO MAXX MACROSORB FOLIAR	1MEC L	0.25 2	2.8fg	6.5cde	3.3c	3.3cd
PRIMO MACROSORB FOLIAR	1EC L	0.25 2	3.6d-g	5.4de	3.9bc	3.3cd
PRIMO WSB MACROSORB FOLIAR	25WP L	0.125 2	3.4d-g	7.4b-e	5.4bc	3.7cd
PRIMO MAXX UREA	1MEC 46G	0.25 0.2 LB A/M	4.1d-g	8.2b-e	4.6bc	3.5cd
PRIMO UREA	1EC 46G	0.25 0.2 LB A/M	3.4d-g	9.8b-e	5.1bc	5.4bc
PRIMO WSB UREA	25WP 46G	0.125 0.2 LB A/M	4.3c-g	8.0b-e	4.9bc	4.2cd
PROXY	2SL	5	7.2ab	18.2a	7.0ab	8.9a
PROXY MACROSORB FOLIAR	2SL L	5 2	6.6abc	13.0b	6.3abc	6.6b
PROXY UREA	2SL 46G	5 0.2 LB A/M	5.5b-e	12.8b	7.0ab	6.8b
PRIMO MAXX PROXY	1MEC 2SL	0.25 5	6.0a-d	11.2bcd	5.5bc	3.8cd
PRIMO MAXX PROXY MACROSORB FOLIAR	1MEC 2SL L	0.25 5 2	2.7fg	4.7e	4.2bc	2.8d
PRIMO MAXX PROXY UREA	1MEC 2SL 46G	0.25 5 0.2 LB A/M	2.0g	4.2e	3.0c	2.7d
BAS 125 11 W MSO	27.5WG L	0.5 LB A/A 1 % V/V	2.9efg	4.0e	3.8bc	2.8d

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 3 (Continued). Fresh clipping weight ratings (in grams) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	07-16	07-22	07-30	08-05
PRIMO MAXX	1MEC	0.25	1.8cd	5.0cde	14.7b	15.2ab
PRIMO	1EC	0.25	1.9cd	4.5cde	18.0ab	15.2ab
PRIMO WSB	25WP	0.125	2.5cd	4.8cde	18.6ab	17.0ab
CHECK			6.8ab	11.5a	23.8ab	16.6ab
PRIMO MAXX	1MEC	0.25	1.2cd	3.3de	18.5ab	13.5ab
MACROSORB FOLIAR	L	2				
PRIMO	1EC	0.25	1.7cd	4.7cde	15.5b	13.0ab
MACROSORB FOLIAR	L	2				
PRIMO WSB	25WP	0.125	1.7cd	4.8cde	16.2b	14.9ab
MACROSORB FOLIAR	L	2				
PRIMO MAXX	1MEC	0.25	3.2c	5.9b-e	22.4ab	16.8ab
UREA	46G	0.2 LB A/M				
PRIMO	1EC	0.25	2.6cd	6.3b-e	27.0a	20.8a
UREA	46G	0.2 LB A/M				
PRIMO WSB	25WP	0.125	2.1cd	4.6cde	21.3ab	13.2ab
UREA	46G	0.2 LB A/M				
PROXY	2SL	5	7.4a	8.9abc	24.2ab	16.4ab
PROXY	2SL	5	5.0b	7.8a-d	23.2ab	13.8ab
MACROSORB FOLIAR	L	2				
PROXY	2SL	5	5.3b	10.1ab	20.5ab	14.3ab
UREA	46G	0.2 LB A/M				
PRIMO MAXX	1MEC	0.25	2.1cd	3.1e	19.3ab	13.9ab
PROXY	2SL	5				
PRIMO MAXX	1MEC	0.25	1.5cd	4.1de	21.9ab	11.9b
PROXY	2SL	5				
MACROSORB FOLIAR	L	2				
PRIMO MAXX	1MEC	0.25	1.6cd	5.4cde	23.4ab	15.2ab
PROXY	2SL	5				
UREA	46G	0.2 LB A/M				
BAS 125 11 W	27.5WG	0.5 LB A/A	0.9d	4.0de	16.3ab	12.7b
MSO	L	1 % V/V				

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 3 (Continued). Fresh clipping weight ratings (in grams) of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	8-12	08-19
PRIMO MAXX	1MEC	0.25	31.3b[1]	11.3a
PRIMO	1EC	0.25	37.8ab	13.3a
PRIMO WSB	25WP	0.125	32.6b	12.6a
CHECK			38.6ab	12.3a
PRIMO MAXX	1MEC	0.25	36.8ab	12.0a
MACROSORB FOLIAR	L	2		
PRIMO	1EC	0.25	38.7ab	13.6a
MACROSORB FOLIAR	L	2		
PRIMO WSB	25WP	0.125	31.8b	11.3a
MACROSORB FOLIAR	L	2		
PRIMO MAXX	1MEC	0.25	44.6ab	14.2a
UREA	46G	0.2 LB A/M		
PRIMO	1EC	0.25	51.4a	13.7a
UREA	46G	0.2 LB A/M		
PRIMO WSB	25WP	0.125	42.3ab	11.4a
UREA	46G	0.2 LB A/M		
PROXY	2SL	5	41.3ab	11.4a
PROXY	2SL	5	38.6ab	10.9a
MACROSORB FOLIAR	L	2		
PROXY	2SL	5	36.5ab	10.0a
UREA	46G	0.2 LB A/M		
PRIMO MAXX	1MEC	0.25	37.9ab	11.9a
PROXY	2SL	5		
PRIMO MAXX	1MEC	0.25	38.8ab	12.2a
PROXY	2SL	5		
MACROSORB FOLIAR	L	2		
PRIMO MAXX	1MEC	0.25	47.2ab	15.7a
PROXY	2SL	5		
UREA	46G	0.2 LB A/M		
BAS 125 11 W	27.5WG	0.5 LB A/A	44.6ab	13.8a
MSO	L	1 % V/V		

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 4. Scalp ratings on a scale of 0-10 where 0 = worst, 7= acceptable, and 10 = none present of PGR's applied to creeping bentgrass taken in 2002.

Treatment	Form	Rate Oz/M	08-12
PRIMO MAXX	1MEC	0.25	10
PRIMO	1EC	0.25	10
PRIMO WSB	25WP	0.125	10
CHECK			10
PRIMO MAXX MACROSORB FOLIAR	1MEC L	0.25 2	10
PRIMO MACROSORB FOLIAR	1EC L	0.25 2	10
PRIMO WSB MACROSORB FOLIAR	25WP L	0.125 2	10
PRIMO MAXX UREA	1MEC 46G	0.25 0.2 LB A/M	10
PRIMO UREA	1EC 46G	0.25 0.2 LB A/M	10
PRIMO WSB UREA	25WP 46G	0.125 0.2 LB A/M	10
PROXY	2SL	5	6.7
PROXY MACROSORB FOLIAR	2SL L	5 2	6.7
PROXY UREA	2SL 46G	5 0.2 LB A/M	4.0
PRIMO MAXX PROXY	1MEC 2SL	0.25 5	6.2
PRIMO MAXX PROXY MACROSORB FOLIAR	1MEC 2SL L	0.25 5 2	6.7
PRIMO MAXX PROXY UREA	1MEC 2SL 46G	0.25 5 0.2 LB A/M	7.3
BAS 125 11 W MSO	27.5WG L	0.5 LB A/A 1 % V/V	10

Poa annua Control in Fairway Height Creeping Bentgrass

Dr. T. L. Watschke, J. A. Borger and J. T. Brosnan[1]

Introduction

This study was conducted on a mature stand of creeping bentgrass (*Agrostis stolonifera*) and *Poa annua* at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine if summer and fall applications of Trimmit and Primo MAXX could eliminate *Poa annua* under fairway conditions.

Methods and Materials

This study was a randomized complete block design with three replications. Treatments were applied on May 30, June 27, July 18, Aug 14, Sept 13, and Oct 12, 2001 and April 4, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi. The test area was maintained at 0.5" using a triplex reel mower clippings collected.

Results and Discussion

The ratings of percent change in *Poa annua* from May 30, 2001 to May 13, 2002 are shown in Table 1. *Poa annua* increased in the untreated check (34.4%), but increased significantly more in plots treated with Primo MAXX alone (100%). Plots receiving Trimmit with Coron had the greatest reduction of *Poa annua*, but not significantly more than those that received Trimmit alone. It should be noted that, from a turf color/quality perspective, when Trimmit was supplemented with Coron, the treated turf had higher quality than turf without a Coron supplement. There did not appear to be any advantage in *Poa annua* reduction by including an October application as part of the management strategy.

[1] Professor, Research Assistant and Turfgrass Student respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Percent change of *Poa annua* ratings from May 30, 2001 to May 13, 2002.

Treatment	Form	Rate (oz/M)	Timing	Percent Change
TRIMMIT	2SC	0.7	MAY/SEPT	38.9ab[1]
TRIMMIT	2SC	0.7	MAY/SEPT	47.2a
CORON	2.9L	0.9 lb N/M		
TRIMMIT	2SC	0.35	APRIL/SEPT/OCT	24.4ab
CHECK				-34.4c[2]
TRIMMIT	2SC	0.35	APRIL/SEPT/OCT	46.7a
CORON	2.9L	0.5 lb N/M		
TRIMMIT	2SC	0.7	MAY/SEPT	0.0bc
PRIMO MAXX	1MEC	0.25	JUNE/JULY/AUG	
PRIMO MAXX	1MEC	0.25	MAY/JUNE/ JULY/AUG/SEPT	-100.0d

1 – Means followed by the same letter do not significantly differ (P = 0.05, Duncan's New MRT).

2 – Positive numbers represent a percent decrease and negative numbers a percent increase.

Post Emergence (2-3 Tiller Stage) Smooth Crabgrass Control and Phytotoxicity Study

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

Post emergence smooth crabgrass (*Digitaria ischaemum*) control and phytotoxicity evaluations were conducted on a mature fairway height stand of "SR 4200"perennial ryegrass (*Lolium perenne* L.)/*Poa annua* at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objectives of the study were to determine the efficacy and phytotoxicity of selected post emergence herbicides for the control of smooth crabgrass in fairway height perennial ryegrass.

Methods and Materials

This study was a randomized complete block design with three replications. Treatments were applied on July 10, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi.

The test site was maintained at 0.5 inches to simulate a golf course fairway.

Results and Discussion

All mesotrione treated turf exhibited unacceptable phytotoxicity on the July 17 rating date (Table 1). The highest rate of mesotrione continued to cause unacceptable phytotoxicity even on the July 24 rating date. None of the other treatments caused any phytotoxicity on any rating date (Table 1).

None of the Drive 75DF nor mesotrione treatments provided acceptable crabgrass control (>85%) (Table 2). However, when MacroSorb Foliar at 2 oz/M was included with Drive 75DF, control was enhanced. The addition of MacroSorb Foliar also enhanced the efficacy of Acclaim Extra, with the 10 oz/A rate (less than half that of label recommendation) provided acceptable control (Table 2).

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Evaluations of "SR 4200" fairway height perennial ryegrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate (lbs ai/A)	(--------Phytotoxicity-------) 7-15	7-18	7-24	8-6
DRIVE	75DF	0.75	10.0	10.0	10.0	10.0
MSO	L	1 % V/V				
DRIVE	75DF	0.5	10.0	10.0	10.0	10.0
MSO	L	1 % V/V				
DRIVE	75DF	0.75	10.0	10.0	10.0	10.0
MSO	L	1 % V/V				
MACROSORB FOLIAR	L	2 OZ/M				
DRIVE	75DF	0.5	10.0	10.0	10.0	10.0
MSO	L	1 % V/V				
MACROSORB FOLIAR	L	2 OZ/M				
CHECK			10.0	10.0	10.0	10.0
ACCLAIM EXTRA	0.57EW	20 OZ/A	10.0	10.0	10.0	10.0
ACCLAIM EXTRA	0.57EW	28 OZ/A	10.0	10.0	10.0	10.0
ACCLAIM EXTRA	0.57EW	39 OZ/A	10.0	10.0	10.0	10.0
ACCLAIM EXTRA	0.57EW	39 OZ/A	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
ACCLAIM EXTRA	0.57EW	20 OZ/A	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
ACCLAIM EXTRA	0.57EW	15 OZ/A	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
ACCLAIM EXTRA	0.57EW	10 OZ/A	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
ACCLAIM EXTRA	0.57EW	28 OZ/A	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
MESOTRIONE	4SC	0.125	6.0	7.0	8.0	10.0
X-77	L	0.25 % V/V				
MESOTRIONE	4SC	0.25	5.0	5.0	8.0	10.0
X-77	L	0.25 % V/V				
MESOTRIONE	4SC	0.5	5.0	2.0	6.0	10.0
X-77	L	0.25 % V/V				

Table 2. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* of the percent control of smooth crabgrass taken on Aug 16, 2002. Commercially acceptable control was considered to be 85% and above.

Treatment	**Form**	**Rate (lbs ai/A)**	**% Control**
DRIVE	75DF	0.75	65.0
MSO	L	1 % V/V	
DRIVE	75DF	0.5	53.3
MSO	L	1 % V/V	
DRIVE	75DF	0.75	75.0
MSO	L	1 % V/V	
MACROSORB FOLIAR	L	2 OZ/M	
DRIVE	75DF	0.5	60.0
MSO	L	1 % V/V	
MACROSORB FOLIAR	L	2 OZ/M	
CHECK			0.0
ACCLAIM EXTRA	0.57EW	20 OZ/A	90.0
ACCLAIM EXTRA	0.57EW	28 OZ/A	93.3
ACCLAIM EXTRA	0.57EW	39 OZ/A	90.0
ACCLAIM EXTRA	0.57EW	39 OZ/A	93.3
MACROSORB FOLIAR	L	2 OZ/M	
ACCLAIM EXTRA	0.57EW	20 OZ/A	95.0
MACROSORB FOLIAR	L	2 OZ/M	
ACCLAIM EXTRA	0.57EW	15 OZ/A	93.3
MACROSORB FOLIAR	L	2 OZ/M	
ACCLAIM EXTRA	0.57EW	10 OZ/A	85.0
MACROSORB FOLIAR	L	2 OZ/M	
ACCLAIM EXTRA	0.57EW	28 OZ/A	91.7
MACROSORB FOLIAR	L	2 OZ/M	
MESOTRIONE	4SC	0.125	38.3
X-77	L	0.25 % V/V	
MESOTRIONE	4SC	0.25	78.3
X-77	L	0.25 % V/V	
MESOTRIONE	4SC	0.5	76.7
X-77	L	0.25 % V/V	

Preemergence Smooth Crabgrass Control and Phytotoxicity Study

Dr. T. L. Watschke, J. A. Borger and J. T. Brosnan[1]

Introduction

Preemergence smooth crabgrass (*Digitaria ischaemum*) control and phytotoxicity evaluations were conducted on different stands of a mature fairway height "SR 4200"perennial ryegrass (*Lolium perenne* L.)/*Poa annua* and fairway height "Penneagle" creeping bentgrass (*Agrostis stolonifera*) respectively, at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objectives of the study were to determine the efficacy of selected preemergence herbicides for the control of smooth crabgrass in fairway height perennial ryegrass and the phytotoxicity of some of these compounds on fairway height creeping bentgrass.

Methods and Materials

Control Study

This study was a randomized complete block design with three replications. Treatments were applied on April 18, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 80 gpa using two, flat fan, 11004 nozzles at 40 psi. Some treatments were re-applied six weeks later on May 30, 2002. Granular treatments were applied with a shaker jar. After application the entire test site received approximately 1.3 inch of water. On April 18, 2002, 0.5 lb N/M was applied from urea and 0.5 lb N/M from a 31-0-0 IBDU fertilizer to treatments that did not contain any nitrogen as a herbicide carrier.

Smooth crabgrass germination was first noted in the test site on April 19, 2002. On April 24, and May 21, 2002 a frost eliminated smooth crabgrass that was present in voids in the test area. Weather data from the Penn State weather station at University Park, PA recorded frost each morning from May 19 through May 22, 2002, inclusive. Smooth crabgrass pressure was rated as being severe in the study site, as infestation in the untreated plots was nearly 100%. Acceptable control was considered for ratings of 85% or greater.

Phytotoxicity Study

Only selected treatments form the preemergence crabgrass control study were applied on the same dates and using the same equipment to the fairway height creeping bentgrass. There was no crabgrass present in the phytotoxicity study test area.

[1] Professor, Research Assistant and Turfgrass Student respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Results and Discussion

All mesotrione treatments applied to "Penneagle" creeping bentgrass caused moderate to severe phytotoxicity (Tables 1, 2, 3). The severity of the injury was rated on June 27 as a percent of exposed soil that existed in the treated plots (Table 4). Clearly, mesotrione has no use "fit" on "Penneagle" creeping bentgrass.

Injury to perennial ryegrass from applications of mesotrione was less severe than on creeping bentgrass, but was still rated as being unacceptable (Table 5). None of the other treatments in the study caused unacceptable phytotoxicity. The injury to perennial ryegrass as a result of mesotrione applications lessened over time, unless a sequential application was made (Table 6). However, over time the injury observed for the sequential applications disappeared and no permanent turf thinning was seen (Table 7).

In May, some thinning of the annual bluegrass in the study area was observed (Table 8). Although the amount of thinning was not considered to be of practical significance (33.3% was best), the Pendulum 3.3EC applied at 2 lbs ai/A thinned the annual bluegrass significantly more than any other treatment.

None of the mesotrione treatments controlled crabgrass to a commercially acceptable degree (Table 9). The best crabgrass control (>85%) was provided by an application of Dimension 40WP at 0.25 lbs ai/A followed six weeks later by another 0.25 lbs ai/A, and Dimension 40WP at 0.5 lbs ai/A, while Barricade 65WDG at 0.75 and a Barricade split application at 0.325 lbs ai/A followed by another 0.325 lbs ai/A six weeks later, both provided 83.3% control (very near commercial acceptance). In addition, the Barricade 65WDG at 0.65 lbs ai/A provided control greater than 80%.

Table 1. Evaluations of "Penneagle" fairway height creeping bentgrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	**Form**	**Rate**	**Timing**	**(--------Phytotoxicity-------)** 04-25	04-30	05-10
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	5.0	6.7
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	PRE	10.0	5.0	5.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	5.0	3.3
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	5.0	6.3
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
CHECK				10.0	10.0	9.7
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	5.0	6.3
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
MESOTRIONE	4SC	0.25 LB A/A	PRE	10.0	5.0	4.7
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
BARRICADE	4FL	0.75 LB A/A	PRE	10.0	10.0	9.3
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	5.0	3.0
X-77	L	0.25 % V/V	PRE			
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	5.0	3.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			

Table 2. Evaluations of "Penneagle" fairway height creeping bentgrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate	Timing	(--------Phytotoxicity-------) 05-17	06-04	06-12
MESOTRIONE	4SC	0.125 LB A/A	PRE	8.0	6.7	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	PRE	5.0	10.0	9.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	3.7	10.0	9.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	PRE	7.0	6.0	6.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
CHECK				10.0	10.0	10.0
MESOTRIONE	4SC	0.125 LB A/A	PRE	6.3	5.3	3.7
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
MESOTRIONE	4SC	0.25 LB A/A	PRE	5.0	4.3	3.5
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
BARRICADE	4FL	0.75 LB A/A	PRE	10.0	10.0	9.7
MESOTRIONE	4SC	0.5 LB A/A	PRE	1.7	10.0	8.3
X-77	L	0.25 % V/V	PRE			
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	1.0	2.0	0.3
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			

Table 3. Evaluations of "Penneagle" fairway height creeping bentgrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate	Timing	(--------Phytotoxicity-------) 06-27	07-11	07-24
MESOTRIONE	4SC	0.125 LB A/A	PRE	9.7	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	PRE	8.7	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	9.3	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	PRE	9.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
CHECK				9.0	10.0	10.0
MESOTRIONE	4SC	0.125 LB A/A	PRE	7.3	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
MESOTRIONE	4SC	0.25 LB A/A	PRE	6.7	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			
BARRICADE	4FL	0.75 LB A/A	PRE	7.3	10.0	10.0
MESOTRIONE	4SC	0.5 LB A/A	PRE	8.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	9.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	6 WAT			
X-77	L	0.25 % V/V	6 WAT			

Table 4. Evaluations of percent exposed soil in "Penneagle" fairway height creeping bentgrass taken on June 27, 2002.

Treatment	Form	Rate	Timing	% Exposed Soil
MESOTRIONE	4SC	0.125 LB A/A	PRE	0.0c[1]
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	PRE	3.3c
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.5 LB A/A	PRE	6.7c
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.125 LB A/A	PRE	0.0c
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.125 LB A/A	6 WAT	
X-77	L	0.25 % V/V	6 WAT	
CHECK				0.0c
MESOTRIONE	4SC	0.125 LB A/A	PRE	3.3c
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	6 WAT	
X-77	L	0.25 % V/V	6 WAT	
MESOTRIONE	4SC	0.25 LB A/A	PRE	16.7b
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	6 WAT	
X-77	L	0.25 % V/V	6 WAT	
BARRICADE	4FL	0.75 LB A/A	PRE	1.7c
MESOTRIONE	4SC	0.5 LB A/A	PRE	18.3b
X-77	L	0.25 % V/V	PRE	
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE	
MESOTRIONE	4SC	0.5 LB A/A	PRE	48.3a
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.5 LB A/A	6 WAT	
X-77	L	0.25 % V/V	6 WAT	

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Table 5. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	**Form**	**Rate**		**(--------Phytotoxicity-------)**		
			Timing	**04-25**	**04-30**	**05-10**
MESOTRIONE	4SC	0.125 LB A/A	PRE	6.0	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	PRE	5.7	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	4.0	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	PRE	5.7	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.125 LB A/A	PRE	6.2	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.25 LB A/A	PRE	6.0	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.5 LB A/A	PRE	5.0	5.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.5 LB A/A	PRE	5.7	5.0	10.0
X-77	L	0.25 % V/V	PRE			
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE			
BARRICADE	4FL	0.75 LB A/A	PRE	10.0	10.0	10.0
CHECK				10.0	10.0	10.0
BETASAN	4EC	7.3 OZ/M	PRE	10.0	10.0	10.0
BETASAN	4EC	4.4 OZ/M	PRE	10.0	10.0	10.0
BETASAN	4EC	2.9 OZ/M	6WAT			
CHECK				10.0	10.0	10.0
PENDULUM	3.3EC	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.3EC	2 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.8CS	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.8CS	2.0 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	2G	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	2G	2 LB A/A	PRE	10.0	10.0	10.0
CHECK				10.0	10.0	10.0
DIMENSION	40WP	0.25 LB A/A	PRE	10.0	10.0	10.0
DIMENSION	40WP	0.25 LB A/A	6WAT			
DIMENSION	40WP	0.5 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.5 LB A/A	PRE	10.0	10.0	10.0

Table 5 (Continued). Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate		(--------Phytotoxicity-------)		
			Timing	04-25	04-30	05-10
BARRICADE	65WDG	0.65 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.75 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.65 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.325 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.325 LB A/A	6 WAT			
BARRICADE	65WDG	0.325 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.325 LB A/A	6 WAT			
BETASAN	4EC	9.4 OZ/M	PRE	10.0	10.0	10.0

Table6. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate		(--------Phytotoxicity-------)		
			Timing	05-17	06-04	06-12
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	7.0	6.5
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	7.0	6.5
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.25 LB A/A	PRE	10.0	7.0	6.5
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	7.0	6.5
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE			
BARRICADE	4FL	0.75 LB A/A	PRE	10.0	10.0	10.0
CHECK				10.0	10.0	10.0
BETASAN	4EC	7.3 OZ/M	PRE	10.0	10.0	10.0

Table 6 (Continued). Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate	Timing	(--------Phytotoxicity-------) 05-17	06-04	06-12
BETASAN	4EC	4.4 OZ/M	PRE	10.0	10.0	10.0
BETASAN	4EC	2.9 OZ/M	6WAT			
CHECK				10.0	10.0	10.0
PENDULUM	3.3EC	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.3EC	2 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.8CS	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.8CS	2.0 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	2G	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	2G	2 LB A/A	PRE	10.0	10.0	10.0
CHECK				10.0	10.0	10.0
DIMENSION	40WP	0.25 LB A/A	PRE	10.0	10.0	10.0
DIMENSION	40WP	0.25 LB A/A	6WAT			
DIMENSION	40WP	0.5 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.5 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.65 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.75 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.65 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.325 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.325 LB A/A	6 WAT			
BARRICADE	65WDG	0.325 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.325 LB A/A	6 WAT			
BETASAN	4EC	9.4 OZ/M	PRE	10.0	10.0	10.0

Table 7. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate	Timing	(--------Phytotoxicity-------) 06-27	07-11	07-24
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.125 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.125 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			

Table 7 (Continued). Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate	Timing	(--------Phytotoxicity-------) 06-27	07-11	07-24
MESOTRIONE	4SC	0.25 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.25 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
MESOTRIONE	4SC	0.5 LB A/A	6WAT			
X-77	L	0.25 % V/V	6WAT			
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0	10.0	10.0
X-77	L	0.25 % V/V	PRE			
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE			
BARRICADE	4FL	0.75 LB A/A	PRE	10.0	10.0	10.0
CHECK				10.0	10.0	10.0
BETASAN	4EC	7.3 OZ/M	PRE	10.0	10.0	10.0
BETASAN	4EC	4.4 OZ/M	PRE	10.0	10.0	10.0
BETASAN	4EC	2.9 OZ/M	6WAT			
CHECK				10.0	10.0	10.0
PENDULUM	3.3EC	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.3EC	2 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.8CS	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	3.8CS	2.0 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	2G	1.5 LB A/A	PRE	10.0	10.0	10.0
PENDULUM	2G	2 LB A/A	PRE	10.0	10.0	10.0
CHECK				10.0	10.0	10.0
DIMENSION	40WP	0.25 LB A/A	PRE	10.0	10.0	10.0
DIMENSION	40WP	0.25 LB A/A	6WAT			
DIMENSION	40WP	0.5 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.5 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.65 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.75 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.65 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.325 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	4FL	0.325 LB A/A	6 WAT			
BARRICADE	65WDG	0.325 LB A/A	PRE	10.0	10.0	10.0
BARRICADE	65WDG	0.325 LB A/A	6 WAT			
BETASAN	4EC	9.4 OZ/M	PRE	10.0	10.0	10.0

Table 8. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* of the percent thinning of the *Poa annua* (of the total plot area). Rating taken on May 24, 2002.

Treatment	Form	Rate	Timing	% Thinning
MESOTRIONE	4SC	0.125 LB A/A	PRE	0.0d[1]
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	PRE	0.0d
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.5 LB A/A	PRE	1.7d
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.125 LB A/A	PRE	0.0d
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.125 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.125 LB A/A	PRE	0.0d
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.25 LB A/A	PRE	0.0d
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.5 LB A/A	PRE	0.0d
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.5 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.5 LB A/A	PRE	0.0d
X-77	L	0.25 % V/V	PRE	
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE	
BARRICADE	4FL	0.75 LB A/A	PRE	1.7d
CHECK				0.0d
BETASAN	4EC	7.3 OZ/M	PRE	0.0d
BETASAN	4EC	4.4 OZ/M	PRE	1.7d
BETASAN	4EC	2.9 OZ/M	6WAT	
CHECK				0.0d
PENDULUM	3.3EC	1.5 LB A/A	PRE	23.3b
PENDULUM	3.3EC	2 LB A/A	PRE	33.3a
PENDULUM	3.8CS	1.5 LB A/A	PRE	5.3cd
PENDULUM	3.8CS	2.0 LB A/A	PRE	3.3d
PENDULUM	2G	1.5 LB A/A	PRE	0.3d
PENDULUM	2G	2 LB A/A	PRE	1.7d
CHECK				0.0d
DIMENSION	40WP	0.25 LB A/A	PRE	0.0d
DIMENSION	40WP	0.25 LB A/A	6WAT	
DIMENSION	40WP	0.5 LB A/A	PRE	9.0c

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Table 8 (Continued). Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* of the pecerent thinning of the *Poa annua* .

Treatment	Form	Rate	Timing	% Thinning
BARRICADE	65WDG	0.5 LB A/A	PRE	0.0d
BARRICADE	65WDG	0.65 LB A/A	PRE	0.3d
BARRICADE	65WDG	0.75 LB A/A	PRE	1.7d
BARRICADE	4FL	0.65 LB A/A	PRE	0.0d
BARRICADE	4FL	0.325 LB A/A	PRE	0.3d
BARRICADE	4FL	0.325 LB A/A	6 WAT	
BARRICADE	65WDG	0.325 LB A/A	PRE	0.0d
BARRICADE	65WDG	0.325 LB A/A	6 WAT	
BETASAN	4EC	9.4 OZ/M	PRE	1.7d

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Table 9. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* of the percent control of smooth crabgrass taken on Aug 16, 2002. Commercially acceptable control was considered to be 85% and above.

Treatment	Form	Rate	Timing	% Control
MESOTRIONE	4SC	0.125 LB A/A	PRE	11.7
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	PRE	11.7
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.5 LB A/A	PRE	10.0
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.125 LB A/A	PRE	23.3
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.125 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.125 LB A/A	PRE	13.3
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.25 LB A/A	PRE	16.7
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.25 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.5 LB A/A	PRE	11.7
X-77	L	0.25 % V/V	PRE	
MESOTRIONE	4SC	0.5 LB A/A	6WAT	
X-77	L	0.25 % V/V	6WAT	
MESOTRIONE	4SC	0.5 LB A/A	PRE	25.0
X-77	L	0.25 % V/V	PRE	
CLOQUINTOCET	0.83EC	0.125 LB A/A	PRE	

Table 9 (Continued). Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* of the percent control of smooth crabgrass taken on Aug 16, 2002. Commercially acceptable control was considered to be 85% and above.

Treatment	Form	Rate	Timing	% Control
BARRICADE	4FL	0.75 LB A/A	PRE	68.3
CHECK				0.0
BETASAN	4EC	7.3 OZ/M	PRE	38.3
BETASAN	4EC	4.4 OZ/M	PRE	55.0
BETASAN	4EC	2.9 OZ/M	6WAT	
CHECK				0.0
PENDULUM	3.3EC	1.5 LB A/A	PRE	8.3
PENDULUM	3.3EC	2 LB A/A	PRE	23.3
PENDULUM	3.8CS	1.5 LB A/A	PRE	20.0
PENDULUM	3.8CS	2.0 LB A/A	PRE	36.7
PENDULUM	2G	1.5 LB A/A	PRE	33.3
PENDULUM	2G	2 LB A/A	PRE	33.3
CHECK				0.0
DIMENSION	40WP	0.25 LB A/A	PRE	95.0
DIMENSION	40WP	0.25 LB A/A	6WAT	
DIMENSION	40WP	0.5 LB A/A	PRE	93.3
BARRICADE	65WDG	0.5 LB A/A	PRE	68.3
BARRICADE	65WDG	0.65 LB A/A	PRE	81.7
BARRICADE	65WDG	0.75 LB A/A	PRE	83.3
BARRICADE	4FL	0.65 LB A/A	PRE	73.3
BARRICADE	4FL	0.325 LB A/A	PRE	71.7
BARRICADE	4FL	0.325 LB A/A	6 WAT	
BARRICADE	65WDG	0.325 LB A/A	PRE	83.3
BARRICADE	65WDG	0.325 LB A/A	6 WAT	
BETASAN	4EC	9.4 OZ/M	PRE	50.0

Progress Report: Preemergence Control of *Poa annua*

Dr. T. L. Watschke, J. A. Borger and J.T.Brosnan[1]

Introduction

This study is being conducted on a simulated putting green (*Poa annua*/A4 creeping bentgrass) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study is to determine the efficacy (over time) of selected herbicides applied in the late summer for the preemergence control of *Poa annua*.

Methods and Materials

This study is a randomized complete block design with three replications. All of the treatments were applied on August 23, 2001 using a three foot CO_2 powered boom sprayer calibrated to deliver 80 gpa using two, flat fan, 6504 nozzles at 40 psi.

Results and Discussion

The amount of *Poa annua* in the study area was very low and remained that way (Table1). In the spring of 2002, severe injury was found on turf treated with Dimension (Table 2). Recovery from the Dimension induced injury has been very slow (Table 3). No injury was observed on turf treated with bensulide.

[1] Professor, Research Assistant and Turfgrass Student, respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Rating of percent cover of *Poa annua* in a simulated *Poa annua*/A4 creeping bentgrass putting green on 8-22-01 and 5-10-02.

Treatment	Form	Rate (LB Ai/A)	(----% *Poa* Cover------) 8-22-01	5-10-02
Bensulide	4L	12.5	1.0a[1]	2.0a
Dimension	40WP	0.5	1.0a	2.0a
Check			1.0a	2.0a

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 2. Rating of phytotoxicity of a simulated *Poa annua*/A4 creeping bentgrass putting green on 4-9-02 and 4-17-02.

Treatment	Form	Rate (lb ai/A)	(----Phytotoxicity--------) 4-9-02	4-17-02
Bensulide	4L	12.5	10.0[1]	10.0
Dimension	40WP	0.5	2.0	2.0
Check			10.0	10.0

1 - 0 = brown, 7 = acceptable, and 10 = dark green

Table 3. Rating of quality of a simulated *Poa annua*/A4 creeping bentgrass putting green on 5-10-02.

Treatment	Form	Rate (lb ai/A)	5-10-02
Bensulide	4L	12.5	9.0[1]
Dimension	40WP	0.5	5.0
Check			9.0

1 – 0 = worst, 7 = acceptable, and 10 = best.

Pre/Post Emergence (2-3 Leaf Stage) Smooth Crabgrass Control and Phytotoxicity Study

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

Preemergence smooth crabgrass (*Digitaria ischaemum*) control and phytotoxicity evaluations were conducted on a mature fairway height stand of "SR 4200"perennial ryegrass (*Lolium perenne* L.)/*Poa annua* at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objectives of the study were to determine the efficacy and phytotoxicity of selected preemergence and post emergence herbicides for the control of smooth crabgrass in fairway height perennial ryegrass.

Methods and Materials

This study was a randomized complete block design with three replications. Treatments were applied on June 17, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi.

The test site was maintained at 0.5 inches to simulate a golf course fairway.

Results and Discussion

The two highest rates of mesotrione were found to cause unacceptable phytotoxicity (ratings below 7) on the June 24 rating date (one week after application) (Table 1).

Crabgrass control was rated on August 16 and Dimension 40WP at 0.5 lbs ai/A, Dimension 40WP plus 2 oz/M of MacroSorb Foliar, Acclaim Extra plus pendimethalin, Drive 75 DF with MSO, without MSO, and with MacroSorb Foliar, at the 0.75 lbs ai/A rate, and Drive 75DF at the 0.5 lbs ai/A rate with MacroSorb Foliar all provided commercially acceptable crabgrass control (Table 2). It appears that the 2 oz/M MacroSorb Foliar tank mix addition to Drive 75DF enhanced efficacy.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Evaluations of "SR 4200" fairway height perennial ryegrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best taken in 2002.

Treatment	Form	Rate	(--------Phytotoxicity-------)			
		(lbs ai/A)	6-24	7-01	7-15	8-12
DIMENSION	40WP	0.25	10.0	10.0	10.0	10.0
DIMENSION	40WP	0.25	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
DIMENSION	40WP	0.5	9.7	10.0	10.0	10.0
DIMENSION	40WP	0.5	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
ACCLAIM EXTRA	0.57EW	0.12	9.3	10.0	10.0	10.0
PENDIMETHLIN	60WDG	1.5				
CHECK			9.7	10.0	10.0	10.0
MESOTRIONE	4SC	0.125	8.0	10.0	10.0	10.0
X-77	L	0.25 % V/V				
MESOTRIONE	4SC	0.25	5.3	10.0	10.0	10.0
X-77	L	0.25 % V/V				
MESOTRIONE	4SC	0.5	3.0	10.0	10.0	10.0
X-77	L	0.25 % V/V				
DRIVE	75DF	0.75	9.3	10.0	10.0	10.0
DRIVE	75DF	0.75	9.7	10.0	10.0	10.0
MSO	L	1 % V/V				
DRIVE	75DF	0.75	10.0	10.0	10.0	10.0
MSO	L	1 % V/V				
MACROSORB FOLIAR	L	2 OZ/M				
ACCLAIM EXTRA	0.57EW	0.12	9.7	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M				
DRIVE	75DF	0.5	10.0	10.0	10.0	10.0
MSO	L	1 % V/V				
MACROSORB FOLIAR	L	2 OZ/M				

Table 2. Evaluations of "SR 4200" fairway height perennial ryegrass/*Poa annua* of the percent control of smooth crabgrass taken on Aug 16, 2002. Commercially acceptable control was considered to be 85% and above.

Treatment	**Form**	**Rate (lbs ai/A)**	**% Control**
DIMENSION	40WP	0.25	50.0
DIMENSION	40WP	0.25	71.7
MACROSORB FOLIAR	L	2 OZ/M	
DIMENSION	40WP	0.5	86.7
DIMENSION	40WP	0.5	93.3
MACROSORB FOLIAR	L	2 OZ/M	
ACCLAIM EXTRA	0.57EW	0.12	95.0
PENDIMETHLIN	60WDG	1.5	
CHECK			0.0
MESOTRIONE	4SC	0.125	51.7
X-77	L	0.25 % V/V	
MESOTRIONE	4SC	0.25	46.7
X-77	L	0.25 % V/V	
MESOTRIONE	4SC	0.5	50.0
X-77	L	0.25 % V/V	
DRIVE	75DF	0.75	88.3
DRIVE	75DF	0.75	88.3
MSO	L	1 % V/V	
DRIVE	75DF	0.75	91.7
MSO	L	1 % V/V	
MACROSORB FOLIAR	L	2 OZ/M	
ACCLAIM EXTRA	0.57EW	0.12	48.3
MACROSORB FOLIAR	L	2 OZ/M	
DRIVE	75DF	0.5	91.7
MSO	L	1 % V/V	
MACROSORB FOLIAR	L	2 OZ/M	

Seedhead Suppression of Annual Bluegrass on a Putting Green

Dr. T. L. Watschke, J. A. Borger and J. T. Brosnan[1]

Introduction

This study was conducted on a mixed stand of creeping bentgrass (*Agrostis stolonifera*) and *Poa annua* at the Penn State Blue Golf Course in State College, PA. The objective of the study was to evaluate selected growth regulators, with and without additional adjuvants, for the seedhead suppression of *Poa annua*.

Methods and Materials

Treatments were applied on April 12, 2002 using a three-foot CO2 powered boom sprayer calibrated to deliver 40 GPA using two 6504 flat fan nozzles at 40 psi. The turf was maintained using cultural practices for irrigation, mowing, and fertilization that would be typical for a green. However, core cultivation was preformed on the study area on May 1, 2002 and mowing resumed on May 5, 2002.

Results and Discussion

All treatments provided at least 70% seedhead suppression on the May 10 rating date (Table 1) compared to the untreated control. Embark T/O at 40 oz/A with Ferromec at 5 oz/A and the combination of Proxy and Primo MAXX at 5 oz/M and 0.125 oz/M respectively had significantly less seedhead suppression than Embark T/O at 40 oz/A, Embark T/O at 40 oz/A with Ferromec at 5 oz/M and Seaweed Cocktail at 0.25 gal/A, and Embark T/O at 40 oz/A with MacroSorb Foliar at 8 oz/M.

On April 15, no treated turf was rated below 7 (an acceptable level) (Table 2). However, on April 18, turf treated with Embark T/O at 40 oz/A, Embark T/O at 40 oz/A with Ferromec at 5 oz/M and MacroSorb Foliar at 8 oz/M had color ratings slightly below acceptable (6.7). On April 26, turf treated with Proxy at 5 oz/M and Primo MAXX at 0.125 oz/M and Proxy at 5 oz/M with Primo MAXX at 0.125 oz/M plus MacroSorb Foliar at 4 and 8 oz/M had color comparable to the untreated check. It appeared the best treatments, considering seedhead suppression and color, were the Proxy at 5 oz/M and Primo MAXX at 0.125 oz/M plus MacroSorb Foliar at both 4 and 8 oz/M.

On May 1, the experimental site was core cultivated. The rate of hole closure was measured on May 2, May 3, May 4, May 5, May 6, May 7, May 8, and May 9, 2002 (Table 3). Mowing resumed on May 5, at which point hole closure was accelerated as the weight of the mowing machine compressed the side walls of the holes. However, the mowing did not influence the differences found in the rate of hole closure on May 6 and May 7. On these two days the rate of hole closure was effected by some of treatments compared to the untreated check. However, treatments that slowed the rate of hole closure on May 6 were not necessarily found to have the same effect on May 7. Overall, with the exception of turf treated with Embark T/O alone, the other treatments did not slow closure more than a day or two.

[1] Professor, Research Assistant and Turfgrass Student respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Ratings of percent suppression of *Poa annua* seedheads on a *Poa annua*/creeping bentgrass putting green.

Treatment	Form	Rate	4-16-02	5-10-02
		oz/A	(-----% Suppression-----)	
EMBARK T/O	0.2L	40	76.7a[1]	86.0a
EMBARK T/O	0.2L	40	50.0a	70.0b
FERROMEC	L	5 OZ/M		
EMBARK T/O	0.2L	40	80.0a	95.0a
FERROMEC	L	5 OZ/M		
SEAWEED COCKTAIL	L	0.25 GAL/A		
CHECK			0.0b	0.0c
EMBARK T/O	0.2L	40	86.7a	80.0ab
MACROSORB FOLIAR	L	4 OZ/M		
EMBARK T/O	0.2L	40	60.0a	86.7a
FERROMEC	L	5 OZ/M		
MACROSORB FOLIAR	L	4 OZ/M		
EMBARK T/O	0.2L	40	80.0a	85.0ab
FERROMEC	L	5 OZ/M		
MACROSORB FOLIAR	L	8 OZ/M		
EMBARK T/O	0.2L	40	73.3a	88.3a
MACROSORB FOLIAR	L	8 OZ/M		
PROXY	2SL	5 OZ/M	86.7a	70.0b
PRIMO MAXX	1MEC	0.125 OZ/M		
PROXY	2SL	5 OZ/M	56.7a	80.0ab
PRIMO MAXX	1MEC	0.125 OZ/M		
MACROSORB FOLIAR	L	4 OZ/M		
PROXY	2SL	5 OZ/M	66.7a	83.3ab
PRIMO MAXX	1MEC	0.125 OZ/M		
MACROSORB FOLIAR	L	8 OZ/M		

1 - Means followed by same letter do not significantly differ (P=0.05 Duncan's New MRT)

Table 2. Ratings of color (2002) on a *Poa annua*/creeping bentgrass putting green.

Treatment	Form	Rate	4-15	4-18	4-26
		oz/A	(---------------Color----------------)		
EMBARK T/O	0.2L	40	7.0[1]	6.7	6.2
EMBARK T/O	0.2L	40	8.0	8.3	7.7
FERROMEC	L	5 OZ/M			
EMBARK T/O	0.2L	40	8.2	7.0	7.3
FERROMEC	L	5 OZ/M			
SEAWEED COCKTAIL	L	0.25 GAL/A			
CHECK			7.7	8.3	9.3
EMBARK T/O	0.2L	40	7.2	7.0	6.3
MACROSORB FOLIAR	L	4 OZ/M			
EMBARK T/O	0.2L	40	8.3	7.0	6.8
FERROMEC	L	5 OZ/M			
MACROSORB FOLIAR	L	4 OZ/M			
EMBARK T/O	0.2L	40	7.9	6.7	6.8
FERROMEC	L	5 OZ/M			
MACROSORB FOLIAR	L	8 OZ/M			
EMBARK T/O	0.2L	40	7.3	7.7	7.0
MACROSORB FOLIAR	L	8 OZ/M			
PROXY	2SL	5 OZ/M	7.3	8.3	9.0
PRIMO MAXX	1MEC	0.125 OZ/M			
PROXY	2SL	5 OZ/M	7.7	8.3	9.3
PRIMO MAXX	1MEC	0.125 OZ/M			
MACROSORB FOLIAR	L	4 OZ/M			
PROXY	2SL	5 OZ/M	7.6	8.3	9.0
PRIMO MAXX	1MEC	0.125 OZ/M			
MACROSORB FOLIAR	L	8 OZ/M			

1 – Rating scale of 0 = brown, 7 = acceptable, 10 = dark green.

Table 3. Ratings of core cultivation hole diameter (mm) in 2002 on a *Poa annua*/creeping bentgrass putting green.

Treatment	Form	Rate oz/A	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9
EMBARK T/O	0.2L	40	14.7ab[1]	14.8a	12.2a	10.9a	6.9abc	7.0a	4.1a	0.9a
EMBARK T/O	0.2L	40	14.6ab	14.8a	10.8a	8.9a	5.2bc	4.0bc	2.4a	0.5a
FERROMEC	L	5 OZ/M								
EMBARK T/O	0.2L	40	14.7ab	14.7a	12.2a	8.2a	4.8bc	3.0c	2.3a	0.4a
FERROMEC	L	5 OZ/M								
SEAWEED COCKTAIL	L	0.25 GAL/A								
CHECK			14.1ab	13.4abc	11.2a	8.3a	3.7c	3.1c	2.7a	0.9a
EMBARK T/O	0.2L	40	14.9a	14.6a	11.5a	9.7a	7.5ab	5.6ab	3.2a	1.0a
MACROSORB FOLIAR	L	4 OZ/M								
EMBARK T/O	0.2L	40	14.8ab	14.8a	13.2a	9.6a	7.4ab	4.0bc	2.3a	0.7a
FERROMEC	L	5 OZ/M								
MACROSORB FOLIAR	L	4 OZ/M								
EMBARK T/O	0.2L	40	14.9a	14.7a	13.3a	11.7a	7.2ab	4.6bc	2.6a	1.3a
FERROMEC	L	5 OZ/M								
MACROSORB FOLIAR	L	8 OZ/M								
EMBARK T/O	0.2L	40	14.7ab	14.1ab	12.6a	11.1a	9.6a	5.8ab	3.4a	1.7a
MACROSORB FOLIAR	L	8 OZ/M								
PROXY	2SL	5 OZ/M	14.6ab	12.8bc	10.3a	9.7a	5.2bc	3.8bc	2.2a	0.7a
PRIMO MAXX	1MEC	0.125 OZ/M								
PROXY	2SL	5 OZ/M	13.7b	11.9c	11.2a	9.8a	6.7abc	2.6c	2.0a	1.0a
PRIMO MAXX	1MEC	0.125 OZ/M								
MACROSORB FOLIAR	L	4 OZ/M								
PROXY	2SL	5 OZ/M	14.1ab	14.5a	12.3a	9.2a	6.4abc	3.8bc	1.9a	0.9a
PRIMO MAXX	1MEC	0.125 OZ/M								
MACROSORB FOLIAR	L	8 OZ/M								

1 - Means followed by same letter do not significantly differ (P=0.05 Duncan's New MRT)

Post Emergence Control of Broadleaf Weeds Study II

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature stand of perennial ryegrass (*Lolium perenne* L.) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the efficacy of selected broadleaf weed herbicides for the control of dandelion, common plantain, and white clover.

Methods and Materials

The study was a randomized complete block design with three replications. All of the treatments were applied on June 7, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. Ratings were taken on May 31, and July 29, 2002. Each plot was rated for individual weed cover prior to treatment.

The site was mowed at one inch with a rotary mower with clippings returned.

Results and Discussion

None of the treatments caused phytotoxicity to the turfgrass (Table 1). Weed phytotoxicity varied and was not evident by the July 2 rating date (Table 2).

Control was rated on July 29, approximately seven weeks after the treatments were applied. All treatments provided excellent control of common plantain (Table 3). The control of dandelion was highly variable, however PCC-1174 plus PCC-1195 plus PCC-1133 plus PCC-140 plus LI-700 at both rates and 2,4-D Amine plus LI-700 provided significantly better control than PCC-1195 plus LI-700 at either rate. Most treatments provided good to excellent control of whte clover. The lowest efficacy ratings tended to be assigned to PCC-1195 plus LI-700 and PCC-1174 plus PCC-1133 plus LI-700, however statistical separation was not found between 34.4% control and 75 % control indicating large variation in the data. Clearly, the practical value of acquiring 75% control versus 34 % control would be important.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Evaluations of perennial ryegrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(-----------------Phytotoxicity---------------)			
			6-14-02	**6-21-02**	**7-2-02**	**7-29-02**
PCC-1195	0.208EC	0.0088 LB A/A	10.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V				
PCC-1195	0.208EC	0.0176 LB A/A	9.7	10.0	10.0	10.0
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1133	2.5L	20.2 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	9.7	10.0	10.0	10.0
PCC-1133	2.5L	40.4 LB A/A				
LI-700	L	0.25 % V/V				
PCC-140	1.5L	0.063 OZ/A	9.7	10.0	10.0	10.0
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
LI-700	L	0.25 % V/V				
CHECK			10.0	10.0	10.0	10.0
PCC-1174	L	1 % V/V	9.7	10.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	9.7	10.0	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				

Table 1 (continued). Evaluations of perennial ryegrass phytotoxicity where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(-----------------Phytotoxicity----------------) 6-14-02	6-21-02	7-2-02	7-29-02
PCC-1174	L	1 % V/V	9.7	10.0	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	9.3	10.0	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
2,4-D AMINE	3.8L	1 LB A/A	10.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V				
CHECK			10.0	10.0	10.0	10.0

Table 2. Evaluations of broadleaf weed phytotoxicity where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(-----------------Phytotoxicity--------------)			
			6-14-02	6-21-02	7-2-02	7-29-02
PCC-1195	0.208EC	0.0088 LB A/A	8.0	9.7	10.0	10.0
LI-700	L	0.25 % V/V				
PCC-1195	0.208EC	0.0176 LB A/A	7.3	9.3	10.0	10.0
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0
PCC-1133	2.5L	20.2 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	7.7	8.7	10.0	10.0
PCC-1133	2.5L	40.4 LB A/A				
LI-700	L	0.25 % V/V				
PCC-140	1.5L	0.063 OZ/A	8.7	9.3	10.0	10.0
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	7.7	9.7	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
LI-700	L	0.25 % V/V				
CHECK			10.0	9.7	10.0	10.0
PCC-1174	L	1 % V/V	7.7	9.3	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	7.0	9.7	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	7.3	9.7	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	6.3	9.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	6.7	8.7	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				

Table 2 (continued). Evaluations of broadleaf weed phytotoxicity where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(------------------Phytotoxicity---------------) 6-14-02	6-21-02	7-2-02	7-29-02
PCC-1174	L	1 % V/V	6.0	8.7	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	20.2 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	6.7	7.3	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-1133	2.5L	40.4 OZ/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	7.3	9.0	10.0	10.0
PCC-1195	0.208EC	0.0088 LB A/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
PCC-1174	L	1 % V/V	6.0	8.0	10.0	10.0
PCC-1195	0.208EC	0.0176 LB A/A				
PCC-140	1.5L	0.063 LB A/A				
LI-700	L	0.25 % V/V				
2,4-D AMINE	3.8L	1 LB A/A	8.0	9.3	10.0	10.0
LI-700	L	0.25 % V/V				
CHECK			10.0	10.0	10.0	10.0

Table 3. Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on July 29, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
PCC-1195	0.208EC	0.0088 LB A/A	33.3bc[1]	25.0cd	88.9a
LI-700	L	0.25 % V/V			
PCC-1195	0.208EC	0.0176 LB A/A	36.1bc	83.3a	100.0a
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	72.2ab	34.4bcd	100.0a
PCC-1133	2.5L	20.2 OZ/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	83.3ab	59.2abc	100.0a
PCC-1133	2.5L	40.4 LB A/A			
LI-700	L	0.25 % V/V			
PCC-140	1.5L	0.063 OZ/A	66.7ab	95.8a	100.0a
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	63.9ab	68.3abc	100.0a
PCC-1195	0.208EC	0.0088 LB A/A			
PCC-1133	2.5L	20.2 OZ/A			
LI-700	L	0.25 % V/V			
CHECK			0.0c	8.3d	0.0b
PCC-1174	L	1 % V/V	83.3ab	68.9abc	100.0a
PCC-1195	0.208EC	0.0088 LB A/A			
PCC-1133	2.5L	40.4 OZ/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	55.6ab	68.3abc	100.0a
PCC-1195	0.208EC	0.0176 LB A/A			
PCC-1133	2.5L	20.2 OZ/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	60.0ab	54.2abc	100.0a
PCC-1195	0.208EC	0.0176 LB A/A			
PCC-1133	2.5L	40.4 OZ/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	100.0a	100.0a	100.0a
PCC-1195	0.208EC	0.0088 LB A/A			
PCC-1133	2.5L	20.2 OZ/A			
PCC-140	1.5L	0.063 LB A/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	72.2ab	100.0a	83.3a
PCC-1195	0.208EC	0.0088 LB A/A			
PCC-1133	2.5L	40.4 OZ/A			
PCC-140	1.5L	0.063 LB A/A			
LI-700	L	0.25 % V/V			

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Table 3 (continued). Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on July 29, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
PCC-1174	L	1 % V/V	77.8ab[1]	100.0a	100.0a
PCC-1195	0.208EC	0.0176 LB A/A			
PCC-1133	2.5L	20.2 OZ/A			
PCC-140	1.5L	0.063 LB A/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	66.7ab	88.9a	100.0a
PCC-1195	0.208EC	0.0176 LB A/A			
PCC-1133	2.5L	40.4 OZ/A			
PCC-140	1.5L	0.063 LB A/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	88.9a	94.4a	66.7a
PCC-1195	0.208EC	0.0088 LB A/A			
PCC-140	1.5L	0.063 LB A/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	55.6ab	94.4a	66.7a
PCC-1195	0.208EC	0.0176 LB A/A			
PCC-140	1.5L	0.063 LB A/A			
LI-700	L	0.25 % V/V			
2,4-D AMINE	3.8L	1 LB A/A	91.7a	75.0ab	100.0a
LI-700	L	0.25 % V/V			
CHECK			0.0c	0.0d	0.0b

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT).

Post Emergence Control of Broadleaf Weeds Study III

Dr. T. L. Watschke, J. A. Borger, J. T. Brosnan and C. J. Lyons[1]

Introduction

This study was conducted on a mature stand of perennial ryegrass (*Lolium perenne* L.) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the efficacy of selected broadleaf weed herbicides for the control of dandelion, common plantain, and white clover.

Methods and Materials

The study was a randomized complete block design with three replications. All of the treatments were applied on June 7, 2002 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. Ratings were taken on May 31, June 28, July 12, and July 29, 2002. Each plot was rated for individual weed cover prior to treatment.

The site was mowed at one inch with a rotary mower with clippings returned.

Results and Discussion

Many of the treatments caused some early phytotoxicity to the turf, but none was rated unacceptable and was not observed two weeks following application (Table 1). Phytotoxicity to weed species varied across the treatments and was not observed after June 21 (Table 2).

All treatments provided excellent control of white clover and common plantain on all rating dates (Tables 3, 4 and 5). Although control was rated as being excellent, on the July 29 rating date (Table 5) clover treated with MEC Amine D and Liberate had some recovery. With regard to dandelion control, there was considerable variation across the treatments and from rating date to rating date (Tables 3, 4 and 5). On June 28, PCC-1174 plus UHS-308 with LI-700, MEC Amine D with Liberate, and Trimec Classic tended to provide the best dandelion control (Table 3). On the July 12 rating date, some treatments were found to increase efficacy compared to the June 28 rating, but most had less efficacy. On the July 29 rating date, most of the trends found on July 12 remained consistent. A notable exception was Chaser Ultra which steadily increased in efficacy on dandelions across the rating dates to a point where it was numerically the best on July 29 (Table 5). The low rate of Chaser Ultra appeared to be enhanced with the addition of MacroSorb Foliar.

[1] Professor, Research Assistant and Turfgrass Students respectively, Department of Crop and Soil Sciences, Penn State University, University Park, PA, 16802

Table 1. Evaluations of perennial ryegrass phytotoxicity in 2002 where 0 = worst, 7 = acceptable and 10 = best.

Treatment	**Form**	**Rate**	**(--------Phytotoxicity----------) 6-14**	**6-21**	**6-28**	**7-2**	**7-12**
PCC-1174	L	1 % V/V	7.3	10.0	10.0	10.0	10.0
UHS-308	L	4 PT/A					
LI-700	L	0.25 % V/V					
PCC-1174	L	1 % V/V	8.0	10.0	10.0	10.0	10.0
UHS-308	L	3 PT/A					
LI-700	L	0.25 % V/V					
PCC-1174	L	1 % V/V	10.0	10.0	10.0	10.0	10.0
UHS-308	L	2 PT/A					
LI-700	L	0.25 % V/V					
CHECK			10.0	10.0	10.0	10.0	10.0
MEC AMINE D	3.96L	4 PT/A	8.3	10.0	10.0	10.0	10.0
MEC AMINE D	3.96L	2 PT/A	8.3	10.0	10.0	10.0	10.0
MEC AMINE D	3.96L	2 PT/A	8.3	10.0	10.0	10.0	10.0
LIBERATE	L	0.25 % V/V					
MEC AMINE D	3.96L	2 PT/A	8.0	10.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V					
MEC AMINE D	3.96L	2 PT/A	7.5	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M					
CHASER ULTRA	4.68L	3 PT/A	7.7	10.0	10.0	10.0	10.0
CHASER ULTRA	4.68L	1.5 PT/A	8.0	10.0	10.0	10.0	10.0
CHASER ULTRA	4.68L	1.5 PT/A	8.7	10.0	10.0	10.0	10.0
LIBERATE	L	0.25 % V/V					
CHASER ULTRA	4.68L	1.5 PT/A	7.7	10.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V					
CHASER ULTRA	4.68L	1.5 PT/A	8.5	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M					
TRIMEC CLASSIC	3.32L	4 PT/A	7.7	10.0	10.0	10.0	10.0
TRIMEC CLASSIC	3.32L	2 PT/A	8.7	10.0	10.0	10.0	10.0
TRIMEC CLASSIC	3.32L	2 PT/A	9.0	10.0	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M					
TRIMEC CLASSIC	3.32L	2 PT/A	8.3	10.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V					
TRIMEC CLASSIC	3.32L	2 PT/A	8.3	10.0	10.0	10.0	10.0
LIBERATE	L	0.25 % V/V					
CHECK			10.0	10.0	10.0	10.0	10.0

Table 2. Evaluations of broadleaf weeds phytotoxicity in 2002 where 0 = worst, 7 = acceptable and 10 = best.

Treatment	Form	Rate	(--------Phytotoxicity----------) 6-14	6-21	6-28	7-2	7-12
PCC-1174	L	1 % V/V	6.8	7.3	10.0	10.0	10.0
UHS-308	L	4 PT/A					
LI-700	L	0.25 % V/V					
PCC-1174	L	1 % V/V	6.7	6.3	10.0	10.0	10.0
UHS-308	L	3 PT/A					
LI-700	L	0.25 % V/V					
PCC-1174	L	1 % V/V	8.0	7.3	10.0	10.0	10.0
UHS-308	L	2 PT/A					
LI-700	L	0.25 % V/V					
CHECK			10.0	10.0	10.0	10.0	10.0
MEC AMINE D	3.96L	4 PT/A	6.0	5.3	10.0	10.0	10.0
MEC AMINE D	3.96L	2 PT/A	8.0	6.3	10.0	10.0	10.0
MEC AMINE D	3.96L	2 PT/A	7.0	8.3	10.0	10.0	10.0
LIBERATE	L	0.25 % V/V					
MEC AMINE D	3.96L	2 PT/A	6.0	6.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V					
MEC AMINE D	3.96L	2 PT/A	6.7	6.3	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M					
CHASER ULTRA	4.68L	3 PT/A	5.7	5.7	10.0	10.0	10.0
CHASER ULTRA	4.68L	1.5 PT/A	6.0	6.0	10.0	10.0	10.0
CHASER ULTRA	4.68L	1.5 PT/A	5.7	6.7	10.0	10.0	10.0
LIBERATE	L	0.25 % V/V					
CHASER ULTRA	4.68L	1.5 PT/A	6.0	7.0	10.0	10.0	10.0
LI-700	L	0.25 % V/V					
CHASER ULTRA	4.68L	1.5 PT/A	6.3	5.7	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M					
TRIMEC CLASSIC	3.32L	4 PT/A	6.0	5.3	10.0	10.0	10.0
TRIMEC CLASSIC	3.32L	2 PT/A	7.3	7.3	10.0	10.0	10.0
TRIMEC CLASSIC	3.32L	2 PT/A	7.0	7.7	10.0	10.0	10.0
MACROSORB FOLIAR	L	2 OZ/M					
TRIMEC CLASSIC	3.32L	2 PT/A	6.3	5.3	10.0	10.0	10.0
LI-700	L	0.25 % V/V					
TRIMEC CLASSIC	3.32L	2 PT/A	8.0	5.0	10.0	10.0	10.0
LIBERATE	L	0.25 % V/V					
CHECK			10.0	10.0	10.0	10.0	10.0

Table 3. Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on June 28, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
PCC-1174	L	1 % V/V	42.8ab[1]	100.0a	100.0a
UHS-308	L	4 PT/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	77.8a	100.0a	100.0a
UHS-308	L	3 PT/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	50.0ab	100.0a	93.3a
UHS-308	L	2 PT/A			
LI-700	L	0.25 % V/V			
CHECK			-33.3c	0.0c	0.0b
MEC AMINE D	3.96L	4 PT/A	71.1ab	100.0a	100.0a
MEC AMINE D	3.96L	2 PT/A	-1.3bc	83.3b	93.3a
MEC AMINE D	3.96L	2 PT/A	83.3a	97.8a	100.0a
LIBERATE	L	0.25 % V/V			
MEC AMINE D	3.96L	2 PT/A	58.3ab	99.3a	93.3a
LI-700	L	0.25 % V/V			
MEC AMINE D	3.96L	2 PT/A	58.3ab	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
CHASER ULTRA	4.68L	3 PT/A	65.0ab	100.0a	100.0a
CHASER ULTRA	4.68L	1.5 PT/A	41.7ab	98.3a	100.0a
CHASER ULTRA	4.68L	1.5 PT/A	47.2ab	100.0a	93.3a
LIBERATE	L	0.25 % V/V			
CHASER ULTRA	4.68L	1.5 PT/A	38.9ab	98.7a	100.0a
LI-700	L	0.25 % V/V			
CHASER ULTRA	4.68L	1.5 PT/A	13.9abc	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
TRIMEC CLASSIC	3.32L	4 PT/A	73.9ab	99.2a	100.0a
TRIMEC CLASSIC	3.32L	2 PT/A	81.1a	100.0a	100.0a
TRIMEC CLASSIC	3.32L	2 PT/A	73.3ab	99.2a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
TRIMEC CLASSIC	3.32L	2 PT/A	33.3abc	100.0a	100.0a
LI-700	L	0.25 % V/V			
TRIMEC CLASSIC	3.32L	2 PT/A	43.3ab	97.2a	100.0a
LIBERATE	L	0.25 % V/V			
CHECK			-36.1c	0.0c	0.0b

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT). Positive numbers are a decrease in population and negative numbers are an increase in population.

Table 4. Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on July 12, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
PCC-1174	L	1 % V/V	32.8ab[1]	100.0a	100.0a
UHS-308	L	4 PT/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	65.6ab	100.0a	100.0a
UHS-308	L	3 PT/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	41.7ab	100.0a	100.0a
UHS-308	L	2 PT/A			
LI-700	L	0.25 % V/V			
CHECK			-100.0c	20.0b	22.2b
MEC AMINE D	3.96L	4 PT/A	63.3ab	100.0a	100.0a
MEC AMINE D	3.96L	2 PT/A	5.7ab	100.0a	100.0a
MEC AMINE D	3.96L	2 PT/A	79.3a	100.0a	100.0a
LIBERATE	L	0.25 % V/V			
MEC AMINE D	3.96L	2 PT/A	73.3ab	100.0a	100.0a
LI-700	L	0.25 % V/V			
MEC AMINE D	3.96L	2 PT/A	33.3ab	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
CHASER ULTRA	4.68L	3 PT/A	31.7ab	100.0a	100.0a
CHASER ULTRA	4.68L	1.5 PT/A	63.3ab	100.0a	100.0a
CHASER ULTRA	4.68L	1.5 PT/A	42.8ab	100.0a	100.0a
LIBERATE	L	0.25 % V/V			
CHASER ULTRA	4.68L	1.5 PT/A	30.0ab	100.0a	100.0a
LI-700	L	0.25 % V/V			
CHASER ULTRA	4.68L	1.5 PT/A	52.8ab	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
TRIMEC CLASSIC	3.32L	4 PT/A	54.4ab	99.2a	100.0a
TRIMEC CLASSIC	3.32L	2 PT/A	61.1ab	100.0a	100.0a
TRIMEC CLASSIC	3.32L	2 PT/A	56.7ab	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
TRIMEC CLASSIC	3.32L	2 PT/A	8.3ab	100.0a	100.0a
LI-700	L	0.25 % V/V			
TRIMEC CLASSIC	3.32L	2 PT/A	21.7ab	100.0a	100.0a
LIBERATE	L	0.25 % V/V			
CHECK			0.0b	0.0c	0.0c

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT). Positive numbers are a decrease in population and negative numbers are an increase in population.

Table 5. Rating of percent control of dandelion, white clover and broadleaf plantain population. Ratings taken on July 29, 2002.

Treatment	Form	Rate	Dand	Clover	Plantain
PCC-1174	L	1 % V/V	60.0abc[1]	100.0a	100.0a
UHS-308	L	4 PT/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	69.4abc	100.0a	100.0a
UHS-308	L	3 PT/A			
LI-700	L	0.25 % V/V			
PCC-1174	L	1 % V/V	41.7abc	100.0a	100.0a
UHS-308	L	2 PT/A			
LI-700	L	0.25 % V/V			
CHECK			0.0d	0.0c	0.0b
MEC AMINE D	3.96L	4 PT/A	72.2abc	100.0a	100.0a
MEC AMINE D	3.96L	2 PT/A	51.7abc	100.0a	100.0a
MEC AMINE D	3.96L	2 PT/A	61.7abc	88.9b	100.0a
LIBERATE	L	0.25 % V/V			
MEC AMINE D	3.96L	2 PT/A	58.3abc	100.0a	100.0a
LI-700	L	0.25 % V/V			
MEC AMINE D	3.96L	2 PT/A	50.0abc	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
CHASER ULTRA	4.68L	3 PT/A	83.3a	100.0a	100.0a
CHASER ULTRA	4.68L	1.5 PT/A	66.7abc	100.0a	100.0a
CHASER ULTRA	4.68L	1.5 PT/A	38.9bc	100.0a	100.0a
LIBERATE	L	0.25 % V/V			
CHASER ULTRA	4.68L	1.5 PT/A	47.2abc	100.0a	100.0a
LI-700	L	0.25 % V/V			
CHASER ULTRA	4.68L	1.5 PT/A	63.9abc	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
TRIMEC CLASSIC	3.32L	4 PT/A	46.1abc	100.0a	100.0a
TRIMEC CLASSIC	3.32L	2 PT/A	77.8ab	100.0a	100.0a
TRIMEC CLASSIC	3.32L	2 PT/A	66.7abc	100.0a	100.0a
MACROSORB FOLIAR	L	2 OZ/M			
TRIMEC CLASSIC	3.32L	2 PT/A	33.3cd	100.0a	100.0a
LI-700	L	0.25 % V/V			
TRIMEC CLASSIC	3.32L	2 PT/A	41.7abc	100.0a	100.0a
LIBERATE	L	0.25 % V/V			
CHECK			0.0d	0.0c	0.0b

1 - Means followed by same letter do not significantly differ (P=.05 Duncan's New MRT). Positive numbers are a decrease in population and negative numbers are an increase in population.

ANNUAL PROGRESS REPORT 2002

PROJECT: Cultivar Development of Greens-type *Poa annua*

David R. Huff and Roy Knupp
Dept of Agronomy, 116 ASI Bldg, Pennsylvania State University
University Park, PA ph:814-863-9805; fax:3-7043; email:drh15@psu.edu

The purpose of this research is not to replace creeping bentgrass as a putting surface but rather to offer an alternative grass to those golf courses where *Poa annua* L. is simply a better choice. One of the main problems with *P. annua* greens is that it normally exists as a patch-work of different strains. This patch-work results in a non-uniform putting surface due to differences among the strains in texture, seed head production, and vertical leaf extension rates after mowing. Differences in pest and environmental stress tolerance among the various strains also complicate the management of such a diverse population of plants. The main focus of this project is to develop commercial seed sources of uniform and stable cultivars of greens-type *P. annua*. Such products would allow superintendents and architects an opportunity to utilize *P. annua* putting surfaces rather than having to wait out the natural evolution of greens-types from the wild and weedy invasive annuals.

<u>Greens-type *Poa annua* evaluation trials</u>: Currently, we have a total of three trials at Penn State. Plot size of each trial is 1.2m x 1.2m with either two or three replicate plots of each cultivar. All plots were initially established from seed and are maintained at 1/8 inch mowing height. Turf quality ratings are collected on an as needed basis (usually every one or two weeks) from April thru November.

2000 Trial (two reps of 60 cultivar plots on sand-based root zone) - Many of the 60 selections continued to display superior turf quality throughout the 2002 growing season. Differences among selections have been observed for resistance to naturally occurring dollar spot disease and anthracnose disease. The summer of 2002 was particularly severe for anthracnose disease. However, four selections were relatively unaffected by the disease while the turf quality of the remaining 57 selections were impacted to varying degrees. The results thus far suggest that most selections in the breeding program are capable of being successfully established and maintained on sand-based root zones and that several selections have superior turf quality.

2001 Trial [three reps of 52 cultivar plots and 12 large (1.2m x 3m) demonstration plots on push-up, sand topdressed green) – The 12 large demonstration plots are of our "top 12" most elite cultivars. The regular cultivar plots contained several of the better performing cultivars from the 2000 trial along with more recently collected cultivars. Differential susceptibility to anthracnose was observed among all cultivars. Several of the more recently collected cultivars displayed turf quality equal to and in some cases exceeding some of the "top 12" cultivars. This result suggests that efforts in collecting new germplasms are still warranted.

2002 Trial [three reps of 46 cultivar plots and 12 large (1.2m x 3m) hyperodes weevil plots on push-up, sand topdressed green) – The 12 large hyperodes weevil plots contain a range of cultivars with different turf qualities. These plots were located adjacent to a row of pine trees that will hopefully encourage the developed hyperodes (annual bluegrass weevil) infestation. The regular cultivar plots also contain a range of variation including several of the better performing cultivars from the 2000 and 2001 trials along with more recently collected cultivars. This trial was established in Fall 2002 at the Landscape Management Research Center.

Collaborative trials:

Dr. David Green at Cal Poly established plots of the "top 12" on an experimental golf green in Nov 2001. Turf qualities and morphological traits were examined and measured. One of Dr. Green's students used this information as his senior research paper. By all accounts, several of the top 12 cultivars are exhibiting turf quality superior to that of creeping bentgrass. Differential susceptibility to anthracnose disease has also been observed among cultivars.

Dr. Gwen Stahnke at Washington State Univ. established plots of some of the "top 12" along with several other breeding cultivars to give a range of diversity among plots. These plots were established in Spring 2002. According to Dr. Stahnke, our worst cultivar (i.e. lowest turf quality) was much better than that of cv. 'Peterson's creeping bluegrass' during the summer of 2002. We are continuing to work with Dr. Stahnke.

On-site testing:

In Fall 2002, approximately 15 lbs of seed was used to overseed existing greens at two Pittsburgh area golf courses. Reports from previous plantings (2000 and 2001) at these golf courses from USGA Regional Agronomist Keith Happ and the two involved superintendents suggest that the performance of Penn State's greens-type *Poa annua* cultivars have been very successful; to the extent that one of the courses has requested to change all their greens to the PSU Poa. These Pennsylvania projects are being performed under the direction of Keith Happ, USGA Regional Agronomist.

In August 2001, approximately 20 lbs of seed, pooled from eight different selections of greens-type *Poa annua*, was used in a mixture (50:50) with a creeping bentgrass blend to establish 4 greens and two practice greens on a Rye, New York golf course. These greens became established in spring 2002 and performed well during the environmentally stressful summer of 2002. By all accounts this on-site planting of PSU Poa has been successful. This New York project is under the direction of Dave Otis, USGA Regional Agronomist.

2002 Seed Harvest:

The total seed harvest of 2002 yielded approximately 27 lbs of seed from all cultivars. Nearly all this seed was hand-harvested, however, several different means of mechanical harvesting were evaluated. To date, we have not discovered a means of mechanical harvesting that seems appropriate for the task at hand. Additional mechanical harvesting techniques will be evaluated in Spring 2003. The 2002 seed crop was used to establish the 2002 evaluation trial plots planted at the Landscape Management Research Center, to plant seed increase fields at both the PSU Turfgrass Breeding Nurseries and the Landscape Management Research Center, and to initiate some additional on-site testing. Each year's seed harvest continues to be very insightful for developing seed harvesting techniques, including the 2001 planting at our Rock Springs farm which was a complete failure.

Germplasm collections:

Additional germplasm collection efforts were performed in 2002. Additional collections were made from several golf courses having predominately Poa greens from each of the following locations: 1) in Australia: Sydney, Adelaide, Melbourne, and Tasmania; 2) in New Zealand: Palmerston North and Auckland; and, 3) from two higher elevation golf courses in Sweden. The Australian work is in collaboration with Dr. David ALdous, University of Melbourne and John Neylan, Australian Golf Course Superintendent's Association. These additional germplasms, along with our North American collection, will be the basis for our world's collection of greens-type *Poa annua*.

Genetic research:

Studying *Poa annua*'s evolutionary history as a species and it's evolutionary history of greens-types will greatly enhance our knowledge and ability to manipulate the species through traditional breeding efforts. With a world's collection in place, we will begin to research genetic variability, higher and lower states of polyploidy, and gene function and regulation of biotic and abiotic stress tolerance. It is anticipated that two graduate students will be brought on board to investigate and perform in this genetic research arena.

Extreme Temperature Tolerance:

Eric Lyons, my NSF Fellow Graduate Student, is completing his research in the root biology of greens-type *Poa annua* and creeping bentgrass. Eric has shown and detailed the differences in seasonality-architecture of rooting among cultivars of *Poa annua* and between Poa and bentgrass. His research will prove useful to the breeding program in the future.

We are continuing our long-standing collaboration with Drs. Julie Dionne (University of Guelph) and Yves Castonguay (Agriculture Canada) by supplying interesting germplasm for their research into the mechanisms of cold tolerance and disease resistance.

Evaluation of Spent Mushroom Substrate as a Topdressing to Established Turf

A. S. McNitt, D.M. Petrunak, and W.X. Uddin

Introduction

In the Northeastern United States, a number of sewage sludge composts are being shipped interstate for use on turfgrass sites. Numerous athletic field managers are using the composted sewage sludge as a topdressing prior to aeration. In Pennsylvania, spent mushroom substrate is a potentially inexpensive alternative organic matter source. Landschoot, McNitt, and Hoyland (1993) reported improved soil physical properties when spent mushroom substrate was tilled into a clay loam subsoil.

Objectives

The objectives of this study were to evaluate the effect of mushroom substrate topdressing on the resistance to wear damage, surface hardness, and soil compaction of a sodded Kentucky bluegrass (*Poa pratensis*, L.) turf over time.

Procedures

A silt loam soil was prepared at the Joseph Valentine Turfgrass Research Center in State College, PA. Kentucky Bluegrass big roll sod seeded to 40% Limosine, 30% Adelphi and 30% Midnight was installed on 16 May, 2001.

On 24 July, 2001 the first set of treatments was applied. Treatments were again applied on 19 December 2001 and 7 May 2002. The experimental design was a two by two by two factorial with eight replications. Treatments for the factorial included:

Level 1
- •Mushroom Substrate Application (6.3 mm surface application)
- •No Substrate Application

Level 2
- •Heavy hollow-tine aeration
 (2 cm diameter tines on 5 cm by 5 cm spacing)
- •No aeration

Level 3
- •Nitrogen Fertilization (49 kg ha^{-1})
- •No Fertilization

The individual plots were split with levels of simulated traffic (wear) beginning 8 Aug. 2001. There were two levels of wear: no wear and wear approximating a football game per day (Cockerham and Brinkman, 1989). The traffic was applied with a Brinkman traffic simulator

(Cockerham and Brinkman, 1989). Wear ended on 2 Nov. 2001. During year two of the study wear began on 1 Jun 2002 and ended on 20 Oct 2002.

Each experimental unit was evaluated by measuring soil bulk density, soil water content, soil organic matter content, surface hardness, and percent living ground cover. Soil chemical properties were also monitored but due to space limitations the data is not presented here.

Soil bulk density data and soil water content are derived from measurements of soil total density and volumetric water content taken with a Troxler 3400-B (Troxler Electronic Laboratories Inc., Research Triangle Park, NC) series surface moisture/density gauge. The Troxler gauge uses neutron scattering simultaneously with gamma ray attenuation to measure the volumetric water content and bulk density of the soil (Gardner, 1986).

Surface hardness was measured using a Clegg Impact Tester (CIT) (Lafayette Instrument Company, Lafayette, IN) equipped with a 2.25 kg missile (Rogers and Waddington, 1990). The average of six hardness measurements taken in different locations on each subplot was used to represent the hardness value of the subplot.

Percent living ground cover was rated visually and serves as an estimate of turfgrass cover.

Results

Due to space restraints, only the data from subplots receiving wear will be presented. Data from the subplots not receiving wear can be obtained from the authors.

The treatments in this study had significant effects on the turfgrass and soil physical properties measured. The aeration and mushroom substrate applications affected percent turfgrass ground cover (Table 1). During 2001, only the mushroom substrate combined with nitrogen treatments measured higher than the control on 29 Oct 2002. These data were measured after only one topdressing application. Plots receiving aeration tended to have less ground cover than the control. During 2002, plots receiving aeration alone had a percent ground cover lower than the control on only two rating dates and was higher than the control on one date. From the first rating date of 2002 through 12 Jul 2002, the plots receiving spend mushroom substrate consistently measured higher in percent ground cover compared to the other treatments. Beginning on the 18 Jul 2002 rating date all treatments measured higher in percent ground cover than the control but the plots receiving mushroom substrate tended to have more ground cover than those treatments not receiving mushroom substrate. For instance, the mushroom substrate alone tended to have greater turf cover than the nitrogen treatment alone and the mushroom substrate combined with aeration tended to have greater turf cover than the nitrogen combined with aeration treatment. The second year data was collected after three treatments had been applied. Nitrogen differences may have accounted for some of the percent ground cover results, although color differences between treatments receiving the mushroom substrate alone and those receiving the nitrogen treatment alone are small in 2001 (Table 2). By the end of 2002, the mushroom substrate was probably supplying more nitrogen than the nitrogen treatment as indicated by the higher color ratings (Table 2).

Differences in percent ground cover could also be due to the mushroom substrate treatments reducing soil bulk density and increasing soil water contents. The mushroom substrate tended to lower soil bulk density, compared to the control, to a greater degree than other treatments (Table 3). This was most apparent in 2002 after three mushroom substrate applications had been made.

Similarly, the application of spent mushroom substrate as a topdressing tended to increase the water retention of the soil (Table 4). The differences measured during 2001, while statistically different may be of little practical significance. During 2002, after three mushroom substrate applications, the water retention of the treatments containing mushroom substrate increased substantially. This may have been due to the increased organic content of the soil or due to the substrate acting as a mulch on the soil surface.

The decrease of soil bulk density and the increase in water retention and percent ground cover could account for the measured reduction in surface hardness as measured by the Clegg impact tester. Treatments that received mushroom substrate applications tended to measure lower in surface hardness than treatments that did not (Table 5).

Conclusions

While data is still being collected and soil chemical property results are still being analyzed, it appears that there is a positive effect to adding spent mushroom substrate topdressing to the maintenance regime of high-wear Kentucky bluegrass turfgrass. The advantages of three 6.3 mm applications include an increase in percent ground cover after wear, decreased soil bulk density, increased soil water retention, and decreased surface hardness when compared to a control and the traditional practices of aeration and fertilization.

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Table 1. Percent ground cover[1] in 2001 and 2002 for Kentucky bluegrass plots receiving wear treatments[2].

2001

Treatment[3]	23-Aug	30-Aug	6-Sep	13-Sep	20-Sep	28-Sep	5-Oct	15-Oct	19-Oct	29-Oct
Control	99.4	98.3	97.9	96.3	94.6	91.6	83.6	85.4	80.8	74.5
M	99.4	98.1	98.9	97.5	95.4	93.5	84.8	87.0	82.4	76.6
A	95.8	93.6	95.6	92.1	89.4	83.0	74.4	76.3	70.3	61.3
N	99.3	97.6	97.3	95.1	92.8	85.9	75.0	80.1	73.6	63.6
MA	96.4	94.6	96.4	94.1	91.1	87.8	78.4	81.3	74.3	65.9
MN	98.6	98.0	98.3	97.6	95.4	94.9	85.0	87.6	82.8	81.4
AN	97.3	95.5	98.0	94.5	89.3	85.6	77.0	82.4	74.9	65.1
MAN	97.8	97.1	98.3	96.6	94.3	92.4	82.4	85.6	81.5	76.4
LSD (p = 0.05)	1.0	1.8	1.1	1.7	2.4	3.5	4.5	3.0	4.0	5.7

2002

Treatment[3]	7-Jun	14-Jun	21-Jun	28-Jun	8-Jul	12-Jul	18-Jul	29-Jul	9-Aug	16-Aug	26-Aug	6-Sep	13-Sep	7-Oct	14-Oct	21-Oct
Control	91.5	85.1	83.8	84.9	77.9	71.8	68.0	65.0	61.4	63.0	67.9	61.4	63.1	59.8	56.0	41.9
M	96.8	95.3	94.1	94.0	91.6	90.9	89.0	87.9	86.4	87.4	88.6	80.3	82.6	79.8	75.8	68.8
A	86.8	82.3	77.8	82.3	76.1	71.6	75.4	69.5	72.9	72.9	73.9	67.9	72.1	70.9	66.4	53.1
N	91.4	88.6	87.3	88.1	80.5	77.6	76.8	74.3	70.1	72.3	76.3	64.8	68.9	66.5	61.6	45.1
MA	95.4	90.3	88.0	90.3	86.5	85.6	88.3	86.5	86.3	86.1	85.0	77.6	81.4	78.1	73.9	60.6
MN	99.4	99.0	98.5	98.3	97.9	95.3	96.3	95.4	92.5	93.5	93.0	88.3	87.5	85.8	84.9	79.9
AN	95.9	94.6	93.7	94.1	93.3	91.0	93.8	91.8	90.5	87.6	90.4	83.3	86.4	83.6	79.0	70.5
LSD (p = 0.05)	3.7	4.3	4.9	4.9	5.2	6.0	6.5	6.5	6.2	6.0	5.9	6.2	5.5	5.9	7.1	9.2

[1] Percent ground cover was determined by estimating the percent of the plot area covered by living turf.

[2] Plots receiving wear treatments were exposed to wear as four passes three times per week with the Brinkman Traffic Simulator beginning on 8 Aug and ending on 2 Nov 2001and beginning on 4 Jun and ending on 21 Oct 2002.

[3] Treatments include untreated control, M = spent mushroom substrate application at 6.33 mm depth, A = aerification with 20 mm hollow tines, N= nitrogen fertilization at 49 kg ha^{-1} N with Nutralene 40-0-0 fertilizer, MA = mushroom substrate application followed by aerification, MN = mushroom substrate application followed by fertilizer application, AN = aerification followed by fertilizer application, MAN = mushroom substrate application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul, 19 Dec 2001, and 8-10 May, 2002.

Table 2. Turf color ratings[1] in 2001 and 2002 for Kentucky bluegrass plots receiving wear[2] treatments.

2001

Treatment	2-Aug	10-Aug	16-Aug	23-Aug	30-Aug	6-Sep	13-Sep	20-Sep	28-Sep	5-Oct	15-Oct	19-Oct	29-Oct
Control	3.8	3.9	4.3	3.7	3.9	4.1	3.7	3.7	3.0	2.6	2.2	1.6	1.4
M	4.3	4.3	4.5	3.9	4.2	4.3	3.8	3.9	3.3	2.9	2.3	1.7	1.5
A	3.2	3.9	4.2	3.8	4.0	4.1	3.9	3.9	3.3	2.9	2.3	1.7	1.5
N	3.8	4.3	4.4	3.8	4.0	4.1	3.9	3.9	2.9	2.7	2.3	1.6	1.4
MA	3.8	4.4	4.4	4.0	4.1	4.1	3.9	4.1	3.3	2.8	2.4	1.7	1.6
MN	4.2	4.8	4.6	4.4	4.4	4.3	4.1	4.2	3.5	3.1	2.5	1.9	1.7
AN	3.4	4.3	4.4	3.8	4.1	4.2	4.0	4.0	3.3	2.7	2.3	1.7	1.6
MAN	3.8	4.8	4.6	4.2	4.4	4.3	4.1	4.3	3.6	3.0	2.4	1.8	1.6
LSD (p = 0.05)	0.2	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1

2002

Treatment	17-May	7-Jun	14-Jun	21-Jun	28-Jun	8-Jul	12-Jul	18-Jul	29-Jul	9-Aug	16-Aug	26-Aug	6-Sep	13-Sep	7-Oct	14-Oct
Control	3.4	3.7	3.4	3.1	3.2	3.4	3.7	3.0	3.8	3.8	3.9	3.9	3.3	3.3	3.3	3.3
M	4.2	4.2	4.0	3.7	4.1	4.1	4.3	4.0	4.3	4.3	4.3	4.2	3.5	3.5	3.3	3.5
A	3.5	3.9	3.9	3.7	4.0	4.3	4.3	4.1	4.2	4.4	4.1	4.3	3.4	3.4	3.5	3.5
N	4.0	4.3	4.2	3.8	4.0	3.9	4.1	3.8	4.1	4.3	3.9	3.9	3.3	3.3	3.3	3.4
MA	3.7	4.3	4.4	4.3	4.6	4.7	4.7	4.5	4.6	4.6	4.5	4.3	3.6	3.6	3.5	3.5
MN	4.2	4.5	4.4	4.4	4.6	4.8	4.6	4.6	4.6	4.6	4.4	4.3	3.5	3.5	3.5	3.5
AN	3.7	4.5	4.4	4.2	4.4	4.5	4.5	4.2	4.3	4.4	4.0	4.1	3.5	3.5	3.4	3.4
MAN	3.8	4.7	4.8	4.8	5.0	4.9	4.9	4.8	4.8	4.7	4.7	4.3	3.8	3.8	3.4	3.5
LSD (p = 0.05)	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1

[1] Color is rated on a 1-5 scale with half units with 1 = brown, 5 = dark green.

[2] Plots receiving wear treatments were exposed to wear as four passes three times per week with the Brinkman Traffic Simulator beginning on 8 Aug and ending on 2 Nov 2001and beginning on 4 Jun and ending on 21 Oct 2002.

[3] Treatments include untreated control, M = spent mushroom substrate application at 6.33 mm depth, A = aerification with 20 mm hollow tines, N= nitrogen fertilization at 49 kg ha^{-1} N with Nutralene 40-0-0 fertilizer, MA = mushroom substrate application followed by aerification, MN = mushroom substrate application followed by fertilizer application, AN = aerification followed by fertilizer application, MAN = mushroom substrate application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul, 19 Dec 2001, and 8-10 May, 2002.

Table 3. Bulk density[1] (g cc[3]) of treatments receiving simulated traffic in 2001 and 2002[2].

	2001		2002		
Treatment[3]	16-Aug	2-Oct	13-Nov	23-May	23-Oct
Control	1.13	1.28	1.27	1.21	1.29
M	1.11	1.25	1.21	1.05	1.16
A	1.13	1.27	1.22	1.11	1.23
N	1.14	1.29	1.27	1.19	1.28
MA	1.11	1.26	1.21	1.03	1.17
MN	1.08	1.23	1.18	0.98	1.13
AN	1.15	1.29	1.24	1.14	1.24
MAN	1.07	1.22	1.17	0.95	1.14
LSD (p = 0.05)	0.02	0.02	0.03	0.03	0.03

[1] Soil bulk density data were derived from measurements of soil total density and volumetric water content taken with a Troxler 3400-B Series Moisture-Density Gauge (Troxler Electronic Laboratories Inc., Triangle Park, NC).

[2] Plots receiving wear treatments were exposed to wear as four passes three times per week with the Brinkman Traffic Simulator beginning on 8 Aug and ending on 2 Nov 2001and beginning on 4 Jun and ending on 21 Oct 2002.

Table 4. Volumetric water content[1] of soil after exposure to simulated traffic in 2001 and 2002[2].

	2001			2002				
Treatment[3]	16-Aug	2-Oct	13-Nov	23-May	1-Aug	3-Sep	8-Oct	22-Oct
Control	28.7	19.4	23.5	21.5	27.9	19.6	20.1	27.8
M	31.7	20.2	25.5	24.8	36.9	23.8	25.9	36.3
A	29.3	18.6	23.7	22.4	27.6	20.1	21.5	29.8
N	28.3	18.3	22.5	20.9	27.5	18.5	19.2	28.3
MA	31.5	19.9	25.6	26.5	34.8	23.4	25.2	34.5
MN	32.0	20.3	25.8	26.6	35.3	24.6	26.2	37.0
AN	28.8	18.1	23.9	21.5	27.8	19.9	21.5	29.6
MAN	33.1	20.1	25.6	27.0	34.3	22.6	24.5	36.7
LSD (p = 0.05)	0.9	0.7	0.8	1.1	1.6	1.3	1.1	1.3

[1]Volumetric water content data were derived from measurements of soil total density and volumetric water content taken with a Troxler 3400-B Series Moisture-Density Gauge (Troxler Electronic Laboratories Inc., Triangle Park, NC).

[2] Plots receiving wear treatments were exposed to wear as four passes three times per week with the Brinkman Traffic simulator beginning on 8 Aug and ending on 2 Nov 2001and beginning on 4 Jun and ending on 21 Oct 2002.

[3] Treatments include untreated control, M = spent mushroom substrate application at 6.33 mm depth, A = aerification with 20 mm hollow tines, N= nitrogen fertilization at 49 kg ha^{-1} N with Nutralene 40-0-0 fertilizer, MA = mushroom substrate application followed by aerification, MN = mushroom substrate application followed by fertilizer application, AN = aerification followed by fertilizer application, MAN = mushroom substrate application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul, 19 Dec 2001, and 8-10 May, 2002.

Table 5. Surface hardness (Gmax) [1] of treatments exposed to simulated traffic in 2001 and 2002[2].

	2001	2002					
Treatment[3]	13-Nov	23-May	17-Jun	2-Jul	1-Aug	3-Sep	8-Oct
Control	93.4	77.2	57.5	99.2	71.4	104.8	102.7
M	91.5	65.2	55.6	85.5	62.1	86.8	87.0
A	96.1	67.1	62.9	94.0	63.3	98.5	98.8
N	107.0	77.6	56.2	105.1	76.1	105.1	102.2
MA	94.4	61.3	69.1	86.0	61.5	90.2	91.0
MN	92.6	61.1	64.8	80.7	63.2	81.1	85.7
AN	98.5	68.5	60.0	98.8	66.1	99.2	100.8
MAN	103.5	56.9	57.7	80.9	60.3	85.7	89.4
LSD (p = 0.05)	5.6	3.3	4.3	6.3	2.2	5.3	6.5

[1] Surface hardness was measured using a Clegg Impact Tester (Lafayette Instrument Company, Lafayette, IN) equipped with a 2.25 kg missile and a drop height of 450 mm.

[2] Plots receiving wear treatments were exposed to wear as four passes three times per week with the Brinkman Traffic simulator beginning on 8 Aug and ending on 2 Nov 2001and beginning on 4 Jun and ending on 21 Oct 2002.

[3] Treatments include untreated control, M = spent mushroom substrate application at 6.33 mm depth, A = aerification with 20 mm hollow tines, N= nitrogen fertilization at 49 kg ha^{-1} N with Nutralene 40-0-0 fertilizer, MA = mushroom substrate application followed by aerification, MN = mushroom substrate application followed by fertilizer application, AN = aerification followed by fertilizer application, MAN = mushroom substrate application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul, 19 Dec 2001, and 8-10 May, 2002.

Divoting Potential of Different Varieties of Kentucky Bluegrass Grown on Sand Maintained at Three Mowing Heights and Three Wear Levels

A. D. Lathrop, A. S. McNitt, and D. M. Petrunak

Introduction

American football is following the golf industry's lead and constructing football fields with predominately sand rootzones. While sand offers excellent internal drainage, the lack of cohesion between soil particles has resulted in an increase in turf damage due to divoting. The objective of this study is to evaluate different Kentucky Bluegrass varieties grown on a predominately sand rootzone. Evaluation will include turfgrass wear resistance, surface hardness, traction, and divot resistance. Since there is no standard method to measure divot resistance, five existing methods will be compared. The effect of mowing height will also be evaluated as lower mowing height increases turfgrass density and may result in better divot resistance.

Materials and Methods

An eight-ten inch layer of 80:20 sand to peat mix was prepared over a layer of gravel at Joseph Valentine Turfgrass Research Center, University Park, PA. This mix was seeded in 10 ft x 15 ft plots on 25 August, 2001 with nine varieties of Kentucky Bluegrass (KBG) including Baron, Rugby II, Princeton 105, Touchdown, Limousine, Midnight, Langara, and two Penn State experimental varieties. The study is a randomized split block, split plot design with three replications.

After the varieties were seeded, the plots were allowed to grow in until the following June while being maintained at 7/8" mowing height. The three different mowing heights, 7/8", 1 1/8", and 1 3/8", were started on 24 June, 2002. Football type wear was simulated at three different levels using the Brinkman wear machine. The wear levels represent the cleat penetration of 0, 3, and 6 games played per week between the hash marks at the 40 yard line on a football field. Wear treatments were started on 17 July, 2002 and ended on 12 October, 2002.

Starting on 14 October, 2002, various measurements were taken on the plots. These included visual ratings of percent ground cover, soil moisture, and surface hardnes. Five different devices were used to measure either traction or divoting.

Results

Only data for percent ground cover will be presented in this report. The remaining data is still being analyzed. After one year of data, significant differences in wear tolerance were observed due to varieties, mowing heights, and wear intensities. The data shown in Table 1 indicate that Limousine, Princeton 105, and Penn State Exp. 1 are showing the best wear tolerance whereas Baron is showing significantly worse wear tolerance than all other varieties across all mowing heights and high wear intensity. All three mowing heights are significantly different from one another with the highest mowing height performing the best and the lowest mowing height performing the worst across all varieties and wear intensities. Similarly, all three wear intensities were significantly different from one another. Low wear plots had the highest percent ground cover and high wear plots had the lowest percent ground cover across all varieties and mowing heights. Data was analyzed with Fisher's protected LSD with a significance level of .05.

Table 1. Mean percent ground cover on high wear plots for each variety over all mowing heights.

Variety	N	Mean % Ground Cover
Limousine	9	91.00
Princeton 105	9	90.22
Penn State Exp. 1	9	89.67
Touchdown	9	87.33
Penn State Exp. 2	9	87.22
Rugby II	9	87.00
Midnight	9	86.33
Langara	9	84.44
Baron	9	74.33
LSD (p=0.05)		2.328

Means with the same letter are not significantly different.

Table 2. Mean percent ground cover for mowing heights over all varieties and wear intensities.

Mowing Height	N	Mean % Ground Cover
1 3/8"	81	95.6296
1 1/8"	81	94.6667
7/8"	81	93.1235
LSD (p=0.05)		0.6136

Table 3. Mean percent ground cover for wear treatments over all varieties and mowing heights.

Wear Intensities	N	Mean % Ground Cover
0 games/wk	81	100.0000
3 games/wk	81	97.0247
6 games/wk	81	86.3951
LSD (p=0.05)		0.8757

Evaluation of Mower Pick-Up of Topdressed Sand on Four Bentgrass Varieties

A.S. McNitt and D.M. Petrunak

Introduction

Golf course superintendents have observed increased mower pick-up of their light frequent topdressing on some of the newer denser bentgrass varieties. This study is being conducted to determine the amount and sizes of topdressing sand being picked up by mowers. The results of this study should inform both superintendents and topdressing suppliers of potential adjustments to the sizing of their sand.

Procedures

Six replications of four bentgrass varieties were seeded in 2000. The grass was maintained at a 0.125 in cutting height. Nitrogen fertility was approximately 2.0 lbs of N per thousand square feet during the 2001 growing season. During the fall of 2001, a measured amount of topdressing was applied to each plot. Sand application was made by hand shaker jars using multiple passes. The sand sizing of the topdressing is shown in Table 1. A 0.125 in irrigation application was made immediately following the application of the topdressing. Approximately 36 hours after irrigation the plots were mowed and the clippings were collected. The clippings and sand collected were oven dried at 105 degrees Celsius for 24 hours. The clippings were separated from the sand using a seed cleaner than employs pressurized air to blow the lighter grass clippings away from the sand particles. Each sand sample was then passed through a set of sieves and weighed. These weights were compared to the amount of sand of that given size that was applied to each plot area. The percentage of that was picked up by the mower is shown in Table 2. Table 2 also shows the total percentage of sand picked up.

Table 1. Size distribution of sand used for topdressing

Size	% separate
>2 mm	0
1-2 mm	0.4
0.5-1 mm	22.5
0.25-0.5 mm	47.0
0.15-0.25 mm	24.5
0.05-0.15 mm	5.5
Pan	0.1

Table 2. Percentage of topdressing sand within size categories collected with clippings[1] for four creeping bentgrass cultivars in 2001.

	Size Category					
Cultivar	1-2 mm	0.5-1.0 mm	0.25-0.5 mm	0.15-0.25 mm	0.05-0.15 mm	Total
A4	55.3 a	35.5 a	13.2 a	5.5 a	1.4 a	15.8 a
L93	35.4 b	23.9 b	9.1 b	3.8 b	0.8 b	10.8 b
Pennlinks	33.2 b	20.0 bc	7.2 c	2.8 c	0.6 b	8.8 c
Penncross	25.1 c	16.3 c	5.9 c	2.4 c	0.5 b	7.2 c
LSD (p=0.05)	7.6	4.6	1.6	0.8	0.4	1.9

[1]Clippings were collected on 5 Nov 2001 using a Toro 1000 walk-behind mower.

Results

The greatest amount of sand was picked up from Penn A4 followed by L93. Penncross yielded the least amount of sand. From these results, it is apparent that topdressing sand used for light frequent topdressing should contain little or no very coarse sand (1-2 mm) and a limited amount of coarse sand (0.5 - 1.0 mm). The particle size of the sand in the coarse sand fraction could be restricted to the finer range of 0.5 - 0.75 mm. Topdressing should not be significantly finer than the existing greens mix so that a perched water table is not formed. Before changing topdressing you should have your greens mix and topdressing tested to assure compatibility. If you are considering one of the denser bentgrass varieties for a new construction, a finer sand should be considered, thus the use of a finer topdressing will not create a layering problem. Again, physical property testing is highly suggested. This study will be expanded and you should expect more detailed results in future research reports.