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2001
Turfgrass Research Report

In Cooperation With The

Pennsylvania Turfgrass Council

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HERBICIDE EVALUATIONS

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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 2001.

Respectfully,
Aaron Lathrop,
Editor

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Cultivar Development of Greens-type *Poa annua*

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Department of Crop and Soil Sciences

Greens-type Poa annua 2000 evaluation trial

A total of 60 selections with 2 replicates of plot size 1.2m x 1.2m were established on an 85-15 sand:peat mixture, that adheres to USGA construction recommendations, in September of 2000 at a rate of approximately 0.75 lb per 1,000 sq.ft. All plots were maintained at 1/8 inch mowing height and turf quality ratings were collected on an as needed basis (usually every one or two weeks) from April through November. One of the 60 selections was more of an annual type that lost all of its green color by the end of May. Many of the remaining selections showed superior turf quality throughout the 2001 growing season. Differences among selections were also observed for resistance to naturally occurring dollar spot disease. For much of the early to mid summer, growing conditions were ideal. Then in mid August, we experienced a hot, humid condition that was accompanied by anthracnose disease. Six selections were relatively unaffected by the disease while the remaining 53 selections were seriously 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 Seed Harvest

The total seed harvest of 2001 yielded approximately 30 lbs of seed from all selections. 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 2002. The 2001 seed crop was used to 1) establish the 2001 evaluation trial plots planted at the Valentine Research Center, 2) to plant seed increase fields at both the turfgrass breeding nursery and the Agronomy farms at Rock Springs, and 3) to initiate some limited on-site testing. The 2001 seed harvest has been very insightful for estimating future seed yield potentials of the project's current elite selections. As a result, the 2002 seed yields of the nursery planting are expected to be in the 30 lb range from all selections while those of the three selections planted at Rock Springs are expected in the 120 to 200 lb range depending on the success of mechanical harvest.

On-site testing

In Fall 2000, approximately 3 lbs of seed was used to overseed "perennial problem-areas" on existing greens at two Pittsburgh area golf courses. Reports from USGA Regional Agronomist Keith Happ and the two involved superintendents suggest that both these plantings were very successful; to the extent that the cups were capable of being located within these "problem areas" during the Summer 2001. 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 on a Rye, New York golf course. These greens have become established and will be evaluated in 2002. This New York project is under the direction of Dave Otis, Director of the Northeast Region, USGA Green Section. An additional 3 lbs of four selections were used to establish approximately 2,000 sq. ft. of new practice greens at two Pennsylvania golf courses (one in the Pittsburgh area and one in the Williamsport area). These practice greens became established in Fall 2001 at each golf course as pure stands of each of the four selections and will be evaluated in 2002. These Pennsylvania projects are being performed under the direction of Keith Happ, USGA Regional Agronomist. Finally, a total of 6.5 lbs of seed, comprised from 12 different selections, was sent to Dr. David Green at Cal Poly University, CA for evaluation as a potential putting green grass for a new golf course construction project in Santa Barbara, CA in Fall 2002. This California project is under the direction of Pat Gross, USGA Regional Agronomist.

Genetic Identification and Manipulation of Polyhaploids

Poa annua's evolutionary history (allopolyploidy) suggests that the sexual sterility of particular strains is likely due to the genetic state of these accessions being sterile dihaploids (plants derived from an unfertilized, reduced egg). These sterile strains are typically (though not always) smaller, finer, and denser than sexually fertile strains. Smaller plant size is likely more adaptive on closely-mown golf greens, and the physiological process that produces dihaploid plants provides an avenue for morphological characters to reach this state (reverse-gigas). In the past, I have reported on my ability to restore the fertility of these sterile dihaploids with the use of colchicine, thereby regaining their original allotetraploid genomic state. What is of interest to me is to further understand the products of this intense evolutionary pathway, i.e. the genomes that result from this intense selection process. To this end I will be collaborating with Drs. Chopra (Agronomy) and Carlson (Forestry) to apply the FISH (florescence *in situ* hybridization) and GISH (genomic *in situ* hybridization) techniques.

Pacific nematode

This project is continuing its collaborative effort with the golf courses of the San Francisco area to screen for resistance to the Pacific shoot nematode (*Anguina pacificae*). Recent local funding from northern California has increased the team to include a nematologist from UC Davis. Currently, my project is attempting to rear and infect various strains of *Poa annua* using this nematode.

Extreme Temperature Tolerance

Eric Lyons, a NSF Fellow Graduate Student, is researching the root biology of greens-type Poa annua and creeping bentgrass. Eric continues to collect data on his experimental green and is beginning to analyze root initiation and longevity across root zone depth throughout the growing season for cultivars and selections of both species.

George Hamilton has completed his Ph.D. dissertation research on the cold and ice coverage tolerance differences between Poa annua and creeping bentgrass in terms of temperature and day length sensitivity during the hardening process. George is currently in the process of writing up the corresponding science journal articles.

The Poa annua breeding program is continuing its long-standing collaboration with Drs. Julie Dionne (University of Guelph) and Yves Castonguay (Agriculture Canada) through discussion and by supplying interesting germplasm for their research.

Heat tolerance testing of greens-type Poa annua selections continues to be the weak link in the project. I am currently looking for a person to fill this position.

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Effect of Basamid Granular Soil Fumigant on Burndown and Kill of Fairway Turf

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Department of Crop and Soil Sciences

Funding Sources: BASF Corporation, The Pennsylvania Turfgrass Council

Introduction

Renovation and species conversion of golf course fairways is increasing in popularity in the northern United States. The most common means of fairway renovation involves using Roundup PRO? (glyphosate) to kill existing turf, followed by seeding of desired turfgrasses. Although this method has been successful in many cases, where high amounts of *Poa annua* L. seed reside in the soil, significant *P. annua* contamination of newly established turf can occur.

Preliminary studies have revealed that Basamid? Granular (dazomet) provides varying degrees of preemergence control of *P. annua* when applied to the surface of established turf. This product may offer golf course superintendents the option of fumigating fairways prior to seeding without injecting phytotoxic gases into soils and covering with plastic. Although Basamid is labeled for turfgrasses, only preliminary research information is available on its ability to inhibit *P. annua* seedling emergence when surface-applied to turfgrass stands. Additional research is needed on the effects of Basamid rate on burndown and kill of established turf and *P. annua* seedling emergence following surface applications.

Basamid? Granular (dazomet) is a soil fumigant that controls fungi, bacteria, nematodes, and weed seeds in soils (Fritsch and Huber, 1995; Harris, 1991). Formulated Basamid contains 99% of the active ingredient dazomet (tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione) and is formulated as a solid micro-granule. When incorporated into moist aerated soil, dazomet is degraded into several volatile intermediate products including methylisothiocyanate (MITC). Methylisothiocyanate is toxic to many soilborne organisms (Fritsch and Huber, 1995; Mappes, 1995). The degradation end products include bicarbonate, nitrate, and sulfate compounds (Fritsch and Huber, 1995).

It is important to determine the effects of Basamid on burndown of established turf because complete kill is essential for the renovation of turfgrass areas. The purpose of this study was to determine the effect of different rates of surface-applied Basamid on burndown and kill of established fairway turf.

Materials and Methods

This experiment was conducted during 2000 and 2001 at the Joseph Valentine Turfgrass Research Center in University Park, PA on a mixed one-year-old stand of perennial ryegrass (*Lolium perenne* L.) ‘ASP400’ (approximately 15%) and *P. annua* (approximately 85%). The soil is a Hagerstown silt loam with a pH of 6.8, 190 lb P/A, a cation exchange capacity of 7.8

meq/100 g of soil, and 0.4 meq exchangeable K/100 g of soil. The stand was fertilized with Nutralene Chip 48-0-0 (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 this experiment, the turf was irrigated to prevent drought stress and mowed with a fairway mower three times a week at a height of 0.5 inch. Clippings were removed from the site. No herbicides (other than treatments) were applied to the site during 2000 or 2001. No seedbed preparation procedures, such as core aeration or verticutting, were employed prior to treatment application.

The five treatments used in this experiment included Basamid applied to the turf surface at 350, 263, and 175 lb/A; Roundup PRO applied at 3.0 qts/A; and a non-treated control. Treatments were arranged in a randomized complete block design with three replications. Each plot was 3.0 by 15 ft and surrounded by a 1.0 ft border.

Basamid treatments were applied to the turf surface with a 3.0 ft-wide Gandy drop spreader (Gandy Company, Owatonna, MN) on 12 July 2000 and 13 July 2001. The walking pace of the applicator was approximately 3.0 mph. Immediately following application of Basamid treatments, 0.5 inch of water was applied to the entire test area. Approximately 1 hr after irrigation, the Roundup PRO treatment was applied in 2.0 gal water/1000 ft^2 at 30 psi using a CO_2-powered boom sprayer equipped with 8004 flat fan nozzles.

Irrigation was withheld from the test area for 24 hr following the application of Roundup PRO. Following the 24 hr waiting period, irrigation was used to supplement rainfall for the duration of the experiment. A total of 1.7 inches of water was supplied to the test area during the 9-day test period in 2000 and 2.2 inches of water was applied during the 9 day period in 2001. Irrigation and rainfall amounts were monitored using rain gauges. The average daily maximum and minimum air temperatures during the 2000 test period were 77 and 59?F, respectively. The average daily maximum and minimum air temperatures during the 2001 test period were 84 and 51?F, respectively.

Burndown ratings were used to evaluate treatment effects on the turf. Burndown ratings were based on a scale of 0 to 10. A rating of ‘0’ was recorded when the turf showed no visible signs of burndown (no discoloration of turf). A rating of ‘10’ was recorded when complete turf burndown (uniform brown turf) was apparent. Burndown ratings were recorded when differences among treatments became apparent and when complete burndown (burndown = 10) was first noticed for the Roundup PRO treatment. Ratings for the 2000 and 2001 tests were made 1, 5 and 9 days after treatment (DAT). Burndown ratings 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.

Results

Differences in burndown ratings were detected among treatments on all rating dates during both years of this experiment (Tables 1 and 2). In 2000 and 2001, turfgrass burndown was apparent 1 day after treatment (DAT) with all Basamid treatments. By 5 DAT, the highest rate of Basamid (350 lb/A) showed nearly complete burndown, whereas the Roundup PRO treatment provided only moderate burndown. At 9 DAT in 2000, the highest rate of Basamid and Roundup PRO were the only treatments that showed complete turf burndown (a rating of 10) on the perennial reygrass/*P. annua* stand. At 9 DAT in 2001, differences in turfgrass burndown were not detected among any of the Basamid and Roundup PRO treatments and none of these treatments received mean burndown ratings of 10. A few small spots (1-2 inch diameter) of unaffected turf remained in plots treated with the 350 and 263 lb/A rates of Basamid at 9 DAT. Presumably, these were due to skips resulting from bridging of Basamid granules over holes in the bottom of the spreader or from an obstruction in one or more of the holes. Although no burndown ratings were made after 9 DAT in either year, the plots were observed for several weeks following application to determine the possibility of further burndown or recovery. No further burndown or recovery from burndown was observed in plots during 2000 and 2001; however, some *P. annua* germination and emergence occurred in Basamid and Roundup PRO plots.

Table 1. Burndown ratings of a mixed stand of perennial ryegrass and *P. annua* treated with Roundup PRO and Basamid (July 2000).

		Burndown[†]		
Treatment	Rate/A	1 DAT[‡]	5 DAT	9 DAT
Roundup PRO	3.0 qts	0.0 d[§]	5.0 d	10.0 a
Basamid	350.0 lbs	7.3 a	9.7 a	10.0 a
Basamid	263.0 lbs	6.0 b	9.0 b	9.0 b
Basamid	175.0 lbs	4.3 c	7.7 c	8.0 c
Control	--	0.0 d	0.0 e	0.0 d

† Burndown based on 0 - 10 scale; 0 = no discoloration of turf, and 10 = uniform brown turf.
‡ DAT = Days after treatment.
§ Column numbers followed by the same letter are not significantly different as determined by Fisher's Protected Least Significant Difference test at $P = 0.05$

Table 2. Burndown ratings of a mixed stand of perennial ryegrass and *P. annua* treated with Roundup PRO and Basamid (July 2001).

		Burndown[†]		
Treatment	Rate/A	1 DAT[‡]	5 DAT	9 DAT
Roundup PRO	3.0 qts	1.0 c[§]	6.0 c	9.7 a
Basamid	350.0 lbs	4.3 a	9.0 a	9.3 a
Basamid	263.0 lbs	3.7 a	8.7 a	9.3 a
Basamid	175.0 lbs	2.3 b	8.0 b	9.0 a
Control	--	0.0 d	0.0 d	0.0 b

† Burndown based on 0 - 10 scale; 0 = no discoloration of turf, and 10 = uniform brown turf.
‡ DAT = Days after treatment.
§ Column numbers followed by the same letter are not significantly different as determined by Fisher's Protected Least Significant Difference test at $P = 0.05$

Discussion

Basamid applied to the surface of a mixed stand of perennial ryegrass and *P. annua* maintained as a golf course fairway resulted in burndown and eventually death of the turf. Complete burndown and death of the turf was achieved only with the highest rate tested (350 lb Basamid/A). If rates lower than 350 lb/A are used for fairway renovation, glyphosate may need to be applied to provide complete kill of the established turf.

The fact that a few small spots of non-injured turf remained in plots treated with the 350 lb/A rate of Basamid in 2001 suggests that bridging of Basamid granules occurred over one or two holes in the bottom of the spreader hopper. If bridging occurred, it may have been due to a damaged hopper opening or obstruction, or to the aggregation of particles. This was probably an isolated occurrence since this problem was not observed in 2000. However, turf managers considering Basamid applications should carefully examine and test spreaders prior to application to be sure the product flows freely and uniformly through the spreader.

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Effects of Plastic Covering and Basamid Rate on *P. annua* Seedling Emergence in Fairway Turf

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Department of Crop and Soil Sciences

Funding Sources: BASF Corporation, The Pennsylvania Turfgrass Council

Introduction

Renovation and species conversion of golf course fairways is increasing in popularity in the northern United States. The most common means of fairway renovation involves using Roundup PRO? (glyphosate) to kill existing turf, followed by seeding of desired turfgrasses. Although this method has been successful in many cases, where high amounts of *Poa annua* L. seed reside in the soil, significant *P. annua* contamination of newly established turf can occur.

Preliminary studies have revealed that Basamid? Granular (dazomet) provides varying degrees of preemergence control of *P. annua* when applied to the surface of established turf. This product may offer golf course superintendents the option of fumigating fairways prior to seeding without injecting phytotoxic gases into soils and covering with plastic. Although Basamid is labeled for turfgrasses, only preliminary research information is available on its ability to inhibit *P. annua* seedling emergence when surface-applied to turfgrass stands. Additional research is needed on the effects of Basamid rate on burndown of established turf and *P. annua* seedling emergence following surface applications.

Rate of Basamid application has been shown to influence weed seed germination and emergence. Eitel (1995) found large increases in the control of seedling emergence of *Acanthospermium hispidum*, *Cyperus esculentus*, *Galinsoga parviflora*, *Portulaca oleracea*, and *Rickardia brasiliensis* as rates of Basamid increased from 98 to 392 kg ai/ha (incorporated into a sandy loam soil).

Covering Basamid-treated soils with plastic sheets has been shown to improve control of certain weed species when compared with treated soils that were not covered. Eitel (1995) reported improved control of *Acanthospermium hispidum*, *Cyperus esculentus*, *Galinsoga parviflora*, *Portulaca oleracea*, and *Rickardia brasiliensis* when Basamid was incorporated into a sandy soil and covered with plastic sheets for 7 days compared to non-covered treatments. The author attributed the improved control to better retention of volatile active compounds (such as MITC) and solarization. Neumann et al. (1983) stated that in cases where plastic covers are not employed on tilled soils, "sealing" the soil surface by watering and rolling with a heavy roller can help to prevent the escape of MITC and other gases.

Although Basamid is labeled for use in turfgrass, only preliminary research information is available on its ability to inhibit *P. annua* seedling emergence when it is surface-applied to turfgrass stands. Additional research is needed on the effects of product rate and plastic covering on *P. annua* seedling emergence following surface applications. The purpose of this study was to determine the effect of rate and plastic covering of surface-applied Basamid on *P. annua* seedling emergence.

Materials and Methods

This experiment was conducted during 2000 and 2001 at the Joseph Valentine Turfgrass Research Center in University Park, PA on a mixed one-year-old stand of perennial ryegrass (*Lolium perenne* L.) 'ASP400' (approximately 15%) and *P. annua* (approximately 85%). The soil is a Hagerstown silt loam with a pH of 6.8, 190 lb P/A, a cation exchange capacity of 7.8 meq/100 g of soil, and 0.4 meq exchangeable K/100 g of soil. The stand was fertilized with Nutralene Chip 48-0-0 (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 this experiment, the turf was irrigated to prevent drought stress and mowed with a fairway mower three times a week at a height of 0.5 inch. Clippings were removed from the site. No herbicides (other than treatments) were applied to the site during 2000 or 2001.

Roundup PRO was applied to the test area prior to treatment applications (11 July 2000 and 28 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 4 Aug 2000 and 6 Aug 2001, the test areas were 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. Following aeration, a Ryan Mataway (Cushman Inc., Lincoln, NE) walk-behind vertical mowing unit was used to break-up soil cores and scarify the surface. Each test area (2000 and 2001) was scarified four times in four different directions. The unit was equipped with vertical blades 1.0 inch apart and blades penetrated the soil to a depth of 0.5 inch. On 5 Aug 2000 and 7 Aug 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 10 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 11 Aug 2000 and on 8 Aug 2001. Following the 2000 application, 0.5 inch of water was applied through an automatic irrigation system to the entire test area. In 2001, only 0.3 inch of water was applied because the test area was inadvertently watered the night before application and the soil became saturated after 0.3 inch was applied. During both tests, water was applied incrementally over about 40 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 18 Aug 2000 and 15 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 1 Sep 2000 (21 DAT) and 4 Sep 2001 (27 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. The grid frame was constructed from PVC pipe and fishing line was used to create the grid lines. There were a total of 180 squares within the grid frame, each measuring 4.5 by 4.5 inches. Individual seedlings were counted within each square and counts for all 180 squares were totaled to produce the number of seedlings in 24.0 ft^2.

Seedling counts were subjected to a square root transformation prior to statistical analysis (Steel and Torrie, 1980). 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 4, 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 and 2001. The interaction indicates that numbers of *P. annua* seedlings decreased as the rate of Basamid increased for non-covered treatments, but there were no differences among Basamid rates with respect to seedling numbers for plastic-covered treatments. When covered with plastic, all Basamid treatments provided greater than 98% control of *P. annua* seedling emergence in 2000 and 2001. When not covered, the 350 lb/A rate of Basamid provided 97% control of *P. annua* seedling emergence in 2000 and 92% control in 2001. The non-covered 175 lb/A rate of Basamid gave only 81% control of *P. annua* seedling emergence in 2000 and 80% control in 2001. No statistically-significant differences in *P. annua* seedling numbers were detected between the 350 lb/A rate and the 306 lb/A rate of Basamid in either year of the experiment.

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

Source	df	Mean squares of *P. annua* seedlings 2000	2001
Replication	2	22.52 NS	14.3 NS
Treatment (T)	4	3164.64 ***	2965.52 ***
Plastic covering (P)	1	1248.68 ***	1004.61 ***
T x P	4	98.25 ***	80.55 **
Error	18	6.89	11.03
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	137 d[‡]	2 b	303 c	23 b
Basamid	306	133 d	4 b	308 c	37 b
Basamid	263	366 c	7 b	341 c	35 b
Basamid	175	760 c	7 b	803 b	43 b
Control	----	3914 a	3407 a	3930 a	3853 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.

Discussion

Surface applications of Basamid on turf that was heavily infested with *P. annua* seed reduced emergence of *P. annua* seedlings; however, the degree of *P. annua* seedling emergence control varied depending on product rate and whether the treatment was covered with plastic. Basamid treatments covered with plastic provided greater than 98% control of *P. annua* seedlings at all rates used in this test. The results of our experiment were similar to results obtained by Eitel (1995) in which improved control of several weed species was found when Basamid-treated plots were covered with plastic. Eitel (1995) attributed the improved weed control to better retention of volatile active compounds (such as MITC) and solarization. Although our experiment demonstrated improved *P. annua* efficacy when Basamid-treated turf was covered with plastic, it is unlikely that golf course superintendents will use plastic to cover large areas of treated turf. This assumption is partially based on the high cost associated with the plastic and labor involved in covering treated areas. Also, because Basamid must be watered-in following applications, golf course superintendents may encounter difficulty covering a fairway with plastic without tracking the Basamid into non-treated areas and covering the entire fairway quickly enough to prevent significant volatilization of the active ingredient. However, plastic covering may be practical for smaller areas, such as approach areas in front of putting greens.

When not covered with plastic, the 350 lb/A rate of Basamid provided 97% control of *P. annua* seedlings in 2000 and 92% control in 2001. The reason why control declined from 97% in 2000 to 92% in 2001 is unclear, but one possibility could be that less water (0.3 inch) was applied immediately following the 2001 application than following the 2000 application (0.5 inch). Currently, little information is available on how irrigation rates following applications of Basamid influence efficacy. Because no significant difference in *P. annua* seedling numbers were detected between the 350 lb/A and the 306 lb/A rates of Basamid in either year of the experiment, we conclude that the 306 lb/A rate is the threshold rate below which *P. annua* control may decline. In this experiment, *P. annua* seedling emergence control declined rather dramatically for the non-covered 263 and 175 lb/A rates.

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Effective Seeding Intervals of Creeping Bentgrass Following Basamid Applications in Fairway Turf

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Introduction

Renovation and species conversion of golf course fairways is increasing in popularity in the northern United States. The most common means of fairway renovation involves using Roundup PRO? (glyphosate) to kill existing turf, followed by seeding of desired turfgrasses. Although this method has been successful in many cases, where high amounts of *Poa annua* L. seed reside in the soil, significant *P. annua* contamination of newly established turf can occur.

Preliminary studies have revealed that Basamid? Granular (dazomet) provides varying degrees of preemergence control of *P. annua* when applied to the surface of established turf. This product may offer golf course superintendents the option of fumigating fairways prior to seeding without injecting phytotoxic gases into soils and covering with plastic. Although Basamid is labeled for turfgrasses, only preliminary research information is available on its ability to inhibit *P. annua* seedling emergence when surface-applied to turfgrass stands. Additional research is needed on the effects of Basamid rate on burndown of established turf and *P. annua* seedling emergence following surface applications.

Basamid? Granular (dazomet) is a soil fumigant that controls fungi, bacteria, nematodes, and weed seeds in soils (Fritsch and Huber, 1995; Harris, 1991). Formulated Basamid contains 99% of the active ingredient dazomet (tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione) and is formulated as a solid micro-granule. When incorporated into moist aerated soil, dazomet is degraded into several volatile intermediate products including methylisothiocyanate (MITC). Methylisothiocyanate is toxic to many soilborne organisms (Fritsch and Huber, 1995; Mappes, 1995). The degradation end products include bicarbonate, nitrate, and sulfate compounds (Fritsch and Huber, 1995).

On golf courses in the northeastern United States, soil fumigation is typically followed by seeding of creeping bentgrass. Since Basamid does not offer selective weed seed control, golf course superintendents must be certain that phytotoxic concentrations of MITC are no longer present in the soil at the time of seeding. Specific information is needed on appropriate intervals for seeding turfgrasses following surface applications of Basamid. The purpose of this study was to determine safe (effective) creeping bentgrass seeding intervals following surface applications of Basamid.

Materials and Methods

This experiment was conducted during 1999 and 2000 at the Landscape Management Research Center in University Park, PA on a four-year-old stand of ‘Baron’ Kentucky bluegrass (*Poa pratensis* L). The 2000 test was immediately adjacent to the 1999 test. This site was chosen because it was not infested with *P. annua* seed. The soil was a Hagerstown silt loam with a pH of 6.6, 72.2 lb P/A, a cation exchange capacity of 14.0 meq/100 g of soil, and 0.52 meq exchangeable k/100g of soil. The turf was fertilized with 1.0 lb N/1000 ft^2 (urea 46-0-0) in the spring of 1999 and 2000 and the test area was mowed every week with a rotary mower at a height of 1.5 inch. Turfgrass clippings were not removed from the site. No herbicides (other than treatments) were applied to the experiment sites during 1999 or 2000.

On 8 Sep 1999 and 14 Aug 2000, Roundup PRO was applied to the entire test area at 3.0 qts/A in 2.0 gal water/1000 ft^2 at 30 psi using a CO_2-powered boom sprayer equipped with 8004 flat fan nozzles. Two weeks after the Roundup PRO application, the area was core cultivated twice (two different directions) using a John Deere Greens Aerifier Aercore 800 equipped with 0.63 inch-diameter tines on 2.0 inch centers. Tines penetrated to a depth of approximately 2.5 inches. Following core cultivation, a Ryan Mataway walk-behind vertical mower was used to scarify the surface four times in four different directions. The vertical mower blades were 1.0 inch apart and sliced the soil to a depth of approximately 0.5 inch.

Following site preparation (aeration and verticutting), the experimental area was divided into three replicate blocks of 10, 4.0 by 6.0 ft plots. Five plots in each replication were treated with Basamid at 350 lbs/A, whereas five were not treated. The seeding interval treatments consisted of creeping bentgrass ‘Penneagle’ seeded at 1.0 lb seed/1000 ft^2 on Basamid-treated and nontreated turf at 3, 6, 9, 12, and 15 days after Basamid was applied to the plots in 1999. In 2000, Penneagle was seeded at 0, 1, 3, 6, and 9 days after Basamid treatments were applied. Treatments were arranged as a 5 x 2 factorial. The experimental design was a randomized complete block design with three replications.

Basamid was applied with shaker jars on 18 Sep 1999 and 12 Sep 2000. Immediately following application (within 30 min), 0.5 inch of water was applied to the entire test area. On each seeding day in 1999, plots were scarified using the Ryan Mataway vertical mower. Three passes of the vertical mower were made in one direction on each plot. The vertical mower blades were set to a depth of 0.5 inch. Following verticutting, Penneagle seed was mixed with 10 lb Milorganite (6-2-0)/1000 ft^2 and applied through shaker jars. Contec Starter Fertilizer (19-25-5) was distributed over each seeded plot using shaker jars at a rate of 1.0 lb N 1000 ft^2. The same procedures were used in 2000, except plots were not scarified prior to seeding. In 1999 and 2000, the soil surface was kept moist by using irrigation to supplement natural rainfall throughout the test

Visual percent ground cover ratings were made for all seeding interval treatments in 1999 and 2000 at 22 days after their respective seeding dates. A plot with complete turf cover and no visible soil or dead turf was considered 100% turf cover. On 22 Apr 2000 and 26 Apr 2001, a 22.4 inch-wide reel mower, bench-set at a cutting height 0.5 inch was used to remove clippings from each plot. Clippings were removed from an area of 11.8 ft^2 in each plot. Clippings were weighed and later force-air dried at 98.6?F. All data was subjected to analysis of variance and means were separated using Fisher's Protected Least Significant Difference test at the 0.05 level of significance.

Results

Analysis of variance of percent ground cover and clipping yield data collected during this experiment revealed that the main effects of treatment and seeding interval were significant (Table 1). The significant treatment effects indicate that differences in percent ground cover and clipping yields of creeping bentgrass occurred between the control and the Basamid treatment when averaged over seeding intervals. The significant seeding interval effects indicate that percent ground cover and clipping yields generally declined as seeding intervals increased following Basamid application [days after fumigation (DAF)] increased.

Comparisons of percent ground cover between the Basamid treatment and the control for individual seeding interval treatments in 1999 and 2000 are shown in Fig. 1 and 2, respectively. In 1999, percent ground cover in Basamid-treated plots was not different from the control plots at 3 DAF, 9 DAF, 12 DAF, and 15 DAF. At 6 DAF, percent ground cover was higher in Basamid-treated plots than control plots. In 2000, there was a significant treatment by seeding interval interaction for percent ground cover (Table 1). When seeding took place on the day of application (0 DAF), percent ground cover was lower in the Basamid-treated plots than in the control plots. No differences in percent ground cover were observed between the Basamid treatment and the control on any other seeding interval date (1, 3, 6, and 9 DAF) during 2000.

Comparisons of clipping yields between the Basamid treatment and the control for individual seeding interval treatments in 2000 and 2001 are shown in Fig. 3 and 4, respectively. Significant treatment by seeding interval interactions for clipping yields occurred during 2000 and 2001 (Table 1). In 2000 and 2001, clipping yields were greater in Basamid-treated plots than in control plots for all seeding interval treatments (3, 6, 9, 12, and 15 DAF in 2000 and 0, 1, 3, 6, and 9 DAF in 2001).

Table 1. Analysis of variance for percent ground cover and clipping yields of 'Penneagle' creeping bentgrass seeded to Basamid and control plots at various intervals following Basamid application.

		Mean squares of % ground cover		Mean squares of clipping yields	
Source	df	1999	2000	2000	2001
Replications	2	200.83 **	25.83 ^{NS}	982.77 ^{NS}	715.09 ^{NS}
Treatment (T)	1	163.33 *	1020.83 ***	495598.83 ***	954440.03 ***
Interval (I)	4	2105.42 ***	3160.42 ***	32534.16 ***	46958.21 ***
T x I	4	27.92 ^{NS}	639.58 ***	16931.70 ***	39571.59 ***
Error (a)	18	24.91	15.65	1699.87	2817.68
Corrected total	29	---	---	---	---

$^{NS, *, **, ***}$Nonsignificant or significant at P ? 0.05, 0.01, or 0.001.

Discussion

Current label instructions do not provide details on safe seeding intervals following surface applications of Basamid, but suggest a period of 12 to 17 days between surface applications and seeding. Results of the 1999 and 2000 seeding interval experiments revealed that creeping bentgrass can be seeded 3 days after a surface application of Basamid with no detrimental effects to the newly seeded turf. This finding is based on applications made during late summer and watered-in with 0.5 inch of water. More research should be conducted on seeding intervals following Basamid applications to determine the influence of soil type and temperature, turf species, seeding depth, and irrigation on the inhibition of turfgrass seed germination and establishment.

Clipping yield results from the seeding interval study indicated that a large surge in creeping bentgrass growth occurred following Basamid applications. Increases in plant growth have been noted in other studies involving soil fumigants, including dazomet (Altman, 1970; Bernard and Hornby (1982); Jenkinson et al. (1972). In a study involving ^{15}N-labelled dazomet, Chabrol et al. (1982) found that dazomet increased maize dry matter yields from 7 tonne/ha to 13 tonne/ha. The authors reported that this yield increase could not be explained entirely by the nitrogen contained in dazomet, and they attributed some of the yield increase to nitrogen released from microbial biomass killed by the dazomet. Chabrol et al. (1982) reported that the dazomet treatment increased nitrogen uptake in maize by 47 kg/ha, with 26 kg nitrogen/ha from dazomet and 21 kg nitrogen/ha from microbial biomass.

Figure 1. Visual estimates of percent ground cover for 'Penneagle' creeping bentgrass established in plots treated with Basamid (September 18, 1999) and control plots. Percent ground cover was rated 22 days after seeding for each treatment.

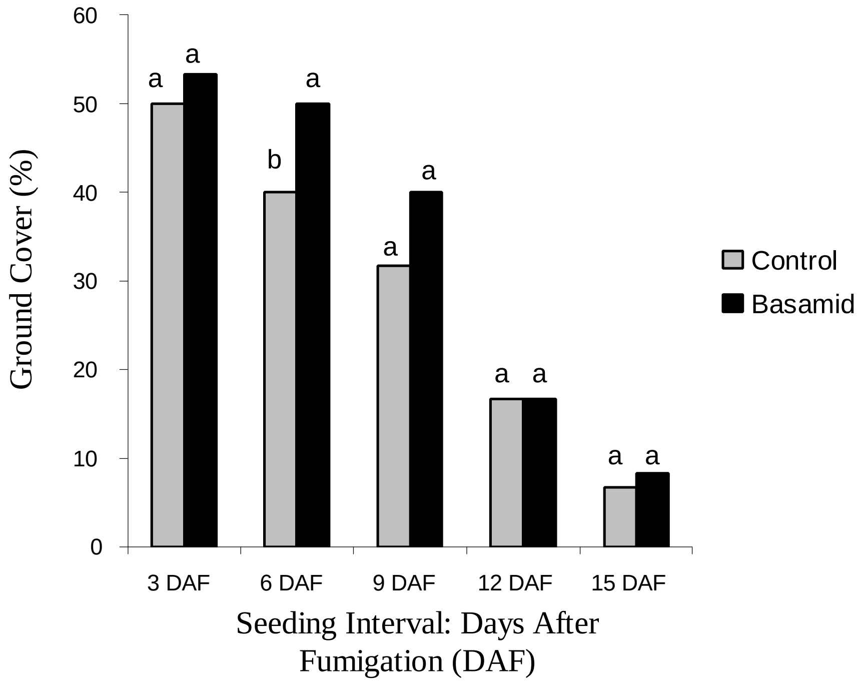


Figure 2. Visual estimates of percent ground cover for 'Penneagle' creeping bentgrass established in plots treated with Basamid (September 12, 2000) and control plots. Percent ground cover was rated 22 days after seeding for each treatment.

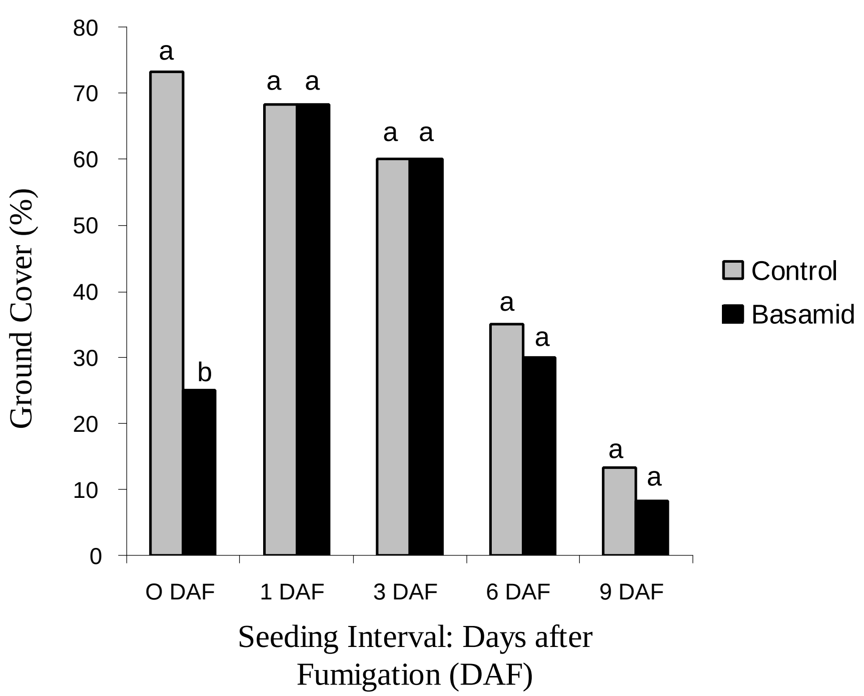


Figure 3. Fresh weight clipping yields for 'Penneagle' creeping bentgrass established in plots treated with Basamid (September 18, 1999) and control plots. Clippings were collected on April 24, 2000.

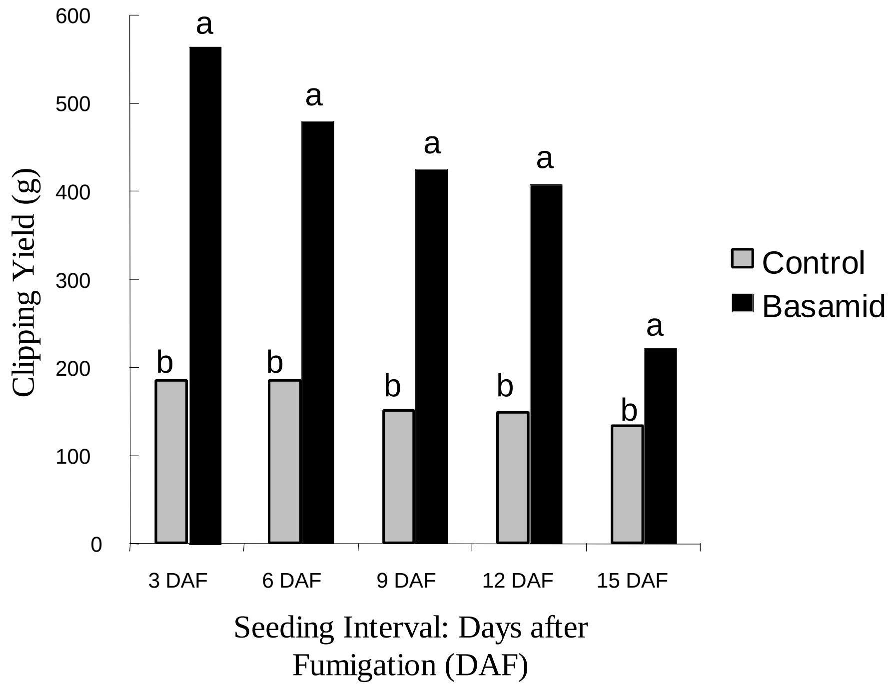
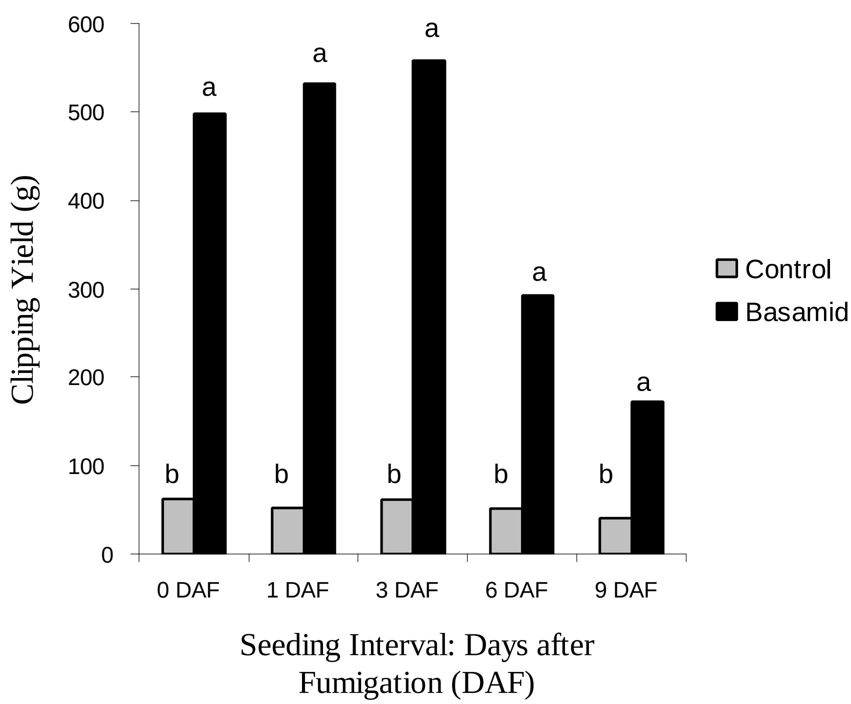


Figure 4. Fresh weight clipping yields for 'Penneagle' creeping bentgrass established in plots treated with Basamid (September 12, 2000) and control plots. Clippings were collected on April 26, 2001.



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Environmental Factors Affecting Creeping Bentgrass and Annual Bluegrass Tolerance to Ice Coverage

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Abstract

Ice damage to golf courses and other high-maintenance sports turfs is a common problem in the northern United States, Canada, and other cool-climate regions. Beard (1964) suggested that ice damage to turf is the result of oxygen depletion or metabolic by-product build-up and toxification (Beard, 1964). Beard's (1996) other theories include other factors such as ice physical properties (i.e., solid vs. porous) and the duration of ice cover.

The objectives of this research focused on determining if several factors associated with plant predisposition and ice coverage affected the carbohydrate concentration and survivability of creeping bentgrass and annual bluegrass. The factors evaluated were low irradiance, low oxygen concentrations, plant hardening replenishing the air in the turf-ice interface, selected phases of water (i.e., water, slush), temperature drop rate, and total non-structural carbohydrate (TNC) concentrations. Another objective was to quantify several ice sheet samples removed from golf course putting greens by determining mean grain sizes and bulk densities.

In the first experiment, two selections each of creeping bentgrass and annual bluegrass were subjected to four different irradiance and temperature treatments. Treatments were: greenhouse irradiance (684 ?mols m^{-2} sec^{-2}) at 21/14 C (day/night temp); florescent/incandescent lamps (266 ?mols m^{-2} sec^{-2}) at 18/10 C and 10/3 C; and metal halide lamp (114 ?mols m^{-2} sec^{-1}) at 18/10 C. Plants were subjected to treatments for 35 days and then were harvested and separated into crowns and verdure and analyzed for TNC concentration.

Creeping bentgrass crown TNC concentrations were not affected by irradiance/temperature treatments while the annual bluegrass crown concentrations were affected. Creeping bentgrass crowns had significantly higher TNC concentrations than annual bluegrass crowns when exposed to all artificial, low irradiance treatments. The bentgrass verdure TNC concentrations decreased more than annual bluegrass when subjected to reduced irradiance treatments.

The second experiment was conducted to determine the effects of low oxygen concentrations on the survival of unhardened creeping bentgrass and annual bluegrass. Both species were exposed to 0, 1, and 3% O_2 environments for 35 days in a constant temperature room maintained at 18/10 C (day/night) with a 16-hr photoperiod at 190 ?mols m^{-2} sec^{-1} irradiance level.

Unhardened creeping bentgrass and annual bluegrass both had good survival (> 60%) to all three treatments. Creeping bentgrass (86%) had a significantly higher survival rate compared to annual bluegrass (66%). TNC concentrations of both species were not significantly

affected by oxygen concentrations, although a trend of increased TNC concentrations with decreased oxygen concentrations was observed.

The third experiment was conducted to determine the effects of air replenishment of the turf/ice interface on the survival of creeping bentgrass and annual bluegrass. Both species in a hardened and unhardened condition were capped with a 20 mm thick ice layer that created a 20 mm air space between the ice and turf. The two treatments involved daily injections of fresh air into the vented air space and no air injections. Plants were maintained in a freezer maintained at –4 C and were removed 30, 60, and 90 days after treatments began.

Creeping bentgrass had significantly higher survival rates than annual bluegrass. The percent survival averaged across all three removal times for hardened creeping bentgrass, and hardened annual bluegrass was 87 and 17%, respectively. The reduction of survival when comparing hardened versus unhardened was much greater for creeping bentgrass, dropping from 87% survival for hardened plants to 18% for unhardened plants.

There was also a strong positive correlation between survival rate and TNC concentrations. The r^2 value was 0.97 for the linear regression for the average of hardened and unhardened plants of TNC concentration versus percent survival over the three removal times.

There were also significant differences in percent survival for the air injection treatments. The plants receiving air injections had a lower survival rate (29%) as compared to plants that were not flushed with air (38%). CO_2 build up in the non-flushed treatments was also observed. CO_2 concentrations averaged 460 ppm and 690 ppm for the flushed and non-flushed treatments, respectively. This study indicated the reduction in survival under ice sheets may be due to a reduction of carbohydrates rather than a decrease in oxygen or increase in CO_2 levels.

The fourth experiment was conducted to determine the effect of carbohydrate concentration, water phase, and temperature drop on the survival of creeping bentgrass and annual bluegrass. Carbohydrates were reduced by placing plants in low-light environments for two to three weeks prior to the beginning of the experiment. All plants were placed in test tubes in a programmable low-temperature bath.

Two treatments of water and slush were put in their respective tubes and an untreated control (air) was also used. Two temperature drop rate treatments were also used, 0.25 degree C $hour^{-1}$ and 1 degree C $hour^{-1}$, and temperatures were dropped from –1 to –4 C. Following the temperature drops, the temperature was raised to 4 C, plants were removed from the tubes, and percent survivals determined.

Plants in the low-irradiance carbohydrate treatment had significantly lower survival rates than plants in the high-irradiance treatment, 25% and 58%, respectively. The slush and water treatments significantly reduced survival as compared to the air treatment. There was no significant difference in plant survival between the two temperature drop rate treatments. Low irradiance, which decreased TNC concentrations, and the presence of water decreased the survivability of unhardened creeping bentgrass and annual bluegrass when exposed to subfreezing temperatures.

The final experiment was conducted to quantify the mean grain size and bulk densities of ice samples removed from putting greens. The samples were sized, dimensions and weights measured, and bulk densities calculated. Samples were mounted on glass and reduced to thin layer sections with a microtome. Thin layers were exposed to cross-polarized light and the images recorded. Selected individual grain sizes were outlined and areas determined with Arc-View.

Mean grain sizes of the samples were variable and ranged from 1.3 to 7.9 sq mm, but bulk densities were consistent and ranged from 0.79 to 0.85 g cc^{-1}. Although the samples were visually different, their bulk densities were similar. This data indicated that visual differences in ice characteristics (i.e., solid, granular, etc.) do not estimate or relate to the bulk density of the ice, and presumably permeability.

These experiments indicated that ice-related damage was affected by carbohydrate concentrations and the presence of water, and species TNC were affected differentially under reduced irradiance. Creeping bentgrass maintained higher crown carbohydrate concentration than annual bluegrass when subjected to low-irradiance or altered irradiance quality (i.e. shade). This would enable creeping bentgrass to have increased carbohydrate reserves at times when irradiance is reduced (e.g., fall and spring). This would also affect carbohydrate reserve build-up created during hardening.

Creeping bentgrass and annual bluegrass appeared to have good tolerance to low-oxygen environments. Although ice has been shown to be impermeable and restricts inward movement of oxygen, reduction or elimination of oxygen in the atmosphere under ice does not appear to be a main factor affecting turfgrass survival.

Evaluation of Spent Mushroom Substrate as a Topdressing for Established Turfgrass

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Introduction

Turfgrass represents a sizable potential market for spent mushroom substrate utilization in the northeastern U.S. Currently, composted brewery waste (Allgro™) and a number of sewage sludge composts are being shipped interstate for use on turfgrass sites.

The turfgrass industry has not embraced the use of spent mushroom soil for several reasons. First, the issue of soluble salts has always been an industry concern. Also, until recently, application techniques for use on established turf had not been developed.

Objectives

The objectives of this study are to measure the effects of topdressing mushroom substrate onto established turfgrass that is exposed to simulated football player traffic. The resistance to wear damage, surface hardness, and soil compaction, and their effects on development of melting-out disease will be evaluated over time. The changes in soil physical and chemical properties will also be monitored in order to make recommendations on frequency of substrate application.

Progress

A silt loam soil area was prepared at the Joseph Valentine Turfgrass Research Center. Kentucky Bluegrass (*Poa Pretensis*, L.) big roll sod was purchased from a sod farmer in Lancaster, PA with soil similar to that at the research center. The sod was installed on 16 May, 2001.

On 24 July, 2001 the first set of treatments was applied. The experimental design was a two by two by two factorial with eight replications. Treatments for the factorial include:

<u>Level 1</u>
- Mushroom Substrate Application (0.25 in surface application)
- No Substrate Application

<u>Level 2</u>
- Heavy hollow-tine aeration
  (2 cm diameter tines on 5 cm by 5 cm spacing)
- No aeration

<u>Level 3</u>
- Fertilization (one pound of actual N per 1000 ft^2)
- No Fertilization

The individual plots were split with two levels of simulated traffic beginning 8 Aug. 2001. The traffic was applied with a Brinkman wear machine (Cockerham and Brinkman, 1989). This device applies both turfgrass wear and scuffing as well as soil compaction. The wear was imposed over the factorial design to create a strip plot factorial with eight replications. There were two levels of wear: no wear and wear approximating a football game per day (Cockerham and Brinkman, 1989). Wear ended for the season on 2 Nov. 2001.

Each experimental unit was evaluated for the following parameters:

1. Soil bulk density
2. Soil water content
3. Soil organic matter content
4. Cation Exchange Capacity
5. pH
6. Soluble Salts
7. Available Cations (Ca, Mg, K, Na,)
8. Total Phosphorus
9. Surface Hardness
10. Percent living ground cover

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). Soil bulk density and soil water content was measured on 16-17 Aug, 3-4 Oct. and 13-14 Nov. 2001.

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. Living ground cover was rated using a scale of zero to five with half units. Zero represents a plot with no turfgrass present and five represents 100% turfgrass cover. Turfgrass density was rated weekly from 10 Aug. to 11 Oct. 2001.

The cation exchange capacity (CEC). PH, and soluble salts of each treatment was determined at the end of the growing season. The available nutrients in the soil were also measured at this time using the Mehlich 3 method (Mehlich, 1984). This data has not been processed as of the writing of this report. Other data not presented includes the total nitrogen recovery from the applied mushroom substrate and nitrogen fertilizer. Clippings are being ground and will be assessed for nitrogen content during the winter of 2002.

Results

The data collected during the 2001 growing season is shown in Tables 1 - 6. This data indicates changes in soil chemical and physical properties. Mushroom substrate applications consistently lowered soil bulk density under both no-wear and wear treatments. The lowest bulk density was achieved with the mushroom substrate, aeration, and nitrogen combination.

The data in Table 2 indicates that the addition of mushroom substrate slightly increases the water holding capacity of the soil. 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 practical value of the measured differences in Table 2 can be debated. However, this difference is apparent after only one quarter inch surface application. As this treatments is reapplied several times over the next two years greater differences may be observed.

Surface hardness measurements are reported in Table 3. There was a significant reduction in surface hardness due to aeration in the no-wear plots but on the plots receiving wear, the mushroom substrate treated plots measured lower than those receiving nitrogen. During the upcoming growing season, surface hardness will be evaluated more frequently under various soil moisture conditions.

Turfgrass color is an indication of nitrogen availability to the Kentucky bluegrass plant. Turf color ratings are shown in Table 4. It is apparent that the mushroom substrate is adding nitrogen to the soil. The actual amount will be better estimated when the collected clippings are analyzed for total nitrogen content this winter.

Similarly the amount of clippings produced from a turfgrass plant is typically highly correlated to the amount of available nitrogen in the soil. The data in Table 5 indicates that the 0.25 inch compost application resulted in similar clipping weights as a one pound of nitrogen per 1000 ft2 fertilizer application. The highest clipping weights were measured on the plots that received both nitrogen fertilizer and compost.

Percent ground cover for the subplots receiving wear are shown in Table 6. During the early rating dates few meaningful differences were found. However, by the last rating date it was apparent that the treatments containing mushroom substrate are improving the retention of grass exposed to football type wear.

Discussion

After applying high quality compost to athletic fields for 18 years, it does not surprise me that we are measuring positive results. I am a little surprised by the consistency of the data after only one mushroom substrate application and hope that the data remains this clear over the coming year. Another surprise is how poorly the aerated plots are performing, since aeration is a standard compaction remedy.

Plans for upcoming year

On 19 Dec. 2001 shortly after wear ended another set of treatments was applied to the plot area. During the 2002 winter season, the soil test data and the clipping nitrogen content will be analyzed. Early in the spring another set of treatments will be applied followed by the inoculation of four of the replications with Drechslera poae (approximately 4 x 104 conidia/ml of water). Disease severity (Index 0-10; 0=turf asymptomatic, 10=91-100% turf area necrotic) assessments will be made every three to five days for a period of six to eight weeks in the spring and fall. Treatment effects on melting-out severity for the individual assessment dates, will be evaluated as disease progress over time (AUDPC, rate r, Y0, and Ymax). All other parameters discussed in this report will be measured during the 2002 growing season. Surface hardness measurements will be assessed more frequently and under various soil water content conditions.

Table 1. Bulk density (g/cm^3) at three dates of eight treatments of Kentucky bluegrass plots with wear and no wear applied.

	Bulk density (g/cm^3)[1]					
	No Wear			Wear[3]		
Treatment[2]	16-Aug	2-Oct	13-Nov	16-Aug	2-Oct	13-Nov
Control	1.12	1.11	1.08	1.13	1.28	1.27
C	1.06	1.07	1.01	1.11	1.25	1.21
A	1.09	1.09	1.04	1.13	1.27	1.22
N	1.12	1.14	1.09	1.14	1.29	1.27
CA	1.03	1.09	1.03	1.11	1.26	1.21
CN	1.05	1.06	1.00	1.08	1.23	1.18
AN	1.11	1.09	1.06	1.15	1.29	1.24
CAN	1.05	1.07	1.02	1.07	1.22	1.17
LSD (p = 0.05)	0.02	0.02	0.02	0.02	0.02	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] Treatments include untreated control, C = spent mushroom compost application at 0.25" depth, A = aerification with 0.75" hollow tines, N= nitrogen fertilization at 1 lb N/1000 ft^2 with Nutralene 40-0-0 fertilizer, CA = compost application followed by aerification, CN = compost application followed by fertilizer application, AN = aerification followed by fertilizer application, CAN = compost application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul and 19 Dec 2001.

[3] 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 2001.

Table 2. Volumetric water content at three dates of eight treatments of plots with wear and no wear applied.

	Soil moisture (%v)[1]					
	No Wear			Wear[3]		
Treatment[2]	16-Aug	2-Oct	13-Nov	16-Aug	2-Oct	13-Nov
Control	27.0	18.3	22.2	28.7	19.4	23.5
C	31.0	19.6	23.8	31.7	20.2	25.5
A	28.1	17.7	22.8	29.3	18.6	23.7
N	23.5	17.4	21.5	28.3	18.3	22.5
CA	32.0	19.6	24.3	31.5	19.9	25.6
CN	30.6	19.7	25.0	32.0	20.3	25.8
AN	28.4	17.7	22.7	28.8	18.1	23.9
CAN	31.3	19.1	23.4	33.1	20.1	25.6
LSD (p = 0.05)	2.0	0.8	0.8	0.9	0.7	0.8

[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] Treatments include untreated control, C = spent mushroom compost application at 0.25" depth, A = aerification with 0.75" hollow tines, N= nitrogen fertilization at 1 lb N/1000 ft^2 with Nutralene 40-0-0 fertilizer, CA = compost application followed by aerification, CN = compost application followed by fertilizer application, AN = aerification followed by fertilizer application, CAN = compost application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul and 19 Dec 2001.

[3] 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 2001.

Table 3. Surface hardness of eight treatments of Kentucky bluegrass plots with wear and no wear applied.

	Surface hardness (Gmax)[1]	
	No Wear	Wear
Treatment	13-Nov	13-Nov
Control	69.2	93.4
C	68.8	91.5
A	65.8	96.1
N	71.2	107.0
CA	65.9	94.4
CN	70.3	92.6
AN	64.7	98.5
CAN	71.5	103.5
LSD (p = 0.05)	3.7	5.6

[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] Treatments include untreated control, C = spent mushroom compost application at 0.25" depth, A = aerification with 0.75" hollow tines, N= nitrogen fertilization at 1 lb N/1000 ft^2 with Nutralene 40-0-0 fertilizer, CA = compost application followed by aerification, CN = compost application followed by fertilizer application, AN = aerification followed by fertilizer application, CAN = compost application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul and 19 Dec 2001.

[3] 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 2001.

Table 4. Turf color ratings[1] for Kentucky bluegrass plots receiving wear and no wear treatments.

	No Wear[2]												
Treatment[3]	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	3.81	3.91	4.34	3.81	4.06	4.06	3.75	3.69	3.13	2.72	2.34	2.06	1.59
C	4.31	4.34	4.59	4.44	4.31	4.13	3.91	3.84	3.25	2.91	2.44	2.09	1.69
A	3.22	3.91	4.50	4.16	4.28	4.16	3.94	3.94	3.38	2.94	2.44	2.34	1.75
N	3.84	4.34	4.47	4.16	4.28	4.03	3.84	3.84	3.06	2.72	2.31	2.19	1.63
CA	3.75	4.10	4.66	4.50	4.41	4.13	3.88	4.03	3.31	2.94	2.50	2.31	1.72
CN	4.16	4.81	4.84	4.78	4.53	4.25	4.09	4.09	3.38	3.03	2.59	2.44	1.91
AN	3.38	4.25	4.56	4.38	4.28	4.13	4.06	4.06	3.31	2.84	2.47	2.25	1.69
CAN	3.84	4.78	4.78	4.75	4.47	4.31	4.13	4.13	3.44	2.94	2.50	2.34	1.88
LSD (p = 0.05)	0.15	0.19	0.14	0.20	0.12	0.09	0.13	0.09	0.13	0.13	0.12	0.15	0.10

	Wear												
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	3.81	3.91	4.28	3.66	3.91	4.06	3.72	3.72	3.00	2.59	2.16	1.63	1.44
C	4.31	4.34	4.47	3.91	4.19	4.25	3.84	3.88	3.28	2.94	2.34	1.72	1.50
A	3.22	3.91	4.19	3.75	3.97	4.09	3.91	3.88	3.28	2.94	2.31	1.72	1.53
N	3.84	4.34	4.41	3.78	4.00	4.13	3.91	3.91	2.88	2.69	2.25	1.56	1.44
CA	3.75	4.41	4.44	3.97	4.09	4.13	3.94	4.06	3.34	2.81	2.38	1.72	1.59
CN	4.16	4.81	4.59	4.41	4.44	4.28	4.06	4.16	3.53	3.06	2.47	1.88	1.69
AN	3.38	4.25	4.41	3.75	4.06	4.16	4.03	4.03	3.25	2.69	2.31	1.66	1.59
CAN	3.84	4.78	4.63	4.22	4.38	4.34	4.09	4.25	3.56	3.03	2.38	1.75	1.63
LSD (p = 0.05)	0.15	0.19	0.15	0.25	0.22	0.13	0.16	0.18	0.24	0.23	0.15	0.12	0.13

[1] Color is rated on a 1-5 scale with half units with 1 = brown, 5 = dark green, and 3 = acceptable color.

[2] Plots receiving wear treatments were exposed to wear as four passes three times per week with the Brinkman Tr affic simulator beginning on 8 Aug and ending on 2 Nov 2001.

[3] Treatments include untreated control, C = spent mushroom compost application at 0.25" depth, A = aerification with 0.75" hollow tines, N= nitrogen fertilization at 1 lb N/1000 ft^2 with Nutralene 40-0-0 fertilizer, CA = compost application followed by aerification, CN = compost application followed by fertilizer application, AN = aerification followed by fertilizer application, CAN = compost application followed by aerification followed by fe rtilizer application. Treatment applications were made on 24 -26 Jul and 19 Dec 2001.

Table 5. Clipping dry weights [1] for Kentucky bluegrass plots receiving wear and no wear treatments.

	No Wear[2]									
Treatment[3]	8-Aug	16-Aug	24-Aug	30-Aug	6-Sep	13-Sep	21-Sep	27-Sep	4-Oct	11-Oct
Control	8.2	16.1	12.8	11.0	12.4	9.0	6.6	3.9	2.7	2.7
C	10.8	18.5	28.9	12.1	12.8	8.9	6.6	3.8	2.7	2.6
A	7.0	14.7	20.3	10.3	11.5	8.0	6.6	3.9	2.6	2.6
N	10.8	19.6	24.0	11.8	13.2	9.2	3.2	3.6	2.6	2.5
CA	9.5	17.3	27.4	12.3	13.1	9.1	7.5	4.3	3.1	3.2
CN	19.0	27.0	38.2	18.1	18.8	13.3	10.2	6.2	4.4	4.5
AN	8.7	17.3	24.7	11.4	12.6	8.7	7.4	4.0	2.7	2.6
CAN	11.4	20.3	32.8	15.7	14.8	11.6	8.9	4.3	3.5	3.2
LSD (p = 0.05)	2.2	2.9	4.0	1.9	2.0	1.7	1.6	0.9	0.6	0.7

	Wear									
Treatment	8-Aug	16-Aug	24-Aug	30-Aug	6-Sep	13-Sep	21-Sep	27-Sep	4-Oct	11-Oct
Control	7.4	11.9	10.9	6.7	5.9	4.7	3.6	2.4	4.3	5.7
C	10.2	12.4	10.7	7.4	5.9	4.8	3.3	2.1	4.3	5.9
A	5.9	10.1	9.0	6.7	6.2	5.2	3.5	2.7	4.4	6.0
N	10.6	14.8	10.7	7.1	6.3	4.8	3.1	2.2	4.7	6.5
CA	6.8	11.2	9.3	7.0	5.8	5.3	3.7	2.4	4.5	5.7
CN	15.2	19.4	17.2	11.4	9.6	8.9	5.5	3.7	4.9	5.8
AN	8.8	12.3	9.3	7.4	6.0	4.9	3.6	2.8	4.7	5.9
CAN	10.3	14.5	14.1	10.2	8.6	7.4	4.8	3.2	4.7	5.9
LSD (p = 0.05)	1.7	2.0	2.1	1.3	1.2	1.2	0.8	0.5	0.4	0.6

[1] Clippings were collected with a Honda rotary mower set at 2” height of cut and were dried at 60C. The area from which clipp ings were collected was 7.6 ft^2.

[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 2001.

[3] Treatments include untreated control, C = spent mushroom compost application at 0.25” depth, A = aerification with 0.75” hollow tines, N= nitrogen fertilization at 1 lb N/1000 ft^2 with Nutralene 40-0-0 fertilizer, CA = compost application followed by aerification, CN = compost application followed by fertilizer application, AN = aerification followed by fertilizer application, CAN = compost application followed by aerification followed by fertilizer application. Treatment applications were made on 24 -26 Jul and 19 Dec 2001.

Table 6. Percent ground cover for Kentucky bluegrass plots receiving wear treatments[1].

Treatment[3]	Percent ground cover[2]									
	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
C	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
CA	96.4	94.6	96.4	94.1	91.1	87.8	78.4	81.3	74.3	65.9
CN	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
CAN	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

[1] 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 2001.

[2] Percent ground cover was determined by estimating the percent of the plot area covered by living turf. Data are presented only for plots receiving wear treatments because plots with no wear were at 100% cover.

[3] Treatments include untreated control, C = spent mushroom compost application at 0.25" depth, A = aerification with 0.75" hollow tines, N= nitrogen fertilization at 1 lb N/1000 ft^2 with Nutralene 40-0-0 fertilizer, CA = compost application followed by aerification, CN = compost application followed by fertilizer application, AN = aerification followed by fertilizer application, CAN = compost application followed by aerification followed by fertilizer application. Treatment applications were made on 24-26 Jul and 19 Dec 2001.

Evaluation of Playing Field Quality on an Infilled Synthetic Turf System

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Introduction

As more synthetic turf systems using sand and crumb rubber infill are introduced into the sports surface market, independent data regarding playing surface quality is required to enable consumers to make informed decisions. Questions have been raised regarding infill depth, infill type (ratio of sand to crumb rubber), and the presence and thickness of an underlying shock absorbing pad. The objectives of this study were to evaluate the wet and dry surface playing quality of varying configurations of an infilled synthetic turf system called Sofsport ^{TM}. We wanted to determine how varying depths and types of infill material and varying thickness and types of an underlying shock absorbing pad affected traction, hardness, and vertical ball rebound.

Materials and Methods

Wooden boxes with dimensions of 630 mm by 630 mm by 230 mm were constructed. Gravel was placed in each box and filled to within 40 mm of the top of the boxes. Underlying pad treatments were installed. They included one of the following pad treatments: no pad, a 19 mm extruded E-layer pad (Tennis Surfaces Co., Bartlett, IL), or a 13 mm or 19 mm Regupol pad (Regupol Manufacturing, Lancaster, PA). The Sofsport material was then installed over the pad treatment. The Sofsport specifications are shown in Table 1.

Infill treatments were added to the Sofsport pile and broomed and watered in. Infill treatments consisted of various ratios of sand and crumb rubber (Tables 3-4). Several different sand and crumb rubber sizes were used and are listed in Table 2.

Treatments were exposed to the weather for 2 months prior to evaluation. Traction was evaluated using ASTM F1551 Suffix AT-030. Surface hardness was measured with the ASTM F355 method and a Clegg Impact Tester (ASTM F1702). Vertical rebound ratio was evaluated using ASTM F1551 Suffix 31 and is expressed as the percentage rebound on the test surface compared to the rebound on a concrete surface.

Results and Discussion

The results are listed in Tables 3-4. The vertical soccer ball rebound ratio was generally lower for treatments containing a shock absorbing pad. As the ratio of crumb rubber in the infill increased, the vertical rebound ratio decreased. Surface hardness was influenced to a greater degree by underlying pad thickness compared to infill type. The heavier missiles of the surface hardness testing devices were influenced to a greater degree by the shock absorbing pad installed below the infill, while the lighter soccer ball was affected to a greater degree by the surface infill layer. The 100% sand infill treatment measured lowest in traction when wet while the 50% coarse sand/50% coarse crumb rubber treatment measured highest in traction when dry.

The results indicate that both vertical soccer ball rebound and surface hardness can be controlled to some degree by infill type and depth but that surface hardness is influenced to a greater degree by the presence of an underlying pad. Under the conditions of this study, the relationship between the Gmax values generated by the F355 method can be compared to the values generated by the Clegg Impact Tester using the regression equation F355 x 0.66 - 9.3 = Clegg. The regression coefficient for this equation was 0.95.

The results of this study should inform consumer's decisions about the presence and type of pad and the ratio, grade, and thickness of the infill material.

Table 1. Sofsport backing and pile specifications.

Pile weight	1400 g/m^2 Face yarn type 100% Polyethylene
Yarn size	8000 Denier
Construction	Broadloom tufted
Stitch rate	9 stitches per 76 mm
Tufting gauge	10 mm tufting machine
Primary backing	Stabilized woven polypropylene
Secondary backing	560 g polyurethane backing
Total product weight	2450 g/m^2

Table 2. Particle size distribution of infill sands and rubber.

	% Retained						
Sand Type	2.0 mm	1.0 mm	0.5 mm	0.25 mm	0.15 mm	0.05 mm	<0.05 mm
Sand A	0.0	0.0	1.9	50.2	42.8	4.6	0.5
Sand B	0.0	0.3	57.8	36.2	5.1	0.0	0.4
Sand C	0.0	0.2	20.0	40.0	34.0	5.5	0.3

Coarser rubber contained predominance of particles between 1.0 - 1.7 mm.
Regular rubber contained predominance of particles between 0.8 - 1.0 mm.

Table 3. Vertical rebound ratio and traction results for sixteen wet and dry artificial playing surfaces.

Treatment			% rebound[1]		Coef. Traction.[2]	
Depth of pile (mm)	Infill Composition [3]	Pad thickness (mm)	Dry	Wet	Dry	Wet
51	80% sand A 20% rubber	19	65.3	66.0	1.00	0.92
51	80% sand A 20% rubber	13	71.5	78.5	1.00	0.99
51	80% sand A 20% rubber	19*	67.4	71.5	0.99	0.97
51	80% sand B 20% rubber	13	66.7	72.9	0.90	0.94
51	80% sand C 20% rubber	13	70.8	71.5	0.96	0.92
38	100% sand A	13	70.1	74.3	0.96	0.86
38	100% sand A	19*	72.2	74.3	1.01	0.92
38	100% sand A	--	78.5	80.6	1.00	0.86
51	50% sand A 50% rubber	13	66.7	76.4	0.92	0.89
51	50% sand A 50% rubber	--	65.3	72.2	0.96	0.95
38	50% sand A 50% rubber	--	72.9	86.1	0.90	0.90
51	50% sand A 50% fine rubber	13	55.6	66.7	0.95	0.88
51	50% sand B 50% coarse rubber	13	47.2	47.2	1.03	0.87
51	10mm 100% rubber base, 29mm sand top layer	13	66.0	66.7	0.97	0.90
51	10mm 100% rubber base, 29mm 80% sand 20% rubber top layer	13	66.7	66.7	0.95	0.87
51	100% rubber	--	42.4	66.7	0.95	0.91

1 Percent rebound of concrete drop. Values are expressed as the ratio of the rebound of a soccer ball on a given test surface to the rebound on a concrete surface.

2 Coefficient of Traction. Wet and dry tra ction values are the average of values from testing in four directions using a Nike Destroyer shoe sole and are expressed as the ratio of the horizontal force to vertical force.

3 Total infill depth is 38 mm for Sofsport pile depth of 51 mm and 25mm for S ofsport pile depth of 38 mm.

* Extruded E-layer pad.

Table 4. Surface hardness of wet and dry artificial playing surfaces as determined by the Clegg impact tester and by the ASTM F355 method.

Treatment			Clegg		F355	
Depth of pile (mm)	Infill Composition [2]	Pad thickness (mm)	Dry	Wet	Dry	Wet
51	80% sand A 20% rubber	19	54.50	54.67	93.94	103.03
51	80% sand A 20% rubber	13	58.50	61.50	103.03	103.03
51	80% sand A 20% rubber	19*	56.83	57.00	98.48	95.45
51	80% sand B 20% rubber	13	45.83	46.33	81.82	86.36
51	80% sand C 20% rubber	13	42.83	42.67	77.27	80.30
38	100% sand A	13	56.33	55.00	96.97	106.06
38	100% sand A	19*	66.50	72.83	112.12	128.79
38	100% sand A	--	104.33	100.83	160.61	175.76
51	50% sand A 50% rubber	13	53.17	58.83	93.94	106.06
51	50% sand A 50% rubber	--	72.33	69.50	118.18	116.67
38	50% sand A 50% rubber	--	73.17	77.33	123.23	142.42
51	50% sand A 50% fine rubber	13	40.00	42.67	77.27	84.85
51	50% sand B 50% coarse rubber	13	36.67	35.33	74.24	68.18
51	10mm 100% rubber base, 29mm sand top layer	13	59.33	63.33	101.01	115.15
51	10mm 100% rubber base, 29mm 80% sand 20% rubber top layer	13	50.17	53.17	88.89	105.05
51	100% rubber	--	81.33	90.67	125.25	154.55

1 Gmax = maximum value of the G encountered during impact. G = the ratio of the acceleration of the missile during impact to the acceleration due to gravity.

2 Total infill depth is 38 mm for Sofsport pile depth of 51 mm and 25mm for Sofsport pi le depth of 38 mm.

* Extruded E-layer pad.

Annual Bluegrass Weevil Management Comparing Registered Pyrethroids, 2001

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Introduction

This experiment was conducted on turfgrass maintained in Bedford County to assess the performance of five formulations against a natural adult annual bluegrass weevil (ABW) population. The area consisted primarily of annual bluegrass (70%) and Kentucky bluegrass (30%).

Methods and Materials

Applications were made when flowering dogwood and shadblow were in full bloom and adults were active on infested areas. 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. At treatment time (3 May), the following soil and environmental conditions existed: air temp, 77? F; soil temp at l inch depth, 68? F; soil temp at 2 inch depth, 61? F; RH, 45%; amt of thatch, 0.75-1.0 inch; water pH, 7; particle analysis, 42.9% sand, 40.6% silt, 16.5% clay; textural class, loam; soil pH, 5.6; % soil water content (% by weight), 26.4; CEC, 13.7; % organic matter, 8.8; soil and thatch condition, moist; application time, noon; and clear sunny skies. Each replicate was irrigated in with 0.25 inch of water immediately after treatment. Posttreatment counts were made on 18 Jun. ABW control was evaluated by removing two 4 inch cup cutter sod samples from each replicate and recording the total no. of ABW life stages (larva, pupa) per sample. Totals were then converted to a ft^2 count and a WD was performed on the data.

Results and Discussion

ABW adults were actively observed on the turfgrass area before treatment. Four treatments provided significant control including DeltaGard, Scimitar, Tempo, and Talstar. No phytotoxicity was noted.

Table 1. Suppression of annual bluegrass weevil (ABW) with pyrethroids.

Treatment/ Formulation[1]	Rate lb (AI)/acre	Avg no. ABW life stages/ft[2] 18 Jun	(% Control)
Untreated Check		115.0 a	
DeltaGard 5SC T&O	0.13	0.0 b	(100)
Talstar F GC	0.1	9.6 b	(91.6)
Scimitar GC	0.06875	0.0 b	(100)
Tempo 20W	0.135	3.8 b	(96.7)

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

Curative Suppression of White Grubs with Applications of Conventional Formulations, 2001

P. R. Heller and R. G. Walker
Department of Entomology

Introduction

This experiment was conducted on a turfgrass area located in Mifflin County which was infested with a natural population of Japanese beetle (JB) and Northern masked chafer (NMC) grubs to determine the effectiveness of experimental and conventional formulations. The turfgrass area consisted primarily of annual bluegrass (50%) and perennial ryegrass (50%).

Methods and Materials

Treatment plots were 9 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 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 (13 Sep) the following soil and environmental conditions existed: air temp, 64? F; soil temp at l inch depth, 63? F; soil temp at 2 inch, 62? F; RH, 60%; amt of thatch, 0.25 inch; percent water content (percent by wt), 8.3; soil textural class, sandy loam; soil particle size analysis: 58.4% sand, 35.7% silt, 5.9% clay; organic matter, 3.6%; CEC, 5.9; and soil pH, 4.8; soil, dry; thatch, moist; water pH, 7.0; and application time, mid morning. Immediately after application the experimental area was irrigated in by using a sprinkling can that contained 2 gal/54 ft^2 of water (0.065 inch irrigation per acre). The experimental area was then irrigated in on the evening of 13 Sep with 0.5 inch of water. Posttreatment counts were made on 10 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.

Results

The experimental area was infested with populations of JB and NMC grubs prior to treatment. Three treatments provided significant reduction of JB and NMC grubs. Results may not be representative of product performance since the experimental area was under water on three separate occasions following treatment as a result of excessive fall rainfall. However, the results do demonstrate what occurred under natural climatic conditions. No phytotoxicity was noted.

Table 1. Curative suppression of Japanese beetle (JB) and Northern masked chafer (NMC) grubs.

Treatment[1]/ formulation	Rate lb (AI)/acre	Avg no. white grubs/ft^2 JB Grubs 10 Oct	NMC Grubs 10 Oct	Total Grubs[2] 10 Oct
Untreated check		5.9 a	4.6 a	10.4 a
Sevin SL	8.0	0.8 b	0.3 b	1.1 c
Dylox 80 T & O	8.1	2.9 ab	2.8 ab	5.7 b
Dylox 6.2G	8.1	1.1 b	0.9 b	2.0 bc
Mach 2 Liquid	1.5	0.3 b	1.6 b	1.9 bc
Permethrin 0.25G	0.272	2.1 ab	3.1 ab	5.2 b

[1] Means followed by the same letter are not significantly different (P = 0.05; WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.
[2] Combination of JB and NMC grubs.

Preventive Suppression of White Grubs with Applications of Conventional and Experimental Formulations, 2001

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Department of Entomology

Introduction

This experiment was conducted on turfgrass located in Centre County which was infested with a natural population of Japanese beetle (JB) and Northern masked chafer (NMC) grubs to determine the effectiveness of experimental and conventional formulations. The turfgrass area consisted primarily of fine fescue (60%) and perennial ryegrass (40%).

Methods and Materials

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 490 ml of water/48 ft^2 or delivering 2.7 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 (10 Jul) the following soil and environmental conditions existed: air temp, 80? F; soil temp at l inch depth, 80? F; soil temp at 2 inch, 79? F; RH, 80%; amt of thatch, 0.5 inch; percent water content (percent by wt), 21.8; soil textural class, silt loam; soil particle size analysis: 34.2% sand, 54.8% silt, 11.0% clay; organic matter, 7.2%; CEC, 12.1; and soil pH, 5.8; soil, dry; thatch, slightly moist; water pH, 7.0; application time, late morning; and clear skies. Immediately after application the experimental area was irrigated in with 0.25 inch of water. The experimental area was irrigated on a regular basis throughout the summer months. Posttreatment counts were made on 20 Sep. 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.

Results and Discussion

The experimental area was previously infested in the spring of 2001 with populations of primarily NMC grubs. NMC adults were first recovered from a black light trap maintained at Penn State's Valentine Turfgrass Research Center on 25 Jun. Peak NMC adult flight was recorded between 29 Jun through 9 Jul. Ninety percent of life stages of NMC recovered from soil samples removed at the Valentine Center on 12 Jul were eggs while the remaining 10% were first instar larvae. All treatments provided significant control of NMC grub populations. JB populations were minimal and not significant. No phytotoxicity was noted.

Table 1. Suppression of Japanese beetle (JB) and Northern masked chafer (NMC) grubs with experimental formulations of thiamethoxam (MERIDIAN) and imidacloprid.

		Avg[1] no. white grubs/ft^2		
		JB Grubs	NMC Grubs	Total Grubs[2]
Treatment/ formulation[1]	**Rate lb (AI)/acre**	**20 Sep**	**20 Sep**	**20 Sep**
Meridian 25WG	0.198	0.0 a	0.6 b	0.6 b
Meridian 0.33G	0.198	0.0 a	0.0 b	0.0 b
Advanced Season Long Grub Control	0.3	0.0 a	0.3 b	0.3 b
Meridian SC	0.198	0.0 a	1.3 b	1.3 b
Meridian SC	0.264	0.0 a	0.0 b	0.0 b
Untreated check		1.2 a	14.4 a	15.7 a

[1] Means followed by the same letter are not significantly different (P = 0.05; WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.
[2] Combination of JB and NMC grubs.

Evaluation of Registered and Experimental Formulations to Curatively Suppress White Grubs, 2001

P. R. Heller and R. G. Walker
Department of Entomology

Introduction

This study was undertaken to determine product effectiveness to control a mixed population of Japanese beetle (JB) and Northern masked chafer (NMC) grubs on turfgrass in State College that consisted of fine fescue (34%), annual bluegrass (33%), and perennial ryegrass (33%).

Methods and Materials

Treatment plots were 9 x 6 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 408 ml of water/54 ft^2 or delivering 2.0 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 (31 Aug) the following soil and environmental conditions existed: air temp, 65? F; soil temp at l inch depth, 62? F; soil temp at 2 inch, 64? F; RH, 95%; amt of thatch, 0.5 inch; water pH, 7.0; application time, early morning; soil dry; thatch moist; and cloudy skies. Immediately after application the experimental area was irrigated in with 0.2 inch of water. General soil conditions were as follows: soil textural class, silt loam; soil particle size analysis: sand, 28.3%; silt, 58.6%; clay, 13.1%; soil percent water content (percent by wt), 11.5; organic matter, 4.8%; CEC, 7.0; and soil pH, 5.3. Posttreatment counts were made on 9 Oct. Three ft^2 sod samples were taken from each replicate. The total no. of JB and NMC grubs/ft^2 was recorded. Data was analyzed using WD.

Results and Discussion

Five treatments provided significant reduction of JB and NMC grubs. NMC was the predominant white grub species present in the research area. Prior to treatment the area was heavily infested with primarily second instar NMC white grubs. No phytotoxicity was noted.

Table 1. Late summer suppression of Japanese beetle (JB) and Northern masked chafer (NMC) grubs with conventional and experimental formulations.

Treatment[1]/ formulation	Rate lb (AI)/acre	Avg[1] no. grubs/ft^2 9 Oct JB	NMC	BOTH[2]
Untreated check		2.0 a	12.2 a	14.2 a
Merit 75W	0.3	0.2 b	2.3 b	2.6 b
Merit 75W plus BreakThru OSS	0.3 + 0.1%	0.3 b	2.3 b	2.7 b
Dylox 6.2G	8.1	0.0 b	1.2 b	1.2 b
Dylox 80SP	8.1	0.0 b	2.3 b	2.3 b
NTN33893 200SL	0.3	0.0 b	5.1 b	5.1 b

[1] Means followed by the same letter are not significantly different (P = 0.05; WD). Always follow label directions since some treatments may be experimental and are for experimental use only.
[2] Combination of JB and NMC grubs.

Preventive Suppression of White Grubs with Applications of Experimental and Conventional Formulations of Imidacloprid, Halofenozide, and Permethrin, 2001

P. R. Heller and R. G. Walker
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Introduction

This experiment was conducted on turfgrass located in Beaver Falls which was infested with a natural population of Japanese beetle (JB) and Northern masked chafer (NMC) grubs to determine the effectiveness of experimental and conventional formulations. The turfgrass area consisted primarily of perennial ryegrass (50%) and annual bluegrass (50%).

Methods and Materials

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 (11 Jun) the following soil and environmental conditions existed: air temp, 80? F; soil temp at l inch depth, 78? F; soil temp at 2 inch, 70? F; RH, 62%; amt of thatch, 0.0625-0.125 inch; percent water content (percent by wt), 28.1; soil textural class, silt loam; soil particle size analysis: 14.9% sand, 75.6% silt, 9.6% clay; organic matter, 4.9%; CEC, 6.9; and soil pH, 4.9; soil moist; thatch moist; water pH, 7.0; application time, mid-afternoon; and overcast 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 throughout the summer months. Posttreatment counts were made on 18 Sep. 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.

Results and Discussion

The experimental area was previously infested in the fall and spring of 2000 with heavy populations of NMC grubs. No treatments provided significant control of JB populations since they were minimal. The predominant white grub species present was NMC and all treatments provided significant reduction of NMC grubs. No phytotoxicity was noted.

Table 1. Early summer suppression of Japanese beetle (JB) and Northern masked chafer (NMC) grubs with experimental and registered formulations of halofenozide, imidacloprid, and permethrin.

		Avg no. white grubs/ft^2	
		JB Grubs	NMC Grubs
Treatment[1]/ formulation	**Rate lb (AI)/acre**	**18 Sep**	**18 Sep**
Untreated check		0.2 a	28.6 a
Imidacloprid 0.2G Season Long	0.25	0.1 a	0.3 c
Imidacloprid 0.2G Biodac	0.25	0.2a	1.2 c
Imidacloprid 0.2G Montmorill	0.25	0.2 a	1.4 c
Imidacloprid 0.2G Attapulgit	0.25	0.2 a	0.3 c
Halofenozide 1.5G GrubEx	1.5	0.0 a	2.4 c
Permethrin 0.25G Spectracide	0.25	0.2 a	17.7 b

[1] Means followed by the same letter are not significantly different (P = 0.05; WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

Mid Summer Evaluation of Registered and Experimental Formulations to Suppress White Grubs, 2001

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Introduction

This study was undertaken to determine product effectiveness to control a mixed white grub population of Japanese beetle (JB) and Northern masked chafer (NMC) on turfgrass maintained in Lewistown. The turfgrass area consisted of perennial ryegrass (50%) and annual bluegrass (50%).

Methods and Materials

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 (9 Aug) the following soil and environmental conditions existed: air temp, 72? F; soil temp at l inch depth, 72? F; soil temp at 2 inch, 72? F; RH, 95%; amt of thatch, 0.5 inch; water pH, 7.0; application time, early morning; soil dry; thatch moist; and clear skies. Immediately after application the experimental area was irrigated in with 0.25 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, 39.6%; silt, 53.2%; clay, 7.3%; soil percent water content (percent by wt), 14.2; organic matter, 3.1%; CEC, 6.5; and soil pH, 5.2. Three sq ft soil samples were randomly removed from each replicate on 27 Sep and the total no. of JB and NMC grubs was recorded. Data was analyzed using WD.

Results and Discussion

Eight treatments provided significant reduction of JB grubs while seven treatments provided significant reduction of NMC grubs. All treatments provided significant reduction when both grub species were combined. No phytotoxicity was noted.

Table 1. Mid-summer suppression of Japanese beetle (JB) and Northern masked chafer (NMC) grubs with experimental and registered formulations of halofenozide, imidacloprid, and permethrin.

Treatment[1]/ formulation	Rate lb (AI)/acre	Avg no. grubs/ft^2 27 Sep JB	NMC	BOTH[2]
Untreated check		5.6 a	3.6 a	9.1 a
Imidacloprid 1.47 SC	0.267	0.0 d	0.0 b	0.0 e
Imidacloprid 0.2G Season Long	0.25	1.3 bc	0.2 b	1.6 cd
Imidacloprid 0.2G Biodac	0.25	0.6 bcd	0.0 b	0.6 cde
Imidacloprid 0.2G Montimorill	0.25	0.1 cd	0.0 b	0.1 de
Imidacloprid 0.2G Attapulgit	0.25	0.1 cd	0.2 b	0.3 de
Imidacloprid 0.5G Merit	0.305	1.1 bcd	0.0 b	1.1 cde
Halofenozide 1.5G GrubEx	1.5	1.4 b	0.4 b	1.9 c
Permethrin 0.25G Spectracide	0.272	1.6 b	3.3 a	4.9 b

[1] Means followed by the same letter are not significantly different (P = 0.05; WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.
[2] Combination of JB and NMC grubs.

Black Cutworm Larval Suppression with Talstar and Tempo Formulations on Creeping Bentgrass, 2001

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Introduction

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 third instar black cutworm (BCW) larvae.

Methods and Materials

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. 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. Three cylinders were placed in each replicate and nine late second to third instar black cutworm larvae were added to each cylinder on 11 Jul. Data was collected (one cylinder per replicate/collection date) on three dates, respectively Jul 14, Jul 16, and Jul 18. 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. Granular formulations were applied with a hand held shaker with top dressing sand used to provide even distribution of product. At treatment time (10 Jul), the following soil and environmental conditions existed: air temp, 67? F; soil temp at l inch depth, 61? F; soil temp at 2 inch depth, 60? F; RH, 80%; amt of thatch, 0.5 inch; soil textural class, sandy loam; soil particle size analysis: 54.4% sand, 35.0% silt, 10.6% clay; percent water content (percent by wt), 17.2; organic matter, 2.3%; water pH, 7.0; soil pH, 7.1; CEC, 7.2; time of application, early morning; thatch and soil, slightly moist; and clear skies. The entire experimental area was irrigated in with 0.125 inch of water immediately after treatment. Efficacy data was recorded on Jul 14, Jul 16, and Jul 18 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. One cylinder was sampled per replicate per data collection date. Data was analyzed by using WD in Tables One and Two and an Abbott’s transformation in Table Two.

Results and Discussion

All treatments provided significant reduction of BCW on Jul 14, Jul 16, and Jul 18. No phytotoxicity was noted, however Tempo 0.1GR A enhanced the overall green color of individual replicates when evaluated on July 18. Small amounts of white carrier granules from Tempo 0.1GR AC01 remained on the green’s surface when sampled on 18 Jul.

Table 1. Suppression of black cutworm (BCW) with conventional and experimental formulations of bifenthrin and cyfluthrin.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg No. Fresh BCW Larvae Flushed To Surface/8 inch Cylinder[2] 14 Jul	16 Jul	18 Jul
Tempo 0.1GR A	0.1	1.7 bc	1.0 b	0.0 b
Tempo 0.1 GR A	0.2	0.7 c	0.0 c	0.0 b
Tempo 0.1GR AC01	0.1	0.7 c	0.0 c	0.0 b
Tempo 0.1GR AC01	0.2	0.3 c	0.0 c	0.0 b
Tempo 0.2GR Cmpd	0.1	0.7 c	0.7 bc	0.0 b
Tempo 0.2GR Cmpd	0.2	3.3 b	0.3 bc	0.0 b
Tempo Ultra	0.0724	1.7 bc	0.0 c	0.0 c
Tempo Ultra	0.1	0.7 c	0.0 b	0.0 c
Talstar PL G	0.1	1.0 c	0.0 c	0.0 b
Talstar PL G	0.2	3.3 b	0.0 c	0.0 b
Untreated Check		7.3 a	6.3 a	9.0 a

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.
[2] Each cylinder infested with nine BCW larvae on 11 Jul.

Table 2. Suppression of black cutworm (BCW) larvae with experimental and conventional formulations of bifenthrin and cyfluthrin by Abbott's analysis.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg Percent Mortality of BCW Flushed To Surface/8 inch Cylinder[2] 14 Jul[3]	16 Jul[3]	18 Jul[3]
Tempo 0.1GR A	0.1	76.2 ab	83.3 a	100.0 a
Tempo 0.1 GR A	0.2	90.5 a	100.0 a	100.0 a
Tempo 0.1GR AC01	0.1	91.7 a	100.0 a	100.0 a
Tempo 0.1GR AC01	0.2	95.2 a	100.0 a	100.0 a
Tempo 0.2GR Cmpd	0.1	90.5 a	89.7 ab	100.0 a
Tempo 0.2GR Cmpd	0.2	55.9 b	94.4 ab	100.0 a
Tempo Ultra	0.0724	76.2 ab	100.0 a	100.0 a
Tempo Ultra	0.1	90.5 a	100.0 a	100.0 a
Talstar PL G	0.1	85.7 a	100.0 a	100.0 a
Talstar PL G	0.2	54.2 b	100.0 a	100.0 a
Untreated Check		0.0 c	0.0 c	0.0 b

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only.
Also, some formulations listed above are not labeled for golf course use.
[2] Each cylinder infested with nine BCW larvae on 11 Jul.
[3] Data transformed using Abbotts formula to calculate a percentage relative to the value of the untreated treatment(s) within the current replicate. A negative number indicates that more BCW larvae survived in the treatment than the untreated check.

Black Cutworm Larval Extended Residual Suppression with Sevin, Scimitar, Deltagard, Talstar, and Tempo Formulations on Creeping Bentgrass, 2001

P. R. Heller and R. G. Walker
Department of Entomology

Introduction

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 third instar black cutworm (BCW) larvae.

Methods and Materials

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. 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 per infestation date (Jul 24, Jul 31, Aug 14) and ten late second instar and third instar black cutworm larvae were placed in each cylinder. 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. Granular formulations were applied with a hand-held shaker, and top dressing sand was added to facilitate product distribution. At treatment time (18 Jul), the following soil and environmental conditions existed: air temp, 66? F; soil temp at l inch depth, 63? F; soil temp at 2 inch depth, 63? F; RH, 90%; amt of thatch, 1.0 inch; soil textural class, sandy loam; soil particle size analysis: 67.3 % sand, 26.8% silt, 5.9% clay; percent water content (percent by wt), 17.3; organic matter, 2.0%; water pH, 7.0; soil pH, 7.1; CEC, 6.7; time of application, early-morning; thatch and soil moist; and cloudy skies. The granular treatment was irrigated in with 0.1 inch of water immediately after application. Efficacy data was recorded on 29 Jul, 5 Aug, and 20 Aug by counting the no. of BCW larvae flushed to the surface within each eight inch PVC cylinder by using a soap irritant drench. Data was analyzed by using WD in Tables One and Two. An Abbott's transformation of the data was completed in Table Two.

Results and Discussion

All treatments provided significant control on 29 Jul (11 DAT) while only four treatments provided significant control on 5 Aug (18 DAT). No treatments provided significant control on 20 Aug (33 DAT). No phytotoxicity was noted.

<u>Table 1</u>. Suppression of black cutworm (BCW) larvae with formulations of pyrethroids and a carbamate.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg No. Fresh BCW Larvae Flushed To Surface/8 inch Cylinder 29 Jul	5 Aug	20 Aug
Untreated Check		6.3 a	4.7 a	6.0 abc
DeltaGard 5SC T & O	0.06	0.0 c	1.0 b	6.0 abc
DeltaGard GR T & O	0.13	0.3 c	0.7 b	3.7 c
Talstar GC F	0.05	0.3 c	4.7 a	5.0 abc
Tempo 20W	0.135	0.0 c	0.7 b	7.3 a
Tempo Ultra	0.0695	0.0 c	2.7 ab	8.0 a
Scimitar GC	0.06875	0.0 c	0.0 b	4.0 bc
Sevin 80 WSP	4.0	3.7 b	4.0 a	7.0 ab

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

Table 2. Suppression of black cutworm (BCW) larvae with formulations of pyrethroids and a carbamate by using Abbott's analysis.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg Percent Mortality of BCW Flushed To Surface/8 inch Cylinder 29 Jul[2]	5 Aug[2]	20 Aug[2]
Untreated Check		0.0 c	0.0 c	0.0 abc
DeltaGard 5SC T & O	0.06	100.0 a	80.0 ab	-4.1 abc
DeltaGard GR T & O	0.13	93.3 a	85.0 a	40.6 a
Talstar GC F	0.05	95.8 a	-6.7 c	15.4 abc
Tempo 20W	0.135	100.0 a	83.3 ab	-25.6 c
Tempo Ultra	0.0695	100.0 a	45.0 abc	-34.8 c
Scimitar GC	0.06875	100.0 a	100.0 a	30.9 ab
Sevin 80 WSP	4.0	37.5 b	13.3 bc	-20.5 bc

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

[2] Data transformed using Abbotts formula to calculate a percentage relative to the value of the untreated treatment(s) within the current replicate. A negative number indicates that more BCW larvae survived in the treatment than the untreated check.

Black Cutworm Larval Extended Residual Suppression with Confirm, Mach 2, and Scimitar Formulations on Creeping Bentgrass, 2001

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Department of Entomology

Introduction

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 third instar black cutworm (BCW) larvae.

Methods and Materials

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. One eight inch diam by six inch long white PVC cylinder was placed in each replicate and secured in place on two separate infestation dates, respectively 31 Jul and 14 Aug. Each cylinder was covered with white meshed shade cloth. Ten late second instar and third instar black cutworm larvae were placed in each cylinder on each infestation date. 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 (31 Jul), the following soil and environmental conditions existed: air temp, 76? F; soil temp at l inch depth, 73? F; soil temp at 2 inch depth, 72? F; RH, 70%; amt of thatch, 1.0 inch; soil textural class, sandy loam; soil particle size analysis: 51.5% sand, 42.3% silt, 6.2% clay; percent water content (percent by wt), 20.0; organic matter, 2.6%; water pH, 7.0; soil pH, 7.2; CEC, 7.0; time of application, early-morning; thatch and soil moist; and sunny skies. A total of 6.6 inches of rainfall or irrigation was recorded through 20 Aug. Treatments were not irrigated in after application. Efficacy data was recorded on 7 Aug and 20 Aug by counting the no. of BCW larvae flushed to the surface within each eight inch PVC cylinder by using a soap irritant drench. Data was analyzed by using a WD. An Abbott's transformation of data is noted in the table in ( ).

Results and Discussion

All treatments provided significant control on 7 Aug, while only Scimitar GC provided significant control on 20 Aug. No phytotoxicity was noted.

Table 1. Suppression of black cutworm (BCW) with Confirm, Mach 2, and Scimitar.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg No. Fresh BCW Larvae Flushed To Surface/8 inch Cylinder: 7 Aug[2] (Abbott's)	20 Aug (Abbott's)
Untreated Check		6.2 a (0.0 c)	8.3 a (0.0 b)
Mach 2SC	1.0	1.0 b (82.7 b)	5.3 ab (35.4 ab)
Scimitar GC	0.06875	0.0 c (100.0 a)	2.7 b (68.0 a)

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Data in ( ) transformed using Abbotts formula to calculate a percentage relative to the value of the untreated treatment(s) within the current replicate. Always follow label directions since some treatments may be experimental and are for experimental use only.

[2] Mean descriptions are reported in arcsine transformed data units, and are not de-transformed.

Black Cutworm Larval Extended Residual Suppression with Tempo and Conserve Formulations on Creeping Bentgrass, 2001

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Introduction

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 third instar black cutworm (BCW) larvae.

Methods and Materials

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. 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 instar and third instar black cutworm larvae were placed in each cylinder. 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 (28 Aug), the following soil and environmental conditions existed: air temp, 62? F; soil temp at l inch depth, 59? F; soil temp at 2 inch depth, 62? F; RH, 90%; amt of thatch, 1.0 inch; soil textural class, sandy loam; soil particle size analysis: 48.4% sand, 46.0% silt, 5.6% clay; percent water content (percent by wt), 20.8; organic matter, 3.0%; water pH, 7.0; soil pH, 7.0; CEC, 7.0; time of application, early-morning; thatch and soil moist; and sunny skies. Excessive rainfall occurred from 28 Aug – 4 Sep that amounted to 1.8 inches. Treatments were not irrigated in after application. Efficacy data was recorded on 4 Sep by counting the no. of BCW larvae flushed to the surface within each eight inch PVC cylinder by using a soap irritant drench. Data was analyzed by using WD.

Results and Discussion

All treatments but Conserve provided significant control on 4 Sept. No phytotoxicity was noted.

Table 1. Suppression of black cutworm (BCW) with Tempo and Conserve.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg No. Fresh BCW Larvae Flushed To Surface/8 in Cylinder 4 Sep[2] (Abbott's[2])
Untreated Check		2.9 a (0.0 a)
Tempo 20W	0.135	0.0 b (100.0 b)
Tempo 20W	0.1	0.0 b (100.0 b)
Conserve T & O	0.4	3.2 a (10.8 a)

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Data in ( ) transformed using Abbotts formula to calculate a percentage relative to the value of the untreated treatment(s) within the current replicate. Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

[2] Mean descriptions are reported in arcsine transformed data units, and are not de-transformed.

Fall Armyworm Suppression with Formulations of Scimitar, Tempo, Deltagard, and Conserve on Creeping Bentgrass, 2001

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Department of Entomology

Introduction

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 third instar fall armyworm (FAW) larvae.

Methods and Materials

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. One eight inch diam by six inch long white PVC cylinders was placed in each replicate and secured in place. Each cylinder was covered with white meshed shade cloth. Each cylinder was infested with ten late second instar and third instar FAW larvae on 21 Aug. 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 (21 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 depth, 62? F; RH, 85%; amt of thatch, 1.0 inch; soil textural class, loam to sandy loam; soil particle size analysis: 51.4% sand, 41.4% silt, 7.3% clay; percent water content (percent by wt), 10.5; organic matter, 3.5%; water pH, 7.0; soil pH, 6.8; CEC, 9.0; time of application, early-morning; thatch and soil, moist; and overcast skies. Efficacy data was recorded on 28 Aug (7 DAT) by counting the no. of FAW larvae flushed to the surface within each eight inch PVC cylinder by using a soap irritant drench. Data was analyzed by using WD.

Results and Discussion

All treatments provided significant control on 28 Aug. No phytotoxicity was noted.

Table 1. Suppression of fall armyworm (FAW) larvae with pyrethroids and spinosa.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg[1] No. Fresh FAW Larvae Flushed To Surface/8 inch Cylinder (Abbott's Transformed Data) 28 Aug	
Untreated Check		3.7 a	(0.0 b)
Scimitar GC	0.06875	0.0 b	(100.0 a)
Conserve T & O	0.4	0.3 b	(91.7 a)
Tempo Ultra	0.0695	0.0 b	(100.0 a)
DeltaGard 5SC T & O	0.06	0.0 b	(100.0 a)

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

Curative Management of Hairy Chinch Bug with Experimental and Registered Formulations on Fine Fescue, 2001

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Introduction

This experiment was conducted on an old established commercial turfgrass area in Somerset to determine the effectiveness of treatments against a natural hairy chinch bug (HCB) population.

Methods and Materials

The turfgrass area consisted primarily of fine leafed fescue. Treatment plots were 4 x 6 ft arranged in a RCB design and replicated 3 times. Liquid formulations were applied by using a CO_2 sprayer with 4 8002VS TeeJet nozzles mounted on a 6 ft boom operating at 28 psi, and applied in 182 ml of water/24 ft^2 or delivering 2.0 gal/1000 ft^2. Granular formulations were applied with a hand held shaker with top dressing sand used to provide even distribution of product. At treatment time (6 Aug) the following soil and environmental conditions existed: air temp, 74?F; soil temp at 1 inch depth, 72?F; soil temp at 2 inch depth, 68?F; RH, 80%; amt of thatch, 0.5 inch; soil textural class, silt loam; soil particle size analysis: 34.9% sand, 55.3% silt, 9.8% clay; percent water content (percent by wt), 10.5%; organic matter, 8.2%; water pH, 7.0; soil pH, 5.0; CEC, 10.7; application time, mid-morning; soil dry; thatch moist; and overcast skies. The granular treatment was irrigated in immediately after treatment with 0.1 inch of water. No other treatments received post-treatment irrigation. HCB was sampled by driving a 6 inch-diam stainless steel cylinder into the turf, filling it with water, and counting the number of HCB nymphs and adults floating to the surface during a 10 min period on three sampling dates, respectively 15 Aug, 22 Aug, and 29 Aug. Two floatation samples were taken randomly from each replicate, and the total number of HCB from each sample was recorded and converted to a ft^2 count.

Results and Discussion

Prior to treatment, an avg of 23.5 HCB nymphs and adults/ft^2 were present on 1 Aug. No treatments provided significant reduction on 15 Aug, while four treatments provided significant control on 22 Aug, and five treatments provided significant control on 29 Aug. No phytotoxicity was noted.

Table 1. Management of hairy chinch bug (HCB) with experimental and conventional formulations.

Treatment/ formulation[1]	Rate lb (AI)/acre	Avg[1] no. HCB/ft^2 15 Aug	22 Aug[2]	29 Aug
Merit 75WP	0.3	24.6 a	23.4 a	15.3 b
Merit 75WP	0.4	33.1 a	9.7 bcd	16.1 b
NTN3893 200SL	0.3	28.0 a	22.0 a	34.0 ab
NTN3893 200SL	0.4	15.3 a	8.1 cd	11.0 b
Tempo Ultra	0.1	34.8 a	13.5 abc	28.0 ab
Tempo 20WP	0.2	24.6 a	0.0 e	11.9 b
Tempo 0.1GR AC01	0.2	11.0 a	17.7 ab	33.1 ab
Talstar F	0.1	25.5 a	3.8 d	8.5 b
Untreated Check		44.2 a	23.5 a	61.2 a

[1] Means followed by the same letter are not significantly different (P = 0.05, WD). Always follow label directions since some treatments may be experimental and are for experimental use only. Also, some formulations listed above are not labeled for golf course use.

[2] Means are reported in arcsine transformed data units, and are not de-transformed.

Effects of Fungicides for Control of Anthracnose on a Putting Green, 2001

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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 fungicides, rates, and application timings in controlling Anthracnose infection.

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 six times per week. The soil was a modified sandy clay loam with a soil pH of 7.0. On 8 May, the site was aerified (0.625 in. tines) and topdressed. Dimension 1EC (1.5 qt per acre) was applied on 11 May for control of crabgrass. The test area was fertilized on 11 May with 0.7 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft, and 15 May with 0.8 lb nitrogen (Scotts 19-0-17) per 1000 sq ft. 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, using TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were made on 13 and 27 Jun, and 11 and 25 Jul, except as noted in the table. Disease severity was evaluated on 17, 25, and 31 Jul, as well as 8 and 20 Aug. Data were subjected to analysis of variance, and the mean values were separated by the Waller-Duncan k-ratio test (P=0.05).

Results and Discussion

Anthracnose basal rot developed on the annual bluegrass. Approximately 50% of the annual bluegrass in the non-treated control plots were necrotic during the period of mid-July through mid-August. Through 8 Aug, 20 of the 44 treatments provided excellent control of anthracnose basal rot. By 20 Aug, disease severity for only eight treatments was significantly different from that of the non-treated check. AMS-21619 at 0.2 and 0.1 oz, the high rate of Lynx, and the tank mixture of Lynx + Daconil Ultrex provided excellent control throughout the study.

Table. Effects of fungicides for control of anthracnose on a putting green, 2001.

Disease Severity[a]

Treatment, formulation, and rate per 1000 sq ft	17 Jul		25 Jul		31 Jul		8 Aug		20 Aug	
Eagle 40WP 1.2 oz[b]	4.3	b-g[c]	3.7	f-k[c]	3.0	d-g[c]	2.3	e-j[c]	8.0	a[c]
Bayleton 50WP 0.25 oz	2.7	d-j	5.0	c-h	4.0	b-e	3.3	b-g	7.7	ab
TD-2390 WG 6.0 oz	6.0	abc	7.3	ab	6.0	a	5.3	a	7.0	abc
TD-2390 WG 8.0 oz	7.0	ab	6.7	a-d	4.7	a-d	4.7	abc	7.0	abc
TD-2389 20WG 8.0 oz	7.7	a	8.7	a	6.3	a	5.0	ab	6.7	a-d
Emerald 70WG 0.18 oz[b]	7.0	ab	5.3	b-g	4.7	a-d	2.7	d-i	6.7	a-d
AMS-21616 1.67SC 0.239 fl oz	2.3	e-j	1.7	k-o	1.0	h-k	2.7	d-i	6.3	a-e
AMS-21616 1.67SC 0.358 fl oz	1.0	hij	1.7	k-o	1.3	g-k	2.0	f-k	6.3	a-e
Honor 50WG 0.2 oz[b]	0.7	ij	3.0	h-m	2.7	e-h	3.0	c-h	6.3	a-e
Fore Rainshield 80W P 8.0 oz	5.0	a-e	6.0	b-e	5.0	abc	3.7	a-f	6.3	a-e
XF-00183 1EC 1.2 fl oz[b]	1.0	hij	2.0	k-o	1.3	g-k	2.7	d-i	6.0	a-e
TopPro Iprodione 2F 2.0 fl oz	3.0	d-i	4.7	d-i	4.7	a-d	4.0	a-e	6.0	a-e
Eagle 40WP 0.6 oz	3.7	c-h	4.3	e-j	3.0	d-g	2.3	e-j	5.7	a-f
TopPro Iprodione 2SC 4.0 fl oz	2.7	d-j	2.7	i-n	3.0	d-g	3.0	c-h	5.7	a-f
XF-00183 1EC 0.76 fl oz[b]	0.7	ij	1.7	k-o	0.3	jk	2.0	f-k	5.3	a-g
XF-00182 1EC 0.76 fl oz + Eagle 40 WP 0.31 oz[b]	1.7	g-j	1.7	k-o	1.0	h-k	1.7	g-l	5.3	a-g
Heritage 50WG 0.4 oz[b]	2.0	f-j	2.3	j-o	2.0	f-j	1.7	g-l	5.3	a-g
TopPro WP Iprodione 50WP 2.0 oz	0.7	ij	1.7	k-o	1.3	g-k	3.0	c-h	5.3	a-g
Chipco 26019 50WP 2.0 oz	3.0	d-i	4.3	e-j	4.7	a-d	5.3	a	5.3	a-g
Emerald 70WG 0.13 oz	4.7	b-f	5.3	b-g	5.0	abc	4.3	a-d	5.3	a-g
Untreated Check	4.3	b-g	5.3	b-g	5.3	abc	4.0	a-e	5.3	a-g
Curalan 50WG 1.0 oz[b]	5.0	a-e	5.7	b-f	3.7	c-f	3.7	a-f	5.0	b-g
Chipco 26GT 2SC 4.0 fl oz	3.0	d-i	3.3	g-l	3.7	c-f	3.7	a-f	5.0	b-g
Fore Rainshield 80WP 6.0 oz + Bayleton 50WP 0.25 oz[b]	5.3	a-d	5.3	b-g	5.3	abc	3.3	b-g	5.0	b-g
XF-00182 1EC 1.5 fl oz[b]	1.0	hij	1.0	mno	1.0	h-k	1.3	h-l	4.7	c-g
Honor 50WG 0.2 oz	4.0	c-g	5.0	c-h	2.3	e-i	2.3	e-j	4.7	c-g
Chipco 26GT 2SC 3.0 fl oz[d]	3.0	d-i	2.3	j-o	3.0	d-g	1.7	g-l	4.3	c-g
Rubigan 1AS 0.75 fl oz[d]	4.3	b-g	2.7	i-n	2.3	e-i	3.0	c-h	4.3	c-g
XF-00183 1EC 0.76 fl oz + Eagle 40WP 0.31 oz[b]	2.0	f-j	1.3	l-o	1.7	g-k	1.0	i-l	4.0	d-h
Cleary 3336 F 4.5F 2.0 fl oz	0.3	ij	0.7	no	0.7	ijk	0.7	jkl	4.0	d-h
Daconil Ultrex 82.5WG 1.82 oz	7.0	ab	7.0	abc	5.7	ab	3.3	b-g	3.7	e-i
XF-00183 1EC 1.5 fl oz[b]	2.0	f-j	2.0	k-o	1.7	g-k	1.3	h-l	3.7	e-i
XF-00182 1EC 1.2 fl oz[b]	1.0	hij	1.3	l-o	1.0	h-k	1.0	i-l	3.7	e-i
TopPro FLO Thiophanate Methyl 4.5F 2.0 fl oz	0.0	j	0.3	o	0.3	jk	0.7	jkl	3.0	f-j
TopPro WP Thiophanate Methyl 50WP 2.0 oz	0.3	ij	0.3	o	0.7	ijk	0.3	kl	3.0	f-j
Honor 50WG 0.2 oz alt. Daconil Ultrex 82.5WG 3.2 oz[e]	1.0	hij	1.3	l-o	1.3	g-k	1.3	h-l	3.0	f-j
Cleary 3336 50WP 2.0 oz	1.0	hij	1.0	mno	1.0	h-k	1.0	i-l	2.7	g-k
Daconil Ultrex 82.5WG 3.2 oz	4.7	b-f	4.7	d-i	3.0	d-g	1.0	i-l	1.3	h-k
Banner Maxx 1.3MC 1.0 fl oz + Heritage 50WG 0.2 oz	2.0	f-j	1.7	k-o	1.0	h-k	0.3	kl	1.3	h-k
XF-00044 WP 3.5 oz	3.0	d-i	2.3	j-o	2.0	f-j	0.3	kl	1.0	ijk
Lynx 45WP 0.278 oz	2.0	f-j	1.0	mno	0.7	ijk	0.0	l	0.3	jk
Lynx 45WP 0.556 oz	0.7	ij	0.7	no	0.3	jk	0.0	l	0.0	k
Lynx 45WP 0.278 oz + Daconil Ultrex 82.5WG 1.82 oz	0.0	j	0.7	no	0.3	jk	0.0	l	0.0	k
AMS-21619 50WP 0.1 oz	0.0	j	0.3	o	0.0	k	0.0	l	0.0	k
AMS-21619 50WP 0.2 oz	0.0	j	0.3	o	0.0	k	0.0	l	0.0	k

[a]Disease severity index 0-10; 0=asymptomatic, and 10= ?90% turf area symptomatic; mean of three replications.
[b]Treatment applied on a 28-day interval (13 Jun and 11 Jul).
[c]Means within each column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[d]Treatment applied on a 21-day interval (13 Jun, 3 and 25 Jul).
[e]Treatments applied alternately on a 14-day interval; Honor applied 13 Jun, 11 Jul; Daconil Ultrex applied 27 Jun, 25 Jul.

Evaluation of Fungicides for Control of Anthracnose on a Putting Green, 2001

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Introduction

Anthracnose *(Colletotrichum graminicola)* is a serious disease on putting greens; particularly those comprised of high populations of annual bluegrass *(Poa annua)*. The use of fungicides plays an important role in the management of Anthracnose. The objective of this study was to evaluate the effectiveness of various fungicides, rates, and application timings in controlling Anthracnose infection.

Materials and Methods

The experiment was conducted on a mixed stand of annual bluegrass and creeping bentgrass maintained under golf course greens management conditions. The turf was mowed six times per week at 0.125 inch cutting height. The soil was a modified sandy clay loam with a soil pH of 7.0. On 27 Apr, Dimension 1EC was applied to the experiment at the rate of 1.125 fl oz per 1000 sq ft for control of crabgrass. On 8 May, the site was aerified (0.625 in. tines) and topdressed. The test area was fertilized on 11 May with 0.16 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft, and 14 Jul with 0.25 lb nitrogen (Lebanon 28-7-14) per 1000 sq ft. On 5 Jun Trimec Bentgrass Formula 1.33EC (1.0 fl oz) was applied for control of broadleaf weeds. The experimental area was brushed one time per week from 18 Jun through 30 Jul. Daconil Weatherstik 6F (6.0 fl oz per 1000 sq ft) was applied on 15 Jun for control of dollar spot. 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, using TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were initiated on 19 Jun, and continued on a 14-day interval through 29 Aug, except as noted in the table. The experimental turf area was inoculated on 2 Aug by applying a *C. graminicola* spore suspension, and covered with 6-mil plastic each night through 18 Aug. Plastic was removed during the daylight hours. Disease severity was evaluated on 20 Aug, and 4 and 12 Sep. Data were subjected to analysis of variance, and the mean values were separated by the Waller-Duncan k-ratio test (P=0.05).

Results and Discussion

Anthracnose basal rot disease developed on the annual bluegrass. Disease was most severe in mid-August. On 20 Aug, 20 of the 22 treatments provided control of anthracnose basal rot that was significantly different from the non-treated check. Throughout the study, excellent control of anthracnose was achieved with the Lynx + Compass tank mixture, both rates of TADS 12529, the 1.0 fl oz rates of Chipco Triton applied on 14 or 21-day intervals, and the Chipco Signature + Triton combination.

Table. Evaluation of fungicides for control of anthracnose on a putting green, 2001.

Treatment, formulation, and rate per 1000 sq ft	Disease Severity[a] 20 Aug	4 Sep	12 Sep
Heritage 50WG 0.4 oz[b]	4.7 ab[c]	6.3 a[c]	6.0 a[c]
Heritage 50WG 0.4 oz[d]	3.7 bcd	5.0 ab	5.7 ab
Compass 50WG 0.15 oz	4.0 bc	5.0 ab	5.0 abc
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz	3.7 bcd	5.0 ab	5.0 abc
Honor 50WG 0.2 oz[b]	4.7 ab	6.7 a	4.7 abc
Insignia 20WG 0.5 oz	2.7 b-e	3.7 bc	4.3 a-d
Insignia 20WG 0.9 oz[b]	2.7 b-e	3.7 bc	4.3 a-d
Heritage 50WG 0.3 oz[d]	2.7 b-e	5.3 ab	4.3 a-d
Cleary's 3336 50WP 4.0 oz	2.0 c-g	3.7 bc	4.3 a-d
Banner MAXX 1.3MC 1.0 fl oz + Heritage 50WG 0.2 oz	2.3 c-f	2.0 cde	4.3 a-d
Rubigan 1AS 3.5 fl oz[b]	2.7 b-e	3.7 bc	4.0 b-e
Honor 50WG 0.2 oz	4.0 bc	3.7 bc	3.7 c-f
Chipco Signature 80WG 4.0 oz[e]	1.7 d-g	2.7 cd	3.7 c-f
Untreated Check	6.7 a	5.3 ab	3.7 c-f
Chipco Triton 1.67SC 0.5 fl oz	2.0 c-g	2.3 cd	2.7 d-g
Daconil Ultrex 82.5WG 3.2 oz	1.7 d-g	2.3 cd	2.3 efg
Chipco Triton 1.67SC 0.5 fl oz[d]	2.3 c-f	2.3 cd	2.0 fgh
Chipco Signature 80WG 4.0 oz + Chipco Triton 1.67SC 0.5 fl oz[e]	0.7 efg	0.3 ef	1.7 gh
Chipco Triton 1.67SC 1.0 fl oz[d]	1.3 efg	1.7 def	1.3 gh
TADS 12529 70WG 0.15 oz	0.7 efg	1.7 def	1.0 gh
Chipco Triton 1.67SC 1.0 fl oz	0.3 fg	0.3 ef	0.3 h
TADS 12529 70WG 0.3 oz	0.3 fg	0.3 ef	0.3 h
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz	0.0 g	0.0 f	0.3 h

[a]Disease severity index 0-10; 0=asymptomatic, and 10= ?90% annual bluegrass symptomatic; means of three replications.
[b]Treatment applied on a 28-day interval (19 Jun, 17 Jul, and 14 Aug).
[c]Means within each column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[d]Treatment applied on a 21-day interval (19 Jun, 10 Jul, 1 and 22 Aug).
[e]Treatment was initiated 5 Jun (2 weeks prior to all other treatments), and applied on a 14-day interval.

Control of Brown Patch with Fungicides, 2001

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Introduction

Brown Patch (*Rhizoctonia solani*) can be a serious disease on golf courses during warm and humid periods of summer. This study was conducted at the Valentine Turfgrass Research Center, University Park, PA, on colonial bentgrass *(Agrostis capillaris)* maintained under golf course fairway management conditions. The objective of the study was to evaluate various fungicide rates, application intervals, and tank-mixtures for effectiveness in controlling brown patch.

Materials and Methods

The experiment was conducted on colonial bentgrass (*Agrostis capillaris*, 'Bardot') mowed three times per week at 0.5 inch cutting height. The soil was Hagerstown silt loam with a soil pH of 6.5. The test area was fertilized on 15 May with 0.8 lb nitrogen (Lebanon 21-3-18) per 1000 sq ft, 7 Jun with 1.0 lb nitrogen (IBDU 31-0-0) per 1000 sq ft, and 15 Jun with 1.0 lb nitrogen (Scotts 22-0-16). 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, using TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were made on 20 Jun, 3, 17, and 31 Jul, unless otherwise noted in the table. The experimental area was inoculated on 18 Jul by hand-scattering *Rhizoctonia solani*-infested rye grains at a density of 15-20 grains per sq ft. From 18 Jul through 4 Aug the study was lightly irrigated and covered during the nights with a 6-mil plastic cover to reduce radiational cooling. Disease severity was assessed on 2, 25, and 31 Jul, and 8 Aug. Data were subjected to analysis of variance, and the mean values were separated by the Waller-Duncan K-ratio Test (P=0.05).

Results and Discussion

Disease severity was high in this experiment. Excellent control of brown patch was obtained throughout the study with Compass, Lynx, combinations of Compass + Lynx, and Compass + Bayleton (0.5 oz + 0.15 oz). Additionally, Heritage, the high rate of Endorse, XF-00044, and Eminent provided excellent control. The chlorothalonil treatments, Echo 720 and Daconil Weatherstik, also provided good control, except for the 31 Jul assessment.

Table. Control of brown patch with fungicides, 2001.

Disease Severity[a]

Treatment, formulation, and rate per 1000 sq ft	2 Jul	25 Jul	31 Jul	8 Aug
Bayleton 50WP 0.5 oz[b]	1.0 def[c]	4.3 b[c]	6.8 a[c]	9.5 a[c]
Rubigan 1AS 1.5 fl oz[b]	2.3 b	7.0 a	7.3 a	8.0 ab
Untreated Check	4.0 a	6.5 a	7.8 a	8.0 ab
Bayleton 50WP 0.5 oz[d]	1.8 bcd	2.8 bcd	6.5 a	7.5 bc
TD-2389 WG 6.0 oz	2.5 b	4.3 b	7.8 a	6.3 bcd
Banner MAXX 1.3MC 2.0 fl oz[b]	1.0 def	2.8 bcd	6.3 a	5.8 cd
Chipco 26GT 2SC 4.0 fl oz[d]	0.5 efg	0.8 efg	3.5 b	5.5 de
Bayleton 50WP 0.5 oz	2.0 bc	2.5 b-e	3.5 b	5.0 def
TD-2390 WG 6.0 oz	2.3 b	3.8 bc	7.0 a	4.8 def
Eagle 40WP 1.2 oz[d]	1.3 cde	2.3 c-f	1.8 b-e	4.5 d-g
Eagle 40WP 0.6 oz	2.3 b	1.3 d-g	1.3 b-e	3.8 e-h
Fore Rainshield 80WP 8.0 oz	0.3 fg	2.0 c-g	2.3 b-e	3.3 f-i
Fore Rainshield 80WP 6.0 oz	2.0 bc	1.8 d-g	3.5 b	2.8 g-j
Cleary's 3336 50WP 2.0oz	0.0 g	1.0 d-g	3.0 bc	2.8 g-j
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz[b]	0.3 fg	0.8 efg	1.0 b-e	2.5 h-k
ProStar 70WP 2.2 oz[b]	0.5 efg	2.0 c-g	3.5 b	2.5 h-k
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz	0.5 efg	0.3 g	1.0 b-e	2.3 h-l
Heritage 50WG 0.2 oz[b]	0.3 fg	0.5 fg	1.3 b-e	2.3 h-l
Compass 50WG 0.15 oz[b]	0.3 fg	0.5 fg	1.8 b-e	1.8 i-l
Eminent 1SL 4.0 fl oz	0.3 fg	0.8 efg	1.0 b-e	1.5 i-l
Heritage 50WG 0.2 oz	0.0 g	0.8 efg	0.8 cde	1.3 jkl
Heritage 50WG 0.4 oz[d]	0.0 g	0.3 g	0.5 cde	1.3 jkl
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz	0.0 g	0.3 g	0.0 e	1.0 jkl
Lynx 45WP 0.556 oz[b]	0.0 g	0.5 fg	1.3 b-e	0.8 kl
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz[b]	0.0 g	0.3 g	0.3 de	0.8 kl
Endorse 2.5WP 4.0 oz	0.5 efg	0.5 fg	2.8 bcd	0.8 kl
XF-00044 WP 3.5 oz	0.0 g	0.3 g	0.8 cde	0.8 kl
Daconil Weatherstik 6F 3.6 fl oz	0.3 fg	0.5 fg	3.5 b	0.8 kl
Echo 720 6F 3.6 fl oz	0.3 fg	1.0 d-g	6.5 a	0.5 l
Endorse 2.5WP 6.0 oz	0.5 efg	0.8 efg	0.8 cde	0.5 l
Compass 50WG 0.15 oz	0.3 fg	0.5 fg	0.3 de	0.5 l
Lynx 45WP 0.556 oz	0.3 fg	0.3 g	0.3 de	0.5 l

[a]Disease severity index 0-10; 0=asymptomatic, and 10= ?90% turf area symptomatic; means of four replications.
[b]Treatment applied on a 21-day interval (20 Jun, 10 and 31 Jul).
[c]Means within a column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[d]Treatment applied on a 28-day interval (20 Jun and 17 Jul).

Evaluation of Fungicides for Control of Dollar Spot on a Putting Green, 2001

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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 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 8 May, the site was aerified (0.625 in. tines) and topdressed. Dimension 1EC (1.5 qt per acre) was applied on 11 May for control of crabgrass. The test area was fertilized on 11 May with 0.7 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft, and 15 May with 0.8 lb nitrogen (Scotts 19-0-17) per 1000 sq ft. 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, using TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were made on 13 and 27 Jun, and 11 and 25 Jul, except as noted in the table. The experimental turf area was inoculated on 21 Jun and 17 Jul by hand -broadcasting *S. homoeocarpa*-infested ryegrains, at a density of 20 - 30 grains per sq ft. A mixture of five isolates of *S. homoeocarpa* was used in each inoculation. Disease severity was evaluated once per week from 26 Jun through 8 Aug. Data were subjected to analysis of variance, and the mean values were separated by the Waller -Duncan k-ratio test (P?0.05).

Results and Discussion

Dollar spot severity was moderate during most of the study period, but was high at the end of July and early August. Most treatments provided control that was significantly different from the untreated check throughout the season. Excellent control was achieved with Eagle, the 0.2 oz rate of AMS-21619, both rates of Lynx as well as the Lynx + Daconil Ultrex combination, Bayleton, Honor at 14 or 28-day intervals, and XF-00044. Complete suppression of dollar spot was achieved with the Banner MAXX + Heritage treatment throughout the study. XF-00183, Fore Rainshield, TD-2389, TD-2390, and Heritage were not effective in controlling dollar spot in this experiment.

Table. Evaluation of fungicides for control of dollar spot on a putting green, 2001.

	Disease incidence[a]					
Treatment, formulation, and rate per 1000 sq ft	**3 Jul**	**10 Jul**	**17 Jul**	**24 Jul**	**31 Jul**	**8 Aug**
TD-2390 WG 8.0 oz	7.7 a[b]	7.0 a[b]	8.7 a[b]	8.7 a[b]	45.7 a[b]	57.0 a[b]
TD-2390 WG 6.0 oz	2.3 c-g	0.7 g	1.0 de	1.7 d-g	28.3 bc	55.3 a
Heritage 50WG 0.4 oz[c]	4.3 a-d	3.3 b-e	4.0 bc	7.0 ab	30.0 bc	52.3 a
Untreated Check	5.7 abc	3.7 bcd	4.0 bc	8.0 ab	33.3 b	48.7 ab
Fore Rainshield 80WP 8.0 oz	3.3 b-g	5.0 ab	5.3 b	5.7 bc	23.0 c	48.0 ab
XF-00183 1EC 1.2 fl oz[c]	2.3 c-g	2.0 c-g	1.7 cde	1.0 efg	29.0 bc	47.3 ab
XF-00183 1EC 0.76 fl oz[c]	1.3 d-g	1.0 fg	1.0 de	1.0 efg	25.7 bc	38.3 bc
XF-00183 1EC 1.5 fl oz[c]	4.0 b-e	4.0 bc	3.7 bcd	3.3 cde	21.0 cd	37.3 bcd
TD-2389 WG 8.0 oz	3.7 b-f	1.3 efg	2.7 b-e	3.7 cd	21.7 c	31.3 cde
XF-00183 1EC 0.76 fl oz + Eagle 40WP 0.31 oz[c]	2.3 c-g	3.0 b-f	2.3 cde	1.0 efg	11.7 de	25.0 def
Daconil Ultrex 82.5WG 1.82 oz	1.0 d-g	2.0 c-g	1.0 de	1.7 d-g	9.7 efg	22.3 efg
Rubigan 1AS 0.75 fl oz[d]	2.7 c-g	0.3 g	0.0 e	0.3 fg	11.7 de	22.3 efg
Chipco 26GT 2SC 3.0 fl oz[d]	6.3 ab	1.7 d-g	1.0 de	2.3 d-g	8.0 efg	21.3 e-h
TopPro Iprodione 2F 2.0 fl oz	0.3 fg	0.0 g	0.0 e	0.0 g	10.7 ef	20.0 e-i
Chipco 26019 50WP 2.0 oz	0.0 g	0.0 g	0.0 e	0.0 g	9.7 efg	18.7 e-j
XF-00182 1EC 1.5 fl oz[c]	0.0 g	0.0 g	0.0 e	0.0 g	5.7 efg	17.7 f-j
XF-00182 1EC 1.2 fl oz[c]	0.0 g	0.7 g	0.0 e	0.3 fg	5.0 efg	15.7 f-k
Emerald 70WG 0.18 oz[c]	0.3 fg	0.0 g	0.0 e	1.0 efg	5.0 efg	15.3 f-l
TopPro WP Iprodione 50WP 2.0 oz	0.3 fg	0.0 g	0.0 e	0.0 g	5.7 efg	13.3 f-m
AMS-21616 1.67SC 0.239 fl oz	0.3 fg	0.0 g	0.0 e	1.3 d-g	6.7 efg	13.0 f-n
Daconil Ultrex 82.5WG 3.2 oz	0.0 g	0.0 g	0.0 e	0.0 g	1.7 fg	11.0 g-o
Honor 50WG 0.2 oz alt. Daconil Ultrex 82.5WG 3.2 oz[e]	0.0 g	0.3 g	0.3 e	0.0 g	1.0 fg	10.7 g-o
XF-00182 1EC 0.76 fl oz + Eagle 40WP 0.31 oz[c]	0.0 g	0.0 g	0.0 e	0.3 fg	6.7 efg	10.3 g-o
Curalan 50WG 1.0 oz[c]	1.0 d-g	0.7 g	1.0 de	1.7 d-g	3.7 efg	10.0 g-o
Chipco 26GT 2SC 4.0 fl oz	0.0 g	0.0 g	0.0 e	0.0 g	1.3 fg	10.0 g-o
Fore Rainshield 80WP 6.0 oz + Bayleton 50WP 0.25 oz[c]	2.7 c-g	0.7 g	0.7 e	2.3 d-g	2.7 efg	9.3 h-o
AMS-21616 1.67SC 0.358 fl oz	1.0 d-g	0.3 g	0.0 e	0.7 fg	5.3 efg	9.0 h-o
Cleary 3336 50WP 2.0 oz	1.0 d-g	1.0 fg	1.0 de	2.7 def	3.7 efg	7.3 i-o
TopPro WP Thiophanate Methyl 50WP 2.0 oz	0.7 efg	0.7 g	0.7 e	1.3 d-g	2.7 efg	6.3 j-o
TopPro Iprodione 2SC 4.0 fl oz	0.0 g	0.0 g	0.0 e	0.0 g	1.0 fg	6.0 j-o
TopPro FLO Thiophanate Methyl 4.5F 2.0 fl oz	0.0 g	0.0 g	0.0 e	1.3 d-g	3.0 efg	3.7 k-o
Cleary 3336 F 4.5F 2.0 fl oz	0.7 efg	0.0 g	0.0 e	0.3 fg	1.0 fg	3.0 k-o
Emerald 70WG 0.13 oz	0.0 g	0.0 g	0.0 e	0.0 g	2.7 efg	2.7 l-o
AMS-21619 50WP 0.1 oz	2.0 d-g	1.3 efg	0.3 e	1.0 efg	1.0 fg	1.0 mno
Eagle 40WP 1.2 oz[c]	0.3 fg	0.0 g	0.3 e	0.0 g	0.3 g	0.7 mno
Lynx 45WP 0.278 oz + Daconil Ultrex 82.5WG 1.82 oz	0.0 g	0.0 g	0.0 e	0.0 g	0.0 g	0.3 no
Honor 50WG 0.2 oz[c]	0.0 g	0.3 g	0.3 e	0.3 fg	0.3 g	0.0 o
XF-00044 WP 3.5 oz	0.0 g	0.0 g	0.0 e	0.7 fg	0.0 g	0.0 o
Honor 50WG 0.2 oz	0.0 g	0.0 g	0.0 e	0.3 fg	0.0 g	0.0 o
Bayleton 50WP 0.25 oz	0.3 fg	0.3 g	0.3 e	0.0 g	0.0 g	0.0 o
Lynx 45WP 0.278 oz	0.7 efg	0.0 g	0.0 e	0.0 g	0.0 g	0.0 o
Lynx 45WP 0.556 oz	0.0 g	0.0 g	0.3 e	0.0 g	0.0 g	0.0 o
AMS-21619 50WP 0.2 oz	0.0 g	0.0 g	0.0 e	0.0 g	0.0 g	0.0 o
Eagle 40WP 0.6 oz	0.0 g	0.0 g	0.0 e	0.0 g	0.0 g	0.0 o
Banner MAXX 1.3MC 1.0 fl oz + Heritage 50WG 0.2oz	0.0 g	0.0 g	0.0 e	0.0 g	0.0 g	0.0 o

[a]Values represent the number of necrotic spots per plot, means of three replication s.
[b]Means within each column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[c]Treatment applied on a 28-day interval (13 Jun and 11 Jul).
[d]Treatment applied on a 21-day interval (13 Jun, 3 and 25 Jul).
[e]Treatments applied alternately on a 14-day interval: Honor (13 Jun, 11 Jul), Daconil Ultrex (27 Jun, 25 Jul).

Evaluation of Fungicides for Control of Gray Leaf Spot on Perennial Ryegrass, 2001

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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 conducted at the Valentine Research Center on 'Pennfine' perennial ryegrass. The objective was to evaluate various fungicides, rates, and fungicide combi nations for their effectiveness in suppressing gray leaf spot.

Materials and Methods

The study was conducted on a newly renovated (9 May) stand of perennial ryegrass at the Valentine Research Center. The site was maintained under golf course fairway ma nagement conditions; mowed three times per week at 0.75-inch cutting height. The soil pH was 6.9. The test plots were fertilized with 1.0 lb nitrogen per 1000 sq ft on 9 May (Scotts 19-25-5) and 22 May (Lebanon 10-18-18). Fore 80WP was applied at 8.0 oz per 1000 sq ft on 29 Jun, as well as 9 and 20 Jul for prevention of seedling damping -off. Treatment plots, 3 ft x 6 ft, were arranged in a randomized complete block design with three replications. Unless otherwise noted in the table, treatments were applied with a CO_2-powered boom sprayer using TeeJet 8004 nozzles at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Treatments were applied on 27 Jul, and 14 and 27 Aug, unless otherwise specified in the table. The experiment was inoculated on 30 Aug and 4 Sep with a spore suspension of *P. grisea*, and covered with a 6-mil polyethylene sheet to maintain leaf wetness and reduce radiational cooling during the night. The experiment was lightly irrigated and covered every night through 17 Sep. The cover w as removed between 10:00 a.m. and 4:00 p.m. daily during this period. Test plots were mowed only once (1.5 -inch height) during this phase of the study, that being 4 Sep, prior to the second inoculation. Disease severity was evaluated on 20 Sep. 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

Disease incidence was moderate in this study where nearly 30% of leaf blades in the untreated check were necrotic. All fungicide treatments were significantly different from the untreated check, with symptomatic blades less than six percent in 17 of the 34 fungicide treatments. Excellent control of gray leaf spot was obtained from the three rates of Fore Rainshield, Insignia alone or in combination with Fore Rainshield, Daconil Ultrex, or TD -2390. Spectro, Heritage, Compass alone or in combination with Bayleton (21 -day interval), and the Banner MAXX/Daconil Ultrex tank mixture also provided excellent control.

Table. Evaluation of fungicides for control of gray leaf spot on perennial ryegrass, 2001.

Treatment, formulation, and rate per 1000 sq ft	**Disease Incidence[a]** **20 Sep**
Check	29.7 a[b]
Banner MAXX 1.3MC 1.0 fl oz	19.3 b
Lynx 45WP 0.556 oz[c]	14.7 bc
Lynx 45WP 0.278 oz[c]	12.7 cd
TD-2390 WG 8.0 oz	12.0 cde
Bayleton 50WP 0.5 oz[c]	11.7 c-f
Endorse 2.5WP 4.0 oz	11.7 c-f
Bayleton 25WG 2.0 oz	11.7 c-f
TD-2389 WG 8.0 oz	10.3 c-g
Daconil Ultrex 82.5WG 1.8 oz	10.0 c-h
Medallion 50WP 0.3 oz	9.7 d-i
Endorse 2.5WP 6.0 oz	9.3 d-j
Compass 50WG 0.15 oz[c]	8.7 d-j
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz[c]	7.3 e-k
Daconil Ultrex 82.5WG 3.6 oz	7.3 e-k
Cleary 3336 50WP 8.0 oz	7.0 f-l
Fore Rainshield 80WP 8.0 oz [c]	7.0 f-l
Cleary's 3336 50WP 4.0 oz	6.3 g-m
Fore Rainshield 80WP 6.0 oz	5.7 g-n
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz[c]	5.3 h-n
Fore Rainshield 80WP 4.0 oz	5.0 i-n
Insignia 20WG 0.5 oz	4.7 j-n
Spectro 90WG 4.0 oz	3.7 k-n
Heritage 50WG 0.2 oz	3.7 k-n
Insignia 20WG 0.5 oz + Fore Rainshield 80WP 8.0 oz	3.3 k-n
Compass 50WG 0.15 oz[c]	3.3 k-n
Insignia 20WG 0.5 oz + TD2390 WG 8.0 oz	3.0 k-n
Insignia 20WG 0.9 oz	3.0 k-n
Banner MAXX 1.3MC 1.0 fl oz + Daconil Ultrex 82.5WG 3.2 oz	3.0 k-n
Compass 50WG 0.3 oz[c]	2.7 k-n
Fore Rainshield 80WP 8.0 oz	2.7 k-n
Insignia 20WG 0.9 oz + Fore Rainshiel d 80WP 8.0 oz	2.3 lmn
Insignia 20WG 0.5 oz + Daconil Ultrex 82.5WG 3.2 oz	2.0 mn
Heritage 50WG 0.4 oz	1.3 n
Insignia 20WG 0.9 oz + TD2390 WG 8.0 oz	1.0 n

[a]Percent leaf blades symptomatic; means of three replications; sample -size 300 blades per replicatio n.
[b]Means within column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[c]Treatment applied on a 21 -day interval (27 Jul and 21 Aug).

Control of Spring Leaf Spot/Melting-out on Kentucky Bluegrass, 2001

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Introduction

Leaf spot diseases caused by species of *Drechslera* and *Bipolaris* are common problems on turfgrasses. The use of fungicides is an important means of managing spring leaf spot/melting-out. This study was conducted at the Valentine Research Center, University Park, PA, on Kentucky bluegrass (*Poa pratensis*, 'S-21'). The objective of the study was to evaluate various treatments and application intervals to assess control of *Drechslera poae*.

Materials and Methods

The study was conducted on Kentucky bluegrass maintained under golf course fairway management conditions, and mowed three times per week at 1.0-inch cutting height. The soil was Hagerstown silt loam with a soil pH of 6.8. The site was fertilized on 4 Apr and 1 May with 1.5 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft, and on 21 May with 0.9 lb nitrogen (urea 46-0-0) per 1000 sq ft. On 11 May, Dimension 1EC was applied at 1.5 qt per acre for control of crabgrass. Treatment plots, 3 ft by 6 ft, were arranged in a randomized complete block design with three replications. Fungicides were applied with a CO_2-powered boom sprayer, using TeeJet 8004 nozzles, at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Applications were made on 26 Apr, 10 and 23 May, and 7 Jun, unless otherwise indicated in the table. 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 high from mid-May through early June. During this period, excellent control of leaf spot/melting-out was provided by the two Chipco 26GT treatments, Honor, and the high rates of Heritage, Insignia, and Compass, all applied on 28-day intervals. Excellent control was also obtained from the low rate of Insignia, both rates of Endorse, and Fore Rainshield. Eagle, TD-2390, TD-2389, and Cleary 3336 were not effective in this study.

Table. Control of spring leaf spot/melting -out on Kentucky bluegrass, 2001.

	Disease Severity[a]		
Treatment, formulation, and rate per 1000 sq ft	**25 Apr**	**16 May**	**6 Jun**
Cleary 3336 50WP 8.0 oz	1.7 a[b]	5.0 cd[b]	8.3 a[b]
TD2389 20WG 8.0 oz	0.7 a	8.7 a	8.3 a
Cleary 3336 50WP 4.0 oz	1.0 a	6.0 c	8.0 ab
Untreated Check	1.0 a	4.7 de	6.7 bc
TD2390 WG 8.0 oz	1.0 a	7.3 b	6.0 c
Eagle 40WP 0.3 oz	1.0 a	3.7 efg	5.3 cd
Eagle 40WP 0.6 oz	0.7 a	4.0 def	4.3 de
Fore Rainshield 80WP 4.0 oz + Compass 50WG 0.15 oz[c]	1.3 a	2.3 hij	3.7 ef
Compass 50WG 0.125 oz[c]	0.7 a	0.7 lmn	2.7 fg
Daconil Ultrex 82.5WG 3.4 oz	1.3 a	2.7 ghi	2.7 fg
Fore Rainshield 80WP 2.0 oz	0.7 a	2.0 h-k	2.3 fgh
Heritage 50WG 0.2 oz[c]	1.3 a	1.7 i-l	2.3 fgh
Compass 50WG 0.15 oz[d]	1.3 a	3.0 fgh	2.0 ghi
Heritage 50WG 0.2 oz + Daconil Ultrex 82.5WG 3.4 oz[c]	0.7 a	1.3 j-m	2.0 ghi
Compass 50WG 0.25 oz[d]	1.3 a	1.3 j-m	1.7 g-j
Spectro 90WG 4.0 oz	1.0 a	2.0 h-k	1.7 g-j
Honor 50WG 0.2 oz	1.0 a	1.0 k-n	1.7 g-j
Compass 50WG 0.25 oz[c]	1.0 a	1.3 j-m	1.3 g-k
Fore Rainshield 80WP 4.0 oz	1.3 a	0.7 lmn	1.3 g-k
Chipco 26GT 2SC 2.0 fl oz[c]	1.3 a	0.7 lmn	1.0 h-k
Heritage 50WG 0.4 oz[c]	1.0 a	1.0 k-n	1.0 h-k
Insignia 20WG 0.9 oz[c]	1.3 a	0.3 mn	1.0 h-k
Honor 50WG 0.2 oz[c]	1.0 a	0.7 lmn	1.0 h-k
Endorse 2.5WP 4.0 oz	1.0 a	0.3 mn	0.7 ijk
Endorse 2.5WP 6.0 oz	1.0 a	0.3 mn	0.7 ijk
Insignia 20WG 0.5 oz	1.7 a	1.0 k-n	0.3 jk
Chipco 26GT 2SC 4.0 fl oz[c]	1.0 a	0.0 n	0.0 k

[a]Disease severity index 0-10; 0=asymptomatic, and 10= ?90% turf area symptomatic; means of three replications.
[b]Means within each column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[c]Treatment applied on a 28-day interval (26 Apr and 23 May).
[d]Treatment applied on a 21-day interval (26 Apr and 16 May).

Control of Pythium Foliar Blight on Perennial Ryegrass, 2001

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Introduction

Pythium foliar blight can be a devastating disease on fine turf. The use of fungicides is an important means of controlling Pythium foliar blight on golf courses. The study was conducted at the Valentine Turfgrass Research Center, University Park, PA, on perennial ryegrass (*Lolium perenne*, 'Pennfine'). The objective of the study was to evaluate various fungicides to determine their effectiveness in suppressing Pythium foliar blight.

Materials and Methods

The experiment was conducted on perennial ryegrass maintained under golf course fairway management conditions, and mowed three times per week at 0.5 -inch cutting height. The soil was Hagerstown silt loam with a soil pH of 7.0. Fertilizer was applied on 29 May providing 1.0 lb nitrogen (Lebanon 10 -18-18) per 1000 sq ft. Lesco Benomyl 50WP (2.0 oz/1000 sq ft) was applied on 26 Jun for control of brown patch. On 29 Jun Ali ette Signature 80WG (8.0 oz per 1000 sq ft) was applied to the site to control a premature outbreak of Pythium blight. Treatment plots, 3 ft x 3 ft, were arranged in a randomized complete block design with three replications. Unless otherwise noted in th e table, treatments were applied on 20 Jul with a CO_2-powered boom sprayer using TeeJet 8004 nozzles. Applications were made at 40 psi in water equivalent to 2 gal per 1000 sq ft. On 6 Aug the experiment was enclosed in 30 ft x 48 ft polyethylene greenho use to reduce radiational cooling. The experiment was inoculated with a mycelial suspension of a six -isolate pool of *Pythium aphanidermatum.* Internal intermittent misting systems provided continuous high relative humidity throughout the experiment. The greenhouse was vented during daylight hours to maintain a temperature range of 85 ? to 95?F. Vents were closed during the nights. Disease severity was assessed from 9 Aug through 13 Aug. Data were subjected to analysis of variance, and the mean values wer e separated using the Waller-Duncan k-ratio Test (P?0.05).

Results and Discussion

Disease severity was high in this experiment. On 9 Aug, disease severity (DS) for Chipco Signature, Banol, Subdue MAXX, and Eagle treatments was significantly different f rom that of the untreated check. By 11 Aug, five days after inoculation, DS for none of the treatments was significantly different from that of the untreated control plots. Heritage and the experimental products XF00182 and XF -00183 were not effective in controlling Pythium foliar blight in this study.

Table. Control of Pythium foliar blight on perennial ryegrass, 2001.

Disease Severity*

Treatment, formulation, and rate per 1000 sq ft	8 Aug	9 Aug	10 Aug	11 Aug
XF-00183 1EC 1.2 fl oz	2.0 ab**	4.0 ab**	7.7 a**	9.3 a**
XF-00182 1EC 1.2 fl oz	2.3 a	5.0 a	7.7 a	9.3 a
XF-00183 1EC 1.5 fl oz	1.3 ab	3.7 ab	7.3 a	8.3 ab
Untreated Check	1.7 ab	4.7 a	7.0 a	9.0 ab
XF-00183 1EC 0.76 fl oz	1.7 ab	3.7 ab	6.7 a	8.3 ab
Heritage 50WG 0.4 oz	1.0 ab	3.3 abc	6.7 a	8.7 ab
Banol 6SL 2.0 fl oz	1.3 ab	2.3 bcd	5.7 ab	8.0 ab
Eagle 40WP 0.6 oz	0.7 ab	2.3 bcd	4.3 bc	7.3 ab
Subdue MAXX 2MC 1.0 fl oz	0.3 ab	1.7 cd	4.0 bc	7.7 ab
Chipco Signature 80WG 4.0 oz	0.0 b	1.0 d	3.3 c	7.0 b

*Disease severity index 0-10; 0=asymptomatic, and 10=?90% turf area symptomatic; means of three replications.

**Means within a column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.

Management of Pythium Foliar Blight with Fungicides, 2001

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Introduction

Pythium foliar blight is a serious disease on turfgrasses. The use of fungicides is an important means of managing Pythium fo liar blight on golf courses. The study was conducted at the Valentine Turfgrass Research Center, University Park, PA, on perennial ryegrass (*Lolium perenne*, 'Pennfine'). The objective of the study was to evaluate various fungicides to determine their effectiveness in managing Pythium foliar blight.

Materials and Methods

The experiment was conducted on perennial ryegrass maintained under golf course fairway management conditions, and mowed three times per week at 0.5 -inch cutting height. The soil was Hagerstown silt loam with a soil pH of 7.0. Fertilizer was applied on 29 May providing 1.0 lb nitrogen (Lebanon 10 -18-18) per 1000 sq ft. Lesco Benomyl 50WP (2.0 oz/1000 sq ft) was applied on 26 Jun for control of brown patch. On 29 Jun, Aliette Signatu re 80WG (8.0 oz per 1000 sq ft) was applied to the site to control a premature outbreak of Pythium blight. Treatment plots, 3 ft x 3 ft, were arranged in a randomized complete block design with three replications. Unless otherwise noted in the table, tre atments were applied on 20 Jul with a CO_2-powered boom sprayer using TeeJet 8004 nozzles. Applications were made at 40 psi in water equivalent to 2 gal per 1000 sq ft. On 6 Aug the experiment was enclosed in 30 ft x 48 ft polyethylene greenhouse to reduce radiational cooling. The experiment was inoculated with a mycelial suspension of a six -isolate pool of *Pythium aphanidermatum.* Internal intermittent misting systems provided continuous high relative humidity throughout the experiment. The greenhouse was vented during daylight hours to maintain a temperature range of 85 ? to 95?F. Vents were closed during the nights. Disease severity was assessed from 8 Aug through 12 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 high in this study. Ten of the 24 treatments provided control that was significantly different from the untreated check throughout the study. ProPhyt, WAC -79, and the WAC-79 + Spectro combination provided excellent disease control. The WAC -79 + Protect T/O tank mixture provided complete control of Pythium foliar blight throughout the study.

Table. Management of Pythium foliar blight with fungicides, 2001.

Disease Severity[a]

Treatment, formulation, and rate per 1000 sq ft	8 Aug	9 Aug	10 Aug	12 Aug
Insignia 20WG 0.9 oz	2.0 cde[b]	4.3 b-f[b]	8.3 ab[b]	10.0 a[b]
Insignia 20WG 0.9 oz + Subdue MAXX 2MC 0.5 fl oz	2.3 b-e	5.3 a-d	8.3 ab	10.0 a
Untreated Check	4.0 a	6.0 ab	8.7 a	10.0 a
Mefenoxam2 2MC 1.0 fl oz	3.7 ab	6.3 a	8.7 a	9.7 a
Insignia 20WG 0.9 oz[c]	2.3 b-e	5.0 a-e	8.3 ab	9.7 a
Insignia 20WG 0.9 oz + Subdue MAXX 2MC 1.0 fl oz[d]	2.7 a-d	3.7 d-g	7.7 abc	9.7 a
Subdue MAXX 2MC 1.0 fl oz	2.0 cde	5.0 a-e	8.0 abc	9.7 a
AMSF-187 WG 0.655 oz	3.0 abc	5.0 a-e	8.3 ab	9.7 a
AMSF-187 WG 0.218 oz + Compass 50WG 0.2 oz	2.3 b-e	4.7 a-e	8.7 a	9.7 a
Heritage 50WG 0.4 oz	3.0 abc	5.7 abc	8.7 a	9.7 a
Mefenoxam2 2MC 0.5 fl oz	2.0 cde	4.0 c-g	7.3 bc	9.3 ab
Subdue MAXX 2MC 0.5 fl oz	2.3 b-e	4.7 a-e	7.7 abc	9.0 ab
AMSF-187 WG 0.437 oz	1.7 c-f	3.3 e-h	7.0 c	9.0 ab
AMSF-187 WG 0.655 oz + Compass 50WG 0.2 oz	2.3 b-e	4.3 b-f	8.0 abc	9.0 ab
Biophos L 12.0 fl oz	1.3 d-g	2.7 fgh	5.7 d	8.3 abc
Biophos L 8.0 fl oz	1.0 efg	2.7 fgh	5.7 d	7.7 bcd
AMSF-187 WG 0.218 oz	1.7 c-f	2.3 ghi	5.3 de	7.7 bcd
Chipco Signature 80WG 4.0 oz	1.3 d-g	2.3 ghi	4.3 e	7.0 cd
Compass 50WG 0.2 oz	2.3 b-e	4.0 c-g	7.3 bc	6.0 de
Biophos L 12.0 fl oz[e]	0.3 fg	0.7 ij	2.3 f	5.0 ef
Banol 6SL 2.0 fl oz	1.0 efg	1.7 hij	1.7 fg	3.3 fg
ProPhyt 4L 8.0 fl oz[f]	0.0 g	0.3 j	0.7 gh	2.7 gh
WAC- L 5.0 fl oz[f]	0.0 g	0.0 j	1.0 gh	1.0 hi
WAC-79 L 5.0 fl oz + Spectro 90 WG 4.0 oz[f]	0.0 g	0.0 j	0.0 h	1.0 hi
WAC-79 L 5.0 fl oz + Protect T/O 80 WG 6.0 oz[f]	0.0 g	0.0 j	0.0 h	0.0 i

[a]Disease severity index 0-10; 0=asymptomatic, and 10= ?90% turf area symptomatic; means of three replications.
[b]Means within each column followed by different letters are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[c]Treatment applied 25 Jul (13 days prior to inoculation).
[d]Insignia applied 20 Jul; and Subdue MAXX applied 25 Jul.
[e]Treatment applied 28 Jul (10 days prior to inoculation).
[f]Treatment applied 4 Aug (three days prior to inoculation).

Fungicidal Control of Pythium Foliar Blight, 2001

W. Uddin and J. Shelton
Department of Plant Pathology

Introduction

Pythium foliar blight is a major disease on turfgrasses. Fungicides are important means of managing Pythium foliar blight on golf cou rses. The study was conducted at the Valentine Turfgrass Research Center, University Park, PA, on perennial ryegrass (*Lolium perenne*, 'Pennfine'). The objective of the study was to evaluate various fungicides to determine their effectiveness in managing P ythium foliar blight.

Materials and Methods

The experiment was conducted on perennial ryegrass maintained under golf course fairway management conditions, and mowed three times per week at 0.5 -inch cutting height. The soil was Hagerstown silt loam wit h a soil pH of 7.0. The site was overseeded on 29 May at the rate of 8.0 lb per 1000 sq ft. Fertilizer was applied on 29 May providing 1.0 lb nitrogen (Lebanon 10-18-18) per 1000 sq ft. On 29 Jun, Aliette Signature 80WG (8.0 oz per 1000 sq ft) was applied to the site to control a premature outbreak of Pythium blight. Treatment plots, 3 ft x 3 ft, were arranged in a randomized complete block design with three replications. Unless otherwise noted in the table, treatments were applied on 14 Aug with a CO_2-powered boom sprayer using TeeJet 8004 nozzles. Applications were made at 40 psi in water equivalent to 2 gal per 1000 sq ft, except. On 18 Aug, the experiment was enclosed in 30 ft x 48 ft polyethylene greenhouse to reduce radiational cooling. On 19 A ug, the experiment was inoculated with a mycelial suspension of a six -isolate pool of *Pythium aphanidermatum.* Internal intermittent misting systems provided continuous high relative humidity throughout the experiment. The greenhouse was vented during daylight hours to maintain a temperature range of 85 ? to 95?F. Vents were closed during the nights. Disease severity was assessed from 24 Aug through 1 Sep. 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 high in the study. All of the eleven treatments provided disease suppression that was significantly different from the untreated check. WAC -79 alone or in combination with Spectro provided excellent control of Pythium foliar blight, while the WAC -79 +Protect T/O tank mixture provided complete control of the disease.

Table. Fungicidal control of Pythium foliar blight, 2001.

Treatment, formulation, and rate per 1000 sq ft	Disease Severity[a] 24 Aug	25 Aug	26 Aug	27 Aug	28 Aug	29 Aug
Untreated Check	6.0 a[b]	7.3 a[b]	8.0 a[b]	9.3 a[b]	10.0a[b]	10.0a[b]
Banol 6SL 2.0 fl oz	1.0 b	1.0 b	1.7 b	1.7 bc	3.0b	4.0b
Heritage 50WG 0.4 oz	0.3 bc	0.3 b	0.3 c	0.7 def	1.0cd	3.3b
Subdue MAXX 2MC 1.0 fl oz	0.3 bc	0.3 b	1.0 bc	1.3 bcd	2.0bc	3.0bc
Chipco Signature 80WG 4.0 oz	0.0 c	0.7 b	0.7 bc	2.0 b	2.7b	3.0bc
WAC-79 L 5.0 fl oz + Spectro 90 WG 4.0 oz[c]	0.0 c	0.0 b	0.0 c	1.0 cde	1.0cd	1.3cd
WAC-79 L 5.0 fl oz[c]	0.0 c	0.0 b	0.3 c	0.3 ef	0.3d	0.7d
WAC-79 L 5.0 fl oz + Protect T/O 80 WG 6.0 oz[c]	0.0 c	0.0 b	0.0 c	0.0 f	0.0d	0.0d

[a]Disease severity index 0-10; 0=asymptomatic, and 10= ?90% turf area symptomatic; means of three replications.
[b]Means within each column followed by different letter s are significantly different (P ?0.05) according to the Waller-Duncan k-ratio test.
[c]Treatment applied 17 Aug (two days prior to inoculation).

Fungicidal Control of Crown Rust of Perennial Ryegrass, 2001

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Introduction

Rust diseases often occur during cool, moist, overcast periods of late summer and fall. Damage to turfgrass can occur under poor growing conditions, such as poor turf nutrition and/or shade. During prolonged periods of such conditions, fungicides may be required to control the disease. The study was conducted at the Valentine Turfgrass Research Center, University Park, PA, on perennial ryegrass (*Lolium perenne* 'Pennfine'). Fungicides were evaluated for efficacy.

Materials and Methods

The study was conducted on a newly renovated (9 May) stand of perennial ryegrass. The site was maintained under golf course fairway management conditions, mowed three times per week at a 0.75-in. cutting height. The soil was Hagerstown silt loam, pH 6.9. The study area was fertilized with 1.0 lb nitrogen per 1000 sq ft on 9 May (Scotts 19-25-5) and 22 May (Lebanon 10-18-18). 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 using TeeJet 8004 nozzles at 40 psi, in water equivalent to 2 gal per 1000 sq ft. Treatments were applied on 27 Jul, and 14 and 27 Aug, except as noted in the table. The turf was mowed once (4 Sep) between 30 Aug and 12 Oct. In mid-October, symptoms of crown rust developed in the experimental area. Disease severity was assessed on 12 Oct. Data were subjected to analysis of variance, and multiple comparisons of the means were made using the Waller-Duncan k-ration test.

Results and discussion

Disease severity was high in the study, with >70% of the turf in the non-treated check being symptomatic. Banner MAXX, Bayleton, Medallion, Endorse, and Lynx were ineffective in this experiment. All Insignia treatments, whether alone or in combination with other products, provided excellent control of crown rust. Spectro, Heritage, Compass, and the Lynx + Compass mixture provided excellent control as well. It should be noted that none of the treatments had been applied since 27 Aug.

Table. Fungicidal control of crown rust of perennial ryegrass turf, 2001.

Treatment, formulation, and rate per 1000 sq ft	Disease Severity[a] 12 Oct	
Untreated Check	7.3	a[b]
Banner MAXX 1.3MC 1.0 fl oz	7.3	a
Bayleton 50WP 0.5 oz[c]	6.6	ab
Medallion 50WP 0.3 oz	6.3	ab
Endorse 2.5WP 6.0 oz	6.2	ab
Lynx 45WP 0.278 o[c]	6.1	ab
Lynx 45WP 0.556 oz[c]	6.1	ab
Bayleton 25WG 2.0 oz	6.0	ab
Endorse 2.5WP 4.0 oz	5.7	b
TD2389 WG 8.0 oz	3.8	c
Fore Rainshield 80WP 6.0 oz	3.0	cde
Compass 50WG 0.15 oz[c]	2.9	c-f
Bayleton 50WP 0.5 oz + Compass 50WG 0.15 oz[c]	2.9	c-f
TD2390 WG 8.0 oz	2.9	c-f
Compass 50WG 0.15 oz[c]	2.4	c-g
Heritage 50WG 0.2 oz	2.2	c-g
Daconil Ultrex 82.5WG 1.8 oz	2.0	d-h
Fore Rainshield 80WP 8.0 oz	2.0	d-h
Fore Rainshield 80WP 8.0 oz[c]	2.0	d-h
Cleary 3336 50WP 8.0 oz	1.7	e-i
Cleary 3336 50WP 4.0 oz	1.7	e-i
Daconil Ultrex 82.5WG 3.6 oz	1.7	e-i
Fore Rainshield 80WP 4.0 oz	1.7	e-i
Banner MAXX 1.3MC 1.0 fl oz + Daconil Ultrex 82.5WG 3.2 oz	1.7	e-i
Compass 50WG 0.3 oz[c]	1.1	g-j
Insignia 20WG 0.5 oz + TD2390 WG 8.0 oz	1.0	g-j
Lynx 45WP 0.556 oz + Compass 50WG 0.15 oz[c]	1.0	g-j
Heritage 50WG 0.4 oz	1.0	g-j
Insignia 20WG 0.9 oz + Fore Rainshield 80WP 8.0 oz	0.9	g-j
Insignia 20WG 0.9 oz + TD2390 WG 8.0 oz	0.6	hij
Insignia 20WG 0.5 oz + Daconil Ultrex 82.5WG 3.2 oz	0.6	hij
Spectro 90WG 4.0 oz	0.6	hij
Insignia 20WG 0.5 oz	0.6	hij
Insignia 20WG 0.9 oz	0.4	ij
Insignia 20WG 0.5 oz + Fore Rainshield 80WP 8.0 oz	0.1	j

[a]Disease severity index 0-10; 0=asymptomatic, and 10=?90% turf area symptomatic; means of three replications.

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

[c]Treatment applied on a 21-day interval (27 Jul and 21 Aug).

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 putting green (*Poa annua*/creeping bentgrass) at the Nittany Six Hole Golf Course, 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 desi gn with three replications. All of the treatments were applied on August 26, 1998, September 1, 2000 and August 25, 2000 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 putting green being used to conduct this experiment was established in 1997. Bensulide and Dimension have been applied as preemergent herbicides in the late summer of 1998, 1999 and 2000 in an attempt to prevent invasion of the green by *Poa annua*. All portions of the green in the study area had one percent or less *Poa annua* invasion when the experiment was initiated. By the May 2001 rating date, the non treated areas were becoming contaminated with *Poa annua*. Areas treated with Dimension ha d less *Poa annua*, while those treated with bensulide were intermediate (5.7%), but tended to be less contaminated than areas not treated. The experiment will be continued.

Table 1. Rating of percent cover of *Poa annua* in a *Poa annua*/creeping bentgrass putting green.

Treatment	**Form**	**Rate**		**% Cover**		
		(LB Ai/A)	**8-26-98**	**5-5-99**	**5-17-00**	**5-9-01**
Bensulide	4L	12.5	1.0a[1]	1.0a	2.7ab	5.7a
Dimension	1EC	0.5	0.3a	0.3a	1.7b	4.3a
Check			1.0a	1.0a	4.3a	11.3a

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

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Post Emergence Control of Broadleaf Weeds

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

Introduction

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

Methods and Materials

This study was a randomized complete block design w ith three replications. All of the treatments were applied on July 16, 2001 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi.

Results and Discussion

None of the treatments caused unacceptable phytotoxicity to the perennial ryegrass (Table 1). As was seen in other broadleaf studies during 2001, Drive, with or without MSO had considerable herbicidal activity on dandelions and white clover, but not on common plantain (Table 2). The addit ion of various adjuvants to Drive did not significantly improve the control of common plantain. However, the addition of MacroSorb Radicular at 2oz/M tended to improve the activity of Drive on the common plantain (although still not to a significant exten t compared to the untreated control). On the September 13 rating date, some of the treated dandelions had recovered, but those materials that exhibited good white clover control at the August rating date, continued to do so in September (Table 3). The best treatment across all rating dates was provided by Trimec (Tables 2,3 and 4).

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Table 1. Evaluations of turfgrass phytotoxicity.

Treatment	Form	Rate (lb ai/A)	(------Phytotoxicity------) 07-23	07-30	08-07	08-13
DRIVE	75DF	0.75	9.0[1]	9.0	9.0	9.0
DRIVE NOBLE MSO	75DF L	0.75 24 OZ/A	9.0	9.0	9.0	9.0
DRIVE TARGET PRO SPREADER	75DF L	0.75 0.25 % V/V	9.0	9.0	9.0	9.0
DRIVE LI 700	75DF L	0.75 0.25 % V/V	9.0	9.0	9.0	9.0
CHECK			9.0	9.0	9.0	9.0
DRIVE THOROUGHBRED	75DF L	0.75 0.25 % V/V	9.0	9.0	9.0	9.0
DRIVE SURF KING	75DF L	0.75 0.25 % V/V	9.0	9.0	9.0	9.0
DRIVE LESCO SPREADER STICKER	75DF L	0.75 0.25 % V/V	9.0	9.0	9.0	9.0
TRIMEC	L	4 PT/A	9.0	9.0	9.0	9.0
CONFRONT	3SL	0.75	9.0	9.0	9.0	9.0
DRIVE MACROSORB FOLIAR	75DF L	0.75 2 OZ/M	9.0	9.0	9.0	9.0
DRIVE MACROSORB RADICULAR	75DF L	0.75 2 OZ/M	9.0	9.0	9.0	9.0

[1] – Scale of 0 – 10 where 0 = worst, 7 = acceptable and 10 = no phytotoxicity.

Table 2. Rating of percent change of dandelion, white clover and broadleaf plantain population. Ratings taken on Aug 13, 2001.

Treatment	Form	Rate (lb ai/A)	Dand	W Clover	B. Plantain
DRIVE	75DF	0.75	94.7a[1]	100.0a	-100.0bc
DRIVE NOBLE MSO	75DF L	0.75 24 OZ/A	96.4a	100.0a	-166.7c
DRIVE TARGET PRO SPREADER	75DF L	0.75 0.25 % V/V	97.3a	100.0a	-100.0bc
DRIVE LI 700	75DF L	0.75 0.25 % V/V	96.9a	100.0a	-33.3abc
CHECK			33.3b	13.3b	0.0abc
DRIVE THOROUGHBRED	75DF L	0.75 0.25 % V/V	97.2a	100.0a	-6.7abc
DRIVE SURF KING	75DF L	0.75 0.25 % V/V	94.7a	100.0a	22.2ab
DRIVE LESCO SPREADER STICKER	75DF L	0.75 0.25 % V/V	94.4a	99.6a	11.1abc
TRIMEC	L	4 PT/A	98.3a	99.5a	100.0a
CONFRONT	3SL	0.75	100.0a	100.0a	33.3ab
DRIVE MACROSORB FOLIAR	75DF L	0.75 2 OZ/M	92.6a	100.0a	-22.2abc
DRIVE MACROSORB RADICULAR	75DF L	0.75 2 OZ/M	95.9a	98.9a	60.0ab

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

Table 3. Rating of percent change of dandelion, white clover and broadleaf plantain populations. Ratings taken on Sept 13, 2001.

Treatment	Form	Rate (lb ai/A)	Dand	W Clover	B. Plantain
DRIVE	75DF	0.75	67.2a[1]	100.0a	-166.7ab
DRIVE	75DF	0.75	76.7a	100.0a	-200.0ab
NOBLE MSO	L	24 OZ/A			
DRIVE	75DF	0.75	78.7a	96.3a	-200.0ab
TARGET PRO SPREADER	L	0.25 % V/V			
DRIVE	75DF	0.75	75.8a	100.0a	22.2ab
LI 700	L	0.25 % V/V			
CHECK			-155.6b	54.2b -	266.7b
DRIVE	75DF	0.75	50.0a	100.0a	20.0ab
THOROUGHBRED	L	0.25 % V/V			
DRIVE	75DF	0.75	94.0a	100.0a	22.2ab
SURF KING	L	0.25 % V/V			
DRIVE	75DF	0.75	92.2a	100.0a	11.1ab
LESCO SPREADER STICKER	L	0.25 % V/V			
TRIMEC	L	4 PT/A	89.4a	100.0a	66.7a
CONFRONT	3SL	0.75	93.3a	100.0a	33.3ab
DRIVE	75DF	0.75	88.6a	100.0a	-44.4ab
MACROSORB FOLIAR	L	2 OZ/M			
DRIVE	75DF	0.75	83.8a	100.0a	26.7ab
MACROSORB RADICULAR	L	2 OZ/M			

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

Table 4. Rating of percent change of dandelion, white clover and broadleaf plantain population. Ratings taken on Oct 15, 2001.

Treatment	Form	Rate (lb ai/A)	Dand	W Clover	B. Plantain
DRIVE	75DF	0.75	49.7a[1]	100.0a	-166.7bc
DRIVE	75DF	0.75	73.3a	100.0a	-133.3abc
NOBLE MSO	L	24 OZ/A			
DRIVE	75DF	0.75	85.3a	100.0a	-166.7bc
TARGET PRO SPREADER	L	0.25 % V/V			
DRIVE	75DF	0.75	75.8a	100.0a	33.3ab
LI 700	L	0.25 % V/V			
CHECK			-155.6b	54.2b -	266.7c
DRIVE	75DF	0.75	55.6a	100.0a	26.7ab
THOROUGHBRED	L	0.25 % V/V			
DRIVE	75DF	0.75	95.3a	100.0a	22.2ab
SURF KING	L	0.25 % V/V			
DRIVE	75DF	0.75	83.3a	8.9a	22.2ab
LESCO SPREADER STICKER	L	0.25 % V/V			
TRIMEC	L	4 PT/A	89.4a	100.0a	100.0a
CONFRONT	3SL	0.75	98.7a	100.0a	33.3ab
DRIVE	75DF	0.75	88.6a	100.0a	22.2ab
MACROSORB FOLIAR	L	2 OZ/M			
DRIVE	75DF	0.75	78.3a	100.0a	60.0ab
MACROSORB RADICULAR	L	2 OZ/M			

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

Evaluation of Plant Growth Regulators on 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 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.

Methods and Materials

This study was a randomized complete block design with three replications. Treatments were applied on May 30, June 13, June 27, July 11 and July 27, 2001 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 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

Only slight variation in color ratings was found throughout the duration of the study. Primo at 0.5 oz/M with 0.2 lbs N/M from urea tended to have slightly improved color compared to untreated turf, while Proxy at 0.5 oz/M tended to have slightly less dark green color on most rating dates than did untreated turf. With regard to height measurements, turf treated with half rate of Primo (0.25 oz/M) plus 2 oz/M of MacroSorb Foliar was consistently as short or shorter than turf treated with Primo at 0.5 oz/M plus urea at a rate of 0.2 lbs N/M. When Primo was applied alone at 0.25 oz/M, treated turf tended to be shorter than untreated. Proxy applied at 5 oz/M caused results similar to that of the Primo applied at 0.5 oz/M plus urea at 0.2 lbs N/M. The addition of MacroSorb Foliar to Proxy resulted in turf responses very similar to those cited for Primo and MacroSorb Foliar. With respect to fresh weight yields, on July 2, and 10, turf treated with Primo plus 0.2 lbs N/M from urea had significantly less yield than untreated turf. Turf treated with Primo alone at 0.25 oz/M had less yield than untreated on 6/19, 7/13, and 8/7, while turf treated with the same rate of Primo plus MacroSorb Foliar at 2 oz/M had less yield than untreated turf on 6/5, 6/19, 7/2, 7/10, 7/17, 7/13, and 8/7. Turf treated with Proxy at 5 oz/M had less yield than untreated turf on 8/7 and 8/21. Turf treated with Proxy at 2.5 oz/M had less yield than untreated turf on 7/23, 7/31, 8/7, and 8/21. Turf treated with Proxy at 2.5 oz/M plus 2 oz/M of MacroSorb Foliar had less yield than untreated turf on 7/23, 7/31 and 8/ 7. It appears from this experiment that using half rates of both Primo and Proxy in combination with MacroSorb Foliar is equal to or more efficacious than using full label rates.

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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.

Treatment	Form	Rate Oz/M	Timing	6-5	6-11	6-19	6-26	7-2	7-10	7-17	7-23	7-31	8-7	8-14	8-21
PRIMO	1MEC	0.5	28 DAT	9.5	9.7	9.5	9.5	9.8	9.8	9.8	9.6	9.9	8.8	9.5	9.5
UREA	46G	0.2 lb ai/M	28 DAT												
PROXY	2SL	5	28 DAT	9.3	9.3	8.8	9.0	9.1	8.9	9.0	9.2	9.1	8.8	9.0	9.0
CHECK				9.5	9.3	8.9	9.1	9.3	9.5	9.3	9.4	9.5	9.0	9.5	9.5
PRIMO	1MEC	0.25	14 DAT	9.5	9.6	9.2	9.5	9.4	9.7	9.7	9.7	9.8	9.2	9.5	9.3
PROXY	2SL	2.5	14 DAT	9.3	9.3	8.8	8.9	9.1	9.4	9.3	9.2	9.3	8.8	9.0	9.0
PRIMO	1MEC	0.25	14 DAT	9.3	9.7	9.2	9.3	9.8	9.8	9.8	9.7	9.8	9.5	9.6	9.3
MACROSORB FOLIAR	L	2	14 DAT												
PROXY	2SL	2.5	14 DAT	9.5	9.3	8.8	8.8	9.1	9.2	9.0	9.2	9.1	8.8	9.0	9.0
MACROSORB FOLIAR	L	2	14 DAT												
PRIMO	1MEC	0.25	14 DAT	9.3	9.8	9.2	9.3	9.8	9.7	9.7	9.7	9.7	9.3	9.5	9.3
ADDITIVE															
PROXY	2SL	2.5	14 DAT	9.5	9.3	8.8	8.9	9.2	9.0	9.2	9.2	9.2	8.8	9.0	9.2
ADDITIVE															

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

Treatment	Form	Rate Oz/M	Timing	6-5	6-19	6-26	7-2	7-10	7-17	7-23
PRIMO	1MEC	0.5	28 DAT	0.40a[1]	0.32a	0.36a	0.29bc	0.31ab	0.29a	0.30a
UREA	46G	0.2 lb ai/M	28 DAT							
PROXY	2SL	5	28 DAT	0.37a	0.33a	0.36a	0.36a	0.35ab	0.34a	0.35a
CHECK				0.40a	0.34a	0.31b	0.29bc	0.36ab	0.30a	0.32a
PRIMO	1MEC	0.25	14 DAT	0.40a	0.30a	0.30b	0.25c	0.29b	0.26a	0.26a
PROXY	2SL	2.5	14 DAT	0.41a	0.29a	0.33ab	0.31abc	0.34ab	0.29a	0.30a
PRIMO	1MEC	0.25	14 DAT	0.35a	0.28a	0.30b	0.27bc	0.31b	0.27a	0.28a
MACROSORB FOLIAR	L	2	14 DAT							
PROXY	2SL	2.5	14 DAT	0.39a	0.33a	0.33ab	0.30abc	0.38a	0.34a	0.37a
MACROSORB FOLIAR	L	2	14 DAT							
PRIMO	1MEC	0.25	14 DAT	0.37a	0.31a	0.31ab	0.28bc	0.33ab	0.26a	0.29a
ADDITIVE										
PROXY	2SL	2.5	14 DAT	0.39a	0.31a	0.34ab	0.33ab	0.35ab	0.31a	0.30a
ADDITIVE										

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.

Treatment	Form	Rate Oz/M	Timing	7-31	8-7	8-14	8-21
PRIMO	1MEC	0.5	28 DAT	0.34bc[1]	0.33a	0.41a	0.40a
UREA	46G	0.2 lb ai/M	28 DAT				
PROXY	2SL	5	28 DAT	0.39ab	0.41a	0.42a	0.38a
CHECK				0.36abc	0.40a	0.41a	0.42a
PRIMO	1MEC	0.25	14 DAT	0.33bc	0.35a	0.43a	0.38a
PROXY	2SL	2.5	14 DAT	0.36abc	0.41a	0.42a	0.38a
PRIMO	1MEC	0.25	14 DAT	0.33c	0.36a	0.39a	0.37a
MACROSORB FOLIAR	L	2	14 DAT				
PROXY	2SL	2.5	14 DAT	0.40a	0.39a	0.44a	0.38a
MACROSORB FOLIAR	L	2	14 DAT				
PRIMO	1MEC	0.25	14 DAT	0.34bc	0.34a	0.42a	0.36a
ADDITIVE							
PROXY	2SL	2.5	14 DAT	0.36abc	0.39a	0.41a	0.37a
ADDITIVE							

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.

Treatment	Form	Rate Oz/M	Timing	6-5	6-19	6-26	7-2	7-10	7-17	7-23
PRIMO	1MEC	0.5	28 DAT	18.7ab[1]	19.7a	20.3a	8.7c	9.0c	11.3ab	15.7a
UREA	46G	0.2 lb ai/M	28 DAT							
PROXY	2SL	5	28 DAT	22.0a	17.0a	20.3a	15.7a	15.3ab	11.7ab	11.3abc
CHECK				23.7a	19.0a	17.7ab	14.3ab	16.7a	13.3a	13.7ab
PRIMO	1MEC	0.25	14 DAT	19.3ab	7.7b	9.7b	9.7bc	13.3abc	9.3ab	9.0bc
PROXY	2SL	2.5	14 DAT	19.7ab	20.0a	14.7ab	12.3abc	14.7ab	9.0ab	6.7c
PRIMO	1MEC	0.25	14 DAT	13.7b	7.3b	8.7b	7.7c	10.7bc	8.0b	6.0c
MACROSORB FOLIAR	L	2	14 DAT							
PROXY	2SL	2.5	14 DAT	22.3a	19.3a	15.7ab	11.7abc	15.0ab	9.3ab	8.0c
MACROSORB FOLIAR	L	2	14 DAT							
PRIMO	1MEC	0.25	14 DAT	14.3b	5.0b	17.3ab	8.0c	11.3bc	8.3b	6.7c
ADDITIVE										
PROXY	2SL	2.5	14 DAT	24.0a	21.7a	12.3ab	14.7a	17.3a	10.0ab	8.0c
ADDITIVE										

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.

Treatment	Form	Rate Oz/M	Timing	7-31	8-7	8-14	8-21
PRIMO	1MEC	0.5	28 DAT	24.0abc[1]	10.3b	40.7ab	27.7a
UREA	46G	0.2 lb ai/M	28 DAT				
PROXY	2SL	5	28 DAT	26.7ab	12.7b	32.0bc	13.0d
CHECK				30.0a	18.7a	37.3abc	23.3abc
PRIMO	1MEC	0.25	14 DAT	19.0bc	13.3b	43.7a	26.3ab
PROXY	2SL	2.5	14 DAT	21.3bc	11.0b	28.7c	11.3d
PRIMO	1MEC	0.25	14 DAT	16.7c	8.7b	37.0abc	25.3ab
MACROSORB FOLIAR	L	2	14 DAT				
PROXY	2SL	2.5	14 DAT	24.0abc	12.0b	31.0bc	15.7cd
MACROSORB FOLIAR	L	2	14 DAT				
PRIMO	1MEC	0.25	14 DAT	16.3c	10.0b	30.7bc	19.7a-d
ADDITIVE							
PROXY	2SL	2.5	14 DAT	24.0abc	11.7b	32.3bc	18.3bcd
ADDITIVE							

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

Poa Annua Control

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 numbered compounds could eliminate *Poa annua* under putting green conditions.

Methods and Materials

This study was a randomized complete block design with three replications. Granular treatments were applied after 5/8 inch diameter core cultivation (3 inch depth, 2 inches on center) plugs were removed from the site. A topdressing followed to fill the holes, the Trimmit treatment was applied and the area was irrigated with 1/2 inch of water. All of the treatments were applied on June 14, 2000 using a shaker jar and a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi. Trimmit was also applied on July 12, August 8, and September 7, 2000. The test area was maintained at 0.125" using a triplex reel mower returning the clippings to the site.

Results and Discussion

The amount of annual bluegrass increased in all treated plots during the course of this experiment (Table 1). However, there was a consistent trend, in that, plots treated with Trimmit and NP-2001 tended to have a lower percent increase in annual bluegrass than untreated.

Table 1. Percent increase of *Poa annua*. Ratings were taken on May 30, 2000 and May 9, 2001.

Treatment	Form	Rate (LB Ai/A)	% Increase
NP-2001-G	G	4.4 LB/M	140.0b[1]
CHECK			80.0ab
TRIMMIT	2 SC	0.25	14.8a
NP-2001	G	4.4 LB/M	31.1ab

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

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Evaluations of Ball Mark Recovery on a Putting Green

Dr. T. L. Watschke, J. A. Borger and J. T. Brosnan[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 studies was to determine the rate of turfgrass recovery from simulated ball marks on a putting green.

Methods and Materials

The study was a randomized complete block design with three replications. Treatments (MacroSorb Foliar and urea) were applied on May 15, May 29, June 13, June 27, July 11, July 27, Aug 7, Aug 23, Sept 13 and Sept 27, 2001 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi. Primo Maxx was applied on July 16, Aug 7, Aug 29 and Sept 25, 2001 using the same equipment as the MacroSorb Foliar and urea applications.

On Aug 20, 2001 ball 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 ball was driven into the putting green until it was completely buried. The compacted turfgrass in the divot that was left was removed leaving a hole 40 millimeters in diameter. This hole was then filled with an 80/20 topdressing to the surface. Each test plot had six divots.

The growing medium of the test area was sand based with 98.6% sand, 0.5% silt and 0.9% clay. The bulk density was 1.51 g/cc, total porosity was 43.0, aeration porosity (-30cm tension) was 16.7, capillary porosity (-30cm tension) 26.2. The saturated hydraulic conductivity was 21.5 in/hr and average field infiltration rate was 16.5 in/hr.

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

Previous research has shown that the growth regulator Primo can improve the rate of divot recovery in creeping bentgrass fairways. This recovery is the result of an increased rate of lateral spread by the stolons of the creeping bentgrass. This enhanced recovery was also accomplished without additional nitrogen application. The bio-stimulant, MacroSorb Foliar has also been shown to improve the recovery rate of turf from mechanical stresses.

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The results of this experimentation were somewhat inconsistent. However, turf treated with the Primo and MacroSorb Foliar alone tended to recover from the ball marks faster than turf that was completely untreated. Turf treated with urea alone did not tend to heal any faster than untreated. However, when turf was treated with a combination of Primo and MacroSorb Foliar, the rate of recovery from the ball mark damage was slightly slower (although not statistically so) than untreated turf. Since MacroSorb Foliar is known to facilitate the absorption of a number of chemicals, it is suspected that enhanced uptake and movement of the applied Primo may have occurred when the combination was used. Further research needs to be conducted to further assess whether reduced rates of Primo in combination with MacroSorb Foliar could bring about the positive response seen for Primo application alone.

It appeared from this experiment that recovery rate from ball mark damage can potentially be enhanced by the application of growth regulators or bio-stimulants without providing increments of nitrogen that would reduce the speed of the greens. However, further research should be conducted on sites that have a higher nitrogen fertilization program than was used on this experimental site.

Table 1. Quality ratings taken on Aug 15, 2001 of creeping bentgrass where 0 = worst, 7 = acceptable and 10 = best.

Treatment	**Form**	**Rate (oz/M)**	**Quality**
PRIMO MAXX	1MEC	0.125	5.7
MACROSORB FOLIAR	L	2	
PRIMO MAXX	1MEC	0.125	7.3
UREA	46G	0.15 lb ai/A	
CHECK			
PRIMO MAXX	1MEC	0.125	7.3
CHECK			7.7
MACROSORB FOLIAR	L	2	
CHECK			5.7
UREA	46G	0.15 lb ai/A	
CHECK			8.0
CHECK			

Table 2. Percent reduction of ball marks in a creeping bentgrass/ *Poa annua* putting green in 2001.

Treatment	Form	Rate (oz/M)	8-21	8-22	8-23	8-24	8-25	8-26	8-27	8-28	8-30
			% Reduction								
PRIMO MAXX	1MEC	0.125	3.1a[1]	7.9a	12.6a	6.1a	6.8a	8.2b	13.2ab	14.3ab	12.6b
MACROSORB FOLIAR	L	2									
PRIMO MAXX	1MEC	0.125	2.9a	12.1a	10.4a	7.4a	8.9a	13.6a	15.6ab	18.6ab	20.4ab
UREA	46G	0.15 lb ai/A									
CHECK			1.1a	11.5a	10.7a	10.1a	10.8a	11.5ab	17.6ab	20.0a	27.1a
PRIMO MAXX	1MEC	0.125									
CHECK			4.2a	9.9a	13.8a	9.2a	7.2a	11.7ab	14.2ab	16.1ab	19.9ab
MACROSORB FOLIAR	L	2									
CHECK			1.5a	8.9a	10.3a	7.1a	3.9a	6.9b	11.4b	12.2b	18.6ab
UREA	46G	0.15 lb ai/A									
CHECK			1.4a	13.9a	10.4a	10.0a	8.9a	14.2a	18.2a	20.3a	26.9a
CHECK											

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

Table 2(Continued). Percent reduction of ball marks in a creeping bentgrass/ *Poa annua* putting green in 2001.

Treatment	Form	Rate (oz/M)	9-04	9-07	9-11	9-14	9-18	9-21	9-25	9-27	10-02
			% Reduction								
PRIMO MAXX	1MEC	0.125	11.9c[1]	23.9b	24.0d	29.4bc	45.8b	44.7b	53.9bc	57.2b	54.4b
MACROSORB FOLIAR	L	2									
PRIMO MAXX	1MEC	0.125	19.6b	30.0b	32.2bc	30.4bc	49.2ab	57.8ab	63.2abc	67.2ab	69.4ab
UREA	46G	0.15 lb ai/A									
CHECK			30.1a	36.3a	40.7a	48.8a	54.4ab	66.9a	76.0a	81.8a	78.5a
PRIMO MAXX	1MEC	0.125									
CHECK			19.4b	29.2b	28.3cd	40.6abc	63.8a	62.5ab	71.1ab	73.5ab	69.7ab
MACROSORB FOLIAR	L	2									
CHECK			17.4b	25.3b	28.6cd	27.5c	41.1b	46.9ab	53.2c	58.1b	58.1b
UREA	46G	0.15 lb ai/A									
CHECK			27.9a	37.9a	38.9ab	45.6ab	48.9ab	58.2ab	64.6abc	71.7ab	69.7ab
CHECK											

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

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 10, 2001 (2 weeks prior to boot stage), April 16, 2001 (1 week prior to boot stage), April 23, 2001 (boot stage), and, in some cases, sequential applications were made on April 30, May 7, and May 15, 2001using a three-foot CO_2 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. The green did not receive any aerification/topdressing prior to or during the study.

Results and Discussion

Treatments that provided 90% or greater seedhead suppression two weeks after application at the boot stage were: Embark T/O at 40 oz/A plus 5 oz/M Ferromec, Embark T/O at 35 oz/A plus 4 oz/M MacroSorb Foliar, Embark T/O at 35 oz/A plus 4 oz/M MacroSorb Foliar plus 5 oz/M Ferromec, and Embark T/O at 40 oz/A plus 5 oz/M Ferromec followed three weeks later with 20 oz/A Embark T/O plus 4 oz/M MacroSorb Foliar, Proxy applied at the boot stage at 5 oz/M provided 85% suppression. Proxy at 5 oz/M was applied two and one week prior to boot stage resulting in 90 and 87% suppression respectfully. Seedhead suppression rated three weeks after application revealed that all Proxy treatments did not persist as the best treatment resulted in 37% suppression. All the other previously mentioned treatments had at least 88% suppression except Embark T/O at 35 oz/A plus 5 oz/M Ferromec which only had 68% suppression after three weeks. With respect to quality ratings, all treated turf had acceptable quality. The addition of MacroSorb Foliar allowed for a decrease in Embark T/O rate from 40 to 35 oz/A without loss of seedhead suppression.

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Table 1. Ratings of phytotoxicity (May 9, 2001) and percent suppression of *Poa annua* seedheads on a *Poa annua*/creeping bentgrass putting green.

Treatment	Form	Rate oz/A	Timing	Phytotoxicity	5-9-01 (----% Suppression----)	5-16-01
EMBARK T/O	0.2 L	40	Boot	6.2[1]	91.7a [2]	91.7a
EMBARK T/O	0.2 L	40	Boot	6.0	95.0a	90.0a
FERROMEC	L	5 OZ/M	Boot			
EMBARK T/O	0.2 L	40	Boot	5.7	91.7a	90.0a
ADDITIVE						
EMBARK T/O	0.2 L	40	Boot	5.3	95.0a	91.7a
ADDITIVE						
EMBARK T/O	0.2 L	40	Boot	5.2	93.3a	90.0a
ADDITIVE						
EMBARK T/O	0.2 L	40	Boot	5.8	91.7a	90.0a
FERROMEC	L	5 OZ/M	Boot			
SEAWEED COCKTAIL	L	0.5 GAL/A	Boot			
CHECK				10.0	0.0c	0.0e
EMBARK T/O	0.2 L	35	Boot	5.7	93.3a	88.3a
MACROSORB FOLIAR	L	4 OZ/M	Boot			
EMBARK T/O	0.2 L	35	Boot	5.3	95.0a	90.0a
ADDITIVE						
EMBARK T/O	0.2 L	35	Boot	6.0	90.0a	88.3a
FERROMEC	L	5 OZ/M	Boot			
MACROSORB FOLIAR	L	4 OZ/M	Boot			
EMBARK T/O	0.2 L	35	Boot	7.3	91.7a	85.0a
FERROMEC	L	5 OZ/M	Boot			
ADDITIVE						
EMBARK T/O	0.2 L	40	Boot	5.3	95.0a	93.3a
FERROMEC	L	5 OZ/M	Boot			
SEAWEED COCKTAIL	L	0.5 GAL/A	Boot			
SEAWEED COCKTAIL	L	0.5 GAL/A	2WAT			
EMBARK T/O	0.2 L	35	Boot	6.7	88.3a	68.3b
FERROMEC	L	5 OZ/M	Boot			
EMBARK T/O	0.2 L	35	Boot	5.8	93.3a	93.3a
EMBARK T/O	0.2 L	40	Boot	6.3	93.3a	90.0a
FERROMEC	L	5 OZ/M	Boot			
EMBARK T/O	0.2 L	20	3WAT			
MACROSORB FOILIAR	L	4 OZ/M	3WAT			
PROXY	2 SL	5 OZ/M	2WPRE	8.0	86.7a	33.3cd
PROXY	2 SL	5 OZ/M	1WPRE	8.0	90.0a	21.7cd
PROXY	2 SL	5 OZ/M	Boot	8.7	85.0a	28.3cd
PROXY	2 SL	5 OZ/M	1WAT	8.3	83.3a	36.7c
PROXY	2 SL	5 OZ/M	2WPRE	8.3	56.7b	20.0d
PROXY	2 SL	5 OZ/M	2WAT			

1 – Rating scale of 0 = worst, 7 = acceptable, 10 = no phytotoxicity.
2 - Means followed by same letter do not significantly differ (P=0.05 Duncan's New MRT)

Table 2. Ratings of quality on a *Poa annua*/creeping bentgrass putting green.

Treatment	Form	Rate oz/A	Timing	5-16-01	5-23-01
				(--------Quality---------)	
EMBARK T/O	0.2 L	40	Boot	7.7[1]	8.7
EMBARK T/O	0.2 L	40	Boot	8.0	10
FERROMEC	L	5 OZ/M	Boot		
EMBARK T/O	0.2 L	40	Boot	7.0	9.3
ADDITIVE					
EMBARK T/O	0.2 L	40	Boot	6.7	9.0
ADDITIVE					
EMBARK T/O	0.2 L	40	Boot	7.0	9.7
ADDITIVE					
EMBARK T/O	0.2 L	40	Boot	8.3	9.3
FERROMEC	L	5 OZ/M	Boot		
SEAWEED COCKTAIL	L	0.5 GAL/A	Boot		
CHECK				6.0	7.0
EMBARK T/O	0.2 L	35	Boot	7.7	9.0
MACROSORB FOLIAR	L	4 OZ/M	Boot		
EMBARK T/O	0.2 L	35	Boot	6.0	8.7
ADDITIVE					
EMBARK T/O	0.2 L	35	Boot	7.3	8.0
FERROMEC	L	5 OZ/M	Boot		
MACROSORB FOLIAR	L	4 OZ/M	Boot		
EMBARK T/O	0.2 L	35	Boot	8.0	8.7
FERROMEC	L	5 OZ/M	Boot		
ADDITIVE					
EMBARK T/O	0.2 L	40	Boot	7.0	9.3
FERROMEC	L	5 OZ/M	Boot		
SEAWEED COCKTAIL	L	0.5 GAL/A	Boot		
SEAWEED COCKTAIL	L	0.5 GAL/A	2WAT		
EMBARK T/O	0.2 L	35	Boot	7.3	8.7
FERROMEC	L	5 OZ/M	Boot		
EMBARK T/O	0.2 L	35	Boot	8.3	8.3
EMBARK T/O	0.2 L	40	Boot	7.0	7.7
FERROMEC	L	5 OZ/M	Boot		
EMBARK T/O	0.2 L	20	3WAT		
MACROSORB FOILIAR	L	4 OZ/M	3WAT		
PROXY	2 SL	5 OZ/M	2WPRE	6.3	7.3
PROXY	2 SL	5 OZ/M	1WPRE	6.3	7.3
PROXY	2 SL	5 OZ/M	Boot	6.0	7.0
PROXY	2 SL	5 OZ/M	1WAT	6.7	6.7
PROXY	2 SL	5 OZ/M	2WPRE	6.0	7.0
PROXY	2 SL	5 OZ/M	2WAT		

1 – Rating scale of 0 = worst, 7 = acceptable, 10 = best.

Post Emergence Control of Broadleaf Weeds in the Fall

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

Introduction

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

Methods and Materials

This study was a randomized complete bl ock design with three replications. All of the treatments were applied on Sept 18, 2001 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi.

Results and Discussion

The control of dandelio n, white clover, and common plantain was rated on October 16 (Table 1) and November 8 (Table 2). On the October rating date, the best, and most consistent control of all three broadleaf weed species was provided by Confront and UHS-302 (Table 2). Milleni um Ultra provided excellent control of dandelion and white clover, but had some weakness in common plantain control. None of the PCC numbered compounds provided acceptable control. Momentum provided excellent control of dandelion and white clover, but wa s also somewhat weak on common plantain. Drive with MSO provided excellent control of dandelion and white clover, but was ineffective for common plantain control. Adding 2,4 D to the Drive treatment dramatically improved the control of common plantain, b ut it was still not improved to an acceptable level. The addition of Lontrel to Drive treatment yielded results similar to that for the addition of 2,4 D. On the November rating date, none of the treatments provided dandelion control. Apparently, the mo st of the treated dandelions recovered or some germination occurred (Table 2). Most likely, a combination of both phenomenon occurred. Most of the treatments maintained reasonably good white clover and common plantain control (Table 1).

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Table 1. Rating of percent change in dandelion, white clover and broadleaf plantain population. Ratings taken on Oct 16, 2001.

Treatment	Form	Rate lbs ai/A	Dand	W. Clover	B. Plant
PCC-1147	0.166SC	0.0088	52.4c[1]	58.9abc	-23.8abc
LI-700	L	0.5% V/V			
PCC-1147	0.166SC	0.0176	66.7bc	56.7abc	-63.3abc
LI-700	L	0.5% V/V			
PCC-1147	0.166SC	0.0352	90.3ab	23.3bc	20.0abc
LI-700	L	0.5% V/V			
CHECK			20.6d	31.0abc	-147.6bc
PCC-1147	0.166SC	0.070	75.0abc	11.9	-183.3c
LI-700	L	0.5% V/V			
PCC-1147	0.166SC	0.141	88.9ab	67.9abc	33.3ab
LI-700	L	0.5% V/V			
CONFRONT	L	2PT/A	97.2a	97.8a	65.6ab
EH1181	L	5PT/A	95.1a	66.7abc	83.3[a]
MILLENIUM ULTRA	L	2.5PT/A	100.0a	100.0a	75.6a
UHS-302	L	3.9PT/A	99.2a	100.0a	60.0ab
MOMENTIUM	L	4PT/A	100.0a	100.0a	50.0 ab
DRIVE	75DF	0.75	100.0a	100.0a	-106.7abc
MSO	L	1% V/V			
DRIVE	75DF	0.75	100.0a	100.0a	73.3a
MSO	L	1% V/V			
2,4-D AMINE	3.8L	1			
CHECK			64.8bc	55.3abc	-33.3abc
DRIVE	75DF	0.75	100.0	90.5ab	-133.3abc
SURF KING	L	0.25% V/V			
DRIVE	75DF	0.75	100.0a	100.0a	-100.0abc
LESCO SPREADER STICKER	L	0.25% V/V			
LONTREL	L	1PT/A	100.0a	100.0a	60.0ab
LONTREL	L	1PT/A	100.0a	100.0a	61.9ab
DRIVE	75DF	0.75			
MSO	L	1% V/V			

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

Table 2. Rating of percent change in dandelion, white clover and broadleaf plantain population. Ratings taken on Nov 8, 2001.

Treatment	Form	Rate lbs ai/A	Dand	W. Clover	B. Plant
PCC-1147	0.166SC	0.0088	0.0a[1]	76.2ab	61.9a
LI-700	L	0.5% V/V			
PCC-1147	0.166SC	0.0176	0.0a	70.0ab	-23.3a
LI-700	L	0.5% V/V			
PCC-1147	0.166SC	0.0352	0.0a	100.0a	53.3a
LI-700	L	0.5% V/V			
CHECK			0.0a	64.2ab	-64.3a
PCC-1147	0.166SC	0.070	0.0a	100.0a	-100.0a
LI-700	L	0.5% V/V			
PCC-1147	0.166SC	0.141	0.0a	91.7a	46.7a
LI-700	L	0.5% V/V			
CONFRONT	L	2PT/A	0.0a	100.0a	93.3a
EH1181	L	5PT/A	0.0a	100.0a	100.0a
MILLENIUM ULTRA	L	2.5PT/A	0.0a	100.0a	100.0a
UHS-302	L	3.9PT/A	0.0a	100.0a	93.3a
MOMENTIUM	L	4PT/A	0.0a	100.0a	100.0a
DRIVE	75DF	0.75	0.0a	100.0a	-23.3a
MSO	L	1% V/V			
DRIVE	75DF	0.75	0.0a	100.0a	100.0a
MSO	L	1% V/V			
2,4-D AMINE	3.8L	1			
CHECK			0.0a	43.3b-	6.7a
DRIVE	75DF	0.75	0.0a	100.0a	-80.0a
SURF KING	L	0.25% V/V			
DRIVE	75DF	0.75	0.0a	100.0a	33.3a
LESCO SPREADER STICKER	L	0.25% V/V			
LONTREL	L	1PT/A	0.0a	100.0a	83.3a
LONTREL	L	1PT/A	0.0a	100.0a	91.9a
DRIVE	75DF	0.75			
MSO	L	1% V/V			

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

Seedhead Suppression of Annual Bluegrass on a Fairway

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

Introduction

This study was conducted on a mixed stand of perennial ryegrass, Kentucky bluegrass 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 10, 2001 (2 weeks prior to boot stage), April 16, 2001 (1 week prior to boot stage), April 23, 2001 (boot stage), and, in some cases sequential applications were made on, April 30 and May 7, 2001using a three-foot CO_2 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 fairway.

Results and Discussion

Treatments that provided 90% or more seedhead suppression when applied at the boot stage of development were; Embark T/O at 80 oz/A, Embark T/O at 60 oz/A plus MacroSorb Foliar at 4 oz/M, and Embark T/O at 80 oz/A plus MacroSorb Foliar at 4 oz/M. Turf treated with Embark T/O at 40 oz/A plus MacroSorb Foliar at 4 oz/M provided 82% seedhead suppression. Turf treated with Embark at 40 or 60 oz/A provided 88% seedhead suppression. Proxy treated turf regardless of rate, provided no more than 57% seedhead suppression. It appears that the addition of MacroSorb Foliar to the application of Embark T/O enhanced seedhead suppression.

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Table 1. Ratings of phytotoxicity (May 9, 2001) and percent suppression of *Poa annua* seedheads *Poa annua*/perennial ryegrass/Kentucky bluegrass fairway.

Treatment	Form	Rate oz/A	Timing	Phytotoxicity	5-9-01	5-16-01
					(-----% Suppression-----)	
EMBARK T/O	0.2 L	80	Boot	6.0[1]	93.3a[2]	93.3a
EMBARK T/O ADDITIVE	0.2 L	80	Boot	6.3	95.0a	93.3a
EMBARK T/O MACROSORB FOLIAR	0.2 L L	60 4 OZ/M	Boot Boot	6.3	93.3a	91.7a
EMBARK T/O MACROSORB FOLIAR	0.2 L L	40 4 OZ/M	Boot Boot	8.7	86.7a	81.7a
CHECK				10	0.0c	0.0d
EMBARK T/O MACROSORB FOLIAR	0.2 L L	80 4 OZ/M	Boot Boot	6.3	95.0a	95.0a
EMBARK T/O	0.2 L	60	Boot	6.8	91.7a	88.3a
EMBARK T/O	0.2 L	40	Boot	7.7	91.7a	83.3a
PROXY	2 SL	5 OZ/M	2WPRE	10.0	3.3c	26.7c
PROXY	2 SL	5 OZ/M	1WPRE	10.0	23.3bc	33.3bc
PROXY	2 SL	5 OZ/M	Boot	10.0	50.0b	50.0bc
PROXY	2 SL	5 OZ/M	1WAT	10.0	26.7bc	56.7b
PROXY PROXY	2 SL 2 SL	5 OZ/M 5 OZ/M	2WPRE 2WAT	10.0	0.0c	50.0bc

1 – Rating scale of 0 = worst, 7 = acceptable, 10 = no phytotoxicity.
2 - Means followed by same letter do not significantly differ (P=0.05 Duncan's New MRT)

Table 2. Ratings of quality on a *Poa annua*/perennial ryegrass/Kentucky bluegrass fairway.

Treatment	Form	Rate oz/A	Timing	5-16-01
EMBARK T/O	0.2 L	80	Boot	7.3[1]
EMBARK T/O ADDITIVE	0.2 L	80	Boot	7.7
EMBARK T/O MACROSORB FOLIAR	0.2 L L	60 4 OZ/M	Boot Boot	8.0
EMBARK T/O MACROSORB FOLIAR	0.2 L L	40 4 OZ/M	Boot Boot	8.0
CHECK				6.0
EMBARK T/O MACROSORB FOLIAR	0.2 L L	80 4 OZ/M	Boot Boot	7.0
EMBARK T/O	0.2 L	60	Boot	7.3
EMBARK T/O	0.2 L	40	Boot	7.3
PROXY	2 SL	5 OZ/M	2WPRE	6.0
PROXY	2 SL	5 OZ/M	1WPRE	6.0
PROXY	2 SL	5 OZ/M	Boot	6.3
PROXY	2 SL	5 OZ/M	1WAT	6.7
PROXY PROXY	2 SL 2 SL	5 OZ/M 5 OZ/M	2WPRE 2WAT	6.3

1 – Rating scale of 0 = worst, 7 = acceptable, 10 = best.

Post Emergence Control of Ground Ivy

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

Introduction

This study was conducted on a mixed stand of perennial ryegrass, Kentucky bluegrass and fine fescue in State College, PA. The objective of the study was to determine the efficacy of broadleaf weed herbicides for the control of ground ivy and wild violets.

Methods and Materials

This study was a randomized complete block design with three replications. All of the treatments were applied on June 7, 2001 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi.

Results and Discussion

Control of ground ivy was rated three times (6/28, 7/18 and 8/8) during the study. In general, control increased from the first rating date to the last. Ground ivy increased in the control (34% from the first to the last rating date). On the final rating date of Aug 8, 2001, three treatments provided control above 85%, UHS 302 at 3.9 pt/A (98%), Confront at 2 pt/A (97%) and Millenium Ultra at 2.5 pt/A (87%). All other treated turf was rated at 72% control or lower.

Table 1. Rating of percent change of the ground ivy population. Initial rating taken on June 6, 2001.

Treatment	**Form**	**Rate (PT/A)**	**(-------------% Change-------------)** 6-28	7-18	8-08
CONFRONT	L	2	68.7abc[1]	76.4ab	96.9a
LONTREL T/O	L	1	10.0de	15.6cd	40.0ab
EH1381	L	5	77.1ab	62.2abc	67.6ab
EH1382	L	5.5	35.6cde	35.6bcd	43.1ab
CHECK			5.6e	0.0d	-34.3c
EH1383	L	4	71.1abc	38.9bcd	24.4b
TRIMEC CLASSIC	L	4	61.7abc	61.7abc	71.7ab
MILLENIUM ULTRA	L	2.5	55.6bc	72.2ab	87.2ab
UHS-302	L	3.9	95.9a	93.5a	97.6a

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT). Positive numbers represent percent decrease and negative numbers a percent increase in population.

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Post Emergence Control of Crabgrass at the Two to Three Tiller Growth Stage

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

Introduction

This study was conducted on a mature stand of perennial ryegrass at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to evaluate the efficacy of pre/post emergence herbicides for the postemergence control of smooth crabgrass.

Methods and Materials

This study was a randomized complete block design with three replications. All of the treatments were applied on July 16, 2001 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 site was maintained at 0.5 inches to simulate a golf course fairway.

Results and Discussion

This study was a repeat of one applied in June. It is known that the control of smooth crabgrass from applications of Drive varies depending on the stage of growth of the crabgrass. In this study the treated crabgrass was tillering. Overall, no treatment provided acceptable control of the smooth crabgrass (Table 1). As was seen in the earlier study, control tended to be improved by the addition of LESCO Spreader Sticker, Noble MSO, Thoroughbred, and MacroSorb Radicular. Control ratings for all of the Drive plus adjuvant treatments tended to be improved over Drive alone.

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Table1. Percent postemergence control of smooth crabgrass rated on Aug 15, 2001 where 85% and above was considered commercially acceptable.

Treatment	Form	Rate (lb ai/A)	% Control
DRIVE	75DF	0.75	36.7
DRIVE NOBLE MSO	75DF L	0.75 24 OZ/A	65.0
DRIVE TARGET PRO SPREADER	75DF L	0.75 0.25 % V/V	51.7
DRIVE LI 700	75DF L	0.75 0.25 % V/V	46.7
CHECK			0.0
DRIVE THOROUGHBRED	75DF L	0.75 0.25 % V/V	58.3
DRIVE SURF KING	75DF L	0.75 0.25 % V/V	50.0
DRIVE LESCO SPREADER STICKER	75DF L	0.75 0.25 % V/V	63.3
DRIVE MACROSORB FOLIAR	75DF L	0.75 2 OZ/M	45.0
DRIVE MACROSORB RADICULAR	75DF L	0.75 2 OZ/M	58.3

Post Emergence Control of Crabgrass at the Two to Three Tiller Growth Stage

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

Introduction

This study was conducted on a mature stand of perennial ryegrass at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to evaluate the efficacy of pre/post emergence herbicides for the postemergence control of smooth crabgrass.

Methods and Materials

This study was a randomized complete block design with three replications. All of the treatments were applied on July 16, 2001 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 site was maintained at 0.5 inches to simulate a golf course fairway.

Results and Discussion

Evaluations of the study revealed that, two treatments, Acclaim Extra 0.57EW at 0.17 lbs ai/A and Acclaim Extra 0.57EW at 0.12 lbs ai/A combined with an additive provided 85% control. Acclaim Extra 0.57EW at 0.09 and 0.12 lbs ai/A and Acclaim Extra 0.57EW at 0.07, 0.09 and 0.12 lbs ai/A combined with MacroSorb Foliar at 2 oz/M provided control in the range of 80% up to 83% of smooth crabgrass. None of the remaining treatments provided control above 78%.

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Table1. Percent postemergence control of smooth crabgrass rated on Aug 15, 2001 where 85% and above was considered commercially acceptable.

Treatment	Form	Rate (lb ai/A)	% Control
DRIVE MSO	75DF L	0.75 1 % V/V	58.3
DRIVE MSO	75DF L	0.5 1 % V/V	40.0
DRIVE MSO MACROSORB FOLIAR	75DF L L	0.75 1 % V/V 2 OZ/M	71.7
DRIVE MSO ADDITIVE	75DF L	0.75 1 % V/V	71.7
DRIVE MSO MACROSORB FOLIAR	75DF L L	0.5 1 % V/V 2 OZ/M	55.0
DRIVE MSO ADDITIVE	75DF L	0.5 1% V/V	48.3
CHECK			0.0
ACCLAIM EXTRA	0.57EW	20 OZ/A	83.3
ACCLAIM EXTRA	0.57EW	28 OZ/A	83.3
ACCLAIM EXTRA	0.57EW	39 OZ/A	85.0
ACCLAIM EXTRA MACROSORB FOLIAR	0.57EW L	20 OZ/A 2 OZ/M	81.7
ACCLAIM EXTRA MACROSORB FOLIAR	0.57EW L	15 OZ/A 2 OZ/M	80.0
ACCLAIM EXTRA MACROSORB FOLIAR	0.57EW L	10 OZ/A 2 OZ/M	66.7
ACCLAIM EXTRA MACROSORB FOLIAR	0.57EW L	28 OZ/A 2 OZ/M	80.0
ACCLAIM EXTRA ADDITIVE	0.57EW	20 OZ/A	78.3
ACCLAIM EXTRA ADDITIVE	0.57EW	15 OZ/A	75.0
ACCLAIM EXTRA ADDITIVE	0.57EW	10 OZ/A	76.7
ACCLAIM EXTRA ADDITIVE	0.57EW	28 OZ/A	85.0

Preemergence Crabgrass Control Study

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

Introduction

This study was conducted on a mature stand of "Midnight" Kentucky bluegrass at the Landscape Management Research Center, Penn State University, University Park, PA. The objective of the study was to evaluate the efficacy of herbicides for the preemergence control of smooth crabgrass.

Methods and Materials

This study was a randomized complete block design with three replications. Treatments were applied on April 11, April 25 and April 27, 2001 (Barricade 4SL treatments were the only treatments applied on April 27, 2001) using a three foot CO_2 powered boom sprayer calibrated to deliver 80 gpa using two, flat fan, 6504 nozzles at 40 psi. Some treatments were re-applied six weeks later on June 6, 2001. Granular treatments were applied with a shaker jar. After application the entire test site received approximately 0.5 inch of water. On April 27, 2001, 0.5 lb N/M was applied from urea and 0.5 lb N/M from a 24-4-12 SCU fertilizer to treatments that did not contain any nitrogen as a herbicide carrier.

Crabgrass germination was first noted in the test site on April 27, 2001. Consequently, on April 27, 2001, Acclaim Extra 0.57EW was applied to the entire test area at a rate of 20 oz/A. On May 5, 2001, Acclaim Extra 0.57EW was applied to only the Barricade 4SL treatments at a rate of 20 oz/A. 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.

Results and Discussion

Acceptable control was achieved by the following herbicide treatments; Dimension 40WP at 0.5 lbs ai/A, Barricade 4SL at 0.75 and 1.0 lbs ai/A, Pendulum 3.3EC using a 6 week split application at .5 lbs ai/A each timing (total 3.0 lbs ai/A), Ronstar 0.95G (LESCO) at 3 lbs ai/A, Ronstar 2G at 3.0 lbs ai/A, Dimension 40WP at 0.25 lbs ai/A, and Betasan 4EC at 9.2 oz/M had control, at least, at the 83% level.

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Table1. Percent control of smooth crabgrass rated on Aug 15, 2001 where 85% and above was considered acceptable.

Treatment	Form	Rate (LB Ai/A)	Timing	% Control
RONSTAR	2G	3	2WKPRIOR[1]	80.0
RONSTAR	2G	3	NORMAL	85.0
RONSTAR (LESCO)	0.95G	3	2WKPRIOR	83.3
RONSTAR (LESCO)	0.95G	3	NORMAL	83.3
RONSTAR (REGAL AC)	2G	3	2WKPRIOR	81.7
RONSTAR (REGAL AC)	2G	3	NORMAL	61.7
DIMENSION	40WP	0.5	2WKPRIOR	86.7
DIMENSION	40WP	0.5	NORMAL	93.3
DIMENSION FERT BLANK	1EC	0.18	NORMAL NORMAL	63.3
DIMENSION FERT BLANK	40WP	0.18	NORMAL NORMAL	83.3
XF-00090	.164G	0.18	NORMAL	88.3
XF-00272 FERT BLANK	2.5SC	0.18	NORMAL NORMAL	76.7
XF-01005 FERT BLANK	2.0SC	0.18	NORMAL NORMAL	70.0
DIMENSION FERT BLANK	1EC	0.25	NORMAL NORMAL	81.7
DIMENSION FERT BLANK	40WP	0.25	NORMAL NORMAL	83.3
XF-00090	.164G	0.25	NORMAL	83.3
XF-00272 FERT BLANK	2.5SC	0.25	NORMAL NORMAL	80.0
XF-01005 FERT BLANK	2.0SC	0.25	NORMAL NORMAL	73.3
PENDULUM	3.3EC	1.5	NORMAL	56.7
PENDULUM	3.3EC	2.0	NORMAL	56.7
PENDULUM	2G	1.5	NORMAL	60.0
PENDULUM	2G	2.0	NORMAL	60.0
BETASAN	4EC	9.2 oz/M	NORMAL	83.3
BETASAN	4EC	7.3 oz/M	NORMAL	70.0
BETASAN BETASAN	4EC 4EC	4.4 oz/M 2.9 oz/M	NORMAL 6 WAT	81.7
BARRICADE	65WDG	0.25	NORMAL	46.7
BARRICADE	65WDG	0.5	NORMAL	70.0
BARRICADE	65WDG	0.75	NORMAL	85.0
BARRICADE	65WDG	1.0	NORMAL	90.0
BARRICADE	4SL	0.25	NORMAL	70.0
BARRICADE	4SL	0.5	NORMAL	78.3
BARRICADE	4SL	0.75	NORMAL	75.0
BARRICADE	4SL	1.0	NORMAL	78.3
CHECK				0.0

1 – 2 WK PRIOR = application on 4/11, NORMAL = application on 4/25 and 6WAT = application on 6/6

Post Emergence Control of Crabgrass at the Two to Three Leaf Growth Stage

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

Introduction

This study was conducted on a mature stand of perennial ryegrass at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to evaluate the efficacy of pre/post emergence herbicides for the postemergence control of smooth crabgrass using various adjuvants.

Methods and Materials

This study was a randomized complete block design with three replications. All of the treatments were applied on June 13, 2001 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 site was maintained at 0. 5 inches to simulate a golf course fairway.

Results and Discussion

None of the treatments provided acceptable control of smooth crabgrass. The activity of Drive did appear to be enhanced by some of the adjuvants, particularly Target Pro Spreader and LESCO Spreader Sticker.

Table1. Percent postemergence control of smooth crabgrass rated on Aug 15, 2001 where 85% and above was considered commercially acceptable.

Treatment	Form	Rate (lb ai/A)	% Control
DRIVE	75DF	0.75	36.7
DRIVE	75DF	0.75	43.3
NOBLE MSO	L	24 OZ/A	
DRIVE	75DF	0.75	50.0
TARGET PRO SPREADER	L	0.25 % V/V	
DRIVE	75DF	0.75	35.0
LI 700	L	0.25 % V/V	
CHECK			0.0
DRIVE	75DF	0.75	40.0
THOROUGHBRED	L	0.25 % V/V	
DRIVE	75DF	0.75	21.7
SURF KING	L	0.25 % V/V	
DRIVE	75DF	0.75	55.0
LESCO SPREADER STICKER	L	0.25 % V/V	
DRIVE	75DF	0.75	38.3
MACROSORB FOLIAR	L	2 OZ/M	
DRIVE	75DF	0.75	28.3
MACROSORB RADICULAR	L	2 OZ/M	

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Post Emergence Control of Crabgrass at the Two to Three Leaf Growth Stage

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

Introduction

This study was conducted on a mature stand of perennial ryegrass at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to evaluate the efficacy of pre/post emergence herbicides for the postemergence control of smooth crabgrass.

Methods and Materials

This study was a randomized complete block design with three replications. Treatments were applied on June 13, 2001 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 site was maintained at 0.5 inches to simulate a golf course fairway.

Results and Discussion

Evaluations of the study revealed that only Dimension (dithiopyr) 1EC at 0.5 lbs ai/A, XF00090 FG 0.164G at 0.5 lbs ai/A, XF 00091 FG 25G at 0.38 lbs ai/A, Dimension 40WP at 0.5 lbs ai/A and XF00090 FG 0.164G at 0.38 lbs a i/A controlled crabgrass within a range of 77% to 83%. This is slightly below the level of commercial acceptability (85% control). None of the other treatments in the study exceeded 67% control.

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Table 1. Percent postemergence control of smooth crabgrass rated on Aug 15, 2001 where 85% and above was considered commercially acceptable.

Treatment	Form	Rate (lb ai/A)	% Control
DIMENSION	1EC	0.5	76.7
DIMENSION	40WP	0.25	53.3
DIMENSION	40WP	0.38	66.7
DIMENSION	40WP	0.5	81.7
CHECK			0.0
XF00090 FG	0.164G	0.25	73.3
XF00090 FG	0.164G	0.38	83.3
XF00091 FG	0.25G	0.25	55.0
XF00091 FG	0.25G	0.38	80.0
XF00272	2.5SC	0.25	35.0
XF00272	2.5SC	0.38	50.0
XF01005	2SC	0.25	35.0
XF01005	2SC	0.38	66.7
ACCLAIM EXTRA PENDIMETHLIN	0.57EW 60WDG	0.12 1.5	56.7
DIMENSION	1EC	0.25	40.0
DIMENSION MACROSORB FOLIAR	40WP L	0.25 2 oz/M	51.7
DIMENSION ADDITIVE	40WP	0.25	51.7

Post Emergence Control of Broadleaf Weeds

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

Introduction

This study was conducted on a mixed stand of perennial ryegrass, Kentucky bluegrass and fine fescue (rough) at the Penn State Blue Golf Course, State College, PA. The objective of the study was to determine the efficacy of broadleaf weed herbicides for the control of white clover.

Methods and Materials

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

Results and Discussion

Control of white clover was rated three times throughout the study (5/7, 5/29 and 6/15). Three treatments, EH1382 at 4 pt/A and EH1381 at 4 pt/A and EH1383 at 4 pt/A provided control above 80 percent on the 5/7 rating date. By the 5/29 rating date all treated turf provided control above 98% and this level of control was also found on 6/15. Phytotoxicity was also rated on the same dates. There was no phytotoxicity during the study.

Table 1. Rating of percent control of white clover. Initial rating taken on April 25, 2001.

Treatment	Form	Rate (PT/A)	(----% Control Clover--------) 5/7	5/29	6/15
EH1382	L	4.5	81.1a	100.0a	100.0a
EH1382	L	5.5	72.1ab	100.0a	100.0a
EH1381	L	4	85.6a	100.0a	100.0a
EH1381	L	5	71.7ab	99.2a	100.0a
CHECK			7.6e	7.6b	7.7b
EH1383	L	4	83.5a	98.3a	98.3a
NB22153	L	5	47.8cd	100.0a	100.0a
TRIMEC CLASSIC	L	4	65.5abc	100.0a	100.0a
MILLENIUM ULTRA	L	2.5	55.7bcd	100.0a	100.0a
BANVEL	4 L	0.5 LB A/A	44.4cd	100.0a	100.0a
BANVEL	4 L	0.25 LB A/A	36.7d	100.0a	100.0a
BANVEL MACROSORB RADICULAR	4 L L	0.25 LB A/A 2 OZ/M	34.4d	98.7a	100.0a

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

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Table 2. Rating of phytotoxicity where 0 = worst, 7= acceptable and 10 = no phytotoxicity.

Treatment	**Form**	**Rate (PT/A)**	**(----Phytotoxicity----) 5/7**	**5/29**	**6/15**
EH1382	L	4.5	10	10	10
EH1382	L	5.5	10	10	10
EH1381	L	4	10	10	10
EH1381	L	5	10	10	10
CHECK			10	10	10
EH1383	L	4	10	10	10
NB22153	L	5	10	10	10
TRIMEC CLASSIC	L	4	10	10	10
MILLENIUM ULTRA	L	2.5	10	10	10
BANVEL	4 L	0.5 LB A/A	10	10	10
BANVEL	4 L	0.25 LB A/A	10	10	10
BANVEL MACROSORB RADICULAR	4 L L	0.25 LB A/A 2 OZ/M	10	10	10

Poa Annua Control in Fairway Height Turfgrass

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 Prograss could eliminate *Poa annua* under fairway conditions.

Methods and Materials

This study was a randomized complete block design with three replications. All of the Trimmit treatments were applied on June 10, 2000 using a three foot CO_2 powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 6504 nozzles at 40 psi. Trimmit was also applied on Oct 3, 2000 and Prograss was applied Oct 26 and Nov 17, 2000. The test area was maintained at 0.5" using a triplex reel mower returning the clippings to the site.

Results and Discussion

The amount (percentage) of annual bluegrass in each plot was rated on June 10, 2000 and again on May 9, 2001. Turf treated with Trimmit 2SC at 0.5 lb ai/A in June and October 2000 significantly decreased annual bluegrass by 40 %. Prograss applied in October and November decreased the amount of annual bluegrass by a similar amount (Table 1). A single application of Trimmit (applied in June) was not found to significantly decrease the amount of annual bluegrass.

Table 1. Percent change of *Poa annua*. Ratings were taken on June 10, 2000 and May 9, 2001.

Treatment	**Form**	**Rate (LB Ai/A)**	**Timing**	**% Change**
Trimmit	2 SC	0.5	June/Oct	39.9a[1]
Trimmit	2 SC	0.5	June	-38.0b[2]
CHECK				-12.0b
PROGRASS	1.5 EC	0.75	Oct/Nov	39.8a

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.

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