Effects of trinexapac ethyl and fungicides on growth of creeping bentgrass

Justin Stewart, Richard Latin, Botany and Plant Pathology Department and Zac Reicher, Agronomy Department

Objective

The objective of this research was to document the effects of trinexapac ethyl applied with two fungicdes on the growth of creeping bentgrass maintained for putting greens and fairways. This investigation was conducted to support subsequent research on the effects of fungicides and plant growth regulators on disease development. This report describes results conducted on creeping bentgrass greens and fairways treated with different combinations of trinexapac ethyl and fungicides.

Rationale

Golf course superintendents apply fungicides and plant growth regulators (PGRs) as part of seasonal turf health management programs. Fungicides such as chlorothalonil and propiconazole are applied to control of a variety of diseases that occur throughout the growing season. Trinexapac ethyl is one of the most widely used PGRs for reducing time and expense associated with clippings on golf courses. Because these chemical tools are used regularly, it is important for golf course superintendents to understand the effects that they have on creeping bentgrass growth on putting greens and fairways.

Methods

The research was conducted at the Daniel Turfgrass Research Center on the campus of Purdue University in West Lafayette, IN during the 2005 growing season. Experimental sites were established on stands of creeping bentgrass, cultivar 'Penncross', and maintained at both putting green (0.125 in) and fairway height (0.500 in). On putting green plots, treatments were initiated prior to the outbreak of dollar spot symptoms. On fairway plots, treatments were initiated pre-outbreak in one set of trials, and post-outbreak in another set. All pre-outbreak experiments had four replications; the post-outbreak experiments had eight replications. All experimental trials included the same six treatments (Table 1) applied to 1m x 2m plots that were randomly distributed across each replication.

Treatments were applied using a custom CO_2 pressurized boom sprayer with three flat fan nozzles (Tee-Jet 8004 EVS). For each experimental trial, trinexapac-ethyl (Primo Maxx®) was applied twice at a rate of 0.125 oz/1000ft^2 with 14 days between applications. Fungicides were applied only once, 7 days after the initial PGR application. Propiconazole (Banner Maxx®) and chlorothalonil (Daconil Ultrex®) were applied at 1.0 oz/1000ft^2 at 3.2 oz/1000ft^2, respectively.

Grass clippings were collected three times; before the start of each experimental trial (clipping harvest 1), five days after the first trinexapac-ethyl application (clipping harvest 2) and 5 days after the second trinexapac ethyl application (clipping harvest 3). Plots were not mowed for at least two days prior to collection of clippings. Clipping samples were harvested from a single 200 cm x 55.8 cm section within the center of each plot using a Jacobsen E-series electric walking greens mower (Jacobsen Division, Textron Inc., Charlotte, NC). Clipping weights were subjected to analysis of variance using the General Linear Model procedure in SAS (Proc GLM, SAS version 9.1, Cary, NC). Orthogonal contrasts were used to examine differences between clipping weights for the preplanned treatment comparisons described in Table 1.

Results

Applications of trinexapac ethyl effectively reduced clipping weights for almost all of the harvest dates. As expected, no differences in clipping weights were observed in any of the experiments prior to trinexapac ethyl or fungicide applications.

There were minor exceptions in each of the experiments. In the putting green experiments, applications of trinexapac ethyl resulted in significantly lower clipping weights in all but two of the pre-planned comparisons (Table 2). During the second clipping harvest in Trial 1, clipping weights from the trinexapac ethyl + propiconazole treatment and the propiconazole alone treatment did not differ. Similar results occurred for clipping harvest 2 of Trial 2, in which case applications of trinexapac ethyl applied alone had no effect on clipping weight relative to the untreated control. It is difficult to identify the causes of the discrepancies. In the case of the putting green experiments, we noted higher disease levels on the date of clipping harvest 2 in plots not treated with trinexapac ethyl. It is likely that plots with more disease also resulted in reduced clipping weights, although over the entire experiment, trinexapac ethyl did not influence disease severity.

During pre-outbreak fairway experiments, differences were observed in all three comparisons within Trial 1 and two comparisons in Trial 2 (Table 3). Clipping weights did not differ between Treatments 5 (chlorothalonil) and Treatment 6 (chlorothalonil + trinexapac ethyl) in Trial 2. There were no observed differences in disease severity between Treatments 5 and 6, suggesting that natural plot variation and experimental error contributed to the similarity in clipping weights for that comparison.

Results from Trial 1 of the post-outbreak experiments revealed significant differences in clipping weights for all three comparisons of clipping harvest 3, while no differences were observed in clipping harvest 2 (Table 4). All clipping weight comparisons for harvests 2 and 3 during Trial 2 resulted in significant differences. Where significant differences were observed, trinexapac ethyl effectively reduced clipping weights compared to plots without. According to the experimental design of the post-outbreak experiments, disease in experimental plots was allowed to develop to unacceptable levels prior to the first application of trinexapac ethyl. Since trinexapac ethyl is primarily foliar-absorbed, higher amounts of disease may have reduced the percentage of healthy tissue where PGR uptake would have occurred. Trial 1 was also observed to have more disease at the start of the experiment than Trial 2. This could explain why all three comparisons in Trial 1 of the post-outbreak experiment did not reveal significant differences at the second clipping harvest.

Summary Interpretation

For comparisons between plots treated with fungicides alone vs. fungicides + trinexapac ethyl, the plots treated with trinexapac ethyl reduced clipping weights for almost all of the harvest dates. Although it is difficult to identify the exact cause(s) of the discrepancies, we suspect that the exceptions may be due to a variety of factors including natural plot variation, fluctuations in environmental conditions, and differences disease severity among plots. As expected, no differences in clipping weights were observed in any of the experiments prior to applying the treatments.

This investigation confirms the growth regulator effects of trinexapac ethyl and will be useful in interpreting research on the influence of trinexapac ethyl on the performance of fungicides for dollar spot control on creeping bentgrass putting greens and fairways.

Table 1. Treatment descriptions and preplanned contrasts for all experiments

Treatment number	Treatment description and application rate
1	no treatment
2	trinexapac ethyl (Primo Maxx) @ 0.125 oz/1000ft^2
3	propiconazole (Banner Maxx) @ 1.0 oz/1000ft^2
4	propiconazole (Banner Maxx) @ 1.0 oz/1000ft^2 plus trinexapac ethyl (Primo Maxx) @ 0.125 oz/1000ft^2
5	chlorothalonil (Daconil Ultrex 82.5WG) @ 3.2 oz/1000ft^2
6	chlorothalonil (Daconil Ultrex 82.5WG) @ 3.2 oz/1000ft^2 plus trinexapac ethyl (Primo Maxx) @ 0.125 oz/1000ft^2

Preplanned Comparisons
Treatment 1 vs Treatment 2
Treatment 3 vs Treatment 4
Treatment 5 vs Treatment 6

Table 2. Influence of trinexapac ethyl and two fungicides applied prior to dollar spot symptom expression on clipping weights from creeping bentgrass putting green field plots

	Trial 1			Trial 2		
	Clipping harvest [x]			Clipping harvest [x]		
Treatment [z]	1	2	3	1	2	3
1. no treatment	29.8	9.2	29.2	24.2	13.8	13.4
2. trinexapac ethyl	29.6	7.9	19.4	25.6	12.7	10.8
3. propiconazole	31.7	8.8	28.9	25.9	14.4	14.6
4. propiconazole + trinexapac ethyl	31.6	8.2	19.3	25.9	11.9	12.7
5. chlorothalonil	29.3	9.8	25.9	24.3	15.4	13.5
6. chlorothalonil + trinexapac ethyl	30.0	7.4	18.1	25.9	11.9	12.0
Contrasts[z]						
1. Treatments 1 vs 2	NS	**	**	NS	NS	**
2. Treatments 3 vs 4	NS	NS	**	NS	**	**
3. Treatments 5 vs 6	NS	**	**	NS	**	*

[x] Clipping harvest is defined as 1 = clippings collected prior to first trinexapac ethyl application, 2 = clippings collected five days after the first trinexapac ethyl application, and 3 = clipping collected after the second trinexapac ethyl application.

[y] Dry weights (grams) represent the means of four replications.

[z] Preplanned comparisons were tested with orthogonal contrasts where NS = differences were not significant, * = differences were significant at P=0.05, and ** = differences were significant at P=0.01.

Table 3. Influence of trinexapac ethyl and two fungicides applied prior to dollar spot symptom expression on clipping weights from creeping bentgrass fairway field plots

	Trial 1 Clipping harvest [x]			Trial 2 Clipping harvest [x]		
Treatment [z]	1	2	3	1	2	3
1. no treatment	2.6	1.5	13.8	17.9	2.9	3.7
2. trinexapac ethyl	2.1	0.6	5.3	14.6	1.4	2.1
3. propiconazole	2.2	1.1	15.4	14.8	3.0	4.0
4. propiconazole + trinexapac ethyl	1.8	0.4	4.9	12.5	1.4	2.5
5. chlorothalonil	2.4	1.4	14.8	15.7	2.5	3.7
6. chlorothalonil + trinexapac ethyl	2.2	0.5	4.5	12.8	2.0	2.6
Contrasts[z]						
1. Treatments 1 vs 2	NS	*	**	NS	*	**
2. Treatments 3 vs 4	NS	*	**	NS	*	*
3. Treatments 5 vs 6	NS	*	**	NS	NS	NS

[x] Clipping harvest is defined as 1 = clippings collected prior to first trinexapac ethyl application, 2 = clippings collected five days after the first trinexapac ethyl application, and 3 = clipping collected after the second trinexapac ethyl application.

[y] Dry weights (grams) represent the means of four replications.

[z] Preplanned comparisons were tested with orthogonal contrasts where NS = differences were not significant, * = differences were significant at P=0.05, and ** = differences were significant at P=0.01.

Table 4. Influence of trinexapac ethyl and two fungicides applied after an outbreak of dollar spot on clipping weights from creeping bentgrass fairway field plots

	Trial 1 Clipping harvest [x]			Trial 2 Clipping harvest [x]		
Treatment [z]	1	2	3	1	2	3
1. no treatment	2.09	1.91	0.79	1.55	0.91	1.40
2. trinexapac ethyl	2.19	1.82	0.27	1.82	0.44	0.69
3. propiconazole	1.86	1.61	3.80	1.24	0.88	1.22
4. propiconazole + trinexapac ethyl	1.70	1.30	1.73	1.23	0.23	0.29
5. chlorothalonil	1.66	1.71	2.70	1.36	0.94	1.53
6. chlorothalonil + trinexapac ethyl	1.67	1.63	1.23	1.61	0.29	0.32
Contrasts[z]						
1. Treatments 1 vs 2	NS	NS	*	NS	**	**
2. Treatments 3 vs 4	NS	NS	**	NS	**	**
3. Treatments 5 vs 6	NS	NS	**	NS	**	**

[x] Clipping harvest is defined as 1 = clippings collected prior to first trinexapac ethyl application, 2 = clippings collected five days after the first trinexapac ethyl application, and 3 = clipping collected after the second trinexapac ethyl application.

[y] Dry weights (grams) represent the means of four replications.

[z] Preplanned comparisons were tested with orthogonal contrasts where NS = differences were not significant, * = differences were significant at P=0.05, and ** = differences were significant at P=0.01.