

Turfgrass and Environmental Research Online

... Using Science to Benefit Golf



Scientists at Pennsylvania State University initiated research to determine if different products containing chlorothalonil, propiconazole, or iprodione provide different levels of control of dollar spot and brown patch diseases of bentgrass maintained as a golf course fairway.

> Volume 9, Number 22 November 15, 2010

PURPOSE

The purpose of USGA Turfgrass and Environmental Research Online is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 450 projects at a cost of \$31 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of **using science to benefit golf**.

Editor

Jeff Nus, Ph.D. 1032 Rogers Place Lawrence, KS 66049 jnus@usga.org (785) 832-2300 (785) 832-9265 (fax)

Research Director

Michael P. Kenna, Ph.D. P.O. Box 2227 Stillwater, OK 74076 mkenna@usga.org (405) 743-3900 (405) 743-3910 (fax)

USGA Turfgrass and Environmental Research Committee

Steve Smyers, Co-chairman Gene McClure, Co-chairman Julie Dionne, Ph.D. Ron Dodson Kimberly Erusha, Ph.D. Pete Grass, CGCS Ali Harivandi, Ph.D. Michael P. Kenna, Ph.D. Jeff Krans, Ph.D. James Moore Jeff Nus, Ph.D. Paul Rieke, Ph.D. James T. Snow Clark Throssell, Ph.D. Ned Tisserat, Ph.D. Scott Warnke, Ph.D. James Watson, Ph.D. Chris Williamson, Ph.D.

Permission to reproduce articles or material in the USGA Turfgrass and Environmental Research Online (ISSN 1541-0277) is granted to newspapers, periodicals, and educational institutions (unless specifically noted otherwise). Credit must be given to the author(s), the article title, and USGA Turfgrass and Environmental Research Online including issue and number. Copyright protection must be afforded. To reprint material in other media, written permission must be obtained from the USGA. In any case, neither articles nor other material may be copied or used for any advertising, promotion, or commercial purposes.

Comparison of Chlorothalonil, Propiconazole, and Iprodione Products for Control of Dollar Spot and Brown Patch Diseases

Peter Landschoot, Michael Fidanza, and Tanner Delvalle

SUMMARY

Scientists at Pennsylvania State University initiated research to determine if different products containing chlorothalonil, propiconazole, or iprodione provide different levels of control of dollar spot and brown patch diseases of bentgrass maintained as a golf course fairway. Their results include:

• With respect to dollar spot control, iprodione products generally showed better control than chlorothalonil and propiconazole products at the University Park location. However, at the Bellewood Golf Club site the three different active ingredients provided similar dollar spot control.

• Generally, chlorothalonil and iprodione products provided better brown patch control than propiconazole products.

• Chlorothalonil products included in this study (Daconil Ultrex, Echo Ultimate, and Chlorothalonil DF) typically performed similarly in both dollar spot trials and the brown patch trial.

• No differences among propiconazole-containing products (Banner MAXX, Propiconazole 14.3, ProPensity 1.3ME, and Spectator Ultra 1.3) were observed with respect to dollar spot control in either dollar spot trial. ProPensity 1.3 ME showed better brown patch efficacy compared with Spectator Ultra 1.3 on one of four rating dates in 2008, but was the only propoconazole treatment showing brown patch suppression in 2009. This was also reflected in AUDPC data (area under disease progression curve).

• Of the three iprodione products (Chipco 26 GT, Ipro 2SE, and Raven), Chipco 26 GT and Ipro 2SE provided the most consistent dollar spot control. Raven showed less dollar spot control when compared with Chipco 26 GT and Ipro 2SE on several rating dates and in AUDPC values in both years. However, at the University Park site, Raven provided equal or better dollar spot control when compared with propiconazole and chlorothalonil products on several rating dates.

Fungicides are a major expenditure for golf courses in the northeastern United States. A survey of golf courses in Pennsylvania revealed that 6.2% of the total golf course maintenance budget is devoted to fungicides, exceeding costs for all weed and insect control measures combined (1).

Chlorothalonil, propiconazole, and iprodione are among the most popular and effective fungicides for controlling foliar diseases of turfgrasses. Patent protection for the original chlorothalonil, propiconazole, and iprodione products has expired, and several 'post-patent' products are now available to golf course superintendents for use in disease control programs. Prices can vary among the different products containing these active ingredients, but questions remain about the handling, mixing, and efficacy of individual products.

The objective of this research is to determine if different fungicide products containing chlorothalonil, propiconazole, or iprodione provide differences in control of dollar spot and brown patch diseases of bentgrass maintained as a golf course fairway.

Materials and Methods

Three fungicide trials were conducted on bentgrass maintained as a golf course fairway at two different locations in Pennsylvania, the Joseph Valentine Turfgrass Research Center in University Park and Bellewood Golf Club in North Coventry. Treatments for all trials included three or four different products applied at the same

USGA Turfgrass and Environmental Research Online 9(21):1-9. TGIF Record Number: 172052

PETER LANDSCHOOT, Ph.D., Professor of Turfgrass Science, Department of Crop and Soil Sciences, Pennsylvania State University, University Park, PA; MICHAEL FIDANZA, Ph.D., Associate Professor of Horticulture, Department of Horticulture, Pennsylvania State University, Berks Campus, Reading, PA; and TANNER DELVALLE, M.S. Candidate in Agronomy, Department of Crop and Soil Sciences, Pennsylvania State University, University Park, PA.



Prices can vary among the different products containing chlorothalonil, propiconazole, and improdione, but questions remain about the handling, mixing, and efficacy of individual products.

rate and timing for each active ingredient (chlorothalonil, propiconazole, and iprodione).

Chlorothalonil products:

• Daconil Ultrex (82.5% chlorothalonil, WDG) (Syngenta Crop Protection, Inc. Greensboro, NC)

• Echo Ultimate (82.5% chlorothalonil, WDG) (Sipcam Agro USA, Inc. Roswell, GA)

• Quali-Pro Chlorothalonil DF (82.5% chlorothalonil, DF) (FarmSaver.com, LLC, Seattle, WA)

• Pegasus DF (82.5% chlorothalonil, WDG) (Phoenix Environmental Care, Valdosta, GA) (Pegasus tested in 2009 only)

Propiconazole products:

Banner MAXX (14.3% propiconazole, MEC) (Syngenta Crop Protection, Inc. Greensboro, NC)
Propiconazole 14.3 (14.3% propiconazole, MEC) (FarmSaver.com, LLC, Seattle, WA) ProPensity 1.3 ME (14.3% propiconazole, MEC) (Sipcam Agro USA, Inc. Roswell, GA)
Spectator Ultra 1.3 Fungicide (14.3% propiconazole, MEC) (Lesco, Inc. Cleveland, OH)

Iprodione products:

• Chipco 26 GT (23.3% iprodione, flowable) (Bayer Environmental Science, Montvale, NJ)

• Quali-Pro Ipro 2SE (23.8% iprodione, SE) (FarmSaver.com, LLC, Seattle, WA)

• Raven (23.3% iprodione, flowable) (Phoenix Environmental Care, Valdosta, GA)

Trials 1 and 2, University Park

Trials 1 and 2 were conducted at the Joseph Valentine Turfgrass Research Center, University Park, PA during 2008 and 2009 on turf maintained as a golf course fairway. The soil at both trial sites is a Hagerstown silt loam. Trial 1 was conducted on a 6-year-old mixed stand of 'Penneagle' creeping bentgrass and annual bluegrass. Trial 2 was conducted on a 3-year-old stand of 'Bardot' colonial bentgrass. Colonial bentgrass was selected for trial 2 due to its high degree of susceptibility to brown patch. The turf at both trial sites was mowed three times per week at a bench setting of 0.5 inches with a Toro 5210 fairway mower. Clippings were collected in baskets. Both trial areas were fertilized with 1.75 lbs N/1000 ft² split into spring and early summer applications in 2008 and 2009. No fungicides were applied to the trial areas in either 2008 or 2009 before or during the test, other than those used as treatments.

Fungicides used in trials 1 and 2 are listed in the first paragraph of the Material and Methods section. All chlorothalonil products were applied at 3.0 oz/1000 ft², propiconazole treatments were applied at 1.5 fl oz/1000 ft², and iprodione treatments were applied at 3.0 fl oz/1000 ft².

In 2008, the first treatment application in both trials was on June 17 and the final application was on August 4. Fungicide treatments for trial 1 were applied after dollar spot symptoms became evident; whereas, treatments in trial 2 were applied prior to symptom expression. In 2008, application intervals for the chlorothalonil products were initially 14 days apart; however, intense disease pressure at the University Park site necessitated changing from 14-day intervals (June 17, July 1, July 15) to 10-day intervals (July 15, July 25, August 4). Timing of propiconazole and iprodione applications in 2008 changed from 21day intervals (June 17, July 8) to 14-day intervals (July 8, July 21, August 4). A total of five applications were made for chlorothalonil treatments, and four applications were made for propiconazole and iprodione treatments.

In 2009, the first application for both trials was on May 31 and the final application was on August 6. Fungicide treatments in trial 1 and trial 2 were applied prior to symptom expression. In 2009, application intervals for the chlorothalonil treatments were 14 days apart, whereas propiconazole and iprodione treatments were 21 days apart. However, due to very low disease pressure at the University Park site in early summer, the second fungicide application for the creeping bentgrass and colonial bentgrass trials was delayed until July 16. A total of four applications were made for chlorothalonil treatments, and three applications were made for propiconazole and iprodione treatments.

The experimental design for both trials in both years was a randomized complete block design with four replications. Plot size was 3 ft by



Patent protection for the original chlorothalonil, propiconazole, and iprodione products has expired, and several 'post-patent' products are now available to golf course superintendents for use in disease control programs.

10 ft. Treatments were applied with a CO_2 -powered backpack sprayer equipped with a single boom fitted with an 11008E nozzle. Applications were made at 40 psi with a dilution rate equal to 1 gallon water/1000 ft².

Dollar spot (trials 1 and 2) and brown patch ratings (trial 2) were made when disease became severe enough to provide an adequate visual evaluation and was uniformly distributed over the entire test area. Dollar spot was assessed visually as disease severity, using a scale of 0 to 10, with 10 indicating severe disease symptoms and 0 indicating no visible symptoms. Brown patch severity was visually assessed on a percentarea-affected basis. At the conclusion of trials 1 and 2 in each year, all disease data were converted to "area under the disease progress curve" (AUDPC) values. Area under the disease progress curve is a calculated value used to assess disease epidemics for an entire test period. Disease severity data 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.

Trial 3, Bellewood Golf Club, North Coventry

Trial 3 was conducted at Bellewood Golf Club, North Coventry, PA during 2008 and 2009 on turf maintained as a golf course fairway. The soil at this site is a silt loam, and the turf is 'PennTrio' creeping bentgrass. The turf was mowed three times per week at a cutting height of 0.425 inch (bench setting). Clippings were not collected in baskets at this site. The trial area was fertilized with N in spring prior to treatment application. No fungicides were applied to the site before or during the test, other than those used as treatments.

Fungicide products and rates used in trial 3 are the same as in trials 1 and 2. In 2008, the first treatment application was on June 23 prior to symptom development, and the last application was made on July 21. Chlorothalonil products were applied every 14 days (June 23, July 7, July 21), and propiconazole and iprodione applications were on 21 day intervals (June 23 and July 14). A total of three applications were made for chlorothalonil treatments, and two applications were made for propiconazole and iprodione treatments.

In 2009, the first treatment application was on May 25 prior to symptom development. The last application was made on August 17. Chlorothalonil, propiconazole and iprodione applications were on 21 day-intervals (May 25, June 17, July 6, July 27, and August 17) for a total of five applications.

The experimental design was a randomized complete block design with three replications. Plot size was 2.5 ft by 4 ft. Treatments were applied with a CO_2 -powered backpack sprayer equipped with a boom fitted with a XR8004E nozzle. Applications were made at 40 psi with a dilution rate equivalent to 1 gallon water/1000 ft².

Dollar spot was measured visually as the number of active infection centers per plot (i.e. disease incidence). At the conclusion of the experiment in each year, dollar spot incidence data were converted to AUDPC values. All disease incidence data 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

2008 Results

Results show differences in disease control among the three active ingredients in two of the three trials and a few differences among products containing the same active ingredient in all three trials (Figures 1-4).

2008, Trials 1 and 2, University Park

Trial 1 was conducted in University Park on creeping bentgrass with a history of severe dollar spot infestations. All fungicide treatments were applied on June 17 after dollar spot symptoms were evident. Differences in dollar spot



Figure 1. Bars represent area under the disease progress curve values calculated from dollar spot severity data between June 16 and September 15, 2008. Fungicide product trial was conducted in University Park, PA on creeping bentgrass maintained as a golf course fairway.

severity were observed among chorothalonil, propiconazole, and iprodione treatments, with iprodione generally showing better control than chlorothalonil and propiconazole over the test period (Figure 1). No differences in control were observed among the three chlorothalonil products (Daconil Ultrex, Echo Ultimate, and Chlorothalonil DF) or the four propiconazole products (Banner MAXX, Propiconazole 14.3, ProPensity 1.3ME, and Spectator Ultra 1.3) at any time during the test. Two of the three iprodione products (Chipco 26 GT and Ipro 2SE) performed similarly with respect to dollar spot control in trial 1. However, Raven showed reduced dollar spot control compared to Chipco 26 GT and Ipro 2SE on three of the nine rating dates. This was also reflected in the AUDPC data.

In Trial 2, (colonial bentgrass),

all fungicide treatments were applied prior to dollar spot and brown patch symptom development. Dollar spot and brown patch infestations were only moderately severe at this location (Figure 2). Differences in dollar spot severity were first observed among treatments on June 30 and subsequentthroughout the test period. ly Differences were observed among chorothalonil, propiconazole, and iprodione treatments on six of the eight rating dates, with iprodione products generally showing better control than chlorothalonil and propiconazole products over the test period. No differences in dollar spot control were observed among the four propiconazole products (Banner MAXX, Propiconazole 14.3, ProPensitv 1.3ME, and Spectator Ultra 1.3) or the three iprodione products (Chipco 26 GT, Ipro 2SE, and Raven) at any time



Figure 2. Bars represent area under the disease progress curve values calculated from dollar spot severity data between June 16 and September 15, 2008. Fungicide product trial was conducted in University Park, PA on colonial bentgrass maintained as a golf course fairway.

during the test. Two of the three chlorothalonil products (Daconil Ultrex and Echo Ultimate) performed similarly with respect to dollar spot control in trial 2. However, Chlorothalonil DF showed reduced dollar spot control compared to Echo Ultimate, but not Daconil Ultrex on two of the eight rating dates. Area under the disease progress curve values indicated the best dollar spot control was achieved with the iprodione products, followed by propiconazole and chlorothalonil products (Figure 2).

By June 30, differences in brown patch severity were observed among chorothalonil, propiconazole, and iprodione fungicides with chlorothalonil and iprodione generally showing better control than propiconazole (Figure 3). No differences in brown patch control were



Figure 3. Bars represent area under the disease progress curve values calculated from brown patch severity data between June 16 and July 21, 2008. Fungicide product trial was conducted in University Park, PA on colonial bentgrass maintained as a golf course course fairway.



Figure 4. Bars represent area under the disease progress curve values calculated from dollar spot incidence data between July 7 and August 28, 2008. Fungicide product trial was conducted at Bellewood Golf Club in North Coventry, PA on creeping bentgrass maintained as a golf course fairway.

observed among the three chlorothalonil products (Daconil Ultrex. Echo Ultimate, and Chlorothalonil DF) or the three iprodione products (Chipco 26 GT, Ipro 2SE, and Raven) on any rating date or among AUDPC values (Figure 3). However, on one of the four rating dates, the Spectator Ultra 1.3 treatment showed reduced control compared to the ProPensity 1.3ME treatment. The AUDPC value for Spectator Ultra 1.3 was higher than for the ProPensity 1.3ME treatment. Area under the disease progress curve values indicate the best brown patch control was achieved with the chlorothalonil and iprodione treatments, followed by propiconazole treatments in 2008.

2008, Experiment 3, Bellewood Golf Club, North Coventry



Figure 5. Bars represent area under the disease progress curve values calculated from dollar spot severity data between August 12 and September 14, 2009. Fungicide product trial was conducted in University Park, PA on creeping bentgrass maintained as a golf course fairway.

At the Bellewood Golf Club site, all fungicide treatments provided good to excellent control of dollar spot. No differences in dollar spot incidence (number of infection centers per plot) were observed between chorothalonil and propiconazole fungicides, or among the three chlorothalonil products (Daconil Ultrex, Echo Ultimate, and Chlorothalonil DF) or the four propiconazole products (Banner MAXX, Propiconazole 14.3, ProPensity 1.3ME, and Spectator Ultra 1.3). Two of the three iprodione products (Chipco 26 GT and Ipro 2SE) performed similarly to the chlorothalonil and propiconazole products with respect to dollar spot control (no differences occurring on any rating date). Only one iprodione product, Raven, showed reduced efficacy compared to Chipco 26 GT and Ipro 2SE on two of the seven rating dates. In this test, the only fungicide with a higher AUDPC value than all other fungicide treatments was the Raven treatment.

2009 Results

Results show differences in disease con-

trol among the three active ingredients in two of the three trials and a few differences among products containing the same active ingredient in all three trials (Figures 5-8).

2009, Trials 1 and 2, University Park

Trial 1 was conducted in University Park on creeping bentgrass with a history of severe dollar spot infestations. All fungicide treatments were applied on May 31 prior to dollar spot symptom development. Due to very low disease pressure at this site in early summer, the second fungicide application was delayed until July 16. The first of five dollar spot severity ratings was taken on August 12 and the final rating was on September 14. Dollar spot severity was moderate in August and early September, and differences in severity were observed among chorothalonil, propiconazole, and iprodione treatments on some rating dates (Figure 5). When differences did occur, iprodione and chlorothalonil generally showed better control than propiconazole.

No differences in disease incidence were



Figure 6. Bars represent area under the disease progress curve values calculated from dollar spot severity data between August 12 and September 14, 2009. Fungicide product trial was conducted in University Park, PA on colonial bentgrass maintained as a golf course fairway.



Figure 7. Bars represent area under the disease progress curve values calculated from brown patch severity data between August 3 and August 29, 2009. Fungicide product trial was conducted in University Park, PA on colonial bentgrass maintained as a golf course fairway.

observed among three of the four chlorothalonil products (Daconil Ultrex, Echo Ultimate, and Pegasus DF), however, the Chlorothalonil DF treatment showed higher disease severity ratings than one or more chlorothalonil treatments on four of the five rating dates, and in the AUDPC data (Figure 5). No differences in disease severity were found among the four propiconazole products at any time during the test (Banner MAXX, Propiconazole 14.3, ProPensity 1.3ME, and Spectator Ultra 1.3). Two of the three iprodione treatments (Chipco 26 GT and Ipro 2SE) did not differ in disease severity at any time during the test, but the Raven treatment revealed higher disease severity ratings than one or more of the other iprodione treatments on three of five rating dates and in the AUDPC data.

In Trial 2, (colonial bentgrass), all fungicide treatments were applied prior to dollar spot and brown patch symptom development. Due to very low disease pressure at this site in early summer, the second fungicide application was delayed until July 16. Beginning in August, dollar spot and brown patch infestations became moderately severe at this location. Differences in dollar spot severity were observed among chorothalonil, propiconazole, and iprodione treatments on most rating dates, with iprodione products generally showing better control than chlorothalonil and propiconazole products over the test period (Figure 6). Differences in dollar spot severity occurred among chlorothalonil treatments on only one rating date, with Pegasus DF providing higher disease severity than Daconil Ultrex and Chlorothalonil DF. No differences in dollar spot control were observed among the four propiconazole products (Banner MAXX, Propiconazole 14.3, ProPensity 1.3ME, and Spectator Ultra 1.3) at any time during the test period. The Raven treatment showed higher disease severity than Ipro 2SE on one of four rating dates, but no differences occurred among the iprodione treatments in the AUDPC data

On August 3, differences in brown patch severity were observed among chorothalonil, propiconazole, and iprodione fungicides, with chlorothalonil and iprodione generally showing better control than propiconazole (Figure 7).



Figure 8. Bars represent area under the disease progress curve values calculated from dollar spot incidence data between July 6 and September 22, 2009. Fungicide product trial was conducted at Bellewood Golf Club in North Coventry, PA on creeping bentgrass maintained as a golf course fairway.

No differences in brown patch severity were observed among the four chlorothalonil products (Daconil Ultrex, Echo Ultimate, Pegasus DF, and Chlorothalonil DF) or the three iprodione products (Chipco 26 GT, Ipro 2SE, and Raven) on any rating date or for AUDPC values (Figure 7).

Area under the disease progress curve values indicate the best brown patch control was achieved with the chlorothalonil and iprodione treatments. With the exception of Spectator Ultra 1.3 (which was only moderately effective at suppressing symptoms compared with untreated control) propiconazole treatments were not effective in controlling brown patch in 2009.

2009, Experiment 3, Bellewood Golf Club, North Coventry

At the Bellewood Golf Club site, chlorothalonil, propiconazole, and iprodione fungicide treatments provided similar control of dollar spot (Figure 8). Differences in dollar spot incidence (number of infection centers per plot) were observed among chorothalonil products on only one of eight rating dates, and no difference were found among AUDPC values for chlorothalonil products. No differences were found among propiconazole products at any time during the test. Differences in dollar spot incidence were observed among iprodione products only once out of eight rating dates, and no difference were found among AUDPC values.

Acknowledgements

The authors of this report would like to acknowledge the Greater Pittsburgh Golf Course Superintendents Association and the USGA's Turfgrass and Environmental Research Program for provided funding for this study. The study was also partially underwritten by the Pennsylvania Turfgrass Council and Penn State University. We thank Derrick Hudson, golf course superintendent, and the members of Bellewood Golf Club for use of their golf course. The following companies graciously provided fungicide products for this study: Advan LLC (a subsidiary of Sipcam Agro USA), Bayer Environmental Science, Genesis Turfgrass Inc., John Deere Golf and Turf; Quali-Pro Professional Turf & Ornamental Products, and Walker Supply Inc.

Literature Cited

1. Evans, W. C., and D. P. Knopf. 1989. Pennsylvania 1989 turfgrass survey. Pennsylvania Agricultural Statistics Service, Pennsylvania Dept. Agriculture. Pennsylvania Turfgrass Council, Lemont, PA. (TGIF Record 20938)