

Interactive Effects Of Fungicides And Two Plant Growth Regulators On Dollar Spot And Turf Quality

By Philip O. Larsen, Professor, and Jill Calabro, Research Assistant
Department of Plant Pathology, University of Minnesota

The support of the Minnesota Golf Course Superintendents' Association to partially fund this research project is gratefully acknowledged.

Introduction

Plant growth regulators (PGRs) have been used on golf course turfgrass for many years to reduce mowing frequency. There are now several plant growth regulators registered for use on turfgrass including compounds classified as mitotic inhibitors or inhibitors of gibberellin biosynthesis. The latter group, which includes paclobutrazol, flurprimidol, and trinexapac-ethyl, has attracted the attention of turf managers because of their reduced potential for phytotoxicity and other beneficial side effects such as improved leaf color and increased stand density.

Recently, Burpee and coworkers have investigated the effects of three gibberellin inhibiting growth regulators on severity of dollar spot disease on bentgrass in Georgia. In multiple year experiments it was found that pretreatment of turfgrass with paclobutrazol, trinexapac-ethyl and flurprimidol enhanced the efficacy of various fungicides including chlorothalonil (Daconil 2787), iprodione (Chipco 26019), and propiconazole (Banner). However, the enhancement effect varied from year to year depending upon the fungicide/PGR combination. Triazole and pyrimidine PGRs are fungistatic invitro and are chemically related to several fungicides. However, until recently the disease suppressive nature of these chemicals has not been investigated.

The purpose of this investigation is to examine the possible interactive effects of two currently registered plant growth regulators in combination with various fungicides to determine effects on suppression of dollar spot disease and turfgrass quality on a bentgrass/annual bluegrass turf area under Minnesota conditions.

PROCEDURES

The PGRs tested included paclobutrazol (Turf Enhancer 2CS, Scotts) and trinexapac-ethyl (Primo 12EC, CIBA). Fungicides included were the contact fungicide chlorothalonil (Daconil 2787 4.17F, ISK Biotech Corp.) and demethylation inhibiting (DMI) fungicides propiconazole (Banner 1.1EC, CIBA), fenarimol (Rubigan 50WSP, DowElanco), triadimefon

(Bayleton 25WP, Bayer), cyproconazole (Sentinel 40WG, Sandoz), and myclobutinol (Eagle 40W, Rohm and Haas Co.). Fungicides and PGRs were applied alone and in combination on June 26 and July 23, 1996, to a bentgrass/annual bluegrass area mowed at 1/2 inch having a natural infestation of dollar spot disease caused by the fungus *Sclerotinia homoeocarpa*. Each treatment was replicated four times in 4' x 5' plots in a randomized complete block design. PGRs and fungicides were applied with a carbon dioxide pressurized experimental plot sprayer at 30 psi in two gallons water per 1000 sq. ft. With combination treatments, fungicides and PGRs were applied to the same plot in separate applications within a one-hour time interval. Untreated plot areas were also included as a basis for comparing treatment effects. Dollar spot symptoms were just beginning to appear at the first application time, June 26. Plots were evaluated for disease severity on June 26, July 23, August 7, August 21 and September 18, 1996. Disease severity was rated on a 10 point scale where 1=10% plot area showing disease symptoms and 10=90-100%. Turf quality was evaluated on the same dates as disease severity except for June 26. Quality was rated on a 1-5 scale (5=highest quality) on the basis of turf color, stand density, presence of phytotoxicity and general turf appearance. To encourage the development of dollar spot, no fertilizer was applied to the plots during the season.

RESULTS

The results of application of fungicides and PGRs alone and in combination are provided in Table 1. Significant disease levels were not observed until July 23, twenty seven days after the first application. At that time, Primo and Turf Enhancer both reduced disease severity below unsprayed treatment levels but not as low as that observed with fungicides alone or fungicide/PGR combinations.

On August 7, fifteen days after the second application, disease levels were low on all plots and no treatment differences were observed. This was probably a result of weather conditions at that date which were not conducive to disease

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development.

On August 21, twenty nine days after the second application, disease levels again were moderate to high on untreated control plots. All fungicide and fungicide/PGR treatments provided excellent disease control. Primo and Turf Enhancer reduced disease severity below levels observed on the untreated plots, but not to the level shown with fungicide and fungicide/PGR combinations.

On September 18, fifty-seven days following the second application, no significant disease reduction was observed with PGRs when compared to the untreated control. Treatments with DMI fungicides alone or in combination with PGRs continued to provide adequate to excellent disease control at this date. When applied alone, the contact fungicide, chlorothalonil, began to lose its efficacy and no longer reduced disease below untreated control levels. However, chlorothalonil in combination with Turf Enhancer or Primo, reduced disease levels below those observed with chlorothalonil alone or the untreated control, but generally not to the disease control levels given by DMI fungicides alone or in combination with PGRs.

Turf Quality

Turf quality evaluations for various treatments are given in Table 2. It was difficult to make clear assessments of turf quality with a high degree of confidence on treatments where significant levels of disease symptoms occurred. However, some statements can be made that reflect some general trends that were observed relative to turf quality. Application of fungicides alone or in combination with PGRs generally improved turf quality ratings over what was observed in untreated control plots. Application of PGRs alone did not improve turf quality above that observed in control plots. As a general trend, turf quality of plots treated with DMI fungicides alone or in combination with PGRs rated higher than treatments with the contact fungicide, chloro-

thalonil, and the untreated control plots fifty-seven days after the final treatment application. This observation was probably correlated with the higher disease levels also associated with these plots.

Conclusions

This investigation provides evidence that the plant growth regulators, Primo and Turf Enhancer, have the capacity to reduce dollar spot severity but not to the level provided by the fungicides rates tested here. This is consistent with the

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Table 1. Interactive Effects of Two Plant Growth Regulators and Six Fungicides on Control of Dollar Spot on Bentgrass/*Poa annua* Turf.

Treatment/1000 sq ft	Disease Rating (1-10) ¹				
	Jun 26 ²	Jul 23 ²	Aug 7	Aug 21	Sept 18
Daconil (6 oz)	1.63 ab ³	2.25 cd	1.00 b	1.75 bc	5.75 a
Daconil (6 oz)+P ⁴	2.50 ab	3.00 c	1.00 b	1.25 c	4.25 b
Daconil (6 oz)+TE ⁴	2.25 ab	2.00 de	1.00 b	1.00 c	3.50 bc
Banner (1 oz)	1.50 ab	1.00 e	1.00 b	1.00 c	2.38 cde
Banner (1 oz)+P	1.75 ab	1.50 de	1.00 b	1.00 c	2.00 de
Banner (1 oz)+TE	2.00 ab	1.00 e	1.00 b	1.00 c	1.00 e
Banner (2 oz)	1.25 ab	1.00 e	1.00 b	1.00 c	1.25 e
Banner (2 oz)+P	2.00 ab	1.00 e	1.00 b	1.00 c	1.00 e
Banner (2 oz)+TE	2.75 a	1.00 e	1.00 b	1.00 c	1.00 e
Bayleton (1 oz)	2.00 ab	1.00 e	1.00 b	1.00 c	1.00 e
Bayleton (1 oz)+P	2.25 ab	1.00 e	1.00 b	1.00 c	1.00 e
Bayleton (1 oz)+TE	2.25 ab	1.00 e	1.00 b	1.00 c	1.00 e
Bayleton (2 oz)	1.63 ab	1.00 e	1.00 b	1.00 c	1.00 e
Bayleton (2 oz)+P	2.00 ab	1.00 e	1.00 b	1.00 c	1.00 e
Bayleton (2 oz)+TE	2.75 a	1.00 e	1.00 b	1.00 c	1.00 e
Rubigan (0.5 oz)	1.75 ab	1.50 de	1.00 b	1.00 c	1.25 e
Rubigan (0.5 oz)+P	2.00 ab	1.25 de	1.00 b	1.00 c	1.25 e
Rubigan (0.5 oz)+TE	1.50 ab	1.25 de	1.00 b	1.00 c	1.00 e
Sentinel (0.16 oz)	1.63 ab	1.00 e	1.00 b	1.00 c	2.88 bcd
Sentinel (0.16 oz)+P	2.25 ab	1.00 e	1.00 b	1.00 c	1.25 e
Sentinel (0.16 oz)+TE	1.75 ab	1.00 e	1.00 b	1.00 c	1.50 de
Eagle (0.6 oz)	1.13 b	1.00 e	1.00 b	1.00 c	1.13 e
Eagle (0.6 oz)+P	2.25 ab	1.00 e	1.00 b	1.00 c	1.25 e
Eagle (0.6 oz)+TE	1.25 ab	1.00 e	1.00 b	1.00 c	1.00 e
Eagle (1.2 oz)	2.00 ab	1.00 e	1.00 b	1.00 c	1.00 e
Eagle (1.2 oz)+P	1.75 ab	1.00 e	1.00 b	1.00 c	1.00 e
Eagle (1.2 oz)+TE	1.25 ab	1.00 e	1.00 b	1.00 c	1.00 e
Primo (0.25 oz)	1.75 ab	4.75 b	2.00 a	2.75 b	6.25 a
Turf Enhancer (0.37 oz)	1.75 ab	4.50 b	1.00 b	2.75 b	5.75 a
Untreated	2.00 ab	6.75 a	1.75 ab	5.00 a	6.26 a

¹Disease was rated on 10 point scale where 1=0-10% diseased area and 10=90-100% diseased area.

²Treatments were applied on June 26 and July 23, 1996.

³Treatments were analyzed using the Duncan's Multiple Range Test. Disease ratings on specific dates followed by the same letter are not statistically different at the 95% level of probability.

⁴Primo (P) and Turf Enhancer (TE) were always applied at 0.25 and 0.37 fluid ounces, respectively.

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Table 2. Interactive Effects of Two Plant Growth Regulators and Six Fungicides on Quality of Bentgrass/*Poa annua* Turf.

Treatment/1000 sq ft	Quality Rating (1-5) ¹			
	Jul 23 ²	Aug 7	Aug 27	Sept 18
Dacnoil (6 oz)	2.25 de	3.50 ab	3.13 abc	1.75 ij
Daconil (6 oz)+P ⁴	2.75 bcde	3.50 ab	3.25 abc	2.25 hi
Daonil (6 oz)+TE ⁴	2.75 bcde	4.00 ab	3.50 ab	2.50 ghi
Banner (1 oz)	3.75 ab	4.38 a	3.75 a	2.75 fgh
Banner (1 oz)+P	3.00 abcde	3.75 ab	4.00 a	3.25 defg
Banner (1 oz)+TE	3.75 ab	3.75 ab	3.50 ab	4.25 abcd
Banner (2 oz)	3.88 ab	4.13 ab	4.13 a	4.00 abcde
Banner (2 oz)+P	3.50 abc	3.25 abc	4.00 a	4.50 abc
Banner (2 oz)+TE	3.75 ab	3.75 ab	3.00 abc	5.00 a
Bayleton (1 oz)	3.00 abcde	3.75 ab	3.63 a	4.13 abcd
Bayleton (1 oz)+P	3.25 abcd	3.75 ab	3.50 ab	4.50 abc
Bayleton (1 oz)+TE	3.00 abcde	3.75 ab	3.25 abc	4.75 ab
Bayleton (2 oz)	3.63 abc	3.88 ab	3.38 ab	4.00 abcde
Bayleton (2 oz)+P	3.75 ab	3.75 ab	3.75 a	4.75 ab
Bayleton (2 oz)+TE	3.75 ab	3.50 ab	3.25 abc	4.75 ab
Rubigan (0.5 oz)	2.75 bcde	3.75 ab	3.25 abc	2.75 fgh
Rubigan (0.5 oz)+P	3.50 abc	4.00 ab	4.25 a	3.50 cdefg
Rubigan (0.5 oz)+TE	3.00 abcde	3.50 ab	3.00 abc	4.00 abcde
Sentinel (0.16 oz)	3.75 ab	3.63 ab	3.63 a	2.75 fgh
Sentinel (0.16 oz)+P	4.00 a	4.00 ab	3.50 ab	3.00 efgh
Sentinel (0.16 oz)+TE	4.00 a	3.75 ab	3.75 a	3.00 efgh
Eagle (0.6 oz)	3.63 abc	4.00 ab	3.75 a	3.38 defg
Eagle (0.6 oz)+P	3.50 abc	3.50 ab	3.75 a	3.50 cdefg
Eagle (0.6 oz)+TE	3.00 abcde	3.50 ab	3.00 abc	3.75 bcdef
Eagle (1.2 oz)	3.63 abc	3.88 ab	3.88 a	4.00 abcde
Eagle (1.2 oz)+P	3.50 abc	3.50 ab	3.75 a	4.00 abcde
Eagle (1.2 oz)+TE	3.25 abcd	3.25 abc	3.00 abc	4.50 abc
Primo (0.25 oz)	2.25 de	3.50 ab	2.25 bcd	1.75 ij
Turf Enhancer (0.37 oz)	2.50 cde	3.00 bc	2.00 cd	1.75 ij
Untreated	2.00 e	2.38 c	1.38 d	1.25 j

¹Turf quality was rated on a 1-5 scale (5=highest quality).

²Treatments were applied on June 26 and July 23, 1996.

³Treatments were analyzed using the Duncan's Multiple Range Test. Disease ratings on specific dates followed by the same letter are not statistically different at the 95% level of probability.

⁴Primo (P) and Turf Enhancer (TE) were always applied at 0.25 and 0.37 fluid ounces, respectively.

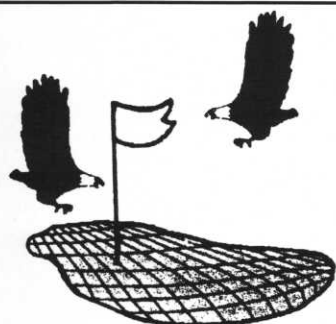
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observation of Burpee et al. (1). The long term high level of control provided by the DMI fungicides tested did not provide an opportunity to observe differences that may occur between treatments with DMI fungicides alone and those where DMI fungicides and PGRs were applied in combination. Allowing for longer post-application periods of observation or applying DMI fungicides at lower rates in combination with Primo or Turf Enhancer would provide further information about the potential for additive or synergistic disease control that might be achieved through application of combinations of the DMI fungicides and PGRs tested here.

Both Primo and Turf Enhancer were able to enhance the efficacy of the contact fungicide, chlorothalonil, when measured at a time when the residual effects of the chlorothalonil alone had declined to the level observed on the untreated control. Based upon this observation, it could be concluded that there is an additive disease control effect that can be achieved through application of combinations of the fungicide, chlorothalonil and the plant growth regulators, Primo or Turf Enhancer. Clearly, more than one season's data are needed to confirm this conclusion.

The effect of various treatments on turf quality data was difficult to assess where significant amounts of disease symptoms occurred. No phytotoxicity was observed with any treatment.



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J.M. Vargas, Jr., Receives Distinguished Service Award from GCSAA

J.M. Vargas, Jr., Ph.D., who received his Ph.D. in plant pathology at the University of Minnesota, was one of three individuals who received a Distinguished Service Award from the board of directors of the Golf Course Superintendents of America. Others receiving the award were Gerald L. Faubel, CGCS, Michigan, and Coleman Y. Ward, Ph.D., Virginia.

Vargas, a professor of botany and plant pathology at Michigan State University for 25 years, has helped enhance the superintendent's profession through his involvement in teaching, research and extension.

Vargas attended the University of Rhode Island and earned a bachelor's degree in agronomy. His initial goal was to become a golf course superintendent, but soon decided to focus his talents toward the academic side of the industry.

"That is one reason this award is so special to me — because I started out wanting to be a golf course superintendent," Vargas says. "It really means a lot, because I work with superintendents and my best friends are golf course superintendents."

Vargas received a master's degree in plant pathology from Oklahoma State University and then his Ph.D. in plant pathology from the University of Minnesota. His research accomplishments have been extraordinary, resulting in such achievements as developing the first mathematical prediction model for turfgrass disease and discovering the first bacterial disease in turf on Toronto creeping bentgrass.

Vargas has shared his knowledge through more than 1,000 presentations at conferences throughout the world including this past year's MTGF Turf Conference and Show in Minneapolis. He has also published more than 200 articles on turfgrass diseases and related subjects, as well as a book, *Management of Turfgrass Diseases*.

Currently, Vargas is working with the Michigan and Border Cities GCSA on a GCSAA Chapter Cooperative Research Program.

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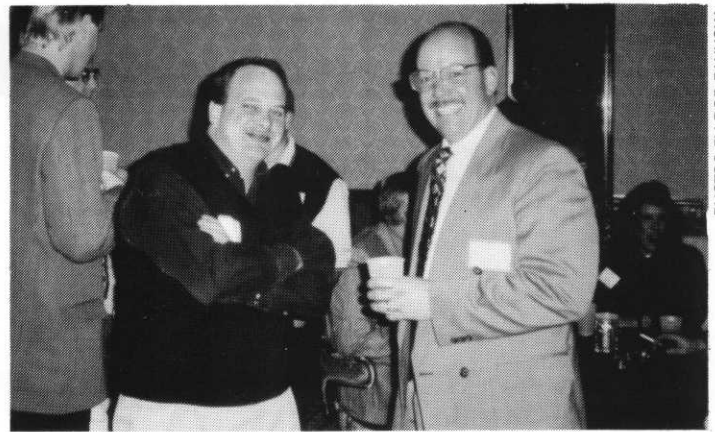


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Jon Almquist, MTI, and Jeff Churchill, NST, compare notes.

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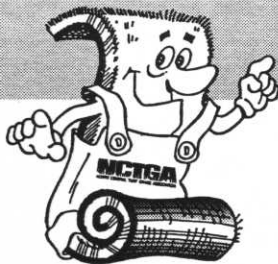
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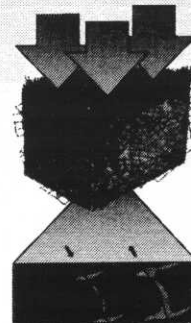
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NATIONAL NEWS

Steve Schumacher Wins Environmental Steward Award Competition

Steve Schumacher, of Izatys Golf and Yacht Club in Onamia, Minn., has been named a regional winner in the resort category for the Environmental Steward Award competition. The award is sponsored by the Golf Course Superintendents Association of America Foundation, and golf industry leaders Novartis, Rain Bird's Golf Division, Jacobsen Division of Textron Inc. and Pursell Industries.

"The Environmental Steward Award represents the kind of principles that we hope all golf courses will embrace," said Bruce R. Williams, CGCS, president of GCSAA. "For entrants, sponsors and especially the public, this award acknowledges all the positive results that can be achieved by focusing on the environment."

The Environmental Steward Award was created to recognize golf course superintendents and golf courses for their work to protect and enhance their local environment. Winners are recognized for overall course management excellence, outstanding programs to maximize pesticide and fertilizer efficacy and irrigation and equipment efficiency, as well as wildlife preservation and habitat enhancement.

Schumacher's entry represented the North-Central region, one of the seven United States Golf Association Green Section regions throughout the country. He was one of 13 superintendents who submitted entries from that region. The North-Central region includes Montana, North and South Dakota, Minnesota, Wisconsin, Michigan, Indiana, Ohio and Kentucky.

Regional winners receive a plaque and seal, and a \$50 donation in the name of each winner goes to the GCSAA Foundation. Merit winners

receive a certificate and letter recognizing them as Environmental Steward Award Merit Winners.

All entries are reviewed by an independent panel of judges selected for their expertise in environmental issues and turfgrass management.

North Star Turf Adds Salesperson

North Star Turf, St. Paul, has announced the addition of Scott Lombard to its sales staff.

Lombard will manage an area of south central Minnesota and a sizable portion of the Twin Cities area. The decision to add a salesperson was made to reduce the geographic size of all eight company sales territories to improve service and response time.

A 1987 graduate of the University of Colorado, Colorado Springs, Lombard is a former assistant superintendent at Pole Creek Golf Club in Winter Park, Colo. Most recently he managed and operated Hydro Green, Inc., River Falls, Wis., a contract aeration business serving accounts throughout the United States.

"Scott's enthusiasm and expertise within the turf business made him an excellent candidate for the position," said Dan Miller of North Star Turf. "He possesses the ability to relate to people in a manner which fits our overall goals and objectives."

Lombard will represent all product lines offered by North Star Turf including: Jacobsen, Smithco, Turfco, National and LandPride equipment and several lines of turf supplies including: The Andersons and Ringer fertilizers, Medalist America grass seed and a full line of turf chemicals and golf accessories.

Bridge America Firm Organized

Formation of Bridge America, Inc., a company providing project develop-

ment, engineering design and project management services for prefabricated pedestrian and light vehicular bridge needs, has been announced in Alexandria, Minn.

Bridge America was founded by Todd L. Vinje, P.E. and Bruce Leland. Their combined expertise includes more than 16 years of experience in directing sales, marketing, design engineering and manufacturing operations required to successfully complete over 2,500 prefabricated bridge projects with a value of over \$50 million dollars.



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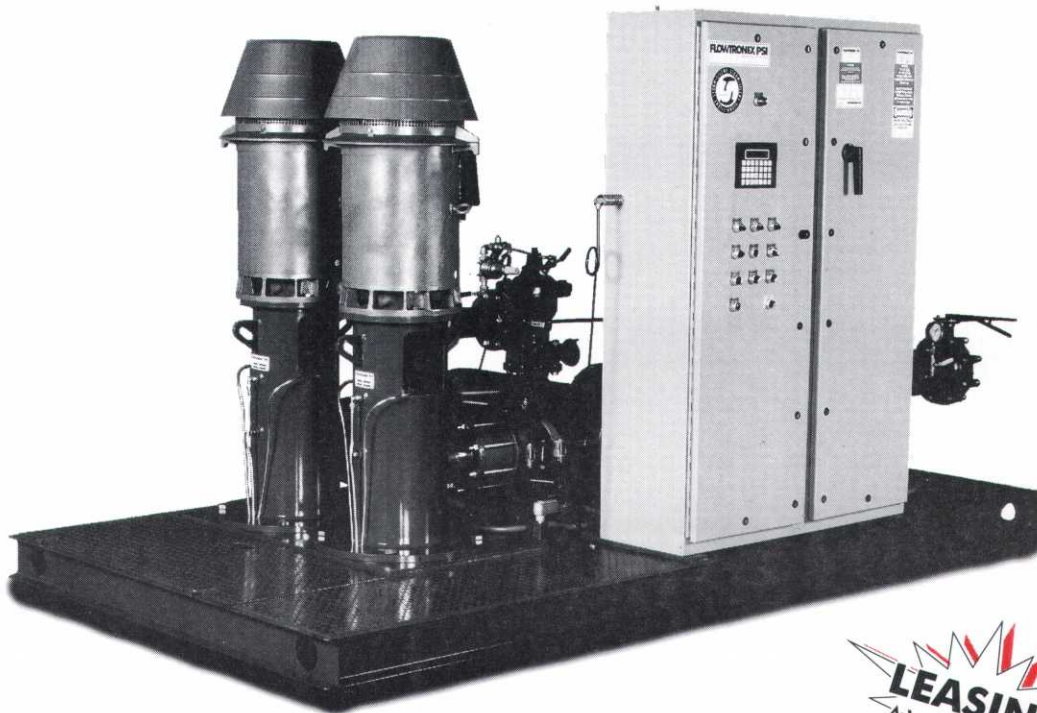
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