Control of Typhula Blight and Pink Snow Mold of Creeping Bentgrass and Residual Suppression of Dollarspot by Triadimefon and Propiconazole

L. L. BURPEE, A. E. MUELLER, and D. J. HANNUSCH, Department of Environmental Biology and the Guelph Turfgrass Institute, University of Guelph, Guelph, Ontario N1G 2W1 Canada

ABSTRACT

Burpee, L. L., Mueller, A. E., and Hannusch, D. J. 1990. Control of Typhula blight and pink snow mold of creeping bentgrass and residual suppression of dollarspot by triadimefon and propiconazole. Plant Dis. 74:687-689.

Two triazole fungicides (triadimefon and propiconazole) were compared with pentachloronitrobenzene (PCNB) for control of Typhula blight and pink snow mold of creeping bentgrass. In an experiment repeated in consecutive years, propiconazole applied at rates of 3.0, 6.0, or 12.0 kg a.i./ha, or triadimefon applied at 12 kg a.i./ha, suppressed the development of Typhula blight and pink snow mold to levels that were not significantly different from disease intensity in plots treated with PCNB at 30.0 kg a.i./ha. Triadimefon, applied at 1.5, 3.0, or 6.0 kg/ha, suppressed Typhula blight, but not pink snow mold, to levels equivalent to those provided by PCNB. Eight months after application, significant residual suppression of dollarspot disease was observed in plots treated with 3, 6, or 12 kg a.i./ha of triadimefon or 12 kg a.i./ha of propiconazole in 1985 or with 12 kg a.i./ha of either fungicide in 1986. A consistent, but nonsignificant ($P = 0.05$), increase in the intensity of dollarspot was observed in 1986 and 1987, 8 mo after application of PCNB.

Additional keywords: gray snow mold, turfgrass, iatrogenic disease, reduced pesticide use

Typhula blight (gray or speckled snow mold) caused by *Typhula ishikariensis* Imai and/or *T. incarnata* Fr., and pink snow mold, caused by *Microdochium nivale* (Fr.) Samuels & Hallet (syn. *Fusarium nivale* (Fr.) Sorauer), are serious diseases of turfgrasses grown in the northern United States and Canada. In southern Ontario, it is not uncommon for both diseases to develop on a sward of turfgrass that has been covered with snow for 90 days or longer (Burpee, *unpublished*). Therefore, preventive chemical control is limited to the use of a relatively small number of fungicides that can effectively suppress the growth of both *Typhula* and *Microdochium* under snow for at least 3 mo.

Fungicides containing mercury or pentachloronitrobenzene (PCNB) are used extensively for management of winter diseases of turfgrass in eastern Canada (Burpee, *unpublished*). However, environmental and health concerns about the use of mercury (5) and the problems associated with the toxicity of PCNB to certain species of grasses (2,3) have prompted us to evaluate other fungicides for effective management of snow molds. The present study was initiated to compare the efficacies of two triazole fungicides (triadimefon and propiconazole) with a standard treatment of PCNB for control of Typhula blight and pink snow mold of creeping bentgrass (*Agrostis palustris* Huds.). In addition, we examined the residual effects of the fungicides on epidemics of dollarspot disease.

Accepted for publication 19 March 1990 (submitted for electronic processing).

MATERIALS AND METHODS

1985-86. Fungicide evaluations were conducted on a 10-yr-old sward of creeping bentgrass on a Fox sandy loam soil (pH 6.8) at the Ontario Ministry of Agriculture and Food (OMAF) Research Station in Cambridge, Ontario. The sward was maintained like a golf putting green (1). Plots (1 × 3 m) of nine fungicide treatments and an untreated control were arranged in a randomized complete block design with four replicates. Fungicide treatments consisted of triadimefon (50 WP) and propiconazole (135 g/L) applied at rates of 1.5, 3.0, 6.0, and 12.0 kg a.i./ha, and PCNB (17G) applied at a rate of 30.0 kg a.i./ha. Triadimefon and propiconazole were applied in 700 L of water per hectare with a wheel-mounted compressed air boom sprayer at 138 kPa. The granular PCNB was applied with a 1-m-wide drop-type fertilizer spreader (O. M. Scott & Sons, Marysville, OH). All treatments were applied on 28 November 1985.

On 29 November, one half of each plot (1.5 m^2) was treated with rye-grain infested with *M. nivale* (isolate F016), and the remaining half was treated with grain infested with *T. ishikariensis* (isolate T004). Inoculum was prepared by placing mycelial plugs of the isolates into separate 1-L Mason jars containing 500 cm^3 of autoclaved grain. The cultures were incubated in the dark at 10 C for 3 mo and then removed from the jars and air-dried for 48 hr in a laminar flow microbial transfer hood. Infested grain was dispersed by hand onto the surface of the turf at a rate of approximately 12.5 g/m^2. Snow covered the plots on 4 December 1985 and melted on 25 March 1986, resulting in 111 days of continuous snow cover.

The Horsfall-Barratt rating scale (7) was used to estimate disease intensity (percent necrotic foliage per plot) on 30 March 1986. Values of disease intensity were subjected to analysis of variance, and means were statistically separated using the Scott-Knott cluster analysis procedure (4).

By 22 May 1986, the bentgrass canopy had redeveloped vegetatively from stolons, and signs and symptoms of snow mold were no longer evident in the treatment plots. On 27 June the plots were treated with inoculum of *Sclerotinia homoeocarpa* F. T. Bennett, the cause of dollarspot disease, to assess residual effects of the snow mold fungicide treatments on dollarspot. Inoculum consisted of autoclaved rye-grain infested with *S. homoeocarpa* (isolate 584). The plots were treated by distributing the infested grain by hand onto the turf surface at a rate of approximately 12.5 g/m^2. Infection was predisposed by sprinkler irrigation (approximately every 4 hr) over a period of 4 days postinoculation.

The Horsfall-Barratt rating scale (7) was used to assess the intensity of dollarspot in the treatment plots at 2-day intervals from 9 July to 20 August. Values of disease intensity were plotted over time for each treatment plot and an area under the disease progress curve (AUDPC) was calculated using the formula of Shaner and Finney (9). Values of AUDPC were subjected to analysis of variance, and means were statistically separated using the Scott-Knott cluster analysis procedure (4).

1986-87. The experiment was repeated on a previously untreated section of a creeping bentgrass sward at the OMAF Research Station in Cambridge, Ontario. Treatments and experimental design were the same as those described for the 1985-86 experiment. Fungicides were applied on 20 November 1986, and

inoculum of *T. ishikariensis* (isolate T004) and *M. nivale* (isolate F016) was applied on the following day. Snow covered the plots on 2 December 1986 and melted on 28 March 1987, resulting in 116 days of snow cover. The plots were rated for disease intensity on 30 March.

By 22 May, the bentgrass canopy had redeveloped, and signs and symptoms of snow molds were no longer evident in the treatment plots. Rye-grain inoculum of *S. homoeocarpa* (isolate 584) was applied on 29 June and disease intensity was assessed at 2-day intervals from 6 July to 14 August. Calculations and analyses of AUDPC values were the same as described for the 1985-86 experiment.

RESULTS

1985-86. The intensities of Typhula blight and pink snow mold were moderate in the spring of 1986. Plots that were not treated with fungicide and infested with *T. ishikariensis* or *M. nivale* exhibited 34% and 61% necrosis, respectively (Fig. 1A). Triadimefon and propiconazole applied at rates of 1.5, 3.0, 6.0, or 12.0 kg a.i./ha suppressed the development of Typhula blight to a level that was not significantly different from the disease intensity in plots treated with PCNB at 30.0 kg a.i./ha. Propiconazole, at rates of 3.0, 6.0, or 12.0 kg a.i./ha, suppressed pink snow mold to a level that was equivalent to PCNB. However, triadimefon failed to provide acceptable control of pink snow mold (<3% disease) at any of the rates tested.

The residual effects of triadimefon and propiconazole on dollarspot were not significantly ($P = 0.05$) different among plots infested with *Typhula* and plots infested with *Microdochium*. Therefore, values of disease intensity were pooled for these plots before statistical analysis. The fungicide treatments had no significant effect on the time of initiation of dollarspot in July 1986. However, AUDPC values for dollarspot were significantly ($P = 0.05$) lower from plots treated with triadimefon at 6.0 or 12.0 kg a.i./ha, or propiconazole at 12.0 kg a.i./ha, than from untreated plots or plots treated with PCNB (Fig. 2A).

1986-87. The intensities of Typhula blight and pink snow mold were high (89% and 97%, respectively) in untreated plots in the spring of 1987 (Fig. 1B). All fungicide treatments suppressed the development of Typhula blight to a level that was not significantly different from the disease suppression provided by PCNB at 30.0 kg a.i./ha. However, only propiconazole at 1.5, 3.0, 6.0, or 12.0 kg a.i./ha and triadimefon at 12 kg a.i./ha suppressed pink snow mold to a level equivalent to that provided by PCNB.

As in 1986, residual effects of triadimefon and propiconazole on dollarspot were not significantly ($P = 0.05$) different among plots infested with *Typhula* and plots infested with *Microdochium*. Therefore, values of disease intensity for these plots were pooled before statistical analysis. The fungicide treatments had no significant effect on the time of initiation of dollarspot in July 1987. However, AUDPC values for dollarspot were significantly ($P = 0.05$) lower from plots treated with triadimefon or propiconazole applied at 12.0 kg a.i./ha than from untreated plots or from plots treated with PCNB (Fig. 2B).

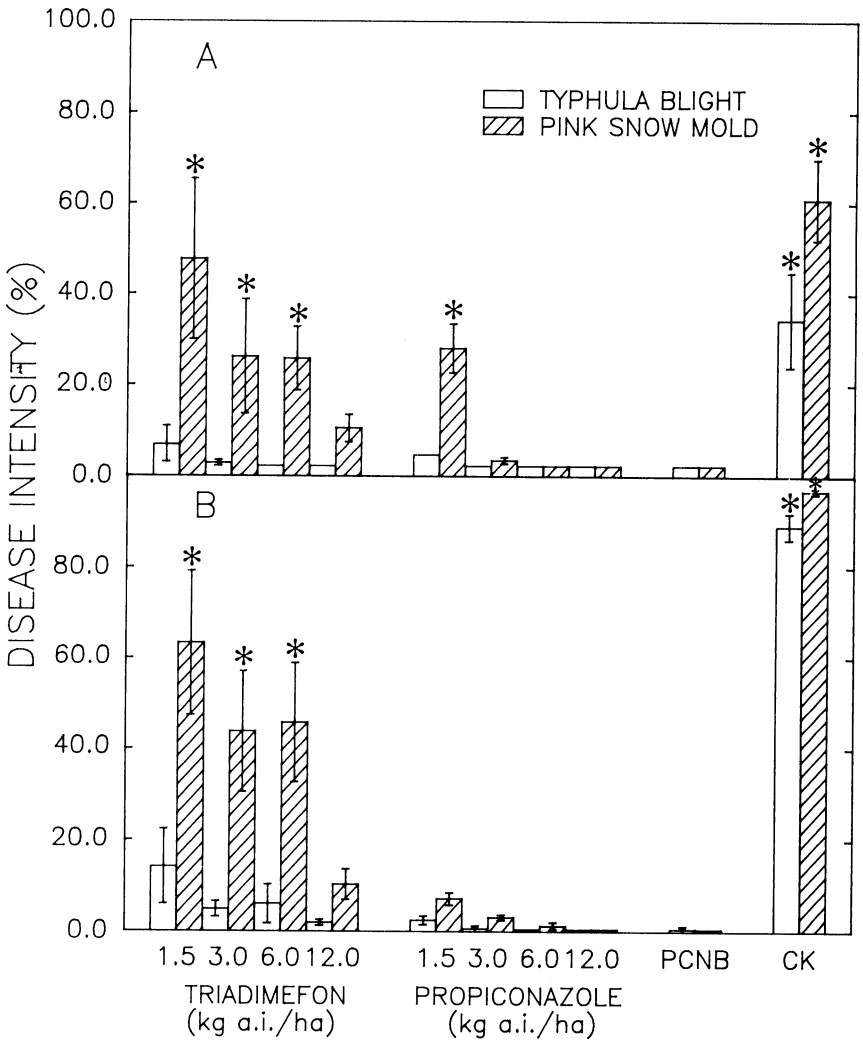

Fig. 1. Suppression of Typhula blight and pink snow mold of creeping bentgrass by the fungicides triadimefon, propiconazole, and pentachloronitrobenzene (PCNB) **(A)** 1986. **(B)** 1987. PCNB applied at 30 kg a.i./ha. Asterisk indicates statistical difference from PCNB treatment based on Scott-Knott cluster analysis test at $P = 0.05$. Standard errors are represented by vertical lines.

DISCUSSION

Results of this study indicate that an application of propiconazole (135 g/L) at 3.0 kg a.i./ha or triadimefon (50 WP) at 12 kg a.i./ha, in late fall (before snowfall), can provide control of Typhula blight and pink snow mold of creeping bentgrass that is equivalent to the control achieved with PCNB (17 G) at 30 kg a.i./ha. These findings are of significance because they provide turfgrass managers with information on possible alternatives to mercury and PCNB for control of two important winter diseases. In addition, the lower application rate of the triazole fungicides, compared to PCNB, could lead to a reduction in the amount of pesticide applied to turfgrass in regions where granular formulations of PCNB are used extensively (eg. southern Ontario).

Efficacies of triadimefon and propiconazole were similar for control of Typhula blight. However, in contrast to propiconazole, triadimefon failed to provide acceptable control (<3% disease) of pink snow mold at the rates tested. Evaluations in vitro (Burpee, *unpublished*) indicated that isolates F016 of *M. nivale* and T004 of *T. ishikariensis* did not differ significantly in sensitivity to triadimefon or propiconazole; and, in the field, both fungicides were highly residual (Fig. 2). Therefore, the differential response observed in disease suppression (Fig. 1) is difficult to explain. Nontarget effects of triadimefon on turfgrasses and microbes should be investigated for their possible role in influencing the efficacy of this fungicide for control of pink snow mold.

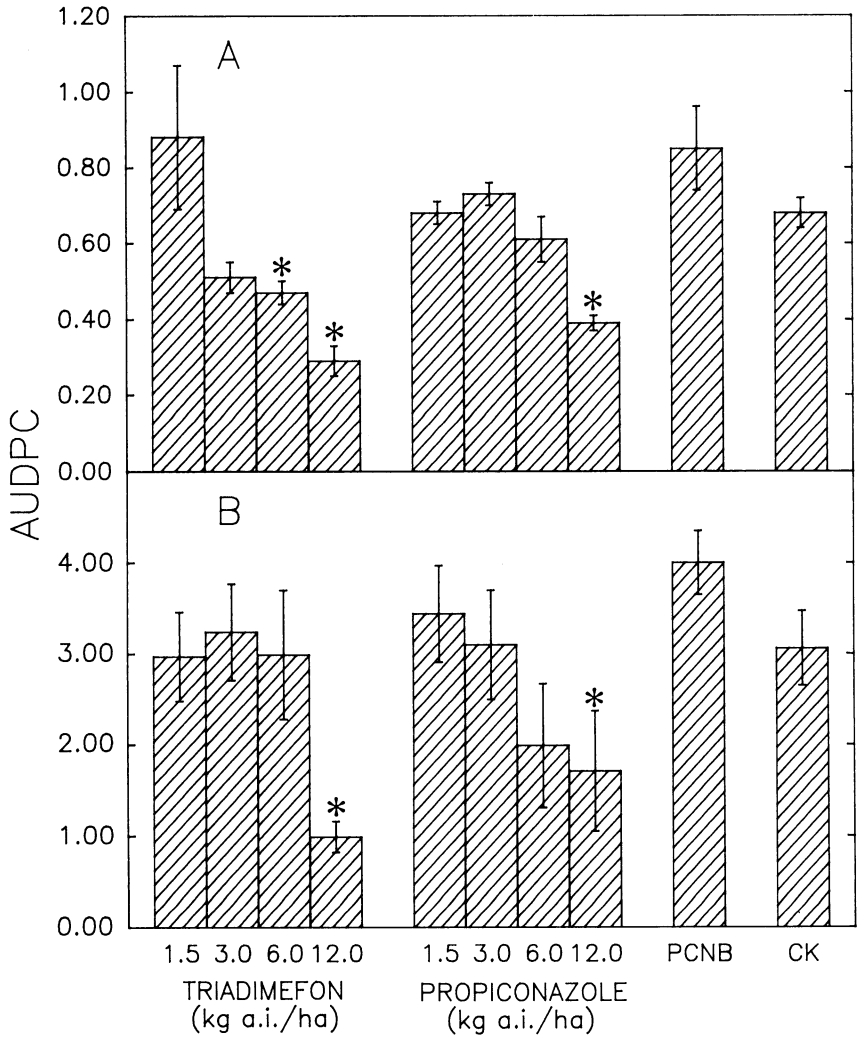

Fig. 2. Residual effects of triadimefon, propiconazole, and pentachloronitrobenzene (PCNB) on dollarspot of creeping bentgrass eight months after application of the fungicides. **(A)** 1986. **(B)** 1987. PCNB applied at 30 kg a.i./ha. Asterisk indicates statistical difference from PCNB treatment based on Scott-Knott cluster analysis test at $P = 0.05$. Standard errors are represented by vertical lines.

The residual disease suppressive effects of the triazole fungicides (Fig. 2) are supported by the findings of Sanders, et al (8). They observed that triadimefon applied to creeping bentgrass at 57 g/93 m^2 resulted in an 85% reduction in dollarspot 1 yr after application. Our results indicate that, in addition to triadimefon, propiconazole is also highly residual. The suppression of dollarspot after inoculation with *S. homoeocarpa* indicated that the residual effect resulted from fungicidal activity rather than from reduction of inoculum. These observations on the long-term effects of these fungicides are important because they will undoubtedly influence future strategies for management of turfgrass diseases. In addition, turfgrass pathologists should be aware that the results of fungicide trials may be influenced, for a year or more, by previous applications of triazole fungicides.

Although the values were not statistically significant ($P = 0.05$), the increase in the intensity of dollarspot in plots treated with PCNB, observed in each year of the study (Fig. 2), warrants further investigation. Dollarspot is a chronic disease of turfgrass on golf courses in southern Ontario, and reduction of factors that predispose turf to this disease may possibly limit the number of fungicide applications required for dollarspot control. Iatrogenic diseases induced by PCNB have been reported for a number of plant species (6), however, mechanisms that regulate this type of predisposition have not been elucidated.

ACKNOWLEDGMENT

This research was supported by the Ontario Ministry of Agriculture and Food and the Ontario Turfgrass Research Foundation.

LITERATURE CITED

1. Beard, J. B. 1982. Turf Management for Golf Courses. Burgess Publishing, Minneapolis, MN. 642 pp.
2. Burpee, L. L., and Goulty, L. G. 1984. Evaluations of fungicides for control of pink and gray snow mold on creeping bentgrass. Pages 6-7 in: Turfgrass Research Annual Report. R. W. Sheard, ed. University of Guelph, Guelph, Ontario. 38 pp.
3. Delty, J. 1982. Label Copy Revisions for Scotts FF-II Fungicide. O. M. Scott & Sons, Marysville, OH.
4. Gates, C. E., and Bilbro, J. D. 1978. Illustration of a cluster analysis method for mean separation. Agron. J. 70:462-465.
5. Granhall, I. 1971. Environmental aspects of using persistent pesticides. Proc. Br. Insectic. Fungic. Conf. 6th.
6. Griffiths, E. 1981. Iatrogenic plant diseases. Ann. Rev. Phytopathol. 19:69-82.
7. Horsfall, J. G., and Cowling, E. B. 1978. Phytopathometry: The measurement of plant disease. Pages 120-136 in: Plant Disease. An Advanced Treatise. Vol. I. J. G. Horsfall and E. B. Cowling, eds. Academic Press, New York. 465 pp.
8. Sanders, P. L., Burpee, L. L., Cole, H., and Duich, J. M. 1978. Uptake, translocation, and efficacy of triadimefon in control of turfgrass pathogens. Phytopathology 68:1482-1487.
9. Shaner, G., and Finney, R. E. 1977. The effect of nitrogen fertilization on the expression of slow-mildewing resistance in Knox wheat. Phytopathology 67:1051-1056.