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Evaluation of fungicide and plant growth regulator tank-mix programmes on dollar spot severity of creeping bentgrass

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Abstract

Dollar spot (*Sclerotinia homoeocarpa* F.T. Bennett) is a common and destructive disease of creeping bentgrass (*Agrostis stolonifera* L.). In 2003 and 2004, field studies were conducted to evaluate 14- and 21-day sequential fungicide tank-mix programmes alone and in combinations with plant growth regulators (PGRs) paclobutrazol, trinexapac-ethyl, or paclobutrazol plus trinexapac-ethyl on dollar spot of fairway-height creeping bentgrass. All fungicide-treated plots, either fungicides plus PGRs or fungicides alone, exhibited greater dollar spot control versus untreated plots. Overall, fungicide efficacy on dollar spot was comparable on plots treated with fungicide tank-mix programmes alone versus fungicides plus PGRs. Creeping bentgrass quality was consistently better in plots treated with fungicides plus PGRs versus fungicides alone. Dollar spot control and creeping bentgrass quality was improved, however, in plots treated with fungicides plus paclobutrazol versus fungicides alone, fungicides plus trinexapac-ethyl, or fungicides plus paclobutrazol plus trinexapac-ethyl.

Keywords: *Sclerotinia homoeocarpa*; Turf; Turfgrass; Turfgrass quality

1. Introduction

Dollar spot (*Sclerotinia homoeocarpa* F.T. Bennett) is a persistent and troublesome foliar disease of turfgrasses worldwide (Couch, 1995). In regions of the USA where the climate is suited to the growth of creeping bentgrass (*Agrostis stolonifera* L.), golf course superintendents frequently apply two or more fungicide products with different modes of action in various tank-mix combinations repeated over a 14- to 28-day interval during the spring, summer, and early autumn to control dollar spot and other diseases that occur during that time (Dernoeden, 2000; Green, 2004; Tredway and Butler, 2004). Within that same time-frame, plant growth regulator (PGR) products are frequently applied to regulate vertical turfgrass growth and canopy height, reduce mowing frequency and clipping yield, improve turfgrass colour and quality, and increase stand density (Beard, 2002; Dernoeden, 1984, 2000; Johnson, 1993; Johnston and Faulkner, 1985; Watschke et al., 1992).

The PGRs registered in commercial turfgrass markets were formerly categorized as either gibberellin biosynthesis inhibitors or mitotic inhibitors (Watschke et al., 1992). A recent revision now places those PGRs into the following five classes: (A) cell elongation inhibitor in late gibberellin biosynthesis pathway (i.e., trinexapac-ethyl); (B) cell elongation inhibitor in early gibberellin biosynthesis pathway (i.e., flurprimidol, paclobutrazol); (C) cell division inhibitor (i.e., mefluidide); (D) herbicides with growth regulating properties (i.e., ethofumesate), and (E) phytohormones (i.e., gibberillic acid) (Turgeon, 2002). PGRs with a triazole-based structure (i.e., paclobutrazol) are chemically similar to some fungicides (i.e., fenarimol, myclobutanil, propiconazole, triadimefon) used to control

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dollar spot in turfgrass (Koller, 1988), and those PGRs have been shown to inhibit growth of *S. homoeocarpa* in vitro (Fletcher et al., 1986). In field studies, Burpee et al. (1996) showed that dollar spot severity was reduced in creeping bentgrass treated with paclobutrazol, but not trinexapac-ethyl. Also, the efficacy of chlorothalonil fungicide on dollar spot was improved on creeping bentgrass pre-treated with paclobutrazol (Burpee et al., 1996).

The effects of combining fungicides and PGRs in sequential tank-mix combinations to golf course turf for dollar spot control are not well documented in the research literature (Burpee et al., 1996; Golembiewski and Danneberger, 1998). Therefore, the objective of this field-based research was to evaluate fungicide plus plant growth regulator tank-mix programmes on dollar spot severity in creeping bentgrass.

2. Materials and methods

2.1. Experiment locations

All test sites were located on golf course fairways in Southeastern Pennsylvania, USA, with a history of dollar spot incidence. In 2003, fungicide and plant growth regulator treatments were applied on a creeping bentgrass fairway on a 14-day interval (experiment one) at Saucon Valley Country Club, Bethlehem, PA, USA, and on a 21-day interval (experiment two) at Wyncote Golf Course, Oxford, PA, USA. In 2004, treatments scheduled on 14- and 21-day intervals (repeat of experiments one and two) were applied at a single location on a creeping bentgrass fairway at St. David's Golf Club, Wayne, PA, USA.

At all three locations, the fairway turf consisted of mostly creeping bentgrass with some annual bluegrass (*Poa annua* L.). All fairway test sites were maintained according to normal or routine mowing, fertilization, irrigation, and other cultural practices normally employed at the golf course (Dernoeden, 2000). The turf population at Bethlehem was visually estimated as 75% creeping bentgrass (cultivar unknown) and 25% annual bluegrass. The fairway was maintained at a 7.6 mm height of cut with a reel mower. Soil pH was 6.2 with 7.7% organic matter on this native soil fairway. The turf at Oxford was mowed at 8.3 mm with a reel mower, and was visually estimated as 80% creeping bentgrass (cv. 'Dominant') and 20% annual bluegrass. Soil pH was 6.5 with 2.3% organic matter on this native soil site. At Wayne, soil pH was 5.7 with 4.5% organic matter. The turf was mowed at 12.7 mm with a reel mower, and visually consisted of 60% creeping bentgrass (cultivar unknown) and 40% annual bluegrass on this native soil site.

2.2. Fungicide and plant growth regulator treatments

The active ingredients of all fungicide and PGR treatments, application rates, and commercial formulations are listed in Table 1. The 14-day interval (experiment one) fungicide tank-mix programme consisted of the following five applications in sequential order: (i) propiconazole + chlorothalonil, (ii) fludioxonil + chlorothalonil, (iii) azoxystrobin + propiconazole, (iv) azoxystrobin + propiconazole, and (v) fludioxonil + chlorothalonil. The 21-day interval (experiment two) fungicide tank-mix programme consisted of the following three applications in sequential order: (i) propiconazole + chlorothalonil, (ii) azoxystrobin + propiconazole, and (iii) azoxystrobin + propiconazole. The sequential fungicide programme was applied alone and in tank-mix combinations with paclobutrazol, trinexapac-ethyl, and paclobutrazol + trinexapac-ethyl. Chlorothalonil is a contact fungicide, whereas the others listed are considered systemic fungicides (Couch, 1995). Paclobutrazol is root absorbed, and trinexapac-ethyl is foliar absorbed in turfgrass (Dernoden, 2000).

Table 1
Fungicide and plant growth regulator (PGR) products applied to creeping bentgrass fairway test sites, 2003 and 2004

Product category	Application rates		
	Active ingredient	kg a.i. ha^{-1}	Commercial formulation[a]
Fungicide	Azoxystrobin	0.30	Heritage 50WG
	Chlorothalonil	4.53	Daconil Ultrex 82.5WDG
	Fludioxonil	0.45	Medallion 50WP
	Propiconazole	0.50	Banner MAXX 1.3MEC
PGR	Paclobutrazol	0.12 or 0.18	Trimmit 2SC
	Trinexapac-ethyl	0.05 or 0.10	Primo MAXX 1MEC

[a]All products manufactured by Syngenta Professional Products, Greensboro, NC, USA.

Therefore, both 14- or 21-day interval experiments consisted of five treatments: (1) fungicides + paclobutrazol, (2) fungicides + trinexapac-ethyl, (3) fungicides + paclobutrazol + trinexapac-ethyl, (4) fungicide programmes applied alone, and (5) an untreated check. These 14- and 21-day fungicide programmes and PGRs were chosen because they are commonly used on creeping bentgrass fairways in the Mid-Atlantic region of the USA (Dernoeden, 2000; Fidanza and Mizikar, 2003; Towers et al., 2003). Specific treatment information, application rates, and application calendar dates for all experiments in both years are listed in Tables 2–5. At all three locations in both years, the experiments began in early June and continued through August which corresponded to dollar spot activity normally observed at that time on those creeping bentgrass fairway sites. All experiments were discontinued by late August.