Moss Control in Creeping Bentgrass Putting Greens

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Additional index words: *Bryum argenteum, Agrostis palustris*

Summary. Moss (*Bryum argenteum*) continues to become one of the most problematic weeds in creeping bentgrass (*Agrostis palustris*) putting greens. Control of moss can be approached in many different ways, including chemical applications, and cultural practices such as correcting shading or poor drainage. A study was conducted at Springdale Country Club (Springdale, Ark.) to evaluate the effectiveness of several different chemical products for the control of moss in a creeping bentgrass putting green. Daconil Zn®, Junction®, Fore®, Zerotol®, ferrous ammonium sulfate, Dawn Ultra®, and DeMoss® were applied every 14 days beginning in early June 2002 for a period of eight weeks. Visual moss control ratings were taken prior to the third application and then every 14 days. Excellent moss control was observed in plots treated with Daconil Zn® and this control was consistent for the remainder of the evaluation period. Limited moss control was observed in plots treated with Junction®, Fore®, and Zerotol®. There was no control of moss using Dawn Ultra®, DeMoss®, or ferrous ammonium sulfate.

The control of moss in putting greens is an issue on golf courses across North America. There are several types of moss that are associated with turf (Cook et al., 2002). *Bryum argenteum* is the moss species that is most often found on putting greens and is commonly referred to as silvery thread moss. Occurrence of moss is usually highest in areas of poor drainage and high shade (McCarty, 2001). The demand for faster and firmer putting greens has led to practices such as reduced mowing heights and reduced fertility that causes decreased turf density and allows moss to invade (Mahady, 2002). Once moss is established, it forms a thick mat over the soil that will continue to spread to weak turf areas if left untreated.

Moss control can be approached in several different ways. The best way to control moss is to have a healthy turf with a good fertility program. Once moss develops, there are several control approaches that can be taken. The first and most aggressive approach is to physically abrade the moss and then topdress it with sand to desiccate the moss (Cook et al., 2002). Since moss is most commonly found in areas of poor drainage and high shade, improving the surface and subsurface drainage, as well as pruning of shade trees to increase exposure to light, can reduce moss infestations. However, if drainage is sufficient and light is not limiting, then other approaches to control must be initiated.

There are several compounds that have been reported to control moss. Dishwashing soaps such as Dawn, Ajax, and Palmolive have shown to reduce moss growth when applied at rates ranging from 4-10 oz 1000 ft^{-2} (1.3 – 1.91/ha). Unfortunately, these treatments can also lead to turf injury. Iron containing compounds such as ferrous ammonium sulfate and granular iron sulfate have demonstrated some moss control when applied at 4-7 oz/1000 ft^2 (1.3 – 2.2 1/ha) and 3 lb/1000 ft^2 (15.0 1/ha), respectively. Specific turfgrass fungicides have also been shown to suppress moss. Chlorothalonil (tradename Daconil), when applied at 4-8 oz/1000 ft^2 (1.3 – 2.6 1/ha), has exhibited good moss control when applied during warmer temperatures (Burnell et al., 2000).

Several studies have investigated various strategies of moss control in recent years, but the majority of these studies produced confounding results. Cook et al. (2002) performed a moss control study in Oregon and found that Dawn® dishwashing soap showed no control of moss during cool, wet conditions. In contrast, Burnell et al. (2000) found that Dawn provided ~74% control when applied at weekly intervals for three weeks, but control subsided to less than 30% by six weeks after the first treatment. Although the moss was controlled well in the first three applications, turf injury was unacceptable and the Dawn® treatments had to be stopped. In this study it was also found that the application of iron-containing products offered some control but was reduced to less than 40% by 10 weeks after the first treatment. Cook et al. (2002) found that products containing copper hydroxide, fatty acid soaps, or iron offered the best moss control in the cool, moist, Pacific Northwest.

Moss is becoming a more serious problem across Northwest Arkansas each year and there has been no local research to identify control strategies for this region. The objective of this study was to evaluate the moss control capabilities of several different products.

Materials and methods.

This study was conducted on a putting green at Springdale Country Club, Springdale, Ark. The green had several moss infestations that ranged in size from a few square meters to an area of approximately 14 m^2 (151 ft^2). The green was built to USGA specification and had been established with 'G-2' creeping bentgrass (*Agrostis palustris*) for approximately 5 years (Anonymous, 1993). The green was mowed daily at 3.3 mm (0.13 in.). All irrigation, fertilizer, and pesticide applications were made consistent with the remainder of the golf course.

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Treatments used in this study included Daconil Zn® (chlorothalonil) at 317 ml 100 m^{-2} (10 oz/1000 ft^2), Junction® (mancozeb + CuOH) at 121.5 g 100 m^{-2} (.2 lb/1000 ft^2 Fore® (mancozeb) at 182.8 g 100 m^{-2} (0.4 lb/1000 ft^2) , Dawn Ultrex® (household detergent) at 126.9 ml 100 m^{-2} (4 oz/1000 ft^2), DeMoss® (Fatty acid soap) at 95.2 ml 100 m^{-2} (3 oz/1000 ft^2), Zerotol® (hydrogen dioxide) at 396.5 ml 100 m^{-2} (12 oz/1000 ft^2), and ferrous ammonium sulfate at 317 ml 100 m^{-2} (10 oz/1000 ft^2). Initial treatments were made on 18 June 2002 and reapplied every 14 days. All treatments were applied to plots using a CO_2-powered sprayer equipped with a single nozzle spray wand with an even flat fan nozzle. Treatments were applied at a spray volume of 1505 l/ha-1 160 gal/A). Plot size was 0.3 m x 1.5 m (1 ft x 5 ft) and each treatment was replicated four times. The experiment was a completely randomized block design. Visual ratings of percent moss control were taken after two applications and then every 14 days throughout the study.

Results and discussion.

Throughout the duration of this study, the only treatment that provided acceptable control was Daconil® Zn, as it provided almost 100% control after two applications (Table 1). Junction® and Fore® provided 24.7 and 16.5% control, respectively, but never fully eradicated the problem. Zerotol®, Dawn®, DeMoss®, and ferrous ammonium sulfate offered minimal or no control. The turf showed no signs of injury from any of the treatments.

The results of this study were consistent with earlier reports in that Daconil® offered good control of silvery thread moss (Burnell et al., 2000; Gelertner and Stowell, 1999). However, it remains unclear why the effect of Daconil in other trials has been inconsistent (Cook et al., 2002). Treatments that had a label for moss control, such as Junction, Zerotol, and DeMoss were not effective in this study. In addition, treatments that had been reported to suppress moss, such as Dawn detergent (Kind, 1998), Junction (Cook et al., 2002) and Zerotol (Carson, 2001), were not effective in this study. Fore® and Junction® are products that both contain the active ingredient, mancozeb, but in addition to mancozeb Junction® also contains copper hydroxide which may explain its greater effectiveness for moss control. Studies have shown that copper hydroxide is an effective control for moss when applied during cool weather (Cook et al., 2002). Since this study was not initiated until warmer temperatures had occurred, it may explain the ineffectiveness of these products. Future studies on moss control are being planned for the upcoming growing season and will be reported in future issues of this research series.

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Table 1. Percent control of moss on a creeping bentgrass putting green using several commercially available products

	% Control			
Treatment	4 WAT[z]	6 WAT	8 WAT	Avg.
Daconil Zn	93.5	93.5	99.0	95.3
Junction	24.7	27.5	22.0	24.7
Fore	16.5	16.5	16.5	16.5
Zerotol	2.7	2.7	0	1.8
Fe NH4SO4	0	0	0	0
Dawn	0	0	0	0
DeMoss	0	0	0	0
LSD (0.05)	14.9	14.3	11.1	12.8

[z] WAT - weeks after initial treatment