

# Moss Control — New Products and Strategies

Promising moss control strategies for Mid-Atlantic Region putting greens.

BY PETER LANDSCHOOT, PH.D., JOSHUA COOK, AND BRADLEY PARK

**M**oss in putting greens is a curse that can frustrate golfers and even the most diligent and experienced superintendents. Moss can creep into a green almost unnoticed, until suddenly it appears as though it is taking over the entire playing surface. Chemical control measures are often harsh on turf and slow in killing the moss. However, some new products and strategies for moss control are providing relief for golf course superintendents.

Recent research at Oregon State University, Cornell University, and other research institutions revealed that two relatively new products — Junction® and TerraCyte™ provide good control of silvery thread moss (*Bryum argenteum*) when used at proper rates and application timings.<sup>1,2</sup> The objective of our research at Penn State University was to confirm if results of moss control research in other regions apply to the Mid-Atlantic region. We also wanted to determine the effects of dishwashing detergents and iron sulfate on moss control in putting greens. The following is a summary of what has been found to date.

## PRODUCT DESCRIPTIONS

Junction is a turf and ornamentals fungicide (sold by Griffin L.L.C., Valdosta, Georgia) formulated as a dry flowable containing 15% mancozeb and 46% copper hydroxide as the active ingredients. Junction currently has a FIFRA Section 2(ee) recommendation for moss control in greens, tees, and



Moss can encroach into a putting green virtually unnoticed until one day it appears to be taking over the surface.

fairways, but no information on moss control appears on the 2003 product label. The 2(ee) recommendation for curative control of moss is 4 oz. Junction/1,000 sq. ft., applied in 2 gal. of water during cool weather at 7- to 14-day intervals. The recommendation states that sequential applications are required and that seven or more applications may be necessary for good control.

TerraCyte is sold by BioSafe Systems (Glastonbury, Connecticut) and contains 34% sodium carbonate peroxyhydrate as the active ingredient. This product is available only as a very

fine granular formulation. The carrier is finely ground dolomitic limestone. Because it is so fine, it should be applied to turf with a drop-type spreader. TerraCyte is labeled for moss control in greens, tees, and fairways, and recommendations call for 8 lb. product/1,000 sq. ft. during spring or fall when temperatures are 50°F or above. Only spot treatments are recommended in summer months. The label states that subsequent applications of 2-4 lb. TerraCyte/1,000 sq. ft. can be made on consecutive days. The product should be watered into the turf immediately following application.



## MOSS CONTROL TRIALS AT PENN STATE

Moss control experiments were conducted at Penn State in 2002 and 2003 on a 20-year-old mixed stand of creeping bentgrass (*Agrostis stolonifera*) Penn-cross and annual bluegrass (*Poa annua*) maintained as a golf course putting green. The soil was a sandy loam with a pH of 6.8 and contained adequate levels of phosphorus and potassium.

Nitrogen-containing fertilizer was applied in several applications during the growing season to provide a total of approximately 3 lb. nitrogen/1,000 sq. ft. The green was mowed six times per week at a height of 0.125 inch. This green had a uniform and heavy natural infestation of silvery thread moss (average of 40% surface area infested with moss). Thus, it was an ideal site for conducting moss control studies.

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### SUMMER TRIALS

Summer moss control trials were conducted during 2002 and 2003. These trials began in mid-July with the intent of evaluating the performance of several products in the heat of the summer. Although we don't recommend trying to control moss during July and August, some superintendents spot treat for moss in summer, and we wanted to look at how different products perform during stressful summer conditions.

The summer trials included three iron sulfate treatments (0.2, 0.4, and 0.6 lb. iron/1,000 sq. ft.); two treatments of Dawn Ultra dishwashing detergent (4.0 and 8.0 oz./1,000 sq. ft.); a combination of Ivory dishwashing detergent (8.0 oz./1,000 sq. ft.) and hydrogen peroxide (8.0 oz./1,000 sq. ft.); three TerraCyte

treatments (8 lb./1,000 sq. ft. and consecutive day applications of 8+4 lb./1,000 sq. ft. and 4+4 lb./1,000 sq. ft.); and two Junction treatments (2.5 and 5.0 oz./1,000 sq. ft.). All products except TerraCyte were applied in 2 gal. of water/1,000 sq. ft. (pH 6.5) and were not watered in. The TerraCyte treatments were applied in granular form on



Junction (plot on left) was ineffective in controlling moss during summer trials, but TerraCyte (plot on right) provided good control. TerraCyte should only be used for spot treatment of moss (applied directly to moss patches and not to turf) during summer when temperatures and humidity levels are high. Broadcast applications can be made during periods of cool temperatures and low humidity.

the day after liquid treatments were applied and watered in with about 0.1 in. water (according to label directions). In 2002, treatments were first applied on July 11 and every two weeks until September 4 to provide a total of five applications. In 2003, treatments commenced on July 13 and every two weeks until August 25 to provide a total of four applications.

**Results:** Dawn Ultra, Ivory/hydrogen peroxide, and Junction treatments were ineffective for controlling moss. On the positive side, we did not observe significant injury from these treatments during the summer months. Some superintendents in Pennsylvania have had success controlling moss with multiple applications of Dawn Ultra at rates between 4.0 and 8.0 oz./1,000 sq. ft. The reason(s) for the lack of moss control with Dawn Ultra in our trials is unknown, but may involve the moss species or biotype, application procedure (drenches of Dawn may be more effective), and/or

differences in environmental conditions between golf courses where Dawn Ultra has been successful and our test site.

Treatments that *were* effective in controlling moss included iron sulfate and TerraCyte. The two highest rates of iron sulfate (0.4 and 0.6 lb. iron/1,000 sq. ft.) provided 90-95% moss control but caused unacceptable injury to the

turf. The lowest rate of iron sulfate (0.2 lb. iron/1,000 sq. ft.) provided 75% control of moss and caused only slight blackening, but no turf thinning. The black turf color diminished within two to three mowings. The TerraCyte treatment that was most effective in controlling moss with the least amount of injury was 8 lb./1,000 sq. ft. every two weeks (78% control in 2002 and 52%

control in 2003). All TerraCyte treatments produced some foliar injury following applications during high-humidity conditions.

### FALL TRIAL

The fall trial was conducted during 2002 beginning in mid-October and continuing into December. Treatments were applied every two weeks for a total of five applications. Treatments included iron sulfate (0.2 lb. iron/1,000 sq. ft.), TerraCyte (8 lb./1,000 sq. ft. and consecutive day applications of 8+4 lb./1,000 sq. ft. and 4+4 lb./1,000 sq. ft.), and Junction (5.0 oz./1,000 sq. ft.). All liquid products were applied in two gallons of water/1,000 sq. ft. and were not watered in. The TerraCyte treatments were applied in granular form on the day after liquid treatments were applied and watered in with about 0.1 inch water.

With Junction, we followed the approach used by Tom Cook and



associates at Oregon State University in which 4.5–6.6 oz. Junction/1,000 sq. ft. (0.1 to 0.15 lb. copper/1,000 sq. ft.) was applied beginning in October and repeated every two weeks to provide five to seven applications.<sup>1</sup> Because snow cover sometimes prohibits spray treatments in late December in central Pennsylvania, we made only five applications.

**Results:** The iron sulfate treatment (0.2 lb. iron/1,000 sq. ft.) provided about 45% moss control, with no serious injury. The 8 lb./1,000 sq. ft. TerraCyte treatment provided the best control (about 80%) and the least injury of all the TerraCyte treatments. As in the summer trials, some foliar injury was noticed

following TerraCyte applications during high-humidity conditions. The most effective treatment in the fall trial was Junction at 5.0 oz./1,000 sq. ft., providing 100% control of moss. Although some yellowing was observed in early spring on turf treated with Junction in fall, the turf fully recovered following two to three mowings. Yellowing of turf has been reported in other studies using fall applications of Junction, and this effect has been implicated as copper-induced iron chlorosis.<sup>1</sup>

## SUMMARY

Results of our studies are similar to those obtained at Oregon State University and Cornell University.<sup>1,2</sup> Junction was ineffective in controlling moss during the summer months, but provided excellent control at 5 oz./1,000 sq. ft. when applied in mid-October and every two weeks for a total of five applications. It is interesting to note that

no moss control was observed with Junction during the period of treatment applications in fall. Control (dead moss) was not observed until the following spring. In our trial, the turf quickly filled in areas containing dead moss once vigorous growth commenced in spring. We are not sure if the yellowing associated with fall applications of



Junction (plot on right) provided 100% control of moss following five applications in fall at 5 oz./1,000 sq. ft. The pitted appearance of the Junction plot is due to patches of dead moss. The plot on the left is an untreated control plot. No injury to moss was observed during the fall, and dead moss was not evident until the following spring.

Junction was due to copper-induced phytotoxicity or a copper-induced iron deficiency. Regardless of the cause, the effect was temporary and did not cause thinning of the turf. Another factor that can potentially affect Junction efficacy is the pH of spray tank water. If the pH of spray tank water is basic, efficacy may be compromised.<sup>2</sup> In our trials, the pH of the spray tank water was 6.5 and did not appear to negatively influence moss control.

TerraCyte at 8 lb./1,000 sq. ft. (four to five applications, two weeks apart) provided good, but not complete control of moss in summer and fall. Although some foliar injury occurred following treatment applications during humid conditions (both summer and fall), the turf recovered following several mowings. Injury resulting from the 8+4 lb./1,000 sq. ft. consecutive day treatment was more severe, and caution should be exercised if using this approach.

Although the purpose of this article is to provide a brief update on chemical control practices, we would be remiss if we did not mention that chemical control strategies must be accompanied by changes in the cultural conditions that allowed moss to encroach into the greens. The most obvious culprits, low nitrogen levels, aggressive mowing practices, and liberal irrigation, can usually be adjusted to allow turf to compete with the moss — at least to some reasonable degree. Other causes of moss encroachment, poor drainage, persistent disease problems, shade, excessive traffic, and poor air circulation, represent a greater challenge. If the major causes of moss encroachment are not dealt with, even the best chemical control

program will not prevent the moss from coming back.

## ACKNOWLEDGEMENTS

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