Curative Control of Surface Algae on Golf Greens

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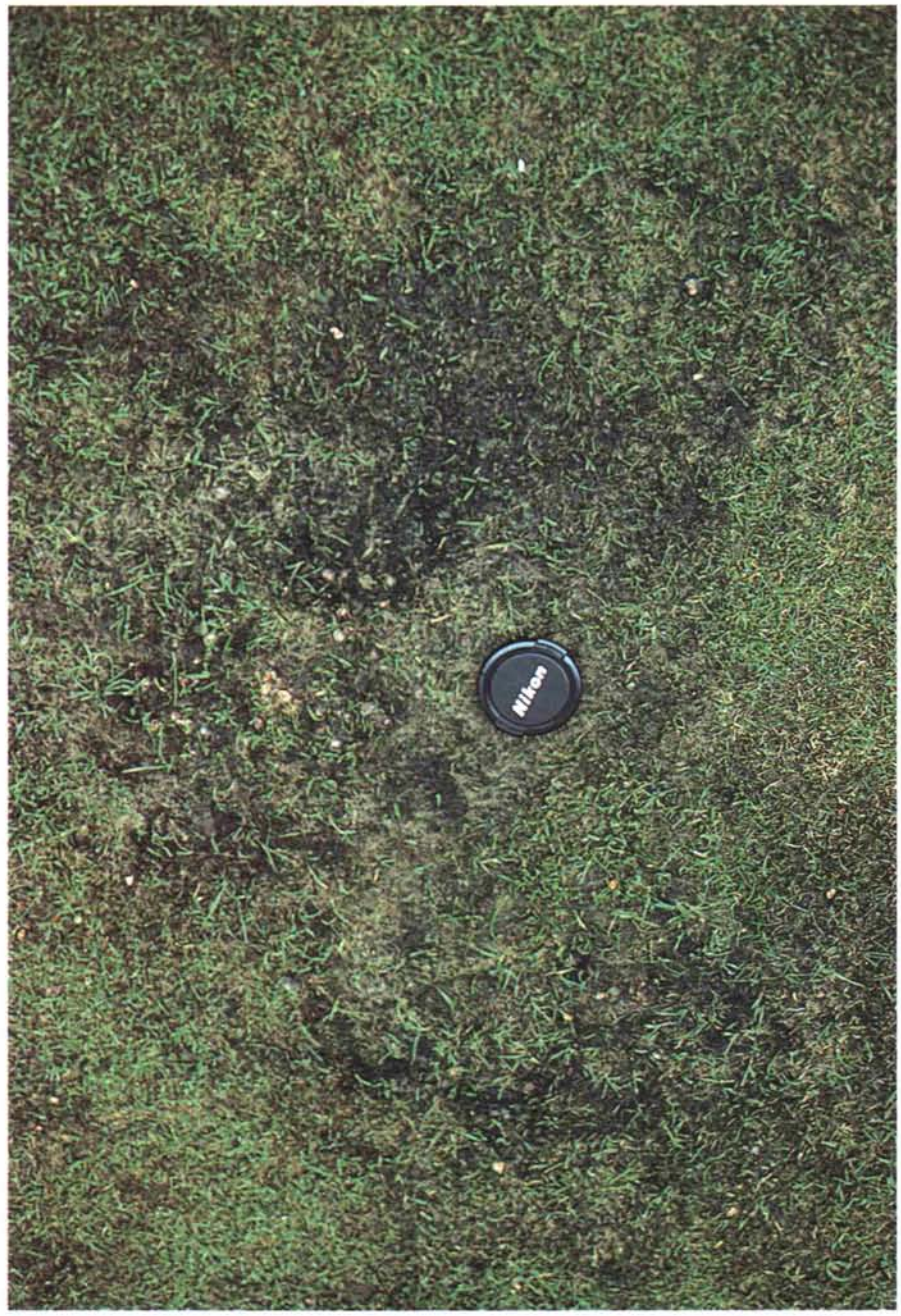

Populations of green and blue-green algae can form layers of slime and crust on the surface of golf greens. These layers disrupt the uniformity of the turfgrass foliar canopy, resulting in an undesirable surface for accurate and precise putting. Algal slime and crust are usually pronounced on areas of greens where the penetration of sunlight through the turfgrass canopy is sufficient to stimulate photosynthesis and subsequent growth of algal cells. In other words, any factor that decreases the density of the turfgrass canopy (e.g., disease, chemical toxicity, mechanical wear) can lead to an intense growth of algae on the root zone surface of a golf green.

In addition to light, moisture and nutrients are required for algal growth. However, the latter two factors do not appear to be as limiting as light for algal development on the root zone surface of greens (see above). We have observed heavy infestations of algae on a green where the turf was thinned due to low soil moisture and nutrients (i.e., no irrigation or fertilizer applications for weeks). This suggests that algae are tolerant to a variety of environmental conditions, and the idea that these organisms will proliferate only in areas of high moisture is exaggerated.

Although most golf greens contain sufficient plant nutrients (N, P, K and minor elements) to support the growth of algae, retention of these nutrients on the surface of root zones may stimulate excessive algal development. In an experiment designed to compare the effect of an organic fertilizer (composted poultry litter) with an inorganic source of nitrogen (ammonium nitrate) on the severity of brown patch disease, we observed that unacceptable amounts of algal slime developed in plots of bentgrass treated with the organic nitrogen, but not the inorganic. We postulated that the slow decomposition of the organic fertilizer, and subsequent retention of nutrients on the surface of the green, served as a "food

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source" for algae. Whereas, the solubility of the ammonium nitrate allowed it to percolate into the root zone and become less available to algal cells on the surface of the green. Further research needs to be conducted on fertilizers and algae.

The application of ergosterol demethylation inhibitor (DMI) fungicides such as Banner, Bayleton, Eagle, Rubigan and Sentinel is another factor that may induce or enhance the intensity of surface algae on golf greens. Results of studies conducted in Georgia in 1995 showed that the amount of surface algae was greater in plots of bentgrass treated for brown patch with DMI fungicides when compared with untreated plots or plots treated with Daconil (1). At application rates for brown patch control, DMI fungicides have a growth regulatory effect on creeping bentgrass at temperatures above 85°F. This effect results in an open turfgrass canopy that allows sunlight to penetrate to the root zone surface, stimulating growth of algae. The growth regulatory effect is not evident when DMI fungicides are applied under cooler temperatures in the spring and the fall (1).

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In 1996 and 1997, studies were conducted at the University of Georgia to identify products that provided preventive control of algae when applied to a creeping bentgrass golf green (2, 3). The results indicated that regular

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Table 1.
Effect of fungicides and algicides
on curative control of surface algae
on a creeping bentgrass green at Griffin, GA - 1998

Treatment	Interval[x]	Rate[w,x]	% Algae					
			8/19	8/26	9/2	9/9	9/16	9/22
Fore 80 WP	14 day	8.0 oz.	14.lb[y]	8.2b	11.7c	1.2b	1.8c	4.1b
Daconil Ultrex	14 day	3.8 oz.	8.2c	5.9c	11.7c	0.6b	1.2c	2.9b
Daconil Zinc	14 day	6.0 oz.	4.7c	7.0b	7.6c	0.0b	0.6c	1.2b
Heritage	28 day	0.4 oz.	12.9b	8.2b	16.4b	2.3a	2.9b	5.3b
Consyst	14 day	4.0 oz.	7.0c	5.9c	8.2c	0.6b	1.2c	4.1b
Prostar	21 day	3.0 oz.	12.9b	9.4b	18.7b	2.3a	2.9b	3.5b
Banner MAXX	21 day	1.0 oz.	12.9b	7.6b	21.lb	4.1a	2.9b	10.5a
Potassium sorbate	14 day	6.0 oz.	16.4b	14.1a	28.1a	5.9a	4.1a	10.5a
PS 598 G	14 day	7.0 oz.	11.7b	9.4b	18.8b	3.5a	2.9b	8.2a
Calcium hydroxide	14 day	16.0 oz.	4.1c	1.8d	4.1d	0.0b	1.2c	2.9b
QuickStop	14 day	1.6 oz.	12.9b	9.4b	16.4b	2.9a	2.3b	11.7a
Junction	14 day	4.0 oz.	0.6c	0.6d	1.8d	0.0b	0.0c	0.0b
Junction	14 day	8.0 oz.	0.6c	0.6d	0.0d	0.0b	0.0c	0.0b
Copper Sulfate	—[z]	2.0 oz.	—	5.9c	2.3d	1.8b	1.2c	0.6b
Control	—	—	25.8a	16.4a	32.8a	2.9a	5.3a	12.9a

[w]Listed as ounces of product per 1,000 sq ft. unless indicated otherwise.
[x]Application dates 14 day - 8/12, 8/26, 9/9
21 day - 8/12, 9/2
28 day - 8/12, 9/9
[y]Within a column, values followed by the same letter are not significantly different at ∝ = 0.05 according to the Scott-Knott cluster analysis procedure.
[z]Copper sulfate was applied on 8/19, 8/26, 9/9.

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applications (every 14 days) of either calcium hydroxide (16 oz./1,000 sq. ft.) or the fungicides Fore (8 oz./1,000 sq. ft.), Daconil Ultrex (6 oz./1,000 sq. ft.) or Daconil Zinc (6 oz./1,000 sq. ft.) provided good to excellent preventive control of surface algae. Applications of the algicide Quickstop (Algamec) every 14 days or sand topdressing every three-four weeks provided marginal to poor preventive control of algae.

In 1998, a study was initiated to determine the effects of various treatments on curative control of algae on golf greens. Preliminary results of this study are presented here.

Materials and Methods

An algae control trial was conducted on an eight-year-old stand of creeping bentgrass cv. Penncross at the Georgia Experiment Station, Griffin, GA, during the summer of 1998. The turfgrass was maintained at a height of 5 mm by mowing three times per week. Turfgrass cultural practices were similar to those used in maintenance of bentgrass golf greens in Georgia. Treatments (Table 1) were arranged as plots (1 x 1 m) in a randomized complete block design with four replications.

Blooms of blue-green algae (primarily Oscillatoria spp.) were induced on the surface of the bentgrass root zone by pretreatment with DMI fungicides (Bayleton 25WP and Banner MAXX 1.1E) and applications of an organic fertilizer (Sustane). In addition, the plots received approximately 13 mm of overhead irrigation nightly to provide wet conditions for algal growth.

Initial applications of fungicides and algicides were made on August 12, 1998 in 7 liters of water per 100 m^2 with a wheel-mounted, CO_2-pressured boom sprayer at 138 kPa. Subsequent applications were made at 14-, 21- or 28-day intervals from the initial application date.

Junction at the 4.0 and 8.0 oz. rates, and copper sulfate at 2.0 oz., were the only treatments that provided acceptable suppression (<3% algae) for the duration of the study.

Visual estimates, using the Horsfall-Barrett rating scale, of that percentage area of each plot covered with algae were made at approximately seven-day intervals from the initial application date. Values were subjected to analysis of variance and means were statistically separated using the Scott-Knott cluster analysis procedure.

Results

Algae covered approximately 12% of plot surfaces on August 12, prior to the first applications of fungicides and algicides. After this date, the intensity of algal coverage was light to moderate, ranging from 2.9% to 32.8% in untreated control plots (Table 1). At the peaks of algal coverage (August 19 and September 2), all treatments, except potassium sorbate, provided significant suppression of algae. Junction at the 4.0 and 8.0 oz. rates, and copper sulfate at 2.0 oz., were the

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only treatments that provided acceptable suppression (<3% algae) for the duration of the study. The active ingredients in Junction are mancozeb and copper hydroxide. Daconil Zinc, Consyst and calcium hydroxide provided marginally acceptable control (<10% algae), while the remaining treatments failed to suppress algae to acceptable levels.

Conclusions

Algal slime and crust will usually develop at any location on a golf green where the turfgrass foliar canopy is too thin to prevent light from reaching the surface of the root zone. Based on the results of our studies, plus some general observations made over the last three years, the following recommendations are provided for algae control on golf greens. Keep in mind that these recommendations will probably change as we learn more about algae.

1. Decrease shade and increase air circulation around greens.

2. Allow the surfaces of greens to dry completely between irrigation events. Avoid irrigation in late afternoon and in evening prior to midnight.

3. Spike greens and topdress every three-four weeks to promote surface drying.

4. Control diseases and other stresses that lead to an open turfgrass canopy.

5. Avoid using DMI fungicides (Banner, Bayleton, Sentinel, Eagle, Rubigan) at moderate to high label rates during summer months. Use only low label rates and do not apply more frequently than once a month.

6. As a preventive algae control, apply fungicides that contain chlorothalonil (e.g., Daconil, Consyst, Thalonil) or mancozeb (e.g., Fore) at brown patch rate every two weeks.

7. As a curative control for algae, apply Junction at 4.0 oz./1,000 sq. ft. or calcium hydroxide at 16 oz./1,000 sq. ft. Warning: Regular, repeated applications of Junction and calcium hydroxide should be avoided until we learn more about their potential long-term effects on turfgrass growth.

Literature Cited
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