Cultural practices to minimize dollar spot on creeping bentgrass

Daily mowing at the appropriate time can significantly reduce the occurrence of dollar spot.

Figure 1. Field study test plots were located at the Minnesota Agricultural Experiment Station in St. Paul. **Photo by A. Ellram**

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Dollar spot disease caused by the fungus *Sclerotinia homoeocarpa* F.T. Bennett is the most economically important disease on amenity turfgrasses in the United States (6). The fungus infects turfgrasses at temperatures from 59 F to 86 F (15 C to 30 C) (5), allowing growth and spread of dollar spot for a large portion of the growing season with several infection cycles on turfgrasses each year. *Sclerotinia homoeocarpa* attacks both warm- and cool-season species, and damage is most severe on low-cut, highly maintained sites.

One important cultural method of reducing plant diseases is to reduce leaf wetness duration. Leaf wetness duration provides a favorable environment for fungal penetration of leaf tissues, and as leaf wetness duration increases, so does the severity of dollar spot and other fungal diseases (3,4,7,8).

We undertook a field study (Figure 1) and a controlled environment study to determine the effects of cultural practices on controlling dollar spot and the influence of leaf wetness duration on the development of dollar spot on Penncross creeping bentgrass.

Field study

Objectives

The objectives of the field study were to determine whether mowing at different times (4 a.m., 10 a.m. or 10 p.m.) alters leaf wetness duration and affects dollar spot incidence on creeping bentgrass/annual bluegrass turf; whether mowing frequency (daily or on alternate days) affects dollar spot incidence; whether using a squeegee to remove dew affects dollar spot incidence as effectively as mowing; whether the sharpness of the mower blade used to cut turf affects the incidence of dollar spot; and finally, to determine the effect of leaf wetness duration of six, 12 and 18 hours on dollar spot development on creeping bentgrass.

Site preparation

This study was conducted on established turf at the Minnesota Agricultural Experiment Station in St. Paul in 2004 and 2005. Study dates were Aug. 2-Sept. 9, 2004, and July 29-Sept. 7, 2005. The turf was approximately 90% Penncross creeping bentgrass (*Agrostis stolonifera* Huds.) and 10% annual bluegrass (*Poa annua* L.). Soil on the site is categorized as a Waukegan silt loam.

Fertilizer applications on this site, which were made in 2004 before the study began, consisted of 0.5 pound/1,000 square feet (24 kilograms/hectare) of urea nitrogen on May 5, 0.75 pound/1,000 square feet (36.5 kilograms/hectare) of methylene urea nitrogen on May 27 and July 2, and 0.25 pound/1,000 square feet (12 kilograms/hectare) of ammonium nitrate on July 28. In 2005, methylene urea nitrogen fertilizer was applied before the study period at rates of 0.5 pound/1,000 square feet (24 kilograms/hectare) on June 8, and 0.37 pound/1,000 square feet (18 kilograms/hectare) on June 25 and July 13.

Plots were irrigated as needed to prevent drought stress. Irrigation was applied during midday hours only so as not to confound leaf wetness duration.

The experiment was set up as a completely randomized design with four replications for a total of 64 plots.

Before beginning mowing treatments, 60 plots, each 4.9 × 9.8 feet (1.5 × 3 meters), were artificially inoculated with *S. homoeocarpa*-infected millet seed. Four plots were left as uninoculated controls.

Treatments

Three different methods were used to remove dew from turf: mowing with a dull Toro 1000 walking greensmower adjusted so no contact was made between the reel and bedknife; mowing with a sharp Toro 1000 walking greensmower that cleanly cut standard printer paper placed between reel and bedknife; and pulling a 17.7-inch (45-centimeter) floor squeegee over plots (on alternate days in combination with mowing with a sharp mower) (Table 1).

Each treatment was conducted at three different times per day (4 a.m., 10 a.m. and 10 p.m.). Treatments were made daily or on alternate days to test for the effect of treatment frequency. All plots were mowed at 0.63 inch (16 millimeters) throughout the study, and clippings were collected. As a control, four plots were not inoculated and were mowed on alternate days with the sharp Toro 1000 walking greensmower.

Mowing treatments were initiated Aug. 5, 2004, and Aug. 3, 2005. Mower adjustment was checked frequently, with alterations and sharpening performed as needed. All treatments were conducted regardless of weather conditions. Clippings were collected, and mowers were washed at the end of each treatment period (4 a.m., 10 a.m. and 10 p.m.) but not between treatments in a given period.

Data collection

Air temperature, relative humidity and leaf wetness data were collected for later use in estimating leaf wetness duration. Leaf wetness duration was estimated two ways. The first method used a model that predicts leaves are wet when relative humidity is greater than or equal to 90% (4). The second method used a sensor grid to estimate leaf wetness.

After the plots were inoculated, the amount of diseased area in each plot was assessed approximately every seven days. Disease assessment dates were Aug. 13, 20, 27; Sept. 3 and Sept. 9, 2004; and Aug. 12, 19, 27; Sept. 2 and Sept. 7, 2005.

Two digital images, approximately 10.8 square feet (1 square meter) in size, were taken of each plot on each assessment. A 3.3-foot × 3.3-foot (1-meter × 1-meter) frame was used in photographing plots, and data were collected from the same area of each plot. Images were saved for later analysis. Captured images of plots were individually evaluated for percent infected tissue.

Controlled environment study

Materials and methods

To determine the influence of leaf wetness duration on the development of dollar spot on Penncross creeping bentgrass, we used three fully enclosed mist

Disease vs. mowing time

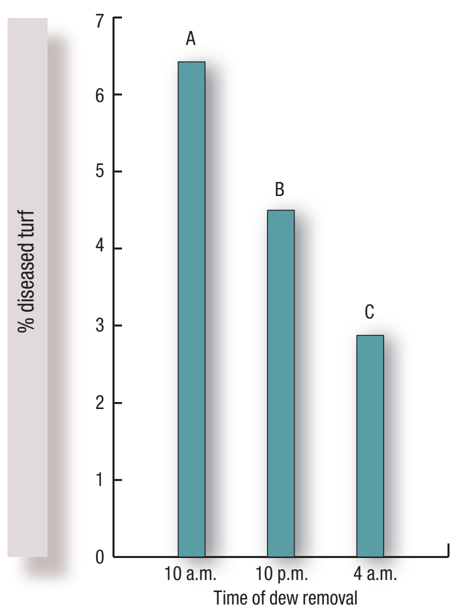

Figure 2. Mean percent diseased area for each mowing time for all data collection dates. Each mean is averaged across all dew removal times and dew removal methods. Means with different letters are significantly different from each other.

Field study treatments

Treatment	Inoculated	Mowing time	Mower adjustment	Dew removal method	Treatment frequency
1	yes	4 a.m.	sharp	mower only	daily
2	yes	10 a.m.	sharp	mower only	daily
3	yes	10 p.m.	sharp	mower only	daily
4	yes	4 a.m.	dull	mower only	daily
5	yes	10 a.m.	dull	mower only	daily
6	yes	10 p.m.	dull	mower only	daily
7	yes	4 a.m.	sharp	mower 3 times squeegee 4 times	daily (alternate methods)
8	yes	10 a.m.	sharp	mower 3 times squeegee 4 times	daily (alternate methods)
9	yes	10 p.m.	sharp	mower 3 times squeegee 4 times	daily (alternate methods)
10	yes	4 a.m.	sharp	mower only	3 times/week
11	yes	10 a.m.	sharp	mower only	3 times/week
12	yes	10 p.m.	sharp	mower only	3 times/week
13	yes	4 a.m.	dull	mower only	3 times/week
14	yes	10 a.m.	dull	mower only	3 times/week
15	yes	10 p.m.	dull	mower only	3 times/week
16	no	10 a.m.	sharp	mower only	3 times/week

Table 1. Treatment combinations for all dollar spot mowing study plots.

Figure 3. The incidence of dollar spot on turf mowed at 4 a.m. (left) was much lower than on turf mowed at 10 a.m. (right). **Photo by A. Ellram**

chambers, where an ultrasonic mister maintained relative humidity at 90% to 100%, and temperature was maintained at 71.6 F-84.2 F (22 C-29 C).

Penncross creeping bentgrass was established in the greenhouse from seed in a commercial growing medium in 3.5-inch × 3.5-inch (9-centimeter × 9-centimeter) pots. Seed was sown at a rate of 0.6 pound/1,000 square feet (3 grams/square meter). Grass was mowed weekly at 0.63 inch (16 millimeters). All samples were maintained in a greenhouse at 59 F-82.4 F (15 C-28 C) for six weeks before initiating the experiments. Plants were fertilized 14 days before the study at a rate of 100 ppm nitrogen, using Plantex 17-5-19 Poinsettia Fertilizer.

Each pot of creeping bentgrass was inoculated with Penncross clippings infected with *Sclerotinia homoeocarpa*. Pots were immediately placed in the mist chamber, and mist was run continuously until moisture was apparent on the leaf tissue.

Disease vs. treatment

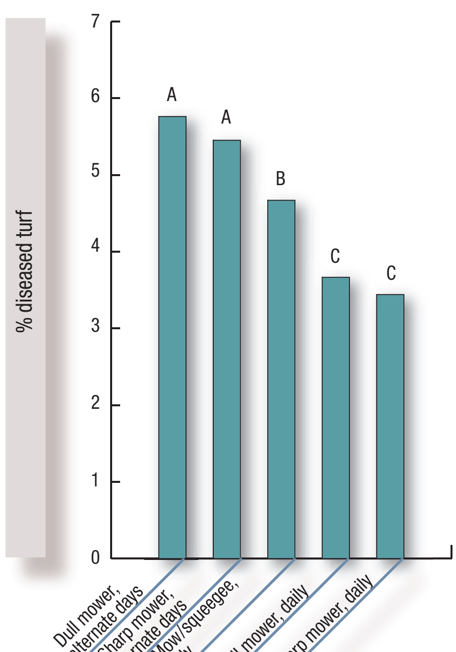

Figure 4. Actual mean percent diseased area for each of five treatment combinations and all data collection dates. Each mean is averaged across all dew removal times and dew removal methods. Means with different letters are significantly different from each other.

Study design

Ten individual pots (five inoculated and five non-inoculated controls) were placed into each of the mist chambers. Experiments lasted seven days and were repeated four times. Each mist chamber's was set to interrupt the leaf wetness period after either six, 12 or 18 hours of mist. Leaf wetness was interrupted every six, 12 or 18 hours by blotting pots with paper towels. After blotting, pots were kept in a dry chamber for the remainder of the 24-hour period until the cycle was repeated. Each set of 10 pots was rotated so that each set was placed in every one of the three chambers once a day.

Disease was scored seven days after inoculation. Dollar spot lesion diameter (in millimeters) was measured, and digital images were taken of all treated and control pots.

Results and discussion

Dew removal

Treatment timing had the most notable effect on dollar spot control. Treaments conducted at 4 a.m. significantly reduced dollar spot compared to treatments conducted at 10 a.m. and 10 p.m., and 10 p.m. treatments significantly reduced dollar spot compared to treatments at 10 a.m. (Figure 2).

When plots were mowed and/or dew was removed with a squeegee at 4 a.m. or 10 p.m., the period of leaf wetness was interrupted, resulting in a shorter duration of continuous leaf wetness and, therefore, a lower level of dollar spot disease. Dew typically set at approximately 9 p.m.-10 p.m. and lifted at 10 a.m. Therefore, removing dew at 4 a.m. typically divided the period of continuous leaf wetness in half, resulting in less dollar spot. The 10 p.m. treatments likely reduced the leaf wetness duration only slightly by directly removing early-setting dew on some evenings and possibly delaying dew set on other evenings. The 10 a.m. treatments probably had little or no effect on leaf wetness duration because dew had already dissipated by the time plots were mowed (Figure 3).

Removing dew every day reduced disease significantly more than treating on alternate days, regardless of the method of dew removal (Figure 4). Daily treatment reduced dollar spot because leaf wetness duration was consistently shorter. Treatments on alternate days allowed longer uninterrupted periods of leaf wetness and resulted in higher dollar spot incidence (Figure 4).

Mower blades

Some differences in dollar spot incidence were attributed to the method of dew removal. When data from all dates and treatment times were averaged, there was no significant difference in dol-

Lesion size vs. wetness duration

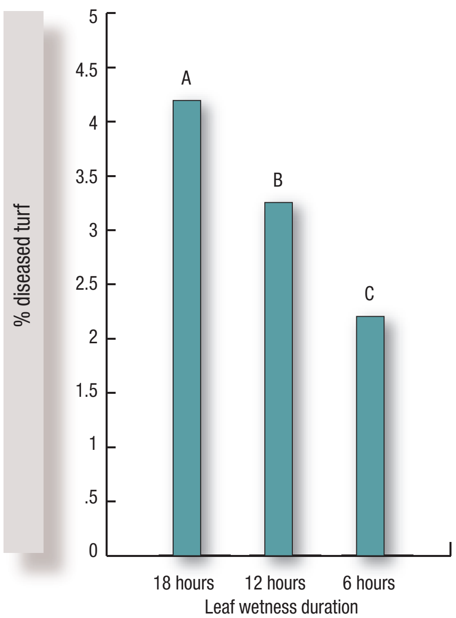

Figure 5. Mean dollar spot lesion diameter measured at six, 12 and 18 hours of leaf wetness duration (number of hours of leaf wetness daily). Means with dissimilar leaf wetness duration times were significantly different.

lar spot incidence between plots that were mowed with a sharp mower blade rather than a dull one. These results seem to contradict the belief that dull mowers increase dollar spot by shredding tissue, weakening the plant and leaving more wounded tissue open to pathogen invasion (2).

Squeegee vs. mowing

Using a squeegee on alternate days was not as effective as mowing in reducing dollar spot. However, removing dew with a squeegee on alternate days reduced dollar spot significantly compared to not removing dew at all on alternate days.

Controlled environment experiment

The mist chamber experiment provided additional data to support the hypothesis that reduced leaf wetness duration results in less dollar spot on creeping bentgrass. Overall, mean lesion diameter increased significantly as leaf wetness duration increased from six to 18 hours (Figure 5).

The results of this experiment are supported by several other studies that indicated increased incidence/severity of fungal diseases of turfgrass as leaf wetness duration increased (3,7,8).

Summary

Timing dew removal so that it divides the length of continuous leaf wetness in half and minimizes leaf wetness duration was most effective in reducing dollar spot. For dew removal, mowing was more effective than dragging a squeegee. Daily dew removal substantially reduced dollar spot as compared to dew removal on alternate days. This information should help superintendents design mowing and dew removal programs that significantly reduce the incidence of dollar spot.

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The research says

➔ **Field studies were** conducted in 2004 and 2005 to discern the effects of time, method and frequency of dew removal on the incidence of dollar spot on fairway-height creeping bentgrass.

➔ **Mowing with either** a sharp or a dull reel mower reduced dollar spot more effectively than alternating mowing with using a squeegee to remove dew.

➔ **Removing dew to** minimize uninterrupted leaf wetness duration was most effective in reducing dollar spot.

➔ **Dull mower blades** were as effective as sharp ones in reducing dollar spot.

➔ **Mowing at 4 a.m.** daily was the most effective treatment for reducing dollar spot in both years.