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TURFGRASS TRENDS

DISEASE CONTROL

CaSi Doesn't Strengthen Creeping Bent, Tall Fescue against Foliar Disease

By Jack Fry, Qi Zhang, Kathy Lowe and Ned Tisserat

Some researchers report that one potential tool for reducing fungicide requirements on turfgrasses may be the use of silicon (Si) fertilizers. Silicon has been reported to suppress diseases on various crops in the last decade (Raid et al., 1992; Chérif et al., 1994; Deren et al., 1994; Seebold et al, 2000; Seebold et al., 2001).

Researchers in North Carolina found that brown patch and dollar spot on creeping bentgrass were reduced approximately 20 percent and 30 percent, respectively, when soluble potassium silicate (21 percent SiO_2) at 0.5 pounds per 1,000 square feet was applied (Uriarte et al., 2004). However, in that study measurable increases in potassium but not Si occurred in creeping bentgrass leaves.

Gray leaf spot on St. Augustinegrass was reduced 9 percent to 28 percent by Si alone (100 pounds per 1,000 square feet) and 59 percent to 68 percent with the com-

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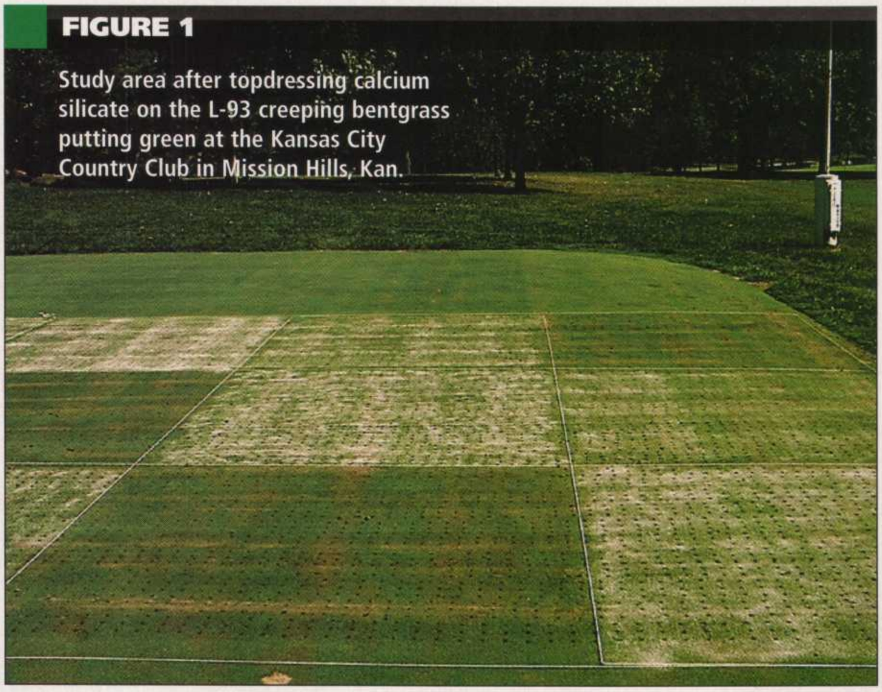
FIGURE 1



Study area after topdressing calcium silicate on the L-93 creeping bentgrass putting green at the Kansas City Country Club in Mission Hills, Kan.

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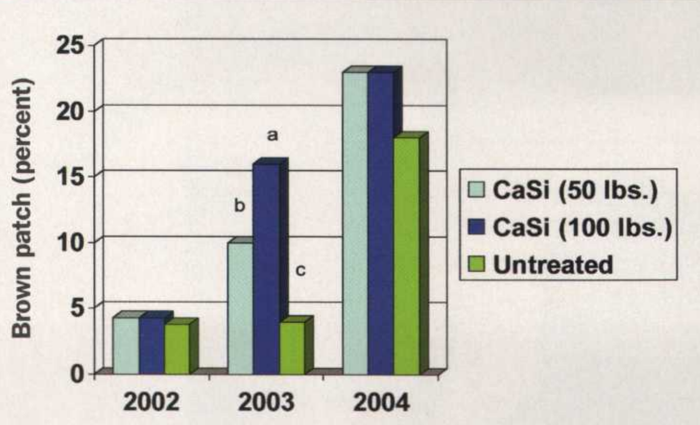
FIGURE 2



Brown patch on L93 creeping bentgrass as affected by calcium silicate at the Kansas City Country Club. Rates indicate amounts applied per 1,000 square feet. Data were collected in August 2002 and 2003 and July 2004. No differences occurred in 2002 or 2004. All treatments were different ($P<0.05$) in 2003.

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bination of Si and the fungicide Daconil (Brecht et al., 2004).

It is believed that Si may reduce foliar diseases by creating a physical barrier to restrict fungal hyphae penetration (Kim et al., 2002). Alternatively, Si may serve to encourage the accumulation of other chemicals in the plant that confer resistance. (Chérif et al., 1992a; Chérif et al., 1992b).

We conducted field experiments to evaluate the potential for calcium silicate ($CaSiO_3$) topdressing to reduce dollar spot on creeping bentgrass and brown patch reduction on creeping bentgrass and tall fescue.

Methods

Creeping Bentgrass: This experiment was conducted on an L-93 creeping bentgrass nursery putting green at the Kansas City Country Club in Mission Hills, Kansas (Fig. 1).

L-93 creeping bentgrass was seeded in March 2002 on a rootzone consisting of 98 percent sand and 2 percent clay. Soil pH was 6.9, and phosphorus (P) and potassium (K) levels were 20 and 25, respectively (Brown, 1998). Soil Si level when tested in untreated plots in 2003 was 2.9 $mg\ kg^{1}$ (milligrams per kilogram, or ppm). Treatments included two levels of $CaSiO_3$ application and untreated turf.

Calcium silicate (31 percent SiO_2, 22 percent calcium [Ca]) was uniformly applied using a hand-held shaker bottle at 50 pounds or 100 pounds per 1,000 square feet on May 24 and Sept. 26, 2002; April 4 and Aug. 15, 2003; and May 4, 2004. Prior to $CaSiO_3$ application, the study area was core aerified.

Nitrogen from a combination of granular and liquid quick-release fertilizers was used throughout each year to provide a total of about 6 pounds of nitrogen (N) per 1,000 square feet. Turf was mowed at 0.118 inches every other day and watered as needed.

Data were collected on turfgrass visual quality, brown patch severity (percentage of brown patch infested area), dollar spot, levels of N, P, K, Ca, Si in leaves and Si levels in soil. Visual quality and brown patch severity were measured once in August in 2002 and 2003 and in July 2004 when the disease was most active in the field.

Tall Fescue: This study was conducted on a 1-year old stand of Tarheel and Bonsai II tall fescue at the Rocky Ford Turfgrass Research Center in Manhattan, Kan. Responses of cultivars to $CaSiO_3$ application were similar and data are averaged over both. Soil was a silt loam and tests indicated a pH of 6.4 and P and K levels of 41 and 367 $mg\ kg^{1}$, respectively, and an initial Si content of 173 $mg\ kg^{-1}$. Turfgrass was mowed at 7.5 cm twice weekly and watered as needed.

Urea (4600) was applied to provide N at 1 pound per 1,000 square feet on April 17, May 3 and Sept. 18, 2002; May 5 and 29 and Sept. 22, 2003.

Calcium silicate was applied at the same rates as in the creeping bentgrass experiment on May 29 and Oct. 10, 2002, and May 14 and Sept. 29, 2003. In addition, a treatment consisting of the fungicide Prostar at 2.2 oz. per 1,000 square feet was applied on 21-day intervals with a CO_2 pressurized sprayer at 30 psi in water equivalent to 87 gallons per acre. The initial Prostar application was made the last week of May in each year and the final application the last week of September.

Data were collected on turfgrass visual quality, leaf N, P, K and Ca concentrations and Si concentration in leaves and soil. Turfgrass visual quality was rated once weekly on a 0 to 9 scale, where 0 = dead turf; 6 = acceptable quality for a home lawn; and 9 = optimum color, density and uniformity. The percentage

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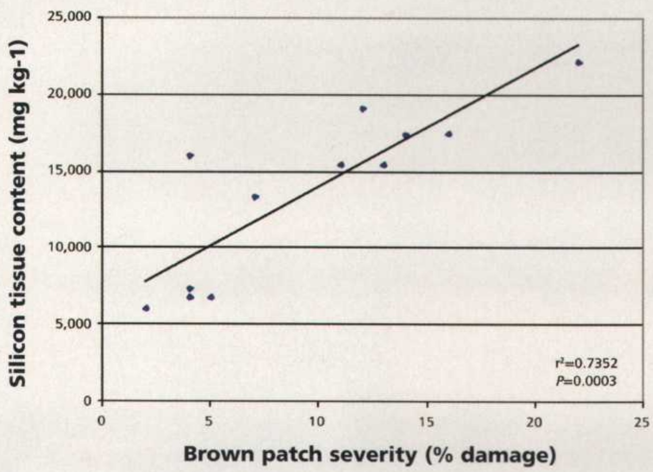
FIGURE 3



Correlation between Si tissue content in L93 creeping bentgrass and brown patch severity in August 2003 in a field experiment at the Kansas City Country Club.

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of each plot infested with brown patch was rated visually each week and analyzed using Area Under the Disease Progress Curve (AUDPC) that allows comparison of treatments using a whole season data summary (Campbell and Madden, 1991).

Leaf nutrient concentration was determined by collecting clippings with a rotary mower on Aug. 2 and Oct. 10, 2002; and May 14, Aug. 20 and Oct. 5, 2003, and using standard laboratory methods. Four soil cores (0.6-inch diameter and three inches deep) were randomly sampled in each plot on the same dates as leaf tissue sampling in 2003.

Results

Creeping Bentgrass: Topdressing creeping bentgrass with $CaSiO_3$ increased soil Si levels on three of four sampling dates over three years and leaf Si levels on each of seven sampling dates over the same period.

Calcium levels in leaves increased on five of seven sampling dates. Brown patch was observed in all three years with the highest pressure observed in untreated plots in 2004, when 23 percent of the plot area was affected. Despite higher soil and leaf Si levels, brown patch severity was not reduced.

In contrast, brown patch increased with $CaSiO_3$ topdressing level in 2003, with 4 percent infection in untreated turf and 23 percent infection in turf receiving $CaSiO_3$ at 50 or 100 pounds per 1,000 square feet (Fig. 2). There was a positive correlation between brown patch severity and Si tissue level on this date (Fig. 3).

Brown patch was not correlated to levels of other nutrient levels measured in leaf tissue, however. A higher percentage of brown patch infection was observed in creeping bentgrass with higher Si tissue contents.

Dollar spot was observed only in July 2004, but there were no differences in the number of infection centers among $CaSiO_3$-treated and untreated turf.

Levels of N, P and K declined in creeping bentgrass leaves as Si tissue levels increased. Nevertheless, levels of all three nutrients were in the sufficiency range throughout the experiment (Waddington, 1989). Turf quality was unacceptable in all three years (quality <5), due mainly to the presence of brown patch.

Tall Fescue: Application of $CaSiO_3$ increased soil levels of Si but raised tall fescue leaf Ca and Si levels on only one of five sampling dates. Only tall fescue treated with Prostar exhibited less brown patch than untreated turf and had acceptable quality throughout both years (Fig. 4).

Tall fescue treated with $CaSiO_3$ at 100 pounds per 1,000 square feet exhibited 23 percent and 26 percent more brown patch than untreated turf in 2002 and 2003, respectively. Tall fescue receiving $CaSiO_3$ at 50 pounds per 1,000 sq. ft. had 30 percent more brown patch than untreated turf in 2003.

We observed that P and K tissue contents were lower in turf treated with $CaSiO_3$ than untreated turf in August, 2002 and 2003, respectively. The consequences of tissue nutrient imbalances created by Si are unknown.

Summary

Initial soil Si levels seemed to play a primary role in whether differences in Si leaf levels were observed. In the tall fescue study, Si soil content in an untreated silt loam soil was 173 mg kg^{-1} and few differences in Si leaf level were observed after $CaSiO_3$ application. In the creeping bentgrass study, initial soil levels were 2.9 mg per kg, and Si leaf accumulation occurred.

Other researchers reported that soluble Si applications helped to reduce leaf spot in bermudagrass and gray leaf spot in St. Augustinegrass in Si-deficient soil (10 mg per kg) (Datnoff and Rutherford, 2003; Brecht et al., 2004).

However, our results indicate that despite increases in tissue Si levels in creeping bentgrass following $CaSiO_3$ application where soil Si content was relatively low (2.9 mg per kg), brown patch was unaffected in two of three years and more severe in one of three years.

Dollar spot was also unaffected by $CaSiO_3$ application on creeping bentgrass. Tall fescue growing on soil with high (173 mg per kg) initial Si levels had higher brown patch levels in each of two years when topdressed with $CaSiO_3$. As such, we observed no benefit to topdressing tall fescue or creeping bentgrass with $CaSiO_3$ in an effort to reduce brown patch or dollar spot.

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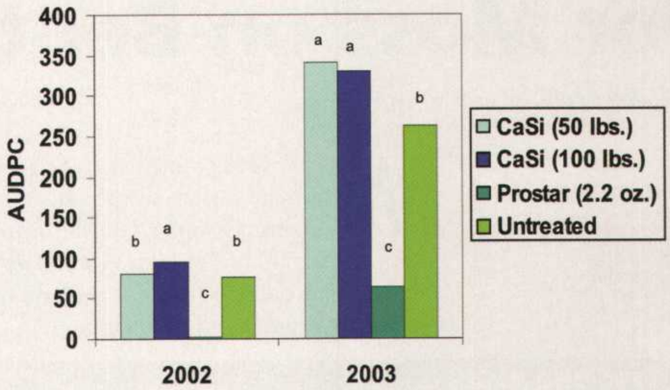
FIGURE 4



Brown patch in tall fescue (area under the disease progress curve, AUDPC) as affected by two levels of calcium silicate (CaSiO3) and the fungicide Prostar (rates are per 1,000 sq. ft.). Bars labeled with different letters are significantly different (P<0.05).

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