Silicon Amendment: A Component of Integrated Gray Leaf Spot Management Strategy

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Objectives:

1. To evaluate accumulation of silicon in perennial ryegrass plants.
2. To determine the effects of soil type, source of silicon, and rate of silicon amendments on gray leaf spot severity and incidence.
3. To devise a management strategy for gray leaf spot through integration of silicon into a fungicide program.

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Project Duration: three years
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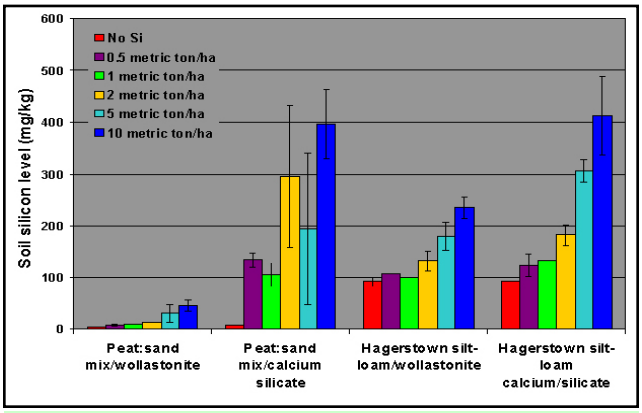
Gray leaf spot, caused by *Magnaporthe oryzae*, is a serious disease of perennial ryegrass turf. Currently, application of fungicides is generally considered to be the most effective approach to management of gray leaf spot. Turf managers often explore the possibilities of various cultural practices that can be relatively easily integrated along with fungicide into a broader disease management strategy.

Although silicon is the second most abundant element after oxygen in the earth's crust, certain soils tend to be low in plant-available silicon. Amending soil with silicon has been proven effective in controlling both soil-borne and foliar fungal diseases of several plants including some turfgrass species. This study was undertaken to investigate the effects silicon on gray leaf spot incidence and severity in perennial ryegrass.

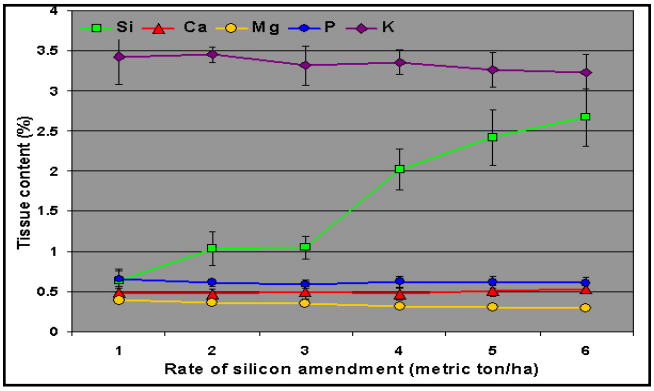
This research experiment addresses the first of the three objectives. The experiments were set up in a split-split-plot design with soil type as the main-plot factor (50:50 peat:sand mix and Hagerstown silt-loam native soil), source of silicon as the split-plot factor(calcium silicate slag and wollastonite) and rate of silicon application (0, 0.5, 1, 2, 5 and 10 metric ton/ha) as the split-split-plot factor. Silicon was incorporated into soil by hand-mixing the material with the appropriate volume of soil. 'Legacy II' perennial ryegrass was seeded at the rate of 20 g/m^2 and maintained in the greenhouse. Plants were fertilized with a water soluble fertilizer (20% N, 20% P_2O_5 and 20% K_2O) at the age of three weeks (0.7 g/L water) to field capacity of the planting medium for the first time, and continued bi-weekly at the same rate thereafter. Plants were trimmed for the first time at the age of three weeks to three inches and trimmed weekly to the same height.



As expected, results showed that soil silicon level increased with increasing levels of application on all soil types.

Soil samples were analyzed for silicon, pH, Ca, Mg, P, K, Mo, Cu, Fe, Mn, Zn, Na, Al, ammonium N, and sulfate S. Tissue samples were analyzed for silicon, P, K, Ca, Mg, Mn, Fe, Cu, B, Al, Zn and Na. Analyses of the data showed that the effects of soil type, silicon source, rate of application, and the soil and source interaction effects were significant.

The percent silicon content in the plants significantly increased with increasing rates of silicon applications in all four soil and source combinations. Perennial ryegrass grown in peat:sand mix amended with 10 metric ton/ha of calcium silicate and wollastonite accumulated silicon up to 3 and 4%, respectively; in Hagerstown silt-loam, 2% for each silicon source. Uptake of Ca, Mg, P, K, Fe, Cu, B, Al, Zn, Mn and Na by perennial ryegrass plants was not significantly influenced by increasing amounts of silicon applied to soil. However, the soil pH increased in peat-sand mix which received high rate (10 metric ton/ha) of silicon.



Although increasing rates of silicon amendment increased tissue silicon content, it did not affect tissue content of Ca, Mg, P, or K.

This study demonstrates that perennial ryegrass is a silicon accumulator, and the future studies will be focused on the effects of silicon on gray leaf spot development in perennial ryegrass turf and an integrated silicon-fungicide program for gray leaf spot management.

Summary Points

- Perennial ryegrass grown in both peat:sand mix and in silt-loam soil amended with calcium silicate or wollastonite significantly accumulated silicon.
- The percent silicon in perennial ryegrass leaf tissue and soil significantly increased with increasing rates of silicon applications in all four soil and silicon source combinations.
- Uptake of Ca, Mg, P, K, Fe, Cu, B, Al, Zn, Mn, and Na by perennial ryegrass plants was not significantly influenced by increasing amounts of silicon to soil.
- The soil pH was significantly higher in silicon-treated peat:sand mix (high rate) than the non-amended control in peat:sand mix.