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

Wakar Uddin
Pennsylvania State University

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 amendment 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.

Start Date: 2006
Project Duration: three years
Total Funding: $45,000

Gray leaf spot, caused by *Magnaporthe oryzae*, is a serious disease of perennial ryegrass turf that can cause extensive damage to turf in golf course fairways. The disease is effectively managed by fungicide applications; however, turf managers often explore the possibilities of various cultural practices that can be easily integrated along with fungicide into a broader disease management strategy.

Soil silicon amendments have been proven effective in controlling both soil-borne and foliar fungal diseases of several plants including some turfgrass species. However, the effects of silicon on gray leaf spot development of perennial ryegrass turf were not known. This study was undertaken to investigate the effects silicon on gray leaf spot incidence and severity in perennial ryegrass.

This research addresses the second of the three objectives. The experimental design was a split-split-plot design with soil type as the main-plot factor, source of silicon as the split-plot factor, and rate of silicon as the split-split-plot factor. The soil types used in this were peat:sand mix (50:50 v/v) and Hagerstown silt loam. Both soil types were amended with two sources of silicon; calcium silicate slag and wollastonite at the rates of 0, 0.5, 1, 2, 5 and 10 metric ton/ha. Each treatment was replicated four times and trials were conducted three times at different periods.

'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 3 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.

In semi-field experiments (microplots), perennial ryegrass was grown in the greenhouse for 6 weeks, and then the pots were placed in cup-cutter size holes in ryegrass turf area maintained as fairway at 2.5-cm height. Nine-week-old perennial ryegrass plants were inoculated with the conidial suspension of *Magnaporthe oryzae* (35 x 10^3 conidia/ml H_2O) by atomizing the leaves until they were completely wet. Plants atomized with distilled water served as the non-inoculated control. The pots were then placed in controlled environment chambers.

In microplot experiments, the pots were placed the cup-cutter holes in the ryegrass area at the same soil level and mowed 2-3 times a week. Disease incidence (% symptomatic leaves) and severity (index 0-10; 0=plant asymptomatic, 10=91-100% of the leaf area necrotic) were assessed 2 weeks after inoculation. Data were analyzed using non-parametric and regression procedures.

The results showed that tissue silicon content consistently increased with increasing amount of silicon in the soils in all four soil and source combinations. Linear models best described the relationship between tissue silicon content and soil silicon level.

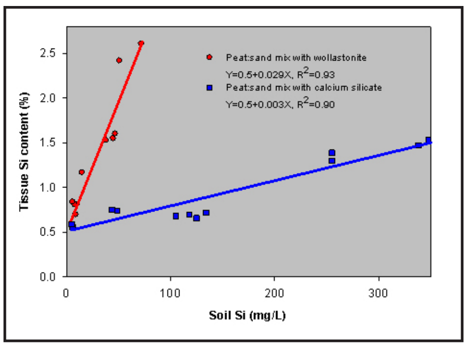

Figure 1. *Tissue silicon content increases in perennial ryegrass plants with increase of soil silicon level in peat:sand mix and Hagerstown silt loam amended with wollastonite and calcium silicate in microplots.*

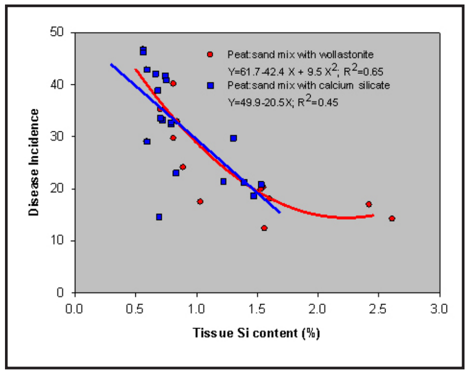

Figure 2. *Disease incidence decreases with increase of tissue silicon content (%) in perennial ryegrass plants grown in peat:sand mix amended with wollastonite and calcium silicate slag in microplots.*

In disease development, disease incidence decreased consistently with increasing tissue silicon content for all four soil and silicon source combinations. Linear and quadratic models best described the relationship between disease incidence and tissue silicon content for calcium silicate and wollastonite, repectively. This study demonstrates that development of gray leaf spot in perennial ryegrass is significantly suppressed by amendment of soil with calcium silicate or wollastonite.

Summary Points

- Tissue silicon content consistently increased with increasing amount of silicon in soil; linear models best described the relationship between tissue silicon content and the soil silicon level.
- The rate effects of silicon on gray leaf spot incidence and severity were significant for both soil and source combinations.
- Disease incidence significantly decreased compared to the non-amended control up to 44% for both soils amended with silicon.
- Disease incidence decreased consistently with increasing tissue silicon; linear and quadratic models describe the relationship between disease incidence and tissue silicon content.