TIGER STRIPING SYMPTOMS CAUSED BY TORYLENCHULUS RENIFORMIS IN UPLAND COTTON

C. Land
K. S. Lawrence
Entomology and Plant Pathology
Auburn, AL
P. Cobine
Biological Sciences
Auburn, AL
G. Lawrence
Plant Pathology
Mississippi State, MS

Abstract

Our objectives were to evaluate the nutrient content of cotton leaves form plants infected with the reniform nematode (*Rotylenchulus reniformis*) and displaying interveinal chlorosis as compared to cotton leaves from cotton plants without the reniform nematode. Symptomatic leaves were collected to determine the nutrient content in the presence and absence of the reniform nematode. Leaves showing reniform symptoms of interveinal chlorosis and distinct green veins were analyzed by inductively coupled plasma spectrometer (ICP) to measure nutrient content and compared to leaves without reniform nematode infestations. The nutrient data was analyzed with SAS 9.3 and means compared using Tukey's HSD ($\alpha \leq 0.10$). Results from the ICP analysis indicated cotton leaves with reniform nematode symptoms had statistically lower amounts of calcium, boron and iron. The minerals zinc, manganese, and magnesium were present in greater concentrations in the reniform nematode symptomatic leaves than in leaves without reniform from Alabama.

Introduction

The reniform nematode (*Rotylenchulus reniformis*) is considered to be a serious pest of cotton in the southeast and is difficult to manage. Reniform female nematodes establish a permanent feeding site in the root pericyclic where the females remain their entire life cycle. The reniform nematode occurs in a wide range of soils, but is most common in soils with greater silt content. Symptoms of the reniform nematode in Alabama soils are identified as a slang term known as Tiger Striping which is interveinal chlorosis with distinct green veins unique to cotton (Figure 1). The objective of this study was to chemically analyze leaf tissue from plants with and without reniform nematode symptoms in Alabama and Mississippi. Our hypothesis was that reniform infested cotton plant leaf tissue with foliar symptoms would have a nutrient deficiency.

Figure 1. Tiger Striping symptoms commonly associated with reniform nematode infection in cotton in Alabama.

Materials and Methods

Leaves were collected from fields with and without reniform in different locations within Alabama. Leaves were also collected from fields with and without reniform in Mississippi as a control due to the fact that these foliar symptoms

associated with Tiger Striping are not observed in Mississippi. Leaves were combined over locations for each of four different types of samples: 1) Alabama cotton with reniform and foliar symptoms, 2) Alabama cotton without reniform and no foliar symptoms, 3) Mississippi cotton with reniform and no foliar symptoms, and 4) Mississippi cotton without reniform and no foliar symptoms. Combining leaves from across each state into the 2 categories eliminated differences among soil types. Each of the 4 types of samples was replicated 5 times. All samples were measured out into 5 and 10 milligram to find upper and lower limits of elements. Samples were digested for one hour at 100°C in 200 µl of mineral free nitric acid. Digested samples were centrifuged and diluted with 800 ml of mineral free water. Samples were analyzed using inductively coupled plasma (ICP) with optical emission spectroscopy. Mineral concentrations were determined by comparing emissions to a standard curve. Data were analyzed with JMP Pro 11.0 (SAS Institute), means were compared using Tukey HSD = ($\alpha \leq .10$).

Results and Discussion

Significant differences in nutrient concentrations were detected between 1) Alabama cotton with reniform and foliar symptoms, 2) Alabama cotton without reniform and no foliar symptoms, 3) Mississippi cotton with reniform and no foliar symptoms, and 4) Mississippi cotton without reniform and no foliar symptoms. We hypothesized a nutrient deficiency would be detected, but cotton leaf tissue samples from reniform nematode fields in Alabama had significantly greater concentrations of the specific elements analyzed compared to cotton leaf tissue from Alabama fields without reniform and from leaf samples that originated from fields in Mississippi with and without the reniform nematode. Zinc concentrations were two times greater in leaf samples originating from Alabama containing the reniform nematode than from fields without the reniform nematode present (Figure 1). Manganese was detected to have five times greater concentrations of the element in reniform fields in Alabama than samples collected from fields without reniform (Figure 2). Magnesium had the smallest increase; however, leaf samples originating from Alabama cotton fields infested with the reniform nematode had 50% greater concentrations of the element than leaf samples originating from Alabama cotton fields that were not infested with the reniform nematode (Figure 3). None of these leaves were observed to contain mineral nutrients in the toxic range for cotton plants.

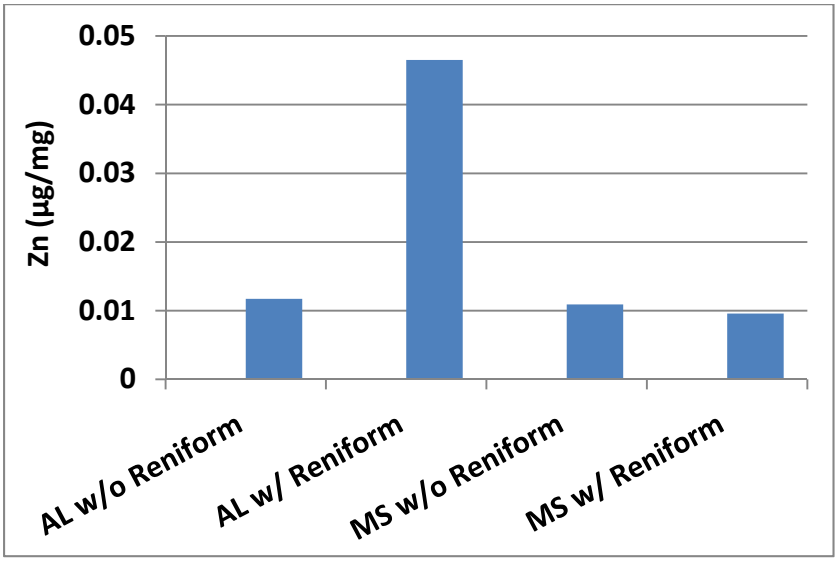

Figure 1. Mean zinc (Zn) concentrations (µg/mg of dry weight) detected in leaf samples originating from fields with and without the reniform nematode in Alabama and Mississippi.

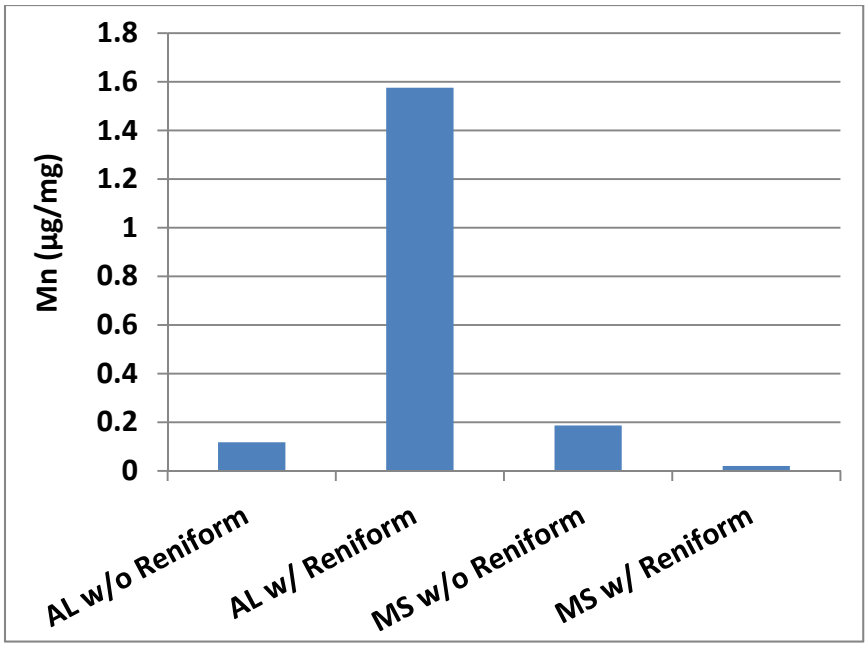

Figure 2. Mean manganese (Mn) concentrations (µg/mg of dry weight) detected in leaf samples originating from fields with and without the reniform nematode in Alabama and Mississippi.

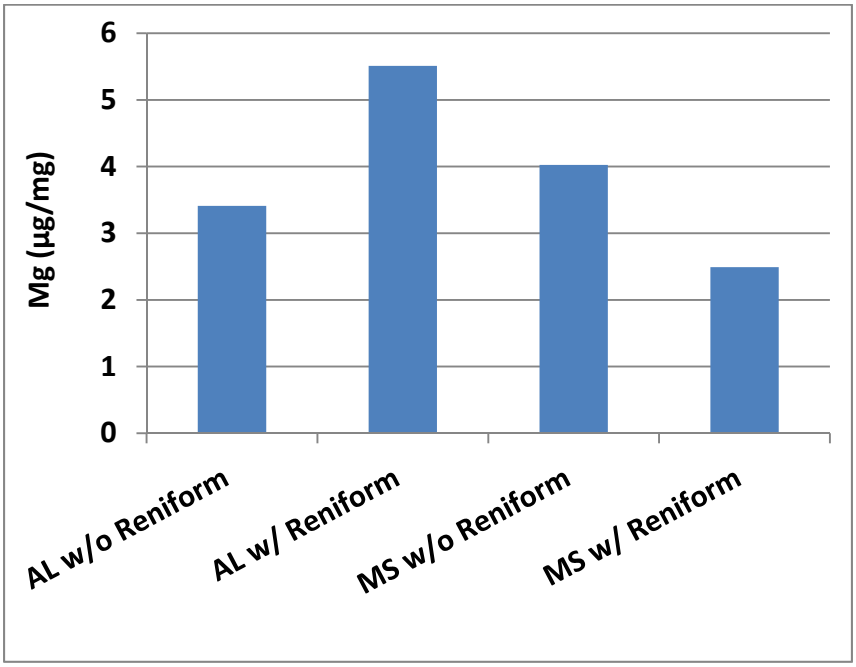

Figure 3. Mean magnesium (Mg) concentrations (µg/mg of dry weight) detected in leaf samples originating from fields with and without the reniform nematode in Alabama and Mississippi.

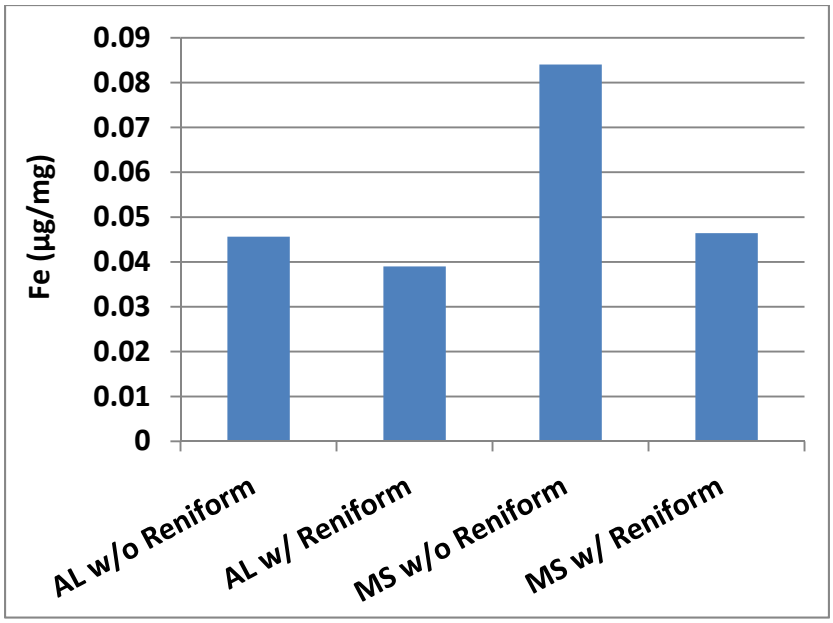

Figure 4. Mean iron (Fe) concentrations (µg/mg of dry weight) detected in leaf samples originating from fields with and without the reniform nematode in Alabama and Mississippi.

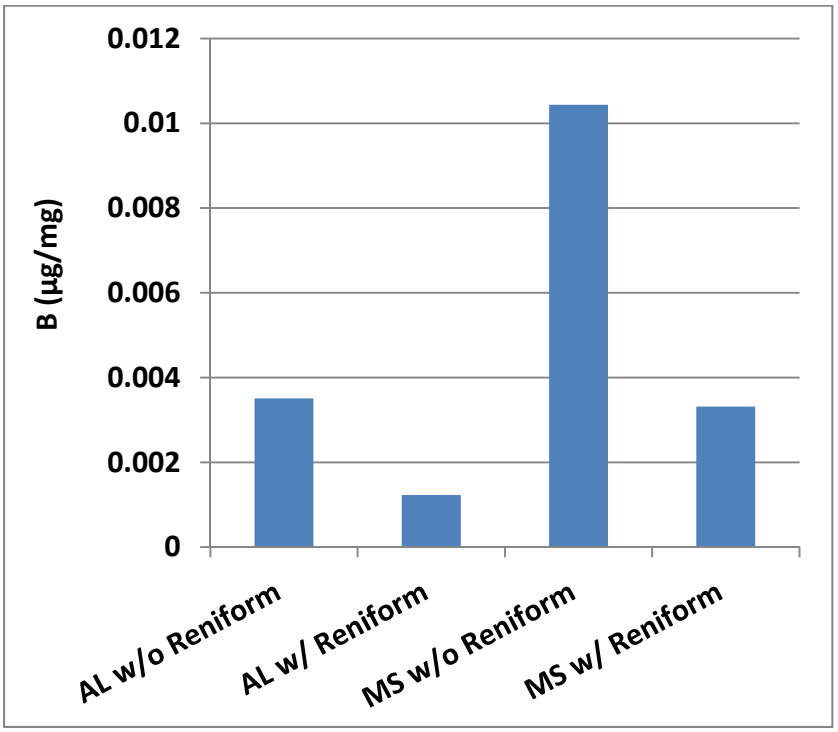

Figure 5. Mean boron (B) concentrations (µg/mg of dry weight) detected in leaf samples originating from fields with and without the reniform nematode in Alabama and Mississippi.

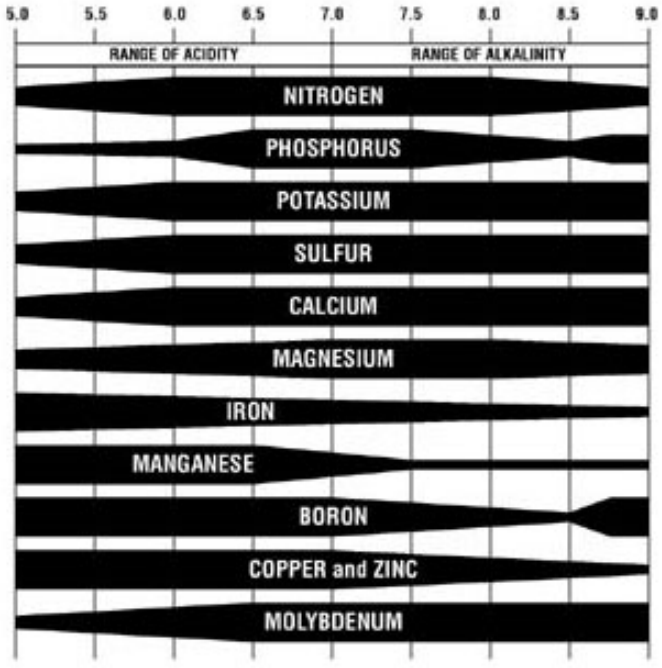

Figure 6. Nutrient availability in cotton field soils.

Nutrient deficiencies were observed for additional nutrients. Symptomatic cotton leaf tissue samples from reniform nematode infested fields in Alabama had significantly lower concentrations of iron (Figure 4) and boron (Figure 5) compared to fields without reniform in Alabama and Mississippi fields. Iron was determined to be 15% lower in leaf tissue that originated from Alabama reniform nematode infested fields than in leaf samples originating from fields without the reniform nematode (Figure 4) and an average of 38% lower than samples collected from Mississippi fields with similar reniform nematode composition. Boron was 56% lower in leaf samples originating from Alabama fields infested with the reniform nematode than collections made from fields without the reniform nematode (Figure 5). A reduction of the concentration of boron on the order of 61% was observed between leaf tissue collected from Mississippi cotton fields that contained the reniform nematode compared to leaf tissue originating from fields without the reniform nematode. However, Tiger Striping symptoms on foliar tissues were not observed in Mississippi cotton fields either with or without an infestation of the reniform nematode. This analysis raises interesting questions regarding the differences between cotton fields in Alabama and Mississippi infested with the reniform nematode. Significant differences are seen between the Alabama reniform group and the other three groups of leaf scmples. The soil availability of each of these specific nutrients (B, Fe, Mg, Mn, and Zn) in acidic soils (4.5-6, pH ranges commonly observed in Alabama and Mississippi) can be readily absorbed by the plant, which makes the deficiencies more puzzling (Figure 6). Another interesting commonality is that four out of the five elements are metals that were determined to be significantly different from Alabama without reniform samples and Mississippi samples regardless of the presence or absence of the reniform nematode.

Conclusions

Reniform nematodes are a difficult pest to manage. Understanding the causation of the foliar symptoms associated with reniform nematode infested fields may lead to a more comprehensive management practice to help improve crop health in reniform infested fields. Micro nutrient packages may possibly help provide the plant with additional nutrients, aiding the plant's health.