Program 9SB-1

Managing Rust And Cercospora Leaf Blight Of Soybean With Foliar Applications Of Minor Elements

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Soybean rust, caused by Phakopsora pachyrhizi, exploded upon the scene, especially in the Gulf South region, during the 2005 growing season. Luckily we had learned from plant pathologists in other countries which fungicides were effective, and this gave us a head start in testing materials and application protocols for managing the disease here in the U.S. Because the disease is readily managed with fungicides in the U.S., soybean rust is now considered to be just another one of the late season diseases that afflicts soybean producers in the Gulf South. However, there are no commercially available resistant varieties, the pathogen exhibits a very high level of genetic diversity and infects a wide variety of other leguminous hosts, including kudzu, and fungicide resistance by the pathogen is widespread in Brazil to the extent that there have been complete control failures. Clearly we must remain vigilant because the disease is so explosive, and it may be just a matter of time before fungicide resistance develops in the U.S. For these reasons, we have been investigating alternative disease management strategies including the effects of minor element nutrition on disease development.

Another problematic disease in soybean is Cercospora leaf blight (CLB), caused by Cercospora kikuchii. This disease is now endemic in many states, disease resistance has been elusive, it occurs every year, it is not readily controlled with fungicides, fungicide resistance is widespread in Louisiana and probably other southern states, and it can reduce yield substantially. This presentation will highlight our research in which we have shown that foliar applications of certain minor elements, especially

iron, can suppress both diseases with a concomitant increase in yield.

With regard to CLB, our previous work evaluated foliar applications of reagent grade micronutrients, and we showed that iron repeatedly suppressed symptoms of this disease. Symptoms consist of bronzing and purpling of leaves as well blight in the upper sun-exposed leaves (Figs. 1 and 2). In some situations, severe defoliation may ensue (Fig. 3). It is well known that the pathogen produces a toxin, cercosporin, that is activated by light and that this is the reason that symptoms appear in the upper canopy.

The objective of this work was to conduct field evaluations of commercial formulations of Fe for their effects on leaf colonization by C. kikuchii, symptom development (blight and purple leaves), and yield. Plants were treated with two commercial formulations of Fe, Manni Plex Fe and Fe EDTA (Brandt Consolidated Inc., Springfield, IL). Four rates of each formulation were applied with a boom sprayer at the R3 and R5 growth stages. Leaf tissue analyses for microelements and qPCR assessments for the pathogen were performed to verify Fe uptake and fungal leaf colonization, respectively. Disease severity was assessed quantitatively for leaf blight and purple symptoms, and yield data were collected. Results showed there was no correlation between leaf colonization by the pathogen and severity of either purple leaves or blight. In addition, Fe concentration in leaves did not affect either biomass of C. kikuchii or severity of purple leaf symptoms. However, Fe concentrations above 280 ppm completely suppressed blight symptoms. These results showed that Fe is not involved with growth and development of C. kikuchii within leaves, but it may reduce fungal virulence. Results also showed a lack of correlation between bronze/purple and blight symptoms, which suggests that these are two separate diseases caused by the same pathogen and that mechanisms of pathogenicity are likely quite different. In addition, our findings suggest that breeding for disease resistance based upon severity of the bronze/purple symptom may be futile. Our previous work showed that the C. kikuchii can exist as an endophyte for the duration of the season without causing symptoms, but we conclude that there must be a physiological signal related to Fe acquisition and metabolism by the plant and endophyte that causes the pathogen to initiate its pathogenic phase. Possible mechanisms of pathogenicity and symptom expression will be discussed.

Figure 1. Purple/bronze symptom of Cercospora leaf blight.

Figure 2. Blight symptom of Cercospora leaf blight.

Figure 3. Severe defoliation caused by Cercospora leaf blight.