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Cover Crop System to Control Charcoal Rot in Soybeans

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Cover Crop System to Control Charcoal Rot in Soybeans

Abstract

This research compares methods of controlling charcoal rot in soybean cultivars from three maturity groups commonly grown in southeast Kansas. The results indicate that a mustard plant that produces high levels of glucosinolates can be used as a cover crop to reduce the charcoal rot disease in soybeans.

Keywords

soybean, charcoal rot, cover crops

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Cover Page Footnote

This research is supported by funding from the Kansas Soybean Commission.

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Summary

This research compares methods of controlling charcoal rot in soybean cultivars from three maturity groups commonly grown in southeast Kansas. The results indicate that a mustard plant that produces high levels of glucosinolates can be used as a cover crop to reduce the charcoal rot disease in soybeans.

Introduction

Charcoal rot is a plant disease caused by the fungus *Macrophomina phaseolina* (Tassi) Goid. It limits yield and performance of soybean. The fungus is highly prevalent in crop fields in southeast Kansas. Certain plants have been shown to produce chemicals that act as biofumigants, controlling or reducing harmful soil fungi, similar to those that may cause charcoal rot. Bacterial control of diseases has been used successfully in potato (Larkin et al., 2011) and cacao production (Melnick et al., 2008). Mengistu et al. (2009) showed some suppression of charcoal rot infestation with altered tillage and use of rye as a cover crop. The research outlined here tested the ability of mustard species used as cover crops to control charcoal rot in soybean production. Incorporating a cover crop into the crop rotation may be a simple method of controlling soil-borne diseases.

Experimental Procedures

Soybean plants were grown in replicated field plots using two methods of charcoal rot control: chemical (fungal seed treatment) and biological (mustard cover crop). The control had no biological or chemical treatment. The biological treatment was a mustard plant, Mighty Mustard Pacific Gold (Johnny's Select Seed, Winslow, ME). This mustard variety produces high glucosinolate concentrations that are suggested to control soil-borne diseases. Chemical control included seed treatment with fungicide prior to planting (Acceleron, 4 oz/100 lb). The fourth treatment included both biological and chemical treatments.

The mustard seed was planted in late March, when soil temperatures were consistently above 50°F. Prior to maturity, the mustard was terminated with herbicide and disked in after the plants had died. The ground was tilled in all plots in preparation for planting. The soybean cultivars selected include two early maturity group 4s, two late group 4s, and a mid- to early-group 5.

To test the charcoal rot infestation in the soil, soil samples were collected after the mustard was terminated and disked in and prior to planting the soybeans. Additional soil samples were taken in the fall coincident with plant sampling at the R7-8 stage. The numbers of colony forming units (CFU's) of the fungi in the plant and soil samples were measured at the Department of Plant Pathology at Kansas State University. Additional samples were used to determine soil microbial activity with the phospholipid fatty acid (PLFA) assay. Final yield was measured at harvest.

Results and Discussion

Mustard plants reduced the number of colony forming units of the fungus in the soil and in the plant roots (Figure 1). Therefore, the mustard reduced the disease pressure from the charcoal rot fungus. The interaction between the mustard and the fungicide control was confounded by environmental factors, as each year showed a different response of number of CFUs in the soil to the combined control. A modest, but significant, improvement in yield was observed in 2016 for the combined chemical and biological control (Figure 2). No difference in yield was observed in 2015. Both years of the study had relatively mild summers, with little incidence of charcoal rot damage reported.

The early maturing soybean varieties showed greater infection rates, with higher number of CFUs in the plant stem and roots (Table 1). This was observed in both years. While this may indicate a greater susceptibility of the early-maturing cultivars to charcoal rot, it is more likely a function of the weather patterns in southeast Kansas. Charcoal rot is most prevalent under hot, dry conditions, usually experienced in July and August in southeast Kansas. This is also the time period during which the early maturing varieties would be flowering. The increased sensitivity to charcoal rot may thus be more dependent on the weather than on the genetics of these varieties.

Acknowledgment

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Table 1. Charcoal rot infection rate as a function of soybean maturity group

Variety	Colony forming units
4.1	2.7
4.2	2.2
4.9	2.0
4.9	1.8
5.3	1.6
5.3	2.0

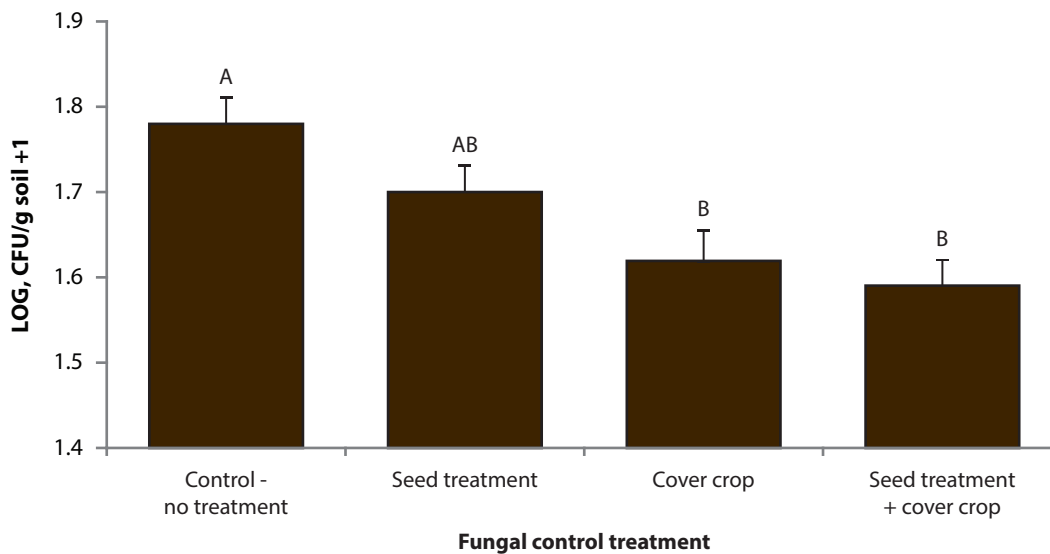


Figure 1. Number of colony forming units (CFUs) in the soil as a function of treatment. Different letters indicate statistically significant differences.

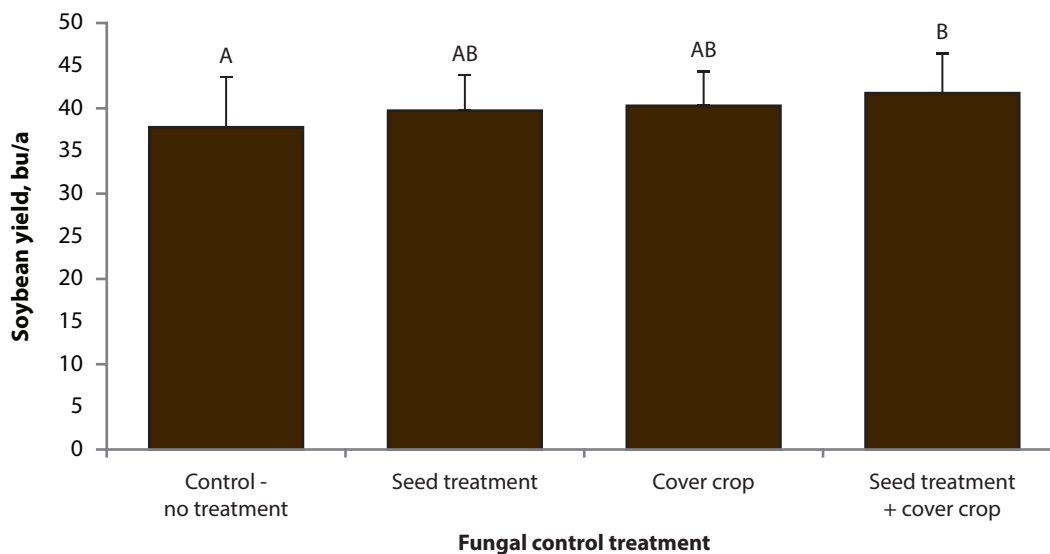


Figure 2. Impact of fungal control method on yield across all cultivars. Different letters indicate statistically significant differences.