Evaluating Nutrient Availability Following Cover Crops in Mississippi Soybean Production Systems.

40-2020

PI: Dr. Justin M. McCoy, Agronomist, North MS Research and Extension Center, Mississippi State University; P.O. Box 1690 Verona, MS 38879, Ph. 662-251-0614: jm1027@msstate.edu

Co-PI: Dr. Mark Shankle, Research Professor, Pontotoc Ridge-Flatwoods Branch Experiment Station, Mississippi State University, Ph. 662-489-4621, mark.shankle@msstate.edu

Dr. Bill Burdine, Extension Specialist I, Extension Center North MS, Mississippi State University; 5338 Cliff Gookin Blvd, Tupelo, MS 38801, Ph. 62-321-5356, bill.burdine@msstate.edu

RATIONALE/JUSTIFICATION FOR RESEARCH:

Numerous studies evaluating cover crops and their influence on soil nutrient availability have been carried out across the U.S. While these studies have touted greater nutrient availability following a cover crop, the actual agronomic value to the subsequent cash crop in a nutrient deficient situation is largely unknown. Similarly, knowledge of the effects of cover crops on P2O5 and K2O availability in Mississippi soybean production systems is lacking. Insufficient P or K availability in soils result in lower soybean yields than the achievable maximum. A previous large scale study conducted throughout Mississippi determined that soybean yields could be increased by an average of 8 to 10 bushels with the addition of P2O5 or K2O fertilizers when soil nutrient values were determined to be insufficient by the state soil testing lab. With this information available, no research has been conducted in Mississippi to determine how cover crops may affect the subsequent soybean crop when P or K may be limiting, and how these cover crop systems may interact with a fall P or K fertilizer regime.

OBJECTIVE(S):

1. **Determine if cover crop systems will improve nutrient availability and subsequent soybean yields in a possible nutrient deficient situation.**

Winter cover crops planted in the fall of 2020 were biomassed on April 13, 2021 from each plot. Results from these samples were discussed in the 40-2020 annual report. Cover Crops were terminated after sampling on April 13 with paraquat at 1 qt/a. Weather permitting spring soil samples were taken from every plot April 21. Soil samples were dried, crushed, and analyzed for macronutrients, micronutrients, CEC, pH, and organic matter content. Soybean variety AG48X9 was planted May 20, 2021 for the 2021 soybean crop. Soybean stand counts were recorded in each plot and biomass, tissue nutrient concentration, and soil analysis will be collected for each plot before harvest.

Soybean plots were tissue sampled for nutrient analysis at the R2 growth stage. Soybean Biomass samples were taken July 29, 2021 dried and weighed to determine if soybean growth differed among treatments. Soybeans were desiccated with 1 pt/a paraquat on September 29, 2021. Each plot was harvested using a small-plot combine October 12, 2021 to determine grain yield. The field will be reshaped, fall fertility treatments applied, and cover crops planted as weather permits. Before fertilizing

and cover crop planting soil samples will be taken from each plot to be analyzed for macronutrients, micronutrients, CEC, pH, and organic matter content.

Following Soybean harvest beds were reshaped. Soil samples of each plot were then taken followed by Cover crop planting and fertilizer spread to corresponding plots on October 20, 2021. Soil samples were dried and sent for analysis of macronutrients, micronutrients, CEC, pH, and organic matter content. Preliminary analysis suggests that the addition of P or K fertilizer increased soybean yield regardless of cover crop species. Differences were observed among cover crop species but interactions did not suggest that P or K availability influenced this. Soil data will be analyzed to further investigate preliminary yield observations.

Cover Crops have had good growing conditions through the 2021-2022 winter and once peak biomass has been reached they will be terminated and prepared for the 2022 soybean crop.

Analysis suggests that the addition of P or K fertilizer increased soybean grain yield regardless of cover crop species. Differences were observed among cover crop species but interactions did not suggest that P or K availability influenced this. Observations from 2021 suggest that the addition of fall fertilizer P or K increased soybean yield regardless of cover crop species in a nutrient deficient situation. Data also suggests that cover crop planting with no fertilizer did not increase nutrient availability to the soybean crop and therefore no yield response was observed to cover crop with no fertilizer in 2021. Preliminary data suggests that cover crop planting has minimal influence on fall fertilizer programs in nutrient deficient situations and soybean yield response to fertilizer may still be observed when nutrients are limiting.

Figure 1. Soybean grain yield as influenced by fertilizer regime pooled across cover crop species.

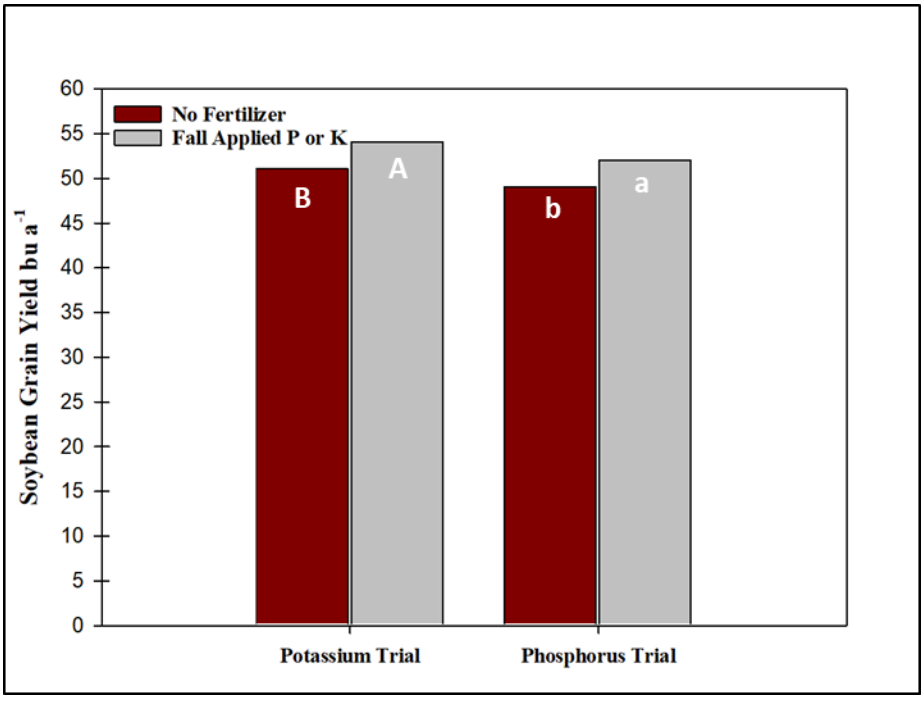

Figure 2. Soybean grain yield as influenced by cover species when pooled across fall fertilizer regime.

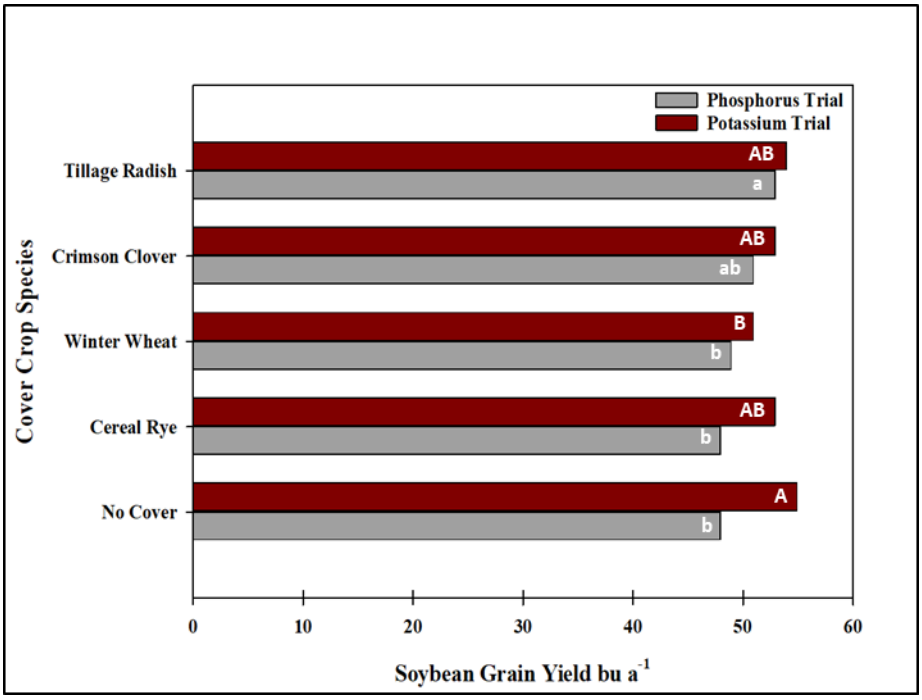

Figure 3. Seeding cover crop at NMREC via gandy box spreader.

Figure 4. Cereal Rye cover crop species 3/11/2022.

Figure 5. Crimson Clover cover crop species 3/11/2022.

Figure 6. No cover crop species 3/11/2022.

Figure 7. Tillage Radish cover crop species 3/11/2022

Figure 8. Winter Wheat cover crop species 3/11/2022.

2. Determine if cover crop systems will improve nutrient availability and subsequent soybean yields following a routine P and K fall fertilization regime.

Winter cover crops planted in the fall of 2020 were biomassed on April 13, 2021 from each plot. Results from these samples were discussed in the 40-2020 annual report. Cover Crops were terminated after sampling on April 13 with paraquat at 1 qt/a. Weather permitting spring soil samples were taken from every plot April 21. Soil samples were dried, crushed, and analyzed for macronutrients, micronutrients, CEC, pH, and organic matter content. Soybean variety AG48X9 was planted May 20, 2021 for the 2021 soybean crop. Soybean stand counts were recorded in each plot and biomass, tissue nutrient concentration, and soil analysis will be collected for each plot before harvest.

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Following Soybean harvest beds were reshaped. Soil samples of each plot were then taken followed by Cover crop planting and fertilizer spread to corresponding plots on October 20, 2021. Soil samples were dried and sent for analysis of macronutrients, micronutrients, CEC, pH, and organic matter content. Preliminary analysis suggests that the addition of P or K fertilizer increased soybean yield regardless of cover crop species. Differences were observed among cover crop species but interactions did not suggest that P or K availability influenced this. Soil data will be analyzed to further investigate preliminary yield observations

Observations from 2021 suggest that, the addition of potash fertilizer increased cover crop biomass by 93 lb $acre^{-1}$ when averaged across all cover crop species. Phosphate fertilizer additions saw a numerical increase of 10 lb $acre^{-1}$ across cover crops but did not differ from cover crops receiving no fertilizer (Figure 1.). Cover crops cereal rye, winter wheat, and crimson clover produced significantly greater biomass in plots receiving muriate of Potash in the fall, when compared to those in plots receiving no fertilizer (Figure 2.). Changes in soil availability of P or K from the fall to the spring were affected by winter cover crops (Figure 3.). Plots where winter wheat was grown were observed to decrease the availability of K by 50 lb/a when compared to the fall sampling. Tillage radish increased both P and K availability in the soil from the fall to the spring. This increase observed in availability due to Tillage Radish is possibly due to the early termination from frost and subsequent breakdown of organic matter accumulated and nutrient release back into the soil solution. The addition of Muriate of Potash fertilizer was observed to increase K soil availability by 30 lb/a, while plots receiving no fertilizer saw a decrease of 60 lb/a possibly due to cover crop uptake (Figure 4.). Effects of cover crops on the 2021 soybean crop were reported above.

Figure 1. Cover crop biomass across fertilizer regime from plots at the NMREC.

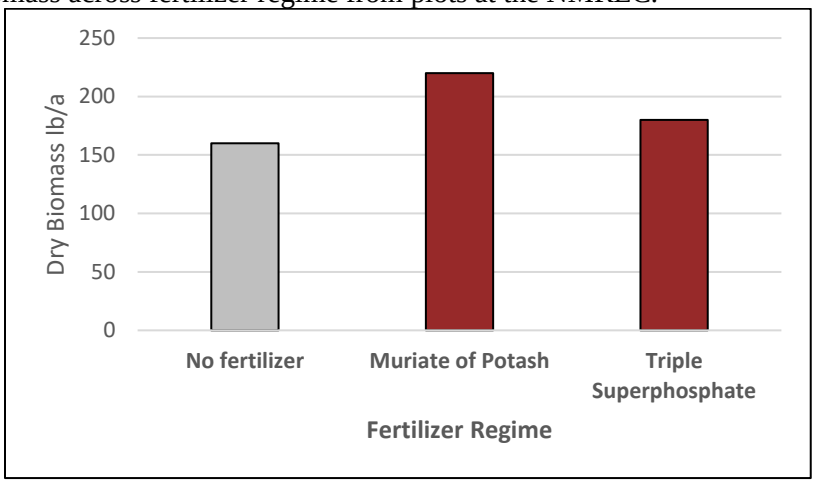


Figure 2. Cover crop biomass as influenced by the addition of Muriate of Potash at the NMREC.

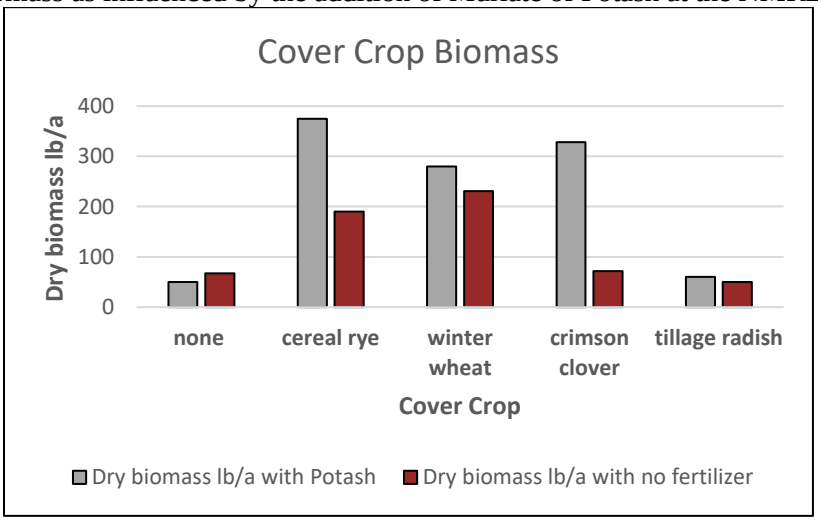


Figure 3. Change in soil availability of nutrients P and K as influenced by cover crop in plots at the NMREC.

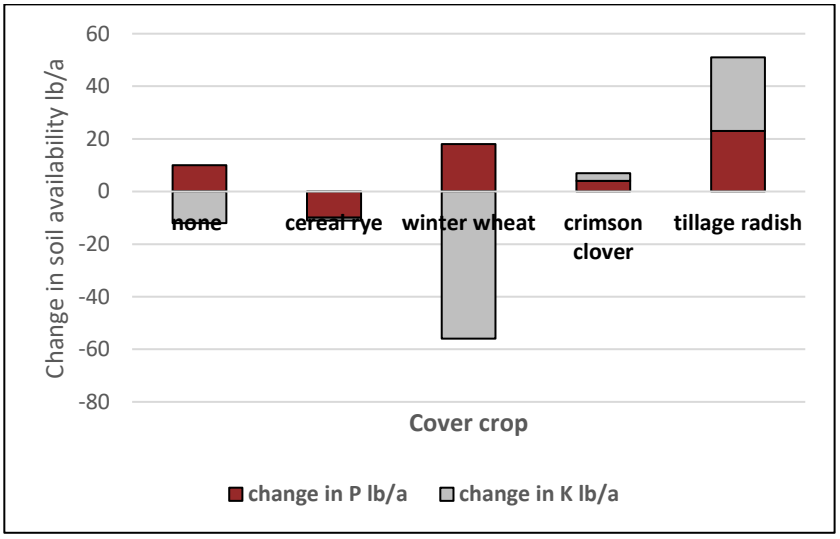
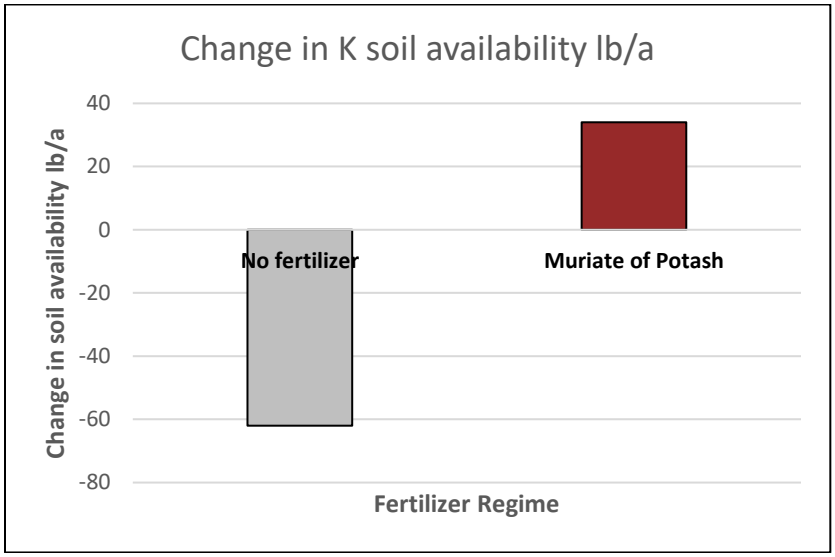


Figure 4. Change in soil availability of K as influenced by the addition of Muriate of Potash in plots at the NMREC.



3. Share project results with producers and stakeholder groups.

A plot tour was held at NMREC August 17, 2021. During this tour preliminary data from cover crop growth and plans to evaluate soybean growth throughout the project were discussed with producers and retailers. An abstract has been submitted and accepted for the annual ASA, SSSA, and CSSA meeting in Salt Lake City, UT titled Evaluation of Nutrient Availability to Cash Crops Following Cover Crops in Mississippi Production Systems, during which this project will be discussed.

Observations from 2021 were presented at the annual ASA, SSSA, and CSSA meeting in Salt Lake City, UT titled Evaluation of Nutrient Availability to Cash Crops Following Cover Crops in Mississippi Production Systems on November 10, 2021. Data was discussed with producers at the MSU row crop short course during the presentation Fertility Management Considerations for MidSouth Cropping Systems on December 7, 2021. Observations are currently being distributed to producers during a series of County Meetings throughout the state.