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MISSISSIPPI SOYBEAN PROMOTION BOARD PROJECT NO. 21-2018 (YEAR 2) 2018 ANNUAL REPORT

TITLE: Effect of Cover Cropping Systems on Dryland Soybean Plant-vigor, Growth, and Yield

INVESTIGATORS:

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BACKGROUND AND OBJECTIVES

Objective 1. Evaluate the effects of cover cropping systems on dryland soybean plant-vigor, growth, and yield.

Objective 2. Evaluate the effects of cover cropping systems on “soil health” (physical characteristics, microorganisms, soil moisture, etc).

Objective 3. Determine the economic benefit of cover crops, source of fertilizer, and planting date on soybean production.

In the **first objective**, different cover crops (native vegetation--NV, cereal rye--CR, wheat--WH, and vetch--VE) will be planted in the fall. These cover crops will be terminated in the spring where biomass yield will be collected. Soybeans will be no-till planted into cover crop residue at two different planting dates. Early season insect management will be practiced to help promote soybean seedling vigor. In addition to planting times, subplots of three fertility practices will be included; 1) a no fertilizer check (NONE); 2) a standard commercial fertilizer rate (FERT) based on MSU soil test recommendations; and 3) a poultry litter (PL) rate that coincides with the standard fertilizer rate based on nutrient analysis. Ratings for soybean growth and development will be made throughout the growing season. Yield data will be collected at the end of season and cover crops will be reestablished.

In the **second objective**, baseline soil samples will be taken at the beginning of the project to evaluate initial soil properties/characteristics and microorganisms in the soil. Soil moisture sensors will be placed to determine effects of the cover cropping system on soil moisture.

In the **third objective**, economics will be used to calculate net return based on the current market price of implementing the different cover cropping systems (cover crop, fertilizer, and soybean).

In **summary**, initial studies will be conducted at the Pontotoc Ridge-Flatwoods Experiment Station with additional studies at locations in Mississippi to evaluate the effects the different cover cropping systems have on soybean growth, development, and yield. Also, the effects on “soil health” (physical characteristics, microorganisms, soil moisture, etc.) will be evaluated.

Site selection will be confined to dryland soybean production fields. Standard agronomic practices for soybean production in the area will be applied. Treatments will include four cover crops, three fertilizer treatments, and three soybean planting times. Baseline soil samples will be taken at the beginning of the project.

A standard commercial fertilizer rate based on MSU soil test recommendations will be made from the baseline soil samples. A nutrient analysis will be conducted to determine poultry litter application rates that coincide



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with the amounts of K applied in the standard commercial fertilizer treatments. Experiments will be split-split plot arrangement in a randomized complete block design. Plot width and length dimensions will be contingent on grower equipment configuration to minimize any adverse effects on farm operations. In addition to simple ANOVA and means separation, we will utilize SAS software for computations of correlation and regression analyses that best describe results (other methods will be employed if warranted).

REPORT OF PROGRESS/ACTIVITY

Objective 1. Evaluate the effects of cover cropping systems on dryland soybean plant-vigor, growth, and yield.

Cover crops were maintained from their fall 2017 planting until termination on April 19 and May 14 for the early and late soybean planting dates, respectively. Prior to termination, biomass samples were taken from each cover crop. Baseline soil samples were collected and inorganic fertilizer treatments were made based on soil test laboratory recommendations.

Asgrow 46X6 soybeans were planted on May 1 and May 24 for the early and late soybean planting dates, respectively. Soybeans were maintained throughout the growing season. The four center rows from each plot were harvested on October 4 and October 19 for the early and late soybean planting dates, respectively. Fall 2018 cover crops were planted on October 29 and will be maintained until termination in the spring prior to soybean planting.

The following data were collected throughout the year and analysis is currently being conducted.

- Root-zone soil samples were collected after cover crop was harvested and after soybean were planted. This is considered an “At Planting” soil sample. A second root-zone soil sample was collected at the R4-R5 soybean growth stage and whole plant samples were also collected at the time. Microbial community will be identified for these samples to ultimately determine population counts of microbes associated with nitrogen fixation processes of the soybean plant (Billy Kingery’s Lab).
- Petiole and leaf samples were collected at the R4-R5 soybean growth stage to determine nutrient content (Haile Tewolde’s Lab).
- Soil moisture was measured in each plot mid-summer.
- Multi-spectral images of high resolution were captured for all plots in the study area through the growing season (NDVI calculated). (Table 1.)
- Leaf area index (LAI) was taken mid-summer. (Tables 2 & 3)
- Plant heights were measured from 4 center rows of the 8 row plots prior to harvest.
- A soybean seed sample was collected from each plot for nutrient testing etc.... (Haile Tewolde’s Lab).

Soybean yield averaged less than 27 bu/acre across the entire trial. There was no difference in soybean yield relative to cover crop treatments. Soybean yield was greater from treatments receiving poultry litter or inorganic fertilizer than from treatments that did not receive fertilizer. Planting date average yield across all treatments was 23.1 and 30.6 bu/ac for the early and late planting dates, respectively. Low yields were attributed to a lack of rainfall during soybean reproductive stages and excessive rainfall after soybean were mature, delaying harvest and reducing seed quality.

Objective 2. Evaluate the effects of cover cropping systems on “soil health” (physical characteristics, microorganisms, soil moisture, etc.).

Dr. Gary Feng and his group along with Dr. Billy Kingery have collected soil samples and installed weather stations to collect environmental data. Baseline soil core samples have been collected from some plots. Surface



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soil samples have been collected from each plot to identify soil microbes that are associated with promotion of nodulation. Microorganism research is being conducted in the laboratory on campus. Soil moisture data have been collected from the center rows of each plot to determine the extent of water conservation among treatments. Remotely sensed imagery is being collected throughout the season by Jay Munyon with USDA-ARS (Haile Tewolde). These data will be used to evaluate crop response to different treatments.

Objective 3. Determine the economic benefit of cover crops, source of fertilizer, and planting date on soybean production. Economic benefits will be determined after more data has been collected.

END PRODUCTS

A graduate student, Sapana Pokhrel, began working on this project in August 2018. She presented preliminary results from this project at the annual meeting of the Mississippi Academy of Sciences in Hattiesburg, MS on Feb 21-22, 2019.

GRAPHICS/TABLES

Table 1. NDVI

| Planting Date 1 | | | | | | Planting Date 2 | | | | |
|-----------------|------|------|------|------|--|-----------------|------|------|------|--|
| June 20 | | | | | | | | | | |
| Cover crop | NONE | FERT | PL | Avg | | NONE | FERT | PL | Avg | |
| CR | 0.84 | 0.81 | 0.83 | 0.82 | | 0.61 | 0.54 | 0.55 | 0.57 | |
| CR/M | 0.74 | 0.68 | 0.76 | 0.73 | | 0.73 | 0.67 | 0.64 | 0.68 | |
| NV | 0.55 | 0.64 | 0.61 | 0.60 | | 0.74 | 0.78 | 0.83 | 0.78 | |
| VE | 0.70 | 0.52 | 0.56 | 0.59 | | 0.78 | 0.76 | 0.82 | 0.79 | |
| WH | 0.71 | 0.74 | 0.80 | 0.75 | | 0.63 | 0.69 | 0.65 | 0.65 | |
| Avg | 0.71 | 0.68 | 0.71 | | | 0.70 | 0.69 | 0.70 | | |
| July 3 | | | | | | | | | | |
| CR | 0.90 | 0.88 | 0.89 | 0.89 | | 0.78 | 0.74 | 0.76 | 0.76 | |
| CR/M | 0.85 | 0.83 | 0.85 | 0.85 | | 0.84 | 0.82 | 0.81 | 0.82 | |
| NV | 0.76 | 0.80 | 0.76 | 0.77 | | 0.85 | 0.88 | 0.88 | 0.87 | |
| VE | 0.83 | 0.76 | 0.78 | 0.79 | | 0.87 | 0.86 | 0.89 | 0.88 | |
| WH | 0.82 | 0.83 | 0.89 | 0.84 | | 0.78 | 0.82 | 0.82 | 0.81 | |
| Avg | 0.83 | 0.82 | 0.83 | | | 0.82 | 0.82 | 0.83 | | |
| July 16 | | | | | | | | | | |
| CR | 0.90 | 0.88 | 0.89 | 0.89 | | 0.84 | 0.81 | 0.83 | 0.83 | |
| CR/M | 0.88 | 0.87 | 0.88 | 0.88 | | 0.87 | 0.87 | 0.86 | 0.86 | |
| NV | 0.86 | 0.87 | 0.86 | 0.86 | | 0.87 | 0.89 | 0.89 | 0.88 | |
| VE | 0.88 | 0.86 | 0.87 | 0.87 | | 0.88 | 0.88 | 0.90 | 0.89 | |
| WH | 0.86 | 0.88 | 0.90 | 0.88 | | 0.83 | 0.86 | 0.86 | 0.85 | |
| Avg | 0.88 | 0.87 | 0.88 | | | 0.86 | 0.86 | 0.87 | | |



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Table 2. LAI, Planting Date 1, July 16, 2018

| Cover crop | NONE | FERT | PL | Avg |
|-------------------|-------------|-------------|-------------|-------------|
| CR | 3.14 | 5.52 | 5.71 | 4.79 |
| CR/M | 3.91 | 4.79 | 5.73 | 4.81 |
| NV | 4.25 | 5.40 | 5.99 | 5.21 |
| VE | 4.44 | 5.81 | 6.02 | 5.42 |
| WH | 3.32 | 5.22 | 5.17 | 4.57 |
| Avg | 3.81 | 5.35 | 5.73 | |

Table 3. LAI, Planting Date 2, July 18, 2018

| Cover crop | NONE | FERT | PL | Avg |
|-------------------|-------------|-------------|-------------|-------------|
| CR | 3.00 | 3.71 | 4.11 | 3.61 |
| CR/M | 3.06 | 4.24 | 3.59 | 3.63 |
| NV | 2.61 | 3.04 | 3.89 | 3.18 |
| VE | 2.91 | 3.78 | 4.09 | 3.59 |
| WH | 2.92 | 3.14 | 3.13 | 3.07 |
| Avg | 2.90 | 3.58 | 3.76 | |