Mississippi Corn Promotion Board
2016 Progress Report

Project Title: Winter cover crops and fall applied poultry litter effects on corn yield, nutrient cycling, and soil health indicators

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Project Summary (Issue/Response)

Finding viable options for growers to best utilize resources available in Mississippi to improve soil health and productivity is critical to maintaining profitability. Cover crops, especially legumes, and poultry litter are resources which can fit in Mississippi production systems and can provide soil health benefits including nutrients such as N. Cover crops were successfully seeded with a Great Plains drill on 23 Oct. 2015 into corn residues. Cover crop treatments included winter fallow, hairy vetch (HV) at 30 lb/acre, rye at 60 lb/acre, and a 50/50 blend of HV-rye at 50 lb/acre were planted. On 23 Nov. 2015, pelletized poultry litter (PL) (Mighty-Grow 3-3-3) at a rate of 2000 lb/acre was broadcast applied to all cover crop treatments including winter fallow. Non-litter treated plots received fertilizer P and K rates equivalent to that supplied by the PL. To estimate the value of cover crop/poultry litter treatments in terms of fertilizer N equivalence, non-cover crop plots received urea-ammonium sulfate (33.5-0-0) broadcast at rates of 0, 50, 100, 150, and 200 lb N/acre. In a separate area, Cover crops of crimson clover, red clover, and hairy vetch were grown with and without rye or Tillage Radish. All treatments were arranged as a randomized complete block design with four replications with the experimental site located at the W.B. Andrews Agricultural Systems Research Farm Mississippi State, MS. Cover crops were harvested for biomass and N production on 5 April, 2016 and and growth was terminated with glyphosate. Corn variety Dekalb DKC66-97 (GENVT2P) was planted at 32,000 kernels/acre on 18 April, 2016 in plots 4 rows wide (38 in. spacing) and 30 or 40 ft long. To determine total N content of the corn, a 39.4 in. length of whole corn plants was sampled on 8 Aug. 2016. Corn for grain was harvested 30 Aug. 2016 with a 2-row Kincaid automated combine.

Project Results/Outcomes

Total N contents (lb/acre) in cover crops were low at 9 for HV, 21 for HV-PL, 13 for Rye, 18 for Rye-PL, 23 Rye-HV, and 27 Rye-HV-PL. Hairy vetch was decimated by *Phytophthora* sp. root rot; thus the low biomass and N yields. Fertilizer N equivalency values (lb N/acre) based on corn grain N content were 77 for HV-PL, 35 for HV-Rye-PL, 41 for HV, 13 HV-Rye, 2.6 Rye-PL, 4 for PL, and 5 for Rye. Soil cores 2 in. diameter X 12 in. length were taken following corn harvest. Core samples were divided into 0- to 2-in., 2- to 4-in., 4- to 6-in., and 6- to 12-in depths. Results from 2015 and 2016 indicate soil bulk density was lowest where treatments included PL. Overall, bulk density was lower in the corn row due to strip tillage versus the non-tilled inter-row area. Total C and N analyses for 2016 samples have not yet been completed. Cover crop plus PL consistently increased enzyme activity, while fertilizer N rate was most prominent in the inter-row where a lack of tillage resulted in increasing residue accumulation with increasing N rates. Most significant was a strong dependency of soil enzyme activity with total soil C regardless of treatments. Although HV succumbed to *Phytophthora* sp. root rot, the results suggest that there was a residual effect on corn grain yield of using a legume cover crop as well as PL the previous 4 years due to increased soil C and N and enzyme activity. In the evaluation of cover crop mixtures, legumes grown alone resulted in biomass N contents of 30 lb/acre for HV and red clover (RC) and 64 lb/acre for crimson clover (CC). Cover crop mixture effects showed that when rye was combined with RC or HV that biomass N content increased approximately 7-8 lb/acre, while for crimson clover

Project Results

no difference was observed. Inclusion of tillage radish (TR) with HV showed an increased biomass N content of 5.6 lb/acre, while no effect was observed with CC and RC. First year legume effects averaged 11 bu/acre better than the non-fertilized control, while inclusion of TR added 5 more bu/acre with HV and CC, but not with RC. Inclusion of rye with a legume resulted in no net corn grain yield benefit.

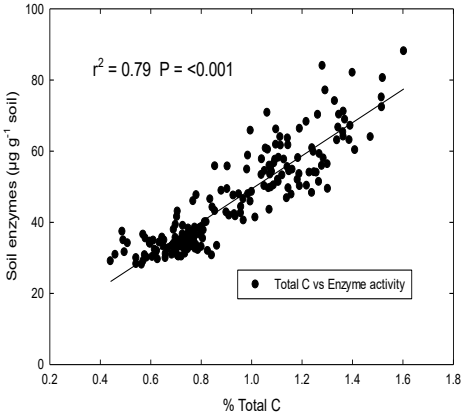

Fig. 1 Relationship of soil enzyme activity to total soil C at corn planting.

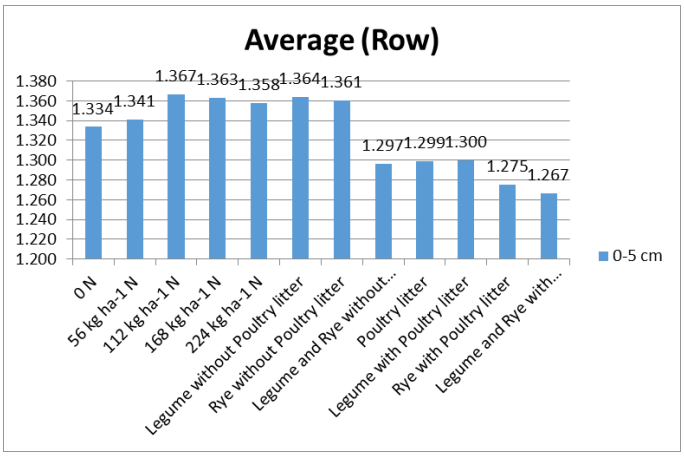

Fig. 2. Cover crop and poultry litter effects on soil bulk density measured fall 2016 following corn harvest.

Project Impacts/Benefits

Results of this project are demonstrating the potential for cover crop/poultry litter systems to substitute for a portion of fertilizer N requirements in a non-irrigated strip-till systems. Soil analysis data is also showing improvement in total C and N contents which serve as indicators of improving soil health. The use of a legume cover crop such as hairy vetch as well as poultry litter suggests the importance of providing a C source for soil microbes to flourish on as opposed to strictly only using commercial fertilizers which generally lack C substrates. The impact of these results can be far reaching as growers adopt greater use of cover crops and poultry litter to improve soil health and productivity.

Project Deliverables

Seman-Varner, R., J.J. Varco, and M.E. O'Rourke. Enhancing fall-applied poultry litter nitrogen benefits to corn with legume and legume-rye cover crops. Agron. J. *Submitted 11/2016.*

Varco, J.J. Building high quality soils with cover crops. 2016. MACA 43rd Annual Conference, 2 & 3 Feb. 2016. The Mill Conference Center, Starkville, MS. MACA.

Varco, J.J. Soil health and productivity. 2016. North Mississippi Fruit & Vegetable Growers Conference. 11 & 12 Feb. 2016. Lee County Agri-Center, Verona Miss. MSU-Extension, MAFES, MDAC, Miss. Fruit and Vegetable Growers Assoc.

Varco, J.J. 2016. Winter cover crop systems with and without fall applied poultry litter effects on corn productivity and N replacement. Row Crops Field Day 11 Aug. 2016. North Miss. Res. & Ext. Center., Verona Miss. MAFES and MSU Extension.

Boupai, A. and J.J. Varco. 2016. Soil health observations influenced by cover crops with and without fall-applied poultry litter in a corn production system. Row Crops Field Day 11 Aug. 2016. North Miss. Res. & Ext. Center., Verona Miss. MAFES and MSU Extension.

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