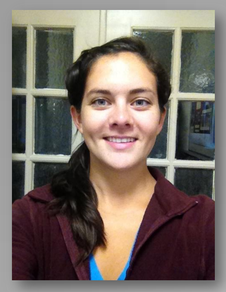
Improving Soils with Summer Cover Crops and Broiler Litter Compost in Fall Organic Vegetable Systems

Sarah M. Reynolds*[1], W. B. Evans[2], C. Montsenbocker[3], G. Panicker[4], R. Mentreddy[5]

[1]Plant and Soil Sciences, Mississippi State University, Crystal Springs, MS., [2]Mississippi State University, Crystal Springs, MS., [3]LSU AgCenter, Baton Rouge, LA, [4]Alcorn State University, Lorman, MS, and [5]Alabama A&M University, Normal, AL



Abstract

Cover crops and composted broiler litter (CBL) are two organic methods used to improve soils and organic vegetable crop production. A study is underway at Crystal Springs, Mississippi testing the influence of four summer cover crops: sunn hemp, sesame, sorghum-sudan grass and a sunn hemp + sesame blend, in combination with four rates of CBL: 0, 2,800, 5,600, 11,200 kg·ha^{-1}, on fall vegetable production. The cover crops, in four replicates, were established in early summer 2011, mowed and incorporated into the soil in August. The CBL rates were applied within each subplot and tilled before transplanting broccoli cv. Marathon into raised beds in September. Soil tests were done pre- and post- cover crop, and after the broccoli were harvested. Soil tests taken after incorporating the cover crops but before applying the CBL did not show any significant differences among cover crop treatments in soil pH, organic matter content or available nutrients (P, K, Ca, Mg, Zn, or S). After application of CBL and production of a late fall broccoli crop, soil tests indicated that cover crop had minimal influences on soil parameters. However, increasing CBL rates led to increased residual P and K availability, with modest elevations in soil pH and organic matter. These changes were not necessarily correlated with broccoli leaf tissue nutrient levels, crop yield or quality.

Introduction

The USDA National Organic Standards (2012) require growers to maintain and/or improve soil health while raising crops. Organic vegetable growers must also produce high quality crops at a volume sufficient to be profitable. Two ways to maintain soil quality and add nutrients to the soil for vegetable crops are planting cover crops and applying organic fertilizers such as chicken broiler litter. How best to use these two together in southeastern U.S. organic vegetable production has not been studied extensively, especially for fall vegetable crops.

Cover crops can build and maintain soil organic matter, which is a major factor for sustaining and increasing agricultural productivity (Nolte and Wang, 2010). Legume cover crops can fix and contribute nitrogen, while non-legumes can trap soil nitrogen. Both can add organic matter to the soil system. In addition to its properties as a fertilizer, broiler litter is more effective in improving soil property components than conventional fertilizer (Adeli et al., 2010). In this research, we are investigating the use and effects of summer cover crops in combination with composted broiler litter for fall vegetable production in Mississippi.

Objectives

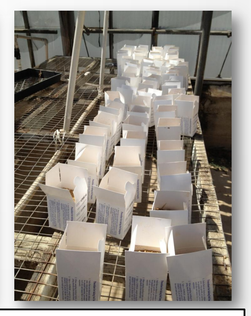
- Determine the extent to which summer cover crops and composted broiler litter alter nutrient availability in the soil.
- Determine how summer cover crops and composted broiler litter influence fall vegetable crops in an organic production system.
- Identify which cover crops and/or broiler litter compost combinations improve fall vegetable crop production the most.

Acknowledgements

We thank the Truck Crops Branch Experiment Station crew in Crystal Springs for maintaining the project, Currie Farms (Smith County, MS) for providing the composted broiler litter, and SunGro Horticulture (Bellvue, WA) for in-kind support. This work was funded by the Southern Sustainable Agriculture and Research Education (SARE) program.

Methods

- Summer cover crops used *(seeding rates (kg·ha^{-1}))* – Plot size of 12 x 4.5 m:
  - Sunn hemp *(Crotalaria juncea), (44)*
  - Sesame *(Sesamum indicum), (13.2)*
  - Sunn hemp + sesame blend, *(22 + 6.6)*
  - Sorghum-sudan grass *(Sorghum X drummondii), (38.5)*
- Rates of broiler litter compost used – Subplot size of 3 x 4.5 m:
  - 0, 2,800, 5,600, 11,200 kg·ha^{-1}
- Succeeding vegetable crop:
  - Broccoli (*Brassica oleracea* L. var. *italica* Plenck. cv. Marathon), transplanted at 0.5 m x 1 m spacing
- Data Taken:
  - Soil samples taken before cover crop planting, after cover crop incorporation, and after the broccoli harvest
  - Marketable vs. unmarketable head number and weight (not shown)
  - Nutrient analysis of young mature leaves (not shown)



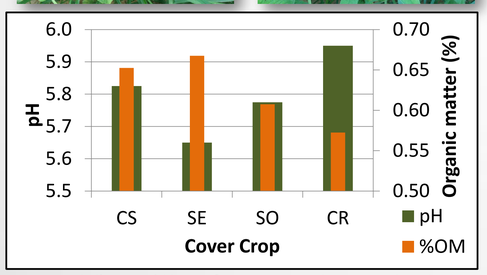


Figure 1. Soil pH and %OM after cover crop incorporation. Sunn hemp + sesame blend (CS), sesame (SE), sorghum-sudan grass (SO) and sunn hemp (CR). All data n.s.

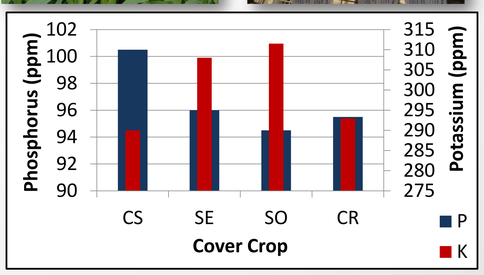


Figure 2. Soil P and K after cover crop incorporation. All data n.s.

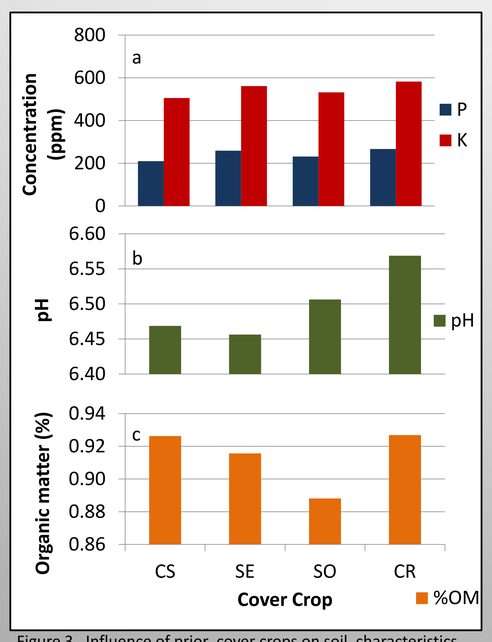


Figure 3. Influence of prior cover crops on soil characteristics after broccoli harvest: (a) extractable P and K, (b) pH, and (c) percentage organic matter. All data n.s.

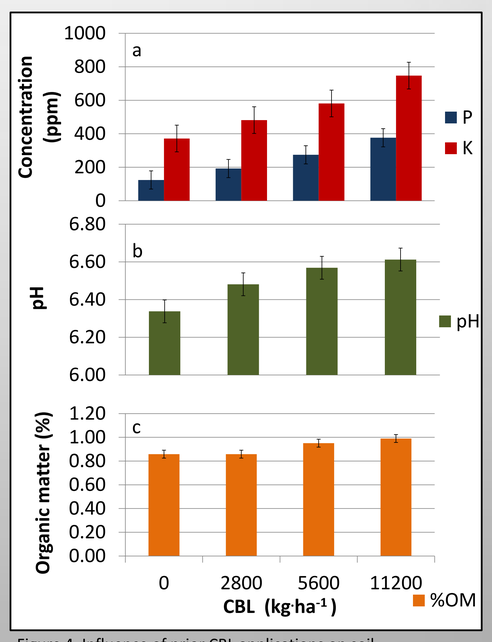


Figure 4. Influence of prior CBL applications on soil characteristics after broccoli harvest: (a) extractable P and K, (b) pH, and (c) percentage organic matter. (+/- s.e.)

Results

With respect to soil tests, there were no significant interactions between the cover crops and the composted broiler litter (CBL) (data not shown). After cover crop incorporation there were no differences in soil pH or organic matter content (%OM) (Figure 1), nor in extractable P and K (Figure 2). After broccoli harvest, no significant differences were seen in soil P, K, pH, and %OM (Figure 3); however, extractable Mg showed slight differences among cover crop treatments (not shown). Increasing CBL application rates led to significant increases in soil P, K, pH, and %OM after broccoli harvest (Figure 4). CBL also increased levels of Ca, Mg, Zn, S, and Na (data not shown).

Conclusions

Other than small differences in magnesium after the vegetable crop, summer cover crops did not significantly alter soil nutrient availability after incorporation nor after the succeeding broccoli crop. Soil test values for pH, %OM and the elements tested were higher after the broccoli crop than before it, after cover crop incorporation. Differences in soil test values among sampling dates may be attributed to seasonal differences in soil temperature and moisture.

The influence of CBL on soil test values was much greater in this study than was the influence of the summer cover crops. Other data from this study show no significance difference in broccoli yield of weight among cover crops, although a significance was seen among CBL application rates (Reynolds and Evans, 2012). Combining the yield data with the soil test data comparing the broiler litter rates suggests that 5,600 kg·ha-1 of composted broiler litter could be the most efficient amount to use since applying more resulted in no significant differences in soil test values or yield, except in soil extractable K concentrations.

This experiment will be repeated two more years, providing more data to reach our objective.

References

Adeli, A., D. Rowe, K. Sistani and H. Tewolde. 2010. Comparison of broiler litter and commercial fertilizer at equivalent N rates on soil properties. *Communications in Soil and Plant Analysis*, 41:2432-2447.

Nolte, K. and G. Wang. 2010. Summer Cover Crop Use in Arizona Vegetable Production Systems. Arizona Cooperative Extension.

Reynolds, S. and W. B. Evans. 2012. Unpublished data.

USDA National Organic Programs. 6-6-2012. 7-27-12. http://www.ams.usda.gov/AMSv1.0/nop.