Soil Health Report

ORGANIC FARMING
RESEARCH FOUNDATION

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Introduction

Soil health is a fundamental principle of organic farming, as well as a priority for organic farmers and others interested in a regenerative system of agriculture. An ecologically balanced community of soil organisms is vital for nutrient cycling, promoting plant immunity to diseases and pests, reducing pressure from noxious weeds, and providing an abundant yield of high quality produce while relying on organic matter as the primary source of fertility. There were two presentations and three posters directly related to soil health.

Researchers at OARS presented the results of using what were described as "Locally derived Effective Microorganisms" (LEMs) in soil amendments in a presentation and two posters. LEMs are a mixture of photosynthetic bacteria, lactobacilli, yeasts, actinomycetes, and ammonia oxidizers. The objective is to increase the populations of these beneficial organisms in the soil through inoculation, either applied directly or via a soil amendment. The goal of the project is the identification, collection, and culturing of microorganisms that are beneficial for soil health and plant growth, and that may result in a more resilient and productive agricultural ecosystem. Another looked at methodologies to make more efficient use of soil organic matter for phosphorus (P) and potassium (K) requirements.

Can Locally Derived Effective Microorganisms Improve Organic Broiler Litter Compost?

Kishan Mahmud (Presenter), Dorcas H. Franklin, Laura C. Ney, Aspen R. Hattabaugh, Miguel L Cabrera, Dennis Hancock, Mussie Y Habteselassie, Quint Newcomer

The objectives of the project were to assess whether compost quality would improve from inoculation with specific organisms. Parameters used to evaluate compost quality included ammonia volatilization, carbon dioxide (CO_2) respiration, nitrogen loss, and germination index. The inoculant was cultured from species commonly found in Southeastern US soils, such as various photosynthetic bacteria and *Lactobacillus* species. Broiler litter treated with LEM during the composting process, with a control consisting of water only, and a treatment labeled 'false LEM' or FLEM that included the nutrient broth used to culture the LEM. LEM significantly reduced ammonia volatilization and nitrogen loss in the poultry litter. Broiler litter compost that was treated with LEM also had a significantly higher germination index than compost that was not made with LEM. However, CO_2 respiration was not significantly different between treatment. Organic farmers can potentially benefit from more efficient nutrient cycling by the treatment of poultry litter with organisms that reduce volatilization and increase mineralization of nitrogen.

Rethinking P and K Fertility in Coastal Plain Soils
Robin W. (Buz) Kloot and Carl Coleman

The project's objective was to quantify the amount of plant available phosphorous (P) and potassium (K) in soils along the coastal plain of the Southeastern US, and look at the validity of fertilizer recommendations based on soil tests. The experimental field was located on a certified organic farm in Columbia, SC. The farmer practiced a rotation of mixed vegetable row crops and winter cover crops. Different levels of P and K fertilizers were applied to test plots. The data showed that there was no significant difference in yield or quality with the addition of potash (K_2O) fertilizers, despite differences in the soil tests. Soil samples are generally taken at a depth of 6", but roots will go deeper. The soils in in the coastal plains of the southeast may have a concentration of K at 12-24" deep that are twice as much as the concentrations in the first six inches. The differences in P at greater soil depths are not as great in the region, but analyses still underestimate the amount that is plant available. Cover crop biomass makes potash and phosphate more biologically available. With the decomposition of cover crop biomass, there is also a measurably greater biological activity. Fertilizer recommendations that do not account for the deeper reserves of potash and phosphate fertilizers from cover crop biomass may result in differences as great as $200/acre. Kloot showed photographic comparisons of soils that have been cover cropped and continuous monoculture. There were visible differences in structure, density, and water holding capacity. The cover cropped soils formed more stable aggregates, had less bulk density, and retained more water. The results of the research are expected to help organic farmers with better advice on soil amendments needed to meet phosphorus and potassium crop requirements.

Increasing Plant-available Phosphorus through Effective Microorganism Treatment
Aspen R. Hattabaugh (Presenter), Dr. Dorcas Franklin, Kishan Mahmud, & Laura C. Ney

Using Local Effective Microorganisms to Improve Nutrient Use Efficiency of Organic Amendments
Laura Ney (Presenter), Dorcas Franklin, Kishan Mahmud, Dennis Hancock, Miguel Cabrera, Mussie Habteselassie, Quint Newcomer

The University of Georgia LEM team presented two posters on research conducted on LEM's effects on the release of phosphorous from poultry litter and on soil nitrogen (N) mineralization and efficiency of plant uptake of N. The objective of the Hattabaugh, et al. poster, was to see if compost made with LEM increased the hydrolytic release of phosphate ions compared with no treatment and FLEM controls. The Ney et al. poster looked at similar effects with the reduction of ammonia volatilization and increased plant available N. Both posters concluded that there were small, but significant improvements in plant nutrient availability compared with no treatment controls and with FLEM in at least some cases. However, the results were not

consistent or predictable. Nitrogen available to rye grass was increased in some, but not all cases. There was no significant difference in yield or quality with the treatments, In the case of phosphorous, there was no significant difference in the first year, but significant differences in the second year. The study is also looking at the soil organism communities with both treatments. Further research is needed to see if the approach can benefit organic farmers by improved nutrient cycling.

On-farm Production and Utilization of Arbuscular Mycorrhizal Fungus Inoculum
David D. Douds, Jr. (Presenter), Joe Lee, Lindsay McKeever

The objective of the study is to look at the viability of farmers producing soil organisms that will assist with the cycling of soil nutrients. Arbuscular mycorrhizal (AM) fungi are beneficial microorganisms that colonize plant roots in a symbiotic relationship to enhance nutrient uptake. on the farm. Plants develop a symbiotic relationship with AM fungi that colonize their roots, which can enhance nutrient uptake. These include *Glomus* spp. and *Gigaspora* spp. Propagating AM on the farm can enable farmers to treat their vegetable seedlings with locally adapted fungi prior to transplanting. Personnel at USDA's Agricultural Research Service have been working on a method that can be used to culture AM fungi in containers with compost and vermiculite, using bahiagrass as the host plant. As a nitrogen source, the study showed that hydrolyzed fish was a better supplemental nutrient source than blood meal. Crop response is influenced by three factors: (1) the response of the host plant to AM; (2) the level of phosphorous that is available in the soil; and (3) the health or size of the AM population indigenous to the soil. Not all plants are responsive, and some are more responsive than others. If soil has sufficient levels of available P and other nutrients are limiting, then AM are not going to increase the amount of plant uptake. Finally, if there is already a large, healthy population of AM, inoculation will not result in a plant response. In certain situations—especially with transitioning depleted soils—organic farmers can benefit from the on-farm production of AM.

Cover Crop Influence on Stored Soil Water Availability to Subsequent Crops
Ricardo St-Aime (Presenter), Sruthi Narayanan, Geoff Zehnder

Another project had the objective of finding out how cover crops can help organic farmers a reduce weed pressure, tillage, and cultivation to improve and maintain soil health, particularly water retention. The treatments included both single species and mixes of cover crops. The researchers analyzed whether water efficiency was greater with cover crops that use less water, those that produce greater biomass, or a combination of the two. Only preliminary results were available at the time of the symposium and the research is on-going. Continued research can help organic farmers with improved water efficiency.

Conclusion

Characteristics of a healthy soil need to be understood in a site-specific as well as global context. One contentious issue is whether microbial inoculants that are introduced into the soil by various mechanisms can improve soil quality in a way that increases plant nutrient availability, improves plant health, increases production, and results in a more stable and resilient soil ecosystem. Another characteristic of organic farming that relies on soil health is the way that essential plant nutrients are stored and released by biological activity rather than applied directly in plant available form as in conventional agriculture. The maxim to ‘feed the soil to feed the plant” requires a better understanding of the mechanisms by which nutrients that are bound to the soil are released by biological activity. The research presented at OARS provides promising results, and demonstrates the need for additional long-term research.