

The Long-Term Agroecological Research (LTAR) experiment: Ecological benefits of organic crop rotations in terms of crop yields, soil quality, global climate change mitigation and economic performance

Abstract: Work continues in Year 16 of a long-term experiment comparing organic and conventional crop rotations. Adverse weather conditions in 2013 affected the production and performance of several crops in the rotations being studied. As a consequence of extended wet weather in spring, poor stands, delayed weed management and subsequent high weed populations, organic soybean yields were 26 percent lower than 2012. Organic corn yields were, however, greater than conventional corn, even when re-planting occurred on June 8.

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The project measured various parameters and determined that, even with reduced yields, organic crops were more lucrative because of lower costs of production coupled with higher premium prices compared to conventional crops. Soil quality effects were evaluated every fall after harvest by quantifying a suite of biological, chemical and physical soil properties. Researchers measured soil organic C, total soil N, microbial biomass C, N mineralization, macroaggregation, extractable $\text{NO}_3\text{-N}$, $\text{NH}_4\text{-N}$, P, K, Mg, and Ca, electrical conductivity, and bulk density.

What was done and why?

The Neely-Kinyon Long-Term Agroecological Research (LTAR) experiment site was established in 1998 to study the extended effects of organic production in Iowa. The plots are located at an Iowa State University Research Farm near Greenfield. Treatments at the LTAR site, replicated four times in a completely randomized design, include these rotations: conventional Corn-Soybean (C-S), organic Corn-Soybean-Oats/Alfalfa (C-S-O/A), organic Corn-Soybean-Oats/Alfalfa-Alfalfa (C-S-O/A-A) and Corn-Soybean-Corn-Oats/Alfalfa (C-SB-C-O/A). The research is intended to assess the viability of organic cropping systems in relation to the agronomic, economic and soil quality effects in conventional cropping systems.

What did we learn?

Despite the serious drought conditions during the growing season in 2012 and 2013, organic management enhanced agroecosystem resilience and maintained a critical soil function, the capacity to supply nutrients to the crops. Soil quality remained high in the organic systems in 2011 and in 2012 even with multiple tillage operations for cover crop incorporation and for weed management.

Impacts of this research include an expanded suite of best management practices for organic and transitioning farmers, including the need to apply manure at least three weeks before planting to avoid seed corn maggot problems and the importance of timely weed management for achieving the highest organic yields. These recommendations were discussed, along with new government support for incorporating cover crops to improve soil quality, at the Neely-Kinyon Field Day on August 20, 2013, with 62 producers and ag agency staff present.

Results from the LTAR experiment have been used as background and supporting evidence for other organic research that examines the effects of organic practices (compost, cover crops, crop rotations, no-tillage) on yields, soil quality and water quality in farming systems.