Perspective on Rodale Institute’s Farming Systems Trial

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After thirty years of research, Rodale Institute’s Farming Systems Trial (FST) still remains a relevant catalyst for change in American agriculture. FST is America’s longest running side-by-side field experiment comparing organic and conventional production systems. Starting in 1981, following on the heels of the 1980 USDA study on organic production, FST was implemented to address several of the transition issues identified in the study as potential barriers to farmers adopting organic production strategies. (Additional details can be found at reference 19.)

In order to assess each barrier, specific and targeted cropping systems were identified for comparison: an organic/livestock system, an organic/legume system, and a conventional/chemical system. While yield data, the standard agronomic measure of success was collected, additional and important data streams were also measured: soil health, energy consumption, greenhouse gas emissions, and economic returns. By every measure the organic systems documented a positive benefit to the soil, the farmer, and to society. Yield was the only standard in which all treatments performed at similar levels.

The study site is located at the Rodale Institute in Kutztown, PA. Field investigations on this 6-ha site began in 1981. Prior to establishment of the experiment, the site was farmed conventionally with continuous corn for at least 25 years. The soil type is a moderately well drained Comly silt loam. The growing climate is sub-humid temperate (average temperature is 12.4°C and average rainfall is 1105 mm per year). Main plots were 18 × 92 m, split into three 6 × 92-m subplots, which allows for comparison of three crops in any given year and the use of farm scale equipment for all operations. The experiment was set up to withstand the rigors of the most intense scrutiny and managed with the assistance of an externally staffed advisory board, to assure the scientific and political communities that the results are sound. Peer review of results found in research papers again assures us all that the data is factual and based on standard acceptable research protocols. (Additional field site and experiment details can be found in reference 9, 10, 13, and 14.)

First we’ll address the yield data since the current conversation seems to focus on the need to feed the world and an ever growing population. Direct crop yield comparisons can only be made between corn, soybeans, and wheat because they are the only crops that are present in all systems. In the first four years of the trial (1981-1984), corn yields were significantly lower in the two organic systems compared to the conventional system, mostly due to N deficiency (due to the research design) and weed competition. During that same time period however, soybean yields were equal between Legume and Conventional and significantly higher in the Manure system. Yields may not need to decrease during the transition from conventional to organic production, if the transition is properly planned, as a similar trial in Iowa showed. Here corn and soybean yields were the same in organic and conventionally managed rotations for the first 3 years and higher in the organic plots in the fourth year. Since those early transition years the yields have been statistically the same across all treatments, except in drought years when the organic systems show yield increases over the conventional systems. (Additional agronomic details can be found in references 6, 9, 10, and 14.)
When we look at the long term stability of any production system we must address the impacts the system has on the primary resource needed to continue production. In the case of agricultural production, that is the soil or more specifically soil health. The long-term soil focus, as a measurement of health was on total C and N although shorter term studies with other concentrations have also been conducted in FST. In 1981 soil C and N were not significantly different between the systems. By 1994 (the first intensive sampling since the start of the trial) both C and N had increased significantly in the organic systems, despite intensive tillage, but not in the conventional plots. Results from the USDA’s long-term systems trial in Maryland demonstrated soil C and N in an organic rotation with tillage were also higher than in conventional no-till systems. Researchers concluded that organic systems provide greater long-term soil benefits.

(Additional details on soil health can be found in references 7, 17, and 20.)

Energy is used in all food production systems. However, efficient use of energy and the concept of internalized energy consumption are critical points of concern for all of society as we approach a new era of fossil fuel use. FST data shows conclusively that organic systems use 45 percent less energy to produce the same amount of crop. The difference isn’t related to direct farm use of energy. Rather, the difference can be attributed to the energy embodied in the production of the external inputs nitrogen fertilizer and herbicides/pesticides utilized extensively in the conventional systems but not needed in the biologically based organic systems where the nitrogen source is based on relatively free atmospheric nitrogen.

(Additional details on energy analysis can be found in references 1 and 13.)

When we examine the overlay of economics (the producer’s true short-term measure of success), several interesting results appear. First, An economic analysis of the first 15 years showed that after a short period of investment in “soil capital” net returns for the organic systems were competitive and sometimes greater than those of the Conventional system, assuming that all farm products received the same market price. However, the most recent economic analysis for the time period 2008 to 2010 for a comparison of the current six systems, where real time crop values, including price premiums for organic crops, where assigned, the organic systems returned a profit to the producer of 2.9 to 3.8 times that of the conventional system. Long-term trials in Maryland, Wisconsin, and Iowa had very similar results for returns of organic and conventional systems. (Additional details on economic analysis can be found in references 2, 3, 4, 5, 8, 10, 11, 12, 13, and 18.)

Recent headlines in prestigious periodicals taken loosely from reputable research institutions comparing organic production systems to conventional systems based on either yield or various quality parameters fail to describe the true picture of either system. With very little research funding, crop production systems based on sound biological principles, following organic production protocols, have proven to be equal in yield, and in drought years, superior to conventional systems. Organic food products have been shown to contain substantially less risk of pesticide contamination and the risk for isolating bacteria resistant to antibiotics was is higher in conventional than in organic chicken and pork. (Additional details can be found in references 15 and 16.)

The results of this experiment and others around the country, which have shorter histories, merely point to new challenges. Through thorough and rigorous scientific research, we have been able to document that by most measures, organic production strategies are an improvement over what we all consider “conventional” agriculture. They improve the health of the resource base, the soil, use less energy, release less greenhouse gas into the atmosphere, are economically viable, and help to mitigate the impacts of a changing climate. We now have enough preliminary evidence to show that redirected research funds and a bold outreach/education program are warranted if we are to face these challenges and propel ourselves into a new food production paradigm. I feel that it is time to embrace new organic production strategies and proactively change policies that artificially support what I believe, we now know, is a flawed production system that threatens our soil health and our future ability to feed a vibrant society.
References