Transition from Conventional to Low-Input or Organic Farming Systems

Steve Temple (California – Integrated Farming Systems Grant)

Project: SW99-008

Title: Transition from Conventional to Low-Input or Organic Farming Systems: Soil Biology, Soil Chemistry, Soil Physics, Energy Utilization, Economics, and Risk

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Tomato was the rotations' most valuable crop.

Major Participants:

UC Davis Faculty: Howard Ferris (Nematology), Kate Scow (Soil Microbiology), William Horwath (Soil Fertility), Wes Wallender (Hydrology), Lynn Epstein (Plant Pathology)
Cooperative Extension: Karen Klonsky (Economics), Tom Lanini (Weed Science), Jeff Mitchell (Soil Quality), Steve Temple (Agronomy), Tom Kearny (Grains), Gene Miyao (Vegetable Crops)
Farmers: Jim Durst, Bruce Rominger, Scott Park, Tony Turkovich, Ed Sills
Staff: Peter Brostrom (Production Manager), Leisa Huyck (Research Manager).

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Situation:

Concerns over environmental degradation, natural resource consumption, human health risks, and economic decline associated with industrial agriculture have led to the emergence of alternative, low-input farming practices in fertility and pest management .

Alternative farming methods typically use a blend of traditional practices and ecological principles to enhance the long-term sustainability of agroecosystems while maintaining productivity and short-term profitability.

To support growers who transition to alternative production methods, information on organic and low-input farming obtained in long-term field studies is needed.

Objectives:

1. Compare pests, soil characteristics, crop yield, profitability, and quality among four farming systems with different levels of reliance on non-renewable resources.
2. Evaluate existing and/or novel sustainable and organic practices.
3. Distribute information generated by the project.

Actions:

Organizational Structure and Management:

The project, termed 'Sustainable Agriculture Farming Systems (SAFS),' was coordinated and managed as a combined effort of university researchers, farm advisors, and farmers, and included the following features:

- Multidisciplinary
- Group leadership
- Consensual decision-making
- Use of 'best farmer management' practices
- Systems oriented

SAFS stakeholders during a planning session.

Farming Systems

The crop rotations and management practices were maintained for a total of 12 years on 56 1/3-acre plots that allowed use of full-scale equipment. The three 4-year, 5 cash crop rotations included tomato-safflower-corn-beans and wheat or hay. Farm management was:

- conventional (synthetic fertilizer, pesticides),
- low-input (cover crops, synthetic fertilizer at reduced rates, pesticides if needed), or
- organic (cover crops, composted manure).

The fourth system, a 2-year tomato-wheat rotation, was managed conventionally.

Data Analysis

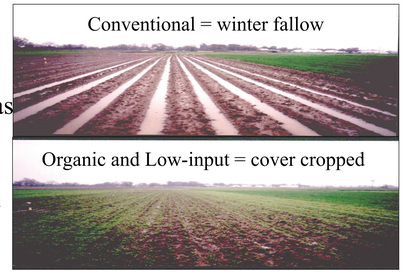
Data on crop production, pests, and soil quality were collected for research as well as adaptive management purposes. Each system's economic performance was quantified by simulating economic performance of a 2000-acre farm based on actual costs of inputs and labor within this region and crop yields measured in the experiment.

Results:

Some of the findings in the large number of studies carried out within the context of this project:

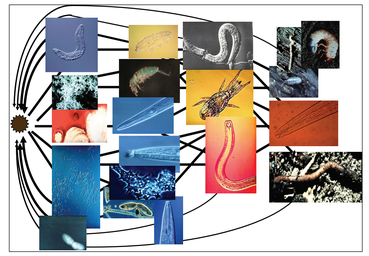
Cover crops:

Water infiltration during irrigation in the winter cover cropped systems (low-input and organic) was twice as high than in the winter fallow systems. The presence of cover crops during the rainy season significantly decreased runoff as a percentage of rainfall.



Soil food web:

Arthropods, pathogens, and nematodes were found to play a relatively small role in influencing yields.



Complexity of soil organisms and relationships increases as we move to the right (up the food chain) in this food web. The SAFS project found that the soil food web in the low-input and organic systems had moved toward the right side, whereas the conventional systems had stayed more to the left.

Weed management:

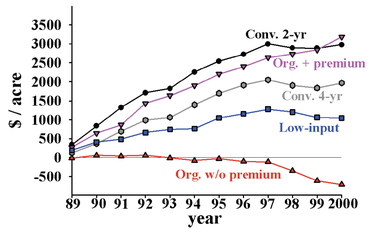
The economic feasibility of reducing pesticides depends on the crop. In corn, mechanical cultivation could substitute for a 50% reduction in pesticides, but in tomato, such a reduction would increase pest management costs by 50% due to the dependence on hand hoeing.

Nitrogen storage and loss:

The long-term balance of nitrogen (N) inputs and outputs and soil N storage indicated average annual unaccounted for losses of 40 to 45 kg N ha^{-1} in the conventional systems. In the organic and low-input systems, these losses were 9 and 3 kg N ha^{-1}, respectively.

Profitability and energy use efficiency:

The 2-year conventional and the organic rotations were the most profitable systems due to the greater frequency of tomato in the former and the organic price premium in the latter. Energy use was lowest in the low-input and highest in the conventional systems.



Cumulative net returns of the four farming systems.