

# Impact of Microbial Processes on Crop Use of Fertilizers from Organic and Mineral Sources

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## **Project Leader**

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## **Objectives**

The primary objectives are to determine relationships among:

1. Microbial biomass and activity
2. Soil fertility parameters, particularly N pools
3. Crop yield and quality at the end of the growing season.

## **Summary**

The premise of this study is that sustainable farming practices need to address the below-ground, as well as above ground, components of an agro-ecosystem. The study was focused on developing an understanding the dynamics of microbial communities associated with different farming management systems and to determine whether differences in soil biology are associated with differences in soil fertility. The study was carried out at the UC Davis, Sustainable Agricultural Farming Systems (SAFS) project which is a comparison of two and four year rotations (tomatoes, safflower, corn, wheat/beans) managed by four farming systems (conventional 2- and 4-year rotations, low input and organic).

It was observed that during the growing season, soil microbial populations were usually higher in size and activity in organic and low input than conventional farming systems. In the organic-amended systems (with cover crop and manure), microbial populations rapidly responded to organic additions, steadily increased until the middle of the growing season, and then declined. Soil inorganic N also increased with increase in microbial populations. Fluctuations in microbial biomass and activity were much less in conventional than the organic-amended systems. Soil nitrate levels were usually significantly lower in the organic than the conventional tomato soils, yet often significantly higher in organic than conventional corn soils. Whereas soil nitrate levels were inversely correlated with microbial biomass levels in organic, they were positively correlated with microbial biomass in conventional tomatoes.

The low input system (combining cover crops and mineral fertilizer) supported crop yields in corn, and usually tomatoes, that were comparable to yields in the conventional 4-year system. The organic system (combining cover crops and composted poultry manure) on the other hand, usually had lower tomato and corn yields than did the other farming systems. The lower yields in the organic system are hypothesized to be the inability of the manure to provide sufficient N

during periods of major crop demand. Differences between the organic and low input tomato systems with respect to microbial biomass were usually negligible whereas the low input system had significantly higher microbial activity than did the organic during the period of high crop demand for N.

Some differences between farming systems in soil fertility and structure appear to be related to differences in soil biology. Microbial biomass was positively correlated with water stable aggregation; water stable aggregation increased from the conventional to low input to organic system. High microbial biomass and activity, and high numbers of bacterial-feeding nematodes, may have been responsible for adequately tomato yields during one year when the C/N ratio of organic inputs was higher than normal. Though certain soil biological parameters are enhanced in organic compared to conventional systems, the conventional soil was nevertheless very active biologically. Under controlled conditions, added cover crop residues were found to decompose at the same rate in soils managed by conventional or organic farming practices. Using a test that estimates the metabolic diversity of the microbial community, no differences were found between the conventional and organic tomato soils.

#### Project Publications

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Clark, M.S., W.R. Horwath, C. Shennan and K.M. Scow. 1998. Changes in soil chemical properties resulting from organic and low-input farming practices. *Agronomy Journal*, 90:662-671.

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