

# How Organic and Conventional Farming Methods Compare

A Swedish comparison of organic and conventional farming methods shows several benefits from an organic system.

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FEW SCIENTIFIC STUDIES have compared organic farming methods with conventional techniques, and even fewer have looked beyond yields at the effect of those systems on the soil, the nutritional value of the crops, and the crops' keeping qualities. A field experiment in Järna, Sweden has done all of those things and over a period of 20 years.

It began in 1958 and was directed by agronomist Bo Pettersson, well known throughout Europe for his work on alternative farming practices. The project tested eight different soil treatments used in four-year rotations of summer wheat (under-sown), clover/grass, potatoes and beets. The treatments ranged from dairy manure composted bio-dynamically, to fresh manure, manure combined with inorganic NPK, to inorganic NPK alone in low, medium and high application levels. The researchers monitored physical, chemical and biological alterations in the soils and crops over the 20 year period. These are the highlights of their important findings:

## Fertilization and Yields

Whether organic or inorganic, the fertilization rates were set to supply a level of available nutrients, which, for the 20 year period, averaged a modest 30 pounds of N, 40 pounds of P and 75 pounds of K per acre each year. The organic treatment supplied in addition approximately 2 tons of dry organic matter per acre each year, or roughly 6 tons of fresh material. In one of the fresh manure treatments this level



was halved and then inorganic NPK was used to make up the nutrient deficit. This combined manure/NPK treatment probably represents the most typical soil treatment in mixed farming practice, and in this experiment provides an important contrast to either the strict organic or inorganic variants.

Because the levels of available nutrients supplied to the soils were similar between the various treatments, no differences in yields should have been expected—all other factors being equal. Yields taken for the 20 year period showed organic treatment averaging 4 percent less

**Swedish researcher Bo Pettersson inspects research plots of clover and grass, wheat and field beets.**

wheat, 8 percent more clover/grass, less than 1 percent fewer potatoes and 3 percent fewer beets. Converting yields to caloric energy produced for each four-year rotation period showed the organic averaging 2 percent more (energy expenditure in fertilizers is not included in the figure). All the soils increased in their yield capac-

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ity with each succeeding rotation while the fertilization levels remained constant. The check plot which received no fertilizer increased in yield capacity by 40 percent, the inorganic parcels by 40 percent and the organic by 50 percent. Apparently, a large factor in this improvement was the favorable effect of the rotations on subsoil structure. One other feature about the yields is that the combined manure-NPK treatment almost invariably gave the highest yields, but at some cost to soil condition.

### Effects On Soils

After the 20 years there was virtually no change in organic matter content in the topsoil. The highest averages were found in the inorganic plots, most likely due to greater amounts of root residues in the plow layer. In the subsoils however, the findings were dramatically different. With inorganic treatment there was little root penetration and subsequently the lowest average levels of organic matter were found there. Over the experimental period organic matter in the subsoil increased by 50 percent with the inorganic treatment and 160 percent with organic. The plots which had the combined manure/NPK fertilization showed the least increases. Consistent with these changes the physical density in the subsoils for all the organic treatments improved. Measurements of earthworm ac-

### Dependence of Potato Storage Losses on Fertilization

	NPK + RAW		LOW HIGH	
	COMPOST	MANURE	CONTROL	NPK NPK
Shrinkage, as % unmarketable tubers @ 259 days	12.1	17.8	28.9	15.1 34.3

tivity revealed marked increases over the check plots in the compost and fresh manure treatments and a slight decrease with inorganic treatments. Other factors such as soil carbon dioxide respiration and enzyme levels were measured and found to correlate strongly with these results. The highest apparent mineralization rate of the soil humus was found where the combined manure/NPK treatment was applied; it is this effect to which the researchers attribute the high yields. Overall, the fresh manure and bio-dynamic compost prompted the greatest biological effects.

### Crop Quality

Potatoes from four years were subjected to a number of tests for physiologic quality. Twelve different tests relating to susceptibility to spoilage were applied. Bulk yields, were contrasted

with dry matter yields and this revealed that the inorganic treatment in general increased the relative water content of the potatoes. Crude protein levels were higher with NPK treatment than with the organic treatments, but the relative true protein levels were greater in potatoes grown in the organic parcels, implying greater protein quality. During the actual growth of the potatoes, the relation of upright stems to horizontal stems was monitored, revealing more vertical growth with organic treatment, a feature associated with better tuber quality. The enzymatic darkening of potato tissue upon exposure was found to relate strongly to the various treatments, increasing with inorganic fertilization. Spoilage losses during 260 days storage showed 12 percent loss in marketable tubers grown with compost treatment and 25 percent average loss in tubers grown with inorganic treatments. Susceptibility of tubers to *Phytophthora infestans* infection was lowest in the bio-dynamic compost and highest in the medium NPK treatment.

Summarizing the quality investigations the researchers conclude that the most favorable overall results are found with the compost treatment, closely linking the results of the soil investigations to the quality tests. The medium application rate of inorganic fertilizer (50-40-75 pounds/acre) gave better results than either the highest or lowest rates, suggesting that less-than optimal fertilization with chemicals is as deleterious as too much fertilizer.

The Swedish research underscores the fact that just one or a few criteria aren't adequate to judge the appropriateness of one agricultural method over another. However, this research with rather modest treatments raises many questions concerning the long term ecology of agricultural methods which customarily rely on much greater nutrient inputs. □

*Editor's Note: A 40-page report on the Järna experiments is available from William F. Brinton at Woods End Agricultural Institute, Orchard Hill Road, Temple, ME 04984 at a price of \$5.00 + \$1.50 postage & hand.*

**Relative percentage of humus (measured as extractable humic acids) in the topsoil and subsoil of samples. Although differences were not great in the topsoils, they were pronounced in the subsoils. It appears that with the inorganic fertilization, a greater portion of the humus is present in a more aged and less soluble and active form.**

