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Course: Principles of Organic farming

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Soil fertility, nutrient recycling

In organic farming systems, soil fertility means more than just providing plants with macro- and micronutrients. Effective fertility management considers plants, soil organic matter (SOM), and soil biology. Ideally, organic farming systems are designed to enhance soil fertility to achieve multiple goals. Important goals include: the protection and, if possible, improvement of soil physical condition so that the soil supports healthy plants and soil-dwelling organisms and has the ability to resist and recover from stresses like flooding or aggressive tillage; the maintenance of soil buffering capacity to minimize environmental degradation caused by soil loss or soils' failure to filter nutrients or degrade harmful compounds; and increased water and nutrient use efficiency by increasing biological fixation and retention of needed nutrients while reducing their loss from the system to the extent possible. Organic farming systems are designed with the aim of maintaining nutrients in organic reservoirs or in bio-available mineral forms instead of just supplying nutrients through frequent fertilizer additions. This is achieved by cycling nutrients through organic reservoirs. Soil fertility is improved by organic matter management and not through input substitution.

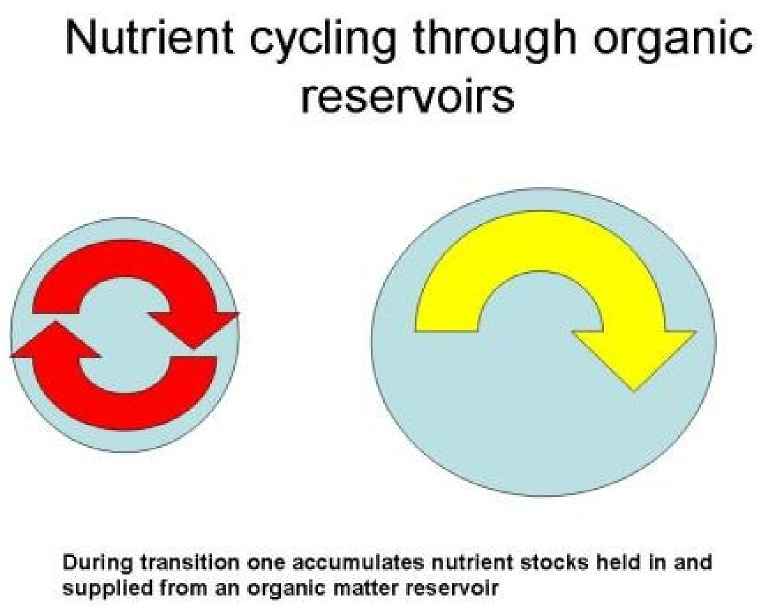

Figure 1. *This cartoon depicts idealized changes that occur where fast mineral nutrient cycling (depicted by red arrows) in depleted organic reservoirs (depicted by blue sphere) is altered by improved management to result in slower cycling rates (yellow arrow) within an enlarged reservoir. Figure credit: Michelle Wander, University of Illinois.*

The intention of organic systems is to manage the full range of soil organic and inorganic

nutrient reservoirs and prevent unwanted loss by retaining them in forms that can be accessed by crops through biological leveraging. One objective during transition is to enhance symbiotic associations between plants and their microbial partners, organic reserves, and the physical environment. For more on the role that microbes play in N cycling see Soil Microbial Nitrogen Cycling for Organic Farms.

This holistic view is the basis for the soil fertility management practices used in organic agriculture.

There are four soil fertility management practices typically used in organic cropping systems that determinethe cycling and availability of nutrients in the soil:

1. use of organic residues as soil amendments or sparingly soluble minerals;
2. use biological N-fixation as the major N source;
3. use of a rotation that includes active plant growth (cover crops, intercrops etc.) as much as possible and thatminimizes bare fallow.
4. Plant species are diversified in space and time to fulfill a variety of functions (minimize weeds and pests, support below-ground processes, erosion control, N fixation, build SOM etc.).

Organic fertility is not a matter of input substitution:-

Organic farming systems cannot rely on use of soluble, inorganic nutrient sources. Conventional fertilizer management guidelines hinge upon assessments of plant-available N and P combined with empirical fertilizer addition studies that are able to provide estimates of the amount of fertilizer required to achieve yield goals.

Although many organic producers do use soil testing to assess soil nutrient levels, they report that while these tests often indicate that plant-available N or P may be limiting, their yields do not reflect these soil test results. There are several reasons to expect that organic production systems require their own suite of management tools.

First, organic soil amendments vary in quantity and quality. Second, the condition of the soil resource plays a large role because it supplies and recycles added nutrients. Results can vary greatly after organic materials are added for a variety of reasons, some of which, can be managed.

Current research on organic fertility management is looking closely into avenues for soil testing and management of amendments and soil biology to optimize fertility by taking into account the synergisms that occur in biologically active soils.

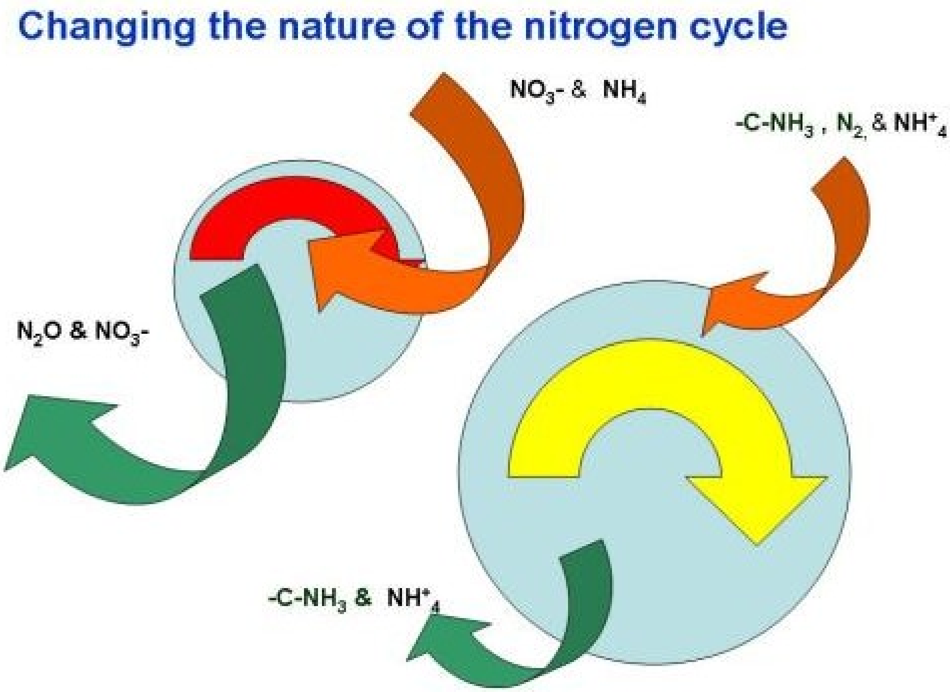

Figure 2. *The figures above depict changes in N cycling in systems where N is supplied in inorganic fertilizers to systems that rely on organic sources. The size of the blue sphere represents the active or labile fraction of soil organic matter and the thickness and coloration of the arrows reflect the size and cycling rates of nutrient reserves. Red arrows identify pools that cycle more rapidly than yellow.*