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Nutrient Management Under Organic Farming

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Introduction

Organic farming is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects (IFOAM, 2013).In these production system Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach. It preserves the reproductive and regenerative capacity of the soil, good plant nutrition, and sound soil management, produces nutritious food rich in vitality which has resistance to diseases (APEDA, 2015).

The organic nutrient dichotomy

Organic farming contains something of a dichotomy regarding nutrient management. One view is the ‘law of return’ where it is considered essential that any nutrients removed in crops or livestock must be returned to maintain fertility i.e., a balanced nutrient budget. The other view considers the farm to be a ‘closed system’ for nutrients, and that they should be carefully (re)cycled within the farm, so there is no need to ‘import’ nutrients. The latter approach of nutrient management does not consider the removal of nutrients in crops. livestock or losses to the atmosphere and through leaching. The scientific evidence is now overwhelming that both must be combined: the law of return (balanced budgets) must be coupled with efficient cycling of nutrients around the farm.

Nutrient management under organic farming

Although nutrient management in organically managed fields is fundamentally different to soils managed conventionally. The same nutrient cycling processes operate in organically farmed soils as those that are farmed non-organically although their relative rates and importance may differ. Organically farmed soils have essentially the same nutrient pools as non-organically farmed soils, but in the absence of regular fertiliser inputs, nutrient reserves in less-available pools may be more important in some conditions. On organic farms, nutrient

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management should meet crop nutrient needs while avoiding soil nutrient depletion. It should also maintain or improve soil productivity without nutrient losses. The chemical, physical, and biological features of soil, as well as their interactions and interactions with the cropping system, all influence nutrient availability. While various soil parameters can be measured, crop performance is the best indicator of soil productivity. Farmers often manage to reduce soil physical and chemical restrictions to long-term productivity by employing techniques such as(Wortman*et al*., 2017):

- ✓ Application of organic sources such as manure, compost and green manures to supply nutrients and maintain soil organic matter
- ✓ Applying bio fertilizers to improve nutrient availability
- ✓ Growing cover crops to re-cycle soil nutrients and atmospheric biological nitrogen fixation
- ✓ Diversifying crop rotations for more efficient recovery and physiological use of nutrients

Impacts on soil

- ❖ Reduced soil erosion.
- ❖ Increased SOM, soil fertility/ soil health.
- ❖ In the longest trial so far (>150 years), at the Rothamsted Experimental Station (UK), SOM and soil total N levels have increased by about 120% in the organic manured plots, and only by about 20% in the plots employing NPK fertilizer. (Gomiero*et al.*, 2011). ¬
- ❖ Higher microbial biomass carbon and nitrogen, and net mineralizable N.
- ❖ Enhanced microbial activity (20-30%).
- ❖ Enhanced aggregate stability and water retention capacity of the soil.
- ❖ Enhanced activity of earthworms and other macro-organisms.
- ❖ Conversion form conventional to organic farming results in increased population of beneficial bacterivore nematodes while reducing plant parasitic nematodes (Briar *et al.,* 2007).

Nutrient sources under organic farming

- **Manure: -** Manure application is often valuable to organic production. The nutrient composition of manures varies with type of animal, quality and quantity of bedding

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material, feed composition, storage conditions and length of storage. Typical estimates of total N, P & K contents of common animal manure types are given in the table below. However, applying manure to meet the whole crop nitrogen (N) demand can lead to excessive soil phosphorus (P) because crops remove more N than P. This excessive soil P is not harmful to crops but contributes to P losses in erosion, runoff and leads to contamination of water bodies. Therefore, crop N needs to be supplemented by biological nitrogen fixation or other nitrogen sources(Wortman*et al*., 2017). Raw organic manure should be applied more than 120 days before harvest if the edible portion of the crop will be in direct contact with soil, and 90 days before harvest if the edible portion of the crop will not be in direct contact with soil. These restrictions are not applicable for composted manure and for crops not grown for human consumption.

Table:1 Typical nutrient content in animal manures (Barry *et al.*, 2008).

Typical N, P & K levels in animal manures

Animal Manure type	N kg/t3	P kg/t3	K kg/t3
Farmyard Manure	4.5	1.2	6.0
Cattle Slurry	5.0	0.8	4.3
Compost	7.5-15.0	1.0 – 2.0	7.0
Poultry Broilers Deep Litter	11.0	6.0	12.0
Layers	23.0	5.5	12.0
Turkeys	28.0	13.8	12.0

- **Compost: -** Composting converts organic waste into material of higher nutrient concentration, and reduces the bulk of organic materials through decomposition, therefore it is often easier to handle than the bulk organic material. Apart from nutrient management composting is also recommended in organic farming as a useful tool for controlling weeds, diseases and pests. Organic standards promote composting, anaerobic digestion, aeration of slurry and correct storage of manure. These treatments greatly reduce pathogen population in manures and increase the range of biological activity, which helps to suppress harmful microbial populations, and by

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high temperature. Compost has less odor and fewer microbial pathogens, with less risk of microbial contamination of fresh produce than with raw manure. In addition to supplying primary nutrients, compost is an important source of other secondary and micronutrients. Compost application improve soil organic matter content, cation exchange capacity, aggregate stability, soil porosity, and water-holding capacity. Soil biological properties, including microbial biomass and microbial enzymatic activities are often increased following compost application. Despite the many advantages of compost, raw manure remains popular due to the higher cost of composting and the loss of nitrogen throughout the composting process.

- **Bio fertilizers:-** Bio fertilizer can be defined as biological products containing living microorganisms that, when applied to seed, plant surfaces, or soil, promote growth by several mechanisms such as increasing the supply of nutrients, increasing root biomass or root area and increasing nutrient uptake capacity of the plant (Vessey, 2003).These are the products designed to provide enhanced nutrient availability and uptake, stimulation of crop growth and protection against insect pests and disease. Depending on the purpose, bio fertilizers can be applied to soil, seeds, or foliar tissue. Several common categories of bio fertilizers include nitrogen-fixers, phosphorus absorbers, phosphorus-solubilises, and humic acid. Nitrogen-fixers such as Rhizobium (with legumes), Azotobacter and Azospirillum, convert atmospheric nitrogen into ammonia. Bacillus and Pseudomonas are examples of phosphorus-solubilising microbes which reduce soil pH to dissolve soil-phosphate to make it available for plant.

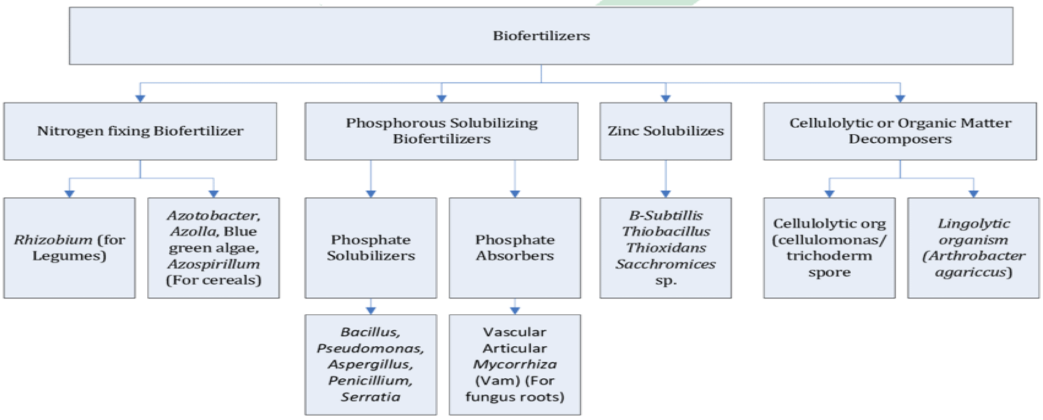

Fig. 1 Classification of bio fertilizers (Abdulkarim *et al*., 2019)

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Arbuscularmycorrhizal fungi take up soil phosphorus, zinc, and copper and transfer these to plant roots, but these are typically abundant in Nebraska agricultural soils. Humic acid is also important to plant growth and it is abundant in most soils.

- **Green Manuring: -** Green manuring is growing in the field plants usually belonging to leguminous family and incorporating into the soil after sufficient growth. The plants that are grown for green manure known as green manure crops. The most important green manure crops are sunnhemp, dhaincha, *pillipesara*,clusterbeans and *Sesbaniarostrata. In addition to source of nutrients* green manuring improves soil structure, increases water holding capacity, decreases soil loss by erosion, reduces off season weed proliferation. Green manuring helps in reclamation of alkaline soils.

Table: 2 Biomass production and N accumulation of green manure crops

Crop	Age (Days)	Dry matter (t/ha)	N accumulated
Sesbaniaaculeata	60	23.2	133
Sunnhemp	60	30.6	134
Cow pea	60	23.2	74
Pillipesara	60	25.0	102
Cluster bean	50	3.2	91
Sesbaniarostrata	50	5.0	96

- **Cover crops:-**Cover crops can improve soil physical properties, and soil microbial activity. Well-grown cover and catch crops can retain nitrogen that might otherwise be lost by volatilization, runoff, or leaching and also provide a source of fresh organic matter. Like other sources of organic nitrogen, nitrogen contained in cover crop biomass is not entirely available to the next crop. The legume crops should be selected as cover crop because nitrogen fixation by a legume can be especially useful for increasing soil nitrogen and balancing the abundant phosphorus and potassium supplied through manure or compost application.
- **Crop rotation:-** Crop rotation can contribute to improved soil physical properties, nutrient availability, pest management, crop yield and nutrient use efficiency. Develop crop rotations that include legumes as a source of nitrogen. Crop rotation sequencing should try to match N release and timing to crop uptake demands. Legume

crops in the rotation can result in a nitrogen credit for subsequent crops due to fixation of atmospheric nitrogen and less immobilization of nitrogen incomparison with a non-legume.Root architecture is critical for long-term crop rotation. Deep-rooted crops such as alfalfa can scavenge immobile nutrients like phosphate and leached nutrients like nitrate-nitrogen from deep soil layers, which can then be released near the soil surface with crop residue decomposition, making them available to succeeding crops in the rotation.

Conclusions

Nutrient management in organically managed fields is fundamentally different to soils managed conventionally which requires a long-term planning and a combination of cultural practices and inputs. Although there are an increasing number of commercially available organic fertilisers and bio fertilizers, the most profitable organic farms often source nutrients on or near the farm by employing organic wastes, scavenging residual soil nutrients, and nitrogen fixation through biological means. Under organic nutrient management system off farm inputs are generally avoided but when off farm and manufactured inputs are necessary, it is critical to check the certification body to ensure that the product is approved in organic farming.

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