

Effect of Organics on Sustainable Agriculture and Soil Quality

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Abstract: Indian agriculture has shifted from traditional to intensive farming with indiscriminate use of chemical fertilizers and pesticides, which in turn has made our soils largely non-productive and contaminated the ground water. Indian soils are also becoming poor in organic matter and there is a growing concern for regular application of organic manures and recycling crop residues to sustain productivity and high responses to NPK fertilizer. Thus, there is need to apply organic manures as essential part of crop production to balanced plant nutrition for sustainable agriculture.

Keywords: Organic, Soil Quality

1. Introduction

To maintain and sustain a higher level of soil fertility and crop productivity the use of organic manures is very important. Organic manures increase the organic matter content of the soil, therefore improving the exchange capacity of nutrients, increasing soil water retention, promoting soil aggregates and buffering the soil against acidity, alkalinity, salinity, pesticides and toxic heavy metals. Among bulky organic manures, green manures come next to compost and FYM both in terms of manurial value and production. Continuous recycling of the organic manures with organic amendments enhances the organic matter content and also supplements the nutrient pool of the soil (Kumar et al., 2008). The balanced use of various plant sources plays a vital role in enhancing the microbial population of soils having sub-optimal population of native micro-organisms in intensive production systems. Besides providing plant nutrients to the crop, these help in mobilizing native nutrients in soil-plant system.

Organic fertilizers

Organic fertilizers are derived from plant, animal, and human residues. Among them are bulky organic manures like farmyard manure, compost, green manure and concentrated manures such as various oilcakes and waste products of animal origin like dried blood, fish manure etc.

Table 1: All India production of organic fertilizers (lac tones) and area under green manures (lakh hectares)

Organic fertilizers	2007-08	2008-09	2009-10
Rural compost	697.42	40.72	76.17
Urban compost	76.25	24.37	23.57
FYM	864.65	126.74	181.25
Vermicompost	12.63	24.58	842.86
Other manures	43.87	29.43	62.25
Total organic fertilizers	1694.82	245.83	1186.10
Green manures			26.57

Source: Anonymous (2010)

Bulky Organic Manures (BOM)

- BOM contain macro and micro nutrients in small quantity

- Applied in large quantities
- Increase organic matter content in soil, water holding capacity of sandy
- Soil and increase drainage of clayey soil
- Carbon dioxide released during decomposition acts as fertilizer
- It also supplies micro-nutrients and helps to make phosphate in the soil more available to plants

Farmyard manure (FYM): FYM consists of two original components: Solid (dung) and liquid (urine)

- On an average, well decomposed FYM contains 0.5 % N, 0.2 % P₂O₅ and 0.5 % K₂O
- FYM acts as a nutrient reservoir and during decomposition, it produces organic acids, thereby absorbed ions are released slowly during entire crop growth period leading to higher yield and yield components
- FYM also improves soil properties like pH, bulk density, porosity and water holding capacity in addition to supply of nutrients
- In association with soil microorganisms, organic manures are known to help in synthesis of certain phytohormones and vitamins which promote the growth and development of crops.

Compost: Composting is largely a biological process in which microorganisms of both types (aerobic and anaerobic) decompose organic matter and lower down C:N ratio of the refuse. Two types of compost are prepared: Composting from farm litter (Rural compost): Utilize weeds, crop stubbles, straw and crop residue, bushes, sugarcane trash, urine soaked waste material, clippings and other things Composting from town refuse (Urban compost): Utilize vegetable refuse, street and dustbin household refuse, wood ash, night soil.

Night soil: Night soil is human excreta, both solid and liquid. It contains 5.5 % N, 4 % P₂O₅ and 2% K₂O.

Sewage and sludge: In the modern system of sanitation adopted in cities and towns, human excreta are flushed out

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with water which is called sewage. The solid portion in the sewage is called sludge and liquid portion is sewage water. Both the components of sewage are separated and are given a preliminary fermentation and oxidation treatments to reduce bacterial contamination and offensive smell.

Vermicompost: Vermicompost is a composting process aided by earthworms. Earthworms consume daily about 2 to 5 times of their body weight, retain 5-10% of the feedstock for their own growth and excrete mucus coated undigested matter known as vermicast. It has an inherent ability to maintain the soil pH and keep it near neutral. It consists of humus which is the basic building block of fertile soil, and has a large number of micro-organisms which are beneficial for soil and plant life.

Biogas slurry: In the gas plant, animal dung and other cellulosic materials are allowed to ferment for a few days under anaerobic conditions. The main advantages of gobar gas plant are: both fuel gas and manure can be obtained from organic wastes without losing its manurial value thus saving firewood, the plant works under hygienic and sanitary conditions, there is no bad odour and fly and mosquito breeding are eliminated.

Green manure: Green, undecomposed plant material used as manure is called green manure. It is obtained in two ways: by growing green manure crops and by collecting green leaf (along with twigs) from plants grown in wastelands, field bunds and forests. The crops usually grown for green manuring are sunhemp (*Crotalaria juncea*), dhaincha (*Sesbania aculeata*), barseem (*Trifolium alexandrinum*), cowpea (*Vigna sinensis*) etc.

- Organic matter and nitrogen are added to the soil by green manuring
- Green manuring improves soil structure, increases water holding capacity and decreases soil loss by erosion
- Growing of green manures in the off season reduces weed proliferation and weed growth
- Green manuring helps in reclamation of alkaline soils
- Root-knot nematodes can be controlled by green manuring.

Table 2: Average nutrient contents of bulky organic fertilizers and industrial wastes

Material	N (%)	P ₂ O ₅ (%)	K ₂ O (%)
Farmyard manure	0.5-1.5	0.1-0.2	0.5-0.6
Compost (urban)	1.0-2.0	1.0	1.5
Compost (rural)	0.5-1.0	0.2	0.5
Biogas slurry	1.6-1.8	1.1-2.0	0.8-1.2
Green manures (avg)	0.5-0.7	1.1-2.0	0.8-1.2
Sewage sludge	1.1-2.3	0.8-2.1	0.5-1.7
City refuse	0.6	0.6-0.7	0.7
Press mud	1.1	2.1-2.4	2.0

Source: FAI (2012)

Concentrated organic manures

Concentrated organic manures are those that are organic in nature and contain higher percentage of major nutrients like nitrogen, phosphorus and potash, compared to bulky organic manures. These manures are by-product of animal or plant industry. The common concentrated organic manures are oil cakes, fish manure, dried blood, blood meal etc.

Oil cakes: Oil cakes are the residues left after the edible or non-edible oil is extracted from oil bearing seeds.

Table 3: Average chemical composition of major oilcakes availa

Oilcakes	N (%)	P ₂ O ₅ (%)	K ₂ O (%)
Edible oilcake			
Ground	7.3	1.5	1.3
Rapeseed/ Muatrad	5.2	1.8	1.2
Linseed	4.9	1.4	1.3
Sesame	6.2	2.0	1.2
Coconut	3.0	1.9	1.8
Cottan seed	6.4	2.9	2.2
Safflower	7.9	2.2	1.9
Nonedible oilcake			
Castor	4.3	1.8	1.3
Mahua	2.5	0.8	1.8
Neem	5.2	1.0	1.4
Karanj	3.9	0.9	1.2
Cottan seed (undecorated)	3.9	1.8	1.6
Safflower (undecorated)	4.9	1.4	1.2

Source: FAI (2012)

Table 4: Nutrient contents of organic manures of animal origin

Material	N (%)	P ₂ O ₅ (%)	K ₂ O (%)
Dried blood	10-12	1-1.5	0.6-0.8
Fish manure	4-10	2-9	0.3-1.5
Bird guano	7-8	11-14	2-3
Poultry manure	2.9	2.9	2.4
Hoof and horn meal	14	1	-
Activated sludge (dry)	5-6.5	3-3.5	0.5-0.7
Settled sludge (dry)	2-2.5	1-1.2	0.4-0.5
Raw bone	3-4	20-25	-
Steamed bone	1-2	25-30	-

Source: FAI (2012)

Advantages of organic manures

- 1) The nutrient supply is more balanced, which helps to keep plants healthy.
- 2) They enhance soil biological activity, which improves nutrient mobilization from organic and chemical sources and decomposition of toxic substances.
- 3) They enhance the colonization of mycorrhizae, which improves P supply.
- 4) It directly added the organic matter in the soil, therefore improving the exchange capacity of nutrients, increasing water retention capacity of soil, promoting soil aggregates and buffering the soil against acidity, alkalinity, salinity, pesticides and toxic heavy metals.
- 5) They release nutrients slowly and contribute to the residual pool of organic N and P in the soil, reducing N leaching loss and P fixation; they can also supply micronutrients.
- 6) They supply food and encourage the growth of beneficial microorganisms and earthworms.
- 7) They help to suppress certain plant diseases, soil borne diseases and parasites.
- 8) They enhance root growth due to better soil structure.

Disadvantages of organic manures

- 1) They are comparatively low in nutrient content, so larger volume is needed to provide enough nutrients for crop growth.

- 2) The nutrient release rate is too slow to meet crop requirements in a short time, hence some nutrient deficiency may occur.
- 3) The major plant nutrients may not exist in organic fertilizer in sufficient quantity to sustain maximum crop growth.
- 4) The nutrient composition of compost is highly variable; the cost is high compared to chemical fertilizers. Long-term or heavy application to agricultural soils may result in salt, nutrient or heavy metal accumulation and may adversely affect plant growth, soil organisms, water quality and animal and human health.

2. Future Thrust

- The importance of use of organic manures is traditionally known by the Indian farmers. There is need to educate them the proper means of conservation and application of these sources of nutrients to minimize the losses.
- Protecting the long term fertility of soils by maintaining organic matter levels, fostering soil biological activity and careful mechanical intervention.
- Providing crop nutrients indirectly by using relatively insoluble nutrient sources which are made available to the plant by the action of soil microorganisms.
- Nitrogen self sufficiency through the use of legumes and biological nitrogen fixation as well as effective recycling of organic materials including crop residues and livestock wastes.
- Careful attention to the impact of the farming system on the wider environment and conservation of biodiversity.

3. Conclusion

It must be recognized that nutrient needs of Indian agriculture are now bigger and more varied. India would require 45 million tonnes of nutrients to produce 300 mt of food grains to feed its population of 1.4 billion by 2015. Application of organic manures is the only option to improve the soil organic carbon for sustenance of soil quality and future agricultural productivity (Ramesh 2008).

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