NUTRIETNT POTENTIAL OF ORGANIC SOURCES FOR SOIL FERTILITY MANAGEMENT IN ORGANIC COTTON PRODUCTION

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Organic cotton is grown in living-soil fields which have been free of synthetic pesticides, herbicides and fertilizers for at least three year. Organic cotton is produced with animal or vegetables matter fertilizers and is free from toxic chemicals. Organic farming relies on crop rotation, mechanical cultivation and botanical or biological controls.

Products made form organic cotton support sustainable cotton farming practices, help reduce contamination of the earth and increase the quality of our health.

Maintenance of Soil Fertility for Organic Cottons Production

Vertisol are swell-shrink type soils with high water retentively, low infiltration rate and high cation exchange capacity. Improvement and maintenance of the organic matter these soils is an essential precondition to sustain reasonable levels of organic cotton production as this would increase water infiltration, reduce erosion, improve soil structure and aggregate stability, besides enhancing the supply of nutrients, particularly, N, P and S. Hence, a good organic matter management programme is needed for fertility management under organic production system. Rainfed cotton crop in Central India removes around 5.8 kg N, 2.0 kg P and 6.6 kg K per 100 kg seed cotton produced. With many such alternate used of FYM, such huge quantities required to meet the crop's nutrient requirement is generally not available. Hence, a combination of sources with different biological properties must be resorted.

Manures

Manures are plant and animal wastes that are used as sources of plant nutrients. Manures can be grouped into bulky organic manures and concentrated organic manures based on concentration of the nutrients.

Bulky Organic Manures

Bulky organic manures contain small percentage of nutrients and they are applied in large quantities. Farmyard manure (FYM), compost and green manure are the most important and widely used bulky organic manures. Use of bulky organic manures have several advantages: (1) they supply plant nutrients including micronutrients, (2) they improve soil physical properties like structure, water holding capacity etc., (3) they increase the availability of nutrients, (4) carbon dioxide released during decomposition acts as a CO_2 fertilizer, and (5) plant parasitic nematodes and fungi are controlled to some extent by altering the balance of microorganisms in the soil.

Farmyard Manure

Farmyard manure refers to the decomposed mixture of dung and urine of the farm animals along with litter and left over material from roughages or fodder fed to the cattle. On

an average well decomposed farmyard manure contains 0.5 per cent N, 0.2 per cent P_2O_5 and 0.5 percent K_2O. The present method of preparing farmyard manure by the farmers is defective. Urine, which is wasted, contains one per cent nitrogen and 1.35 per cent potassium. Nitrogen present in urine is mostly in the form of urea which is subjected to volatilization losses. Even during storage, nutrients are lost due to leaching and volatilization. However, it is practically impossible to avoid losses altogether, but can be reduced by following improved method of preparation of farmyard manure. Trenches of size 6m to 7.5m length, 1.5m to 2.0m width and 1.0m deep are dug. All available litter and refuse is mixed with soil and spread in the shed so as to absorb urine. The next morning, urine of the trench from one end should be taken up for filling with daily collection. When the section is filled up to a height of 45 cm to 60 cm above the grow level, the top of the heap is made into a dome and plastered with cowered earth slurry. The process is continued and when the first trench is completely filled, second trench is prepared. The manure becomes ready for use in about four to five months after plastering.

Compost

A mass of rotted organic matter made from waste is called compost. The compost made from farm waste like sugarcane trash, paddy straw, weeds and other plants and other waste is called farm compost. The average nutrient contents of farm compost is 0.5 per cent N, 0.15 per cent P_2O_5 and 0.5 per cent K_2O. The compost made from town refuses like night soil, street sweepings and dustbin refuse is called town compost. It contains 1.4 per cent N, 1.00 per cent P_2O_5 and 1.4 per cent K_2O.

Farm compost is made by placing farm wastes in trenches of suitable size, say 4.5 m to 5.0 m long, 1.5 m to 2.0m wide and 1.0 m to 2.0m deep. Waste is placed in the trenches layer by layer. Each layer is well need by sprinkling cow-dung slurry or water. Trenches are filled up to of 0.5 m above the ground. The compost is ready for application five to six months.

Sewage and Sludge

In the modern system of sanitation adopted in cities and town, human excreta if flushed out 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.

Green Manure

Green, undecomposed plant material used as manure is called green manure. It is obtained in to ways: growing green manure crops or by collecting green leaf (along with twigs) from plants grown in wastelands, field bunds and forest. Green manuring is frown in the field plants usually belonging to leguminous family and incorporating into the soil after sufficient growth. The most important green manure crops are sunhemp, dhaincha, *pillipesara*, clusterbeans and Sesbania rostrana.

Nutrient content of Green Manure Crops and Green Leaf Manure

Plant	Scientific Name	Nutrient content (%) air dry basis		
		N	P_2O_5	K_2O
Green Manure Crops				
Sunhemp	Crotalaria juncea	2.30	0.50	1.80
Dhaincha	Sesbania aculeata	3.50	0.60	1.20
Sesbania	Sesbania speciosa	2.71	0.53	2.21
Green Leaf Manure				
Forest tree leaf		1.20	0.60	0.40
Green weeds		0.80	0.30	0.20
Pongamia leaf	*Pongamia glabra*	3.31	0.44	2.39

Application to the field, green leaves and twigs of trees, shrubs and herbs collected form elsewhere is known as green-leaf manuring. The important plant species useful for green-leaf manure are neem, mahua, wild indigo, glyricidia, Karanji (*Pongamia glabra*) calotropis. avise (*Sesbens grandiflora*), subadul and other shrubs.

Several advantages accrue due to the addition of green manures. Organic matter and nitrogen are added to the soil. Growing deep rooted green-manure crops and their incorporation facilitates in bringing nutrients to the top layer from deeper layers. Nutrient availability increases due to production of carbon dioxide and organic acids during decomposition. Green manuring improves soil structure, increases water-holding capacity and decreases soil loss by erosion. Green manuring helps in reclamation of alkaline soils. Root-knot nematodes can be controlled by green manuring.

Sheep and Goat Manure

The dropping of sheep and goats contain higher nutrients than farmyard manure and compost. On an average, the manure contains 3 per cent N, 1 per cent P_2O_5 and 2 per cent K_2O. It is applied to the field in two ways. The sweeping of sheep or goat sheds are placed in pits for decomposition and it is applied later to the field. The nutrients present in the urine are wasted in the method. The second method is sheep penning, wherein sheep and goats are allowed to stay overmight in the field and urine and fecal matter is added to the soil which is incorporated to a shallow depth by running blade harrow or cultivar.

Poultry Manure

The excreta of birds ferments very quickly. If left exposed, 50 per cent of its nitrogen is lost within 30 days. Poultry manure contains higher nitrogen and phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 per cent N, 2.63 per cent P_2O_5 and 1.4 per cent K_2O.

Concentrated Organic Manures

Concentrated organic manures have higher nutrient content than bulky organic manure. The important concentrated organic manures are oilcakes, bloodmeal, fish manure etc. These are also known as organic nitrogen fertilizer. Before their organic nitrogen is used by the crops, it is converted through bacterial action into readily usable ammoniacal nitrogen

and nitrate nitrogen. These organic fertilizers are, therefore, relatively slow acting, but they supply variables nitrogen for a longer period.

Oilcakes

After oil is extracted from oilseeds, the remaining solid portion is dried as cake which can be used as a manure. The oil-cakes are of two types:

1. Edible oil-cakes which can be safely fed to livestock, e.g.: Groundnut cake, coconut cake etc.,
2. Non-edible oil cakes which are not fit for feeding livestock e.g.: Castor cake, neem cake, mahua cake etc.,

Both edible and non-edible oil-cakes can be used as manures. Nutrients present in oil-cakes, after mineralization, are made available to crops 7 to 10 days after application. Oil-cakes need to be well powdered before application for even distribution and quicker decomposition. The average nutrient content of different oil-cakes are presented.

Average nutrient contents of oil-cakes

Oil cakes	Nutrient-content (%)		
	N	P_2O_5	K_2O
Non-edible oil-cakes			
Castor cake			
Cotton seed cake			
Karanji cake			
Mahua cake (Decorticated)			
Edible oil-cakes			
Coconut cake	3.0	1.9	1.8
Cotton seed cake (Decorticated)	6.4	2.9	2.2
Groundnut cake	7.3	1.5	1.3
Linseed cake	4.9	1.4	1.3
Niger cake	4.7	1.8	1.3
Rape seed cake	5.2	1.8	1.2
Safflower cake (Decorticated)	7.9	2.2	1.9
Sesamum cake	6.2	2.0	1.2

Other Concentrated Organic Manures

Blood-meal when dried and powdered can be used as a manure. The meat of dead animals is dried and converted into meat-meal which is a good source of nitrogen.

Crop residues

Substantial quantities of crop residues are produced in India every year Major crops like rice, Wheat Sorghum, Peal mullet and Maize alone yield approximately 236 m.t straw per year. The nutrient potential of cereal straw/residue from five crops comes to 1.13 m.t N. 1.41 t + P205 and 3.54 m.t. K20. Crop residues can be recycled either by compositing or by way of mulch or direct incorporation in the soil.

Table 6. Potential of farm residues and plant-nutrients in them

Crop	Residue production (mt)	Per cent over dry basis		
Rice straw	106.01	0.58	0.23	1.66
Wheat straw	80.99	0.49	0.25	1.28
Sorghum	21.04	0.40	0.23	2.17
Pearl millet	15.58	0.65	0.75	2.50
Maize	12.50	0.59	0.31	1.31
Total pulses	13.70	1.60	0.15	2.00
Pigeonpea	6.65	1.10	0.58	1.28
Chickpea	5.05	1.19	N.A	1.25
Sugarcane	40.92	0.35	0.04	0.50
Oilseeds	35.78	-	-	-

Soil Physical Properties

Use of organic amendments improve the various physical properties of the soil. Yin-Po Wang and Chen-Ching Chao (1995) reported that the bulk density, total porosity and aggregate stability of surface soil improved by the organic farming and this can be attributed to the higher organic matter levels of the organic farming soil.

Soil Chemical Properties

Yin-Po Wang and Chen-Ching Chao (1995) reported that application of green manure continuously after four cropping cycles the soil pH of the organic farming increased to as high as 7.6 to 8.3 than conventional farming (pH 5.7 to 6.6).

Soil Microbial Population

Organic farming have direct contribution to soil organic matter levels thereby increase the microbial population. Scullion and Ram Shaw (1987) showed that earth worm populations increased due to FYM application. Application of poultry manure encourage costing and burrowing to the surface whereas application of inorganic fertilizers of high rates discouraged these activities.

Effect on Organic Carbon

Biswas et al (1971) earlier and Kanwar and Prihar (1992) reported that continuous application of FYM increased the organic carbon content as well as nitrogen contents. Yadav (1995) reported that pressmud application increases the organic carbon content.

Effect on Micronutrients

Continuous application of FYM at 15 t ha-I for 3 years increased zinc level from 0.48 to 0.87 percent (Radhav and Takakar. 1975). Biogas slurry poultry manure compost and pressmud have been found to be superior sources of Zn a compared to Zinc sulphate particularly in Zn deficient calcareous soil (Prasad et al. 1981, 1984, 1985) Azolla incorporation increased the availability of Fe and Mm in soils (Sing 1992).

ROLE OF BIOFERTILISERS IN COTTON

Biofertiliser is one of natural and sustainable nutritional input. Mainly there are two types of biofertilizers which are used on mass scale. These are nitrogenous and phosphatic biofertilizers.

The nitrogenous biofertiliser for cotton are *Azotobacter (A.chroococcum)* and *Azospirillum* (A. braazilense). These organisms with the help of nitrogenase enzyme fix atmospheric nitrogen known as biological nitrogen fixation. The phosphorus biofertilizers consist of several bacteria (*Bacillus megatherium, Pseudomonas striata*) and fungi (*Aspergillus awamori* and *Penicillium digitatum*).

It has been estimated that 1 ton *Azotobacter/ Azospirillum* is equivalent to 40 ton Nitrogen @ 20 kg N fixed/year/ crop at 500/g dose and 1 tom PSM is equivalent to 24 ton Phosphorus (P_2O_5).

The use of *Azotobacter* enhances the yield of cotton depending on variety and strain efficiency. Pandey and Kumar (1989) reported 7 to 28% increased yield in cotton with *Azotobacter* inoculation.

Response of Azospirillum

It is reported that *Azospirillum* has positive response in increasing seed cotton yield and better dry matter production (Marappan and Narayanan, 1993). The application *Azospirillum* recorded 430 kg/ha has increased yield over the control. Further, the residual effect of *Azospirillum* was also found positive in terms of yield and population.

REFERENCE

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