

ORGANIC FARMING

GREEN LEAF MANURE

Application of green leaves and twigs of trees, shrubs and herbs collected from elsewhere is known as green leaf manuring. Forest tree leaves are the main sources for green leaf manure. Plants growing in wastelands, field bunds etc., are another source of green leaf manure. The important plant species useful for green leaf manure are neem, mahua, wild indigo, Glyricidia, Karanji (*Pongamia glabra*) calotropis, avise(*Sesbania grandiflora*), subabul and other shrubs.

Nutrient content of green leaf manure

Plant	Scientific name	Nutrient content (%) on air dry basis		
		N	P2O5	K
Gliricidia	<i>Gliricidia sepium</i>	2.76	0.28	4.60
Pongania	<i>Pongamia glabra</i>	3.31	0.44	2.39
Neem	<i>Azadirachta indica</i>	2.83	0.28	0.35
Gulmohur	<i>Delonix regia</i>	2.76	0.46	0.50
Peltophorum	<i>Peltophorum ferrugenum</i>	2.63	0.37	0.50
Weeds				
Parthenium	<i>Parthenium hysterophorus</i>	2.68	0.68	1.45
Water hyacinth	<i>Eichhornia crassipes</i>	3.01	0.90	0.15
Trianthema	<i>Trianthema portulacastrum</i>	2.64	0.43	1.30
Ipomoea	<i>Ipomoea</i>	2.01	0.33	0.40
Calotropis	<i>Calotropis gigantea</i>	2.06	0.54	0.31
Cassia	<i>Cassia fistula</i>	1.60	0.24	1.20

Advantages

1. Green manuring improves soil structure, increases water holding capacity and decreases soil loss by erosion.
2. Growing of green manure crops in the off season reduces weed proliferation and weed growth.
3. Green manuring helps in reclamation of alkaline soils. Root knot nematodes can be controlled by green manuring.

Green Manure

Green undecomposed material used as manure is called green manure. It is obtained in two ways: by growing green manure crops or by collecting green leaf (along with twigs) from plants grown in wastelands, field bunds and forest. 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 *Sesbania rostrata*.

Biomass production and N accumulation of green manure crops

Crop	Age (Days)	Dry matter (t/ha)	N accumulated
<i>Sesbania aculeata</i>	60	23.2	133
Sunnhemp	60	30.6	134
Cow pea	60	23.2	74
<i>Pillipesara</i>	60	25.0	102
Cluster bean	50	3.2	91
<i>Sesbania rostrata</i>	50	5.0	96

Nutrient content of green manure crops

Plant	Scientific name	Nutrient content (%) on air dry basis		
		N	P2O5	K
Sunnhemp	<i>Crotalaria juncea</i>	2.30	0.50	1.80
Dhaincha	<i>Sesbania aculeata</i>	3.50	0.60	1.20
Sesbania	<i>Sesbania speciosa</i>	2.71	0.53	2.21

Sesbania rostrata is a stem nodulating green manure crop which is a native of West Africa. As it is a short-day plant and sensitive to photoperiod, the length of vegetative period is short when sown in August or September. A mutant (TSR-I) developed by Bhabha Atomic Research Centre, Bombay is insensitive to photoperiod, tolerant to salinity and waterlogged condition. Growth and nitrogen fixation is higher with TSR-I compared to the existing strains.

Advantages

1. Improves soil structure
2. Increases water holding capacity and
3. Decreases soil loss by erosion

MANURES

Manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients after their decomposition. The art of collecting and using wastes from animal, human and vegetable sources for improving crop productivity is as old as agriculture. Manures are the organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. Naturally occurring or synthetic chemicals containing plant nutrients are called fertilizers. Manures with low nutrient, content per unit quantity have longer residual effect besides improving soil physical properties compared to fertilizer with high nutrient content. Major sources of manures are:

1. Cattle shed wastes-dung, urine and slurry from biogas plants
2. Human habitation wastes-night soil, human urine, town refuse, sewage, sludge and sullage
3. Poultry Jitter, droppings of sheep and goat
4. Slaughterhouse wastes-bone meal, meat meal, blood meal, horn and hoof meal, Fish wastes
5. Byproducts of agro industries-oil cakes, bagasse and press mud, fruit and vegetable processing wastes etc
6. Crop wastes-sugarcane trash, stubbles and other related material
7. Water hyacinth, weeds and tank silt, and
8. Green manure crops and green leaf manuring material

Manures can also 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 has 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 CO₂ 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 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 P₂O₅ and 0.5 per cent K₂O. 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 6 m to 7.5 m length, 1.5 m to 2.0 m width and 1.0 m 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 soaked refuse along with dung is collected and placed in the trench. A section 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 ground level, the top of the heap is made into a dome and plastered with cow dung 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. If urine is not collected in the bedding, it can be collected along with washings of the cattle shed in a cemented pit from which it is later added to the farmyard manure pit. Chemical preservatives can also be used to reduce losses and enrich farmyard manure. The commonly used chemicals are gypsum and superphosphate. Gypsum is spread in the cattle shed which absorbs urine and prevents volatilization loss of urea present in the urine and also adds calcium and sulphur. Superphosphate also acts similarly in reducing losses and also increases phosphorus content.

Partially rotten farmyard manure has to be applied three to four weeks before sowing while well rotten manure can be applied immediately before sowing. Generally 10 to 20 t/ha is applied, but more than 20 t/ha is applied to fodder grasses and vegetables. In such cases farmyard manure should be applied at least 15 days in advance to avoid immobilization of nitrogen. The existing practice of leaving manure in small heaps scattered in the field for a very long period leads to loss of nutrients. These losses can be reduced by spreading the manure and incorporating by ploughing immediately after application.

Vegetable crops like potato, tomato, sweet-potato, carrot, raddish, onion etc., respond well to the farmyard manure. The other responsive crops are sugarcane, rice, napier grass and orchard crops like oranges, banana, mango and plantation crop like coconut.

The entire amount of nutrients present in farmyard manure is not available immediately. About 30 per cent of nitrogen, 60 to 70 per cent of phosphorus and 70 per cent of potassium are available to the first crop.



Farm yard manure

Sheep and Goat Manure

The droppings 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 P₂O₅ and 2 per cent K₂O. 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 this method. The second method is sheep penning, wherein sheep and goats are kept overnight in the field and urine and fecal matter added to the soil is incorporated to a shallow depth by working blade harrow or cultivator or cultivator.

Poultry Manure

The excreta of birds ferment very quickly. If left exposed, 50 percent 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 P₂O₅ and 1.4 per cent K₂O.

Concentrated organic manures

Concentrated organic manures have higher nutrient content than bulky organic manure. The important concentrated organic manures are oilcakes, blood meal, 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 available nitrogen for a longer period.

Oil cakes

After oil is extracted from oilseeds, the remaining solid portion is dried as cake which can, be used as 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., and
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. However, edible oil cakes are fed to cattle and non-edible oil cakes are used as manures especially for horticultural crops. Nutrients present in oil cakes, after mineralization, are made available to crops 7 to

10 days after application. Oilcakes need to be well powdered before application for even distribution and quicker decomposition.



Average nutrient content of oil cakes

Oil-cakes	Nutrient content (%)		
	N	P ₂ O ₅	K ₂ O
Non edible oil-cakes			
Castor cake	4.3	1.8	1.3
Cotton seed cake (undecorticated)	3.9	1.8	1.6
Karanj cake	3.9	0.9	1.2
Mahua cake	2.5	0.8	1.2
Safflower cake (undecorticated)	4.9	1.4	1.2
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 manure. The meat of dead animals is dried and converted into meat meal which is a good source of nitrogen. Average nutrient content of animal based concentrated organic manures is given as follows.

Average nutrient content of animal based concentrated organic manures

Organic manures	Nutrient content (%)		
	N	P ₂ O ₅	K ₂ O
Blood meal	10 - 12	1 - 2	1.0
Meat meal	10.5	2.5	0.5
Fish meal	4 - 10	3 - 9	0.3 - 1.5
Horn and Hoof meal	13	-	-
Raw bone meal	3 - 4	20 - 25	-
Steamed bone meal	1 - 2	25 - 30	-

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 are 0.5 per cent N, 0.15 per cent P₂O₅ and 0.5 per cent K₂O. The nutrient value of farm compost can be increased by application of superphosphate or rock phosphate at 10 to 15 kg/t of raw material at the initial stage of filling the compost pit. 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 P₂O₅ and 1.4 per cent K₂O.

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 2.0 m wide and 1.0 m to 2.0 m deep. Farm waste is placed in the trenches layer by layer. Each layer is well moistened by sprinkling cow dung slurry or water. Trenches are filled up to a height of 0.5 m above the ground. The compost is ready for application within five to six months.

Composting is essentially a microbiological decomposition of organic residues collected from rural area (rural compost) or urban area (urban compost).

Methods of composting

In **Coimbatore method**, composting is done in pits of different sizes depending on the waste material available. A layer of waste materials is first laid in the pit. It is moistened with a suspension of 5-10 kg cow dung in 2.5 to 5.0 l of water and 0.5 to 1.0 kg fine bone meal sprinkled over it uniformly. Similar layers are laid one over the other till the material rises 0.75 m above the ground level. It is finally plastered with wet mud and left undisturbed for 8 to 10 weeks. Plaster is then removed, material moistened with water, given a turning and made into a rectangular heap under a shade. It is left undisturbed till its use.

In the **Indore method** of composting, organic wastes are spread in the cattle shed to serve as bedding. Urine soaked material along with dung is removed every day and formed into a layer of about 15 cm thick at suitable sites. Urine soaked earth, scraped from cattle sheds is mixed with water and sprinkled over the layer of wastes twice or thrice a day. Layering process continued for about a fortnight. A thin layer of well decomposed compost is sprinkled over top and the heap given a turning and reformed. Old compost acts as inoculum for decomposing the material. The heap is left undisturbed for about a month. Then it is thoroughly moistened and given a turning. The compost is ready for application in another month.

In the **Bangalore method** of composting, dry waste material of 25 cm thick is spread in a pit and a thick suspension of cow dung in water is sprinkled over for moistening. A thin layer of dry waste is laid over the moistened layer. The pit is filled alternately with dry layers of material and cow dung suspension till it rises 0.5 m above ground level. It is left exposed without covering for 15 days. It is given a turning, plastered with wet mud and left undisturbed for about 5 months or till required.

In Coimbatore method, there is anaerobic decomposition to start with, following by aerobic fermentation. It is the reverse in Bangalore method. The Bangalore compost is not so thoroughly decomposed as the Indore compost or even as much as the Coimbatore compost, but it is bulkiest.

Biofertilizer

Bio-fertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.

Very often microorganisms are not as efficient in natural surroundings as one would expect them to be and therefore artificially multiplied cultures of efficient selected microorganisms play a vital role in accelerating the microbial processes in soil.

Use of bio-fertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Several microorganisms and their association with crop plants are being exploited in the production of bio-fertilizers. They can be grouped in different ways based on their nature and function.

S. No.	Groups	Examples
N₂ fixing Biofertilizers		
1.	Free-living	<i>Azotobacter, Beijerinckia, Clostridium, Klebsiella, Anabaena, Nostoc,</i>
2.	Symbiotic	<i>Rhizobium, Frankia, Anabaena azollae</i>
3.	Associative Symbiotic	<i>Azospirillum</i>
P Solubilizing Biofertilizers		
1.	Bacteria	<i>Bacillus megaterium var. phosphaticum, Bacillus subtilis, Bacillus circulans, Pseudomonas striata</i>
2.	Fungi	<i>Penicillium sp, Aspergillus awamori</i>
P Mobilizing Biofertilizers		
1.	Arbuscular mycorrhiza	<i>Glomus sp., Gigaspora sp., Acaulospora sp., Scutellospora sp. & Sclerocystis sp.</i>
2.	Ectomycorrhiza	<i>Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.</i>
3.	Ericoid mycorrhizae	<i>Pezizella ericae</i>
4.	Orchid mycorrhiza	<i>Rhizoctonia solani</i>
Biofertilizers for Micro nutrients		
1.	Silicate and Zinc solubilizers	<i>Bacillus sp.</i>
Plant Growth Promoting Rhizobacteria		
1.	Pseudomonas	<i>Pseudomonas fluorescens</i>