

Integrated organic nutrient management

for soil and plant health management under organic and natural farming

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Maintenance of soil fertility may be achieved through organic matter recycling, enrichment of compost, vermicomposting, animal manure, urine, farm yard manure, litter composting, use of botanicals, green manuring, etc. The major challenge in organic agriculture is the availability of huge quantities of organic inputs for satisfying the farm demand. Use of animal excreta-based manure alone is not sufficient for meeting the nutrient needs of the crops. It is therefore, necessary to utilize all the sources available on and off-farm effectively. Natural farming is a sustainable method of farming practices that helps the farmers in retaining soil fertility, rejuvenates soil health to ensure a chemical free agriculture and low cost of production and thereby doubling the income of the farmers. It aims at cultivating plants by promoting self-reliance to farmers while protecting the environment and stimulating harmony between animals, humans and plants for a sustainable development. In this article, all the possible sources of organic nutrients have been discussed for soil and plant health management in organic and natural farming.

Keywords: Fertility, Natural farming, Organic nutrient management, Soil

INTEGRATED organic nutrient management refers to maintenance of soil fertility and plant nutrient supply at an optimum level for sustaining desired productivity through optimization of benefits from all possible sources of organic and biological components in an integrated manner. It involves proper combination of chemical fertilizers, organic manure, crop residues, N₂ fixing crops (like pulses such as rice bean, black gram (Paheli dal), other pulses and oilseeds such as soybean and biofertilizers suitable to the system of land use and ecological, social and economic conditions. Organic production involves recycling of crop residues, crop rotation, inclusion of legumes in system both in sequence or as an intercrop, green manuring, off-farm waste recycling, use of mineral rocks like rock phosphate, mechanical cultivation, biological pest control and avoiding use of synthetic agrochemicals with

overall objective of sustainable production, maintaining resources and environmental quality. Weed control, soil fertility and management of pest and diseases are the principal challenges associated with organic production. Relevant/appropriate measures should be taken to ameliorate acid soil.

Farmyard manure

Farmyard manure (FYM) 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. Entire amount of nutrients present in farmyard manure is not available immediately. About 30% nitrogen, 60–70% phosphorus and 70% potassium are available to the first crop. Gypsum and rock phosphate are spread in the cattle shed which absorbs urine and prevents volatilization loss of urea present in the urine and also adds calcium and sulphur.

Fresh cow urine

Cow urine, which is wasted, contains 1.0% nitrogen and 1.35% potassium. Fresh cow urine can be used in any crop in all the seasons. Dilute 1 litre of cow urine with 10 (1:10) litre of water and use it as foliar spray. For one acre of crop, 200 litre of such dilute suspension will be sufficient.

Compost

A mass of decomposed organic matter made from waste is called compost. Compost made from farm waste like sugarcane trash, paddy



Application of farmyard manure in the field

straw, weeds and other plants wastes is called farm compost. Nutrient value of farm compost can be increased by application of superphosphate or rock phosphate @10–15 kg/tonne of raw material at initial stage of filling the compost pit.

Phospho-compost/rock phosphate-enriched compost

It is prepared by mixing rock phosphate @5–10% w/w with the composting mass (FYM, goat manure, poultry manure or pig manure). The mixture is decomposed for a minimum period of 70–90 days. Phospho-compost contains 1.5–2.0% N, 2.0–3.0% P with C:N ratio 16–18. Phosphate solubilizing microorganisms, namely *Pseudomonas striata* and *Bacillus polymixa*, N-fixer (*Azotobacter chroococcum*), etc. may also be used in this composting process to accelerate the decomposition process.

Sheep and goat manure

The droppings of sheep and goats contain higher nutrients than farmyard manure and compost. Goat manure is considered cool, and it has a more balanced pH and less salt. Pelletized droppings allow for more air in the composting manure pile, and the dry nature allows it to compost faster. Sheep manure is referred to as cold manure because of its low nitrogen content (but high P and K). It is a natural slow-release fertilizer.

Poultry manure

The excreta of birds ferment very quickly. If left exposed, 50% of its nitrogen is lost within 30 days. Poultry manure contains higher N and P_2O_5 compared to other bulky organic manures. The predominant form is uric acid, which readily transforms to ammonia (NH_3), a gaseous form of nitrogen that can evaporate if not mixed into the soil. Thus, soil mixing can reduce nitrogen losses and increase its amount available to plants.

Pig manure

The best way for using pig manure is to compost it (60–90 days). Pig



Vermicomposting technology from locally available manure and biomass

manure should be added to compost pile and allowed to rot long enough and hot enough. This will break down and kill all the organisms (*E. coli*, *Salmonella*, parasitic worms, etc.) it might carry.

Oil cakes

The non-edible oil cakes are used as manures especially for horticultural crops. Application of the neem seed cake to crops provides them with various mineral nutrients (especially nitrogen). Neem seed cake reduces the number of soil insect pests, fungi, white ants, bacteria and nematodes and protects the crop from damage caused by these organisms. It can reduce alkalinity in the soil by producing organic acids when mixed with the soil.

Soil amendments

Liming materials such as dolomite, limestone, burnt lime and slaked lime are used to reduce soil acidity. Materials like sand, tank silt, pressmud, crop residues are added to the soil for improving soil physical conditions. Low cost biochar is also used for ameliorating the acid soil as well as soil fertility management at an application rate of 5–10 t/ha.

Green manure

The increase in yield after green manuring is usually 30–50%. For *in situ* green manuring, green manuring crops are grown and buried in the same field which is to be green manured, either as a pure crop or as an intercrop with the main crop. Most common green manure crops are sunnhemp, dhaincha and cluster bean. For *ex situ* green leaf manuring, collection of leaves and tender twigs from shrubs and trees

growing on bunds, wasteland and nearby forest areas is done and incorporated into cultivable field. Common shrubs and trees used for green leaf manuring are *Gliricidia* spp., *Sesbania speciosa*, karanj, *Ipomea* and *Jatropha* spp.

Bio-fertilizers

Some biofertilizers are azolla, blue-green algae (BGA), *Rhizobium*, *Azotobacter*, *Azospirillum* and others. Generally, 200 g biofertilizer is suspended in 200–400 ml water to make slurry, which is poured on seeds slowly and mixed thoroughly with culture. Inoculation of seeds with efficient strains of *Azospirillum* and *Azotobacter* contributes about 15–20 kg N/ha in different crops. Azolla can be used both as a green manure before transplanting and as a dual crop after transplanting in rice. BGA cyanobacteria (*Anabaena azollae*) present as symbiont fixes atmospheric nitrogen around 25 kg/ha. Members of *Pseudomonas* and *Bacillus* are some of the phosphate solubilizing microorganisms and use of P solubilizing bacteria with rock phosphate contributes about 30–35 kg P_2O_5 /ha. Fungi Vesicular Arbuscular Mycorrhiza (VAM) are very suitable for groundnut, soybean, millets, citrus and pepper. Mycorrhizae help in mobilizing insoluble soil phosphates.

Vermicompost

Compost that is prepared with the help of earth worm (may be local species or more vigorous exotic ones) is called vermicompost. General recommended dose for field crops is 4–6 t/ha, fruit crops is 2–4 t/ha and pots is 100–200 g/pot. Unlike mineral fertilizers, vermicompost does not burn plants when applied even in higher amounts. A recommended rate of vermicompost application is 15–20%. *Eisenia foetida* is preferred because it produces higher production of vermicompost in short period of time and more number of young ones in the composting period. The harvested vermicompost should have minimum 40% moisture.

Vermicompost can be produced in any place with shade, high humidity and cool. It is rich in beneficial micro flora like N-fixer, P-solubilizers, cellulose decomposing micro-flora. It contains valuable vitamins, enzymes and hormones like auxins, gibberellins.

Vermiwash

For its preparation, atleast 60% moisture should be maintained throughout the vermicomposting. The resulting liquid is used as a fertilizer or sprayed on the plants (Vermiwash). Vermiwash at 5–10% dilution inhibits the mycelial growth of pathogenic fungi. Diluted 0.5 litre of vermiwash + 0.5 litres of cow urine in 10 litres of water is used as foliar spray.

Panchagavya and dasagavya

The preparation of panchgavya comprises of majorly 5 constituents obtained from cow source. The three direct constituents are cow dung, urine, and milk; the two derived products are curd and ghee. Mixed them thoroughly both in morning and evening and kept for 3 days. After 3 days, mixed cow urine and water, and kept for 15 days with regular mixing both in morning and evening. After 15 days of mixing, mixed tender coconut water, jaggery and well riped poovan banana, and the panchagavya will be ready after 30 days. The container should be kept open under shade. The content is to be stirred twice a day both in morning and evening. Approx 3% solution was found to be most effective compared to the higher and lower concentrations investigated. Dasagavya is made from 10 products. The first five are cow dung, cow urine, cow milk, curd, and ghee. The remaining five are plant extracts from commonly available weed plants.

Crop residue

Average 25% N and P, 50% S and 75% K is retained in cereal residues making them valuable nutrient sources. Around 2–4 mg N could be fixed by microorganism per gram of straw added in soil.



In situ green manuring before rice transplanting

Jeevamrutham/jivamrita/jeevamrit

Jeevamrutham is prepared by mixing 250 litre water, 10 kg of cow dung, 10 litre of cow urine, 1–2 kg jaggery, 2 kg of pigeonpea flour and hand full of undisturbed soil collected from farm. All these are put in drum, mixed thoroughly and kept in shade for 7–9 days. For one acre land, 200 litres of Jeevamrit is sufficient. Apply twice a month with irrigation water or as 10% foliar spray. It provides an environment to beneficial microbes. Application of Jeevamrutham to soil improves the soil considerably. It also encourages microbial activity in the soil. Jeevamrit is used as a preventive measure against fungal and bacterial diseases.

Ghanjeevamrit

It is prepared by mixing 100 kg of indigenous cow dung (air dried for 4–5 days), 1 kg of jaggery, 1 kg pulse flour, 3 litres of indigenous cow urine and 250 g of soil from undisturbed bunds/forest. It is prepared within 10 days. Prior to sowing, Ghanjeevamrit is applied @250 kg/ha as per recommended dose. It is best until 6 months when stored in cool and dry place.

Beejamrutam/Bijamrita/Beejamrit

For its preparation, taken 20 litre water, 5 kg cow dung, 5 litre cow urine, 50 g lime and handful soil from the bund of the farm. Thoroughly mixed all the ingredients in plastic/glass jar and kept overnight. For

leguminous crop, the seeds are just dipped and dried quickly. The seeds are soaked in Beejamrutham for 10–15 min and let dry for 2–3 hours in shadow. The seeds are germinated before sowing into soil which eliminates any virus on seeds and also avoids any soil insects to attack the seed.

Neemashtra

Neemashtra is liquid based formulation of neem and cow urine prepared within 3–4 days. It is sprayed on crops to control insect-pests like aphids, jassids, mealy bugs, thrips, whiteflies, small caterpillars and other sucking pests. Liquid formulation can be made by mixing 5 kg of fresh neem leaves/ 5 kg of neem seed kernels, 100 litres of water, 5 litres cow urine and 1 kg of cow dung. Recommended application dose is 250 litres per hectare of crop. It is a botanical formulation prepared by using neem leaves, chilli fruits, garlic and cow urine. It is used to manage stem borers, fruit borers and other different types of caterpillars of the crop. Taken half kg each of green chilli and garlic, 5 kg of fresh neem leaves, 20 litres of cow urine and mixed. Boiled the contents for 20 min and then cooled, followed by filter. Applied 5–6 litres of Agniashtra for spraying in one hectare after dilution in 250 litres of water.

Brahmashttra

It is a cow urine and botanicals-based formulation. Take 3 kg of



Zero budget natural farming experiment at Indian Council of Agricultural Research, Sikkim

fresh neem leaves and 2 kg of karanj leaves or take 5 kg of neem leaves, take 2 kg of custard apple leaves, 2 kg of Datura leaves and mix in 10 litres cow urine. Boil the mixture for about 20–25 min followed by cooling and filter the content. Take 5–6 litres of filtrate and dilute in 250 litres of water for spraying on one hectare. If infection is high use 4% foliar spray.

Acchadana/mulching

Mulching is the process of covering the top soil with crop waste/dried leaves or with cover crops. It protects the top soil from erosion; it improves soil aeration,

conserves soil moisture, increases water retention capacity of the soil, and encourages soil fauna as well as soil nutrient status and controls weed growth.

Whapasa/moisture

Whapasa is the condition where both air and water molecules are present in the soil. Good aeration is required in the soil for proper plant growth and development. It improves soil aeration, thus improves humus content, good water holding capacity and soil structure which is most suitable for crop plant growth especially during drought periods.

Chilli-garlic extract

As name denotes, it is chili and garlic-based formulation with cow urine, neem and basharam (*Ipomea carnea*) leaves. It is useful to manage different kinds of caterpillar, i.e. leaf rollers, stem, fruit and pod borers.

Mixed leaf extract (decoction)

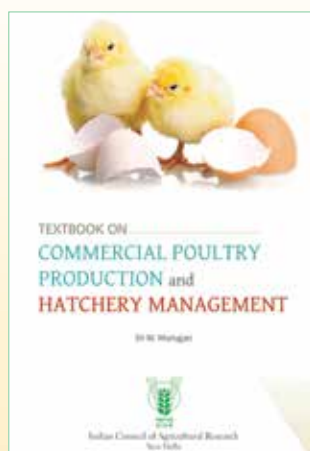
It is also a cow urine and botanicals-based formulation prepared by using the leaves of 5 different kinds of trees easily available on the farm, i.e. custard apple, papaya, pomegranate and guava leaves.

SUMMARY

One of the biggest challenges faced by new or transitioning organic farmers, and agricultural professionals working with them is determining appropriate organic fertilizer and other inputs based on a standard soil test. Nutrient management for organic or sustainable systems requires a different approach from that used in conventional crop production of the late 20th century. Organic nutrient management aims to build a healthy, living soil, in which the action of soil organisms on active (decomposable) soil organic matter releases most of the nutrients required by the crop.

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TECHNICAL SPECIFICATIONS

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