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ORGANIC FARMING AND NUTRIENT MANAGEMENT

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ABSTRACT

Modern agriculture largely depends on the use of fossil fuels based inputs such as chemical fertilizers, pesticides, herbicides and labour saving but energy intensive farm machinery while, application of such high input technologies has undoubtedly increased production and labour efficiency, there is a growing concern about the adverse effects on soil productivity and environmental quality. Organic farming through sustainable agriculture meets not only the food requirements of present generation in an environment friendly way but also the requirements of future generations and maintains our environment. Organic farming provides macronutrients and micronutrients to the plants and also improves soil physical, chemical and biological characteristics of soil. Organic nutrients are nutritionally rich and biologically and environmental friendly one and sustainable. The organic nutrients which are interfered with healthier agriculture for the betterment of life; the organic nutrient source which are compost, crop residues, green manure, biofertilizer, farm yard manure, vermicompost, etc which are playing very important role in the healthier crop production system. Many researchers are confirmed the better results of the organic nutrients and its effect on the agriculture and horticulture crops.

Key words : Organic farming, sustainable agriculture, modern agriculture, biofertilizer, farm yard manure, vermicompost.

The organic movement in India has its origin in the work of Howard (1940) who formulated and conceptualized most of the views which were later accepted by those people who became active in this movement. India is strong in production of certain high quality crops, vegetables, fruits and spices which are suitable for organic production system. Organic farming is production system which avoids or largely excludes the use of synthetic fertilizers, pesticides, growth regulators and livestock feed additives. During green revolution, with advent of high yielding short duration varieties, use of high analysis chemical fertilizers and pesticides, India achieved self-sufficiency in food production, but the excessive use of chemical substance and declined share of organic manures as a source of plant nutrient, decrease the availability of trace elements to the plant and increase the ill effect on soil, animal, human and natural resources. To fulfil the food demand of rising population, large scale conversion into organic agriculture is not feasible. The key characteristics include protecting the long-term fertility of soils by maintaining organic matter levels, fostering soil biological activity, careful mechanical intervention, nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, effective recycling of organic materials including crop residues and livestock wastes and weed, and diseases and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, and resistant varieties. A great emphasis is placed to maintain the soil fertility by returning all the wastes to it chiefly through compost to minimize the gap between NPK addition and removal from the soil (Chhonkar, 2002). For promotion of organic farming, identification of potential areas and crops is crucial. Priority area for promotion of organic farming should be rain fed situation where agro-chemicals consumption is already very low. For increasing the production in a sustainable manner we need to have site-specific balanced and adequate fertilization by an integrated plant nutrient supply system involving organics, inorganic and bio-fertilizers. In the name of increased productivity indiscriminate application of enormous quantity of chemical fertilizers is being followed keeping the health factor at bay. Hence an alternative method of farming is of urgent need which could satisfy the needs of increased food production as well as providing a security against any potential health problem. Organic farming has been proved as a solution to both of these problems. Application of organic sources encouraged the growth and activity of mycorrhizae and other beneficial organisms in the soil and is also helpful in

alleviating the increasing incidence or deficiency of secondary and micronutrients and is capable of sustaining high crop productivity and soil health.

(A) Components of Organic Farming

Components of organic farming are biological nitrogen fixation, crop rotation, residues of crops, bio pesticides, biogas slurry etc. Vermicomposting has emerged as a major component in organic farming which is very effective in enhancing soil fertility and growth of crops in a sustainable way. Organic sources is capable of sustaining higher crop productivity, improving soil quality, and productivity on long-term basis (Chhonkar, 2002). Application of organic sources encouraged the growth and activity of mycorhizae and other beneficial organisms in the soil and is also helpful in alleviating the increasing incidence or deficiency of secondary and micronutrients and is capable of sustaining high crop productivity and soil health (Nambiar *et al.,* 1992).

The various components of organic farming are :

1. Crop rotation : Crop rotation is beneficial in sustaining both yield and quality of vegetables, as it has a potential to overcome all those factors which are responsible for decline in yield like loss of soil fertility, unbalanced nutrient uptake & presence of pest and weeds, legumes in rotation have been found to increase the yield by 25-30%, besides fixing atmospheric nitrogen to the extent of 30-40 kg ha^{-1} in tropical and sub-tropical regions. Singh *et al.,*(1991) reported that legumes in rotation can fix nitrogen from 100-200 kg ha^{-1} within 55 days. Rhizobial inoculation can improve the potential of legumes. Thus crop rotation can be an effective tool in integrated nutrient management for realizing sustainableyields.

2.Crop Residue : Crop residues are non-economical plant parts that are usually left in the field after harvest, left in packing sheds or processing units and serve as a potential source of nutrients, besides promoting and improving soil and water conservation, soil fertility and crop productivity. India has great potential of using residues of crops and straw of cereals and pulses in recycling of nutrients during organic farming. Crop residues when inoculated with fungal species improve physico-chemical properties of soil and crop yields.

3. Organic manure : The organic manure is obtained from biological sources (plant, animal and human residues). Organic manure helps in increasing crop growth directly by improving the uptake of humic substances and indirectly promoting soil productivity by increasing availability of major and minor plant nutrients through soil microorganisms.

(a) Bulky organic manure : Bulky organic manure includes compost, FYM and green manure having less nutrients in comparison to concentrated organic manure.

FYM : Farm Yard Manure (FYM) refers to the well decomposed combination of dung, urine, farm litter and leftover materials (roughages or fodder).

Compost : Large quantities of waste material (vegetable refuse, weeds, stubble, bhusa, sugarcane trash, Sewage sludge, animal waste, human and industrial refuse) can be converted into compostmanure by anaerobic decomposition. Compost is used in the same way as FYM and is good for application to different type of soils and crops.

Green Manuring : The practice of ploughing or turning into the soil undecomposed green plant tissue for the purpose of improving physical condition as well as fertility of soil is referred to as green manuring and the manures obtained by this method is known as green manures. Crops here are grown either insitu or brought from outside and upon decomposition, besides releasing nutrients, they add organic matter, produce enzymes, vitamins and antibiotics. It helps in improving physical and chemical properties of soil, absorb nutrients from the lower layer of soils and leave them in the soil surface layer when ploughed in for use by the succeeding crops. Green manuring helps to maintain organic matter status of soil, acts as source of food and energy to soil microbes and increases their population. Prevents leaching of nutrients to lower layers, increases aeration of rice soils by stimulating the activities of surface films of algae and bacteria, reduces soil temperature and protects the soil from the erosion action of water as it forms canopy cover on the soil. Commonly used green manure crops are such as Sun hemp (*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), Cowpea, Cluster Bean, Senji (*Melilotus parviflor, Vigna sinensis*), Berseem (*Trifolium alexandrium*) etc.

(b) Concentrated Organic Manure : Oilcakes, blood meal, fishmeal, meat meal and horn and hoof meal (Concentrated organic manures) that are organic in nature made from raw materials of animal or plant origin andcontain higher percentage of vital plant

nutrients such as nitrogen, phosphorous and potash, as compared to bulky organic manures.

4. Waste :

1. Industrial waste : Industrial by products such as spent wash & coir waste can be used as manure.

2. Municipal and Sewage waste : It is an important component of organic waste.

5. Biofertilizers : Biofertilizer is a substance which contains living microorganisms such as nitrogen fixer or phosphorus solubilizer which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Biofertilizers play a significant role in improving soil fertility and plant growthby fixing atmospheric nitrogen either symbiotically or freely, solubilizing insoluble phosphates into soluble phosphates thereby increasing availability of phosphorus and secreting growth promoting substances for better plant growth. Biofertilizers include *Rhizobium* (Symbiotic nitrogen fixer), *Azotobactor* and Azospirrilium (Non symbiotic nitrogen fixer) *Pseudomonas, Phosphobacteria, Flavobacterium* (Phosphorous Solublizers) *Vesicular arbuscular mycorhizae* (Phosphorous mobalizers) etc. Biofertilizers are cost effective, eco-friendly and renewable source of plant nutrient to supplements fertilizers for sustainable vegetable production. Hence becomes an integral part of INM. These biofertilizers are used as seed, seedling and soil inoculant.

Types of Biofertilizers :

There are two types of bio-fertilizers.

1. Symbiotic Nitrogen-fixation :

Rhizobium : Rhizobium Bacteria fixes atmospheric nitrogen in roots of leguminous plants, form tumours like growth known as root nodules. It is widely used biofertilizer which can fix around 100-300 kg N/ha in one crop season.

2. Asymbiotic N-fixation : Blue Green Algae, Azolla, Azotobacter, Mycorhizae and Azospirrilium grow on decomposing soil organic matter and fixes atmospheric nitrogen in suitable soil medium.

(i) Azotobacter : Azotobactor has beneficial effect on vegetables, millets, cereals, sugarcane and cotton. Organism is capable of producing nitrogen as well as antifungal, antibacterial compounds, siderophores and harmones.

(ii) Azospirillium : Azospirillium has beneficial effect on oats, barley, maize, sorghum, forage crop and pearl millet. It fixes nitrogen by colonising root zones.

(iii) Blue Green Algae : Blue-green algae reduce soil alkalinity and it is good for rice cultivation and bio-reclamation of land.

(iv) Azolla : Small floating fern, *Azolla harbours* blue-green algae, anabaena, commonly seen in shallow fresh water bodies and in low land fields. They fix nitrogen in association.

(v) Mycorhizae : Mycorhizae is symbiotic association of fungi with roots of Vascular plants. This helps in increasing phosphorous uptake and improve the growth of plants.

6. **Bio-pesticide :** Biopesticides are of plant origin and include plant products like alkaloids, phenolics, terpenoids and some secondary chemicals. They are biologically active against insects, fungi, nematodes affecting their behaviour and physiology. Commonly known insecticides are Pyrethrum, Nicotine, Neem, Margosa, Rotenone etc.

7. **Vermicompost :** Vermicompost is organic manure or compost produced by the use of earthworms that generally live in soil, eat organic matter and excrete it in digested form. These are rich in macro and micronutrients, vitamins, growth hormones and immobilized microflora essential for plant growth (Nagavallemma*et al*., 2004).

(B) Effect of Organic Nutrition on Soil Fertility

Minhas and Sood (1994) also reported that the organic matter after decomposition release macro- and micronutrients to the soil solution, which becomes available to the plants, resulting in higher uptake. Organic farming was capable of sustaining higher crop productivity and improving soil quality and productivity by manipulating the soil properties on long term basis. It was reported that organic and low-input farming practices after 4 years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and also the reserve pool of stored nutrients and maintained relativity stable EC level (Clark *et al*., 1998 & Gaur *et al*., 2002). Normal composting takes a long time leading to considerable loss of organic materials as CO_2 or does not contribute to the organic pool(Subba Rao, 1999). Bulluck *et al*.2002 reported that the use of compost raised soil pH from 6.0 without

compost to 6.5 with compost and reduced the broadleaf weed population by 29 per cent and grassy weed population by 78 per cent. Degradation of soil organic matter reduced nutrient supplying capacity, especially, on soils with high initial soil organic matter content in rice-wheat cropping system (Yadav *et al*., 2002). Organic farming improved organic matter content and labile status of nutrients and also soil physicochemical properties (Subbiah and Kumaraswamy, 2000). Addition of carbonaceous materials such as straw, wood, bark, sawdust, or corn cobs helped the composting characteristics of a manure. These materials reduced water content and raised the C: N ratio. However, under Indian conditions, joint composting of the manure slurries with plant residues was more viable and profitable than its separate composting. Use of FYM and green manure maintained high levels of Zn, Fe, Cu, and Mn in rice-wheat rotation (Singh *et al*., 2002). Laxminarayana and Patiram, 2006 concluded that the decline in soil reaction might be due to organic compounds added to the soil in the form of green as well as root biomass which produced more humus and organic acids on decomposition. Urkurkar *et al.,* reported that supply of 100 per cent nitrogen, that is, 120 kg/ha for rice and 150 kg/ha for potato in a rice-potato cropping system 1/3 each from cow dung manure, neem cake, and composed crop residue appreciably increased the organic carbon (6.3 g kg^{-1}) over initial value (5.8 g kg^{-1}) as compared to supply from inorganic fertilizers alone. However, availability of phosphorus and potassium did not show any perceptible change after completion of five cropping cycles under organic as well as integrated nutrient approaches.

(C) Effect of Organic Nutrition on Soil Biological Properties

Compost contains bacterial, actinomycetes, and fungi; hence, a fresh supply of humic material not only added microorganisms but also stimulated them (Balasubramanian, 1972 and Gaur *et al*., 1973). Besides, compost played an important role in control of plant nematodes and in mitigating the effect of pesticides through sorption. Sorption is the most important interaction between soil/organic matter and pesticides and limits degradation as well as transport in soil. Pesticides bound to soil organic matter or clay particles are less mobile, bioavailable but also less accessible to microbial degradation and thus more persistent (Gaur and Prasad (1970), Prasad *et al*., 1972 and Gaur, 1975. Composting material added plenty of carbon and thus increased heterotrophic bacteria and fungi in soil and further increased the activity of soil enzymes responsible for the conversion of unavailable to available form of nutrients. The application of FYM with rhizobium and coinoculation of PSB with rhizobium augmented soybean (*Glycine max* L. Merr.) production (Sharma and Namdeo, 1999). Agricultural practices have had an impact on soil biophysiochemical properties. Densities of bacteria, protozoa, nematodes, and arthropods in soils under organic farming were higher than under conventional farming (Wu *et al*., 2002). Bulluck *et al*., (2002) reported that organic fertility amendments enhanced beneficial soil microorganisms, reduced pathogen population, total carbon, and cation exchange capacity, and lowered down bulk densities, thus improved soil quality.

The National Academy of Agricultural Sciences (NAAS) recommended a holistic approach involving integrated nutrient management (INM), integrated pest management (IPM) for enhanced input use efficiency, and adoption of region specific promising cropping systems as an alternative organic farming strategy for India and to begin with the practice of organic farming should value crops like spices, medicinal plants, fruits, and vegetables (Bhattacharya and Chakraborty (2005). cropping system recorded higher population of bacteria, actinomycetes, and fungi than rice-wheat cropping system. Field experiment conducted with P solubilizers like *Aspergillus awamori*, *Pseudomonas striata,* and *Bacillus polymyxa* significantly increased the yield of various crops like wheat, rice, cowpea (*Vigna sinensis* L.), and so forth in presence of rock phosphate and saved 30 Kg P_2O_5 ha^{-1} with the use of phosphate solubilizing microorganisms. Vegetable crops, in general, responded better to *Azotobacter* inoculation than other field crops. Nevertheless, yield increase in case of wheat, maize, jowar (*Sorghum bicolor* L. Moench), cotton (*Gossypium* spp.), and mustard crop using *Azotobacter chrooccocum* culture was 0–31 per cent higher than control (Shende and Apte, 1982).In low-input agriculture, the crop productivity under organic farming is comparable to conventional farming. Integrated use of rice straw compost + *Azotobacter* and PSB was found better than rice straw alone (Kalyan, 2003). Azotobacter produced growth promoting substances which improved seed germination and growth with extended root system. It also produced polysaccharides which improved soil

aggregation (Gaur, 2006). Seed inoculation of chickpea with rhizobium + PSB (phosphate solubilising bacteria) increased dry matter accumulation, grain yield, and grain protein content in chickpea, dry fodder yield of succeeding maize, and total nitrogen and phosphorus uptake by the cropping system over no inoculation and inoculation with rhizobium alone.

CONCLUSIONS

Organic farming is the system of farming that promotes environmentally, socially and economically sound products of food and fibres. As the awareness about the harmful effect of chemicals on health, soil, environment etc., is increasing; that's why inorganic farming is shifting its way towards organic farming. Organic farming can provide quality food without adversely affecting the soil's health and the environment. There is need to identify suitable crops/ products on regional basis for organic production that has international market demands. India with diverse agro climatic conditions has great potential for organic farming and many products are produced organically in India. High price for organic products and lack of proper marketing functions within domestic markets are the major constraints in organic farming in India.

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