

Review Article

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Impact of Organic Nutrient Management on Crop Quality, Yield and Soil Health: A Review

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ABSTRACT

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Organic nutrients are proven things that improving crop productivity, quality and yield which in turn enhance the quality and richness of the soil properties and make way for the healthier environment for the beneficial soil micro-organism. The organic nutrients which are interfered with healthier agriculture for the betterment of life; the organic nutrient source which are liquid biofertilizer, farm yard manure, vermicompost, banana pseudostem sap, panchagavya, beejamrut, amritpani etc which are playing very important role in the healthier crop production system. Organic nutrients are nutritionally rich and biologically and environmental friendly one and sustainable. Many agricultural practices and synthetic agro-chemicals risked the soil fertility and spoiling the eternity of the nature. Not only the organic nutrient enhances the quality and yield which also enhances the life span of the nature and its entities. Many researchers are confirmed the better results of the organic nutrients and its effect on the agriculture and horticulture crops. To fulfill the biologically and economically sound practices in agriculture system there is a need of inclusion of organic component in the present farming practices.

Introduction

Organic farming is an age old traditional practice evolved by our fore fathers wherein only organic manures or natural inputs available on the farm are used thus reduces the cost of production against chemical inputs. Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects (IFOAM). General acceptance of organic farming is not only due

to the greater demand for pollution-free food but also due to natural advantage of organic farming in supporting the sustainability in agriculture. The natural inputs used in organic farming are easily available, releases nutrients slowly, supplies macro and micro nutrients and provides favourable soil environment for microbial population (Shashidhara, 2000; Devakumar *et al.*, 2011).

Imbalanced and unscientific use of agricultural chemicals viz., fertilizer and synthetic pesticides resulted in unhealthy soil; ultimately which affects the quality of farm

produce. Farm produces with unwarranted chemicals are considered to be harmful to consumer's health. Increasing awareness about devastating impact of agricultural chemicals on environment, stringent rules and regulations of food safety and deadly effect on human wellbeing compelled to raise the crops devoid of these dangerous chemicals. Under such circumstances when demand of higher quality food is increasing day by day, crops which are raised with eco-friendly techniques are one of the potential options. This can be achieved by adopting organic farming practices. The demand of quality and health friendly organic product has also been increasing and now it become more popular and also sold at a premium prices in domestic and foreign market.

For successful organic farming in any crops depends upon the availability of nutrients at right time and in right amount, particularly in short duration crops. If nutrient supply is not matching with the requirements then crop production is adversely affected. The availability of nutrients from organic manures is depending upon the C:N ratio of the manures. Wider the C:N ratio, slower the nutrient release and sometime immobilization is occurred. Therefore, integration of different organic manures to narrow the C:N ratio can increase the rate of decomposition and speedup the nutrient release. India is known for higher sugarcane production therefore, number of sugar factories is working in this area and produce biocompost as byproduct. Vermicompost and FYM are widely used organic manures. When these manures mix with concentrate viz., castor or neem cake having higher content of N, releases the available nutrient particularly N at faster rate. Numbers of experiments were conducted on this line and the results of these experiments indicated that through integration of these manures achieved the yield equivalent to chemical fertilizers (Anon., 2011b). Organic

manures are slow release natural fertilizers and also improve the nutrient use efficiency and quality of the crops. Apart from these, it improves the soil physical conditions which are more desirable for tuber crops like onion and more so under high clay containing soils.

It is well known that banana is the heavy feeder crop of nutrients. After harvest of banana, remaining plant parts treated as waste. This contain high amount of essential plant nutrients, which is being lost. By utilizing such waste plant material, many useful by-products like fibre, paper, fabrics, organic manure etc. can be prepared. While separating fibers from the banana pseudostem, the liquid available is known as sap which contains good amount of essential macro and micronutrients as well as growth boosters. Salunkhe (2010) analysed the samples of banana pseudostem for its elemental composition and found that banana pseudostem contained macro elements in the range of 1.00 to 1.12 % N, 0.50 to 0.71 % P, 2.39 to 20.2 % K and micro nutrients in the range of 259 to 323.2 mg/kg Fe, 47.3 to 241.3 mg/kg Mn, 10.1 to 107.4 mg/kg Zn and 13.4 to 83.6 mg/kg Cu.

Panchagavya, Jeevamrutha Amritpani are plant growth promoting substances containing beneficial microorganisms which promotes growth and yield of crop. Micro-organisms are well activated in the soil by the addition of jeevamrutha. The microorganisms such as nitrogen fixer, *Azotobacter*, *Azospirillum* and phosphorus solubilizing bacteria *Pseudomonas fluorescence* and potash solubilizing bacteria like *Bacillus silicus* are present in the cow dung that is used to prepare jeevamrutha (Ramprasad *et al.*, 2009). Individual application of organic sources could not produce significant effect thus the diversification of organic sources of plant nutrients is becoming popular in these days. Use of farm yard manure and organic liquid

formulations like Panchagavya, cow urine and jeevamruta are potential sources of organic nutrients. Hence, the present experiment was conducted to study the combined effect of FYM and jeevamrutha on growth and yield of fieldbean. Farm yard manure is a decomposed organic matter obtained by the action of microbial population in a warm and moist aerobic environment using cow dung, cow urine and other waste materials available from backyard cattle (Ramprasad *et al.*, 2009). Farmyard manure is a rich source of nutrients having inherent ability to improve the soil health and aeration, water holding capacity and substrate for beneficial microbial population. Decomposition of farmyard manure by microorganism results in release of carbon dioxide, water and mineral plant nutrients such as nitrogen, phosphorus, potassium and micronutrients.

Anti disease and microbial properties

Many plants have been used because study of antioxidant and antimicrobial properties, phytochemical screening and analysis of sap extracted from banana (*Musa acuminata*) pseudostem, which are due to compounds synthesized in the secondary metabolism of the plant (Nagarajan *et al.*, 2013).

Sampath Kumar *et al.*, (2012) reported the antifungal and antibiotic activity of peel and pulp of fully ripe bananas and a fungicide in the peel and pulp of green fruits is active against a fungus disease of tomato plants.

Priya *et al.*, (2014) reported the phytochemical screening and analysis of pseudostem sap indicated the presence of these carbohydrates, protein and phenolic compounds and the antimicrobial studies with different fungal and bacterial strains indicated the antimicrobial properties for the sap as well.

Effect on yield and yield attribute

The liquid organic manures contains small amount of nutrients and growth boosters. When it applied to the crops it removes the imbalances in terms of physical, chemical and physiological aspects and harmonizes the basic element which revitalizes the growth process (Natarajan, 2008). Application of soil + mine spoil + coir pith vermicompost (1:1:1) + RDF significantly enhanced plant height (27.2 cm), number of leaves (33.3), and yield per plant (38.5g), as compared to mine spoil alone + RDF Thanunathan *et al.*, (1997). application of 50% N through vermicompost + 50% N and 100% PK (chemical fertilizer) with the combinations of *Azospirillum* significantly increases bulb yield of onion while combinations of these treatments with *Azotobacter* significantly increases plant height (60.90 cm), number of leaves per plant (16.19) and leaf area per plant (781.55 cm²) as compared to application of organic manures alone (FYM @ 20 t/ha, VC @ 5 t/ha and FYM @ 10 t/ha) Jayathilake *et al.*, (2002). Higher pods per plant, seed yield and biological yield in the treatment application of farm compost @ 5t/ha + poultry manure @ 1t/ha as compared to control and application of farm compost @ 5t/ha + VC @ 1t/ha. They also found that spraying of biofertilizer + cow urine increase pods/plant, test weight and seed yield as compared to control and spraying of biofertilizer only, Abraham and Lal (2003). Somasundaram *et al.*, (2003) application of panchagavya @ 3% significantly increased grain yield (17.7 q/ha), number of seed per pod (12.1) and 100 grain weight (4.0g) as compared to application of recommended dose of fertilizer. The higher plant height, number of leaves, leaf area, flowers per plant and weight of flower was observed in the treatment of vermiwash spray as compared to cow dung extract, cow urine and vermicast extract Sivasubramanian and Ganeshkumar (2004). The result revealed that the yield

components viz., productive tillers/hill, panicle length, filled grain panicle, seed test weight, grain yield and straw yield were found significantly higher in the treatment of panchgavya spray @ 3% Yadav and Christopher (2006). George *et al.*, (2007) application of vermicompost @ 2.5 t/ha along with vermiwash 1:1 spray registered significantly maximum dry chilli yield of 2.99 t/ha and plant height of 78.1 cm. soil application of bio-gas slurry from 3 milch animals with 3% foliar spray of panchagavya recorded significantly higher grain yield of maize, sunflower, green gram Somasundaram *et al.*, (2007). Bindumathi Mohan (2008) observed maximum number of fruits per plant and yield per plant of brinjal in the treatment of bokashi @ 750 kg/ha while in tomato the number of fruits per plant and yield per plant was observed maximum in the treatment of Bokashi @ 1250 kg/ha. However, panchagavya was found the most cost effective as it recorded higher CBR followed by amrit pani and bokashi. Foliar spray of panchagavya @ 3 % in combination with any organic source increases growth and yield of Kalmegh (*Andrographis paniculata*) as compared to application of organic sources alone. However, the highest yield was observed in the treatment of FYM+NPK+ Panchagavya Sanjutha *et al.*, (2008), higher values of growth and yield parameter viz. plant height, leaf area index, dry matter production, number of flower per plant, number of pods per plant, number of filled grain per pod and grain yield were recorded in the treatment of 1% urea or 2% DAP spray followed by vermiwash spray at floral initiation and 15 days after flowering (Kumar *et al.*, 2008).

Application of 33t FYM + 8t neem cake/ha significantly increases the grain yield (20.5 q/ha) and straw yield (24.5 q/ha) of soyabean. Whereas, the highest crude protein (19.3%) observed in the treatment received the

nutrients based on STCR target 25 q/ha (50:145:43 NPK kg/ha) Patil *et al.*, (2008). Kagne *et al.*, (2008) observed that application of vermicompost @ 2.5 t/ha along with seed treatment of *Azospirillum* and PSB enhanced the growth and quality of sorghum and produced highest seed yield (21.7 q/ha). application of 50% RDN + 50% N through FYM + VAM and PSB @ 12.5 kg/ha + panchagavya @ 3% spray recorded significantly higher number of branches/plant, number of fruits/plant, fruit length and fruit yield as compared to RDF. This treatment also registered highest B:C ratio Naidu *et al.*, (2009). Venkatalakshmi *et al.*, (2009) observed that foliar application of panchagavya @ 3 % significantly increased number of leaves, LAI, green leaf yield and dry matter yield of *Amaranthus viride* and also higher result indicated that when panchagavya applied @ 3% and 6% with seed soaking treatment recorded 11 and 9 t/ha green leaf yield. Application of FYM @ 6 t/ha + Rhizobium + PSM significantly increased plant height (32.9 cm), pod weight per plant (11.9), seed index (55.3 g) and yield (1278 kg/ha) Zalate and Padmani (2009). A field trial to study the effect of banana pseudostem sap and vermiwash on fruit setting in mango was conducted at NAU, Navsari during 2009 to 2011. There were seven treatments comprising of 1% foliar spray of banana pseudostem sap, enriched banana pseudostem sap, vermiwash and its combinations along with control, apply 4 sprays i.e. at the time of flowering and 25, 50 and 100% flower opening. They observed maximum fruit retention with the treatment of sap and vermiwash in 1:1 ratio as compared to control. However it was at par with the treatment of enriched sap alone and sap and vermiwash in 2:1 ratio (Anon, 2011b). Application of 100% RDF + panchagavya spray @ 2% significantly increased the plant height (131.7 cm), fruit length (21.8 cm), fruit girth (4.66cm), fruit weight (13.9 g /fruit),

fruit yield (12.7 q/ha), dry matter production (5.9 g per plant) and number of branches (3.2 per plant) Vennila and Jayanthi (2010), Salunkhe (2010) revealed that the application of banana pseudostem sap @ 2000 l/ha through micro irrigation system increase the plant height, leaf area per plant, bulb weight, average bulb weight and dry matter yield of onion, foliar application of 6 % cow urine followed by panchagavya 6 % was found to be superior in increasing the auxin content and reducing activity of IAA oxidase enzyme in shoot tip of cotton. According to them this information becomes useful to increasing the number of branches and productivity of *desi* cotton Bais *et al.*, (2010), Sritharan *et al.*, (2010) application of panchagavya 4% foliar spray registered higher dry matter production of 73.1 g/plant followed by moringa 5% foliar spray recording yield of 70.0 g/plant, highest number of tubers (575000/ha) and tuber yield (28.7 t/ha) in the treatment of 3% spraying of panchagavya at 15 days interval as compared to 3% spraying of panchagavya Ravichandran *et al.*, (2011). Higher number of leaves, leaf length, height of the plant and root length of rice Tharmaraj *et al.*, (2011), An experiment on evaluation of banana pseudostem sap as liquid fertilizer through drip irrigation in Banana was conducted at Soil and Water Management Research Unit at NAU, Navsari. The result revealed that the higher fruit yield was recorded in the treatment, application of three litre pseudostem sap per plant + 80 % RDF. It was at par with the treatment, application of 4 litre pseudostem sap + 80 % RDF and 4 litre pseudostem sap + 100 % RDF. Treatment, 4 litre pseudostem sap + 100% RDF recorded significantly more number of fingers per bunch then the remaining treatments. Similar experiment was also conducted on sugarcane and recorded the yield level during first and second year ranging from 140 to 200 t/ha. Through the treatment effect was not significant yet, numerically the cane yield was tended to

increase with increase in level of sap application from 5000 l/ha to 15000 l/ha (Anon., 2011b), Application of biocompost @ 20 t/ha to paddy recorded significantly higher yield attributes and yield of paddy and castor Virdia *et al.*, (2011).

Effect on nutrient content and uptake

Somasundaram *et al.*, (2007) soil application of bio-gas slurry from 3 milch animals along with 3 % foliar spray of panchagavya recorded significantly higher N uptake by maize, sunflower and green gram, foliar spray of panchagavya @ 3 % in combination with any organic source increase content and uptake of N, P and K by Kalmegh as compared to application of organic sources alone. However, the highest content and uptake of these nutrients were found in the treatment, FYM + NPK (75-75-50 kg/ha) + Panchagavya Sanjutha *et al.*, (2008), similarly highest uptake of major and micronutrients by chili in the treatment 50% RDN+50% N through FYM + BF + Panchagavya @ 3% foliar spray Naidu *et al.*, (2009), Venkataramana *et al.*, (2010) foliar spray of vermiwash @ 200 mg/l significantly increases N, P and K content in mulberry leaves, found higher content and uptake of N (0.84 % 277.82 kg/ha), P (0.22 % 64.27 kg/ha) and K (0.88 % 270.52 kg/ha) in the treatment of foliar application of humic acid @ 0.05% as compared to foliar application of panchagavya (3 and 4 %), vermiwash (10 and 20 %), EM (1 and 2 %) (Sathish and Paramaguru, 2010).

Effect on quality

Paramasivam *et al.*, (2006) reported that There was no significant improvement in oil and protein content in groundnut seed was observed when applied composted poultry manure, composted pressmud or vermicompost on N equivalent base alone but

in combination with panchagavya spray @ 3 % the results were significantly improved the quality of groundnut similarly Somasundaram *et al.*, (2007) reported that application of biogas slurry of 3 milch animal + spray of Panchgavya @ 3 % increase soluble protein content of 15.20, 15.93, 16.94 mg/g in maize, sunflower, green gram respectively while Sanjutha *et al.*, (2008), observed that significantly the highest andrographolide content (1.31 %) and yield (8.11 kg/ha) in the treatment of FYM @ 15 t/ha + RDF + panchgavya foliar application @ 3 %.

However, the higher content and yield of andrographolide among organic treatments was recorded in the treatment of FYM @ 5 t/ha + panchagavya foliar application @ 3 % in kalmegh (*Andrographis paniculata*). Surekha *et al.*, (2009) reported that organic treatment improves the cooking quality in terms of elongation ratio and nutritional quality in terms of P and K content in brown and white rice grown in kharif as compared to inorganic treatment. Both the treatments were on par with respect to hulling (%), head rice recovery (%), length/breadth of seed, amylase (%) and protein (%).

Sritharan *et al.*, (2010) reported that application of panchagavya 4 % enhanced the quality parameters of black pepper like solasodine, ascorbic acid (34 mg/100g), TSS (9.2) and Total Fenolics (0.697 mg/g) content in fruit as compared to other bioregulators i.e. leaf extract of mukia, moringa, prosopis and root extract of withania, while foliar spray of vermiwash and cowdung each at 100, 150 and 200 mg/l on biochemical content of mulberry was studied and the result was found that significantly improvement in quality of mulberry fruit in terms of chlorophyll a and b, protein and carbohydrate content when applied 200 mg/l vermiwash as compared to control Venkatarmana *et al.*, (2010).

Effect on soil physical and chemical properties

A long term study was conducted by Surekha *et al.*, (2009) and reported that improvement in physical properties of soil under organic treatment. The values of soil BD under inorganic and organic treatments were 1.48 and 1.30 g/cc, respectively. Whereas, the values of penetration resistance under respective treatments were 11.8 and 7.7 kg/cm, similarly Tharmaraj *et al.*, (2011) reported that soil application of vermicompost and spray of vermiwash improved physical (water holding capacity, porosity and moisture content), chemical properties (pH and EC) as well as soil fertility (N, P, K, Ca and Mg) over control and its individual application. Effect of integrated nutrient management on soil fertility management on soil fertility were studied by Naidu *et al.*, (2009) and results revealed that highest status of major and micronutrients in soil in the treatment, 50% RDN+50% N through FYM + BF + Panchagavya @ 3% foliar spray similar results were obtained by Ansari and Kumar (2010) i.e. the significantly higher content of organic C in the treatment of vermiwash + vermicompost followed by only vermicompost and only cowdung (100 g/plant). However, higher content of N, P, K, Ca, Mg, Fe, Mn, Zn and Cu were observed in the chemical fertilizer treatment followed by treatments of vermiwash + vermicompost. Ramesh *et al.*, (2010) surveyed the certified organic farm of Maharashtra, Karnataka, Tamil Nadu, Kerala, Uttarakhand to ascertain the real benefits and feasibility of organic farming in terms of the production potential, economics and soil health in comparison to the conventional farms. The survey result revealed that there was an all over improvement in soil quality in terms of physical, chemical, fertility and biological properties of soil.

With all the study were concluded that the organic nutrients which significantly increases the crop growth, yield, quality and soil qualities in better manner and which significantly reflects on the soil micro-organism and soil enzymes.

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