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Effect of different organic inputs on biological properties of soil, yield and quality of crops under certified organic farms in Nagpur district of Maharashtra

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Abstract
The field investigation in relation to "Effect of different organic inputs on soil biological properties, yield and quality of crops under certified organic farms in Nagpur district of Maharashtra" was carried out during kharif- rabi season of 2017 – 18, to assess the biological properties of soil, quality and yield different crops as influenced by various organic resources. Soil samples of 0-10 cm depth were collected randomly after the harvest of crops from six locations of Nagpur district were selected for recording various observations and collected plant samples for quality parameters. Yield of crops was noted from farmer's field of above locations. The maximum microbial count was recorded in organic field over the inorganic field. The count of bacteria, fungi and actinomycetes were varied from 16.25 to 22.50 X 10^7cfu g^{-1}, 10.75 to16.25 X 10^5cfu g^{-1} and 7.25 to 13.5 X 10^5cfu g^{-1} respectively..In all the locations the yield of Nagpur Mandarin found higher as compared to national average productivity of Nagpur mandarin (10.4 t ha^{-1}). The yield of sweet orange recorded 14.0 t ha $^{-1}$ with the application of Ghanjivamrut @ 500 kg ha^{-1}. Grain yield of wheat was obtained between 1.9 kg ha^{-1}.When the field applied FYM for 9 years, maximum grain yield of pigeonpea was obtained with fertilizers alone as compared to application of organic source. The quality of crops was improved with application of organic inputs over the fertilizers application. The higher ascorbic acid concentration (49.15 mg 100 ml^{-1}) of mandarin was recorded when ghanjivamrut @ 500 kg ha^{-1} was applied, Similarly in tomato the maximum ascorbic acid contain (23.37 mg 100 ml^{-1}) was recorded in organically produce tomato. The protein percent of rice was found maximum in organic field. From the study it can be concluded that, the application of organic inputs improve the chemical, biological properties and fertility status of soil. In case of yield due to organic inputs littilbit decreased. Therefore organic and inorganic fertilizers in balanced form are efficiently sustain and enhance the fertility status of soil and maintained the yield and nutritional quality of various crops.

Keywords: Organic inputs, soil biological properties, FYM

Introduction
Organic farming was practiced in India since thousands of years. In traditional India, the entire agriculture was practiced using organic techniques, where nutrient, pesticides, etc. were obtained from plant and animal products.
Without the activities of soil organisms, organic materials would accumulate and litter the soil surface, and there would be no food for plants. The soil biota includes: moles, rabbits and rodents, woodlice, earthworm, beetles, centipedes, slugs, snails, ants, yeasts, bacteria (commonly action bacteria), fungi, protozoa, roundworms and rotifers. Of these, bacteria and fungi play roles in maintaining a healthy soil they act as decomposers that break down organic materials to produce detritus and other breakdown products.
Organic farming has been considered as one of the best options for protecting sustaining soil health and productivity and is gaining lot of importance in present-day agriculture. Significant improvements in soil physical, fertility and biological properties have been reported in several organic farming experiments although grain yield under organic farming is often less than under conventional farming due to so-called organic transition effect.

Materials and methods
The field investigation was conducted during kharif - rabi season of 2017-2018 at the certified farmer's fields (organic field) of Nagpur district. Survey and samples were taken on organic and in the vicinity of organic farms (farmer's field) from Kalmeshwar, Saoner and Mauda tehsil of Nagpur district.

For determination of microbial count, soil samples at depth 0-10 cm depth were collected from different location. Soil microbial count was determined by serial dilution plate technique (Dhingra and Sinclair, 1993) [2]. In this technique one gram of soil sample was taken under aseptic condition in 10 ml sterile test tube and added 9 ml distilled water, shaked thoroughly for uniform mixing and form suspension. Then 1 ml suspension transferred in a 10 ml test tube and added 9 ml distilled water in it, shake the test tube well and diluted 10 times by distilled water to get desired water level of 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8} and 10^{-9} dilutions. After dilution transferred 1 ml of suspension in petridish in particular media for specific growth of micro-organism. For bacteria nutrient agar media, for fungi potato dextrose media and for actinomycetes was used.

Protein was determined by Kjeldahl's method given by Jackson (1973) [5]. Oil was determined by using Soxhlet's apparatus method by Piper (1966) [8]. Ascorbic acid was determined by Rapid titration method given by Ranganna (1987) [11]. The yield was recorded from farmers of different crops according to location of Nagpur district.

Results and discussion

Influence of organic inputs on microbial population of soils

The data pertaining to microbial population of bacteria, fungi and actinomycetes are presented in table-1. Bacterial population showed higher as compared to fungi and actinomycetes in the organic and inorganic cultivation.

The range of bacterial, fungal and actinomycetes count were observed from 16.25 to 22.50 X 10^7cfu g^{-1},10.75 to 16.25 X 10^5cfu g^{-1} and 7.25 to 13.75 X 10^5cfu g^{-1} respectively at selected location. The bacteria count was increased by the application of organic inputs.The maximum fungal count was found in onion field when FYM @10 t ha^{-1} was applied. This could be ascribed to the FYM which supplied large amount of readily available carbon, resulting in more diverse and dynamic microbial system than in inorganically fertilized soil. Similarly the count of actinomycetes was found more in organic input applied field than the fertilizers applied field. Ingle *et al.* (2014) [4] recorded that, the bacterial, fungal and actinomycetes was 22.5 X 10^7cfu g^{-1}, 12.50 X 10^4cfu g^{-1} and 13 X 10^6cfu g^{-1} respectively in FYM @ 10 t ha^{-1} applied field, where as the count of bacteria, fungi and actinomycetes was 15.5 X 10^7cfu g^{-1}, 11.25 X 10^4cfu g^{-1} and 11.75 X 10^6cfu g^{-1} recorded respectively in 100% NPK applied field which was less than FYM applied field.

Yield of different crops

The data regarding yield of different crops is presented in table- 2 as influenced by use of organic and inorganic sources. The yield of mandarin was recorded from 14.5 to 18 t ha^{-1}. The results revealed that, decreased the yield of Nagpur mandarin of 16.0, 17, 15 and 14.5 t ha^{-1} at location of Selu, Gangner, Chacher and Chinchbhavan respectively, when these farmers applied organic input since 7-17 years over the inorganically produced mandarin (18 t ha^{-1}). The yield of sweet orange recorded 14 t ha^{-1} with the application of Ghanjivamrut @ 500 kg ha^{-1} since 9 years, at Saoner location.The grain yield of wheat is presented in table-2. The grain yield of wheat was 1.9 t ha^{-1} where the continuous use of 10 t FYM ha^{-1} at Saoner. In the present study, trend of grain yield of wheat under organic sources was found more as compared to yield of wheat under conventional farming (1.5 t ha^{-1}) as reported by Ramesh *et al*. (2010) [10].

Rahile (2014) [9] reported that the grain yield of wheat was noted 2.5 t ha^{-1} with the application of amritpani 500 lit. ha^{-1} + FYM @ 5 t ha^{-1} at Nandapur location of Nagpur district when the incorporation of solid and liquid organic materials continuously for 6-8 years. Singh *et al.* (2014) [12] reported that, the grain yield of wheat were increased when 120 kg N ha^{-1} + FYM @ 6 t ha^{-1} (5.87 t ha^{-1}) where as grain yield of wheat (5.11 t ha^{-1}) was obtained with 120 kg N ha^{-1} alone under tillage condition. The increase in grain yield of wheat may be ascribed to the better availability of nutrients/ leaving to better minerlization and also stimulate the enzymatic and microorganis activity resulted an increased the yield of wheat.

Yield of Pigeonpea (t ha^{-1})

Result indicated that, the application of organic and inorganic sources found sustainable grain yield of pigeonpea (table – 2). The grain yield of pigeonpea varied from 1.1 to 1.4 t ha^{-1} with the management of organic and inorganic sources. The application of chemical fertilizer resulted maximum grain yield of pigeon pea (1.4 t ha^{-1}) as compared to application of organic source. At Saoner recorded grain yield of pigeonpea1.1 t ha^{-1} when they applied FYM @ 2.5 t ha^{-1} from 9 years.

Yield of Rice (t ha^{-1})

The grain yield of Rice as influenced by different organic sources is presented in table-2. The grain yield of rice was recorded between 2.4 and 2.2 t ha^{-1} where the continuous use of 5 t FYM ha^{-1} at Gangner and Chacher locations, respectively. The grain yield of rice recorded more in field where inorganic fertilizer was applied. Similar observations were repeated by Nishan *et al.* (2016) [6] that loss the grain yield of the rice to the tune of 15.25 per cent in organically grown rice over INM treatment.

Yield of vegetables (t ha^{-1})

Results indicated that the application of organic and inorganic sources found sustainable yield of vegetable (table – 2). The yield of vegetables varied from 25, 6.2 and 20 t ha^{-1} of tomato, fenugreek + spinach and onion, respectively with the management of organic sources. In Selu the yield was found more in inorganically produced tomato 29 t ha^{-1}. Chaudhary and Tehlan (2014) [1] observed that, the yield of fenugreek 1.78 and 1.80 t ha^{-1} when the application of poultry manure (1.5 t $acre^{-1}$) and FYM t $acre^{-1}$ whereas 2.07 t ha^{-1} with 15:20:10 NPK $acre^{-1}$. Kumar *et al*. (2014) [12] revealed that, the application of FYM + panchagavya (3%) was found effective and showed better performance on growth and bulb yield of onion (17.4 ha^{-1}).

Quality of crops influenced by organic sources

The data on quality parameter of crops is furnished in table-3. The quality parameter such as ascorbic acid in fruit, protein content and oil content was analysed.

Ascorbic acid (mg 100 ml^{-1})

The ascorbic acid concentration of mandarin was ranged from 47.24 to 49.15 mg 100 ml^{-1}. The results revealed that, more concentration of ascorbic acid was observed in organically grown mandarin over the inorganically grown mandarin. The maximum ascorbic acid concentration was recorded at Chacher when Ghanjivamrut @ 500 kg ha^{-1} was applied. Similar findings were reported by Duarte *et al.* (2010) [3] that, the highest concentrations of vitamin C were recorded in fruits from organic farming, but the response depended on

species and cultivar. The concentration of ascorbic acid in tomato found more in organically cultivated tomato (23.37 mg 100 ml^{-1}) where Ghanjivamrut @ 500 kg ha^{-1} was applied over the inorganically grown tomato (22.81 mg 100 ml^{-1}) at Selu.

Similar findings were reported by Pal *et al.* (2015) [7] observed that, the maximum total soluble solids, ascorbic acid, total sugars, reducing sugar, non-reducing sugar with the application of (T6) FYM 50% +Vermicompost 50%.

Protein (%)

From the data, protein per cent of rice grain varied from 7.16 to 7.74 per cent. The highest protein percent observed in Gangner location when FYM @ 5 t ha^{-1} applied. The result showed that, the higher protein concentration was in organically grown rice. Tiwari *et al.* (2001) [13] observed that application of 10 tone FYM ha^{-1} produce higher protein content of rice grain.

Oil (%)

The data about oil content in soybean depicted in table 3. The oil percent in soybean ranges from 17.90 to 18.20 percent. The maximum oil percent was recorded in inorganically grown soybean but it was nearly same of organically grown soybean.

Table 1: Effect of various organic sources on microbial count (cfu g^{-1}) of soil

Location	Crops		Source	Bacteria (X 10^7 cfu g^{-1})	Fungi (X 10^5 cfu g^{-1})	Actinomycetes (X 10^5 cfu g^{-1})
Selu	1)	Mandarin[e]	Organic	18.25	13.75	9.00
	2)	Mandarin	Fertilizer	16.50	12.50	7.25
	3)	Tomato[e]	Organic	20.75	13.75	12.75
	4)	Tomato	Fertilizer	18.50	12.50	10.25
Kalmeshwar	1)	Fenugreek+ Spinach[d]	Organic	21.50	14.00	10.50
	2)	Inorganic	Fertilizer	18.75	12.25	11.75
Gangner	1)	Mandarin [e]	Organic	19.50	13.75	11.00
	2)	Mandarin	Fertilizer	17.25	12.50	9.25
	3)	Rice [b]	Organic	18.50	13.75	9.75
	4)	Soybean[d]	Organic	22.25	14.25	10.50
	5)	Inorganic	Fertilizer	17.75	11.75	8.25
Saoner	1)	Pigeonpea[c]	Organic	22.50	14.00	13.50
	2)	Pigeonpea	Fertilizer	21.25	12.75	11.00
	3)	Wheat [a]	Organic	21.50	13.50	10.75
	4)	Sweet orange [e]	Organic	18.75	13.75	9.25
	5)	Inorganic	Fertilizer	16.25	12.75	8.50
Chacher	1)	Rice [b]	Organic	21.50	12.50	11.75
	2)	Rice	Fertilizer	18.75	10.75	12.50
	3)	Mandarin[e]	Organic	20.25	13.50	10.00
	4)	Soybean [c]	Organic	22.00	13.25	12.75
	5)	Inorganic	Fertilizer	18.75	12.75	13.50
Chinchbhavan	1)	Mandarin [e]	Organic	19.00	13.50	9.25
	2)	Sorghum (Maldandi) [b]	Organic	18.25	15.00	11.25
	3)	Onion [a]	Organic	21.75	16.25	9.50
	4)	Inorganic	Fertilizer	17.00	13.75	8.25

a = 10 t FYM ha^{-1}, *b* = 5 t FYM ha^{-1}, *c* = 2.5 t FYM ha^{-1},
d = Jivamrut @ 500 lit ha^{-1}, *e* = Ghanjivamrut@ 500 kg ha^{-1}.

Table 2: Effect of various organic sources and fertilizer on yield (t ha^{-1}) of various crops

Location	Crops		Source	Organic source applied since	Yield (t ha^{-1})
Selu	1)	Mandarin[e]	Organic	10 Years	16
	2)	Mandarin	Fertilizer		18
	3)	Tomato[e]	Organic		25
	4)	Tomato	Fertilizer		31
Kalmeshwar	1)	Fenugreek+ Spinach[d]	Organic	8 Years	5.2
	2)	Inorganic	Fertilizer		-
Gangner	1)	Mandarin [e]	Organic	7 Years	17
	2)	Mandarin	Fertilizer		19
	3)	Rice [b]	Organic		2.4
	4)	Soybean[d]	Organic		1.9
	5)	Inorganic	Fertilizer		-
Saoner	1)	Pigeonpea[c]	Organic	9 Years	1.1
	2)	Pigeonpea	Fertilizer		1.4
	3)	Wheat [a]	Organic		1.9
	4)	Sweet orange [e]	Organic		14
	5)	Inorganic	Fertilizer		

Chacher	1)	Rice [b]	Organic	13 Year	2.2
	2)	Rice	Fertilizer		2.6
	3)	Mandarin[e]	Organic		15
	4)	Soybean [c]	Organic		1.7
	5)	Inorganic	Fertilizer		
Chinchbhavan	1)	Mandarin [e]	Organic	17 years	14.5
	2)	Sorghum (Maldandi) [b]	Organic		1.2
	3)	Onion [a]	Organic		19
	4)	Inorganic	Fertilizer		

a = 10 t FYM ha^{-1}, *b* = 5 t FYM ha^{-1}, *c* = 2.5 t FYM ha^{-1},
d = Jivamrut @ 500 lit ha^{-1}, *e* = Ghanjivamrut@ 500 kg ha^{-1}.

Table 3: Quality of crops influenced by organic sources

Mandarin				
Location		**Crops**	**Source**	**Ascorbic Acid (mg 100 ml^{-1})**
Selu	1)	Mandarin[e]	Organic	48.82
	2)	Mandarin	Fertilizer	47.36
Gangner	1)	Mandarin [e]	Organic	47.61
	2)	Mandarin	Fertilizer	46.26
Chacher	1)	Mandarin[e]	Organic	49.15
Chinchbhavan	1)	Mandarin [e]	Organic	47.24
Tomato				
Location		**Crops**	**Source**	**Ascorbic Acid (mg 100 ml^{-1})**
Selu	1)	Tomato[e]	Organic	23.37
	2)	Tomato	Fertilizer	22.81
Rice				
Location		**Crops**	**Source**	**Protein (%)**
Gangner	1)	Rice [b]	Organic	7.74
Chacher	1)	Rice [b]	Organic	7.36
	2)	Rice	Fertilizer	7.18
Soyabean				
Location		**Crops**	**Source**	**Oil (%)**
Gangner	1)	Soybean[d]	Organic	17.90
Chacher	1)	Soybean[c]	Organic	18.14
	2)	Soybean	Fertilizer	18.20

a = 10 t FYM ha^{-1}, *b* = 5 t FYM ha^{-1}, *c* = 2.5 t FYM ha^{-1},
d = Jivamrut @ 500 lit ha^{-1}, *e* = Ghanjivamrut@ 500 kg ha^{-1}.

Conclusion

From the study it can be concluded that, the application of organic inputs improve the chemical, biological properties and fertility status of soil.

In case of yield due to organic inputs littilbit decreased. Therefore organic and inorganic fertilizers in balanced form are efficiently sustain and enhance the fertility status of soil and maintained the yield and nutritional quality of various crops

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