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Enzyme activity and soil biological properties influenced by application of different nutrient sources in onion under vertisols of Maharashtra

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Abstract
Field experiment was conducted in *Rabi* season of 2016-17 at Research Farm of at AICRP on Integrated farming System. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani entitled "Enzyme activity and Soil Biological Properties influenced by application of Different Nutrient sources in Onion under Vertisols of Maharashtra". The experiment was laid out on Vertisols with eight treatment combination, replicated three times in randomized block design. The treatment consists of T_1- (50% recommended NPK + 50% N through FYM + Inorganic sources of micronutrient as per soil test), T_2- (Different organic sources each equivalent to 1/3 recommended N (FYM + Vermi-compost + non edible oil cake), T_3- (T_2 + Intercropping of trap crop), T_4- (T_2 + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide), T_5- (50% N as FYM + Bio-fertilizer for N + Rock phosphate to substitute the P requirement of crops + Phosphate solubilizing bacterial culture), T_6- (T_2 + bio-fertilizer containing N and P carriers), T_7- (100% NPK + Secondary and micronutrient based on soil test (ZnSO4 10 kg + S 25 kg), T_8- (Absolute control). The results reneged out from the experiment field stated that the maximum population of bacteria 348.33 x 107 cfu g $^{-1}$ soil, fungi 20.00 x 104 cfu g^{-1} soil and Actinomycetes 105.33 x 105 cfu g^{-1} soil was recorded by treatments T_6- (T_2 + bio-fertilizer containing N and P carriers), than all other treatments. The dehydrogenase enzyme activity 343.33 µg TPF 24 h^{-1} g^{-1} soil and microbial biomass carbon 345.66 µg g^{-1} soil was recorded by treatments T_1- (50% recommended NPK + 50% N through FYM + inorganic sources of micronutrient as per soil test) at harvest of onion crop. The onion yield was recorded maximum by application of treatment T_6, T_2 and biofertiilizers enter N and P carries.

Keyword: Enzyme activity, soil biological properties influenced, nutrient sources, vertisols

Introduction
Onion (*Allium cepa L.*) is one of the most important commercial vegetable crop cultivated extensively in India and it belongs to family Alliaceae. Onion is liked for its flavour and pungency which is due to presence of a volatile oil "allyl propyl disulphide" an organic compound rich in *sulphur*. Onion bulb is rich source of mineral like phosphorus, calcium and carbohydrates and also contains pralines and Vit C. It is also known for good medicinal value, which contains several anti-cancer agents which help to prevent the cancer. Onion is an important vegetable crop in all continents commercially cultivated over hundred countries of the world. However about three fourth of global production of vegetable crop is accounted by 18 countries, important of which are China, India, USA, USSR, Japan, Spain, Turkey, Brazil, Iran, (Anonymous, 1991). Onion falls second only to tomato in terms of annual world production.

Dehydrogenase enzyme plays significant role in the oxidation of soil organic matter by transferring H from substrate (Organic matter) to accepters and considered good indicator of metabolic activity in soil. Application of biofertiilizers (*Azotobacter* + PSB) provided bulk source of microorganisms in soil resulting in higher diversity and activity of microorganisms accompanied by better dehydrogenase activity. The dehydrogenase as an intracellular enzyme activity of microorganisms and has been used as a parameter to study the biological activity of soil. Similar findings were also reported by Singh and Pathak (2003) and Fraser *et al.* (1998). Soil microbial population, enzyme activities and microbial biomass carbon are being used as early and sensitive indicators to measure effects of soil manipulation such as crop management

and environment change on soil health **(**Brooks, 1995, Naseby and Lynch, 1998**)**. The judicious use of organic and inorganic fertilizer is indispensable to achieve the targeted yield and to maintain good soil health. Organic material such as FYM and Vermicompost and biofertiilizers improves soil enzyme activities and microbial properties properties which are important for plant growth (Snyman *et al.*, 1998).

The present study was undertaken to evaluate and compare the organic, inorganic source of nutrient in alone and in combination with chemical fertilizers and their effects on soil enzymes, microbial biomass carbon and microbial population of soil at harvesting.

Material and Methods

Field experiment was conducted in *Rabi* season of the year 2016-17 to study the "Enzyme activity and Soil Biological Properties influenced by application of Different Nutrient sources in Onion under Vertisols of Maharashtra" by using different sources of organic, inorganic and INM at research farm of AICRP on Integrated farming System. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. to achieve the objectives of the study. The experiment was laid out on Vertisols with eight treatment combination, replicated three times in randomized block design the treatment consist of T_{1}- (50% recommended NPK + 50% N through FYM + Inorganic sources of micronutrient as per soil test**)**, T_{2}- (Different organic sources each equivalent to 1/3 recommended N(FYM + Vermi-compost + non edible oil cake), T_{3}- (T_2 + Intercropping of trap crop), T_{4}- (T_2 + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide), T_{5}- (50% N as FYM + Bio-fertilizer for N + Rock phosphate to substitute the P requirement of crops + Phosphate solubilizing bacterial culture), T_{6}- (T2 + bio-fertilizer containing N and P carriers), T_{7}- (100% NPK + Secondary and micronutrient based on soil test ($ZnSO_4$ 10 kg + S 25 kg), T_{8}- (Absolute control). long term fertility experiments have also clearly demonstrated that chemical fertilizers above cannot sustain the productivity at correct level under intensive cropping systems. So to overcome the burden of chemical fertilizers and for achieving the higher productivity, vermicompost, FYM, biofertiilizers offers a potential opportunity in reducing doses of chemical fertilizers, especially N, P and K for onion production in eco-friendly manners. Plowghingof field was done after growing of weed up to 10 to 15 cm height and thereafter sowing of onion was carried out as per agronomical practice for weed control. Seeds of onion (AFLR) raised on seed bed for two months and transplanted to main field. Two subsequent irrigation were given to make transplantation of onion to cultivate in experiment field. The organic source such as FYM and vermicompost was incorporated in soil. And chemical fertilizers are applied through urea, Rock phosphate and murate of potash before sowing of crop. The seed treatment of *Azotobactor* and PSB were carried out prior to sowing. A composite soil sample was prepared and analyzed for soil enzyme activity, microbial population and microbial biomass carbon after harvest of onion crop.

Results and Discussion

Microbial population

The data recorded on bacteria, fungi and actinomycetes are presented in (table1) revealed that, the significant variations were observed on bacteria, fungi and actinomycetes population due to different organic, inorganic and INM treatments at harvest of onion crop. The results obtained from experimental finding showed that, the bacteria, fungi and actinomycetes counts were ranged from (185.00 to 348.33 X 10^7 cfu g-1soil), (11.33 to 20.00 X 10^4 cfu g^{-1}soil) and (60.33 to 105.33 X 10^5 cfu g^{-1}soil) at harvest respectively. The maximum bacterial count (348.33 X 10^7 cfu g^{-1} soil), fungal colonies (20.00 X 10^4 cfu g^{-1}soil) and actinomycetes count (105.33 X 10^5 cfu g^{-1} soil) at harvest. recorded by treatment T_6- (T_2 + bio-fertilizer containing N and P carriers) followed by treatment T_5- (50% N as FYM + Bio-fertilizer for N + Rock phosphate to substitute the P requirement of crops + Phosphate solubilising bacterial culture) and T_4- (T_2 + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide) bacteria (344.33 and 301.66 X 10^7 cfu g^{-1} soil), fungi (16.66 and 15.33 x 10^4 cfu g^{-1}soil) and actinomycetes (98.33 and 83.33 X 10^5 cfu g^{-1}soil) at harvest, respectively. The lowest bacteria population (185.00 X 10^7 cfu g^{-1}soil), fungi (11.33 X 10^4 cfu g^{-1} soil) and actinomycetes (60.33 X 10^5 cfu g^{-1}soil) at harvest, was recorded by absolute control treatment. Similar, results were reported by. (Tiwari *et al*., 2002). Soil biological properties showed improvement in the soil microbial counts over its initial values in different cropping sequences due to supplementation of organic sources. The control treatment had relatively low values of soil microbial count than the organic treatments due to the favorable effects of organics on soil biological properties is a proven fact which helped in providing ideal conditions and presumably increased the microbial activity because of the available high organic matter. Hati *et al*. (2001) and Shanmei *et al*. (2002) also reported favourable effects of organic manures on soil biological properties.

Table 1: Effect of organic, inorganic sources and INM on soil microbial population, Enzyme activity and microbial biomass carbon

S. No	Treatment Details	Bacteria (cfu x10^{-7})	Fungi (cfu x10^{-4})	Actinomycetes (cfu x10^{-5})	Dehydrogenease activity (µg TPF 24 h^{-1} g^{-1}soil)	Microbial biomass carbon (µg g^{-1}soil)
T_1-	50% recommended NPK + 50% N through FYM + Inorganic sources of micronutrient as per soil test.	281.66	14.33	77.00	343.33	345.66
T_2-	Different organic sources each equivalent to 1/3 recommended N (FYM + Vermi-compost + Neem cake)	286.66	13.00	66.66	281.33	326.33
T_3-	T_2 + Intercropping of trap crop.	301.66	13.33	74.00	290.00	331.33
T_4-	T_2 + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide).	301.66	15.33	83.33	308.33	330.66
T_5-	50% N as FYM + Bio-fertilizer for N+ Rock phosphate to substitute the P requirement of crops + Phosphate solubilising bacterial culture	344.33	16.66	98.33	323.33	332.33
T_6-	T_2 + bio-fertilizer containing N and P carriers.	348.33	20.00	105.33	326.33	334.33
T_7-	100% NPK + Secondary and micronutrient based on soil test ($ZnSO_4$ 10 kg + S 25 kg).	213.33	12.66	73.33	270.00	318.66

T_8-	Absolute control.	185.00	11.33	60.33	250.00	306.66
	S Em±	3.93	1.38	3.89	6.25	6.20
	C.D.@ 5%	12.06	4.23	11.92	19.14	19.00

Dehydrogenase enzyme

The data recorded on Dehydrogenase enzyme activity are presented in table 1 revealed that, the significant results were observed on dehydrogenase enzyme activity due to different nutrient sources of organic and inorganics at harvest of onion crop. The results enranged from experimental field showed that, the dehydrogenase enzyme activity were ranged from 250.33 to 343.33 µg TPF 24 h^{-1} g^{-1}soil at harvest of onion in Vertisol. The maximum dehydrogenase enzyme activity 343.33 µg TPF 24 h^{-1} g^{-1}soil at harvest, recorded by application of T_1- (50% recommended NPK + 50% N trough FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test) followed by treatment T_6- (T_2 + bio-fertilizer containing N and P carriers) and T_5- (50% N as FYM + Bio-fertilizer for N+ Rock phosphate to substitute the P requirement of crops + Phosphate solubilising bacterial culture) dehydrogenase enzyme activity (326.33 and 323.33 µg TPF 24 h^{-1} g^{-1}soil) at harvest respectively. The minimum dehydrogenase enzyme activity (250.00 µg TPF 24 h^{-1} g^{-1}soil) at harvest, was observed in absolute control. These results are in close agreements with Nath *et al.* (2011) [11] and Jarak *et al.* (1997) who reported the dehydrogenase as an intracellular enzyme activity of microorganisms and has been used as a parameter to study the biological activity of soil. Which tips in improvement of soil health, availability of nutrients and uptake of the nutrients.

Soil microbial biomass carbon

The data recorded on microbial biomass carbon are presented in table 4.11 and depicted in fig 4.11 revealed that, the significant were observed on microbial biomass carbon due to different organic, inorganic and INM treatments at harvest of onion crop. The results obtained from experimental finding showed that, the microbial biomass carbon were ranged from (306.66 to 345.66 µg g^{-1}soil) at harvest. The maximum microbial biomass carbon (345.66 µg g^{-1}soil) at harvest. recorded by treatment T1- (50% recommended NPK + 50% N trough FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test) followed by treatment T6- (T2 + bio-fertilizer containing N and P carriers) and T5- (50% N as FYM + Bio-fertilizer for N+ Rock phosphate to substitute the P requirement of crops + Phosphate solubilizing bacterial culture) microbial biomass carbon (343.33 and 332.33 µg g^{-1}soil) at harvest respectively, The minimum microbial biomass carbon (306.66 µg g^{-1}soil) at harvest. Was recorded by absolute control.. Thus, the addition of organics under the integrated treatments maintained the organic matter level of soil, thereby, improving microbial status, enzyme activity and enhancement of population of beneficial microbes and their activities in organic matter decomposition and biological nitrogen fixation. Kausadikar *et al*. (2012) also found the highest microbial carbon found with 50% RD of NPK + 50% N through FYM. This could be attributed due to more availability organic carbon by application of FYM, vermicompost and bio fertilizers like PSB and *Azotobactor*. The microorganisms' activity would also plays role during decomposition and solubilisation of nutrients and release of various organic sources from different plant parts

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