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Effect of Organic Nutrient Management Practices on Soil Enzyme Activity and Microbial Biomass at Harvest of Bajra in Bajra-Groundnut Cropping System

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ABSTRACT

Field experiment was carried out during 2014-15 and 2015-16 at Main Agricultural Research Station, UAS, Raichur to study the effect of organic manures on microbial biomass and enzymatic activity in bajra groundnut cropping system. The two years pooled data indicated that soil application of organic manures and foliar application of liquid organic manure produced significantly higher micro flora and better soil health compared to the application of inorganic fertilizer. Application of compost + vermicompost + panchagavya recorded significantly higher dehydrogenase (11.25 µg TPF formed g^{-1} soil day^{-1}) activity and phosphatase activity (61.59 µg PNP g^{-1} soil h^{-1}). Microbial population such as bacterial population (27.73 × 10^7 CFU g^{-1} of soil), fungi (35.23 × 10^4 CFU g^{-1} of soil) and phosphorus solubilizers (30.82 × 10^3 CFU g^{-1} of soil) was found significant with compost + vermicompost + panchagavya.

Key words: *enzyme activity, organic manure, bajra, fungi.*

INTRODUCTION

In organic production system, use of organic manures, green manures and crop residues is known for multiple benefits to crop growth and soil health by adding much needed organic and mineral matter to the soil. The organic matter added is an indispensable component of soil and plays an important role in maintenance and improvement of soil fertility and productivity. The proper management of soil fertility as well as soil productivity makes it possible to increase the efficiency of use of soil and added nutrients. Further, soil harbors a dynamic microbial population, arthropods and others. This living phase is greatly stimulated by addition of organic matter which acts as carbon and energy source for proliferating micro-organisms and they may inturn alter the accompanying enzyme status. Interest in soil enzyme activity has increased recently since these activities are believed to reflect the potential capacity of soil to perform nutrient transformations.

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Since soil microbial and enzyme systems are associated with organic manure management, incorporation of organic manures into soil not only plays an important role in improving the soil physical, chemical and biological activities, but also affects the rate at which nutrients become available to crop plants.

MATERIALS AND METHODS

An field experiment was conducted to study the effect of phosphorus management through rock phosphate application to preceding crops in organic cultivation of groundnut at Main Agricultural Research Station, University of Agricultural Sciences, Raichur, during *kharif* and *rabi* seasons of 2014-15 and 2015-16. The soil of the experimental site was sandy clay loam in texture with bulk density of 1.34 g per cc, pH of 7.75 with organic carbon content of 0.43%. The soils were low in available N (272.2 kg/ha) and available P_2O_5 (32.5 kg ha^{-1}) and medium in available K_2O (292.4 kg ha^{-1}). The experiment consisted of fourteen treatments comprised of compost (100% RDN), vermicompost (100% RDN), compost (50% RDN)+vermicompost (50% RDN) and compost (37.5% RDN)+vermicompost (37.5% RDN)+GLM (25% RDN) alone and in combination with 3.0% panchagavya spray and 10 % vermiwash spray along with RDF and RDF + FYM. Green leaf manure, compost and farm yard manure were incorporated into the soil two weeks before the sowing as per the treatments. The recommended dose of fertilizer for groundnut is 25:75:25 NPK kg ha^{-1}. The deficit P after application of organic manures was supplemented through rock phosphate. The experiment was laid out on fixed site in two consecutive years in Randomized Complete Block Design (RCBD) and the treatments were replicated thrice. In all the organic treatments groundnut seeds were treated with bio-fertilizers such as *rhizobium*, phosphate solubilising bacteria in both the years. Organic treatments also received 250 kg ha^{-1} of neem cake.

The initial soil microbial population like Bacteria, fungi and Phosphorus solubilizers (28.6 x 10^7 CFU g^{-1} of soil, 14.3 x 10^4 CFU g^{-1} of soil and 11.2 x 10^3 CFU g^{-1} of soil, respectively) in experimental site were analysed with the serial dilution plate count technique[4]. The initial soil dehydrogenase activity (3.80 µg TPF g^{-1} soil h^{-1}) was determined the procedure as described by Casida *et al*[1]. Initial soil status of phosphatase activity (0.91 µg PNP g^{-1} soil h^{-1}) was determined by following the procedure of Evazi and Tabatabai[3].

RESULTS AND DISCUSSION

Soil microbial population

All the organic treatments showed higher number of bacterial colonies when compared to RDF (20.73 × 10^7 CFU g^{-1} of soil). Significantly higher bacterial population was recorded with compost + vermicompost + panchagavya (27.73 × 10^7 CFU g^{-1} of soil) and was on par with compost + vermicompost + vermiwash (26.01 × 10^7 CFU g^{-1} of soil), compost + vermicompost + GLM + panchagavya (25.91 × 10^7 CFU g^{-1} of soil), compost + vermicompost + GLM + vermiwash (25.81 × 10^7 CFU g^{-1} of soil), vermicompost + panchagavya (25.69 × 10^7 CFU g^{-1} of soil), vermicompost + vermiwash (25.18 × 10^7 CFU g^{-1} of soil), compost + panchagavya (25.06 × 10^7 CFU g^{-1} of soil) and compost + vermiwash (24.69 × 10^7 CFU g^{-1} of soil). Significantly lower bacterial population was noticed with RDF (20.73 × 10^7 CFU g^{-1} of soil).

significantly higher number of fungal colonies at harvest (90 DAS) registered with application of compost + vermicompost + panchagavya (35.23 × 10^4 CFU g^{-1} of soil) was found at par with compost + vermicompost + vermiwash (34.33 × 10^4 CFU g^{-1} of soil), compost + vermicompost + GLM + panchagavya (32.00 × 10^4 CFU g^{-1} of soil) and compost + vermicompost + GLM (28.67 × 10^4 CFU g^{-1} of soil). Significantly lower fungal population was recorded with compost (23.86 × 10^4 CFU g^{-1} of soil), vermicompost (24.62 × 10^4 CFU g^{-1} of soil) and RDF (23.20 × 10^4 CFU g^{-1} of soil, respectively).

Treatment receiving compost + vermicompost + panchagavya (30.82 × 10^3

CFU g^{-1} soil), compost + vermicompost + GLM + panchagavya (28.62×10^3 CFU g^{-1} soil), compost + vermicompost + GLM + vermiwash (28.52×10^3 CFU g^{-1} soil), vermicompost + panchagavya (27.93×10^3 CFU g^{-1} soil) and vermicompost + vermiwash (27.86×10^3 CFU g^{-1} soil) were on par with each other and significantly superior over RDF (21.09×10^3 CFU g^{-1} soil). Significantly lower colonies of P solubilizers were recorded with compost + vermicompost (24.33×10^3 CFU g^{-1} soil), vermicompost (23.31×10^3 CFU g^{-1} soil) compost (23.00×10^3 CFU g^{-1} soil), and RDF (21.09×10^3 CFU g^{-1} soil), which inturn was on par with each other.

The enhancement of soil microbial biomass is known to influence crop productivity and nutrient cycling. In the present study, significant improvement in the population of soil micro-organisms *viz*., bacteria, fungi, actinomycetes, N_2 fixer's and P solubilizers were with organic manorial treatments noticed at different stages of bajra and groundnut (Table 1). This might be due to the presence of easily metabolizable compounds at the beginning of the crop was also under active growth phase releasing higher amounts of root exudates, supporting numerous and diverse micro flora. The significant increase in microbial population was observed with the addition of organic manures in combination with liquid organic manure (panchagavya and vermiwash) at various growth stages of bajra. These results are in line with the findings of Sreenivasa[7], Deshpande *et al*[2].

Soil enzymatic activity

Significantly higher dehydrogenase activity was recorded with application of compost + vermicompost + panchagavya (11.25 µg TPF formed g^{-1} soil day^{-1}) and it was at par with vermicompost + compost + vermiwash (10.25 µg TPF g^{-1} soil day^{-1}), vermicompost + compost + GLM + panchagavya (9.85 µg TPF g^{-1} soil day^{-1}), vermicompost + compost + GLM + vermiwash (9.78 µg TPF g^{-1} soil day^{-1}) and vermicompost + panchagavya (9.60 µg TPF g^{-1} soil day^{-1}).

Phosphatase activity was significantly higher with the application of compost + vermicompost + panchagavya (61.59 µg PNP g^{-1} soil h^{-1}) and it was on par with rest of all the treatments except compost (51.20 µg PNP g^{-1} soil h^{-1}) and RDF (44.74 µg PNP g^{-1} soil h^{-1}). Application of RDF resulted in significantly lower phosphatase activity (48.49 µg PNP g^{-1} soil h^{-1}) and it was on par with all other treatments except RDF + FYM (58.76 µg PNP g^{-1} soil h^{-1}), compost + vermicompost + GLM + panchagavya (65.02 µg PNP g^{-1} soil h^{-1}), compost + vermicompost + GLM + vermiwash (63.32 µg PNP g^{-1} soil h^{-1}) and compost + vermicompost + panchagavya (68.53 µg PNP g^{-1} soil h^{-1}). These results are in confirmation with finding of Singaram and Kamalkumari[6] and Ramesh *et al*[5].

Table 1: Microbial population and enzymatic activity in soil at harvest of bajra as influenced by nutrient management practices through organics in bajra-groundnut cropping system (Pooled data of 2014-15 and 2015-16)

Treatments	Bacteria (No. × 10^7 CFU g^{-1} of soil	Fungi (No. × 10^4 CFU g^{-1} of soil)	Phosphorus solubilizers (No. × 10^3 CFU g^{-1} of soil)	Dehydrogenase activity (µg TPF formed g^{-1} of sol day^{-1})	Phosphatase activity (µg PNP released g^{-1} of soil h^{-1})
T_1: Compost (100% RDN)	21.49	23.86	23.00	7.90	51.20
T_2: Vermicompost (100% RDN)	23.56	24.62	23.31	8.17	55.34
T_3: Compost (50% RDN) + Vermicompost (50% RDN)	24.28	27.95	24.33	8.22	55.50
T_4: Compost (33.3% RDN) + Vermicompost (33.3% RDN) + GLM (33.3% RDN)	24.47	28.67	25.14	8.28	56.54
T_5: T_1 + 3% Panchagavya	25.06	30.08	26.48	9.08	58.37
T_6: T_1 + 10% Vermiwash	24.69	29.53	25.89	8.95	58.00
T_7: T_2 + 3% Panchagavya	25.69	30.81	27.93	9.60	59.04
T_8: T_2 + 10% Vermiwash	25.18	30.34	27.86	9.10	58.84
T_9: T_3 + 3% Panchagavya	27.73	35.23	30.82	11.25	61.59
T_{10}: T_3 + 10% Vermiwash	26.01	34.33	29.12	10.25	61.50
T_{11}: T_4 + 3% Panchagavya	25.91	32.00	28.62	9.85	60.62
T_{12}: T_4 + 10% Vermiwash	25.81	30.90	28.52	9.78	60.25
T_{13}: Recommended dose of fertilizers (RDF)	20.73	23.20	21.09	7.80	44.74
T_{14}: RDF+FYM	24.59	29.34	25.44	8.41	57.57
S. Em±	**1.06**	**0.80**	**1.26**	**0.578**	**2.591**
C. D. at 5%	**3.20**	**2.44**	**3.83**	**1.752**	**7.860**

RDN: Recommended dose of nitrogen GLM: Green leaf manure (*Glyricidia*)

CONCLUSION

Combined application of compost and vermicompost in equal proportion to 100 % RDN along with foliar spray of panchagavya at 3.0 % or vermiwash at 10 % soil biological environment in bajra-groundnut system.

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