Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(3): 271-273
Received: 22-03-2018
Accepted: 26-04-2018

Jahnavi RK
Assistant Professor, Department of Soil Science & Agril. Chemistry, University of Agricultural Sciences, Dharwad, Karnataka, India

Math KK
Professor, Department of Soil Science &Agril. Chemistry, University of Agricultural Sciences, Dharwad, Karnataka, India

Patil CR
Professor, Department of Agril. Microbiology, University of Agricultural Sciences, Dharwad, Karnataka, India

Correspondence
Jahnavi RK
Assistant Professor, Department of Soil Science &Agril. Chemistry, University of Agricultural Sciences, Dharwad, Karnataka, India

Biological properties as influenced by different nutrient management practices and cropping systems in vertisol of northern transition zone of Karnataka

Jahnavi RK, Math KK and Patil CR

Abstract
A long term field experiment on Effect of different nutrient management practices and cropping systems on biological properties under in Vertisol of Northern Transition Zone of Karnataka was initiated in 2004-05 on a Typic Haplustert at MARS, IOF, UAS, and Dharwad. Organic manure application to the soil for long duration enhanced the enzyme activities of the soil (Dehydrogenase activity, Phosphatase activity and Urease activity) when compared to other nutrient management practices. Organic nutrient application recorded higher urease activity of 24.7 µg NH_4-N/g/day, 32.2 µg pNP/g/hr of phosphatase activity and 19.6 µg TPF/g/day of dehydrogenase activity. Microbial Biomass (Carbon and Nitrogen) recorded higher values of 79.0 mg/kg of SMB-C and 21.7 mg/kg of SMB-N followed by inorganic nutrient management practices.

Keywords: biological properties, chemical properties, cropping systems, nutrient management practices, soil microbial biomass

Introduction
Soil enzymes play crucial role in maintaining soil properties, fertility and health and help in the overall process of organic matter decomposition in the soil system. They are important in catalyzing several vital reactions necessary for the life processes of micro-organisms in soils and the stabilization of soil structure by acting as cementing agent, the decomposition of organic wastes, organic matter formation leading to formation of stable aggregates and nutrient cycling, hence play an important role in agriculture.
Soil organic biomass consists of total mass of bacteria, fungi, actinomyctes, algae and protozoa. Soil Microbial Biomass (SMB) study reflecting energy flow, acts as an agent of transformation of C, N, P and S. Soil microbial biomass carbon (SMBC) is a very important biological indicator of soil health. It is the most sensitive one for assessing short term changes in soil fertility and quality [1, 2], although it comprises only 1-4 per cent of the total organic carbon. The SMBC responds very well to the seasonal addition of inorganic and organic nutrient sources. Manure addition affects enzyme activity and microbial biomass. Soil biological properties are regarded as soil quality indicators as they respond rapidly to environmental changes and these can be particularly useful for assessing soil fertility and quality in long-term experiments. Hence the present investigation on soil biological properties as influenced by nutrient management is carried out.

Materials and Methods
The long term field trial on the "Performance evaluation of important crops/cropping systems under organic farming" is in progress on a fixed site since 2004-05 under 'Network Project of Organic Farming' at the Institute of Organic Farming, University of Agricultural Sciences, Dharwad. The present investigation was under taken during 2012-13 *rabi* season. The average annual rainfall (past 62 years) was 711.8 mm which was fairly well distributed from April to November. The mean maximum temperature varied from 27.3^{0}C (July, August) to 36.9^{0}C (April) whereas, mean minimum temperature varied from 12.7^{0}C (December) to 21.8^{0}C (May). The mean monthly highest and the lowest relative humidity was 89 per cent (July) and 47 per cent (January) respectively.
The organic, inorganic, integrated and RDF+FYM strips of 15 m were laid out with the cropping systems as sub plots of 20 m length. Across the four main strips of nutrient management practices, five cropping systems mainly groundnut- sorghum, soybean- wheat, maize- chickpea, pigeonpea + soybean and cotton + peas were laid out. The design followed

was strip plot with three replications.
The soils were collected from the field after the *rabi* crop of the year 2012-13 from 0-30 cm for the analysis of biological properties by employing standard methods. The data collected from the laboratory analysis were subjected to statistical analysis [3].

Urease activity
The reaction mixture comprising of 10 g of soil, 1 ml of toluene, 10 ml of phosphate buffer (pH 6.7) and 10 ml of 10 per cent urea solution in distilled water was incubated at 30ºC for 24 hours, later 15 ml of 1 N KCl solution was added. 1 ml of aliquot filtrate was mixed with 2 ml of 10 per cent sodium tartarate solution and 0.5 ml of Nessler's reagent. The intensity of yellow colour developed was read in spectrophotometer after 30 minutes at 610 nm [4] against blank.

Dehydrogenase activity
To 5 grams of soil in a stoppered test tube, 2.5 ml distilled water and one ml of 2, 3, 5-triphenyl tetrazolium chloride (3%) were added and incubated at 37ºC for 24 hours. The supernatant was filtered through Whatman No. 50 filter paper and the soil was washed repeatedly with methanol till the filtrate was free from red colour and the pooled filtrate was diluted to 100 ml. The colour intensity was measured at 485 nm in a spectrophotometer [5].

Phosphatase activity
The reaction mixture comprising of 1 g of soil, 0.2 ml toluene, 4 ml modified universal buffer (pH 7.5) and 1 ml of p-nitrophenol phosphate solution were mixed and incubated at 37 ºC for 1 hour. 1 ml of 0.5 M $CaCl_2$ and 4 ml of 0.5 M NaOH were added, swirled and filtered. The intensity of yellow colour was measured at 420 nm against the reagent blank [6].
Soil microbial biomass carbon (SMB_C) was determined using the $CHCl_3$ fumigation extraction method [7]. Samples of oven dry weight of soil (10 g) were used in duplicates, and K_2SO_4 extractable C was determined using dichromate digestion. Microbial biomass carbon was calculated using the equation

Biomass C = EC/ 0.54.

Where, EC = (organic C in K_2SO_4 from fumigated soil)—(organic C in K_2SO_4 from unfumigated soil).
The concentration of N in the extractant was determined on the Lachat flow injection analyzer after digestion using alkaline persulfate oxidation [8]. Soil microbial biomass nitrogen (SBM-N) was calculated using the equation

Biomass N = EC/ 0.45.

Where, EC = (total N in fumigated soil)—(total N in unfumigated soil).

Results
The different nutrient management practices significantly influenced urease activity in soil at 0-30 cm (Table 1). It ranged from 14.5 µg NH_4-N g^{-1} day^{-1} to 24.7 µg NH_4-N g^{-1} day^{-1} in surface soil. The highest urease activity in soil at 0-30 cm was recorded in organic nutrient management practice (24.7 µg NH_4-N/g/day). The urease activity in soil was not significantly influenced by these cropping systems at 0-30 cm soil depth. Interaction of nutrient management practices and cropping systems on urease activity in soil at surface layers was non-significant.
The different nutrient management practices significantly influenced phosphatase activity in soil and it ranged from 10.7 µg pNP g^{-1} hr^{-1} to 32.2 µg pNP g^{-1} hr^{-1} at the surface layers of soil (Table 1). The organic nutrient management practice recorded higher phosphatase activity in soil (32.2 µg pNP/g/hr). The phosphatase activity in soil at 0-30 cm depth did not differ significantly with the cropping systems. The interaction effect of nutrient management practices and cropping systems was non-significant.
The dehydrogenase activity in soil under various nutrient management practices ranged from 8.4 µg TPF g^{-1} day^{-1} to 19.6 µg TPF g^{-1} day^{-1} at surface layers (Table 1). The higher dehydrogenase activity in soil at surface layers was recorded in organic nutrient management practice (19.6 µg TPF/g/day). The dehydrogenase activity in soil was not significantly influenced by these cropping systems. Interaction of nutrient management practices and cropping systems on dehydrogenase activity in soil at the surface layers was non significant.
The different nutrient management practices significantly influenced microbial biomass carbon in soil at 0-30 cm (Table 2). It ranged from 63.8 mg kg^{-1} to 79.0 mg kg^{-1} in surface soil. The highest microbial biomass carbon in soil at 0-30 cm was recorded in organic nutrient management practice (79.0 mg/kg).The microbial biomass carbon in soil was not significantly influenced by these cropping systems. Interaction of nutrient management practices and cropping systems on microbial biomass carbon in soil at surface layers was non-significant.
The different nutrient management practices significantly influenced microbial biomass nitrogen in soil and it ranged from 9.7 mg kg^{-1} to 21.7 mg kg^{-1} at the surface layers of soil (Table 2). The organic nutrient management practice recorded higher microbial biomass nitrogen in soil (21.7 mg/kg). The microbial biomass nitrogen in soil did not differ significantly with the cropping systems. The interaction effect of nutrient management practices and cropping systems on soil microbial biomass nitrogen in soil was non-significant.

Table 1: Effect of nutrient management practices and cropping systems on enzyme activity in soil at surface layer

Cropping systems (CS)	Enzyme Activity														
	Urease(µg NH_4-N/g/day)					Phosphatase(µg pNP/g/hr)					Dehydrogenase(µg TPF/g/day)				
	NM1	MN2	NM3	NM4	Mean	NM1	MN2	NM3	NM4	Mean	NM1	MN2	NM3	NM4	Mean
CS1	24.2	23.1	18.4	15.2	20.5	31.7	24.2	15.4	11.0	20.6	19.1	15.7	11.3	8.2	13.6
CS2	24.2	22.0	19.1	15.0	20.3	31.7	22.4	15.1	10.8	20.0	19.6	14.9	11.2	8.7	13.6
CS3	25.2	21.5	18.5	14.0	20.1	34.2	22.9	15.8	10.2	20.8	19.7	15.3	11.0	8.6	13.7
CS4	25.6	22.2	18.4	14.2	20.3	32.7	23.1	15.2	10.7	20.4	20.1	15.2	10.7	9.0	13.7
CS5	24.3	23.6	19.6	14.2	20.4	30.8	22.3	14.4	10.8	19.6	19.4	14.5	10.6	7.8	13.1
Mean	24.7	22.5	18.8	14.5		32.2	23.0	15.2	10.7		19.6	15.1	11.0	8.4	
	S. Em±		CD at 5%			S. Em±		CD at 5%			S. Em±		CD at 5%		
NM	0.93		3.21			0.99		3.41			0.34		1.19		

CS	0.96	NS	1.22	NS	0.67	NS
NM×CS	1.32	NS	1.69	NS	1.00	NS

iCS1: Groundnut-Sorghum CS2: Soybean-Wheat CS3: b Maize-ChickpeaCS4: Pigeonpea + Soybe CS5: Cotton + Pea
NM1: OrganicNM2Integrated NM3: RDF+FYMNM4: Inorgan

Table 2: Effect of Nutrient management practices and cropping systems on soil microbial biomass carbon and nitrogen (mg/kg)

T	Microbial Biomass Carbon					Microbial Biomass Nitrogen				
	NM1	NM2	NM3	NM4	Mean	NM1	NM2	NM3	NM4	Mean
CS1	78.2	73.3	69.8	64.2	71.4	22.2	17.1	12.3	10.0	15.4
CS2	77.6	74.1	69.9	63.5	71.3	21.1	17.8	13.2	10.0	15.5
CS3	79.4	74.1	69.7	64.0	71.8	22.4	16.7	12.8	9.4	15.3
CS4	80.1	73.8	69.8	63.5	71.8	21.9	16.7	12.6	9.6	15.2
CS5	79.8	74.0	70.5	63.8	72.0	21.1	16.3	12.3	9.6	14.8
Mean	79.0	73.8	69.9	63.8		21.7	16.9	12.6	9.7	
	S. Em±		CD at 5%			S. Em±		CD at 5%		
NM	0.58		2.02			0.86		2.99		
CS	1.06		NS			1.01		NS		
NM×CS	1.67		NS			0.97		NS		

CS1: Groundnut-Sorghum CS2: Soybean-Wheat CS3: Maize-Chickpea CS4: Pigeonpea + Soybean CS5: Cotton + Peas
NM1: Organic NM2: Integrated NM3: RDF+FYM NM4: Inorganic

Discussion

The higher urease activity in soil under organic nutrient management practice could be attributed to their higher N content and faster decomposition of organic manures and release of NH_4-N. [9] reported a decrease in the urease activity with addition of inorganic N whereas crop residues and organic manure additions increased it.

Addition of organic amendments and adoption of management practices that increase soil organic matter lead to increased enzyme activity [10]. Reported that the addition of organic substances to the soil served as a carbon source that enhanced microbial biomass and phosphatase activity, showing that these enzymes are of microbiological origin

Due to continuous addition of organic manures in organic and integrated nutrient management plots might have resulted in higher activities when compared to inorganic nutrient management practices. Application of organic manure increased microbial population thereby increasing the dehydrogenase activity [11].

The higher SMB-C content in soil under organic treatment is due to the supply of additional mineralizable and readily hydrolysable C due to organic manure application resulted in higher microbial activity and in return higher SMB-C. The readily available carbon fraction of FYM, vermicompost or green manure supported the development of microbial biomass that increased soil microbial biomass carbon. This is consistent with the finding of [12] who reported that microbial biomass was greater in soil after the application of farmyard manure.

Higher soil organic carbon content, more proliferation and additional supply of N by FYM to micro-organisms might be responsible for increasing levels of SMB-N [13]. The SMB-N was significantly influenced with the application of FYM over treatment receiving continuous inorganic fertilization.

Conclusion

Organic nutrient management practice resulted in improvement of soil physico-chemical and biological properties thereby, enhancing the fertility status of soil. Improvement in soil biological properties measured in terms of enzyme activity and soil microbial biomass was recorded under organic nutrient management practice followed by integrated nutrient management practice.

Acknowledgement

The authors are greatfull to the Insitute of Organic Farming, UAS, Dharwad for providing their experimental site to carry out the present research work.

References

1. Ladd JN, Amato M, Li-kai Z, Schultz JE. Soil Biol. Biochem. 1994; 26:821-831.
2. Powlson DS, Brookers PC, Christensen BT. Soil Biol. Biochem. 1987; 19:159-164.
3. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. An International Rice Research Institute Book, A Wiley Interscience, John Wiley and Sons Inc., New York, USA, 1984.
4. Pancholy SK, Rice EL. Soil Sci. Soc. American Proc. 1973; 37:47-50.
5. Casida LE, Klein DA, Santoto T. Soil Sci. 1964; 98:371-376.
6. Evasi F, Tabatabi MA. Soil Biol. Biochem. 1979; 9:167-172.
7. Vance ED, Brookes PC, Jeckinson DS. Soil Biochem. 1987; 19:703-707.
8. Cabera ML, Beare MH. Soil Sci. Soc. Am. J. 1993; 57:1007-1012.
9. Maestre FT, Puche MD, Guerrero C, Escudero A. Soil Biol. Biochem. 2011; 43:1746-1749.
10. Sriramachandrasekharan MV, Ravichandran M. Agric. Segm. 2011; 2 (2):AGS/1558.
11. Watts DB, Allen TH, Feng Y, Prior SA. Soil Sci. 2010; 175:474-486.
12. Bohem L, Langer U, Bohem F. Agric. Ecosyst. Environ. 2005; 109:141-152.
13. Verma G, Mathur AK. J Indian Soc. Soil Sci. 2009; 57(3):317-322.