Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [1] 2017: 59-62

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95
FULL LENGTH ARTICLE **OPEN ACCESS**

Study of Enzyme Activities in Intercropped Maize with Different Nutrient Application

P.V. Geetha Sireesha, G. Padmaja, M.Venkata Ramana and P.C. Rao
Dept. of Soil Science And Agricultural Chemistry, College Of Agriculture,
PJTSAU, Rajendranagar, Hyderabad - 500 030.
*Corresponding author: E-mail: geethashirisha048@gmail.com

ABSTRACT
The aim of this study was to investigate the effect of different levels of chemical fertilizers (CF) alone or in combination with farmyard manure (FYM), vermin compost and bio fertilizers on biological properties of the rhizosphere soil of maize, grown as intercrop with onion in s sandy loam soils at AICRP on Integrated Farming Systems, Rajendranagar, Hyderabad. The enzyme activities viz., urease (51.88 and 50.06 µg of NH_4^+-N g^{-1} soil $2h^{-1}$), dehydrogenase (78.43 and 78.75 µg of TPF g^{-1} soil day^{-1}) and acid (53.92 and 55.82 µg p-nitrophenol g^{-1} soil h^{-1}) and alkaline phosphatase (99.97 and 106.97 µg p-nitrophenol g^{-1} soil h^{-1}) were significantly higher in treatment T_3 (50 % RD of NPK + 50 % N through FYM). The enzyme activity of soils, which is governed by microbial population is also significantly higher in INM treatments. This study revealed that integrated application of optimum level of inorganic fertilizer, farmyard manure along with biofertilizers the biological properties of soil as well as the growth of maize under maize-onion intercropping system.
KEYWORDS: Biofertilizers, Dehydrogenase, INM, phosphatase and urease activity

Received 18.07.2017 Revised 02.08.2017 Accepted 21.08. 2017

INTRODUCTION

Biologically mediated processes in soils are central to the ecological function of soils. Soil biotic activity is the driving force in the degradation and conservation of exogenous plant material and anthropogenic depositions, transformations of organic matter and evolution and maintenance of soil structure (Bandick *et al.,* 1999). Energy obtained by the primary decomposers of organic matter supports the activity of a number of trophic levels in soils. In turn this activity plays a primary function in nutrient cycling and support of plant life (Balota *et al.,* 2003). Soil enzyme activities commonly correlate with microbial parameters (Kandeler and Murer, 1993) and have been shown to be a sensitive index of long-term management effects such as crop rotations, animal and green manures, and tillage. The measurement of soil enzymes can be used as
indicative of the biological activity or biochemical process. Soil enzyme activities have potential to provide an unique integrative biological assessment of soils because of their relationship to soil biology, easy of measurement and rapid response to changes in soil management (Kirchner *et al.,* 1993). The effects of green manure on soil enzymatic activities were studied in many countries. In order to obtain new data on the soil enzymological effects of soil management practices we have determined some enzymatic activities in a brown luvic soil submitted to a complex fertilization experiment at the AICRP on Integrated Farming Systems, Rajendranagar, Hyderabad.

MATERIAL AND METHODS

The long-term experiment on maize-onion cropping system was initiated in *kharif*, 2003 under AICRP on Integrated Farming Systems, Rajendranagar, Hyderabad. The monthly mean maximum temperatures during the crop growth period ranged from 28.0 ^{0}C to 37.7 ^{0}C with an average of 31.3 ^{0}C, while the monthly mean minimum temperature ranged from 10.1 ^{0}C to 23.9 ^{0}C with an average of 19.2 ^{0}C. The total rainfall received during the crop growth period was 1052.7 mm distributed throughout the year. This experiment was laid out in an observation trail basis without replications had six treatments during both *kharif* (maize) and *rabi* (onion) and the treatments were as follows:

T_1 – Control
T_2 – 100 % NPK + Secondary and micronutrients based on soil test (Sulphur through gypsum)
T_3 – 50 % RD of NPK + 50 % N through FYM
T_4 – FYM + Vermicompost + Neemcake (Each equivalent to 1/3rd RD of N)
T_5 – 50 % N through FYM + Biofertilizer for N (*Azospirillum*) + Rock Phophate for P + Phosphate Solubilising Bacteria (PSB)
T_6 – T_4 + Biofertlizer containing N (*Azospirillum*) & P (PSB) carrier

The seeds of maize (DHM 117) were sown by hand dibbling method and seeds of onion (Mahan) were first sown in well prepared nursery and the seedlings were transplanted in main field at 25 days after sowing. The recommended fertilizer dose (180:60:60 for maize and 150:60:60 for onion) was applied in the form of nitrogen as urea (46 % N), phosphorus as single super phosphate (16 % P_2O_5) and potassium as muriate of potash (60 % K_2O). The organic manures used in different treatment combinations were vermicompost (0.96, 0.15 and 0.50 % N, P and K), neem cake (0.89, 0.46 and 1.12 %N, P and K) and farmyard manure (0.82, 0.18 and 0.75 % N, P and K). These manures were applied two weeks before sowing of crops. The mixture of *Azospirillum*, PSB, cow dung and rock phosphate were kept under shade overnight and maintained 50% moisture. The mixture was used as soil application during leveling of soil.

Soil sample analysis: The initial soil was clay loam, neutral in reaction pH 7.6 (Jackson, 1973), non saline in nature EC 0.51 dS m^{-1} (Jackson, 1973), low in organic carbon OC 0.36 % (Walkley and Black (1934). Urease activity was assayed by quantifying the rate of release of NH_4^+ from the hydrolysis of urea as described by Tabatabai and Bremner (1972). Dehydrogenase activity in the soil was determined by the procedure given by Casida *et al.* (1964). The method involved spectrophotometric determination of the Tri Phenyl Formazon (TPF) produced when soil is treated with Triphenyl Tetrazolium Chloride (TTC). The acid and alkaline phosphatase activity was assayed by quantifying the amount of p-nitrophenol released and expressed as µg of p-nitrophenol released g^{-1} soil h^{-1} as described by Tabatabai and Bremner (1969).

RESULTS AND DISCUSSION

Soil enzyme activity is an indirect indication on the activities of microbes which is directly correlated with soil microbial dynamics. Enzyme activity in the soil environment is considered to be a major contributor of overall soil microbial activity (Burns *et al.,* 2013). Due to the effects of external disturbance on their activity, enzymes can serve as sensitive indicators of soil quality (Nedunchezhiyan *et al.,* 2013). The data pertaining to the effect of different INM treatments on the enzyme activities and their correlations with organic carbon content were presented in the table 1 and 2.

Urease (µg of NH_4^+-N g^{-1} soil $2h^{-1}$)

Urease activity ranged from 28.13 to 51.88 µg NH_4^+ released g^{-1} soil $2h^{-1}$ at harvest of maize. Higher activity was recorded in T_3 (50 % RD of NPK + 50 % N through FYM) while lower activity was registered under control (Table 1). Similar trends were observed during *rabi* and ranged from 30.25 to 50.06 µg NH_4^+ released g^{-1} soil $2h^{-1}$ at harvest of onion. The highest urease activity was recorded in the treatment of 50 % RD of NPK + 50 % N through FYM (T_3) followed by T_4 (FYM + vermicompost + neem cake (Each equivalent to 1/3rd RD of N), T_6 (T_4 + biofertilizer containing N & P carrier), T_5 (50 % N through FYM + biofertilizer for N (Azospirillum) + rock phosphate for P + PSB) and T_2 (100 % RD of NPK + S) with urease activity of 46.20, 46.19, 42.25 and 39.26 µg NH_4^+ released g^{-1} soil $2h^{-1}$, respectively.

Highest urease activity with the application of organic manure alone or in combination with RDF may be attributed to increasing population of microorganisms like bacteria etc., due to increased availability of substrate through manures releasing in these enzymes of extra cellular origin. Similar findings were reported by Singaram and Kamala Kumari (2000).

Dehydrogenase (µg of TPF g^{-1} soil day^{-1})

Dehydrodenase activity of soils at harvest of maize and onion revealed that highest activity (78.43 and 78.75 µg of TPF g^{-1} soil day^{-1}) was showed in the treatment receiving 50 % RD of NPK + 50 % N through FYM (T_3) under both *kharif* and *rabi,* respectively. Whereas lowest activity were observed in control (34.52 and 35.36 µg of TPF g^{-1} soil day^{-1}) under both *kharif* and *rabi* (Table 1).

Balanced nutrition of crop was responsible for better proliferation of root (rhizosphere) and hence for maximum activity of enzymes. These findings corroborate the findings of Rai and Yadav (2011) who reported maximum activity of dehydrogenase in the rhizosphere of legumes and wheat, respectively.

Acid and Alkaline Phosphatase (µg p-nitrophenol g^{-1} soil h^{-1})

Among the treatments, higher acid phosphatase activity were recorded in T_3 (50 % RD of NPK + 50 % N through FYM) with 53.92 and 55.82 µg p-nitrophenol released g^{-1} soil h^{-1} at harvest of both maize and onion, respectively, followed by T_6 (51.72 and 52.27 µg p-nitrophenol released g^{-1} soil h^{-1}, respectively). The lowest activity (40.63 and 41.73 µg p-nitrophenol released g^{-1} soil h^{-1}, respectively) was registered in

T_1 (control).

The data pertaining to alkaline phosphatase activity revealed that T_3 (50 % RD of NPK + 50 % N through FYM) showed highest 99.97 and 106.97 µg p-nitrophenol released g^{-1} soil h^{-1} at harvest of maize and onion, respectively (Table 1). The lowest alkaline phosphatase activity of 61.40 and 65.40 µg p-nitrophenol released g^{-1} soil h^{-1} was noticed in T_1 (control) at harvest of both maize and onion, respectively.

Higher activity of phosphatase enzyme might be due to added quantity of organic matter along with inorganic fertilizer which inturn increased the organic carbon and nitrogen (Kadlag *et al.,* 2008). Further, the organic acids produced during decomposition of farmyard manure might have resulted in enhanced enzyme activity. Similar results were reported by Srilatha *et al.* (2013).

Table 1. Long-term effects of INM on enzyme activities of the soils under Maize-Onion cropping system at Rajendranagar

Treatments	OC (%)		Acid phosphatase		Alkaline phosphatase		Dehydrogenase (μg of TPF g^{-1} soil day^{-1})		Urease (μg of NH_4^+-N g^{-1} soil $2h^{-1}$)	
			(μg p-nitrophenol g^{-1} soil h^{-1})				Maize	Onion	Maize	Onion
	Maize	Onion	Maize	Onion	Maize	Onion				
T_1 – Control	0.35	0.36	40.63	41.73	61.40	65.40	34.52	35.36	28.13	30.25
T_2 – 100 % RD of NPK + S	0.55	0.58	48.07	49.02	80.02	86.07	40.84	48.92	38.75	39.26
T_3 – 50 % RD of NPK + 50 % N through FYM	0.69	0.70	53.92	55.82	99.97	106.97	78.43	78.75	51.88	50.06
T_4 – FYM + Vermicompost + Neem cake (Each equivalent to 1/3rd RD of N)	0.65	0.62	50.01	50.98	85.34	93.34	64.87	66.58	43.38	46.20
T_5 – 50 % N through FYM + Biofertilizer for N (*Azospirillum*) + Rock Phosphate for P + PSB	0.64	0.60	50.88	51.17	90.88	94.88	53.45	59.25	41.28	42.25
T_6 – T_4 + Biofertilizer containing N & P carrier	0.67	0.68	51.72	52.27	96.65	101.65	70.40	72.12	45.88	46.19

MAIZE **ONION**

Plate 1. Maize-Onion cropping system at Rajendranagar, Hyderabad- Southern Telangana Zone (2013-14)

ACKNOWLEDGEMENTS

I gratefully acknowledge the Acharya N.G. Ranga Agricultural University, Government of Andhra Pradesh and Professor Jayashankar Telangana State Agricultural University Government of Telangana for their financial assistance provided in the form of stipend during my Ph.D. programme.

REFERENCES

1. Balota, E.L., Colozzi-Filho, A.C., Andrade, D.S., Dick, R.P. 2003. Microbial biomass in soils under different tillage

and crop rotation system. Biol. Fertil. Soils, 35: 300-306.

2. Bandick, A.K., Dick, R.P. 1999. Field management effects on soil enzyme activities. Soil. Biol. Biochem., 31: 1471-1479.
3. Burns, R. G., DeForest, J. L., Marxsen, J., Sinsabaugh, R. L., Stromberger, M. E., Wallenstein, M. D., Michael, N. W. and Zoppini, A. 2013. Soil enzymes in a changing environment: Current knowledge and future directions. *Soil Biol. & Biochem.* 58: 216-234.
4. Casida, L.E., Klein, D.A and Santaro, J. 1964. Soil dehydrogenase activity. *Soil Science*. 98: 371-376.
5. Jackson, M.L. 1973.. *Soil Chemical Analysis*. Oxford IBH Publishing House, Bombay. 38.
6. Kadlag, A.D., Jadav, A.B and Kale, Y.B. 2008. Urease and acid phosphatase soil enzymes are influenced by vermicompost and scepter herbicide. *Journal of Maharastra Agricultural University*. 33 (2): 148-151.
7. Kandeler, E and Murer, E. 1993. Aggregate stability and soil microbial processes in a soil with different cultivation. *Geoderma*, 56: 503-513.
8. Kirchner, M.J., Wollum, A.G., King, L.D.1993. Soil microbial populations and activities in reduced chemicalinput agroecosystems. *Soil Sci. Soc. Am. J,* 57: 1289- 1295.
9. Nedunchezhiyan, M., Byju, G., Dash, S. N. and Ranasingh, N. 2013. Selected soil enzyme activities, soil microbial biomass carbon and root yield as influenced by organic production systems in sweet potato, *Communications in Soil Science and Plant Analysis*. DOI:10.1080/00103624.2012.756506.
10. Rai, T.N and Yadav, J. 2011. Influence of organic and inorganic sources on soil enzyme activities. *Journal of the Indian Society of Soil Science.* 59 (1): 54-59.
11. Singaram, P and Kamala Kumari. 2000. Effect of continuous application of different levels of fertilizers with farm yard manure on enzyme dynamics of soil. *Madras Agricultural Journal*. 87 (4-6): 364-365.
12. Srilatha, M., Rao, P.C., Sharma, S.H.K and Bhanu Rekha, K. 2013. Influence of long-term fertilizer application on soil phosphatase enzyme activity and nutrient availability in rice – rice cropping system. *Journal of Rice Research*. 6 (2): 45-52.
13. Tabatabai, M.A and Bremner, J.M. 1969. Use of *p*-nitrophenol phosphate for assay of soil phosphatase activity. *Soil Biology and Biochemistry*. 1: 301-307.
14. Tabatabai, M.A and Bremner, J.M. 1972. Assay of Urease activity in soils. *Soil Biology and Biochemistry*. 4: 479-487.
15. Tabatabai, M.A and Eivazi, F. 1977. Phosphatases in soils. *Soil Biology and Biochemistry*. 9: 167-172.
16. Walkley, A and Black, C.A. 1934. Estimation of organic carbon by chromic acid titration method. *Soil Science*. 37: 29-38.

CITATION OF THIS ARTICLE

P.V. Geetha Sireesha, G. Padmaja, M.Venkata Ramana and P.C. Rao. Study of Enzyme Activities in Intercropped Maize with Different Nutrient Application. Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 1, 2017: 59-62