Effects of Pesticides on Enzyme Activity of Dehydrogenase and Urease Enzymes in Soil of Aligarh Region (U.P.) India

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Abstract

The Pesticide use in agriculture has significantly increased crop yield; however, most pesticides now pollute water, soil, the atmosphere, and food. Pesticides also have an effect on soil enzymes which are the essential catalysts that govern the quality of soil life. In the present study, the role of pesticides viz; acephate and two pyridyl methyl amine class insecticide acetamiprid and imidacloprid in collected soil in rainy season (August, 2021) from different regions of Aligarh (Atrauli, Khair and Iglas). On analysis than the effects of pesticides on enzyme activity of dehydrogenase and urease enzymes feable decrease while without pesticides enzyme activity of dehydrogenase and urease enzyme feably increase

Keywords: *Soil, Pesticides, Dehydrogenase and Urease.*

INTRODUCTION

Soil enzymes plays significant biochemical roles in the overall decomposition of organic matter in the soil system1. They play an important role in catalysing so many important reactions required for the life processes of microorganisms in soils and the stabilization of soil structure, such as organic decomposition of waste, organic matter formation, and nutrient cycling2. In the soil, these enzymes are constantly synthesized, accumulated, inactivated, and/or decomposed, and thus play an important role in agriculture, especially in nutrient cycling3. These enzymes' activities in soils are influenced by complex biochemical processes that include integrated and ecologically connected synthetic processes, as well as immobilisation and enzyme stability4. In this regard, all soils have a collection of enzymes that determine soil metabolic processes5, which are dependent on its physical, chemical, and biological properties. The amount of enzymes in soil systems varies primarily because each soil type has a distinct level of organic matter content, composition and function of its living organisms, as well as intensity of biological processes6. In practice, biochemical reactions are largely mediated by the catalytic contribution of enzymes and changeable substrates that serve as sources of energy for microorganisms7.

Materials and Methods

Collection of Soil

The soil pertaining to the experimental setup was collected from the region of Aligarh (Atrauli, Khair and Iglas) in rainy season (August). The soil collected was sieved through 2 mm mes before its transportation to the laboratory. The soil so collected was air –dried and stored at room temperature.

COLLECTION OF PESTICIDE

The pesticide like as acephate and two pyridyal methyl amine class insecticides acetamiprid and imidacloprid pertaining to the experimental setup was procured from Merck, Mumbai (India).

ANALYTICAL METHODS

SOIL ANALYSIS

To determine the Physicochemical characteristics of soil (control) and selected pesticides with soil of Aligarh Region. To determine the parameters such as pH, EC (Electric Conductivity), TOC (Total Organic Carbon), TKN (Total Kjeldahl Nitrogen), TP (Total Phosphorous) and TK (Total Potassium) from selected soil and include pesticides soil. It will be used analytical procedures by total kjeldahl nitrogen (TKN) and total organic carbon (TOC) of the soil analysis were measured with the micro kjeldahl methods8 and Walkely and Black's Rapid titration method (1934)9 respectively, total phosphorous (TP) will be determined spectrophotometrically10 While total potassium (TK) will be detected by flame photometer.11

Enzymes activity analysis

- The dehydrogenase activity was measured using 0.40% 2-p-iodophenyl-3-p-trinitrophenyl terazolium chloride (TTC) substrate. The TPF (triphenyl formazan) produced during TTC reduction was measured using a spectrophotometer at 490 nm12.

- The substrates for urease activity were 0.03 M N-x-benzoyl-1-argininamide (BAA) and 6.4% urea, respectively. An ammonium selective electrode was used to measure the ammonium released by the two hydrolytic reactions13.

STATISTICAL ANALYSIS

It was used statistical analysis of all the results reported are the means of the three replicates one way analysis of–variance (ANOVA) will be done using the INDOSTAT programme and graph represent by MATLAB.

RESULTS AND DISCUSSION

Soil enzymes play an important role in the fertility of soils by making available mobilized nutrients from complex organic substances. The enzymes selected for the present study include dehydrogenase and urease as these play an important role in soil fertility programmes. The dehydrogenase enzyme activity is commonly used as an indicator of biological activity and fertility programmes in soil14 while as urease enzyme activity is responsible for the hydrolysis of urea fertilizer applied to the soil into ammonia (NH_3) and carbondioxide (CO_2).

Keeping in view, the paramount importance of these enzymes in soil fertility programmes, their maintenance in soil fertility is of utmost importance. So the studied of parameters for soil enzymes becomes necessary for evaluating and improving soil quality. Thus the effects of pesticides on enzyme activity of dehydrogenase and urease enzymes in soil of Aligarh region (Atrauli, Khair and Iglas) were observed in the present study, the observed facts are shown below.

Table 1 : Physico-chemical characteristics of soil of Aligarh (Atrauli, Khair and Iglas) region in rainy season (August 2021). The various physico-chemical properties were obtained from R.G. College of Pharmacy, Hathras.

pH (1:2.5)	EC (dS/m) 1:2.5	Organic carbon (%)	Available P_2O_5 (mg kg^{-1})	Available K_2O (mg kg^{-1})	Available Nitrogen (mg kg^{-1})	Sodium (%)
ATRAULI REGION						
7.64	7.70	0.43	13.33	343.55	161.68	0.58
KHAIR REGION						
7.52	7.71	0.44	13.35	347.01	166.80	0.61
IGLAS REGION						
7.59	7.93	0.40	14.01	336.20	155.79	0.55

Table 2 : Dehydrogenase Activity of Atrauli in rainy season (August 2021) (µg TPF g –1 24hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.95	15.9	15.9 ± 0.05
		2	15.95		
		3	15.90		
2	Sa	1	13.58	13.93	13.93 ± 0.37
		2	14.32		
		3	13.92		
3	Sb	1	12.57	12.65	12.65 ± 0.13
		2	12.58		
		3	12.80		
4	Sc	1	13.52	13.83	13.83 ± 0.29
		2	13.89		
		3	14.10		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 1 : Dehydrogenase Activity of Atrauli in rainy season (August 2021) (µg TPF g –1 24hr–1)

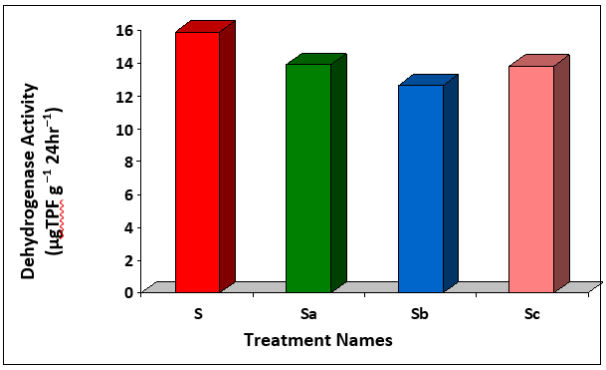


Table 3: Dehydrogenase Activity of Khair in rainy season (August 2021) (µgTPF g –1 24hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.92	15.79	15.79 ± 0.13
		2	15.80		
		3	15.65		
2	Sa	1	13.02	13.10	13.10 ± 0.09
		2	13.10		
		3	13.20		
3	Sb	1	14.97	14.91	14.91 ± 0.06
		2	14.92		
		3	14.85		
4	Sc	1	14.98	14.99	14.99 ± 0.95
		2	14.90		
		3	15.09		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 2 : Dehydrogenase Activity of Khair in rainy season (August 2021) (µgTPF g –1 24hr–1)

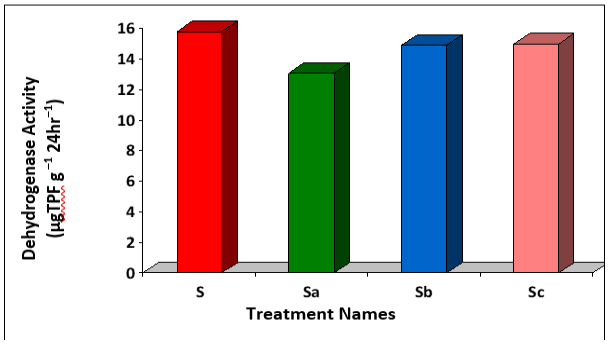


Table 4 : Dehydrogenase Activity of Iglas in rainy season (August 2021) (µgTPF g –1 24hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	18.66	18.80	18.80 ± 0.12
		2	18.90		
		3	18.85		
2	Sa	1	16.82	16.80	16.80 ± 0.10
		2	16.90		
		3	16.70		
3	Sb	1	15.75	15.83	15.83 ± 0.10
		2	15.80		
		3	15.90		
4	Sc	1	18.92	18.44	18.44 ± 0.42
		2	18.10		
		3	18.30		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 3 : Dehydrogenase Activity of Iglas in rainy season (August 2021) (µg TPF g –1 24hr–1)

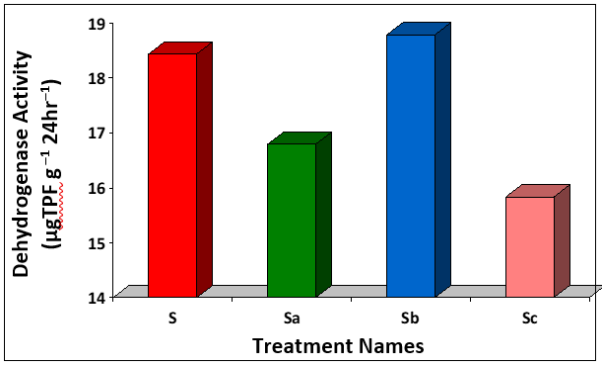


Table 5 : Urease Activity of Atrauli in rainy season (August 2021) (µg ammonia g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	26.54	26.70	26.70 ± 0.24
		2	26.58		
		3	26.98		
2	Sa	1	25.43	25.13	25.13 ± 0.50
		2	24.46		
		3	25.45		
3	Sb	1	20.25	19.95	19.95 ± 4.84

		2	18.30		
		3	21.32		
4	Sc	1	25.12	24.13	24.13 ± 0.98
		2	23.15		
		3	24.12		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 4 : Urease Activity of Atrauli in rainy season (August 2021) (µg ammonia g –1 hr–1)

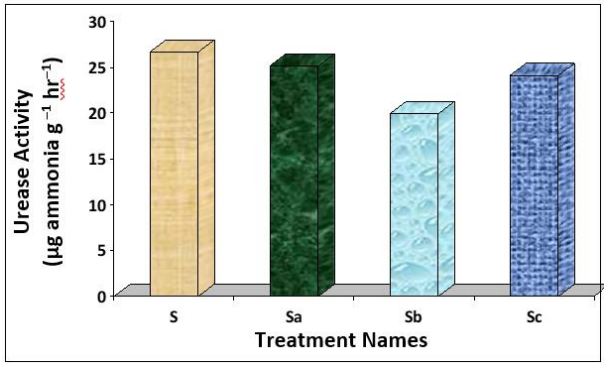


Table 6 : Urease Activity of Khair in rainy season (August 2021) (µg ammonia g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	29.17	29.07	29.07 ± 0.19
		2	29.20		
		3	28.85		
2	Sa	1	25.46	25.48	25.48 ± 0.020
		2	25.49		
		3	25.50		
3	Sb	1	24.60	24.65	24.65 ± 0.027
		2	24.75		
		3	24.60		
4	Sc	1	27.08	27.12	27.12 ± 0.94
		2	28.09		
		3	26.20		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 5 : Urease Activity of Khair in rainy season (August 2021) (µg ammonia g –1 hr–1)

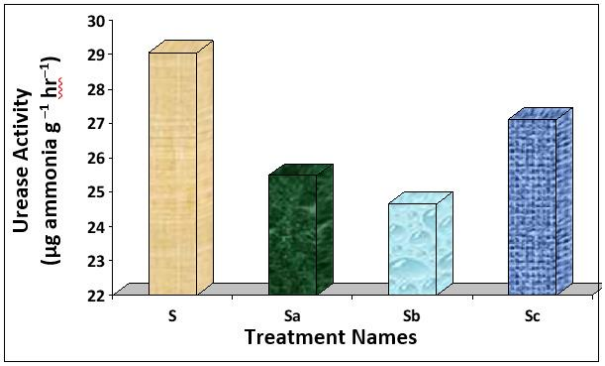


Table 7 : Urease Activity of Iglas in rainy season (August 2021) (µg ammonia g –1 hr–1)

Sample code	Treatment Name	Replicates	Results	Mean	Mean ± Standard Deviation
1	S	1	38.40	38.75	38.75 ± 0.60
		2	39.45		
		3	38.40		
2	Sa	1	30.28	30.45	30.45 ± 0155
		2	30.50		
		3	30.58		
3	Sb	1	35.40	35.71	35.71 ± 0.27
		2	38.85		
		3	35.90		
4	Sc	1	28.09	28.91	28.91 ± 0.17
		2	29.30		
		3	29.35		

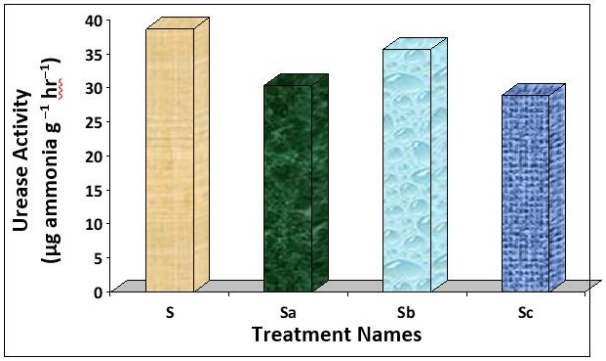
S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 6 : Urease Activity of Iglas in rainy season (August 2021) (µg ammonia g –1 hr–1)



CONCLUSION

From the present study, It was concluded that the effects of pesticides on enzyme activity of dehydrogenase and urease enzymes in soil of Aligarh region (Atrauli, Khair and Iglas) feable decrease as compared to without pesticides in soil of Aligarh region.

ACKNOWLEDGEMENT

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References

Burns R.G. (1983). In: Microbes in Their Natural Environment pp. 249-298. Cambridge University Press, London.

Dick R.P., Sandor J.A., Eash N.S. (1994). Agric. Ecosyst. Environ. 50: 123 – 131.

Tabatabai M.A. (1994). SSSA Book Series No. 5. Soil Sci. Soc. Am. Madison, Wis., pp. 775-833.

Khaziyev F.K., Gulke A.Y. (1991). Pochvovedenie, 8: 88-103.

McGill W.B., Colle C.V. (1981). Geoderma. 26: 267-286.

Schmidt G., Laskowski M. (1961). Academic Press, New York, pp. 3-35.

Kiss S., Dragan-Bularda M., Radulescu D. (1978). In: Soil Enzymes . Academic Press, London.pp.117-147.

Shaw J., Beadle, L.C. (1949). J. Exp. Biol. 26: 15-23.

Walkely, J.A., Black, J.A. (1934). Soil Science. 37: 29-31.

Fiske, C.H., Row Subha, Y. (1925). J. Biol. Chem. 66: 375-400.

Person, R.W. (1952). J. Soil Science, 74(4): 301-310.

Garica C., Hernahdez F., Costa C., Masciandaro., Ciardi C. (1993).Bioresour. Technology. 44: 17-23.

Burens R.G., Taylor J.P., Wilson B., Mills M.S. (2002). Soil Biology and Biochemistry, 34 (3): 387-401

Burns R.G. (1998). Soil enzymes, Academic Press, New York, P. 370.