Effects of Pesticides on Enzyme Activity of β-GLUCOSIDASE and Cellulase Enzyme in soil of Farrukhabad Region (U.P.) INDIA

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Abstract

In the present study, modern agriculture depends upon the chemical pesticides are frequently used in agriculture fields to increase crop production. Effect of pesticides on enzyme activity of β-glucosidase and cellulase enzymes in soil of Farrukhabad region. Soil were collected in rainy season (August 2021) from Farrukhabad region viz., Kaimganj, Amritpur and Farrukhabad tahsil. Soil microbial diversification is indispensible to maintain functional diversity and enzyme mediated critical soil process that detoxify soil from environmental pollutants like pesticides, due to excessive use of pesticides viz., Cypermethrin, Endosulfan and Mancozeb controlling the insects. In India the present study was carried out to assess the effect of different concentration of the pesticides. Results shown that the effect of pesticides on soil enzyme activity slightly decreases while with out pesticides enzyme activity of β-glucosidase and cellulase increases in selected soil.

Keywords: *Pesticides, Soil, β-glucosidase and Cellulase enzyme.*

INTRODUCTION

In modern agriculture, a wide range of synthetically produced chemicals, such as insecticides, fungicides, herbicides, and other pesticides, are used1. Soil enzymes play critical biochemical roles in the overall decomposition of organic matter in the soil system2. They play an important role in catalysing some many important reactions required for the life processes of microorganisms in soils and the stabilisation of soil structure, such as organic waste decomposition, organic matter formation, and nutrient cycling3. In the soil, these enzymes are constantly synthesized, accumulated, inactivated, and decomposed, as well as play an important role in agriculture, specially in nutrient cycling4. 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 stability5. In this regard, most soils include a collection of enzymes that regulate soil metabolic processes6, which are influenced by the physical, chemical, microbiological, and biochemical properties of the soil.

β-glucosidase

In soils, -glucosidase is a common and dominant enzyme7. It is named after the type of bond it hydrolyses. This enzyme is important in soils because it catalyses the hydrolysis and biodegradation of various -glucosides found in plant debris that is decomposing in the ecosystem. Its final product is glucose, a vital carbon energy source for soil microbes8.

Cellulase

Cellulase forms the most abundant organic compound in the global ecosystem,

accounting for almost fifty percent of the biomass produced by photosynthetic CO2 fixation9. The growth and survival of microorganisms significant in most agricultural soils is dependent on the carbon source contained in soil cellulase10. However, in order for carbon to be released as an energy source for microorganisms, cellulase in plant debris must be degraded by cellulases enzymes into glucose, cellobiose, and high molecular weight oligosaccharides11. Cellulases are a class of enzymes that catalyse the breakdown of cellulase, which is a polysaccharide composed of 1,4 linked glucose units12.

MATERIALS AND METHODS

Collection of Soil Sample

The soil pertaining to the experimental setup will be collected from the region of Farrukhabad U.P., India at different sample drying.

Pesticides

It will be used selected pesticides cypermethrin (insecticides), endosulfan (insecticide) and mancozeb (fungicide). It will be used techniques Flamphotometer, UV Vis spectrophotometer and X–ray differaction spectroscopy in proposed research work.

Soil Analysis

To determine the Physicochemical characteristics of soil (control) and selected pesticides with soil of Farrukhabad Region. To determine the parameters such as pH, EC (Electric Conductivity), TOC (Total Organic Carbon), TKN (Total Kjeldahl Nitrogen), TP (Total Phosphorous), TK (Total Potassium) and TKN (Total Kjeldahl Nitrogen) 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 methods13 and Walkely and Black's Rapid titration method (1934)14 respectively, total phosphorous (TP) was determined spectrophotometrically15 While total potassium (TK) was detected by flame photometer.16

Enzyme Analysis

β-glucosidase activity was determined by measuring the amount of p-nitrophenol released after incubating samples (1 gm fresh weight) with p-nitrophenolglucoside (0.025 m) for 1 hour at 37oC in a microplate reader at 400nm17.

Cellulase activity was determined using a microplate reader 690 nm after incubating samples (5 g fresh weight) with carboxymethylcellulase (CMC), sodium salt (0.7%) for 24 hours at 50oC17.

RESULT AND DISCUSSION

Cellulase enzymes perform an important role in the global recycling of nature's most abundant polymer, cellulose. It would be essential to better understand this enzyme to ensure that it is used more frequently as a decision support tool in our soil fertility programmes. β-glucosidase is a useful indicator of soil quality and may reflect past biological activity. The capacity of soil to stabilise soil organic matter and can be used to detect management effects on soils18. Understanding the dynamics of enzyme activities in these systems is critical for predicting their interactions, as their activities may regulate nutrient uptake and plant growth. Thus the effects of pesticides on enzyme activity of cellulase and □-glucosidase enzymes in soil of Farrukhabad region (Amritpur, Kaimganj and Farrukhabad) were observed in the present study, the observed results shown are given below:

TABLE 1 Physico-chemical characteristics of soil of Farrukhabad (Amritpur, Kaimganj and Farrukhabad) 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 (%)
AMRITPUR REGION						
7.71	7.88	0.49	14.41	401.08	173.80	0.54
KAIMGANJ REGION						
7.63	7.90	0.53	14.98	412.01	178.13	0.59
FARRUKHABAD REGION						
7.60	7.98	0.55	15.60	427.20	165.79	0.63

TABLE 2 Cellulase Activity of Amritpur soil in rainy season (August 2021) (µg glucose g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.73	15.45	15.45 ± 0.32
		2	15.10		
		3	15.53		
2	Sa	1	14.96	14.57	14.57 ± 0.73
		2	13.72		
		3	15.03		
3	Sb	1	12.96	12.40	12.40 ± 0.84
		2	12.83		
		3	11.43		
4	Sc	1	13.52	13.83	13.83 ± 0.29
		2	13.89		
		3	14.10		

S = soil; Sa = soil + cypermethrin;

Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 1: Cellulase Activity of Amritpur soil in rainy season (August 2021) (µg glucose g –1 hr–1)

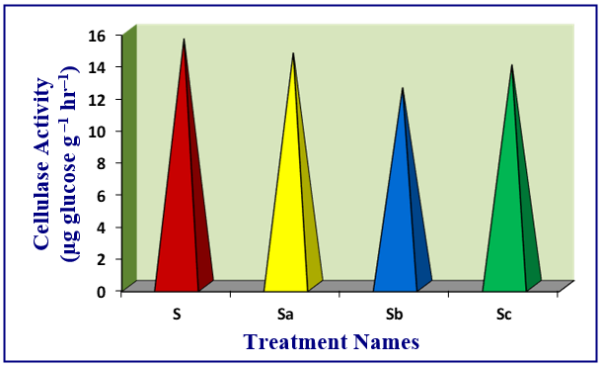


TABLE 3 Cellulase Activity of Kaimganj soil in rainy season (August 2021) (µg glucose g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	38.03	38.46	38.46 ± 0.27
		2	38.85		
		3	38.50		
2	Sa	1	36.23	35.56	35.56 ± 0.58
		2	35.13		
		3	35.33		
3	Sb	1	26.34	26.09	26.09 ± 0.26
		2	26.14		
		3	25.81		
4	Sc	1	30.21	30.99	30.99 ± 0.72
		2	31.63		
		3	31.13		

S = soil; Sa = soil + cypermethrin;

Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 2: Cellulase Activity of Kaimganj soil in rainy season (August 2021) (µg glucose g –1 hr–1)

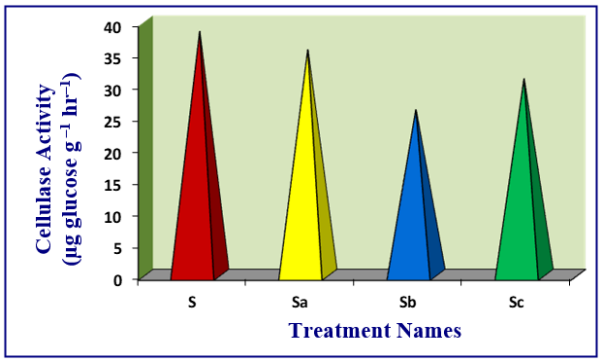


TABLE 4 Cellulase Activity of Farrukhabad soil in rainy season (August 2021) (µg glucose g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	53.12	53.19	53.19 ± 0.41
		2	52.81		
		3	53.64		
2	Sa	1	49.23	49.89	49.89 ± 0.58
		2	50.12		
		3	50.33		
3	Sb	1	37.73	37.45	37.45 ± 0.31
		2	37.11		
		3	37.53		
4	Sc	1	43.33	43.10	43.10 ± 0.31
		2	43.23		
		3	42.75		

S = soil; Sa = soil + cypermethrin;

Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 3: Cellulase Activity of Farrukhabad soil in rainy season (August 2021) (µg glucose g –1 hr–1)

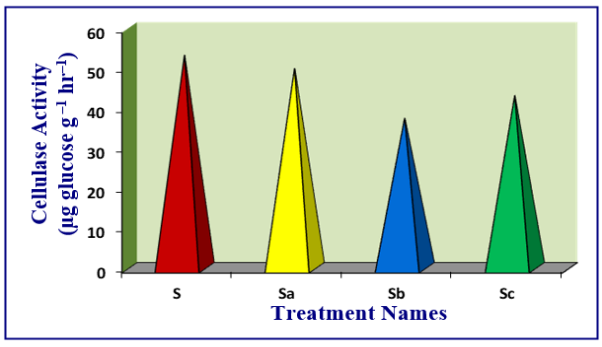


TABLE 5 β-glucosidase Activity of Amritpur soil in rainy season (August 2021) (µg PNP g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	16.99	16.86	16.86 ± 0.61
		2	16.20		
		3	17.41		
2	Sa	1	15.78	15.06	15.06 ± 0.63
		2	14.86		
		3	14.55		
3	Sb	1	13.02	13.56	13.56 ± 0.47
		2	13.87		
		3	13.81		
4	Sc	1	14.64	14.22	14.22 ± 0.77
		2	14.70		
		3	13.33		

S = soil; Sa = soil + cypermethrin;

Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 4: -glucosidase Activity of Amritpur soil in rainy season (August 2021) (µg PNP g –1 hr–1)

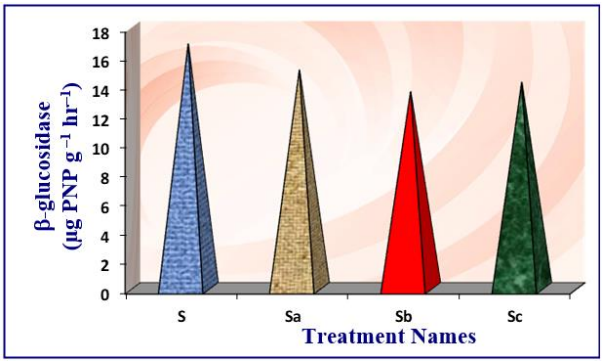


TABLE 6 β-glucosidase Activity of Kaimganj soil in rainy season (August 2021) (µg PNP g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	19.66	20.15	20.15 ± 0.68
		2	19.87		
		3	20.93		
2	Sa	1	17.03	17.35	17.35 ± 0.29
		2	17.44		
		3	17.60		

3	Sb	1	14.11	14.39	14.39 ± 0.24
		2	14.49		
		3	14.58		
4	Sc	1	14.98	15.12	15.12 ± 0.16
		2	15.09		
		3	15.30		

S = soil; Sa = soil + cypermethrin;

Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 5: □-glucosidase Activity of Kaimganj soil in rainy season (August 2021) (µg PNP g –1 hr–1)

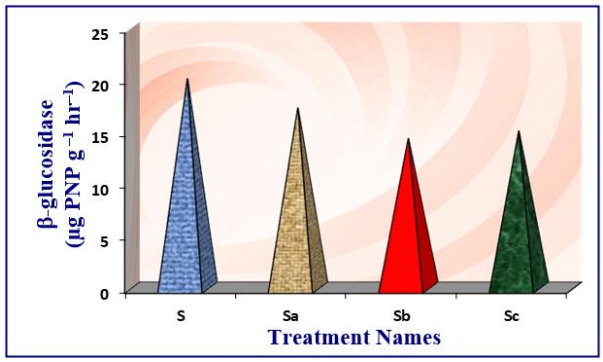
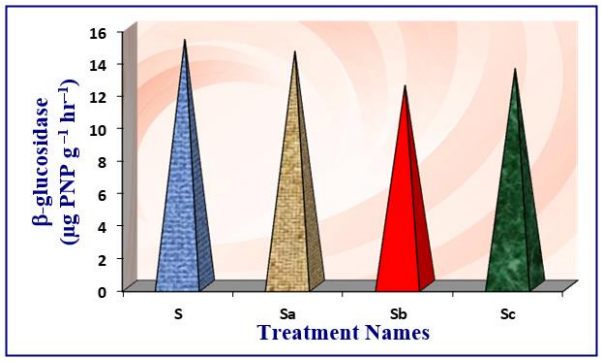


TABLE 7 β-glucosidase Activity of Farrukhabad soil in rainy season (August 2021) (µg PNP g –1 hr–1)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.11	15.23	15.23 ± 0.33
		2	14.98		
		3	15.62		
2	Sa	1	14.52	14.50	14.50 ± 0.39
		2	14.89		
		3	14.10		
3	Sb	1	12.96	12.40	12.40 ± 0.84
		2	12.83		
		3	11.43		
4	Sc	1	13.19	13.43	13.43 ± 0.37
		2	13.24		
		3	13.87		

Figure 6: □-glucosidase Activity of Farrukhabad soil in rainy season (August 2021) (µg PNP g –1 hr–1)



CONCLUSION

During last decades, pesticides were increasingly used in agriculture in order to limit crop diseases and increase food production. This research illustrated that the effects of pesticides on enzyme activity of β-glucosidase and cellulase enzymes feable decrease as compared to without pesticides soil of Farrukhabad region.

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