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EFFECTS OF PESTICIDES AND SAMPLE DRYING ON ENZYME ACTIVITY OF β-GLUCOSIDASE AND CELLULASE ENZYME IN SOIL OF FARRUKHABAD REGION (UP) INDIA

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Abstract

In the present study, pesticides are widely used in crop production and are known to cause major environmental problems. Effect of pesticides on enzyme activity of β-glucosidase and cellulase enzymes in soil of Farrukhabad region. Soil were collected in winter season (January 2022) 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.

Keyword : Pesticides, Soil, β-glucosidase and Cellulase enzyme.

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INTRODUCTION

Pesticides are widely used in crop production and are known to cause major environmental problems. With increasing pesticides use, questions are rising on potential effect regarding public health and environment. Pesticides pollute air, soil, water resources and contaminate the food chain. The interaction between soil components and pesticides influences the biochemical processes driven by microorganisms. The effect of pesticides on soil micro-organism could be determined by the study of functional parameters such as carbon and nitrogen mineralization that are governed by enzymatic activities. Those activities, play an important role because all biochemical transformations in soil depend on or are related to the presence of enzymes.[1] Soil enzymes play key biochemical functions in the overall process of organic matter decomposition in the soil system.[2] They are important in catalysing several important reactions necessary for the life processes of micro-organisms in soils and the stabilization of soil structure, the decomposition of organic wastes, organic matter formation and nutrient cycling.[3] These enzymes are constantly being synthesized, accumulated, inactivated and/or decomposed in the soil, hence playing an important role in agriculture and particularly in nutrients cycling.[4] The activities of these enzymes in soils undergo complex biochemical processes consisting of integrated and ecologically-connected synthetic processes, and in the immobilisation and enzyme stability.[5] In this regard, all soils contain a group of enzymes that determine soil metabolic processes[6] which, in turn, depend on its physical, chemical, microbiological and biochemical properties.

β-glucosidase

β-glucosidase is characteristically useful as a soil quality indicator, and may give a reflection of past biological activity. The capacity of soil to stabilise the soil organic matter, and can be used to detect management effect on soils. It is named according to the type of bond that it hydrolyses. This enzyme plays an important role in soils because it is involved in catalysing the hydrolysis and biodegradation of various β-glucosides present in plant debris decomposing in the ecosystem. Its final product is glucose, an important carbon energy source of life to microbes in the soil.[7]

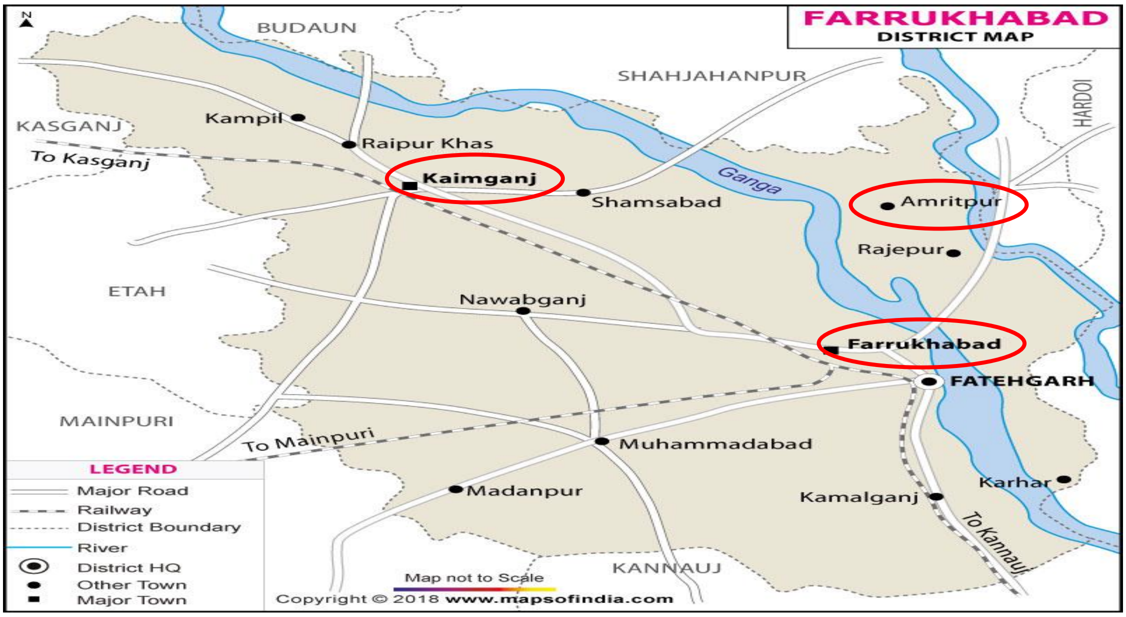
Cellulase

Cellulase is the most abundant organic compound in the biosphere, comprising almost 50% of the biomass synthesized by photosynthetic fixation of CO_2.[8] Growth and survival of micro-organisms important in most agricultural soils depends on the carbon source contained in the cellulase occurring in the soils.[9] However, for carbon to be released as an energy source for use by the micro-organisms, cellulase in plant debris has to be degraded into glucose, cellobiose and high molecular weight oligosaccharides by cellulases enzymes.[10] Cellulases are a group of enzymes that catalyse the degradation of cellulase, polysaccharides build up of 1, 4 linked glucose units.[11]

MATERIALS AND METHODS

Collection of Soil Sample

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



Site Map

Pesticides

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

Soil Analysis

Physicochemical characteristics of soil (control) and selected pesticides were determined with soil of Farrukhabad Region. Parameters were determined 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 were used analytical procedures by total kjeldahl nitrogen (TKN) and total organic carbon (TOC) of the soil analysis were measured with the micro kjeldahl methods[12] and Walkely and Black's Rapid titration method (1934)[13] respectively, total phosphorous (TP) was determined spectrophotometrically[14] While total potassium (TK) was detected by flame photometer.[15]

Enzyme Analysis

- β-glucosidase activity was assessed by determination of the released p-nitro phenol after incubation of samples (1 gm fresh weight) with p-nitrophenolglucoside (0.025 m) for 1h at 37ºC in a microplate reader at 400nm.
- Cellulase activity was estimated by determination of released reducing sugars after incubation of samples (5 g fresh weight) with carboxymethylcellulase (CMC), sodium salt (0.7%) for 24 h at 50ºC in a microplate reader 690 nm.[16]

RESULT AND DISCUSSION

β-glucosidase is characteristically useful as a soil quality indicator, and may give a reflection of past biological activity. The capacity of soil to stabilise the soil organic matter, and can be used to detect management effect on soils[17]. Understanding the dynamics of enzyme activities in these systems is crucial for predicting their interactions as their activities may, in turn, regulate nutrient uptake and plant growth. Cellulase enzymes play an important role in global recycling of the most abundant polymer, cellulose in nature, it would be of critical importance to understand this enzyme better so that it may be used more regularly as a predictive tool in our soil fertility programmes. 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.[18] 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 winter season (January 2022). 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						
7.61	7.70	0.51	14.38	403.11	172.85	0.51
KAIMGANJ REGION						
7.53	7.85	0.50	14.78	413.02	177.67	0.56
FARRUKHABAD REGION						
7.53	7.67	0.51	15.12	427.57	166.83	0.67

TABLE 2

Cellulase Activity of Amritpur soil in winter season (January 2022) (µg glucose g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	14.85	14.70	14.70 ± 0.11
		2	14.67		
		3	14.58		
2	Sa	1	13.10	13.22	13.22 ± 0.09
		2	13.25		
		3	13.33		
3	Sb	1	11.93	11.81	11.81 ± 0.10
		2	11.85		
		3	11.67		
4	Sc	1	12.37	12.49	12.49 ± 0.12
		2	12.45		
		3	12.67		

S = soil; Sa = soil + cypermethrin;
Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 1 : Cellulase Activity of Amritpur soil in winter season (January 2022) (µg glucose g^{-1} hr^{-1})

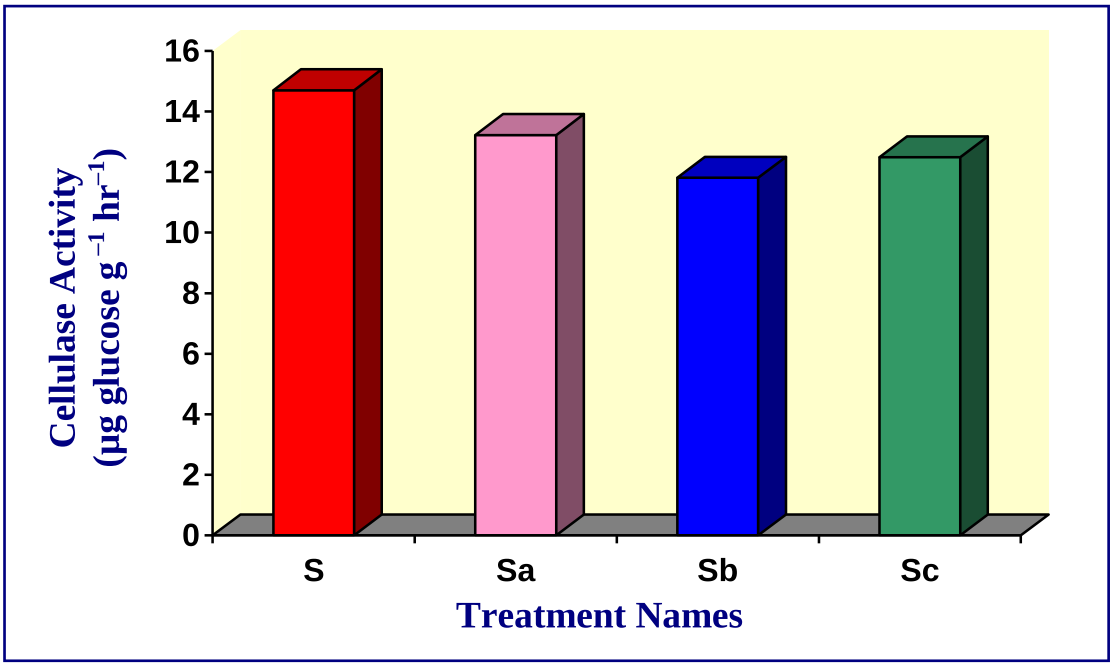


TABLE 3

Cellulase Activity of Kaimganj soil in winter season (January 2022) (µg glucose g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	37.15	37.32	37.32 ± 0.13
		2	37.33		
		3	37.48		
2	Sa	1	35.85	35.52	35.52 ± 0.25
		2	35.23		
		3	35.48		
3	Sb	1	25.48	25.59	25.59 ± 0.10
		2	25.57		
		3	25.74		
4	Sc	1	30.93	30.59	30.59 ± 0.31
		2	30.68		
		3	30.18		

S = soil; Sa = soil + cypermethrin;
Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 2 : Cellulase Activity of Kaimganj soil in winter season (January 2022) (µg glucose g^{-1} hr^{-1})

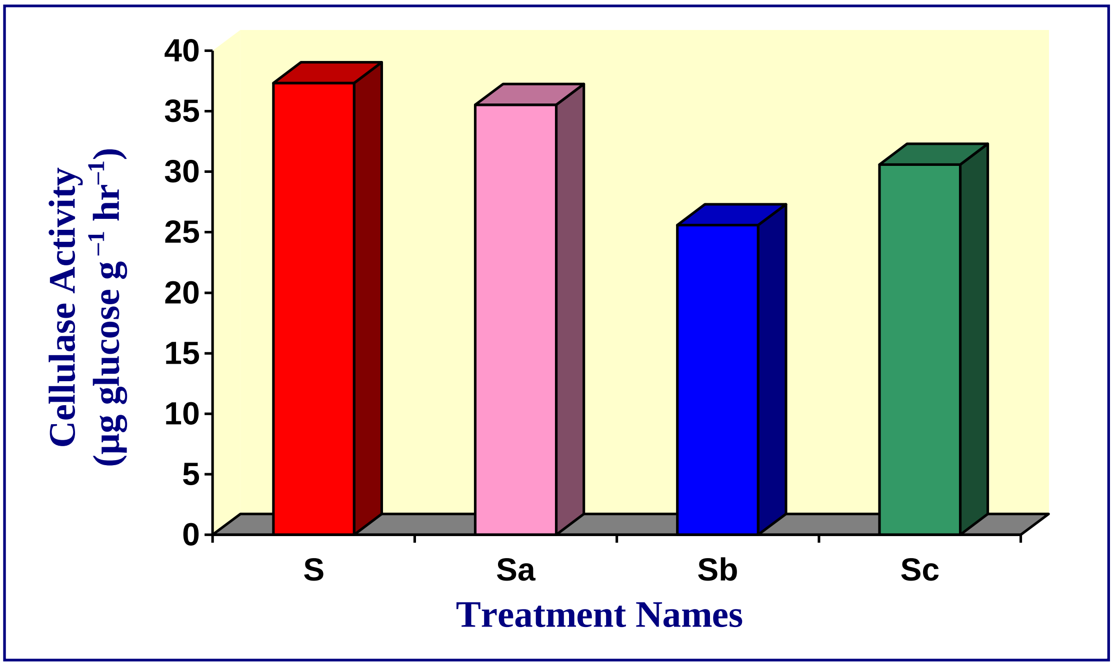


TABLE 4

Cellulase Activity of Farrukhabad soil in winter season (January 2022) (µg glucose g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	51.18	51.90	51.90 ± 0.61
		2	51.85		
		3	52.68		
2	Sa	1	48.25	48.92	48.92 ± 0.47
		2	49.18		
		3	49.33		
3	Sb	1	36.85	36.61	36.61 ± 0.32
		2	36.15		
		3	36.83		
4	Sc	1	42.38	42.58	42.58 ± 0.18
		2	42.83		
		3	42.55		

S = soil; Sa = soil + cypermethrin;
Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 3 : Cellulase Activity of Farrukhabad soil in winter season (January 2022) (µg glucose g^{-1} hr^{-1})

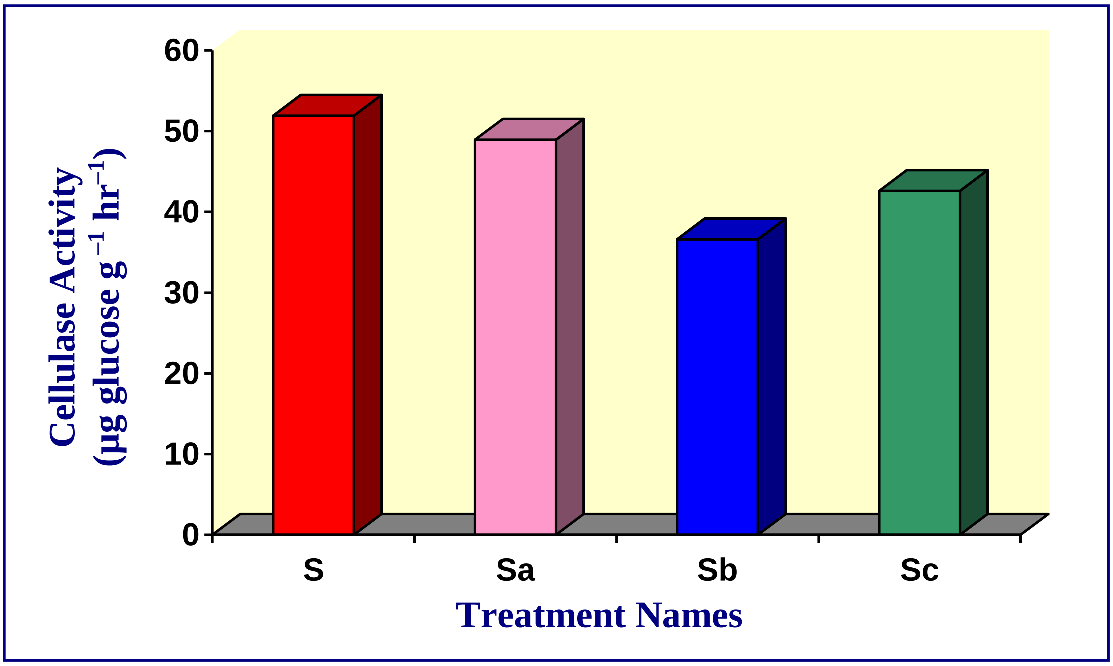


TABLE 5

β-glucosidase Activity of Amritpur soil in winter season (January 2022) (μg PNP g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.85	15.81	15.81 ± 0.33
		2	15.77		
		3	15.81		
2	Sa	1	14.83	14.44	14.44 ± 0.29
		2	14.33		
		3	14.11		
3	Sb	1	12.14	12.54	12.54 ± 0.30
		2	12.88		
		3	12.61		
4	Sc	1	14.10	14.18	14.18 ± 0.16
		2	14.41		
		3	14.03		

S = soil; Sa = soil + cypermethrin;
Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 4 : -glucosidase Activity of Amritpur soil in winter season (January 2022) (μg PNP g^{-1} hr^{-1})

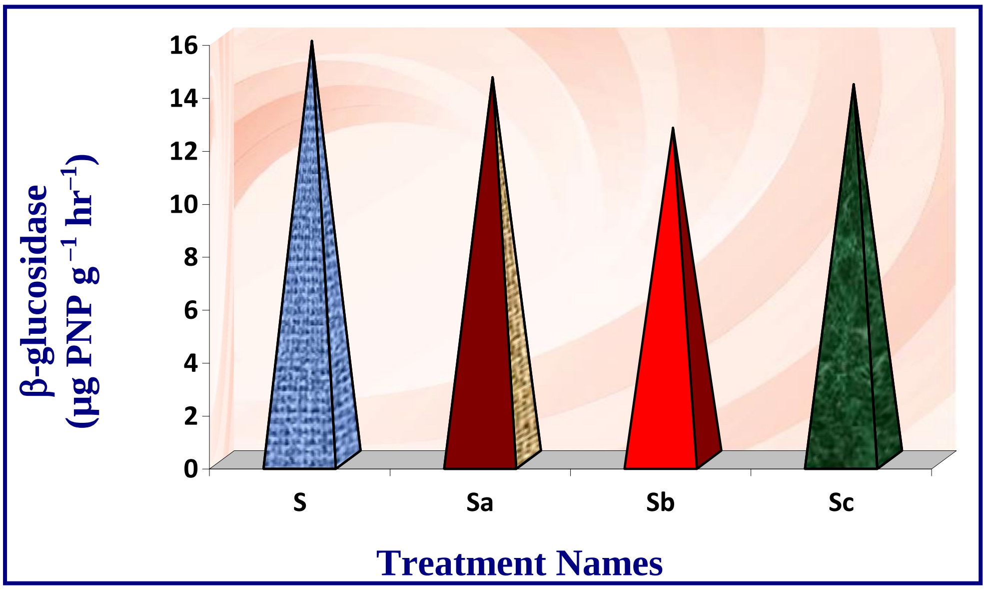


TABLE 6

β-glucosidase Activity of Kaimganj soil in winter season (January 2022) (μg PNP g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	18.58	18.79	18.79 ± 0.15
		2	18.87		
		3	18.93		
2	Sa	1	16.95	16.68	16.68 ± 0.21
		2	16.43		
		3	16.67		
3	Sb	1	12.67	12.73	12.73 ± 0.14
		2	12.59		
		3	12.93		
4	Sc	1	13.95	13.74	13.74 ± 0.25
		2	13.89		
		3	13.39		

S = soil; Sa = soil + cypermethrin;
Sb = soil + endosulfan; Sc = soil + mencozeb.

Figure 5 : □-glucosidase Activity of Kaimganj soil in winter season (January 2022) (μg PNP g^{-1} hr^{-1})

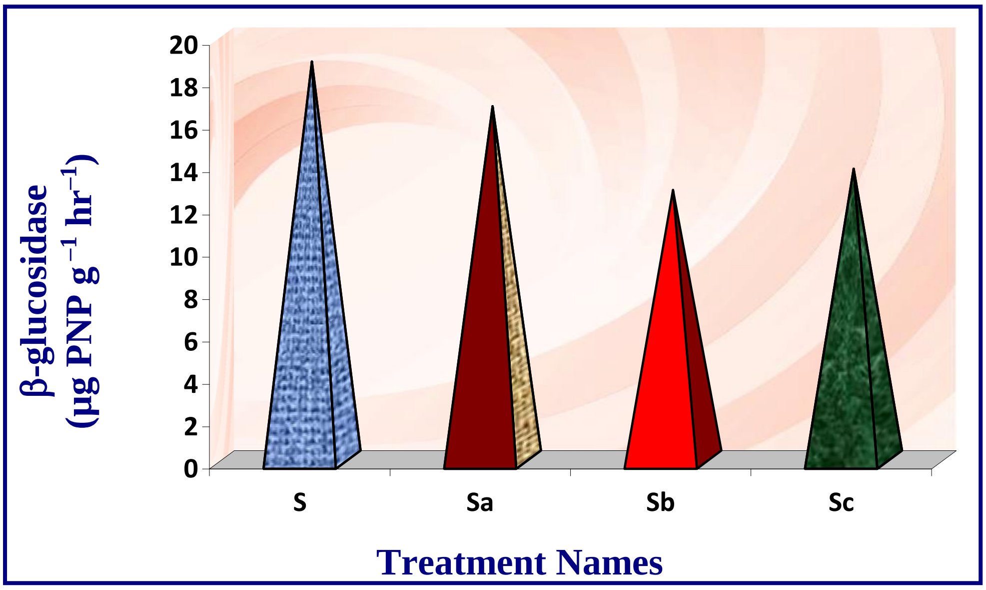
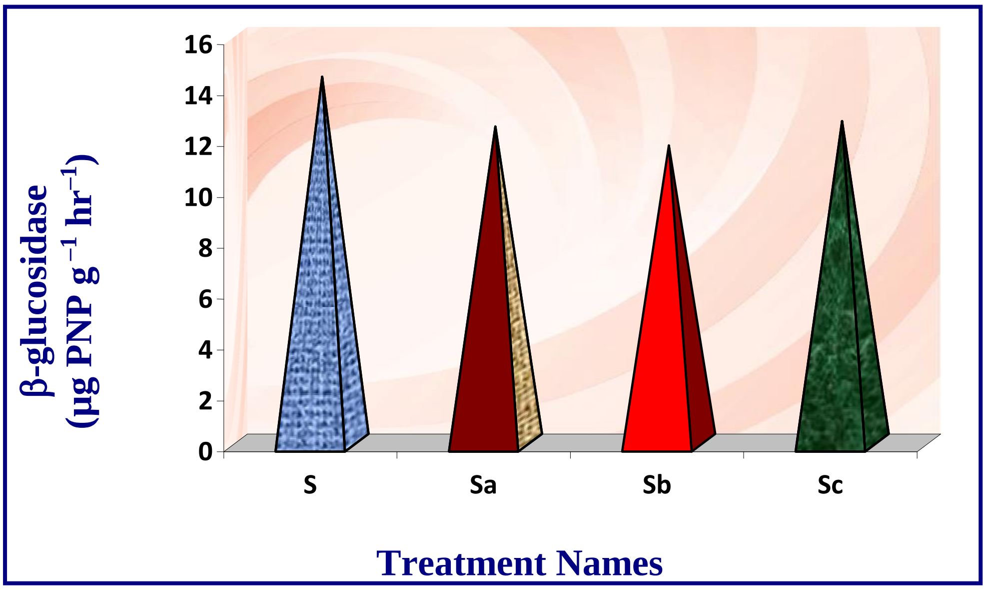


TABLE 7

β-glucosidase Activity of Farrukhabad soil in winter season (January 2022) (μg PNP g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	14.05	14.39	14.39 ± 0.36
		2	14.35		
		3	13.97		
2	Sa	1	12.11	12.43	12.43 ± 0.31
		2	12.33		
		3	12.85		
3	Sb	1	11.89	11.69	11.69 ± 0.20
		2	11.77		
		3	11.41		
4	Sc	1	12.23	12.64	12.64 ± 0.29
		2	12.81		
		3	12.89		

Figure 6 : -glucosidase Activity of Farrukhabad soil in winter season (January 2022) (μg PNP g^{-1} hr^{-1})



CONCLUSION

The results obtained in the present study indicate that pesticides were increasingly used in agriculture in order to limit crop diseases and increase food production. Effects of pesticides on enzyme activity of β-glucosidase and cellulase enzymes feable decrease as compared to without pesticides soil of Farrukhabad region (U.P.) India.

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