



IMPACT OF SELECTED PESTICIDES ON ENZYME ACTIVITY OF AMYLASE AND PHOSPHATASE ENZYMES IN SOIL OF KANNAUJ REGION (U.P.) INDIA

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ABSTRACT

Pesticides are the chemical agent that comes in routine in India to increase soil productivity but pollutes air, water and soil while enzyme released nutrient in the soil by means of organic matter decomposition and increased soil productivity by increasing soil quality and soil health. This study deals with the effect of pesticides such as atrazine, paraquat and fluridone on enzyme activities of amylase and phosphatase soil enzymes in selected soil from different region of Kannauj U.P. (Tehsil: Tirwaganj, Chhibramau and Kannauj) in summer season. From the present study, It was observed that an effect of pesticides on enzyme activity of amylase and phosphatase slightly decreased as compared to control soil in selected region of Kannauj (U.P.).

Keywords : Soil, Pesticides, Amylase and Phosphatase.

Introduction

Enzymes are major components of biological soil processes, such as degradation of organic compounds, their mineralization and the liberation or recycling of nutrients including nitrogen, phosphorous, sulphur and other essential minerals. Soil enzymes play key biochemical functions in the overall process of organic matter decomposition in the soil system¹. They are important in catalysing several important reactions necessary for the life processes of micro-organisms in soils and the stabilisation of soil structure, the decomposition of organic wastes, organic matter formation and nutrient cycling². These enzymes are

constantly being synthesised, accumulated, inactivated and decomposed in the soil, hence playing an important role in agriculture and particularly in nutrients cycling³.

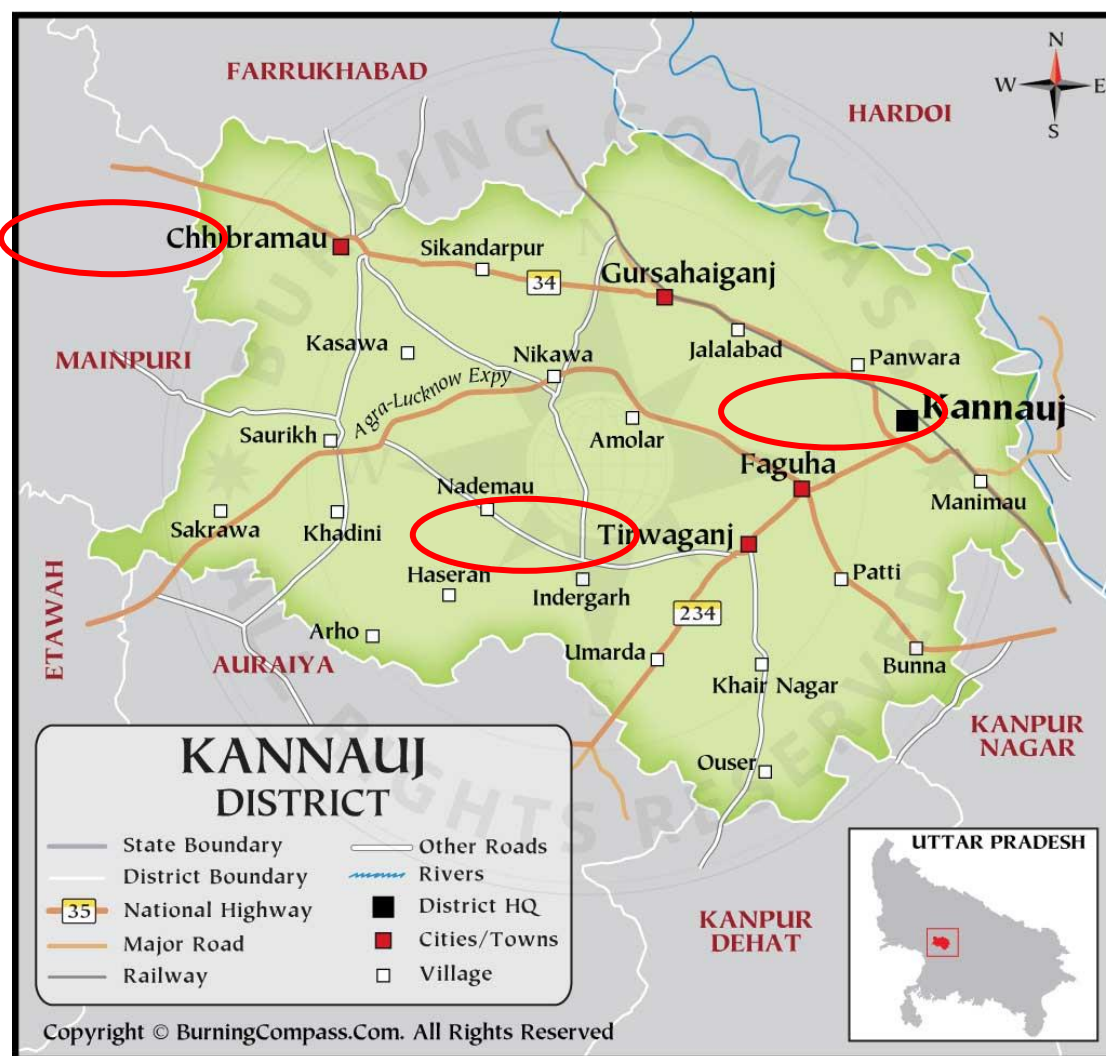
Amylase is a starch hydrolysing enzyme⁴. It is known to be constituted by α -amylase and β -amylase⁵. Studies have shown that α -amylase are synthesized by plants, animals and microorganisms where as β -amylase is mainly synthesized by plants⁶. This enzyme play a significant role in the breakdown of starch. Research evidence suggests that several other enzymes are involved in the hydrolysis of starch⁷, but of major importance are α -amylase, which converts starch to glucose and β -amylase, which converts starch to maltose⁸. Studies have indicated that roles and activities of α -amylase and β -amylase enzymes may be influenced by different factors ranging from agricultural practices, type of vegetation environment and soil types⁹.

Phosphatase enzyme are a broad group of enzymes that are capable of catalysing hydrolysis of esters and anhydrides of phosphoric acid. In soil ecosystem, these enzymes are believed to play critical roles in phosphorus cycles¹⁰ as evidence shows that they are correlated to phosphorous stress and plant growth. Apart from being good indicators of soil fertility, phosphatase enzymes play key roles in the soil system¹¹.

MATERIALS AND METHODS

Collection of Soil Sample

The soil pertaining to the experimental setup will be collected from the different region of Kannauj U.P., India in summer season (June 2022). The soil will be collected stored at room temperature.



Pesticides and Tools

Selected pesticides in proposed research work are atrazine, paraquat and fluridone. Tools will be used for detection enzymatic activity are Flamphotometer, UV Vis spectrophotometer in proposed research work.

Analytical Procedure

Soil Analysis

To determine the Physicochemical characteristics of soil (control) and selected pesticides with soil of Kannauj Region. To determine the parameters such as pH, EC (Electric Conductivity), TOC (Total Organic Carbon), 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 methods¹² and Walkely and Black's Rapid titration method (1934)¹³ respectively, total phosphorous (TP) was determined spectrophotometrically¹⁴ While total potassium (TK) was detected by flame photometer¹⁵.

Procedures for determination of enzymatic activities in soil

Amylase activity will be determined according to Tu CM method

A total of 5 g soil samples in test tubes were incubated with selected pesticides singly and in combination. Duplicate soil samples were withdrawn after 10 days of incubation at room temperature ($28 \pm 4^\circ\text{C}$) to determine the amylase activity. The method employed for determining amylase activity is the method adapted by Tu CM.

Soil samples were transferred in 200 ml erlenmeyer flasks and 1 ml of toluene was added. After 15 min., 6 ml of 0.2 M acetate-phosphate buffer (pH – 5.5) containing 2% of starch was added to the soil samples and the flasks were stoppered and held for 24 and 72 h at 30°C . Soil extract were passed through Whatmann No. 1 filter paper and glucose content in the filtrate was assayed.

Activity of Phosphatase will be determined according to Tabataba and Bremner (1969)¹⁶ and Eivazi and Tabataba (1977)¹⁷ using p-nitrophenyl phosphate solution as the substrate. Clear yellow coloured solution formed as a result of the action of phosphatase on the substrate was analysed spectrophotometrically at a wavelength of 410 nm to measure the amount of p-nitrophenol released.

RESULTS AND DISCUSSION

Amylase and *Phosphatase* were the enzymes of choice in the soils of Kannauj region (U.P.) because of their paramount importance in biochemical functions in the overall process of organic matter decomposition in soil system. Since amylase enzymes play an important role in global recycling of starch, 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. To date, there have been few studies examining the influence of management options in the ecosystem on phosphatase activity in soil where most crops are grown. 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. In the present study, the observed facts are shown below :

TABLE 1 : Physico-chemical characteristics of soil of Kannauj (Tirwaganj, Chhibramau and Kannauj) region in summer season (June 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 ₂ O ₅ (mg kg ⁻¹)	Available K ₂ O (mg kg ⁻¹)	Available Nitrogen (mg kg ⁻¹)	Sodium (%)
TIRWAGANJ REGION						
7.12	7.65	0.44	13.28	368.11	163.32	0.57
CHHIBRAMAU REGION						
7.22	7.66	0.41	13.20	350.0	160.32	0.54
KANNAUJ REGION						
7.32	7.60	0.45	13.10	337.50	162.32	0.56

TABLE 2
Phosphatase Activity of Tirwaganj soil in summer season
(June 2022) ($\mu\text{g PNP g}^{-1}\text{hr}^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean \pm Standard Deviation
1	S	1	16.24	16.33	16.33 \pm 0.91
		2	15.26		
		3	17.50		
2	Sa	1	14.41	13.94	13.94 \pm 0.67
		2	12.99		
		3	14.44		
3	Sb	1	13.45	13.72	13.72 \pm 0.22
		2	14.01		
		3	13.71		
4	Sc	1	13.21	13.14	13.14 \pm 0.18
		2	13.32		
		3	12.89		

S = soil; Sa = soil + atrazine; Sb = soil + paraquat; Sc = soil + fluridone.

Figure 1 : Phosphatase Activity of Tirwaganj soil in summer season (June 2022) ($\mu\text{g PNP g}^{-1} \text{hr}^{-1}$)

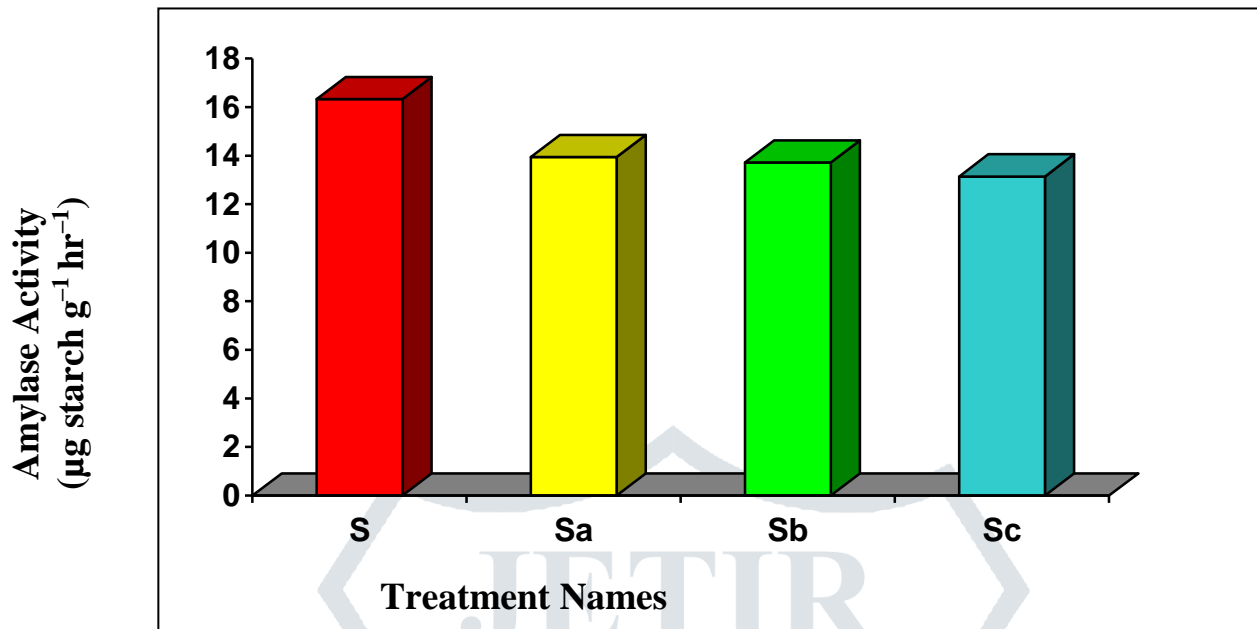


TABLE 3
Phosphatase Activity of Chhibramau soil in summer season (June 2022)
($\mu\text{g PNP g}^{-1} \text{hr}^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean \pm Standard Deviation
1	S	1	17.71	17.51	17.51 \pm 0.74
		2	16.51		
		3	18.31		
2	Sa	1	16.01	15.80	15.80 \pm 0.21
		2	15.51		
		3	15.89		
3	Sb	1	14.01	14.17	14.17 \pm 0.31
		2	14.61		
		3	13.89		
4	Sc	1	12.01	12.24	12.24 \pm 0.17
		2	12.32		
		3	12.41		

S = soil;

Sb = soil + paraquat;

Sa = soil + atrazine;

Sc = soil + fluridone.

**Figure 2 : Phosphatase Activity of Chhibramu soil
in summer season (June 2022) ($\mu\text{g PNP g}^{-1} \text{hr}^{-1}$)**

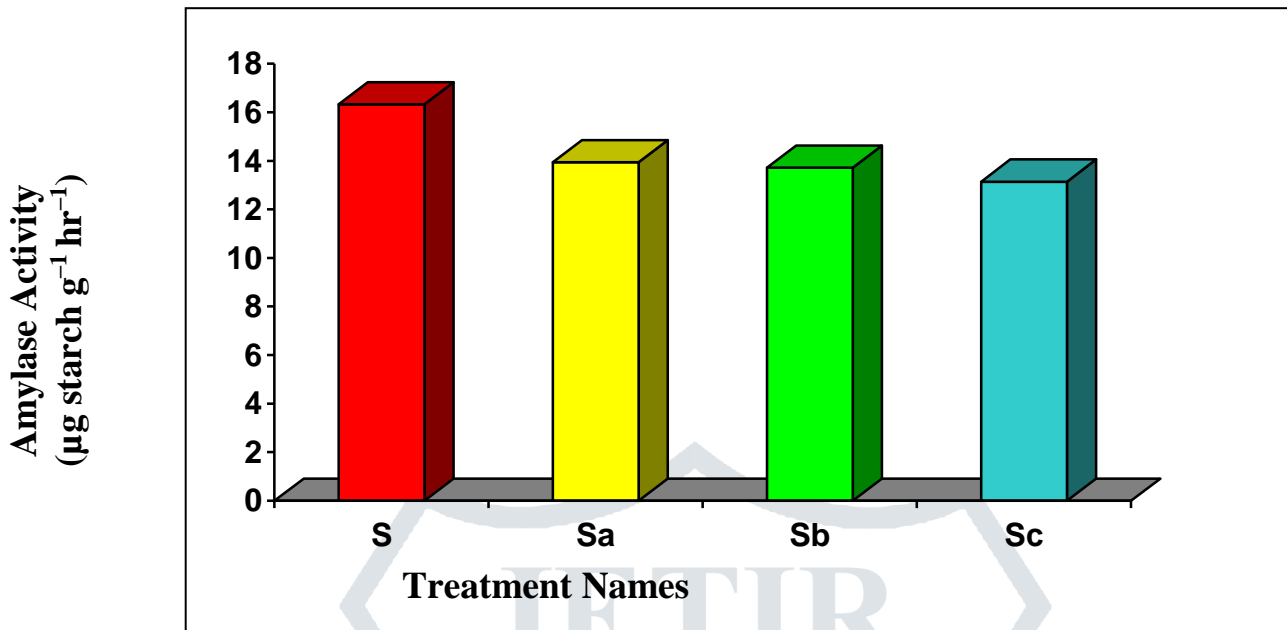


TABLE 4

**Phosphatase Activity of Kannauj soil in summer season (June 2022)
($\mu\text{g PNP g}^{-1}\text{hr}^{-1}$)**

Sample code	Treatment Name	Replicates	Activity	Mean	Mean \pm Standard Deviation
1	S	1	19.01	18.53	18.53 \pm 0.34
		2	18.20		
		3	18.40		
2	Sa	1	16.41	16.54	16.54 \pm 0.10
		2	16.66		
		3	16.55		
3	Sb	1	14.44	14.54	14.54 \pm 0.09
		2	14.52		
		3	14.66		
4	Sc	1	17.80	17.13	17.13 \pm 0.74
		2	17.51		
		3	16.09		

Figure 3 : Phosphatase Activity of Kannauj soil in summer season (June 2022) ($\mu\text{g PNP g}^{-1} \text{hr}^{-1}$)

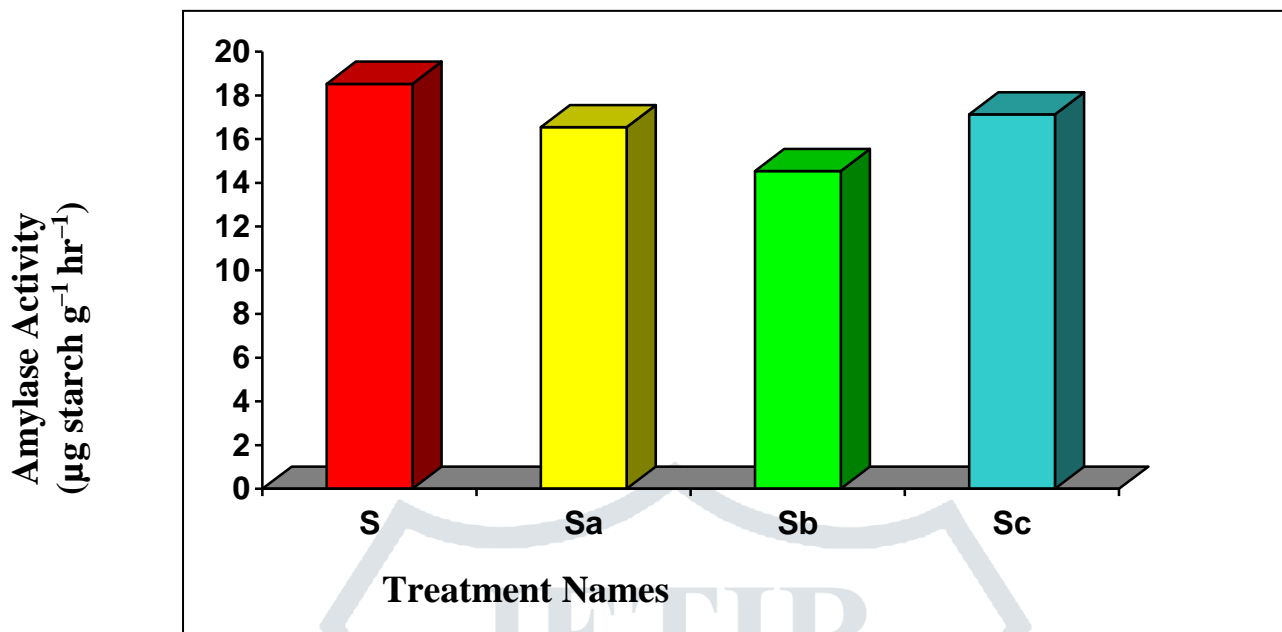


TABLE 5

Amylase Activity of Tirwaganj soil in summer season (June 2022) ($\mu\text{g starch g}^{-1} \text{hr}^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean \pm Standard Deviation
1	S	1	25.51	25.17	25.17 \pm 0.54
		2	24.41		
		3	25.61		
2	Sa	1	22.01	20.51	20.51 \pm 1.71
		2	21.41		
		3	18.11		
3	Sb	1	22.55	21.57	21.57 \pm 0.81
		2	20.55		
		3	21.61		
4	Sc	1	20.91	21.45	21.45 \pm 0.56
		2	21.22		
		3	22.24		

S = soil;

Sa = soil + atrazine;

Sb = soil + paraquat;

Sc = soil + floridone.

Figure 4 : Amylase Activity of Tirwaganj soil in summer season (June 2022) ($\mu\text{g starch g}^{-1} \text{hr}^{-1}$)

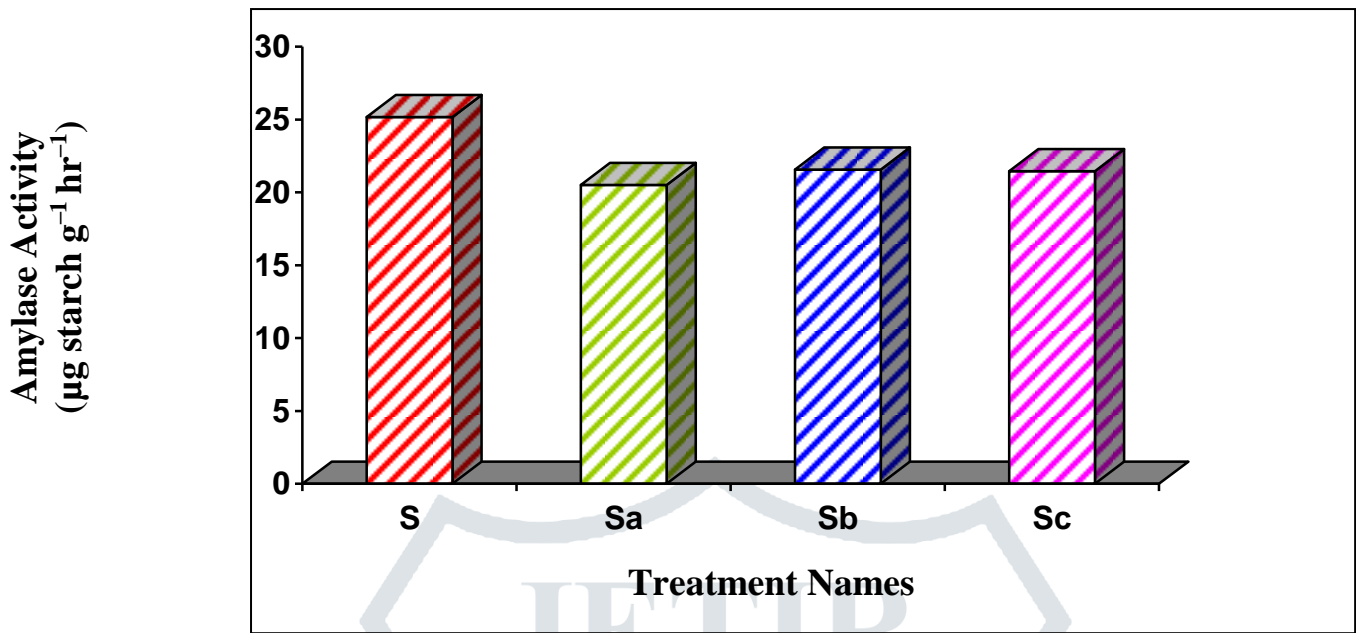


TABLE 6

Amylase Activity of Chhibramau soil in summer season (June 2022)

 $(\mu\text{g starch g}^{-1}\text{hr}^{-1})$

Sample code	Treatment Name	Replicates	Activity	Mean	Mean \pm Standard Deviation
1	S	1	26.40	26.64	26.64 \pm 0.71
		2	27.61		
		3	25.91		
2	Sa	1	25.01	24.66	24.66 \pm 0.39
		2	24.88		
		3	24.11		
3	Sb	1	24.15	24.19	24.19 \pm 0.09
		2	24.32		
		3	24.10		
4	Sc	1	21.99	22.29	22.29 \pm 0.32
		2	22.74		
		3	22.15		

S = soil;

Sa = soil + atrazine;

Sb = soil + paraquat;

Sc = soil + floridone.

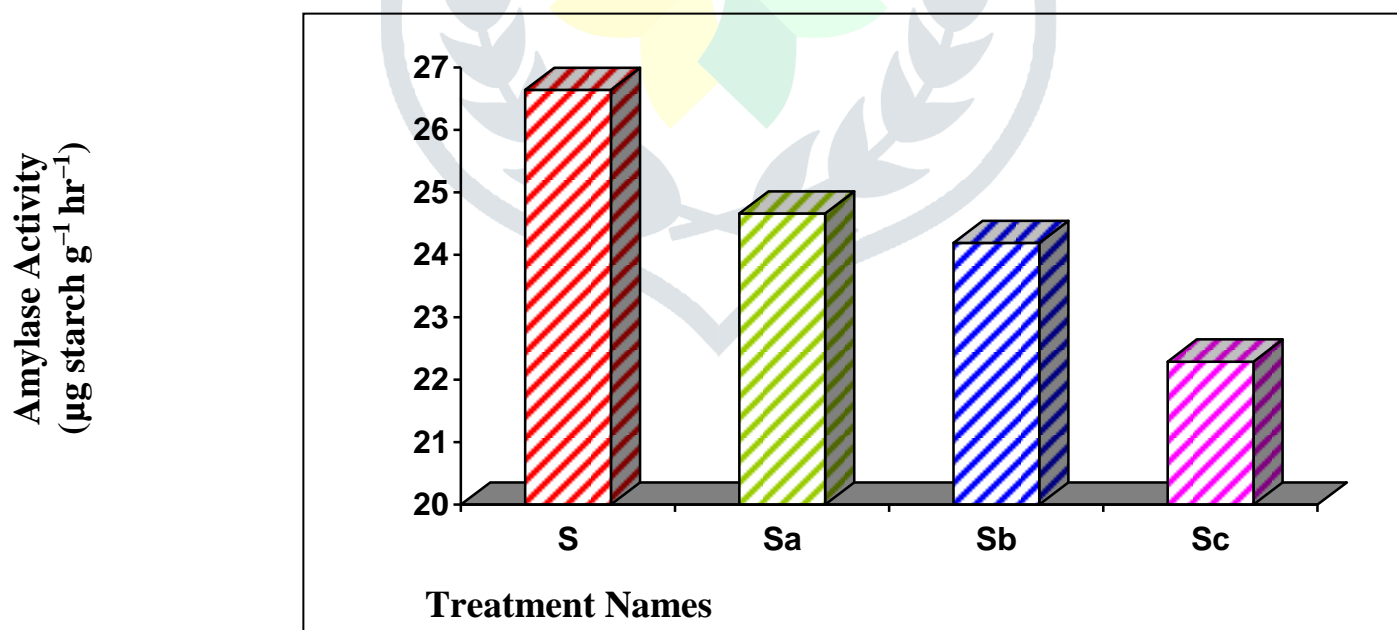
Figure 5 : Amylase Activity of Chhibramau soil in summer season (June 2022) ($\mu\text{g starch g}^{-1}\text{hr}^{-1}$)

TABLE 7

Amylase Activity of Kannauj soil in summer season (June 2022)
($\mu\text{g starch g}^{-1}\text{hr}^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean \pm Standard Deviation
1	S	1	28.10	28.45	28.45 \pm 0.32
		2	28.88		
		3	28.37		
2	Sa	1	27.10	25.80	25.80 \pm 1.25
		2	24.10		
		3	26.20		
3	Sb	1	26.51	25.24	25.24 \pm 1.38
		2	25.91		
		3	23.31		
4	Sc	1	28.01	26.54	26.54 \pm 1.08
		2	26.20		
		3	25.41		

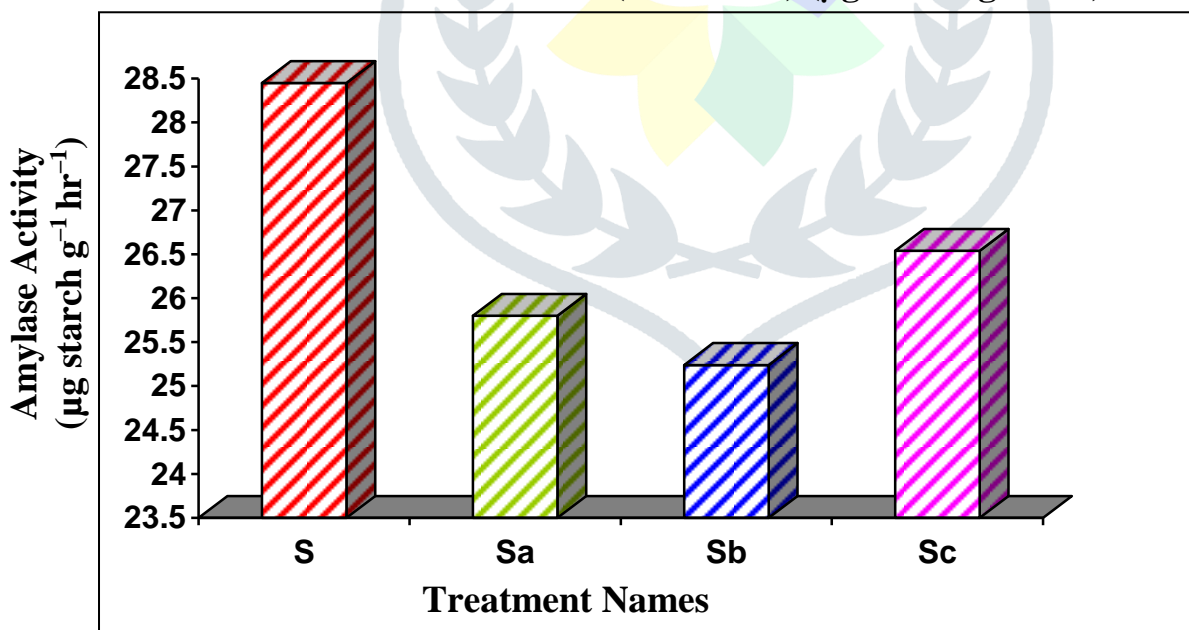
S = soil;

Sa = soil + atrazine;

Sb = soil + paraquat;

Sc = soil + floridone.

**Figure 6 : Amylase Activity of Kannauj soil
in summer season (June 2022) ($\mu\text{g starch g}^{-1}\text{hr}^{-1}$)**



CONCLUSION

From this research study, It was concluded that the effects of pesticides (Atrazine, Paraquate and Floridone) on enzymatic activity of amylase and phosphatase slightly decreases as compared to control soil in selected region of Kannauj (Tirwaganj, Chhibramau and

Kannauj) U.P. India. So it is suggested to declines the use of pesticides to maintain soil health and soil quality.

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