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EFFECTS OF PESTICIDES AND SAMPLING TIME ON ENZYME ACTIVITY OF DEHYDROGENASE AND UREASE ENZYMES IN SOIL OF ALIGARH REGION (U.P) INDIA

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Abstract

In the present study, pesticides are widely used in crop production and are known to induce major environmental problems in India. With an increased pesticide use, questions are rising on potential effects regarding public health, environment and soil health fertility. Pesticides pollute air, soil, water resources and contaminate the food chain. Which are essential catalyst rulings the quality of soil life. The role of pesticides viz; acephate and two pyridyl methyl amine class insecticide acetamiprid and imidacloprid on collected soil in winter season from different regions of Aligarh (Atrauli, Gabhana, Iglas, Khair and Koil). Results shown that the effects of pesticides on enzyme activity of dehydrogenase and urease enzymes slightly decrease while without pesticides enzyme activity of dehydrogenase and urease enzyme slightly increase

Key words: Soil, Pesticides, Dehydrogenase and Urease.

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INTRODUCTION

Dehydrogenase

The dehydrogenase enzyme activity is commonly used as an indicator of biological activity in soils[1]. Dehydrogenase enzyme is known to oxidise soil organic matter by transferring protons and electrons from substrates to acceptors. These processes are part of respiration pathways of soil micro-organisms and are closely related to the type of soil and soil air-water conditions[2]. Since these processes are part of respiration pathways of soil microorganisms, studies on the activities of dehydrogenase enzyme in the soil is very important as it may give indications of the potential of the soil to support biochemical processes which are essential for maintaining soil fertility.

Urease

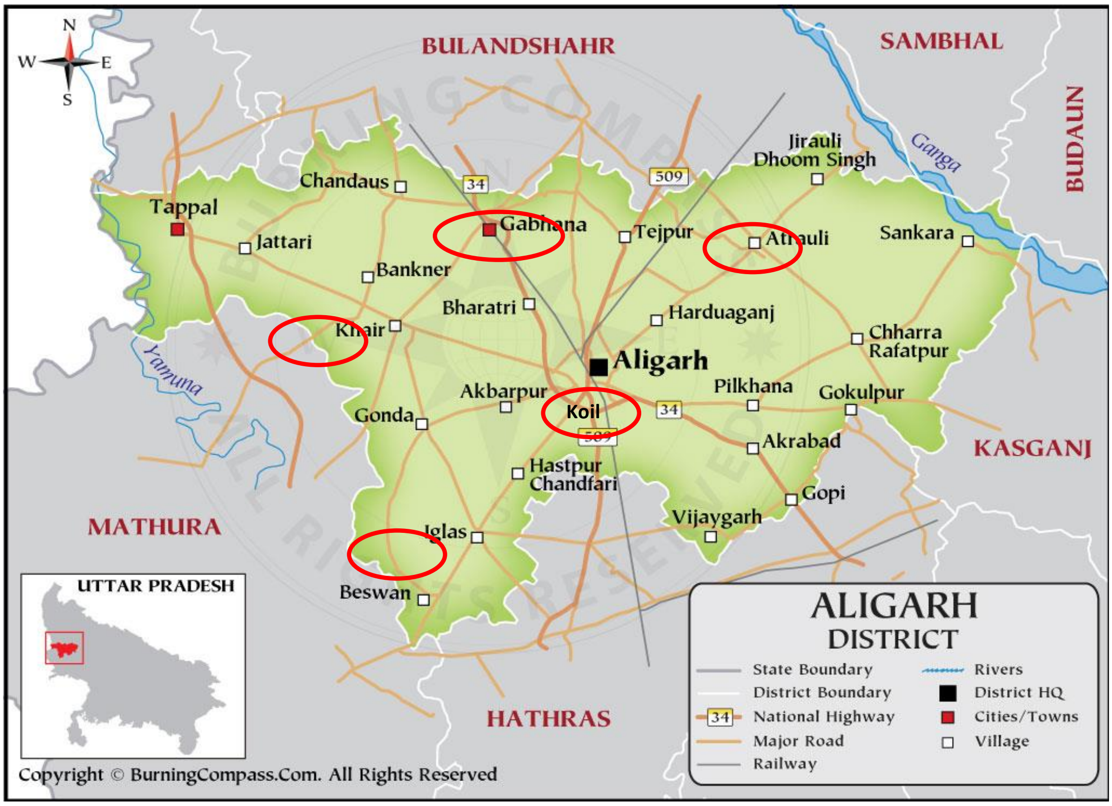
Urease enzyme is responsible for the hydrolysis of urea fertiliser applied to the soil into NH_3 and CO_2 with the concomitant rise in soil pH[3]. This, in turn, results in a rapid nitrogen loss to the atmosphere through NH_3 volatilisation[4]. Due to this role, urease activities in soils have received a lot of attention since it was first reported by[5] a process considered vital in the regulation of nitrogen supply to plants after urea fertilization.

Often, urea is the main source of nitrogen in many crops including flooded or irrigated rice and maize in many parts of Africa and Asia[6]. Despite the importance of this fertiliser, its efficiency has been reported as low[7] due to substantial nitrogen lost to the atmosphere through volatilisation, a process mediated by the urease enzyme[8].

METHODS

Soil

The soil pertaining to the experimental setup was collected from the region of Aligarh (Atrauli, Gabhana, Iglas, Khari and Koil) in winter season (January 2022). The soil collected was sieved through 2 mm mes before its transportation to the laboratory and stored at room temperature.



Site Map

PESTICIDES

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 PROCEDURES

SOIL ANALYSIS

To determine the Physicochemical characteristics of soil (control) and selected pesticides with soil of Aligarh region (Atrauli, Gabhana, Iglas, Khari and Koil). 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 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[9] and Walkely and Black's Rapid titration method (1934)[10] respectively, total phosphorous (TP) were determined spectrophotometrically[11] While total potassium (TK) were detected by flame photometer.[12]

Enzymatic activities

- To determine the dehydrogenase activity, 0.4% 2-p-iodophenyl-3-p-trinitrophenyl terazolium chloride (TTC) was used as substrate. Triphenyl formazan (TPF) produced in the reduction of TTC was measured with spectrophotometer at 490 nm.[13]
- To determine the urease activity, 0.03 M N-x-benzoyl-1-argininamide (BAA) and 6.4% urea, respectively, were used as substrates. The ammonium released by the two hydrolytic reactions were measured by an ammonium selective electrode.[14]

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 soil[14] 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). The role of catalase enzyme in various aspects of biocremediation catalase has proven to be one of the most abundant and easily available enzymes in soil.[15] The activity of the majority of enzymes was positively correlated with the content of mineral nitrogen, phosphorus, and potassium.[16] The climate change and human activities, change the biomass, vegetation species composition, and soil nutrient input sources and thus affects of soil nutrient cycling and enzyme activities.[17] The effect of pesticides on enzymatic activities of dehydrogenase and urease enzymes slightly decrease in collected soil without pesticides.[18]

Thus the effects of pesticides on enzyme activity of dehydrogenase and urease enzymes in soil of Aligarh region (Atrauli, Gabhana, Iglas, Khair and Koil) were observed in the present study, facts are shown below.

Table 1 : Physico-chemical characteristics of soil of Aligarh (Atrauli, Gabhana, Iglas, Khair and Koil) 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 (%)
ATRAULI REGION						
7.61	7.64	0.40	12.98	333.10	158.03	0.56
GABHANA REGION						
7.49	7.70	0.38	13.07	342.78	163.26	0.58
IGLAS REGION						
7.55	7.88	0.35	13.80	329.11	151.90	0.52
KHAIR REGION						
7.58	7.83	0.40	13.96	351.06	155.15	0.61
KOIL REGION						
7.44	7.50	0.28	12.76	309.66	149.60	0.50

Table 2 : Dehydrogenase Activity of Atrauli in winter season (January 2022) (µg TPF g^{-1} $24hr^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.85	15.86	15.86 ± 0.03
		2	15.83		
		3	15.91		
2	Sa	1	13.60	13.97	13.97 ± 0.29
		2	14.33		
		3	13.99		
3	Sb	1	12.58	12.66	12.66 ± 0.10
		2	12.59		
		3	12.81		
4	Sc	1	13.55	13.85	13.85 ± 0.26
		2	13.80		
		3	14.20		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 1 : Dehydrogenase Activity of Atrauli in winter season (January 2022) (µg TPF g^{-1} 24hr^{-1})

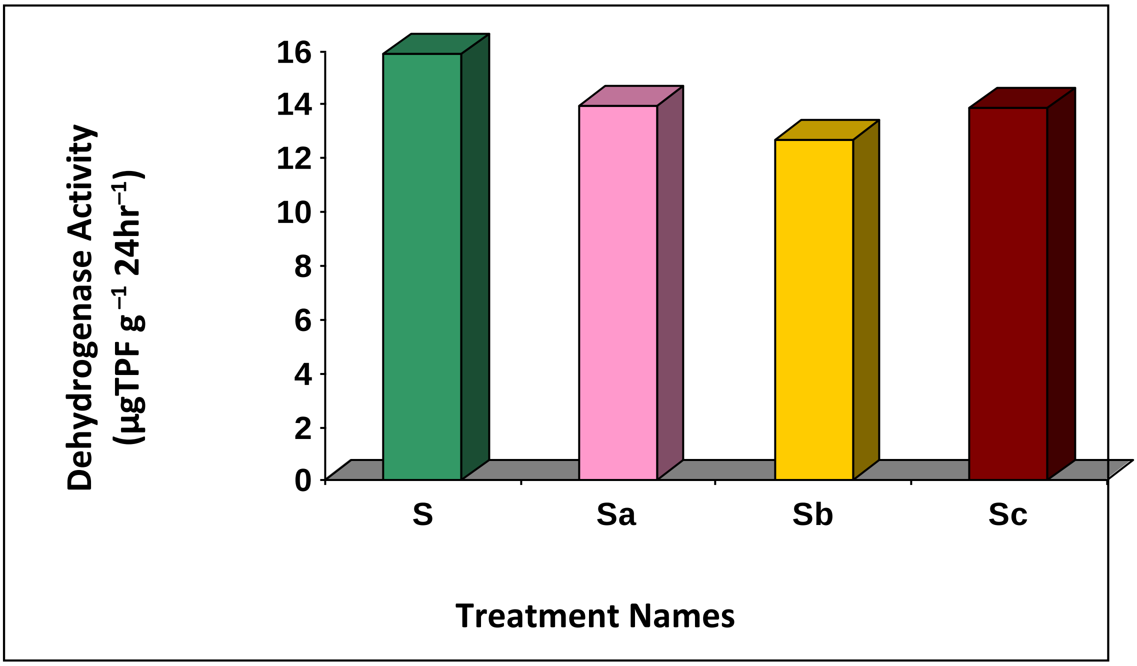


Table 3: Dehydrogenase Activity of Gabhana in winter season (January 2022) (µgTPF g^{-1} 24hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	15.96	16.14	16.14 ± 0.36
		2	15.81		
		3	16.65		
2	Sa	1	14.30	13.88	13.88 ± 0.52
		2	13.15		
		3	14.20		
3	Sb	1	14.97	14.91	14.91 ± 0.04
		2	14.92		
		3	14.86		
4	Sc	1	14.65	14.88	14.88 ± 0.18
		2	14.90		
		3	15.10		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 2 : Dehydrogenase Activity of Gabhana in winter season (January 2022) (µgTPF g $^{-1}$ 24hr $^{-1}$)

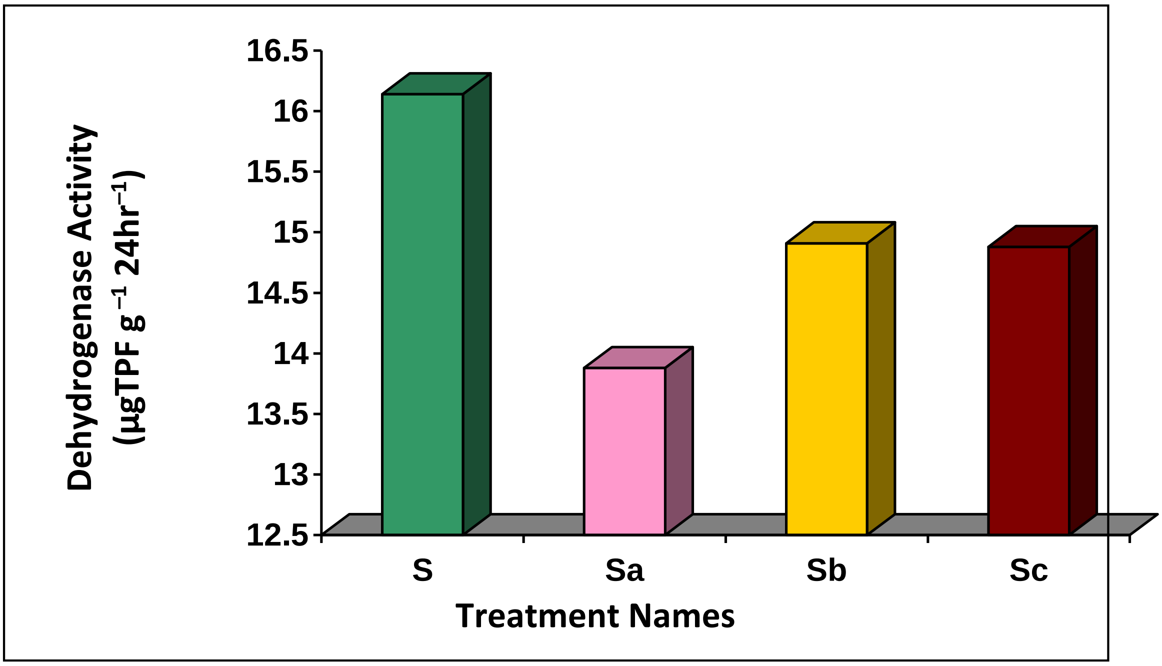


Table 4 : Dehydrogenase Activity of Iglas in winter season (January 2022) (µgTPF g $^{-1}$ 24hr $^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	18.68	18.87	18.87 ± 0.13
		2	18.96		
		3	18.97		
2	Sa	1	16.83	16.82	16.82 ± 0.13
		2	16.98		
		3	16.66		
3	Sb	1	15.70	15.71	15.71 ± 0.02
		2	15.75		
		3	15.70		
4	Sc	1	18.91	18.10	18.10 ± 0.65
		2	18.09		
		3	17.30		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 3 : Dehydrogenase Activity of Iglas in winter season (January 2022) (μg TPF g^{-1} $24hr^{-1}$)

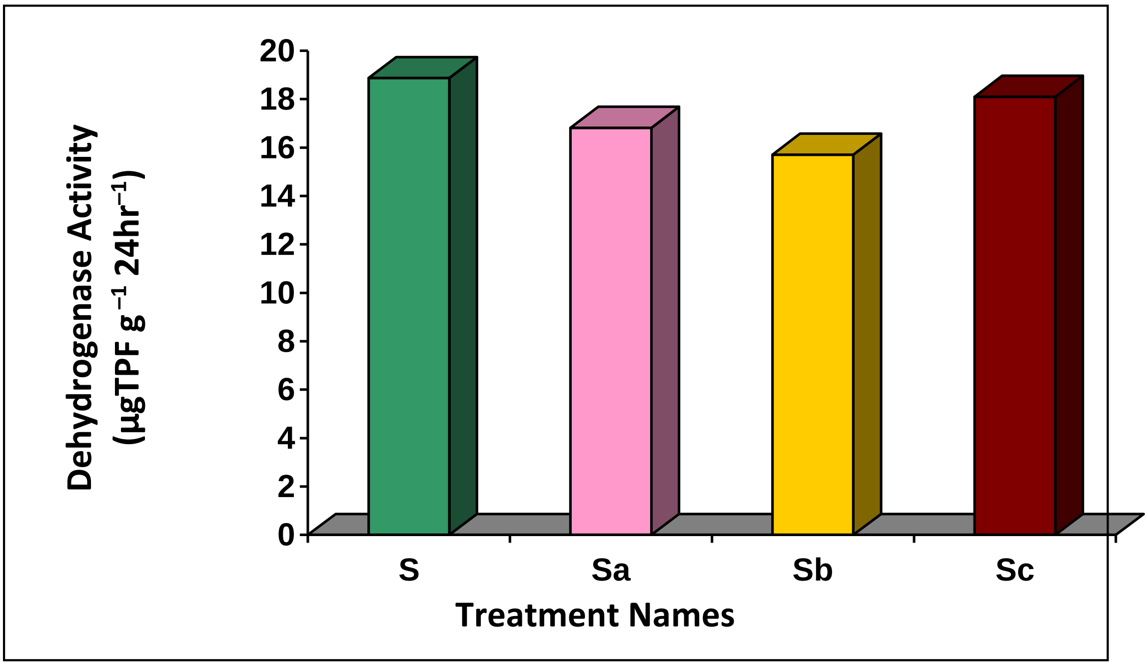


Table 5 : Dehydrogenase Activity of Khair in winter season (January 2022) (μgTPF g^{-1} $24hr^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	17.65	17.63	17.63 ± 0.01
		2	17.63		
		3	17.61		
2	Sa	1	16.72	16.63	16.63 ± 0.08
		2	16.66		
		3	16.52		
3	Sb	1	15.76	15.71	15.71 ± 0.05
		2	15.73		
		3	15.64		
4	Sc	1	18.93	18.49	18.49 ± 0.34
		2	18.10		
		3	18.44		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 4 : Dehydrogenase Activity of Khair in winter season (January 2022) (µg TPF g^{-1} $24hr^{-1}$)

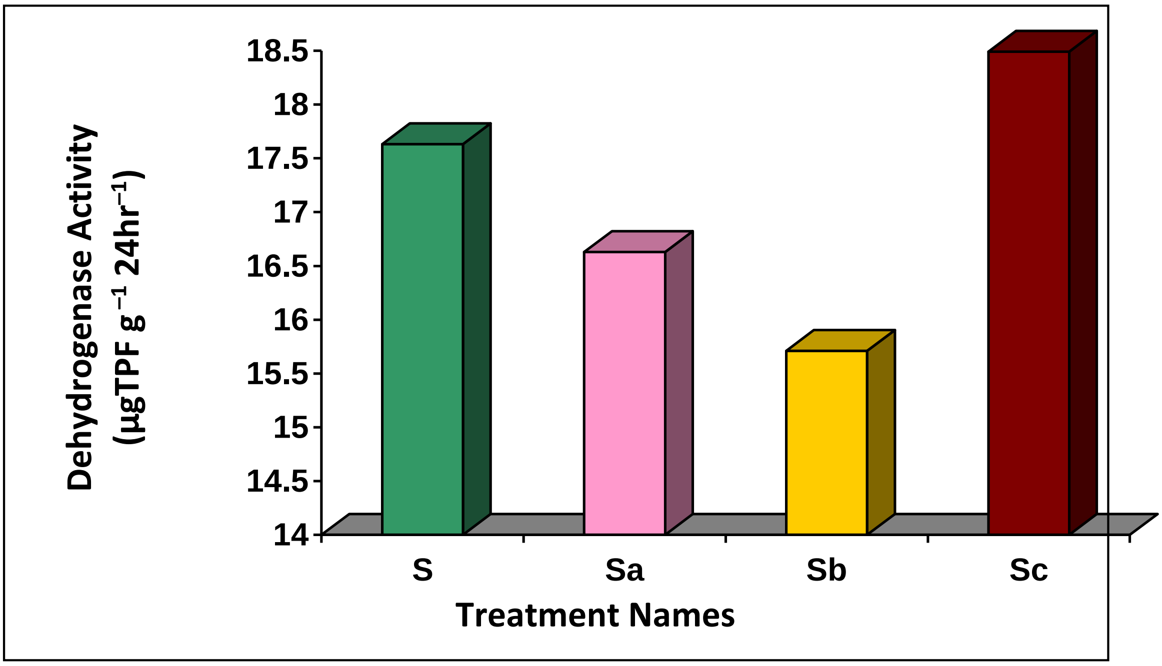


Table 6 : Dehydrogenase Activity of Koil in winter season (January 2022) (µgTPF g^{-1} $24hr^{-1}$)

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	17.85	17.50	17.50 ± 0.86
		2	18.35		
		3	16.32		
2	Sa	1	16.73	16.76	16.76 ± 0.04
		2	16.83		
		3	16.73		
3	Sb	1	15.73	15.12	15.12 ± 0.61
		2	15.35		
		3	14.28		
4	Sc	1	17.92	17.83	17.83 ± 0.13
		2	17.94		
		3	17.65		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 5 : Dehydrogenase Activity of Koil in winter season (January 2022) (µg TPF g $^{-1}$ 24hr^{-1})

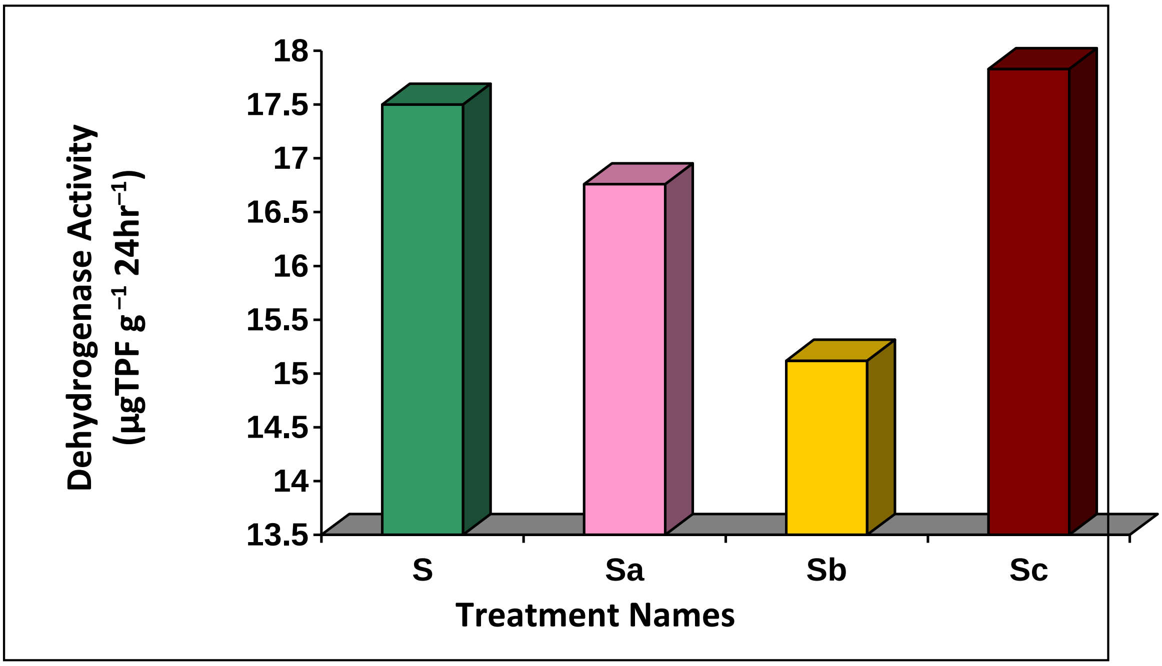


Table 7 : Urease Activity of Atrauli in winter season (January 2022) (µg ammonia g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	26.52	26.66	26.66 ± 0.11
		2	26.68		
		3	26.80		
2	Sa	1	25.44	25.08	25.08 ± 0.53
		2	25.48		
		3	24.32		
3	Sb	1	20.5	20.01	20.01 ± 1.25
		2	18.34		
		3	21.36		
4	Sc	1	25.65	24.40	24.40 ± 0.98
		2	23.25		
		3	24.30		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 6 : Urease Activity of Atrauli in winter season (January 2022) (μg ammonia g^{-1} hr^{-1})

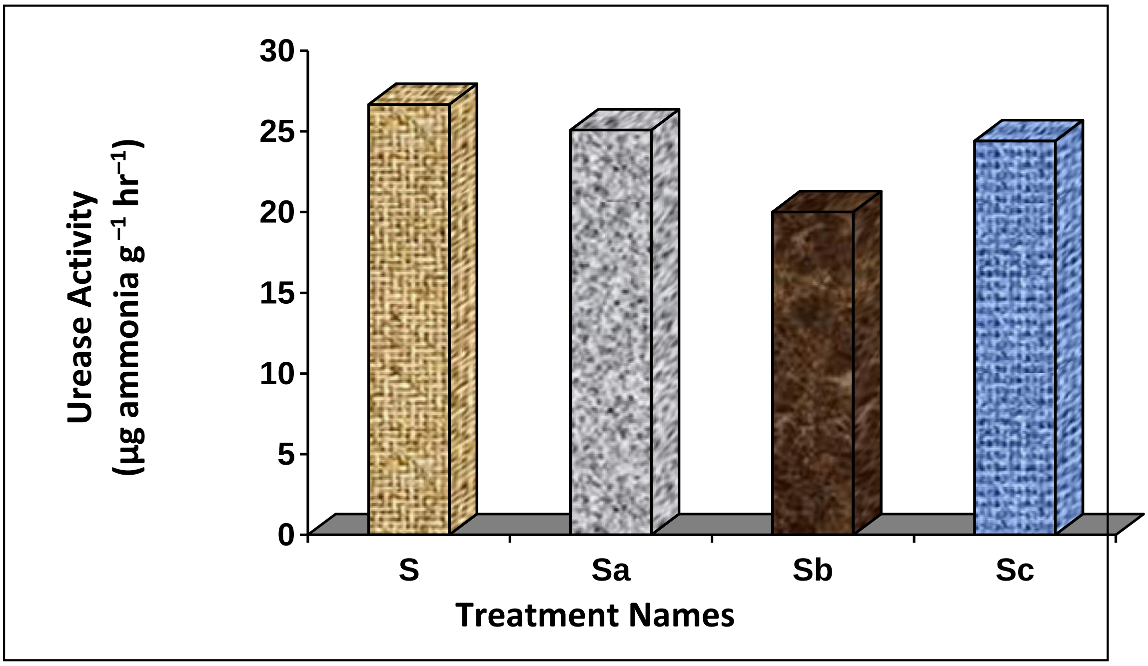


Table 8 : Urease Activity of Gabhana in winter season (January 2022) (μg ammonia g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Activity	Mean	Mean ± Standard Deviation
1	S	1	29.98	29.19	29.19 ± 0.57
		2	28.97		
		3	28.63		
2	Sa	1	25.66	25.66	25.66 ± 0.26
		2	25.98		
		3	25.34		
3	Sb	1	24.65	24.65	24.65 ± 0.26
		2	24.98		
		3	24.34		
4	Sc	1	27.80	27.42	27.42 ± 0.49
		2	26.73		
		3	27.75		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 7 : Urease Activity of Gabhana in winter season (January 2022) (µg ammonia g^{-1} hr^{-1})

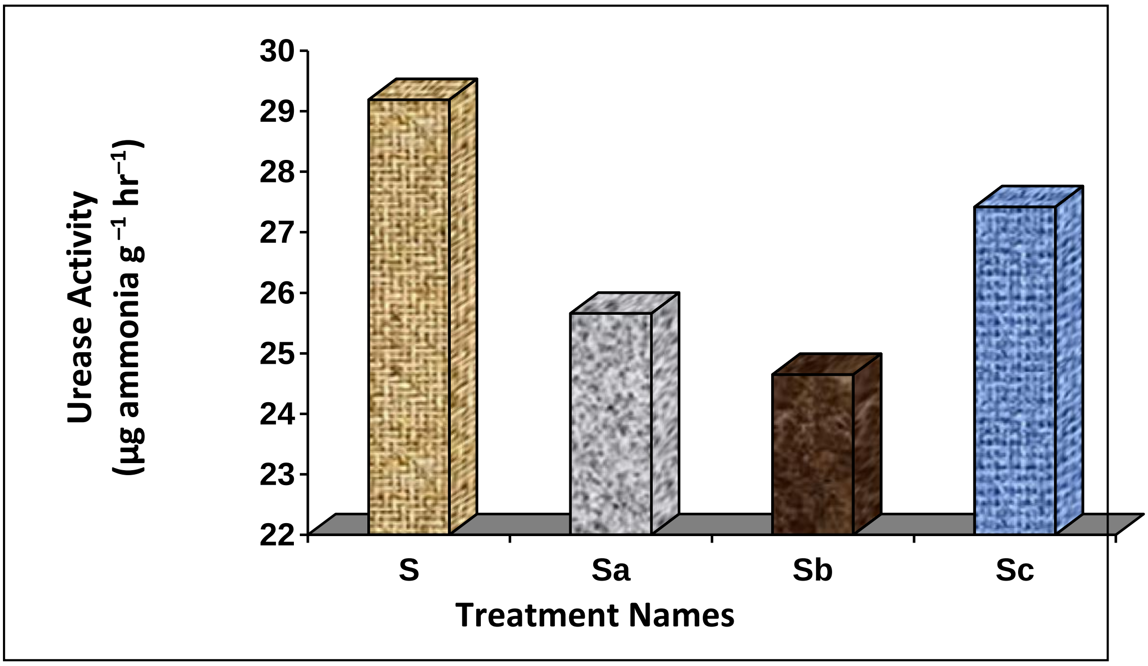


Table 9 : Urease Activity of Iglas in winter season (January 2022) (µg ammonia g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Results	Mean	Mean ± Standard Deviation
1	S	1	38.45	38.76	38.76 ± 0.59
		2	39.60		
		3	38.25		
2	Sa	1	30.26	30.11	30.11 ± 0.40
		2	30.53		
		3	29.56		
3	Sb	1	35.46	35.45	35.45 ± 0.83
		2	36.47		
		3	34.43		
4	Sc	1	28.93	29.52	29.52 ± 0.22
		2	29.30		
		3	29.45		

S = soil;

Sa = soil + acephate pesticide;

Sb = soil + acetamiprid;

Sc = soil + imidacloprid.

Figure 8 : Urease Activity of Iglas in winter season (January 2022) (µg ammonia g^{-1} hr^{-1})

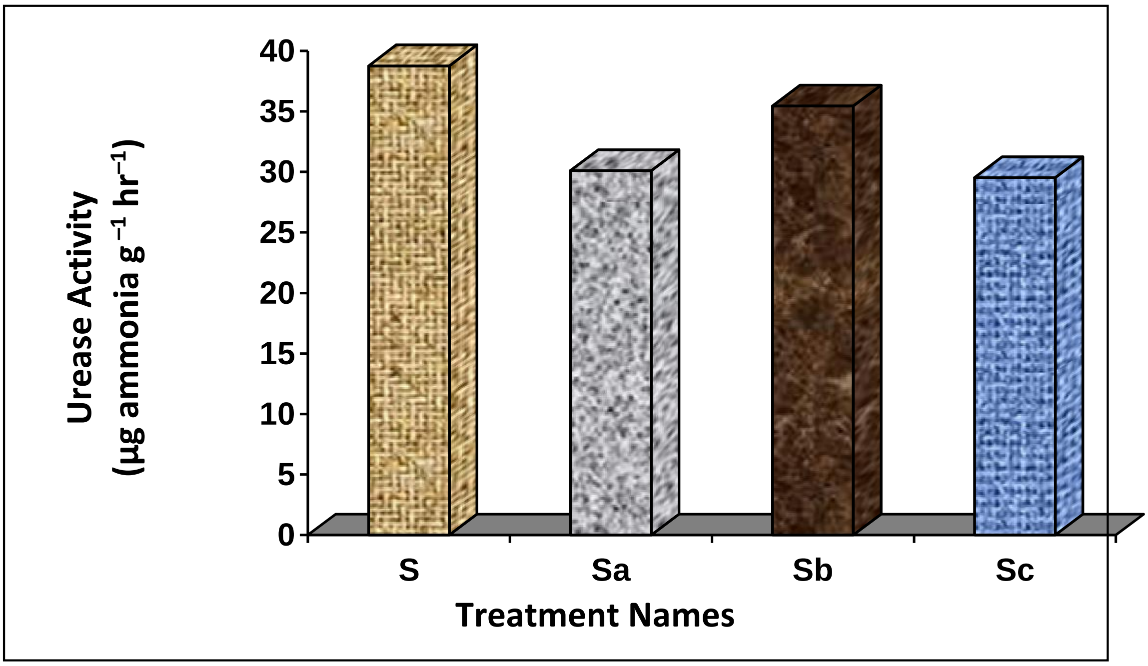


Table 10 : Urease Activity of Khair in winter season (January 2022) (µg ammonia g^{-1} hr^{-1})

Sample code	Treatment Name	Replicates	Results	Mean	Mean ± Standard Deviation
1	S	1	40.61	38.95	38.95 ± 1.23
		2	38.63		
		3	37.63		
2	Sa	1	32.26	32.24	32.24 ± 0.02
		2	32.21		
		3	32.25		
3	Sb	1	35.96	35.62	35.62 ± 0.49
		2	35.98		
		3	34.93		
4	Sc	1	27.94	28.54	28.54 ± 0.53
		2	29.25		
		3	28.45		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 9 : Urease Activity of Khair in winter season (January 2022) (µg ammonia g $^{-1}$ hr $^{-1}$)

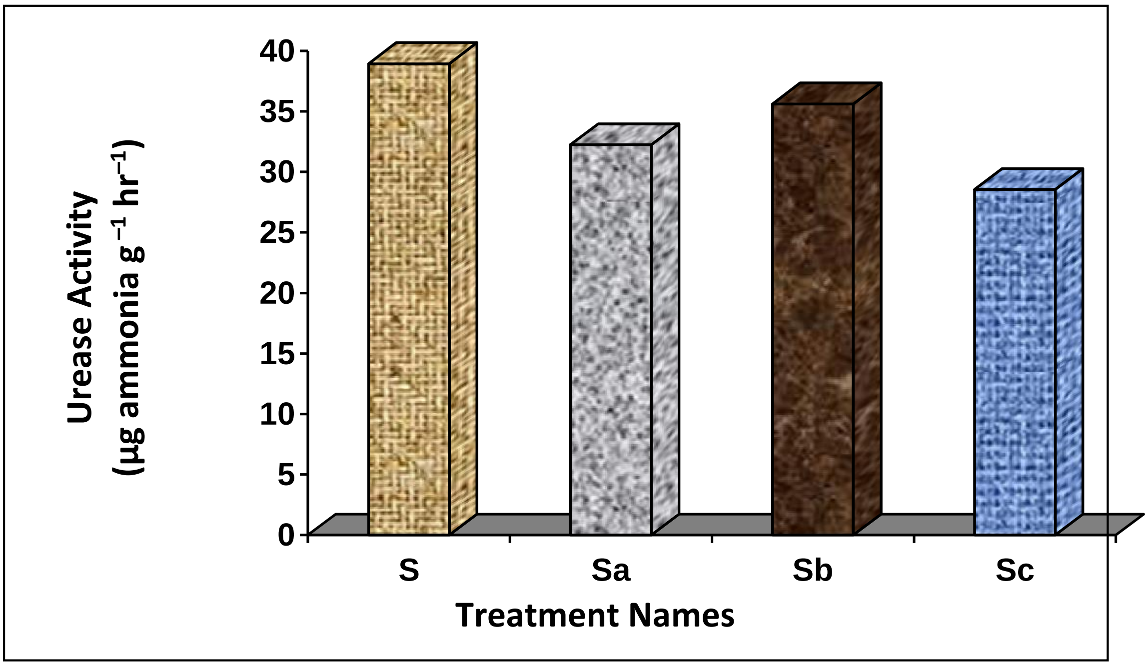
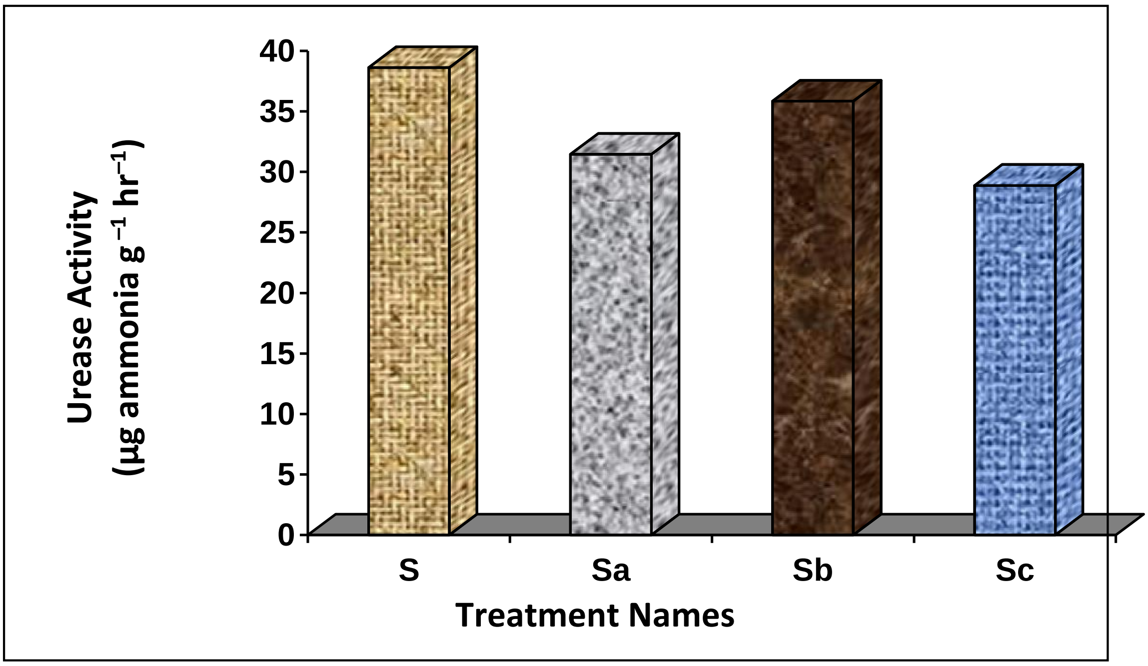


Table 11 : Urease Activity of Koil in winter season (January 2022) (µg ammonia g $^{-1}$ hr $^{-1}$)

Sample code	Treatment Name	Replicates	Results	Mean	Mean ± Standard Deviation
1	S	1	39.60	38.62	38.62 ± 0.80
		2	38.63		
		3	37.63		
2	Sa	1	31.26	31.45	31.45 ± 0.13
		2	31.53		
		3	31.56		
3	Sb	1	35.98	35.85	35.85 ± 0.14
		2	35.93		
		3	35.65		
4	Sc	1	28.94	28.88	28.88 ± 0.32
		2	29.25		
		3	28.45		

S = soil;
Sa = soil + acephate pesticide;
Sb = soil + acetamiprid;
Sc = soil + imidacloprid.

Figure 10 : Urease Activity of Koil in winter season (January 2022) (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, Gabhana, Iglas, Khari and Koil) slightly decrease as compared to without pesticides in soil of Aligarh region. The effects of imidacloprid pesticides on soil enzyme activity decrease of dehydrogenase and urease as compared to acetamiprid and acephate pesticides.

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