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EFFECT OF COMMONLY USED INSECTICIDES VIZ., CYPERMETHRIN AND IMIDACLOPRID ON THE ENZYME ACTIVITY OF SOIL PHOSPHATASE IN THE SLIT LOAM SOIL OF KANNAUJ REGION (INDIA)

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ABSTRACT: Soil microbial diversity is indispensable to maintain functional diversity and enzyme- mediated critical soil processes that detoxify soil from environmental pollutants, like pesticides. Due to excessive use of insecticides viz., imidacloprid and cypermethrin for controlling the insects on cotton, lettuce pecans etc in india, the present study was carried out to assess the effect of different concentrations of the insecticides viz., cypermethrin and imidacloprid on the activities of soil phosphatase in the slit loam soil of Kannauj region, india. In comparison to control (untreated soil), the application of imidacloprid at higher concentration exhibited an inhibitory effect on soil phosphatase over the incubation time .The enzyme activities in soil related with 5.34 and 7.12 µg a.i g^{-1} dry soil were significantly lower than the control over the course of incubation .The response of soil phosphatase to different concentrations of cypermethrin did not show significant difference between the treated soil samples and the control with the incubation period. However a slight incubation was observed at higher concentrations of cypermethrin.

KEY WORDS; Microbial activity, insecticide, Soil microbial enzymes.

INTRODUCTION: Arable land is often amended with agrochemicals like fertilizers and pesticides to increase agriculture productivity, and such practices are an integral part of modern agriculture. In a country like India, the greatest challenge in improving agricultural productivity still remains the curtailment of crop losses due to pests , estimated at about 50% of total food production and 20-30% of sown crops valued at Rs 900 billion per annum (Anonymous 2002). The insecticide viz., imidacloprid and cypermethrin are extensively used for controlling the insects on cotton , lettuce and pecans, but they have the potential to effect the quality of soil and hence the biodiversity in soils. Because of their relationship to soil biology and rapid response to changes in soil management, soil enzymes are recognized as sensitive indicators of soils health and quality (**Bandick and Dick, 1999; Caldwell, 2005; Dick etal.1996)** In fact, they been related to soil physico- chemical characteristics (Amander etal.1997), microbial community structures **(Kourtev et al. 2002)** and disturbance**(Boerner et al.2000)** with respect ions to pesticides, however so little has been done in so few locations that broad generalizations cannot be drawn **(Schaffer 1993).** Thus the present investigation was aimed to specifically focus on the effects of cypermethrin and imidacloprid at different active ingredient concentrations on the key enzyme phosphatase involved in phosphorous cycling in slit loam soil, which is commonly found in Kannuaj region (India).

MATERIALS AND METHODS

Insecticide Application: Cypermethrin{ (+/-) alpha cyano-(3-phenoxy phenyl) methyl(+) cis,trans-3(2,2 dichloroethyl) 2,2 dimethyl cyclopropane carboxylate} is a synthetic pyrithroid used in large scale commercial applications as well as in consumer products for domestic purposes. It behaves as a fast acting neurotoxin in insects. In india cypermethrin is predominantly used to kill insects on cotton, lettuce etc. The application rates in the present study include:

(a) control i.e. without cypermethrin

(b) 5 µg a.i g^{-1} cypermethrin

(c)7. 5 µg a.i g^{-1} cypermethrin

(d) 10 µg a.i g^{-1} cypermethrin

Imidacloropid is a neonicotinoid insecticide, used widely on a wide array of plants including major crops. Its IUPAC name is (+/-) alpha-cyano-(3-phenoxy phenol) methyl (+) – cis, trans-3-(2,2-dichloro ethyl) -2,2-dimethyl cyclopropane carboxylate. The application rates in the present study include.

(a) control without imidacloprid

(b) 3.5 g a.i g^{-1} imidacloprid

(c) 5.34 g a.i g^{-1} imidacloprid

(d) 7.21 g a.i g^{-1} imidacloprid

SOIL ENZYME ASSAYS:

Activity of phosphatase was assayed according to **Tabatabai and Bremner (1969)** and **Eivazi and Tabatabai (1977**) 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:

ALKALINE PHOSPHATASE ACTIVITY

The effect of different active ingredient concentrations of imidacloprid and cypermethrin on soil phosphhatase is presented in **Table 1** and **Table 2** and the same results are depicted in **TABLE 1** : Enzyme activity of soil phosphatase as affected by different concentrations of imidacloprid (17.8% SL)

Days of incubation	**Concentration of imidacloprid (μg a.i g^{-1} soil)**			
	0	**3.56**	**5.34**	**7.12**
0	48.33	43.13	40.51	38.64
7	46.91	40.53	35.35	36.33
14	48.10	40.93	38.63	35.91
21	49.43	38.83	37.79	37.11
28	45.11	39.43	37.34	35.43
35	43.13	37.73	35.91	30.23

SYMBOLS : a.i : Active ingredient, SL : Soluble (liquid) concentrate

The response of phosphatase to imidacloprid was note worthy. The results showed that imidacloprid exhibited an inhibitory effect on soil phosphatase over the incubation time. The enzyme activities in soil treated with 5.34 and 7.12 μg a.i g^{-1} of dry soil were significantly lower than the control over the course of incubation.

TABLE 2 : Enzyme activity of soil
phosphatase as affected by different concentrations of cypermethrin (25% EC)

Days of incubation	**Concentration of Cypermethrin (μg a.i g^{-1} soil)**			
	0	**5**	**7.5**	**10**
0	46.23	45.33	46.93	41.72
7	45.11	43.14	47.81	40.34
14	43.23	44.73	40.40	42.14
21	45.83	40.44	38.35	39.31
28	47.43	42.79	41.19	38.53
35	42.12	43.33	40.34	39.23

SYMBOLS : a.i = active ingredient, EC = Emulsifiable concentrate

The response of soil phosphatase to different concentrations of cypermethrin did not show significant difference between the treated soil samples and the control with the incubation period. However a slight inhibition was observed at higher concentrations of cypermethrin.

DISCUSSION

In the present study imidacloprid and cypermethrin acted differently towards phosphatase. Imidacloprid had an inhibitory effect on the phosphatase at the concentrations taken relative to the control. However no marked effect was observed with the experimental concentrations of cypermethrin. Because of the involvement of soil alkaline phosphatase in making phosphate available to crop plants **(Somervillee and Greaves 1987),** soil phosphatase has been extensively studied in relation to pesticide use. **Atlas et al. (1978)** reported no change in soil phosphatase activity in response to application of folpet and captafol, Tarafdar(1968) observed a decrease in phosphatase activity due to fluchloralin, methabenzthiazuron, metoxuron, 2,4- D and isoproturon applied at recommended field rates. However stimulation in phosphatase activity under the influence of paraquat, trifluralin, glyphosate and atrazine has been reported by Hazel and Greaves(1981). The results of the present study suggest that insecticide application affects activity of soil phosphatase differently. While the activity of soil phosphatase were generally inhibited in response to imidacloprid. However a feable inhibition in its activity was observed at higher concentration of cypermethrin. Thus, a judicious use of cypermethrin for control of insects on cotton is recommended so as to prevent adverse impacts on the biology and biochemistry of the soil. However the excessive use of imidacloprid should be avoided as the present study revealed its deleterious effect on soil alkaline phosphatase at higher active ingredient concentration.

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