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Leaching of Bifenthrin in Sandy Soil Under Laboratory Condition

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ABSTRACT: *Leaching studies of bifenthrin in sandy soil was carried out under laboratory conditions.Plexi glass columns (90 cm x 5 cm i.d) fitted with perforated plexi glass sieve covered with filter paper (Whatmann No.1) at the bottom were used Commercial formulation of bifenthrin available as Talstar 10 % EC was applied at two treatment levels i.e. 25 and 50 µg as single and double dose, respectively. Estimation of micro quantities of bifenthrin residues in leachate as well as in soil samples were carried out by GC-ECD system equipped with capillary column. Total amount of bifenthrin recovered out of 25 and 50µg were 88.00 and 90.50 per cent from single and double dose, respectively. More than 90 per cent of bifenthrin was retained in 15 cm soil section which shows the immobility of this pyrethroid insecticide in soil. Beyond the depth of 25 cm of soil, the amount of bifenthrin could not detected in any of the doses. No residues were detected in the leachate fractions of the insecticide.*

Key words: Bifenthrin, Leaching, Residues, Soil.

Over use of pesticide is the contamination of soil and water sources including the aquatic system. Several scientists reported effect of pesticides in soil (Frampton et al. 2006[4]; Coupe et al. 2005[3]; Willian and Mueller 1994[10]; Balasubramanya and Patil 1980)[1]. Bifenthrin (2-Methyl-3-phenyl phenyl methyl (1*S*, 3*S*)-3-(Z)-2-chloro-3,3,3-triflouroprop-1-enyl 2,2-dimethylcyclopropane-1-carboxylate; Fig. 1) is a third generation pyrethroid. It is used in agriculture, public health and forestry. Pesticides may have potential to bind to soil, the extent of which depends greatly on the nature of the chemical used. Therefore it has been observed that the physico-chemical nature of the soil is important for the persistence, metabolism and binding of pesticides in soil. They include sorption to soil constituents, movement of the soil in runoff, movement into the air by volatilization, movement downward in the soil by leaching, and movement upward in the soil through capillary forces. The main processes potentially affecting the ultimate fate of pesticides in soil are retention by soil materials (involving adsorption/desorption processes), transformation processes (biological and chemical degradation), and transport (through soil, atmosphere, surface water, or ground water) (Saltzman and Yaron 1986[7]; van der Hoff and van Zoonen 1999)[9]. The present study was undertaken to determine the leaching of bifenthrin in sandy soil at different doses under laboratory condition.

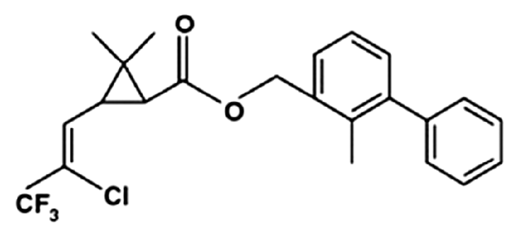

Figure. 1 Chemical structure of bifenthrin

MATERIALS AND METHODS

Leaching studies was carried out in sandy soil. Soil was collected from Haryana. The physico- chemical properties of the soil are presented in Table 1.

For laboratory experiment, plexi glass columns (90 cm x 5 cm i.d) fitted with perforated plexi glass sieve covered with filter paper (Whatmann No.1) at the bottom were used. Each column was filled with

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Table 1
Physico-chemical characteristics of Sandy soil

Soil Property						
Texture	pH	EC_e (dSm^{-1})	O.C. (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Sand	7.85	0.21	0.92	90	10	102

soil up to 60 cm height to a uniform bulk density of 1.20 g cm^{-3} ± 0.1. Weighed amount of sandy soil 118 g was poured in the different columns each time with the help of a funnel (1 cm i.d) tapped gently from a fixed height and pressed uniformly by a wooden roller. The soil in each column was covered with a filter paper which was topped by a glass wool swab. Soil column so filled were installed vertically on wooden stand with their bottom resting on the fixed perforated sieve, so as to facilitate collection of effluents during leaching.

Leaching studies were carried out in triplicates. Soil (5 g) was fortified with 25 µg (single dose) and 50 µg (double dose) solution of bifenthrin. Added this fortified soil at the top of the column. Cotton swabs prewashed with acetone, dried and were placed on top of soil to avoid disturbance of soil. One column packed with soil was kept as control to which no pesticide was added.

Each time 50 mm lot of leaching water (98 ml) was added with the help of a pipette, with the care that no spattering of soil took place. The leaching with the next 50 mm lot of distilled water was done after 24 hrs. After the disappearance of the standing water in the column, leaching was repeated till each leaching cycle of 200, 400 and 600 mm depth was completed. During leaching, the columns were covered with perforated polythene bags to minimize the loss of leaching water due to evaporation. During leaching 2-3 drops of toluene solution was added to each column to check microbial growth in it.

Leachate oozing out of all the column were collected and processed for the presence of bifenthrin.Total three fraction of leachates were collected.Collect 10 ml of each fraction. After completion of leaching, intact soil cores were taken out of the plexi glass column. Leachate samples were processed as per method of Kumari et al. (2008)[5].

Leachate sample was taken in 250ml separatory funnel, to which 5g sodium chloride was added.

The solution was partitioned with 15% dichloromethane (DCM) in hexane thrice (30, 20, 10 ml) by shaking vigorously for 1 minute every time. The organic layers were collected and passed through 2-3 cm pad of anhydrous sodium sulphate.The organic layer was evaporated to near dryness on rotary evaporator followed by gas manifold evaporator.The residues were redissolved in n- hexane to make final volume to 2 ml for GC analysis.

Extraction and clean-up of soil sample was carried out as per method of Kumari et al. (2008)[5]. Ground, sieved and dry representative (15 g) of soil mixed with charcoal and florisil (0.3 g each) and 10 g of anhydrous sodium sulphate. The mixture was packed compactly in a glass column (60 cm × 22 mm) in between two layers of anhydrous sodium sulphate. Residues were eluted with 100 mL of hexane:acetone (9:1 v/v) at flow rate of 2–3 mL/min. The eluate was concentrated on flash evaporator and made the final volume to 2 mL for GC analysis. Estimation of micro quantities of bifenthrin residues in leachate as well as in soil samples were carried out by GC-ECD system equipped with capillary column.

RESULTS AND DISCUSSION

The data on leaching potential of bifenthrin in sandy soil are presented in Table 2 and Fig. 3. Total amount of bifenthrin recovered out of 25 and 50µg were 88.00 and 90.50 per cent from single and double dose, respectively**.** Beyond the plough depth (25 cm) of the soil, the amount of bifenthrin could not be detected in any of the doses. None of the leachate fractions from both the treatments showed the presence of bifenthrin residues.

Table 2
Per cent recovery of bifenthrin in sandy soil

Fortification levels(mg kg $^{-1}$)	*Average Recoveries* (%)±SD*
0.10	88.00±1.56
0.25	90.50±2.40
Mean	89.25

*Average of three replicates

Similar results were observed by Chauhan et al. (2011) [2]for leaching behaviour of bifenthrin and lambda-cyhalothrin in sandy loam soil. More than 90 % of bifenthrin as well as lambda-cyhalothrin were retained in 5 cm soil section, which shows their immobility in soil. Both the insecticides restricted up to ploughed soil (15 cm depth) in both the doses.

Table 3
Leaching behaviour of bifenthrin in sandy soil

Depth (cm) Soil Column	*Residues (µg)* Single dose (25 µg) ±SD*	*% Retention*	*Double± dose (50µg) SD*	*% Retention*
	15.75±1.52	71.59	32.25±2.5	71.27
5-10	3.25±0.04	14.77	5.50±2.1	12.15
10-15	2.25±0.03	10.22	4.00±2	8.84
15-20	0.75±0.03	3.40	2.50±0.3	5.52
20-25	BDL	-	1.00±0	2.20

*Average residues of three replicates
Leachate contained no residues

Manoj and Gajbhiye (2007) [6]reported low mobility of bifenthrin in soil. Its residues remained with in top 15 cm and more than 99 percent of residues were recovered from top 0-10 cm layer. Tariq et al. (2006) [9]reported highest concentrations of lambda-cyhalothrin were found in the top 0–10 cm layer.

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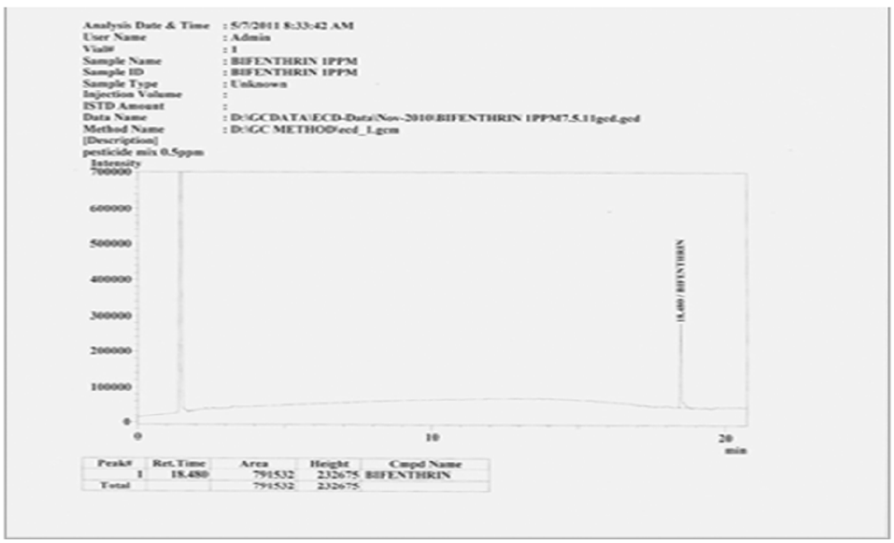
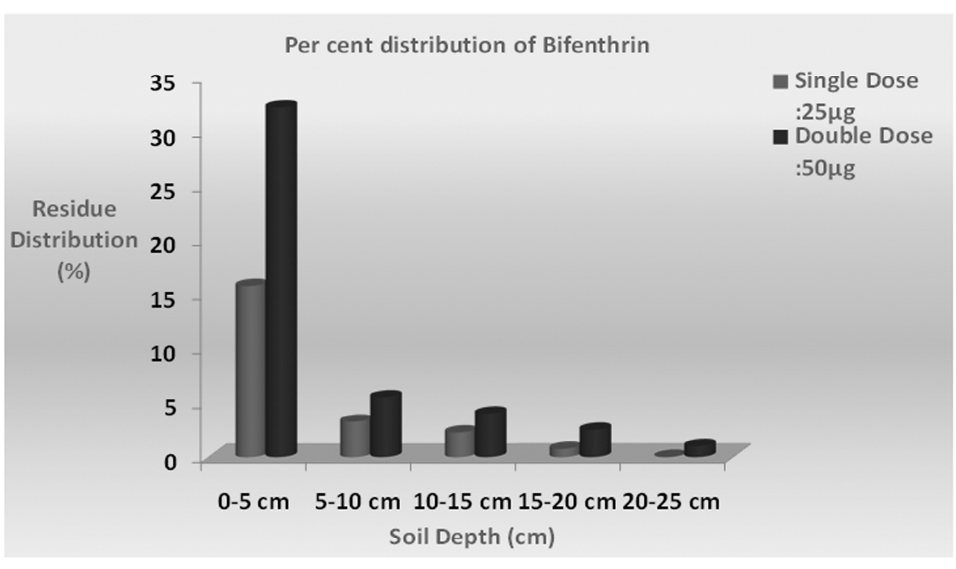


Chromatogram of Bifenthrin



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