Indian Journal of Applied Entomology **26**(1) : 6–9 (2012)

PERSISTENCE AND RESIDUAL TOXICITY OF NEW INSECTICIDES AGAINST *HELICOVERPA ARMIGERA* (HÜBNER) IN TOMATO

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ABSTRACT

Among the new insecticides evaluated against *H. armigera* on tomato, flubendiamide 480 SC @ 125 and 150 ml/ha persisted for the shortest period of 11 days during both the years. Persistence toxicity (PT) values for flubendiamide 480 SC @ 125 and 150 ml/ha were 531.66, 553.04 and 537.77, 565.27 during 2008–09 and 2009–10, respectively; whereas, the corresponding lethal time (LT_{50}) values were 4.78, 5.18 days and 4.93, 5.32 days during both the years, respectively, The highest persistent toxicity and LT_{50} values of 1003.84, 1000.65 and 8.83, 9.29 were recorded in case of endosulfan 35 EC during 2008–09 and 2009–10, respectively.

Key words: *H. armigera*, Tomato, Flubendiamide, Residual Toxicity, Persistence

INTRODUCTION

Vegetables constitute an important part of our dietary menu. The tomato is an important vegetable crop, which is cultivated throughout the year in the country. Various factors have been recognized which are responsible for low yield of tomato. Among all the known factors, insect pests are of prime importance and significantly affect the production. Almost all the stages of tomato crop right from nursery to maturity are attacked by a large spectrum of insect pests. Tomato fruit borer, *Helicoverpa armigera* (Hub.) is a very important pest which causes 40–50 per cent damage to the tomato crop (Pareek and Bhargava, 2003). The old and traditional insecticides became ineffective for the management of *H. armigera*, even if these are used at very higher doses. In such situation, newer group of insecticides offer great scope as they maintain higher toxicity to insects at lower doses and are not persisted in environment as conventional insecticides (Singh and Singh, 2000).Therefore, efforts were made to work out the persistence and residual toxicity of newer insecticides against *H. armigera*.

MATERIALS AND METHODS

The persistence and residual toxicity resulting from three foliar application of insecticides *viz*., beta–cyfluthrin 2.5 SC, flubendiamide 480 SC, indoxacarb 14.5 SC, lambda–cyhalothrin 5 EC and endosulfan 35 EC were determined on tomato against 3 to 4 days old larvae of *H. armigera* which were used as test insect. The test insect was reared on natural food (tomato fruits) and on semi–synthetic diet based on chickpea flour (Anonymous, 1995) for getting regular supply of culture. The sprayed leaves and fruits were taken at regular intervals from field. Ten larvae of *H. armigera* were released individually in each sprayed material after 0 (1–2 hours), 3, 5, 7, 9, 11, 13, 15, 17, 19 and 21 days of treatments and larval mortality was recorded. The released ten 3 to 4 day–old larvae of *H. armigera* were allowed to feed for 24 hours. A parallel control was run by providing untreated leaves and fruits of tomato. Before releasing the larvae on treated plant they were given pre–treatment conditions by feeding them 24 hours on untreated fruits and leaves of tomato. Mortality counts were made 24 hours after releasing the larvae on treated plant. Moribund insects were also counted as dead larvae.

Per cent mortality for each day sampling observations was corrected (Abbott, 1925) and the data were subjected to Probit analysis (Finney, 1971) for determination of LT_{50} values. The residual toxicity of each insecticide was also worked out as per the criteria suggested by Pradhan and Venkatraman (1962) in which persistent toxicity was taken as an index i.e.

$$\text{Persistent Toxicity} = P \times T$$

Where,

P = The period for which some toxicity observed (time in days upto which some mortality observed)

T= Average residual toxicity (mean corrected per cent mortality of the period P)

RESULTS AND DISCUSSION

The persistence and residual toxicity of insecticides were determined on tomato crop during *kharif* 2008–09 and 2009–10 based on PT values and LT_{50} and the results obtained are presented in Table 1 to 4. The data revealed

Table 1. Persistent toxicity of insecticides against 3 to 4 day–old larvae of *H. armigera* on tomato crop during *kharif* 2008–09

Treatments	Mean per cent mortality after different day intervals												
	1	3	5	7	9	11	13	15	17	19	21	P*	T**	PT***
T_1 Beta–cyfluthrin 2.5SC @ 700ml/ha	91.67	81.67	73.33	65.00	51.67	38.33	21.67	5.00	0.0	0.0	0.0	15	53.54	803.13
T_2 Beta–cyfluthrin 2.5SC @ 750ml/ha	95.00	83.33	75.00	66.67	53.33	40.00	23.33	8.33	0.0	0.0	0.0	15	55.62	834.35
T_3 Flubendiamide 480 SC @ 125ml/ha	98.33	85.00	56.67	40.00	23.33	10.00	0.0	0.0	0.0	0.0	0.0	11	52.22	574.43
T_4 Flubendiamide 480 SC @ 150ml/ha	98.33	86.67	58.33	41.67	28.33	13.33	0.0	0.0	0.0	0.0	0.0	11	54.44	598.87
T_5 Indoxacarb 14.5 SC @ 450ml/ha	93.33	81.67	70.00	55.00	38.33	15.00	6.67	0.0	0.0	0.0	0.0	13	51.42	668.57
T_6 Indoxacarb 14.5 SC @ 500ml/ha	96.67	83.33	73.33	56.67	38.33	16.67	8.33	0.0	0.0	0.0	0.0	13	53.33	693.32
T_7 Lambda–cyhalothrin 5 EC @ 300ml/ha	81.67	78.33	71.67	66.67	56.67	48.33	25.00	10.0	0.0	0.0	0.0	15	54.79	821.88
T_8 Lambda–cyhalothrin 5 EC @ 350ml/ha	83.33	78.33	73.33	68.33	58.33	50.00	28.33	11.67	0.0	0.0	0.0	15	56.45	846.84
T_9 Endosulfan 35 EC @ 1.25l/ha	90.00	80.00	76.67	71.66	61.66	56.67	41.67	28.33	16.67	3.33	0.0	19	52.83	1003.84

*P = Period (days); **T = Average toxicity; ***PT = Index of persistent toxicity

Table 2. Persistent toxicity of insecticides against 3 to 4 day–old larvae of *H. armigera* on tomato crop during *kharif* 2009–10

Treatments	Mean per cent mortality after different day intervals												
	1	3	5	7	9	11	13	15	17	19	21	P*	T**	PT***
T_1 Beta–cyfluthrin 2.5SC @ 700ml/ha	91.67	80.00	71.67	65.00	51.67	38.33	21.67	6.67	0.0	0.0	0.0	15	53.33	800.02
T_2 Beta–cyfluthrin 2.5SC @ 750ml/ha	95.00	83.33	75.00	66.67	53.33	40.00	23.33	10.00	0.0	0.0	0.0	15	55.83	837.48
T_3 Flubendiamide 480 SC @ 125ml/ha	96.67	86.67	55.00	38.33	23.33	6.67	0.0	0.0	0.0	0.0	0.0	11	51.11	562.22
T_4 Flubendiamide 480 SC @ 150ml/ha	98.33	86.67	58.33	40.00	28.33	10.00	0.0	0.0	0.0	0.0	0.0	11	53.61	589.71
T_5 Indoxacarb 14.5 SC @ 450ml/ha	93.33	81.67	68.33	56.67	35.00	13.33	5.00	0.0	0.0	0.0	0.0	13	50.47	656.18
T_6 Indoxacarb 14.5 SC @ 500ml/ha	95.00	85.00	70.00	56.67	38.33	16.67	6.67	0.0	0.0	0.0	0.0	13	52.62	684.06
T_7 Lambda–cyhalothrin 5 EC @ 300ml/ha	80.00	76.67	71.67	66.67	53.33	46.67	25.00	8.33	0.0	0.0	0.0	15	53.54	803.13
T_8 Lambda–cyhalothrin 5 EC @ 350ml/ha	81.67	78.33	71.67	68.33	56.67	51.67	36.67	18.33	3.33	0.0	0.0	17	51.85	881.48
T_9 Endosulfan 35 EC @ 1.25l/ha	88.33	80.00	75.00	71.67	63.33	53.33	41.67	28.33	18.33	6.67	0.0	19	52.66	1000.65

*P = Period (days); **T = Average toxicity; ***PT = Index of persistent toxicity

Table 3. Residual toxicity of insecticides against 3 to 4 day–old larvae of *H. armigera* on tomato crop during *kharif* 2008–09

Treatments	Regression equation	LT_{50} (days)	Fiducial limit
T_1 Beta–cyfluthrin 2.5SC @ 700ml/ha	Y = 14.2776 – 2.4325 X	7.3521	9.0576 ± 5.9678
T_2 Beta–cyfluthrin 2.5SC @ 750ml/ha	Y = 15.2391 – 2.6533 X	7.8827	9.4827 ± 6.5528
T_3 Flubendiamide 480 SC @ 125ml/ha	Y = 15.9848 – 2.9708 X	4.7804	5.7912 ± 3.9461
T_4 Flubendiamide 480 SC @ 150ml/ha	Y = 17.8449 – 3.4414 X	5.1813	6.2162 ± 4.3188
T_5 Indoxacarb 14.5 SC @ 450ml/ha	Y = 14.7998 – 2.5907 X	5.9984	7.3130 ± 4.9202
T_6 Indoxacarb 14.5 SC @ 500ml/ha	Y = 15.4792 – 2.7657 X	6.3974	7.7135 ± 5.3060
T_7 Lambda–cyhalothrin 5 EC @ 300ml/ha	Y = 13.3093 – 2.1208 X	8.0317	10.1046 ± 6.3842
T_8 Lambda–cyhalothrin 5 EC @ 350ml/ha	Y = 13.6988 – 2.2071 X	8.4063	10.4922 ± 6.7352
T_9 Endosulfan 35 EC @ 1.25l/ha	Y = 13.7011 – 2.2570 X	8.8376	10.6996 ± 7.2997

X = log (day x 10^3); Y = Probit kill; LT_{50} : Time calculated in days to give 50 per cent mortality

Table 4. Residual toxicity of insecticides against 3 to 4 day–old larvae of *H. armigera* on tomato crop during *kharif* 2009–10

Treatments	Regression equation	LT_{50} (days)	Fiducial limit
T_1 Beta–cyfluthrin 2.5SC @ 700ml/ha	Y = 14.2496 – 2.4085 X	7.4108	9.0485 ± 6.0695
T_2 Beta–cyfluthrin 2.5SC @ 750ml/ha	Y = 14.8545 – 2.5583 X	7.9167	9.5820 ± 6.5410
T_3 Flubendiamide 480 SC @ 125ml/ha	Y = 16.9345 – 3.2342 X	4.9371	5.9200 ± 4.1174
T_4 Flubendiamide 480 SC @ 150ml/ha	Y = 17.6380 – 3.4259 X	5.3215	6.3429 ± 4.4647
T_5 Indoxacarb 14.5 SC @ 450ml/ha	Y = 15.0522 – 2.6775 X	5.9092	7.1699 ± 4.8704
T_6 Indoxacarb 14.5 SC @ 500ml/ha	Y = 15.5905 – 2.7949 X	6.2959	7.5718 ± 5.2350
T_7 Lambda–cyhalothrin 5 EC @ 300ml/ha	Y = 13.1656 – 2.0927 X	7.8555	9.8464 ± 6.2672
T_8 Lambda–cyhalothrin 5 EC @ 350ml/ha	Y = 13.3410 – 2.1069 X	8.8596	10.9370 ± 7.1768
T_9 Endosulfan 35 EC @ 1.25l/ha	Y = 13.7944 – 2.2296 X	9.2963	11.2384 ± 7.6900

X = log (day x 10^3); Y = Probit kill; LT_{50} : Time calculated in days to give 50 per cent mortality that flubendiamide @ 125 and 150 ml/ha persisted for shortest period of 11 days while, endosulfan @ 1.25 l/ha persisted for the longest period of 19 days during both the years (Table 1 and 2).

The insecticides in the decreasing order of persistent toxicity (PT) could be arranged as endosulfan @ 1.25 l/ha (PT 1003.84, 1000.65) > lambda–cyhalothrin @ 350 ml/ha (PT 846.84, 881.40) > beta–cyfluthrin @ 750 ml/ha (PT 834.35, 837.48) > lambda–cyhalothrin @ 300 ml/ha (PT 821.88, 803.13) > beta–cyfluthrin @ 700 ml/ha (PT 803.38, 800.02 > indoxacarb @ 500 ml/ha (PT 693.32, 684.06) > indoxacarb @ 450 ml/ha (PT 668.57, 656.18) > flubendiamide @ 150 ml/ha (PT 598.87, 589.71) > flubendiamide @ 125 ml/ha (PT 574.43, 562.22) during 2008–09 and 2009–10, respectively.

However more appropriate results could be derived (Table 3 to 4) by comparing LT_{50} values (lethal time required to give 50 per cent mortality of the test insect). The LT_{50} values were found higher in case of endosulfan which was recorded 8.83 and 9.29 days during 2008–09 and 2009–10, respectively. While, flubendiamide @ 125 ml/ha required shortest time of 4.78 and 4.93 days to kill 50 per cent population of tomato fruit borer during 2008–09 and 2009–10, respectively. The insecticides in the decreasing order of LT_{50} values can be arranged as endosulfan @ 1.25 l/ha (8.83 days) > lambda–cyhalothrin @ 350 ml/ha (8.40 days) > lambda–cyhalothrin @ 300 ml/ha (8.03 days) > beta–cyfluthrin @ 750 ml/ha (7.88 days) > betacyfluthrin @ 700 ml/ha (7.35 days) > indoxacarb @ 500 ml/ha (6.39 days) > indoxacarb @ 450 ml/ha (5.99 days) > flubendiamide @ 150 ml/ha (5.18 days) > flubendiamide @ 125 ml/ha (4.78 days) during 2008–09. While, decreasing order of LT_{50} values during 2009–10 was endosulfan @ 1.25 l/ha (9.29 days) > lambda–cyhalothrin @ 350 ml/ha (8.85 days) > beta–cyfluthrin @ 750 ml/ha (7.91 days) > lambda–cyhalothrin @ 300 ml/ha (7.85 days) > beta–cyfluthrin @ 700 ml/ha (7.41 days) > indoxacarb @ 500 ml/ha (6.29 days) > indoxacarb @ 450 ml/ha (5.90 days) > flubendiamide @ 150 ml/ha (5.32 days) > flubendiamide @ 125 ml/ha (4.93 days).

The results of present investigations are in agreement with the findings of Premchand *et al*. (2003) who recorded that endosulfan 35 EC persisted for more than 15 days on tomato. Similarly, Sheikh and Tikoo (1998) observed that residue of endosulfan persisted for over 21 days on leaves and curd of cauliflower. Nain and Gupta (2004) also observed residual toxicity on the basis of PT and LT_{50} values on okra crop and found that beta–cyfluthrin @ 500ml/ha persisted for 6.053 days (LT_{50}) with 715.605 persistent toxicity (PT).

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