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PERSISTENT TOXICITY OF DIAMIDE INSECTICIDES AGAINST *HENOSEPILACHNA VIGINTIOCTOPUNCTATA* (F.) ON BRINJAL

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ABSTRACT

The persistent toxicity (PT) of diamide insecticides viz. chlorantraniliprole and flubendiamide @0.01 and 0.008% has been determined on brinjal (*Solanum melongena* L.) against three days old grubs (mean grub wt.= 0.0013 g/ grub) of *Henosepilachna vigintioctopunctata* (F.) during May, 2019. Chlorantraniliprole @0.01% was the most persistent with a PT value of 1026.52 followed by flubendiamide @0.01% (933.2), chlorantraniliprole @0.008% (755.4) and flubendiamide @0.008% (606.58) at 24 hr after feeding (HAF). On increasing the feeding period from 24 to 48 hr on the same leaves, chlorantraniliprole @0.01% showed the maximum PT value of 1791.75 followed by flubendiamide @0.01% (1422.2), chlorantraniliprole @0.008% (1382.92) and flubendiamide @0.008% (918.58). After 72 hr of feeding on the treated leaves, chlorantraniliprole @0.01% again showed maximum PT value of 2000.0 followed by chlorantraniliprole @0.008% (1634.16), flubendiamide @0.01% (1613.26) and flubendiamide @0.008% (1400.00). The order of persistent toxicity was same on brinjal plants at 24 and 48 HAF i.e., chlorantraniliprole @0.01%> flubendiamide @0.01%> chlorantraniliprole @0.008%> flubendiamide @0.008%.

Key words: Brinjal, *Henosepilachna vigintioctopunctata*, grubs, persistent toxicity, diamide, chlorantraniliprole, flubendiamide, PT value, feeding period, bioassay

Brinjal or eggplant (*Solanum melongena* L.) is one of the important vegetable crops grown all over India (Sharma and Saxena, 2012; Patel et al., 2016). It is heavily infested by a number of insect pests, among which hadda (epilachna) beetle *Henosepilachna vigintioctopunctata* (F.) (Coleoptera: Coccinellidae) is one of the most destructive and devastating pests in mid-hills and plains of India (Kumar and Kumar, 1998). It is widely distributed in South-East Asia, Australia, Sri Lanka, Malaya, East Indies, Oceania and North America, Siberia, China and India (Rajagopal and Trivedi, 1989; Jamwal et al., 2013). Both the grub and adult stages scrap the chlorophyll and skeletonise the leaves in a characteristic manner leaving the entire upper epidermal tissue (Mohasin and De, 1994; Rath et al., 2002). The grubs usually feed on the lower surface and adults on the upper surface of the leaves (Pradhan et al., 1990) and 35 to 75% leaves get severely damaged (Srivastava and Katiyar, 1991). Bhalla and Pawar (1977) also reported 65% loss in vegetative stage, and about 80% loss in yield is observed due to this pest (Bhagat and Munshi, 2004).

Generally, organophosphates and synthetic pyrethroids have been used to control hadda beetle in solanaceous vegetables (Kumar and Kumar, 1998; Khursheed and Desh Raj, 2013; and Chand and Srivastava, 2017). The novel insecticide molecules have several advantages over conventional ones, such as high selectivity to target pests, excellent efficacy at low rates or dosage and less harmful effects on environment (Kodandaram et al., 2010). Laboratory studies had been done to evaluate the efficacy of the diamide insecticides against *H. vigintioctopunctata*, however there are no reports available on the persistent toxicity of these on host plants. The persistent toxicity of these is known against other agriculturally important insect pests (Thakur and Srivastava, 2020; Rimpy and Verma, 2018; Sreedhar, 2014). The present study is on the persistent toxicity of diamide insecticides against *H. vigintioctopunctata* on brinjal.

MATERIALS AND METHODS

The test insecticides viz., chlorantraniliprole (Coragen 18.5 SC) and flubendiamide (Fame 480 SC) were purchased from market and stored in a refrigerator. The seedlings of brinjal were prepare in small plots around the Insecticide Toxicology/ Mulberry Sericulture Laboratory as per requirement. The doses of the insecticides at 0.01 and 0.008%, as recommended by CIB&RC (2020) were prepared in tap water and sprayed on brinjal plants using a small hand atomizer and each plant was sprayed to the point of slight runoff. Plants in control were sprayed with tap water alone.

Sufficient space was left between two treatments so as avoid any spray drift. All the treated plants were tagged and labelled. The persistent toxicity was assessed at an interval of 1 day, and thereafter at 3, 5, 7, 13, 20, 22, 25 and 28 days after spraying (DAS). The leaves were randomly plucked from each treated plot and brought to the laboratory for feeding to the grubs. Newly emerged untreated leaves were avoided for feeding. The petiole of freshly plucked leaves were wrapped with wet cotton swab and placed in plastic boxes (24x15x8 cm). Each treatment was replicated three times and five grubs (3 days old) (mean weight = 0.0013 g/ grub) were placed in each containing treated leaves. The larval mortality was recorded at 24, 48 and 72 hr after the leaves were offered for feeding. PT values were calculated for each exposure period viz., 24, 48 and 72 hr separately following Pradhan (1967). The observations on mortality were corrected using Abbott's formula (Abbott, 1925). The data obtained was subjected to angular transformation (arc sin transformation). With n<50, zero and hundred % proportions were counted as 1/ 4 n and (n- 1/ 4)/ n before applying the transformation, respectively, as suggested by Bartlett (1947) (c.f. Snedecor and Cochran, 1967). The corrected % mortality data obtained at various specific periods was used to calculate mean residual toxicity (T). The persistent toxicity was found out by calculating the index called PT value- product of mean % residual toxicity (T) and period (P) for which the toxicity persisted (Sarup et al., 1970; Kanwar et al., 2012; Negi and Srivastava, 2018; Thakur and Srivastava, 2020).

RESULTS AND DISCUSSION

The data given in Table 1 indicate that chlorantraniliprole @0.01% was the most persistent insecticide with a PT value of 1026.52 followed by flubendiamide @0.01% (933.2), chlorantraniliprole @0.008% (755.4) and flubendiamide @0.008% (606.58) when the mortality was observed at 24 hr after feeding (HAF); mean toxicity (T) at 24 HAF was 46.66 for the three treatments viz. chlorantraniliprole @0.01%, flubendiamide @0.01%, and flubendiamide @0.008%; and for chlorantraniliprole @0.008% it was 37.77. But the period for which persistence last was the least in case of flubendiamide @0.008% i.e. 13d, which is evident from its least PT value at 24 HAF. The persistence was observed for 22 days in case of chlorantraniliprole @0.01% (showing maximum PT value) and 20 days for flubendiamide @0.01 and chlorantraniliprole @0.008%. On increasing the feeding period from 24 to 48 hr on the same leaves, chlorantraniliprole @0.01% showed the maximum PT value of 1791.75 followed by flubendiamide @0.01% (1422.2), chlorantraniliprole @0.008% (1382.92) and flubendiamide @0.008% (918.58). The toxicity at 48 HAF was maximum (71.67) for chlorantraniliprole @0.01% and the period of persistence was 25 days; this was followed by flubendiamide @0.01% (71.11) with 20 days, flubendiamide @0.008% (70.66) with 13 days and chlorantraniliprole @0.008% (62.86) with 22 days. After 72 HAF, chlorantraniliprole @0.01% again showed maximum PT value of 2000.0 followed by chlorantraniliprole @0.008% (1634.16); toxicity was maximum (80.00) for chlorantraniliprole @0.01% with persistence of 25 days. The order of persistent toxicity was same at 24 and 48 HAF i.e., chlorantraniliprole @0.01%> flubendiamide @0.01%> chlorantraniliprole @0.008%> flubendiamide @0.008%. At 72HAF however, chlorantraniliprole @0.01% showed maximum PT value followed by chlorantraniliprole @0.008%. A fast degradation of flubendiamide @0.008% was observed on brinjal which resulted in lower PT values.

The persistent toxicity of chlorantraniliprole and flubendiamide on brinjal plant against 3d old grubs of *H. vigitioctopunctata* is not known; however, on cowpea and soybean plants as evaluated by Thakur and Srivastava (2020) against 4 days old larvae of *S. litura* at 24 HAF, spinetoram @0.01% was the most persistent followed by flubendiamide @0.01% and chlorantraniliprole @0.006%; soybean spinetoram @0.01% was the most persistent followed by chlorantraniliprole @0.006% and flubendiamide @0.01%; and order of persistent toxicity was same for both the crop crops at 72 HAF. On cowpea plant at 24 HAF, the order of persistent toxicity was spinetoram > flubendiamide > chlorantraniliprole; and on soybean it was spinetoram > chlorantraniliprole > flubendiamide at all 24, 48 and 72 HAF. Teja et al. (2019) reported that chlorantraniliprole showed maximum persistent toxicity against 3rd instar larvae of diamond back moth *Plutella xylostella* followed by flubendiamide> chlorfenapyr> fipronil> emamectin benzoate. The persistent toxicity on rajmah bean and mulberry plants was evaluated by Negi and Srivastava (2018) against the 5 days old larvae of *S. litura*- revealing that chlorantraniliprole + lambda-cyhalothrin @0.027% was found to be the most persistent followed by cypermethrin+ indoxacarb @0.02% on mulberry and rajmah bean plants, respectively.

Rimpy and Verma (2018) reported that flubendiamide @0.004% showed maximum PT value against the 3rd instar larvae of *Agrotis ipsilon* and *A. segetum*. Dake et al. (2017) reported that emamectin benzoate @0.002% was the most persistent followed by flubendiamide @0.007% and chlorantraniliprole @0.005% against

Table 1. Persistent toxicity of diamide insecticides against *H. vigintioctopunctata* (3d old grubs) - brinjal

Insecticide (Trade name)	Conc (%)	Mortality (%) 1 DAS 24	1 DAS 48	1 DAS 72	3 DAS 24	3 DAS 48	3 DAS 72	5 DAS HAF 24	5 DAS HAF 48	5 DAS HAF 72	7 DAS 24	7 DAS 48	7 DAS 72	13 DAS 24	13 DAS 48	13 DAS 72
Chlorantra- niliprole	0.01	100.00 (84.74)	100.00 (84.74)	100.00 (84.74)	80.00 (63.44)	100.00 (84.74)	100.00 (84.74)	33.33 (35.24)	93.33 (75.00)	100.00 (84.74)	46.66 (42.88)	100.00 (84.74)	100.00 (84.74)	33.33 (35.24)	80.00 (63.44)	93.33 (75.00)
(Coragen1 8.5 SC)	0.008	73.33 (58.89)	100.00 (84.74)	100.00 (84.74)	66.66 (54.70)	100.00 (84.74)	100.00 (84.74)	26.66 (31.05)	80.00 (63.44)	100.00 (84.74)	33.33 (35.24)	73.33 (58.89)	86.66 (68.53)	20 (26.56)	60.00 (50.77)	93.33 (75.00)
Flubendiamide (Fame	0.01	100.00 (84.74)	100.00 (84.74)	100.00 (84.74)	73.33 (58.89)	93.33 (75.00)	100.00 (84.74)	33.33 (35.24)	80.00 (63.44)	100.00 (84.74)	33.33 (35.24)	66.66 (54.70)	93.33 (75.00)	33.33 (35.24)	66.66 (54.70)	80.00 (63.44)
480 SC)	0.008	100.00 (84.74)	100.00 (84.74)	100.00 (84.74)	73.33 (58.89)	86.66 (68.53)	100.00 (84.74)	20.00 (26.56)	66.66 (54.70)	86.66 (68.53)	26.66 (31.05)	60.00 (50.77)	73.33 (58.89)	13.33 (21.39)	40.00 (39.23)	53.33 (46.89)
Control		0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)

Mortality (%) HAF 20 DAS 24	20 DAS 48	20 DAS 72	22 DAS 24	22 DAS 48	22 DAS 72	25 DAS 24	25 DAS 48	25 DAS 72	28 DAS 24	28 DAS 48	28 DAS 72	Toxicity (T) HAF 24	T 48	T 72	Period (days) (P) HAF 24	P 48	P 72	PT 24 HAF	PT 48 HAF	PT 72 HAF
20.00 (26.56)	53.33 (46.89)	73.33 (58.89)	0.00 (5.23)	13.33 (21.39)	33.33 (35.24)	0.00 (5.23)	13.33 (21.39)	26.66 (31.05)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	46.66	71.67	0.00	22	25	25	1026.52	1791.75	2000.00
6.66 (14.89)	20.00 (26.56)	33.33 (35.24)	0.00 (5.23)	6.66 (14.89)	6.66 (14.89)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	-	-	-	37.77	62.86	74.28	20	22	22	755.4	1382.92	1634.16
6.66 (14.89)	20.00 (26.56)	26.66 (31.05)	0.00 (5.23)	0.00 (5.23)	13.33 (21.39)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	-	-	-	46.66	71.11	73.33	20	20	22	933.2	1422.2	1613.26
0.00 (5.23)	0.00 (5.23)	6.66 (14.89)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	-	-	-	-	-	-	46.66	70.66	70.00	13	13	20	606.58	918.58	1400.00
0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	0.00 (5.23)	-	-	-	-	-	-	-	-	-	-	-	-

Mean grub weight = 0 .0013 g/ larva (3d old); PT= Persistent toxicity value; DAS= Days after spraying; HAF= Hours after feeding; n = 15; Data in parentheses angular transformed (arc sin) values.

head borer of sunflowe, *Helicoverpa armigera* (Hubner). Sreedhar (2014) reported that rynaxypyr was the most persistent showing highest PT value followed by flubendiamide> spinosad> emamectin benzoate> chlorpyriphos against tobacco stem borer *Scrobipalpa heliopa* in Virginia tobacco. Dake and Bhamare (2019) reported that imidacloprid @0.003% was the most persistent and flubendiamide @0.007% was the least persistent against whitefly *Bemisia tabaci* (Gennadius) on sunflower. Hardke et al. (2011) reported that chlorantraniliprole and cyantraniliprole resulted in 53.1% mortality when observed at 72 HAF at 28 days after treatment against the fall army worm *Spodoptera frugiperda* in grain sorghum. Thus, the present study on the persistent toxicity of diamide insecticides revealed that chlorantraniliprole @0.01% was the most effective with maximum PT values against three day old grubs of *H. vigintioctopunctata* on brinjal.

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