Pesticide Research Journal Vol. 16(2) : 22-25, December, 2004

Bioefficacy and Persistent Toxicity of Different Insecticides and Neem Derivatives against Cucurbits Fruit Fly, *Bactrocera cucurbitae.* Coq. on Summer Squash

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A field experiment conducted at the College of Agriculture, CSKHPKV, Palampur, H.P. during 1999-2000 revealed that the synthetic pyrethroid treatments *viz.*, deltamethrin (37.5 g ai ha^{-1}), cypermethrin (75 g ai ha^{-1}) and fenvalerate (75 g ai ha^{-1}) gave significantly less fruit infestation of cucurbit fruit fly, *Bactrocera cucurbitae* Coq. upto 14 days of spray on summer squash compared to malathion (375 g ai ha^{-1}). The neem derivatives namely Achook, Econeem and Neemjeevan although were statistically superior over untreated check but were less effective than synthetic insecticides in suppressing the infestation. Maximum yield was observed in deltamethrin treatment (205.61 q ha^{-1}) followed by cypermethrin, fenvalerate, malathion, deltamethrin + achook, deltamethrin + Neemjeevan, Achook, Neemjeevan and Econeem. The synthetic pyrethroids had the higher persistent toxicity (PT 7 days) compared to malathion or the neem derivatives (PT 3 days or less).

Key words : *Bactrocera cucurbitae,* fruit fly, synthetic pyrethroids, malathion, neem derivatives, bioefficacy.

Bactrocera cucurbitae Coq is a very destructive pest causing 40-80% losses in cucurbits[1]. The fruits, attacked in their early stages, do not develop and drop down and rot. Many research workers[2-5] have advocated the use of chemical control measures as the most effective and economical. Chemical control of this pest is often successful but can be hazardous and toxic to human beings and non-target organisms. Insects may also develop resistance. The present investigation was undertaken to evaluate the bioefficacy of certain insecticides and the neem derivatives against the cucurbit fruit fly infesting summer squash, *Cucurbita pepo* L.

MATERIALS AND METHODS

The field investigation was conducted in the Entomology Farm, HPKV, Palampur. The experiment was laid out in the randomized block design with three replications. Summer squash (var. Australian green) seedlings were raised in polybags in March and transplanted in the field in April 1999 in pits when they were in the two leaf stage. The plot size was 3 m X 1.8 m with 16 plants per plot with row to row spacing of 75 cm and plant to plant 45 cm. The schedule comprised of two sprays at an interval of 15 days. Four commercial grade insecticides deltamethrin (Decis 2.8 EC @ 37.5 g ai ha^{-1}), cypermethrin (Cybil 25 EC @ 75 g ai ha^{-1}), fenvalerate (Sumicidin 20 EC @ 75 g ai ha^{-1}) and malathion (Massthion 50 EC @ 375 g ai ha^{-1}), three commercially available neem based products *viz.*, Neemjeevan (3000 ppm @ 6.75 g ai ha^{-1}), Achook (1500 ppm @ 3.38 g ai ha^{-1}) and Econeem (3000 ppm @ 6.75 g ai ha^{-1}) and tank mixed combinations of deltamethrin + Neemjeevan (@ 18.75 +3.375 g ai ha^{-1}) and deltamethrin + Achook (@ 18.75 +1.69 g ai ha^{-1}) at half their recommended concentrations were tested against fruit fly infestation. Gur solution (1%) was used in all the treatments excluding control. The control plots were sprayed with water only.

The entire marketable size fruits of each crop irrespective of the healthy and the infested ones were plucked separately in each treatment after 7, 14 and 20 days after the second spray and the percent fruit infestation was calculated and subjected to statistical analysis.

For rearing of fruit fly in the laboratory, the infested summer squash fruits were collected from the untreated plots and the culture of fruit fly was maintained under the laboratory conditions on summer squash, bittergourd and

*Part of M.Sc. Thesis.

cucumber kept in wiremesh cages of size 25 x 20 x 20 cm with one fourth of the cage filled with sieved and sterilized river bed sand. The adult flies were provided with their host as well as a dry mixture of sucrose and protinex in the ratio of 1:1 (kept in small petridishes). The diet was changed daily. In addition the water was kept in small plastic vials (6 x 2.5 cm) fitted with cotton wicks on the top to prevent the flies from drowning.

For the persistence toxicity studies, the fruit samples were collected at random from the treated plots after 0, 1, 3, 7 and 15 days of second spray, cut into peels of uniform size (4 x 4 x 0.5 cm) and kept in the petriplate on a moist filter paper. Neonate larvae of *B. cucurbitae* obtained from the laboratory culture were released on these peel slices and the petriplates were kept in the incubator at 27±1^{0}C and 85-90% RH. Relative persistence toxicity values were calculated from mortality data as per method given by Pradhan[6].

Relative persistence toxicity = P X T

where, P = Period for which the toxicity persisted and T = Average residual toxicity which is calculated by adding values of percent mortality at different intervals and then dividing by the total number of the observations.

RESULTS AND DISCUSSION

The results on fruit infestation in summer squash fruits for different treatments are presented in Table 1. After 7 days of the spray, minimum infestation was observed in the deltamethrin treatment (16.99%). All the synthetic pyrethroids were significantly superior to malathion and the neem derivatives upto 14 days after spray in controlling fruit fly infestation. The neem products, Achook, Econeem, Neemjeevan and combinations deltamethrin + Achook and deltamethrin + Neemjeevan were statistically at par with each other. However, 20 days after spray, all the treatments behaved similarly in checking the menace of fruit fly. High effectiveness of the synthetic pyrethroids in reducing the fruit fly infestation has also been reported earlier[7,8].

All the treatments except Econeem gave significantly high yields compared to control (Table 1). Maximum yield (205.61 q ha^{-1}) was recorded in the deltamethrin treatment followed by cypermethrin (186.13 q ha^{-1}), fenvalerate (174.71 q ha^{-1}), malathion (168.22 q ha^{-1}) and deltamethrin + Achook combination (163.29 q ha^{-1}). Interestingly, deltamethrin + Achook combination at half the recommended doses was at par with malathion, cypermethrin or fenvalerate treatments. This could probably be

Table 1. Bioefficacy of insecticides and neem derivatives against *Bactrocera cucurbitae* under the field conditions

S.No.	Treatment	Dosage g ai ha^{-1}	Mean percent fruit infestation			Mean Yield (q ha^{-1})
			7 DAS*	14 DAS	20 DAS	
1.	Cypermethrin	75	18.89** (25.73)	20.56 (26.88)	35.55 (36.57)	186.13
2.	Deltamethrin	37.5	16.99 (24.28)	18.89 (25.73)	32.78 (34.82)	205.61
3.	Fenvalerate	75	19.63 (26.25)	21.67 (27.69)	35.55 (36.57)	174.71
4.	Malathion	375	27.38 (31.53)	31.74 (34.26)	37.78 (37.89)	168.22
5.	Achook	3.375#	31.74 (34.26)	35.55 (36.57)	41.11 (39.82)	140.71
6.	Econeem	6.75#	38.89 (38.49)	41.11 (39.82)	46.67 (43.06)	126.92
7.	Neemjeevan	6.75#	32.78 (34.82)	38.73 (38.45)	44.44 (41.73)	130.76
8.	Deltamethrin + Achook	18.75+1.688	27.78 (31.53)	33.97 (35.59)	38.89 (38.49)	163.29
9.	Deltamethrin + Neemjeevan	18.75+3.375	31.11 (33.67)	35.55 (36.67)	43.33 (41.14)	154.33
10.	Control	Water spray	53.33 (46.90)	58.89 (50.15)	60.00 (50.75)	95.73
	CD (P=0.05)		6.89	5.61	6.88	34.20

*Days after second spray; **Mean of three replications; # Azadirachtin; Gur solution (1%) was used in all treatments excluding control; Figures in parentheses denote angular transformed values.

Table 2. Persistent toxicity of insecticides and neem derivatives on summer squash against *B. cucurbitae*

S. No.	Treatment	Dosage (g a.i./ha)	Percent mortality*				
			0 d	1 d	3 d	7 d	PT
1.	Cypermethrin	75	97.76 (84.44)	73.33 (59.00)	46.67 (43.06)	11.11 (19.26)	400.52
2.	Deltamethrin	37.5	100.00 (89.15)	88.88 (73.71)	48.89 (44.35)	17.78 (24.84)	447.21
3.	Fenvalerate	75	86.67 (68.99)	66.67 (54.78)	42.22 (40.45)	8.89 (17.11)	357.79
4.	Malathion	375	77.78 (61.90)	64.45 (53.39)	22.23 (23.77)	0.00 (0.81)	164.45
5.	Achook	3.375#	31.1 (33.86)	20.00 (26.35)	6.67 (14.96)	0.00 (0.81)	57.78
6.	Econeem	6.75#	20.00 (26.35)	11.11 (19.26)	0.00 (0.81)	0.00 (0.81)	15.56
7.	Neemieevan	6.75#	26.67 (30.96)	17.78 (24.84)	4.45 (10.24)	0.00 (0.81)	48.90
8.	Deltamethrin + Achook	18.75+ 1.688	71.11 (57.49)	60.00 (50.78)	37.78 (37.89)	8.89 (17.11)	311.12
9.	Deltamethrin+ Neemieevan	18.75+ 3.375	68.89 (56.10)	51.11 (45.62)	28.89 (32.47)	6.67 (14.96)	272.23
10.	Control	Water spray	0.00 (0.81)	0.00 (0.81)	0.00 (0.81)	0.00 (0.81)	0.00
	CD (P=0.05)		7.29	9.83	12.19	4.05	

*Mean of three replications; # Azadirachtin; Gur solution (1%) was used in all treatments excluding control; Figures in parentheses denote angular transformed values; No mortality was observed on 15th day fruits in any treatment ; PT = Index of persistence toxicity.

because of the potentiation effect and high compatibility of the botanical pesticides with synthetic pyrethroids.

On the basis of the persistent toxicity (PT) values (Table 2), the order of effectiveness of insecticides was deltamethrin (447.21) > cypermethrin (400.52) > fenvalerate (357.79) > deltamethrin + Achook (311.12) > deltamethrin + Neemjeevan (48.90) > malathion (164.45). The present findings are in conformity with those of Chand[9] who also reported that malathion is less effective than deltamethrin in controlling *B. cucurbitae.*

The study recommended that farmer spray the summer squash crop with deltamethrin (37.5 g ai ha^{-1}) mixed with gur solution (1%) or a mixture of deltamethrin (18.75 g ai ha^{-1}) and Achook (1.69 g ai ha^{-1}) along with 1% gur solution for the effective management of fruit fly attack and at the same time reducing the pesticide pressure on the environment.

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