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Bio-efficacy of Insecticides against Pod Borers Infesting Cowpea [*Vigna unguiculata* (L.) Walp.]

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ABSTRACT

Nine insecticides were evaluated on cowpea against pod borers (Maruca vitrata and Heliocverpa armigera) during kharif 2017 & 2018 and results revealed that flubendiamide 0.02% (0.16 larva/plant), fipronil 0.01% (0.35 larva/plant) and chlorantraniliprole 0.0056% (1.18 larva/plant) were found highly effective insecticides whereas, spinosad 0.009% (1.24 larva/plant), profenophos 0.05% (1.40 larva/plant), novaluron 0.01% (1.43 larva/plant) and emamectin benzoate 0.0025% (1.48 larva/plant) were found moderately effective insecticides against M. vitrata. Treatments of chlorantraniliprole 0.0056% (0.19 larva/plant), flubendiamide 0.02% (0.27 larva/plant) and fipronil 0.01% (0.30 larva/plant) were found highly effective insecticides whereas, spinosad 0.009% (0.91 larva/plant), profenophos 0.05% (1.06 larva/plant), novaluron 0.01% (1.11 larva/plant) and emamectin benzoate 0.0025% (1.11 larva/plant) were found moderately effective insecticides against H. armigera. Treatments of acephate 0.075% and thiamethoxam 0.005% were found least effective insecticides against pod borers.

Keywords: *Maruca vitrata, Heliocverpa armigera, Flubendiamide, Fipronil, Chlorantraniliprole, Cowpea*

INTRODUCTION

Pod borers, *Maruca vitrata* (Fabricius) and *Helicoverpa armigera* (Hubner) Hardwick are the most damaging pests and cause heavy yield losses in cowpea. The legume pod borer *Maruca vitrata* (Fabricius) (Lepidoptera: Crambidae; Syn: *Maruca testulalis*), is distributed throughout the tropical and subtropical regions of the world. *M. vitrata* is a serious pest of grain legumes because of its extensive host range, destructiveness, and distribution. The larval stages of *M. vitrata* are destructive within agricultural and forest eco-systems as they feed on flowers and pods of more than 39 host plants (Raheja, 1974).

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The larvae of *M. vitrata* web the flowers or inflorescence with the adjacent leaves and pods, feed from inside the webbed mass which protects them from the natural enemies and adverse natural conditions. The later instar larvae bore in to the pods and feed on developing grains. Excretory material is often seen at the entrance of bore holes. The larvae of *H. armigera* also cause extensive damage by feeding on various plant parts *viz*., leaves, buds, flowers and pods of cowpea. Young larvae feed on the leaves, while fully grown larvae feed on the pods by thrusting its head into the pod and keeping remaining body outside. The avoidable losses in yield due to insect pests have been recorded in the range of 66 to 100 per cent in cowpea (Pandey et.al., 1991). Thus, considering the damage and yield loss due to pod borers in cowpea, it is necessary to evaluate bio-efficacy of various new insecticides against pod borers.

MATERIALS AND METHODS

An experiment was conducted on management of pod borers (*M. vitrata* and *H. armigera*) infesting cowpea at College of Agriculture, Navsari Agricultural University, Campus Bharuch (Gujarat) during *kharif* 2017 and 2018. The experiment was carried out in randomized block design with 10 treatments. The observations were recorded from plot size; gross 2.25m x 2.00m and net 1.35m x 1.60m. Gujarat cowpea-4 variety was sown at a distance of 45cm × 20cm and crop was raised successfully by adopting recommended agronomical practices. Three spray of insecticides were given at an interval of 10 days. The first spray was given on appearance of pests and second and third spray was given at an interval of 10 days from first spray. The observations on larval populations of *M. vitrata* and *H. armigera* were recorded from randomly selected five plants from each treatment by counting numbers of larva/plant before first spray as well as 3, 7 and 10 day(s) after each spray. The data on mean larval population were subjected to ANOVA after transforming into $\sqrt{X + 0.5}$ transformation.

RESULTS AND DISCUSSION

Spotted pod borer, *Maruca vitrata*

The data on larval population pooled over sprays and years are presented in Table 1 and depicted in Fig. 1. The pooled data of before spray of two years were not significantly differed indicating homogenous distribution of larval population (Column 3). All the insecticidal treatments recorded significantly lower larval population than control.

Two years pooled data of first spray (column 4) revealed that flubendiamide 0.02% (0.24 larva/plant) recorded significantly lowest larval population than rest of treatments followed by fipronil 0.01% (0.43 larva/plant). The treatments of chlorantraniliprole 0.0056% (1.21 larva/plant), spinosad 0.009% (1.24 larva/plant) and profenophos 0.05% (1.41 larva/plant) as well as novaluron 0.01% (1.60 larva/plant) and emamectin benzoate 0.0025% (1.61 larva/plant) were at par with each other. Acephate 0.075% (2.31 larva/plant) and thiamethoxam 0.005% (2.43 larva/plant) proved less effective and recorded higher larval population. Similar trend was observed after second spray (column 5), flubendiamide 0.02% (0.16 larva/plant) and fipronil 0.01% (0.32 larva/plant) recorded significantly lower larval population than rest of the treatments. The treatments of chlorantraniliprole 0.0056% (1.20 larva/plant), spinosad 0.009% (1.28 larva/plant) and profenophos 0.05% (1.46 larva/plant) were found at par. Treatments of novaluron 0.01% (1.50 larva/plant) and emamectin benzoate 0.0025% (1.51 larva/plant) found moderately effective against *M. vitrata* and were at par with profenophos 0.05%. The treatments of acephate 0.075% (2.34 larva/plant) and thiamethoxam 0.005% (2.41 larva/plant) showed low efficacy against larval population. The data after third spray revealed (Column 6) that flubendiamide 0.02% (0.09 larva/plant) and fipronil 0.01% (0.29 larva/plant) recorded significantly lower larval population than rest of the treatments. The treatments of chlorantraniliprole 0.0056% (1.13 larva/plant), spinosad 0.009% (1.19 larva/plant) and novaluron 0.01% (1.20 larva/plant) were at par. Treatments of emamectin benzoate 0.0025% (1.31 larva/plant) and profenophos 0.05% (1.33 larva/plant) found moderately effective. The treatments of acephate 0.075% (1.89 larva/plant) and thiamethoxam 0.005% (1.92 larva/plant) found less effective and recorded higher larval population. Pooled data over sprays and years (column 7) indicated that flubendiamide 0.02% (0.16 larva/plant) recorded significantly lowest larval population than rest of the treatments and proved best efficacy against larval population followed by fipronil 0.01% (0.35 larva/plant). Chlorantraniliprole 0.0056% (1.18 larva/plant) and spinosad 0.009% (1.24 larva/plant) were found at par with each other and recorded lower larval population. Treatments of profenophos 0.05% (1.40 larva/plant), novaluron 0.01% (1.43 larva/plant) and emamectin benzoate 0.0025% (1.48 larva/plant) found moderately effective and remained at par. The treatments of acephate 0.075% (2.18 larva/plant) and thiamethoxam 0.005% (2.26 larva/plant) found less effective. Interactions (YxT) between years and treatments were found non significant indicating the consistent performance of treatments over the years.

Thus, flubendiamide 0.02% and fipronil 0.01% were found highly effective insecticides. The insecticides like chlorantraniliprole 0.0056%, spinosad 0.009% and novaluron 0.01% were found effective insecticides. The insecticides like emamectin benzoate 0.0025% and profenophos 0.05% found moderately effective insecticides. The treatments of acephate 0.075% and thiamethoxam 0.005% were found least effective insecticides against *M. vitrata* on cowpea.

The higher efficacay of flubendiamide against *M. vitrata* was reported by various workers *viz*., Patil et al. (2008), Ameta et al. (2011), Joshi (2011), Dey et al. (2012) and Subhasree and Mathew (2014). The higher efficacy of fipronil was reported by Chandrayudu et al. (2006) and Singh and Singh (2015). The higher efficacy of spinosad was reported by Lakshmi et al. (2002), Srihari and Patnaik (2006) and Bairwa and Singh (2015). The good efficacy of emamectin benzoate was reported by Prudhvi (2007). The effcetviness of profenophos was reported by Prajapati et al. (2009) and Umbarkar and Parsana (2014). Thus results of present investigation is more or less in conformity with the work done by previous workers.

Pod borer, *Helicoverpa armigera*

The data on larval population pooled over sprays and years are presented in Table 2 and depicted in Fig. 2. The pooled data of before spray of two years were not significantly differed hence homogenous distribution of larval population in different plots under different treatment (Column 3). All the insecticidal treatments recorded significantly lower larval population than control.

Two years pooled data of first spray (column 4) revealed that chlorantraniliprole 0.0056% (0.47 larva/plant), flubendiamide 0.02% (0.57 larva/plant) and fipronil 0.01% (0.59 larva/plant) were found most effective insecticidal treatments and recorded lower larval population than rest of the treatments followed by spinosad 0.009% (1.11 larva/plant). Profenophos 0.05% (1.28 larva/plant), emamectin benzoate 0.0025% (1.33 larva/plant) and novaluron 0.01% (1.36 larva/plant) were at par and found moderately effective. The treatments of acephate 0.075% (1.94 larva/plant) and thiamethoxam 0.005% (2.02 larva/plant) recorded higher larval population. Two years pooled data of second spray (column 5) revealed that chlorantraniliprole 0.0056% (0.06 larva/plant) found most effective treatment and remained at par with flubendiamide 0.02% (0.16 larva/plant) followed by fipronil 0.01% (0.20 larva/plant) which was at par with flubendiamide 0.02%. The treatments of spinosad 0.009% (0.96 larva/plant) was found next effective treatment. Profenophos 0.05% (1.14 larva/plant), novaluron 0.01% (1.22 larva/plant) and emamectin benzoate 0.0025% (1.22 larva/plant) remained at par and found moderately effective. The treatments of acephate 0.075% (1.81 larva/plant) and thiamethoxam 0.005% (1.90

larva/plant) recorded significantly higher larval population. Two years pooled data of third spray (column 6) revealed that chlorantraniliprole 0.0056% (0.06 larva/plant), flubendiamide 0.02% (0.09 larva/plant) and fipronil 0.01% (0.10 larva/plant) were at par with each other and recorded lower larval population than rest of the treatments. The treatments of spinosad 0.009% (0.67 larva/plant) was found next best treatment. Profenophos 0.05% (0.76 larva/plant), novaluron 0.01% (0.77 larva/plant) and emamectin benzoate 0.0025% (0.79 larva/plant) were moderately effective and remained at par. The treatments of acephate 0.075% (1.24 larva/plant) and thiamethoxam 0.005% (1.34 larva/plant) recorded higher larval population showing poor efficacy against larval population. The pooled data over sprays over years (Column 7) revealed that chlorantraniliprole 0.0056% (0.19 larva/plant) recorded significantly lowest larval population than rest of the treatments. The next effective treatments were flubendiamide 0.02% (0.27 larva/plant) and fipronil 0.01% (0.30 larva/plant) which were remained at par with each other. The next treatment recorded lower larval population was of spinosad 0.009% (0.91 larva/plant). Profenophos 0.05% (1.06 larva/plant), novaluron 0.01% (1.11 larva/plant) and emamectin benzoate 0.0025% (1.11 larva/plant) remained at par and found moderately effective. Acephate 0.075% (1.67 larva/plant) and thiamethoxam 0.005% (1.76 larva/plant) were found least effective insecticides and recorded higher larval population. The Interactions (YxT) effects were non significant indicating the consistent performance of treatments over the years.

Thus, the results revealed that chlorantraniliprole 0.0056%, flubendiamide 0.02% and fipronil 0.01% were found most effective insecticides for management of *H. armigera* followed by spinosad 0.009%. Treatments of Profenophos 0.05%, emamectin benzoate 0.0025% and novaluron 0.01% were found moderately effective. The treatments of acephate 0.075% and thiamethoxam 0.005% were found least effective insecticides and recorded higher larval population.

The higher efficacy of chlorantraniliprole against *H. armigera* was reported by Joshi (2011), Sreekanth et al. (2014) and Kumar and Sarada (2015). The effectiveness of flubendiamide against *H. armigera* was reported by Gowda et al. (2003) and Kumar and Sarada (2015). These all reports are in agreement with present findings.

Table 1: Bio-efficacy of different insecticides against *Maruca vitrata* infesting cowpea (Pooled of 2017 and 2018)

Treat No.	Treatments	Mean larval population / plant				
		Before spray	First spray	Second spray	Third spray	Pooled over sprays & years
1	2	3	4	5	6	7
1	Profenophos 50 EC @ 0.05%	1.73 (2.53)	1.37c (1.41)	1.39de (1.46)	1.35d (1.33)	1.37d (1.40)
2	Thiamethoxam 25 WG @ 0.005%	1.80 (2.77)	1.71e (2.43)	1.70f (2.41)	1.56e (1.92)	1.66e (2.26)
3	Flubendiamide 39.35 SC @ 0.02%	1.74 (2.57)	0.86a (0.24)	0.81a (0.16)	0.76a (0.09)	0.81a (0.16)
4	Chlorantraniliprole 18.5 SC @ 0.0056%	1.73 (2.50)	1.30c (1.21)	1.30c (1.20)	1.27c (1.13)	1.29c (1.18)
5	Emamectin benzoate 5 SG @ 0.0025%	1.81 (2.80)	1.45d (1.61)	1.41e (1.51)	1.34d (1.31)	1.40d (1.48)
6	Acephate 75 SP @ 0.075%	1.83 (2.87)	1.67e (2.31)	1.68f (2.34)	1.54e (1.89)	1.63e (2.18)
7	Fipronil 5 SC @ 0.01%	1.80 (2.77)	0.96b (0.43)	0.90b (0.32)	0.88b (0.29)	0.92b (0.35)
8	Spinosad 45 SC @	1.77	1.32c	1.33cd	1.29cd	1.31c

	0.009%	(2.67)	(1.24)	(1.28)	(1.19)	(1.24)
9	Novaluron 10 EC @ 0.01%	1.80 (2.77)	1.45[d] (1.60)	1.41[e] (1.50)	1.30[cd] (1.20)	1.38[d] (1.43)
10	Control (Water spray)	1.80 (2.77)	1.95[f] (3.30)	1.95[g] (3.31)	1.79[f] (2.71)	1.89[f] (3.11)
	S.Em. ± T	0.07	0.02	0.02	0.02	0.01
	YxT	0.10	0.06	0.06	0.06	0.06
	CD at 5% T	NS	0.07	0.06	0.06	0.04
	YxT	NS	NS	NS	NS	NS
	CV%	9.66	7.70	7.81	7.77	7.76

Note:
1.Figures in parentheses are original values whereas outside are transformed values.
$\sqrt{X+0.5}$2. Treatment means with letter(s) in common are not significantly different at 5% level of significance

Table 2: Bio-efficacy of different insecticides against *Helicoverpa armigera* infesting cowpea (Pooled of 2017 and 2018)

Treat No.	Treatments	Mean larval population / plant				
		Before spray	First spray	Second spray	Third spray	Pooled over sprays & years
1	2	3	4	5	6	7
1	Profenophos 50 EC @ 0.05%	1.52 (2.47)	1.33[c] (1.28)	1.28[d] (1.14)	1.12[c] (0.76)	1.24[d] (1.06)
2	Thiamethoxam 25 WG @ 0.005%	1.61 (2.43)	1.59[d] (2.02)	1.55[e] (1.90)	1.35[d] (1.34)	1.50[e] (1.76)
3	Flubendiamide 39.35 SC @ 0.02%	1.51 (2.70)	1.03[a] (0.57)	0.81[ab] (0.16)	0.77[a] (0.09)	0.87[b] (0.27)
4	Chlorantraniliprole 18.5 SC @ 0.0056%	1.40 (2.50)	0.98[a] (0.47)	0.75[a] (0.06)	0.75[a] (0.06)	0.82[a] (0.19)
5	Emamectin benzoate 5 SG @ 0.0025%	1.52 (2.23)	1.35[c] (1.33)	1.31[d] (1.22)	1.13[c] (0.79)	1.26[d] (1.11)
6	Acephate 75 SP @ 0.075%	1.73 (2.87)	1.56[d] (1.94)	1.52[e] (1.81)	1.32[d] (1.24)	1.46[e] (1.67)
7	Fipronil 5 SC @ 0.01%	1.48 (2.23)	1.04[a] (0.59)	0.84[b] (0.20)	0.78[a] (0.10)	0.88[b] (0.30)
8	Spinosad 45 SC @ 0.009%	1.40 (2.40)	1.26[b] (1.11)	1.20[c] (0.96)	1.07[b] (0.67)	1.18[c] (0.91)
9	Novaluron 10 EC @ 0.01%	1.45 (2.20)	1.36[c] (1.36)	1.31[d] (1.22)	1.12[c] (0.77)	1.26[d] (1.11)
10	Control (Water spray)	1.70 (2.53)	1.81[e] (2.78)	1.77[f] (2.66)	1.59[e] (2.03)	1.72[f] (2.49)
	S.Em. ± T	0.10	0.02	0.02	0.02	0.01
	YxT	0.08	0.06	0.06	0.06	0.06
	CD at 5% T	NS	0.06	0.06	0.06	0.04
	YxT	NS	NS	NS	NS	NS
	CV%	9.24	7.84	8.00	9.48	8.38

Note:
1.Figures in parentheses are original values whereas outside are transformed values.
$\sqrt{X+0.5}$2. Treatment means with letter(s) in common are not significantly different at 5% level of significance

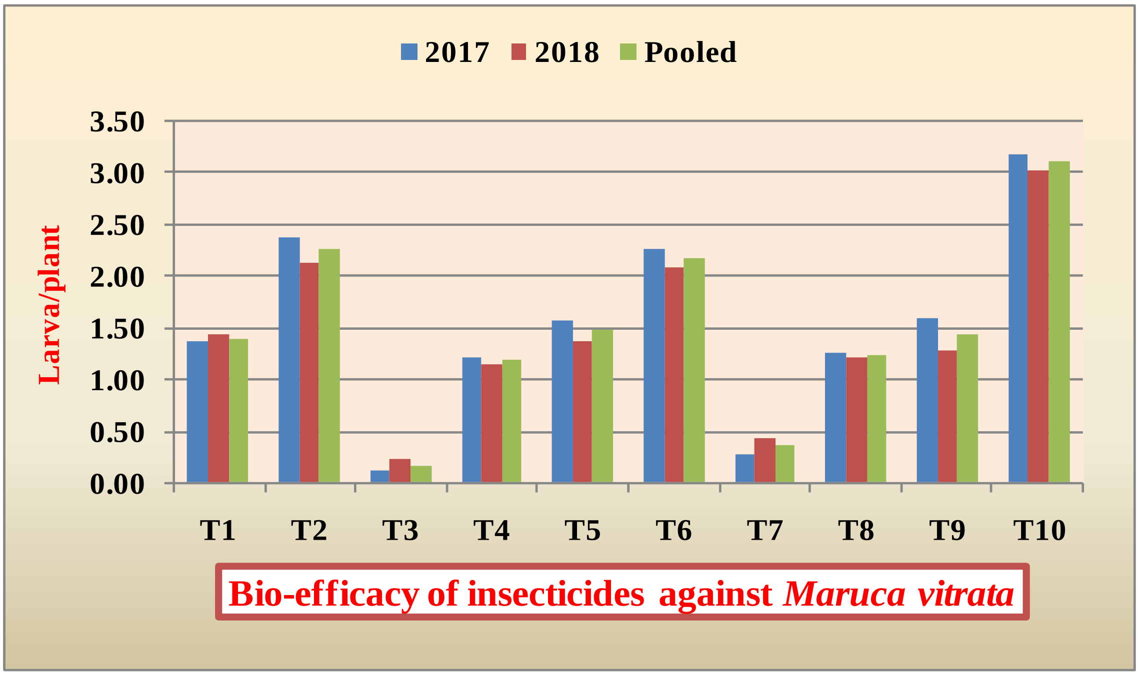

Fig. 1: Bio-efficacy of insecticidal treatments against *M. vitrata* in cowpea

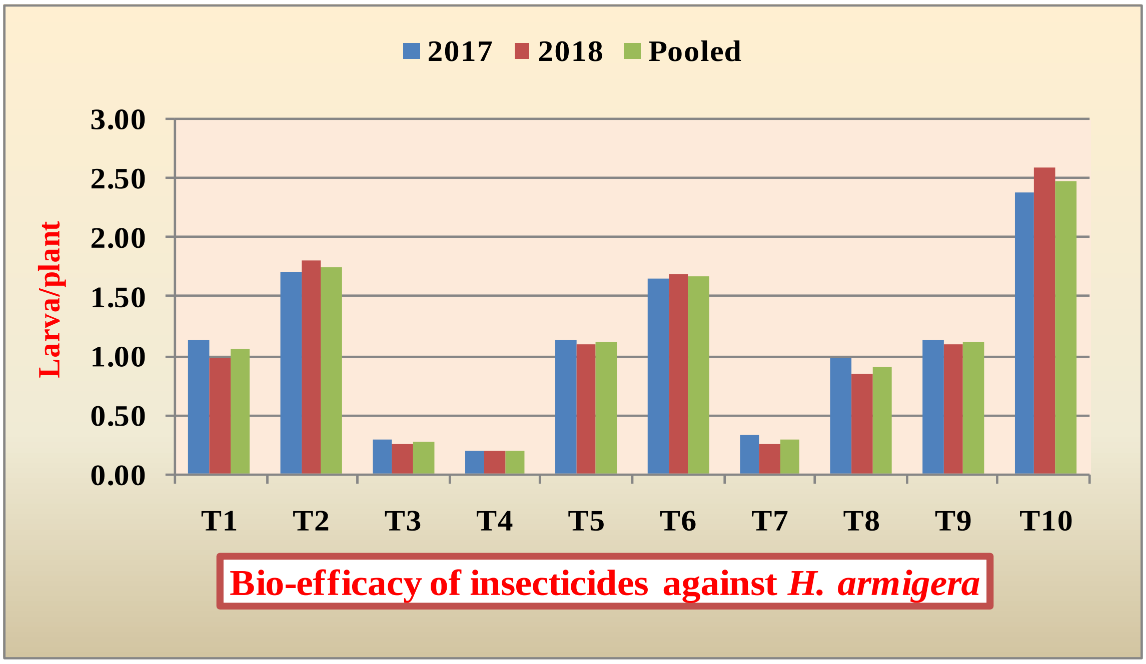

Fig. 2: Bio-efficacy of insecticidal treatments against *H. armigera* in cowpea

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