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Evaluation of Flubendiamide 480 SC against fruit borers damage in okra

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Abstract
Two field experiments were conducted in farmer's holdings at Thondamuthur, Coimbatore district, Tamil Nadu from September 2012 - December 2012 and August 2013 – November 2013 under irrigated conditions. Flubendiamide 480 SC @ 60 g a.i.ha^{-1} was significantly effective when sprayed twice at 15 days interval, minimized the fruit borer damage and increased okra fruit yield. Flubendiamide 480 SC @ 60, 120 and 240g a.i.ha^{-1}concentrations had not caused any phytotoxic effects like injury to leaf tip, leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty.

Keywords: Flubendiamide*, Earias vitella, Helicoverpa armigera***,** phytotoixicity, okra

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] is an important vegetable crop belonging to family Malvaceae. It is grown throughout the tropical and sub-tropical regions and also in the warmer parts of the temperate regions. The nutritional value of 100 g of edible okra is characterized by 1.9 g protein, 0.2 g fat, 6.4 g carbohydrate, 0.7 g minerals and 1.2 g fibre. Okra has a good potential as a foreign exchange crop and accounts for 60 per cent of the export of fresh vegetables. It is cultivated in 452 ha area with the production of 4803 mt and productivity of 10 mt ha^{-1} in India. The major okra producing states are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh and Karnataka (Anonymous, 2012) [1]. While the use of insecticides remains an important component of integrated pest management (IPM), biological suppression of insect pests is also considered as an equally important tool. The crop is affected by shoot and fruit borer, *Helicoverpa armigera* (Hubner), spotted bollworm, *Earias* spp.is the most destructive pests causing economic damage to the crop at all the growth stages. The chemical insecticides are used as the front line defense sources against insect pest.

Many research workers evaluated different insecticides against *E. vittella* and *H. armigera* in okra. Indiscriminate use of organophosphates, carbamates and synthetic pyrethroids has created serious problems such as pests developing resistance to insecticides (McCaffery *et al*., 1989) [4], pest resurgence (Hardin *et al.,* 1995) [3] and bioconcentrations of pesticide residues in consumable produce at harvest (Rolando *et al.,* 1982) [6]. Among the harmful effects of insecticides, persistence of toxic pesticide residues in plants, soil and water are of great concern for consumer's health and safety to animals. At the same time, to overcome the above problems, identification of new molecules are needed to combat the associated drawbacks. At present, the golden age of insecticide research has come with selective, neuro active and easily degradable compounds.

These newer molecules always have a higher stability and superiority over conventional pesticides to control the pest population in a classical manner at field level. However, flubendiamide is a novel class of insecticide having a unique chemical structure used against broad spectrum of insects and safe to non target insects (parasitoids, predators and pollinators) and acts on ryanodine receptor modulator. It is also used to control insects which are found resistant to other insecticides and fits into IPM programs. With the above background, investigations were carried out on flubendiamide 480 SC a new formulation.

Materials and Methods

Two field experiments were conducted in farmers holdings at Thondamuthur, Coimbatore district Tamil Nadu from September 2012- December 2012 and August 2013 – November 2013 under irrigated conditions. The experiments were conducted using RBD with seven treatments replicated thrice with a plot size of 4 x 5 m using the variety Mahyco 10.

The treatments were imposed when the pests appeared at critical growth stages like flowering and fruit developing stages and repeated at 15 days interval using a knapsack sprayer with spray volume of 500 l ha^{-1} to a level of runoff. The data on percentage were transformed in to arcsine values and the population number into $\sqrt{X+0.5}$ before statistical analysis. The mean values were separated using Duncan's Multiple Range Test (DMRT). The treatments evaluated were as follows

S. No	Name of the treatment	Dose g a.i ha^{-1}
1	Flubendiamide 480 SC	48
2	Flubendiamide 480 SC	60
3	Flubendiamide 480 SC	36
4	Cypermethrin 10 EC	50
5	Pyridalyl 10 EC	50
6	Untreated check	-

H. armigera and *E. vittella* and their damage on okra fruits were recorded on ten randomly tagged plants per plot before insecticide application and at 3, 7, 10 and 14 days after spraying. The fruit damage was assessed based on bore holes found on the fruit. The total number of fruits and infested fruits in ten randomly selected plants per plot were counted and the per cent fruit damage was worked out as per the method followed by Shobanadevi (2003) [9]. The larval population and the yield were also recorded. To know the crop tolerance, the plants were observed on 1, 3, 5, 7, 10 and 14 days after spraying as per the protocol of Central Insecticide Board Registration Committee (C.I.B. and R.C) for the phytotoxic symptoms like (leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty).

Results and Discussion

The results of field experiments revealed that all the doses of flubendiamide 480 SC recorded a significant reduction in the damage caused by fruit borers. During the first season, the per cent damage before imposing treatments ranged from 26.93 to 27.97. There was a significant reduction in fruit damage after spraying flubendiamide 480 SC @ 60 g a.i.ha^{-1} (73.38%) which was on par with flubendiamide 480SC @ 48 g a.i.ha^{-1} (70.47%) followed by flubendiamide 480SC at 36 g a.i. ha^{-1} (66.41%) when compared to the untreated check.. The least reduction in fruit damage was observed in pyridalyl 10 EC @ 50 g a.i. ha^{-1} (49.61%) followed by cypermethrin 10EC @ 50 g a.i.ha^{-1} (52.67%).

Table 1: Effect of flubendiamide 480 SC against fruit damage caused by *Earias vitella* and *Helicoverpa armigera in* okra, First season - Pooled analysis

Treatments	Dose (g a.i ha^{-1})		*Per cent fruit damage ten $plants^{-1}$				
		PTC	3 DAS	5 DAS	7 DAS	Mean	PR (%)
Flubendiamide 480 SC	36	26.95	11.69 $(19.98)^b$	9.53 $(17.93)^b$	11.00 $(19.36)^b$	10.74	66.41
Flubendiamide 480 SC	48	27.86	10.47 $(18.78)^{ab}$	8.17 $(16.60)^{ab}$	9.67 $(18.06)^{ab}$	9.44	70.47
Flubendiamide 480 SC	60	27.09	9.07 $(17.52)^a$	7.47 $(15.85)^a$	9.00 $(17.45)^a$	8.51	73.38
Cypermethrin 10 EC	50	27.97	15.29 $(23.01)^c$	13.73 $(21.74)^c$	16.27 $(23.78)^c$	15.13	52.67
Pyridalyl 10EC	50	26.93	16.47 $(26.84)^d$	14.97 $(32.55)^d$	16.89 $(32.03)^d$	16.11	49.61
Untreated check	-	27.09	30.20 $(33.33)^e$	31.74 $(34.28)^e$	33.97 $(35.60)^e$	31.97	-

*Mean of three replications; PTC- Pretreatment count, DAS – Days after spraying; PR- Per cent reduction, Values in parentheses are arc sine transformed values.
In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

During the second season, flubendiamide 480 SC @ 60 g a.i.ha^{-1} recorded minimum mean fruit damage (5.23%) and was on par with flubendiamide 480SC at 48 g a.i.ha^{-1} (6.26 %) followed by flubendiamide 480SC at 36 g a.i.ha^{-1} (8.83%). The highest mean damage among insecticide treatments was observed in pyridalyl 10 EC @ 50 g a.i. $ha^{-1}$and cypermethrin 10EC @ 50 g a.i.ha^{-1} with 16.02 and 13.54 per cent, respectively while untreated check recorded 36.88 per cent fruit damage (Table 2).

Table 2: Effect of flubendiamide 480 SC against fruit damage caused by *Earias vitella* and *Helicoverpa armigera in* okra, Second season - Pooled analysis

Treatments	Dose (g a.i ha^{-1})	PTC	*Per cent fruit damage ten $plants^{-1}$				
			3 DAS	5 DAS	7 DAS	Mean	PR (%)
Flubendiamide 480 SC	36	20.45	9.67 $(18.06)^b$	8.87 $(17.23)^b$	7.93 $(16.27)^b$	8.83	76.06
Flubendiamide 480 SC	48	22.85	6.17 $(14.37)^a$	7.37 $(15.74)^{ab}$	5.23 $(13.21)^a$	6.26	83.02
Flubendiamide 480 SC	60	20.15	5.23 $(13.21)^a$	6.10 $(14.28)^a$	4.37 $(12.05)^a$	5.23	85.82
Cypermethrin 10 EC	50	20.90	14.27 $(22.28)^c$	13.67 $(21.69)^d$	12.69 $(20.86)^c$	13.54	63.29
Pyridalyl 10EC	50	22.25	16.67 $(25.60)^d$	16.13 $(25.93)^e$	15.27 $(24.55)^d$	16.02	56.56
Untreated check	-	23.00	36.57 $(37.20)^e$	37.17 $(37.56)^f$	36.89 $(37.40)^e$	36.88	-

*Mean of three replications; PTC- Pretreatment count, DAS – Days after spraying; PR- Per cent reduction, Values in parentheses are arc sine transformed values.
In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

The data recorded on the yield of okra on the first trial indicated that flubendiamide 480SC @ 60 g a.i.ha^{-1} exhibited significantly higher yield (8000.00 kg ha^{-1}) and was on par with flubendiamide 480SC @ 48 g a.i.ha^{-1} (7800.50 kg ha^{-1}) followed by flubendiamide 480 SC @ 36 g a.i.ha^{-1} (7226.67 kg ha^{-1}) (Table 3). Standard checks, cypermethrin 10 EC and pyridalyl 10EC each @ 50 g a.i. ha^{-1} recorded a lower yield of 5140.00 and 5548.30 kg ha^{-1} and were found to be better than untreated check (4880.00 kg ha^{-1}).

Table 3: Effect of flubendiamide 480 SC on yield of okra I and II seasons (Pooled analysis)

Treatments	Dose (g a.i ha^{-1})	Yield (Kg ha^{-1})
Flubendiamide 480 SC	36	7226.67^{c}
Flubendiamide 480 SC	48	7800.50^{ab}
Flubendiamide 480 SC	60	8000.00^{a}
Cypermethrin 10 EC	50	5140.00^{c}
Pyridalyl 10EC	50	5548.30^{d}
Untreated check	-	4880.00^{e}

The present findings are in line with the findings of Pramod Katti and Shwetha Surpur, (2015) [5], who reported that three days after first spray, the shoot damage ranged between 8.70 to 28.70, the lowest shoot damage was recorded in flubendiamide 480 SC @ 60 g a.i / ha (8.70%) followed by flubendiamide 480 SC @ 48 g a.i/ha (10.00%). Shimoge and Vemuri (2014) [8] recorded that flubendiamide at 60 g a.i. ha^{-1} recorded lowest per cent fruit borer infestation of 11.07 as against 39.15 per cent fruit borer infestation in control. Bangar and Patel (2012) [2] who revealed that among the three insecticides, flubendiamide has recorded lower shoot and fruit borer larval population, per cent shoot as well as fruit damage and registered higher okra fruit yield can be considered as most effective insecticide. Flubendiamide 480 SC @ 60, 120 and 240 g a.i. ha^{-1} concentrations had not caused any phytotoxic effects like injury to leaf tip, leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty. Based on the results, it is concluded that flubendiamide 480 SC @ 60 g a.i.ha^{-1} was effective in reducing the fruit damage in okra and increasing the yield. Flubendiamide 480 SC @ 60, 120 and 240 g a.i. ha^{-1} concentrations had not caused any phytotoxic effects. Hence it can be recommended for the management of shoot and fruit borer in okra.

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