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IMPACT OF CERTAIN AGROCHEMICALS ON SHOOT AND FRUIT BORER (*EARIAS VITTELLA* FAB.) (LEPIDOPTERA: NOCTUIDAE) IN BHENDI (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH) ECOSYSTEM

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ABSTRACT

Two supervised field experiments were conducted with the bhendi hybrid MH 10 during *kharif*, 2012 and *rabi*, 2012-13 to study the impact of agrochemicals on shoot and fruit borer damage. The agrochemicals used were fertilizer, insecticide and herbicide individually as well as in combinations. It was found that the shoot damage, fruit damage (number basis) and fruit damage (weight basis) was higher in the untreated check 20.63, 35.08 and 40.29 percent respectively while a low per cent damage was recorded in the treatment with insecticide alone8.01, 12.41 and 11.98 per cent respectively during *kharif,* 2012. In *rabi,* 2012-13, a higher per cent damage was recorded in the untreated check 20.38, 37.74 and 40.74 per centrespectively while a low per cent damage was observed in the treatment with insecticide 11.56, 18.89 and 20.03 per cent respectively. The per cent damage was higher in the treatment with fertilizer alone compared to the other treatments in both the seasons. The highest yield and benefit cost ratio was observed in the treatment with herbicide + fertilizer + insecticide, in both the seasons.Hence, a need based application of agrochemicals protect the ecosystem and exhibit a higher yield.

INTRODUCTION

Okra, *Abelmoschusesculentus* (L.) Moench is commonly known as bhendi is an important vegetable crop belonging to family malvaceae. In India, it is cultivated throughout the year and it occupiesan area of 0.49 million hectares with an annual production of 5.80 million tonnes and productivity of 11.6 tonnes per hectare (Anon., 2011).Okrais valued for its delicious tender fruits. It is the best source of iodine and calcium. Okra accounts for 60 per cent of export of fresh vegetables excluding potato, onion and garlic (Sharma and Arora, 1993). The continuous growth is congenial for the infestation of insect pests and it is one of the major limiting factors in the profitable cultivation of the crop. It is infested by several insect pests among them, spotted boll worm, Eariasvittella considered major pest which cause severe damage to crop (Shitole and Patel, 2009).It is reported that about 54.04% losses in marketable yield due to attack of this insect pest (Choudhary and Dadheech, 1989). The average fruit damage has been estimated from 35-76 per cent (Hafeez and Rizvi, 1994).

The adult female of okra shoot and fruit borer, *E. vittella* lays eggs individually on leaves, floral buds, and on tender fruits. Small brown caterpillars bore into the top shoot and feed inside the shoot before fruit formation. The shoot wilt and dry as a result the damage of the plant develop in branches. Later on caterpillars bore into the fruits and feed inside as a result the infested plant bears smaller and deformed pods (Rahman *et al.*, 2013).

Conventionally farmers are using various types of synthetic chemical insecticides to control okra shoot and fruit borer. But due to the unconscious and unjustified use of synthetic pesticides create several problems in agro-ecosystem such as direct toxicity to beneficial insects, fishes, and man (Goodland *et al.*, 1985). It is now urgently need to use agrochemicals judiciously to protect ecosystem from contamination. Therefore, an attempt has been made to evaluate the impact of certain agrochemicals (fertilizer, herbicide, insecticide) to manage fruit and shoot borer, *E. vittella*on okra.

MATERIALS AND METHODS

Two field experiments were conducted to assess the impact of certain agrochemicals on *Eariasvittella*population in bhendi during *kharif,* 2012 and *rabi,* 2012-13 at Eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA and RI), Karaikal, U.T. of Puducherry, India on the bhendi hybrid MH 10. The experiment was laid out in a Randomized Block Design (RBD) with three replications and eight treatments in a 5.4 x 4.5 square meter plots. The treatments include untreated check, herbicide only

(Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 days after sowing (DAS)), fertilizer only (NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS), insecticide only (Carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS), herbicide + fertilizer (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 DAS and NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS), herbicide + insecticide (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 DAS and carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS), fertilizer + insecticide (NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS and carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS) and herbicide + insecticide + fertilizer (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 DAS and NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS and carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS). The effect of agrochemicals on the shoot and fruit borer, *Eariasvittella* was assessed at weekly intervals based on shoot damage and fruit damage basis (Bebitha, 2009).

The shoot damage by *E. vittella* was assessed based on the total number of shoots and affected shoots in a plot on 10 randomly selected plants and shoot damage was worked out.

$$\text{Percent shoot damage} = \frac{\text{No. of affected shoots}}{\text{Total no. of shoots}} \times 100$$

The fruit damage by *E. vittella*on number basis was assessed based on the total number of fruits and affected fruits in aplot on 10 randomly selected plants and the fruit damage was worked out (Bebitha, 2009).

$$\text{Percent fruit damage} = \frac{\text{No. of affected fruits}}{\text{Total no. of fruits}} \times 100$$

(on number basis)

Similarly, on weight basis, the damage was assessed based on the weight of total number of fruits and damaged fruits in a plot on 10 randomly selected plants and the per cent fruit damage was worked out by the following formula.

$$\text{Percent fruit damage} = \frac{\text{Weight of the damaged fruits}}{\text{Weight of the total fruits}} \times 100$$

(on weight basis)

The data obtained from the field experiments were analysed in a Randomized Block Design by 'F' test for significance as described by Panse and Sukhatme (1958). Critical difference values were calculated at 5% probability level and the treatment mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS

Kharif, 2012

On shoot damage basis

The results on the impact of agrochemicals on shoot and fruit borer, *E.vittella* on shoot damage basis during *kharif*, 2012 are given in Table 1. At 1st and 2nd week after sowing there was no shoot damage and hence the per cent shoot damage was observed from 3rd week and continued upto 12th week after sowing. The mean per cent shoot damage during *kharif*ranged from 8.01 to 20.63 per cent/plant. It was found that the per cent shoot damage was low in the treatment with insecticide (8.01%) alone with per cent reduction of 61.17 per cent followed by the treatment with herbicide + insecticide (9.44%) compared to the untreated check (20.63%) while a lower per cent reduction of insect population was observed in the treatment with fertilizer alone (28.59%).

Fruit damage (On number basis)

The mean per cent fruit damage during *kharif*ranged from 12.41 to 35.08 per cent/plant. It was found that the per cent fruit damage was low in the treatment with insecticide (12.41%) alone with per cent reduction of 64.62 per cent followed by the treatment with herbicide + insecticide (15.13%) compared to the untreated check (35.08%).while a lower per cent reduction of insect population was observed in the treatment with fertilizer alone (32.52%).

Fruit damage (On weight basis)

The mean per cent fruit damage during *kharif*ranged from 11.98 to 40.29 per cent/plant. It was found that the per cent fruit damage was low in the treatment with insecticide (11.98%) alone with per cent reduction of 70.26 per cent followed by the treatment with herbicide + insecticide (15.71%) compared to the untreated check (40.29%) while a lower per cent reduction of insect population was observed in the treatment with fertilizer alone (19.98%).

Rabi, 2012-13

On shoot damage basis

The results on the impact of agrochemicals on shoot and fruit borer, *E.vittella* on shoot damage basis during *rabi*, 2012-13 are given in Table 2. At 1st and 2nd week after sowing there was no shoot damage and hence the per cent shoot damage was observed from 3rd week and continued upto 12th week after sowing. The mean per cent shoot damage during *rabi*ranged from 11.56 to 20.38 per cent/plant. It was found that the per cent shoot damage was low in the treatment with insecticide (11.56%) alone with per cent reduction of 43.28 per cent followed by the treatment with herbicide + insecticide (13.30%) compared to the untreated check (20.38%)while a lower per cent reduction of insect population was observed in the treatment with fertilizer alone (15.95%).

Fruit damage (On number basis)

The mean per cent fruit damage during *rabi* ranged from 18.89 to 37.74 per cent/plant. It was found that the per cent fruit damage was low in the treatment with insecticide (18.89%) alone with per cent reduction of 49.95 per cent followed by the treatment with herbicide + insecticide (21.09%) compared to the untreated check (37.74%) while a lower per cent reduction of insect population was observed in the treatment with fertilizer alone (13.17%).

Fruit damage (On weight basis)

The mean per cent fruit damage during *rabi* ranged from 20.03 to 40.74 per cent/plant. It was found that the per cent fruit damage was low in the treatment with insecticide (20.03%) alone with per cent reduction of 50.83 per cent which was at par with herbicide + insecticide treatment (21.93%) compared

Table 1: Impact of agrochemicals on shoot and fruit borer, *E. vittella* in bhendi during *kharif*, 2012 and *rabi*, 2012-13

Treatments	Percent shoot damage #				Percent fruit damage (number basis) #				Percent fruit damage (weight basis) #			
	Kharif		*Rabi*		*Kharif*		*Rabi*		*Kharif*		*Rabi*	
	Mean percent damage	Percent reduction over control	Mean percent damage	Percent reduction over control	Mean percent damage	Percent reduction over control	Mean percent damage	Percent reduction over control	Mean percent damage	Percent reduction over control	Mean percent damage	Percent reduction over control
Untreated check	20.63(26.97)^{f}	-	20.38(26.71)^{e}	-	35.08(36.31)^{f}	-	37.74 (37.88)^{e}	-	40.29(39.38)^{g}	-	40.74 (39.63)^{f}	-
Herbicide	10.80(19.02)^{c}	47.64	15.79(23.26)^{c}	22.52	20.29(26.74)^{d}	42.16	26.68 (31.08)^{c}	29.30	28.31(32.12)^{e}	29.73	29.23 (32.67)^{d}	28.25
Fertilizer	14.73(22.56)^{e}	28.59	17.13(24.27)^{d}	15.95	23.67(29.09)^{e}	32.52	32.77 (34.89)^{d}	13.17	32.24(34.55)^{f}	19.98	33.61 (35.38)^{e}	17.50
Insecticide	8.01(16.31)^{a}	61.17	11.56(19.53)^{a}	43.28	12.41(20.61)^{a}	64.62	18.89 (25.70)^{a}	49.95	11.98(20.17)^{a}	70.26	20.03 (26.45)^{a}	50.83
Herbicide+fertilizer	13.59(21.62)^{de}	34.12	14.76(22.41)^{c}	27.57	22.50(28.29)^{e}	35.86	26.48 (30.96)^{c}	29.83	23.40(28.88)^{d}	41.92	26.49 (30.89)^{cd}	34.98
Herbicide+insecticide	9.44(17.85)^{b}	54.24	13.30(21.15)^{b}	34.74	15.13(22.88)^{b}	56.87	21.09 (27.29)^{a}	44.12	15.71(23.23)^{b}	61.00	21.93 (27.82)^{ab}	46.17
Fertilizer+insecticide	12.66(20.81)^{d}	38.63	15.09(22.70)^{c}	25.96	19.54(26.19)^{d}	44.29	23.87 (29.18)^{b}	36.75	20.89(27.08)^{cd}	48.15	26.38 (30.82)^{cd}	35.25
Herbicide+fertilizer +insecticide	12.74(20.90)^{d}	38.24	15.40(22.91)^{c}	24.43	17.53(24.73)^{c}	50.02	26.34 (30.82)^{c}	30.21	19.49(26.10)^{c}	51.62	24.19 (29.38)^{bc}	40.62
CD(P=0.05)	1.785**	-	1.486**	-	1.994**	-	3.051**	-	3.922**	-	3.481**	-

**- Significant at P=0.01 #- Mean of 10 plants Mean of 3 Replications In a coloum mean followed by a common letter are not significantly different by DMRT (P=0.05); Values in parentheses are arcsin transformed values

to the untreated check (40.74%) while a lower per cent reduction of insect population was observed in the treatment with fertilizer alone (17.50%).

Yield and benefit cost ratio (BCR)

The yield and BCR of bhendi from the field experiments were recorded and are given in Table 2. In *kharif*, 2012, the yield ranged from 1875 to 4806 kg/ha. The highest yield was observed in the treatment with herbicide + fertilizer + insecticide (4806 kg/ha) followed by fertilizer + insecticide (4292 kg/ha) and herbicide + fertilizer (4035 kg/ha). It was found that the herbicide + fertilizer + insecticide (4806 kg/ ha) was superior among the treatments. All the treatments were found to be superior than the untreated check (1875 kg/ha). In *rabi*, 2012-13, the yield ranged from 2722 to 5642 kg/ha while a higher yield was recorded in the treatment with herbicide + fertilizer + insecticide (5642 kg/ha) and similar trend was observed as in *kharif*.

In *kharif*, 2012, it was found that the treatment with herbicide + fertilizer + insecticide recorded maximum benefit cost ratio (1:2.69) followed by fertilizer + insecticide (1:2.55) while a lower benefit cost ratio was recorded in the untreated check (1:1.32) compared to other treatments. In *rabi*, 2012-13, a higher BCR was observed in the treatment with herbicide + fertilizer + insecticide (1:3.24) and similar trend was noticed as in *kharif*.

DISCUSSION

The present findings revealed that, there was a higher reduction of fruit and shoot damage in the treatment with the insecticide alone followed by herbicide + insecticide and other treatments. The results also showed a lower per cent reduction in the treatment with fertilizer alone. Hence, the agrochemicals namely insecticide found to have an impact on the shoot and fruit borer, *E. vittella* while fertilizer alone found to have a lesser impact.

Surekha and Arjuna Rao (2000) stated that vermicompost @ 7.5 t/ha was significantly more effective in bringing down the population of fruit borer, *H. armigera, E. vittella* and *E. insulana* followed by FYM @ 30 t/ha when compared to NPK as inorganic fertilizers. It was stated that imidacloprid 70 WS @ 5 g/kg seed + monocrotophos 36 SL @ 500 g a.i./ha (Sujay Pandey *et al.*, 2008), indoxacarb 14.5 SC @ 75 g a.i./ha (Sharma and Bhati, 2008), cypermethrin 10 EW @ 280 and 140 g a.i./ha (Ashok Kumar *et al.*, 2009),spinosad 45 SC @ 75 g a.i./ha (Mane *et al.*, 2010), NSKE @ 5 per cent + cypermethrin 10 EC @ 0.01 per cent (Girhe*et al.*, 2011), Multineem (1500 ppm) and Triazophos (35%) + deltamethrin (1%) (Bhushan*et al.*, 2011), indoxacarb 14.5 SC @ 500 ml/ha and cypermethrin 5 EC + chlorpyriphos 50 EC @ 100 ml/ha (Mallapur*et al.*, 2012)was found to exhibit a minimum fruit and shoot damage in bhendi ecosystem.

Manjanaik *et al.* (2002) stated that the treatment with endosulfan (0.05%) and carbaryl (0.10%) gave the highest yield and benefit cost ratio in bhendi. Shweta Sharma and Patel (2011) observed that a higher number of bhendi fruit yield was recorded in the treatment with pre-emergence application of pendimethalin @ 1000 g/ha followed by a hand weeding at 30 DAS. Senjobi *et al.* (2013)reported that the

Table 2: Yield of bhendi hybrid MH 10

Sl. No.	Treatments	Yield (Kg/ha) #		Benefit cost ratio (BCR)	
		Kharif	*Rabi*	*Kharif*	*Rabi*
1.	Untreated check	1875[f]	2722[g]	1:1.32	1:1.91
2.	Herbicide	2804[e]	3626[f]	1:1.89	1:2.45
3.	Fertilizer	4000[c]	4722[c]	1:2.44	1:2.88
4.	Insecticide	2792[e]	3993[e]	1:1.90	1:2.72
5.	Herbicide+fertilizer	4035[bc]	4875[c]	1:2.38	1:2.87
6.	Herbicide+insecticide	3431[d]	4483[d]	1:2.25	1:2.94
7.	Fertilizer+insecticide	4292[b]	5251[b]	1:2.55	1:3.11
8.	Herbicide+fertilizer+insecticide	4806[a]	5642[a]	1:2.69	1:3.24
	CD (P=0.05)	1.981**	1.198**	-	-

In a column means followed by a common letter are not significantly different by DMRT; ** - Significant at P=0.01, # - Mean of 3 replications

combined application of various pesticides and NPK fertilizer reemitted in a higher yield in bhendi. The present findings are in accordance with the above findings.

The experimental results indicated that there was a greater impact on the total population of insects and natural enemies in the various treatments with agrochemicals with an exception in the treatment with fertilizer alone which recorded a higher population of insects and natural enemies. Even though the treatment with agrochemicals namely herbicide, fertilizer, insecticide showed an impact on the population of insects and natural enemies, a higher yield was recorded in the treatment with agrochemicals with a higher benefit cost ratio. Hence, a need based application of agrochemicals protects the ecosystem and exhibit a higher yield.

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