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Entomology

Field Efficacy, Net Profit and Cost Benefit Ratio of Certain Insecticides against Fruit Borer, *Helicoverpa armigera* (Hubner) in Tomato

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Abstract

A field experiment was conducted to study the field efficacy, net profit and cost benefit ratio of certain insecticides against fruit borer, *Helicoverpa armigera* (Hubner) in tomato during *Rabi* season 2008. The pooled and statistical data indicated that spraying of endosulfan 35 EC was found to be most effective as it recorded lowest larval population (2.33 larvae per plant) as compared to control (7.02 larvae per plant). Endosulfan 35 EC recorded significantly lowest fruit damage (22.85 per cent). Further, the present findings revealed that the per cent of fruit damage caused by fruit borer was highest at the beginning of the picking seasons and as the number of pickings increased there was a decrease in the fruit damage. All the insecticidal treatments significantly recorded lower fruit yield losses as compared to control (50.85 per cent). Maximum fruit yield was registered by treatment endosulfan (69.50 q/ha) which was followed by cypermethrin (64 q /ha) and fenvalerate (61.33 q/ha) and lowest in control (20.33 q/ha). The net profit ranged from ₹ 7,424/- per ha (ë-cyhalothrin) to ₹ 38,528/- per ha (endosulfan). Spraying of cypermethrin twice on tomato crop, gave maximum cost benefit ratio (1:0.98) which was obviously due to its low price as compared to other insecticides.

Highlights

- Endosulfan 35 EC was found to be most effective treatment which recorded lowest larval population (2.33 larvae per plant) and significantly lowest fruit damage (22.85 per cent)
- Maximum fruit yield was registered by treatment endosulfan (69.50 q/ha) which was followed by cypermethrin (64 q /ha) and fenvalerate (61.33 q/ha) and lowest in control (20.33 q/ha)
- Net Profit ranged from Rs. 7,424/- per ha (ë-cyhalothrin) to Rs. 38,528/- per ha (endosulfan)
- Spraying of cypermethrin twice on tomato crop, gave maximum cost benefit ratio (1:0.98) due to its low price as compared to other insecticides

Keywords: *Helicoverpa armigera*, insecticides, yield loss, net profit, cost benefit ratio

The fruit borer, *Helicoverpa armigera* (Hubner) is a polyphagous and key pest of tomato throughout Madhya Pradesh, India and abroad (Umesh *et al.*, 2002; Amalendu Ghosh *et al*., 2010; Rudramuni *et al*., 2011). The infested fruits become unmarketable and unsuitable for human consumption. The various tools of management are

advocated to manage the economic losses caused by this pest and use of insecticides is the first line of defence. In tropical and subtropical areas, tomato production has been seriously affected in recent years by populations that have developed resistance to a wide range of insecticides. New chemicals along with conventional insecticides, if used judiciously and its rotation can help in preventing the insecticide resistance in this pest. Keeping this in view, the present studies were conducted under field conditions to evaluate the different insecticides with diversified modes of action against *H. armigera* to provide the organized guidance for the selection of pesticides in order to develop suitable strategy for its management and also to study the per cent loss in fruit yield by *H. armigera*, net profit and cost benefit ratio of different insecticides.

Materials and Methods

The field experiments were conducted during *rabi* 2007-2008 at the Department of Entomology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhyapradesh. Jawahar-99 was transplanted in 3x3 m plots at a spacing of 50×50 cm. The experiment was laid out in randomized block design (RBD) with eleven treatments including untreated control and replicated thrice. All the recommended agricultural practices were followed while raising the crop. Observations on fruit borer, *Helicoverpa armigera* (Hubner) larval population were recorded on 5 tagged plants per plot. Pre-treatment observations on *H. armigera* larval population were taken 24 hours before spraying, while post treatment observations were taken 3 days, 7 days, 10 days and 14 days after treatment. Further, the efficacy of different treatments against fruit borer were judged by counting healthy marketable fruits and infested fruits collected from 5 randomly selected sampled plants per treatment per replication at each picking. At maturity, per cent fruit damage were calculated, which were further transformed into arcsine values for statistical analysis as suggested by Snedecor and Cochran (1967). Healthy and damage fruit yield per plot were recorded during each picking and at maturity were summed up separately and per cent loss in fruit yield was worked out. Further, net profit and cost benefit ratio of different treatments were computed. The data were analyzed statistically by using Agres and Agdata

Results and Discussion

Bioefficacy of insecticides against H. armigera

All the insecticidal treatments significantly reduced the larval population (Table 1) as compared to control (5.00 larvae per plant). Among the treatments, endosulfan 35 EC was found to be most effective as it recorded lowest larval population at 3 days after spray (0.83 larvae per plant), 7 days after spray (1.16 larvae per plant), 10 days after spray (2.83 larvae per plant) and 14 days after spray (4.50 larvae per plant) as compared to untreated check. Overall mean of two sprays, the differences in larval population among different treatments were significant. All the insecticidal treatments significantly reduced the larval population. Endosulfan 35 EC was found to be most effective as it recorded lowest larval population (2.33 larvae per plant), this was followed by chlorpyriphos 20 EC (3.57 larvae per plant) as compared to control (7.02 larvae per plant).

Per cent fruit damage by H. armigera

All the insecticidal treatments significantly recorded lowest fruit damage as compared to control (51.41 per cent) (Table 1). Among the insecticides tested, endosulfan 35 EC noticed significantly lowest fruit damage (22.85 per cent) followed by cypermethrin 25 EC (26.08 per cent). The present findings further revealed that the per cent of fruit damage caused by fruit borer was highest at the beginning of the picking seasons and as the number of pickings increased there was a decrease in the fruit damage.

Per cent loss in fruit yield due to H. armigera infestation

On the basis of overall mean of fruit yield losses, significant differences among different treatments were observed (Table 1). All the insecticidal treatments significantly recorded lower fruit yield losses as compared to control (50.85 per cent). Among the treatments, endosulfan 35 EC recorded significant minimum fruit yield losses (29.48 per cent) followed by cypermethrin 25 EC (31.27 per cent), but non-significant difference was observed between them.

Table 1: Bioefficacy of insecticides, fruit damage and yield loss by *H. armigera* on tomato

Treatments	Dose (ml or g per ha)	PTC	Mean *H. armigera* larval population / plant*#				Fruit damage (%)*@	Yield loss (%)*@
			3 DAS	7 DAS	10 DAS	14 DAS		
Endosulfan 35EC	852	6.33(2.61)	0.83(1.15)	1.16(1.28)	2.83(1.82)	4.50(2.23)	22.85(28.50)	29.48(32.73)
Chlorpyriphos 20EC	1500	6.33(2.61)	1.99(1.57)	2.33(1.68)	3.83(2.08)	6.16(2.58)	30.71(33.59)	34.59(35.94)
Indoxacarb 14.5 EC	500	5.67(2.48)	2.66(1.77)	3.66(2.03)	3.83(2.08)	5.83(2.51)	29.03(32.45)	33.09(35.00)
Malathion 50EC	600	7.33(2.79)	2.34(1.67)	2.66(1.77)	5.16(2.37)	6.83(2.70)	31.40(34.02)	33.21(35.19)
Cypermethrin 25 EC	240	5.33(2.41)	2.00(1.58)	1.83(1.52)	5.33(2.41)	6.33(2.61)	26.08(30.65)	31.27(33.89)
Decamethrin 2.8 EC	852	6.33(2.61)	3.16(1.91)	2.00(1.58)	4.00(2.12)	5.66(2.48)	29.69(32.96)	33.35(35.20)
Fenvalerate 20 EC	600	6.33(2.61)	1.50(1.41)	1.83(1.52)	4.83(2.30)	6.33(2.61)	28.07(32.19)	31.87(34.28)
ë Cyhalothrin 5 EC	1000	5.66(2.48)	2.16(1.63)	3.00(1.87)	4.16(2.15)	6.00(2.54)	30.39(33.41)	34.15(35.68)
Emamectin benzoate 5 SG	180	6.00(2.54)	1.99(1.57)	3.00(1.87)	5.00(2.34)	6.16(2.58)	29.18(32.62)	34.40(35.87)
Spinosad 45 SC	125	6.33(2.58)	2.50(1.73)	2.48(1.72)	4.16(2.15)	6.17(2.58)	29.67(32.95)	33.93(35.56)
Control	-	6.00(2.54)	5.00(2.34)	5.83(2.41)	7.83(2.88)	9.43(3.15)	51.41(46.15)	50.85(45.29)
	Mean	**6.14**	**2.29**	**2.70**	**4.63**	**6.30**	**30.56**	**34.55**
	SEm ±	ns	0.10	0.18	0.10	0.12	0.49	0.71
	CD at 5%	ns	0.31	0.54	0.29	0.35	1.47	2.10

ns: non-significant, *mean of three replications, #figures in parentheses are "x+ 0.5 square root transformed values, @ figures in parentheses are arcsine transformed values

Table 2: Economics of some insecticides against *H. armigera* on tomato

Treatments	Dose(ml or g per ha)	Fruit yield (q/ha)	Increase in yield over control (q/ha)	Avoidable loss (%)	Cost of insecticides/ ha + Labour*	Cost of increased yield over control @ ₹ 800/q	Net profit (₹/ha)	Cost benefit ratio
Endosulfan 35EC	852	69.50	49.17	-	808=00	39,336=00	38,528=00	1 : 0.97
Chlorpyriphos 20EC	1500	45.66	25.33	34.30	1000=00	20,264=00	19,264=00	1 : 0.95
Indoxacarb 14.5 EC	500	51.44	31.11	25.98	3600=00	24,888=00	21,288=00	1 : 0.85
Malathion 50EC	600	47.77	27.44	31.26	628=00	21,952=00	21,324=00	1 : 0.97
Cypermethrin 25 EC	240	64.00	43.67	7.91	592=00	34,936=00	34,344=00	1 : 0.98
Decamethrin 2.8 EC	852	53.11	32.78	23.58	3126=00	26,224=00	23,098=00	1 : 0.88
Fenvalerate 20 EC	600	61.33	41.00	11.75	1312=00	32,800=00	31,488=00	1 : 0.96
λ Cyhalothrin 5 EC	1000	45.11	24.78	35.09	12400=00	19,824=00	7,424=00	1 : 0.37
Emamectin benzoate 5 SG	180	47.55	27.22	31.58	3640=00	21,776=00	18,136=00	1 : 0.83
Spinosad 45 SC	125	50.55	30.22	27.26	3150=00	24,176=00	21,026=00	1 : 0.86
Control	-	20.33	-	70.74	-	-	-	-

*Labour rate per day = ₹ 100 /- (2 labours required for spraying 1 ha of tomato crop in 1 day)

Endosulfan 35EC	:	₹ 240 /lit	Fenvalerate 20 EC	:	₹ 760 / lit
Chlorpyriphos 20EC	:	₹ 200 / lit	λ Cyhalothrin 5 EC	:	₹ 6000 / lit
Indoxacarb 14.5 EC	:	₹ 3200 / lit	Emamectin benzoate 5 SG	:	₹ 9000 / kg
Malathion 50 EC	:	₹ 190 / lit	Spinosad 45 SC	:	₹ 11000 / lit
Cypermethrin 25 EC	:	₹ 400 / lit	Decamethrin 2.8 EC	:	₹ 1600 / lit

Fruit yield

All the insecticidal treatments significantly recorded higher healthy fruit yields as compared to control (20.33 q/ha). Endosulfan 35 EC recorded highest healthy fruit yields (69.50 q/ha), this was followed by cypermethrin 25 EC (64.00 q/ha) and fenvalerate 20 EC (61.33 q/ha) and they differed significantly from each other (Table 2).

Economics

Maximum fruit yield was registered by treatment endosulfan (69.50 q/ha) which was followed by cypermethrin (64 q / ha) and fenvalerate (61.33 q/ha) and lowest in control (20.33 q/ha). Thus the quantity of fruit saved per hectare by applying different insecticides ranged from 24.78 (ë-cyhalothrin) to 49.17q/ha (endosulfan). Taking into account the prevailing market price of tomato fruit i.e. Rs. 800/- per q, the cost of fruit saved ranged from 19,824/- (ë-cyhalothrin) to 39,336/- (endosulfan). The net profit ranged from ₹ 7,424/- per ha (ë-cyhalothrin) to Rs. 38,528/ - per ha (endosulfan). The cost benefit (CB) ratio ranged from 1:0.37 (ë-cyhalothrin) to 1: 0.98 (cypermethrin). It shows that spraying of cypermethrin twice on tomato crop, gave maximum cost benefit ratio (1:0.98) which was obviously due to its low price as compared to other insecticides (Table 2). The present findings are in accordance with the findings of Karabhantanal and Awaknavor (2004) who also reported that indoxacarb due to its highest expenditure cost gave lowest cost benefit ratio. Rudramuni *et al.,* (2011) reported that the cost benefit ratio was maximum in methomyl (1:2.68).

The study of insecticidal treatments against larval population of *H. armigera* revealed

significantly reduced the larval population. The present finding confirms the findings of Sandeep *et al.,* (2006). Studies carried out by Rudramuni *et al.,* (2011) revealed methomyl recorded the lowest (0.87) bollworm population. Amalendu Ghosh *et al.,* (2010) reported that spinosad recorded hundred per cent mortality to *H. armigera* population.

In the present findings, the fruit borer *H. armigera* have been recorded to cause severe damage to the tomato crop, which amply supports the findings of Dhamdhere (1990), who also reported that tomato fruit borer as the limiting factor in the tomato production.

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