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Efficacy and economics of different insecticides against *Earias vittella* (Fabricius) on Okra (*Abelmoschus esculentus* L. Moench)

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Abstract
An experiment was directed to observe the efficacy of some insecticides against shoot and fruit borer of okra during kharif season of 2014 at the Entomological experimental field, JNKVV Jabalpur (M.P.). The treatments emamectin benzoate 5% SG @ 12 g a.i./ha. Recorded higher fruit yield (58.00 q/ha) as compared to control (23.69 q/ha). Followed by emamectin benzoate 5% SG @ 10 g a.i./ha (52.00 q/ha) and triazophos 40% EC @ 400 g a.i./ha (50.00 q/ha) both were found to at par each other. Whereas other insecticide Thiamethoxam 25% WG @ 50 g a.i./ha (41.53 q/ha), thiamethoxam 25% WG @ 25 g a.i./ha (38.70 q/ha) and imidacloprid 17.8% SL @ 21.36 g a.i./ha (36.65 q/ha) was also shows better results. The highest net return was obtained from emamectin benzoate 5% SG @ 12 g a.i./ha but the cost benefit ratio was lowest (1:9.83). And the maximum cost benefit ratio was obtained in triazophos 40% EC @ 400 g a.i./ha (1:15.60) due to lower cost than others.

Keywords: Shoot and Fruit Borer, Emamectin benzoate, Thiamethoxam, Imidacloprid, Okra

1. Introduction

Vegetables constitute an important item of our food, supplying vitamins, carbohydrates and minerals needed for a balanced diet. Their value is important especially in under developed and developing countries like India.

India is a major vegetable producing and consuming country and vegetables form an important dietary component. Among them okra, *Abelmoschus esculentus* L. Moench, is one of the popular and commercially cultivated vegetable crops, popularly known as Bhindi or lady's finger belongs to family Malvaceae and is an important crop grown throughout the year. Besides India, it is grown in many tropical and subtropical parts of the world. Tender fruits are used as vegetables or in culinary preparations as sliced and dried pieces. It is also used for thickening gravies and soups, because of its high mucilage content. The roots and stems of okra are used for cleaning cane juice (Chauhan, 1972) [8]. The matured fruits and stems containing crude fibre are used in paper industry.

Okra is cultivated for its immature fruits to be consumed as a fresh and canned food as well as for seed purpose. Fruits of okra contain a mucilaginous substance that thickens the soup and stews. It has good nutritional value, particularly the high content of vitamin C (13.10 mg/100g), calcium (66mg/100g), iron (35mg/100g), magnesium (53g/100g), potassium (103g/100g) and carbohydrates (6.4g/100g) (Gopalan *et al.*, 2007) [10].

The West Bengal (14%) is a leading okra producing states followed by Bihar (12%), Gujrat (12%) (Anonymous, 2014) [3]. Though okra finds its origin in South-Africa, India stands top in area and production.

In World, vegetable is cultivated in an area of 56.69 mha with a total production of 1087.59 MT and average productivity of 19.18 MT/ha and okra is cultivated in an area of 1.06 mha with a total production of 7.83 MT and average productivity of 7.4 MT/ha (Anonymous, 2011) [1]. In India vegetable cultivated in 9355.00 mha with an annual production of 163388.00 MT in 2014-15 (Anonymous, 2014-15) [6] and productivity 17.30 MT/ha in 2013-14 (Anonymous, 2014) [4] and the okra is cultivated 524.00 mha with an annual production of 6203.00 MT (Anonymous, 2014-15) [6] and productivity 11.90 MT/ha in 2013-14 (Anonymous, 2014) [5]. In Madhya Pradesh total vegetables cultivated area is 628.72 mha and annual production 13019.31 MT and productivity 20.70 MT/ha while the okra is cultivated in 26.51 mha area and production 305.90 MT with productivity of 11.53 MT/ha in 2013-14 (Anonymous, 2014) [5].

In Jabalpur division okra is cultivated in an area of 4667.3 ha and annual production 65585 MT while particularly in Jabalpur district okra is cultivated in an area of 1985 ha and annual production 29775 MT in 2012-13 (Anonymous, 2012-13) [2].

Okra is attacked by a number of insect pests of which the shoot and fruit borer, *Earias vittella* (Fabricius) is a serious pest while many of the pests occuring on cotton are found to ravage of okra crop. As high as 72 species of insects have been recorded on okra (Rao and Rajendran, 2003) [16]. Singh and Brak, 1994 [17] reported 32.06-40.48 per cent losses in okra due to Shoot and fruit borers *(E. vittella).* The productivity of okra is low due to many factors and one of the most important constraints in production is the attack of insect pests. Aphid (*Aphis gossypii* Glover), shoot and fruit borer, *Earias insulana* (Boisduval) and *E. vittella* (Fabricius) and Jassid, *Amrasca biguttula biguttula* (Ishida) are most serious pests of okra and cause 45.00-57.10% damage to fruits (Shrinivasan and Krishna Kumar, 1983 [14] and Nderitu *et al*., 2008 [18]). The idea of controlling pests by using various agro-techniques in combination with selective use of insecticides making compatible with other components of the management of okra pests are gaining importance as the most effective measure.

2. Material and methods

The present investigation entitled, "Studies on Efficacy and Economics of different insecticides against *Earias vittella* (Fabricius) on okra (*Abelmoschus esculentus* L. Moench)." was carried out in the experimental field of Department of Entomology, Live Stock Farm, Adhartal, JNKW, Jabalpur, Madhya Pradesh during *kharif* season 2014.

2.1. Observations of Shoot and Fruit borer, *Earias vittella* (Fabricius) pest was recorded as detailed below

Observations on the intensity of fruit infestation by fruit borer (*Earias vittella*) at each picking were recorded as follows:

Fruit infestation by *E. vittella* was judged by counting the healthy fruits and fruits damaged by *E. vittella*, and the per cent fruit borer infestation was computed as follows:

$$\text{Per cent fruit infestation} = \frac{\text{Number of fruit damaged}}{\text{Total number of fruits observed}} \times 100$$

2.2. Method of observation

- Pretreatment observations were recorded 24 hours before spraying and post treatment observation were taken 1st, 5th, 7th, and 10th day after application of treatment.
- Observations on fruit borer, *Earias vittella* (Fab.) was recorded per-plot percent fruit infestation was worked out at each picking. Marketable fruit yield/plot was recorded at each picking.

Table 1: Treatment details of Insecticides

Treatment code	Treatments	a.i. g/ha	Dose g/ml/ha
T_1	Thiamethoxam 25% WG	25	100
T_2	Thiamethoxam 25% WG	50	200
T_3	Imidacloprid 17.8% SL	21.36	120
T_4	Emamectin benzoate 5% SG	10	200
T_5	Emamectin benzoate 5% SG	12	240
T_6	Triazophos 40% EC	400	1000
T_7	Control	-	-

3. Results and discussion

3.1. Per cent shoot and fruit damage by fruit borer and fruit yield

On the basis of overall mean fruit damage, all the insecticidal treatments recorded significantly less fruit damage as compared to control (39.58%). Among the treatments emamectin benzoate 5% SG @ 12 g a.i./ha recorded lowest fruit damage (13.61%) this was followed by emamectin benzoate 5% SG @ 10 g a.i./ha (16.00%) and triazophos 40% EC @ 400 g a.i./ha (16.94%), both were found to be at par with each other.

The next effective group of treatments included thiamethoxam 25% WG @ 50 g a.i./ha (21.16%) and thiamethoxam 25% WG @ 25 g a.i./ha (22.50%), both were found to be at par with each other while imidacloprid 17.8% SL @ 21.36 g a.i./ha (24.19%) was found to be at par with thiamethoxam 25% WG @ 25 g a.i./ha.

All the insecticidal treatments significantly recorded higher fruit yield as compared to control (23.69 q/ha). Highest yield (58.00 q/ha) was recorded with treatment emamectin benzoate 5% SG @ 12 g a.i./ha. The next effective treatments were emamectin benzoate 5% SG @ 10 g a.i./ha (52.00 q/ha) and triazophos 40% EC @ 400 g a.i./ha (50.00 q/ha), both were found to at par each other. Thiamethoxam 25% WG @ 50 g a.i./ha (41.53 q/ha) and thiamethoxam 25% WG @ 25 g a.i./ha (38.70 q/ha) were the next better treatments as both were at par to each other, while imidacloprid 17.8% SL @ 21.36 g a.i./ha (36.65 q/ha) was also at par with thiamethoxam 25% WG @ 25 g a.i./ha (Table-2).

In accordance with the present findings (Govindan *et al.,* 2012) [11] also reported that emamectin benzoate 5% SG @ 11 g a.i./ha and 13 g a.i./ha were highly effective in reducing the fruit damage per cent of shoot and fruit borer and increasing the healthy fruit yield of okra, whereas (Patra *et al.* 2007) [15], (Aulakh *et al.*, 2012) [7] and (Dhanalakshami and Mallapur, 2010) [9] reported that emamectin benzoate 5% SG @ 15 g a.i./ha, 5% SG @ 150, 170, & 200 g/ha and 5% SG @ 0.2/L respectively were found significantly effective in reducing the per cent fruit damage and increasing the healthy fruit yield against shoot and fruit borer in okra. However, (Harinkhere, 2014) [12] found that emamectin benzoate 5% SG @ 25 g a.i./ha and thiamethoxam 25% WG @ 25 g a.i./ha were the most effective treatment with lowest fruit damage and highest healthy fruit yield in okra.

The present findings further revealed that the mean percent fruit damage caused by shoot and fruit borer was highest at the beginning of picking season and as the number of pickings increased there was a decrease the fruit damage.

3.2 Economics of treatments

Maximum increase in fruit yield over control was registered emamectin benzoate 5% SG @ 12 g a.i./ha (34.31 q/ha) this

was followed by emamectin benzoate 5% SG @ 10 g a.i./ha (28.31 q/ha), triazophos 40% EC @ 400 g a.i./ha (26.31 q/ha), thiamethoxam 25% WG @ 50 g a.i./ha (17.84 q/ha), thiamethoxam 25% WG @ 25 g a.i./ha (15.01 q/ha) and imidacloprid 17.8% SL @ 21.36 g a.i./ha (12.96 q/ha), respectively. Maximum net profit was registered in emamectin benzoate 5% SG @ 12 g a.i./ha (Rs. 62,284) this was followed by emamectin benzoate 5% SG @ 10 g a.i./ha (Rs.51,112), triazophos 40% EC @ 400 g a.i./ha (Rs.49,452), thiamethoxam 25% WG @ 50 g a.i./ha (Rs.33,112), thiamethoxam 25% WG @ 25 g a.i./ha (Rs.28,052) and imidacloprid 17.8% SL @ 21.36 g a.i./ha (Rs.24,084), respectively. Maximum cost benefit ratio was obtained in triazophos 40% EC @ 400 g a.i./ha (1:15.60) this was followed by thiamethoxam 25% WG @ 25 g a.i./ha (1:14.25), imidacloprid 17.8% SL @ 21.36 g a.i./ha (1:13.11), thiamethoxam 25% WG @ 50 g a.i./ha (1:12.89), emamectin benzoate 5% SG @ 12 g a.i./ha (1:9.83) and emamectin benzoate 5% SG @ 10 g a.i./ha (1:9.27), respectively. It showed that spraying of triazophos 40% EC @ 400 g a.i./ha on okra crop gave maximum cost benefit ratio, however its cost was low as compared to, thiamethoxam 25% WG @ 25 g a.i./ha, imidacloprid 17.8% SL @ 21.36 g a.i./ha, thiamethoxam 25% WG @ 50 g a.i./ha, emamectin benzoate 5% SG @ 12 g a.i./ha and emamectin benzoate 5% SG @ 10 g a.i./ha, respectively (Table-3). (Konar *et al*., 2013) [13] also reported that highest net return was obtained from emamectin benzoate 5% SG @ 18 g a.i./ha in okra. Similarly (Harinkhere, 2014) [12] found that highest net return was obtained from emamectin benzoate 5% SG @ 25 g a.i./ha but the cost benefit ratio was lowest (1:4.1) among all the insecticides in okra.

4. Cost involve during the experiment

1. Rate of labour per day Rs. 228/- (2 labours required for spraying 1 ha okra crop in 1 day)
2. Cost of insecticide /ha.

Thiamethoxam 25 WG = Rs. 2000/Kg
Imidacloprid 17.8 SL = Rs.1300/Litre
Emamectin benzoate 5 SG = Rs. 6902/Kg
Triazophos 40 EC = Rs 600/Litre

Table 2: Efficacy of different insecticides against shoot and fruit borer percent damage, fruit yield and percent avoidable losses on okra

Treatment code	Treatment details	Dose g a.i./ha.	Mean percentage Fruit damage by shoot and fruit borer*	Fruit Yield (q/ha)	Percent avoidable losses
T_1	Thiamethoxam 25% WG	25	22.50 (28.31)	38.70	38.78
T_2	Thiamethoxam 25% WG	50	21.16 (27.38)	41.53	42.95
T_3	Imidacloprid 17.8% SL	21.36	24.19 (29.46)	36.65	35.36 L
T_4	Emamectin benzoate 5% SG	10	16.00 (23.57)	52.00	54.44
T_5	Emamectin benzoate 5% SG	12	13.61 (21.64) L	58.0 H	59.15 H
T_6	Triazophos 40% EC	400	16.94 (24.3)	50.00	52.61
T_7	Control	-	39.58 (38.98) H	23.69 L	
SEm±			0.38	0.98	
CD at 5%			1.16	3.03	

*Mean of 12 pickings, ( ) Figures in parentheses are arcsin transformed value, L= Lowest H= Highest

Table 3: Economics of different insecticides on fruit yield of okra during *kharif* 2014

Treatment Code	Treatment Details	Dose g a.i./ha.	Fruit yield (q/ha)	Increase in yield over control	Cost of treatments	Cost increased yield over control @ Rs. 2000/- per quintal	Net Profit (Rs/ha.)	Cost benefit ratio
T_1	Thiamethoxam 25% WG	25	38.70	15.01	1968	30020	28052	1:14.25
T_2	Thiamethoxam 25% WG	50	41.53	17.84	2568	35680	33112	1:12.89
T_3	Imidacloprid 17.8% SL	21.36	36.65	12.96	1836	25920	24084	1:13.11
T_4	Emamectin benzoate 5% SG	10	52.00	28.31	5508	56620	51112	1:9.27L
T_5	Emamectin benzoate 5% SG	12	58.00	34.31	6336	68620	62284	1:9.83
T_6	Triazophos 40% EC	400	50.00	26.31	3168	52620	49452	1:15.60H
T_7	Control	-	23.69					

L=Lowest, H=Highest

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