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Bio-efficacy of newer insecticides against fruit borers of okra

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Abstract
The field experiment was carried out to study the bioefficacy of newer insecticides against fruit borers of okra at Department of Agricultural Entomology, VNMKV, Parbhani during *Kharif* 2018. The trial was laid out in Randomized Block Design with thrice replications. Seven insecticides treatments *viz*., T_1:Emamectin benzoate 5% SG @ 135 g/ha, T_2:Lambda cyhalothrin 4.9% CS @ 300 ml/ha, T_3: Chlorantriniprole 18.5% SC @ 125 ml/ha, T_4: Fenpropathrin 30% EC @ 170 ml/ha, T_5: Flubendiamide 39.37% SC @ 100 ml/ha, T_6:Spinotoram 11.7% SC @ 420 ml/ha and T_7: Spinosad 45% SC @160 ml/ha in comparison to control (water spray) were tested for their efficacy against fruit borers of okra.
The results revealed that all the insecticide treatments were significantly effective in reduction of fruit borers infestation on number basis as well as weight basis after first and second sprays on okra. Among the test insecticides, chlorantraniliprole 18.5% SC (2.99 and 3.30%) recorded minimum mean per cent fruit infestation on number basis as well as weight basis, respectively and it was at par with spinetoram 11.7% SC (3.28 and 3.81%) and spinosad 45% SC (4.02 and 4.33%). Whereas, lambda cyhalothrin 4.9% CS was least effective against fruit borer on number basis (7.26%) and weight basis (7.82%) with mean fruit infestation on first and second sprays, respectively.
The highest marketable fruit yield of 90.20 q/ha was recorded in the treatment chlorantraniliprole 18.5% SC followed by spinotoram 11.7% SC (89.35 q/ha). The highest net returns of Rs. 35375/ha was also achieved through chlorantraniliprole 18.5% SC. The highest incremental cost benefit ratio (ICBR) of 1:18.70 was achieved with emamectin benzoate followed by lambda cyhalothrin (1:17.51). Whereas, the lowest ICRB (1:02.89) was found in plot treated with spinetoram 11.7% SC, it may the expensive cost of insecticide.

Keywords: Insecticides, fruit borer, okra

Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) a commercial vegetable crop, commonly known as bhindi in India and it is of African origin. It grown extensively in the tropical, subtropical and warm temperature regions of the world especially in U.S.A., Africa, Asia, Nigeria, Sudan, Iraq, Pakistan, Turkey, Australia, U.K. and other neighbouring countries. India ranks first in area and production in the world. It is a major commercial vegetable cultivated all over India particularly in the states of Andhra Pradesh, West Bengal, Jharkhand, Orissa, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat and Maharashtra. In Maharashtra, Bhendi is grown throughout the year providing continuous and good source of income to the farmers. During summer season, it fetches lucrative price due to shortage of other vegetables in the market. It is extensively grown in the districts *viz*., Ahmednagar, Amravati, Aurangabad, Beed, Dhule, Jalgaon, Nagpur, Nashik, Osmanabad, Parbhani and Pune. In India, it was cultivated on an area of 528.4 thousand hectares with annual production of 6146 thousand tones and productivity of 11.60 t/ha and in Maharashtra area 14.43 thousand hectare, production 148.09 MT and productivity 10.26 MT/ha reported by Anonymous (2018) [1].

Okra is a good source of vitamin A, B and C. It also contains protein, calcium, potassium and some minerals. Tender green fruit are cooked in curry and soup. Okra has several medicinal uses (Nadkarni, 1927) [18]. It is excellent source of iodine and so useful for control of goitre disease. Okra's dry seeds contain 18 to 22 per cent oil and 20 to 30 per cent protein (Berry *et al.*, 1988) [3]. Mucilage from the stem and roots is used for clarifying sugarcane juice in gur or jaggery manufacture in India (Chauhan, 1972) [5].

Okra plants are attacked by twenty insect pests during different growth stages. The problem of pests in okra is more or less similar to that of cotton crops. The major insect pests of okra are shoot and fruit borer and sucking pests. In the later stages, the crop is severely attacked by shoot and fruit borer, *Earias vittella* (Fabricius) and *E. insulana* (Boisd). Larvae bore into growing shoot of okra plant to fruit formation resulting in withering and drying of growing shoot on availability of fruits, larvae start feeding on them and thus cause direct loss of yield in marketable fruits. The losses in okra due to fruit borer (*Earias vittella*) were 49-74 per cent, reported by Krishnaiah (1980) [14] and the losses in the yield of okra by fruit borer were 69 per cent (Rawat and Sahu, 1975) [23].

Okra and its pests complex forms “okra ecosystem” which also includes natural enemies living on these pests. The predatory insects like ladybird beetle, spider and aphid lion or green lacewing feeds on aphid and other soft bodied insects, it helps to control pests which feed on okra.

Pest control in okra by small-scale farmers is still heavily dependent on chemical insecticides even though their use is associated with many undesirable and sometimes lethal consequences. Improper and wide-spread use of chemical insecticides can cause under-ground and surface water pollution. Excessive use of insecticides also induces resistance development in target pests as well as killing beneficial organisms such as pollinators (especially bees) and natural enemies (insect parasitoids and predators) (Pedigo and Rice, 2006) [22]. In the present studies, the new molecules with less harmful to natural enemies and pollinators were used in view to minimize the fruit infestation caused by fruit borers on okra.

Material and Methods

The field experiment was conducted to evaluate the bio-efficacy of newer insecticides against fruit borers of okra during *Kharif* season 2018 at Research farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was laid out in Randomized Block Design in three replications with eight treatments including control. Okra cv. Parbhani OK crop sown on 5th July, 2018 in gross plot size of 3.6 and 3.0 m^2 with row to row and plant to plant of 60 cm x 30 cm spacing, respectively.

Treatment details

In the present experiment, eight treatments i.e. T_1:Emamectin benzoate 5% SG @ 135 g/ha, T_2:Lambda cyhalothrin 4.9% CS @ 300 ml/ha, T_3: Chlorantriniprole 18.5% SC @ 125 ml/ha, T_4: Fenpropathrin 30% EC @ 170 ml/ha, T_5: Flubendiamide 39.37% SC @ 100 ml/ha, T_6:Spinotoram 11.7% SC @ 420 ml/ha, T_7: Spinosad 45% SC @ 160 ml/ha and T_8:Control (water spray) were tried.

The application of treatments were initiated with ETL of fruit borers and continued thereafter at 15 days interval. The spray volume for each spray was calculated by spraying untreated plots with plain water just upto drip-off stage. Spraying was done in early morning hours to avoid the mid day heat. Spraying was done using knapsack sprayer with solid cone nozzle by using spray fluid of 500 litres.

Observations

The observations of fruit borers of okra were recorded 1 day before spraying, 1, 3, 7 and 14 days after each spraying. For recording observations on fruit borer i.e. *Earias vittella* and *Helicoverpa armigera* infestation on the harvested okra fruits were separated as healthy and infested fruits, on the basis of presence of entry or exit hole. The healthy and damaged fruits were counted separately and the percentage of fruit infestation was computed using the following formula.

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

$$\text{Per cent fruit infestation (Weight basis)} = \frac{\text{Weight of damaged fruits}}{\text{Total weight of fruits}} \times 100$$

Statistical analysis

The data on fruit damage was transformed using angular values. Then these data were subjected to statistical analysis for interpreting the results to analysis of variance. Critical difference (CD) was applied for comparing treatment means (Gomez and Gomez, 1984) [11].

Results and Discussion

The studies on bioefficacy of newer insecticides against fruit borers of okra were undertaken on fruit infestation of okra (number basis and weight basis) during *Kharif* 2018. The results obtained during the course of investigations are presented in Table 1 and 2.

i. Per cent fruit infestation (number basis)

First spray

The results from Table 1 revealed that pre count of per cent fruit infestation by fruit borers *i.e. E. vittella and H. armigera* was non-significant showing even distribution of fruit infestation before spraying in the range of 24.96 to 31.50 per cent.

On one day after sprays (DAS), all the insecticide treatments were found significantly superior over control in reducing per cent fruit infestation of okra fruit borers after first application of insecticides. However, chlorantraniliprole 18.5% SC (2.59%) recorded minimum per cent fruit infestation of fruit borers and it was at par with spinetoram 11.7% SC (2.80%), spinosad 45% SC (3.52%), fenpropathrin 30% EC (3.85%) and flubendiamide 39.37% SC (4.09). Emamectin benzoate 5% SG (4.93%) and lambda cyhalothrin 4.9% CS (5.70%) was found also effective against fruit borers on okra. Maximum fruit infestation was recorded in control treatment (32.54%).

The results of three days after spraying indicated that chlorantraniliprole 18.5% SC (1.92%) also recorded minimum per cent fruit infestation of fruit borers followed by spinetoram 11.7% SC (2.10%), spinosad 45% SC (2.41%) and flubendiamide 39.37% SC (2.51%) and it found at par with each other. Rest of the treatments *viz*., fenpropathrin 30% EC (3.09%), emamectin benzoate 5% SG (3.72%) and lambda cyhalothrin 4.9% CS (5.0%) were also effective in reducing the fruit borers infestation as against control (31.55%).

The observations recorded on seven days after spraying revealed that chlorantraniliprole 18.5% SC (3.15%) recorded minimum per cent fruit infestation and it was at par with spinetoram 11.7% SC (3.51%), spinosad 45% SC (3.86%), fenpropathrin 30% EC (4.51%) and flubendiamide 39.37% SC (4.57%). Other treatments i.e. emamectin benzoate 5% SG (6.02%) and lambda cyhalothrin 4.9% CS (8.52%) were also lowering the fruit infestation over control (32.14%).

The results of fourteen days after spraying shows, chlorantraniliprole 18.5% SC (4.12%) recorded reducing fruit infestation of fruit borers followed by spinetoram 11.7% SC (4.61%) and it was at par with each other. The treatments i.e. spinosad 45% SC (6.27%), flubendiamide 39.37% SC (6.59%), fenpropathrin 30% EC (7.07%), emamectin benzoate 5% SG (7.81%) and lambda cyhalothrin 4.9% CS (9.38%) were effective in reducing the fruit infestation caused by fruit borers. In control treatment, fruit infestation was noted significantly maximum (35.37%) than insecticides treatments.

Second spray

The results of one day after spraying indicated that chlorantraniliprole 18.5% SC (2.71%) recorded minimum per cent fruit infestation of fruit borers and it was at par with spinetoram 11.7% SC (2.91%) and spinosad 45% SC (3.61%). Rest of the treatments *viz*., fenpropathrin 30%EC (3.93%), flubendiamide 39.37% SC (4.21%), emamectin benzoate 5% SG (5.14%) and lambda cyhalothrin 4.9% CS (5.92%) were also effective against fruit borers over control (38.61%).

Data pertaining to per cent fruit infestation of fruit borers on three days after spraying indicated that least per cent fruit infestation of fruit borers was recorded in the plot treated with chlorantraniliprole 18.5% SC (1.93%) followed by spinetoram 11.7% SC (2.25%) spinosad 45% SC (2.44%) and flubendiamide 39.37% SC (2.62%) and found at par with each other. Fenpropathrin 30%EC (3.10%), emamectin benzoate 5% SG (3.89%) and lambda cyhalothrin 4.9% CS (5.17%) were also minimize the fruit infestation as against control (36.80%).

The results of seven day after spraying observed that chlorantraniliprole 18.5% SC (3.35%) found to be reducing fruit infestation caused by fruit borers and which was at par with spinetoram 11.7% SC (3.41%), spinosad 45% SC (3.96%) and fenpropathrin 30% EC (4.58%). Rest of the treatment *viz*., flubendiamide 39.37% SC (4.65%), emamectin benzoate 5% SG (6.29%) and lambda cyhalothrin 4.9% CS (8.73%) were also reduce fruit infestation over control (38.40%).

On fourteen days after spray, indicated that chlorantraniliprole 18.5% SC (4.18%) recorded least per cent fruit infestation of fruit borers and it was at par with spinetoram 11.7% SC (4.71%). It was followed by spinosad 45% SC (6.12%), fenpropathrin 30% EC (7.18%), emamectin benzoate 5% SG (8.12%). Lambda cyhalothrin 4.9% CS (9.73%) treatment was also effective over control (42.11%).

Mean of first and second spray, it revealed that chlorantraniliprole 18.5% SC (2.99%) recorded significantly minimum per cent fruit infestation on number basis and it was at par with spinetoram 11.7% SC (3.28%) and spinosad 45% SC (4.02%). Rest of the treatments *viz*., flubendiamide 39.37% SC (4.49%), fenpropathrin 30% EC (4.66%), emamectin benzoate 5% SG (5.74%) and lambda cyhalothrin 4.9% CS (7.26%) were also reduced fruit infestation over control (35.37%).

ii. Per cent fruit infestation (weight basis)

First spray

The data regarding effect of different insecticides on per cent fruit infestation of fruit borers *(E. vittella,* and *H. armigera)* on weight basis are presented in Table 2. The observation of the pre count of per cent fruit infestation was non-significant showing even distribution in the range of 25.12 to 31.86 per cent before spraying.

On one days after spray, all the insecticides were found significantly superior over control in reducing per cent fruit infestation of okra. Chlorantraniliprole 18.5% SC (2.92%) recorded less per cent fruit infestation followed by spinetoram 11.7% SC (3.61%), spinosad 45% SC (3.52%) and fenpropathrin 30%EC (4.50%) and found at par with each other. Rest of the treatments *viz*., flubendiamide 39.37% SC (4.70), emamectin benzoate 5% SG (5.01%) and lambda cyhalothrin 4.9% CS (6.57%) were also effective against fruit borers over control (29.40%).

The results of three and seven days after spraying indicated that minimum per cent fruit infestation was recorded in chlorantraniliprole 18.5% SC (2.46 and 3.58%) which was at par with spinetoram 11.7% SC (2.97 and 4.44%), spinosad 45% SC (2.61and 4.80%), flubendiamide 39.37% SC (3.01 and 5.33%) and fenpropathrin 30% EC (3.65 and 5.48%), respectively. Emamectin benzoate 5% SG (3.87 and 6.37%) and lambda cyhalothrin 4.9% CS (5.96 and 9.40%) was also minimise fruit borers infestation over control (32.56 and 32.60%), respectively.

The observations of fourteen days after spraying indicated that chlorantraniliprole 18.5% SC (4.52%) recorded significantly minimum per cent fruit infestation and it was at par with spinetoram 11.7% SC (5.54%). It was followed by spinosad 45% SC (6.98%), flubendiamide 39.37% SC (7.56%), fenpropathrin 30%EC (7.78%), emamectin benzoate 5% SG (8.35%) and lambda cyhalothrin 4.9% CS (10.02%) effective to minimize per cent fruit infestation. The significantly maximum per cent fruit infestation was recorded in control (36.95%) treatment than insecticides.

Second spray

The results of one day after second spraying revealed that chlorantraniliprole 18.5% SC (2.99%) recorded minimum per cent fruit infestation of fruit borers followed by spinetoram 11.7% SC (3.12%) and spinosad 45% SC (3.78%). Other treatments *viz*., flubendiamide 39.37% SC (4.42%), fenpropathrin 30% EC (4.20%), emamectin benzoate 5% SG (5.43%) and lambda cyhalothrin 4.9% CS (6.18%) and they were found at par with each other. All the insecticide treatments proved effective against fruit borers over control treatment (38.61%).

Data pertaining to per cent fruit infestation on three days after spraying indicated that chlorantraniliprole 18.5% SC (2.06%) recorded less per cent fruit infestation and it was at par with spinetoram 11.7% SC (2.41%). It was followed by spinosad 45% SC (2.62%), flubendiamide 39.37% SC (2.83%), fenpropathrin 30% EC (3.28%), emamectin benzoate 5% SG (4.17%) and lambda cyhalothrin 4.9% CS (5.44%) were reduced fruit infestation as against control (37.76%).

The results of seven day after spraying observed that chlorantraniliprole 18.5% SC (3.57%) recorded less per cent fruit infestation and at par with other tested insecticides treatments except emamectin benzoate 5% SG (6.43%) and lambda cyhalothrin 4.9% CS (8.95%).

On fourteen days after spray, it seems that chlorantraniliprole 18.5% SC (4.37%) recorded minimum per cent fruit infestation of fruit borers and it was at par with spinetoram 11.7% SC (4.80%). Rest of the treatments *viz*., spinosad 45% SC (6.27%), flubendiamide 39.37% SC (6.95%), fenpropathrin 30%EC (7.47%), emamectin benzoate 5% SG (8.40%) and lambda cyhalothrin 4.9% CS (10.08%) were minimize fruit borer infestation over control (42.89%).

Mean of first and second spray per cent fruit infestation on weight basis, it revealed that chlorantraniliprole 18.5% SC (3.30%) recorded least per cent fruit infestation of fruit borers and it was at par with spinetoram 11.7% SC (3.81%) and spinosad 45% SC (4.33%) and followed by flubendiamide

39.37% SC (4.95%), fenpropathrin 30%EC (5.13%), emamectin benzoate 5% SG (6.00%) and lambda cyhalothrin 4.9% CS (7.82%). The control treatment was recorded maximum fruit infestation (36.29%).

The results of the present studies are lined with the finding of earlier workers as under:

Deepak *et al.* (2017) [7] reported that flubendiamide at 60g a.i.ha^{-1} recorded lowest fruit borer infestation of 14.40 per cent on number basis and 15.90 per cent on weight basis in okra. Bangar *et al.* (2012) [2] revealed that flubendiamide 0.0144% recorded lower larval population of *E. vittella* infesting okra shoot damage and found most effective followed by indoxacarb and emamectin benzoate.

Dhaker *et al.* (2017) [9] and Javed *et al.* (2018) [12] reported that emamectin benzoate 5 SG was most effective with mean shoot damage and fruit damage of 9.91 and 12.51 per cent, respectively. Devi *et al.* (2015) [8] and Yadav *et al.* (2017) [26] revealed that emamectin benzoate 12 g a.i./ha provided the best fruit protection against *Earias vittella* (Fab.) on okra over control followed by spinosad 12.5% SC. Naveena *et al.*, (2015) [19] also revealed that emamectin benzoate 5WG @ 7.50 g a.i/ha were recorded minimum mean larval population of shoot and fruit borer, *E. vittella* (0.33) per plant and fruit borer, *H. armigera* (0.73) and with a minimum shoot and fruit damage of 1.43 and 6.05 per cent, respectively.

Mane (2007) [17], Dhar and Bhattacharya (2015) [10] and Pachole *et al.* (2017) [20] reported that spinosad at 45 SC was found most effective against okra shoot and fruit borer, *E. vittella*.

Bheemanna *et al.* (2008) [4] reported that chloranthraniliprole 20 SC was @ 40 g a i./ha recorded minimum fruiting bodies in cotton bollworms. Saha *et al.* (2014) [24] reported that rynaxypyr 20 SC @ 0.006%, flubendiamide 480 SC @ 0.01%, spinosad 45 SC @ 0.0135% and emamectin benzoate 5 WG 0.0025% provided superior control of shoot and fruit borer [*Leucinodes orbonalis* (Guenee)] on brinjal.

iii. Fruit yield and ICBR

The data in respect of effect of insecticides on fruit yield of okra is presented in Table 3. The results indicated that all the insecticide treatments were significantly harvested higher fruit yield of okra over untreated control. The marketable fruit yield ranged from 49.50 to 90.20 q/ha harvested in the treatments tested. The highest yield (90.20 q/ha) was recorded in the plot treated with chlorantraniliprole 18.5 SC @ 125 ml/ha and which was at par with spinetoram 11.7% SC (89.30q/ha). Among insecticidal treatments, the lowest fruit yield (79.12 q/ha) was recorded in the treatment lambda cyhalothrin 4.9% CS @ 300 ml/ha and it was also significantly higher than control (49.50 q/ha).

The data pertaining to economic of different treatments revealed that treatments with emamectin benzoate 5 SG had highest incremental cost benefit ratio (ICBR) of 1:18.70 followed by lambda cyhalothrin 4.9% CS (1:17.51), fenpropathrin 30% EC (1:17.25), flubendiamide 39.37% SC (1:08.07), chlorantriniprole 18.5% SC (1:06.57) and spinosad 45% SC (1:04.96). Whereas, the lowest ICBR (1:02.89) was found in plot treated with spinetoram 11.7% SC, it may the expensive cost of insecticide.

These findings are accordance with the results reported by Parmar and Borad (2009) [21] who reported that emamectin benzoate perform better to protect the okra fruits from infestation of *H.armigera* and higher yields of okra fruits and economic return of 1:16.76. Kuttalam *et al.* (2008) [16] reported that use of emamectin benzoate recorded higher yields of okra per hectare compared to other treatments. Kumar *et al.* (2016) [15] reported that highest fruit yield was recorded in spinosad @ 100 ml/ha (73.07q/ha) as compared to control (42.08 q/ha). Pachole *et al.* (2017) [20] revealed that spinosad 45 SC was the best treatment against *E. vittella* on okra and most economical. Bangar *et al.* (2012) [2] reported that flubendiamide registered significantly higher fruit yield (76.73 q/ha) amongst tested insecticides.

Table 1: Bio-efficacy of newer insecticides against fruit borers of okra (Number basis)

Tr. No.	Treatments	Dose (g or ml/ha)	Pre -count	Percent fruit infestation of fruit after								
				First spray				Second spray				Mean
				1DAS	3DAS	7DAS	14DAS	1DAS	3DAS	7DAS	14DAS	
T1	Emamectin benzoate 5% SG	135	24.96 (29.95)*	4.93 (12.81)	3.72 (11.12)	6.02 (14.19)	7.81 (16.22)	5.14 (13.09)	3.89 (11.37)	6.29 (14.51)	8.12 (16.55)	5.74 (13.82)
T2	Lambda cyhalothrin 4.9% CS	300	25.19 (30.04)	5.70 (13.80)	5.00 (12.92)	8.52 (16.96)	9.38 (17.82)	5.92 (14.07)	5.17 (13.14)	8.73 (17.17)	9.73 (18.17)	7.26 (15.62)
T3	Chlorantriniprole 18.5% SC	125	29.10 (32.55)	2.59 (9.23)	1.92 (7.95)	3.15 (10.20)	4.12 (11.70)	2.71 (9.44	1.93 (7.97)	3.35 (10.54)	4.18 (11.79)	2.99 (9.91)
T4	Fenpropathrin 30%EC	170	25.95 (30.44)	3.85 (11.30)	3.09 (10.11)	4.51 (12.25)	7.07 (15.41)	3.93 (11.43)	3.10 (10.12)	4.58 (12.35)	7.18 (15.53)	4.66 (12.44)
T5	Flubendiamide 39.37% SC	100	31.50 (34.10)	4.09 (11.66)	2.51 (9.10)	4.57 (12.33)	6.59 (14.86)	4.21 (11.83)	2.62 (9.30)	4.65 (12.45)	6.69 (14.98)	4.49 (12.21)
T6	Spinotoram 11.7% SC	420	27.98 (31.70)	2.80 (9.62)	2.10 (8.31)	3.51 (10.79)	4.61 (12.38)	2.91 (9.81)	2.25 (8.61)	3.41 (10.63)	4.71 (12.52)	3.28 (10.43)
T7	Spinosad 45% SC	160	30.30 (33.35)	3.52 (10.80)	2.41 (8.93)	3.86 (11.31)	6.27 (14.49)	3.61 (10.94)	2.44 (8.98)	3.96 (11.46)	6.12 (14.32)	4.02 (11.50)
T8	Control	---	28.80 (32.28)	29.10 (32.54)	31.55 (34.11)	32.14 (34.44)	34.30 (35.82)	38.61 (38.39)	36.80 (37.31)	38.40 (38.25)	42.11 (40.43)	35.37 (36.47)
SE ±			2.27	0.83	0.61	0.87	0.60	0.55	0.55	0.61	0.58	0.53
C.D.@ 5%			NS	2.56	1.88	2.69	1.84	1.69	1.68	1.88	1.79	1.63
C.V.(%)			12.25	10.36	8.29	9.94	6.02	6.43	7.14	6.68	5.61	6.03

*Figures in parentheses are angular transformed values NS = Non significant DAS = Days after spray

Table 2: Bio-efficacy of newer insecticides against fruit borers of okra (Weight basis)

Tr. No.	Treatments	Dose (g or ml/ha)	Pre -count	Percent fruit infestation of fruit after								
				First spray				Second spray				Mean
				1DAS	3DAS	7DAS	14DAS	1DAS	3DAS	7DAS	14DAS	
T1	Emamectin benzoate 5% SG	135	25.12 (30.06)*	5.01 (12.92)	3.87 (11.34)	6.37 (14.60)	8.35 (16.78)	5.43 (13.46)	4.17 (11.77)	6.43 (14.68)	8.40 (16.83)	6.00 (14.10)
T2	Lambda cyhalothrin 4.9% CS	300	25.35 (30.15)	6.57 (14.85)	5.96 (14.12)	9.40 (17.84)	10.02 (18.44)	6.18 (14.39)	5.44 (13.48)	8.95 (17.40)	10.08 (18.50)	7.82 (16.21)
T3	Chlorantriniprole 18.5% SC	125	28.72 (32.30)	2.92 (9.81)	2.46 (9.00)	3.58 (10.89)	4.52 (12.27)	2.99 (9.93)	2.06 (8.23)	3.57 (10.87)	4.37 (12.05)	3.30 (10.46)
T4	Fenpropathrin 30%EC	170	26.14 (30.56)	4.50 (12.23)	3.65 (11.01)	5.45 (13.49)	7.78 (16.18)	4.20 (11.82)	3.28 (10.43)	4.74 (12.56)	7.47 (15.85)	5.13 (13.07)
T5	Flubendiamide 39.37% SC	100	31.86 (34.32)	4.70 (12.51)	3.01 (9.98)	5.33 (13.34)	7.56 (15.94)	4.42 (12.12)	2.83 (9.67)	4.85 (12.71)	6.95 (15.27)	4.95 (12.86)
T6	Spinotoram 11.7% SC	420	28.17 (31.82)	3.61 (10.95)	2.97 (9.92)	4.44 (12.16)	5.54 (13.61)	3.12 (10.16)	2.41 (8.92)	3.60 (10.92)	4.80 (12.65)	3.81 (11.18)
T7	Spinosad45% SC	160	30.42 (33.43)	3.52 (10.80)	2.61 (9.24)	4.80 (12.64)	6.98 (15.31)	3.78 (11.20)	2.62 (9.30)	4.12 (11.70)	6.27 (14.49)	4.33 (11.95)
T8	Control	---	29.00 (32.41)	29.40 (32.75)	32.56 (34.73)	32.60 (34.71)	36.95 (37.37)	38.61 (38.39)	37.76 (37.88)	39.58 (38.94)	42.89 (40.89)	36.29 (37.02)
SE ±			2.30	0.86	0.66	0.94	0.79	0.54	0.53	0.60	0.53	0.63
C.D.			NS	2.66	2.04	2.90	2.44	1.67	1.62	1.83	1.63	1.92
C.V.(%)			12.53	10.30	8.441	10.13	7.56	6.22	6.69	6.40	5.04	6.87

*Figures in parentheses are angular transformed values NS = Non significant DAS = Days after spray

Table 3: Incremental cost benefit ratio (ICBR) of different insecticides used against fruit borers of okra

Tr. No.	Treatments	Dose (g or ml/ha)	Fruit Yield (q/ha)	Increase in yield over control (q/ha)	Cost of insecticides per litre or kg (Rs)	Quantity required for two sprays	Cost of insecticide required for two sprays (Rs/ha)	Spraying Charges for two sprays (Rs/ha)	Total cost (Rs/ha) (7+8)	Value of additional yield over untreated control (Rs/ha)	Net profit (Rs/ha)	ICBR	Rank
1	2	3	4	5	6	7	8	9	10	11	12	13	14
T_1	Emamectin benzoate 5% SG	135	82.50	33.00	2500	270 g	675	1000	1675	33000	31325	1:18.70	1
T_2	Lambda cyhalothrin 4.9% CS	300	79.12	29.62	1000	600 ml	600	1000	1600	29620	28020	1:17.51	2
T_3	Chlorantriniprole 18.5% SC	125	90.20	40.70	17500	250 ml	4375	1000	5375	40700	35325	1:06.57	5
T_4	Fenpropathrin 30% EC	170	84.65	33.15	2400	340 ml	816	1000	1816	33150	31334	1:17.25	3
T_5	Flubendiamide 39.35% SC	100	84.00	34.50	14000	200 ml	2800	1000	3800	34500	30700	1:08.08	4
T_6	Spinetoram 11.7% SC	420	89.35	39.85	11000	840 ml	9240	1000	10240	39850	29610	1:02.89	7
T_7	Spinosad 45% SC	160	86.00	36.50	16000	320 ml	5120	1000	6120	36500	30380	1:04.96	6
T_8	Control	---	49.50	-	-	-	-	-	-	-	-	-	-

Rate: Okra fruits @10/- kg

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