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Bio-efficacy of different newer insecticides and bio-pesticides against okra shoot and fruit borer, *Earias* spp.

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Abstract
The present field experiment was conducted to study the bio-efficacy of insecticides against okra shoot and fruit borer, *Earias* spp. during *summer* 2016 and 2017 at RARS, Karjat. Results of the efficacy of insecticide against okra shoot and fruit borer on number basis of fruits obtained from average data from year 2016-2017 indicated that the Treatment T5 (Spiromesifen 22.9% SC 1st spray and 2nd spray Thiodicarb 75% WP and 3rd spray Emamectin Benzoate 5% SG) was recorded minimum fruit borer percent infestation (14.03) and it was at par with all other treatment except untreated check.

Keywords: bio-efficacy, shoot and fruit borer, okra, insecticides, *Aphis gossypii* glover

Introduction
Okra [*Abelmoschus esculentus* (L). Moench] is commonly known as lady's finger in western style and 'Bhindi' or 'Bhendi' in Indian style language. It is one of the major vegetable crops grown over worldwide. Pests and diseases have been most frequently cited as the major agronomic constraints in intensive monocrop horticultural fields.

Producers of okra frequently complain yield losses due to insect pests. Butani and Verma (1976) [2] recorded 20 pests infesting okra crop. In summer, okra fruits fetch higher price in the market however, the sucking pest attack is comparatively more, which results in low yields of marketable fruits than other seasons (Radke and Undirwade, 1981) [7]. The important pests affecting the yield of okra are shoot and fruit borer (*Earias vittella* Fab.), jassids (*Amrasca biguttula biguttula* Ishida), aphids (*Aphis gossypii* Glover), whiteflies (*Bemisia tabaci* Genn.) and mites (*Tetranychus* spp.). The shoot and fruit borer is major pest causing direct damage to marketable produce *i.e.* green fruits. It is alone reported to cause 57.17 per cent fruit damage and 54.04 per cent net yield loss in okra (Chaudhary and Dadheech, 1989) [3].

In order to prevent crop loss due to attack of different pests various conventional insecticides have been recommended, which are hazardous and harmful to human being due to their presence in fruit as residue. The insecticides also affect the population of parasites, predators and non-targeted organisms which are beneficial to the farmers. Generally, the wide spectrum insecticides also lead the pest resurgence and cause secondary pest outbreak. However, safe uses of pesticides have no option in present day available IPM technology. Therefore, novel insecticides needs to be evaluated for their efficacy so that the effective insecticides will be incorporated suitably in IPM of okra without or less affecting the environment to manage the okra shoot and fruit borer.

Materials and Methods
Experimental site
The experiment was carried out at Regional Agriculture Research Station, Karjat (M.S). During *summer* season of year 2016 and 2017.

Preparation of experimental plot
After harvest of previous crop, the field was ploughed twice followed by clod crushing and harrowing to bring soil to a fine tilth. The experimental plot was laid out with two replications and fourteen treatments for first objective and three replications and ten treatments for second

Objective, of gross plot size of 2.5 ×3.0 m for each treatment. The flat beds were prepared in each plot for growing okra.

Seeds
The seed of okra variety Varsha upahar was used.

Manures
Organic manure in the form of F.Y.M. @ 20 t/ha was applied in the soil before last harrowing so that it could be mixed well in the soil.

Fertilizers
The recommended dose of fertilizers, 100 Kg N_2O, 50 Kg P_2O_5 and 50 Kg K_2O/ha was applied in the form of straight fertilizers through urea (46.4 per cent N), single super phosphate (16 per cent P_2O_5) and muriate of potash (60 per cent K_2O) to each plot. Nitrogen was applied in 3 split doses, 1/3rd N at the time of sowing and 2/3rd dose of N at 30 and 60 days after sowing while phosphorus and potassium was applied as basal dose.

Variety	:	Varsha upahar
Plot size	:	2.5 m × 3.0 m
Sowing date	:	9th January, 2016 and 2017
Spacing	:	45 cm x 30 cm
Design	:	Randomised Block Design
No. of replications	:	Three
Treatments	:	Seven

Table: Treatments details

Treatments	1st spray	2nd spray	3rd spray	4th spray
T1	Clothianidin 50% WG @ 60 g/ha	Flubendiamide 39.35% SC @ 125 ml / ha	Azadirachtin 5% @ 500 ml / ha	*Beauveria bassiana* @ 1x10^8 spores/ g
T2	Flonicamid 50% WG @ 150 g/ha	Emamectin benzoate 5% SG @ 170g /ha	*B.t.*@ 1kg/ ha	*Beauveria bassiana* @ 1x10^8 spores/ g
T3	Thiamethoxam 25% WG @ 100 g/ha	Thiodicarb 75% WP @1000 g / ha	*B.t.*@ 500 g/ ha	*Verticillium lecani* @ 1x10^8 spores/ g
T4	Tolfenpyrad 15% EC @ 1000 ml/ha	Deltamethrin 2.8% EC @ 400 ml / ha	*Beauveria bassiana* @ 1x10^8 spores/g	Spinosad @ 170 g / ha
T5	Spiromesifen 22.9% SC @ 500 ml/ha	Thiodicarb75%WP @1000 g / ha	Emamectin benzoate 5% SG @ 170g /ha	Flubendiamide 39.35% SC @ 125 ml / ha
T6	Azadirachtin 5% @ 500 ml / ha	*Verticillium lecani* @ 1x10^8 spores/ g	*B.t.* @ 500 g/ ha	*Beauveria bassiana* @ 1x10^8 spores/ g
T7	Untreated Check			

Method and time of insecticide application
Actual quantity of spray material required per plot was calibrated prior to each spray using water alone. The spraying was done with manually operated knapsack sprayer. The desired concentration of various insecticides were prepared on the basis of percentage of active ingredient present in respective trade product and applied in respective plots thoroughly in form of fine droplets using high volume spray. The sprayer was washed off thoroughly after completion of spraying in each treatment.
The first spray could not be given due to absence of shoot borer infestation. Therefore, first application of insecticides was given at the time of initiation of flowering and subsequent two more sprays were given at an interval of 15 days thereafter.

Method of recording observations
The pre count observations were recorded 1 day prior to treatment and post treatment observations were recorded 3, 7 and 14 days after each spray.
Observations on the incidence or infestation were recorded by following standard method as described below.
Initially the observations were recorded on shoot infestation. Later, the observations were recorded both on shoots as well as flower buds and fruits.
The observations on shoot infestation and flower bud infestation were recorded from five randomly selected plants from each plot. There was no shoot infestation and flower bud infestation was minor. The observations on fruit infestation were recorded from five randomly selected plants from each plot. Total number of fruits, healthy fruits and infested fruits were recorded from five randomly selected plants of each treatment. The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The data was converted into per cent infested fruit and analysed statistically.
The per cent infestation was worked out on the basis of healthy and infested fruits on number basis.

Results and Discussion
Efficacy of different treatments against Shoot and fruit borer of okra during 2016.
On number basis
The data on the efficacy of various treatments in reducing the Shoot & fruit borer percent infestation after first, second and third spraying are furnished in Table 1.

Table 1: Efficacy of some insecticide and biopesticides against okra Shoot and Fruit borer, *Earias vittella* Fab. Recorded at different intervals on Number basis during 2016

Tr. No.	Treatment	Pre count	Mean reduction of okra Shoot and Fruit (%) days after sprays								
			1st spray			2nd spray			3rd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50% WG @ 60 g/ha 2nd spray- Flubendiamide39.35% SC @125 ml / h 3rd spray- Azadirachtin 5%@ 500 ml / ha	30.73 (33.65)	21.09 (27.28)	14.62 (22.38)	17.33 (24.58)	11.74 (20.00)	6.63 (14.89)	8.33 (16.74)	6.63 (14.54)	4.45 (12.11)	6.63 (16.89)
T_2	1st spray- Flonicamid 50% WG @ 150 g/ha 2nd spray- Emamectin benzoate 5% SG @ 170g /ha 3rd spray- *B.t.* @ 1kg/ ha	29.41 (32.83)	22.50 (28.32)	16.55 (23.97)	18.87 (25.70)	12.34 (20.53)	7.39 (15.68)	9.11 (17.56)	7.39 (15.68)	6.16 (14.30)	8.33 (16.74)
T_3	1st spray- Thiamethoxam 25%WG @ 100 g/ha	29.80	25.48	17.50	19.66	13.53	8.33	9.15	7.39	6.63	9.38

	2nd spray- Thiodicarb 75%WP @1000 g / ha 3rd spray- *B.t.* @ 500 g/ ha	(33.09)	(30.26)	(24.73)	(26.28)	(21.56)	(16.74)	(17.56)	(15.68)	(14.89)	(17.76)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin 2.8% EC@ 400 ml / ha 3rd spray- *Beauveria bassiana* @ 1x10^8 spores/ g	30.00 (33.21)	24.42 (29.60)	17.30 (24.58)	19.34 (26.06)	13.05 (21.13)	9.11 (17.56)	10.00 (18.44)	8.68 (17.05)	7.16 (15.45)	9.57 (17.97)
T_5	1st spray- Spiromesifen 22.9% SC @ 500 ml/ha 2nd spray- Thiodicarb 75%WP @1000 g / ha 3rd spray- Emamectin benzoate 5% SG @ 170g /ha	28.80 (32.46)	22.50 (28.32)	14.51 (22.38)	16.47 (23.89)	10.81 (19.19)	6.16 (14.30)	7.39 (15.68)	6.16 (14.30)	4.38 (11.97)	7.39 (15.68)
T_6	1st spray- Azadirachtin 5% @ 500 ml / ha 2nd spray- *Verticillium lecani* @ 1x10^8 spores/ g 3rd spray- *B.t.* @ 500 g/ ha	34.57 (35.97)	27.20 (31.44)	19.66 (26.28)	21.04 (27.28)	14.51 (22.38)	10.00 (18.44)	12.25 (20.44)	10.00 (18.44)	8.33 (16.74)	10.38 (18.72)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	31.16 (33.89)	32.55 (34.76)	33.68 (35.43)	36.04 (36.87)	36.68 (37.23)	36.55 (37.17)	36.20 (36.99)	35.30 (36.45)	35.68 (36.63)	36.20 (36.99)
	S.Em.±	0.34	0.32	0.42	0.31	0.23	0.41	0.18	0.26	0.22	0.28
	CD (p=0.05)	1.05	0.98	1.30	0.97	0.72	1.27	0.56	0.80	0.68	0.88

First spray

There was no significant difference in the percent Shoot & fruit borer percent infestation on a day before imposition of different treatments and infestation was recorded in the range of 28.80 to 34.57 percent Shoot & fruit borer percent infestation. The percent Shoot & fruit borer percent infestation was observed uniform in all the treatments before spray. All the insecticides were significantly superior to untreated check up to 14 DAS. After 3 DAS, the minimum Shoot & fruit borer percent infestation was recorded in the treatment T1 Clothianidin 50% WG (21.09 percent) among various treatments. The treatment T5 and T2 (22.50 percent) was the next best treatment followed by T4, T3, T6 and untreated check to minimise Shoot & fruit borer percent infestation. At 7 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Spiromesifen 22.9% SC (14.51 percent) among various treatments. The treatment T1 (14.62 percent) was the second best treatment followed by T2 (16.55 percent), T4, T3, T6 and untreated check to minimise Shoot & fruit borer percent infestation. At 14 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Spiromesifen 22.9% SC (16.47 percent) among various treatments. The treatment T1 (17.33 percent) was the second best treatment followed by T2 (18.87 percent), T4, T3, T6 and untreated check to minimise Shoot & fruit borer percent infestation.

Second spray

The Shoot & fruit borer percent infestation was uniform in all the treatments before spray. All the insecticides were significantly superior to untreated check up to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75% WP was recorded least Shoot & fruit borer percent infestation (10.81 percent) among various treatments and it was at par with treatment T1 (11.74 percent). The next best treatment was T2 (12.34 percent) followed by T4, T3, T6 and untreated check to minimise the Shoot & fruit borer percent infestation. At 7 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Thiodicarb 75% WP (6.16 percent) among various treatments. The treatment T1 (6.63 percent) was the second best treatment followed by T2 (7.39 percent), T3, T4, T6 and untreated check to minimise Shoot &fruit borer percent infestation. At 14 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Thiodicarb 75% WP (7.39 percent) among various treatments and it was at par with treatment T1 (8.33 percent). The next best treatment was T2 (9.11 percent) followed by T3, T4, T6 and untreated check to minimise Shoot & fruit borer percent infestation.

Third spray

The Shoot & fruit borer percent infestation was uniform in all the treatments before spray. All the insecticides were significantly superior to untreated check up to 14 DAS. After 3 DAS, the treatment T5 Emamectin Benzoate 5% SG was recorded least Shoot & fruit borer percent infestation (6.16 percent) among various treatments and it was at par with treatment T1 (6.63 percent). The next best treatment was T2 (7.39 percent) followed by T3, T4, T6 and untreated check to minimise Shoot & fruit borer percent infestation. At 7 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Emamectin Benzoate 5% SG (4.38 percent) among various treatments and it was at par with the treatment T1 (4.45 percent). The next best treatment was T2 (6.16 percent) followed by T3, T4, T6 and untreated check to minimise Shoot & fruit borer percent infestation. At 14 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T1 Azadiractin (6.63 percent) among various treatments and it was at par with treatment T5 (7.39 percent). The next best treatment was T2 (8.33 percent) followed by T3 (9.38 percent) was at par, T4, T6 and untreated check to minimise Shoot & fruit borer percent infestation.

Results obtained from average data of two year presented in Table 3 and results indicated that all the treatments were significantly superior over untreated check. Treatment T5 (Spiromesifen 22.9% SC 1st spray, 2nd spray Thiodicarb 75% WP and 3rd spray Emamectin benzoate 5% SG) was recorded minimum Shoot & fruit borer percent infestation and it was at par with all other treatment except untreated check. The trend of treatments as per their effectiveness to untreated check Shoot borer infestation. Shoot & fruit borer percent infestation was T1 (14.80) followed by T2, T4, T3, T6 and T7 (Untreated check) respectively.

Efficacy of different treatments against Shoot and fruit borer of okra during 2017

On Number Basis

The data on the efficacy of various treatments in reducing the Shoot & fruit borer percent infestation after first and second spraying are furnished in Table 2.

Table 2: Efficacy of some insecticide and bio pesticides against okra Shoot and Fruit borer, *Earias vittella* Fab. recorded at different intervals on Number basis during 2017

Tr. No.	Treatment	Pre count	Mean reduction of okra Shoot and Fruit (%) days after sprays								
			1st spray			2nd spray			3rd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50% WG @ 60 g/ha 2nd spray- Flubendiamide39.35% SC @125 ml / ha 3rd spray- Azadirachtin 5%@ 500 ml / ha	32.82 (34.94)	25.40 (30.26)	20.04 (26.56)	21.34 (27.49)	12.77 (20.88)	14.22 (22.14)	16.67 (24.04)	10.00 (18.44)	6.16 (14.30)	7.39 (15.68)
T_2	1st spray- Flonicamid 50% WG @ 150 g/ha 2nd spray- Emamectin benzoate 5% SG @ 170g /ha 3rd spray- *B.t.* @ 1kg/ ha	34.01 (35.73)	27.81 (31.82)	23.50 (29.00)	25.63 (30.40)	16.75 (24.12)	14.02 (21.97)	16.25 (23.73)	11.81 (20.09)	7.39 (15.8)	9.11 (17.56)
T_3	1st spray- Thiamethoxam 25%WG @ 100 g/ha 2nd spray- Thiodicarb 75%WP @1000 g / ha 3rd spray- *B.t.* @ 500 g/ ha	31.06 (33.83)	26.20 (30.79)	22.50 (28.32)	24.48 (29.60)	18.14 (25.18)	16.67 (24.04)	19.09 (25.84)	13.05 (21.13)	9.11 (17.56)	10.00 (18.44)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin 2.8% EC@ 400 ml / ha 3rd spray- *Beauveria bassiana* @ $1x10^8$ spores/ g	30.05 (33.21)	24.50 (29.67)	25.91 (27.90)	22.81 (28.52)	17.04 (24.35)	16.25 (23.73)	19.25 (25.99)	13.24 (21.30)	9.15 (17.56)	10.36 (18.72)
T_5	1st spray- Spiromesifen 22.9% SC @ 500 ml/ha 2nd spray- Thiodicarb 75%WP @1000 g / ha 3rd spray- Emamectin benzoate 5% SG @ 170g /ha	31.26 (33.96)	25.66 (30.40)	20.48 (26.85)	21.10 (27.35)	12.11 (20.36)	10.00 (18.44)	12.25 (20.44)	7.92 (16.32)	4.45 (12.11)	6.16 (14.30)
T_6	1st spray- Azadirachtin 5% @ 500 ml / ha 2nd spray- *Verticillium lecani* @ $1x10^8$ spores/ g 3rd spray- *B.t.* @ 500 g/ ha	33.06 (35.06)	27.21 (31.44)	23.42 (28.93)	24.54 (29.67)	17.31 (24.58)	16.23 (23.73)	18.82 (25.70)	12.25 (20.44)	8.76 (17.16)	9.15 (17.56)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	33.12 (35.12)	34.68 (36.03)	35.00 (36.27)	35.68 (36.63)	36.36 (37.05)	37.02 (37.47)	37.84 (37.94)	37.67 (37.82)	36.36 (37.05)	36.20 (36.99)
	S.Em.±	0.08	0.37	1.00	0.88	0.06	0.12	0.12	0.08	0.40	0.12
	CD (p=0.05)	0.26	1.13	3.07	2.72	0.17	0.37	0.37	0.25	1.23	0.37

First spray

There was no significant difference in the percent Shoot & fruit borer percent infestation at a day before imposition of different treatments and infestation was recorded in the range of 30.05 to 34.01 percent Shoot & fruit borer percent infestation. The percent Shoot & fruit borer percent infestation was observed uniform in all the treatments before spray as treatment difference was non-significant. All the insecticides were significantly superior to untreated check up to 14 DAS. After 3 DAS, the minimum Shoot & fruit borer percent infestation was recorded in the treatment T4 Tolfenpyrad 15% EC (24.50 percent) among various treatments and it was at par with treatment T1 (25.40 percent). The next best treatment was T5 (25.66 percent), T3 (26.20 percent) followed by T6, T2 and untreated check to minimise Shoot & fruit borer percent infestation. At 7 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T1 Clothianidin 50% WG (20.04 percent) Shoot & fruit borer percent infestation among various treatments and it was at par with all other treatment except untreated check. The average number of Shoot & fruit borer percent infestation/ 3 leaves in other treatments was T5 (20.48) > T3 (22.50) > T6 (23.42) > T2 (23.50) > T4 (25.91) > T7 untreated check (35.00). At 14 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Spiromesifen 22.9% SC (21.10 percent) among various treatments. The treatment T1 (21.34 percent) was the second best treatment followed by T4 (22.81 percent), T3, T6, T2 and untreated check to minimise Shoot & fruit borer percent infestation among various treatments and it was at par with all other treatment except untreated check.

Second spray

The Shoot & fruit borer percent infestation was uniform in all the treatments before spray as treatment difference was non-significant. All the insecticides were significantly superior to untreated check up to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75% WP was recorded least Shoot & fruit borer percent infestation (12.11 percent) among various treatments. The treatment T1 (12.77 percent) was the second best treatment followed by T2 (16.75 percent), T4, T6, T3 and untreated check to minimise Shoot & fruit borer percent infestation. At 7 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Thiodicarb 75% WP (10.00 percent) among various treatments. The treatment T2 (14.02 percent) was the second best treatment followed by T1 (14.22 percent), T6, T4, T3 and untreated check to minimise Shoot & fruit borer percent infestation. At 14 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Thiodicarb 75% WP (12.25 percent) among various treatments. The treatment T2 (16.25 percent) was the second best treatment followed by T1 (16.67 percent), T6, T3, T4 and untreated check to minimise Shoot & fruit borer percent infestation.

Third spray

The Shoot & fruit borer percent infestation was uniform in all the treatments before spray as treatment difference was non-significant. All the insecticides were significantly superior to untreated check up to 14 DAS. After 3 DAS, the treatment T5 Emamectin Benzoate 5% SG was recorded least Shoot & fruit borer percent infestation (7.92 percent) among various treatments. The treatment T1 (10.00 percent) was the second best treatment followed by T2 (11.81 percent), T6, T3, T4 and untreated check to minimise Shoot & fruit borer percent infestation. At 7 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Emamectin Benzoate 5% SG (4.45 percent) among various treatments. The treatment T5 (6.16 percent) was the second best treatment followed by T1 (7.39 percent), T6, T3, T4 and untreated check to minimise Shoot & fruit borer percent infestation. At 14 DAS, the least Shoot & fruit borer percent infestation was recorded in the treatment T5 Emamectin Benzoate 5% SG (6.16 percent) among various treatments. The treatment T1 (7.39 percent) was the second best treatment followed by T2 (9.11 percent), T6, T3, T4 and untreated check to minimise Shoot & fruit borer percent infestation.

Results obtained from average data of two year presented in Table 3 and results indicated that all the treatments were significantly superior over untreated check. Treatment T5 (Spiromesifen 22.9% SC 1st spray and 2nd spray Thiodicarb 75% WP and 3rd spray Emamectin Benzoate 5% SG) was recorded minimum fruit borer percent infestation (14.03) and it was at par with all other treatment except untreated check. The trend of treatments as per their effectiveness to untreated check shoot and fruit borer percent infestation.

The present findings results more or less similarly with results from Dhanalakshmi and Mallapur (2010) [5]. They reported that, the Emamectin benzoate 5 SG @ 0.2 g/ l was found most superior treatment by recording the least per cent fruit damage (7.82%) and resulted in highest good fruit yield (47.02 q/ha). The next effective treatment included Spinosad 45 SC @ 0.1 ml/l (9.19% damage with 45.94 q/ha yield). It revealed that Emamectin benzoate 5 SG at 15 g a.i./ ha was the best treatment recording low larval population of *E. vittella* and also yielding highest at both locations.

Shinde *et al.* (2011) [8] revealed that the spinosad 0.005 per cent was an effective insecticide to control the shoot and fruit borer in okra, followed by indoxacarb 0.01 per cent and profenophos 0.08 per cent. The highest yield of okra was observed in spinosad @ 0.005 per cent. Dhaka and Prajapati (2013) [4] revealed that the insecticide indoxacarb 14.5 SC @ 0.5 lit/ha recorded lowest shoot and fruit damage 1.67 per cent and 3.33 per cent in okra respectively. It reported that the bio-efficacy of emamectin benzoate 5 SG @ 8.50 g a.i./ha was the most effective treatment which reduced the larval population 74.18 to 88.01 per cent and increased fruit yield up to 72.13 per cent over untreated control.

Bajad (2014) [1] reported that cypermethrin 25 EC@ 0.05 per cent was found most effective in managing the fruit borer infestation on okra followed by indoxacarb 14.05 SC @ 0.007 per cent and spinosad 45 EC @ 0.015 per cent.

Ghule (2014) [6] evaluated the efficacy of seven biorational insecticides *viz*., *Bacillus thuringiensis* var. *kurstaki*., emamectin 27 benzoate, spinosad, chlorofenapyr, *B. bassiana*, Neem and *V. lecanii* against *E. vittella*. The data revealed that the spinosad 45SC@ 50 g a.i/ha (5.62%) recorded significantly minimum shoot and fruit infestation followed by chlorfenapyr @ 100 g a.i/ha (6.16%), emamectin benzoate 5 SG @ 12 g a.i./ha (6.89), *B. thuringiensis* @1000ml/ha (7.56%), *B. bassiana* @ 300 g a.i./ha (8.30%), *V. lecanii* @ 1000ml/ha (8.64%) and neem 10000 ppm @ 3 g a.i./ha (9.37%).

Table 3: Efficacy of some insecticide and biopesticides against okra Shoot and Fruit borer, *Earias vittella* Fab. Recorded at different intervals on Number basis during 2016 and 2017

Tr. No.	Treatment	Per cent infestation shoot and fruit borer			Over all mean population
		1st spray	2nd spray	3rd spray	
T_1	1st spray- Clothianidin 50% WG @ 60 g/ha 2nd spray- Flubendiamide 39.35% SC @125 ml / ha 3rd spray- Azadirachtin 5% @ 500 ml / ha	22.49 (28.13)	13.63 (21.35)	8.29 (16.60)	14.80 (22.03)
T_2	1st spray- Flonicamid 50% WG @ 150 g/ha 2nd spray- Emamectin benzoate 5% SG @ 170g /ha 3rd spray- *B.t.* @ 1kg/ ha	24.79 (29.73)	15.05 (22.47)	9.45 (17.69)	16.43 (23.30)
T_3	1st spray- Thiamethoxam 25%WG @ 100 g/ha 2nd spray- Thiodicarb 75%WP @1000 g / ha 3rd spray- *B.t.* @ 500 g/ ha	24.59 (29.62)	16.14 (23.36)	10.48 (18.61)	17.07 (23.86)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin 2.8% EC@ 400 ml / ha 3rd spray- *Beauveria bassiana* @ 1x10^8 spores/ g	24.30 (29.10)	15.86 (23.23)	10.93 (19.06)	17.03 (23.80)
T_5	1st spray- Spiromesifen 22.9% SC @ 500 ml/ha 2nd spray- Thiodicarb 75%WP @1000 g / ha 3rd spray- Emamectin benzoate 5% SG @ 170g /ha	23.04 (28.48)	12.04 (19.96)	7.02 (15.10)	14.03 (21.18)
T_6	1st spray- Azadirachtin 5% @ 500 ml / ha 2nd spray- *Verticillium lecani* @ 1x10^8 spores/ g 3rd spray- *B.t.* @ 500 g/ ha	26.34 (30.76)	16.84 (24.03)	11.25 (19.41)	18.14 (24.73)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	33.99 (35.63)	36.55 (37.17)	36.44 (37.11)	35.66 (36.64)
	S.Em.±	0.28	0.15	0.20	0.21
	CD (p=0.05)	0.85	0.46	0.62	0.64

Conclusion

During this field study for management of okra shoot and fruit borer, results revealed from average data of two year on number basis of fruits indicated that all the treatments were significantly superior over untreated check. Treatment T5 (Spiromesifen 22.9% SC 1st spray and 2nd spray Thiodicarb 75% WP and 3rd spray Emamectin Benzoate 5% SG) was recorded minimum fruit borer percent infestation (14.03) and it was at par with all other treatment except untreated check.

References

1. Bajad VV, Singh HP, Patil SC. Efficacy of chemical insecticides against shoot and fruit borer, *Earias vittella* (Fab.) on okra. Trends in Bioscience. 2014; 7(14):1644-1646.
2. Butani DK, Verma S. Insect pests of vegetables and their control 3: Lady’s finger. Pestol. 1976*;* 10(7):31-37.
3. Chaudhary HR, Dadheech LN. Incidence of insects attacking okra and the avoidable losses caused by them. Ann. Arid Zone. 1989; 28(3-4):35-37.
4. Dhaka SS, Prajapati CR. Management of okra fruit borer, *Earias vittella* Fab. With chemicals and bio pesticides. Progressive Res. 2013; 8:186-189.
5. Dhanalakshmi DN, Mallapur CP. Evaluation of new promising molecules against fruit borers in okra. Inter. J Pl. Protec. 2010; 3(2):268-270.
6. Ghule TM, Devi LL, Senapati AK, Chatarjee ML. Comparative efficacy of some bio rational insecticides for management of shoot and fruit borer (*Earias vittella* Fab.) on Okra. Indian J of Appl. Res. 2014; 4(9):7-10.
7. Radke SG, Undirwade RS. Seasonal abundance and insecticidal control of shoot and fruit borer, *Earias* spp. on okra. Indian J Ent. 1981; 43(3):283-287.
8. Shinde ST, Shetgarm SS, Badgujar AG. Bio-efficacy of different insecticides against major pests of okra. J Ent. Res. 2011; 35(2):133-137.