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Efficacy of newer insecticides against *Leucinodes orbonalis* (Guen.) on brinjal

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Abstract
The present work entitled, "efficacy of newer insecticides against *Leucinodes orbonalis* (Guen.) on brinjal" were planned to study the efficacy of newer molecules for the management of brinjal shoot and fruit borer on Phule Harit cultivar of brinjal and yield performance by using insecticides. The experiment was conducted in kharif season of 2017-18 on the Insectary field of Department of Entomology, College of agriculture, Nagpur. The experiment was laid out in Randomized Block Design (RBD) with eight treatments including control (water spray) replicated thrice. All the treatments were found significantly superior over (T8) control plot. The treatment (T1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit was found most promising in reducing the BSFB incidence on which recording observations on 3rd, 7th, 10th and 14th DAS to the tune of 8.16, 8.31, 9.27 and 9.83 per cent lowest shoot damage with 71.01, 72.18, 66.16 and 63.01 per cent reduction in infestation over control respectively. The second best treatment was (T3) emamectin benzoate 5 SG @ 0.4 gm/lit which showed effective to curb menace of BSFB and registered shoot infestation on 3rd, 7th 10th and 14th DAS to the tune of 11.27, 12.10, 12.27 and 13.65 per cent with 59.96, 59.50, 55.20 and 48.65 per cent reduction over control.

Keywords: *Leucinodes orbonalis* (guen.), chlorantraniliprole 18.5 SC, verity phule harit, emamectin benzoate 5 SG

1. Introduction
Vegetable farming has an important place in Indian agriculture due to their nutritional, medicinal and commercial value. (Choudhary, B. 1977) [3]. amongst the vegetables, brinjal or eggplant (*Solanum melongena* Linn.) is normally self-fertilized, solanaceous crop having chromosome no. 2n=24 and it is native of India. Brinjal or eggplant is worldwide known as aubergine or guinea squash which is most popular and principle vegetable crop hence regarded as "king of vegetable". The global area under brinjal cultivation has been estimated at 1.87 Million hectares with total production of brinjal fruit 49.67 million tonnes productivity of 26.5 tonnes per hectare (Anonymous, 2014) [1]. Production share of brinjal with8.3 per cent stands at fourth position after potato, along with tomato and onion. Globally, is the second largest brinjal producing country after china with 27.1% share. Here, it is grown in about 711.31 thousand ha with an annual production nearly 13.55 Million tonnes with an average productivity of 19.1 MT/ha and in Maharashtra, 30.00 thousand hectare acreage and production nearly 690 MT (NHB, 2014). In India, the major brinjal growing states are Andra Pradesh, Karnataka, West bengal, Tamilnadu, Maharashtra, Orissa, Uttar Pradesh, Bihar and rajsthan. It is a perennial but grown commercially as an annual crop. A number of cultivars are grown in India and the consumers' preference being dependent upon fruit colour, size and shape. Brinjal is an important dietary vegetable crop suitable for both vegetarians as well as non-vegetarians owing to its medicinal and nutritive values. Brinjal fruit (unripe) is primarily consumed as cooked vegetable in various ways and dried plants are used as fuel in rural areas. It is low in calories and fats, contains mostly water, some protein, fibre and carbohydrates. It is a good source of minerals and vitamins and is rich in total water soluble sugars, free reducing sugars, amide proteins among other nutrients. Brinjal fruits are widely used in various culinary preparations *viz*., stuffed curry, bertha, vangibath, chutney, sliced bhaji, etc. Contrary to the common belief, the fruits are rich source of vitamin "A" and "B". The green leaves of brinjal plant are the main source for the supply of antiscorbic vitamin "C". It is used in Ayurveda as appetizer, aphrodisiac, cardiotonic etc. (Chadha, 1993) [4]. Brinjal has been a staple vegetable in our diet since ancient time one hundred grams of edible part of brinjal has a potential to supply 40 gm carbohydrate, 1.4 gm proteins, 0.3 gm minerals, (including phosphorus 47mg,

calcium 18 mg, potassium 2.0 mg and iron 0.9 mg) with vitamins A, B, C respectively. (Arycord, 1983) [2]. Hence brinjal has wide spectrum of use for maintaining human health and primarily a source for building economic trading of farmers. The climatic conditions are responsible for development of the life cycle of *L. orbonalis* in eggplant (FAO 2003). The pest (BSFB) active in summer months, especially during the rainy season and less active from November to February. Mall *et al*. (1992) [13] studied the seasonal incidence of *L. orbonalis* on brinjal and reported that the pest infestation on shoots started in 3rd week of August and resumed a serious status during September with 76.66 – 93.30 per cent damaged plants by the pest.

2. Objectives

1. To study the efficacy of newer insecticides against *Leucinodes orbonalis* (Guen.) on brinjal.

3. Material and methods

The experiment was conducted in kharif season of 2017-18 on the insectory field of Department of Entomology, College of agriculture, Nagpur. The randomized block design. The observation was initiated at the start of infestation i. e. 29 days after transplanting. Further spraying was applied thereafter at 15 days interval. Total 3 no. of sprays were given with the help of knapsack sprayer. Pre-treatment observations were taken 24 hrs before spray and post treatment observations were recorded on 3, 7, 10 and 14th days after each spraying. Insecticidal treatments were undertaken on following dates. First spray 04-09-2017 Second spray 19-09-2017. From each plot, five plants were selected randomly and labeled for recording observations. On field survey the infestation of pest on shoots and number of infested shoots of five observational plants from were seen, the observation was recorded at 3, 7, 10 and 14 days after imposing treatments. Percentage of infested fruits on weight basis At each picking the weight of healthy and infested fruits were recorded on the basis of fruit of five observational plants from each treatments replication wise. Percentage of infested fruit on a number basis. The number of infested and healthy fruits were recorded on five observational plants.

4. Statistical analysis

The data recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of R. B. D. experiment (Gomez and Gomez, 1984) [10].

5. Results and discussion

5.1 Efficacy of newer molecule of insecticides against *Leucinodes orbonalis* Guen. On shoot of brinjal

5.2 Cumulative per cent shoot infestation on 3rd days after spraying

The observation on shoot infestation recorded 3 days after spraying during 2017-18 is presented in Table 1 and Fig. 1 revealed that, all the treatments were found significantly superior in suppressing shoot infestation over control. The cumulative mean per cent shoot infestation in different molecules was varied from 8.16 to 28.15 per cent (Maximum 28.15% in control plot).

Table 1: Cumulative per cent shoot infestation on 3rd days after spraying

Tr. No.	Treatments	Replication				Per cent reduction over control
		R – I	R - II	R - III	Mean	
T1	Chlorantraniliprole 18.5 SC	8.55 (17.0)	6.99 (15.32)	8.94 (17.40)	8.16 (16.60)	71.01
T2	Lambda cyhalothrin 5 EC	12.67 (20.86)	15.77 (23.41)	13.96 (21.95)	14.13 (22.09)	49.80
T3	Emamectin benzoate 5 SG	10.80 (19.19)	11.80 (20.05)	11.20 (19.55)	11.27 (19.62)	59.96
T4	Fenvalerate 20 EC	13.63 (21.67)	15.04 (22.83)	15.94 (23.54)	14.87 (22.70)	47.18
T5	Dimethoate 30 EC	13.85 (21.86)	13.25 (21.35)	14.66 (22.51)	13.92 (21.91)	50.55
T6	Spinosad 45 SC	10.41 (18.82)	8.73 (17.18)	9.21 (17.67)	9.45 (17.90)	66.43
T7	Deltamethrin 1% + Triazophos 35 EC	12.30 (20.53)	13.04 (21.17)	13.01 (21.14)	12.78 (20.96)	54.60
T8	Control (water spray)	27.15 (31.42)	28.19 (32.10)	29.11 (32.66)	28.15 (32.06)	
	'F' test				Sig.	
	SE m (±)				0.47	
	CD at 5%				1.42	

(Figures in parenthesis are arc sin transformed values.)

The effect of (T_1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit and (T_6) spinosad 45 SC @ 0.32 ml/lit were found on par with each other and these treatment recorded 8.16 and 9.45 per cent shoot infestation with 71.01 and 66.43 per cent reduction over control respectively. The present findings corroborate the findings of Deshpande (2005) [7]. He reported that, the performance of spinosad against brinjal shoot and fruit borer with shoot infestation on 3 DAS was 10.72 per cent with 67.27 per cent reduction over control. The next promising insecticides were (T_3) emamectin benzoate 5 SG @ 0.4 gm/lit and (T_7) deltamethrin 1% + triazophos 35 EC @ 2.5 ml/lit which recorded shoot infestation of 11.27 and 12.78 per cent with 59.96 and 54.60 per cent reduction as compared to control and found on par with each other. However the treatment (T_3) emamectin benzoate 5 SG @ 0.4 gm/lit (11.27%) also found on par with (T_6) spinosad 45 SC @ 0.32 ml/lit (9.45%). Remaining treatments fallow by them.

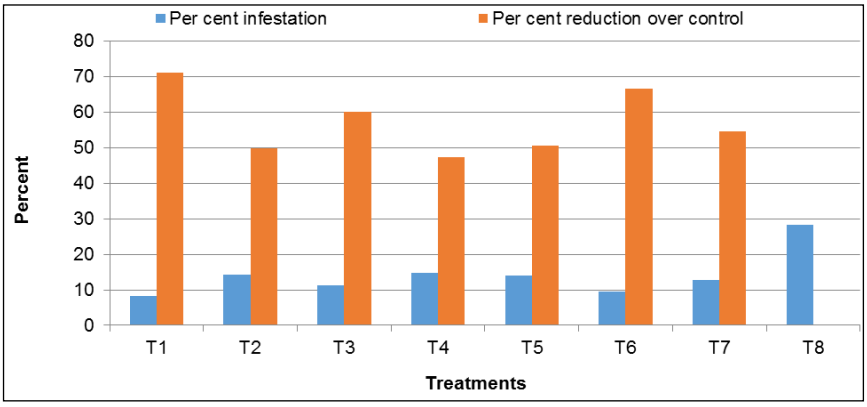

Fig 1: Cumulative per cent shoot infestation on 3rd days after spraying.

6. Cumulative per cent shoot infestation on 7th days after spraying

The results obtained on 7 days after spraying during 2017-18 are presented in Table 2 and illustrated in Fig. 2 indicated that, all treatments were found statistically significant in reducing mean per cent shoot infestation as compared to control. The per cent mean shoot infestation by *Leucinodes orbonalis* in various treatments was varied from 8.31 to 29.88 (29.88 per cent in control plot).

Table 2: Cumulative per cent shoot infestation on 7th days after spraying

Tr. No.	Treatments	Replication			Mean	Per cent reduction over control
		R – I	R - II	R – III		
T1	Chlorantraniliprole 18.5 SC	8.71 (17.16)	8.13 (16.57)	8.10 (16.54)	8.31 (16.75)	72.18
T2	Lambda cyhalothrin 5 EC	14.07 (22.04)	15.27 (23.02)	14.39 (22.31)	14.58 (22.45)	51.20
T3	Emamectin benzoate 5 SG	12.27 (20.51)	10.13 (18.56)	13.90 (21.89)	12.10 (20.36)	59.50
T4	Fenvalerate 20 EC	13.97 (21.96)	15.39 (23.12)	16.36 (23.87)	15.24 (22.98)	49.00
T5	Dimethoate 30 EC	15.58 (23.26)	14.91 (22.72)	16.49 (23.98)	15.66 (23.31)	47.59
T6	Spinosad 45 SC	10.48 (18.89)	11.86 (20.11)	9.28 (17.74)	10.54 (18.94)	64.73
T7	Deltamethrin 1% + Triazophos 35 EC	12.63 (20.82)	14.29 (22.21)	12.40 (20.62)	13.11 (21.23)	56.12
T8	Control (water spray)	30.43 (33.49)	30.98 (33.85)	28.23 (32.11)	29.88 (33.14)	
	'F' test				Sig.	
	SE m (±)				0.59	
	CD at 5%				2.17	

(Figures in parenthesis are arc sin transformed values)

Treatment, (T_1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit was found to be statistically significant and superior over all other insecticides which exhibited lowest 8.31 per cent shoot infestation indicating 72.18 per cent reduction over control. The next promising insecticide which was found to be effective was (T_6) spinosad 45 SC @ 0.32 ml/lit registering 10.54 per cent shoot infestation with 64.73 per cent infestation reduction over control and was found on par with (T_3) emamectin benzoate 5 SG @ 0.4 gm/lit which registered 12.10 per cent shoot infestation and 59.50 per cent reduction over control. The present findings were supported by Deshpande (2005) [7], found that the performance of spinosad against brinjal shoot and fruit borer with shoot

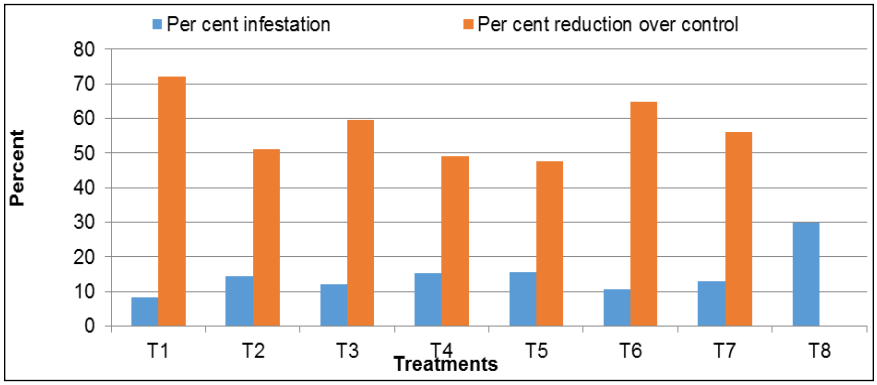

Fig 2: Cumulative per cent shoot infestation on 7th days after spraying

Infestation on 7 DAS was 8.49 per cent with 73.24 per cent reduction over control. These results are comparable with the findings of Ghoshal *et al.* (2013) [9] who found that, rynaxypyr 18.5 SC to be superior over other treatments which recorded lowest shoot (2.65%) infestation in brinjal. Dash *et al.* (2014) revealed that emamectin benzoate 5 SG registered minimum shoot damage. The treatment (T_7) deltamethrin 1% + triazophos 35 EC @ 2.5ml/lit registered 13.11 per cent shoot infestation and found on par with (T_3) emamectin benzoate 5 SG @ 0.4 gm/lit (12.10%) and (T_2) lambda

cyhalothrin 5 EC @ 1ml/lit (14.13%). The remaining three insecticidal treatments viz., (T_2) lambda cyhalothrin 5 EC @ 1ml/lit (14.58%), (T_4) fenvalerate 20 EC @ 0.75 ml/lit (15.24%) and (T_5) dimethoate 30 EC @ 0.7 ml/lit (15.66%) shown parity with each other in recording shoot infestation over control (29.88%). The above findings correlates with the findings of Devi *et al.* (2014). They noticed that, rynaxypyr 20 EC recorded least shoot infestation (8.35%) and found on par with spinosad 45 SC (10.55%) and deltamethrin 1% + triazophos 35% EC (10.98%).

7. Cumulative per cent shoot infestation on 10th day after spraying

The result obtained on 10th days after spraying regarding shoot infestation during 2017-18 is presented in Table 3 and depicted in Fig. 3 revealed that all insecticides were found significantly effective in minimizing shoot infestation as compared to control. The cumulative mean per cent shoot infestation by *Leucinodes orbonalis* on brinjal in different treatment was varied from 9.27 to 27.39 per cent (27.39 % in control plot).

Table 3: Cumulative per cent shoot infestation on 10th days after spraying

Tr. No.	Treatments	Replication				Per cent reduction over control
		R - I	R - II	R – III	Mean	
T1	Chlorantraniliprole 18.5 SC	9.75 (18.19)	7.96 (16.39)	10.11 (18.54)	9.27 (17.73)	66.16
T2	Lambda cyhalothrin 5 EC	14.16 (22.11)	17.63 (24.83)	15.61 (23.27)	15.80 (23.42)	42.31
T3	Emamectin benzoate 5 SG	11.76 (20.06)	10.67 (19.07)	14.38 (22.28)	12.27 (20.50)	55.20
T4	Fenvalerate 20 EC	14.42 (22.32)	15.86 (23.47)	16.91 (24.28)	15.73 (23.37)	42.57
T5	Dimethoate 30 EC	16.58 (24.03)	16.23 (23.76)	17.74 (24.91)	16.85 (24.23)	38.48
T6	Spinosad 45 SC	10.96 (19.33)	11.40 (19.73)	10.90 (19.28)	11.09 (19.45)	59.51
T7	Deltamethrin 1% + Triazophos 35 EC	13.28 (21.37)	14.25 (22.18)	14.12 (22.07)	13.88 (21.87)	49.32
T8	Control (water spray)	27.01 (31.31)	29.22 (32.72)	25.93 (30.61)	27.39 (31.56)	
	'F' test				Sig.	
	SE m (±)				0.58	
	CD at 5%				1.74	

(Figures in parenthesis are arc sin transformed values)

Among different treatments, (T_1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit was found to be best which exhibited 9.27% shoot infestation with 66.16 per cent reduction over control and shown parity with microbial insecticide i.e. (T_6) spinosad 45 SC @ 0.32 ml/lit which recorded 11.09 per cent shoot infestation with 59.51 per cent reduction over control plot. Mahata *et al.* (2014) reported, chlorantraniliprole 18.5 g a.i./ha against *Leucinodes orbonalis* Guen. in brinjal (3.76%) found effective. The next promising insecticides were (T_3) emamectin benzoate 5 SG @ 0.4 gm/lit and (T_7) deltamethrin 1% + triazophos 35 EC @ 2.5ml/lit recorded 12.27 and 13.88 per cent respectively shoot infestation with 55.20, 49.32 per cent infestation reduction over control untreated plot and found on par with each other. The present findings corroborates with the reports of Patra *et al.* (2009). They noticed that, the lowest shoot infestation recorded in spinosad 2.5 EC treated plot (7.47%) followed by emamectin benzoate 5 SG (10.95%) and recorded higher yield. The remaining insecticidal treatments, (T_4) fenvalerate 20 EC @ 0.75 ml/lit and (T_2) lambda cyhalothrin 5 EC @ 1 ml/lit and (T_7) deltamethrin 1% + triazophos 35 EC @ 2.5 ml/lit recorded shoot infestation of 15.73, 15.80 and 13.88 per cent respectively with per cent reduction over control registered as 42.57, 42.31 and 49.32 per cent respectively.

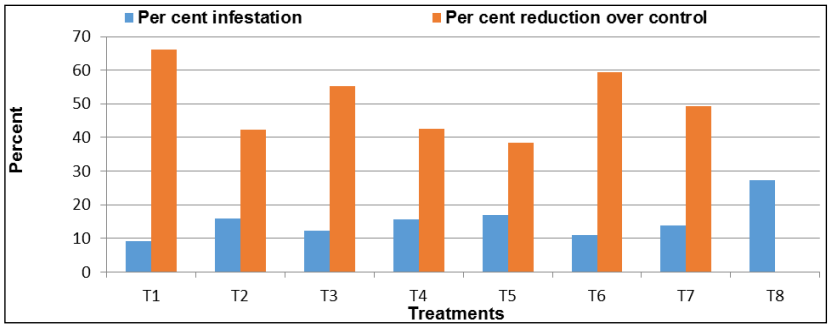

Fig 3: Cumulative per cent shoot infestation on 10th days after spaying.

8. Cumulative per cent shoot infestation on 14th days after spraying

The results obtained on 14th days after spraying during 2017-18 are presented in Table 4 and depicted in Fig. 4 showed that, all treatments were found superior over control treatment in recording shoot infestation. The mean per cent shoot infestation in different treatment was varied from 9.83 to 26.58 per cent shoot infestation by *Leucinodes orbonalis.* (26.58 per cent in control plot). In present investigation, (T_1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit was found most promising and statistically significant treatment which recorded lowest shoot infestation of 9.83% with 63.01 per cent infestation reduction over control. The microbial insecticides, (T_6) spinosad 45 SC @ 0.32 ml/lit, (T_3) emamectin benzoate 30 EC @ 0.4 gm/lit and chemical insecticide, (T_7) deltamethrin 1% + triazophos 35 EC @ 2.5 ml/lit which recorded shoot infestation of 12.84, 13.65 and 13.85 per cent with 51.69, 48.65, 47.89 per cent reduction over control treatment were found on par with each other. Tripura *et al.* (2017) reported that, mean shoot infestation was minimum in chlorantraniliprole 18.5 SC (7.45%) followed by spinosad (9.55%) with 70.98 and 62.81 per cent protection over control and corroborates our present findings.

Table 4: Cumulative per cent shoot infestation on 14th days after spraying

Tr. No.	Treatments	Replication				Per cent reduction over control
		R – I	R – II	R – III	Mean	
T1	Chlorantraniliprole 18.5 SC	10.30 (18.72)	9.43 (17.88)	9.77 (18.21)	9.83 (18.27)	63.01
T2	Lambda cyhalothrin 5 EC	17.35 (24.62)	17.10 (24.43)	16.91 (24.28)	17.12 (24.44)	35.59
T3	Emamectin benzoate 5 SG	13.08 (21.21)	11.87 (20.16)	15.99 (23.57)	13.65 (21.68)	48.65
T4	Fenvalerate 20 EC	16.84 (24.23)	17.32 (24.59)	18.66 (25.59)	17.61 (24.81)	33.75
T5	Dimethoate 30 EC	18.95 (25.81)	16.17 (23.71)	18.99 (25.84)	18.04 (25.13)	32.13
T6	Spinosad 45 SC	12.76 (20.93)	13.45 (21.51)	12.30 (20.53)	12.84 (21.00)	51.69
T7	Deltamethrin 1% + Triazophos 35 EC	12.53 (20.73)	13.60 (21.64)	15.40 (23.11)	13.85 (21.84)	47.89
T8	Control (water spray)	27.01 (31.31)	26.75 (31.14)	25.98 (30.64)	26.58 (31.03)	
	'F' test				Sig.	
	SE m (±)				0.52	
	CD at 5%				1.56	

(Figures in parenthesis are arc sin transformed values.)

Results on efficacy of spinosad and emamectin benzoate are in conformity with the findings of Sharma and Tayade (2017) [16]. They reported that minimum per cent of shoot infestation was noticed in cypermethrin check (6.69%) followed by spinosad (13.20%) and emamectin benzoate (14.03%). The remaining chemical treatments are less effective and the highest shoot infestation was noticed in (T_8) control plot (26.58%)

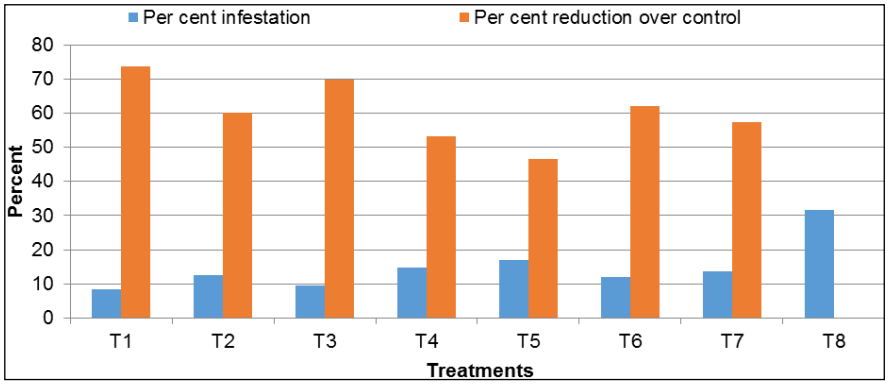

Fig 4: Cumulative per cent shoot infestation on 14th days after spraying.

8.1 Efficacy of newer molecule of insecticides against *Leucinodes orbonalis* Guen. On fruit of brinjal.

8.1.1 Mean per cent fruit infestation at each picking on number basis

The data presented in Table 5, regarding fruit infestation on number basis revealed that, all the treatments were found effective against management of *Leucinodes orbonalis* and found significantly superior over (T8) control plot in recording minimum per cent fruit infestation of brinjal shoot and fruit borer during subsequent six pickings and expressed in Table 5 and illustrated in Fig.7.

Table 5: Mean per cent fruit infestation at each picking on number basis

Tr. NO.	Treatments	Mean per cent fruit infestation by *L. orbonalis* at different pickings					
		I picking	II picking	III picking	IV picking	V picking	VI picking
T1	Chlorantraniliprole 18.5 SC	8.86 (17.32)	8.31 (16.75)	8.13 (16.57)	8.59 (17.04)	7.87 (16.30)	7.64 (16.05)
T2	Lambda cyhalothrin 5 EC	12.89 (21.04)	12.71 (20.88)	13.06 (21.19)	13.48 (21.54)	11.64 (19.95)	10.27 (18.69)
T3	Emamectin benzoate 5 SG	9.08 (17.54)	9.51 (17.96)	9.50 (17.95)	9.63 (18.08)	9.71 (18.16)	8.89 (17.35)
T4	Fenvalrate 20 EC	19.68 (26.33)	13.49 (21.55)	13.80 (21.81)	12.91 (21.06)	12.99 (21.13)	12.58 (20.77)
T5	Dimethoate 30 EC	18.22 (25.27)	16.60 (24.04)	15.45 (23.14)	16.02 (23.59)	15.73 (23.37)	14.98 (22.77)
T6	Spinosad 45SC	11.48 (19.80)	11.89 (20.17)	11.24 (19.59)	10.95 (19.32)	10.95 (19.33)	8.71 (17.17)
T7	Deltamethrin 1% + Triazophos 35 EC	13.28 (21.37)	13.49 (21.55)	14.75 (22.59)	12.84 (21.00)	12.29 (20.52)	10.44 (18.85)
T8	Control (Water spray)	28.93 (32.34)	28.55 (32.30)	30.63 (33.61)	31.66 (32.24)	33.65 (35.46)	31.37 (34.04)
	F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE m (±)	0.78	0.74	0.82	0.79	0.76	0.64
	CD at 5%	2.34	2.23	2.46	2.37	2.30	1.94

(Fig. in parenthesis are the arc sin transformed values)

8.2 Cumulative mean per cent of fruit infestation on number basis during subsequent pickings

The data regarding infestation of fruit on number basis presented in Table 6 and depicted in Fig. 6 revealed that, all the treatments were statistically significant and superior over control plot in recording minimum per cent fruit infestation of *Leucinodes orbonalis*. Among different treatments, (T1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit was proved to be most promising one, which recorded lowest fruit infestation on number basis to the tune of 8.23 per cent and recorded 73.28 per cent reduction over (T8) control plot and found to be at par with treatment (T3) emamectin benzoate 5 SG @ 0.4

gm/lit which showed 9.39 per cent fruit infestation of BSFB on number basis with 65.51 per cent reduction in infestation over control respectively. The present findings on efficacy of chlorantraniliprole 18.5 SC found comparable with the results of Shirale *et al.* (2012) [18]. They evaluated, efficacy of chlorantraniliprole 18.5% SC (Coragen) over other insecticides in reducing infestation of brinjal shoot and fruit borer. The findings too are comparable with the reports of Mainali *et al.* (2015) [11]. They recorded lowest fruit infestation on number basis in chlorantraniliprole treated plot (6.57%) and spinosad (12.08%) treated plots as compared to other treatments. The next effective treatment in reducing the fruit infestation was (T6) spinosad 45 SC @ 0.32 ml/lit which recorded 10.87% fruit infestation on number basis and was found to be at par with (T2) lambda cyhalothrin @ 5 EC @ 1ml/lit and (T7) deltamethrin 1% + triazophos 35 EC @ 2.5 ml/lit which recorded 12.34 per cent and 12.85 per cent fruit damage respectively with 64.71, 59.93 and 58.28 per cent infestation reduction over control plots respectively. Our present investigations are related with the findings of Shinde *et al.* (2007) [17] in which they concluded that, all insecticidal treatments significantly reduced the per cent fruit borer infestation on okra both on number and weight basis as compared to untreated control. The minimum fruit infestation was recorded in spinosad 45 SC @ 75 g a.i./ha followed by deltamethrin 2.8 EC @ 12.5 g a.i./ha and was at par with the lambda cyhalothrin 5 EC 30 g a.i./ha. The treatment (T7) deltamethrin 1% + triazophos 35 EC @ 2.5 ml/lit (12.85%) also found at par with (T4) fenvalerate 20 EC @ 0.75 ml/lit (14.24%).

Table 6: Cumulative mean per cent fruit infestation on number basis during subsequent pickings

Tr. No.	Treatments	Replication			Mean	Per cent reduction over control
		R – I	R – II	R – III		
T1	Chlorantraniliprole 18.5 SC	8.19 (16.63)	7.83 (16.25)	8.67 (17.12)	8.23 (16.67)	73.28
T2	Lambda cyhalothrin 5 EC	12.27 (20.51)	13.88 (21.88)	10.86 (19.25)	12.34 (20.57)	59.93
T3	Emamectin benzoate 5 SG	8.30 (16.74)	10.31 (18.73)	9.56 (18.00)	9.39 (17.84)	65.51
T4	Fenvalerate 20 EC	15.03 (22.81)	14.45 (22.34)	13.25 (21.34)	14.24 (22.17)	53.77
T5	Dimethoate 30 EC	15.82 (23.44)	17.38 (24.64)	15.31 (23.03)	16.17 (23.71)	47.50
T6	Spinosad 45 SC	12.37 (20.59)	9.98 (18.42)	10.26 (18.68)	10.87 (19.25)	64.71
T7	Deltamethrin 1% + Triazophos 35 EC	10.97 (19.34)	14.24 (22.17)	13.35 (21.43)	12.85 (21.00)	58.28
T8	Control (water spray)	30.80 (33.71)	29.48 (32.88)	32.11 (34.52)	30.80 (33.71)	
	'F' test				Sig.	
	SE m (±)				0.61	
	CD at 5%				1.84	

(Fig. in parenthesis are the arc sin transformed values)

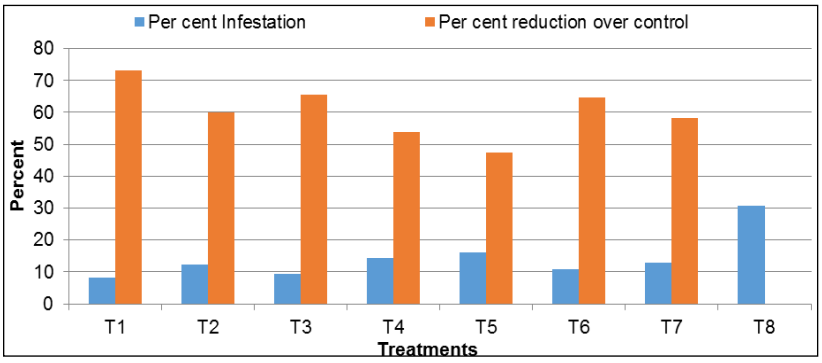

Fig 6: Cumulative per cent fruit infestation on number basis during six pickings

8.3 Mean per cent fruit infestation at each picking on weight basis

The data presented in Table 7 and illustrated in Fig. 7 indicated that, all the treatments were found statistically significant in reducing mean per cent fruit infestation of *Leucinodes orbonalis* over control plot during subsequent six pickings.

Table 7: Mean per cent fruit infestation at each picking on weight basis

Tr. No.	Treatments	Mean per cent fruit infestation by *L. orbonalis* at different pickings					
		I picking	II picking	III picking	IV picking	V picking	VI picking
T1	Chlorantraniliprole 18.5 SC	8.63 (17.08)	9.13 (17.59)	8.89 (17.35)	8.16 (16.60)	8.21 (16.65)	7.23 (15.60)
T2	Lambda cyhalothrin 5 EC	14.27 (22.19)	13.17 (21.28)	12.73 (20.90)	12.87 (21.02)	11.48 (19.80)	11.50 (19.82)
T3	Emamectin benzoate 5 SG	9.41 (17.86)	9.82 (18.27)	10.59 (18.99)	10.24 (18.66)	9.16 (17.61)	8.56 (17.01)
T4	Fenvalrate 20 EC	20.36 (26.82)	13.97 (21.95)	13.94 (21.92)	14.32 (22.25)	13.06 (21.19)	13.47 (21.53)
T5	Dimethoate 30 EC	17.06 (24.40)	17.05 (24.39)	18.55 (25.51)	18.49 (25.47)	15.76 (23.39)	14.95 (22.75)
T6	Spinosad 45 SC	13.20 (21.30)	13.09 (21.21)	12.14 (20.39)	11.81 (20.10)	11.14 (19.50)	10.69 (19.09)
T7	Deltamethrin 1% +Triazophos 35 EC	14.38 (22.28)	14.67 (22.52)	13.82 (21.82)	14.02 (21.99)	13.63 (21.67)	10.98 (19.35)
T8	Control (Water spray)	31.68 (34.25)	32.27 (34.61)	33.69 (35.48)	31.75 (34.30)	31.24 (33.98)	29.88 (33.14)
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE m (±)	0.85	0.67	0.68	0.87	0.72	0.66
	CD at 5%	2.57	2.02	2.05	2.63	2.17	1.99

(Fig. in parenthesis are the arc sin transformed values)

8.4 Cumulative mean per cent of fruit infestation on weight basis during subsequent pickings

The cumulative mean percentage regarding fruit damage on weight basis revealed that, (Table 8, and illustrated in Fig. 7) all the treatments were significantly superior over control (31.75%) in recording minimum per cent fruit infestation of *Leucinodes orbonalis* (Guen.). The treatment (T_1) chlorantraniliprole 18.5% SC @ 0.3 ml/lit and (T_3) emamectin benzoate 5 SG @ 0.4 gm/lit found significantly superior over all other chemicals and found on par with each other registering 8.37 and 9.63 per cent fruit infestation on weight basis with 73.64 and 69.67 per cent reduction in infestation of BSFB over control plot respectively. Present investigation found relevant to the findings of Kameshwaran and Kumar (2015), who reported chlorantraniliprole 20 EC @ 40 g a.i./2ha followed by emamectin benzoate 25 WG @ 11 g a.i./ha found effective treatments against lesser fruit infestation of BSFB. The next promising treatments in reducing the fruit infestation were (T_6) spinosad 45 SC @ 0.32 ml/lit which showed 12.01 per cent fruit infestation on weight basis with 62.17 per cent reduction over control. spinosad was found to be at par with treatment (T_2) lambda cyhalothrin 5 EC @ 1 ml/lit and (T_7) deltamethrin 1% + triazophos35 EC @ 2.5 ml/lit registering 12.67 per cent, 13.58 per cent fruit infestation and 60.09 per cent, 57.23 per cent infestation reduction over control plot and (T_4) fenvalrate 20 EC @ 0.75 ml/lit (14.85 %) were found on par with each other

Table 8: Cumulative mean per cent of fruit infestation on weight basis during subsequent pickings

Tr. No.	Treatments	Replication				Per cent reduction over control
		R – I	R - II	R – III	Mean	
T1	Chlorantraniliprole 18.5 SC	8.33 (16.77)	7.97 (16.40)	8.81 (17.27)	8.37 (16.82)	73.64
T2	Lambda cyhalothrin 5 EC	12.60 (20.79)	14.25 (22.18)	11.16 (19.51)	12.67 (20.85)	60.09
T3	Emamectin benzoate 5 SG	8.51 (16.96)	10.58 (18.98)	9.80 (18.24)	9.63 (18.08)	69.67
T4	Fenvalerate 20 EC	15.67 (23.32)	15.07 (22.84)	13.81 (21.82)	14.85 (22.67)	53.23
T5	Dimethoate 30 EC	16.62 (24.06)	18.25 (25.29)	16.07 (23.63)	16.98 (24.33)	46.52
T6	Spinosad 45 SC	13.67 (21.70)	11.03 (19.39)	11.34 (19.68)	12.01 (20.28)	62.17
T7	Deltamethrin 1% + Triazophos 35 EC	11.59 (19.90)	15.17 (22.92)	13.98 (21.95)	13.58 (21.62)	57.23
T8	Control (water spray)	31.75 (34.29)	30.39 (33.46)	33.11 (35.12)	31.75 (34.29)	
	'F' test				Sig.	
	SE m (±)				0.63	
	CD at 5%				1.89	

(Figures in parentheses are arc sin transformed values)

Treatment, (T_5) dimethoate 30 EC @ 0.7ml/lit recorded 16.98 per cent fruit infestation on weight basis with 46.52 per cent infestation reduction over control. However, (T_8) control plot which recorded significantly highest range of fruit damage 31.75 per cent. The present findings are correlated with results obtained by Chouke (2004). He noticed that minimum shoot and fruit borer damage on number and weight basis on brinjal was recorded 9.81 and 10.82 per cent respectively in spinosad 45 SC treated plots. The treatment of deltamethrin 1 % + triazophos 35 EC proved superior earlier by Walnuj et. al. (1998). They reported that, this treatment found superior and recorded least fruit damage both in number and weight basis effectively.

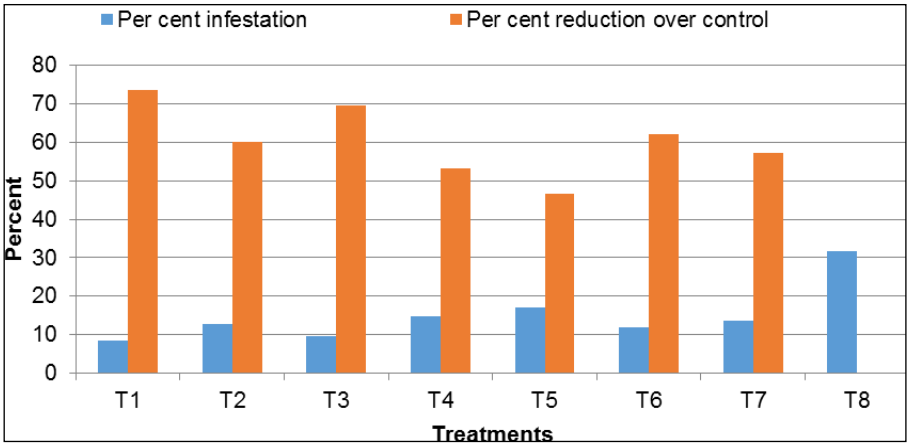

Fig 7: Cumulative per cent fruit infestation on weight basis during six pickings

9. Conclusions

Considering all parameters together on the basis of overall comparative performance of newer insecticides it could be concluded that, (T1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit proved to be best treatment in managing infestation of BSFB followed by (T3) emamectin benzoate 5 SG @ 0.4 gm/lit, (T6) spinosad 45 SC @ 0.32 ml/lit, (T7) deltamethrin 1% + triazophos 35 EC @ 2.5 ml/lit, (T2) lambda cyhalothrin 5 EC @ 1 ml/lit, (T4) fenvalerate 20 EC @ 0.75 ml/lit and (T5) dimethoate 30 EC @ 0.7 ml/lit were also found effective in suppressing the incidence of BSFB on brinjal. Although the treatment, (T1) chlorantraniliprole 18.5 SC @ 0.3 ml/lit was found superior on the basis of lowest shoot and fruit infestation. However, the treatment of microbial origin, (T3) emamectin benzoate 5 SG @ 0.4 gm/lit shown promise in all parameters recording comparatively lower infestation on shoots and fruits.

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