International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 1664-1669

Received: 22-08-2020
Accepted: 03-10-2020

Bioefficacy of insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner)

RS Wasu, YS Saindane, DY Ghirhepunje, PK Akolkar and PN Bande

RS Wasu
Post Graduate, Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India

YS Saindane
Assistant Residue Analyst, AINP on Pesticide Residues, Department of Agricultural Entomology, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India

DY Ghirhepunje
Post Graduate, Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India

PK Akolkar
Post Graduate, Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India

PN Bande
Post Graduate, Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India

Corresponding Author:
RS Wasu
Post Graduate, Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India

DOI: https://doi.org/10.22271/chemi.2020.v8.i6x.11001

Abstract
Selected insecticides *viz.* Flubendiamide 39.35% SC, Indoxacarb 14.5% SC, Lambda cyhalothrin 5% EC, Novaluron 10% EC, Quinalphos 25% EC, Spirotetramat 120% SC+ Imidacloprid 120% SC Chlorantraniliprole 18.5% SC were evaluated for their effectiveness against tomato fruit borer by conducting field trial at PGI, MPKV, Rahuri during the year 2019. Three sprays of each insecticide were applied at the occurrence of the pest. The result revealed that lowest larval population (1.14 larvae/plant) of *H. armigera* was recorded in treatment of chlorantraniliprole 18.5% SC. Flubendiamide 39.35% SC (1.51 larvae/plant) was the next promising treatment followed by indoxacarb 14.5% SC exhibiting 1.70 larvae/plant. Treatments *viz.* spirotetramat 120% SC + imidacloprid 120% SC, lambda cyhalothrin 5% EC, quinalphos 25% EC found to be moderately effective against *H. armigera* and recorded larval population ranging from 1.99 to 2.27 larvae/plant *H. armigera*. Novaluron 10% EC was least effective, with maximum (2.42 larvae/plant) population of *H. armigera.*

Keywords: Selected insecticides, fruit borer *H. armigera*, tomato, chlorantraniliprole

Introduction
Tomato (*Solanum lycopersicon* Miller.) is one of the most important and remunerative vegetable crop grown in tropical and subtropical region of the world for fresh market and processing, constituting an important part of our human diet. Globally, tomato is cultivated over an area of 4.8 million ha with annual production of 282,830 million MT with the productivity of 37.66 MT ha^{-1} (Anon., 2018) [2]. In India, tomato is mainly grown in *kharif* and *rabi* seasons across the country whereas in some regions it is produced throughout the year. It occupies an area of about 0.78 million ha producing over 19.37 million MT with productivity of 24.65 MT ha^{-1}. In Maharashtra approximately 43640 ha area is covered under tomato with a production of 0.95 million MT with average productivity of 21.93 MT^{-1} (Anon., 2018) [2]. Tomato, like other vegetables, is prone to insect pests and disease mainly due to tenderness and softness as compared to other crops. The tomato yield in India is considerably lower because of several factors of which damage caused by insect pests is most important. It is devastated by an array of pests like jassids, aphids, tobacco caterpillar, flea bettles, spider mites, and fruit borer. However the major economic damage is caused by the fruit borer. Tomato fruit borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is most destructive polyphagous and assumed a status of 'key pest' in all part of world. It feeds and breeds on 181 species of host plant (Manjunath *et al*., 1989) [5].

The rapid growth, potential natural dispersal and resistance to insecticides render this pest as the most serious threat for tomato production systems worldwide (Desneux *et al.*, 2010) [4]. Various methods have been tried for the control of insect-pests. But use of chemical method is an important approach for their control because of its quick action, effectiveness and adaptability to various situations. Several insecticides have been recommended and used for the effective management of tomato insect-pests. But according to several reports many of these label claimed insecticides could not achieved effective results. Therefore, keeping the above information in view Bio-efficacy of selected insecticides against this pest was conducted.

Material and methods

The experiment was conducted at Research Farm, Post Graduate Institute, MPKV, Rahuri during 2019-20. The field was prepared with deep ploughing and harrowing. The trial was laid out in a randomized block design (RBD) with three replications and eight treatments. The seed of 'Meghdhoot' was used for nursery sowing. The treatment plots of size 3.6 m x 3.6 m were prepared and the distance between replication was kept 0.6 m. Insecticides of different chemical groups were selected and the treatments were imposed as foliar sprays against the tomato fruit borer. Total three sprays were given at an interval of 10 days, initiating the first spray on appearance of fruit borer infestation. Quantity of spray fluid required per plot was calculated by spraying untreated control plot with water, taking into consideration the recommended rate of 500 lit/ha. Five plants in each plot were randomly selected and tagged for recording observations on survival larval population. The larval population was recorded one day before spray as pretreatment count. Post treatment count was taken at three, seven and ten days after each spraying. Percent reduction in larval population over control after three sprays was also worked out.

Effect of different insecticides on larval population of fruit borer (*Helicoverpa armigera*) after first spray

The data recorded on larval population of *H. armigera* presented in (Table 1) and depicted in (Fig.1). The larval population was found to be nonsignificant indicating uniformality in population in all the treatments a day before spraying. The data recorded at 3 DAS indicated that all the insecticidal treatments recorded significantly lower larval population as compared to control (1.86 larvae/plant). Among the different insecticidal treatments, lowest larval population (0.66 larvae/plant) of *H. armigera* was recorded in the treatment with chlorantraniliprole 18.5 % SC followed by flubendiamide 39.35 % SC (0.92 larvae/ plant) and indoxacarb 14.5 % SC (1.06 larvae/plant). Spirotetramat 120 SC + imidacloprid 120 SC (1.27 larvae/plant) which was at par with treatment lymbda cyhalothrin 5 % EC (1.35 larvae/plant). As treatment with novaluron 10 % EC was found least effective recording highest larval population (1.62 larvae/ plant).

The perusal of data recorded at 7 DAS revealed that treatment chlorantraniliprole 18.5 % SC maintains its superiority over other treatments by recording lowest larval population (0.80 larvae/plant) followed by flubendiamide 39.35 % SC (1.04 larvae/plant) and indoxacarb 14.5 % SC (1.23 larvae/plant).The next promising treatment was spirotetramat 120 SC + imidacloprid 120 SC (1.53 larvae/plant) and it was statistically at par with treatment of lymbda cyhalothrin 5 % EC recorded (1.51 larvae/plant). The order of effectiveness of remaining insecticide was quinalphos 25 % EC (1.65 larvae / plant) > novaluron 10 % EC (1.62 larvae /plant).

The data on larval population on 10 DAS indicated that the treatment of chlorantraniliprole 18.5 % SC proved to be the most effective with lowest larval population of 1.06 larvae/plant followed by flubendiamide 39.35 % SC (1.32 larvae/plant) and indoxacarb 14.5 % SC (1.49 larvae/plant). Whereas the treatment spirotetramat 120 SC + imidacloprid 120 SC (1.81 larvae/plant) was at par with lymbda cyhalothrin 5 % EC (1.80 larvae/plant). Whereas maximum larval population (2.11 larvae/plant) was recorded in the treatment novaluron 10 % EC. While the rest of treatment quinalphos 25 % EC recorded (1.97 larvae/plant) against (2.54 larvae/plant) in untreated control.

The mean data presented in (Table 1) and depicted in (Fig.1) revealed that all the insecticidal treatments exhibited significantly less larval population of *H.armigera* as compared to control. However, the chlorantraniliprole 18.5 % SC found to be the most effective recording significantly minimum larval population (0.84 larvae/plant) throughout the study period. The treatment novaluron 10 % EC was found to be the least effective (1.84 larva/plant). The order of effectiveness of remaining insecticides was flubendiamide 39.35 % SC (1.09 larvae/plant) > indoxacarb 14.5 % SC (1.26 larvae/plant) > spirotetramat 120% SC + imidacloprid 120 % SC (1.54 larvae/plant) > lymbda cyhalothrin 5 % EC (1.55 larvae/plant) > quinalphos 25 % EC (1.70 larvae/ plant) > novaluron 10 % EC (1.84 larvae/plant).

Effect of different insecticides on larval population of fruit borer (*Helicoverpa armigera*) after second spray

The data (Table 2) & (Fig.2) recorded on larval population at 3 DAS of second spraying indicated that all the insecticidal treatments recorded significantly lowest larval population as compared to control. Among the different insecticidal treatments, the lowest (0.94 larva/plant) larval population of *H. armigera* was recorded in chlorantraniliprole 18.5 % SC. Next promising treatment was flubendiamide 39.35 % SC (1.17 larva/plant) followed by indoxacarb 14.5 % SC (1.37 larva/ plant). The subsequent effective treatment were spirotetramat 120 % SC + imidacloprid 120 % SC (1.61 larva/plant) which was at par with lymbda cyhalothrin 5 % EC (1.69 larva/plant) followed by 25 % EC (2.00 larva/plant). However, the treatment novaluron 10 % EC exhibited highest larval population (2.17 larva / plant) of *H. armigera*.

At 7 DAS, the treatment chlorantraniliprole 18.5 % SC maintained its superiority over the treatments by recording the minimum larval population (1.20 larva/plant). Flubendiamide 39.35 % SC (1.42 larva/plant) was next better treatment followed by indoxacarb 14.5 % SC (1.60 larva/ plant). The treatment spirotetramat 120 % SC + imidacloprid 120 % SC (1.78 larva/plant) which was at par with lymbda cyhalothrin 5 % EC (1.83 larva/plant). The treatment of quinalphos has larval population of 2.12 larva/plant whereas the treatment novaluron 10 % EC exhibited highest larval population (2.26 larva/plant) of *H. armigera*.

The data on larval population obtained at 10 DAS (Table 3) indicated that the treatment of chlorantraniliprole 18.5 % SC found to be effective against *H. armigera* recording (1.46 larva/plant) followed by flubendiamide 39.35 % SC (1.83 larva/plant), indoxacarb 14.5 % SC (2.00 larva/plant). The upcoming better treatments for minimizing larval population was spirotetramat 120 % SC + imidacloprid 120 % SC (2.32 larva/plant) which was at par with treatment lymbda cyhalothrin 5 % EC (2.37 larva/plant) followed by quinalphos 25 % EC (2.51 larva/plant). The treatment novaluron 10 % EC exhibited highest larval population (2.66 larva/plant) of *H. armigera*. However, in untreated control recorded significantly higher larval population (3.46 larva/plant) of *H. armigera*.

Mean data of second spray revealed that chlorantraniliprole 18.5 % SC was found to be superior among all other tested insecticides which recorded (1.20 larva/plant) followed by treatment of flubendiamide 39.35 % SC (1.47 larva/plant) and indoxacarb 14.5 % SC (1.66 larva/plant). The effectiveness of the remaining insecticides was spirotetramat 120% SC + imidacloprid 120 % SC (1.90 larvae/plant) > lymbda cyhalothrin 5 % EC (1.96 larvae/plant) > quinalphos 25 EC (2.21 larvae/plant) > novaluron 10 % EC (2.36 larvae/plant).

The highest larval population was recorded in untreated control with 3.02 larva/plant of *H. armigera.*

Effect of different insecticides on larval population of fruit borer (*Helicoverpa armigera*) after third spray

The data (Table.3) & (Fig.3) recorded at 3 DAS indicated that all insecticidal treatments recorded significantly less larval population as compared to control. Lowest larval population (1.12 larva/plant) of *H. armigera* was recorded in treatment of chlorantraniliprole 18.5 % SC. Flubendiamide 39.35 % SC (1.68 larva/plant) was next promising treatment which was followed by indoxacarb 14.5 % SC exhibiting (1.88 larva/plant) of tomato fruit borer. Treatments *viz*., Spirotetramat 120 % SC + imidacloprid 120 % SC (2.21 larva/plant) which was at par with lymbda cyhalothrin 5 % EC (2.26 larva / plant) followed by quinalphos 25 % EC (2.59 larva/plant) found moderately effective against *H. armigera.* Novaluron 10 % EC was least effective with maximum (2.75 larva/plant) population of *H. armigera*.

It is evident from the data that the larval population of *H. armigera* varied from 1.38 to 2.98 larvae per plant in different insecticidal treatments at 7 DAS. Minimum Larval population (1.38 larva/plant) was noted in the treatment chlorantraniliprole 18.5 % SC. Treatment novaluron 10 % EC (2.98 larva/plant) showed comparatively maximum larval population of H. *armigera*. The rest of the treatments flubendiamide 39.35 % SC, indoxacarb 14.5 % SC, spirotetramat 120 % SC + imidacloprid 120 % SC, Lymbda cyhalothrin 5 % EC and quinalphos 25 % EC recorded 1.93, 2.11, 2.43, 2.48, 2.82 larval population per plant, respectively.

At 10 DAS, chlorantraniliprole 18.5 % SC maintains its dominance by exhibiting lowest larval population (1.64 larva/plant). The next promising treatment were flubendiamide 39.35 % SC (2.34 larva/plant) followed by the treatment indoxacarb 14.5 % SC (2.51 larva/plant). While, the treatment spirotetramat 120 % SC + imidacloprid 120 % SC (2.92 larva/plant) which was significantly at par with lymbda cyhalothrin 5 % EC (2.97 larva/plant) followed by the treatment quinalphos 25 % EC (3.25 larva/plant). However, maximum larval population (3.41 larva/plant) was recorded in treatment of novaluron 10 % EC which was observed least effective against *H. armigera.*

The mean data of third spray revealed that all the insecticidal treatments recorded significantly lowest larval population as compared to control. Among the different insecticidal treatment tested, the lowest larval population (1.38 larva/plant) of *H. armigera* was noticed in treatment chlorantraniliprole 18.5 % SC. Subsequently effective treatment were flubendiamide 39.35 % SC (1.98 larva/plant) and indoxacarb 14.5 % SC (2.17 larva/plant). The effectiveness of the remaining insecticides was spirotetramat 120% SC + imidacloprid 120 % SC (2.52 larvae/plant) > lymbda cyhalothrin 5 % EC (2.57 larvae/plant) > quinalphos 25 EC (2.89 larvae/plant) > novaluron 10 % EC (3.05 larvae/plant). The highest larval population was recorded in untreated control with 4.15 larva/plant of *H. armigera.*

Effect of different insecticides on larval population of fruit borer (*Helicoverpa armigera*) after three sprays

The data on cumulative effect of different treatments on larval population after three spray are presented in (Table 4) and depicted in (Fig. 4).

All the insecticidal treatments recorded significantly less larval population as compared to control. Lowest larval population (1.14 larva/plant) of *H. armigera* was recorded in treatment of chlorantraniliprole 18.5 % SC. Flubendiamide 39.35 % SC (1.51 larva/plant) was next promising treatment which was followed by indoxacarb 14.5 % SC exhibiting (1.70 larva/plant). Treatments *viz.*, spirotetramat 120% SC + imidacloprid 120 % SC, lymbda cyhalothrin 5 % EC, quinalphos 25 % EC found to be moderately effective against *H. armigera* and recorded larval population ranging 1.99 to 2.27 larvae per plant of *H.armigera*. Novaluron 10 % EC was least effective, with maximum (2.42 larvae per plant) population of *H.armigera*.

The data on per cent reduction in larval population over control after three sprays clearly indicates the effectiveness of the treatment chlorantraniliprole 18.5 % SC with highest (63.58 %) reduction over control. Whereas, novaluron exhibited lowest (22.68 %) reduction over control. Per cent reduction over control in rest of the treatments ranged from 30.67 to 51.76 percent.

The results of present investigation are in close agreement with result of Patel *et al.* (2016) [6] reported that chlorantraniliprole 35 WG @ 30 g a.i./ ha recorded the reduced larval population of *H. armigera* on tomato. Ambule *et al*. (2015) [1] reported that flubendiamide 20 % WG recorded minimum (0.43 larva/plant) larval population and which was at par with chorantraniliprole 18.5 % SC which recorded the 0.58 larva/plant. Abbas *et al*. (2015) [3] recorded the maximum larval mortality (89.36 %) in tomato when sprayed with chlorantraniliprole + thiamethoxam. The result of above researchers lends support the present findings.

Table 1: Efficacy of selected insecticides on larval population of tomato fruit borer after first spray

Sr. No	Treatments	Mean larval population of *H. armigera*				
		Pre count	**3 DAS**	**7 DAS**	**10 DAS**	**Mean**
1	Flubendiamide 39.35 % SC	2.13 (1.08)	0.92 (1.19)	1.04 (1.24)	1.32 (1.35)	1.09 (1.26)
2	Indoxacarb 14.5 % SC	2.07 (1.02)	1.06 (1.25)	1.23 (1.32)	1.49 (1.41)	1.26 (1.33)
3	Lambda cyhalothrin 5 % EC	2.33 (1.02)	1.35) (1.36)	1.51 (1.42)	1.80 (1.52)	1.55 (1.43)
4	Novaluron 10 % EC	2.20 (1.02)	1.62 (1.46)	1.80 (1.52)	2.11 (1.62)	1.84 (1.53)
5	Quinalphos 25 % EC	2.28 (1.05)	1.49 (1.41)	1.65 (1.47)	1.97 (1.57)	1.70 (1.48)
6	Spirotetramat 120 % SC + Imidacloprid 120 % SC	2.00 (0.98)	1.27 (1.33)	1.53 (1.42)	1.81 (1.52)	1.54 (1.43)
7	Chlorantraniliprole 18.5 % SC	1.93 (1.02)	0.66 (1.08)	0.80 (1.14)	1.06 (1.25)	0.84 (1.16)
8	Untreated control	1.78 (1.02)	1.86 (1.54)	2.26 (1.66)	2.54 (1.74)	2.22 (1.65)
	S.E. ±	NS	0.04	0.03	0.04	0.03
	CD at 5 %		0.12	0.11	0.12	0.12

Figures in the parenthesis are square root transformed values

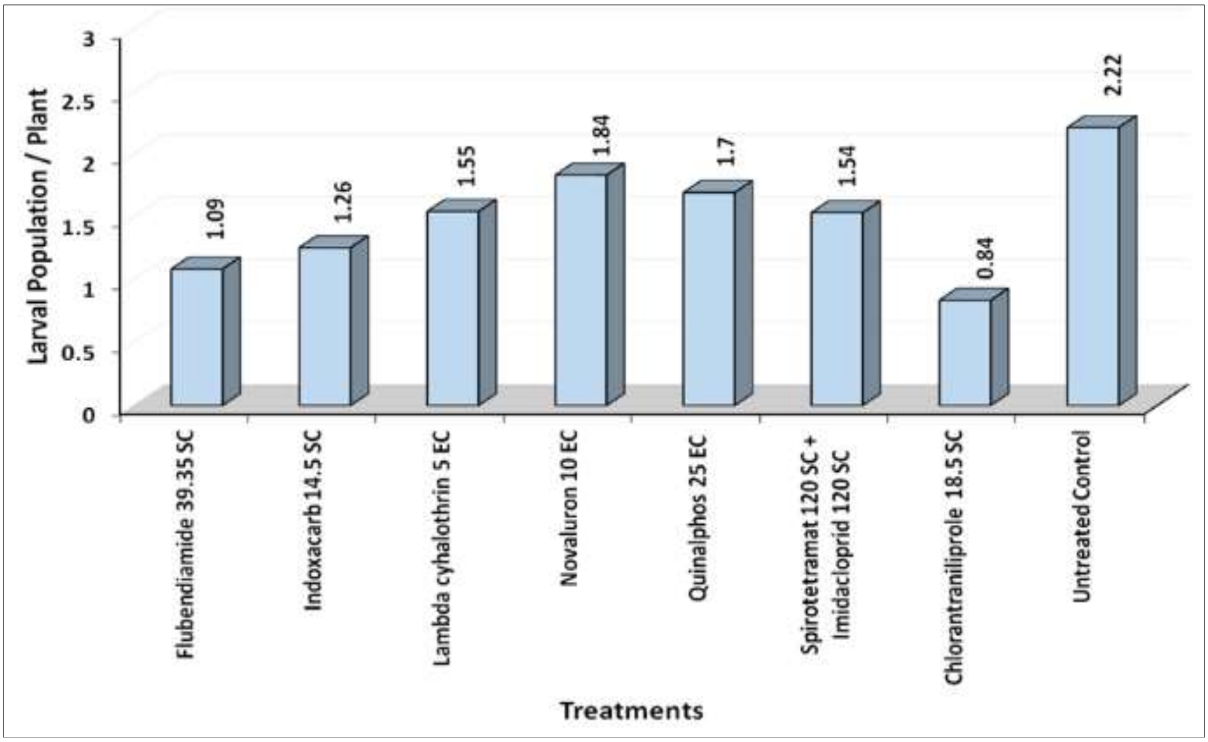

Fig 1: Efficacy of selected insecticide against larval population of tomato fruit borer after first spray

Table 2: Efficacy of selected insecticides on larval population of tomato fruit borer after second spray

Sr. No	Treatments	Mean larval population of *H. armigera*			
		3 DAS	7 DAS	10 DAS	Mean
1	Flubendiamide 39.35 % SC	1.17 (1.29)	1.42 (1.39)	1.83 (1.53)	1.47 (1.40)
2	Indoxacarb 14.5 % SC	1.37 (1.37)	1.60 (1.45)	2.00 (1.58)	1.66 (1.47)
3	Lambda cyhalothrin 5 % EC	1.69 (1.48)	1.83 (1.53)	2.37 (1.69)	1.96 (1.57)
4	Novaluron 10 % EC	2.17 (1.63)	2.26 (1.66)	2.66 (1.78)	2.36 (1.69)
5	Quinalphos 25 % EC	2.00 (1.58)	2.12 (1.62)	2.51 (1.73)	2.21 (1.65)
6	Spirotetramat 120 % SC + Imidacloprid 120 % SC	1.61 (1.45)	1.78 (1.51)	2.32 (1.68)	1.90 (1.55)
7	Chlorantraniliprole 18.5 % SC	0.94 (1.20)	1.20 (1.30)	1.46 (1.40)	1.20 (1.30)
8	Untreated control	2.66 (1.78)	2.94 (1.85)	3.46 (1.49)	3.02 (1.88)
	S.E. ±	0.04	0.04	0.04	0.04
	CD at 5 %	0.14	0.12	0.14	0.13

Figures in the parenthesis are square root transformed values

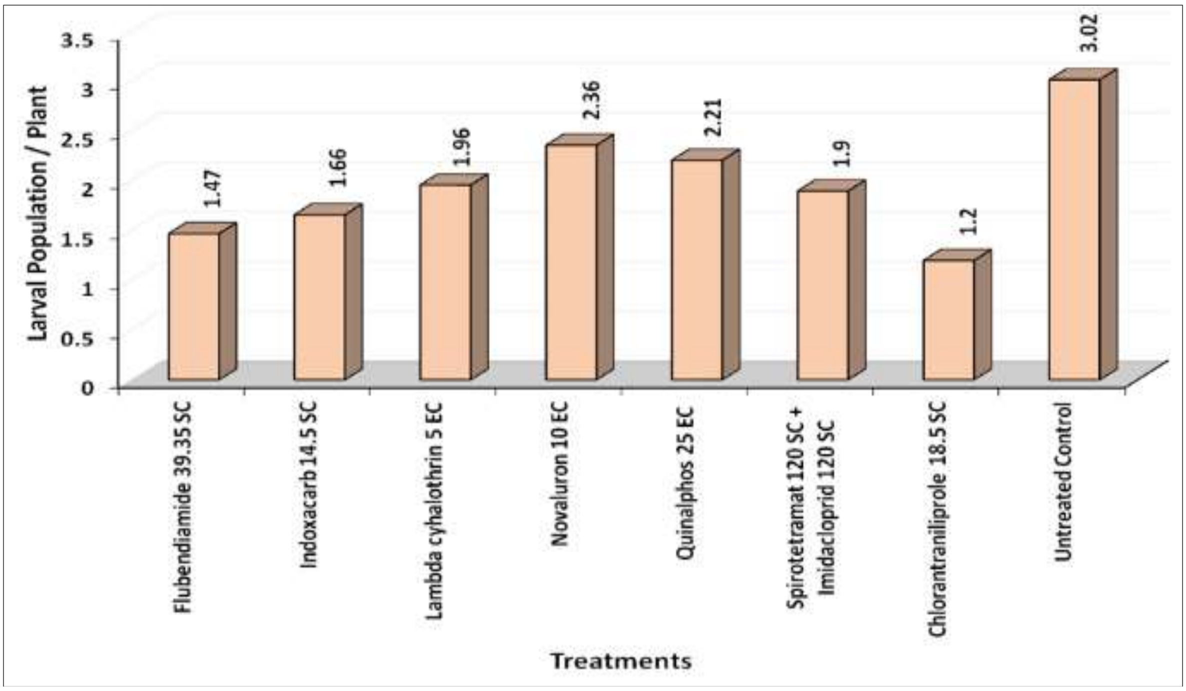

Fig 2: Efficacy of selected insecticide against larval population of tomato fruit borer after second spray

Table 3: Efficacy of selected insecticides on larval population of tomato fruit borer after third Spray

Sr. No	Treatments	Mean larval population of *H. armigera*			
		3 DAS	7 DAS	10 DAS	Mean
1	Flubendiamide 39.35 % SC	1.68 (1.48)	1.93 (1.56)	2.34 (1.69)	1.98 (1.57)
2	Indoxacarb 14.5 % SC	1.88 (1.54)	2.11 (1.62)	2.51 (1.73)	2.17 (1.63)
3	Lambda cyhalothrin 5 % EC	2.26 (1.66)	2.48 (1.73)	2.97 (1.86)	2.57 (1.75)
4	Novaluron 10 % EC	2.75 (1.80)	2.98 (1.87)	3.41 (1.98)	3.05 (1.88)
5	Quinalphos 25 % EC	2.59 (1.76)	2.82 (1.82)	3.25 (1.94)	2.89 (1.84)
6	Spirotetramat 120 % SC + Imidacloprid 120 % SC	2.21 (1.65)	2.43 (1.71)	2.92 (1.85)	2.52 (1.74)
7	Chlorantraniliprole 18.5 % SC	1.12 (1.27)	1.38 (1.37)	1.64 (1.46)	1.38 (1.37)
8	Untreated control	3.74 (2.06)	4.00 (2.12)	4.72 (2.28)	4.15 (2.16)
	S.E. ±	0.04	0.05	0.04	0.04
	CD at 5 %	0.13	0.15	0.14	0.14

Figures in the parenthesis are square root transformed values

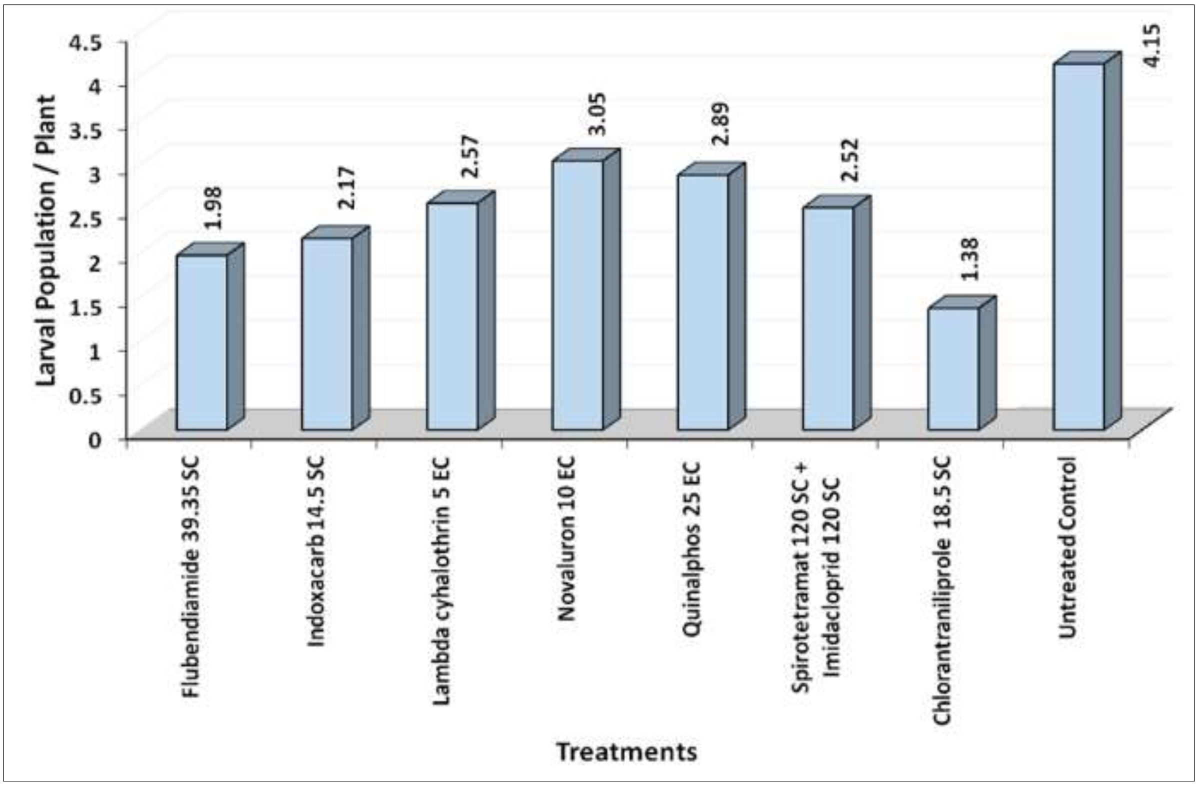

Fig 3: Efficacy of selected insecticide against larval population of tomato fruit borer after third spray

Table 4: Cumulative effect of selected insecticides on larval population of tomato fruit borer

Sr. No	Treatments	Mean larval population of *H. armigera*			
		I spray	II spray	III spray	Mean
1	Flubendiamide 39.35 % SC	1.09 (1.26)	1.47 (1.40)	1.98 (1.57)	1.51 (1.42)
2	Indoxacarb 14.5 % SC	1.26 (1.33)	1.66 (1.47)	2.17 (1.63)	1.70 (1.48)
3	Lambda cyhalothrin 5 % EC	1.55 (1.43)	1.96 (1.57)	2.57 (1.75)	2.03 (1.59)
4	Novaluron 10 % EC	1.84 (1.53)	2.36 (1.69)	3.05 (1.88)	2.42 (1.71)
5	Quinalphos 25 % EC	1.70 (1.48)	2.21 (1.65)	2.89 (1.84)	2.27 (1.66)
6	Spirotetramat 120 % SC + Imidacloprid 120 % SC	1.54 (1.43)	1.90 (1.55)	2.52 (1.74)	1.99 (1.58)
7	Chlorantraniliprole 18.5 % SC	0.84 (1.16)	1.20 (1.30)	1.38 (1.37)	1.14 (1.28)
8	Untreated control	2.22 (1.65)	3.02 (1.88)	4.15 (2.16)	3.13 (1.19)
	S.E. ±	0.03	0.04	0.04	0.04
	CD at 5 %	0.12	0.13	0.14	0.14

Figures in the parenthesis are square root transformed values

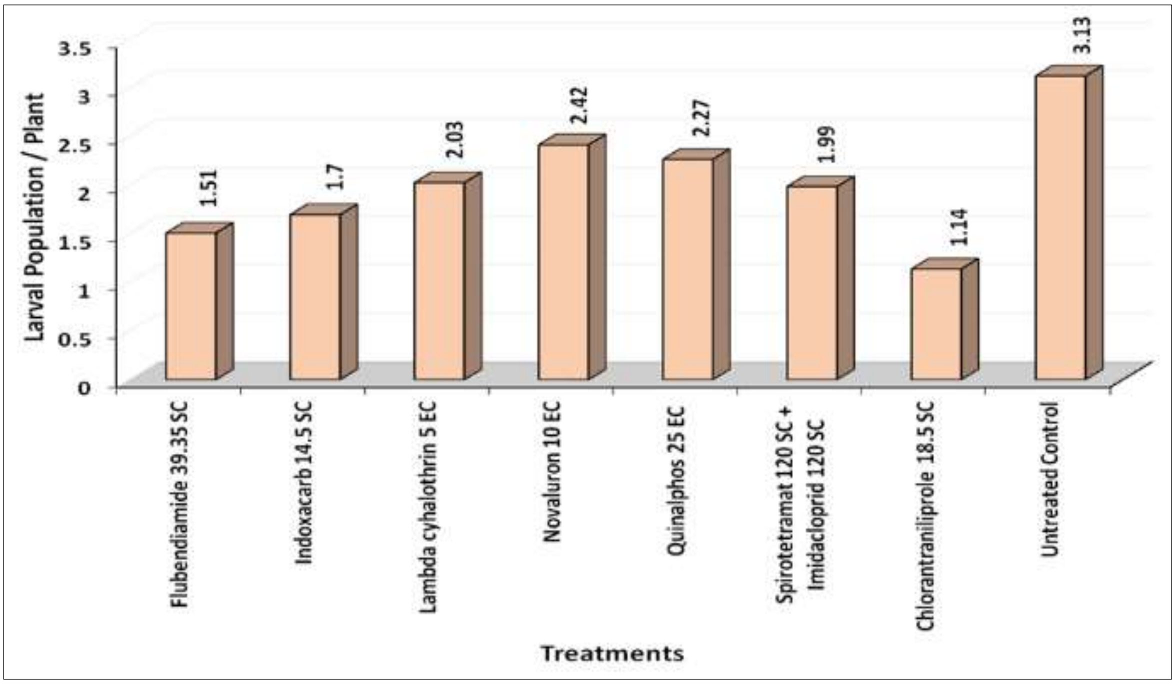

Fig 4: Cumulative effect of selected insecticide against larval population of tomato fruit borer after three sprays

References

1. Ambule AT, Radadia GG, Shinde CU, Patil DL. Relative efficacy of newer insecticides against *Helicoverpa armigera* (Hubner) in tomato under South Gujarat condition. Int. J Pl. Prote 2015;3(8):250-255.
2. Anonymous. India Agristat. (www.indiastat.com/table/agriculture/tomato/data.aspx), 2018.
3. Abbas G, Hassan N, Farhan M, Haq I, Karar H. Effect of selected insecticides on *Helicoverpa armigera* Hubner. (Lepidoptera: Noctuidae) on tomato (*Lycopersicon esculentum* Miller) and their successful management. Adv. Entomol 2015;3:16-23.
4. Desneux N, Wajnberg E, Wyckhuys KAG, Burgio G, Arpaia, Narvaez-Vasquez CA *et al*. DNA primers for amplification of mitochondrial cytochrome oxidase subunit I from diverse metazoan invertebrates. Mol. Mar. Bio. Biotechnol 2010;3:294-299.
5. Manjunath TM, Bhatnagar VS, Pawar CS, Sithanantham S. Economic important of *Heliothis* spp. in India and an assessment of their natural enemies and host plants. In: proceeding of workshop of biological control of *Heliothis* increasing the effectiveness of natural enemies (Ed. King IG and Jackson RD). For Eastern Regional Research Office, United States, Department of Agriculture, New Delhi, 1989, 197-228.
6. Patel RD, Parmar VR, Patel NB. Bio-efficacy of chlorantraniliprole 35 WG against *Helicoverpa armigera* (Hubner) Hardwick in tomato. Trends Biosci 2016;9(15):793-798.