International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 3326-3330

Received: 20-05-2018
Accepted: 22-06-2018

SD Sapkal
Department of Agricultural Entomology, College of Agriculture, Parbhani (MS) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

MM Sonkamble
Department of Agricultural Entomology, College of Agriculture, Parbhani (MS) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

BB Gaikwad
Department of Agricultural Entomology, College of Agriculture, Parbhani (MS) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Correspondence
SD Sapkal
Department of Agricultural Entomology, College of Agriculture, Parbhani (MS) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Bioefficacy of newer insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner) on tomato, *Lycopersicon esculentum* (mill) under protected cultivation

SD Sapkal, MM Sonkamble and BB Gaikwad

Abstract
For tomato fruit borer management seven newer insecticides were taken viz., spinosad 45% SC, chlorantraniliprole 18.5% SC, emamectin benzoate 5% SG, indoxacarb 14.5% SC, cyantraniliprole 10.26% OD, spinatoram 11.7% SC and flubendiamide 39.35% SG. The total three numbers of sprays were done. The treatment Chlorantraniliprole 18.5% SC, Flubendiamide 39.35% SG, Emamectin benzoate 5% SG, Indoxacarb 14.5% SC and Spinatoram 11.7 SC% was significantly at par with each other. Among them chlorantraniliprole 18.5% SC found most effective than all other treatment. The descending order of efficacy was recorded in all three sprays as chlorantraniliprole 18.5% SC > flubendiamide 39.35% SG > emamectin benzoate 5% SG > indoxacarb 14.5% SC > spinatoram 11.7% SC > cyantraniliprole 10.26% OD > spinosad 45% SC.

Keywords: newer insecticides, fruit borer *H. armigera*, tomato, protected cultivation

Introduction
Tomato (*Lycopersicon esculentum* Mill.), belonging to family Solanaceae is the most important vegetable grown widely both for fresh market and processing. It is said to be a native of tropical America. Tomato is the world's largest vegetable crop after potato and sweet potato and it tops the list of canned vegetables and occupies an area of 4.5 mha in world with an annual production of 130 mt. (Anonymous, 2016) [2]. The productivity of tomato in India is very low (15.60 t/ha) compared to the global average (25.09 t/ha). Tomato is one of the important vegetable grown in India with 774 ('000 ha) area with a production of 18732 ('000 mt) (NHB, 2016) [6]. The production and quality of tomato fruits are considerably affected by array of insect pests infesting at different stages of crop growth. Though there are dozens of pests on tomato, besides other insect pests causing considerable damage, fruit borer *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae) is the serious one which causes considerable losses in quantity as well as quality of tomato fruits (Singh and Chahal, 1978; Tewari and Moorthy, 1984; Reddy and Zehrm, 2004) [10, 15, 9]. Considerable economic losses due to *Helicoverpa armigera* reported by many workers to the extent of about 50-60% fruits (Singh and Singh, 1977) [11] and 25.99 to 41.34% fruits in Chhattisgarh (Singh, 1997) [11]. Economic significance of crop produce compelled the commercial farmer to advocate insecticidal almost in alternate days, sometimes almost double the recommended doses. Such indiscriminate use of insecticides leads to development of resurgence and resistance. So these days, there is a need to search for newer chemical that are selective which can replace older spurious chemicals on tomato. Therefore, keeping the above information in view bioefficacy of newer insecticides against tomato fruit borer, *H. armigera* (Hubner) on tomato, *Lycopersicon esculentum* (Mill.) under protected condition.

Material and Methods
The experiment was carried out with tomato crop using variety Pusa Ruby at research farm Department of Horticulture, VNMKV, Parbhani during *Kharif* 2017-18. The experiment was conducted in a randomized block design (RBD) with three replications and eight treatment.
Two raised beds were prepared in poly house having 0.4 meter height, 1 meter width and 17 meter length.

They were prepared by applying well decomposed farm yard manure. Seedling preparation tomato seeds were sown in portrays (98 cell) on June 30th using coco peat as growing media for nursery production. The seedlings of 30 days old, vigorous and uniform size were selected and transplanted on 29-07-2017 with a spacing 60x45 cm^2 at a shallow depth of 2-2.5 cm in paired row on a bed. The sprays were given during reproductive stage of the crop when *H. armigera* appears to be severe causing economic damage. The observations of fruit borer larvae was recorded from five randomly selected and tagged plants in each treatment plot before one day and 1, 3, 7 and 14 days after application of insecticides and data obtained was analyzed by standard analysis of variance method.

Results and Discussion

Effect of different insecticides on larval population of fruit borer (*Helicoverpa armigera* Hubner).

Table 1: Treatment details

S. No	Treatment details	Dose (g a.i) per ha	Conc. (%)	Dose (gm or ml/ 10lit. water)
T_1	Spinosad 45 SC	83	0.0144	3.2
T_2	Chlorantraniliprole 18.5 SC	30	0.0055	2.97
T_3	Emamectin benzoate 5 SG	10	0.0022	4.4
T_4	Indoxacarb 14.5 SC	75	0.0116	8
T_5	Cyantraniliprole 10.26 OD	60	0.0184	18
T_6	Spinatoram 11.7 SC	60	0.0010	0.85
T_7	Flubendiamide 39.35 SG	60	0.0078	1.98
T_8	Untreated control.	-	-	-

Table 2: Population of *Helicoverpa armigera* per plant in polyhouse tomato before and after first spray:

S. No	Treatments	Dosages (g.a.i/ha)	Number of Larvae per plant before and after first spraying				
			Pre-count	1 DAS	3 DAS	7DAS	14 DAS
T_1	Spinosad 45 SC	83	2.07(1.60)*	0.80(1.14)	0.87(1.17)	0.93(1.20)	1.20(1.30)
T_2	Chlorantraniliprole 18.5 SC	30	1.87(1.53)	0.33(0.91)	0.40(0.94)	0.53(1.01)	0.67(1.08)
T_3	Emamectin benzoate 5 SG	10	1.80(1.52)	0.47(0.98)	0.60(1.05)	0.67(1.08)	0.87(1.16)
T_4	Indoxacarb 14.5 SC	75	2.13(1.62)	0.53(1.02)	0.67(1.08)	0.73(1.11)	0.93(1.19)
T_5	Cyantraniliprole 10.26 OD	60	2.33(1.68)	0.73(1.11)	0.80(1.14)	0.87(1.17)	1.13(1.28)
T_6	Spinatoram 11.7 SC	60	2.00(1.58)	0.60(1.04)	0.73(1.11)	0.80(1.14)	1.00(1.22)
T_7	Flubendiamide 39.35 SG	60	1.93(1.56)	0.40(0.94)	0.53(1.02)	0.60(1.04)	0.80(1.14)
T_8	Untreated control.	-	2.20(1.64)	2.27(1.66)	2.47(1.72)	2.60(1.76)	2.67(1.78)
	S.E. $\pm$		0.067	0.051	0.054	0.056	0.058
	C.D. at 5%		NS	0.157	0.166	0.176	0.158

*Fig in parenthesis are $\sqrt{X + 0.5}$ transformed values, NS: Non Significant, DAS: Days after Spraying

The data is presented on *Helicoverpa armigera* population in Table 2 and depicted in Fig 1. On one day before first spray the results were statistically non-significant before application of insecticides indicating uniform distribution of *H. armigera* population. There were significant differences among the treatments on one days after spray. All the treatments were recorded significantly lower population of *H. armigera* than untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.33 larvae/ plant), which was significantly superior over rest of the treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (2.27 larvae/ plant) was observed in untreated control. There were significant differences among the treatments on three days after spray. All the treatments were recorded significantly lower population of *H. armigera* than untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.40 larvae/ plant), which was significantly superior over rest of the treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, were significantly at par with each other. The highest population of *H. armigera* (2.47 larvae/ plant) was observed in untreated control. The result obtained on *H. armigera* population recorded on 7 DAS of first spray all the treatments were recorded significantly lower population of *H. armigera* than untreated control. The treatment Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was recorded lower incidence of *H. armigera* (0.53 larvae/plant). The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha, Cyantraniliprole 10.26 OD @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (2.60 larvae/ plant) was observed in untreated control. The data on 14 DAS indicated that all the insecticides were superior over untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.67 larvae/plant), which was significantly superior over rest of the other treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (2.67 larvae/ plant) was observed in untreated control.

Table 3: Population of *Helicoverpa armigera* per plant in polyhouse tomato before and after second spray

Tr. No.	Treatments	Dosages (g.a.i/ha)	Number of Larvae per plant before and after second spraying				
			Pre-count	1 DAS	3 DAS	7 DAS	14 DAS
T_1	Spinosad 45 SC	83	2.13(1.62)*	0.87 (1.17)	0.93 (1.20)	1.07 (1.25)	1.27 (1.33)
T_2	Chlorantraniliprole 18.5 SC	30	1.93 (1.56)	0.40 (0.94)	0.53 (1.01)	0.60 (1.04)	0.87 (1.16)
T_3	Emamectin benzoate 5 SG	10	2.00 (1.58)	0.53 (1.01)	0.67 (1.08)	0.73 (1.11)	1.00 (1.22)
T_4	Indoxacarb 14.5 SC	75	2.20 (1.64)	0.67 (1.07)	0.73 (1.11)	0.80 (1.14)	1.07 (1.25)
T_5	Cyantraniliprole 10.26 OD	60	2.27 (1.60)	0.80 (1.14)	0.87 (1.16)	0.93 (1.20)	1.20 (1.30)
T_6	Spinatoram 11.7 SC	60	2.07 (1.60)	0.73 (1.11)	0.80 (1.14)	0.87 (1.17)	1.13 (1.28)
T_7	Flubendiamide 39.35 SG	60	1.87 (1.53)	0.47 (0.98)	0.60 (1.05)	0.67 (1.08)	0.93 (1.19)
T_8	Untreated control.	-	2.67 (1.78)	2.73 (1.80)	2.80 (1.82)	2.87 (1.83)	2.93 (1.85)
	S.E. ±		0.066	0.051	0.053	0.051	0.052
	C.D. at 5%		NS	0.156	0.163	0.158	0.161

*Fig in parenthesis are $\sqrt{X + 0.5}$ transformed values, NS: Non-Significant, DAS: Days After Spraying

The data is presented on *Helicoverpa armigera* population in Table 3 and depicted in Fig 2. On one day before second spray the results were statistically non significant before application of insecticides indicating uniform distribution of *H. armigera* population. The population of *H. armigera* ranges from 0.40 larvae/plant to 0.87 larvae/plant within one days after second spray. Lowest population of *H. armigera* was recorded in treatment of Chlorantraniliprole18.5 SC @ 30 g a.i/ha (0.40 larvae/ plant) which was significantly superior over other treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, were significantly at par with each other. The highest population of *H. armigera* (2.73 larvae/ plant) was observed in untreated control. There were significant differences among the treatments on three days after spray. All the treatments were recorded significantly lower population of *H. armigera* than untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.53 larvae/ plant), which was significantly superior over rest of the treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha, Cyantraniliprole 10.26 OD @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (2.80 larvae/ plant) was observed in untreated control. The population of *H. armigera* on 7 DAS varies from 0.60 to 1.07 larvae/plant indicates that all the insecticides were significantly superior over untreated control. Chlorantraniliprole 18.5 SC @ 30 g a.i/ha recorded the lowest population of *H. armigera* (0.60 larvae/plant) which was significantly superior over other treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha, were significantly at par with each other. The highest population of *H. armigera* (2.87 larvae/ plant) was observed in untreated control. The data on 14 DAS indicated that all the insecticides were superior over untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.87 larvae/plant), which was significantly superior over rest of the other treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha, Cyantraniliprole 10.26 OD @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (2.93 larvae/ plant) was observed in untreated control.

Table 4: Population of *Helicoverpa armigera* per plant in polyhouse tomato before and after third spray

T. No	Treatments	Dosages (g.a.i/ha)	Number of Larvae per plant before and after second spraying				
			Pre-count	1 DAS	3 DAS	7DAS	14 DAS
T_1	Spinosad 45 SC	83	2.20(1.64)*	0.93 (1.20)	1.13 (1.28)	1.27 (1.33)	1.40 (1.38)
T_2	Chlorantraniliprole 18.5 SC	30	1.93 (1.56)	0.53 (1.02)	0.67 (1.08)	0.73 (1.11)	0.93 (1.19)
T_3	Emamectin benzoate 5 SG	10	2.07 (1.60)	0.67 (1.08)	0.80 (1.14)	0.93 (1.20)	1.00(1.22)
T_4	Indoxacarb 14.5 SC	75	2.33 (1.68)	0.73 (1.10)	0.87 (1.17)	1.07 (1.25)	1.13 (1.28)
T_5	Cyantraniliprole 10.26 OD	60	2.40 (1.69)	0.87 (1.17)	1.00 (1.22)	1.20 (1.30)	1.33 (1.35)
T_6	Spinatoram 11.7 SC	60	2.13 (1.62)	0.80 (1.14)	0.93 (1.19)	1.13 (1.28)	1.20 (1.30)
T_7	Flubendiamide 39.35 SG	60	2.00 (1.58)	0.60 (1.05)	0.73 (1.11)	0.80 (1.13)	1.07 (1.25)
T_8	Untreated control.	-	3.00 (1.87)	3.07 (1.89)	3.13 (1.91)	3.13 (1.91)	3.20 (1.92)
	S.E. ±		0.065	0.049	0.051	0.057	0.059
	C.D. at 5%		NS	0.152	0.158	0.177	0.182

*Fig in parenthesis are $\sqrt{X + 0.5}$ transformed values, NS: Non-Significant, DAS: Days After Spraying

The data is presented on *Helicoverpa armigera* population in Table 4 and depicted in Fig 3. On one day before third spray the results were statistically non-significant before application of insecticides indicating uniform distribution of *H. armigera* population. There were significant differences among the treatments on one days after spray. All the treatments were recorded significantly lower population of *H. armigera* than untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.53 larvae/ plant), which was significantly superior over rest of the treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha and Cyantraniliprole 10.26 OD @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (3.07 larvae/ plant) was observed in untreated control. There were significant differences among the treatments on third days after spray. All the treatments were recorded significantly lower population of *H. armigera* than untreated

control. The treatment Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was recorded lower incidence of *H. armigera* (0.67 larvae/plant). The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha and Cyantraniliprole 10.26 OD @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (3.13 larvae/ plant) was observed in untreated control. The population of *H. armigera* on 7 DAS varies from 0.73 to 1.13 larvae/ plant on 7 DAS indicates that all the insecticides were significantly superior over untreated control. Chlorantraniliprole 18.5 SC @ 30 g a.i/ha recorded the lowest population of *H. armigera* (0.73 larvae/plant) which was significantly superior over other treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha, were significantly at par with each other. The highest population of *H. armigera* (3.13 larvae/ plant) was observed in untreated control. There were significant differences among the treatments on fourteen days after spray. All the treatments were recorded significantly lower population of *H. armigera* than untreated control. The population of *H. armigera* in Chlorantraniliprole 18.5 SC @ 30 g a.i/ha was lowest (0.93 larvae/ plant), which was significantly superior over rest of the treatments. The treatments Chlorantraniliprole 18.5 SC @ 30 g a.i/ha, Flubendiamide 39.35 SG @ 60 g a.i/ha, Emamectin benzoate 5 SG @ 10 g a.i/ha, Indoxacarb 14.5 SC @ 75 g.a.i/ha, Spinatoram 11.7 SC @ 60 g a.i/ha, Cyantraniliprole 10.26 OD @ 60 g a.i/ha were significantly at par with each other. The highest population of *H. armigera* (3.20 larvae/ plant) was observed in untreated control.

The significance efficacy of treatment chlorantraniliprole effective for the reduction of *Helicoverpa armigera* population is proved by Prasad and Rao (2010) [7]. Similarly, Mohanraj *et al.* (2012) [5], Gadhiya *et al.* (2014) [3] evaluated chlorantraniliprole 20 per cent SC effective against *H. armigera.* However, flubendiamide 480 SC at 100 ml per ha caused significantly high reduction in larvae by Ameta *et al.* (2011) [1], Priyadarshini *et al.* (2013) [8], Gadhiya *et al.* (2014) [3]. Similarly, Ghoshal *et al.* (2012) [4] reported that flubendiamide 20% WG @ 30 g a.i./ha was effective against *H. armigera.*

Also Sreekant *et al.*, (2014) [14] experimented efficacy of new insecticides against *H. armigera*, viz, chlorantraniliprole 20SC, flubendiamide 480SC and spinosad 45SC these are effective against *Helicoverpa armigera* population. Sinha *et al.*, (2013) [13] evaluated the efficacy of insecticides against caterpillar pest, flubendiamide 480SC was most effective treatment against the lepidopteran pests.

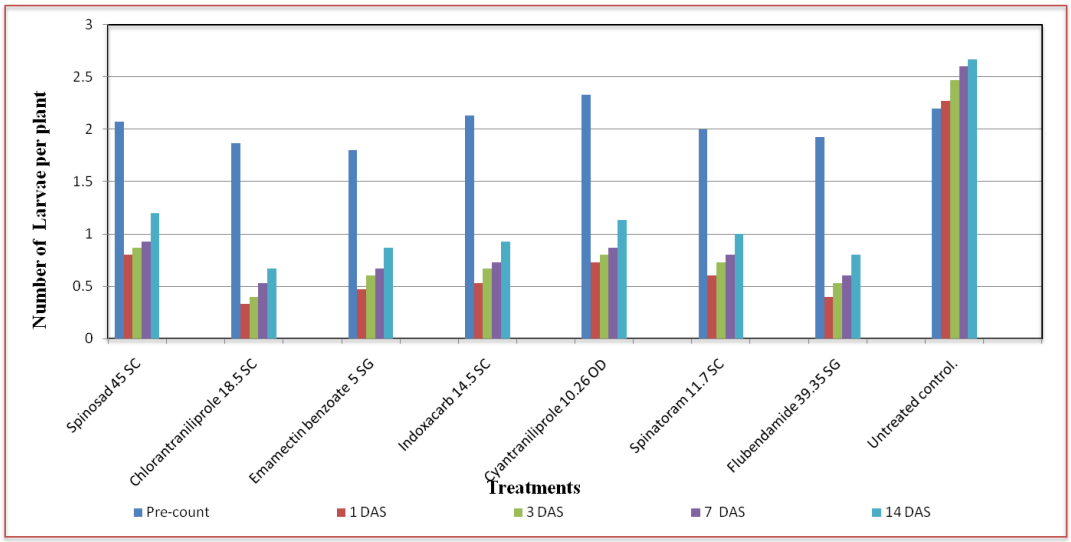

Fig 1: Population of *Helicoverpa armigera* per plant in polyhouse tomato before and after first spray

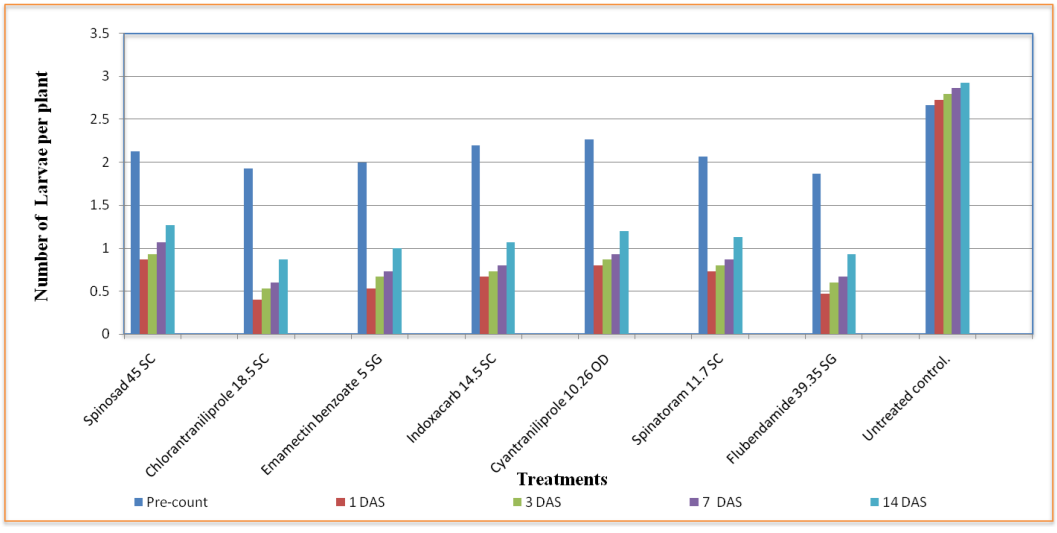

Fig 2: Population of *Helicoverpa armigera* per plant in polyhouse tomato before and after second spray

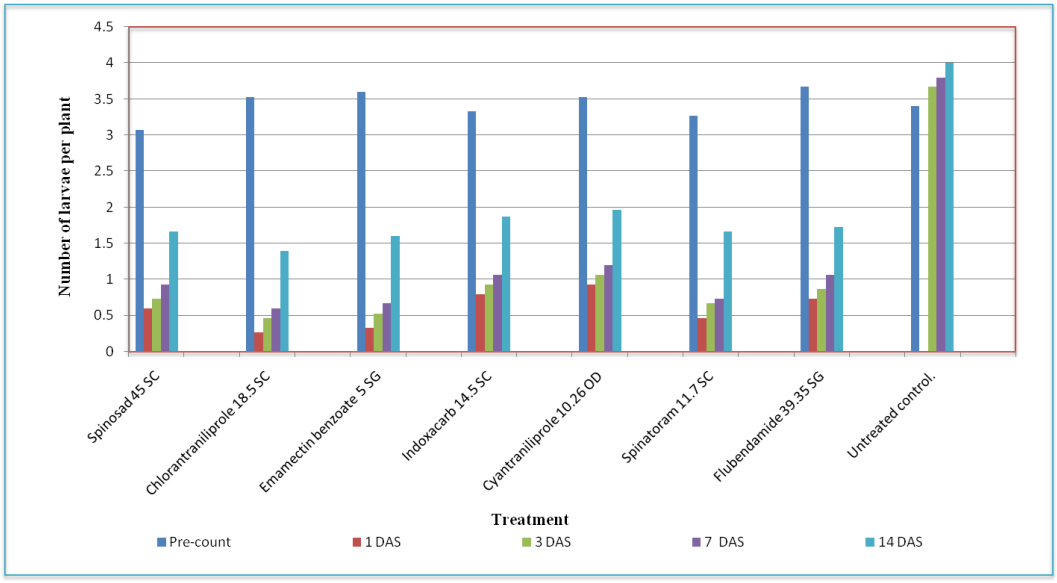

Fig 3: Population of *Tuta absoluta* per plant in polyhouse tomato before and after third spray

References

1. Ameta OP, Sharma US, Jain HK. Relative efficacy of flubendiamide 480 SC against *Helicoverpa armigera* (Hub.) in chick pea. Pestology. 2011; 34(11):31-35.
2. Anonymous. Annual report 2016-17, Indian Institute of Vegetable Research, Varanasi, 2016.
3. Gadhiya HA, Borad PK, Bhut JB. Effectiveness of synthetic insecticides against *Helicoverpa armigera* (Hubner) Hardwick and *Spodoptera litura* (Fabricius) infesting groundnut. The Bioscan. 2014; 9(1):23-26.
4. Ghoshal A, Chatterjee ML, Manna D. Studies on some insecticides with novel mode of action for the management of tomato fruit borer (*Helicoverpa armigera* Hub.). Journal of Crop and Weed. 2012; 8(2):126-129.
5. Mohanraj A, Bharathi K, Rajavel DS. Evaluation of chlorantraniliprole 20 per cent SC against pests of black gram. Pestology. 2012; 36(4):39-43.
6. NHB. National Horticulture Database, 2016.
7. Prasad NVVSD, Rao NHP. Bio-efficacy of chlorantraniliprole against *Helicoverpa armigera* (Hubner) on cotton. Pesticide Res. J. 2010; 22(1):23-26.
8. Priyadarshini G, Reddy NC, Reddy JD. Bioefficacy of selective insecticides against lepidopteran pod borers in pigeon pea. Indian J Pl. Prot. 2013; 41(1):6-10.
9. Reddy KVS, Zehrm UB. Novel Strategies for Overcoming Pests and Diseases in India. Maharashtra Hybrid Seeds Co. Ltd., India, 2004.
10. Singh D, Chahal BS. Control of tomato fruit borer (*Heliothis armigera* Hubner) in Punjab, Haryana. J Hortic. Sci. 1978; 7:182-186.
11. Singh H, Singh G. Biology studies on *Heliothis armigera* (Hub.) in Punjab, India. J. Entomol. 1977; 27:154-164.
12. Singh VV. Study on *Heliothis armigera* (Hub.) with special reference to its microbial control by Nuclear Polyhedrosis Virus (NPV) on tomato crop (Var.: Pusa Ruby). M.Sc. (Ag.). Thesis, I.G.K.V, Raipur India, 1997, 98.
13. Sinha D, Sahoo AK, Sonkar K. Bioefficacy of insecticides against caterpillar pests of soybean crop. Research Journal of Agricultural Science. 2013; 4(3):609-611.
14. Sreekanth M, Lakshmi MSM, Rao YK. Bio-efficacy and economics of certain new insecticides against gram pod borer, *Helicoverpa armigera* (Hub.) infesting pigeon pea (*Cajanus cajan* L.). Inter. J Pl., Animal and Environ. Sci. 2014; 4(1):11-15.
15. Tewari GC, Moorthy PNK. Yield loss in tomato caused by fruit borer. Indian J Agric. Sci. 1984; 54:341-343.