Biological Forum – An International Journal **15(10): 1178-1185(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Evaluation of Different Insecticides Against *Spodoptera frugiperda* (J.E. Smith) in Maize

Ghoderao T.N.[1*], Suradkar A.L.[2] and Patil B.V.[3]

[1]M.Sc. Student, Agril. Entomology, Department of Entomology, College of Agriculture, Badnapur, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani (Maharashtra), India.

[2]Department of Entomology, College of Agriculture, Badnapur, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani (Maharashtra), India.

[3]Associate Professor, Department of Entomology, College of Agriculture, Badnapur, Vasantrao Naik Marathwada, Krishi Vidyapeeth Parbhani (Maharashtra), India.

(Corresponding author: Ghoderao T.N.)*

(Received: 15 August 2023; Revised: 17 September 2023; Accepted: 02 October 2023; Published: 15 October 2023)
(Published by Research Trend)

ABSTRACT: The investigation of "Evaluation of different insecticides against *Spodoptera frugiperda* (J.E. Smith) in maize". The field experiment was conducted on the field of progressive farmer Shree. Baburao Mhaske Domegoan, Taluka Ambad, Dist. Jalna under the guidance of research guide, college of agriculture Badnapur during *kharif* 2021. The work was carried out in Randomized Block Design with three replications and Seven treatments. The net plot size and gross plot size was 3.0 m × 2.2 m and 4.2 m × 3 m respectively with maize crop variety Fourtuner. The studies revealed that, after three application of insecticides for the management of *Spodoptera frugiperda*, Emamectin benzoate 5SG (T_1) was found to be effective against the fall armyworm and egg masses of fall armyworm population, followed by Chlorantraniliprole 18.5 SC (T_2), Spinetoram 11.7 % SC (T_3), Flubendiamide 49.35 SC (T_3), Indoxacarb 15.8 EC (T_4) and Chlorfluazuron 5.4 EC (T_6). The maximum population of fall armyworm and egg masses of fall armyworm was observed in untreated control as compare to all other treatments. To convince the farmer for layout experiment in already planted crop and to keep watch on the activities of pest and it's response to different treatments were the challenges. The entire research programme monitored and guided by research guide besides all the inputs were provided by college of agriculture Badnapur and losses occurred in the plant population during layout and losses in the yield caused by untreated control were beared by farmer.

Keywords: Insecticides, Maize, *Spodoptera frugiperda*, fall armyworm, egg masses.

INTRODUCTION

Maize or corn (*Zea mays* L.) is a crop of global importance, which holds a unique position in world agriculture. Maize belongs to the family of Poaceae, originated from South America, from where it was taken to all parts of the world.

In India maize production estimated about 20240 tonnes in *kharif* and 8470 tonnes in rabi. Although in 2018-19 production were decreased by 20220 tonnes in *kharif* and 7580 tonnes in rabi. In Chhattisgarh, it is well informed in an area of 226.79 hec. With productivityof 2458 kg/hec. of *kharif* season. Although 74.45 ha. Area and 1950 kg/ha. Productivity of *rabi* season in 2017-18.

Among the maize growing countries India rank 4th in area and 7th in production representing around 4% of the world maize area and 2% of total production. In India, maize is cultivated on an area of 9.89 million ha with 31.65 million tonnes of production and 31.65 quintal per hactares of productivity during 2021-22. (Anonymous 2021).

Although 139 insect pests cause varying degree of damage to maize crop, only about a dozenof these are quite serious and require control measures like maize stalk borer, pink stem borer, and shoofly are the insects of national importance while the armyworm, jassids, thrips, aphids, pyrilla, grasshoppers, white grub, cut worms, hairy caterpillars, termites, and the leaf miner are more serious regional level insect pests. Amongst the most serious pests shoot fly and maize stem bore, (Chilo partellus Swinhoe, Sesamia inferens Walker) occurs as serious pests in India (Nagarjuna *et al.*, 2015). The fall army worm is a lepidopteron pest that feeds in large numbers on leaves and stems of more than 80 plant species, causing major damage to economically cultivated grasses such as maize, rice, sorghum, sugarcane but also other vegetable crops and cotton. The literature on this pest is extensive (Ashley *et al.*, 1989).

On maize, if 5% of seedlings are cut or 20% of whorls of small plants (during the first 30 days) are infested, it is recommended that an insecticide be applied on sorghum the pest threshold level is regarded as one (or two) larvae per leaf whorl and two per head (Pitre *et al.*, 1983).

The fall armyworm is lepidopteron pest that feeds in large numbers on leaves and stem of more than 80 plant species including maize, sorghum, millets, sugarcane

and vegetable crops, however, its maximum incidence and damage has been recorded on maize crop right from emergence to tasseling, silking and cob formation, but mostfrequently in the whorl of young plant up to 45 days old. Larvae usually consume alarge amount of foliage and sometimes destroy the growing point of the plant. Young larva mainly feed on epidermal leaf tissue and also make holes in leaves, which is the typical damage symptoms of *S. frugiperda*. Yield reductions in maize due to feeding of the fall army worm have been reported as high as 34 % (Deole and Paul 2018).

MATERIALS AND METHODS

A field experiment was conducted on the field of progressive farmer Shree. Baburao Mhaske Domegoan, Taluka Ambad, Dist. Jalna under the guidance of College of Agriculture Badnapur during *kharif* 2021 under field condition to Evaluation of different insecticides against *Spodoptera frugiperda*. The hybrid of maize variety use for study is Fortuner.

1. Design of experiment	Randomized Block Designs
2. Variety	Fortuner
3. Spacing	60×20cm
4. Date of sowing	4 July *Kharif* 2021
5. Season	*Kharif* 2020-21

The observation on larval and egg masses were recorded from five randomly selected plants from each treatment plots. Every plant was observed for larval population along with the whorl. The plant was also observed along with undersurface of the leaf for the egg masses of the *S. frugiperda*. The treatment was imposed observing ETL. The larval count of *S. frugiperda* and the egg masses were observed one day before and 3, 7, 10 and 14 days after spraying. The need-based applications were given at 15 days interval observing ETL.

Treatment details:

Sr. No.	Name of the treatment	Dose/10 lit of water
1.	Emamectin benzoate 5 SG	4 gm
2.	Chlorantranilprole 18.5 SC	3 ml
3.	Flubendiamide 49.35 SC	2.5 ml
4.	Indoxacarb 15.8 EC	10 ml
5.	Spinetoram 11.7 SC	10 ml
6.	Chlorfluazuron 5.4 EC	3.0 ml
7.	Untreated control	-

RESULTS AND DISCUSSIONS

Efficacy of insecticide of egg masses of *S. frugiperda* after first spraying Pre count one day before of egg masses *S. frugiperda* of first spraying. The data on egg masses of *S. frugiperda* one day before of first spraying is presented in Table 1 The results were statistically non-significant indicate that uniform distribution of egg masses of *S. frugipearda* population in experimental plot ranged from 0.37 to 0.53 egg mass/plant. Three day after first spraying. The data show in Table 1. There were significant differences among the treatments on third day after first spraying. The minimum no of egg masses of *S. frugiperda* (0.04) mass/plant was recorded with the treatment of Emamectin benzoate 5SG (T_1) @ 4gm/10L of water and significantly superior over control. The treatment of Chlorantraniliprole 18.5 SC (T_2) (0.08) egg mass/plant was at par with superior treatment (T_1). The treatment of Spinetoram 11.7 SC (T_5) (0.13) egg mass/plant was recorded second best treatment after that Flubendiamide 49.35 SC (T_3) (0.20) egg mass/plant was at par with second best treatment T_5. The treatment of indoxacarb 15.8 EC (T_4) (0.26) egg mass/plant and Chlorfluazuron 5.4 EC (T_6) (0.33) egg mass/plant were superior to control plot. The maximum number of egg masses was observed in control plot (T_7) (0.50) egg masses/plant.

Seven day after first spraying. The data tabulated in Table 1 indicate that there were significant differences among the treatments on the seventh day after first spraying. 0.02 number of egg masses of *S. frugiperda* recorded with the treatment of Emamectin benzoate 5SG (T_1) @ 4gm/10L which was significantly superior over treatment and Chlorantraniliprole 18.5 SC (T_2) @ 3ml/10L of water 0.04 egg masses/plant and at par with superior treatment T_1 then the treatment of Spinetoram 11.7SC (T_5) 10ml/10L of water (0.06) egg mass/plant was best treatment after superior treatment (T_1) and (T_2). The treatment of Flubendiamide 49.35 SC (T_3) 2.5ml/10L of water (0.13) egg masses/plant at par with the treatment of T_5. The treatment of Indoxacarb 15.8 EC (T4) 0.20 egg mass/plant and Chlorfluazuron 5.4EC (T_6) 0.26 egg mass/plant showed less efficacy as compare to all treatment. The maximum no. of egg masses was observed in control plot (T_7) (0.52 egg mass/plant).

Ten day after first spraying. The data presented in Table 1 showing the increased population of egg masses and significant difference recorded among the treatments on tenth day after first spraying. The treatment of Emamectin benzoate 5SG (T_1) (0.15) egg/plant prove its superiority over other. The treatments of chlorantraniliprole 18.5 SC (T_2) 0.20 egg mass/plant and Spinetoram 11.7 SC (T_5) 0.24 egg mass/plant were at par with superior treatment T_1. The treatments and Flubendiamide 49.35 SC (T_3) 0.26 egg mass/plant, Indoxacarb 15.8 EC (T_4) 0.33 and treatment Chlorfluazuron 5.4 EC (T_6) 0.40 egg mass/plant were second best treatment. Maximum number of egg mass was observed in control plot (T_7) 0.54 egg mass/plant.

Fourteen day after first spraying. The data is tabulated in Table 1 showed significant differences among the treatments at fourteenth days after the first spraying. All the treatments have recorded a lower population of egg masses of *S. frugiperda* over untreated control. The population of egg masses of *S. frugiperda* ranged between 0.23 to 0.60 egg masses/plant. The data recorded fourteen days after application revealed that among the various treatments, Emamectine benzoate (T_1) @ 4 gm /10 L with 0.23 egg masses/plant proved its superiority over other treatments. Chlorantraniliprole 18.5 SC (T_2) @ 3 ml / 10 L with 0.26 egg masses/plant and Spinetoram 11.7 SC (T_5) @ 10ml/ 10 L 0.31 egg masses/plant, flubendiamide 49.35 SC (T_3) 0.33 egg masses/plant,

indoxacarb 15.8EC (T_4) 0.36 egg mass/plant were at par with superior treatment T_1 and Chlorfluazuron 5.4 EC (T_6) 0.40 egg masses/plant were second best treatment. Maximum number of egg masses was observed in control plot (T_7) 0.60 egg masses/plant.

Efficacy of insecticide against egg masses of *S. frugiperda* after second spraying. The data on egg masses of *S. frugiperda* of second spraying is presented in Table 2. The results were statistically significant.

Three day after second spraying. Data presented in Table showed that on 3rd days after 2nd spraying all the insecticidal treatments significantly reduced the number of egg masses of *S. frugiperda* except control plot. Emamectin benzoate 5SG (T_1) was found to be significantly effective among all the treatments at it recorded lowest number of egg masses 0.08 egg mass/plant. The treatment of Chlorantraniliprole 18.5 SC (T_2) 0.11 eggmass/plant at par with superior treatment T1. The treatment of Spinetoram 11.7 SC (T_5) 0.16 egg mass/plant was second best treatment. The treatment of Flubendiamide 49.35 EC (T_3) 0.24 egg mass/Plant was at par with second bet treatment T_5. It was followed by Indoxacarb 15.8 EC (T_4) 0.30 egg mass/plant and treatment of Chlorfluazuron 5.4 EC 0.33 egg masses/plant. The maximum number of egg masses was observed in control plot (T_7) 0.48 egg mass/plant.

Seven day after of second spraying. Observations of seventh day after second spraying, all the insecticidal treatments show significant variability in the egg masses of *S. frugiperda* where Emamectin benzoate 5SG (T_1) was raised once again as most effective treatment and it recorded lowest number egg masses (0.14) egg masses/plant. Followed by Chlorantraniliprole 18.5 SC (T_2) (0.20) number of egg mass/plant and Spinetoram 11.7 SC (0.22) egg mass/plant at par with superior treatment T_1. The treatment of Flubendiamide 49.35 EC (T_3) (0.28) egg mass/ plant, Chlorfluazuron 5.4 EC (T_6) (0.34) egg mass/plant and Indoxacarb 15.8 EC (T_6) (0.33) egg mass/plant were second best treatment. The maximum number of egg masses was observed in control plot (T_7) (0.40) egg masses/plant.

Ten days after second spraying. On 10th day after second spraying, Emamectin benzoate 5SG (T_1) found as superior treatment and recorded lowest number of egg masses 0.26 egg mass/plant. Followed by Chlorantraniliprole 18.5 SC (T_2) 0.33 egg mass/plant, Spinetoram 11.7SC (T_5) 0.33 egg mass/plant, Flubendiamide 49.35 EC (T_3) 0.40 egg masses/plant and Indoxacarb 15.8 EC (T_4) 0.35 egg mass/plant at par with treatment T1 and treatment of Chlorfluazuron (T_6) 0.46 egg mass/plant was second best treatment. Untreated plot was recorded maximum number of egg masses (T_7) 0.60 egg mass/plant.

Fourteen day after second spraying. Observation recorded on number of egg masses of *S. frugiperda* at fourteenth days after second spraying showed significance differences among all treatment. Minimum number of egg masses of *S. frugiperda* (0.30) was observed in Emamectin benzoate 5SG (T_1) which was superior treatment among all over treatment. The treatments of Chlorantraniliprole 18.5 SC (T_2) (0.40) egg mass/plant and Spinetoram 11.7 SC (T_5) (0.42) egg mass/plant at par with superior treatment T_1. The treatment of flubendiamide 49.35 SC (T_3) 0.46 egg mass/plant was second best treatment. Indoxacarb 15.8 EC (T_4) 0.53 egg mass/plant superior treatment. Maximum number of egg masses was observed in control plot (T_7) 0.70 egg mass/plant.

Efficacy of insecticide against egg masses of *S. frugiperda* after third spraying. The data on egg masses of *S. frugiperda* after third spraying is presented in Table 3. The results were statistically significant.

Three day after third spraying. Observation noted at three days after third spraying indicated that Emamectin benzoate 5SG (T_1) @ 4gm/10L of water was significantly superior (0.20 egg mass/plant) as it recorded lowest egg masses of FAW over control. The next effective treatment was Chlorantraniliprole. The treatments of Flubendiamide 49.35 SC (T_3) @ 2.5 ml/10L of water (0.40) egg mass/plant and Indoxacarb 15.8 EC (T_4) 10ml/10L of water (0.46) were second best treatment. The treatment of Chlorfluazuron 5.4 EC (T_6) @ 3ml/10L of water (0.48) egg mass/plant was at par with treatment T_4. Maximum number of egg masses was observed in control plot (T_7) (0.66) egg mass/plant.

Seven days after third spraying. The data regarding the population of egg masses of *S. frugiperda* recorded seventh day after third spraying indicate that the lowest population of egg masses of *S. frugiperda* was recorded with the treatment of Emamectin benzoate 5SG (T_1) @ 4gm/10L of water was significantly superior (0.13 egg mass/plant) over control. The treatment of Chlorantraniliprole 18.5 EC (T_2) @ 3ml/10L of water (0.20) egg mass/plant was at par with superior treatment T_1. The treatments of Spinetoram 11.7 SC (T_5) @ 10ml/10L of water (0.26) egg mass/plant and Flubendiamide 49.35 SC (T_3) @ 2.5 ml/10L of water (0.33) egg mass/plant were second best treatment. The treatment of Indoxacarb 15.8 EC (T_4) 10ml/10L of water 0.40 egg mass/plant was at par with second best treatment T_5 and T_3. The treatment of Chlorfluazuron 5.4 EC (T_6) @ 3ml/10L of water (0.46) egg mass/plant was at par with treatment T_4. The maximum number of egg masses was observed in control plot T_7 (0.66) egg mass/plant.

Ten day after third spraying. The data recorded at 10th day after third spraying showed that the treatment of Emamectin benzoate 5SG (T_1) @ 4gm/10L once again proved to be significantly superior (0.28 egg mass/plant) over control followed by Chlorantraniliprole 18.5 SC (T_2) 3ml/10 L of water (0.34) egg mass/plant, Spinetoram 11.7 (T_5) SC@ 10ml/10L of water (0.42) egg mass/plant and Flubendiamide 49.35 SC (T_3) @ 2.5 ml/10L of water 0.42 egg mass/plant were at par with superior treatment T_1. The treatments of Indoxacarb 15.8 EC (T_4) @10ml/10L of water 0.48 egg mass/plant and Chlorfluazuron 5.4 EC (T_6) @ 3ml/10 L of water (0.50) egg mass/plant were recorded as second best treatments. The maximum number of egg mass was observed in control plot (T_7) 0.60 egg mass/plant.

Fourteen day after third spraying. The data recorded on fourteenth day after third spraying the lowest population of egg mass was observed in Emamectin benzoate 5SG (T_1) @ 4gm/10L once again proved to be significantly superior (0.40 egg mass/plant) over control. The treatments of Chlorantraniliprole 18.5 SC (T_2) 3ml/10 L of water (0.46) egg mass/plant, Spinetoram 11.7 (T_5) SC@ 10ml/10L of water 0.50 egg mass/plant and Flubendiamide 49.35 SC (T_3) @ 2.5 ml/10L of water 0.52 egg mass/plant, Indoxacarb 15.8 EC (T_4) @ 10ml/10L of water 0.56 egg mass/plant and Chlorfluazuron 5.4 EC (T_6) @ 3ml/10 L of water 0.53 egg mass/plant were at par with treatment T_1. The maximum number of egg mass was observed in control plot (T_7) 0.60 egg mass/plant.

Mallapur *et al*. (2019) field experiment was carried out at Dharwad, Karnataka during 2018. The laboratory conclusion obtained that Spinetoram 11.7 SC and Emamectin benzoate 5 SG were remarkable superior over other treatment with percent mortality at 60 hours after application. The field expeiment also indicated that Spinetoram, Emamectin benzoate and Spinosad 45 SC were remarkable superior over all other treatment with the reduction of larval population of 98.13, 96.26 and 96.2% respectively at 7 days after treatment application. Among other checked molecules, thiamethoxam 0.25% WG and fipronil 0.5 SC were least effective (68.65 and 73.14 mortality, respectively).

Efficacy of insecticide against *S. frugiperda* after 1st spraying

Pre-count one day before first spraying. The data on *S. frugiperda* population on one day before 1st spraying is presented in Table 4. The results were statistically non-significant indicating uniform distribution of *S. frugiperda* population and experimental plot ranged from 2.27 to 3.2 larvae/plant.

Three day after 1st spraying. Data regarding the population of *S. frugiperda* recorded third day after the first spraying indicating that lowest population of *S. frugiperda* (1.00 larvae/plant) was recorded with the treatment of Emamectin Benzoate 5 SG (T_1) @ 4gm/10L of water and significantly superior over control. The treatments of Chlorantraniliprole 18.5 SC (T_2) @ 3ml/10L of water was (1.40 larvae/plant) and Spinetoram 11.7 SC (T_5) @ 10 ml/10L of water was (1.43 larvae/plant) and Flubendiamide 49.35 SC (T_3) @ 2.5ml/10L (1.50 larvae/plant) at par with treatment T_1 followed by the treatment of Indoxacarb 15.8 EC (T_4) (2.00 larvae/plant) and Chlorfluazuron 5.4 EC (2.20 larvae/plant) were recorded as second best treatment. The maximum population of *S. frugiperda* (2.83 larvae/plant) recorded in control plot (T_7).

Seven day after 1st spraying. Data revealed the population of *S. frugiperda* seventh day after 1st spraying show that lowest population of *S. frugiperda* (0.88 larvae/plant) was recorded with the treatment of Emamectin Benzoate 5 SG (T_1) @ 4gm/10 L of water and significantly superior over control. The treatments of Chlorantraniliprole 18.5 SC (T_2) @ 3ml/10L (1.13 larvae/plant), Spinetoram 11.7 SC (T_5) @ 10ml/10L (1.20 larvae/plant) at par with superior treatment T_1 and Flubendiamide 49.35 SC (T_3) @ 2.5ml/10L of water have the population *S. frugiperda* (1.30 larvae/plant) recorded as Second best treatment. Indoxacarb 15.8 EC (T_4) @ 10ml/10L of water was (2.00 larvae/plant) followed by Chlorfluazuron 5.4 EC (T5) @ 3ml/10 L of water (2.20 larvae/plant) were at par with second best treatment T_3. The maximum population of *S. frugiperda* was observed in control plot (T_7) which is (2.70 larvae/plan

Matti et al. (2022) found that cyantraniliprole 10 OD @ 0.30 g/l and spinetoram 11.7 SC @ 0.50 ml/l treatments causing cent per cent larval mortality within 3 days of application. By 7th day, more than 80 per cent larval mortality was registered in all other chemical treatments as compared to less than 50 per cent in case of biopesticides.

Ten day after 1st spraying. The data showed that a significant difference was observed in all the treatments on the 10th day after spraying. Maximum reduction of *S. frugiperda* exhibited by the treatment of Emamectin benzoate 5 SG (T1) 4gm/10L (1.20 larvae/plant) which was superior over control and at par with Chlorantraniliprole 18.5 SC (T_2) (1.43 larvae/plant), spinetoram 11.7 SC (T_5) 1.70 larvae/plant and Flubendiamide 49.35 SC (T_3) 1.75 larvae/plant. Indoxacarb 15.8 EC (T_4) 2.20 larvae/plant and Chlorfluazuron 5.4 EC (T_6) (2.30 larvae/plant) were second best treatment. The highest population of FAW *S. frugiperda* 2.53 larvae/plant was observed in control plot (T_7).

Fourteen days after 1st spraying. The data showed that significant differences were noticed in all treatments on fourteenth day after 1st spraying. The treatment of Emamectin benzoate 5 SG (T_1) 1.40 larvae/plant found to be consistently superior over all treatments however at par with chlorantraniliprole 18.5 EC (T_2) 2.00 larvae/plant, Spinetoram 11.7 SC (T_5) 2.10 larvae/plant. Flubendiamide 49.35 SC (T_3) 2.20 larvae/plant, Indoxacarb 15.8 EC (T_4) 2.60 larvae/plant and Chlorfluazuron 5.4 EC (T_5) 2.62 larvae/plant were recorded as second best treatment. Maximum population of *S. frugiperda* was observed in control plot (3.00 larvae/plant).

Efficacy of insecticide against *S. frugiperda* after second spraying. The data on *S. frugiperda* population on second spraying is presented in Table 5. The results were statically significant.

Three day after second spraying. The data showed that significant differences were observed in all treatments on third day after second spraying indicates that the lowest population of *S. frugiperda* (1.00 larvae/plant) was recorded with the treatment of Emamectin benzoate 5 SG (T_1) significantly superior over control. The treatments of Chlorantraniliprole 18.5 SC (T_2) (1.20 larvae/plant), Spinetoram 11.7 SC (T_5) 1.30 larvae/plant, Flubendiamide 49.35 SC (T_3) 1.38 larvae/plant and Indoxacarb 15.8 EC 1.50 larvae/plant were at par with T_1. Chlorfluazuron 5.4 EC (T_6) (1.60) larvae/plant recorded as second best treatment whereas maximum population of fall armyworm was observed in control plots 2.23 larvae/plant.

Seven day after second spraying. The data observed that population of *S. frugiperda* after seventh day of

second spraying the lowest population of *S. frugiperda* was recorded with the treatment of Emamectin benzoate 5 SG (T_1) (0.50 larvae/plant) significantly superior over control. The treatment Chlorantraniliprole 18.5 SC (T2) (0.80) were at par with superior treatment T1 after that Spinetoram 11.7 SC (T_5) 1.35 larvae/plant and Flubendiamide 49.35 SC (T_3) (1.40) Larvae/plant and were recorded as second best treatment. Indoxacarb 15.8 EC (T_4) 1.87 larvae/plant and Chlorfluazuron 5.4 EC (T_6) (1.90 larvae/plant) were at par with second best treatment T_4 and T_6. Maximum population of *S. frugiperda* was recorded in untreated plot (T_7) (2.50 larvae/plant).

Ten day after second spraying. The data regarding population of *S. frugiperda* was recorded after tenth day of second spraying indicate that lowest population of *S. frugiperda* was observed that (1.10 larvae/plant) was recorded with treatment of Emamectin benzoate 5 SG (T_1) was significantly superior over treatment then Chlorantraniliprole 18.5 SC (T_2) 1.70 larvae/plant, Spinetoram 11.7 SC (T_5) 1.80 larvae/plant were at par with treatment T_1. Indoxacarb 15.8 EC (T_4) 2.47 larvae/plant, Flubendiamide 49.35 SC (T_3) 2.00 larvae/plant and Chlorfluazuron 5.4 EC (T_6) (2.48) larvae/plant was second best treatment. Maximum population was observed in control plot (T_7) 2.63 larvae/plant.

Fourteen day after second spraying. The data regarding population of *S. frugiperda* was recorded after fourteenth day of second spraying indicate that lowest population of *S. frugiperda* was observed that (1.30) larvae/plant was recorded with treatment of Emamectin benzoate 5SG (T_1) was significantly superior over treatment then the treatment of Chlorantraniliprole 18.5 SC (T_2) 1.6 larvae/plant at par with superior treatment T_1. Spinetoram 11.7 SC (T_5) 2.20 larvae/plant, flubendiamide 49.35 SC (T_3) 2.40 larvae/plant, Indoxacarb 15.8 EC (T_4) 2.50 larvae/plant and chlorfluazuron 5.4 EC (T_6) 2.60 larvae/plant were recorded as second best treatment. Maximum population was observed in control plot (T_7) 2.88 larvae/plant.

Efficacy of insecticides against *S. frugiperda* after third spraying. The data on *S. frugiperda* population after third spraying presented in Table 6. The results were statistically significant.

Three day after 3rd spraying. The data regarding population of *S. frugiperda* was recorded after third day of third spraying indicate that minimum population of *S. frugiperda* 0.80 larvae/plant with the treatment of Emamectin benzoate 5SG (T_1) was significantly superior over treatment. Then Chlortraniliprole 18.5 SC (T_2) 1.00larvae/plant was at par with treatment T1. After that the treatments of spinetoram11.7 SC (T_5) 1.62 larvae/plant, Flubendiamide 49.35 (T_3) 1.80 larvae/plant were recorded as second best treatment. The treatment of Indoxacarb 15.8 EC (T_4) was superior treatment 2.00 larvae/plant and Chlorfluazuron 5.4 EC (T_6) 2.10 larvae/plant were at par with second best treatment T_3 and T_5. Maximum population of FAW *S. frugiperda* was observed in control plot (T_7) 2.90 larvae/plant.

Deshmukh *et al.*(2020) conducted a field experiment at Zonal Agriculture and Horticulture Research station, Karnataka. The insecticides having different mode of action were study the control of second instar larvae by the leaf dip bioassay method as well as under field condition also. Emamectin benzoate 5 SG showed the highest acute toxicity, followed by chlorantraniprole 18.5 SC and spinetoram 11.7 SC whereas toxicities of flubendiamide 480 SC, indoxacarb 14.5 SC, lambda-cyhalothrin 5 EC and novaluron 10 EC were at par by the leaf-dip bioassay.

Seven day after 3rd spraying. The data show that population of *S. frugiperda* after seventh day of third spraying indicate the maximum population of was observed in control plot (T_7) 2.60 larvae/plant. The minimum number of population of *S. frugiperda* 0.73 larvae/plant with the treatment of Emamectin benzoate 5 SG (T_1) was superior over control. The treatment of Chlorantraniliprole 18.5 SC (T_2) 0.85 larvae/plant was at par with superior treatment T_1 then the treatments of Spinetoram 11.7 SC (T_5) 1.42 larvae/plant, Flubendiamide 49.35 SC (T_3) 1.60 larvae/plant, Indoxacarb 15.8 EC (T_6) 1.80 larvae/plant and chlorfluazuron 5.4 EC (T_6) 1.83 were recorded as second best treatment.

Ten day after third spraying. Regarding population of *S. frugiperda* recorded after tenth days of third spraying indicate that minimum population of *S. frugiperda* (1.22) larvae/plant with the treatment of Emamectin benzoate 5 SG (T_1) was significantly superior over treatment after that the treatments of Chlorantraniliprole 18.5 SC (T_2) 1.40 larvae/plant, spinetoram11.7 SC (T_5) 1.70 larvae/plant at par with T1. Flubendiamide 49.35 SC (T_3) 2.10 larvae/plant, Indoxacarb15.8 EC (T_4) 2.20 larvae/plant and Chlorofluazuron 5.4 EC (T_6) 2.30 larvae/plant were recorded as second best treatments. The maximum number of population was observed that in control plot (T_7) 2.75 larvae/plant.

Fourteen day after third spraying. The maximum number of population of *S. frugiperda* was recorded after fourteenth day of third spraying in control plot (T_7) 2.70 larvae/plant. Minimum population of *S.frugiperda* 1.30 larvae/plant with the treatment of Emamectin benzoate 5SG (T_1) was significantly superior over treatment. The treatment of Chlorantraniliprole 18.5SC (T_2) 1.40 larvae/plant, spinetoram 11.7 SC (T_5) 1.80 larvae/plant at par with superior treatment T_1. The treatment of Flubendiamide 49.35 SC (T_3) 2.20 larvae/plant, Indoxacarb 15.8 EC (T_4) 2.40 larvae/plant and Chlorfluazuron 5.4 EC (T_6) 2.44 larvae/plant was second best treatment.

Sangle *et al.* (2020) the experiment was carried out an during *rabi* 2018-2019 to study the effect of seven newer insecticide molecules *viz*., Profenphos 50 EC @ 30 ml, Indoxacarb @ 8.5ml, Emamectin benzoate 5 SG @ 4 g, Spinosad 45 SC @ 4 ml, Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 @ 2.5 ml, Chlorantranilprole 18.5 SC 3 ml and Flubendiamide 49.35 SC @ 2.5 per lit of water respectively. The highest yield was recorded in the treatment of Emamectin benzoate 5 SG @ (42.5 g/ha) followed by Chlorantraniprole 18.5 %SC (40.01

q/ha), Flubendiamide 39.35 SC (38.5 q/ha) and Thimethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC (37.6 q/ha 14.5).

Kumar *et al.* (2022) the lowest leaf damage was observed in Emamectin benzoate 5 SG which recorded 1.3% damage, followed by Acephate 50% + Imidacloprid 1.8% SP, Flubendiamide 480SC, thiacloprid 240SC, Spinosad 45SC, Acephate 75SP, Chlorpyriphos 50% + Cypermethrin 5% EC and Fipronil 5SC.

Table 1: Population of egg mass of *S. frugiperda* after first spraying.

Tr. No.	Name of Treatments	Dose /10 L	Average number of egg mass of *S. frugiperda*/plant				
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS
T_1	Emamectinbenzoate5 SG	4 ml	0.37 (0.58)	0.04 (0.20)	0.02 (0.12)	0.15 (0.38)	0.23 (0.47)
T_2	Chlorantraniliprole 18.5 SC	3ml	0.39 (0.61)	0.08 (0.28)	0.04 (0.20)	0.20 (0.42)	0.26 (0.50)
T_3	Flubendiamide 49.35 SC	2.5ml	0.38 (0.60)	0.20 (0.44)	0.13 (0.35)	0.26 (0.50)	0.33 (0.57)
T_4	Indoxacarb 15.8EC	10ml	0.40 (0.62)	0.26 (0.50)	0.20 (0.44)	0.33 (0.57)	0.36 (0.58)
T_5	Spinetoram11.7SC	10ml	0.20 (0.44)	0.13 (0.36)	0.06 (0.24)	0.24 (0.48)	0.31 (0.55)
T_6	Chlrofluazuron5.4EC	3.0ml	0.49 (0.68)	0.33 (0.55)	0.26 (0.50)	0.40 (0.62)	0.40 (0.62)
T_7	Untreated check		0.53 (0.72)	0.50 (0.70)	0.52 (0.71)	0.54 (0.73)	0.60 (0.76)
	SE(m)±		0.044	0.030	0.026	0.035	0.035
	CD at 5 %		NS	0.091	0.081	0.107	0.107
	CV (%)		12.60	11.86	12.44	11.38	10.47

*Figures in parenthesis are square root transformed values

Table 2: Population of egg masses of *S. frugiperda* on maize after second spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Egg mass of *S. frugiperda*/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T_1	Emamectin benzoate5 SG	4 gm	0.08 (0.23)	0.14 (0.37)	0.26 (0.50)	0.30 (0.52)
T_2	Chlorantraniliprole 18.5 SC	3ml	0.11 (0.31)	0.20 (0.44)	0.33 (0.57)	0.40 (0.62)
T_3	Flubendiamide 49.35 SC	2.5ml	0.24 (0.47)	0.28 (0.52)	0.40 (0.62)	0.46 (0.67)
T_4	Indoxacarb15.8EC	10ml	0.30 (0.52)	0.33 (0.57)	0.35 (0.57)	0.53 (0.72)
T_5	Spinetoram11.7SC	10ml	0.16 (0.38)	0.22 (0.46)	0.33 (0.57)	0.42 (0.63)
T_6	Chlorfluazuron5.4EC	3.0ml	0.33 (0.57)	0.34 (0.56)	0.46 (0.67)	0.56 (0.74)
T_7	Untreated check	——	0.48 (0.67)	0.40 (0.62)	0.60 (0.76)	0.70 (0.83)
	SE(m) ±		0.026	0.033	0.041	0.047
	CD at 5%		0.082	0.103	0.125	0.146
	CV (%)		10.18	11.47	11.59	10.42

*Figures in parenthesis are square root transformed values

Table 3: Population of egg masses of *S. frugiperda* after third spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Egg mass of *S. frugiperda*/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T_1	Emamectinbenzoate5 SG	4 gm	0.20 (0.44)	0.13 (0.36)	0.28 (0.52)	0.40 (0.62)
T_2	Chlorantraniliprole 18.5 SC	3ml	0.26 (0.49)	0.20 (0.44)	0.34 (0.57)	0.46 (0.67)
T_3	Flubendiamide 49.35 SC	2.5ml	0.40 (0.61)	0.33 (0.55)	0.42 (0.63)	0.52 (0.70)
T4	Indoxacarb15.8EC	10ml	0.46 (0.67)	0.40 (0.62)	0.48 (0.68)	0.56 (0.74)
T5	Spinetoram11.7SC	10ml	0.33 (0.56)	0.26 (0.50)	0.42 (0.63)	0.50 (0.70)
T6	Chlorfluazuron5.4EC	3.0ml	0.48 (0.68)	0.46 (0.67)	0.50 (0.70)	0.53 (0.72)
T7	Untreated check	——	0.66 (0.79)	0.66 (0.80)	0.60 (0.76)	0.60 (0.76)
	SE(m) ±		0.045	0.040	0.038	0.045
	CD at 5%		0.140	0.129	0.117	0.138
	CV (%)		12.90	12.96	10.26	11.09

*Figures in parenthesis are square root transformed values

Table 4: Population of *S. frugiperda* on maize after 1st spraying.

Tr. No.	Name of Treatment	Dose /10 L	Average number of *S. frugiperda*/plant				
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS
T_1	Emamectinbenzoate 5 SG	4 gm	2.27 (1.44)	1.00 (0.97)	0.88 (0.92)	1.20 (1.07)	1.40 (1.16)
T_2	Chlorantraniliprole 18.5 SC	3ml	2.40 (1.54)	1.40 (1.17)	1.13 (1.06)	1.43 (1.17)	2.00 (1.38)
T_3	Flubendiamide 49.35 SC	2.5ml	2.60 (1.61)	1.50 (1.21)	1.30 (1.14)	1.75 (1.29)	2.20 (1.46)
T_4	Indoxacarb 15.8EC	10ml	2.8 (1.67)	2.00 (1.38)	2.00 (1.41)	2.20 (1.45)	2.60 (1.59)
T_5	Spinetoram11.7SC	10ml	2.60 (1.61)	1.43 (1.18)	1.20 (1.08)	1.70 (1.27)	2.10 (1.42)
T_6	Chlorfluazuron 5.4EC	3.0ml	3.0 (1.73)	2.20 (1.47)	2.20 (1.48)	2.30 (1.49)	2.62 (1.60)
T_7	Untreated check		3.2 (1.79)	2.83 (1.68)	2.70 (1.68)	2.53 (1.57)	3.0 (1.72)
	SE(m)±		0.108	0.095	0.069	0.079	0.091
	CD at 5 %		NS	0.292	0.212	0.244	0.280
	CV (%)		11.55	12.67	9.59	10.25	10.67

*Figures in parenthesis are square root transformed value

Table 5: Population of *S. frugiperda* on maize after 2nd spraying.

Tr. No.	Treatments	Dose /10L	Average no. of *S. frugiperda*/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T_1	Emamectinbenzoate5 SG	4 gm	1.00 (0.98)	0.50 0.71)	1.10 (1.03)	1.30 (1.12)
T_2	Chlorantraniliprole 18.5 SC	3ml	1.20 (1.07)	0.80 (0.87)	1.70 (1.26)	1.60 (1.24)
T_3	Flubendiamide 49.35 SC	2.5ml	1.38 (1.17)	1.40 (1.16)	2.0 (1.38)	2.40 (1.53)
T_4	Indoxacarb15.8EC	10ml	1.50 (1.21)	1.87 (1.33)	2.47 (1.55)	2.50 (1.56)
T_5	Spinetoram11.7SC	10ml	1.30 (1.12)	1.35 (1.14)	1.80 (1.30)	2.20 (1.46)
T_6	Chlorfluazuron5.4EC	3.0ml	1.60 (1.24)	1.90 (1.34)	2.48 (1.55)	2.60 (1.59)
T_7	Untreated check	—	2.23 (1.47)	2.50 (1.56)	2.63 (1.60)	2.88 (1.68)
	SE(m) ±		0.076	0.077	0.090	0.088
	CD at 5%		0.234	0.233	0.276	0.270
	CV (%)		11.14	11.30	11.23	10.45

*Figures in parenthesis are square root transformed values

Table 6: Population of *S. frugiperda* on Maize after third spraying.

Tr. No.	Treatments	Dose /10L	Average no. of *S. frugiperda*/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T_1	Emamectinbenzoate5 SG	4 gm	0.80 (0.87)	0.73 (0.83)	1.22 (1.02)	1.30 (1.12)
T_2	Chlorantraniliprole 18.5 SC	3ml	1.00 (0.98)	0.85 (0.90)	1.40 (1.16)	1.40 (1.16)
T_3	Flubendiamide 49.35 SC	2.5ml	1.80 (1.31)	1.60 (1.20)	2.10 (1.42)	2.20 (1.46)
T_4	Indoxacarb15.8EC	10ml	2.00 (1.38)	1.80 (1.31)	2.20 (1.46)	2.40 (1.53)
T_5	Spinetoram11.7SC	10ml	1.62 (1.23)	1.42 (1.13)	1.70 (1.26)	1.80 (1.31)
T_6	Chlorfluazuron 5.4EC	3.0ml	2.10 (1.42)	1.83 (1.32)	2.30 (1.47)	2.44 (1.54)
T_7	Untreated check	—	2.90 (1.69)	2.60 (1.59)	2.75 (1.64)	2.70 (1.62)
	SE(m) ±		0.077	0.084	0.085	0.080
	CD at 5%		0.236	0.259	0.262	0.247
	CV (%)		10.59	12.33	10.94	10.00

*Figures in parenthesis are square root transformed value

After second spray, Emamectin benzoate 5 SG recorded lowest leaf damage (3.85%), which was in line with the Acephate 50%+ Imidacloprid 1.8% SP, Acephate 75SP, Spinosad 45 SC, Flubendiamide 480SC, Thiacloprid 240SC, Chlorpyriphos 50% + Cypermethrin 5% EC and Fipronil 5SC. While untreated check recorded highest damage as there was no intervention with the insecticide spray.

CONCLUSIONS

The study indicate that among the all treatments Emamectine benzoate 5 SG (T_1) @ 4 gm/10 L was found best with the lowest population of *spodoptera frugiperda* larvae and their egg masses. Result revealed that next better treatment was Chlorantraniliprole 18.5 SC (T_2) @ 3 ml/10 were found effective against fall armyworm of Maize.

FUTURE SCOPE

To provide exact recommendation for insecticide application, it is essential to time the treatment after the pest population cross the economic threshold level (ETL). These approaches ensure that insecticides are used with accuracy and not indiscriminately. By following these methods, we can safeguard the natural enemies present in the field, promoting a balanced ecosystem and effective pest management.

REFERENCES

Anonymous (2021). Area, production and productivity in India. *Indian institute of maize research.*

Anil Kumar S.T., Kiran Kumar G.N., K. Chandrakumara, Moulya M.R., K. Srinivas and R.S. Meena (2022). Assessing the Effectiveness of Newer Insecticides against Rice Leaf Folder, *Cnaphalocrocis medinalis* (Crambidae: Lepidoptera). *Biological Forum – An International Journal*, *14*(4), 552-555.

Ashley, T. R., Wiseman, B. R., Davis, F. M., Andrews, K. L. (1989). The fall armyworm: bibliography (1989). *Florida Entomologist*, *72*, 152-202.

Deole, S. and Paul, N. (2018). First report of fall armyworm, *Spodoptera frugiperda* (J. E. Smith), their nature of damage and biology on maize crop at Raipur, Chatthisgarh, *Journal of Entomology and zoology studies*, *6*(6), 219-221.

Deshmukh, S., Pravithra, H. B., Kalleshwarasawmy, C. M., Shivanna, B. K., Maruthi, M. S. and David, M. S. (2020) Field efficacy of insecticide for management of fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) on maize in India. *Florida Entomologist-V 103*, No.2, 221-227.

Mallapur, C. P., Naik, A. K., Hagari, S. T., Praveen, T. and Naik, M. (2019). Laboratory field evaluation of new insecticide molecules against fall armyworm, *Spodoptera frugiperda* (J.E. Smith) on maize. *Journal of entomology and zoology studies*, *7*(5), 729-733.

Matti, M. V., Mallapur, C. P., Kambrekar D. N., Harlapur, S. I. and Hulihalli, U. K. (2022). Field Efficacy of Selected Newer Insecticide Molecules on *Spodoptera frugiperda* (J. E. Smith) in Maize. *Biological forum – An International Journal*, *14*(4), 76-82.

Nagarjuna, B., Manjunath, M., Latha M., (2015). Studies on varital screening of maize hybrid against stem borer, *Seasamia inferens* (Walkar). *Journal of Eco-friendly Agriculture*, *10*, 64-66.

Pitre, H. N., Malrooney, J. E., and Hogg, B. D. (1983). Fall armyworm (Lepidoptera: Noctuidae) ovipostion: crop prefrences and egg distribution in plant. *Journal of Economic Entomology*, *76*(3), 463-466.

Sangle, S. V., Jayewar, N. E., Kadam, D. R. (2020). Efficacy of insecticides on larval population of fall armyworm, *Spodoptera frugiperda* on maize. *Journal of entomology and zoology study*, *8*(6), 1831-1834.

How to cite this article: Ghoderao T.N., Suradkar A.L. and Patil B.V. (2023). Evaluation of Different Insecticides Against *Spodoptera frugiperda* (J.E. Smith) in Maize. *Biological Forum – An International Journal*, *15*(10): 1178-1185.