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Bio-efficacy of new generation insecticides against fall armyworm, *Spodoptera frugiperda* (J.E. Smith) in terms of per cent plant damage in maize (*Zea mays* L.) during spring

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Abstract

A field experiment was conducted at the Agronomy Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan during Spring 2025. The study was conducted to evaluate the bio-efficacy of selected new-generation insecticides against fall armyworm (*Spodoptera frugiperda*) in spring maize. The experiment was laid out in a Randomized Block Design (RBD) with seven treatments and three replications. Treatments included Spinetoram 11.7 SC, Chlorantraniliprole 18.5 SC, Flubendiamide 480 SC, Emamectin benzoate 5 SG, Novaluron 10 EC, Profenofos 50 EC and an untreated control. Observations on per cent plant damage were recorded before spraying and at 3, 7 and 14 days after spraying (DAS) following two consecutive applications. The results revealed significant differences among treatments. Chlorantraniliprole 18.5 SC recorded the lowest overall plant damage (24.53%), followed by Flubendiamide 480 SC (24.58%) and Emamectin benzoate 5 SG (27.93%). The untreated control exhibited the highest plant damage (42.98%). The results demonstrated that Chlorantraniliprole 18.5 SC and Flubendiamide 480 SC were highly effective against fall armyworm under the agro-climatic conditions of southern Rajasthan.

Keywords: Fall armyworm, Maize, Plant damage, Bio-efficacy, Chlorantraniliprole

1. Introduction

Maize (*Zea mays* L.), commonly called the “Queen of Cereals,” is recognized for its superior genetic yield potential among cereal crops and serves as a major source of food, feed and industrial raw material. In India, maize contributes substantially to agricultural production and rural livelihoods. Globally, maize is cultivated on more than 200 million hectares, with an annual production exceeding 1.2 billion tonnes, making it the most widely produced cereal crop (FAOSTAT, 2025) ^[4]. The average global productivity is about 6 t/ha, although yields vary widely from over 10 t/ha in the United States to below 3 t/ha in certain low-income regions (Cairns and Prasanna, 2018) ^[1]. In India, maize ranks third after rice and wheat in both area and production. During 2024-25, it was grown on approximately 10.5 million hectares, producing around 34.6 million tonnes with an average yield of 3.2 t/ha (DES, 2025) ^[3].

Maize is cultivated in all seasons viz. *Kharif*, *Rabi* and spring in India (Parkash and Peshin, 2020) ^[12]. The predominant maize growing states that contributes more than 80 per cent of the total maize production are Andhra Pradesh (20.9 %), Karnataka (16.5 %), Rajasthan (9.9 %), Maharashtra (9.1 %), Bihar (8.9 %), Uttar Pradesh (6.1 %), Madhya Pradesh (5.7 %), Himachal Pradesh (4.4 %). Rajasthan alone contributes significantly, with about 1.1 million hectares under maize, producing approximately 4.5 Mt and yielding around 4.1 t/ha (Government of Rajasthan, 2025) ^[6]. In recent years, Spring maize accounts for about 20-25 per cent of India's total maize area and contributes over 30 per cent of total production, with productivity ranged between 4.5-6.0 t/ha, significantly higher than the *Kharif* season maize (ICAR-IIMR, 2025) ^[7]. The cultivation of spring maize has been increasingly threatened by insect pests such as fall armyworm (*Spodoptera frugiperda*), Maize Stem borer (*Chilo*

partellus) and maize cob worm (*Helicoverpa armigera*), which cause significant yield losses. In India, FAW was first detected in August 2018 on maize near Shivamogga, Karnataka (Ganiger *et al.*, 2018)^[5] and later spread to other maize-growing states including Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra, Gujarat and several North-Eastern states (Chormule *et al.*, 2019)^[2].

Materials and Methods

The field experiment was conducted at the Agronomy Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during spring 2025. The experiment was laid out in a Randomized Block Design (RBD) with three replications, seven treatments consisting of different insecticides and one untreated control were evaluated.

Table 1: Treatment Details

S. No.	Treatments	Dose
T ₁	Spinetoram 11.7 SC	250ml/ha
T ₂	Chlorantraniliprole 18.5 SC	200 ml/ha
T ₃	Flubendiamide 480 SC	200 ml/ha
T ₄	Emamectin Benzoate 5 SG	250 gm/ha
T ₅	Novaluron 10 EC	500 ml/ha
T ₆	Profenfos 50 EC	1500 ml/ha
T ₇	Untreated control	-

Observations recorded

The bio-efficacy of seven different treatments on Fall Armyworm will be evaluated by recording the observations on the infestation of pests before and 3, 7 and 14 days after the two sprays. The observations were recorded from the 10 randomly selected tagged plants for each treatment in the three replications as describe below -

Per cent plant infestation: The observation will be recorded and data will be express in percentage by using the following formula.

$$\text{Infested plants(per cent)} = \frac{\text{number of infested plants}}{\text{Total number of plants observed}} \times 100$$

Results

Effect of insecticides on plant damage percentage

The data pertaining to per cent plant damage caused by fall armyworm are presented in Table 2.

First Spray

The data recorded on the mean per cent plant damage of fall armyworm revealed that the mean per cent plant damage of 16.36 and 16.40 per cent of fall armyworm was recorded in the plots treated with Chlorantraniliprole 18.5 SC and Flubendiamide 480 SC with minimum per cent plant damage after the first spray during spring 2025 and proved to be the most effective treatments. These two treatments were at par with each other in terms of per cent plant damage of fall armyworm. It was followed by the treatments application of Emamectin Benzoate 5 SG and Spinoetoram

11.7 SC, which resulted in mean per cent plant damage of 19.31 and 19.49 per cent respectively, after the first spray during spring 2025 and proved intermediate effective treatments. These two treatments were at par with each other. The treatments application of Novaluron 10 EC and Profenfos 50 EC resulted in mean per cent plant damage of 22.46 and 22.52 per cent, respectively and were proved to be least effective treatment with maximum per cent plant damage after the first spray during spring, 2025. The maximum mean per cent plant damage of fall armyworm 31.58 per cent was recorded in the Untreated (Control) during spring 2025.

Second Spray

After the second spray results show that all the treatments proved significantly superior over the control. The data recorded on the mean per cent plant damage of fall armyworm show that the mean per cent plant damage of 32.70 and 32.77 per cent of fall armyworm was recorded in the plots treated with Chlorantraniliprole 18.5 SC and Flubendiamide 480 SC with minimum per cent plant damage after the second spray during spring 2025 and proved to be the most effective treatments. These two treatments were at par with each other in terms of per cent plant damage of fall armyworm. It was followed by the treatments application of Emamectin Benzoate 5 SG and Spinoetoram 11.7 SC, which resulted in mean per cent plant damage of 36.54 and 36.59 per cent, respectively after the second spray during spring 2025 and proved intermediate effective treatments. These two treatments were at par with each other. The treatments application of Novaluron 10 EC and Profenfos 50 EC resulted in mean per cent plant damage of 40.71 and 40.80 per cent, respectively after the second spray during spring 2025 and were proved to be least effective treatment with maximum per cent plant damage. The maximum mean per cent plant damage of fall armyworm 54.39 per cent was recorded in the Untreated (Control) during spring 2025.

Overall Mean

The overall mean data of per cent plant damage due to fall armyworm after the first and second spray indicated that Chlorantraniliprole 18.5 SC and Flubendiamide 480 SC was the treatment with the minimum mean per cent plant damage of 24.53 and 24.58 per cent of fall armyworm. They were statistically at par and significantly most effective to the remaining treatments. It was followed by Emamectin Benzoate 5 SG and Spinoetoram 11.7 SC treatment with 27.93 and 28.04 mean per cent plant damage, respectively and they were statistically at par with each other. The next least effective treatment with maximum per cent plant damage were Novaluron 10 EC and Profenfos 50 EC, which recorded 31.58 and 31.66 mean per cent plant damage, respectively and were found statistically at par with each other. The overall maximum mean per cent plant damage of 42.98 per cent was recorded in the Untreated (Control) during spring 2025.

Table 2: Bio-efficacy of different insecticides in terms of per cent plant damage of fall army worm infesting spring maize during 2025.

Treatments	Before Spray	Per cent Plant Damage								Overall Mean
		First Spray				Second spray				
		3 DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean	
Spinetoram 11.7 SC	10.15 (18.58)*	14.88 (22.68)	19.97 (26.54)	23.63 (29.08)	19.49 (26.1)	27.95 (31.94)	37.93 (38.01)	43.89 (41.49)	36.59 (37.15)	28.04 (31.62)
Chlorantraniliprole 18.5 SC	9.00 (17.46)	12.00 (20.27)	17.01 (24.36)	20.07 (26.61)	16.36 (23.75)	24.04 (29.36)	34.03 (35.69)	40.03 (39.25)	32.70 (34.77)	24.53 (29.26)
Flubendiamide 480 SC	9.07 (17.52)	12.07 (20.33)	17.04 (24.38)	20.10 (26.64)	16.40 (23.78)	24.07 (29.38)	34.10 (35.73)	40.13 (39.31)	32.77 (34.81)	24.58 (29.29)
Emamectin Benzoate 5 SG	10.70 (19.07)	14.67 (22.41)	19.93 (26.51)	23.33 (28.88)	19.31 (25.94)	27.92 (31.89)	37.90 (38.00)	43.81 (41.45)	36.54 (37.11)	27.93 (31.52)
Novaluron 10 EC	9.37 (17.83)	17.73 (24.9)	22.89 (28.58)	26.75 (31.15)	22.46 (28.21)	32.73 (34.9)	41.53 (40.12)	47.86 (43.77)	40.71 (39.6)	31.58 (33.9)
Profenfos 50 EC	9.55 (18.00)	17.77 (24.93)	22.99 (28.65)	26.80 (31.18)	22.52 (28.25)	32.83 (34.95)	41.67 (40.2)	47.89 (43.79)	40.80 (39.65)	31.66 (33.95)
Untreated control	10.34 (18.74)	25.08 (30.04)	31.33 (34.00)	38.33 (38.24)	31.58 (34.09)	45.30 (42.3)	53.45 (46.98)	64.41 (53.4)	54.39 (47.56)	42.98 (40.83)
SEm ±	0.51	0.65	0.65	0.65	0.65	0.65	0.68	0.66	0.67	0.66
CD at 5 %	1.58	2.01	2.00	1.99	2.00	1.97	2.09	1.98	2.01	2.01

**figures in parentheses are arc sine transformed values

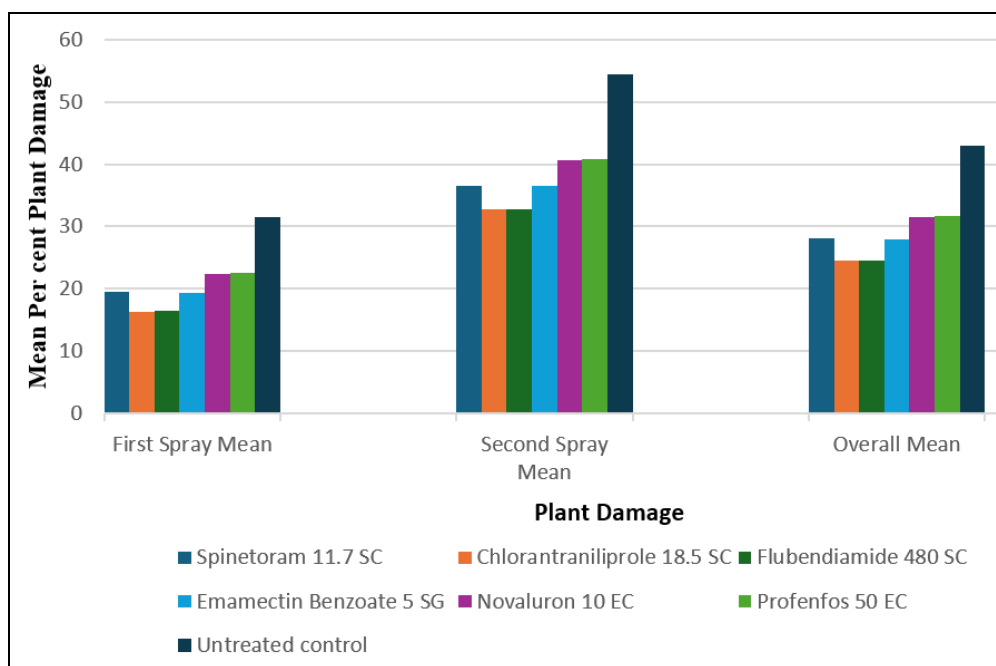


Fig 1 : Bio-efficacy of different insecticides in terms of per cent plant damage of fall army worm, *Spodoptera frugiperda* (Smith) infesting spring maize during 2025.

Discussion

The present findings clearly indicate that the diamide insecticides, particularly Chlorantraniliprole and Flubendiamide, were highly effective in suppressing fall armyworm damage in maize. The treatment comprising the Novaluron 10 EC and Profenfos 50 EC proved to be least effective with the mean plant damage after the first and second spray, respectively during spring, 2025. The present findings on per cent plant damage caused by fall armyworm are in agreement with reports of Janarthanan *et al.* (2022) [8] observed that spinetoram, either alone or in combination with novaluron and emamectin benzoate, effectively reduced fall armyworm infestation and plant injury in maize. Karki *et al.* (2023) [10] reported that chlorantraniliprole 18.5 SC provided excellent control of fall armyworm and significantly reduced crop damage under field conditions. Kalisetti *et al.* (2024) [9] also found that

chlorantraniliprole, spinetoram and emamectin benzoate significantly lowered Davis damage scores and foliar injury compared with the untreated control. Similarly, Marella *et al.* (2024) [11] reported that spinetoram recorded the highest reduction in leaf damage, followed by chlorantraniliprole and emamectin benzoate, resulting in lower cob damage and improved grain yield.

Conclusion

The study revealed significant differences among insecticidal treatments against fall armyworm infestation in spring maize. Chlorantraniliprole 18.5 SC was found to be the most effective treatment, recording the lowest per cent plant damage (24.53%), followed closely by Flubendiamide 480 SC (24.58%). Therefore, these insecticides can be recommended for effective management of fall armyworm in spring maize as part of an integrated pest management

programme.

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