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Bio-efficacy of selected insecticides against fall armyworm, *Spodoptera frugiperda* (J.E. Smith) on sweet corn at Raipur (Chhattisgarh)

Mo Sohel Rizvi and Sonali Deole

Abstract
Studies on bio-efficacy of seven insecticides against fall armyworm, *Spodoptera frugiperda* revealed that spinetoram 11.7% SC @ 30 ml a.i./ha was found most effective insecticide, which recorded the highest reduction in larval population i.e., 76.30% and 86.28% after first and second sprays, respectively followed by Chlorantraniliprole 18.5% SC @ 27.75 ml a.i./ha which recorded 71.67% and 82.30% reduction in larval population after first and second sprays, respectively. The overall mean population of *S. frugiperda* was recorded minimum in Spinetoram 11.7% SC having 0.41 larva/plant after first spray and 0.31 larva/plant after second spray followed by Chlorantraniliprole 18.5% SC having 0.49 larva/plant after first spray while 0.40 larva/plant after second spray.

Keywords: Bio-efficacy, sweet corn and *Spodoptera frugiperda*

Introduction
Maize, *Zea mays* L. is a member of the family: Poaceae and is the third most important food crop in India after rice and wheat accounting for about 20% of the global area under cereals (FAO, 2005). The six major types of maize (corn) are dent corn, pod corn, flint corn, popcorn, flour corn and sweet corn. Sweet corn (*Zea mays* L. var. *saccharata* Sturt) is a variety of maize with a high sugar content. It is also called Indian corn, sugar corn and pole corn. Sweet corn differs from other corns because the kernels have a high sugar content in the milk on early dough stage (Najeeb *et al*., 2011) [16]. Growing sweet corn is similar to growing maize, sweet corn can either be grown for the fresh market or for the processing market. At present fall armyworm is reported as major pest and pose a serious threat to production and productivity of maize crop.

Fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is native to American continent. It was reported for the first time from the African continent, in Nigeria, Sao Tome´, Benin and Togo region (Goergen *et al*., 2016) [10]. In India, it was reported for the first time in the research fields of maize at the University of Agricultural and Horticultural Sciences, Shimoga, Karnataka (Sharanabasappa *et al*., 2018). In Chhattisgarh *Spodoptera frugiperda* was first reported at Raipur (Deole and Paul, 2018) [7]. Fall armyworm is a polyphagous pest, which causes economic losses in so many crops, such as maize, cotton, soybean and beans (Pogue, 2002; Nagoshi *et al*., 2007; Bueno *et al.*, 2010) [18, 15, 4]. In maize, fall armyworm attacks in all stages of the plant, from seedling until tasseling and causing defoliation, killing young plant, resulting in grain damage and subsequently reduces quantity and quality of yield (Peairs and Sanders, 1979) [17]. without proper management, FAW can cause maize yield losses ranging from 8-21 million tonnes (CABI, 2017) [5]. For the effective management of this pest chemical control is required but the indiscriminate use of chemical pesticides in the past has created a number of problems such as insecticide resistance, insecticide residues, environmental pollution and direct and indirect dangers to humans etc. hence there is a need to develop and use the minimum effective dosage of this chemicals.

Materials and Methods
The investigation related to insecticidal management of fall armyworm on sweet corn was conducted during *Kharif* 2021, for the purpose to assess the comparative efficacy of seven insecticides *viz.,* Spinetoram 11.7% SC @ 30 ml a.i./ha, Chlorantraniliprole 18.5% SC @ 27.75 ml a.i./ha, Indoxacarb 14.5% SC @ 72.5 ml a.i./ha, Thiodicarb 75% WP @ 750 gm a.i./ha, Emamectin benzoate 5% SG @ 10 gm a.i./ha, Fipronil 80% WG @ 40 gm a.i./ha and

Flubendiamide 39.35% SC@72 ml a.i./ha against *Spodoptera frugiperda* infesting sweet corn. The experiment was conducted at Research cum instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The trial was laid out in randomize block design (RBD) with three replications along with its untreated check for comparison. The insecticides were sprayed twice, on 15 and 30 days after the emergence of crop. The pre-treatment observations on number of larvae/plants were made 24 hours prior to spraying, while the post-treatment observations were taken 3, 5, 7 and 10 days subsequent to spraying on randomly selected five plants from each plot. The mean population of *S. frugiperda* was subjected to square root transformation. These transformed values were analysed statistically by using the techniques of analysis of variance for randomized block design and significance was tested by "F" test.

The mean original data of percentage reduction over control was calculated with the following formula (Abbott's 1925) [1].

$$\text{Percent reduction} = \frac{C-T}{C} \times 100$$

Where,

T = Insect population reduction in treated plot.

C = Insect population reduction in control plot.

Results and Discussion

The larval population of fall armyworm was recorded first. The average larval population was estimated from randomly selected five plants from each plot, one day before the application of insecticides as pre-treatment observations and after three, five, seven and ten days as post-treatment observations.

The observations were recorded after first spray revealed that, percent reduction of *S. frugiperda* population over control was ranged from 43.35 to 76.30% in various treatments. The maximum larval population reduction was recorded in T_1 (76.30%), which was treated by Spinetoram 11.7% SC @ 30 ml a.i./ha followed by T_2-Chlorantraniliprole 18.5% SC @ 27.75 ml a.i./ha (71.67%), T_5-Emamectin benzoate 5% SG @ 10 gm a.i./ha (65.89%), T_4-Thiodicarb 75% WP @ 750 gm a.i./ha (58.95%), T_3-Indoxacarb 14.5% SC @ 72.50 ml a.i./ha (53.17%), T_6-Fipronil 80% WG @ 40 gm a.i./ha (49.13%) while lowest in T_7-Flubendiamide 39.35% SC @ 72 ml a.i./ha treated plot and was recorded only 43.35% reduction in insect population (Table 1).

During second spray, percent reduction of *S. frugiperda* population over control was variate from 63.27 to 86.28% in different treatments. The maximum larval population reduction was recorded in T_1 plot i.e., 86.28, which was treated by Spinetoram 11.7% SC @ 30 ml a.i./ha, followed by T_2-Chlorantraniliprole 18.5% SC @ 27.75 ml a.i./ha (82.30), T_5-Emamectin benzoate 5% SG @ 10 gm a.i./ha (79.20%), T_4-Thiodicarb 75% WP @ 750 gm a.i./ha (75.22%), T_3-Indoxacarb 14.5% SC @ 72.50 ml a.i./ha (71.68%), T_6-Fipronil 80% WG @ 40 gm a.i./ha (67.69%) while lowest in T_7-Flubendiamide 39.35% SC @ 72 ml a.i./ha treated plot and was recorded only 63.27% reduction in insect population (Table 2).

The overall mean population of *S. frugiperda* was recorded minimum in Spinetoram 11.7% SC having 0.41 larva/plant after first spray and 0.31 larva/plant after second spray, which was most effective and followed by Chlorantraniliprole 18.5% SC having 0.49 larva/plant after first spray while 0.40 larva/plant after second spray.

More or less, similar findings were recorded by the various workers *viz.* Belay *et al.* (2012) [2], Metzler and Mora (2017) [14], Mallapur *et al.* (2019) [13], Bharadwaj *et al.* (2020) [3], Chimweta *et al.* (2020) [6], Dileep Kumar *et al.* (2020) [11], Deshmukh *et al.* (2020) [8], Sneha Tiwari (2020) and Rohit Kumar (2021) [12] etc. According to Belay *et al.* (2012) [2], spinetoram caused significantly higher (>60%) FAW mortality after 16 hours of application. According to Dileep Kumar *et al.* (2020) [11], spinetoram was found highly effective in reducing the larval population, followed by chlorantraniliprole with 97.32 and 90.43% reduction in larval population respectively, over untreated control.

Table 1: Bio-efficacy of insecticides against *S. frugiperda* (J.E. Smith) on sweet corn, after first spray

Treatments	Insecticides	Pre-treatment observation	Post-treatment observation				Overall mean population	% Reduction of insect population over control
			3 DAS	5 DAS	7 DAS	10 DAS		
T_1	Spinetoram 11.7% SC	2.26 (1.80)	0.66 (1.29)	0.20 (1.09)	0.33 (1.14)	0.46 (1.21)	0.41	76.30
T_2	Chlorantraniliprole 18.5% SC	2.20 (1.78)	0.73 (1.31)	0.26 (1.12)	0.46 (1.21)	0.53 (1.23)	0.49	71.67
T_3	Indoxacarb 14.5% SC	1.93 (1.71)	1.06 (1.43)	0.53 (1.23)	0.80 (1.33)	0.86 (1.36)	0.81	53.17
T_4	Thiodicarb 75% WP	2.00 (1.76)	1.00 (1.41)	0.40 (1.18)	0.66 (1.29)	0.80 (1.33)	0.71	58.95
T_5	Emamectin benzoate 5% SG	2.13 (1.73)	0.86 (1.36)	0.33 (1.15)	0.53 (1.23)	0.66 (1.28)	0.59	65.89
T_6	Fipronil 80% WG	1.86 (1.69)	1.13 (1.45)	0.60 (1.26)	0.86 (1.36)	0.93 (1.38)	0.88	49.13
T_7	Flubendiamide 39.35% SC	1.73 (1.69)	1.26 (1.50)	0.73 (1.31)	0.93 (1.38)	1.00 (1.41)	0.98	43.35
T_8	Untreated control	2.60 (1.88)	1.80 (1.67)	1.60 (1.61)	1.66 (1.63)	1.86 (1.68)	1.73	-
	SE(m) ±	0.081	0.058	0.037	0.049	0.050	-	-
	CD at 5%	N/S	0.178	0.113	0.150	0.154	-	-

Figures in parentheses are square root transformed values.

Table 2: Bio-efficacy of insecticides against *S. frugiperda* (J.E. Smith) on sweet corn, after second spray

Treatments	Insecticides	Pre-treatment observation	Post-treatment observation				Overall mean population	% Reduction of insect population over control
			3 DAS	5 DAS	7 DAS	10 DAS		
T_1	Spinetoram 11.7% SC	2.00 (1.73)	0.73 (1.31)	0.13 (1.06)	0.06 (1.03)	0.33 (1.14)	0.31	86.28
T_2	Chlorantraniliprole 18.5% SC	1.93 (1.71)	0.80 (1.33)	0.20 (1.09)	0.20 (1.09)	0.40 (1.18)	0.40	82.30
T_3	Indoxacarb 14.5% SC	1.73 (1.64)	1.13 (1.45)	0.40 (1.18)	0.40 (1.18)	0.66 (1.29)	0.64	71.68
T_4	Thiodicarb 75% WP	1.80 (1.66)	1.06 (1.43)	0.33 (1.15)	0.33 (1.15)	0.53 (1.22)	0.56	75.22
T_5	Emamectin benzoate 5% SG	1.86 (1.68)	0.93 (1.38)	0.26 (1.12)	0.26 (1.12)	0.46 (1.20)	0.47	79.20
T_6	Fipronil 80% WG	1.66 (1.63)	1.20 (1.48)	0.46 (1.21)	0.53 (1.23)	0.73 (1.30)	0.73	67.69
T_7	Flubendiamide 39.35% SC	1.53 (1.59)	1.33 (1.52)	0.53 (1.23)	0.66 (1.28)	0.80 (1.34)	0.83	63.27
T_8	Untreated control	2.53 (1.87)	2.06 (1.74)	2.13 (1.76)	2.20 (1.77)	2.66 (1.91)	2.26	-
	SE(m) ±	0.08	0.072	0.044	0.047	0.083	-	-
	CD at 5%	N/S	0.220	0.135	0.145	0.254	-	-

Figures in parentheses are square root transformed values.

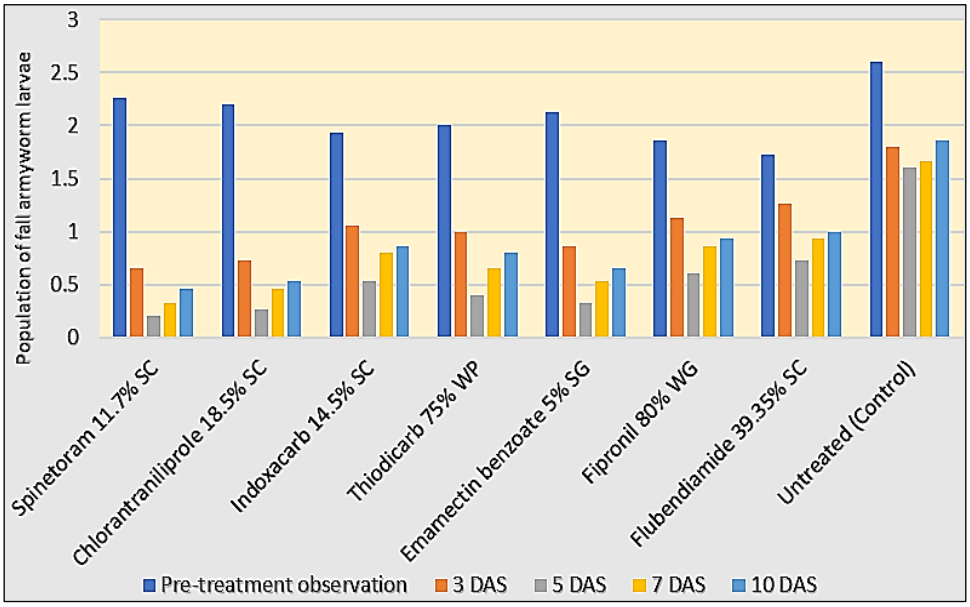

Fig 1: Percent reduction of population of *Spodoptera frugiperda* after first spray

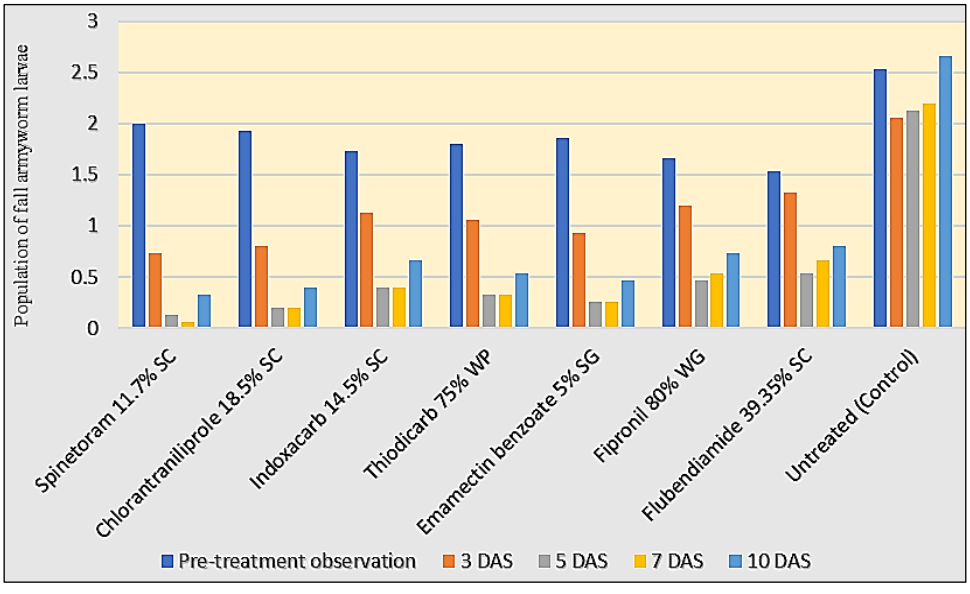

Fig 2: Percent reduction of population of *Spodoptera frugiperda* after second spray

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