Original Research Article

Comparative efficacy of selected chemicals and biopesticides against fall army worm, *Spodoptera frugiperda* (J.E. Smith) on maize (*Zea mays L.*)

ABSTRACT

A field trail was conducted at Cental Research Farm, SHUATS, Naini, Prayagraj, U.P. during *kharif* season of 2021. The field was laid in Randomised Block Design with eight treatments viz., Spinetoram 11.7%SC, Chlorantraniliprole 18.5%SC, Flubendiamide 39.35%SC, Emamectin benzoate 5%SG, Neem oil 2%, NPV, Novaluron 10%EC along with control plot. First and second spray were carried with 15 days interval, the results revealed that, among the different treatments Spinetoram 11.7%SC, (4.93) was most effective treatment over control followed by Chlorantraniliprole 18.5%SC (6.24), Flubendiamide 39.35% SC (6.42), Emamectin benzoate 5%SG (6.90), Novaluron 10%EC (8.13), NPV (8.28) and Neem oil 2% (8.37). Among the treatments studied, the best and most economical treatment was Spinetoram 11.7%SC (1:1.79), followed by Chlorantraniliprole 18.5%SC (1:1.78), Flubendiamide 39.35%SC (1:1.77), Emamectin benzoate 5%SG (1:1.74), Novaluron 10%EC (1:1.68), NPV (1:1.60) and Neem oil 2% (1:1.44) when compared to control plot (1:1.25).

Key word; Biopesticides, Chemical insecticides, Cost benefit ratio, *Spodoptera frugiperda*

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INTRODUCTION

Maize, *Zea mays L*. is a member of the family: Poaceae also known as corn. It is one of the most flexible growing crops with greater adaptability to different agro-climatic conditions. Because of higher genetic yield potential among the cereals, this crop is globally popular as the "Queen of cereals" **(Jeyaraman, 2017**).

Although about 139 insect pests cause varying degree of damage to maize crop, but only about a dozen of these are quite serious and require control measures, i.e., maize stalk borer, pink stem borer, and shoofly are the insects of national importance, while the armyworm, jassid, thrips, pyrilla, grasshopper, white grub, cut worm hairy caterpillar, termite, and the leaf miner are more serious pest of regional level **(NIPMP, 2001)**. Amongst all. Shoot fly. *Atherigona orientalis*, Maize stem borer, *Chilo partellus* (Swinhoe) and Pink stem borer, *Sesamia inferens* (Wlaker) are the most serious pest in India. In past few years a new pest fall armyworm became an invasive challenge across the world. However, the relatively high damage by fall armyworm is occasionally reported **(Porter *et al.*, 2000).**

Fall armyworm, *Spodoptera frugiperda* (J.E. Smith) belongs to the order Lepidoptera and family Noctuidae is native to tropical and subtropical regions of the Americas. It was reported for the first time from the African continent, in Nigeria, Sao Tomé. Benin and Togo region **(Goergen *et al.*, 2016)**. In India, fall armyworm (FAW) was firstly reported in the research fields of maize at the University of Agricultural and Horticultural Sciences, Shimoga, Karnataka. In Chhattisgarh the *Spodoptera frugiperda* was first reported at Raipur **(Deole and Paul, 2018).**

Fall armyworm is a highly polyphagous insect pest that attacks more than 80 plant species, including maize, sorghum, millet, sugarcane, and vegetable crops nevertheless, maize is the main crop affected by FAW in Africa. Given the importance of maize in Africa as a primary staple food crop, the recent invasion of FAW threatens the food security of millions of people in a region that will likely have an aggravated drought due to climate change/El Nino in SSA (**Birhanu *et al*., 2019)**

The FAW moth populations are capable of migrating very fast (almost 100 km per nightand nearly 500 km before laying eggs) and thus, can invade new areas quickly **(Johnson, 1987**). The pest completes its life cycle in about 30-45 days (depending on weather conditions). In cooler temperatures the life cycle may extend up to 60-90 days. The female moth lays on an average about 1500 eggs attaching them to the foliage. The egg stage lasts for only 2 to 3 days in warmer weather. The FAW in general has six larval instars (stages) before it goes for pupation. The entire larval stage lasts for 14 to 30 days depending on the weather conditions especially temperature and humidity **(Padhee and Prasanna, 2019).**

Materials and Methods

The experiment was conducted at'' Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Department of Entomology, Central Research Farm'' Naini, Prayagraj, during the *kharif* season of 2021. The research field is situated at 25.47° North latitude 81.19° East longitudes and at an altitude of 96 meters above sea level. On sandy loam soil, having moderately basic PH (7.2), available N (106.0kg/ha), P (22.7kg/ha), K (260.0kg/ha), EC (0.14 dSm^{-1}), S (16.8.00 ppm) and Zn (0.51 ppm). The experiment was laid out in Randomized Block Design (RBD) with 3 replications and 8 treatments using variety GA-85 in a plot size of (2m × 2m) at a spacing of (60 × 20) with a recommended package of practices excluding plant protection.

The observations on pest population of *Spodoptera frugiperda* were recorded visually per plant from five randomly selected plants and tagged plants in each plot. The insecticides were sprayed at recommended doses when larval population reaches ETL level. The Observations were recorded on larval population in each plot a day before, 3^{rd}, 7^{th} and 14^{th} days after spraying on selected plants in a plot.

The healthy marketable yield obtained from different treatments was collected separately and weighed. The cost of insecticides used in this experiment was recorded during season of *kharif* 2021. The cost of biopesticides lused was obtained from nearby market. The total cost of plant protection consisted of cost of treatments, sprayer rent and labour charges for the spray. There were two sprays throughout the research period and the overall plant protection expenses were calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from total income. Benefit over the control for each sprayed treatment was obtainedy subtracting the income of the control treatment from that of each sprayed treatment.

Results and Discussion

The result revealed that the pre count of fall armryworm, *spodoptera frugiperda* was non-significant. showed that all the treatments were significantly superior in reducing the larval population resulting in increasing the yield, significantly as compared to control. On third day after spraying the minimum larval population of fall armyworm, (9.53) was recorded in Spinetoram 11.7%SC followed by Chlorantraniliprole 18.5%SC (10.80) and Flubendiamide 39.35%SC (11.00) treated plots, respective that differed significantly with other treatment plots but statistically at par with each other. The lowest larval population was recorded in Spinetoram 11.7%SC (6.93 and 7.73) treated plots followed by Chlorantraniliprole 18.5%SC (8.20 and 9.00) and Flubendiamide 39.35%SC (8.40 and 9.20) respectively on 7th and 14th day after spray. (Table 1).

Spinetoram 11.7%SC treated plots was found to reduce the fall armyworm, larval population in all observations on 3rd, 7th and 14th day after spray with 6.13, 3.33 and 5.33 followed by Chlorantraniliprole 18.5%SC (7.40, 4.73 and 6.60). These results are supported by **Dileep *et al.*, (2020)**, **Murali *et al.*, (2020)** and **Bharadwaj *et al.*, (2020)** reported that Spinetoram 11.7%SC proved superior over other insecticides in reducing larval population infestation of *spodoptera frugiperda*. **Jayarajan *et al.*, (2021**) and **Thumar *et al.*, (2020)** found Chlorantraniliprole 18.5%SC as the most effective treatment.

The highest yield of grain was recorded in the plot, treated with Spinetoram 11.7%SC (41.10 q/ha), which was followed by Chlorantraniliprole 18.5%SC (35.91 q/ha), Flubendiamide 39.35%SC (34.95 q/ha), Emamectin benzoate 5%SG (32.18 q/ha), Novaluron 10%EC (31.88 q/ha), NPV (29.44 q/ha) and Neem oil 2% (26.26 q/ha) as compared to control plot (22.31 q/ha) this findings are supported by **Dileep *et al.*, (2020), Sangle *et al.*, (2020)** and **Mallapur *et al.*, (2019).**

Among the treatment studied, the best and most economical treatment was Spinetoram 11.7%SC (1:1.79), which was followed by Chlorantraniliprole 18.5%SC (1:1.78), Flubendiamide 39.35%SC (1:1.77), Emamectin benzoate 5%SG (1:1.74), Novaluron 10%EC (1:1.68), NPV (1:1.60) and Neem oil 2% (1:1.44), as compared to control (1:1.25) this findings are supported by **Deshmukh *et al.*, (2020), Metzler *et al.*, (2017), Sharma *et al*., (2018)** and **Martin *et al*., (2020).**

TABLE 1. Efficacy of insecticides and biopesticides against *Spodoptera frugiperda*

S.No.	Treatments	larval population								Yield (q/ha)	B:C ratio
		First spray				Second spray			Overall mean		
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS			
T_1	Chlorantraniliprole18.5 % SC	14.20	10.80^{de}	8.20^{cd}	9.00^{c}	7.40^{de}	4.73^{d}	6.60^{c}	7.78^{b}	35.91	1:1.78
T_2	Flubendiamide 39.35% SC	12.46	11.00^{d}	8.40^{cd}	9.20^{c}	7.60^{d}	4.86^{d}	6.80^{c}	7.97^{b}	34.95	1:1.77
T_3	Emamectin Benzoate 5% SG	12.00	11.53^{cd}	8.93^{bc}	9.73^{c}	8.13^{cd}	5.26^{cd}	7.33^{c}	8.48^{b}	32.18	1:1.74
T_4	Spinetoram 11.7 % SC	14.80	9.53^{e}	6.93^{d}	7.73^{d}	6.13^{e}	3.33^{e}	5.33^{d}	6.49^{b}	41.10	1:1.79
T_5	Neem oil @ 2%	11.53	13.00^{b}	10.40^{b}	11.20^{b}	9.60^{b}	6.73^{b}	8.80^{b}	9.95^{b}	26.66	1:1.44
T_6	NPV	11.46	12.93^{b}	10.33^{b}	11.13^{b}	9.53^{b}	6.60^{b}	8.73^{b}	9.87^{b}	29.44	1:1.60
T_7	Novaluron 10% EC	11.33	12.80^{bc}	10.20^{b}	11.00^{b}	9.40^{bc}	6.40b^{c}	8.60^{b}	9.73^{b}	31.88	1:1.68
T_0	Control	15.4	17.40^{a}	18.86^{a}	20.00^{a}	22.73^{a}	23.20^{a}	24.60^{a}	21.13^{a}	22.31	1:1.25
	F-test	NS	S	S	S	S	S	S	S	……	……
	S. Ed (±)	21.63	0.580	0.962	0.505	0.542	0.545	0.500	3.908	……	……
	C.D. (P = 0.5)	………	1.334	1.717	1.245	1.289	1.293	1.238	4.675	……	……

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