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Cost Effective Analysis of Fall Armyworm (Lepidoptera: Noctuidae) on Maize at Allahabad

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

During *Kharif* 2022, an experiment was conducted to evaluate the cost benefit ratio by using different insecticidal application *viz.,* Indoxacarb 14.5 SC @ 425ml/ha, Spinetoram 11.7 SC @ 250ml/ha, Azadirachtin 0.15% @ 5ml/ha, Nisco sixer plus @ 500 ml/ha, lambda cyhalothrin 5 EC @ 320ml/ha, cypermethrin 25 EC @ 1lit/ha, fipronil 0.6% G @ 60 g/ha and untreated control against fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), on maize with three replications. Results revealed that highest grain yield was recorded in (T_2) Spinetoram 11.7 SC (64.58 q/ha) followed by (T_1) Indoxacarb 14.5 SC (60.49 q/ha), (T_5) Lambda cyhalothrin 5 EC (58.34 q/ha). Insecticidal treatment with (T_2) Spinetoram 11.7 SC (1:2.31) had the highest cost benefit ratio, followed by (T_1) Indoxacarb 14.5 SC (1:2.11), (T_5) Lambda cyhalothrin (1:2.10), (T_6)

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Cypermethrin 25% EC (1:2.04), (T_7) Fipronil 0.6 % G (1:2.03), (T_4) Nisco sixer plus (1:1.99), (T_3) Azadirachtin 0.15 % (1:1.97) over untreated control (1:1.91). End of the experiment it reported that spinetoram is best for crop compare to other chemicals.

Keywords: Cost benefit ratio; fall armyworm; maize; spinetoram.

1. INTRODUCTION

Maize (*Zea mays* L.) is a cereal crop that is extensively grown across the world and has the largest productivity of any cereal crop. *Zea* is a Greek term that means "life sustainer" and *Mays* is a Taino word that means "life giver". Because of its enormous potential production among cereal crops worldwide, it is often regarded as "Queen of Cereals" [1]. Maize is grown on over 150 million hectares in about 160 nations with a vast range of soil, temperature, biodiversity and management practices, accounting for 36% (728 million tonnes) of world grain output. Maize acreage in India reached 9.2 million ha in 2018-19, with a yield of 27.8 million tonnes and a productivity of 2965 kg/ha [2].

The fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae), is an economically damaging, highly migratory pest and highly prevalent to tropical and subtropical America [3]. Recently, this pest has invaded and expanded rapidly in several countries, particularly the African continent, becoming a disastrous pest causing devastating damage to maize and other graminaceous crops [4] and threatening the dietary safety for millions of people. FAW is a versatile Lepidopteran pest from Brazil with a host range of 353 plant species from 76 plant families, including island nations, have discovered the pest within their boundaries [3]. Maize yield losses have ranged from 8.3 million tonnes to 20.6 million tonnes per year in 12 maize producing countries [5].

Depending on the stage of crop and the age of the larvae, the developing larvae devour different portions of the host plant. Larvae are always restricted to the leaf whorl part and feed while hiding in whorls. Young larvae typically feed on leaves, resulting in a distinctive "windowing" look and damp sawdust-like frass near the funnel. This feeding, especially early in the season, might destroy the growth point, preventing cob production. Larger larvae on older plants can dig into growing maize cobs, lowering yield quantity and quality [6]. The use of different pesticides with diverse modes of action improves the approach for managing insecticide resistance. Thus, in order to show these prospective pest control technologies in farmers' fields, an economic comparison of alternative insecticidal treatments is required.

2. EXPERIMENTAL DETAILS

The trials were carried out during *Kharif* 2022 at Central Research Farm, SHUATS, Prayagraj in a randomized block design with a spacing of 40 cm X 20 cm. The experiment was carried out in 2 m x 2 m of each plot with seven treatments *viz*., Indoxacarb 14.5 SC, Spinetoram 11.7 SC, Azadirachtin 0.15 %, Nisco sixer plus, Lambda cyhalothrin 5 EC, Cypermethrin 25 EC, Fipronil 0.6% G and untreated control were evaluated against fall armyworm including untreated control. Each treatment was replicated thrice. All the agronomic practices were followed as per the recommended package of practices. Two sprays were given for all treatments when the crop is at 25 days old except untreated check and the second time 15 days later. During spraying, insecticides were directed specifically at the whorl region. The observations were recorded on five randomly selected plants in each replication.

2.1 Grain Yield: (q/ha)

The maize cobs were picked from all plants per plot and grains were shelled. The average weight of picked cob grains was used to calculate the grain yield. Grain yield was calculated by the following formula

$$Grain\ yield = \frac{Grain\ yield\ per\ plot}{Plot\ size} x100$$

2.2 Benefit Cost Ratio

Gross return was calculated by multiplying total yield with the market price of the produce. Cost benefit ratio by following formula

$$B{:}C\ Ratio = \frac{Gross\ returns}{Total\ Cost\ of\ cultivation}$$

Where,

B:C = Benefit Cost Ratio

3. RESULTS AND DISCUSSION

The yields among the different treatments were significant. All the treatments were superior over control. The highest yield was recorded in Spinetoram 11.7 SC (64.58 q/ha) followed by Indoxacarb 14.5 SC (60.49 q/ha), Lambda cyhalothrin 5 EC (58.34 q/ha), Cypermethrin 25% EC (57.81), Fipronil 0.6% G (55.83 q/ha), Nisco sixer plus (55.75 q/ha) and Azadirachtin 0.15% (55.61 q/ha) as compared to control (51.06 q/ha). These findings are supported by [7] with a yield of 51.43 q/ha for Spinetoram 11.7 SC and 49.85 q/ha for Lambda Cyhalothrin 4.6+ Chlorantraniliprole 9.3 ZC. The findings supported by [8] are Lambda cyhalothrin 5 EC and Fipronil 0.6% G.

The increased per cent yield over control treatment was different. All treatments were superior over control. The highest increase yield over control was recorded in Spinetoram 11.7 SC (13.52 q/ha) followed by Indoxacarb 14.5 SC (9.43 q/ha), Lambda cyhalothrin 5 EC (7.28 q/ha), Cypermethrin 25% EC (6.75), Fipronil 0.6% G (4.77 q/ha), Nisco sixer plus (4.69 q/ha) and Azadirachtin 0.15% (4.55 q/ha).

When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Spinetoram 11.7 SC (1:2.11) with the similar findings made by [9], followed by Indoxacarb 14.5 SC (1:2.11) with the similar findings made by [10], followed by Lambda cyhalothrin 5 EC (1:2.10) with similar findings made by [7] with cost benefit ratio of 1:2.43, Cypermethrin 5% EC (1:2.04) with similar findings made by [11,12] with cost benefit ratio of 1:2.01, followed by Fipronil 0.6% G (1:2.03) with similar findings made by [13] followed by Nisco sixer plus (1:1.99) with similar findings made by [14] followed by Azadirachtin 0.15% (1:1.97) with similar findings made by [15] as compared to control plot (1:1.91).

From the Table 3. it shows that higher yield comes from spinetoram insecticides and also more benefit is seen in spinetoram compared to other treatments used in the experiment. Among all the treatments spinetoram is effective.

Table 1. Cost of agronomical practices of cultivation/ha

S. No	Particulars	Unit	Quantity	Rate/Unit (Rs	Amount (Rs)
A	**Land preparation**				
I.	Land rent	ha	1	**5000/month**	**20000**
II.	Ploughing with MB plough	Hrs	3	**700**	**2100**
III.	Planking and levelling	Hrs	3	**340**	**1020**
IV	Layout	Labour	6	**340**	**2040**
B	**Manures and Fertilizers**				
I.	Urea	Kg	261	**10**	**2610**
II.	FYM	ton	20tonnes	**300**	**6000**
III.	SSP	Kg	375	**10**	**3750**
IV.	MOP	Kg	100	**16**	**1600**
V.	Application charges	Labour	2	**340**	**680**
C	Seed sowing and material				
I.	Seed material	Kg	20	**250**	**5000**
II.	Labour charges	Labour	2	**340**	**680**
D	**Plant protection**				
I.	Hand weeding	Labour	3 x 2 times	**340**	**2040**
E	**Harvesting**				
I.	Labour charges	Labour	5	**340**	**1700**
	Common cost cultivation				**49220**

Table 2. Economics of treatments

S. No	Treatments	Use of chemical (2 times spray) /ha	Cost of chemical (₹) / lit	Total cost of chemical ₹ / ha	No. of labours for 2 sprays @ 340 ₹/ labour	Total labour cost (₹)	Total cost of treatment (₹)
T_1	Indoxacarb 14.5 SC	850 ml/ha	2800/lit	2320	4	1360	3680
T_2	Spinetoram 11.7 SC	500 ml/ha	2000/lit	1000	4	1360	2360
T_3	Azadirachtin 0.15%	1 lit/ha	1500/lit	1500	4	1360	2860
T_4	Nisco sixer plus	1 lit/ha	1200/lit	1200	4	1360	2560
T_5	Lambda cyhalothrin 5 EC	640 ml/ha	950/lit	608	4	1360	1968
T_6	Cypermethrin 25% EC	2 lit/ha	820/lit	1640	4	1360	3000
T_7	Fipronil 0.6% G	240 g/ha	400/kg	192	4	1360	1552
T_8	Control	---	----	---	---	---	---

Table 3. Economic analysis of different insecticides on maize yield

S. No	Treatments	Dose	Yield q/ha	Total cost of yield (₹)	Cultivation cost (₹)	Treatment cost (₹)	Total cost of cultivation (₹)	C:B ratio
T_1	Indoxacarb 14.5 SC	425 ml/ha	60.49	111906.5	49220	3680	52900	1:2.11
T_2	Spinetoram 11.7 SC	250 ml/ha	64.58	119473	49220	2360	51580	1:2.31
T_3	Azadirachtin 0.15%	5 ml/ha	55.61	102878.5	49220	2860	52080	1:1.97
T_4	Nisco sixer plus	500 ml/ha	55.75	103137.5	49220	2560	51780	1:1.99
T_5	Lambda cyhalothrin 5 EC	320 ml/ha	58.34	107929	49220	1968	51188	1:2.10
T_6	Cypermethrin 25% EC	1 lit/ ha	57.81	106948.5	49220	3000	52220	1:2.04
T_7	Fipronil 0.6% G	60 g/ha	55.83	103285.5	49220	1552	50772	1:2.03
T_8	Control	--	51.06	94461	49220	0	49220	1:1.91

Cost of maize per quintal is 1850 ₹

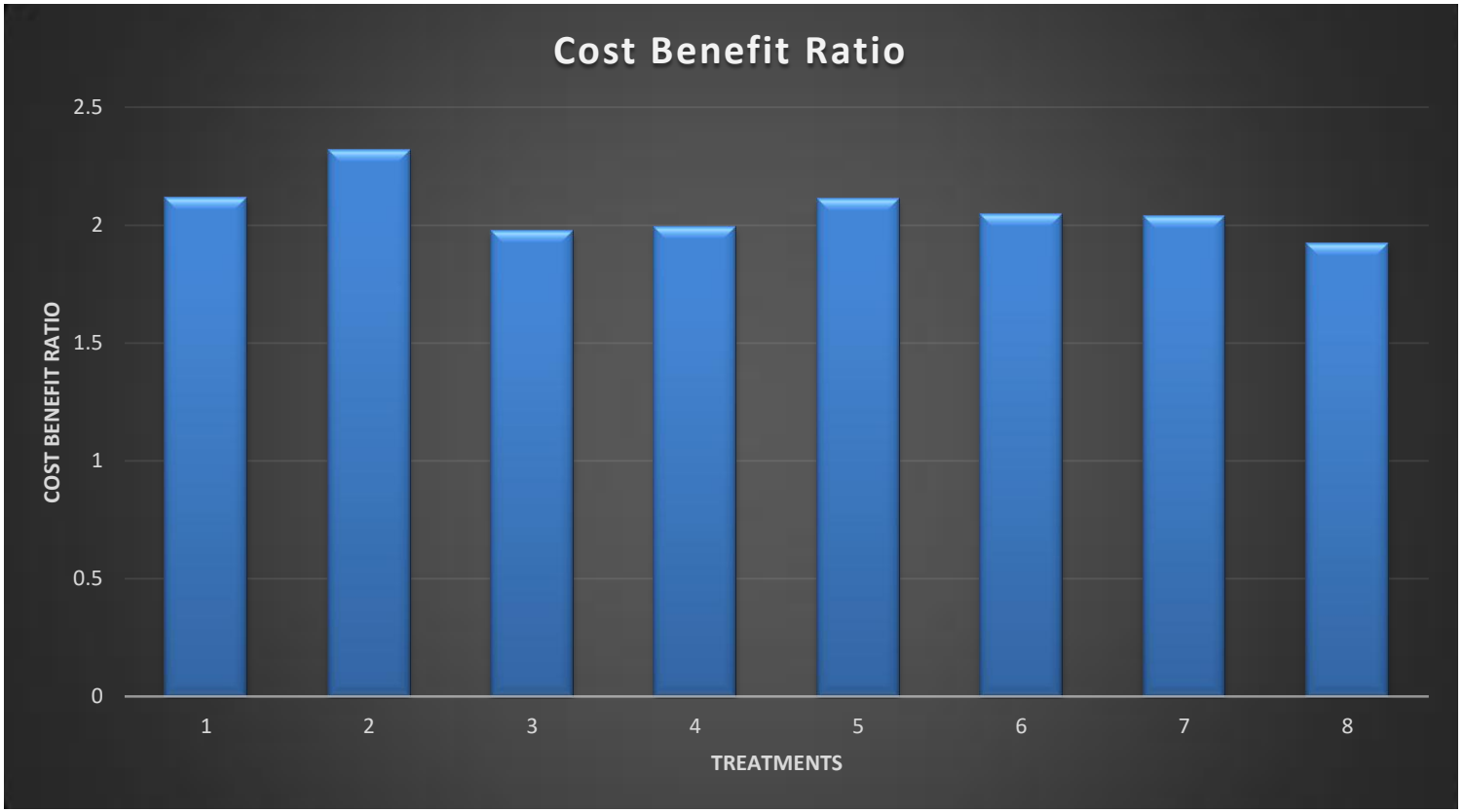

Fig. 1. Effect of selected insecticides against maize fall armyworm of cost benefit ratio

4. CONCLUSION

Results revealed that the maximum yield and cost benefit ratio is recorded at Spinetoram 11.7 SC, followed by Indoxacarb 14.5 SC, Lambda cyhalothrin 5 EC can be suitably incorporated in pest management schedule against Fall Armyworm as an effective tool under chemical control.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Rakshit S, Chikkappa GK. Perspective of maize scenario in India: Way forward. Maize Journal. 2018;7(2):49-55.
2. FICCI. A knowledge report on Maize Vision 2022; 2018.
3. Prasanna BM, Huesing JE, Eddy R, Virginia MP. Fall armyworm in Africa: A Guide for Integrated Pest Management, First Edition. Mexico; 2018.
4. Goergen G, Kumar PL, Sankung SB, Togola A, Tamò M. First report of outbreaks of the fall armyworm *Spodoptera frugiperda* (JE Smith) (Lepidoptera, Noctuidae), a new alien invasive pest in West and Central Africa. PloS One. 2016;11(10):e0165632.
5. CABI. Datasheet. *Spodoptera frugiperda* (fall army worm). Invasive Species Compendium; 2016.
6. Dileep Kumar NT, Mohan KM, Prabhu CG, Mahesh HM. Safe and cost-effective management of the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) using green insecticide baits. International Journal of Chemical Studies. 2020;8(5): 106-110.
7. Patidar S, Das SB, Vishwakarma R, Kumari P, Mohanta S, Paradkar VK. Field evaluation of insecticides against fall armyworm infesting maize. The pharma Innovation Journal. 2022;11(4):892-895.
8. Gouthami BD, Seetha RP, Dhljrtja S, Suresh M. Field evaluation of insecticides against fall armyworm *Spodoptera frugiperda* (J.E. Smith) in sweet corn. Indian Journal of Entomology. 2021;83(2): 219-222.
9. Ramesh M, Tayde AR. Comparative efficacy of selected chemicals and biopesticides against fall armyworm, *Spodoptera frugiperda* (J.E.Smith) on maize (*Zea mays* L.). International Journal of Plant and Soil Science. 2022; 34(23):466-470.
10. Chouraddi M, Mallapur CP. Impacts of newer molecules of insecticides on management of maize stem borers. Journal of Entomology and Zoology Studies. 2017;5(4):1424-1428.
11. Reddy GV, Kumar A. Efficacy of various insecticides against maize stem borer *chilo partellus* (Swinhoe) and their cost benefit analysis at Prayagraj. Journal of Entomology and Zoology Studies. 2021; 9(6):130-134.
12. Bhat ZH, Baba ZA. Efficacy of different insecticides against maize stem borer *Chilo partellus* (Swinhoe) and Maize aphid *Rhapalosiphum maidis* (Fitch) infesting maize. Pakistan Entomologist. 2007;29(2): 73-76.
13. Jamir RL, Kumar A. Field efficacy and economics of some biopesticides against tomato fruit borer. The Pharma Innovation Journal. 2022;11(6):1798-1802.
14. Montezano DG, Specht A, Sosa-Gómez DR, Roque, Specht, VF, Sousa-Silva JC, Paula-Moraes SV. Host plants of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) in the Americas. African Entomology. 2018;26(2):286-300.

15. Rani DS, Sri ChNS, Kumar KA, Venkatesh MN. Economic evaluation and efficacy of various insecticides against maize stem borers. Journal of Pharmacognosy and Phytochemistry. 2018;7(3):15-20.

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