

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

ABSTRACT

The field trial was conducted during *Kharif* 2022 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), management on maize with three replications. Results revealed that highest grain yield is recorded for T₂ Spinetoram 11.7 SC (64.58 q/ha) followed by T₁ Indoxacarb 14.5 SC (60.49 q/ha), Lambda cyhalothrin 5 EC (58.34 q/ha). Insecticidal treatment with T₂ Spinetoram 11.7 SC (1:2.31) had the highest cost benefit ratio, followed by T₁ Indoxacarb 14.5 SC (1:2.11), T₅ Lambda cyhalothrin (1:2.10), T₆ Cypermethrin 25% EC (1:2.04), T₇ Fipronil 0.6 % G (1:2.03), T₄ Nisco sixer plus (1:1.99), T₃ Azadirachtin 0.15 % (1:1.97) over untreated control (1:1.91).

Key words: 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.

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

$$\text{Grain yield} = \frac{\text{Grain yield per plot}}{\text{Plot size}} \times 100$$

Benefit cost ratio:

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

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

Where,

B:C = Benefit Cost Ratio

3. RESULT 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 [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).

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.

Table 1. 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 ₹

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, Dhilrjta 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 *Rhopalosiphum 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.