Original Research Article

COMPARATIVE EFFICACY OF INSECTICIDES AGAINST FALL ARMYWORM (*Spodoptera frugiperda)* IN BABY CORN

ABSTRACT

Aims: Baby corn is a high-value crop known for its high nutritive value, delicious taste, low calories, and high fiber content without cholesterol. This study aimed to evaluate the efficacy of various insecticides against fall armyworm (*Spodoptera frugiperda*) in baby corn, with the goal of optimizing pest management practices and ensuring crop productivity and profitability.
Study Design: Randomized Block Design (RBD)
Place and Duration of Study: Maize Research Centre, Agricultural Research Institute, Rajendranagar, Hyderabad, during the rabi season of 2022–2023.
Methodology: The experiment followed a Randomized Block Design with three replications and eight treatments. The baby corn variety 'Almora' was cultivated with a row spacing of 45 cm and plant spacing of 20 cm. Insecticides were applied twice at a 14-day interval. Observations on leaf injury rating (LIR) and percent infestation were recorded. Pre-treatment observations were taken one day before spraying, and post-treatment observations were recorded at 7 and 14 days after each application. Parameters such as percent reduction over control, dehusked cob yield, green fodder yield, and cost-benefit ratio were calculated to evaluate treatment efficacy.
Results: Chemical treatments significantly reduced fall armyworm infestations compared to the untreated control (T8). T_2 (cyantraniliprole 19.8% + thiamethoxam 19.8% FS and spinetoram spray) consistently recorded the lowest LIR and percent infestation, demonstrating superior efficacy. T_3 (cyantraniliprole 600 FS and chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC spray) exhibited comparable performance. T_3 yielded the highest cob and fodder yield with highest cost-benefit ratio making it the most cost-effective treatment, which is on par with T_2.
Conclusion: The study highlights the effectiveness of integrating seed treatments with foliar sprays for managing *S. frugiperda* in baby corn. T_3 and T_2 emerged as the most effective treatments, both in terms of pest control and economic viability, underscoring their potential for sustainable pest management and enhanced crop productivity.

Keywords: Almora, Baby corn, fall armyworm, Insecticide, Leaf injury rating, Per cent infestation

1. INTRODUCTION

Baby corn (*Zea mays* L.), an economically significant crop, has gained prominence as a nutritious and versatile vegetable consumed globally. Its tender, immature cobs are a rich source of vitamins, minerals, and dietary fiber, making it a key ingredient in various culinary dishes [1]. Additionally, baby corn is a short-duration crop with immense potential for both domestic markets and export, thus serving as a vital income source for farmers [2]. However, its successful cultivation faces numerous challenges, with pest infestations being a major concern. Among the pests threatening baby corn production, the fall armyworm (*Spodoptera frugiperda*) has emerged as a formidable adversary. Originating in the Americas, this polyphagous pest has rapidly spread to Asia and Africa, causing extensive damage to maize and related crops [3]. The pest's voracious feeding behavior, high reproductive rate, and ability to develop resistance to control measures make it a significant threat to food and nutritional security [3]. Infestation by fall armyworm in baby corn can lead to substantial yield losses, reducing the crop's marketable value and affecting farmers' livelihoods. Insecticides remain one of the most effective tools in managing fall armyworm infestations [4]. The judicious use of insecticides not only mitigates crop damage but also ensures economic viability for farmers. However, the choice of insecticide, its efficacy, and the timing of application are critical for effective pest management. Evaluating the performance of different insecticides under field conditions is essential to develop sustainable and integrated pest management (IPM) strategies [5]. Such studies not only help

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identify the most effective options but also minimize the environmental footprint and delay the onset of resistance in pest populations. This current study focuses on assessing the efficacy of various insecticides against fall armyworm in baby corn, with the objective of optimizing pest management practices and safeguarding the productivity and profitability of this vital crop.

2. MATERIAL AND METHODS

A field experiment was conducted during the *Rabi* 2022-2023 at the Maize Research Centre, Agricultural Research Institute, Rajendranagar, Hyderabad, to evaluate the effectiveness of different insecticides in managing *Spodoptera frugiperda* in ~~*Zea mays* L~~maize. The baby corn variety 'Almora' was used, with each plot measuring 3 m × 3.6 m. The crop was sown with a row spacing of 45 cm and plant spacing of 20 cm, under protective irrigation, following a randomized block design (RBD) with eight treatments and three replications. Insecticides were applied twice at a 14-day interval. Observations on leaf injury rating (LIR) were recorded using the standard 1–9 scale [6], along with percent infestation data. Pre-treatment observations were taken one day before spraying, while post-treatment observations were recorded at 7 and 14 days after each application. The LIR data were square-root transformed (√X + 0.5), and percent infestation data were arcsine transformed [7]. The transformed data were analyzed using ANOVA. Additionally, percent reduction in infestation over the untreated control (mean of percent reduction over control at 14 days after first spray and 14 days after second spray), dehusked cob yield, green fodder yield and cost-benefit ratio were calculated to assess treatment efficacy.

3. RESULTS AND DISCUSSION

3.1 EFFICACY OF INSECTICIDES

All treatments performed significantly better than the control, with seed treatment followed by foliar spray proving more effective than other methods. T_2 (cyantraniliprole 19.8% + thiamethoxam 19.8% FS and spinetoram spray) consistently recorded the lowest leaf injury ratings (LIR) at both 7 and 14 days after spraying (DAS), demonstrating its superior efficacy against *S~~podoptera~~ frugiperda*. This treatment was on par with T_3 (cyantraniliprole 600 FS and chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC spray), followed by T_1 (tetraniliprole ST 480 FS and cyantraniliprole 10.26% OD), which was comparable to T_4 (chlorantraniliprole 18.5% SC). Conversely, T_8 (control) exhibited the highest LIR values, indicating severe damage by *S. frugiperda*. The percent infestation followed a similar trend. T_2 (cyantraniliprole 19.8% + thiamethoxam 19.8% FS and spinetoram spray) exhibited the least infestation across all observations and was on par with T_3 (cyantraniliprole 600 FS and chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC spray). This was followed by T_1 (tetraniliprole ST 480 FS and cyantraniliprole 10.26% OD), which was comparable to T_4 (chlorantraniliprole 18.5% SC). The untreated control (T_8) showed the highest infestation percentages, emphasizing the necessity of effective management strategies. The highest percent reduction over control in LIR was observed in T_2 (59.16%), followed by T_3 (51.79%) and T_1 (41.18%). Among foliar sprays, T_4 (33.88%) recorded the highest percent reduction, followed by emamectin benzoate 5% SG (22.11%). The superior performance of T_2 (cyantraniliprole 19.8% + thiamethoxam 19.8% FS and spinetoram spray) can be attributed to its dual-action mechanism targeting both larval ~~and adult~~ stages ~~s~~ of *S. frugiperda*. Cyantraniliprole, a diamide insecticide, disrupts calcium ion balance in muscles, causing paralysis, while thiamethoxam enhances systemic activity. These findings align with [8], who reported significantly lower plant damage within the first 3–5 weeks of growth in seeds treated with cyantraniliprole 19.8% + thiamethoxam 19.8% FS. Additionally, [9] demonstrated that chlorantraniliprole 625 FS @ 6 ml kg^{-1} treated seeds provided the highest protection against fall armyworm, followed by cyantraniliprole + thiamethoxam 19.8% FS and tetraniliprole 480 FS. Furthermore, [10] highlighted spinetoram as the most efficient pesticide against *S. frugiperda*, achieving a population reduction of 97.61%.

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Comment [NK3]: Mention whether it is public sector or private sector and whetehr it is hybrid or variety....if it is private hybrid, mention the company name

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Comment [NK5]: Compare LIR and percent reduction control with the respective insecticides sprayed

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Table 1. Management of fall armyworm in maize (baby corn) during *rabi* 2022-2023

	Chemical Name	Dosage/ha		Leaf injury rating					Per cent infestation					Overall Mean Per cent reduction over control	Dehusked cob yield (Kg ha^{-1})	Green fodder yield (Kg ha^{-1})	CB ratio
				1 DBS	DAS (1st spray)		DAS (2nd spray)		1 DBS	DAS (1st spray)		DAS (2nd spray)					
		a.i. (g)	g or ml		7	14	7	14		7	14	7	14				
T_1	(i) Tetraniliprole ST 480 FS	3.6 g/kg seed		3.80 (2.19)^{b}	2.20 (1.79)^{ab}	5.00 (2.45)^{bc}	2.83 (1.96)^{bc}	2.05 (1.75)^{b}	74.50 (59.87)^{b}	48.50 (44.12)^{c}	68.33 (55.84)^{bc}	42.76 (40.81)^{b}	40.25 (39.34)^{b}	41.18	2050 (45.27)^{a}	25650 (160.05)^{a}	1:1.10
	(ii) Cyantraniliprole 10.26% OD	71.8	700														
T_2	(i) Cyantraniliprole 19.8% +Thiamethoxam 19.8 % FS	6 ml/kg seed		2.65 (1.91)^{a}	1.35 (1.53)^{a}	3.43 (2.11)^{a}	1.40 (1.55)^{a}	1.00 (1.41)^{a}	58.50 (49.88)^{a}	22.35 (28.18)^{a}	55.35 (48.06)^{a}	22.75 (28.48)^{a}	19.85 (26.44)^{a}	59.16	2120 (46.04)^{a}	26220 (161.92)^{a}	1:1.19
	(ii)Spinetoram 11.7% SC	30	256.4														
T_3	(i) Cyantraniliprole 600 FS	2.4 ml/kg seed		2.95 (1.99)^{ab}	1.60 (1.61)^{a}	4.40 (2.32)^{ab}	1.90 (1.70)^{ab}	1.35 (1.53)^{a}	65.65 (54.18)^{ab}	32.76 (34.90)^{b}	61.50 (51.63)^{ab}	31.25 (33.95)^{a}	27.36 (31.52)^{a}	51.79	2185 (46.72)^{a}	26880 (163.79)^{a}	1:1.28
	(ii) Chlorantraniliprole 9.3%+ lambda cyhalothrin 4.6% ZC	35	251.82														
T_4	Chlorantraniliprole 18.5% SC	40	216.21	5.25 (2.50)^{c}	2.55 (1.88)^{bc}	5.37 (2.52)^{bc}	2.90 (1.97)^{bc}	2.68 (1.92)^{b}	86.60 (69.22)^{c}	53.35 (46.90)^{c}	74.65 (59.98)^{cd}	49.52 (44.70)^{b}	47.45 (43.52)^{b}	33.88	1850 (43.01)^{ab}	25100 (158.26)^{a}	1:0.95
T_5	Emamectin benzoate 5 % SG	10	200	5.28 (2.50)^{c}	3.28 (2.07)^{cd}	5.83 (2.61)^{cd}	3.97 (2.23)^{cd}	3.65 (2.16)^{c}	86.95 (68.83)^{c}	63.45 (52.84)^{d}	80.50 (64.14)^{de}	65.65 (54.20)^{c}	63.52 (53.00)^{c}	22.11	1615 (40.18)^{bc}	23850 (154.31)^{ab}	1:0.75
T_6	Flubendamide 480 SC (39.35 w/w)	59	150	5.30 (2.51)^{c}	3.87 (2.21)^{de}	6.30 (2.70)^{cd}	4.23 (2.29)^{cd}	3.95 (2.23)^{cd}	87.20 (69.06)^{c}	72.52 (58.47)^{e}	82.50 (65.36)^{de}	69.55 (56.48)^{c}	67.46 (55.24)^{c}	18.92	1585 (39.81)^{bc}	23620 (153.66)^{ab}	1:0.70
T_7	Dimethoate 30 EC	300	1000	5.32 (2.51)^{c}	4.47 (2.33)^{e}	6.80 (2.79)^{d}	5.18 (2.46)^{d}	4.78 (2.40)^{d}	87.80 (69.75)^{c}	80.55 (63.81)^{f}	87.80 (69.54)^{ef}	79.55 (63.20)^{d}	77.68 (61.78)^{d}	10.56	1325 (36.36)^{c}	23125 (152.06)^{ab}	1:0.48
T_8	Control	-		5.35 (2.51)^{c}	6.90 (2.80)^{f}	7.20 (2.85)^{d}	7.95 (2.98)^{e}	7.80 (2.96)^{e}	87.80 (69.68)^{c}	90.25 (72.19)^{g}	91.52 (73.13)^{f}	94.00 (76.83)^{e}	93.65 (76.82)^{e}	0	820 (28.08)^{d}	20350 (142.51)^{b}	-
	SE(m)			0.07	0.08	0.08	0.10	0.07	2.34	1.76	2.04	2.13	1.86	-	1.54	3.99	-
	CD 5%			0.21	0.24	0.25	0.31	0.21	7.15	5.38	6.25	6.52	5.69	-	4.62	11.96	-
	CV%			5.06	6.75	5.49	8.30	5.76	6.34	6.07	5.80	7.40	6.64	-	6.48	4.38	-

DBS- Days before spraying; DAS- Days after spraying; Figures in parantheses are square root transformed values; Treatments denoted with same alphabets within a column are not significant at 5 % level CB- cost benefit

3.2 ECONOMIC VIABILITY

T_3 (cyantraniliprole 600 FS and chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC spray) resulted in the highest dehusked cob yield (2,185 kg/ha) and green fodder yield (26,880 kg/ha), with a cost-benefit ratio of 1:1.28, indicating its cost-effectiveness for large-scale applications. This was on par with T_2 (cyantraniliprole 19.8% + thiamethoxam 19.8% FS and spinetoram spray), which recorded a dehusked cob yield of 2,120 kg/ha and green fodder yield of 26,220 kg/ha, along with a cost-benefit ratio of 1:1.19. Thus, T_3 emerged as the most economically viable treatment, followed by T_2. The lowest yield and cost-benefit ratio were recorded in the untreated control (T_8). These results are supported by [11], who reported that chlorantraniliprole was highly effective against fall armyworm (*Spodoptera frugiperda*) in maize, yielding the highest grain output. Emamectin benzoate showed similar effectiveness to chlorantraniliprole and had the highest Incremental Benefit-Cost Ratio (ICBR). Chlorantraniliprole recorded a higher grain yield of 6,650 kg/ha, comparable to emamectin benzoate (6,517 kg/ha) and spinetoram (6,467 kg/ha). The untreated control recorded the lowest yield (3,246 kg/ha) [4]. These results underscore the importance of integrating seed treatments with foliar sprays for effective management of *S. frugiperda* and minimizing crop losses.

4. CONCLUSION

The study demonstrates that integrating seed treatments with foliar sprays is an effective strategy for managing *S. frugiperda* in baby corn. T_3 (cyantraniliprole 600 FS and chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC spray) and T_2 (cyantraniliprole 19.8% + thiamethoxam 19.8% FS and spinetoram spray) emerged as the most efficient treatments, providing superior pest control, higher yields, and better economic returns. These findings underscore their potential for sustainable pest management practices and enhanced productivity in baby corn cultivation.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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