Research Article

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Empowering farmers through front line demonstrations on the management of shoot and fruit borer (*Leucinodes orbonalis* Guenee) in brinjal

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ABSTRACT

This study assessed the efficacy of emamectin benzoate 5 SG (0.0025%) in managing the shoot and fruit borer of brinjal through front line demonstrations (FLDs) conducted during 2021-22, 2022-23, and 2023-24 in Kalol Taluka and Panchmahal districts of Gujarat. The study compared demonstrated practice (emamectin benzoate 5 SG @ 12.5 g a.i./ ha) with farmer's practice (inconsistent pesticide use). Results revealed significant reduction in pest damage under the recommended practice, with shoot borer infestation decreasing from 7.25% to 8.50% and fruit borer damage reducing from 13.50% to 15.50%, compared to 17.50%-18.75% and 22.75%-23.50%, respectively, under farmer's practice. Yield increased from 235.25 q/ ha (2021-22) to 249.75 q/ ha (2023-24) in the recommended practice, significantly higher than farmer's practice yields (170.50 to 198.50 q/ ha). The technology gap was 45.83 q/ ha, extension gap 55.75 q/ha, and technology index 16.37%. Economic analysis showed a B:C ratio of 3.10 for the recommended practice versus 2.56 in farmer's practice, with an additional net return of ₹ 28,400/ ha. The study confirms that emamectin benzoate 5 SG effectively manages brinjal fruit and shoot borer, enhancing productivity and profitability, making it a viable pest control strategy for sustainable brinjal cultivation.

Introduction

Brinjal (*Solanum melongena* L.) is widely cultivated in India and the second-largest producer after China. Despite its significance, brinjal cultivation faces severe challenges due to insect pests, with the fruit and shoot borer (*Leucinodes orbonalis* Guenee) being the most destructive. This pest can cause 14-43% fruit damage, leading to significant yield losses (Khajuria *et al.,* 2014a; Khajuria *et al.*, 2014b; Khajuria *et al.*, 2015; Khajuria *et al.*, 2017; Khajuria, 2022). Farmers often rely on chemical pesticides for pest control, but their indiscriminate use leads to pesticide resistance, environmental pollution, and health risks. Therefore, sustainable pest management strategies are needed to improve yield and economic returns, while reducing pesticide dependence.

Front line demonstrations (FLDs) played a vital role in promoting improved agricultural practices by demonstrating scientifically tested technologies in real farm conditions. This study evaluates the effectiveness of emamectin benzoate 5 SG (0.0025%) in controlling brinjal fruit and shoot borer through FLDs. The study compares demonstrated technology with farmer's conventional practices, assessing yield performance, cost-benefit ratio, and economic gains. Additionally,

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technology gap, extension gap and technology index were analyzed to understand technology dissemination. The findings aim to support brinjal production and encourage the adoption of improved pest management practices among farmers.

Material and Methods

The study was conducted during the *kharif* seasons of 2021-22, 2022-23 and 2023-24 to evaluate the effectiveness of emamectin benzoate 5 SG (0.0025%) in managing brinjal fruit and shoot borer under front line demonstrations. The demonstrations were carried out in selected farmer's fields in Kalol Taluka, Panchmahal district, Gujarat, under the supervision of ICAR-Krishi Vigyan Kendra, Panchmahal. A total of 10 farmers per year were selected based on their willingness to participate and adopt the demonstrated pest management practices.

Demonstration details

The study compared two pest management practices to evaluate the effectiveness of emamectin benzoate 5 SG in managing brinjal fruit and shoot borer. In the demonstrated practice (FLD Plots), emamectin benzoate 5 SG was applied at a rate of 5 g per 10 liters of water (12.5 g a.i./ ha) for pest management. In contrast, the farmer's practice involved the use of inconsistent pesticide applications, which varied among farmers based on their individual practices. This comparative approach helped assess the efficacy, yield impact, and economic benefits of the demonstrated technology over conventional methods.

The FLDs were conducted by adopting standard agronomic practices including land preparation, spacing, irrigation, and disease management, as per scientific recommendations.

Data collection and observations

To assess the effectiveness of emamectin benzoate 5 SG in managing brinjal fruit and shoot borer, various parameters were recorded. Pest damage was evaluated by calculating the percentage of shoot and fruit infestation, determined using the ratio of infested shoots or fruits to the total number, multiplied by 100. Crop yield (q/ha) was measured separately for demonstration plots and farmer's practice plots. Economic indicators, including the cost of cultivation, gross return, net return, and benefit-cost ratio (B:C ratio), were analyzed to determine the profitability of the demonstrated technology. Additionally, the study assessed technology and extension impact by calculating the technology gap (difference between potential and demonstration yield), extension gap (difference between demonstration yield and farmer's practice yield) and technology index (%) is calculated as the difference between potential yield and demonstration yield, divided by potential yield and multiplied by 100. It reflects the extent of technology adoption.

Statistical analysis

The collected data were analyzed following the methods of Panse and Sukhatme (1989). Mean values were compared using the Least Significant Difference (LSD) test to determine treatment differences. Angular transformation was applied as per standard procedures. ANOVA was used to assess yield variations across different years, ensuring statistical reliability.

Results and Discussion

Impact of recommended practice on pest infestation and yield in brinjal

The study evaluates the impact of recommended and farmer's practices on shoot borer damage, fruit borer damage, and yield in brinjal over three consecutive years (2021-24). The results indicate a significant reduction in pest infestation and an increase in yield under the recommended practice compared to the farmer's practice.

In the recommended practice, shoot borer damage ranged from 7.25% to 8.50%, while in the farmer's practice, it was considerably higher, ranging from 17.50% to 18.75%. Similarly, fruit borer damage was significantly lower in the recommended practice (13.50%-15.50%) compared to the farmer's practice (22.75%-23.50%). These results are in accordance with the study conducted by Shamik (2019), who found that emamectin benzoate was promising insecticide to reduce brinjal fruit and shoot infestation. The transformed angular values further support these findings.

Yield data highlights the effectiveness of the recommended practice, with an increase from 235.25 q/ ha in 2021-22 to 249.75 q/ha in 2023-24, whereas the farmer's practice recorded significantly lower yields, ranging from 170.50 q/ ha to 198.50 q/ha (Table 1 and Fig. 1). Shubham et al. (2021) found that emamectin benzoate 5% SG @ 200 g a.i./ha was the most effective treatment, resulting in maximum fruit yield. Statistical parameters indicate significant differences, confirming the reliability of the findings.

Statistical analysis: ANOVA test for yield differences

The ANOVA results confirm that the recommended practice consistently produced a higher yield than the farmer's practice over three years. The low CV% (0.44, 0.06, 0.04) and significant LSD (1.34, 0.18, 0.14) indicate reliable findings. Additionally, the SEm± values (0.36, 0.05, 0.03) confirm

statistical accuracy. Thus, the recommended practice is a better way to increase brinjal yield and improve farming results (Fig. 2).

Table 1. Effect of recommended and farmer's practices on shoot borer damage, fruit borer damage, and yield in brinjal (2021-2024)

Variables	Shoot borer damage (%)			Fruit borer damage (%)			Yield (q/ ha)		
	2021-22	2022-23	2023-24	2021-22	2022-23	2023-24	2021-22	2022-23	2023-24
Recommended practice	8.50 (16.96)	7.50 (15.87)	7.25 (15.63)	15.50 (23.17)	14.75 (22.59)	13.50 (21.56)	235.25	247.50	249.75
Farmer's practice	17.50 (24.75)	18.25 (25.28)	18.75 (25.67)	23.25 (28.84)	23.50 (28.98)	22.75 (28.48)	170.50	196.25	198.50
SEm±	0.24	0.04	0.05	0.20	0.22	0.26	0.36	0.05	0.03
CV (%)	3.46	0.57	0.80	1.84	2.13	2.56	0.44	0.06	0.04
LSD (5%)	0.62	0.09	0.13	0.71	0.81	0.95	1.34	0.18	0.14

Figures in parenthesis are transformed angular values

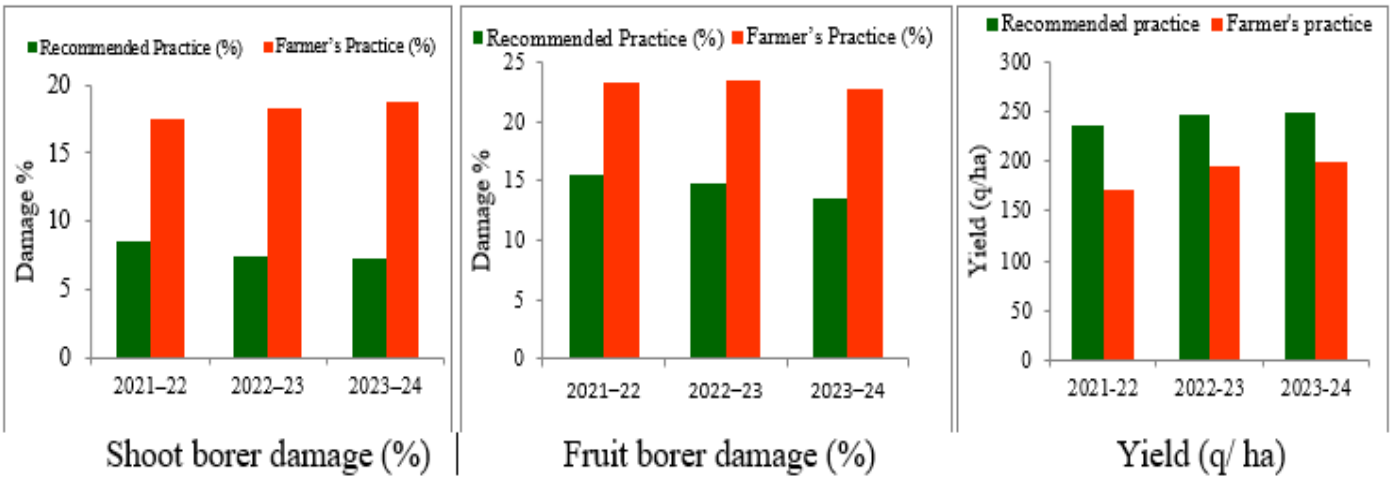

Fig. 1. Reduction in borer damage and yield enhancement in brinjal under recommended practices compared to farmer's practice

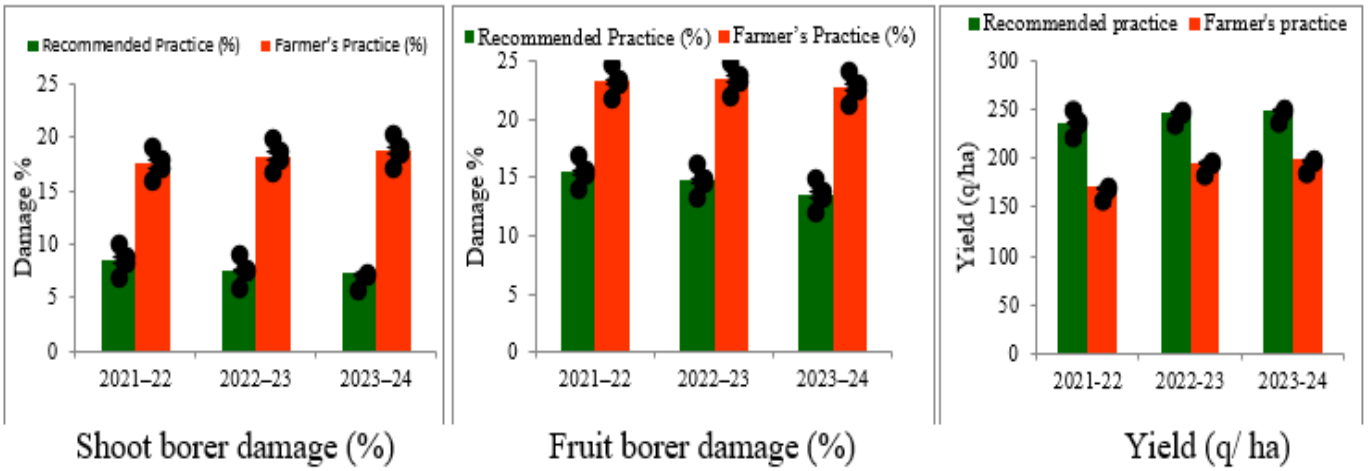

Fig. 2. Comparison of practices with standard error bars for pest damage (%) and yield of brinjal

Yield improvement and technology gap in brinjal

The impact of the recommended practice on yield, yield increase, technology gap, extension gap, and technology index in brinjal is presented in Table 2 and Fig. 3 based on pooled data over three years. The results highlight a significant improvement in yield under the recommended practice compared to the farmer's practice. The average yield obtained from the recommended practice was 244.17 q/ ha, which was notably higher than the 188.42 q/ ha recorded under the farmer's practice. This resulted in a substantial yield increase of 29.59%. These findings are similar to those of Shamik (2019), who reported that emamectin benzoate increased marketable fruit yield.

The technology gap, representing the difference between potential yield and observed yield under the recommended practice, was 45.83 q/ ha, indicating that there is still scope for further improvement. The extension gap, which reflects the difference between yields from the recommended and farmer's practices, was observed to be 55.75 q/ ha, emphasizing the need for wider adoption of improved pest management strategies. Additionally, the technology index, which quantifies the effectiveness of the recommended practice in achieving potential yield, was recorded at 16.37%. The results of the present study were in consonance with the findings of Khajuria *et al.* (2016) in case of cotton crop.

The higher yield and reduced pest infestation achieved under the recommended practice were primarily due to the application of emamectin benzoate 5 SG @ 12.5 g a.i./ ha, an effective insecticide for managing fruit and shoot borer infestations. These findings underscore the importance of adopting scientifically validated pest management practices to enhance brinjal productivity. These results emphasize the effectiveness of the recommended practice in boosting productivity and reducing pest related losses.

Table 2. Impact of recommended practice on yield, yield increase, technology gap, extension gap and technology index in brinjal (Pooled data of 3 years)

Variables	Yield (q/ ha)	% yield increase (q/ ha)	Technology gap (q/ ha)	Extension gap (q/ ha)	Technology index (%)
Farmer's practice	188.42	-	-	-	-
Recommended practice*	244.17	29.59%	45.83	55.75	16.37

*Foliar spray of emamectin benzoate 5 SG @ 12.5 g a.i./ ha

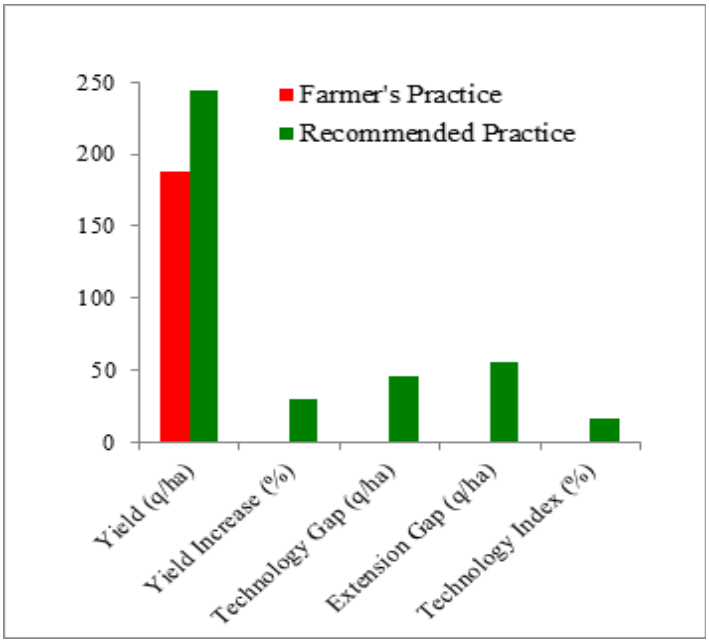

Fig. 3. Impact of recommended practice on yield and associated factors in brinjal

Economic viability of recommended practice in brinjal cultivation

The economic analysis (Table 3) highlights the financial benefits of adopting the recommended practice over the farmer's practice in brinjal cultivation, based on pooled data over three years. The cost of cultivation under the recommended practice was ₹ 44,666.67/ ha, slightly higher than the ₹ 41,833.33/ ha incurred in the farmer's practice, mainly due to the use of emamectin benzoate 5 SG (12.5 g a.i./ha). However, the gross return was significantly higher in the recommended practice (₹ 138,650.0/ ha) compared to the farmer's practice (₹ 107,416.70/ ha), resulting in a net return of ₹ 93,983.33/ ha, which was ₹ 28,400/ ha higher than the farmer's practice (₹ 65,583.33/ ha). The benefit cost ratio (BCR) improved from 2.56 in the farmer's practice to 3.10 under the recommended practice, demonstrating the profitability of adopting improved pest management strategies (Table 3 & Fig. 4).

These findings align with previous studies (Patel & Radadia, 2015; Shamik, 2019), which confirm that effective pest control measures significantly reduce brinjal fruit and shoot borer infestation, leading to improved yields and higher profitability. The study shows that emamectin benzoate helps make brinjal cultivation better and more affordable.

These findings suggest that the recommended practice not only enhances productivity but also provides higher profitability to farmers, making it a financially sustainable pest management approach. This economic gain encourages wider adoption of scientifically recommended pest control methods, leading to improved income and livelihood security for brinjal growers.

Table 3. Economic analysis of farmer's practice vs. recommended practice in brinjal cultivation (Pooled data of 3 years)

Variables	Cost of cultivation (₹/ ha)	Gross return (₹/ ha)	Net return (₹/ ha)	Benefit: cost ratio
Farmer's practice	41,833.33	107,416.70	65,583.33	2.56
Recommended practice	44,666.67	138,650.00	93,983.33	3.10
Additional in recommended practice	2,833.34	31,233.30	28,400	

*Incremental benefit: cost ratio

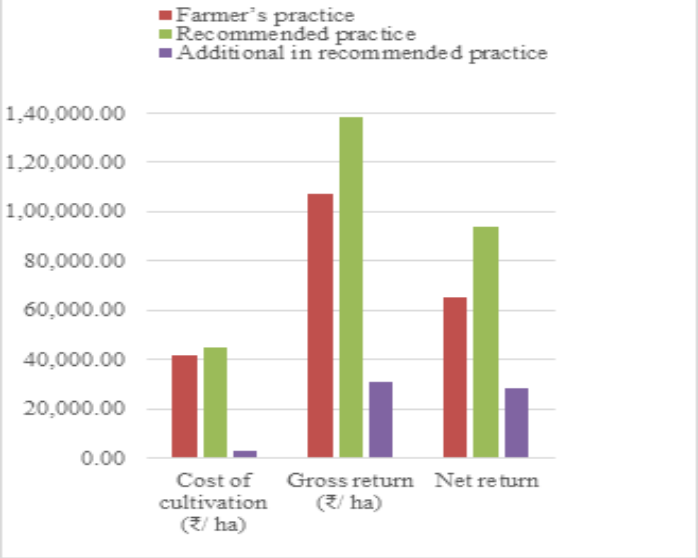

Fig. 4. Economic analysis of farmer's practice vs. recommended practice

Conclusion

The study confirms that emamectin benzoate 5 SG (12.5 g a.i./ ha) effectively manages brinjal fruit and shoot borer, significantly reducing shoot (7.25-8.50%) and fruit borer (13.50-15.50%) damage while increasing yield (244.17 q/ ha) compared to farmer's practices. The technology gap (45.83 q/ ha) and extension gap (55.75 q/ ha) highlight the need for wider adoption. Economic analysis revealed higher profitability with B:C ratio of 3.10, ensuring better returns for farmers. The front line demonstrations successfully motivated most farmers to adopt the recommended technology due to its clear advantages and effective management of brinjal shoot and fruit borer. These innovative practices contribute to improved decision making among farmers and enhance their ability to adapt and modify existing farming practices.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript

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