International Journal of Economic Plants

https://ojs.pphouse.org/index.php/IJEP

Crossref

IJEP March 2025, 12(2): 01-04

Article IJEP5723

Full Research

Stress Management

Doi: HTTPS://DOI.ORG/10.23910/2/2025.5723

Efficacy of Technologies on Management of Rice Leaf Folder and Yield

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Article History

Received on 19th August, 2024

Received in revised form on 05th February, 2025

Accepted in final form on 18th February, 2025

Published on 06th March, 2025

Abstract

The present study was conducted during *rabi* (November, 2020 to March, 2021 and November, 2021 to March, 2022) in Dakshina Kannada district of Coastal Karnataka, India to study the efficacy of newer insecticide molecule on effective management of rice leaf folder. The field experiments were set up in a completely randomised block design with four treatments and five replications. Results from the present study revealed that, foliar application of (T_3) indoxacarb 14.5 SC @ 0.5 ml l^{-1} during 25 days and 40 days after transplantation was found most effective in reducing leaf folder incidence (3.46%) by 70.92 per cent and higher yield (40.90 q ha^{-1}) leading to 19.59% increase over farmers practice (11.89%) and yield (34.20 q ha^{-1}) respectively. The economic analysis of yield performance from the present study revealed that foliar application of indoxacarb 14.5 SC @ 0.5 ml l^{-1} during 25 and 40 days after transplantation achieved higher net return (₹ 56,911 ha^{-1}) with higher benefit cost ration (1:2.46) as compared to farmer practice recorded lowest net return (44,901) with lowest benefit cost ratio (1:1.98). The study recorded a technology gap 9.10 q ha^{-1}, extension gap of 6.70 q ha^{-1} and a technology index of 18.20% in T_3. The present study, highlighted that the recommended practices are both feasible and economically viable over farmer's practices, offering a superior option for managing rice leaf folder under field condition.

Keywords: Rice, leaf folder, management, incidence, yield

1. Introduction

Rice (*Oryzae sativa* L.,) is considered as one of the most important and widely cultivated food crop in the world and served as a staple food crop for more than half of the world's population (Yuan, 2014). It plays a key role in global food security and livelihoods. India, the second largest producer and exporter of rice in the world, cultivates it on approximately 47.83 mha, producing 135.75 mt with a productivity of 28.38 q ha^{-1} (Anonymous, 2022). In Karnataka, rice is grown on 13.28 lakh hectares with the production of 4.28 mt and productivity of 32.33 q ha^{-1} (Anonymous, 2022).

However, rice cultivation is prone to both abiotic and biotic stress, with biotic factors alone contributing to substantial global production losses. It is estimated that approximately 52% total rice yield is affected annually by biotic stresses, with insects pests accounting for 21% loss (Yarasi et al., 2008: Tenguri et al., 2023). There are more than 100 insects pests attacking rice but few of these are considered to be the major pests. Amongst the major insect pests infesting rice, the rice leaf folder (*Cnaphalocrocis medinalis* Guenee) is a important migratory insect pest of rice, widely distributed in the rice-growing regions of humid tropical and temperate countries (Khan et al., 1988). The number of major insect pests are increasing day by day. Rice leaf folder earlier considered as a miner pest has attained the status of major pest, causing population outbreaks in recent decades in various parts of India (Singh et al., 2017). The larval stage of the rice leaf folder inflicts damage by folding one or more leaf blades longitudinally using silk strands, creating a protective environment within which the different stages of caterpillar feeds on the mesophyll tissue by scraping it off. This activity disrupts photosynthesis and hampers plant growth, ultimately leading to a reduction in rice yield (Gangwar, 2015). Severe infestation by this pest can result in significant economic losses in rice production. Avoidable losses due to leaf folder in rice were reported to be 37.90% (Chhavi et al., 2017). For this, rice pests management is crucial to achieve rice production in a sustainable manner (Savary et al., 2006). The yield losses vary from 1.2 to 2.2 t ha^{-1} due to combine attack of diseases, pests and weeds (Savary et al., 2012). On the other hand, potential yield gains of at least 10 to 20% of the current yields may be achieved through effective pest management techniques (Oerke, 2006; Savary et al., 2012). Various strategies have been deployed for the management of rice leaf folder and insecticides as chemical control factors as the first line of defence mechanism. For effective control of rice leaf folder, identification of newer insecticides molecules with selective properties and novel mode of action is required for sustainable integrated pest management. Therefore, to overcome the plateau in rice production, the sustainable management of rice leaf folder through environmentally friendly approaches has become increasingly imperative.

In responses to the evolving challenges in rice cultivation, the present study aimed to evaluate the efficacy of new technologies for the effective management of rice leaf folder under field condition during *rabi*, 2020–21 and 2021–22 in Dakshina Kannada district of Coastal Karnataka. The present investigation highlights the impact of recommended dose of fertilisers, newer insecticide molecule and biological control management strategies applied, while assessing the level of productivity improvement and rice leaf folder management.

2. Materials and Methods

2.1. *Experimental site and design*

The experiment was conducted during *rabi* season at five randomly selected farmers' fields in Nadagram of Belthangady taluk from November, 2020 to March, 2021, and in Konaje village of Mangaluru taluks during November, 2021 to March, 2022 in the Dakshina Kannada districts of coastal Karnataka. The study aimed to evaluate the efficacy of different technologies against rice leaf folder. The field trials were set up in a completely randomised block design with four treatments and five replications during 2020–2021 and 2021–2022. Following four treatments were compared during the study period.

2.2. *Details of the treatments*

The knapsack sprayer and spray volume @ 500 l ha^{-1} used with hollow cone nozzle to impose the uniform spray of insecticides in each treatment application (Table 1).

Table 1: Treatments details

T_1	:	Farmers practices: No recommended pest management practice
T_2	:	Foliar application of profenophos @ 2 ml l^{-1} during 25 days after transplanting (DAT) and 40 DAT and followed recommended dose of fertiliser
T_3	:	Foliar application of Indoxacarb 14.5 SC @ 0.5 ml l^{-1} during 25 and 40 days after transplantation and recommended dose of fertilisers
T_4	:	Use of rope to dislodge the leaf feeding larvae on 40 DAT Release of Trichogramma japonicum thrice on 37th, 44th, and 51st day after transplanting @ 1,25,000 egg parasitoide ha^{-1}

2.3. *Observations recorded*

2.3.1. *Leaf folder infestation*

Observations were recorded by counting the number of healthy and damaged leaves from 20 randomly selected hills from the inner rows in each plot one day before the application of treatments as pretreatment observations followed by 60th day after transplantation as post treatment observation. The per cent incidence of leaf folder was calculated as follows:

Leaf folder damage (%)=(No.of folded leaves in a hill/Total no.of leavse in a hill)×100

To estimate the technology gap, extension gap and technology index, following formula by Samui et al. (2000), Sagar and Chandra (2004) were used.

Technology gap=Pi(Potential yield)- Di(Demonstration Yield)

Extension gap=Di(Demonstration Yield)-Fi(Farmers Yield)

Technology index=Pi(Potential yield)- Di(Demonstration Yield)/(Potential yield)×100

2.3.2. *Statistical analysis*

Completely randomised block design with five replications of each treatment was used for statistical analysis to known the effect of treatments. Duncan's multiple range test (DMRT) was applied for comparing the treatments means, following the procedure outlined by Gomez and Gomez (1984). WASP software was used to perform angular transformation analysis on the data at 5% significance level (Jangam and Thali, 1998).

3. Results and Discussion

3.1. *Leaf folder incidence*

Assessment of technologies with farmers practice were analysed and present in the table 2, table 3 and table 4. Results from the present investigation, foliar application of (T_3) indoxacarb 14.5 SC @ 0.5 ml l^{-1} during 25 and 40 days after transplantation was found to be significantly most effective in managing rice leaf folder (3.46%) leading to 70.92% reduction over farmer practice (11.89%). Also, treatment (T_2) also showed significant effectiveness with a 54.31% reduction over farmer practice (T_1). T_4 was less effective but still provided a notable reduction of leaf folder incidence over farmer practice (T_1). Present findings are in close agreement with Sharma and Raju (2018) and Khajuria et al. (2021a and 2022) reported that application of insecticides in recommended practices i.e., indoxacarb 14.5 SC @ 125 g a.i. ha^{-1} and indoxacarb 15.8 EC @ 0.015% (79 g a.i. ha^{-1}) were found most effective in managing leaf folder as compared to farmers practices.

Table 2: Efficacy of technologies on leaf folder incidence during *rabi*

Treatments	Leaf folder incidence (60 DAT)			
	2020–2021	2021–2022	Mean	Per cent reduction over FP
T_1	12.47[a] (20.67)	11.32[a] (19.66)	11.89	-
T_2	4.25[c] (11.90)	6.62[c] (14.91)	5.43	54.31
T_3	3.75[d] (11.17)	3.17[d] (10.24)	3.46	70.92
T_4	5.20[b] (13.20)	8.70[b] (17.16)	6.95	41.55
SEm±	0.07	0.14	-	-
CD (p=0.05)	0.22	0.43	-	-

Figures in the parenthesis are angular transformed value, FP: Farmer practice; DAT: Days after transplantation; Mean values of 5 replicates; within columns, mean followed by common letters do not significantly differ at p=0.05

Foliar application of (T_3) indoxacarb 14.5 SC @ 0.5 ml l^{-1} during 25 and 40 days after transplantation along with recommended dose of fertiliser application indicated its superiority in grain yield of 40.90 q ha^{-1} leading to 19.59% increase over farmers practices, 4.20% over T_2 and 9.21% over T_4. Yield enhancement in rice through the evaluation of insecticides had been reported by Khajuria et al. (2022) and Sharma and Raju (2018), who observed significantly higher yields in plots treated with indoxacarb, which also provided effective control of the rice leaf folder. These finding highlighted the efficacy of indoxacarb in managing leaf folder infestations while simultaneously boosting crop productivity.

The results clearly demonstrated that the tested technology outperformed traditional farming practices under identical environmental conditions. Farmers were motivated by increased productivity and have begun adopting these technologies. Yield comparisons between on-farm testing and the crops potential yield highlighted the yield gaps, which were further analysed in terms of the technology index and technology gap.

The technology gap, indicating the difference between the potential yield (50 q ha^{-1}) and the demonstration yield, was recorded at 9.10 q ha^{-1}. on-farm testing conducted under Krishi Vigyan Kendra (Dakshina Kannada) Mangaluru supervision revealed this gap, likely due to variations in soil fertility and weather conditions. These results highlighted the need for location specific recommendations to bridge the yield gap. These finding were similar to the findings of Rai et al., 2018 and Rai et al., 2020 in case of maize and groundnut respectively.

Table 3: Yield, technology gap, extension gap and technology index of trials

Variables	No. of trials	Mean yield of 2020–2021 and 2021–2022 (q ha^{-1})	Increase over farmers practice (%)	Technology gap (q ha^{-1})	Extension gap (q ha^{-1})	Technology index (%)
T_1	8	34.20[c]	-	-	-	-
T_2	8	39.25[a]	14.77	10.75	5.05	21.5
T_3	8	40.90[a]	19.59	9.10	6.70	18.2
T_4	8	37.45[b]	9.50	12.55	3.25	25.1

Mean values of 5 replicates; within columns, mean followed by common letters do not significantly differ at p=0.05

Table 4: Economics (Average of two years) of rice production under on farm testing

Technology options	No. of trials	Mean yield (q ha^{-1})	Net return ₹ ha^{-1}	B:C ratio
T_1	5	34.20	44,901	1.98
T_2	5	39.25	54,003	2.35
T_3	5	40.90	56,911	2.46
T_4	5	37.45	50,655	2.23

The extension gap of 6.70 highlighted the necessity of educating farmers and supporting them in enhancing yields through the adoption of improved scientific practices. Increased use of scientific technologies by farmers was expected to reduce the existing extension gap over time. The technology index, which indicated the feasibility of a technology at the farmers level was observed at a low value of 18.20 (Table 3), suggesting that the technology was well suited for the Dakshina Kannada district in Coastal Karnataka. These finding aligned with the results of Khajuria et al., 2016a in chili and Khajuria et al., 2021b in rice crop.

The economic analysis of rice production revealed that treatment T_3 recorded higher net return (₹ 56,911/-) with higher benefit cost ration (1:2.46) as compared to farmer practice. These results are in accordance with finding of Khajuria et al., 2022.

4. Conclusion

Foliar application of (T_3) indoxacarb 14.5 SC @ 0.5 ml l^{-1} during 25 and 40 days after transplantation was found most effective in reducing leaf folder incidence (3.46%) by 70.92% and higher yield (40.90 q ha^{-1}) leading to 19.59% increase over farmers practice (11.89%) and yield (34.20 q ha^{-1}) respectively.

5. Acknowledgement

The authors would like to acknowledge Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar for the support and ICAR-ATARI, Bengaluru (Zone XI) for providing funds to ICAR-KVK (D.K) Mangaluru for successful implementation of on farm testing in farmers' fields. Also, acknowledge ICAR-National Rice Research Institute, Cuttack for providing Trichocards. Also, acknowledge the farming community for generously allowing us to conduct demonstrations in their fields.

6. References

Anonymous, 2022. Indiastastfacts. Available from https://www.indiastat.com/table /rice/selected-state-season-wise-area-production-product/63808. Accessed on 15th August, 2024.

Chhavi, Srivastav, A., Sharma, P.K., 2017. Assessment of yield losses of rice caused by paddy leaf folder, *Cnaphalocrocis medinalis* (Guenee). Agricultural Science Digest 37(1), 72–74.

Gangwar, R.K., 2015. Life cycle and abundance of rice leaf folder, *Cnaphalocrocis medinalis* (Guenee)-a review. Journal of Natural Sciences 5(15), 103–105.

Gomez, K.A., Gomez, A.A., 1984. Statistical procedures for agricultural research. John Wiley and Sons. Pp690.

Jangam, A.K., Thali, P., 2004. WASP-Web Agri Stat Package (2004). ICAR Research Complex for Goa, Ela, Old Goa, Goa. 403 402. India. Available from https://ccari.icar.gov.in/wasp2.0/index.php. Accessed on 15th August 2024.

Khajuria, S., Rai, A.K., Lata, K., Kumar, R., Jadav, J.K., 2016a. Frontline demonstrations: An approach for management of chilli thrips (*Scirtothrips dorsalis* Hood). Indian Journal of Arid Horticulture 11(1–2), 96–98. https://acspublisher.com/journals/index.php/ijah/article/view/18296.

Khajuria, S., Rai, A.K., Lata, K., Khadda, B.S., Raj, K., 2021a. Frontline demonstrations: An approach for management of paddy leaf folder (*Cnaphalocrocis medinalis* Guenee) 2021. In 1st International conference on emerging global trends in agricultural, biological and pharmaceutical sciences [ICEGTABPS-2021]. Biology, Agriculture, Scitech and Environment 1, Pp 41.

Khajuria, S., Rai, A.K., Lata, K., Khadda, B.S., Raj, K., 2021b. Evaluation of IPM module for the management of major insect pests of paddy. In: 1st International Conference on Emerging Global Trends in Agricultural, Biological and Pharmaceutical Sciences [ICEGTABPS-2021]. Biology, Agriculture, Scitech and Environment 1, 16–17.

Khajuria, S., Rai, A.K., Lata, K., 2022. Impact of frontline demonstrations in transfer of technology for management of paddy leaf folder. Gujarat Journal of Extension Education 34(2), 124–127. https://doi.org/10.56572/gjoee.2022.34.2.0027.

Khan, Z.R., Barrion, A.T., Litsinger, J.A., Castilla, N.P., Joshi, R.C., 1988. A bibliography of rice leaf folders (Lepidoptera: Pyralidae)-Mini review. Insect Science and its Application 9(2), 129–174.

Oerke, E.C., 2006. Crop losses to pests. Journal of Agricultural Science 144(1), 31–43.

Rai, A.K., Khajuria, S., Kumar, R., 2018. Knowledge and adoption of improved production technology of maize by the farmers of Panchmahal district in Gujarat. Gujarat Journal of Extension Education 29(1), 44–46.

Rai, A.K., Khajuria, S., Lata, K., 2020. Impact of front line demonstrations in transfer of groundnut production technology in semi-arid region. Gujarat Journal of Extension Education 31(1), 6–10.

Savary, S., Horgan, F., Willocquet, L., Heong, K.L., 2012. A review of principles for sustainable pest management in rice. Crop Protection 32, 54–63.

Savary, S., Teng, P. S., Willocquet, L., Nutter, F. W. J., 2006. Quantification and modeling of crop losses: a review of purposes. Annual Review of Phytopathology 44(1), 89–112.

Sharma, K.R., Raju, S.V.S., 2018. Efficacy of new insecticide combinations and alone application against leaf folder, *C. medinalis* rice crop. Annals of Plant Protection Sciences 26(2), 236–239.

Singh, P., Chander, S., Husain, M., Pal, V., Singh, P., 2017. Development of a forewarning model to predict rice leaf folder (*Cnaphalocrocis medinalis* Guenee) incidence in Punjab, India. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences 87, 201–206.

Tenguri, P., Chander, S., Nebapure, S., Arya, P. S., Madhu, T.N., Yele, Y., 2023. Effect of silicon amendment on herbivore-induced plant volatiles of rice plant infested by brown planthopper *Nilaparvata lugens*(Stal). Indian Journal of Entomology 85(2), 385–388.

Xu, H., Ya-jun, Y., Yan-Hui, L., Xu-song, Z., Jun-ce, T., Feng-xiang, L., Qiang, F., Zhong-xian, L., 2017. Sustainable management of rice insect pests by non-chemical-insecticide technologies in China. Rice Science 24(2), 61–72. https://doi.org/10.1016/j.rsci.2017.01.001.

Yarasi, B., Sadumpati, V., Immanni, C.P., Vudem, D.R., Khareedu, V.R., 2008. Transgenic rice expressing Allium sativum leaf agglutinin (ASAL) exhibits high-level resistance against major sap-sucking pests. BMC Plant Biology 8, 102. https://doi.org/10.1186/1471-2229-8-102.

Yuan, L.P., 2014. Development of hybrid rice to ensure food security. Rice Science 21, 1–2.

