Plant Archives Vol. 24, No. 2, 2024 pp. 1753-1756 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.251

EFFICACY OF ECO-FRIENDLY TECHNOLOGIES FOR THE MANAGEMENT OF RICE PESTS

Kedarnath[1*], Ramesha T.J.[1], Veershetty[2], Mallikarjuna Lingappa[1], Ashwini Koute[3], Chethan N.[1] and Thejaswi Kumar[4]

[1]ICAR-Krishi Vigyan Kendra (Dakshina Kannada), Karnataka, Veterinary Animal and Fisheries University Bidar, 575 002, Karnataka, India

[2]Division of Agricultural Statistics, I.C.A.R.-Indian Agricultural Research Institute, New Delhi 110012, India.

[3]Department of Electronics and Communication Engineering, National Institute of Technology, Surathkal, Karnataka 575 025, India.

[4]College of Fisheries, Mangaluru, KVAFSU Bidar, 575 002, Karnataka, India.

*Corresponding author email: kedarnath.govin@gmail.com

(Date of Receiving-14-06-2024; Date of Acceptance-29-08-2024)

ABSTRACT

Field experiments were conducted during *Kharif* season of 2019-20, 2020-21 and 2021-22 at farmers' fields of Dakshina Kannada district of Karnataka to evaluate the efficacy of eco-friendly technologies against yellow stem borer, leaf folder and ear head bug in paddy. The results revealed that, mean dead hearts and white ear incidence was lower in demonstration plots (2.34% and 2.42%) as compared to farmers practice (6.26% and 4.84%), respectively. The mean leaf folder incidence was lower in demonstration plots (4.11%) as compared with farmers practice (8.74%) and mean ear head bug incidence was significantly lower in demonstration plots (2.56%) as compared to farmers practice (5.44%). The grain yield was higher in demonstration plots (47.23qha^{-1}), with an increase of 16.99% over the farmers practice (40.62q ha^{-1}). The net returns and benefit-cost were obtained more in demonstrations plots as compared to farmers practices. Hence, the adoption of technologies in organic farming system proved to be eco-friendly, economical, and sustainable in the rice production system.

***Key words*:** Rice, Yellow stem borer, Dead heart, Leaf folder, Eco-friendly.

Introduction

Rice is a major staple cereal, providing over 20% of the daily calorie intake for more than 3.5 billion people worldwide (IRRI, 2010). It is cultivated in approximately 114 countries with Asia and Africa being the primary regions of production. This plays a crucial role in ensuring food security and providing livelihood options for these Nations. Karnataka occupies an area of 1514.28 thousand hectares with the production of 4.71 million tones and productivity of 3179 kg per hectares (Annon, 2022).

In India, more than 300 insect pests damage rice crops (Pasalu *et al.*, 2004) and twenty insect species are identified as major pest cause an yield losses of about 10-60 per cent (Bhogadhi and Bentur, 2015). Among the primary pests affecting rice, the yellow stem borer *Scirpophagaincertulas* (Walker), is most severe once which is prolific in both lowland and upland rice fields and can infest young plants even at the nursery stage (Litsinger *et al.*, 2006b) and main field causing annual yield loss of 27-34 per cent (Prasad *et al.*, 2007). Damage inflicted by leaf folder during the reproductive stage leads to yield reductions ranging from 63 to 80 per cent (Teng *et al.*, 1993). The ear head bug *Leptocorisa acuta* (Thunberg) (Hemiptera: Alydidae), causes damage during the pre-flowering stage and continues to the milky stage of the crop in both nymph and adult stages (Rao and Prakash, 1995). In severe cases, this damage can result in yield losses of upto 30 per cent (Tiwari *et al.*, 2014).To manage the pests, farmers primarily depend on chemical insecticides. The repeated and over use of same pesticides results in several undesirable consequences

like disrupting natural enemy complexes, emergence of secondary pest, pest resurgence, development of resistance, environmental contamination, health hazards and increasing demand for pesticides residues free food products has resulted in acceptance and adoption of organic paddy cultivation in the district. To address these issues the present experiments were carried out to evaluate the efficacy of eco-friendly technologies for management of economically important pests of rice crop.

Material and Methods

The field experiments were conducted in farmer fields at three clusters villages *viz*., Kadubetta of Bantwal taluk, Belalu of Belthangady taluk and Konaje of Mangaluru taluks of Dakshina Kannada districts for three consecutive years in *Kharif* 2019-20, 2020-21 to 2021-22 to demonstrate and validate the efficacy of eco-friendly technologies for the management of rice pests. The field experiments were carried out at organic farming practice fields of farmers using MO 4 rice variety, which is a common red rice variety cultivated by most of the coastal farmers. All the recommended agronomic practices (except eco-friendly pest management practices) were followed for organic paddy cultivation in both demonstration and farmers practices plots.

Details of the treatments

T_1: Demonstration of eco-friendly technologies

Seed treatment with *Pseudomonasfluorescence* @ 10 g Kg^{-1} of seed, clipping of the rice seedling tips before transplanting, release of parasitoide *Trichogramma japonicum* eggs @ 50,000/acre at 30, 37 and 44 days after transplantation (DAT), installation of pheromone traps@ 4 per acre, application of neem oil (Azadiractin 0.15% EC) @ 2mlL^{-1} during 25 DAT, 60 DAT andduring ear head formation.

T_2: Farmer's practice

Application of Neem oil @ 2 ml L of water during 25 days after transplanting (DAT), 60 DAT and 75 DAT and setting of bird perches @ 10 per acre.

Treatments were imposed in 8 ha area with 20 replications (20 farmers field). For comparison, a conventional organic farming practices plots from a nearby area (within the cluster village) were selected.

Observations recorded

Yellow stem borer

Observation on the stem borer incidence as dead heart (DH) and white ears recorded during vegetative stage (35days after transplanting-DAT) and reproductive stage (90 DAT), respectively by selecting 10 hills randomly. The percentage of damage caused by yellow stem borer was calculated using the following formula (Raut *et al.*, 2017).

Per cent of dead heart

$$Dead\ heart\ (\%) = \frac{No.\ of\ dead\ hearts\ per\ hill}{total\ no.\ of\ tiller\ per\ hill} \times 100$$

Per cent of white ear

$$White\ ear\ (\%) = \frac{No.\ of\ white\ ears\ per\ hill}{total\ no.\ of\ tiller\ per\ hill} \times 100$$

Leaf folder

Damage assessment data were recorded at 35 DAT. The observations were taken from 20 randomly selected plants from the inner rows in eachplot.

$$Leaf\ folder\ damage\ (\%) = \frac{No.\ of\ folded\ leaves\ in\ a\ hill}{total\ no.\ of\ leaves\ in\ a\ hill} \times 100$$

Ear head bug

The ear head bug damage was calculated by counting total grain to infested grains in the sampled panicles (twenty panicles) from each plot.

$$\%\ Ear\ head\ bug\ damage = \frac{Total\ no.\ of\ damaged\ grain\ in\ 20\ panicles}{Total\ no.\ of\ grains\ (damage + healthy\ grains)\ in\ 20\ panicles} \times 100$$

Yield and B:C ratio

The grain yields were estimated through random plot wise (5 × 5 m area) cutting method from each treatment of each replication and converted in to yield per hectare. Increase in yield over the farmers practices was calculated as per standard statistical procedures through t-test. For economic evaluation the net return and cost-benefit ratio was also calculated.

Table 1: Efficacy of eco-friendly management practices on stem borer incidence in paddy during 2019-20 to 2021-22.

Year	Dead Hearts (%)		White Ear heads (%)	
	Demonst-ration's practice (T1)	Farmers Practice (T2)	Demonst-ration's practice (T1)	Farmers Practice (T2)
2019-20	1.73#	5.47#	0.60	2.33
2020-21	2.63#	8.57#	3.47	6.70
2021-22	2.65##	4.76##	3.19	5.49
Mean	**2.34**	**6.26**	**2.42**	**4.84**
***t*-value**	-3.25		-1.52	
***p*-value**	0.04*		0.016**	

* Samples are significantly differed at P< 0.05,**Samples are not significantly differed at P< 0.05,
# Mean of 5 Farmers, ## Mean of 10 Farmers.

Table 2: Efficacy of eco-friendly management practices on leaf folder and ear head bug incidence in paddy during 2019-20 to 2021-22.

Year	Leaf folder incidence (%)		Ear head bug incidence (%)	
	Demonst-ration's practice (T1)	Farmers Practice (T2)	Demonst-ration's practice (T1)	Farmers Practice (T2)
2019-20	4.35#	9.84#	2.17#	5.37#
2020-21	3.68#	9.81#	2.13#	4.67#
2021-22	4.30##	6.56##	3.38##	6.30##
Mean	**4.11**	**8.74**	**2.56**	**5.44**
***t*-value**	-4.17		-4.53	
***p*-value**	0.03**		0.002*	

* Samples are significantly differed at P< 0.05,**Samples are not significantly differed at P< 0.05,
# Mean of 5 Farmers, ## Mean of 10 Farmers.

Results and Discussion

The eco-friendly pest management technologies were evaluated against important pests of rice crop *viz*., yellow stem borer, leaf folder and ear head bug for three consecutive years from 2019-20 to 2021-22 and data revealed that the lower incidence of dead hearts was 1.73%, 2.63%, 2.65% recorded in T_1 as compared to T_2 5.47%, 8.57%, and 4.76% during *Kharif* 2019-20, 2020-21 and 2021-22, respectively (Table 1). The mean dead hearts incidence was significantly lower in T_1 (2.34%) as compared to T_2 (6.26%). The white ear heads were 0.60%, 3.47%, and 3.19% in demonstration plots (T_1) as compared to 2.33%, 6.70% and 5.49%, incidence in farmers practice (T_2) during *Kharif* 2019-20, 2020-21 and 2021-22, respectively. The mean white ear incidence was low in T_1(2.42%) as compared to T_2(4.84%).

Observation on leaf folder damage (%) indicated that the incidence of leaf folder was found to be minimum in the T_1(4.35%, 3.68%, and 4.30%) as compared to T_2 (9.84%, 9.81%, and 6.56%) at 40 days after transplanting during *Kharif* 2019-20, 2020-21, and 2021-22, respectively (Table 2). The mean leaf folder incidence was not significantly differed in T_1(4.11%) as compared with T_2(8.74%).

Ear head bug in the T_1 recorded lowest incidence of 2.17%, 2.13%, and 3.38% as compared to T_2(5.37%, 4.67% and 6.30%) during *Kharif* 2019-20, 2020-21 and 2021-22, respectively. The average ear head bug incidence was significantly lower in T_1(2.56%) as compared to T_2(5.44%).

The pest incidence in farmers practice was higher due to the non-adoption of recent eco-friendly approaches. These results clearly indicated that demonstrations through eco-friendly technologies had a positive impact on reduction in pest incidence and yield enhancement. The results obtained from the present study corroborated with findings of Prasad *et al.*, (2007) where neem based commercial formulation at different concentrations registered reduction of yellow stem borer incidence and leaf folder. Application of neem oil @ 3ml L^{-1} recorded lower leaf folder damage (9.83%) at 3 days after spraying (Ravichandra *et al.*, 2014). Egg masses of yellow stem borer were parasitized by the *Trichogrammajaponicum* (Chakraborty, 2012; Ganeshwari and Kumar, 2019; Manju *et al.*, 2002). The study (Lakshmi *et al.*, 2010) revealed that egg parasitoides regulated the population of stem borer by parasitizing 95% of the egg masses. The inundative release of egg parasitoide, *T. japonicum* was effective in reducing stem borer infestation (Deshapande *et al.*, 2023; Pasalu *et al.*, 2004).

The grain yield of 51qha^{-1}, 42.58q ha^{-1}, and 48.11 q ha^{-1} were recorded in demonstration plotscompared to 44 q ha^{-1}, 33.86 q ha^{-1} and 44.01 q ha^{-1} in farmers practices during *Kharif* season of 2019-20, 2020-21 and 2021-22, respectively (Table 3). A mean yield increases of 16.99 per cent was recorded in demonstration plots compared to farmers plots. The demonstrations plots recorded higher net return of Rs. 59466.67 ha^{-1} and benefit cost ratio of 2.61 as compared to farmers practices. The findings of present study agree with those of (Ponnusamy, 2003) have reported a quantum jump of yield generation by 11.79% when the paddy field was treated with neem formulations and adoption of eco-friendly approaches.

Table 3: Efficacy of eco-friendly management practices on yield and economics of paddy during *Kharif* 2019-20 to 2021-22.

Year	Yield (q ha^{-1})		% Increase Over Farmers practice	Net Return		B:C ratio	
	Demo Plot	Farmers Practice		Demo Plot	Farmers Practice	Demo Plot	Farmers Practice
2019-20	51.00#	44.00#	15.91	60502.00#	50756.00#	2.97	2.55
2020-21	42.58#	33.86#	25.76	59285.00#	43055.00#	2.44	1.77
2021-22	48.11##	44.01##	9.32	58613.00##	49107.00##	2.41	2.01
Mean	**47.23**	**40.62**	**16.99**	**59466.67**	**47639.33**	**2.61**	**2.11**
***t*-value**	-1.58						
***p*-value**	0.02**						

**Samples are not significantly different at P< 0.05, # Mean of 5 Farmers, ## Mean of 10 Farmers.

Conclusion

The results of the present study clearly indicated that the eco-friendly approaches minimised the incidence of yellow stem borer, leaf folder and ear head bug during *Kharif* season of 2019-20, 2020-21 and 2021-22 and obtained higher grain yield, net return and benefit cost ratio compared to farmers practices plots. Hence, the adoption of technologies in organic farming system proved to be eco-friendly, economical, and sustainable in the rice production system.

Acknowledgments

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 demonstrations in farmers' fields. Also, acknowledge ICAR-National Bureau of Agricultural Insect Resources, Bengaluru for supply of egg parasitoide during the demonstration. Also, acknowledge the farming community for generously allowing us to conduct demonstrations in their fields.

Conflict of interest disclosure: The authors declare no conflict of interest

Authorship and contributions: Kedarnath: Conducted the experiments and drafted the manuscript. T.J. Ramesha, Mallikarjuna Lingappa and Chethan N coordinated in conducting the experiment. Veershetty coordinated in data analysis. Ashwini S. Koute coordinated in review and editing. Thejaswi Kumar J coordinated in data analysis.

References

Annonymos (2023). Report on the status of estimation of agriculture production in Karnataka. *Directorate of Economics and Statistics Bengaluru*, 67.

Bhogadhi, S.C. and Bentur J.S. (2015). Screening of rice varieties for resistance to brown plant hopper biotype 4 and detection of BPH resistance genes. *International Journal of Life Sciences Biotechnology and Pharma Research*, **4(2)**, 90-94.

Chakraborty, K. (2012). Relative composition of egg parasitoid species of yellow stem borer, *Scirpophagaincertulas* Wlk. in paddy field at Uttar Dinajpur, West Bengal, India. *Current Biotica*, **6**, 42-52.

Deshpande, P.P., Kulkarni U.S., Undirwade D.B. and Nagdeote V.G. (2023). Evaluation of *Trichogramma* spp. against yellow stem borer (*Scirpophagaincertulas* Walker) on paddy. *The Pharma Innovation J*., **12(3)**, 1904-1907.

Ganeshwari and Kumar S. (2019). Studies on relative composition of egg parasitoids of rice yellow stem borer, *Scirpophagaincertulas* (Walker) in *Kharif* 2017. *Journal of Pharmacognosy and Phytochemistry*, **8(3)**, 4821-4822.

IRRI, Africa Rice and CIAT (2010). Global Rice Science Partnership (GRiSP). CGIAR Thematic Area 3: sustainable crop productivity increase for global food security. A CGIAR Research Program on Rice-Based Production Systems. November 2010. IRRI, Philippines, Africa Rice, Benin and CIAT, Colombia.

Lakshmi, V.J., Surekha K. and Pasalu I.C. (2010). Parasitization of rice yellow stem borer, *Scirpophagaincertulas* (Walker) egg masses. *Annals of Plant Protection Science*, **8(2)**, 366-3.

Litsinger, J.A., Alviola A.L., Dela Cruz C.G., Canapi B.L., Batay-An III E.H. and Barrion A.T. (2006b). Rice white stemborer, *Scirpophagainnotata* (Walker) in southern Mindanao, Philippines. I. Supplantation of yellow stemborer, *S. incertulas* (Walker) and pest status. *Int. J. Pest Manag*. **52(1)**, 11-21.

Manju, S., Thangaraju D. and David P.M. (2002). Egg parasitism in rice yellow stem borer, *Scirpophagaincertulas* (Walker). *Indian Journal of Plant Protection*, **30(1)**, 91.

Pasalu, I.C., Mishra B., Krishnaiah N.V. and Katti G. (2004). Integrated pest management in rice in India: Status and prospects. In: integrated pest management in Indian agriculture (eds.) Birthal PS and Sharma OP, Proceedings 11. *National centre for agricultural economics and policy research and National centre for integrated pest management*, New delhi, India. 25-50.

Ponnusamy, K. (2003). Farmers' participatory assessment of neembased insecticide in controlling the ear head bug (*Leptocorisaacuta*) in rice. *Madras Agri. J*., **90(7-9)**, 564-566.

Prasad, S.S., Gupta P.K. and Kanaujia B.L. (2007). Simulation study on yield loss due to *Scirpophagaincertulas* on semi deepwater rice. *Annuals of Plant Protection Sciences*, **15**, 491-492.

Rao, J. and Prakash A. (1995). Biodegradation of paddy seed quality due to insects and mites and its control using botanicals. *Final report ICAR/CRRI Ad-hoc Scheme* (1992-95), 87.

Raut, A.M., Satpathi C.R. and Krishnaiah K. (2017). Management of rice yellow stem borer *Scirpophagaincertulas* (Walker) using different formulations of insect sex pheromone in West Bengal. *J Pure and Applied Microbial*, **11(1)**, 549-558.

Ravichandra, Y.P., Sreenivas A.G., Prabhuraj A., Hiremath G.M., Rachappa V. and Vendan K.T. (2014). Management of insect-pests of paddy by organic approaches. *Journal of Biological Control*, **28(3)**, 166-176.

Teng, P.S., Heong K.L. and Moody K. (1993). Advances in tropical rice integrated pest management research. New frontiers in rice research. Muralidharan, K., Siddiq, E.A., (ed.). Directorate of Rice Research, Hyderabad, India. 241-255.

Tiwari, A., Pandey J.P., Tripathi K., Pandey D., Pandey B. and Shukla N. (2014). Effectiveness of insecticides and biopesticides against gundhi bug on rice crop in district Rewa (M. P.), India. *International Journal of Science and Research*, **4(1)**: 1-4.