International Journal of Plant & Soil Science

Volume 34, Issue 24, Page 363-368, 2022; Article no.IJPSS.94883
ISSN: 2320-7035

Integrated Pest Management of Brown Plant Hopper (*Nilaparvata lugens* (Stal)) in rice of Mancherial District, Telangana State, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i242651

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/94883

Original Research Article

Received: 12/10/2022
Accepted: 23/12/2022
Published: 27/12/2022

ABSTRACT

The present study on Integrated Pest Management (IPM) of brown plant hopper, Nilaparvata lugens (Stal) in rice has been conducted as a Front Line Demonstration (FLD) in the adopted villages of KVK, Bellampalli, Mancherial district of Telangana state during the kharif (June – December), season of 2018–19, 2019–20 and 2020–21 respectively to create awareness among the farming community on the IPM practices to manage the pest. The adoption of IPM practices includes formation of alleyways, recommended dose of nitrogen fertilizer, alternate wetting and drying, spraying of need based insecticides like Dinotefuran 20 SG @ 0.4 g or Pymetrozine 50 WDG @ 0.6 g l^{-1} of water were carried out. The study reveals that the lowest hoppers incidence was witnessed in the demonstrated plot with 1.84, 12.18 and 19.0 adults $hill^{-1}$ in tillering stage and 7.76, 24.95 and

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52.38 adults hill^{-1} in panicle stage over farmers practice (3.33, 35.40 and 25.42 adults hill^{-1} in tillering stage and 19.84, 50.30 and 63.47 adults hill^{-1}). The average yields of IPM module demonstrated plot was 7130, 5513 and 5065 kg ha^{-1} whereas in farmer practice the yield was 6733, 4851 and 4768 kg ha^{-1} during *Kharif* (June–December), 2018–19, 2019–20 and 2020–21 respectively with an increased yield of 5.88%, 13.64% and 6.22% during corresponding *Kharif* (June–December), 2018–19, 2019–20 and 2020–21. Further the Cost-Benefit ratio of 1.88, 2.68 and 1.78 in the technology demonstrated plots whereas in farmers practice the recorded Cost-Benefit ratio of 1.43, 1.94 and 1.48 during corresponding *Kharif* (June–December), 2018–19, 2019–20 and 2020–21 respectively.

Keywords: Rice; brown plant hopper; integrated pest management; alle ways; insecticides; alternate wetting and drying.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop of the world and second largest cultivated crop after wheat [1] and providing a staple food for more than half of the world population [2]. The crop is attacked by 300 insect pests in the different stages of the crop and among them only 23 species causes notable damage [3]. Among which brown plant hopper, *Nilaparvata lugens* (Stal), (Hemiptera: Delphacidae) is one of the most economically significant insect-pests of rice in most of the Asian countries causing a noticeable damage to the crop by reducing the yields ranges from 10%–90% and in Asia the loss have been estimated as more than $300 million annually [4]. If timely control measures are not taken up, there may be a chance of total crop loss within a very short period [5]. In addition to this it also transmits the ragged stunt virus, striped virus and grassy stunt virus [6,7]. The search and evaluation of new insecticide molecules must also be a systematic practice so as to develop safer and effective alternatives to minimalize the brown plant hoppers damage [8,9]. This continuous and indiscriminate use of one insecticide has resulted in the rapid development of insecticide resistance and exhaustion of most insecticide options in many rice-growing regions [10] including organophosphates, carbamates, pyrethroids, neonicotinoids and phenylpyrazoles [11]. Insecticides remain, as a significant weapon in the integrated pest management (IPM) system because of its speedy, efficient, economical and easy to use against pests [12-14]. To overcome these lapses KVKs acts as a Knowledge and Resource Centre at district level to demonstrate the technologies [15] and the output of the research is disseminated to farmers through conduction of frontline demonstrations about the developed technologies [16]. For this IPM technologies need to be practiced in cluster approach to manage the pest [17]. Integrated pest management (IPM) practices is one of the eco-friendly approaches, which can be applied to regulate the indiscriminate use of insecticides to control rice insect pests [18,19]. Hence, the following integrated pest management module under front line demonstrations were formulated with all integrated approaches like formation of alleyways, recommended dose of nitrogen fertilizer, alternate wetting and drying are being added along with chemical control to manage brown plant hopper, *Niaparvatha lugens* (Stal) in the present study conducted by Krishi Vigyan Kendra, Bellampalli, Mancherial District, which was undertaken during kharif (June–December), 2018–19, 2019–20 and 2020–21 respectively to manage the brown plant hopper, *Niaparvatha lugens* (Stal) by instigating integrated pest management practices in the farmer fields of villages in the various mandals of Mancherial district of Telangana state.

2. MATERIALS AND METHODS

The present study was carried out in the various adopted villages of KVK, Bellampalli in the Mancherial district during *kharif* (June–December), 2018–19, 2019–20 and 2020–21. In this study, 30 farmers (10 farmers/year) were selected for the demonstration of the technology over the three years. The improved technology were imposed, consisting formation of alleyways, recommended dose of nitrogen fertilizer, alternate wetting and drying, spraying of need based insecticides like Dinotefuran 20 SG @ 0.4 g or Pymetrozine 50 WDG @ 0.6 g l^{-1} of water in the demonstrated plots. Whereas in the farmers practice, indiscriminate spraying of Acephate 75 SP @ 1.5 g, Imidacloprid 17.8 SL @ 0.25 ml, Buprofezin 25 SC @ 1.6 ml and Imidachloprid+Ethiprole 40 WG @ 0.25 g l^{-1} etc. of which results in the heavy infestations of *N. lugens* (Farmers practice). The hopper population (nymph or adult) hill^{-1} was recorded

Table 1. Brown plant hoppers incidence in relation with weather during *kharif,* 2018–19, 2019–20 AND 2020–21

Month	**Average Population Hill^{-1}**						**Meteorological Observation**								
	2018–19		**2019–20**		**2020–21**		**Temperature °C (Max.)**			**Temperature °C (Min.)**			**Rain fall (mm)**		
	Demo	**Farmer's Practice**	**Demo**	**Farmer's Practice**	**Demo**	**Farmer's Practice**	**2018–19**	**2019–20**	**2020–21**	**2018 –19**	**2019–20**	**2020–21**	**2018–19**	**2019 –20**	**2020–21**
Vegetative Period	1.84	3.33	12.18	35.40	19.00	25.42	31.3	30.6	30.3	23.1	23.4	30.6	346.7	379.0	263.8
Reproductive Period	7.76	19.84	24.95	50.30	52.38	63.47	32.0	30.4	30.2	17.8	18.5	18.2	12.12	44.1	35.9

*Vegetative period (August–September) and Reproductive Period (October–December)

Table 2. Economic impact of experiment during *Kharif* (June–December), 2018–19, 2019–20 and 2020-21

Particulars	**Yield (Kg ha^{-1})**			**Percent increasein yield over check (%)**			**Cost of cultivation (□ ha^{-1})**			**Gross returns(□ ha^{-1})**			**B:C Ratio**		
	2018–19	**2019–20**	**2020–21**	**2018–19**	**2019–20**	**2020–21**	**2018–19**	**2019–20**	**2020–21**	**2018–19**	**2019–20**	**2020–21**	**2018–19**	**2019–20**	**2020–21**
IPM Module	7130	5513	5065	5.88	13.64	6.22	54950	38068	49915	103378	101981	88642	1.88	2.68	1.78
Farmer's Practice	6733	4851	4768	-	-	-	68238	46353	65653	97636	89744	83440	1.43	1.94	1.27

during the vegetative and reproductive stage of the crop after each spray and 7 days after each application and the percent reduction over control of hoppers was calculated. Finally, the grain yield (kg ha^{-1}) and cost - benefit ratios of demonstrated plots and farmers practice were also recorded and calculated.

3. RESULTS AND DISCUSSION

Results revealed that the incidence of *N. lugens* was lower in the demonstrated plots with 1.84 nymphs or adults $hill^{-1}$ in the vegetative stage and 7.76 nymphs or adults $hill^{-1}$ in reproductive stage during *kharif,* 2018–19 and with 12.18 nymphs or adults $hill^{-1}$ in the vegetative stage and 24.95 nymphs or adults $hill^{-1}$ in reproductive stage during *kharif,* 2019–20 and with 19.0 nymphs or adults $hill^{-1}$ in the vegetative stage and 52.38 nymphs or adults $hill^{-1}$ in reproductive stage during *kharif,* 2020–21. The higher infestation was observed in farmer practices with 3.33 nymphs or adults $hill^{-1}$ in the vegetative stage and 19.84 nymphs or adults $hill^{-1}$ in reproductive stage during *kharif* (June–December), 2018–19 and with 35.40 nymphs or adults $hill^{-1}$ in the vegetative stage and 50.30 nymphs or adults $hill^{-1}$ in reproductive stage during *kharif* (June–December), 2019–20 and with 25.42 nymphs or adults $hill^{-1}$ in the vegetative stage and 63.47 nymphs or adults $hill^{-1}$ in reproductive stage during *kharif* (June – December), 2020–21 (Table 1).

The total cost of cultivation incurred, gross and net returns & B:C ratio in this study to assess the economic impact of technology of IPM module and farmer practice. The data in Table 2 revealed that the yield of IPM module followed plot was 7130, 5513 and 5065 kg ha^{-1} whereas in farmer practice the yield was 6733, 4851 and 4768 kg ha^{-1} during (June–December), 2018–19, 2019–20 and 2020–21 respectively. The economic analysis results revealed that the paddy crop recorded higher gross income from IPM module were ₹10337, ₹101981 and ₹88642 ha^{-1} as related to ₹97636, ₹89744 and ₹83440 ha^{-1} in farmers practice during *kharif* (June – December), 2018–19, 2019–20 and 2020–21 respectively. The B:C Ratio in IPM module was 1.88, 2.68 and 1.78 while in farmer practice plot was 1.43, 1.94 and 1.27 during *kharif* (June – December), 2018–19, 2019–20 and 2020–21 respectively. The results of the current study are in line with the findings [20-23]. IPM module shown positive results in respect of yield and economics of rice. It was marked from the results that B:C Ratio of rice crop in IPM module was higher as compared to farmer practice in both the years. Because of non-adoption of IPM module for brown plant hopper management in rice crop resulted in lower B:C Ratio in farmer practice. Thus, promising B:C Ratio and higher net returns in IPM module showed the economic sustainability of the demonstrated technology and influenced the farmers on the utility of technology provided at actual farming situation. Therefore, it is concluded that the technology demonstrated treatments can be recommended in large scale to manage brown plant hoppers in rice fields in ensuing cropping seasons (Table 2).

4. CONCLUSION

In IPM module, documented higher paddy yield with net returns of ₹48428, ₹63913 and ₹38727 ha^{-1} which was about 5.88%, 13.64% and 6.22% with corresponding B:C ratios of 1.88, 2.68 and 1.78 higher than the non IPM module with ₹29398, ₹43391 and ₹17787 ha^{-1} during *kharif*, 2018–19, 2019–20 and 2020-21 respectively. The IPM based practices were found effective in comparison to farmer practice. From the above study, it can be concluded that by adopting IPM based brown plant hopper management strategies in in can be efficiently managed instead of practicing chemical control measure alone.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/94883