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# Validation of Integrated Pest Management Modules against Piercing and Sucking Insect Pest of Rice

I. Yimjenjang Longkumer[1,2], Md. Abbas Ahmad[2],
Sandeep Choudhary[1], M.A. Laichattiwar[3], R. Bajia[4]

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## ABSTRACT

**Background:** Rice is one of the most common cereal crops in India, which has been found attacked by several insect pests including hoppers, stem borer, leaf folder, gall midge and ear head bugs. Farmers typically employ insecticides as preventative and curative management which causes needless issues. Although integrated pest management (IPM) has been recommended to nullify the ill effects of chemicals pesticides, farmers are hesitant to employ the IPM's components and mostly rely on pesticides. IPM integrates knowledge-based techniques of biological, cultural, physical, host plant resistance and chemical control strategies in order to limit pest populations considered economically acceptable. Present investigation was conducted to evaluate the effectiveness of IPM strategy improving upon the crop productivity.

**Methods:** An Integrated Pest Management (IPM) module comprising of spacing, introduction of natural enemies, application of botanicals, entomopathogenic fungi, installation of yellow sticky traps and chemical pesticide (Thiamethoxam) was assessed in comparison with Farmers Practice (FP) (usual routine followed by the farmer during the cropping season) in the farmer's fields.

**Result:** The pooled mean data of per cent leaf incidence by *Nephotettix virescens* ranged between 4.59-6.25% during the two years research in IPM module, while in farmers practices mean leaf damage varied between 8.09-8.61%. Similarly, the leaf damage caused by *Nilaparvata lugens* ranged between 4.88-7.61% as compared to 8.64-10% in the farmers practices. The BC ration was recorded to be 1: 7.6 and 1:6.85 during 2018 and 2019, respectively.

**Key words:** IPM, *Nephotettix virescens, Nilaparvata lugens*, Rice.

## INTRODCUTION

Rice (*Oryza sativa* L., Family: Poaceae) is the most significant grain and staple crop in the world including Asia. According to FAO (2018), rice is the third most produced agricultural crop in the world, after sugarcane and maize. Rice is a good source of protein, fats, crude fibre and carbohydrates along with vitamins and salts including riboflavin, niacin, tocopherol, calcium and other salts (Verma, 2011) The United Nations declared 2004 as the "Worldwide Year of Rice" to recognize significance of rice that have an impact on millions of people's economy, nutrition and cultural practices. In India, rice is grown across an area of 47 million hectares, producing 134 million tonnes (Anonymous, 2023). Rice is grown in Bihar throughout both the *Kharif* and Rabi seasons under various natural and climatic circumstances, covering an area of 2.914 million hectares and yielding 6.8 million tonnes (Anonymous, 2018). Around 52% of the world's rice output get loss due to damage caused by biotic factors, of which 21- 25% is due to damage from pest fauna (Yarasi *et al*., 2008; Dhaliwal *et al*., 2015). Rice gall midge (*Orseolia oryzae* Wood Mason), rice leaf folder (*Cnaphalocrocis medinalis* Guenee), brown planthoppers (*Nilaparvata* lugens Stal), yellow stemborer (*Scirpophaga incertulas* Walker), Green leafhopper (*Nephotettix virescens* Distant) and white-backed planthopper (*Sogatella furcifera* Horvath) are the most serious rice pests causing significant reduction in yield. (Anonymous, 1996; Singh and Kumari, 2020). Farmers use broad-spectrum pesticides indiscriminately to manage these pests, which leads to a number of risks including insecticide resistance, secondary pest outbreaks, phytotoxicity, toxicity to beneficial organisms and environmental pollution like groundwater contamination (Halder *et al*., 2014) in addition to with the pesticide residue. Integrated pest management (IPM), is a combination of cultural, physical, mechanical, botanical, chemical (when required) and other management methods which plays a significant role in countering the

[1]Department of Entomology, School of Agriculture, Lovely Professional University, Phagwara-144 411, Punjab, India.
[2]Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa-848 125, Bihar, India.
[3]Department of Entomology, College of Agriculture, Parul University, Vadodara-391 760, Gujarat, India.
[4]Department of Agriculture, Jagannath University, Jaipur-302 022, Rajasthan, India.

**Corresponding Author:** I. Yimjenjang Longkumer, Department of Entomology, School of Agriculture, Lovely Professional University, Phagwara-144 411, Punjab, India.
Email: yimjenjang.28315@lpu.co.in

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population of pest in a sound manner. Many researchers had already proven the usefulness of IPM integrating of each and all available components in managing the pest population of rice below those causing economic injury (Alam *et al*., 2016; Tanwar *et al*., 2016; Anurag *et al,* 2020; Jahnavi *et al.,* 2022). Therefore, the present study was designed to assess the effectiveness of a knowledge based IPM module in insect pest management of rice as well as its economics, which is crucial from the perspective of the farmer.

## MATERIALS AND METHODS

The research trial was conducted during *Kharif* season of 2018 and 2019 at Pusa Rice Research Farm, Dr. Rajendra Prasad Central Agricultural University, Bihar. The field was first leveled properly to have uniform geology and two blocks of 440 $m^2$ was prepared. Each block was sub-divided into five equal parts, which was taken as replication. The packages followed are given in (Table 1).

### Observations recorded

Observation on pest incidence was initiated from 15 DAT by randomly selecting 5 hills in each replication at fortnightly interval. Total 25 hills in IPM block and 25 hills in Farmers practice block at each observation no. of nymphs, adults and leaf damages were recorded. The data so obtained was analysed with ANOVA using SPSS software.

## RESULTS AND DISCUSSION

### *Nilaparvata lugens*

The pooled incidence of *Nilaparvata lugens* (Table 2) recorded at 15 DAT upto 113 DAT varied widely ranging from 4.88 to 7.61 per cent incidence in IPM module whereas in farmer's practices the incidence varied from 8.64 to 10. The peak incidence in farmer's practices 9.65, 10 and 9.60% leaf damage was recorded at 43 DAT, 57 DAT and 57 DAT. As the crop reaches its maturity the incidence gradually declined from 6.06 per cent to 4.88 per cent incidence in IPM modules which was recorded from the period at 85 DAT to 113 DAT which was contradictory incase of farmer's practices whereby *Nilaparvata lugens* incidence remained consistently higher during this period with a per cent incidence of 8.74 to 8.91 recorded at 85 DAT to 113 DAT.

### *Nephotettix virescens*

The pooled data data on effect of IPM technologies as against farmers practices depicted in Table 3 shows that mean incidence of leaf damage from 15 DAT to 113 DAT ranged from 4.59 to 6.25 per cent incidence of leaf damage as compared to 8.09 to 8.61% leaf damage in farmers practices. The mean incidence of leaf damage was also significantly higher during the period from 57 DAT to 113 DAT in farmers plot whereas the mean leaf damage of 4.59% to 5.70% was recorded in the IPM plot during the period. Similar, finding was also recorded by (Gautam *et al*., 2017) where the impact of IPM practices had a significant effect on technology efficiency level. Higher technology efficiency is due to the improvement in extension services, such as training and demonstrations; as these factors are necessary and had a significant impact on adoption (Rahman and Norton, 2019). Developing of the IPM modules and its adoption by the farmers can only ensures the successful management of insect-pests. In a study carried out by Bagenia and Meena, (2017) revealed that majority of farmers incorporated the cultural practices such as summer deep ploughing, sanitation of fields, manual weeding, inter

**Table 1:** Packages and practice of IPM module and farmers practices.

| Treatment/period | IPM module | Farmer's practice |
|---|---|---|
| Nursery | Broadcasting carbofuran @ 1.1 kg a.i. $ha^{-1}$ | Nil |
| Main field | Optimum spacing: 20 x 15 cmBased on the ETL, application of Thiamethoxam 25 WG @ 0.5 ml/lt for the management of hoppers Installation of Yellow sticky traps 15 DAT @ 3 traps for monitoring. The traps were replaced after every 30 days. | High density planting |
| 30-59 DAT | Mid-season drainage, hand weeding, spraying of neem @ 5 ml/l of water, Verticillium *lecanii* @ 5 ml/l of water | Hand weeding, proper irrigation |
| 60-90 DAT | Introduction of coccinellid beetle @ 500 adults/week Mid-season drainage, hand weeding | Removal of damaged plant parts |
| 90 DAT to harvest | Yield was recorded and also the cost involved in IPM | |

**Table 2:** Impact of IPM modules on incidence (%) of *Nilaparvata lugens* (*Kharif*, pooled data of 2018 and 2019).

| Treatment | Incidence (%) of *Nilaparvata lugens* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 15 DAT | 29 DAT | 43 DAT | 57 DAT | 71 DAT | 85 DAT | 99 DAT | 113 DAT |
| IPM module | 7.08 | 6.87 | 7.61 | 6.93 | 6.39 | 6.06 | 5.25 | 4.88 |
| Farmers practice | 8.76 | 8.89 | 9.65 | 10 | 9.60 | 8.74 | 8.64 | 8.91 |
| S.Ed. (±) | 0.13 | 0.13 | 0.06 | 0.18 | 0.23 | 0.18 | 0.17 | 0.18 |
| C.D. (P=0.05) | 0.3 | 0.31 | 0.15 | 0.42 | 0.52 | 0.40 | 0.39 | 0.40 |

DAT= Days after transplanting.

**Table 3:** Impact of IPM modules on incidence (%) of *Nephotettix virescens* (*Kharif*, pooled data of 2018 and 2019).

| Treatment | Per cent incidence of *Nephotettix virescens* (2018) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 15 DAT | 29 DAT | 43 DAT | 57 DAT | 71 DAT | 85 DAT | 99 DAT | 113 DAT |
| IPM module | 5.11 | 5.85 | 6.25 | 5.70 | 5.21 | 5.02 | 4.85 | 4.59 |
| Farmers practice | 8.29 | 8.1 | 8.17 | 8.61 | 8.46 | 8.40 | 8.09 | 8.17 |
| S.Ed (±) | 0.15 | 0.15 | 0.74 | 0.09 | 0.26 | 0.24 | 0.09 | 0.05 |
| CD (0.05) | 0.34 | 0.35 | 1.78 | 0.21 | 0.61 | 0.54 | 0.21 | 0.13 |

**Table 4:** Cost-benefit ratio of the IPM Modules and Farmers practices against major insect pest of rice during *Kharif*, 2018 and 2019.

| Treatment | Yield (t ha$^{1}$) | | Increased yield (t ha$^{1}$) | | Gross return (₹ ha$^{1}$) | | Management cost (₹ ha$^{1}$) | | Net return (₹ ha$^{1}$) | | BCR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| IPM block | 4.22 | 4.34 | 3.05 | 2.77 | 56425 | 51245 | 6520 | 6520 | 49905 | 44725 | 1: 7.65 | 1: 6.85 |
| Farmers practices | 1.17 | 1.57 | - | - | 2164.5 | 2904.5 | - | - | - | - | - | - |

cropping and inter row earthing up and practices neem based botanicals which resulted in low incidence of the pest (Bagenia and Meena, 2017). Divya and Mariappan (2020) revealed that IPM practices was effective in reducing the population of insect pest with minimal effect on natural enemies *viz*., spiders 10.95/ 10 hill and coccinellid 9.95/ 10 hill and significantly superior over farmers practice. The present finding is in conformity with the result of (Shanmugam *et al*., 2022) and (Swathi *et al*., 2018) who reported the component of chemicals with less residues and minimum negative effect of beneficial insects such as thiamethoxam to be effective in lowering the pest population. Gautam *et al*. (2013) also observed the efficacy of botanicals as IPM component when Neem 5% was found effective in managing the incidence of pest and were found relatively safe against predators and parasitoids such as *Chrysoperla carnea* and *Trichogramma chilonis* compared with pesticides. Similar findings are also in agreement with the present result where incorporation of Entomopathogens and insecticides from animal origin contributed significant result in reducing the pest population (Laichattiwar and Meena, 2014; Dhaker *et al*., 2017; Javed *et al*., (2019).

**Economics and yield (2018 and 2019)**

Harvested yield data presented in Table 4 indicates that the validated modules gave 4.22 t/ha during 2018 with an increase of 3.05 t/ha over farmer's practices. The results showed IPM module not only increases the grain yield but also gave high net return of Rs. 49905 with 1:7.64 cost: benefit ratio. Similarly, during the second trial, the validated modules gave 4.34 t/ha with an increase of 2.77 t/ha over farmer's practices. The results showed IPM module not only increased grain yield but also provided high net return of 44725 with 1: 6.85 cost: benefit ratio. Earlier, Singh *et al*., 2018 and Surendra *et al*. (2016) studied the effect of IPM modules against rice pest and compared with farmer practice and reported increased in grain yield in IPM Modules respectively over farmers practices. It was shown that high benefit cost ratio of tested Module 1 and Module 2 over farmer's practice was obtained. Borkakati and Saika (2020) observed maximum yield and cost: benefit ratio (1: 8.46) in the IPM plot and the proposed IPM module was found superior with highest yield and cost-benefit ratio. Mohankumar *et al*. (2016) and Singh *et al*. (2017) also observed that IPM approach was effective against piercing sucking insect pests giving maximum cost: benefit ratio.

## CONCLUSION

The present study's findings lead to the conclusion that the IPM module is more effective than other practices in managing the sucking pest in rice. IPM refers to the logical blending of several techniques, particularly the blending of chemical pesticides with other ecologically friendly components to control the pest below ETL. It can be concluded that the IPM module is a comprehensive strategy for sustainability in crop protection that focuses on managing the pest and has been enshrined as the best module that is both economically viable and environmentally feasible.

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