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Dissemination and impact of a bio-intensive pest management package for Sali rice in Tinsukia district of Assam

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Abstract

The excessive and indiscriminate use of chemical pesticides in rice cultivation has resulted in pest resurgence, resistance development and serious environmental and health concerns. Bio-intensive pest management (BIPM), which integrates biological, cultural and ecological approaches, offers a sustainable alternative for effective pest and disease management in rice ecosystems. The present study evaluates the dissemination and field-level impact of a bio-intensive pest management package for Sali rice in Tinsukia district of Assam through Front Line Demonstrations (FLDs) conducted during 2019-20 and 2020-21. The demonstrations were conducted at six locations across four development blocks covering a total area of 2 ha. The BIPM package comprised seed treatment with *Pseudomonas fluorescens*, application of *Beauveria bassiana*, release of *Trichogramma japonicum*, installation of pheromone traps and bird perches, need-based application of botanicals and spray of *Pseudomonas fluorescens* against diseases. The performance of the BIPM package was compared with farmers' conventional practices. Data on pest infestation, disease incidence, grain yield and economic returns were recorded and analysed. The results revealed a substantial reduction in pest infestation (15.5 and 13.5%) under BIPM compared to farmers' practices (40.0 and 34.5%) during 2019-20 and 2020-21, respectively. Similarly, disease incidence was significantly lower in the BIPM plots (13.0 and 15.0%) than in farmers' fields (35.6 and 39.0%). Adoption of the BIPM package resulted in higher grain yield (40.0 and 39.5 q ha⁻¹) compared to farmers' practice (34.6 and 35.0 q ha⁻¹). The technology also recorded higher net returns and favourable benefit-cost ratios in both the years of study. The study clearly demonstrates that the bio-intensive pest management package is an economically viable and environmentally safe approach for managing major insect pests and diseases of Sali rice in Tinsukia district and holds strong potential for wider dissemination among rice-growing farmers of Assam.

Keywords: *Pseudomonas fluorescens*, *Beauveria bassiana*, *Trichogramma japonicum*, bio intensive, pest, disease

Introduction

Rice is the staple food for more than half of the world's population. India is the second largest producer and the largest exporter of rice globally. According to the Department of Agriculture and Farmers Welfare, Government of India, rice production during 2025-26 was 124.50 million tonnes from an area of 44.17 million hectares. Rice cultivation in India is not only an important agricultural activity but also forms the cultural, economic and ecological foundation of rural livelihoods. It is a primary source of income and employment for more than 200 million households worldwide (Muthayya *et al.*, 2014) [6]. In India, rice is mostly cultivated in states like West Bengal, Uttar Pradesh, Punjab, Andhra Pradesh, Tamil Nadu, Bihar, Odisha, and Assam. In Assam, rice is the principal crop and plays an important role in State agriculture and economy. In Assam, rice is cultivated in three seasons viz., Autumn, Winter and Summer and classified into different groups such as 'Ahu or Autumn Rice' cultivated during March-April to June-July, 'Sali or Winter rice' cultivated during June-July to November-

December, 'Asra or Semi Deep Water Rice' cultivated during April-May to December-January, 'Bao or Deep Water Rice' during April-May to December-January, 'Boro or Summer Rice' during November-December to May-June and 'Hill Rice' cultivated direct-seeded in Jhum land during April to September. In terms of production and productivity in Assam, rice occupies 2.54 million hectares, over 60% of Assam's gross cropped area which is about 4.16 million hectares and accounts for 96% of total food grain production (Basumatary *et al.*, 2025) [2]. During 2022-23, rice production in Assam was 6.04 million tons with an average yield of 2,652 kg/hectare, up from 5.44 million tonnes and 2,271 kg/hectare in 2018-19 (Basumatary *et al.*, 2025) [2]. Tinsukia district is an important rice-growing district of Assam, where Sali rice is cultivated over an area of about 56,949 ha with a production of 92,744 tonnes and an average productivity of 1,653 kg per ha. In case of summer rice, it is grown in an area of 5377 ha with average production of 8337 tonnes and a productivity of 1576 kg/ha during 2019-20. However, rice cultivation in the district is constrained by several biotic and abiotic stresses, among

which insect pests and diseases constitute major yield-limiting factors. More than 120 insect species have been reported to damage rice, of which about 15-20 are economically important (Kalode, 2005) [4]. Amongst the major pests, rice stem borer, gall midge, case worm, leaf folder, plant hopper and rice bug infestation are predominant in the district. In case of diseases, blast, brown spot, sheath blight, bacterial leaf blight and false smut are the major yield limiting factors. Farmers usually go for chemical pesticides directly to manage these pests and diseases of rice without being concerned about the increasing environmental pollution and global warming. Indiscriminate and repeated use of pesticides has resulted in pest resistance, resurgence of minor pests, pesticide residues in produce and adverse effects on the environment and human health. Therefore, adoption of a bio-intensive pest management (BIPM) approach integrating biological, cultural and mechanical methods is essential for sustainable management of pests and diseases in rice ecosystems. With this objective, Krishi Vigyan Kendra (KVK), Tinsukia has undertaken On Farm Trials (OFTs) on 'Bio intensive pest management package of Sali rice' during 2017 to 2019. Based on the encouraging results, Front Line Demonstrations (FLDs) were subsequently conducted during 2019-20 and 2020-21 to disseminate the technology at farmers' fields and to assess its performance under real farming situations.

Materials and Methods

The study is based on data recorded under Front Line Demonstration (FLD) programmes on 'Bio intensive pest management package of Sali rice' conducted in Tinsukia district of Assam in two consecutive years viz., 2019-20 and 2020-21. KVK, Tinsukia has conducted FLDs at six locations of four Blocks viz., Gutibari village of Guijan Block, Dighal Haku village of Hapjan Block, Kherjan, Dirak and Bordirak area of Kakopathar Block as well as Dholla area under Sadiya Block (Plate 10, 11 and 12). Before conducting demonstrations, a survey was done by following the methods suggested by Choudhary (1999) [3] for selection of farmers for the demonstrations. Moreover, for the demonstration the major rice growing belts of the district were selected from where higher incidence of pests and diseases was recorded earlier. The total area covered under this technology was 2 ha. During the programme, treatment (T₁) 'BIPM package of Sali rice' was compared with farmers' practice (T₂). The treatment details were as follows:

T₁: BIPM package of Sali rice

- Seed treatment with *Pseudomonas fluorescens* @8 g/kg of seed.
- Spray of *Beauveria bassiana* @ 10³ spore/ha against sucking pest for 2 times at 15 days interval.
- Release of *Trichogramma japonicum* @ 100000/ha twice at 30 days after planting.
- Spray of *Pseudomonas fluorescens* @ 2% against disease.
- Erection of bird perches @ 15 nos./ha.
- Use of pheromone trap @ 8 nos./ha.
- Need based application of botanicals twice at 10 days interval.

T₂: Farmers practice

For conducting the demonstration programme critical inputs were provided to the farmers and regular monitoring was done to record pest and disease incidence in the fields. Moreover, method demonstrations on seed treatment, release of Trichocards (Plate 1, 2 and 8), installation of pheromone traps (Plate 3) and preparation of biopesticide spray solutions (Plate 4, 5 and 6) as well as group discussions were also conducted to disseminate the technology in a wider way. The crop sowing was done during mid-June and transplanting was done in mid-July and harvested during the month of October-November. Seeds were treated with *Pseudomonas fluorescens* @ 8 g/kg of seed in treatment plot whereas seeds were not treated in case of farmers' practice. Other components of the BIPM package were applied at appropriate crop stages in the demonstration plots, whereas farmers' practice followed their conventional pest management schedule. During the period of assessment, data related to % pest infestation, % disease incidence, grain yield and economic parameters such as cost of cultivation, gross return, net return were collected from demonstration area. % pest infestation, % disease incidence were calculated by using the below-mentioned formula.

$$\% \text{ Pest infestation} = \frac{\text{Number of infested units}}{\text{Total Number of Units Assessed}} \times 100$$

$$\% \text{ Disease incidence} = \frac{\text{Number of infected plant units}}{\text{Total Number of Units Assessed}} \times 100$$

Results and Discussion

The increasing concerns over the reduced effectiveness of chemical pesticides and their adverse environmental consequences have led to a paradigm shift towards Integrated Pest Management (IPM) or Bio Intensive Pest Management (BIPM) as a sustainable crop protection strategy. Under the National Agricultural Policy of the Government of India, IPM has been recognized as a key component of plant protection owing to its ecological safety, economic feasibility, and social acceptability (Prakash *et al.*, 2014) [8]. The present study reinforces the importance of IPM/BIPM as a holistic approach involving multiple compatible tactics for effective management of insect pests and diseases. The BIPM package evaluated in the present investigation comprised biological seed treatments (Plate 4), use of microbial antagonists (Plate 8), conservation and augmentation of natural enemies, pest monitoring tools (Plate 3), and need-based botanical interventions. Pest surveillance through agro-ecosystem analysis, field scouting, and trap-based monitoring enabled timely decision-making based on economic threshold levels, thereby avoiding unnecessary pesticide applications. Such monitoring-based interventions are essential for sustainable pest suppression in rice ecosystems.

The present study showed that lower pest infestation of 15.5 and 13.5% was recorded in treatment plot as compared to 40.0 and 34.5% in farmers' practices during 2019-20 and 2020-21 respectively (Table 1 and 2). Most prevalent pests in the fields during the evaluated years were rice stem borer (Plate 7 and 9), leaf folder and gundhi bug. Moreover,

records on % disease incidence showed 13.0 and 15.0% in treatment plot as compared to 35.6 and 39.0% in farmers' practices during 2019-20 and 2020-21 (Table 1 and 2). In case of diseases, blast, brown spot and false smut were observed in experimental plots. Similar results were also

found in the study conducted by Balasubramaniam, M in the year 2022 ^[1], where lower incidence of stem borer (6.5%), leaf folder (7.3%), gall midge (5.4%) and blast (5.1%) was recorded in treatment plot as compared to the farmers' practice.

Table 1: Performance of bio intensive pest management (BIPM) package in rice under front line demonstration during 2019-20

Parameters*	BIPM	Farmer's practice (FP)
% pest infestation	15.5	40.0
% disease incidence	13.0	35.6
Grain Yield (q/ha)	40	34.6
% yield increase over FP	13.5	-
Gross Cost (Rs./ha)	32000	29800
Gross Income (Rs./ha)	57400	49000
Net Income (Rs./ha)	25400	19200
BC Ratio	1.79	1.69

The lower incidence of key insect pests and diseases observed under BIPM practices can be attributed to the combined effect of biological control agents, pheromone-based monitoring, and botanical pesticides. The use of *Pseudomonas fluorescens* as seed treatment, soil application, and seedling root dip possibly enhanced plant vigor and suppressed soil- and seed-borne pathogens. Similarly, periodic release of *Trichogramma japonicum* played a crucial role in regulating lepidopteran pest populations such as stem borer and leaf folder. Installation of pheromone traps further contributed to effective monitoring and mass trapping of adult moths, thereby reducing pest pressure.

The higher abundance of natural enemies recorded in BIPM fields compared to farmers' practices highlights the ecological compatibility of biological and botanical interventions. Avoidance of broad-spectrum chemical pesticides under BIPM practices likely facilitated the conservation of beneficial insects, which in turn contributed to natural pest regulation.

Table 2: Performance of bio intensive pest management (BIPM) package in rice under front line demonstration during 2020-21

Parameters*	BIPM	Farmer's practice (FP)
% pest infestation	13.5	34.5
% disease incidence	15.0	39.0
Grain Yield (q/ha)	39.5	35.0
% yield increase over FP	11.39	-
Gross Cost (Rs./ha)	32850	29000
Gross Income (Rs./ha)	58500	49800
Net Income (Rs./ha)	25650	20800
BC Ratio	1.78	1.71

In this study, it was also observed that treatment plot showed higher yield of 40 and 39.5 q/ha as compared to 34.6 and 35.0 q/ha in farmers' practice in both the years of evaluation (Plate 13 and 14). Due to the improvement in the yield of the crop it could provide a good net return of Rs. 25400/- as compared to Rs. 19200/- in farmers practice with B: C ratio of 1.79 and 1.69 respectively during 2019-20 (Table 1). Similar results were also observed in the year 2020-21, in which the net return obtained was Rs. 25650/- in treatment plot as compared to Rs. 20800/- in farmers practice with B: C ratio of 1.78 in treatment plot and 1.71 in farmers' practice (Table 2). Similarly, IPDM demonstration plots recorded a higher yield (5.41 tonnes/ha), net return (Rs

37,040) and benefit-cost ratio (1.87) (Balasubramaniam, 2022) ^[1]. The yield improvement, higher net returns, and favorable benefit-cost ratio recorded in IPDM demonstration plots indicate the economic viability of the technology. Reduced pest and disease incidence, coupled with improved crop health, resulted in enhanced productivity and profitability. Similar results were also observed in the evaluations conducted by Katti *et al.* (2000) ^[5], Samiayyan *et al.* (2010) ^[9], Prajapati *et al.* (2013) ^[7], Sehgal *et al.* (2001) ^[11], and Saravanakumar (2020) ^[10], who have documented the effectiveness of IPM/IPDM practices in rice. Monitoring and management of yellow stem borer through pheromone traps has been emphasized as a critical component of BIPM. Installation of pheromone traps at recommended densities has been found useful for monitoring moth activity and facilitating timely control measures. Mass trapping of male moths using pheromone traps during the early crop stages has also been reported to significantly suppress pest populations. However, the success of biological control through inundative or inoculative releases in rice ecosystems has been variable, underscoring the need for integration with other compatible management strategies. Timely release of *Trichogramma* spp. based on pest incidence has been suggested as an effective measure for managing stem borer and leaf folder populations (Prakash *et al.*, 2014) ^[8]. Overall, the present study validates the role of BIPM as a sustainable and economically viable approach for managing major insect pests and diseases in rice, while simultaneously conserving natural enemies and reducing dependence on chemical pesticides.

Conclusion

The present study clearly establishes the superiority of the bio-intensive pest management package over prevailing farmers' practices for managing major insect pests and diseases of Sali rice in Tinsukia district of Assam. The BIPM approach significantly reduced pest infestation and disease incidence, enhanced grain yield and improved economic returns while minimizing dependence on chemical pesticides. The results demonstrate that the technology is environmentally safe, economically viable and suitable for large-scale dissemination through the Krishi Vigyan Kendra system for sustainable rice production in Assam.



Plate 1: Release of Tricho cards



Plate 2: Demonstration on release of Tricho cards



Plate 3: Demonstration on installation of Pheromone trap



Plate 4: Demonstration on seed treatment with biopesticides



Plate 5: Demonstration on preparation of biopesticide for spraying



Plate 6: Spraying of biopesticides



Plate 7: Stem Borer observed in the field



Plate 8: Colour change observed in trichocards



Plate 9: Dead heart observed in the field



Plate 10: Field visits



Plate11: Crop at vegetative stage



Plate 12: Crop at harvesting stage



Plate 13: Crop Cutting



Plate 14: Crop Cutting

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