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VALIDATION OF BIOINTENSIVE IPM PRACTICES AGAINST PEST COMPLEX OF ORGANIC BLACK RICE

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ABSTRACT

Field Experiment to validate the Biointensive IPM (BIPM) package on black rice variety "*Kola Chaul*" revealed that BIPM package consisting seedlings root dip with *Pseudomonas fluorescens* @ 2% solution; application of organic manure MUKTA @ 2 t ha^{-1}; application of *Beauveria bassiana* @ 10^{13} spores ha^{-1} against sucking pests, use of bird perch (10 ha^{-1}), 6 releases of *Trichogramma japonicum* @ 50,000 ha^{-1} at 10 days interval starting from 30 days after treatment (DAT) for stem borer and leaf folder infestation along with need based application of botanicals NSKE 5% (5 l/ l^{-1}) could suppress the major rice pests and produce higher grain yield as compared to the farmer's practice (FP). Maximum grain yield of 3124.8 kg ha^{-1} and 3139.10 kg ha^{-1} was recorded in BIPM field as compared to 2882.6 kg ha^{-1} and 2897.20 kg ha^{-1} in farmers practice plot during 2020-21 and 2021-22, respectively. Thus, BIPM practice was observed to be superior to FP with higher benefit: cost ratio.

Key words: *Kola Chaul*, *Pseudomonas fluorescens, Trichogramma japonicum*, BIPM, farmers' practice, Assam, grain yield, net benefit, stem borer, deadheart, white earhead, leaf folder, yield, additional yield over chemical control, C:B ratio

India produced 118.40 mt of rice from an area of 43.78 m ha with productivity of 2.7 t ha^{-1} milled rice during 2019-20 (Anonymous, 2021). As per the estimate of Viraktamath (2013), India has to produce at least 140-150 mt of milled rice by 2030 to maintain the present level of self-sufficiency. However, the biotic pressure of insect pest is also high and >70 pests are associated with rice, out of which 20 species are regular (Bhogadhi and Bentur, 2015). As a result, rice cultivation has become chemocentric leading to the pollution of soil-air-water as well as human health hazard. Hence, biointensive integrated pest management (BIPM) is the need of the hour. Moreover, it is necessary to make innovative changes in plant protection measures and improve the education of farmers who can fully understand both direct and indirect benefits and risk involved in it (Trivedi and Ahuja, 2011). Validation of IPM has reduced use of pesticides up to 20 g a.i.ha^{-1} as against 2250 g a.i.ha^{-1} used in the fields with farmers' practices (Anonymous, 2012). The present attempts validation of BIPM practices against major pests of organic black rice especially lepidopteran pests associated with rice.

MATERIALS AND METHODS

Field experiment was carried out at the Instruction-cum-Research (ICR) Farm, AAU, Jorhat (26.757874°N:, 94.2037°E) during 2020-21 and 2021-22 on variety "*Kola Chaul*". Twenty-five days old seedlings were transplanted during last fortnight of July and recommended agronomic practices as per package of practices of AAU, Jorhat were followed. The BIPM package as mentioned below was evaluated in comparison with farmers' practice (FP) where chlorantraniliprole 18.5SC @20 g.ai ha^{-1} was applied with an area of 0.5 ha each and data were collected from 10 randomly selected 1 m^2 quadrats. Four rounds of chemical sprays were imposed at 35, 45, 55 and 65 days after transplanting (DAT) in farmers practice plots. A set of IPM tactics were implemented at BIPM practiced plot in a systematic way, - organic manure Mukta @ 2 t ha^{-1} was applied at the time of final ploughing. Seedlings root dip treatment of uprooted seedlings with *Pseudomonas fluorescens*@ 2% solution was carried out before transplanting. To control sucking pests *Beauveria bassiana* @ 10^{13} spores ha^{-1} was applied just after transplanting and second spray was imposed 15 DAT. Application of bird perch (10 ha^{-1}) during vegetative stage before panicle initiation was helpful for IPM. Egg parasitoid *Trichogramma japonicum* @ 50,000 ha^{-1} was released at 30 DAT and subsequent release

was conducted at 10 days interval for management of lepidopteran pests especially stem borer *Scirpophaga* sp. and leaf folder *Cnaphalocrocis medinalis*; and need based application of botanicals NSKE 5% (5 ml/ l) was imposed during milky stage against gundhi bug *Leptocorisa acuta*.

Observations on the damage symptoms by *Scirpophaga* sp. (deadheart and white earhead) and *C. medinalis* (rolled leaf) were recorded from 1 m^2 quadrat at 10 randomly selected spots at weekly intervals from both BIPM and FP plots, before and after imposing treatments. Population of skippers, hairy caterpillar was negligible during observation. As regards leaf hopper, hispa and case worm infestation was also very low (<1%). Statistical analysis was carried out using student 't' test after suitable transformation with XLSTAT (Addinsoft, 2022) software.

RESULTS AND DISCUSSION

The result indicated that the incidence of deadheart (DH) and white earhead (WEH) due to stem borer infestation as well as damage of leaf due to leaf folder (LFD) were much lower (<3.0%) in both BIPM and farmers practice field after imposing treatments. However, the mean DH and WEH incidence in BIPM fields were 2.82% and 2.60% at 65 and 90 DAT, whereas in farmers practice were 2.78% and 2.99 % in 2020-21, respectively. The corresponding figures about DH and WEH during 2021-22 were 1.79% and 2.11% in BIPM in contrast to 2.03% and 2.41% in farmers practice (FP) plot. Pooled data of 2.30% and 2.35% recorded in BIPM plot and 2.35% and 2.74% were recorded in FP plot. Similarly leaf folder damage in BIPM field and FP plots were 2.64 % and 2.95 % during 2020-21, while it was 2.25% and 2.41% in 2021-22. The natural enemies in the rice ecosystem were also affected by the pesticide. However, BIPM treated plot encouraged the conservation of these as well as the efficiency of egg parasitoid, trichogrammatids. Therefore, the insect infestation was comparatively almost same in BIPM treated plot with farmers practice or chemical treated plot. Similar findings were also obtained from the earlier experiments conducted with BIPM package along with chemical control approaches (Mohapatra and Nayak, 2015; Mathur et al., 1999; Chakraborti, 2001; Garg et al., 2007; Saikia et al., 2016). Further, maximum grain yield of 3124.8 kg ha^{-1} and 3139.10 kg ha^{-1} was recorded in BIPM field as compared to minimum yield of 2882.6 kg ha^{-1} and 2897.20 kg ha^{-1} in FP plot during 2020-21 and 2021-22, respectively. Though rice is a

Table 1. Effect of stem borer and leaf folder on yield of black rice

Treatments	2020-21			2021-22			Pooled mean			2020-21			2021-22			Pooled mean		Yield (2020-21)	Yield (2021-22)	Pooled mean of Yield (Kg. ha^{-1})	Additional yield over chemical control (kg ha^{-1})	Value of yield/ ha (Rs. ha^{-1})*	Cost of cultivation (Rs ha-1)	Net return (Rs/ ha)	C:B ratio
	Pre count DH (%) 30 DAT	DH (%) 65 DAT	WEH (%) 90 DAT	Pre count DH (%) 30 DAT	DH (%) 65 DAT	WEH (%) 90 DAT	Pre count DH (%)	DH (%)	WEH (%)	Pre count LFD (%) 30 DAT	LFD (%) 45 DAT		Pre count LFD (%) 30 DAT	LFD (%) 45 DAT		Pre count LFD (%)	LFD (%)								
BIPM Package	5.02	2.82	2.6	4.99	1.79	2.11	5	2.3	2.35	3.62	2.64		3.87	2.25		3.65	1.12	3124.8	3139.1	3131.9	60758.86	25000	35758.86	3131.9	1.43
Farmers' practice	5.01	2.78	2.99	5.02	2.03	2.41	5.01	2.35	2.74	3.58	2.95		3.9	2.41		3.67	1.2	2882.6	2897.2	2889.9	56064.06	26000	30064.06	2889.9	1.16
"t" value		1.01	2.82		0.73	0.5		0.89	1.8		1.31			0.25			0.86								
Remarks	NS	S	S	NS	S	S	NS	S	S	NS	S		NS	S		S	S								

Dead heart (DH), White ear head (WEH), leaf folder damage (LFD); Price of rice Rs. 19.40/ kg

self-pollinated (Tsunoda and Takahashi, 1984), so when pollen grains from anther fall by gravity onto the stigma of rice flower then only pollination takes place and this function may be accelerated by different arthropod fauna present in rice ecosystem. Therefore, the chance of pollination is higher in BIPM plot. Moreover, from the present investigation it had been observed that BIPM practice plot was superior to FP plot with superior benefit: cost ratio of 1.43 and 1.16. Use of ecofriendly pesticides was the reason for higher population of predators in BIPM plot as compared to FP plot was in conformity with Dash et al. (2006).

Thus, it can be interpreted that BIPM package consisting of different tactics viz., seedlings root dip with *Pseudomonas fluorescens*@ 2% solution; application of organic manure Mukta @ 2t ha^{-1}; application of *Beauveria bassiana* @10^{13} spores ha^{-1} against sucking pests, use of bird perch (10 ha^{-1}), 6 releases of *Trichogramma japonicum* @ 50,000 ha^{-1} at 10 days interval starting from 30 DAT for stem borer and leaf folder infestation along with need based application of botanicals NSKE 5% (5 ml/ l) could suppress the major rice pests and produce higher grain yield as compared to the farmer's practice plot. Therefore, the BIPM package may be recommended for the rice farmers associated with organically cultivated black rice or "*Kola Choul*" which will give maximum yield as compared to chemocentric agriculture and BIPM will help to increase the income of farmers.

Integrated pest management involves integration of IPM viz., cultural, mechanical, biological and finally the chemical control (Dent, 1991), (Pretty et al., 1998; Atanassov et al., 2002). However, least or no use of chemical pesticides encourages conservation of natural enemies (Garg et al., 2002; Saikia et al., 2017; Borkakati et al., 2018; Tandon and Srivastava, 2022). Earlier attempts with BIPM practices showed satisfactory results over chemo-centric agriculture in regards to sugarcane (Saikia et al., 2020) and vegetables like tomato, brinjal etc. (Saikia and Borkakati, 2019; Borkakati et al., 2020)

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AUTHOR CONTRIBUTION STATEMENT

RNBK and DKS: Conceptualized, planned the work; RNBK, JG and MG: Conducted research, written manuscript; RNBK, RPP & SB: corrected manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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