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Integrated management of pests of paddy on farmers field

B. N. Chaudhari, P. R. Panchbhai, V. R. Dhepe, V. J. Tambe and N. V. Lavhe

College of Agriculture, Nagpur Dr. PDKV, Akola, Maharashtra, India

ABSTRACT

Field experiments were conducted on integrated pest management (IPM) in rice with 2 treatments viz., IPM and farmers practices on 0.40 ha area each by Agriculture Research Station, Sakoli, Dist. Bhandara, Maharashtra for five years on 3 farmers' fields in each years from kharif 2015 to kharif2019 with an objective to validate IPM practices from a basket of options available and demonstrate to farmers the management of pests in a holistic way (including insects, diseases and weeds).The results on pooled data revealed that theIPM practice was found more effective as compared to farmer practices in terms of management of insect pest of rice crop viz. stem borer and leaf folder, reduction of sheath rot disease and weed incidence translating into higher yield and higher Benefit-Cost ratio.

Keywords: *Rice, Integrated pest management, farmers' field, insect pests, diseases, weeds.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of at least half of the world's population and is grown in approximately 148 million ha of land globally. Nearly 90 per cent of this area falls in the Asian region. Intensive cultivation of rice has resulted in the frequent occurrence of biotic stresses that formed a major constraint in rice production. Rice crop is ravaged by a number of biotic constraints like insect pests, diseases, and weeds throughout the crop growth period. Indiscriminate and rampant use of insecticides had no effect on yield and yield contributing characters of rice, when insect pest infestation is below ETL. So, farmers could avoid injudicious use of insecticides, which ultimately save input cost and protect the environment from insecticidal pollution as well (Bari *et al.,* 2015). To overcome these problems efficiently, adoption of integrated pest management in a participatory mode is the primary option. Earlier efforts have been made for to evaluation and validation of integrated pest management practices in rice (Razak, 1986; Sankaran, 1987; Krishnaiah and Reddy, 1989; Karthikeyan, *et al.* 2010;Elakkiya and Sujeetha, 2011; Chakraborty, 2012; Visalakshmi, *et al.* 2013 and Anonymous, 2015). Though the effectiveness of IPM in rice has been validated on farmers fields, there is still adequate scope to enhance use of eco-friendly components within the framework of IPM, so as to minimize the use of toxic chemicals, for long term economic, ecological and social benefits to farmers. Therefore, trials on integrated pest management (IPM) in rice were conducted on farmers fields with an objective to validate IPM practices from a basket ofoptions available and demonstrate to farmers themanagement of pests in a holistic way (includinginsects, diseases and weeds).

MATERIAL AND METHODS

Integrated pest management (IPM) in rice trials were conducted on with 2 treatments *viz.,* IPM and farmers practices on 0.40 ha area each by Agriculture Research Station, Sakoli, Dist. Bhandara in Maharashtra state for five years on 3 farmers fields in each year from *kharif*2015 to *kharif*2019. Details of IPM trialsinformation were given below.

Year	Name of Farmer	Farmer	Varity	Sowing date	Transplanting Date	Harvesting date
Kharif 2015	Shri. Y.S. Waghmare	Farmer-I	RPN Gold	13.06.2015	08.07.2015	26.10.20115
	Shri. H.M. Khotele	Farmer-II	Jai Shriram	16.06.2015	10.07.2015	08.11.2015
	Shri. A.V. Borkar	Farmer-III	PKV HMT	24.06.2015	08.08.2015	07.11.2015
Kharif2016	Shri. R. S. Doye	Farmer-I	Kesar	18.06.2016	14.07.2016	13.11.2016
	Shri. K. Y. Ghormare	Farmer-II	Jai Shriram	20.06.2016	14.07.2016	12.11.2016
	Shri. K. R. Khotele	Farmer-III	Jai Shriram	21.06.2016	20.07.2016	12.11.2016
Kharif 2017	Shri. U. G. Waghmare	Farmer-I	Balwan	18.06.2017	06.07.2017	04.11.2017
	Shri. T. M. Kharkate	Farmer-II	Pawanputra	07.06.2017	04.07.2017	02.11.2017
	Shri. D. G. Wadhai	Farmer-III	Jai ram	11.06.2017	06.07.2017	21.10.2017
Kharif 2018	Shri. D. R. Fande	Farmer-I	Kesar	10.06.2018	03.07.2018	03.11.2018
	Shri. Y. R. Kapgate	Farmer-II	Yashoda 1312	08.06.2018	06.07.2018	05.11.2018
	Shri. T. G. Waghmare	Farmer-III	Yashoda 1312	12.06.2018	18.07.2018	10.11.2018
Kharif 2019	Shri. R. G. Khotele	Farmer-I	DRK-2	17.06.2019	15.07.2019	16.11.2019
	Shri. S. R. Khandait	Farmer-II	ShriSai	26.06.2019	31.7.2019	10.11.2019
	Shri. A. T. Khotele	Farmer-III	MTU 1008	10.07.2019	06.8.2019	22.11.2019

Details of practices followed in IPM trialwere given below:

Corresponding Author:* ***B. N. Chaudhari*

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A) IPM Practice :

a) Common practices followed in IPM treatment - Nursery:

1. Seed treated with Carbendazim 50 % WP @ 2 g/kg seed.
2. Applied Carbofuran 3 % CG @ 25 kg/ha (Carbofuran 3 % CG @ 250 g for 100 m^2 nursery), 5 days before pulling seedlings from

nursery for transplantingfor management of stem borer and gall midge.

Main field (After Transplanting):

3. Seedlings transplanted at spacing of 20 cm X 15 cm.
4. Alleyways of 30 cm after every 10 rows.
5. Applied Butachlor 50 % EC @ 3 litre/ha within one week after transplanting when there is water and water should not be drained out for a minimum 48 hours.
6. Pheromone traps were installed @ 8 traps/ha for stem borer monitoring at 15 after transplanting.
7. Applied split doses of nitrogen, particularly the second dose delayed, when symptoms of bacterial leaf blight were seen between 20 to 30 days after transplanting.
8. Followed 1 to 2 manual weeding as per need.
9. Applied Propiconazole 25 % EC @ 10 ml in 10 liters of water for management of sheath blight at 60 to 90 days after transplanting.
10. Applied Cartap hydrochloride 50 % SP @ 12 g in 10 liters of water for management of stem borer and leaf folder, when incidence crosses economic threshold level at 60 to 90 days after transplanting.
11. Mid-season drainage was followed for brown plant hopper management.
12. When pest population exceeds above economic threshold level then suitable recommended and CIBRC label claimed need-based pesticides were applied**.**

b) Other need based practices adopted in IPM treatment -:
Main field (After Transplanting):

- Sprayed Streptocycline @ 1 g in 10 liters of water for management of bacterial leaf blight at 82 DAT (*Kharif* 2018).
- Applied Chlorantraniliprole 0.4% GR @ 10 kg/ha for management of stem borer at 67 DAT (*Kharif*2018).
- Sprayed Imidacloprid 17.8 SL @ 2.2 ml in 10 liters of water for management of plant hoppers at 95 DAT (*Kharif* 2018).
- Sprayed Flonicamid 50 % WG @ 3 g in 10 liters of water for management of plant hoppers at 94 DAT (*Kharif*2019)

B) Farmer Practice (As per local farmers practices) :
Nursery:

- Seed treatment with 3 % Salt Solution (Shri. D. G. Wadhai-kh 2017, Shri. R. G. Khotele, Shri. S. R. Khandait, Shri. A. T. Khotele, -*kh*2019)
- Seed treatment with Thirum @ 3 g/kg seeds (Shri. H.M. Khotele-kh 2015).
- Applied Phorate 10 G @ 10 kg/ha, 5 days before pulling seedlings from nursery for transplantation (Shri. T. M. Kharkate -kh 2017, Shri. T. G. Waghmare-*kh*2018, Shri. S. R. Khandait-*kh*2019)

Main field (After Transplanting) :

- Seedlings were transplanted randomly (All farmers Kh. 2015 to Kh.2019).
- Applied Eraze(Pretilachlor 50 EC) @ 833 ml/ha at 6th day after transplantation (Shri. U. G. Waghmare-*kh* 2017)
- Applied Eraze(Pretilachlor 50 EC) @ 1 liter/ha at 3rdday after transplantation (Shri. D. G. Wadhai-kh 2017,Shri. D. R. Fande-*kh*2018).
- Applied Pretilachlor 50 EC @ 1.5 liter/ha at 5thday after transplantation (Shri. A.V. Borkar-kh 2015).
- Applied Saathi (Pyrazosulfuron Ethyl 10% WP) @ 200 g/ha at 3rd day after transplantation (Shri. K. R. Khotele-kh 2016, Shri. T. M. Kharkate-*kh*2017. Shri. T. G. Waghmare-*kh*2018)
- Applied Check (weedicide) @ 833 ml/ha at 4thday after transplantation (Shri. Y. R. Kapgate-*kh*2018)
- One manual weeding ((Shri. H.M. Khotele-kh 2015, Shri. A.V. Borkar-*kh*2015, Shri. R. S. Doye-kh 2016, Shri. K. Y. Ghormare – kh 2016, Shri. U. G. Waghmare-*kh* 2017, Shri. D. G. Wadhai-kh 2017,Shri. D. R. Fande, Shri. Y. R. Kapgate-*kh*2018)
- Two manual weeding (Shri. K. R. Khotele-kh 2016, Shri. T. G. Waghmare-*kh*2018, Shri. R. G. Khotele, Shri. A. T. Khotele-*kh*2019)
- Spraying with Neem oil 1.25 liter/ha at 70 DAT (Shri. H.M. Khotele- *km* 2015).
- Imidacloprid 17.8 SL @ 416 ml/ha was sprayed at 73 DAT for management of plant hoppers (Shri. Y. R. Kapgate-*kh*2018)
- Mixture of Two insecticides viz., (Chlorpyrifos 50 % + Cypermethrin 5%EC) @ 833 ml/ha and Acephate @ 833 g/ha was sprayed at 100 DAT(Shri. Y. R. Kapgate-*kh*2018).
- Imidacloprid 17.8 SL @ 500 ml/ha +Acephate @ 500 g/ha was sprayed at 94 DAT for management of plant hoppers (Shri. D. R. Fande-*kh*2018).
- Spraying with Imidacloprid 17.8 SL @ 125ml/ha for management of Plant hoppers at 68 DAT (Shri. A.V. Borkar-*kh* 2015).
- Spraying with monocrotophos 700 ml/ha for management of BPH and WBPH at 80 DAT (Shri. H.M. Khotele-*kh* 2015).
- Spraying with Monocrotophos @500ml/ha at 86 DAT for management of plant hoppers (Shri. T. M. Kharkate -*kh* 2017).
- Acephate @ 500 g/ha was sprayed at 96 DAT for management of plant hoppers (Shri. T. M. Kharkate -kh 2017)
- Cannon @ 750ml/ha was sprayed at 82 DAT for management of plant hoppers (Shri. U. G. Waghmare-kh 2017)
- Spraying with Satisfy (Chlorpyriphos 50 % + Cypermethrin 5 % EC) @313 ml/ha on date 15.08.2016 (Shri. K. Y. Ghormare-kh 2016).
- Spraying with Hamala (Chlorpyriphos 50 % + Cypermethrin 50 %) @ 1250ml/ha on date 25.09.2016 (Shri. R. S. Doye-kh 2016)
- Acephate @ 500 g/ha was sprayed at 98 DAT for management of plant hoppers (Shri. U. G. Waghmare-kh 2017)

METHOD OF OBSERVATION

Depending on the pest incidence IPM components were used in IPM plots. Starting from 15 DAT, observations on pest incidence were recorded on 5 randomly selected hills in each replication (25 hills/each practice/farmer) at weekly interval and continued till harvesting. Observations on number of tillers damaged by stem borers (dead heart/white ear head), gall midge (silver shoot), number of leaf folder damaged leaves and number of plant hoppers per hills were recorded from the selected hills. Incidence of major diseases was also recorded. Weed number and weed biomass per $m^2$was also observed. Yield was recorded from 5 x 5 m^2 plot from each replication. The economics of each treatment application was a workout.

RESULTS AND DISCUSSION

Fiveyear cumulative pooled results presented in Table 1 indicated that IPM practice recorded significantly minimum incidence of stem borer (3.87 % dead heart and 5.09 % white ear) against 5.18 % dead heart and 12.04 % white ear in farmer practice.

The lowest incidence of gall midge (4.32 % silver shoot) was recorded in IPM practice and highest incidence of 4.98 % silver shoot in farmer practice.

Similarly, significant minimum damage by leaf folder (1.66 %) recorded in IPM practice and maximum damage of 1.99 % was recorded in farmer practice.

Non significant difference in population of green leaf hopper, brown plant hopper and white backed plant hopper was exhibited in both the practice.

Pooled effect of different treatments against the mean incidence of diseases during *kharif*2015-2019 was presented in Table 2. It indicated that IPM practice recorded significantly minimum incidence of sheath rot (1.86 %) against 2.31 % in farmer practice.

Non significant difference in incidence of other diseases viz., leaf blast, neck blast, bacterial leaf blight, brown spot, sheath blight and stem rot was noticed in both the practice.

Pooled data (Table 3) of weed population and weed dry mass recorded at 30 DAT and 60 DAT during *kharif*2015-2019revealed that IPM practice had low weed population (11.95 and 9.25 no./m^2) as compared to farmer practice (16.77 and 12.21 no./m^2). Weed dry mass was low inIPM practices (17.39 and 12.20 g/m^2) as compared to farmer practices (30.75 and 19.33 g/m^2).

The highest yield of 53.12 q/ha was harvested from IPM practice against41.51 q/ha in farmer practice The benefit-cost ratio of 1:2.82 was found superior in IPM practice than farmer practice(1:2.46).

The present findings are in accordance with Dash *et al.* (2006) who found that IPM module as more effective for irrigated rice to manage major insect pests and to obtain highest grain yield, in Sambalpur, Orrisa. Similarly, Tripathy and Kanungo (2008) demonstrated IPM technology in Kulei village of Anguli district of Orrisa and reported a lower incidence of stem borer and BPH with higher monetary benefit in the farmers rice field with IPM practice than non IPM practice. Samiayyan*et al.* (2010) also confirmed that the adoption of IPM module in rice crop resulted in significantly higher yield, more natural enemies and lesser pests than the farmer's practice. Jena *et al.* (2012) found lower incidence of insect pests on rice crop and highest grain yield in chemical + non chemical module as compared to farmers practice. Nalini*et al.* (2013) evaluated the IPDM module in four villages at Madurai East block and revealed significantly reduced the incidence of brown plant hopper, white-backed plant hopper, stem borer, leaf folder and gall midge. Bacterial leaf blight disease was also decreased. Higher grain yield and cost benefit ratio were recorded in IPDM module compared to farmer practice. Visalakshmi*et al.* (2013) reported that chemical+ non chemical pest management module was most effective with low incidence of stem borer and gall midge which also gave higher grain yield and cost-benefit ratio.

The present results are in close proximity with Chaudhari*et al*. (2014) revealed that incidence of gall midge, stem borer, leaf folder, brown plant hopper, white backed plant hopper, leaf blast, bacterial leaf blight and weeds were lower in IPMS as compared to farmers practice, with higher grain yield and high BC ratio. Chaudhari *et al*. (2017a)revealed that the IPM comprising seed treatment with Carbandezim 50% WP @ 2 g/kg seed, application of Carbofuran 3 G @ 1.1 kg a.i./ha 5 days before pulling seedlings, seedlings transplanted at spacing of 20 x 15 cm, alleyways of 30 cm after every 10 rows, application of Butachlor @ 1.5 kg a.i./ha on 5th day after transplanting + 1 manual weeding, installation of pheromone traps (Scirpoload) @ 8 traps/ha for stem borer monitoring, application of Carbofuron 3 G @ 25 kg/ha, application of Cartap hydrochloride 50 WP @ 600 g/ha at 60 DAT, application of Propiconazole0.1% and mid-season drainage found good with low incidence of weeds and white ear head (2.66 %), reduced severity of all the diseases like neck blast, sheath rot and brown spot. Chaudhari*et al*. (2017b) showed that the reduced incidence of gall midge and stems borer and low severity of sheath rot disease were noticed in IPM plots. Weed population and weed biomass were considerably reduced in IPM plots as compared to farmers' practices. Grain yield was high in IPM as compared to farmers' practice. Similarly, BC ratio was high in IPM than farmers practices. Sawai*et al*. (2017) reported that the adoption of IPM module reduces the incidence of major insect pests of rice *viz.,* gall midge, stem borer, leaf folder, army worm, green leaf hopper, brown plant hopper and white backed plant hopper as compared to unprotected control and it was at par with chemical control. Also, the implementation of IPM elevated the population of natural enemies. Due to reduced pest incidence, grain yield was significantly high in IPM resulting in higher BC ratio. Kumar *et al* (2020) reported that paddy insect-pest infestation and yield indicated that integrated pest management was superior to farmers' practice. The minimum incidence of yellow stem borer and leaf folder was found in IPM module as compared to farmers' practice. The population of green leaf hopper and brown plant hopper was also less in IPM plots. There was 13.05 per cent more yield in IPM demonstration plots than control and the highest net return and benefit cost ratio was also obtained by the application of recommended practices.

CONCLUSION

From the study carried out during *Kharif* 2015-2019 at ARS, Sakoli, the present findings conclude that IPM practice was found more effective as compared to farmer practices in terms of management of insect pest of rice crop viz. stem borer and leaf folder, reduction of sheath rot disease and weed incidence translating into higher yield and higher Benefit Cost ratio.

Table 1:Pooled effect of different treatmentson mean incidence of insect pests (cumulative pooled) during kharif2015-2019.

Treatment No.	Treatment	Stem borer		Gall Midge (% Silver Shoot)	Leaf Folder (% Damage)	Population no./hills		
		% Dead Heart	% White Earhead			BPH	WBPH	GLH
T_1	**IPM**	3.87	5.09	4.32	1.66	3.40	1.79	1.14
T_2	**Farmers Practice(FP)**	5.18	12.04	4.98	1.99	3.50	1.75	1.17
T_1 vs. T_2	**'t' test**	**Sig.**	**Sig.**	Non-Sig.	**Sig.**	Non-Sig.	Non-Sig.	Non-Sig.
	't' cal	8.36	10.13	0.66	2.95	0.29	0.39	0.40

ttabvalue at 5 % level of significance and 28 degree of freedom = 2.05

Table 2:Pooled effect of different treatmentson mean incidence of diseases (cumulative pooled) during kharif2015-2019.

Treatment No.	Treatment	Disease incidence (%)						
		Leaf Blast	Neck blast	BLB	Brown Spot	Sheath blight	Sheath rot	Stem rot
T_1	IPM	1.17	1.70	4.02	2.01	1.56	**1.86**	1.43
T_2	Farmers Practice (FP)	1.12	1.98	3.91	2.26	1.66	**2.31**	1.57
T_1 vs. T_2	't' test	Non-Sig.	Non-Sig.	Non-Sig.	Non-Sig.	Non-Sig.	**Sig.**	Non-Sig.
	't' cal	0.54	1.77	0.64	0.91	0.98	**2.55**	1.27

ttabvalue at 5 % level of significance and 28 degree of freedom = 2.05

Table 3: Pooled effect of different treatments on weed incidence(cumulative pooled) during kharif2015-2019.

Treatment No.	Treatment	Weed Incidence			
		weed population (No./m²)		Weed biomass (dry wt. gm²)	
		30 DAT	60 DAT	30 DAT	60 DAT
T_1	IPM	11.95	9.25	17.39	12.20
T_2	Farmers Practice (FP)	16.77	12.21	30.75	19.33
T_1 vs. T_2	't' test	**Sig.**	**Sig.**	**Sig.**	**Sig.**
	't' cal	2.94	6.30	4.57	6.33

Table 3: Pooled effect of different treatments on yield and cost benefit ratio during Kharif2015-2019.

Treat. No.	Treatment	Yield (q/ha)	Price of paddy (Rs.)	Gross return (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	B:C ratio
T_1	IPM	53.12	1930	101803	37000	64803	2.82
T_2	Farmers Practice (FP)	41.51	1930	79568	33016	46552	2.46
T_1 vs. T_2	't' test	Sig.					
	't' cal	5.41					

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