



Integrated Management of Rice Fungal Diseases by the application of newer fungicides on Farmers field

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ABSTRACT

This study was conducted as farm trial of Rice var. MTU 7029 in the Sheikhpura district of Bihar in the year 2012 and 2013 for assessment of new fungicides in Integrated Disease Management (IDM) of rice fungal diseases. The spraying of fungicides was done at the booting stage of rice. Results indicated that the single spray of all the three technology options of fungicides combination significantly reduced fungal diseases along with corresponding enhancement of grain yield, net profit and BC ratio. Out of them Nativio 75 WG (Tebuconazole 50% + Trifloxystrobin 25%) @ 0.05 %, reduced all five fungal diseases viz. sheath blight, neck blast, brown spot, false smut & grain discoloration to minimum level of 9.4, 4.2, 6.5, 8.1 and 3.3 percent respectively along with corresponding highest grain yield (5230 kg/ha), net return of Rs.28900/ha and B:C ratio 2.24. Both other combinations viz. Monceren 250 SC (Pencycuron 22.9%SC) @ 0.12 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @0.25 % +Bavistin (Carbendazim) 50WP @ 0.1 % resulted into significantly lower diseases level at par of 12.1, 9.7, 8.5, 19.4 and 6.6 % along with corresponding higher grain yield (4360 kg/ha), net return of Rs.20800/ha and B:C ratio 1.94 in comparison of 38.3, 15.5, 18.4, 25.5 and 12.3 % diseases level along with 3720 kg/ha grain yield, Rs.15,700/ha as net profit and 1.73 as BC ratio in the Farmers practice. The single spray of Nativio 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 250 gram/ha in 500 liters of water at booting stage of Rice cultivar MTU 7029 may be highly effective method to manage major fungal to get maximum net profit.

KEYWORD

On-Farm trial, Rice, IDM, Fungal diseases, Nativio 75 WP

INTRODUCTION

Rice continues to be the most important food crop for more than half of the world's population. India is the largest rice growing country with an area of around 44 m ha with a production of more than 100 million tons (www.fas.usda.gov/psdonline). It forms the major dietary energy form of food and it covers more than 9% of earth's arable land. It contributes 21% of global per capita energy and 15% of global per capita protein (FAO, 2016). It is grown in almost all the states of India and plays a major role in country's food security and provides livelihood for about 70% of the population (Diwakar, 2009). Sustainable rice production for food security has emerged as challenging task especially in the background of rapidly increasing population, declining cultivable land, decreasing availability of agricultural labour and yield losses due to abiotic and biotic stresses. Pest and diseases not only reduce crop yields but also affect the grain quality. Rice crop is attacked by a number of fungal, bacterial, viral diseases and pathogens. Among them, diseases like sheath blight, neck blast, brown spot, false smut & grain discoloration caused by fungal pathogens are the major cause for crop damages and loss of grain yield. Earlier, scientific literatures have been focusing on management of single disease by integrated approach. No literatures are available for the need of farmers for combined management of these five fungal diseases on their field under natural condition. Identifying the level and extent of the problem of fungal diseases in major rice growing cultivar MTU 7029 in Sheikhpura district of Bihar a farmer's participatory on-farm trial was planned and conducted for consecutive two years in *kharif* 2012 and 2013 with the objective of the assessment of the effect of single spray at booting stage of rice crop with three technology options of fungicides combination viz. Nativio 75 WG (Tebuconazole 50% + Trifloxystrobin 25%) @ 0.05 %, Monceren 250 SC (Pencycuron 22.9%SC) @ 0.12% + Bavistin (Carbendazim) 50WP @ 0.1%, and Sheathmar (Validamycin 3% L) @ 0.25% + Bavistin (Carbendazim) 50WP @ 0.1% on the severity (Percent Disease Intensity or Incidence) of major fungal diseases, grain yield and economics of the production.

MATERIALS AND METHODS

Rice fungal diseases on and after booting stage causing reduction of the yield and quality, was diagnosed as the most significant problem of farmers through benchmark survey and participatory rural appraisal (PRA) survey of the farmers. Searching suitable technological options for solving this problem as the main biotic stress causing yield loss in main rice growing cultivar MTU 7029. This study was planned and conducted at the farmers' field in the operational area of Krishi Vigyan Kendra, Sheikhpura, Bihar as the farmers participatory on-farm trial on Rice var. MTU 7029 during *kharif* season in the year 2012 and 2013 for the assessment of new fungicides in Integrated Disease Management (IDM) of rice fungal diseases (sheath blight, neck blast, brown spot, false smut & grain discoloration). A total of 10 farmers as replication with 0.4 ha each, under a total of four treatments (farmers practice and three technology options) was included in the study as follows:

Farmer's practice: (No. spray of any fungicide)

Technology Option (T O)-1: Single spray of Nativio 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 250 gram/ha in 500 liters of water at booting stage.

Technology Option(T O)-2: Single spray of Monceren 250 SC (Pencycuron 22.9%SC) @ 625ml+Bavistin (Carbendazim) 50WP @ 500gram/ha in 500 liters of water at booting stage.

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Technology Option(T O)-3: Single spray of Sheathmar (Validamycin 3% L) @ 1250ml+Bavistin (Carbendazim) 50WP @500gram/ha in 500 liters of water at booting stage.

The spraying of fungicides was done at the booting stage of rice crop followed by recording the data on different diseases

and grain yield at appropriate time.

Assessment of the disease

Fungal diseases of rice after booting stage of crop growth were assessed with the standard evaluation system of IRRI 2002.

Table 1: Method adopted for the assessment of the rice fungal diseases under on-farm trial

Disease	Pathogen	Identification	Scoring	Source
Sheath blight It is a major fungal disease. The incidence and severity of the disease is increasing in intensified and hybrid rice production systems.	<i>Rhizoctoniasolani</i> (Teleomorph: <i>Thanatephorus cucumeris</i>) The pathogen is soil borne and survives in crop debris.	Oval or ellipsoidal greenish-gray lesions, usually 1-3 cm long, on the leaf sheath, initially just above the soil or water level. Lesions on the leaves usually have irregular lesions, often with gray-white centers and brown margins as they grow older.	Scoring (at growth stage 3-6) Scale Relative lesion height 0 No infection observed 1 Lesion limited to lower 20 % of the plant height 3 20-30 % 5 31-45 % 7 45-65 % 9 More than 65 %	IRRI, 2002
Neck Blast It's early infection of rice panicles causes severe reduction in grain yield.	<i>Pyriculariaoryzae</i> (Teleomorph: <i>Magnaportheoryzae</i>) The pathogen is seed borne and overwinters in infected crop debris.	Lesions on the neck are grayish brown and can cause girdling. If infection of the neck occurs before milky stage, no grain is formed, but if infection occurs later, lower weight and poor quality grains are formed. Neck and node blast can also cause whiteheads or white Panicles.	Scale No. of infected panicles 0 No incidence 1 Less than 5 % 3 5-10 % 5 11-25% 7 26-50% 9 More than 50%	IRRI, 2002
Brown spot It is a major fungal disease of rice worldwide. It causes both quantity and quality losses.	<i>Bipolarisoryzae</i> [syn. <i>Helminthosporiumoryzae</i> (Teleomorph: <i>Cochliobolusmiyabeanus</i>)] The fungus is seed borne and overwinters in infected crop debris	Lesions on the leaves are initially small, circular, and dark brown to purple-brown. Fully developed lesions are circular to oval with a light brown to gray center, surrounded by a reddish-brown margin. Spikelets can also be infected. Infection of florets leads to incomplete or disrupted grain filling and a reduction in grain quality	Scale Infected leaf area 0 No incidence 1 Less than 1 % 2 1-3 % 3 4-5% 4 46-10% 5 11-15% 6 16-25% 7 26-50% 8 51-75% 9 76-100%	IRRI, 2002
False smut The initial stage of the disease occurs at the early flowering stage of rice crop, when the ovary is destroyed.	<i>Ustilagoideavirens</i>	Plants infected with false smut have individual rice grains transformed into a mass of spore balls (sori). These spore balls are initially orange, and then turn greenish-black when mature.	Scale Infected florets 0 No incidence 1 Less than 1 % 3 1-5% 5 6-25% 7 26-50% 9 51-100%	IRRI, 2002
Grain discolouration	Pathogen: Species of <i>Sarocladium</i> , <i>Bipolaris</i> , <i>Alternaria</i> , <i>Microdochium</i> , <i>Fusarium</i> , <i>Phoma</i> , <i>Curvularia</i> , <i>Pseudomonas</i> , etc	Darkening of glumes of spikelets, brown to black colour including rotten glumes caused by one or more pathogens. Intensity ranges from sporadic discolouration to discolouration of the whole glume.	Scale grains with severely Discoloured glumes 0 No incidence 1 Less than 1 % 3 1-5% 5 6-25% 7 26-50% 9 51-100%	IRRI, 2002

* (Snedecor and Cochran, 1994)

RESULTS AND DISCUSSION

Result was analyzed for two years data for the effect of technology options of fungicide combination on five different fungal diseases has been presented (in Table 2) and the effect on grain yield, net profit, BC Ratio in Table 3.

Sheath blight

All the three technology options of fungicide combination significantly reduced sheath blight disease out of which, Nativo 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 0.05% resulted into lowest disease intensity of 9.4 % followed by Monceren250 SC (Pencycuron 22.9%SC) @ 0.10 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L@0.2%+Bavistin (Carbendazim) 50WP @ 0.1 % both of which resulted into very lower disease intensity at par of 12.1 and 12.5 % in comparison of 38.3 % in farmers practice. Roy and Saikia (1976) also obtained the best control of sheath blight with carbendazim or by benomyl sprays (0.05%) both in green house and field tests. Swamy *et al.* (2009) also reported that new fungicide formulations tricyclozole 400g + propiconazole 125g @ 0.25% and trifloxystrobin 25g + tebuconazole 50g @ 0.04% was on par with the standard checks hexaconazole 5% EC @ 0.2% and validamycin 3L @ 0.25%. Lore *et al.*, 2005 and Biswas, 2002 also reported that Pencycuron 250 EC was very effective under Punjab and West

Bengal rice growing conditions against sheath blight when sprayed at maximum tillering stage. Carbendazim, benomyl, ediphenfos and kitazin have been reported to be the most effective chemicals (Premalatha, 1990).

Foliar sprays of fungicides such as Validamycin Vietnam, Thailand, Korea, Malaysia and Japan and Pencycuron in Malaysia have been widely used (IRRI, 1993). First spray is applied between the stage of early internode elongation and the development of 2.5 to 5 cm panicle in the boot, and the second on 80-90% of emerging panicles from 10-14 days later. The best time to apply chemicals was at the jointing stage, during which time the percentage tiller infected was highly correlated with sheath blight at wax ripeness stage, percentage yield loss depended on disease index at wax ripeness (CPC, 2005). Groth and Bond (2006) showed that application of azoxystrobin between panicle differentiation and 50% heading stage reduced sheath blight severity and incidence, resulting in higher yield and high head rice milling yield compared with inoculated but non-sprayed plots. Parsons *et al.*, (2009) showed that a newly formulated mixture of azoxystrobin and propiconazole called Quilt Xcel™ was highly effective in controlling sheath blight and protecting rice yield and milling quality.

Table 2: Effect of single spray of fungicides at booting stages on Rice Fungal Diseases

Technology Options	Sheath blight (% disease Intensity)			Neck Blast (% Panicle infected)			Brown Spot (% disease Intensity)			False Smut (% panicle infected)			Grain discolouration (% grain infected)		
	2012	2013	Mean	2012	2013	Mean	2012	2013	Mean	2012	2013	Mean	2012	2013	Mean
FP	34.4	42.2	38.3	14.8	16.2	15.5	16.4	20.4	18.4	25.2	25.8	25.5	12.6	12	12.3
T O 1	8.4	10.4	9.4	4.6	3.8	4.2	6.2	6.8	6.5	8.2	8	8.1	3.4	3.2	3.3
T O 2	12.2	12	12.1	10.6	8.8	9.7	8.4	8.6	8.5	20.4	18.4	19.4	6.8	6.4	6.6
T O 3	10.8	14.2	12.5	8.4	10.2	9.3	8.8	8.2	8.5	16	16.2	16.1	8	8.6	8.3
CD at 5%	1.02	0.68		1.60	1.88		1.24	0.46		2.01	1.49		1.11	1.02	
CV	12.04	14.4		14.27	11.66		13.09	14.3		16.24	9.8		12.54	8.61	

Neck Blast

All the three technology options of fungicide combination significantly reduced percent Panicle infected with neck blast disease also, among which Nativo 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 0.04% resulted into lowest disease incidence of 4.2 % followed by Monceren250 SC (Pencycuron 22.9%SC) @ 0.10 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @ 0.2% + Bavistin (Carbendazim) 50WP @ 0.1 % both of which resulted into significantly lower disease intensity at par of 9.7 % and 9.3 % in comparison of 15.5 % in the farmers practice.

Saikia (1991) has confirmed that sprays of edifenphos, thiophanate methyl and carbendazim at 0.1% effectively reducing the leaf blast by 71.3-81% and neck blast by 60-65% with corresponding increase in yield. Prasanna *et al.* (2011) evaluated three new QoI fungicides (Kresoxim methyl, Metaminostrobin and Trifloxystrobin) in combinations with other groups for two seasons against blast and sheath blight of rice. All the QoI group fungicides were very effective in controlling leaf and neck blast and also improved the growth of the plant in terms of height, test weight and yield. Ghazanfar *et al.* (2009) evaluated several fungicides on a

highly susceptible rice variety Basmati C-622 and also observed the control of disease in case of neck blast was shown by Tetrachlorophthalide 30 WP @ 3g/liter, Difenoconazole 250 EC and Tebuconazole + Trifloxystrobin @ 0.8 g/litre of water to the tune of 12.81%, 14.24% and 17.01%, respectively.

Brown Spot

Brown spot is one of the most important rice diseases in India. The disease affects the yield and milling quality of the grain but in our study area this disease was in mild condition. All the three technology options of fungicide combination significantly reduced percent disease intensity of brown spot also, out of which Nativo 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 0.04% resulted into lowest disease intensity of 6.5 % followed by Monceren250 SC (Pencycuron 22.9%SC) @ 0.10 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @ 0.2% + Bavistin (Carbendazim) 50WP @ 0.1 % both of which resulted into significantly lower disease intensity at par of 8.5 % in comparison of 18.4 % in the Farmers practice.

Celmer *et al.* (2007) also found that tebuconazole,

azoxystrobin and trifloxystrobin + propiconazole effectively reduced brown spot with enhanced grain yield. [Sunder et al. \(2010\)](#) reported that among six fungicides evaluated, propiconazole (2ml/l) proved most effective and reduced the brown leaf spot with significant increase in yield.

False Smut

In our study spray of all the three technology options of fungicide combinations at booting stage of rice, significantly reduced percent panicle infected with false smut disease also, among which, Nativo 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 0.04% resulted into lowest disease incidence of 8.1 % followed by Monceren250 SC (Pencycuron 22.9%SC) @ 0.10 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @0.2% + Bavistin (Carbendazim) 50WP @0.1 %, both of which resulted into significantly lower disease incidence of 19.4 % and 16.1 % in comparison of 25.5 % in the farmers practice.

[Singh and Sunder \(2015\)](#) reported that spraying of Trifloxystrobin 25% + tebuconazole 50% @ 0.4 g/l at booting stage caused minimum incidence/ % infected panicles (8.05%) and severity/ % infected grains (0.39 %) of False smut and maximum grain yield (5117 kg/ha) in rice genotype CR333-6-1. He also found that spraying the fungicides at 100% panicle emergence stage provided less disease control compared to spraying at booting and 50% panicle emergence stage. Evaluation of fungicides trifloxystrobin 25% + tebuconazole 50% and propiconazole 25 EC in vitro and in vivo condition showed 100% inhibition to growth of fungal mycelium. Application of prochloraz + carbendazim followed by chlorothalonil had effective in controlling the false smut of rice ([Mohiddin et al., 2012](#)). [Raji et al. \(2016\)](#) reported that propiconazole 25EC (0.1 %) recorded lowest disease severity than other treatments followed by trifloxystrobin +

tebuconazole 75 WG when sprayed at booting or 50% panicle emergence. Higher yields were obtained by spraying of Propiconazole25 EC at booting stage and also trifloxystrobin + tebuconazole 75 WG at booting.

Grain discolouration

In our study spray of all the three technology options of fungicide combinations at booting stage of rice, significantly reduced percent grain infected with grain discolouration disease also, among which Nativo75 WG (Tebuconazole 50%+Trifloxystrobin 25%) @ 0.04% resulted into lowest disease incidence of 3.3 % followed by Monceren250 SC (Pencycuron 22.9%SC) @ 0.10 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @0.2% + Bavistin (Carbendazim) 50WP @0.1 %, both of which resulted into significantly lower disease incidence of 6.6 % and 8.3 % in comparison of 12.3 % in the farmers practice.

[Hunjan et al. \(2011\)](#) also found Trifloxystrobin 25% + tebuconazole 50% as highly effective in managing sheath blight, brown spot and grain discolouration of rice.

Rice grain discoloration is a disease complex caused by many pathogens. Nativo 75% WG was able to check grain discoloration to moderate extent. The grain discoloration ranged between 13.2% and 18.2% at the test doses of Nativo 75 WG (200, 150 and 100 g/ha) as compared to 29.4% in untreated control ([Goswami and Thind, 2018](#)).

[Mustafa and Mohsan \(2017\)](#) reported that among the twelve treatment including control for the management of grain discolouration, Nativo 75 WG outclassed all the chemicals in reducing discoloured panicle by 49.59% as compared to control 67.40%.and hence improving the paddy yield.

Table 3: Effect of single spray of fungicides at booting stages on grain yield and economics of cultivation of Rice

Technology Options	Yield (q/ha)			Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B : C ratio
	2012	2013	Mean				
Farmer's practice/Check: (No. spray)	35.6	39	37.2	21,500	37200	15,700	1.73
T O-1: Nativo 75 WG @ 250 gram/ha	50.4	54	52.3	23,400	52300	28,900	2.24
T O-2: Monceren250 SC (Pencycuron 22.9%SC) @ 625ml + Bavistin (Carbendazim)50WP @500gram/ ha	42.8	44	43.6	22,800	43600	20,800	1.91
T O-3: Sheathmar (Validamycin 3% L) @ 1250 ml+Bavistin 50WP @500gram/ ha	44.4	42	43.3	22,600	43300	20,700	1.92
CD at 5%	1.21						
CV	12.15						

Grain Yield and Economics of cultivation

Besides the effect on significant reduction of five fungal diseases in rice, application of all the three technology options of fungicide combinations at booting stage of rice, significantly enhanced the grain yield, net profit and B:C ratio in both years of study. Nativo 75 WG (Tebuconazole

50%+Trifloxystrobin 25%) @ 0.05% resulted into highest mean grain yield of 5230 kg/ha, net profit of Rs 28,900 / ha with B:C Ratio as 2.24. Other two options as Monceren 250 SC (Pencycuron 22.9%SC) @ 0.10 % +Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @0.2%+Bavistin (Carbendazim) 50WP @0.1 %, resulted at par

yield of 4360 and 4330 kg/ha, net profit of 20,800 and B:C ratio as 1.92, in comparison with that of 3720 kg/ha, Rs.15700 and 1.73, respectively in the farmers practice. Saikia (1991) has confirmed that sprays of edifenphos, thiophanate methyl and carbendazim at 0.1% effectively reducing the leaf blast by 71.3-81% and neck blast by 60-65% with corresponding increase in yield. Groth and Bond (2006) showed that application of azoxystrobin between panicle differentiation and 50% heading stage reduced sheath blight severity and incidence, resulting in higher yield. Celmer *et al.* (2007) also found that tebuconazole, azoxystrobin and trifloxystrobin + propiconazole effectively reduced brown spot with enhanced grain yield. Hunjan *et al.* (2011) also found Trifloxystrobin 25% + tebuconazole 50% as highly effective in managing sheath blight, brown spot and grain discoloration of rice along with higher yield. Higher grain yield with effective control of false smut and grain discoloration of rice was found with use of Trifloxystrobin 25% + tebuconazole 50% also by Raji *et al.* (2016); Mustafa and Mohsan (2017) reported that among the twelve treatment including control for the management of grain discoloration, Nativo 75 WP outclassed all the chemicals in reducing discoloured panicle by 49.59% as compared to control 67.40% and hence improving the paddy grain yield.

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CONCLUSION

Under farmer field condition with standard agronomic practices single spray of all the technology options of fungicides combinations like Nativo 75 WG (Tebuconazole 50% + Trifloxystrobin 25%) @ 0.05%, (Pencycuron 22.9% SC) @ 0.12% + Bavistin (Carbendazim) 50WP @ 0.1% and Sheathmar (Validamycin 3% L) @ 0.25% + Bavistin (Carbendazim) 50WP @ 0.1% at booting stage can significantly reduce the extent of damage caused by all five fungal diseases viz. sheath blight, neck blast, brown spot, false smut & grain discoloration along with corresponding higher grain yield, net return and B:C ratio in comparison to the farmers practice. However, single spray of Nativo 75WG (Tebuconazole 50% + Trifloxystrobin 25%) @ 0.05% in susceptible rice cultivar like MTU 7029 and may result into minimum diseases level with maximum yield, net profit and Benefit Cost ratio.

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