Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6648

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (4):** 651-655 (2018)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

A New Combination Fungicide for the Management of Sheath Blight and Neck Blast Diseases of Paddy

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Received: 22.06.2018 | Revised: 27.07.2018 | Accepted: 5.08.2018

ABSTRACT

Sheath blight and neck blast are the most important diseases affecting rice production in India. In recent years, resistance development in pathogens a new constraint has emerged due to repeated fungicide usage with single mode of action. The farmers are demanding for crop protection products of lower dosage and less toxic with nonthreatening environmental profile. In this context an attempt was made to search a new molecule of fungicide with novel and broad spectrum modes of action. In the present study various fungicides were screened against sheath blight and neck blast of rice. Among the fungicides evaluated tricyclazole 45% + hexaconazole 10% WG @1g/l was significantly effective in reducing the disease severity of sheath blight and neck blast with PDI of 10.36 and 9.78 and an yield of 5954 kg/ha as against a PDI of 65.18 and 61.06 and yield of 3061 kg/ha in untreated control. Tricyclazole 45% + hexaconazole 10% WG at higher concentration did not show any symptoms of phyto-toxicity till 15 days after application.

Key words: *Tricyclazole, Phyto-toxicity, Paddy, Fungicide*

INTRODUCTION

Rice *(Oryza sativa* L.) is the single most important food crop and the staple diet of more than three billion people. About 92 per cent of rice grown in world is produced and consumed in Asian countries. India has largest area among rice growing countries and it stands second in production and consumtion of rice in the world. The production of rice worldwide is limited by biotic and abiotic constraints. Rice Yields must double over the next 40 years if we have to sustain the nutritional needs of the ever-expanding global population. Of the various biotic factors limiting rice production and productivity, diseases continues to be an enigmatic problem in several rice growing ecosystems of both tropical and temperate regions of the world. The annual losses due to rice diseases are estimated to be 10-15% on an average basis worldwide.

Cite this article: Chethana, B.S., A New Combination Fungicide for the Management of Sheath Blight and Neck Blast Diseases of Paddy, *Int. J. Pure App. Biosci.* **6(4):** 651-655 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6648

Among the various diseases limiting rice productivity, blast (causal organism: *Pyricularia oryzae* cavara.) and sheath blight (causal organism: *Rhizoctonia solani* Kühn,)[1,7] continues to be an enigmatic problem in several rice growing ecosystems of the world especially in intensive production systems[6,10]. Rice blast disease has caused significant yield losses in many rice growing countries. Frequent epidemics and outbreaks of rice blast were reported in different major rice growing countries, with yield losses ranging from 20 to 100%[11]. Out of the total yield loss due to diseases in rice, 35% is by blast, 25% by sheath blight 20% by BLB, 10% by tungro and remaining 10% by other diseases [9].

The most usual approaches for the management of the disease include planting of resistant cultivars, manipulation of planting time, recommended application of fertilizers and irrigation management[2,4,3,5]. But till date only a few variety were released with lower level of resistance and none of the varieties under commercial cultivation has resistance. In recent years due to climate change high temperatures and erratic rainfall in India have contributed to an increase in the incidence of rice diseases. During the cropping season under congenial weather condition the disease spreads at faster rate, use of fungicides is the only way of minimizing the disease in case of large scale cultivation. In this context management of the disease by adopting cultural practices combined with need based application of the fungicide is the best practice to minimize the loss due to disease and to attain economical yield. Further repeated use of same fungicides in the same field or plot sometimes become less or not effective may result in development of fungicide resistance in the pathogen. In this view, the present exploration was undertaken to appraise the efficacy of new combination fungicides against neck blast and sheath blight diseases under field conditions

MATERIAL AND METHODS

Field experiment was conducted using popular susceptible variety MTU1001 during *Kharif* 2015 and 2016 at ZARS, VC farm Mandya, Karnataka under field condition. The field comprised of red sandy loam soils with unique soil properties consist of pH 5.9 to 6.2, 0.30 % organic matter, 25.0 kg ha-1 of available N, 24.23 kg ha-1 of P2O5 and 215.55 kg ha-1 of available K2O. The experimental plots were filled with water and ploughed until any soil aggregates were wrecked up. Excess water was drained out, and the field was partitioned into several blocks based upon the prerequisite for the experiment. In the present investigation, experiment was laid in Randomized block design using MTU1001 variety. Uniform plant population was sustained throughout the plot, with the spacing of 20x15 cm between rows and plants. The virulent local isolate of *R. solani*, was obtained from a sheath blight-infested rice was multiplied under laboratory conditions. The culture was mass multiplied on sterilized rice grain and rice hull mixture (1:3 w/w) in autoclavable plastic bags and incubated at room temperature for 2 weeks. The *R. solani* inoculum were artificially inoculated at maximum tillering stage by manually placing between the tillers just above the water line at 40 DAP. Neck blast was evaluated under natural screening. Treatments were implemented through foliar application just after the initiation of disease for sheath blight and at 5% panicle emergence for neck blast. A total of two sprays were given. Observation on disease severity was taken before treatment implementation and after fourteen days after the fungicide application. The disease was measured using the disease rating scale of 0-9 developed by International Rice Research Institute (SES 2013) for blast and sheath blight disease. Further, per cent disease index (PDI) was calculated using formula given below.

Disease severity (%) PDI

$$PDI = \frac{\text{Total sum of numerical ratings}}{\text{Maximum disease rating}} \times \frac{100}{\text{Number of observations taken}}$$

The data were analyzed using ANOVA and means were separated by a least significant difference (LSD) at $P = 0.05$.

Two years data was pooled to get the average PDI and yield values. Subsequently, the data on disease severity and yield parameters were subjected to appropriate statistical analysis. Economic analysis was carried out based on the yield obtained in the pooled data. The benefit cost ratio (B:C) was calculated by considering the cost of cultivation (including the cost of test fungicides) and market price of the product.

RESULTS AND DISCUSSION

The pooled data of two seasons revealed all the fungicides significantly reduced blast and sheath blight disease severity compared to control. The combination fungicide products evaluated were found significantly effective compare to their individual fungicide in decreasing the disease severity. The treatment Tricyclazole 45% + hexaconazole 10% WG @1g/l was significantly effective in reducing the disease severity of sheath blight and neck blast with PDI 10.36 and 9.78 with 84.15% and 83.98% disease reduction followed by Tricyclazole 18%+ Mancozeb 62% WP with PDI of 14.81 and 16.66 and 77.28% and 72.72% disease reduction over control as against a PDI of 65.18 and 61.08. The results pertaining to effectiveness of Tricyclazole 18%+ Mancozeb 62% WP against blast and sheath blight disease are in line with Pramesh *et al.*[8], The combination fungicide Mancozeb 63% WP + Carbendazim 12% WP @1.5g /L was significantly less effective in reducing sheath blight and blast severity with PDI 50.39 and 48.26 respectively. Among the individual fungicides evaluated against sheath blight , Hexaconazole 5% EC @2ml /l recorded sheath blight severity of 31.37 with 51.88% disease reduction but was not significantly effective over Tricyclazole 45% + hexaconazole 10% WG @1g/l in reducing the disease. While Carbendazim 50%WP @1g/l recorded PDI 34.37 with 47.27% reduction in disease. This might be due to frequent use of the same fungicide with single mode of action. Tricyclazole recorded the neck blast severity of 24.29 and was not significantly effective as compare to Tricyclazole 45% + hexaconazole 10% WG @1g/l and Tricyclazole 18%+ Mancozeb 62% WP .This could be due to repeated use of Tricyclazole 75 WP for blast disease management from many years which may have lead to the development of resistant fungal population. This observation is in agreement with the previous researchers[12], The remaining fungicides evaluated viz., Hexaconazole 5% EC, Carbendazim 50%WP, Mancozeb 75% WP and mancozeb 63% + carbendazim 12% WP were less effective and showed poor efficacy against neck blast and sheath blight but were significantly superior over control.

In both the season Hexaconazole 5% EC and Carbendazim 50%WP which were used as standard fungicide for the management of sheath blight were less effective with PDI of 31.37 and 34.37 and 51.88% and 47.27% disease reduction respectively. This might be due to resistance development in the pathogen as they are of single mode of action.

Efficacy of the two new combination products *viz.,* Tricyclazole 45% + hexaconazole 10% WG and Tricyclazole 18%+ Mancozeb 62% WP is due to tricyclazole and hexaconazole as one of the constituents. Use of tricyclazole, a melanin biosynthesis inhibitor has been advocated by Yamaguchi[13], as this is an environmentally safe fungicide and is less likely to lead to resistance development in the pathogen. The combination of tricyclazole with chemicals of different modes of action like mancozeb and hexaconazole may further reduce the risk of resistance development in the pathogen besides being more effective than tricyclazole and hexaconozole alone.

Though several fungicides have been recommended for the management of blast *viz.,* carbendazim, Tricyclazole, iprobenphos Isoprothiolane and sheath blight *viz.,* propiconazole, hexaconazole but in areas which regularly suffer with severe sheath blight and neck blast disease application of combination product Tricyclazole 45% + hexaconazole 10% WG would be more effective and economical for the management of the these diseases .

Grain yield

Pooled data on grain yield revealed Tricyclazole 45% + hexaconazole 10% WG @1g/l was significantly effective recording highest yield of 5954 kg/ha with 48.59 % increased yield over control. Tricyclazole 18%+ Mancozeb 62% WP was the next best fungicide with 5171 kg/ha and 40.80% increased yield. The economic analysis based on the pooled grain yield showed highest cost benefit ratio of 2.23 in Tricyclazole 45% + hexaconazole 10% WG followed by 1.88 in Tricyclazole 75%WP.

Table 1: Bioefficacy of Tricyclazole 45% + Hexaconazole 10% WG against sheath blight and neck blast of rice

Treatments		Kharif 2014			Kharif 2015		
		Percent disease Index (%)		Yield Kg/Ha	Percent disease Index (%)		Yield Kg/Ha
	Dosage/L	Sheath blight	Neck blast		Sheath blight	Neck blast	
Tricyclazole 45% + hexaconazole 10% WG	1.0 g	8.89 (17.36)	9.63 (18.09)	6006	11.83 (20.13)	9.93 (18.83)	5902
Tricyclazole 18%+ Mancozeb 62% WP)	2.5 g	13.33 (21.42)	15.56 (23.24)	4860	16.29 (23.82)	17.75 (24.93)	5481
Tricyclazole 75% WP	0.6 g	25.19 (30.14)	33.33 (35.28)	4479	34.19 (35.80)	23.38 (28.93)	5293
Hexaconazole 5%EC	2.0 ml	34.81 (36.18)	28.89 (32.53)	4068	27.92 (31.91)	35.61 (36.60)	4246
Mancozeb 75%WP	2.0 g	43.70 (41.40)	51.11 (45.66)	4725	53.52 (47.04)	42.63 (40.78)	3787
Mancozeb 63% WP + Carbendazim 12% WP	1.5 g	46.67 (43.11)	52.59 (46.51)	4704	54.11 (47.38)	43.93 (41.83)	3728
Carbendazium 50%WP	1.0 g	33.33 (35.28)	25.93 (30.63)	4800	35.41 (36.54)	31.06 (33.89)	4579
Control		64.44 (53.42)	58.89 (50.15)	3483	65.92 (54.31)	63.23 (52.70)	2638
S. Em± CD at 5% CV (%)		1.58 4.80 7.80	1.52 4.62 7.59	759 142 8.8	1.01 2.99 5.5	0.89 2.63 5.15	78.6 219 5.5

Table 2: Bioefficacy of tricyclazole 45% + hexaconazole 10% WG against sheath blight and neck blast of rice (pooled data)

Treatments		Sheath blight		Neck blast		Yield Kg/Ha	% increasein yield	B :C Ratio
		Percent disease Index (%)	% reduction in disease	Percent disease Index (%)	% reduction in disease			
Name	Dose /L	Sheath blight		Neck blast				
Tricyclazole 45% + hexaconazole 10% WG	1.0 g	10.36 (18.76)	84.15	9.78 (18.23)	83.98	5954	48.59	2.23
Tricyclazole 18%+ Mancozeb 62% WP)	2.5 g	14.81 (22.65)	77.28	16.66 (24.10)	72.72	5171	40.80	1.60
Tricyclazole 75% WP	0.6 g	33.76 (35.54)	48.20	24.29 (29.54)	60.23	4886	35.29	1.88
Hexaconazole 5%EC	2.0 ml	31.37 (34.08)	51.88	32.25 (34.62)	47.18	4157	22.43	1.59
Mancozeb 75%WP	2.0 g	48.51 (44.17)	25.58	46.87 (43.23)	23.24	4256	28.75	1.66
Mancozeb 63% WP + Carbendazim 12% WP	1.5 g	50.39 (45.25)	22.69	48.26 (44.03)	20.96	4216	27.14	1.61
Carbendazium 50%WP	1.0 g	34.37 (35.91)	47.27	28.50 (32.28)	53.33	4690	38.64	1.81
Control		65.18 (53.86)	0.00	61.06 (51.42)		3061		
S. Em± CD at 5% CV (%)		1.11 3.30 5.30		1.76 5.44 9.50		78.6 419 5.50		

CONCLUSION

Investigation on evaluation of Tricyclazole 45% + hexaconazole 10% WG @1g/ l provide the field efficacy of a fungicide for the management of neck blast and sheath blight disease of paddy.

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