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Newly Evolved Different Fungicide Combinations against Paddy Sheath Blight under Field Conditions in West Bengal

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ABSTRACT

Rice (*Oryza sativa* L.) is a vital global food crop, consumed by over half the world's population. In India, it covers 43.5 M ha, yielding 112.9 Mt at a productivity of 2.56 t ha^{-1}. In West Bengal, it spans 5.15 M ha, producing 15.09 Mt with a high productivity of 2933 kg ha^{-1}. Rice sheath blight, caused by *Rhizoctonia solani* (also known as *Thanatephorus cucumeris*), is a highly destructive disease that has led to significant output losses in the last two decades. Reports suggest that production losses due to this disease can range from 5.2% to 50%, depending on factors like environmental conditions, crop growth stages, management practices, and rice cultivars used. This disease is called "sheath blight" because it initially infects the leaf sheath. To combat this disease, various fungicide compounds with diverse modes of action are available on the market. The research aimed to identify the most effective and cost-efficient fungicide combination for managing rice sheath blight. The experiment evaluated the efficacy and economics of Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC, and Hexaconazole 4% + Zineb 68%, as well as Mancozeb 75% WP under field conditions. The results showed that Mancozeb 52.6% + Hexaconazole 2.4% achieved the highest disease reduction over the control (46.10%), followed by Hexaconazole 5% EC (42.30%).

Keywords Rice, Sheath blight, Fungicide.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops. It provides 20% of the world's dietary energy supply followed by maize and wheat. To fulfil world demand, it is predicted that an extra 114 Mt of milled rice would be needed by 2035, representing a 26% increase over the following 25 years. Rice is cultivated in all the continents except Antarctica, over an area of more than 150 M ha, but Asia stands first for the production of rice. Depending upon the age of the plant, time of infection and sevearity of the disease cause yield loss to the extent of 5.9 to 69%. In India rice occupies an area of 43.5 M ha, production of 112.9 Mt and productivity of 2.56 t ha^{-1}. In West Bengal it occupies an area of 5.15 M ha, production of 15.09 Mt and productivity of 2933 kg ha^{-1} (Indiastat

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2018). Rice production and productivity is affected by number of biotic and abiotic factors, which causes yield losses up to 20–30%. Fungal infections are the most common biotic limitations worldwide, regardless of where rice is farmed. Sheath blight caused by *Rhizoctonia solani* Kuhn (Teleomorph: *Thanatephorus cucumeris* (Frank) Donk) is potentially devastating fungal disease in all temperate and tropical rice production regions especially in irrigated eco-system. It has become more prevalent on most of the improved varieties currently grown in India. Fungicide application is the most common approach among the farmers for the management of sheath blight throughout the world due to resistant or tolerant sources to sheath blight are not available and biological control is still not successful at field level. Although, most of fungicides are effective against sheath blight disease, it has been advised to rotate the fungicides to overcome the development of fungicide resistance in targeted fungal population. Due to the ongoing development of fungicide tolerance in the fungal population, it is unavoidable to look for a new group of fungicides with a different mode of action so that farmers may learn about a range of fungicides with distinct modes of action. In this regard, we have tested four fungicides with different modes of action under field conditions to know their effectiveness.

Since, *Rhizoctonia solani* is a typical soil borne fungus and its management over and done with use of chemicals is expensive and not feasible, because of the physiological heterogeneity of the soil and other edaphic influences might prevent effective concentrations of the chemical reaching to the pathogen. Integrated approaches for the disease management are paying more diligence in terms of sustainability. This approach mainly emphasis on the cultural practices, resistant variety, environmentally friendly means i.e. through the use of biological control with a need based applicants ion of chemical molecules for disease management (Reddy 2017).

MATERIALS AND METHODS

The field trials were conducted in a Randomized Block Design (RBD) with three replications and plot size of 4.0 m × 5.0 m on rice variety Swarna MTU 7029 at Rice regional research substation, Chakdah, BCKV to study the efficacy of different fungicides against sheath blight of rice. These fungicides viz., of Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC and Hexaconazole 4% + Zineb 68 %, Mancozeb 75% WP. Two sprays were given, first spray was given at the initiation of the disease and the second spray given at milking stage. Grain yield was measured and recorded on a plot-by-plot basis, and the results were reported in q/ha. Disease severity was recorded at random selection of 5 plants per plot and all plants were labeled per hill. These labeled plants were kept under observation for disease intensity using methods described in SES for Rice (IRRI 2002). The disease rating was recorded by adopting the methodology using 0-9 SES scale. The degree of sheath blight was measured the day before, during, and after each spraying, as well as during harvest. Grain and straw yield was recorded from net plot area after harvesting.

Formula for calculating per cent disease intensity is :

$$PDI = \frac{\text{Sum of disease rating}}{\text{No. of observations} \times \text{Highest no. of rating scale}} \times 100$$

RESULTS AND DISCUSSION

Evaluation of different fungicide combinations against paddy sheath blight under field conditions

Sheath blight of rice caused by *Rhizoctonia solani* (Fig.1) (Teleomorph : *Thanatephorus cucumeris* (Frank) Donk) is one of the major biotic constraints

Fig. 1. Rice sheath blight symptoms in field condition.

Fig. 2. Experiment field.

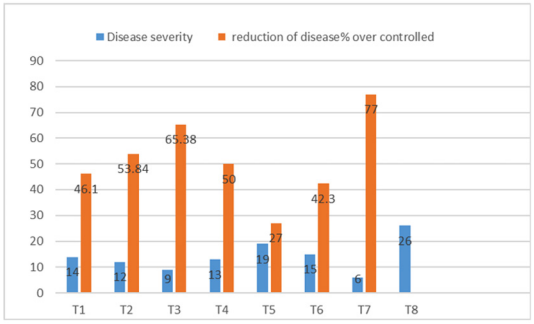

Fig. 3. Spraying of fungicides in field condition against sheath blight disease of rice.

in India and can reduce yields ranging from 20-50% depending on the severity of the disease and stages of infection. The disease has spread widely in terms of both occurrence and intensity over past 20 years (POS, 1991-2011). In West Bengal the disease occurs in moderate to severe form in all the districts. Keeping in view the importance of the disease in rice production, the present investigation was carried out to identify the causal organism associated with sheath blight in different regions of West Bengal, to study evaluating the *in vivo* efficacy of fungicides, bio-efficacy against, *R. solani* field conditions (Fig. 2).

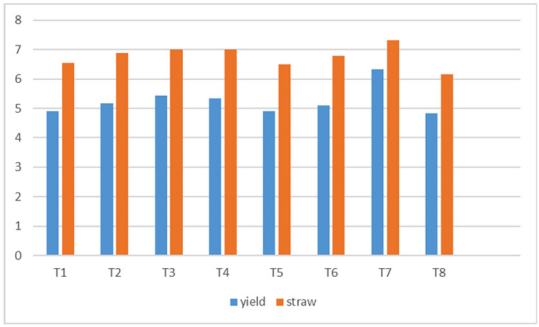

Fig. 4. Effect of fungicides on paddy yield under field condition during *kharif* 2018.

The results of grain yield had showed significantly highest grain yield (6.3 kg plot^{-1}) was harvested in Mancozeb 52.6% + Hexaconazole 2.4% (14.4 ml) which was at par with Mancozeb 52.6% + Hexaconazole 2.4% (9 ml) (5.43 kg plot^{-1}) and Hexaconazole 5% EC (3.6 ml) (5.33 kg plot^{-1}) followed by, Mancozeb 52.6% + Hexaconazole 2.4% (7.2 ml) (5.17 kg plot^{-1}), Hexaconazole 4% + Zineb 68% (4.5 g) (5.10 kg plot^{-1}) and Mancozeb 52.6% + Hexaconazole 2.4% (5.4 ml) (4.91 kg plot^{-1}). Whereas, Mancozeb 75 % WP (7.2 ml) yielded with (4.90 kg plot^{-1}) grain yield. Regarding straw yield, the highest straw yield (7.33

Table 1. Evaluation of different new fungicide combinations against paddy sheath blight under field condition.

Treatment	Fungicides	Disease severity (%)	Percentage of disease reduction over controlled	Dose (g or ml/l)	Growth parameters Grain yield (kg/ plot)	Straw yield (kg/plot)
T_1	Mancozeb 52.6%+Hexaconazole 2.4%	14/0	46.10	1.8	4.91	6.55
T_2	Mancozeb 52.6%+Hexaconazole 2.4%	12	53.84	2.4	5.17	6.88
T_3	Mancozeb 52.6%+Hexaconazole 2.4%	9	65.38	3.0	5.43	7.00
T_4	Hexaconazole 5% EC	13	50.00	1.2	5.33	7.00
T_5	Mancozeb 75% WP	19	27.00	2.4	4.90	6.50
T_6	Hexaconazole 4% +Zineb 68%	15	42.30	1.5	5.10	6.88
T_7	Mancozeb 52.6%+Hexaconazole 2.4%	6	77.00	4.8	6.33	7.33
T_8	Control	26	-	-	4.83	6.16
	CD at 5% level	1.02	-	-	1.30	1.34

kg plot^{-1}) was recorded in plot treated with Mancozeb 52.6% + Hexaconazole 2.4% (14.4 ml) which was at par with Mancozeb 52.6% + Hexaconazole 2.4% (9 ml) (7.00 kg plot^{-1}) and Hexaconazole 5% EC(3.6 ml) (7.00 kg plot^{-1}) followed by Mancozeb 52.6% + Hexaconazole 2.4% (7.2 ml) (6.88 kg plot^{-1}), Hexaconazole 4% + Zineb 68% (4.5 g) (6.88 kg plot^{-1}), Mancozeb 52.6% + Hexaconazole 2.4% (5.4 ml) (6.55 kg plot^{-1}) and Mancozeb 75 % WP (7.2 ml) (6.50 kg plot^{-1}) (Table 1) (Figs. 3–4).

The experiment was conducted under field condition during 2018-2019 *kharif* crop season. Four newly evolved fungicides namely Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC, Hexaconazole 4% + Zineb 68%, Mancozeb 75% WP were tested against sheath blight disease under natural environment the observations are presented in Table 1. Maximum disease reduction over control was observed in case of Mancozeb 52.6% + Hexaconazole 2.4%, followed by Hexaconazole 5% EC, Hexaconazole 4% + Zineb 68% which are 46.10 % and 42.30% respectively.

This present investigation get positive support of the work done by Raji *et al.* (2016), Gupta *et al*. (2015), Manish and Sunder (2013), Bag *et al.* (2016), Pramesh *et al.* (2017), who reported that Hexaconazole 5% was effective in incidence of sheath blight.

CONCLUSION

The experiment was conducted under field condition during 2018-2019 *kharif* crop season. Four newly evolved fungicides namely Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC, Hexaconazole 4% + Zineb 68%, Mancozeb 75% WP were tested against sheath blight disease.

The present results indicates Mancozeb 52.6% + Hexaconazole 2.4% is more effective followed by Hexaconazole 5% EC and Hexaconazole 4%+Zineb 68% against *R. solani*. Hence these chemicals may be utilized in the disease management.

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