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Evaluation of bio efficacy and Phytotoxicity of new molecule tebuconazole 15%+Zineb 57% WG against sheath blight, blast and brown spot of rice

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Abstract
A field experiment to evaluate the bio efficacy and Phytotoxicity of new molecule Tebuconazole 15%+Zineb 57% WG against sheath blight, blast and brown spot of rice was undertaken during Kharif 2016-17 (season I) and 2017-18(season II) in the RRS (OAZ), UBKV, Majhian, Dakshin Dinajpur. The result revealed that all the treatments were superior over control and the treatment T3 (Tebuconazole 15%+Zineb 57% WG) @1500 g/ha showed lowest PDI against sheath blight (10.82 after 1st spray & 15.09 after 2nd spay during season I and 9.84 after 1st spray and 14.39 after 2nd spray during season II), blast (1.4 after 1st spray and 3.34 after 2nd spray & 2.54 after 1st spray & 4.87 after 2nd spray during season II) and brown spot (3.21 after 1st spray and 4.10 after 2nd spray during season I and 4.19 after 1st spay & 6.90 after 2nd spray during season II). The highest yield (34.24 q/ha during season I and 34.16 q/ha during season II) was found in the treatment T3 (Tebuconazole 15%+Zineb 57% WG) @1500 g/ha. Considering the 2 parameters PDI and yield, it was found that T3 (Tebuconazole 15%+Zineb 57% WG) @1500 g/ha was the most effective treatment. Phytotoxicity studies revealed that none of the doses of Tebuconazole 15%+Zineb 57% WG exhibited any Phytotoxicity sign or symptoms in comparison to untreated control during both the seasons.

Keywords: Bioefficacy, Phytotoxicity, tebuconazole 15%+Zineb 57% WG, sheath blight, leaf blast, brown leaf spot, rice

Introduction
Rice (*Oryza sativa* L.) is one of the most important cereal crops in the world. In India, rice crop is grown under wide range of agro-climatic conditions and is being cultivated over an area of 44.40 m hectares with total production of 104.32 m tonnes during 2011-12 (Anonymous 2013) [2]. Under field condition, the productivity of rice is affected by many biotic and abiotic factors. Among the different biotic constraints, diseases caused by fungal pathogens such as sheath blight, blast, brown spot, sheath rot, bacterial leaf blight false smut and stem rot are the most prevalent ones.

Rice sheath blight caused by *Rhizoctonia solani* Kuhn is a destructive disease worldwide causing considerable loss in grain yield (Ou 1985: Savary *et al.*, 2006) [13, 14]. Annual yield losses up to 40% were reported with sheath blight under optimum conditions of disease development (Zhong *et al.*, 2007) [19]. Many epidemics of rice diseases have occurred resulting in threat to food security (Thind, 2002) [16].

Blast of rice caused by *Magnaporthe grisea* is another most widespread and destructive disease of rice which is more severe in upland and rainfed low land ecosystems than in other ecologies. The estimated yield loss due the disease was about 60% of the total yield and approximately 6.5 million tons of paddy lost in Thailand (Disthaporn, 1994).

Brown spot of rice caused by *Bipolaris oryzae* Subr. And Jain is another important disease of rice. In India, it is known to occur in all the rice growing states (Gangopadhyay, 1983; Ou, 1985) [6, 13] The disease is of great importance in several countries and has been reported to cause enormous losses in grain yield (upto 90%) particularly when leaf spotting phase assumes epiphytotic proportions as observed in Great Bengal Famine during 1942 (Ghose *et al*., 1960) [7]. The disease especially occurs in environment where water supply is scarce combined with nutritional imbalance particularly lack of nitrogen (Baranwal *et al*., 2013) [4].

Presently these diseases are being managed by application of chemical fungicides such as carbendazim, mancozeb, tricyclozole, propiconazole etc. and many workers have reported carbendazim as the most effective against blast and sheath blight diseases (Kumar, 1992: Narayanaprasad *et al.*, 2011) [10, 11]. Considering the economic damage caused by the diseases, several fungicides have been recommended against these diseases but still there is a need to widen the choice by introducing new molecules. Keeping in view, the present investigation was undertaken to assess the bioefficacy and phytotoxicity of new molecule Tebuconazole 15%+Zineb 57% WG against sheath blight, blast and brown spot of rice.

Materials and Methods

The field experiment was conducted under natural condition during Kharif 2016-17(Season I) and Kharif 2017-18 (Season II) at Regional Research Station (OAZ), UBKV, Majhian, Dakshin Dinajpur, West Bengal in Randomized Block Design (RBD) with seven treatments and three replications. The seeds of a local variety of MTU-7029 were sown in small beds for raising nursery and 25 days old seedlings were transplanted into the field with 20 cm inter and 15 cm intra row spacing in plots measuring 5.0 m x 5.0 m. All other cultural practices were followed as recommended in Agronomic package of practices. The evaluation of the test fungicide was done along with prevailing standard checks and untreated control against the incidences of sheath blight, leaf blast and brown leaf spot diseases of paddy. Higher dose of Tebuconazole 15%+Zineb 57% WG (2500g/ha) was also tested separately for phytotoxicity evaluation. In each plot 10 plants were randomly selected and graded for sheath blight, blast and brown spot diseases using 0-9 scale. Visual scoring of incidence and severity of disease (0-9 scale for Sheath blight, Blast and Brown spot of rice) was done using the International Rice Research Institute (IRRI) standard evaluation scale (IRRI, 1996) [9] and SES score (Anonymous, 2002) [1]. The data for percent disease index were recorded 10 days interval after each spray application. Percent disease index (PDI) was calculated by using the formula given by Wheeler (1969) [18] as stated below.

$$PDI = \frac{\text{Sum of numerical values}}{\text{Number of hills or plants or leaves observed}} X \frac{100}{\text{Maximum disease rating value}}$$

The PDIs and per cent rating data were suitably transformed into arcsine values and analysed statistically.

For phytotoxicity evaluations, The fungicide (Tebuconazole 15%+Zineb 57% WG) was sprayed at the concentration of 1250 g/ha and 2500 g/ha and compared with untreated check. The phytotoxic symptoms (leaf tip/surface injury, wilting, vein clearing, necrosis, epinasty and hyponasty) were recorded (Archana, 2009) [3] at 0, 1, 3, 5, 7 and 10 days after each spray as per CIB guidelines using a rating scale of 0-10.

Yield Recorded

The weight of harvested grains were summed up for calculating plot wise total yield and converted into quintal/ha and statistically analysed. Cost benefit ratio was computed based on input cost and net benefit obtained in each treatment.

Statistical analysis: All the data of diseases incidence and yields were statistically analyzed by the following procedure of RBD. Calculations were made after applying the test of significance of the means. The per cent data of disease incidence was transformed to Arch sine value.

Application method

All the fungicidal treatments were applied into three replications on the appearance of initial disease sign and symptoms. All the agronomical practices were followed as and when required. Two fungicidal sprays were given at an interval of 10-15 days by using knapsack sprayer fitted with hollow cone nozzle. Spray volume used was of 500 L/ha.

Results and Discussion

Bioefficacy of Tebuconazole 15%+Zineb 57% WG against sheath blight disease of paddy

The fungicides tested against sheath blight disease in paddy during season I (Table 1) revealed that the treatment plots sprayed with Tebuconazole 15%+Zineb 57% WG @ 1500 g/ha and Tebuconazole 15%+Zineb 57% WG @ 1250 g/ha after two applications recorded least PDI and were significantly superior over control treatment and other fungicidal standards. Tebuconazole 15%+Zineb 57% WG @ 1250 g/ha was statistically on par with Hexaconazole 4% + Zineb 68% WP @ 1250g/ha treatment. Followed by Tebuconazole 15%+Zineb 57% WG @ 1000 g/ha was recorded next effective fungicide treatment and found statistically at par with Tebuconazole 25.9% EC @ 750 ml/ha. Standard check, Zineb 75% WP @ 2000 g/ha was less efficacy compared to other fungicide treatments to reduce sheath blight disease. However, it was significantly superior over untreated control.

Similar trend of the efficacy of all fungicidal treatments against the sheath blight disease of paddy were recorded during season II (Table 2), where, maximum PDI was recorded under untreated control plots.

Bioefficacy of Tebuconazole 15%+Zineb 57% WG against leaf blast of paddy

The fungicides tested against leaf blast disease in paddy during season I (Table 3) revealed that the treatment plots sprayed with Tebuconazole 15%+Zineb 57% WG after two applications recorded least PDI and it was significantly superior over control treatment and other fungicidal standards. Tebuconazole 15%+Zineb 57% WG @ 1500 g/ha recorded least PDI among all the treatments and was on par with Tebuconazole 15%+Zineb 57% WG @ 1250 g/ha and Hexaconazole 4% + Zineb 68% WP @ 1250 g/ha at both the interval of observation followed by rest of the treatments.

Similar trend of the efficacy of all fungicidal treatments against the leaf blast disease of paddy were recorded during season II (Table 4), where, maximum PDI was recorded in untreated control plots.

Bioefficacy of Tebuconazole 15%+Zineb 57% WG against brown leaf spot disease of paddy

The fungicides tested against brown leaf spot disease in paddy during season I (Table 5) revealed that the treatment plots sprayed with Tebuconazole 15%+Zineb 57% WG @ 1500 g/ha, Tebuconazole 15%+Zineb 57% WG @ 1250 g/ha and Hexaconazole 4% + Zineb 68% WP @ 1250g/ha treatments recorded least PDI, remained on par among themselves and were significantly superior over control treatment and other fungicidal standards. Followed by Tebuconazole 15%+Zineb 57% WG @ 1000 g/ha, Zineb 75% WP @ 2000 g/ha and

Tebuconazole 25.9% EC @ 750 ml/ha were recorded next effective fungicide treatments to reduce brown spot disease and found significantly superior over untreated control.
Similar trend of the efficacy of all fungicidal treatments against the brown leaf spot disease of paddy were recorded during season II (Table 6), where, maximum PDI was recorded under untreated control plots.

Grain yield
The paddy grain yield levels in the trial ranged in between 22.42 to 34.24 q/ha during season I and 21.15 to 34.16 q/ha during season II (Table 7). All the fungicidal treatments significantly increased the grain yield in comparison of untreated control, however, maximum yield of 34.24 q/ha and 34.16 q/ha were recorded in Tebuconazole 15%+Zineb 57% WG @ 1500 g/ha dose which was on par with the Tebuconazole 15%+Zineb 57% WG @ 1250 g/ha with yield of 32.83 q/ha and 32.63 q/ha, Hexaconazole 4% + Zineb 68% WP @ 1250 g/ha with yield of 30.50 q/ha and 30.60 q/ha respectively for season I and season II. Lower dose of Tebuconazole 15%+Zineb 57% WG Tebuconazole 15%+Zineb 57% WG @ 1000 g/ha was found statistically at par with other standard checks, Tebuconazole 25.9% EC and Zineb 75% WP. Minimum grain yield recorded under untreated control were of 22.42 q/ha and 21.15 q/ha, respectively during season I and season II.
Plots treated with Tebuconazole 15%+Zineb 57% WG @ 1500 g/ha and 1250 g/ha were calculated maximum cost benefit ratio compared other treatments.
Singh and Sunder, 2015 [15], reported that, use of combi product Trifloxistrobin 25% + Tebuconazole @50% at 0.4g/l reduced the blast incidence from 23.75 to 9.18% along with significant increase in grain yield. Trifloxistrobin 25% + Tebuconazole@50% and Propiconazole have been found highly effective in managing sheath blight of rice (Hunjan *et al.*, 2011) [8]. Fungicides are now well considered to be the second line of defence in plant disease control after disease resistance (Thind, 2015) [17].

Phytotoxicity
Two doses of Tebuconazole 15%+Zineb 57% WG @ 1250 g/ha and 2500 g/ha were assessed for the phytotoxicity on paddy crop along with untreated control plot. The observation on different parameters revealed that none of the doses of Tebuconazole 15%+Zineb 57% WG exhibited any phytotoxicity sign or symptoms in comparison to untreated control during both the seasons. The crop stand and the crop growth were normal at every stage of observations (1, 3, 5, 7, 10 days after each applications) (Table 8 and 9).

Table 1: Bioefficacy of Tebuconazole 15%+Zineb 57% WG against Sheath blight of Paddy during Season I

Treatment detail	Dose (g or ml/ha)	PDI of Sheath blight		
		10 Days after 1st spray	10 Days after 2nd spray	% Disease Control after 2nd spray
T1- Tebuconazole 15%+Zineb 57% WG	1000	19.05 (25.81)	25.19 (30.05)	54.79
T2- Tebuconazole 15%+Zineb 57% WG	1250	12.77 (20.88)	16.62 (24.00)	70.17
T3- Tebuconazole 15%+Zineb 57% WG	1500	10.82 (19.16)	15.09 (22.81)	72.92
T4- Tebuconazole 25.9% EC	750	20.10 (26.61)	26.10 (30.69)	53.16
T5- Zineb 75% WP	2000	33.44 (35.28)	37.51 (37.72)	32.68
T6- Hexaconazole 4% + Zineb 68% WP	1250	14.13 (22.02)	18.15 (25.16)	67.43
T7- Untreated control (UTC)	-	35.39 (36.48)	55.72 (48.27)	-
CD at 5% level		2.39	2.94	-

Values presented under parenthesis are arc sin transformed values

Table 2: Bioefficacy of Tebuconazole 15%+Zineb 57% WG against Sheath blight of Paddy during Season II

Treatment detail	Dose (g or ml/ha)	PDI of Sheath blight		
		10 Days after 1st spray	10 Days after 2nd spray	% Disease Control after 2nd spray
T1- Tebuconazole 15%+Zineb 57% WG	1000	15.89 (23.43)	21.07 (27.25)	59.26
T2- Tebuconazole 15%+Zineb 57% WG	1250	10.93 (19.26)	16.76 (24.11)	67.59
T3- Tebuconazole 15%+Zineb 57% WG	1500	9.84 (18.24)	14.39 (22.25)	72.17
T4- Tebuconazole 25.9% EC	750	17.00 (24.32)	22.20 (28.08)	57.07
T5- Zineb 75% WP	2000	30.45 (33.44)	33.51 (35.32)	35.20
T6- Hexaconazole 4% + Zineb 68% WP	1250	13.92 (21.85)	17.35 (24.56)	66.45
T7- Untreated control (UTC)	-	32.61 (34.80)	51.72 (45.97)	-
CD at 5% level		2.22	2.71	-

Values presented under parenthesis are arc sin transformed values

Table 3: Bioefficacy of Tebuconazole 15%+Zineb 57% WG against Leaf blast of Paddy during Season I

Treatment detail	Dose (g or ml/ha)	PDI of Leaf blast		
		10 Days after 1st spray	10 Days after 2nd spray	% Disease Control after 2nd spray
T1- Tebuconazole 15%+Zineb 57% WG	1000	3.33 (10.48)	6.85 (15.13)	50.43
T2- Tebuconazole 15%+Zineb 57% WG	1250	1.67 (7.40)	3.95 (11.43)	71.42
T3- Tebuconazole 15%+Zineb 57% WG	1500	1.40 (6.78)	3.34 (10.51)	75.83
T4- Tebuconazole 25.9% EC	750	3.20 (10.29)	5.68 (13.77)	58.90
T5- Zineb 75% WP	2000	5.00 (12.90)	8.60 (17.02)	37.77
T6- Hexaconazole 4% + Zineb 68% WP	1250	1.90 (7.90)	3.95 (11.43)	71.42
T7- Untreated control (UTC)	-	8.75 (17.19)	13.82 (21.80)	-
CD at 5% level		0.88	1.23	-

Values presented under parenthesis are arc sin transformed values

Table 4: Bioefficacy of Tebuconazole 15%+Zineb 57% WG against Leaf blast of Paddy during Season II

Treatment detail	Dose (g or ml/ha)	PDI of Leaf blast		
		10 Days after 1st spray	10 Days after 2nd spray	% Disease Control after 2nd spray
T1- Tebuconazole 15%+Zineb 57% WG	1000	4.57 (12.30)	8.59 (16.99)	5017
T2- Tebuconazole 15%+Zineb 57% WG	1250	2.85 (9.69)	5.77 (13.86)	66.53
T3- Tebuconazole 15%+Zineb 57% WG	1500	2.54 (9.15)	4.87 (12.72)	71.75
T4- Tebuconazole 25.9% EC	750	5.06 (12.98)	7.67 (16.06)	55.51
T5- Zineb 75% WP	2000	6.28 (14.48)	10.42 (18.80)	39.55
T6- Hexaconazole 4% + Zineb 68% WP	1250	2.20 (8.51)	6.89 (15.18)	60.03
T7- Untreated control (UTC)	-	10.17 (18.58)	17.24 (24.51)	-
CD at 5% level		1.01	1.41	-

Values presented under parenthesis are arc sin transformed values

Table 5: Bioefficacy of Tebuconazole 15%+Zineb 57% WG against Brown leaf spot of Paddy during Season I

Treatment detail	Dose (g or ml/ha)	PDI of Brown leaf spot		
		10 Days after 1st spray	10 Days after 2nd spray	% Disease Control after 2nd spray
T1- Tebuconazole 15%+Zineb 57% WG	1000	5.84 (13.94)	9.10 (17.50)	51.41
T2- Tebuconazole 15%+Zineb 57% WG	1250	3.42 (10.63)	4.39 (12.06)	76.56
T3- Tebuconazole 15%+Zineb 57% WG	1500	3.21 (10.30)	4.10 (11.66)	78.11
T4- Tebuconazole 25.9% EC	750	6.34 (14.57)	10.78 (19.15)	42.45
T5- Zineb 75% WP	2000	5.60 (13.66)	8.32 (16.73)	55.58
T6- Hexaconazole 4% + Zineb 68% WP	1250	3.26 (10.37)	5.05 (12.95)	73.04
T7- Untreated control (UTC)	-	10.64 (19.02)	18.73 (25.62)	-
CD at 5% level		1.08	1.38	-

Values presented under parenthesis are arc sin transformed values

Table 6: Bioefficacy of Tebuconazole 15%+Zineb 57% WG against Brown leaf spot of Paddy during Season II

Treatment detail	Dose (g or ml/ha)	PDI of Brown leaf spot		
		10 Days after 1st spray	10 Days after 2nd spray	% Disease Control after 2nd spray
T1- Tebuconazole 15%+Zineb 57% WG	1000	7.97 (16.35)	12.23 (20.41)	48.02
T2- Tebuconazole 15%+Zineb 57% WG	1250	4.42 (12.10)	7.17 (15.49)	69.52
T3- Tebuconazole 15%+Zineb 57% WG	1500	4.19 (11.79)	6.90 (15.20)	70.67
T4- Tebuconazole 25.9% EC	750	8.60 (17.03)	14.23 (22.14)	39.52
T5- Zineb 75% WP	2000	6.65 (14.91)	9.98 (18.38)	57.58
T6- Hexaconazole 4% + Zineb 68% WP	1250	4.59 (12.34)	8.05 (16.44)	65.78
T7- Untreated control (UTC)	-	12.64 (20.81)	23.53 (28.99)	-
CD at 5% level		1.24	1.63	-

Values presented under parenthesis are arc sin transformed values

Table 7: Effect of Tebuconazole 15%+Zineb 57% WG on Paddy Grain yield

Treatment detail	Formulation g or ml/ha	Season I Yield (q/ha)	CB Ratio	Season II Yield (q/ha)	CB Ratio
T1- Tebuconazole 15%+Zineb 57% WG	1000	29.15	1:1.59	29.14	1:1.62
T2- Tebuconazole 15%+Zineb 57% WG	1250	32.83	1:1.76	32.63	1:1.78
T3- Tebuconazole 15%+Zineb 57% WG	1500	34.24	1:1.81	34.16	1:1.84
T4- Tebuconazole 25.9% EC	750	28.70	1:1.53	28.25	1:1.53
T5- Zineb 75% WP	2000	27.85	1:1.51	27.56	1:1.52
T6- Hexaconazole 4% + Zineb 68% WP	1250	30.50	1:1.61	30.60	1:1.64
T7- Untreated control (UTC)	-	22.42	1:1.30	21.15	1:1.25
CD at 5% level		4.74	-	4.72	-

Table 8: Observation on Phytotoxicity on Paddy during Season I

Treatments	Epinasty & Hyponasty (DAA)					Leaf Injury & Vein clearing (DAA)					Necrosis & Yellowing (DAA)					Stunting & Wilting (DAA)				
	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
T7- Untreated control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2- Tebuconazole 15%+Zineb 57% WG @ 1250g/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T8- Tebuconazole 15%+Zineb 57% WG @ 2500g/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9: Observation on Phytotoxicity on Paddy during Season II

Treatments	Epinasty & Hyponasty (DAA)					Leaf Injury & Vein clearing (DAA)					Necrosis & Yellowing (DAA)					Stunting & Wilting (DAA)				
	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
T7- Untreated control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2- Tebuconazole 15%+Zineb 57% WG @ 1250g/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T8- Tebuconazole 15%+Zineb 57% WG @ 2500g/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DAA-Days after applications

Conclusion

The two season field trial conducted at University Instructional Farm, UBKV, Coochbehar (West Bengal) indicated that Tebuconazole 15%+Zineb 57% WG @ 1500 g/ha and 1250 g/ha dose can effectively control sheath blight, leaf blast and brown leaf spot of paddy crop with resulted better yield. The Tebuconazole 15%+Zineb 57% WG was safe to paddy crop as no phytotoxicity was observed up to the dosage of 2500 g/ha *i.e.* double of the effective dose.

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