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Pre-mix evaluation of azoxystrobin 16.7% + tricyclazole 33.3% SC in controlling Sheeth blight, blast and brown spot diseases of rice (*Oryza sativa* L.)

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Abstract
A combi-product of Azoxystrobin 16.7% + Tricyclazole 33.3% SC was tested against sheath blight, blast and brown spot diseases of rice under field conditions during Rabi 2019-20 and Kharif 2020-21 at College of Agriculture, Hanumanamatti, Ranebennur (Tq), Haveri (Dist.) Karnataka (State). Three sprays of the chemical Azoxystrobin 16.7% + Tricyclazole 33.3% SC was given at 450 ml/ha, 500 ml/ha and 750 ml/ha respectively. The pooled data indicated that, the least incidence of sheath blight, blast and brown spot diseases (7.20 PDI, 10.38 PDI and 10.38 PDI respectively) was recorded in Azoxystrobin 16.7% + Tricyclazole 33.3% SC at 750 ml/ha followed by Azoxystrobin 16.7% + Tricyclazole 33.3% SC at 500 ml/ha (7.33 PDI, 11.18 PDI and 11.18 PDI of sheath blight, blast and brown spot respectively). Whereas, the untreated control recorded the 20.03 PDI, 21.68 PDI and 21.68 PDI of sheath blight, blast and brown spot respectively. The highest grain yield (5.170 t/ha) and highest net return (Rs.35,240 / ha) was recorded in the treatment with Azoxystrobin 16.7% + Tricyclazole 33.3% SC at 750 ml/ha followed by Azoxystrobin 16.7% + Tricyclazole 33.3% SC at 500 ml/ha (4.900 t/ha and Rs.32,200/ha).

Keywords: Pre-mix fungicides, sheath blight, blast, brown spot, tricyclazole, azoxystrobin

Introduction
Rice (*Oryza sativa* L.) is one of the most important food crops worldwide. In Asia, more than 90% of the rice is grown and consumed by nearly 60% of the world's population [1, 2]. It is affected by many biotic and abiotic stresses, among the biotic stresses, sheath blight, blast and brown spot are very important diseases. Among these three, sheath blight of rice caused by *Rhizoctonia solani* (teleomorph: *Thanatephorus cucumeris*) is a destructive disease in many rice growing areas of the world and this could reduce the grain yield by 58.60% [1, 3, 4]. In India, it is estimated that, losses due to the sheath blight disease alone is up to 54.3% [5, 6]. The disease has got more importance in intensive rice production systems due to excess use of nitrogenous fertilizers [7, 8]. Sheath blight disease is one of the most important diseases of rice but there is no genetic resistance available in rice against this disease [9]. Management of sheath blight of rice through fungicides is successful in majority of the cases [7, 10, 11, 12, 13]. Although, fungicides are very effective in managing the fungal diseases, continuous use of same fungicide can lead to development of fungicide tolerance or even resurgence in fungal population; therefore, it is inevitable to search for new group of molecules. The blast is a more frequent and ferocious disease in both temperate and sub-tropical areas and cause severe damage at all stages of the crop growth [14]. *Magnaporthe oryzae* Couch (anamorph; *Pyricularia oryzae* Cavara) is the causal agent of rice blast disease. Annual losses caused by the rice blast vary between 10 to 30 per cent and sometimes even up to 50 per cent or more [15]. However, even 10 per cent loss is sufficient to feed 60 million people for one year [16, 17]. The damage caused due to rice blast depends on the susceptibility of variety, virulence of the pathogen, and the application of fungicide [15]. Rice blast is challenging to control because of the pathogen ability to survive and multiply in harsh environmental conditions and quickly spread to new fields. The losses can be minimized by managing the disease by employing various methods [18]. Alteration of planting date, using of bio-agents [19] application of anti-blast chemicals [14], host plant resistance [20, 21]. fertilizer dose and irrigation schedules are the beneficial and practical approaches for the management of rice blast disease [8, 12, 22, 23]. Brown spot is one of the important rice diseases in the world. It can be a serious disease causing a considerable yield loss. Where, it affects the quality and the number of grains per panicle and reduces the kernel weight [24].

New information generated on diverse fungicides with different modes of action can be offered to farmers for effective control of fungal diseases. In this view, the present study was undertaken to appraise the field efficacy of Azoxystrobin 16.7% +Tricyclazole 33.3% SC against sheath blight, blast and brown spot of paddy under field conditions.

Material and Methods

A field experiment was carried out to evaluate the bio-efficacy of a pre-mix fungicide Azoxystrobin 16.7% + Tricyclazole 33.3% SC in controlling sheeth blight, blast and brown spot diseases of rice during Rabi 2019-20 and Kharif 2020-21 at College of Agriculture, Hanumanamatti, Ranebennur (Tq), Haveri (Dist.), Karnataka. The test variety PAC-837 was used. The experimental plots were laid out in randomized block design (RBD) with three replications of seven treatments with a plot size of 25 Sq. m each and seedlings of 30 days old were tansplanted in trail plots at 20 X 10 cm spacing. The buffer zone of 1.0 m was kept in between the replicated plots to avoid spray drift. A new fungicide Azoxystrobin 16.7% + Tricyclazole 33.3% SC was tested in three doses @ 450, 500 and 750 ml/ha respectively along with Azoxystrobin 23% SC @ 500 ml/ha, Tricyclazole 75% WP @ 400g/ha, Propineb 70% WP @ 2000 g/ha and untreated control. Three sequential sprays of fungicides were given at 15 days interval starting from the initiation of the disease. The foliar application of the fungicides was carried out using Knapsack sprayer fitted with hollow cone nozzle. Observations were recorded on disease severity in each treatment before and seven days after each spray of the fungicide as per the standard method. The observations on severity of sheath blight, blast and brown spot disease were recorded using 0-9 scale at before and seven days after each spray. In each replicated plots, ten hills were randomly selected and scored as per scale. The per cent disease index (PDI) of plants was calculated by the following formula (25).

$$PDI = \frac{\text{Sum of numerical rating}}{\text{Total no. of hills observed X Maximum grade}} \text{ X } 100$$

Table 1: Scale for sheath blight disease

Score	Description
0	No infection
1	Vertical spread of the disease up to 20% of plant height
3	Vertical spread of the disease up to 21-30% of plant height
5	Vertical spread of the disease up to 31- 45% of plant height
7	Vertical spread of the disease up to 46 – 65% of plant height
9	Vertical spread of the disease more than 66% of plant height

Table 2: Scale for leaf blast disease

Score	Description
0	No lesions
1	Small brown specks of pin-point size or larger brown specks without sporulating centre.
2	Small roundish to slightly elongated necrotic sporulating spots, about 1-2 mm in diameter with a distinct brown margin or yellow hallow found on the lower leaves
3	Lesion type is same as scale 2, but significant number of lesions are on the upper leaves.
4	Typical sporulating blast lesions, 3mm or longer, infecting less than 2% of the leaves area
5	Typical blast lesions infecting 2-10% of leaf area
6	Blast lesions infecting 11-25% of leaf area
7	Blast lesions infecting 26 -50% of leaf area
8	Blast lesions infecting 51 - 75% of leaf area
9	More than 75% leaf area affected

Table 3: Scale for Brown spot disease

Score	Description (Affected leaf area)
0	No incidence
1	Less than 1%
2	1 – 3%
3	4 – 5%
4	6 – 10%
5	11 – 15%
6	16 – 25%
7	26 – 50%
8	51 – 75%
9	76 – 100%

Grain Yield

The grain yield was recorded from each plot during harvest of the trials conducted in *Rabi* 2019-2020 and *Kharif* 2020-21. The yield was estimated per hectare basis. Quality of grains was also judged in all the plots.

Phytotoxicity trial (*Rabi*-2019-2020 and *Kharif*-2020-21)

Table 4: The phytotoxicity of Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 500 and 1000 ml/ hectare was assesed

Sl. No.	Name of the product	Dose (Formulations)
1.	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	500 ml/ ha
2.	Azoxystrobin 16.7% + Tricyclazole 33.3% SC)	1000 ml /ha
3.	Control	--

The parameters on phytotoxicity of chemical was recorded on epinasty, hyponasty, leaf necrosis, vein clearing, leaf tip and surface injury, yellowing and wilting using following 0 –10 scale scoring system.

Table 5: Rating scale for phytotoxicity

Crop response / Crop injury	Grade
0 – 00	0
01– 10%	1
11 – 20-%	2
21 – 30%	3
31 – 40%	4
41 – 50%	5
51 – 60%	6
61 – 70%	7
71 – 80%	8
81 – 90%	9
91– 100%	10

Table 6: Treatment details

T. No.	Treatments	Formulation dose	Method of Application	Dilution in water (lit/ha)
T_1	Azotrix (Azoxystrobin 16.7% + Tricyclazole 33.3% SC)	450 ml/ha	Foliar spray	500
T_2	Azotrix (Azoxystrobin 16.7% + Tricyclazole 33.3% SC)	500 ml/ha	Foliar spray	500
T_3	Azotrix (Azoxystrobin 16.7% + Tricyclazole 33.3% SC)	750 ml/ha	Foliar spray	500
T_4	Azoxystrobin 23% SC market sample as standard check	500 ml/ha	Foliar spray	500
T_5	Tricyclazole 75% WP market sample as standard check	400 g/ha	Foliar spray	500
T_6	Propineb 70% WP - Market Sample as standard check	2000 g/ha	Foliar spray	500
T_7	Control	---	-------	500
T_8	Azoxystrobin 16.7% + Tricyclazole 33.3% SC) (only for phytotoxicity)	1000 ml/ha	Foliar spray	500

3. Results and Discussion

In recent years, pre-mix fungicides are being widely used for the management of fungal diseases under field conditions in paddy due to their broad spectrum, curative action and low dosage compared to their solo formulations. In paddy, the efficacy of such combi-products in managing fungal diseases has been reported previously [7, 10, 11, 12, 13, 16]. In the present study, the field experiments revealed that, the sparying of pre-mix fungicide Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha has controlloed the sheath blight, blast and brown spot in paddy very effectively comapred to other treatments

a. **Effect of Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha against sheath blight, blast and brown spot:** The test chemical Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha recorded the least disease severity of sheath blight, blast and brown spot (7.20, 10.38 and 10.38 PDI respectively). It was statistically on par with Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 500 ml/ha (Table 7, 8 and 9). The maximum incidence of disease (sheath blight-20.03 PDI, blast -21.68 PDI and brown spot-21.68 PDI) was recorded in control. The highest per cent disease reduction over control was noticed in plants treated with Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha (sheath blight-64.66%, blast -70.86% and brown Spot-55.52%) followed by Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 500 ml/ha (sheath blight-60.7%, blast- 68.99% and brown spot-52.84%). The similar results were also reported by varoius scientists [10, 26, 27].

b. **Efficacy of Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha on yeild of rice:** The optimum use of fungicides has been reported to enhance the crop yields. The difference in the yield level between treated and untreated plots was very much significant during both the seasons (Table 10). The pooled data indicated that, Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha recorded the highest grain yield (5.170 t/ha) followed by Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 500 ml/ha (4.900 t/ha) compared to untreated control (3.150 t/ha).

c. **Efficacy of Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha on net returns:** The treatment with Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha has recorded the highest net return of Rs 35,240/- ha followed by Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 500 ml/ha which is Rs. 32,200/ha. Whereas, the least net return of Rs. 5,550/ha was recorded in untreated control.

Table 7: Effect of spraying of Azoxystrobin 16.7% + Tricyclazole 33.30 SC against Sheath blight of rice during Rabi– 2019-2020 and Kharif-2020-21 (Pooled)

Sl. No.	Name of the product	Dose (Formulations)	Sheath blight (PDI)				Mean	% reduction over control
			Before Spray	7 days after 1st spray	7 days after 2nd spray	7 days after 3rd spray		
T_1	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	450 ml/ha	3.4* (10.65)	8.75 (17.15)	9.0 (17.46)	11.7 (20.0)	9.81	38.98
T_2	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	500 ml/ha	5.8 (13.94)	6.8 (15.12)	8.2 (16.64)	8.2 (16.64)	7.73	60.78
T_3	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	750 ml/ha	4.4 (12.11)	5.8 (13.94)	7.2 (15.56)	8.6 (17.05)	7.20	64.66
T_4	Azoxystrobin 23% SC market sample as standard check	500 ml/ha	3.45 (10.63)	8.1 (16.54)	12.8 (20.96)	14.5 (22.38)	11.80	41.12
T_5	Tricyclazole 75% WP market sample as	400 g/ha	4.0 (11.55)	13.4 (21.47)	18.05 (25.10)	22.0 (27.97)	17.81	9.88

	standard check							
T_6	Propineb 70% WP - Market Sample as standard check	2000 g/ha	4.1 (11.68)	14.4 (22.30)	17.5 (24.7)	21.9 (27.9)	17.93	21.85
T_7	Control	---	4.05 (11.54)	16.1 (23.66)	19.7 (26.35)	24.3 (29.53)	20.03	
CD (P< 0.05)			NS	2.44	2.35	2.2		
S.Em+_				0.823	0.791	0.741		

*Figures in parentheses indicate angular transform value, NS: Non-significant

Table 8: Effect of spraying of Azoxystrobin 16.7% + Tricyclazole 33.30 SC against Brown Spot of rice during *Rabi*– 2019-2020 *Kharif*-2020-21 (Pooled)

Sl. No.	Name of the product	Dose (Formulations)	Brown Spot of Rice (PDI)				Mean	% reduction over control
			Before Spray	7 days after 1st spray	7 days after 2nd spray	7 days after 3rd spray		
T_1	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	450 ml/ha	6.35 (14.55)	12.15 (20.4)	14.1 (22.05)	15.85 (23.45)	14.03	42.31
T_2	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	500 ml/ha	7.15 (15.5)	9.35 (17.8)	11.25 (19.6)	12.95 (20.96)	11.18	52.835
T_3	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	750 ml/ha	6.55 (14.8)	8.7 (17.1)	10.25 (18.7)	12.2 (20.41)	10.38	55.515
T_4	Azoxystrobin 23% SC market sample as standard check	500 ml/ha	6.7 (15.0)	11.15 (19.45)	12.9 (21.5)	15.4 (23.11)	13.15	43.765
T_5	Tricyclazole 75% WP market sample as standard check	400 g/ha	6.5 (14.7)	8.1 (16.54)	9.75 (18.4)	11.75 (20.00)	9.86	45.24
T_6	Propineb 70% WP - Market Sample as standard check	2000 g/ha	3 (9.9)	5.05 (12.9)	6.3 (14.5)	7.3 (22.85)	6.21	46.34
T_7	Control	---	6.95 (15.25)	16.7 (24.1)	20.85 (27.1)	27.5 (31.6)	21.68	0
CD (P< 0.05)			NS	1.25	1.69	1.25		
S. Em+_				0.421	0.569	0.421		

Table 9: Effect of spraying of Azoxystrobin 16.7% + Tricyclazole 33.30 SC against Blast of rice during *Rabi*– 2019-2020 *Kharif*-2020-21 (Pooled)

Sl. No.	Name of the product	Dose (Formulations)	Leaf blast (PDI)				Mean	Per cent reduction over control after 3rd spraying
			Pre-treatment	7 days after 1st spraying	7days after 2nd spraying	7 days after 3rd spraying		
T_1	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	450 ml/ha	6.35 (14.55)	12.15 (20.4)	14.1 (22.05)	15.85 (23.45)	14.03	50.50
T_2	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	500 ml/ha	7.15 (15.5)	9.35 (17.8)	11.25 (19.6)	12.95 (21.05)	11.18	68.99
T_3	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	750 ml/ha	6.55 (14.8)	8.7 (17.1)	10.25 (18.7)	12.2 (20.4)	10.38	70.86
T_4	Azoxystrobin 23% SC market sample as standard check	500 ml/ha	6.7 (14.95)	11.15 (19.45)	12.9 (21.05)	15.4 (23.15)	13.15	47.77
T_5	Tricyclazole 75% WP market sample as standard check	400 g/ha	6.6 (14.8)	14.7 (22.5)	17.6 (24.8)	20.65 (26.95)	17.65	59.94
T_6	Propineb 70% WP - Market Sample as standard check	2000 g/ha	6.4 (14.65)	10.15 (18.6)	12.85 (21)	14.7 (22.55)	12.56	32.83
T_7	Control	---	6.95 (15.25)	16.7 (24.1)	20.85 (27.1)	27.5 (31.6)	21.68	
CD (P< 0.05)			NS	1.79	1.395	2.485		
S.Em+_				0.603	0.471	0.337		

*Figures in second row indicate angular transform value, NS: Non-significant

Table 10: Effect of spraying of AZOXYSTROBIN 16.7% + TRICYCLAZOLE 33.3% SC on grain yield in rice during *Rabi*-2019-2020 (1st season) and *Kharif*- 2020-21 (2nd season)

Tr. No.	Name of the Product	Dose formulation	Grain yield (t/ha)		
			Rabi-2019-2020	*Kharif*-2020	Pooled
T_1	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	450 ml/ha	4.54	4.04	4.29
T_2	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	500 ml/ha	5.21	4.59	4.90
T_3	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	750 ml/ha	5.42	4.91	5.17
T_4	Azoxystrobin 23% SC market sample as standard check	500 ml/ha	4.60	4.11	4.36
T_5	Tricyclazole 75% WP market sample as standard check	400 g/ha	5.06	4.29	4.68
T_6	Propineb 70% WP - Market Sample as standard check	2000 g/ha	3.58	3.39	3.49
T_7	Control	---	3.27	3.02	3.15
	CD (P< 0.05)		0.43	0.30	0.36
	S.Em+_		0.145	0.101	0.121

Table 11: Cost of cultivation of fungicides on management of rice diseases

Treatment		Yield (t/ha)	General cost (Rs)	Treatment cost (Rs in lakhs)	Total cost of cultivation (Rs. In lakhs)	Gross return (Rs)	Net return (Rs)	B: C ratio
T1	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	4.29	48000	2790	50790	72930	22140	3.29
T2	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	4.9	48000	3100	51100	83300	32200	2.59
T3	Azoxystrobin 16.7% + Tricyclazole 33.3% SC	5.17	48000	4650	52650	87890	35240	2.49
T4	Azoxystrobin 23% SC market sample as standard check	4.36	48000	4170	52170	74120	21950	3.38
T5	Tricyclazole 75% WP market sample as standard check	4.68	48000	1600	49600	79560	29960	2.66
T6	Propineb 70% WP - Market Sample as standard check	3.49	48000	3040	51040	59330	8290	7.15
T7	Control	3.15	48000	0	48000	53850	5550	9.65

Variety: PAC 837 (fine variety) Price: Rs. 1700/Q

Conclusion

Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 750 ml/ha was best in controlling the sheath blight, blast and brown spot disease of paddy, which was however found to be on par with 500 ml/ha dose of Azoxystrobin 16.7% + Tricyclazole 33.3% SC. Further, this product did not show any phytotoxicity effects even at higher dose and found to be safe and increased in the yield and the net returns.

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