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Efficacy of fungicides for the management of blast disease in rice seed production

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ABSTRACT

Efficacy of different fungicidal sprays viz., carbendazim, mancozeb and tricyclazole were tested at three growth stages viz., fifty per cent flowering, milk/dough stage and physiological maturity for control of blast disease (Pyricularia grisea) in rice cv. Shalivahana at Ponnampet, Karnatak. The seeds produced were evaluated for various seed quality parameters including standard blotter test. Among the 10 treatment combinations, tricyclazole significantly increased number of tillers hill^{-1} (8.63), productive tillers hill^{-1} (8), number of filled spiklets panicle^{-1} (58) and germination (91 %). Whereas, number of chaffy seeds panicle^{-1} (14), infected seeds (1 %) and discoloured seeds (5 %) were reduced significantly. Spraying the crop, once at 50 per cent flowering + milk/ dough stage and at physiological maturity recorded higher yield, quality and disease free seeds. Detection of seed borne and storage fungi by "standard blotter test" revealed that the percentage of seeds infected ranged from 4-63(%). Lowest infection (4 %) of samples by pathogens were recorded upon spraying of tricyclazole at all the three critical stages indicating it as potential chemical for controlling rice blast in seed production.

Key words: *rice blast, seed quality, standard blotter test, tricyclazole*

Outbreaks of rice blast disease are persistent problem in rice-growing regions of the world and this disease is extremely difficult to control (Dean *et al*.2005). This disease is caused by *Magnaporthe grisea* (Hebert) Barr) (Syn: *Pyricularia grisea* (Cooke) Sacc.) a filamentous ascomycetes. Infection occurs on leaves during vegetative phase, on panicles and neck during reproductive phase of the crop resulting in significant loss in yield and quality. Several diseases are considered as major constraint for obtaining good quality seeds in rice because of their widespread occurrence and destructive nature causing heavy losses in seed yield. Among them blast of rice is one of the most important constraint in rice cultivation. It reduces the yield at least up to 40 to 50 (%) in the worst period of disease (Yang *et al*., 2012). Suitable management practices are necessary to combat these diseases effectively to obtain good quality seed by spraying of seed crop with suitable fungicides.

During seed production it is very much necessary to combat the disease effectively by suitable management practices. In contaminated seeds under dry conditions at room temperature, conidia are able to survive for more than a year and mycelium for almost three years (Ou 1985). Thus, rice blast disease is a significant and persistent problem to rice cultivation and the strategies for management of rice blast disease are limited. Consequently, it is crucial to evaluate new fungicides in the field to produce quality rice seed without seed infection or with minimum permissible level of seed born inoculum. Hence, this study was undertaken to evaluate fungicides and schedule of sprays for the control of diseases in rice seed crop.

MATERIAL AND METHODS

The seeds of cv. Shalivahana were collected from the respective breeder of Ponnampet, Karnatak and sown to raise nursery for 22 days and transplanted in the main field to raise the as seed crop. All the seeds were treated with Thiram @ 2g kg^{-1} except for control before raising nursery. The experiment was laid out in a split plot design with 20 x 15 cm spacing at Agricultural

Research Station, Ponnampet as it is an hot spot for rice blast disease. In the present study an attempt was made to evaluate the effect of different chemicals sprayed at different growth stages for the control of this disease. Crop was sprayed with different fungicides *viz.,* carbendazim (Bavistin) @ 0.1%, mancozeb (Dithane M-45) @ 0.2% and tricyclazole (Beam) @ 0.06% at three growth stages viz. single spray at 50% flowering, two sprays once at 50% flowering and another at milky/dough stage and two sprays once at 50% flowering and another at milky/dough stage + third spray at physiological maturity. The seed crop was evaluated for number of tillers hill^{-1}, number of productive tillers hill^{-1} were recorded on randomly selected 10 plants in three replications and the seed yield was computed. The resulting seeds from various treatment combinations were used to evaluate seed quality by standard germination test and detection of seed borne fungi by standard blotter method (SBM) as recommended by ISTA (1996). Briefly, the standard germination test was conducted upon one hundred seeds of four replicates placed equidistantly between moist kraft paper towels. The rolled towels were placed at 45^0 angle in the germination chamber, with 25±1^{0}C and 90 per cent RH. The seedlings were evaluated on 14th day of incubation and the cumulative percentage of germination was expressed based on normal seedlings. In the standard blotter method, before placing the seeds into glass petri dishes of 9cm diameter, the blotters were dipped in 0.2 per cent 2, 4-D solution to prevent germination of seeds. Three replications of twenty five seeds were placed equidistantly in circles on three moist blotters. Sufficient moisture was maintained by adding 0.2 per cent 2, 4-D solution. The seeds were incubated for seven days in an incubator at 25 ± 1^0 C with 12 hours light and 12 hours dark alternate cycles. After seven days, the seeds were examined by a low power stereo binocular microscope and the different seed borne fungi found on the seed were recorded and expressed in percentage. The filed data was statistically analyzed by subjecting to ANOVA as described by Sundara Raj *et al*. (1972), adopting the Fisher's Analysis of Variance Technique.

RESULTS AND DISCUSSION

Application of tricyclazole recorded higher number of tillers hill^{-1} (8.63) and lowest number of tillers hill^{-1} were recorded in control among the chemical sprays. Whereas, amongst stages of sprays evaluated single spray at 50% flowering recorded highest number of tillers hill^{-1} and the lowest number of tillers hill^{-1} in two sprays once at 50 % flowering and another at milky/ dough stage + third spray at physiological maturity (Table 1). Number of productive tillers hill^{-1} was found significant across the treatment of chemicals and stages of sprays. Tricyclazole recorded highest number of productive tillers hill^{-1}. Among the stages of sprays,

Table 1. Yield parameters as influenced by different chemicals and stage of spray at Ponnampet with cv. Shalivahana.

Treatments	Seed quality parameters															
	No. of tillers hill^{-1}				No. of productive tillers hill^{-1}				No. of filled spiklets panicle^{-1}				No. of chaffy seeds panicle^{-1}			
Chemicals / Sprays	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
Control	4.9	4.9	4.9	4.90	3.7	3.7	4.1	3.83	16	16	16	16	59	43	48	50
Carbendazim (Bavistin)@0.1%	7.0	6.7	6.4	6.70	6.7	5.8	6.4	6.30	24	25	19	23	34	29	31	31
Mancozeb (Dithane M-45)@0.2%	8.0	7.7	7.3	7.67	7.6	6.9	7.2	7.23	38	41	30	36	36	24	28	29
Tricyclazole (Beam)@0.06%	8.9	8.7	8.3	8.63	8.3	7.7	8.0	8.00	59	63	53	58	16	13	14	14
Mean	7.20	7.00	6.73	6.98	6.58	6.03	6.43	6.34	34	36	30	33	36	27	30	50
CD (P<0.05) : Sprays		0.567				1.84				4.92				3.04		
: Chemicals		1.80				1.98				4.55				0.54		
: CXS		3.11+				3.44+				7.89+				21.05+		

CXS - Comparison of two means of sprays at same level of chemicals

S_1 : Single spray at 50 % flowering
S_2 : Two sprays once at 50 % flowering another at milky/ dough stage
S_3 : S_2 + third spray at physiological maturity

single spray at 50% flowering recorded the highest number of productive tillers hill^{-1}. With respect to the interaction of chemicals and stages of spraying of tricyclazole @ 0.06% once at 50% flowering recorded significantly highest number productive tillers hill^{-1}. Similar findings were reported by Tewari (1983); Zhang (1984) with tricyclazole. Significant differences were observed for number of filled spiklets panicle^{-1} (Table 1). Among the chemicals evaluated tricyclazole recorded highest number of filled spikelets panicle^{-1}. Whereas, with different stages of spray, two sprays once at 50% flowering another at milk/dough stage recorded highest number of filled spiklets panicle^{-1}. The application of tricyclazole at 50% flowering at milk/dough stage interacted well to recorded significantly highest number of filled spiklets panicle^{-1}. Similar finding was reported by Dubey (2000), who reported the spray schedule of tricyclazole, 0.03%, mancozeb 0.2%proved most efficient with minimum neck and node infection. Significant differences were also observed for number of chaffy seeds panicle^{-1} (Table 1). Control plots recorded highest number of chaffy seeds with tricyclazole treatment, while, the chaffy seeds were lowest. Between the interactions the treatment involving spraying of tricyclazole 0.06% thrice lowest number of chaffy seeds panicle^{-1} were observed. The present findings are in line with Sleverding *et al.* (1998) as well as Dubey (2000).

Stages of spray and their interaction with chemicals differed significantly (Table 2). Among the sprays, three sprays recorded the lowest number of infected seeds. The discolored seeds (%) differed significantly due to chemicals, stages of spray and their interaction (Table 2). Among the different chemicals evaluated, lowest number of discoloured seeds were noticed in tricyclazole treatment. Among the different stages of spays, application of three sprays recorded lowest number of discoloured seeds. Chemicals and stages of spray as well their interaction differed significantly for seed yield. Tricyclazole treatment recorded significantly higher seed yield which was followed by carbendazim with 4.82 t ha^{-1}. Whereas, crop received two sprays one at 50% flowering another at milk /dough stage recorded highest (3.96 ton) seed yield ha^{-1}. Rice crop sprayed with tricyclazole at all three stages recorded highest seed yield (4.87 t ha^{-1}). Tricyclazole was found effective in reducing the disease incidence and increasing seed yield. These findings are in accordance with the results of Momhamuda Haroon, 1994; Ram Singh *et al.* (1994). While, Gowda and Gowda (1986) established that carbendazim spray at tillering, Edifenphos 1gm lt^{-1} at heading and after flowering effectively controlled *Pyricularia oryzae* thus resulting in increased seed yield.

The per cent germination also differed significantly and the highest germination was observed

Table 2. Seed quality parameters as influenced by different chemicals and stage of spray at Ponnampet with cv. Shalivahana

Treatments	Seed quality parameters															
	Infected seeds (%)				Discolored seed (%)				Seed yield (t ha^{-1})				Germination (%)			
Chemicals / Sprays	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
Control	16	16	16	16	49	49	49	49	2.17	2.15	2.15	2.16	71	71	71	71
Carbendazim (Bavistin)@0.1%	10	9	8	9	30	24	19	24	2.46	2.89	4.00	3.12	74	75	77	75
Mancozeb (Dithane M-45)@0.2%	6	5	3	5	17	14	11	14	3.07	4.20	4.82	4.03	80	82	84	82
Tricyclazole (Beam)@0.06%	2	1	1	1	7	5	3	5	3.31	4.61	4.87	4.26	87	91	94	91
Mean	9	8	7	8	26	23	21	23	2.75	3.46	3.96	3.39	78	80	82	80
CD(P<0.05) : Sprays		2.044**				2.795*				1.02*				3.99*		
: Chemicals		NS				4.583**				1.65**				3.66**		
: CXS		3.541+				7.739+				1.08+				6.34+		

CXS - Comparison of two means of sprays at same level of chemicals

S_1 : Single spray at 50 % flowering
S_2 : Two sprays once at 50 % flowering another at milky/ dough stage
S_3 : S_2 + third spray at physiological maturity

in seeds sprayed with tricyclazole and the lowest in unsprayed control (80 %), which, was below prescribed seed certification standard. Crop sprayed once at 50% flowering, another at milk /dough sage as well as at physiological maturity recoded highest percentage of germination. Among the interactions tricyclazole sprayed thrice recoded highest percentage of germination.

Evaluation of seeds produced under different treatment combinations for seed mycoflora revealed that percentage of seeds infected ranged from zero to eight (Table 3). Suitable management practices with Tricyclazole @ 0.06 % or Dithane M-45 @ 0.2% can effectively combat rice blast during seed production. The percentage of infection by various fungi was recorded individually, which ranged from 20 to 90 per cent. The total number of seeds infected from all the treatments were highest with, *Pyricularia grisea* (25) followed by *Alternaria* sp. (21), *Bipoloris oryzae* and *Curvularia* sp. (20). The highest mean per cent infection was by *Pyricularia grisea* (2.5) followed by *Alternaria* sp (2.1), *Bipoloris oryzae* and *Curvularia* sp (two each) (Table 3). Among the treatment combinations, highest infected seeds were recorded crop without any chemical sprays. Whereas, lowest number of infected seeds was observed with tricyclazole spray at 50% flowering followed by one more spray at milk /dough sage as well as at physiological maturity (S_3).

Advantage of spraying tricyclozole @ 0.06% even once at 50% flowering was found to be superior in reducing the infection load of seed borne blast causing pathogens on seed crop. Tricyclozole being systemic fungicide thus provided comprehensive disease control

Table 3. Effect of various chemical and stages of sprays on occurrence of field and storage fungi on rice seeds.

Treatment	Control	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	B	C	D	E	F
Pathogen	A	A	A	A	A	A	A	A	A	A					
Bipolaris oryzae	6	2	3	1	2	1	1	2	2	0	9	90	20	2.0	<6
Curvularia sp.	8	1	2	1	3	0	0	3	2	0	7	70	20	2.0	<8
Dreschlera oryzae	6	2	1	1	3	1	0	3	1	1	9	90	19	1.9	<6
Epiccum sp.	3	0	0	0	2	0	0	1	0	0	3	30	6	0.6	<3
Nigrospora sp.	3	1	0	0	1	1	0	0	0	0	4	40	6	0.6	<3
Phoma sp.	5	3	1	1	3	0	1	1	1	0	8	80	16	1.6	<5
Pyricularia grisea	7	4	2	1	5	1	2	2	1	0	9	90	25	2.5	<7
Rhizoctonia oryzae	3	1	0	0	2	2	1	0	0	0	5	50	9	0.9	<3
Rhizopus sp.	4	0	2	0	2	3	1	0	0	0	5	50	12	1.2	<4
Sarocladium oryzae	1	1	0	0	1	1	0	0	0	0	4	40	4	0.4	<1
T. padwikii	2	0	0	0	1	0	0	0	0	0	2	20	3	0.3	<2
Alternaria sp.	5	2	2	0	2	2	1	2	3	2	9	90	21	2.1	<5
Aspergilles sp.	4	1	1	1	2	2	1	1	0	0	8	80	13	1.3	<4
Fusarium sp.	3	3	0	0	2	1	0	2	0	0	5	50	11	1.1	<3
Penicillium sp.	3	1	0	0	0	1	0	0	2	1	5	50	8	0.8	<3
Unidentified	0	0	0	0	0	1	0	1	0	0	2	20	2	0.2	<2
Total	63	22	14	6	31	17	8	18	12	4	94	-	195	19.5	-

No.	Treatment combination	No.	Treatment combination	No.	Treatment combination	No.	Treatment combination
T_1	Control	T_4	C_1S_3	T_7	C_2S_3	T_{10}	C_3S_3
T_2	C_1S_1	T_5	C_2S_1	T_8	C_3S_1		
T_3	C_1S_2	T_6	C_2S_2	T_9	C_3S_2		

A: Percentage of seeds infected, B: Total No. of samples infected from all the treatment, C: % infection from all treatments, D: Total no. of seeds infected from all the treatments, E: Mean % infection treatments^{-1}, F: Range of infection

Chemicals :

C_0 : Control
C_1 : Carbendazim (Bavistin) @ 0.1%
C_2 : Mancozeb (Dithane M-45) @ 0.2%
C_3 : Tricyclazole (Beam) @ 0.06%

Sprays :

S_1 : Single spray at 5o % flowering
S_2 : Two sprays once at 5o % flowering another at milky/dough stage
S_3 : S_2 + third spray at physiological maturity

and enhanced production of quality seed with least infection of blast. Consequently, rice crop sprayed with tricyclozole @ 0.06 per cent at three stages of seed crop recorded significant improvement in seed quality and seed yield with considerable reduction in mycoflora compared to carbendazim and mancozeb.

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