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Fungicidal management of blast disease (*Pyricularia grisea*) of rice

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Abstract
Field experiment was conducted to find out an effective fungicide to manage the blast disease of rice at AICRIP, RRTTS, Chiplima during kharif season of 2016 and 2017. A number of chemicals were used for both seed treatment and spraying and all of them were found effective to manage the disease as compared to untreated control. Among 11 treatments, seed treatment with tricyclazole 75 WP @ 3g/kg seed followed by 2 spraying of tricyclazole 75 WP @ 0.6 g/l recorded minimum leaf blast severity and neck blast incidence in terms of per cent disease index (PDI) with highest BC ratio of 1.71. It was closely followed by seed treatment with carboxin 37.5% + thiram 37.5% @ 2.5 g/kg seed and 2 foliar spraying of isoprothiolane 40 EC @ 1.5 ml/l. Both the treatments were statistically at par with each other with respect to leaf blast infection, neck blast incidence as well as yield.

Keywords: Rice, blast, management, fungicides

1. Introduction

Rice is vital to global security, being a staple food for more than 60 per cent of world population (Mathur *et al*., 1999) [14]. India is number one in area with approximately 43.8 million hectares of land under rice cultivation and ranks second in production with approximately 116.4 million tonnes but the productivity of 2659 kg/ha is far below the world's average productivity (Annonymous, 2019) [1]. One of the reasons for low productivity of rice is that rice production has been faced by serious biotic constraints notably plant diseases of which, the most devastating is rice blast. Rice blast caused by *Magnaporthe grisea* Barr (anamorph, *Pyricularia oryzae* Cav. or *Pyricularia grisea*) is the most destructive pathogen of rice worldwide causing significant yield losses (Kunova *et al*., 2013) [13] ranging up to even 100% (Filippi *et al*., 2014) [3]. The outbreaks of rice blast are a serious and recurrent problem in all rice-growing regions of the world (Kapoor and Katoch, 2014) [10] and especially in India the disease is a serious threat to rice crop (Sireesha, 2013) [22]. The efficacies of various systemic and broad-spectrum fungicides have gained favour for rice blast control throughout the world. The fungicides have efficiency to control leaf blast up to a range of 40 to 84% (Swamy *et al*., 2009) [23]. Presently a number of fungicides are available for its control but to keep novel fungicides effective against it in the pipeline, evaluation of chemicals should be a continuous process. With a view to this, a field experiment was conducted to find out an effective fungicide to manage the disease at AICRIP, RRTTS, Chiplima.

2. Materials and Methods

Field experiment was conducted during kharif season of 2016 and 2017 at All India Co-ordinated Rice Improvement Project, Regional Research and Technology Transfer Station, Chiplima, Sambalpur, Odisha. The experimental site is situated at an altitude of 178.8 m above mean sea level with $20^{0}21'$ N latitude and $80^{0}55'$ E longitude. The details of the materials used and the methodology adopted during this investigation are described here under. A susceptible rice variety, Swarna (MTU 7029) was used in this trial. The experiment was laid in RBD with 3 replications. Each plot measured 20 square meter with a spacing of 20 X 15 cm with bunds all around the plots. Replications were separated with a gap of 1 meter for irrigation channels. The rice variety Swarna (MTU 7029) was planted with recommended package of practices except plant protection measures. Recommended doses of NPK @ 100: 50: 50 kg/ha was applied in the form of Urea, DAP and MOP in three split doses at basal, active tillering stage and at panicle initiation stage. No artificial inoculations were made, as natural inoculum was sufficient to cause disease. The treatment consisted of T_1=Seed treatment (ST) with tricyclazole 75 WP @ 3g/kg; T_2=ST with carboxin 37.5%+thiram 37.5% @ 2.5 g/kg;

T_3=T_1+Foliar spray (FS) of tricyclazole 75 WP @ 0.6 g/l; T_4=T_1+FS of hexaconazole 5 SC @ 2 ml/l; T_5=T_1+FS of carbendazim 50 WP @ 1g/l; T_6=T_1+FS of isoprothiolane 40 EC @ 1.5 ml/l;T_7=T_2+Foliar spray (FS) of tricyclazole 75 WP @ 0.6 g/l; T_8=T_2+FS of hexaconazole 5 Sc @ 2 ml/l; T_9=T_2+FS of carbendazim 50 WP @ 1g/l; T_{10}=T_2+FS of isoprothiolane 40 EC @ 1.5 ml/l; T_{11} =Control (No spraying)
Two sprayings of each chemical were done; first spraying was given just after initiation of the symptom of the disease in the experimental plots and second spraying was done 15 days after the first. Weeds were controlled by hand picking. Leaf blast severity and neck blast incidence were recorded by selecting 10 hills randomly in 1 sq.m area and 3 such readings were taken in each plot following SES Scale (IRRI, 2013) [9]. After scoring the percent disease severity of leaf blast and percent disease incidence of neck blast, Percent Disease Index (PDI) was calculated following standard formula given by Mckinny (1923) [15].

$$PDI = \frac{\text{Sum of al the numerical rating}}{\text{Number of observation x Max rating}} \text{x100}$$

The leaf blast observations were recorded before spraying of fungicides and ten days after each spraying of fungicides. The first recording on neck blast incidence was done when heading was complete and the second was taken between milk and dough stages. The grain yield of each plot was recorded at the time of harvest and converted to q/ha. The data obtained were subjected to statistical analysis and were tested at five per cent level of significance to interpret the treatment differences following Gomez and Gomez (1984) [7].

3. Results and Discussion

Evaluation of different fungicides on leaf and neck blast disease of rice under field condition and their ultimate effect on crop yield are presented in Table 1, 2 and 3. The treatments significantly (P=0.05) reduced leaf and neck blast disease as compared to control.
During kharif 2016, all the treatments significantly reduced the leaf blast disease severity compared to unsprayed plots but significantly less PDI (12.96) was recorded in T_3 plots i.e., seed treatment with tricyclazole @ 3g/kg and foliar spray of tricyclazole @ 0.6 g/l closely followed by T_6 (16.67) and T_7 (17.03) and were superior as compared to the other treatments and unsprayed plot (PDI 55.56).

Table 1: Effect of different fungicides on leaf blast disease severity in rice

Treatment Details		Dose	Leaf blast severity % (PDI)		Pooled of 2016 &2017	% Efficacy Disease Control
			2016	2017		
T_1	Seed treatment (ST) with tricyclazole	3g/kg	38.52 *(38.34)	40.37 (39.43)	39.45 (38.89)	33.2
T_2	ST with carboxin + thiram	2.5g/kg	39.63 (38.96)	46.30 (42.85)	42.96 (40.93)	27.3
T_3	T_1 + Foliar spray (FS) of tricyclazole	0.6g/l	12.96 (20.99)	17.78 (24.88)	15.37 (23.06)	74.0
T_4	T_1 + FS of hexaconazole	2ml/l	27.04 (31.24)	35.18 (36.36)	31.11 (33.88)	47.3
T_5	T_1 + FS of carbendazim	1g/l	29.26 (32.71)	37.41 (37.68)	33.33 (35.25)	43.6
T_6	T_1 + FS of isoprothiolane	1.5 ml/l	16.67 (23.93)	22.96 (28.55)	19.82 (26.40)	66.5
T_7	T_2 + FS of tricyclazole	0.6g/l	17.03 (24.29)	24.07 (29.36)	20.55 (26.95)	65.2
T_8	T_2 + FS of hexaconazole	2ml/l	28.52 (32.21)	36.67 (37.24)	32.59 (34.78)	44.8
T_9	T_2 + FS of carbendazim	1g/l	27.04 (31.30)	36.29 (37.00)	31.67 (34.21)	46.4
T_{10}	T_2 + FS of isoprothiolane	1.5 ml/l	19.63 (26.12)	18.15 (25.17)	18.89 (25.74)	68.0
T_{11}	Control	-	55.56 (48.19)	62.59 (52.29)	59.08 (50.22)	-
CD (p=0.05)		-	5.72	4.07	2.73	-

*Figures in the parenthsis are angular transformed value

During kharif 2017, the percent disease index (PDI) of leaf blast disease in unsprayed plot was to the tune of 62.59. Different fungicides controlled the disease effectively as compared to the control or unsprayed plot. Among the different fungicides, the per cent disease index was again significantly less (17.78) in T_3 plots (Table 1) immediately followed by T_{10} *i.e.* seed treatment with carboxin 37.5% + thiram 37.5% @ 2.5 g/kg and foliar spray of isoprothiolane @ 1.5 ml/l (PDI 18.15) and T_6 i.e., seed treatment with tricyclazole @ 3g/kg and foliar spray of isoprothiolane @ 1.5 ml/l (PDI 22.96).

While considering the neck blast incidence during kharif, 2016 (Table 2), it was found that minimum disease incidence in terms of PDI was recorded in T_3 (11.11) though four treatments *viz.* T_3, T_{10}, T_7 and T_6 were statistically at par with each other and were significantly superior from all other treatments. The PDI of neck blast infection in control plot reached to the tune of 40.74 during 2016.
During kharif, 2017 also similar trend was noticed in case of neck blast incidence. All the four treatments *viz.* T_3, T_{10}, T_6 and T_7 were statistically at par with each other and were.

Table 2: Effect of different fungicides on neck blast disease incidence in rice

Treatment Details		Dose	Neck blast incidence% (PDI)		Pooled of 2016 &2017	% Efficacy Disease Control
			2016	2017		
T_1	Seed treatment (ST) with tricyclazole	3g/kg	29.26 (32.69)	22.22 (28.05)	25.74 (30.45)	28.7
T_2	ST with carboxin 37.5% + thiram 37.5%	2.5g/kg	32.59 (34.75)	25.19 (30.09)	28.89 (32.47)	20.0
T_3	T_1 + Foliar spray (FS) of tricyclazole	0.6g/l	11.11 (19.28)	8.89 (17.32)	10.00 (18.38)	72.3
T_4	T_1 + FS of hexaconazole	2ml/l	20.37 (26.63)	16.30 (23.77)	18.33 (25.28)	49.2
T_5	T_1 + FS of carbendazim	1g/l	24.07 (29.27)	19.26 (25.95)	21.67 (27.67)	40.0
T_6	T_1 + FS of isoprothiolane	1.5 ml/l	17.41 (24.50)	10.00 (18.41)	13.70 (21.68)	62.1
T_7	T_2 + FS of tricyclazole	0.6g/l	15.56 (23.16)	11.48 (19.77)	13.52 (21.56)	62.6
T_8	T_2 + FS of hexaconazole	2ml/l	25.93 (30.45)	19.63 (26.28)	22.78 (28.46)	36.9
T_9	T_2 + FS of carbendazim	1g/l	28.15 (32.02)	21.48 (27.59)	24.82 (29.86)	31.3
T_{10}	T_2 + FS of isoprothiolane	1.5 ml/l	14.81 (22.54)	10.41 (18.78)	12.61 (20.73)	65.1
T_{11}	Control	-	40.74 (39.64)	31.48 (34.10)	36.11 (36.92)	-
CD (p=0.05)		-	5.79	3.26	3.43	-

*Figures in the parenthsis are angular transformed value

significantly superior from all other treatments (Table 2). The disease incidence of neck blast in terms of PDI reached to 31.48 in unsprayed plots and it was significantly different from all other treatments which indicated that all the treatments were significantly effective to manage neck blast disease.

Two years pooled data revealed that minimum leaf blast severity in terms of PDI (15.37) was recorded in T_3 *i.e.* seed treatment with tricyclazole @ 3g/kg and foliar spray of tricyclazole @ 0.6 g/l followed byT_{10} *i.e.* seed treatment with carboxin 37.5% + thiram 37.5% @ 2.5 g/kg and foliar spray of isoprothiolane @ 1.5 ml/l with a pooled PDI of 18.89 but both the treatments did not differ significantly from each other. All the other treatments were significantly effective in managing leaf blast disease as compared to unsprayed plots (PDI 59.08).

Neck blast disease incidence in terms of pooled PDI (10.0) was also minimum in T_3 *i.e.* seed treatment with tricyclazole @ 3g/kg and foliar spray of tricyclazole @ 0.6 g/l followed by T_{10} *i.e.* seed treatment with carboxin +thiram @ 2.5 g/kg and foliar spray of isoprothiolane @ 1.5 ml/l with a pooled PDI of 12.61 but they were statistically at par with each other. The percent disease index (PDI) of neck blast disease in unsprayed plot was to the tune of 36.11.

Table 3: Effect of different fungicides on the grain yield and economy of rice

Treatment Details		Dose	Yield (q/ha)		Pooled of 2016 & 2017	% Disease Control	B:C
			2016	2017			
T_1	Seed treatment (ST) with tricyclazole	3g/kg	36.0	34.4	35.2	14.7	1.16
T_2	ST with carboxin 37.5% + thiram 37.5%	2.5g/kg	34.1	31.7	32.9	7.2	1.13
T_3	T_1 + Foliar spray (FS) of tricyclazole	0.6g/l	48.6	45.1	46.9	52.8	1.71
T_4	T_1 + FS of hexaconazole	2ml/l	41.3	38.7	40.0	30.3	1.41
T_5	T_1 + FS of carbendazim	1g/l	39.1	35.5	37.3	21.5	1.29
T_6	T_1 + FS of isoprothiolane	1.5 ml/l	44.4	42.7	43.5	41.7	1.51
T_7	T_2 + FS of tricyclazole	0.6g/l	45.2	42.3	43.8	42.7	1.59
T_8	T_2 + FS of hexaconazole	2ml/l	40.7	37.2	39.0	27.0	1.38
T_9	T_2 + FS of carbendazim	1g/l	37.8	35.0	36.4	18.6	1.22
T_{10}	T_2 + FS of isoprothiolane	1.5 ml/l	46.8	43.0	44.9	46.3	1.63
T_{11}	Control	-	31.8	29.6	30.7	-	-
CD(p=0.05)		-	3.9	7.0	4.1	-	-

Treatments T_3 and T_{10} did not differ significantly from each other in reducing leaf blast disease severity, while in case of neck blast disease incidence, T_3, T_6, T_7 and T_{10} were found statistically at par with each other and were significantly superior from all the other treatments. The fungicides carbendazim and hexaconazole showed intermediate results in managing both leaf blast and neck blast infection.

While considering the impact of the diseases on the yield of crop (Table 3), it was found that, during kharif, 2016 a maximum grain yield of 48.6 q/ha was recorded from T_3 plots followed by T_{10} that received 46.8 q/ha. But T_6 and T_7 were also found statistically at par with the above two treatments recording 44.4 and 45.2 q/ha grain yield respectively.

During kharif 2017, treatments T_3, T_6, T_7 and T_{10} produced significantly higher yield compared to the control plot but the treatments did not differ significantly among each other. Maximum grain yield of 45.1 q/ha was.

achieved by T_3 treatment and minimum grain yield was recorded in control plot (29.6 q/ha).

Correspondingly, pooled maximum grain yield of 46.9 q/ha was recorded in T_3 plots followed by T_{10}, T_7 and T_6 plots which recorded 44.9 q/ha, 43.8 q/ha and 43.5 q/ha respectively though all the four treatments were again statistically at par with each other. The fungicides like carbendazim and hexaconazole showed intermediate results where as pooled minimum yield was recorded from control plots (30.7 q/ha).

Tricyclazole belongs to melanin biosynthesis inhibitors (MBI) group of fungicides and prevents melanin biosynthesis in appressoria of the blast pathogen, *Pyricularia oryzae* (Kumar *et al.* 2013) [12]. Pandey (2016) [19] reported that, among the 11 foliar fungicides tested against leaf blast pathogen, tricyclazole @ 0.6 g/l was found significantly superior in controlling the disease severity, number of tillers/plant, number of spikelet/panicle, panicle length, grain yield and 100 seed weight. Ganesh *et al.* (2012) [5] evaluatedten fungicides for management of rice blast disease and concluded that per cent disease index was significantly less (15.56%) in tricyclazole sprayed plots followed by kitazine (17.63%) and ediphenphos (18.03%). The findings are in conformity with Iqbal *et al.* (2014) [8] and Kumar and Veerabhadraswamy (2014) [11] who also found that tricyclazole was most effective in reducing the leaf blast severity. Pal and Mandal (2014) [16] found that balanced use of nitrogenous fertilizers along with need based sprays of tricyclazole 75 WP @ 0.6 g/ l can be used for the management of leaf blast with increased grain yield. According to Ghimire *et al*. (2017) [6] tricyclazole appeared better to control neck blast disease of rice. Several other products and fungicides were also reported to be effective against blast disease. Pal *et al.* (2017) [18] reported that application of FYM @ 10 t/ha contributed not only to plant nutrition but also to disease resistance. FYM was effective in increasing resistance to blast by supplying silicic acid to rice plants as silica is known for increasing the resistance of rice plants to blast. Raji and Louis (2007) [20] revealed after a field study that, isoprothiolane 40 EC@ 1.5 ml/l was effective to reduce the leaf blast by 41%, neck blast by 34% and increased the yield by 36.3%. This finding is in line with the present finding. Isoprothiolane inhibits the blast pathogen by inhibiting the formation of infection peg by the infecting hyphae. Pal and Mandal (2015) [17] concluded that, 3 spraying of trifloxystrobin 25% + tebuconazole 50% @ 0.4g/l was effective against leaf blast disease. Gaikwad and Balgude (2016) [4] reported metaminostrobin 20 SC @ 0.2% as the best fungicide against blast of rice with highest leaf and neck blast reduction of 77.80% and 45.68% respectively followed by propiconazole 25 EC @ 0.1% and isoprothiolane 40 EC @ 0.15%. Kapoor and Katoch (2014) [10] reported that seed treatment with tricyclazole was effective against fungal pathogen *Magnaporthe oryzae* and provided protection to seed up to 8 weeks after sowing. Chen *et al.* (2013) [2] observed that tricyclazole exhibited better protective than curative activity. Sachin and Rana (2011) [21] observed increasein grain yield with the application of tricyclazole. Ganesh *et al.* (2012) [5] also observed that tricyclazole, kitazine and ediphenphos were found significantly superior in increasing the grain yield.

The pooled data over the two years on the intensity of disease indicated that the treatment T_3 i.e. seed treatment with tricyclazole @ 3g/kg and foliar spray of tricyclazole @ 0.6 g/l was superior in reducing the leaf blast disease severity by 74% as well as the neck blast disease incidence by 72.3% but was at par with treatment T_{10} *i.e.* seed treatment with carboxin 37.5% + thiram 37.5% @ 2.5 g/kg and foliar spray of isoprothiolane @ 1.5 ml/l (Table 1 and 2). So, both the treatments can be used effectively in managing both the diseases. Considering the economy point of view,

though there was no significant difference between T_3, T_6, T_7 and T_{10} in grain yield but the highest BC ratio of 1.71 and highest % disease control of 52.8% were recorded from T_3 which implies that T_3 is superior compared to all other treatments in terms of yield (Table 3).

4. Conclusions

It can be concluded from the experiment over two years that, seed treatment with tricyclazole @ 3g/kg and foliar spray of tricyclazole @ 0.6 g/l is the most effective treatment to manage both leaf blast and neck blast disease of rice. Moreover, seed treatment with carboxin 37.5% + thiram 37.5% @ 2.5 g/kg and foliar spray of isoprothiolane @ 1.5 ml/l can also be used effectively to manage both the diseases. This trial was tested in multilocations for generalized recommendation and produced almost similar result in all the locations and hence can be included as an essential input in leaf blast and neck blast management in rice.

5. References

1. Anonymous. Agricultural Statistics at a Glance. Directorate of Economics and Statistics, Govt of India, 2019.
2. Chen Y, Yao J, Wang W, Gao T, Yang X, Zhang A. Effect of epoxiconazole on rice blast and rice grain yield in China. Eur. J. Plant Pathol 2013;135:675-682.
3. Filippi MS, Silva GB, Lobo VLS, Viana HF, Côrtes MVCB, Prabhu AS. Induction of resistance to rice leaf blast by avirulent isolates of *Magnaporthe oryzae.* Rev. Cienc. Agrar. 2014;57:388-395.
4. Gaikwad AP, Balgude YS. Metominostrobin, a novel strobilurin fungicide for managing Rice blast. Journal of Rice Research 2016;9(1):50-52.
5. Ganesh NR, Gangadhara NB, Basavaraja NT, Krishna NR. Fungicidal management of leaf blast disease in rice. Global Journal of Bio-Science and Bio-Technology 2012;1**(**1):18-21.
6. Ghimire P, Gopal KC, Shrestha SM, Parajuli G. Evaluation of Fungicides and Bio-agent against Neck Blast Disease of Rice. J Plant Pathol Microbiol 2017;8:428. doi: 10.4172/2157-7471.1000428.
7. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd Edn., John Wiley and Sons Inc., New York, USA. 1984, 680.
8. Iqbal MF, Hussain M, Waqar MQ, Ali MA, Nawaz R, Iqbal Z. Efficacy of fungicides used for controlling leaf blast in transplanted rice. Int. J. Adv. Res. Biol. Sci. 2014;1:07-10.
9. IRRI. Standard evaluation system for rice. 5th edition. IRRI, Manila, Phillipines 2013.
10. Kapoor P, Katoch A. Past, present and future of rice blast management. Plant Sci. Today 2014;1:165-173.
11. Kumar PMK, Veerabhadraswamy AL. Appraise a combination of fungicides against blast and sheath blight diseases of paddy (*Oryza sativa* L.). J Expt. Bio. Agri. Sci 2014;2:49-57.
12. Kumar PMK, Sidde Gowda DK, Rishikant M, Kiran Kumar N, Pandurange Gowda KT, Vishwanath K.

Impact of fungicides on rice production in India. *In*: Fungicides –showcases of integrated plant disease management from around the world (open access chapter) 2013, 77-98.
13. Kunova A, Pizzatti C, Cortesi P. Impact of tricyclazole and azoxystrobin on growth, sporulation and secondary infection of the rice blast fungus, *Magnaporthe oryzae*. Pest. Manag. Sci 2013;69:278-284.
14. Mathur KC, Reddy PR, Rajamali S, Murthy BTS. Integrated pest management of rice to improve productivity and sustainability. Oryza 1999;36(3):195-207.
15. McKinny HH. A new system of grading plant diseases. Agric. Res. 1923;26:95-98.
16. Pal R, Mandal D. Effects of nitrogen management and Tricyclazole treatment on leaf blast severity in rice. Oryza 2014;51(1):67-69.
17. Pal R, Mandal D. New fungicides for the management of leaf blast disease of rice. Indian Journal of Plant Protection 2015;43(3):389-391.
18. Pal R, Mandal D, Naik BS. Studies on the interaction between varietal resistance and management practices against leaf blast of rice. International Journal of Current Microbiology and Applied Science 2017;6(11):112-116.
19. Pandey S. Effect of fungicides on leaf blast and grain yield of rice in Kymore region of Madhya Pradesh in India**.** Bangladesh J. Bot. 2016;45(2):353-359.
20. Raji P, Louis V. Isoprothiolane- a new fungicide for the management of rice blast. Oryza 2007;44(4):366-367.
21. Sachin U, Rana SK. Effect of fungicides on neck blast incidence and grain yield of rice in mid hills of Himachal Pradesh. Plant Dis. Res 2011;26:196.
22. Sireesha O. Effect of different fungicides on blast disease of rice caused by *Magnaporthegrisea*at different nitrogen levels. RJPBCS 2013;4:708.
23. Swamy HN, Syed S, Kumar MD. Evaluation of new fungicides against rice blast in Cauvery delta. Kar. J. Agric. Sci 2009;22:450-451.