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Bio-efficacy of fungicides for management of blast disease caused by *Pyricularia oryzae* Cavara in rice

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Abstract

Blast disease caused by *Pyricularia oryzae* Cavara [synonym *Pyricularia grisea* Sacc. the anamorph *Magnaporthe grisea* (Herbert) Yaegashi and Udagawa], is an important disease of rice. For effective management of blast disease of rice through fungicides a field trial was conducted during *kharif* 2015 at Regional Agricultural Research Station, Shillongani, Nagaon - 782002, Assam. Of the 7(seven) fungicides tested, trifloxystrobin 25% + tebuconazole 50% w/w (Nativo 75 WG) @ 0.04% recorded lowest PDI of leaf blast 3.9% followed by tricyclazole 75 WP @ 0.06% with PDI 6.16% were statistically at par. Further, neck blast incidence in two fungicides namely, trifloxystrobin 25% + tebuconazole 50% w/w @ 0.04% and tricyclazole 75 WP @ 0.06% recorded 4.53 per cent and 4.7 per cent were found statistically at par, whereas yield recorded 3.57 t/ha and 3.30 t/ha with an increased yield 90.91% and 76.48% over the control were also statistically at par with BC ratio 1.73 and 1.74 respectively. Besides, neck blast incidence and yield recorded in fungicide carbendazim 50 WP were found statistically at par with Nativo 75 WG and tricyclazole 75 WP with highest BC ratio 1.75. These three fungicides namely, Nativo 75 WG, Tricyclazole 75 WP and Carbendazim 50 WP may rotate to reduce the chances of new strain development of the fungus *Pyricularia oryzae* in rice cultivation.

Keywords: Rice, blast, *Magnaporthe grisea*, chemicals, yield, fungicides

Introduction

Rice is the staple food, being cultivated in 3 (three) seasons viz., *ahu*, *sali* and *boro* in Assam. Maximum acreage (area 18.8 lakh hectare of total rice area 24.96 lakh ha) is under *sali* season (Anonymous, 2015). The cultivated rice encountered with many diseases, out of which blast is considered as a major disease of rice. Blast caused by *Pyricularia oryzae* Cavara [synonym *Pyricularia grisea* Sacc. the anamorph *Magnaporthe grisea* (Herbert) Yaegashi and Udagawa], is a devastating disease, because of its wide distribution and destructiveness under favourable conditions (Ou, 1985). The blast fungus can attack the aerial parts of the rice plant at any stage of its growth, which is characterized by the appearance of the lesions on leaves, nodes and panicles. In India, the damage to the rice crop due to this disease was reported as high as 75 per cent (Padmanabhan, 1959) [6]. However, management of the disease through resistant gene(s) is an eco-friendly approach but not permanent because of frequent changes in the genetic sequence of pathogen leads to development of new strain which break down the resistance character of the variety (ies). This reflects, in nature resistance gene(s) is/are not stable for long period. However, alternative means for management of blast disease may be considered through chemical fungicide without effecting environment. In agriculture judicious use of fungicides should always be considered. Keeping that in view, an attempt has been made to find out effective fungicide(s) to manage the blast disease.

Methodology

The experiment was laid out at Regional Agricultural Research Station, Shillongani, Nagaon – 782002, Assam during *kharif* 2015 in hot spot area for blast disease with a susceptible rice variety/cultivar ‘IR 50’. Thirty day old seedlings were transplanted in a plot size 5 x 2 sq m each with a spacing of 20 x 20 cm in randomized block design (RBD) with 3 (three) replications for each treatment with 120:30:30 NPK kg/ha. Application of fertilizers was done as per package of practices for *kharif* crops of Assam (Anon., 2009). A total of 7 (seven) different fungicides were tested at different concentrations are given below-

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Treatments

T ₁ = Trifloxystrobin 25% + Tebuconazole 50% w/w (Nativo 75 WG) 0.4g/l	
T ₂ = Tebuconazole 25 EC	1ml/l
T ₃ = Azoxystrobin 23 EC	1ml/l
T ₄ = Carbendazim 50 WP	1 g/l
T ₅ = Tricyclazole 75 WP	0.6 g/l
T ₆ = Hexaconazole 5 EC	2 ml/l
T ₇ = Propiconazole 25 EC	2ml/l
T ₈ = Check	Water

Application of fungicide(s) was done with first appearance of natural infection of the disease. Altogether, three sprays of all fungicides were given at 10-day-interval and only with water to control. Per cent disease index (PDI) of leaf blast was recorded when control shows high susceptible reaction. PDI was worked out using 0-9 scale (IRRI, 1996) from the following formula out of randomly selected fifteen hills per plot –

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of numerical of all the ratings}}{\text{Total number of leaves observed} \times \text{Maximum score}} \times 100$$

Per cent disease incidence of neck blast was calculated from randomly selected thirty hills per plot using following formula ---

$$\text{Disease Incidence} = \frac{\text{Number of infected hills}}{\text{Total number of hills observed}} \times 100$$

Yield was calculated out in terms of tone/hectare

Results and Discussion

The results of field experiment given in table 1 reflected that three sprayings of Trifloxystrobin 25% + Tebuconazole 50% w/w (Nativo 75 WG) @ 0.04% at 10 days interval was found most effective in reduction of diseases as well as increased the yield. However, reduction of PDI of leaf and neck blast disease by 94.70 and 93.49% respectively and increased the yield by 90.91% over the untreated check followed by Tricyclazole 75WP @ 0.06% with reduction PDI of leaf and neck blast incidence by 91.62 and 93.24% respectively and increased of yield by 76.48%. In Carbendazim 50 WP @ 0.1% recorded PDI 9.10 per cent and neck blast 6 per cent with a yield 3.30 q/ha. The

treatment Nativo 75 WG recorded PDI 3.9 per cent of leaf blast was found statistically significant over the control and other treatments except Tricyclazole 75 WP (6.16%). Moreover, the neck blast incidence recorded lowest in Nativo 75 WG (4.53%) was found statistically at par with Tricyclazole 75 WP (4.7%) and Carbendazim (6.0%); showed significant over the other treatments. The yield recorded 3.57 t/ha in Nativo 75 WG was found statistically at par with other fungicides except Azoxystrobin 23 EC (2.27 t/ha) and control (1.47 t/ha). In the present study, Nativo 75 WG @ 0.4 g/l performed better with PDI of 3.9 than the Tricyclazole 75 WP @ 0.6 g/h (PDI of 6.16) (Table 1 & fig 1) may be due to repeated use of Tricyclazole 75 WP for blast disease management from many years, which may have led to the development of resistant in fungal population. Tangdiabang *et al.* (2006) [10] suggested the rotation -of different groups of fungicide for managing the development of fungicide resistance population.

A new combination fungicide Nativo 75 WG composed of Trifloxystrobin 25% (Strobilurin) and Tebuconazole 50% (Triazole) was found more effective in controlling the blast disease as compare to the single use of fungicide was supported by the findings of Dubey (1997) [4] and Pramesh *et al.* (2016) [7]. The present findings was also in the line of report of Saifulla *et al.* (1998) [8] that Tricyclazole 75 WP effective in controlling leaf blast disease and Carbendazim 50 WP in neck blast disease too. Further, Tricyclazole 75 WP was also found effective in controlling neck blast disease and also increased the yield by 76.48% over control was reported by Sood *et al.* (1997) [9].

The difference in PDI among the different fungicides was reflected in grain yield (table 1). The treatment with Nativo 75 WG @ 0.4 g/l recorded highest yield 3.57 t/ha as compare to the other fungicides where the yield were varies within 2.53 – 3.30 t/ha (Table 1 & fig 1). Application of fungicide Nativo 75 WG in management of blast disease not only reduces the disease (leaf and neck blast by 94.70% and 93.49% respectively) but also increases the yield by 90.91 t/ha followed by Tricyclazole 75 WP and Carbendazim 50 WP. The lowest yield was recorded in control 1.87 t/ha with high PDI of leaf blast (73.57%) and neck blast incidence (69.57%). The results given in table 1 is conformity with previous reports of Usman *et al.* (2009) [12], Sood *et al.* (1997) [9] and Tirmali *et al.* (2001) [11] that fungicides application increases the yield of rice.

Table 1: Effect of chemicals on the incidence of leaf and neck blast and of yield of rice caused by *Magnaporthe grisea*

Treatments (Name of chemicals)	Dosage / lit of water	PDI of leaf blast	Reduction in PDI (%)	Neck blast incidence (%)	Reduction in Neck blast incidence (%)	Yield (t/ha)	Yield increase over control (%)
Trifloxystrobin 25% + Tebuconazole 50% w/w (Nativo 75 WG)	0.4g/l	3.9 (11.20)*	94.70	4.53 (12.21)*	93.49	3.57 (11.03)*	90.91
Tebuconazole 25.9 EC	1 ml/l	11.96 (20.12)	73.40	8.47 (16.83)	87.83	3.13 (10.20)	67.38
Azoxystrobin 23 EC	1 ml/l	49.23 (44.54)	33.08	40.73 (39.62)	41.45	2.27 (8.50)	21.39
Carbendazim 50 WP	1 g/l	9.10 (17.52)	87.63	6.0 (14.19)	91.37	3.20 (10.41)	71.12
Tricyclazole 75 WP	0.6 g/l	6.16 (14.34)	91.62	4.7 (12.43)	93.24	3.30 (10.46)	76.48
Hexaconazole 5 EC	2 ml/l	43.17 (41.07)	41.32	32.87 (34.97)	61.09	2.53 (9.15)	35.29
Propiconazole 25 EC	2 ml/l	21.17 (27.39)	71.22	21.2 (27.31)	69.53	2.53 (9.14)	35.21
Control	-	73.57 (59.79)	-	69.57 (56.63)	-	1.87 (7.87)	-
ESm±		1.216		0.699		0.633	
C.D. at 5% level		3.69		2.12		1.92	
CV (%)		3.75		3.12		8.30	

*Values within parenthesis are angular transformed values

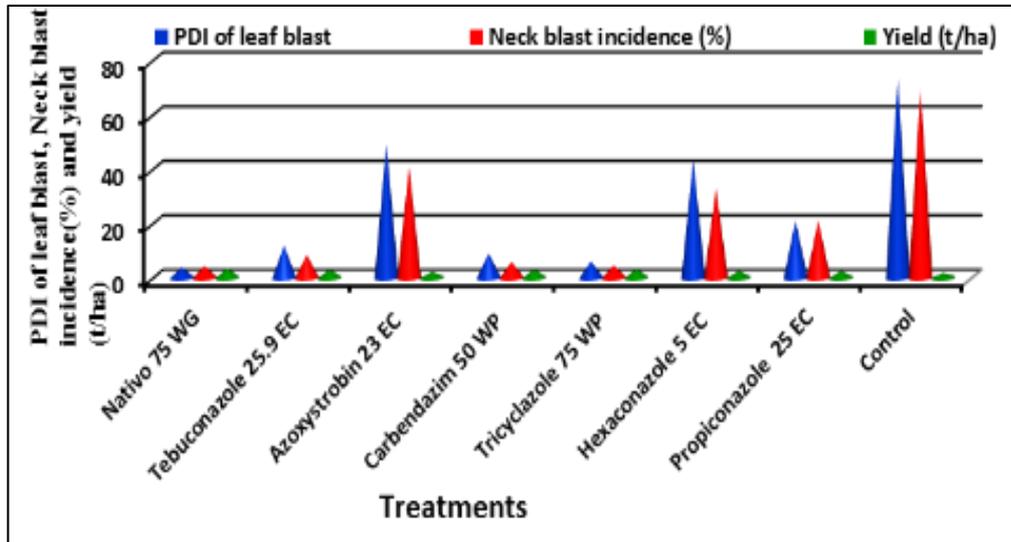


Fig 1: PDI of leaf blast, neck blast incidence and yield in different treatments

Economic analysis of 7 different fungicides depicted in table 2, revealed that in terms of net income, the highest (Rs. 23,268/-) was obtained in Nativo 75 WG followed by Tricyclazole 75 WP (Rs. 21,783/-) with BC ratio 1.73 and 1.74 respectively. However, the highest BC ratio was calculated 1.75 in Carbendazim 50 WP and lowest BC ratio 1.21 was obtained in the treatment Azoxystrobin 23 EC.

The present study also revealed that the three fungicides namely, Nativo 75 WG, Tricyclazole 75 WP and Carbendazim 50 WP were found effective in management of blast disease. Therefore, by following Tangdiabang *et al.* (2006) [10] recommendation, these fungicides may schedule for rotation to manage the blast disease in rice cultivation and this practice will also help to reduce development of fungicide resistance population / new strain of *Pyricularia oryzae*.

Table 2: Economic analysis of different fungicides in kharif rice crop against rice blast disease

Treatments (Name of chemicals)	Dosage / lit of water	Yield (t/ha)	Gross income (Rs)	Total cost (Rs)	Net Income (Rs)	BC ratio
Trifloxystrobin 25% + Tebuconazole 50% w/w (Nativo 75 WG)	0.4g/l	3.57	55,339.00	32,067.00	23,268.00	1.73
Tebuconazole 25 EC	1 ml/l	3.13	48,515.00	31,887.00	16,628.00	1.52
Azoxystrobin 23 EC	1 ml/l	2.27	35,185.00	29,007.00	6,178.00	1.21
Carbendazim 50 WP	1 g/l	3.20	49,600.00	28,197.00	21,403.00	1.75
Tricyclazole 75 WP	0.6 g/l	3.30	51,150.00	29,367.00	21,783.00	1.74
Hexaconazole 5 EC	2 ml/l	2.53	39,215.00	29,547.00	9,668.00	1.33
Propiconazole 25EC	2 ml/l	2.53	39,215.00	32,067.00	7,148.00	1.22
Control	-	1.81	28,055.00	26,667.00	1,388.00	1.05

Market price

Rice = Rs 1550/- per quintal, Nativo 75 WP = Rs. 750/- per 100g, Tebuconazole 25 EC = Rs. 290/- per 100 ml, Azoxystrobin 23 EC = Rs 130/- per 100ml, Carbendazim 50 WP = 85/- per 100g, Tricyclazole 75 WP = 250/- per 250g, Hexaconazole 5 EC = 150/- per 100 ml and Propiconazole 25 EC = 150/- per 100 ml.

Conclusion

From The present study, it has been revealed that three sprayings of Nativo 75 WG @ 0.4 g/l at 10 days interval was found most effective fungicide in reduction of diseases (leaf and neck blast by 94.70% and 93.49% respectively) and increased the yield by 90.91% over untreated control. The amount of fungicide that found to be effective against the disease was only 0.04% (0.4 g/lit of water) which is very low in comparison to the other fungicides *i.e.*, why chances towards pollution of environment is seems to be very remote. In fact, the fungicide Nativo 75 WG @ 0.04% is not only reduced the diseases but also simultaneously increased the yield by 90.91%, which is more important point to consider for the state like Assam for self-sufficiency with net return Rs. 23,268.00 (BC ratio 1.73). Though, the present scenario of agriculture, stress is given on organic cultivation, may lead to sudden fall in productivity, which will lead to food crisis. Therefore, complete cessation of chemical use is not possible considering only environment

or ecological imbalance rather side by side to manage disease(s) judicious use of chemical(s) is also needed to sustain the productivity. Considering the effectiveness of the fungicides namely, Nativo 75 WG, Tricyclazole 75 WP and Carbendazim 50 WP in management of blast disease of rice, may introduce in fungicide rotation to reduce development of fungicide resistance population / new strain of *Pyricularia oryzae*.

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