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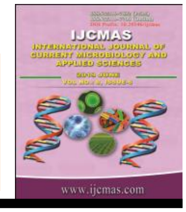

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Efficacy of Different Fungicides against Rice Blast caused by *Pyricularia oryzae* (Cav.) under Field Condition in Satna District of Madhya Pradesh

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A B S T R A C T

Rice blast caused by *Pyricularia oryzae*, Cav. is one of the major disease of rice and cause approximately 45-50 % yield losses. The present study was conducted at the experimental field of Krishi Vigyan Kendra Majhgawan, Satna (M.P.) during Kharif season of 2017-18 to know the efficacy of different foliar fungicides against blast disease of rice. Seven treatments including control with three replications were taken up by using RBD. The fungicides viz., azoxystrobin 18.2 % + difenoconazole 11.4 % (Amistar top 29.6 % SC) @ 0.13 % (T1), tebuconazole 50 % + trifloxystrobin 25 % (Nativo 75 % WG) @ 0.07 % (T2), carbendazim 12 % + mancozeb 63 % (Saaf 75 % WP) @ 0.2 % (T3), tebuconazole 25.9 % (Folicur 250 % EC) @ 0.2 % (T4), hexaconazole 5 % (Contaf plus 5 % SC) @ 0.2 % (T5), difenoconazole (Score 250 % EC) @ 0.06 % (T6) and control (Spray of plain water)- T7, were applied first at just after occurrence of disease symptoms and second at 15 days after the first spray. Observations were recorded at 10 days after the second spray. Analysis of the data showed that among the six fungicides, the minimum disease per cent intensity was recorded in T2 i.e. tebuconazole 50 % + trifloxystrobin 25 % (WG) 11.46 per cent, followed by T1 i.e. azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) with 12.85 per cent, respectively. The highest per cent disease intensity of 69.40 per cent was observed in Control (Spray of normal water) treatment. Significantly highest grain yield was recorded in tebuconazole + trifloxystrobin 75 % (WG) sprayed treatment i.e. (4102.11 kg/ha), followed by azoxystrobin + difenoconazole 29.6 % (SC) (3967.28 kg/ha) and the lowest yield of 2116.23 kg/ha was recorded with untreated control.

Introduction

Rice (*Oryza sativa*, L.) is the world's most important crop and staple food for more than a half of the world's population. Global rice consumption has increased by more than 50 million tons, with an average annual growth of nearly 2 per cent in the past 7 years. India is the largest rice growing country accounting for about one third of the world acreage under the crop. In India's annual rice production is 103.6 million tons during 2016 (Anon, 2016). Rice is grown throughout India in all the states. The major rice growing states of India are West Bengal, Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Andhra Pradesh, Karnataka and Chhattisgarh. But some of the major limiting factor in rice production are several biotic and a biotic constraints. Rice blast caused by *pyricularia oryzae,* Cav. (synonym *Pyricularia grisea* Sacc. The anamorph of *Magnaporthe grisea*), is one of the most destructive and wide spread disease (Jia *et al.,* 2000). Blast epidemics happened across various rice growing countries including India, China, Korea, Vietnam and United States to the extent of 50 % yield loss (Wilson and Talbot, 2009). *M. oryzae* in rice brings forth typical disease symptoms such as leaf blast, nodal blast, neck blast or panicle blast. Compared to leaf blast, neck blast causes highest yield loss since it affects the panicle directly. An area with high rainfall and cooler climate are sternly affected (Ghatak *et al.,* 2013). The commonly used management approaches to deal with blast are fungicides or to develop resistant varieties. Several plant genes confer rice blast resistance. However, most of these resistant varieties are short-lived and the resistance is broken down due to variable nature of fungal pathogen. In addition, the fungus also gains fungicide resistance by mutating the target genes of fungicides (Kim *et al.,* 2003). Among the methods, fungicidal control is largely practiced for blast disease in many temperate or subtropical rice growing countries, primarily in Japan, China, South Korea, Taiwan and Vietnam (Kumar *et al.,* 2014). With the objective to ascertain the efficacy of various combination fungicides on the management of rice blast disease, the research has been undertaken.

Symptoms and signs

The symptoms of rice blast include lesions that can be found on all parts of the plant, including leaves, leaf collars, necks, panicles and seeds. However, the most common and diagnostic symptom, diamond shaped lesions, of rice blast occur on the leaves, whereas lesions on the sheaths are relatively rare. The symptoms on leaves may vary according to the environmental conditions, the age of the plant, and the levels of resistance of the host cultivars. On susceptible cultivars, lesions may initially appear gray-green and water-soaked with a darker green border and they expand rapidly to several centimeters in length. On susceptible cultivars, older lesions often become spindle shape, light tan in color with necrotic borders (Fig. 1). On resistant cultivars, lesions often remain small in size (1-2 mm.) and brown to dark brown in color. The collar of a rice plant refers to the junction of the leaf and the stem sheath. Symptoms of infection of the collars consist of a general area of necrosis at the union of the two tissues (Fig. 2). Collar infections can kill the entire leaf and may extend a few millimeters into and around the sheath.

Materials and Methods

An experiment was conducted at Krishi Vigyan Kendra Majhgawan, Satna (M. P.) during *Kharif* season, 2017-18 in RCBD with 3 replications and 7 treatments including control to evaluate different fungicides against rice blast disease under field condition. The plot size for each treatment was 2 x 6 meters with eight rows in each plot and plant to plant and row to row distance was 20 cm. 25 days old seedlings of susceptible cultivar (IR-36) were planted. The agronomic practices were followed as per package of practices for raising the crop. Fertilizers were applied @ 100:50:50 kg. NPK/ha and weeds were controlled by bispyribac sodium 10 % (SC) as weedicide @ 250 ml/ha at 20 DAT. Recently, many studies conducted on combination fungicides such as tebuconazole 50 % + trifloxystrobin 25 % (WG) and azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) have shown the capability to control the blast disease under field condition (Bag *et al.,* 2009, Bhuvaneswari *et al.,* 2012 and Kumar *et al.,* 2014). The different fungicides tested are listed in (Table 1). The fungicides *viz*., azoxystrobin 18.2 % + difenoconazole 11.4 % SC (T1), tebuconazole 50 % + trifloxystrobin 25 % WG (T2), carbendazim 12 % + mancozeb 63 % WP (T3), tebuconazole 25.9 % EC (T4), hexaconazole 5 % SC (T5) and difenoconazole 25 % EC (T6). In total two sprays were given, first at appearance of the disease as prophylactic spray and second at 15 days after the first spray. The observations on occurrence of leaf blast were recorded as per cent disease intensity (PDI) at 10 days after the second or final spray by using 0-9 scale given by IRRI (1996). Finally, the grain yield in each plot was recorded and expressed in kg/ha. The leaf blast incidence was calculated by using formula (Wheeler, 1969):

$$\textbf{PDI} = \frac{\text{Sum of individual rating}}{\text{Number of leaves assessed x Maximum disease grade value}} \times 100$$

Statistical analysis

All data from each experiment were subjected to analysis of variance (ANOVA) by using Duncan's Multiple Range-Test (DMRT) at 5 % significance (Gomez and Gomez, 1984).

Results and Discussion

The results of field experiment revealed that, there was a significant difference among the treatments with respect to per cent disease intensity (PDI) of blast disease and all the treatments recorded significantly lower per cent disease intensity and higher yield compared to untreated control plots. Efficacy of different fungicides against leaf blast under field condition and their ultimate effects on crop yield is given in the (Table 2). Maximum plant height was recorded in T2 treatment with tebuconazole 50 % + trifloxystrobin 25 % (WG) 71.10 cm, followed by in T1 treatment with azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) 69.04 cm. Minimum plant height was recorded in untreated control (46.99 cm) i.e. T7 treatment. The treatment T2 in which fungicide combination tebuconazole 50 % + trifloxystrobin 25 % (WG) were applied showed the best results with minimum per cent disease intensity (11.46 %) followed by treatment T1 in which fungicide combination azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) 12.85 %, were sprayed. The treatment T4 in which fungicides like tebuconazole 25.9 % (EC) was applied, had intermediate per cent disease intensity i.e. 15.97 % which resulted in poor yield. Maximum per cent disease intensity of 69.40 % was recorded in untreated control. Further, the highest grain yield (4102.11 kg/ ha) was recorded in T2 treatment with fungicide combinations tebuconazole 50 % + trifloxystrobin 25 % (WG) followed byT1 treatment with fungicide combination azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) resulted in. 3967.28 kg/ha, production. The lowest grain yield was observed in T7 treatment i.e. control (2116.23 kg/ha). There was no significant difference among treatments with regard to average plant height taken at harvesting stage. All the treatments evaluated under field condition showed significant differences in blast disease reduction and grain yield. The results are supported by the work of (Narayanswamy *et al,* 2009) who reported that application of tebuconazole 50 % + trifloxystrobin 25 % (WG) was found most effective in controlling leaf blast as it controlled the disease up to the extent of 84 per cent compared to control. (Mohan *et al.*, 2011 and Nirmalkar *et al.*, 2017) reported that, tebuconazole 50 % + trifloxystrobin 25 % (WG) and tebuconazole 25.9 % (EC) were found most effective against the leaf and neck blast of paddy under field condition. Various experimental reports confirmed that strobilurin derived fungicides found to be effective in controlling rice blast disease compared to other fungicides (Pramesh *et al.*, 2016 and Debashis *et al.*, 2012). Tirmali *et al.*, (2001) reported that, the efficacy of new fungicides in controlling rice blast treated with tebuconazole 25.9 % (EC) and difenoconazole 25 % (EC) at maximum tillering, panicle initiation and at heading stage of crop and found that all these new fungicides have significantly reduced the occurrence rice blast disease incidence. Among the six fungicides tested under field conditions, the fungicides *viz.*, tebuconazole 50 % + trifloxystrobin 25 % (WG) and azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) were the most effective against leaf blast disease with great reduction in the per cent disease intensity and getting higher grain yield while tebuconazole 25.9 % (EC) exhibited intermediate effectiveness (Usman Ghazanfar *et al*, 2009).

Table.1 List of fungicides evaluated under field condition against rice blast

Treatment	Chemical name	Trade name	Concentration (%)
T1	Azoxystrobin 18.2 % + Difenoconazole 11.4 % (SC)	Amistar top	0.13
T2	Tebuconazole 50 % + Trifloxystrobin 25 % (WG)	Nativo	0.07
T3	Carbendazim 12 % + Mancozeb 63 % (WP)	Saaf	0.2
T4	Tebuconazole 25.9 % (EC)	Folicur	0.2
T5	Hexaconazole 5 % (SC)	Contaf plus	0.2
T6	Difenoconazole 25 % (EC)	Score	0.06
T7	Control	Normal water	-

Table.2 Efficacy of different fungicides against blast disease of rice under field condition

S. No.	Treatments	Concentration (%)	Average plant height (cm.)	Average No. of tillers/ hill	Leaf blast (per cent disease intensity) (PDI)	Yield (kg/ha)
01	Azoxystrobin 18.2 % + Difenoconazole 11.4 % (SC)	0.13	69.04	19.32	12.85	3967.28
02	Tebuconazole 50 % + Trifloxystrobin 25 % (WG)	0.07	71.10	20.11	11.46	4102.11
03	Carbendazim 12 % + Mancozeb 63 % (WP)	0.2	66.34	19.12	20.73	3425.67
04	Tebuconazole 25.9 % (EC)	0.2	67.15	19.31	15.97	3706.32
05	Difenoconazole 25 % (EC)	0.06	66.03	18.91	17.12	
06	Hexaconazole 5 % (SC)	0.2	63.58	18.96	21.34	
07	Control	-	46.99	18.10	69.40	

Fig.1 Symptoms of leaf blast with spindle shape and light tan in color

Fig.2 Symptoms of neck blast

The chemical control is an important strategy for the farmers to harvest economic yield. Although, resistant variety is the best option to minimize the cost of production but cultivation of resistant varieties with few protective fungicidal spray will reduce the risk of development of matching virulence by suppressing the population growth of matching virulence. Thus, in present situation good agronomic practices combined with foliar application of fungicide at the most appropriate stage i.e. initiation of disease is the most suitable and recommended practice to manage the disease and even in integrated pest management system which will also helpful in minimizing pollution and balancing the ecosysytem. Hence in the present study, two sprays of tebuconazole 50 % + trifloxystrobin 25 % (WG) had not only reduced the per cent disease intensity (11.46 %) but also resulted in the higher grain yield (4104.11 kg/ha), followed by azoxystrobin 18.2 % + difenoconazole 11.4 % (SC) with 12.85 per cent disease incidence and yield of 3967.28 kg/ha, respectively. This is obviously due to their mode of action and also lowering of both leaf and neck blast incidence.

Summary and conclusions are as follows:

The present investigation with six different fungicides examined against rice blast pathogen, two fungicides namely- Tebuconazole 50 % + Trifloxystrobin 25 % (WG) and Azoxystrobin 18.2 % + Difenoconazole 11.4 % (SC) were significantly reduced the blast disease incidence. The fungicide, Tebuconazole 50 % + Trifloxystrobin 25 % (WG) was recorded minimum per cent disease intensity (11.46 %) and highest grain yield (4102.11 kg/ha). Hence the combination fungicides are better than fungicides with single mode of action, as it provides rigorous control by its diversified mode of action and withstands longer time to pathogens' resurgence in the boom and burst cycle.

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