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Bio efficacy of fungicides against rice sheath blight caused by *Rhizoctonia solani* under *in vitro* condition

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ABSTRACT

Sheath blight caused by *Rhizoctonia solani* Kuhn [*Thanatephorus cucumeris* (Frank) Donk], occurs throughout the temperate and tropical rice growing regions. Rice sheath blight was considered as a minor disease in earlier days, but now it is regarded as an internationally important disease second only to rice blast. Use of fungicides with a broad spectrum of activity against more than one disease is common in rice. The foliar spray of fungicides is the single most effective method for the management of sheath blight disease. The bio efficacy of various fungicides like Carbendazim 50 per cent WP, Mancozeb 50 per cent WP, Benomyl 50 per cent WP, Copper oxychloride 50 per cent WP, Edifenphos 50 per cent EC, Iprobenphos 50 per cent EC and Hexaconazole 5 EC were used to test against the *R. solani* by Poisoned food technique and Mycelial dry weight is analyzed. All the tested fungicides registered appreciable inhibition in colony growth and mycelia dry weight. Among the eight fungicides, Hexaconazole 200 ppm and 400 ppm were completely inhibiting the mycelial growth of *R. solani.* Among the fungicides, Hexaconazole showed the highest level of inhibition and recorded 49.3 mg mean of mycelial dry weight. The result of the experiment revealed the superiority of Hexaconazole in the control of *R. solani*, hence the same was used for further studies.

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INTRODUCTION

Use of fungicides with a broad spectrum of activity against more than one disease is common in rice. Resistance alone however has not been proved sufficient (Mew, 1988). The foliar spray of fungicides is the single most effective method for the management of sheath blight disease (Lore *et al.*, 2012). Many chemicals, including antibiotics were tested against sheath blight of rice (Kannaiyan and Prasad, 1976 and Devi *et al.*, 1987).

Hexaconazole is an ergosterol biosynthesis inhibitor. Because of its outstanding protectant and systemic activities, it is being used effectively against diseases of many crops at very low concentration (Shephard *et al.*, 1986).

Brown *et al.* (1989) reported that the redistribution of fungicide, hexaconazole within the leaf and other tissue enhanced sheath blight disease control in untreated parts remote from the sprayed tissue, thus increasing overall effectiveness against *R. solani*. Dubey and Toppo (1997) and Chia Tiohuat (1997) also reported that hexaconazole was most effective in reducing the rice sheath blight disease intensity and increased the yield. Similarly the effectiveness of hexaconazole against *R. solani* and other multinucleate and binucleate *Rhizoctonia* was reported by Carling *et al.* (1990).

Fungicides with multiple effects on the pathogen like sclerotial germination, mycelial growth inhibition and reduction of the disease spread will be most ideal (Kandhari *et al.,* 2003). Among different fungicides screened under laboratory and field conditions (from 2002 to 2004), Tilt 25 EC (propiconazole) at 0.1 per cent was highly effective against sheath blight disease. Bavistin 50 WP (carbendazim) and Contaf 5 EC (hexaconazole) at 0.1 per cent concentration were effective against sheath blight. Among other fungicides, Rhizocin 3 L (validamycin) at 0.25 per cent was effective against sheath blight. Laboratory studies revealed that Tilt 25 EC followed by Contaf 5 EC were effective against *R. solani* (Lore *et al.,* 2007 and Savary *et al.,* 2012*)*. In this context, the present study was carried out to test the effective fungicide against the *R. solani*.

MATERIAL AND METHODS

Fungicides used against *R. solani :*

The efficacy of the fungicides listed the in Table A was tested against *R. solani.*

Evaluation of fungicide toxicity against *R. solani :*

Poisoned food technique (Schmitz, 1930) :

Eight fungicides, Carbendazim 50 per cent WP, Mancozeb 50 per cent WP, Benomyl 50 per cent WP, Copper oxychloride 50 per cent WP, Edifenphos 50 per cent EC, Iprobenphos 50 per cent EC, Hexaconazole 5 EC and Propiconazole 25 per cent EC were tested for this study. The effect of various fungicides on the radial growth of the pathogen was studied by poisoned food technique. Required quantity of fungicide solutions were mixed with autoclaved and cooled PDA just before pouring into Petri plates, so as to obtain the required concentrations *viz.*, 100, 200, 400 ppm. The medium was then dispensed uniformly into 90 mm diameter Petri plates and inoculated with 9 mm mycelial disc of the pathogen from8 day old culture with their mycelial side down. Un-amended medium served as control. The growth of the fungus was measured by the radial growth (mm) every 24 h till the fungus covers the plate completely in control plate. The per cent inhibition(PI) of the fungus over control was calculated using the following formula:

$$PI = \frac{(A - B)}{A} \times 100$$

where, A is colony diameter of the fungus in control plates (mm) and B is colony diameter of the fungus in treated plates (mm).

Mycelial dry weight :

Required quantities of each fungicide was added to potato dextrose broths to have concentrations of 100, 200 and 400 ppm and autoclaved. The Erlenmeyer flasks were inoculated with 9 mm mycelial discs obtained from the periphery of the fungal culture (8 days old). Similar procedure has been followed for taking the mycelial dry weight as stated earlier.

Table A : List of fungicide used against *R. solani*

Sr. No.	Chemical name	Concentration (%)	Trade name
1.	Carbendazim 50% WP	0.2	Bavistin
2	Mancozeb 50% WP	0.2	Mancozeb
3.	Benomyl 50% WP	0.2	Benlate
4.	Copper oxychloride 50% WP	0.3	Fytolan
5.	Edifenphos 50% EC	0.2	Hinosan
6.	Iprobenphos 50% EC	0.2	Iprobenfos
7.	Hexaconazole 5 EC	0.2	Contaf

Table 1 : Evaluation of the fungicides against *R. solani*

Fungicides	Mycelial growth of *R. solani* (mm)				Mycelial dry weight (mg/50 ml broth)			
	100 ppm	200 ppm	400 ppm	Mean	100 ppm	200 ppm	400 ppm	Mean
Carbendazim 50% WP	18.20	10.60	2.00	10.26[c]	170.0	88.0	24.0	94.0[b]
Mancozeb 50% WP	31.00	14.00	6.00	17.00[c]	283.0	142.0	108.0	177.0[c]
Benomyl 50% WP	54.50	25.00	22.10	33.86[d]	327.0	172.0	137.0	212.0[d]
Copper oxychloride 50% WP	58.20	28.10	17.10	34.46[d]	329.0	176.0	139.0	214.6[d]
Edifenphos 50% EC	21.00	8.90	0.00	9.96[b]	200.0	106.0	56.0	120.6[b]
Iprobenphos 50% EC	61.20	31.10	20.10	37.46[e]	330.0	180.0	142.0	217.3[d]
Hexaconazole 5 SC	6.20	0.00	0.00	2.06[a]	135.0	8.0	5.0	49.3[a]
Propiconazole 5 SC	16.20	5.60	0.00	7.26[b]	150.0	60.0	15.0	75.0[b]
Control	88.00	88.00	88.00	88.00[f]	390.0	390.0	390.0	390.0[e]

* Values in the column followed by common letters do not differ significantly by DMRT (P=0.05)

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

Poisoned food technique :

In the present study eight fungicides were tested against *R. solani* and presented in Table 1. All the tested fungicides registered appreciable inhibition in colony growth and mycelia dry weight. Among the eight fungicides, Hexaconazole 200 ppm and 400 ppm were completely inhibiting the mycelial growth of *R.solani.* Carbendazim, Mancozeb, Benomyl, Copper oxychloride and Iprobenphos @ 400 ppm recorded 2.00 cm, 6.00 cm, 22.10 cm, 17.10 cm and 20.10 cm radial growth of test pathogen, respectively. Hexaconazole was appearing to be significantly inferior in comparison to other fungicide inhibiting the colony growth.

Mycelial growth :

Under *in vitro* condition, all the eight fungicides inhibited the growth of mycelial biomass of *R. solani*. Among the fungicides, Hexaconazole showed the highest level of inhibition and recorded 49.3 mg mean of mycelial dry weight. It was followed by Propiconazole which recorded 75.0 mg mean value of mycelial dry weight. In all *in vitro* experiments conducted, the level of efficacy of Hexaconazole was superior to that of other fungicides (Table 1).

The results of the present study revealed that, all the tested eight fungicides inhibited the mycelial growth of the pathogen when compared to control. Of these hexaconazole exhibited the highest level of inhibition of *R. solani* even at very low concentration (200 ppm). Similarly, Brown *et al*. (1989), who reported that hexaconazolewas highly effective against *R. solani*by way of inhibiting mycelial growth and conidial germination at lower concentrations in *in vitro* and *in vivo* conditions. Dubey and Toppo (1997) and Lore *et al.* (2012) also reported that the hexaconazolewas most effective in reducing the rice sheath blight disease intensity and increased the yield. There are several workers have been reported on the efficacy of hexaconazole against *R. solani* (Dinakaran *et al.*, 2011 and Gupta *et al.*, 2013). This may be due to demethylation of C-14 during ergosterol biosynthesis that leads to accumulation of C-14 methyl sterols. The above results lend supports to the present finding.

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