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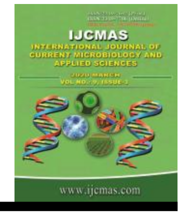

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Bio-Efficacy of Fungicides against *Magnaporthe oryzae* Causing Blast of Rice

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A B S T R A C T

The present *in-vitro* study was conducted at the Department of Plant Pathology, University of Agricultural Sciences, Dharwad, Karnataka, India during July 2018, to evaluate different fungicides against rice blast incited by *Magnaporthe oryzae* Couch and Kohn. Among the four contact fungicides tested, propineb 70 % WP recorded cent per cent inhibition of mycelial growth in all the concentrations (*i.e.*, 1000 ppm, 1500 ppm and 2000 ppm), mancozeb 75 % WP recorded next highest inhibition of mycelial growth. Among the eight systemic fungicides, complete inhibition of mycelial growth of the fungus was recorded in all the concentration (*i.e.*, 500 ppm, 750 ppm and 1000 ppm) in six fungicides *viz*., propiconazole 25 % EC, carbendazim 50 % WP, thiophanate methyl 70 % WP, tebuconazole 25 % EC, isoprothiolane 5 % EC and tricyclazole 75 %. Minimum inhibition was observed in azoxystrobin 25 % SC, with 55.83, 63.62 and 70.52 per cent inhibition at 500, 750 and 1000ppm concentration respectively with a mean of 63.66 per cent. In general, the inhibition of radial growth of fungus increased with increase in concentration of each fungicide.

Introduction

Rice (*Oryza sativa* L.) is a self-pollinated crop belongs to the botanical family *Poaceae* (*Gramineae*), tribe *Oryzeae*. It is one of the maximum critical plants of the area both in phrases of place and production, approximately 90 per cent of global rice is grown and fed on in Asia and 60 in line with cent of world population additionally depends on rice for their half of the calorie consumption from this crop. Rice is consumed in diverse paperwork like roti, boiled rice, puffed rice, idli, canned rice and fermented products, dosa and so on.

In rice production, China leading the list and India stands next to it but India stands first in global area of rice cultivation. Rice contributes around 43 per cent of total food grain production and 55 per cent of cereals production in the country; in world rice is grown in an area of 157.46 million hectares with the production of 503.80 million tonnes and in India rice is cultivated in 43.41 million hectares with a production of 112.91 million tonnes during 2017-18 (Anon., 2018).

Rice suffers from many diseases caused by fungi, bacteria, viruses, phytoplasma, nematodes and other non-parasitic disorders. Among the fungal diseases, blast is considered as a major threat to rice production because of its wide spread distribution and its destructiveness under favourable conditions (Webster and Gunnell, 1992).

There are several methods practiced to combat the problem of blast disease but disease management through fungicide plays a very crucial role as many high yielding and popular varieties have become susceptible to the disease.

Rice blast caused by *Magnaporthe oryzae* Couch and Kohn (Anamorph: *Pyricularia oryzae* Cavara) belongs to ascomycetes known to infect quite 50 hosts. Rice blast was 1^{st} came into notice in China (1637) later from Japan (1704). In India, the disease gained importance once a devastating epidemic occurred in Thanjavur (Tanjore) delta of Tamilnadu throughout 1919 (Nagarajan, 1988).

The pathogen may infect all the above ground parts of a rice plant at different growth stages *viz.*, leaf, collar, node, internodes, base or neck and other parts of the panicle and sometimes the leaf sheath. A typical blast lesion on a rice leaf is gray at the centre, has a dark border and it is spindle-shaped.

Materials and Methods

The efficacy of different fungicides was assayed. The fungicides were tested against the *M. oryzae* by following 'Poisoned food technique'. The required concentrations of chemicals were weighed and incorporated into sterilized, cooled potato dextrose agar. Twenty ml of cooled molten medium was poured into 90 mm sterilized Petri dishes and all plates were inoculated with actively growing five mm mycelial disc of pathogen separately.

Three replications were maintained for each treatment. These plates were incubated at 27 $\pm 1^0$ C for 12-14 days, and colony diameter was recorded. The per cent inhibition of growth was calculated by using the formula given by Vincent (1947).

$$I = \frac{(C - T)}{C} \times 100$$

Where,
I = Per cent inhibition of mycelial growth
C= Growth of mycelium in control.
T = Growth of mycelium in treatment.

List of fungicides used for *in vitro* evaluation

Contact fungicides

The following contact fungicides were evaluated at 1000, 1500 and 2000 ppm concentrations.

Sl. No.	Common name	Trade name
1.	Copper hydroxide 35 % WG	Kocide 2000
2.	Propineb 70 % WP	Antracol
3.	Mancozeb 75 % WP	Indofil M-45
4.	Chlorothalonil 75 % WP	Kavach

Systemic fungicides

The following systemic fungicides were

evaluated at 500, 750 and 1000 ppm concentrations.

Sl. No.	Common name	Trade name
1.	Azoxystrobin 25 % SC	Amistar
2.	Thiophanate methyl 70 % WP	Roko
3.	Propiconazole 25 % EC	Tilt
4.	Difenconazole 25 % EC	Score
5.	Tricyclazole 75 % WP	Beam
6.	Carbendazim 50 % WP	Bavistin
7.	Tebuconazole 25 % EC	Folicur
8.	Isoprothiolane 5 % EC	Fujione

Results and Discussion

Efficacy of four contact and eight systemic fungicides was tested at three different concentrations by poison food technique as per the procedure explained in Material and Methods. The results obtained on testing efficacy of fungicides against the *M. oryzae* are depicted in Table1, 2 and Plate 1, 2.

Contact fungicides

Among the three different concentrations tested, the maximum mean inhibition of mycelial growth (100 %) among the fungicides was recorded in propineb 70 % WP, followed by mancozeb 75 % WP (90.85 %) and the least mean inhibition of mycelial growth (37.25 %) was recorded in case of copper hydroxide 35 % WG whereas, maximum mean inhibition of mycelial growth (80.78 %). Among the concentrations was recorded in 2000 ppm, followed by 1500 ppm (74.12 %) and the least mean inhibition of mycelial growth (66.67 %) was recorded in case of 1000 ppm. In all the three tested concentrations *viz.*, 1000 ppm, 1500 ppm and 2000 ppm, propineb 70 % WP recorded cent per cent inhibition of mycelial growth, mancozeb 75 % WP was the next best non systemic fungicide in all the concentrations (84.31 %, 89.80 % and 98.43 %, respectively). The least effectiveness in all the three concentration was seen in copper hydroxide 35 % WG (28.63 %, 38.04 % and 45.10 %, respectively). So, propineb 70 % WP found to be the best non systemic fungicide at all the concentrations and mancozeb 75 % WP found to be the next best non systemic fungicide. Gohel *et al.,* (2008) and Hajano *et al.,* (2012) also recorded similar types of results.

Systemic fungicides

Among the fungicides, the highest inhibition of mycelial growth (100 %) was recorded in six fungicides *viz.*, propiconazole 25 % EC, carbendazim 50 %WP, Thiophanate methyl 70 % WP, tebuconazole 25 % EC, isoprothiolane 5 % EC and tricyclazole 75 % WP at all the three concentrations whereas, the least was recorded in case of azoxystrobin 25 % SC (70.20 %). Maximum mean inhibition of mycelial growth (90.85 %) among the fungicides was recorded in six fungicides *viz.*, propiconazole 25 % EC, carbendazim 50 %WP, Thiophanate methyl 70 % WP, tebuconazole 25 % EC, isoprothiolane 5 % EC and tricyclazole 75 % WP, followed by difenconazole 25 % and the least mean inhibition of mycelial growth (74.38 %) was recorded in case of azoxystrobin 25 % SC whereas, the maximum mean inhibition of mycelial growth (97.25 %) among the concentrations was recorded at 1000 ppm, followed by 750 ppm (95.59 %) and the least mean inhibition of mycelial growth (94.12 %) was recorded at 500 ppm.

Table.1 *In Vitro* evaluation of contact fungicides against *M. Oryzae*

Treatment	Fungicides	Per cent mycelial growth inhibition			Mean
		1000 ppm	1500 ppm	2000 ppm	
T_1	Propineb 70% WP	100.00 (90.00)*	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**
T_2	Mancozeb 75% WP	84.31 (66.67)	89.80 (71.37)	98.43 (82.80)	**90.85 (72.39)**
T_3	Chlorothalonil 75% WP	53.73 (47.14)	68.63 (55.94)	79.61 (63.16)	**67.32 (55.13)**
T_4	Copper hydroxide 35% WG	28.63 (32.35)	38.04 (38.08)	45.10 (42.19)	**37.25 (37.61)**
Mean		**66.67 (54.74)**	**74.12 (59.42)**	**80.78 (64.00)**	
		S.Em. ±	C.D. @ 1%		
Fungicide (F)		0.60	1.75		
Concentration (C)		0.52	1.51		
Fungicide × Concentration (F×C)		1.04	3.03		

*Arc sine transformed values

Table.2 *In vitro* evaluation of systemic fungicides against *M. oryzae*

Treatment	Fungicides	Per cent mycelial growth inhibition			Mean
		500 ppm	750 ppm	1000 ppm	
T_1	Azoxystrobin 25% SC	70.20 (56.91)*	74.90 (59.93)	78.04 (62.06)	74.38 (59.59)
T_2	Difenoconazole 25% EC	82.75 (65.46)	89.80 (71.37)	100.00 (90.00)	90.85 (72.39)
T_3	Propiconazole 25% EC	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_4	Carbendazim 50% WP	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_5	Thiophanate methyl 70% WP	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_6	Tebuconazole 25% EC	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_7	Isoprothiolane 5% EC	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_8	Tricyclazole 75% WP	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
Mean		94.12 (75.97)	95.59 (77.88)	97.25 (80.45)	
		S.Em. ±	C.D. @ 1%		
Fungicide (F)		0.89	1.80		
Concentration (C)		0.55	1.10		
Fungicide × Concentration (F×C)		1.55	3.12		

*Arc sine transformed values

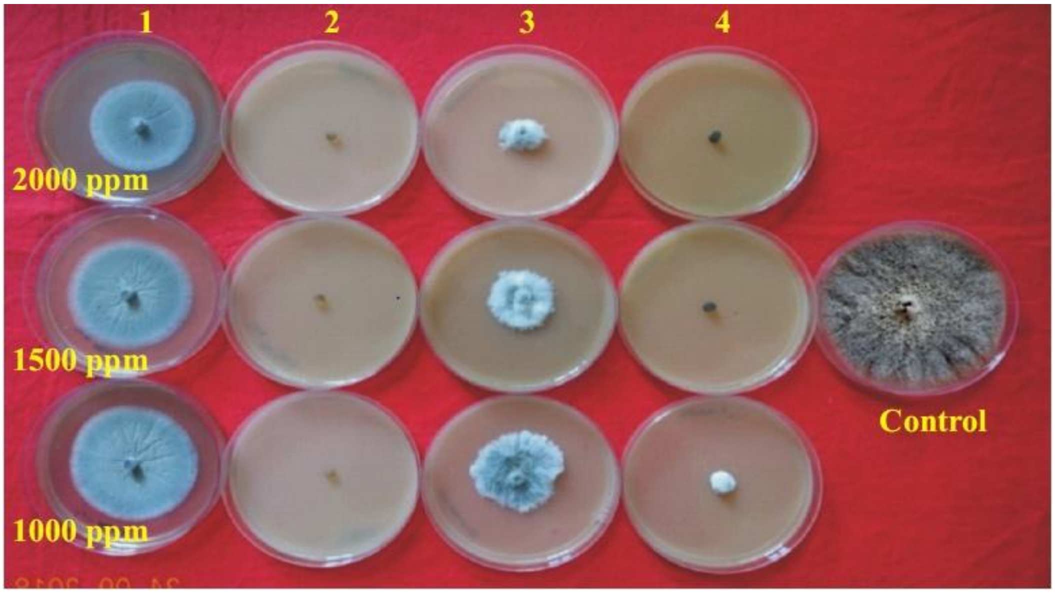

Plate.1 *In vitro* efficacy of contact fungicides against *M. oryzae*

Where, Copper hydroxide 35% WG; Propineb 70% WP; Chlorothalonil 75% WP; Mancozeb 75% WP

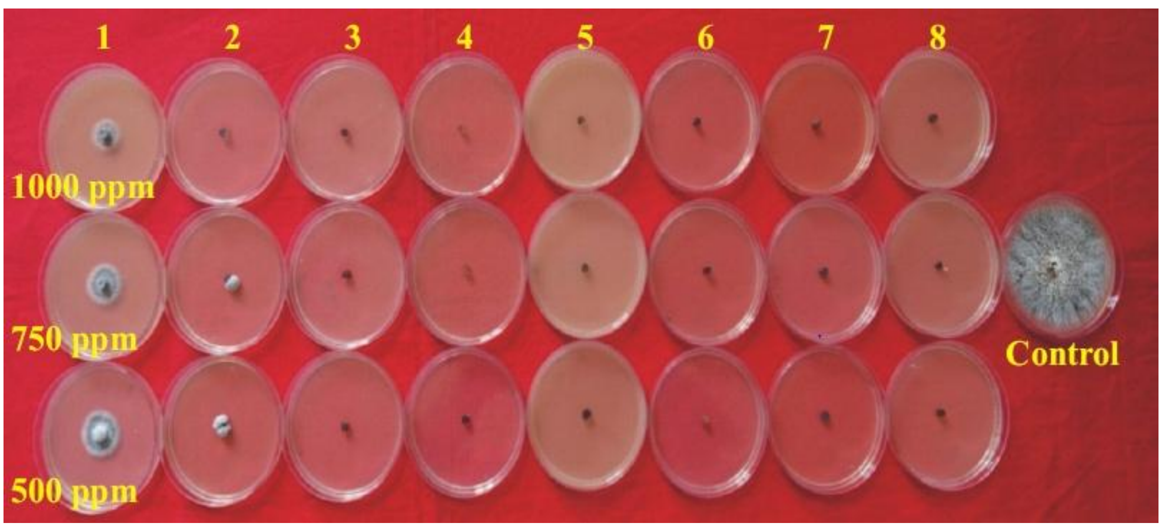

Plate.2 *In vitro* efficacy of systemic fungicides against *M. oryzae*

Where, Azoxystrobin 25 % SC ; Difenoconazole 25 % EC; Tebuconazole 25% EC; Isoprothiolane 5% EC ; Carbendazim 50% WP; Propiconazole 25% EC; Tricyclazole 75% WP; Thiophanate methyl 70% WP

In all the three tested concentrations *viz.*, 500 ppm, 750 ppm and 1000 ppm, six fungicides have recorded cent per cent inhibition of mycelial growth, difenconazole 25 % EC found to be the next best systemic fungicide in all the concentrations (82.75 %, 89.80 % and 100.00 %, respectively). Least effectiveness in all the three concentration was seen in azoxystrobin 25 % SC (70.20 %, 74.90 % and 78.04 %, respectively). Majority of the fungicides which had shown cent per cent inhibition belong to triazole group. Which are strong ergosterol biosynthesis inhibitors in the fungal membrane. Ergosterol is essential for cell wall structure and inhibition of sterol biosynthesis will be deleterious to fungal cell (Dupont *et al.*, 2012).

In conclusion *in vitro* effectiveness of twelve fungicides comprising of four contact and eight systemic were tested at three different concentrations against *M. oryzae.* The obtained results revealed that, in all the concentrations tested seven fungicides *viz.*, propineb 70 % WP, propiconazole 25 % EC, carbendazim 50 %WP, Thiophanate methyl 70 % WP, tebuconazole 25 % EC, isoprothiolane 5 % EC, tricyclazole 75 % WP have shown cent per cent mycelial growth inhibition over control.

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