Annals of Plant and Soil Research 26(4): 760-764 (2024)
https://doi.org/10.47815/apsr.2024.10428

In-vitro efficacy of different fungicides against *Rhizoctonia solani* causing sheath blight of rice

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Received, July, 2024; Revised accepted, September, 2024

ABSTRACT

Rice sheath blight is a worldwide destructive disease that causes a sub stantial reduction of seed quality and significant yield losses. The disease caused by the fungus R. solani Kuhn (Asexualstage) and perfect stageThanatephorus cucumeries (frank) Donk belong to phylum Basidiomycota. The pathogen is emerging as a devastating disease-causing enormous yield loss. To overcome the disease severity, numerous novel fungicides were addressed for amending productivity of crop. Among various fungicides tested, Tebuconazole (25.9 EC) and Trifloxystrobin + Tebuconazole 75% WG recorded 100% mycelial growth inhibition, followedby Difenconazole 11.4 % SC (94.32%), Kresoxim methyl 44.3% SC (83.45%) and Carbendazim 12% + Mancozeb 63% WP (75.18%), respectively.

Keywords: Sheath blight, *R. solani,* fungicides, mycelial growth

INTRODUCTION

Rice (*Oryza sativa* L.) is the crucial cereal food graincrop of the world which addresses the staple food about 60percent of the world's population. Rice contributes 43 percent oftotal food grain production and 46 percent of total cereal production in India. Rice cropping system accommodate the income and employment for more than 50million households. One third of Asia's **r**ice production is consumed in China and one fifth in India. India is the second largest rice producer and consumer next to China globally. About ninety per cent of all rice grown in the world is produce and consumed in Asian region. In the world, the area of rice estimated to 165.25million hectares with total production of 519.5 million tones (Shahbandesh, 2023). Rice has unique position in Indian economy. India ranks second in rice production followed by China. The India's rice production reached to 129.47million tones from area of 46.27million hectares with 35.25 q per ha. Productivity (Anonymous, 2022). In Maharashtra state, rice is cultivated in about 1.65 million hectares area with annual production 3.59 tonnes is productive of 29.95 qha^{-1} and in Konkan area under rice cultivation 0.39 M ha with 2.90 MT production and productivity of 25.54q ha^{-1} (Anonymous, 2022). *R. solani* world wide devastating pathogen that causes a substantial reduction of seed quality and significant yield losses (Lee and Rush, 1983). In India, the disease was first reported by Paracer andChahal, (1963) from Gurudaspur, Punjab and later Kohli, (1966) reported it fromUttar Pradesh. Now its occurrence is observed in almost all rice growing states of India with an estimated loss of grain yield to theextent of 5.20 to 50 percent (Das and Mishra, 1990; Rao *et al.,* 2020). When humidity reaches above 95 % and temperature ranges from 29 to 32°C, infection drastically spreads on entire plant parts, including leaf blades, showing irregular shaped lesions with brown borders as bands.The disease is also called 'snake skin disease', 'mosaic foot stalk', and 'rotten foot stalk' because of its special disease symptoms (Molla *et al.,* 2020). Although, the disease Causing 5-50% significant yield losses depending on the environmental conditions, crop stage at which the disease occurs, cultivation practices and cultivars used (Marchetti and Bolllich 1991). The pathogen over winters as soil-borne dormant structure and infected plant debris which constitute the primary inoculum.

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However, the control of soil borne disease is difficult because of its ecological behavior, it's extremely broad host range and the high survival rate of sclerotia under various environmental conditions (Groth *et al.,* 2006). So far, no rice variety completely resistant to this fungus has been found, although screening of different germplasm has been elucidated in rice (Oard *et al.,* 2004). In the absence of a desired level of host resistance, the disease is currently managed by using promising fungicides (Mohanty, 2020) which may be potential in reducing the sheath blight disease severity (Das and Hazarika, 2000).

MATERIALS AND METHODS

Efficacy of different fungicides against *Rhizotonia solani* causing Sheath blight of rice

Efficacy of different fungicides was examined by using poison food technique. Eight fungicides were used for *in vitro* at different concentration against *Rhizotonia solani* pathogen causing Sheath blight. Required quantity of each fungicide were measured as per concentration and added separately into sterile molten and warm media taken 250 ml conical flask and thoroughly mix to dissolve the chemical and get appropriate concentration of each fungicide. 20ml poison medium poured into each 90 mm sterilized petriplate separately. Petriplate without amended fungicide was serve as control and 3 replications were kept for each treatment. Each plate was placed 5mm mycelia bit aseptically taken from seven-day old culture and incubated at $28+1^0$C. Average diameter of colony growth was recorded for each treatment. Fungicide which was most effective *in vitro* were taken for field management of Disease.

RESULTS

In-vitro evaluation of fungicides against *Rhizoctonia solani* causing sheath blight of Rice

Among different fungicides tested against mycelial growth inhibition with tebuconazole (25.9 EC) and trifloxystrobin + tebuconazole 75% WG (each @ 0.075, 0.1, and 0.15 %), difenoconazole 11.4 % SC (each @ 0.1 and 0.15 %) overcontrol. These were followed by Flusilazole 40 % + Carbendazim 37.5 % EC (91.48%), Azoxystrobin 23.0 % SC (88.52%) Kresoxim methyl 44.3% SC (88.14 %) and (each @ 0.15 % conc.) over untreated control. Averageper cent inhibition of mycelial growth recorded with fungicides tested was varied from 41.60 to 100.00 %. As a consequence, it was significantly highest and cent per cent mycelial growth inhibition with fungicidesTebuconazole 25.9 % EC and Trifloxystrobin + Tebuconazole 75% WG followed by Difenconazole 11.4 % SC (94.32%), Kresoxim methyl 44.3% SC (83.45%) and Carbendazim 12% + Mancozeb 63% WP (75.18 %) respectively.

Table 1: Fungicide used *in-vitro* evaluation against *Rhizotonia solani*

Treatmemt	Technical Name	Trade name	Manufacturer
T_1	Difenoconazole 11.4% SC	Concor	Katyayani organics Ltd.
T_2	Azoxystrobin 23% SC	Amistar	Syngenta India Pvt Ltd company
T_3	Tebuconazole 25.9% EC	Tebulla	Cistronics Pesticides Ltd,
T_4	Flusilazole 40% EC +Carbendazim37.5 EC	Lustre	Dhanuka Agritech Limited.
T_5	(Trifloxystrobin 50% + Tebuconazole 25%)75 WG	Nativo	Bayer Crop Science
T_6	(Carbendazim 12%+Mancozeb63%) 75Wp	Saaf	United Phosphorus Ltd.
T_7	Pencycuron 22.9% SC	Monceren	Bayer Crop Science
T_8	Kresoxim methyl 44.3% SC	Ergon	Tata Rallis India

DISCUSSION

In vitro evaluation of fungicides revealed that Difenconazole 11.4% SC (0.1 % and 0.15%), Tebuconazole 25.9% EC (0.075 %, 0.1 % and 0.15%) and Trifloxystrobin + Tebuconazole 75% WG (0.075 %, 0.1 % and 0.15%) displayed complete inhibition with 100 per cent inhibition of mycelial growth of *R. solani.* According to Sharma *et al.* (2024), different fungicides were tested in order to minimize sheath blight disease significantly. Percent

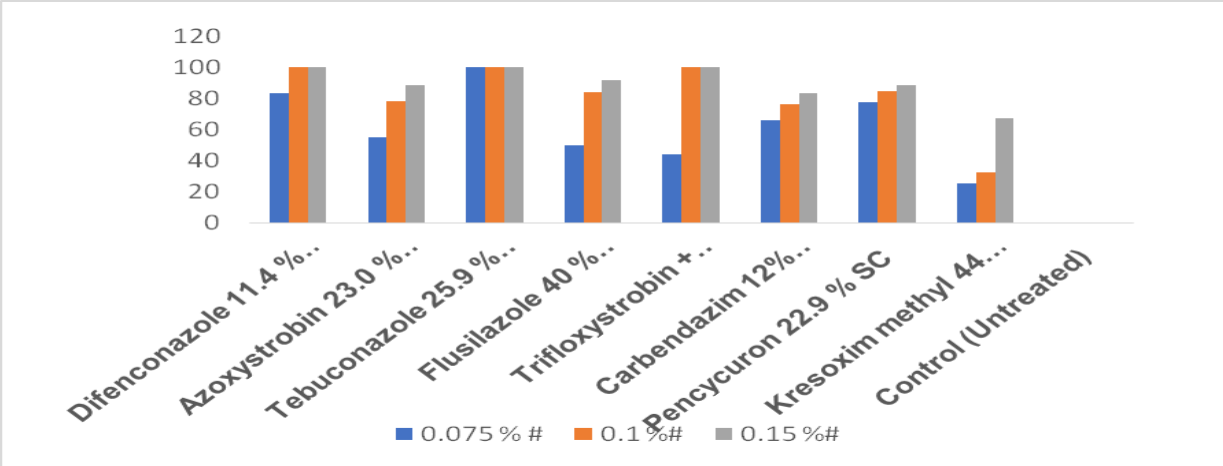


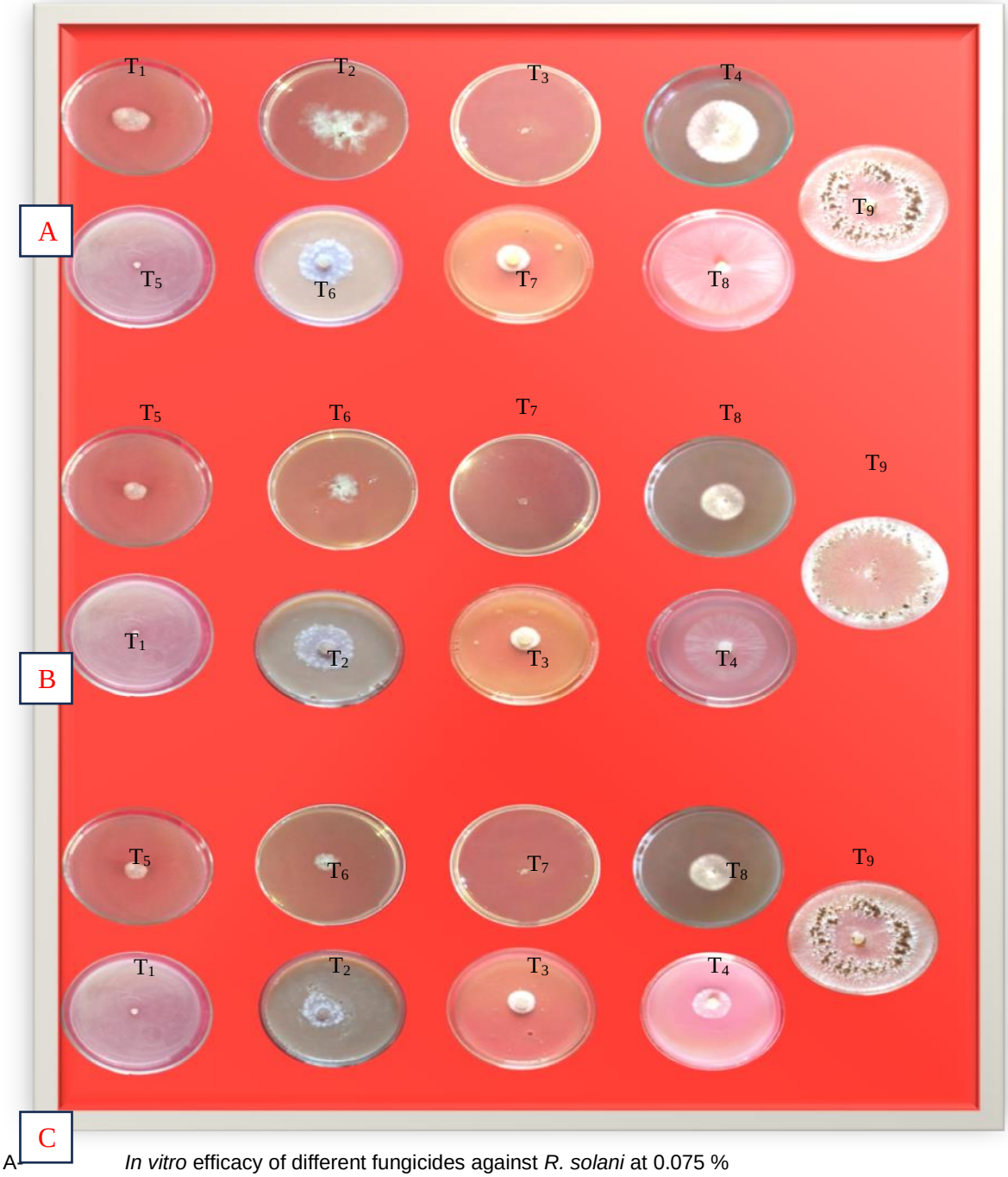
Fig 1: *In vitro* efficacy of different fungicides against *R. solani*causing sheath blight of rice

disease severity ranging from 11.16 to 34.85% with 53.1 to 67.9% reduction in PDI were exhibited in different treatments. Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) was found the best to lessened the PDI 67.9% followed by T_2 (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) and T_6 (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) were found prominent to minimize the PDI 65.8 and 61.6%, respectively.In concurrence with current study,Mohanty *et al.* (2020) tested six chemicals with different concentrations were evaluated *in vitro* against *Rhizoctonia solani* and revealed that, (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG and Hexaconazole 5% SC had the highest impact on mycelial growth inhibition (100%) at 200 ppm concentration followed by Propiconazole 25% EC (93.10%) and Azoxystrobin 25% EC (90.60%), Carbendazim 50% WP (87.60%) respectively.Mushineni *et al.* (2022) evaluated seven new generation chemical compounds against Sheath blight disease and elucidated that, Tebuconazole 50% + Trifloxystrobin 25% WG gave the lowest ED50 value (0.0054g/L) followed by the Hexaconazole 5%SC (0.005ml/L) and Propiconazole 25% EC (0.011ml/L).

Table 2: *In vitro* efficacy of different fungicides against *R. solani*

Sl. No	Fungicides	Colony Diameter* (mm)			Per cent inhibition		
		0.075%	0.1%	0.15%	0.075 %	0.1 %	0.15 %
T_1	Difenconazole 11.4 % SC	15.33	0.00	0.00	82.97 (65.66)	100.00 (90.00)	100.00 (90.00)
T_2	Azoxystrobin 23.0 % SC	40.67	19.67	10.33	54.81 (47.78)	78.14 (62.23)	88.52 (70.21)
T_3	Tebuconazole 25.9 % EC	0.00	0.00	0.00	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_4	Flusilazole 40 % + Carbendazim 37.5 % EC	45.33	14.67	7.67	49.63 (54.35)	83.70 (60.90)	91.48 (66.10)
T_5	Trifloxystrobin + Tebuconazole 75% WG	0.00	0.00	0.00	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_6	Carbendazim 12% + Mancozeb 63% WP #	30.67	21.33	15.00	65.92 (54.35)	76.30 (60.90)	83.33 (66.10)
T_7	Kresoxim methyl 44.3% SC	20.33	13.67	10.67	77.41 (61.71)	84.81 (67.17)	88.14 (69.90)
T_8	Pencycuron 22.9 % SC	67.33	60.67	29.67	25.19 (30.11)	32.59 (34.80)	67.03 (54.99)
T_9	Control (Untreated)	90.00	90.00	90.00	0.00	0.00	0.00
SE±		1.98	1.45	1.30	1.31	1.18	1.06
CD P=0.01%		5.96	5.90	5.27	5.33	4.79	4.35

**Mean of three replications; Carbendazim 12% +Mancozeb63% WP (each @ 0.1, 0.2 and 0.25 %)*



A- *In vitro* efficacy of different fungicides against *R. solani* at 0.075 %
B- *In vitro* efficacy of different fungicides against *R. solani* at 0.10 %
C- *In vitro* efficacy of different fungicides against *R. solani* at 0.15 %

CONCLUSION

The *in vitro* efficacy of different fungicides and bioagents, Difenconazole (0.1 % and 0.15%), Tebuconazole (0.075 %, 0.1 % and 0.15%) and Trifloxystrobin + Tebuconazole (0.075 %, 0.1 % and 0.15%) found highly prominent in inhibition of radial growth of the pathogen. Integrated management studies revealed minimum percent disease intensity intreatment of seed treatment with (Mancozeb 63 % WP + Carbendazim 12%) 75WP @ 2gm per kg seed + seedling dip with *Trichoderma harzianum* 10% + First spray of Tebuconozole + Trifloxystrobin 75WG 0.15 percent at maximum tillering to boot stage of crop as soon as the disease appears and second and third sprays 15 days of intervals .

Future Scope

Plant pathogens have the potential to cause significant crop losses in both pre and post harvest situations and fungicides remain a critical tool for protecting seed quality and significant increase crop productivity. Fungicides play a crucial impact on managing plant diseases caused by multiple fungal pathogens, which have the potential to cause considerable crop losses before harvest and after harvest in transit and storage as well.

ACKNOWLEDGEMENT

The authors express thanks to the ARS, Shirgaon, Ratnagiri, Maharashtra for conducting experimental trail and valuable suggestions for present research work. I would also like to extend my sincere thanks to the research guide and members of Advisory Committee.

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