Biological Forum – An International Journal **15(12): 278-281(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

In-vitro Evaluation of Fungicides against Sheath Blight (*Rhizoctonia solani*) Disease of Rice

Prabhat Kumar[1], Anupam Kumar[1*], Vinod Kumar[2], Rajan Kamboj[3], Ravinder[4], Shivani Kaundal[5], Sahil Chaudhary[1], Preeti Thakur[1], Neeraj Bhardwaj[1] and Ashish[1]

[1]Department of Plant Pathology, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.
[2]Department of Seed Science and Technology ANDUA&T, Kumarganj Ayodhya (Uttar Pradesh), India.
[3]Department of Entomology, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.
[4]Department of Soil Science, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.
[5]Department of Plant Physiology, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.

(Corresponding author: Anupam Kumar)*
(Received: 19 October 2023; Revised: 12 November 2023; Accepted: 23 November 2023; Published: 15 December 2023)
(Published by Research Trend)

ABSTRACT: Rice (*Oryza sativa*) is one of the major food crops of the world and is the staple food for more than half of the world's population. It is an important cereal crop of India, affected by various fungal, bacterial and viral diseases, Sheath blight of rice caused by *Rhizoctonia solani* has become a major constraint to rice production. In order to combat this menace, an assessment of three fungicides namely Mancozeb, Mancozeb + Carbendazim, and Propiconazole was conducted at concentrations of 100 ppm, 200 ppm, and 300 ppm. The evaluation involved monitoring radial growth after 24 hours, 48 hours, and 72 hours of incubation. The findings unequivocally established the efficacy of all tested fungicides, significantly surpassing the control group in inhibiting the radial growth of *R. solani*. Remarkably, maximum growth inhibition, reaching 100%, was consistently observed across all treatments at 24 and 48 hours. Notably, treatments T_1 through T_6, encompassing various concentrations (100 ppm, 200 ppm, and 300 ppm), exhibited complete growth inhibition. However, at 72 hours, Propiconazole (T_9) exhibiting a slightly lower growth inhibition of 95.45%, followed by T_8 (93.95%) and T_7 (92.50%), yet still show casing commendable efficacy. Overall, the study underscores the effectiveness of Mancozeb, Mancozeb + Carbendazim, and Propiconazole in combatting sheath blight in rice, with the latter two fungicides proving particularly potent in achieving complete inhibition of *R. solani* growth, even at varied concentrations, after 72 hours of exposure.

Keywords: Rice, *Rhizoctonia solani*, fungicides, inhibition and management.

INTRODUCTION

Rice (*Oryza sativa*), a consumable starchy cereal grain belonging to the Poaceae family, plays a pivotal role in global sustenance. Approximately half of the world's population, with a concentration in East and Southeast Asia, relies heavily on rice as a dietary staple. Notably, 96% of the global rice harvest caters to human consumption, with rice finding diverse culinary applications, including breakfast cereals, noodles, and the production of alcoholic beverages like Japanese sake. The cultivation of rice traces back around 8000 years to northeastern India and southern China. The preeminence of rice is underscored by over 90% of its global production and consumption occurring in key Asian nations such as India, China, Indonesia, Bangladesh, Vietnam, and Japan (Abdullah *et al.*, 2015).

Rice holds a substantial position in India's agricultural landscape, contributing approximately 45% to the country's cereal production and serving as the primary food source for over 60% of the population. In the global trade arena, India plays a notable role, accounting for approximately 20-25% of the world's rice transactions. The expansive cultivation of rice spans approximately 46 million hectares, yielding an impressive annual production of 135.75 million tonnes, as reported by the Ministry of Agriculture & Farmers Welfare 2023 (MAFW, 2023). Beyond being a crucial source of carbohydrates, rice contributes about 20% to the world's dietary energy supply. Additionally, it boasts significant protein content, with select varieties containing up to 10%, and offers a diverse array of essential vitamins and minerals, including iron and zinc.

The major rice production constraints in India are drought and submergence. Additionally, diseases such as bacterial blight, leaf blast, bakanae, brown spot, false smut, and stem rot pose significant economic threats to rice cultivation. Among these, sheath blight, attributed to the pathogen *Rhizoctonia solani*, stands out as the most critical affliction affecting rice crops. Addressing these production constraints and combatting prevalent

diseases are pivotal for sustaining and enhancing the productivity of rice cultivation in India.

Sheath blight, also known as 'leaf blight' of rice caused by *Rhizoctonia solani* Kuhn was first reported in Japan by Miyake (1910). Subsequently, its occurrence was recorded throughout the temperate and tropical rice growing areas including Africa, Bangladesh, Brazil, Burma, Colombia, China, Germany, Fiji, India, Indonesia, Iran, Korea, Liberia, Madagascar, Malaysia, Nigeria, Philippines, Russia, Sri Lanka, Taiwan, Thailand, UK, USA and Vietnam (Gangopadhyay and Chakrabarti 1982; Ou, 1985; Premalatha Dath, 1990; Dasgupta, 1992; Sivalingam *et al*., 2006).

In India sheath blight, first reported from Gurdaspur by Paracer and Chahal (1963), has become a major production constraint in Punjab, Haryana, Uttar Pradesh, Himachal Pradesh, Uttarakhand, Bihar, West Bengal, Odisha, Chhatisgarh, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Jammu and Kashmir, Madhya Pradesh, Assam, Manipur and Tripura (DRR, 2006-2010) due to wide spread cultivation of high yielding varieties with a narrow genetic base, heavy dependency on chemical fertilizers and apparent changes in climate.

The manifestation of sheath blight occurs during the tillering stage on the leaf sheath, presenting as elliptical or irregular greenish-grey spots, measuring 1-3 cm in length, with a distinctive brown margin situated at or above the water line. The accumulation of numerous such spots imparts a visual resemblance to snake skin. Under favourable conditions, the infection undergoes swift propagation, extending to the upper sections of the plant and adjacent plants through the dissemination of runner hyphae. This rapid progression culminates in the comprehensive demise of the affected leaf, tiller, and ultimately, the entire plant. Notably, infected plants often exhibit a discernible circular pattern colloquially termed as a 'bird's nest' (Hollier *et al*., 2009).

MATERIALS AND METHODS

A. Collection of disease samples, isolation and purification of pathogen (R. solani)

(i) Collection of disease sample. Rice plant showing symptoms of sheath blight disease were collected from the research farm of University. The collected disease specimen brought to the laboratory and examined and studied for the symptoms of the disease, isolation and purification of the pathogen.

(ii) Isolation of *Rhizoctonia solani.* The diseased samples were washed thoroughly with tap water. With the help of a sterilized scalpel blade, small portions of both healthy and diseased tissues were sliced into 0.5-1 cm under aseptic condition. To get rid of any remaining chemical, these pieces were surface sterilized using a solution of 1 per cent sodium hypochlorite for 1 minute, followed by 3 changes of sterilized water. The fragments were then aseptically transferred to petri plates filled with Potato Dextrose Agar (PDA) medium under aseptic condition with the help of sterilized forceps, where they were incubated at a temperature of 26±2°C in BOD incubator. The petri dishes were examined at regular intervals for fungal growth.

(iii) Purification. Approximately 15-20 ml of Potato Dextrose Agar (PDA) medium were added to each petri dish after a pinch of streptomycin sulphate was added to prevent unwelcome bacterial contamination. A small bit of mycelial growth was transplanted to solidified PDA on a petri dish from a recently isolated culture. The dishes were incubated in a BOD incubator at 26±2°C. There were enough transformations produced for further purification. The finally purified culture of the pathogen was used for further studies of cultural characteristic of *Rhizoctonia solani*.

B. In-vitro effect of different fungicides on the management of Rhizoctonia solani of rice

Efficacy of fungicides belonging from different groups were tested at 100, 200 and 300 ppm concentrations *in-vitro* for their efficacy to inhibit the growth of the pathogen to a maximum extent. Effect on the growth of *Rhizoctonia solani* was studied using poisoned food technique.

Potato dextrose agar (PDA) was prepared and 100 ml of the medium was taken in 250 ml of flasks and sterilized them. To the molten, cooled, sterile medium required quantity of fungicides were added separately and mixed thoroughly so as to get the required concentrations for each fungicide. Fifteen to twenty ml of poisoned medium was poured into each of 90 mm sterilized petri plate. After that 5 mm disc of mycelium of the pathogen was inoculated at the center of the plates. One checked control treatment is maintained without fungicide in PDA medium. Three replications were maintained for each treatment and plates were incubated at 26 ± 2 °C till the growth of the colony.

C. Observations recorded

The per cent inhibition of fungal pathogen was calculated after growth of pathogen in control plate by using formula (Vincent *et al*., 1947).

$$\text{Per cent of Inhibition } I = \frac{C - T}{C} \times 100$$

Where, I = Per cent inhibition of mycelium
C = Radial growth (mm) in control
T = Radial growth (mm) in treatment

RESULTS AND DISCUSSION

A. In vitro efficacy of fungicides at different concentration against Rhizoctonia solani

Laboratory experiments was conducted to evaluate the efficacy of three fungicides namely Mancozeb, Mancozeb + Carbendazim and Propiconazole. Three concentrations of each fungicides i.e. 100 ppm, 200 ppm and 300 ppm were tested against *Rhizoctonia solani*.

The results presented in Table 1, Fig. 1 and Plate (1, 2 and 3) revealed that all fungicides were found significantly superior over control inhibiting radial growth of *R. solani*. The maximum per cent growth inhibition (100 %) were recorded in all the treatments at 24 and 48 hours. Whereas, maximum percent growth inhibition (100 %) were recorded in T_1- Mancozeb, T_2, T_3, T_4, T_5. T_6 in 100, 200 and 300 ppm. Minimum per cent growth inhibition were recorded in T_9- Propiconazole (95.45 %) followed by T_8 (93.95 %) and

T_7 (92.50 %) at 72 hours, respectively. Similarly, Singh *et al.* (2018) reported the effect of the different fungicides in controlling sheath blight of rice. These fungicides were evaluated for the control of the pathogen at different stages of the plant growth while the control plots were left un-treated. *In vitro*, Azoxystrobin 23% SC was found most effective and showed 100 per cent inhibition of mycelial growth of *R. solani*, from 25 ppm. Jahan *et al*. (2014) tested eight fungicides against *Rhizoctonia oryzae-sativae*, the causal fungus of aggregate sheath spot disease of rice. Potato dextrose agar (PDA) was amended with the fungicides at 0.00, 0.25, 0.50, 1.00, 10.00 and 100.00 ppm. Amended PDA was poured into Petri dishes at 20 ml per dish and inoculated with mycelia blocks of *R. oryzae-sativae*. *Rhizoctonia oryzae-sativae* was found to be sensitive to all the fungicides tested.

Table 1: *In vitro* efficacy of fungicides at different concentration against *Rhizoctonia solani.*

Sr. No.	Treatments	Conc. (ppm)	24 Hours		48 Hours		72 Hours	
			Average Radial Growth (mm)	Inhibition %	Average Radial Growth (mm)	Inhibition %	Average Radial Growth (mm)	Inhibition %
1.	Mancozeb	100	0.00	100.00	0.00	100.00	0.00	100.00
2.	Mancozeb	200	0.00	100.00	0.00	100.00	0.00	100.00
3.	Mancozeb	300	0.00	100.00	0.00	100.00	0.00	100.00
4.	Mancozeb + Carbendazim	100	0.00	100.00	0.00	100.00	0.00	100.00
5.	Mancozeb + Carbendazim	200	0.00	100.00	0.00	100.00	0.00	100.00
6.	Mancozeb + Carbendazim	300	0.00	100.00	0.00	100.00	0.00	100.00
7.	Propiconazole	100	0.00	100.00	0.00	100.00	3.33	92.50
8.	Propiconazole	200	0.00	100.00	0.00	100.00	2.66	93.95
9.	Propiconazole	300	0.00	100.00	0.00	100.00	2.00	95.45
10.	Control		10.00		20.00		44.00	
	CD (At 5% level)		0.163		0.325		0.833	
	SE (m)		0.055		0.110		0.280	

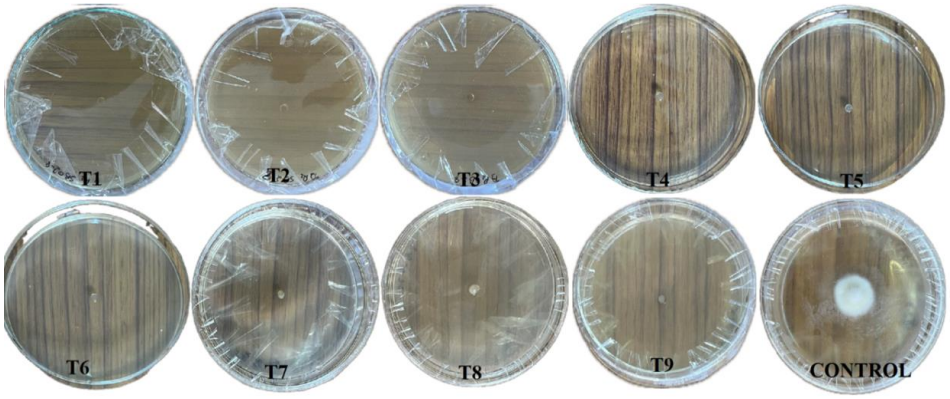

Plate 1. Effect of fungicides on the radial growth of *R. solani* after 24 hours.

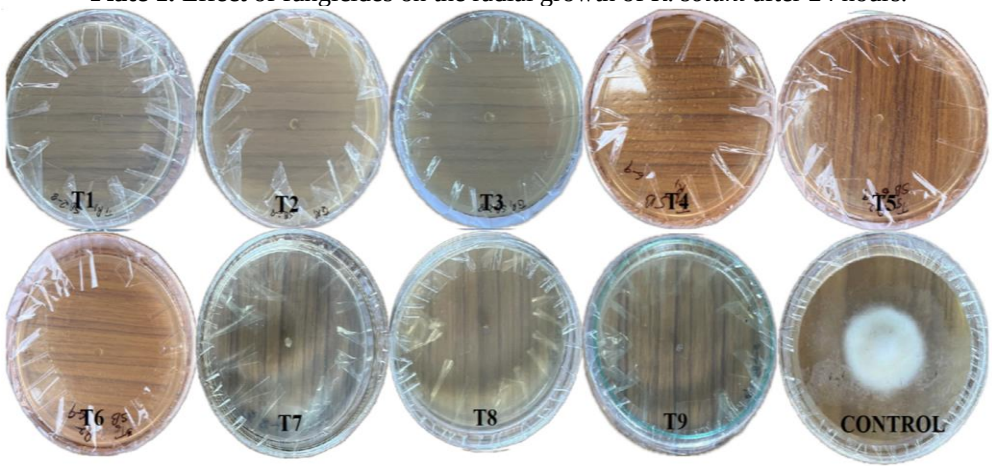

Plate 2. Effect of fungicides on the radial growth of *R. solani* after 48 hours.

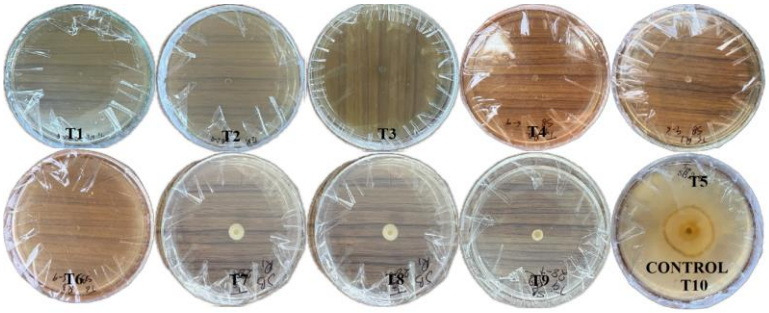

Plate 3. Effect of fungicides on the radial growth of *R. solani* after 72 hours.

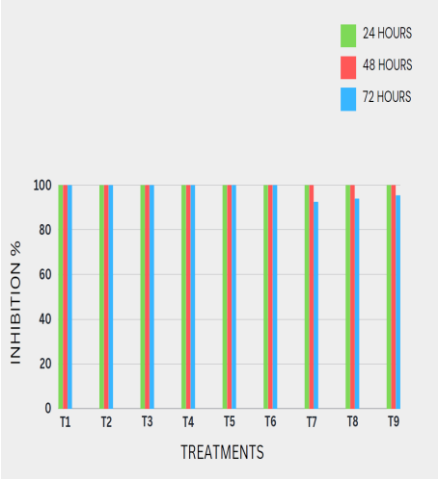

Fig. 1. *In vitro* efficacy of fungicides at different concentration against *R. solani*.

CONCLUSIONS

It was observed that Mancozeb and Mancozeb + Carbendazim were found most effective resulting complete inhibition of growth of *Rhizoctonia solani* at all concentration while Propiconazole showed least radial growth after 72 hours.

Acknowledgment. The authors wish to thanks HOD, Department of Plant Pathology, School of agriculture, Abhilashi University Mandi H.P. 175028, for providing need based facilities conducting this research work.

REFERENCES

Abdullah, A. A., Hajime, K. H., Ichizen, M. I. and Shoichi, I. T. O. S. (2015). World rice demand towards 2050: impact of decreasing demand of per capita rice consumption for China and India. Research Gate p.1-18.

Dasgupta, M. K. (1992). Rice sheath blight: The challenge continues. In: Plant Diseases of International Importance: Diseases of Cereals and Pulses. New India Publishing Agency pp115.

DRR (2006-2010). Progress Report, 2005-2009, Vol. 2, Crop Protection, Entomology and Pathology, All India Coordinated Rice Improvement Project, ICAR, DRR, Rajendranagar, Hyderabad, Andhra Pradesh, India.

Gangopadhyay, S. and Chakrabarti, N. K. (1982). Sheath blight of rice. *Rev- PL. Patho*, *61*, 451-460.

Hollier, C. A., Rush, M. C. and Groth, D. E. (2009). Sheath blight of rice *Thanetophorus cucumeris* (A.B. Frank) Donk *Rhizoctonia solani* Kuhn). Louisiana Plant Pathology Disease Identification and Management Series Publication, p 3123.

Jahan, S. B., Ali, M. A., Alam, S., Moni, Z. R. and Mian, M. S. (2014). Evaluation of Fungicides against *Rhizoctonia Oryzae-Sativae*, The causal fungus of aggregate shedath spot of rice. *Bangladesh J. Plant Pathol.*, *30*(1&2).

MAFW. (2023). Ministry of Agriculture & Farmers Welfare. Final estimates of production of major crops released for the year 2022-23.

Miyake, I. (1910). Studien uber die Pilze der Reispflanze in Japan. *Journal of the College of Agriculture, Imperial Univrsity of Tokyo*, *2*, 237-276.

Ou, S. H. (1985). Rice Diseases. 2nd Edn. Commonwealth Mycological Institute, Kew, Surrey, U.K. pp 272-286.

Paracer, C. S. and Chahal, D. S. (1963). Sheath blight of Rice caused by *Rhizoctonia solani* Kuhn-a new record in India. *Current Science*, *32*(7), 328-329.

Premalatha Dath, A. (1990). Sheath Blight of Rice and its Management. Associated Publishing Co., Shidipura, Karol Bagh, New Delhi, pp 129.

Singh, O., Mahantesh, Vishwanath and Singh D. (2018). Efficacy of fungicides for the management of Sheath Blight of rice. *Chem Sci Rev Lett*., *7*(27), 714-718.

Sivalingam, P. N., Vishwakarma, S. N. and Singh, U. S. (2006). Role of seed-borne inoculum of *Rhizoctonia solani* in sheath blight of rice. *Indian Phytopath*, *59*, 445-452.

Vincent, J. M. (1947). Distortion of fungal hypha in presence of certain inhibitors. *Nature*, pp-196-596.

How to cite this article: Prabhat Kumar, Anupam Kumar, Vinod Kumar, Rajan Kamboj, Ravinder, Shivani Kaundal, Sahil Chaudhary, Preeti Thakur, Neeraj Bhardwaj and Ashish (2023). *In-vitro* evaluation of Fungicides against Sheath Blight (*Rhizoctonia solani*) Disease of Rice. *Biological Forum – An International Journal*, *15*(12): 278-281.