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EVALUATION OF BOTANICALS, BIO CONTROL AGENTS AND FUNGICIDES UNDER *IN VITRO* CONDITIONS AGAINST RICE SHEATH BLIGHT CAUSING PATHOGEN *Rhizoctonia solani* KÜHN

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ABSTRACT

Sheath blight of rice caused by *Rhizoctonia solani* Kühn is one the important disease of rice crop. The pathogen can survive in high temperatures and can cause huge yield losses. Effective management of the pathogen plays a crucial role in increasing the yield and productivity. The present study has evaluated different botanicals, bio control agents and fungicides against *R. solani* under *in vitro* conditions. Among different botanicals tested garlic has exhibited highest inhibition of 60% and 71.85% at 5% and 10% concentration, respectively. Turmeric was least effective with an inhibition percentage of 4.81% and 23.07%. *Trichoderma* isolate T-4 (54.80%) was found effective in controlling the growth of pathogen. Whereas *Pseudomonas* isolate P-9704 has reduced growth of mycelium by 50.37%. The combination fungicide Tebuconazole 50% + Trifloxystrobin 25% WG has shown an inhibition of 88.52% at 50 ppm concentration and Mancozeb 75% WP (78.15%) was less effective at the same concentration. At 100 ppm concentration all fungicides except Mancozeb 75% WP (87.41%) has exhibited 100% inhibition.

Key words : Rice, Sheath blight, *Rhizoctonia solani*, Botanicals, Bio control agents, Fungicides.

Introduction

Rice (*Oryza sativa* L.), belongs to Poaceae, serves as the critical staple crop for almost half of the world's population (Raman, 2021). In Asia, rice crop ensures food security, which accounts an area of almost 92% of world's rice cultivation (Wanasundara *et al*., 2024). During 2024-25, Rice production in India was 150.18 million tonnes in an area of 51.26 million hectares, which made it to become leading rice producer by surpassing China (Government of India, 2025). Decline in global rice production was accounted by both biotic and abiotic stresses, among them abiotic factors cause 10 to 15% yield loss and biotic factors like pathogens and insect pests cause 37.4% total yield loss (Savary *et al*., 2019).

Among diseases of rice, Sheath blight has emerged as one of the major important disease after blast. Under ideal conditions yield losses due to Sheath blight range from 10 to 50% (Zhang *et al*., 2019). Rice Sheath blight is caused by *Rhizoctonia solani* Kühn (Teleomorph: *Thanetophorus cucumeris* (Frank) Donk). Sheath blight was documented for the first time by Miyake in Japan in 1910 and in India, it was first reported by Paracer and Chahal in 1963 in Gurdaspur district of Punjab. The disease will appear as small water soaked lesions which later develop into grayish white spots with dark margins (Mohapatra *et al*., 2025). High temperatures of 30-33°C, high relative humidity and warm nights, favours the spread of the disease (Kasniya *et al*., 2025).

Currently, management of the disease mainly relied on the spraying of fungicides. Continuous use of the chemicals deteriorates the environment and the pathogen will slowly start developing resistance. In order to control the disease along with the fungicide spray, management should also include usage of botanicals and biocontrol agents, which are nature friendly (Jamali *et al*., 2020). Although, the effect of these bio agents is slow, when combined with the other cultural practices they can show better results.

Materials and Methods

Collection of samples

Samples of rice plants showing typical sheath blight symptoms were collected from the fields of College of Agriculture, IGKV, Raipur, Chhattisgarh, India.

Isolation of *Rhizoctonia solani* from the infected samples

For isolation of the pathogen, the infected samples showing typical symptoms collected, were washed thoroughly with running tap water to remove any dust and debris. Then the infected plant part along with the healthy plant tissues were cut into 0.5 cm using sterile scalpel. These tissues were placed in 0.1% sodium hypochlorite for almost 1 min and then rinsed in sterile distilled water for three times to make them free of the chemical. After drying on blotting paper, the tissues were transferred onto petri plate with Potato Dextrose Agar (PDA). Petri plates were incubated in BOD incubator at 28± 2°C. Plates were observed at regular intervals for the growth of the pathogen.

Preparation of botanical extracts

Fresh leaves, bulb and rhizomes of test botanicals were washed thoroughly and grinded in mortar and pestle with sterile distilled water. The crude homogenate was filtered through double layered muslin cloth to obtain crude extract.

Evaluation of botanicals, biocontrol agents and fungicides under *in vitro* conditions against *R. solani*

In vitro evaluation of botanicals and fungicides was conducted through poisoned food technique and the evaluation of biocontrol agents by dual culture technique. The experiment was done in Completely Randomized Design (CRD).

Eight different botanicals viz. leaves of Neem, Datura and Karanj, rhizome of Turmeric and Ginger, cloves of Garlic, bulb of Onion and fruit of Chilli were tested against *R. solani* in three replications at 5% and 10% concentrations. Extracts of botanicals was taken in required quantities *i.e.*; 5ml and 10ml and added to 95ml and 90ml of PDA, respectively. 20 ml of this media is poured into each petri plate.

Biocontrol agents *Trichoderma* and *Pseudomonas* were evaluated against *R. solani*. Five isolates of *Trichoderma i.e.*; T-4, T-5, T-9, T-14 and T-97, isolated from different locations of Chhattisgarh and one isolate of *Pseudomonas fluorescens*, P-9704 were tested in the study. Dual culture technique was used to study effect against the pathogen. 7 days old culture of *R. solani* was inoculated at one side of the plate and the culture of *Trichoderma* was inoculated on opposite side. For *Pseudomonas* isolate, funnel ring method was used.

Five different fungicides were assessed against *R. solani*. The tested fungicides were Thiophanate methyl 12% + Mancozeb 64% WP, Mancozeb 75% WP, Thiophanate methyl 70% WP, Carendazim 12% + Mancozeb 63% WP, Tebuconazole 50% + Trifloxystrobin 25% WG at 50 ppm and 100ppm in three replications. The required quantities of fungicides were mixed in the PDA media and 20 ml of this media was poured into each petri plate.

Mycelial growth was recorded and the efficacy of the agents were determined by calculating percentage inhibition using the formula given by Vincent (1974):

$$\text{Percent inhibition} = \frac{C - T}{T} \times 100$$

Where,

C = Colony growth in control

T = Colony growth in treatment

Statistical analysis

Data obtained from the experiment was subjected to Analysis of variance (ANOVA) using CRD model. Treatment means of all treatments were compared to each other to know their efficacy in managing the growth of the pathogen, *R. solani*.

Results and Discussion

Evaluation of botanicals against *R. solani*under *in vitro* conditions through poisoned food technique

Among different botanicals evaluated Garlic has exhibited maximum inhibition of 60% and 71.85% at both 5% and 10% concentration, respectively. At 5% concentration, Garlic was followed by Ginger (41.85%), Neem (41.11%), Onion (36.85%), Karanj (27.03%), chilli (24.44%) and Datura (24.33%). At 10% concentration, Garlic was followed by Ginger (54.07%), Karanj (47.77%), Onion (47.40%), Neem (41.85%), Chilli (39.25%) and Datura (36.85%). At both concentrations, turmeric was less effective compared to other botanicals against *R. solani*.

Studies conducted by Kumar *et al*. (2017) and Sharma *et al*. (2018) has also showed that garlic was highly effective and it was followed by ginger which was effective against management of *R. solani*. Findings of the study were also in agreement with Yadav *et al*. (2021).

Evaluation of biocontrol agents against *R. solani* under *in vitro* conditions through dual culture technique

Table 1 : Evaluation of different botanicals against *R. solani* at different concentrations under *in vitro* conditions through poisoned food technique.

Treatment No.	Botanical	Scientific name	Concentration of botanical			
			5 %		10 %	
			Mycelial Growth (mm)	Percent inhibition of growth	Mycelial Growth (mm)	Percent inhibition of growth
T_1	Neem	*Azadhiracta indica*	53.00	41.11	52.33	41.85
T_2	Turmeric	*Curcuma longa*	85.67	4.814	68.67	23.07
T_3	Garlic	*Allium sativum*	36.00	60.00	25.33	71.85
T_4	Ginger	*Zingiber officinalis*	52.33	41.85	41.33	54.07
T_5	Onion	*Allium cepa*	56.83	36.85	47.33	47.40
T_6	Chilli	*Capsicum annuum*	68.00	24.44	54.67	39.25
T_7	Karanj	*Millettia pinnata*	65.67	27.03	47.00	47.77
T_8	Datura	*Datura stramonium*	68.33	24.33	56.83	36.85
T_9	Control		90.00	-	90.00	-
	CD (1%)		**3.70**		**3.01**	
	SE (m)		**0.91**		**0.74**	

Table 2 : Evaluation of bio control agents against *R. solani* under *in vitro* conditions through dual culture technique.

S. no.	Treatments		Mycelial growth (mm)	Percent inhibition of growth
	Code	Place of isolation		
1	T-4	Raigarh	**40.66**	54.82
2	T-5	Kondagaon (Makdii)	45.00	50.00
3	T-9	Pathalgaon	41.33	54.07
4	T-14	Balod (Fundni)	41.00	54.44
5	T-97	Raipur (*Trichoderma harzianum*)	49.33	45.18
6	P-9704	*Pseudomonas fluorescens*	44.66	50.37
7	Control		90.00	-
	CD (1%)		**3.35**	
	SE (m)±		**0.79**	

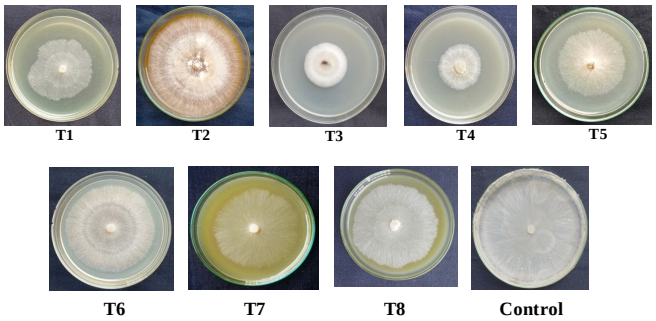


Plate 1 : Evaluation of different botanicals against *R. solani* at 5% concentration under *in vitro* conditions through poisoned food technique.

Among different isolates of *Trichoderma* evaluated, highest inhibition of mycelium growth was observed in T-4 (54.82%), it is at par with the isolates T-14 and T-9, which has shown 54.44% and 54.07% inhibition. Isolate T-5 has shown 50.00% inhibition, followed by isolate T-97 with inhibition percentage of 45.18. The *Pseudomonas* isolate P-9704 has recorded 50.37% inhibition. The results of present study are comparable with the findings of Yadav *et al*. (2024) and Usendi *et al*. (2020). Both the experiments have already shown that *Trichoderma* isolates are highly effective against management of *Rhizoctonia solani* compared to other bio control agents like *Pseudomonas* and *Bacillus*.

Evaluation of fungicides against *R. solani* under *in vitro* conditions through poisoned food technique

Among five different fungicides evaluated, at 50 ppm, Tebuconazole 50% + Trifloxystrobin 25% WG has

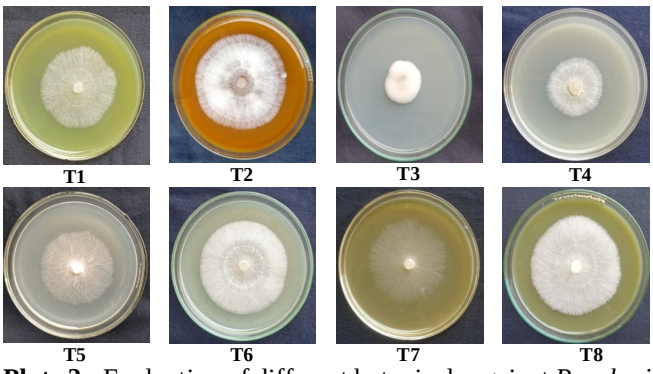


Plate 2 : Evaluation of different botanicals against *R. solani* at 10% concentration under *in vitro* conditions through poisoned food technique.

Table 3 : Evaluation of fungicides against *R. solani* under *in vitro* conditions through poisoned food technique.

S. no.	Treatment Description	Mycelial growth (mm)		Percent inhibition of growth	
		50ppm	100ppm	50ppm	100ppm
1.	Thiophanate methyl 12% + Mancozeb 64% WP	13.00	0	85.55	100
2.	Mancozeb 75% WP	19.66	11.33	78.15	87.41
3.	Thiophanate methyl 70% WP	16.33	0	81.85	100
4.	Carendazim12% + Mancozeb 63% WP	13.66	0	84.82	100
5.	Tebuconazole50% + Trifloxystrobin 25% WG	10.33	0	88.52	100
6.	Control	90.00	90.00	-	-
	CD (1%)	**3.42**	**1.55**		
	SE (m)	**0.79**	**0.36**		

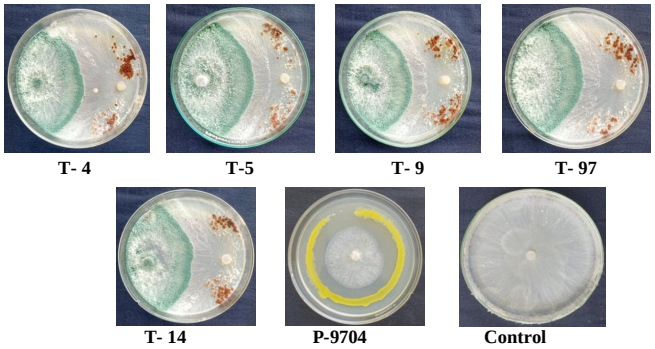


Plate 3 : Evaluation of bio control agents against *R. solani* under *in vitro* conditions through dual culture technique.

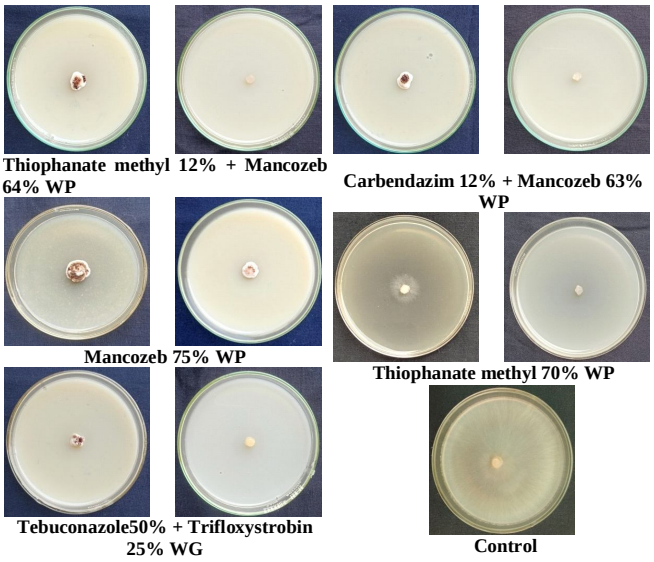


Plate 4 : Evaluation of fungicides under *in vitro* conditions against *R. solani* through poisoned food technique.

exhibited maximum inhibition of the pathogen *i.e.*; 88.52%. It was followed by Thiophanate methyl 12% + Mancozeb 64% WP (85.55%), Carbendazim 12% + Mancozeb 63% WP (84.83%), Thiophanate methyl 70% WP (81.85%). Mancozeb 75% WP being the less effective compared to other chemicals with an inhibition percentage of 78.15%. At 100 ppm concentration, all the test fungicides have shown 100% inhibition except Mancozeb 75% WP which has shown 87.41% inhibition of *R. solani*.

Pawar *et al*. (2024) has reported that both Tebuconazole 25.9% EC and the combination product Tebuconazole 50% + Trifloxystrobin 25% WG has recorded 100% inhibition of the pathogen and Carbendazim 12% + Mancozeb 63% WP was least effective. Studies of Mohanty *et al*. (2020) has assessed that Tebuconazole 25% + Trifloxystrobin 50% WG was highly effective and Carbendazim 50% WP was less effective among the fungicides tested under that study.

Conclusion

This study was conducted to demonstrate the effect of different botanicals, bio control agents and fungicides against the sheath blight causing pathogen *Rhizoctonia solani* under *in vitro* conditions. Among different botanicals evaluated garlic and ginger has outperformed other botanicals and effectively managed the growth of the pathogen and turmeric has produced least effect. *Trichoderma* isolates were found superior to the *Pseudomonas* isolate P-9704 in controlling the growth of *R. solani*. Among different fungicides tested Tebuconazole 50% + Trifloxystrobin 25% WG has recorded highest inhibition percentage and Mancozeb 75% WP being less effective compared to other fungicides evaluated. As botanicals, biocontrol agents and fungicides have shown significant effect on the growth of *R. solani*, they can be evaluated in field conditions and can be an important practice for the management of the disease, sheath blight of rice.

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