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In vitro EFFICACY OF BOTANICALS, COW-BASED NATURAL PRODUCTS AND SOIL AMENDMENT AGAINST *Rhizoctonia solani* CAUSING BANDED LEAF AND SHEATH BLIGHT (BLSB) IN LITTLE MILLET

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ABSTRACT

Little millet (*Panicum sumatrense*) is an important minor millet crop that originated in India and is grown mainly as a food for humans and as fodder for cattle. Banded leaf and sheath blight (BLSB) caused by *Rhizoctonia solani* (Teleomorph: *Thanetophorus cucumeris*) is one of the major menaces in the successful cultivation of little millet. Management of the disease through synthetic chemicals can lead to the development of resistant strains, residual toxicity. Eco-friendly practices can effectively reduce disease incidence and crop losses. In this study, *in vitro* evaluation of different botanicals, cow based organic compounds and soil amendments were evaluated against *R. solani*. Among the treatments against *R. solani*, panchagavya completely inhibited fungal growth at all concentrations (100%), comparable to propiconazole (0.1%), which also inhibited 100%, followed by garlic extract, which showed high efficacy with 86.40% mean inhibition and complete inhibition at 10% and 15% concentrations. Least inhibition was recorded with cow urine (6.40%).
***Keywords* :** Banded blight, Botanicals, Panchagavya and *Rhizoctonia solani*.

Introduction

Millets are the oldest food crops known to humans, with origins dating back 4000 years (Changmei and Dorothy, 2014). They are often referred to as “wonder cereals” and are resilient orphan crops that survive in adverse climatic conditions (Kishore *et al.*, 2025). Millets are a rich source of various nutrients, provide substantial health benefits, and play an important role in enhancing global food and nutritional security, particularly in developing regions (Barretto *et al*., 2021). Among the small millets, little millet (*Panicum sumatrense*), a member of the *Poaceae* (Graminae) family, is self-pollinated and chasmogamous (Nandini *et al*., 2019). It is originated in India and grown as an annual minor millet crop in Indonesia, Myanmar, and the semi-arid and hilly regions of India and Pakistan (Indirani *et al*., 2021). Little millet is rich in Proteins, dietary fiber, healthy fats, and minerals, including calcium, zinc, magnesium, phosphorus and potassium which are mostly required for human health (Vetriventhan *et al.*, 2020; Kumari *et al*., 2025). The little millet contains 8.7 grams of protein, 75.7 grams of carbohydrate, 5.3 grams of fat and 1.7 grams of minerals per 100 grams. Little millet is a rich source of complex carbohydrates, antioxidants and phenolic compounds, helping to prevent metabolic disorders such as diabetes, cancer, oxidative stress and obesity (Kumar *et al.*, 2018).

Banded leaf and sheath blight (BLSB) caused by *Rhizoctonia solani* (Teleomorph: *Thanetophorus cucumeris*) (Plate 2) is one of the major menaces in the successful cultivation of little millet, which causes significant yield loss and reduces grain quality. The disease is characterized by copper or brown bands across leaves, producing banded appearance (Patro *et al*., 2018) (Plate 1). These lesions enlarge rapidly and coalesce, covering large portions of the leaf sheath and lamina (Patro and Madhuri, 2014; Nagaraja *et al*., 2007). *R. solani* (Teleomorph: *Thanetophorus cucumeris*) is one of the most widespread, destructive and versatile pathogens found in most parts of the world and infects a vast range of host plants, causing seed decay, damping off, stem canker, root rot, aerial blight, and seed or cob decay (Ogoshi, 1987). Disease development is favoured by low light, overcast conditions, high temperatures, and high relative humidity (Ou, 1985). The pathogen persists in soil through infected plant debris and survives unfavourable conditions by forming survival structure known as sclerotia (Bashyal *et al*., 2021). The recorded yield losses in little millet crop due to BLSB is 40.23–64.07% 1.8 to 8.2 on the severity scale (Palanna *et al*., 2021). Management of BLSB is becoming a very big challenge due to its wide host range, ecological adaptability, and high sclerotial survival under diverse environmental conditions. However, integrated disease management strategies including botanicals, cow-based natural products, biological control agents, resistant cultivars, and other eco-friendly practices can effectively reduce disease incidence and crop losses.

Management through systemic fungicides such as hexaconazole, propiconazole, and carbendazim has been reported to be effective against the disease (Tiwari and Das, 2011; Kumar *et al*., 2017). However, extensive use of synthetic chemicals can lead to the development of resistant strains, residual toxicity, and potential carcinogenic risks, posing harmful effects on humans and animals. In view of increasing emphasis on sustainable agriculture, plant-derived extracts and cow-based products are being investigated as eco-friendly alternatives for disease management (Tamuli, 2014).

Plate 1 : Disease symptoms

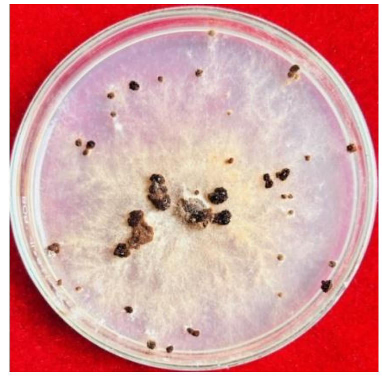

Plate 2 : *R.solani* pure culture

Materials and Methods

The present study was carried out at Agricultural Research Station, ANGRAU, Vizianagaram, Andhra Pradesh during *kharif* 2023-2024. The sensitivity of *Rhizoctonia solani* to different botanicals, cow-based natural products and soil amendments was assayed using the poisoned food technique described by Grover and Moore (1962). The experiment was conducted with three replications for each treatment, and the data were analyzed using a factorial Completely Randomized Design (CRD). Details of the treatments are presented in the table 1.

Table 1: List of different products and their concentrations used against *R. solani*

Treatments	Compounds	Concentrations
T_1	Karanj oil	5%,10% and 15%
T_2	Garlic	5%,10% and 15%
T_3	Cow urine	5%, 10% and 15%
T_4	Neem cake	5%,10% and 15%
T_5	Neem oil	5%,10% and 15%
T_6	Panchagavya	5%, 10% and 15%
T_7	Propiconazole	0.1%, 0.05 %and 0.025%
T_8	Control	-

Method of Preparation of Different Compounds

Preparation of panchagavya: Added cow dung (7 kg), cow ghee (1 kg), cow urine (3 lit) and water (10 lit) into a plastic tub. Mix it thoroughly, incubate for 2 days to ferment and stir properly in the morning and evening daily for a week. For better microbial activity, add jaggery (3 kg), Cow milk (3 lit), Cow curd (2 lit), Tender coconut water (3 lit) and 12 Well-ripened bananas and leave it for two to three weeks (Chadha *et al*., 2012).

Preparation of garlic extract: Fresh and healthy garlic cloves were collected from healthy plants, washed thoroughly in running water and dipped in 1% sodium hypochlorite solution for 1 min. The cloves were washed with distilled water to rinse the sodium hypochlorite solution from the material. Cloves of 100 gm were ground separately with 100 ml of distilled water by using a pestle and mortar; the macerate was filtered through a muslin cloth to get the crude extract (Tiwari *et al*., 2023).

Preparation of soil amendment solution: The neem cake was dried at room temperature for 3-4 days, broken into small pieces, ground thoroughly with a mortar and pestle, and soaked in sterilized water at a 1:2 (W/V) ratio. After 24 h, the hydrated cake was squeezed through four folds of sterilized muslin cloth and the oil cake extract was collected and centrifuged at 5000 rpm for 10 min. The supernatant was filtered through bacterial-proof filters and decanted into a 250 ml conical flask. The extract was prepared using the method described by Bhadrasree (2007).

Panchagavya, cow urine, garlic extract, plant oils and soil amendment (neem cake) were evaluated at 5%, 10% and 15%. The extracts were filtered through a double-layered muslin cloth into a beaker, and the collected filtrate was considered as the 100 per cent concentration of the extract. The liquid extract was then transferred into 15 ml vials and centrifuged in a cooling centrifuge at 5000 rpm for 10 min. Subsequently, the supernatant was collected and used for further experimentation. Fungicide propiconazole 25 EC was used as a check at 0.1, 0.05 and 0.025%. For the poisoned food technique, the poisoned PDA medium was poured into sterile petri plates (90 mm diameter) for different treatments, and un amended medium poured into the sterile Petri plate (90 mm) with the pathogen at the centre served as the control. From a seven-day-old pure culture of *Rhizoctonia solani*, 5 mm mycelial discs were cut using a cork borer and placed at the centre of the poured Petri plates. The plates were then incubated in a BOD incubator at 28 ± 2 °C for three days. Observations were recorded when the control plate was fully covered with *R. solani*. Mycelial growth of the fungus was recorded at 24, 48, and 72 hours after inoculation. Percentage inhibition in colony growth was recorded as per Vincent (1947).

Observations on radial growth of the pathogen were recorded, and the percentage inhibition of the growth of the pathogen over the control was calculated using the following formula:

$$\text{Growth Inhibition}(\%) = \frac{(C - T)}{C} \times 100$$

Where

I = Per cent inhibition of mycelial growth

C = Radial mycelial growth of *Rhizoctonia solani* in control

T = Radial *mycelial* growth of *Rhizoctonia solani* in treatment

Results and Discussion

The efficacy of different botanicals and cow-based products and soil amendment against *R. solani* was evaluated *in vitro* after four days of inoculation. The results revealed that all the tested treatments showed significant variations and reduced the radial growth of *R. solani* compared with the untreated control. The control recorded a colony diameter of 8.03 cm, indicating maximal pathogen growth, whereas the fungicidal check, propiconazole at 0.1%, completely inhibited fungal growth (0.00 cm). Various concentrations of different treatments were evaluated against *R. solani* using the poisoned food technique (Table 2; Plate3; Figure 1).

The efficacy of different botanicals and cow-based natural products at three concentrations (5, 10 and 15%) against the radial growth of *Rhizoctonia solani* was evaluated *in vitro* four days after inoculation. Among all the treatments, panchagavya exhibited complete inhibition of fungal growth at all concentrations (5%, 10%, and 15%), recording 100% inhibition with no colony diameter, which was on par with the chemical check, Propiconazole (0.1%). The results are presented in (Table 2; Figure 1).

The results revealed significant differences among treatments in inhibiting *R. solani.* Panchagavya completely inhibited fungal growth at all concentrations (100% inhibition), comparable to propiconazole (0.1%). Garlic extract showed high efficacy with 86.40% mean inhibition and complete inhibition at 10% and 15% concentrations. Neem cake (70.88%) and neem oil (68.03%) also exhibited considerable antifungal activity. In contrast, karanj oil (14.43%) and cow urine (6.40%) were less effective. The untreated control recorded maximum colony growth (9.00 cm). Overall, panchagavya and garlic extract are highly effective in inhibiting *R. solani*, followed by neem-based products, suggesting their potential as eco-friendly alternatives to chemical fungicides (Plate 3).

These findings are supported by Karthika *et al*. (2017) who reported complete inhibition of *R. solani* mycelial growth at a 5% concentration of Panchagavya. These results were similar to the findings of Pandya *et al.* (2024) who evaluated *in vitro* efficacy of panchagavya on rice crop caused by *Rhizoctonia solani* where panchagavya was found to be most effective in suppressing the mycelial growth of *R. solani*. According to Toorray *et al*. (2019), garlic extract, neem extract, and panchagavya were reported to be the most effective treatments against *Rhizoctonia solani*. Punam *et al.* (2020) evaluated six botanical extracts against *R. Solani* and found that complete inhibition of fungal mycelium was observed with garlic bulb extract, which was significantly superior to the remaining treatments.

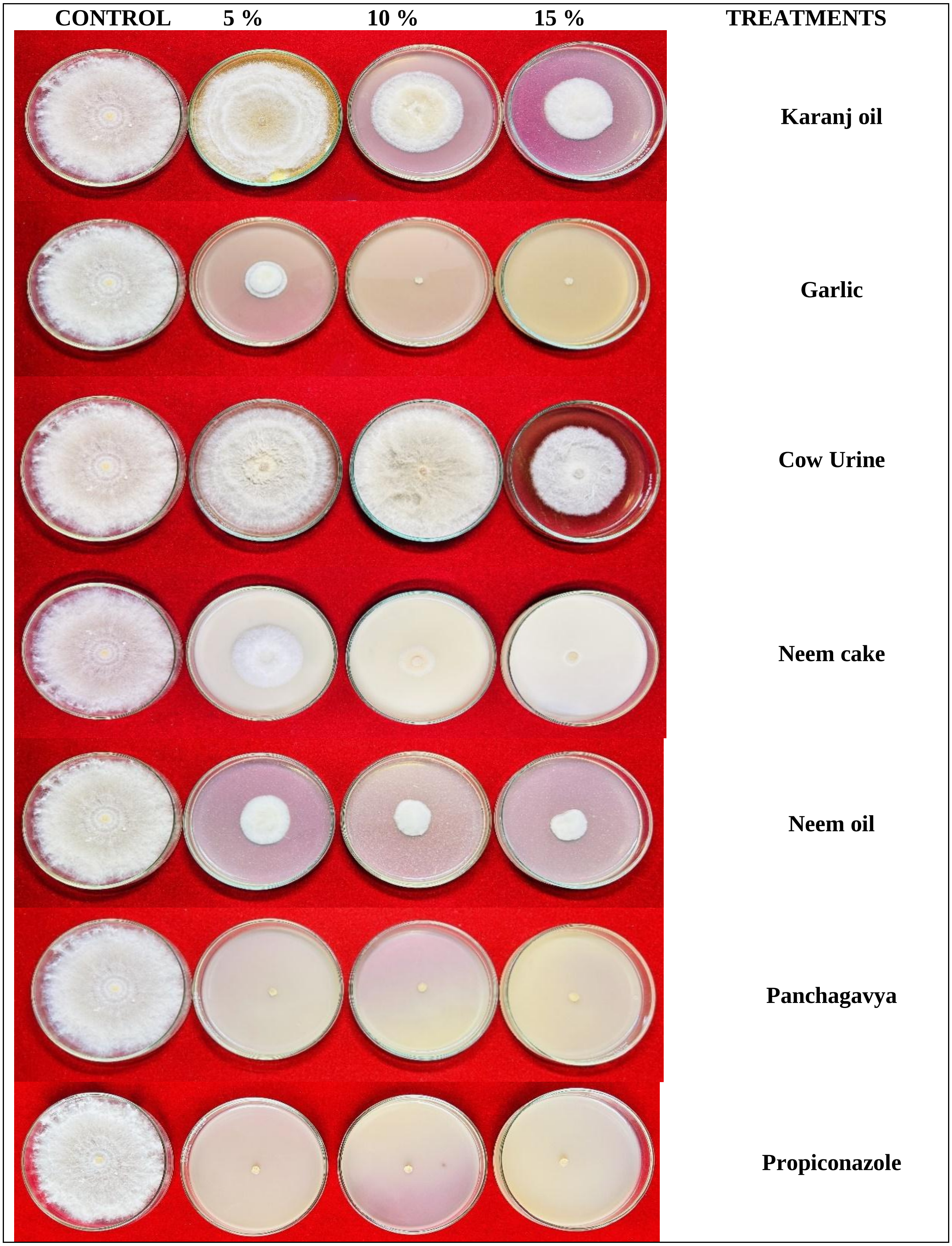

Plate 3: Bio-efficacy of botanicals and cow-based natural products against *R. solani*

Table 2 : Evaluation of Botanicals and Cow Natural products at different concentrations on radial growth at 60 hrs of *R. solani in vitro*

S. No	Treatments/ Concentration	Colony Diameter (cm)			Mean (%)	Per cent Inhibition (%)			Mean %
1	Karanj oil	8.73 (3.04)	7.90 (2.90)	6.47 (2.64)	7.70	3.00	12.20	28.11	14.43
2	Garlic	3.67 (2.04)	0.00 (0.71)	0.00 (0.71)	1.22	59.22	100	100	86.40
3	Cow Urine	9.00 (3.08)	9.00 (3.08)	7.27 (2.79)	8.42	0.00	0.00	19.22	6.40
4	Neem cake	4.23 (2.16)	2.40 (1.70)	1.23 (1.31)	2.62	53.00	73.33	86.33	70.88
5	Neem oil	3.73 (2.06)	2.93 (1.85)	1.97 (1.57)	2.87	58.55	67.44	78.11	68.03
6	Panchagavya	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00	100	100	100	100
	Mean	4.89	3.705	2.82		45.62	58.82	68.62	
7.	Control	9.00							
8.	Propiconazole @0.1% check	0.00			0.00				
		Treatments (T)	Concentration (C)	T×C	Check Vs Others				
	SEm±	**0.01**	**0.02**	**0.06**	**0.07**				
	CD (P ≤ 0.05)	**0.03**	**0.0**	**0.17**	**0.17**				

* Mean of three replications values in parenthesis are square root transformed

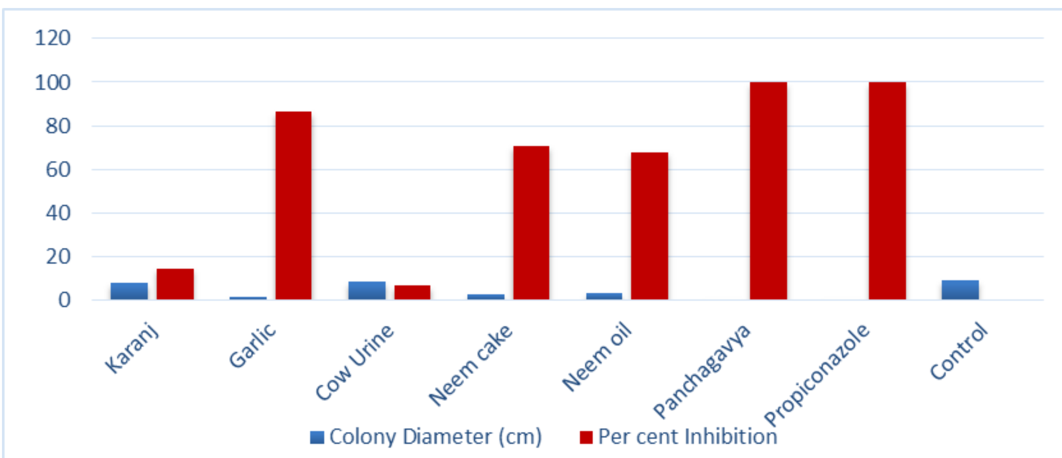

Fig. 1 : Efficacy of different treatments against radial growth of *R. solani* at different concentrations *in vitro*

Conclusion

From this in vitro study, it is concluded that among the different components tested against *R. solani*, panchagavya inhibited the pathogen at all the concentrations similar to propiconazole. Hence, instead of using chemicals always for disease management, panchagavya is also an excellent alternate source for controlling banded leaf and sheath blight pathogen inciting different crops.

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