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Assessing *in vitro* antifungal activity of plant extracts against *Rhizoctonia solani* causing sheath blight of rice (*Oryza sativa*. L)

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Abstract
Rice (*Oryza sativa.* L) is the world's second most important cereal crop. It is the staple food crop for most of the people of south, south-east and eastern Asia where 90 per cent of the world's rice is produced and consumed. Among fungal diseases, sheath blight, caused by multinucleate, ubiquitous pathogen *Rhizoctonia solani* Kuhn (Teleomorph: *Thanatephorus cucumeris* Donk), is an important fungal disease of rice which ranks only after blast and often rivalling it. The potential loss due to sheath blight alone in India has been up to 51.3%. In this study an attempt was made to investigate *invitro* antifungal efficacy of botanicals *viz.,* Garlic (*Allium sativum*), Marigold (*Tagetes* spp.*),* Eucalyptus *(Eucalyptus globules*), Turmeric (*Curcuma longa*), Ginger (*Zingiber officinale*), Onion (*Allium cepa*), and Tulsi (*Ocmium* spp.) by the technique of food poisoning. The pathogen *Rhizoctonia solani* was allowed to grow on Potato Dextrose Agar amended with various botanical extract of concentrations 2.5, 5.0 and 10 per cent respectively. The effect of botanical extracts on mycelial growth inhibition was recorded after 72 hours of incubation. Among the botanicals used garlic showed cent of mycelial inhibition followed by Ginger (80.00%), Turmeric (78.51%), (Marigold (76.29%), and Eucalyptus (75.55%). The least mycelial growth inhibition was showed by Onion and Tulsi with (37.77%) respectively. On the basis of available information and preliminary studies, it is suggested that Ginger can be suggested for management of sheath blight disease of rice caused by *Rhizoctonia solani.*

Keywords: Rice, *Rhizoctonia solani*, botanicals, food poison technique, mycelial inhibition

Introduction
Rice (*Oryza sativa.* L) is pre-eminent cereal crop around the world. Globally rice is consumed by more than three billion people. The consumption of rice is at utmost level by world populace of tremendously developing low-income countries. The consumption report conveys that, rice constitutes for ample of daily caloric intake (Pareja *et al.,* 2011) [8]. The projected demand of rice must be increased approximately 30% by 2050 with the current status production (Mohanty Wailes and Chavez 2010; FAO-UN, 2015). The supply at moderate levels can unveil large impacts on consumers, as rice provides 21% of global human per capita energy and 15% of per capita protein (IRRI, 2013). The production of rice during 2017 was all-time high of 769.9 million tonnes (510.6 million tonnes, milled basis) (FAO, 2018).

The attributions to low yields of rice in the country include number of biotic ad abiotic stress. Biotic stress includes disease causing pathogens, insect pest and nematodes which cause significant loss to the crop. The rivalling nature of different diseases, cause significant damage to the crop. Among them sheath blight caused by *Rhizoctonia solani* stands in the second place inflicting 51.3% loss in rice production in the country. Sheath blight is the most important disease of rice incited by *Rhizoctonia solani* (Kuhn), first reported by Paracer and Chahal (1963) [7] from Gurdaspur in Punjab state. Initial symptoms occur on leaf sheaths near the water line as water-soaked lesions. Secondary infections are caused by hyphae growing upward towards uninfected plant parts, producing additional lesions and sclerotia on leaf sheaths to complete the disease cycle (Brooks 2007) [1].

Since, the fungus *Rhizoctonia solani* is a typical soil borne, the management through chemicals is highly expensive and not feasible. The edaphic factors and soil heterogenicity etc., makes the management measures ineffective by preventing the concentrated chemicals reaching the pathogen. Integrated approaches for the disease management are paving way more dividence in terms of sustainability. This approach mainly emphasizes on eco-friendly means of management *i.e*., by the use of botanicals and bio-pesticides etc.

Materials and Methodology

Phyto-extracts of seven different botanicals belonging to different families were evaluated under *in-vitro* against *R. solani* by "Food poison technique" suggested by (Grover and Moore, 1962) [4]. Fresh and healthy plant parts *viz*., leaves, bulb, cloves, rhizomes and finger parts as listed in Table 1. were collected. The plant parts were washed thrice thoroughly under running tap water and once with 70% ethanol for 1minute. Then they were finally rinsed with sterile distilled water. Hundred grams of each plant part was grinded by addition of 100ml of sterile distilled water with the help of mixer grinder. Then the mixture of each extract was subjected/ passed through sterile double layered muslin cloth and was collected in 500ml comical flasks and the flasks were air-tightened by plugging them with non absorbent cotton plugs. These filtrates were used as 100% phyto extracts. The filtrates were diluted to different concentrations as listed in the Table 1. The different concentrated filtrates were amended with PDA in required quantities and poured into sterile petri dishes. All the food poisoned PDA containing petridishes were inoculated with 5mm discs of vigorously growing 7 days pure old culture of *R. solani* and the dishes were incubated in BOD at temperature (28 ± 2 °C) for 2 days.

Three replications of each treatment were maintained and the plates without phyto-extracts served as control. The observations on radial mycelial growth were recorded. Mycelial growth was measured at 24 hours interval till the colony in the control plate was fully covered with the growth of mycelium. The Per cent Growth Inhibition (PGI) was calculated by using the formula suggested by Vincent (1947).

$$PGI = \frac{DC - DT}{DC} \times 100$$

Where,
PGI = Per cent growth inhibition
DC = Average diameter of mycelial colony of control plate
DT = Average diameter of mycelial colony of treated plate

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

S. No.	Common Name	Scientific Name	Plant part used	Concentration (%)		
1	Garlic	*Allium sativum*	Cloves	2.5	5	10
2	Marigold	*Tagetes* spp.	Leaves	2.5	5	10
3	Eucalyptus	*Eucalyptus globules*	Leaves	2.5	5	10
4	Turmeric	*Curcuma longa*	Rhizome	2.5	5	10
5	Ginger	*Zingiber officinale*	Rhizome	2.5	5	10
6	Onion	*Allium cepa*	Bulb	2.5	5	10
7	Tulsi	*Ocmium* spp.	Leaves	2.5	5	10

Results

The current *in-vitro* studies of botanicals on mycelial growth of *R.solani* revealed that all the phyto-extracts used deliberately showed a significant control on mycelial growth. All the results obtained are relayed in Table 2. (Plate 1, Figure 1). among all phyto-extracts tested, garlic had shown highest percent of inhibition. It has shown cent per cent of mycelial inhibition at 2.5% concentration. The mycelial growth inhibition was next followed by ginger extract with 80% of inhibition at 10% of concentration, turmeric extract with 78.52%, marigold leaf extract with 76.30%, and eucalyptus leaf extract with 75.56% of inhibitions at 10% of concentrations respectively. The least inhibition percent was shown depicted by the extracts of onion and tulsi with inhibition percent of 37.78% each respectively at 10%cencentrations.

Discussions

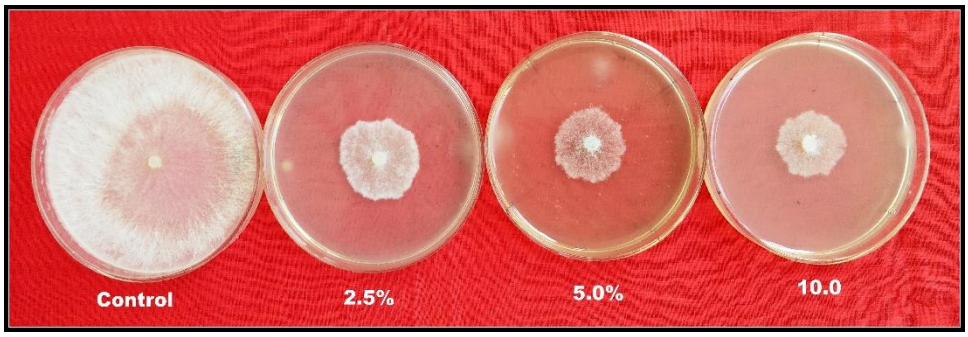
The present study concludes that out of seven phyto-extracts tested by food poison

Table 2: Effect of different phyto-extracts on growth of *R.solani*

Plant Name	Plant part used	Concentration (%)	Inhibition (%)* after 48hrs of incubation
Garlic (*Allium sativum*)	Cloves	2.50	100.00 (10.02)
		5.00	100.00 (10.02)
		10.00	100.00 (10.02)
Marigold (*Tagetes* spp.)	Leaves	2.50	61.85 (7.89)
		5.00	72.96 (8.57)
		10.00	76.30 (8.76)
Eucalyptus (*Eucalyptus globules*)	Leaves	2.50	58.89 (7.70)
		5.00	70.74 (8.43)
		10.00	75.56 (8.72)
Turmeric (*Curcuma longa*)	Rhizome	2.50	67.04 (8.21)
		5.00	73.33 (8.59)
		10.00	78.52 (8.88)
Ginger (*Zingiber officinale*)	Rhizome	2.50	67.78 (8.26)
		5.00	73.33(8.59)
		10.00	80.00 (8.97)
Onion (*Allium cepa*)	Bulb	2.50	13.33 (3.71)
		5.00	25.93 (5.13)
		10.00	37.78 (6.18)
Tulsi (*Ocmium* spp.)	Leaves	2.50	29.63 (5.48)
		5.00	32.96 (5.78)
		10.00	37.78 (6.18)
SE(d)±			0.11
$CD_{(5\%)}$			0.23

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

A



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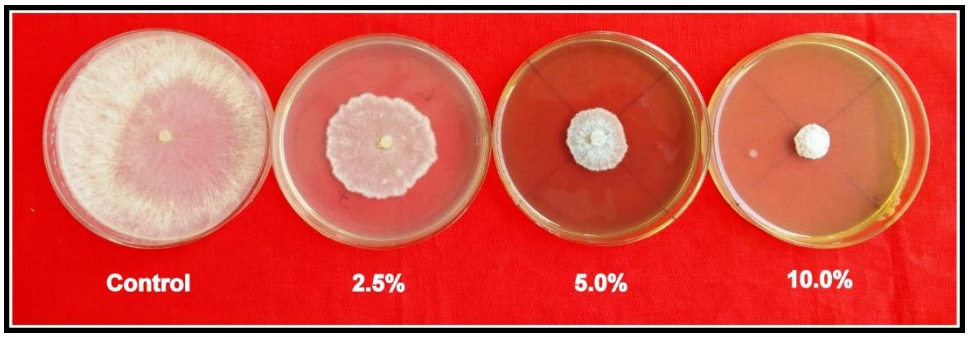

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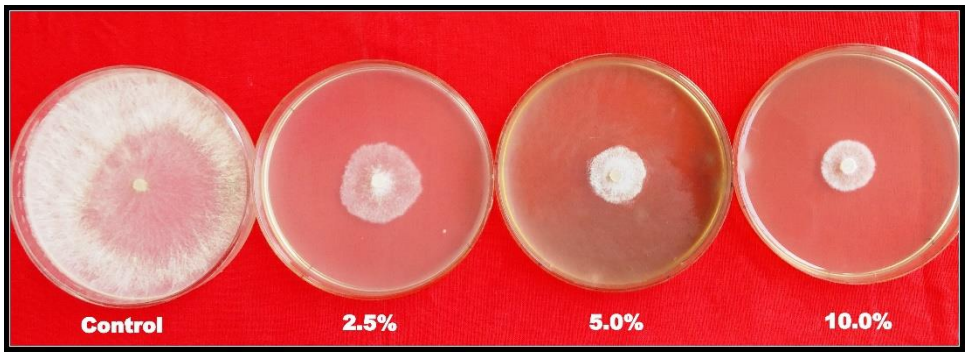

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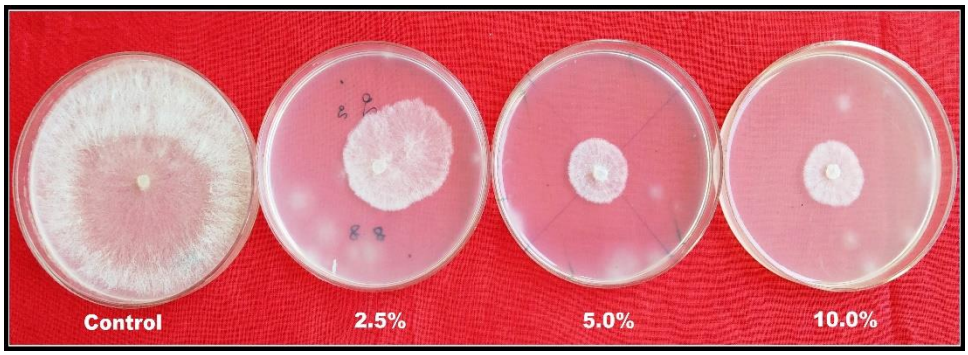

E

F

G

Plate 1: Effect of different phyto-extracts on growth of *R. solani* A. Garlic B. Marigold C. Eucalyptus D. Turmeric E. Ginger F. Onion G. Tulsi

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