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Original Research Article

In vitro Evaluation of Botanicals against *R. solani* Causing Sheath Blight of Paddy

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Paddy, *R. solani*, Botanicals

A B S T R A C T

Paddy (*Oryza sativa* L.) is the world's second most important cereal crop and is the staple food crop for people of south, south-east and eastern Asia where 90 per cent of the world's rice is produced and consumed. In the present study, we have evaluated aqueous extracts of commonly available ten plant species belonging to ten families *in vitro* for their inhibitory effect on the mycelia growth of *Rhizoctonia solani*. In this experiment result was found as the lowest mycelial growth of *R. solani* was recorded in clove extract of garlic (*Allium sativum* L.) which was found significantly superior among all the treatment with lowest mycelial growth of pathogen (25.33 mm). Results in terms of percent growth inhibition of *R. solani* revealed that clove extract of garlic produced maximum inhibition (71.85 %) followed by leaf extract of karanj (38.88 %), bulb extract of onion (37.03%), leaf extract of jetropha (30 %).

Introduction

Paddy is second most important food crops of the world after wheat. Paddy is the staple food crop for people of south, south-east and eastern Asia where 90 per cent of the world's rice is produced and consumed. It is grown in 114 countries across the world on an area about 160 million hectares with annual production of 494.3 million tones, and total supply of 711.5 million tones (Anonymous, 2016). In India, it is grown in 44.40 million hectares in diverse ecological conditions with an annual production of 104.80 million tons and productivity of 2462 kg ha^{-1} (Anonymous, 2015). In India, Gujarat ranks 15th and 9th in terms of rice production and productivity, respectively.

It plays a unique role for supplying calories to the majority of population of Asian and Latin American countries. It contain protein 7.3 g, carbohydrates 78 g, fat 3.6 g, crude fibre 0.4 g, mineral matter 0.6 g, thiamine 0.42 mg, riboflavin 0.02 mg, iron 0.4 mg, magnesium 32 mg, zinc 1.8 mg, calcium 51 mg, phosphorus 150 mg per 100g (Anonymous, 2002).

The low yield of rice in the country may be attributed by a number of biotic factors. Among the biotic stresses, the loss inflicted by pathogens, insect pests and nematodes are considerably significant. Different diseases like blast, bacterial blight, sheath

blight, sheath rot and grain discoloration causes significant damage to rice crop. Sheath blight is the most important disease of rice incited by *Rhizoctonia solani* (Kuhn), first reported by Paracer and Chahal (1963) 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).

Lesion formation on infected sheaths of lower rice leaves may lead to softness of the stem and subsequently stem lodging (Wu *et al.*, 2012). In addition, the fungus survives between crops as "sclerotia" that can lie dormant in the soil for at least two to three years (University of Arkansas Cooperative Extension Service, 2015).

Since, *Rhizoctonia solani* is a typical soil borne fungus and its management through chemicals is expensive and not feasible, because of the physiological heterogenicity of the soil and other edaphic factors etc. might prevent effective concentrations of the chemical reaching to the pathogen. Integrated approaches for the disease management are paying more dividence in terms of sustainability. This approach mainly emphasizes on the management through eco-friendly means *i.e.* through the use of botanicals and bio-pesticides etc.

Materials and Methods

Phyto-extracts of ten plant species belonging to different families were evaluated against *R.solani* by 'Poisoned Food Technique' as suggested by (Grover and Moore, 1962). Fresh healthy plant parts *viz.*, leaves, bulb, finger parts as listed in Table (1) were collected, washed thoroughly with tap water and finally rinsed with sterile distilled water. Fifty grams of leaves, bulbs and finger parts were mixed with the help of grinder by adding 50 ml distilled water. The extracts were filtered through double layered sterile muslin cloth and collected in 150 ml conical flasks and plugged with non-absorbent cotton. Thus, filtered phyto-extracts autoclaved at 1.2 kg cm^{-2} pressure for 20 minutes before use these phyto-extracts in the poisoned food technique. Autoclaved extracts were individually added in previously sterilized PDA 10 per cent (2 ml extract ±18 ml PDA) at the time of pouring in plates and mixed thoroughly at the time of pouring in the previously sterilized Petri plates. All the plates containing phyto-extracts were inoculated aseptically after solidification by placing a mycelial disc of 5 mm diameter of vigorously growing 7 days old pure culture of *R. solani* and incubated at temperature (28 ± 2 ^{0}C) for 7 days.

Three repetitions 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 covered with the growth of mycelium of pathogen. 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 set

DT = Average diameter of mycelial colony of treated set

Table.1 List of different botanicals tested for their efficacy against the *R. solani in vitro* (10 % concentration)

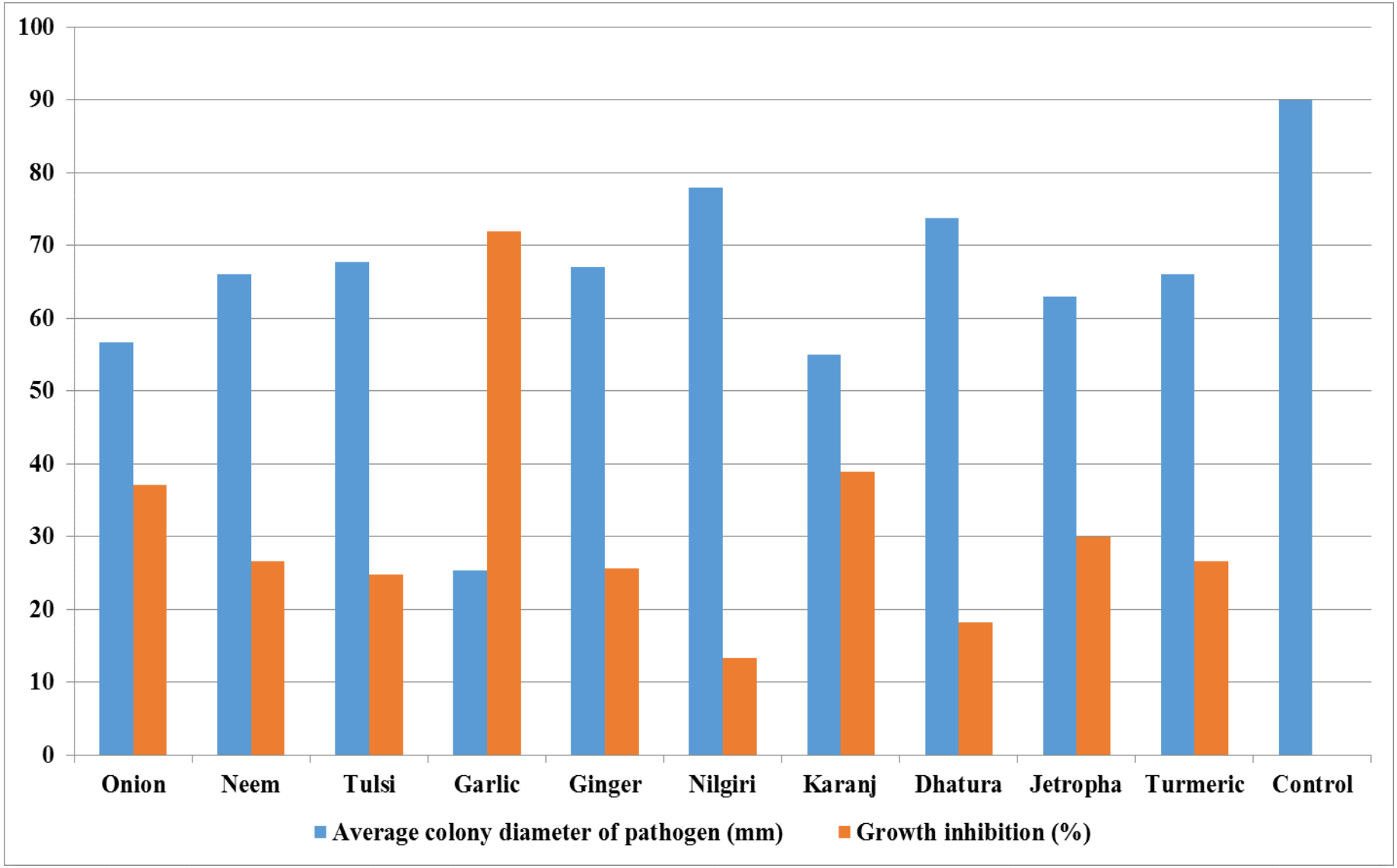
Treatment No.	Common name	Botanical name	Plant parts for extracts
T_1	Onion	*Allium cepa* L.	Bulb
T_2	Neem	*Azadirachtaindica* L.	Leaves
T_3	Tulsi	*Ocimum sanctum* L.	Leaves
T_4	Garlic	*Allium sativum* L.	Bulb
T_5	Ginger	*Zingiber officinalis* Rosa	Rhizome
T_6	Nilgiri	*Eucalyptus citridora* Hook	Leaves
T_7	Karanj	*Pongamia glubra* L.	Leaves
T_8	Dhatura	*Datura stamoneum* L.	Leaves
T_9	Jetropha	*Jetropha curcas* L.	Leaves
T_{10}	Turmeric	*Curcuma longa* L.	Leaves
T_{11}	Control (Untreated)	-	-

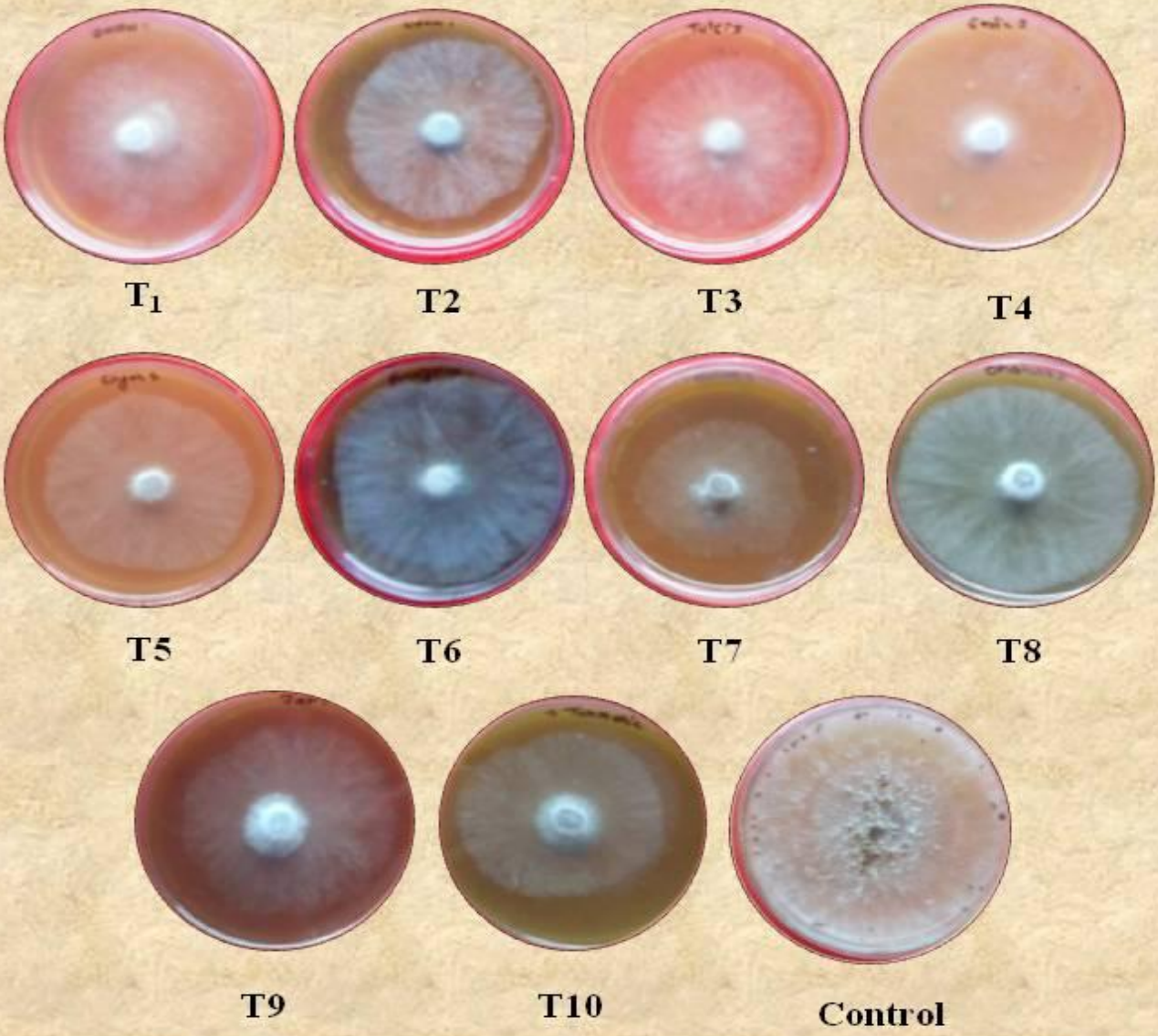
Table.2 Effect of botanicals against the pathogen *in vitro*

TreatmentNo.	Phyto-extracts	Plants part used	Botanical name	Average diameter of pathogen after 7 days (mm)	Growth inhibition (%)
T_1	Onion	Bulb	*Allium cepa L.*	7.57** (56.67)*	37.03
T_2	Neem	Leaves	*Azadirachta indica L.*	8.12 (66.00)	26.66
T_3	Tulsi	Leaves	*Ocimum sanctum L.*	8.24 (67.67)	24.81
T_4	Garlic	Cloves	*Allium sativum* L.	5.02 (25.33)	71.85
T_5	Ginger	Rhizome	*Zingiber officinalis Rosa*	8.18 (67.00)	25.55
T_6	Nilgiri	Leaves	*Eucalyptus citridora Hook*	8.83 (78.00)	13.33
T_7	Karanj	Leaves	*Pongamia glubra L.*	7.41 (55.00)	38.88
T_8	Dhatura	Leaves	*Datura stamoneum L.*	8.58 (73.67)	18.14
T_9	Jetropha	Leaves	*Jetropha curcas L.*	7.93 (63.00)	30.00
T_{10}	Turmeric	Rhizome	*Curcuma longa L.*	8.12 (66.00)	26.66
T_{11}	Control	--	--	9.48 (90.00)	--
S. Em±				0.09	--
C.D. at 5 %				0.27	--
C.V. (%)				2.01	--

*Figures in parenthesis are original value; **Figures outside parenthesis are $\sqrt{x} + 0.5$ transformed value

Fig.1 Effect of botanicals against *R. solani in vitro*





Treatments

T1 = Onion T2 = Neem T3 = Tulsi T4 = Garlic T5 = Ginger

T6 = Nilgiri T7 = Karanj T8= Dhatura T9 = Jetropha T10 = Turmeric

T11 = Control

Plate No.1 Effect of botanicals against *R. solani in vitro*

Results and Discussion

The results presented in table (2) and depicted in plate (1) and figure (1) revealed that all the plants extracts inhibited the growth of the fungus significantly as compared to control. Among the effective botanicals, the lowest mycelial growth of *R. solani* was recorded in clove extract of garlic (*Allium sativum* L.) which was found significantly superior among all the treatment with lowest mycelial growth of pathogen (25.33 mm). This was significantly superior in its efficacy over the rest. Next best botanical in order of merit was leaf extract of karanj (*Pongamia gliubra* L.) (55.00 mm) which was followed by bulb extract of onion (*Allium cepa* L.) (56.67 mm).

Moreover, leaf extract of jetropha with (63.00 mm) mycelia growth, was found moderately effective followed by rhizome extract of turmeric (66.00 mm) which was statistically at par with leaf extract of neem (66.00 mm). Whereas, rhizome extract of ginger with mycelial growth of (67.00 mm) and leaf extract of tulsi (67.67 mm) was also found less effective.

Among least effective botanicals, leaf extract of dhatura and leaf extract of nilgiri recorded highest myecilial growth of pathogen which was (73.67 mm) and (78.00 mm) respectively. The clove extract of garlic produced maximum inhibition (71.85 %) followed by leaf extract of karanj (38.88 %), bulb extract of onion (37.03%), leaf extract of jetropha (30 %). While leaf extract of neem and rhizome extract of turmeric (26.66 %), rhizome extract of ginger (25.55 %), leaf extract of tulsi (24.81 %), leaf extract of dhatura (18.14 %) and leaf extract of nilgiri (13.33 %) were proved to be least effective in inhibiting the growth of the pathogen.

From this experiment, it is very clear that extracts of garlic (*Allium sativum* L.), karanj (*Pongamia glubra* L.), onion (*Allium cepa* L.) have some toxic principle present in their extract which directly affects the growth of the pathogen.

The results obtained in this experiment are close with the findings of Shejpal *et al.*, (2009). They tested forty four plant extracts for their efficacy as antifungal botanicals against sheath blight of rice caused by *R. solani.* and found that clove extract of garlic (*Allium sativum* L.) exhibited strong fungi toxicity even at low concentration of (100 ppm).

Sinha *et al.*, (2009) screened the ten botanicals under *in vitro* condition against *R. solani* and they found that extracts of garlic and ginger recorded maximum (100 %) inhibition followed by neem (70 %).

Srinivas *et al.*, (2013) studied phyto-toxic effect of thirteen plant extracts and reported highest growth inhibition of fungus by garlic at (10%) concentration.

The present study concludes that out of ten tested phytoextracts by poisoned food techniques for their inhibitory effect on mycelial growth of *R. solani* at 10 per cent concentration. The maximum inhibition was found in the clove extracts of garlic (*Allium satium* L.) (71.85 %) followed by leaf extract of karanj (*Pongamia glubra* L.) (38.88 %) and bulb extract of onion (*Allium cepa* L.) (37.03 %).

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