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Evaluation of botanicals against growth of *Rhizoctonia solani* under *in vitro* condition

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Abstract
*Rhizoctonia solani*is a multiphagous widely distributed plant pathogen. Web blight caused by *Rhizoctonia solani* causes huge yield loses in urdbean (*Vigna mungo*). All the commercially grown varieties are susceptible. Being a typical soil borne fungus, its management through chemicals is expensive and not feasible, because of the physiological heterogeneity of the soil and other edaphic factors etc. Integrated approaches of the disease management are paying more attentiveness in terms of sustainability. The study was conducted at Department of Plant Pathology, College of Agriculture, Jabalpur, Jawaharlal Nehru Krishi Vishwavidyalaya (M.P) during 2018-19. It was carried out to know the efficacy of different botanicals on the mycelial growth of *Rhizoctonia solani* under *in vitro* condition. From the present study it could be concluded that all eight tested phytoextracts evaluated for their efficacy inhibiting *R. solani*at different concentration of 10% and 20% under *in vitro* conditions using poisoned food technique significantly inhibited the growth of *R. solani*. The maximum percent inhibition in growth was recorded by onion and garlic bulb extracts.

Keywords: *Rhizoctonia solani*, phytoextracts, mycelial growth

Introduction
Urd bean (*Vignamungo* (L.) Hepper) is an important pulse crop of India. This crop is a major source of dietary proteins, minerals and vitamins for vegetarian population of India. It is also rich in phosphoric acid. Urd bean is also cultivated as mixed crop with finger millet or barnyard millet in the hills of Uttaranchal during the *kharif* season. In North India, it is grown in *kharif* and summer season. In India, urd bean is cultivated in 2.89 million ha area with production of 1.28 million tones and productivity of 440 kg/ha (Anonymous, 2003). It is cultivated in *Kharif*, spring and summer seasons in India and covering 3.77 million hectares area and production 1.52 million tonnes. (Purushottam and Singh, 2015) [11]. Despite being an important pulse crop its productivity has been quite low probably due to various biotic and abiotic constraints. Urdbean is vulnerable to a variety of diseases *viz.*, anthracnose (*Glomerella lindemuthianum*), dry root rot (*Macrophomina phaseolina*), leaf spot (*Cercospora canescens*), powdery mildew (*Erysiphe polygoni*), rust (*Uromyces phaseoli*), web blight (*Rhizoctonia solani*), Mosaic and leaf crinkle (Bara, 2007) [1]. Among the biotic constraints, web blight disease of urdbean caused by *Rhizoctonia solani* Kuhn [Teleomorph: *Thanatephorous cucumeris*(Frank) Donk] is considered as an important constraint accountable for losses in production as well as productivity in India up to 20-30% (Kumar *et al.* 2018) [7]. The disease had been reported in other countries like Pakistan, Sri Lanka, West Indies, Japan, Philippines, Myanmar, North America, South America, Argentina, Brazil, and Mexico too beside India. The disease has been reported from various urdbean growing areas of India including; Punjab, Haryana, Bihar, Rajasthan, Uttarakhand, Madhya Pradesh, Uttar Pradesh, West Bengal, Himachal Pradesh and Jammu and Kashmir (Shailbala and Tripathi, 2007) [15]. The disease appears about 21-25 days after sowing depending on cultivars, environmental conditions, crop stages and cultivation practices (Dubey and Patel, 2001; Shailbala and Tripathi, 2007) [15]. Seed quality and grain yield are heavily affected in this disease. Web blight of urd bean is a seed and soil borne disease (Saksena and Dwivedi, 1973; Dwivedi and Saksena, 1974) [16] and managed by chemical seed treatment (Dubey and Dwivedi, 1988) [3]. The chemicals not only disturb the ecology of soil but also develop hazardous impact on surroundings including *Rhizobium* spp.

Biological seed treatment with fungal antagonist has significant promise against such devastating pathogens (Mukhopadhyay, 1994) [9] but suitable methods of seed treatment and optimum doses are ingredients for successful management. The first report of occurrence of web blight on urdbean caused by *Rhizoctonia solani* Kuhn [Teleomorph: *Thanatephorous cucumeris* (Frank) Donk] in India was reported by Saksena and Dwivedi in 1973 [16]. This disease is known to occur in other leguminous crops like mungbean (Dwivedi and Saksena, 1975) [5], pigeonpea (Dwivedi and Saksena, 1975) [5], cowpea (Lakshman *et al.* 1979) [8], soybean (Verma and Thapliyal, 1976) [17], groundnut (Dwivedi and Dubey, 1986) [4] and rice bean (Jalali, 1989) [6].

Material and Methods

The experiment was laid out in a complete randomized design (CRD) with eight treatments including untreated control and replicated thrice eight botanicals *viz.*, Onion, Neem, Tulsi, Garlic, Karanj, Dhatura, Jatropha and Turmeric were evaluate against *R. solani.* The present study was undertaken in the laboratory conditions to find out their relative efficacy to inhibit the radial growth of the pathogen on PDA medium by poisoned food technique (Nene and Thapliyal (1979). The calculated quantity of botanicals was added to potato dextrose agar (PDA), mixed thoroughly and poured into sterilized Petri plates and allowed to solidify. After solidification, each plate was inoculated with a 5 mm diameter disc obtained from an actively growing margin of *R.solani* colony on PDA. The Petri dishes were incubated at 25± 1ºC in BOD incubator and allow to growth. The data of efficacy of botanicals against *R.solani was* recorded after 7 days after inoculation (DAI) for growth of pathogen at 25± 1ºC. Percent over control was calculated by the following formula suggested by Vincent (1947)[18] and confirmed by Hegde *et al.* (2014) against *R.solani*.

$$\text{Percent growth inhibition} = \frac{(C-T)}{C} \text{ X } 100$$

Where

C = growth of fungus in control

T = growth of fungus in treatment

Results

In vitro studies revealed that botanicals like garlic and onion showed complete inhibition of mycelial growth against *R. solani*, summarized in (Table 1, 2). Out of eight botanicals including control *viz*., Onion, Neem, Tulsi, Garlic, Karanj, Dhatura, Jatropha and Turmeric were used to evaluate against *R. solani*under *in-vitro* condition at two different concentrations of 10 and 20 percent and were compared with control. The fungal growth was recorded at 5 and 7 days after inoculation. and the data is summarized in (Table 1) in 120 hours after inoculation at 10 and 20 percent concentration of botanical were tested the minimum mycelium growth was recorded in garlic (8.00 mm and 2.50 mm), followed by Onion (22.66 mm and 17.33 mm), Turmeric (23.33 mm and 18.33mm), Datura (24.33 mm and 21.00 mm), Neem (28.00 mm and 24.33 mm), Tulsi (30.66 mm and 25.50 mm), Karanj (36.66 mm and 30.66 mm) and Jatropha (39.33 mm and 34.33 mm), while maximum fungal growth was recorded in control (81.33 mm) in 120 hours after inoculation maximum inhibitions are recorded in garlic (90.00% and 96.00%), followed by Onion (72.14% and 78.69%), Turmeric (71.11% and 76.85%), Datura (70.08% and 74.08%), Neem (65.57% and 70.08%), Tulsi (62.30% and 68.65%), Karanj (52.92% and 62.30%) and Jatropha (51.64% and 57.79%) while minimum inhibitions percent was recorded in control (0.00%) in 144 hours after inoculation at 10 and 20 percent concentration of botanical were tested the minimum mycelium growth was recorded in garlic (15.50 mm and 4.50 mm) followed by Onion (37.50 mm and 34.00 mm), Datura (52.00 mm and 47.00 mm), Turmeric (56.33 mm and 51.50 mm), Tulsi (56.33 mm and 51.50 mm), Neem (46.33 mm and 40.66 mm), Karanj (61.00 mm and 55.66 mm) and Jatropha (67.33 mm and 60.33 mm), while maximum fungal growth was recorded in control (89.33 mm and 89.00 mm) in 144 hours after inoculation maximum inhibitions are recorded in garlic (82.75% and 96.00%) followed by Onion (58.25% and 62.15%), Neem (48.42% and 54.84%), Datura (42.11% and 47.66%), Turmeric (37.29% and 42.67%), Tulsi (37.29% and 42.86%), Karanj (32.09% and 38.04%) and Jatropha (25.02% and 32.84%), while minimum inhibitions percent was recorded in control (0.00%).

Table 1: *In vitro* evaluation of botanical against *R.solani*at 120 hours after inoculations

Treatment	Radial growth of mycelium at two concentration				Average radial growth (mm)	Average (%inhibition)
	10%		20%			
	Mean radial growth (mm)*	% inhibition	Mean radial growth (mm)*	% inhibition		
Onion	22.66	72.14	17.33	78.69	20.00	75.41
Neem	28.00	65.57	24.33	70.08	26.17	67.83
Tulsi	30.66	62.30	25.50	68.65	28.08	65.47
Garlic	8.00	90.16	2.50	96.93	5.25	93.54
Karanj	36.66	54.92	30.66	62.30	33.66	58.61
Datura	24.33	70.08	21.00	74.18	22.67	72.13
Jatropha	39.33	51.64	34.33	57.79	36.83	54.72
Turmeric	23.50	71.11	18.83	76.85	21.17	73.98
Control	81.33	0.00	81.33	0.00	81.33	0.00
SEm±	A= 0.403, B= 0.190, A x B= 0.569					
CD @ 5%	A= 1.159, B= 0.563, A x B= 1.639					

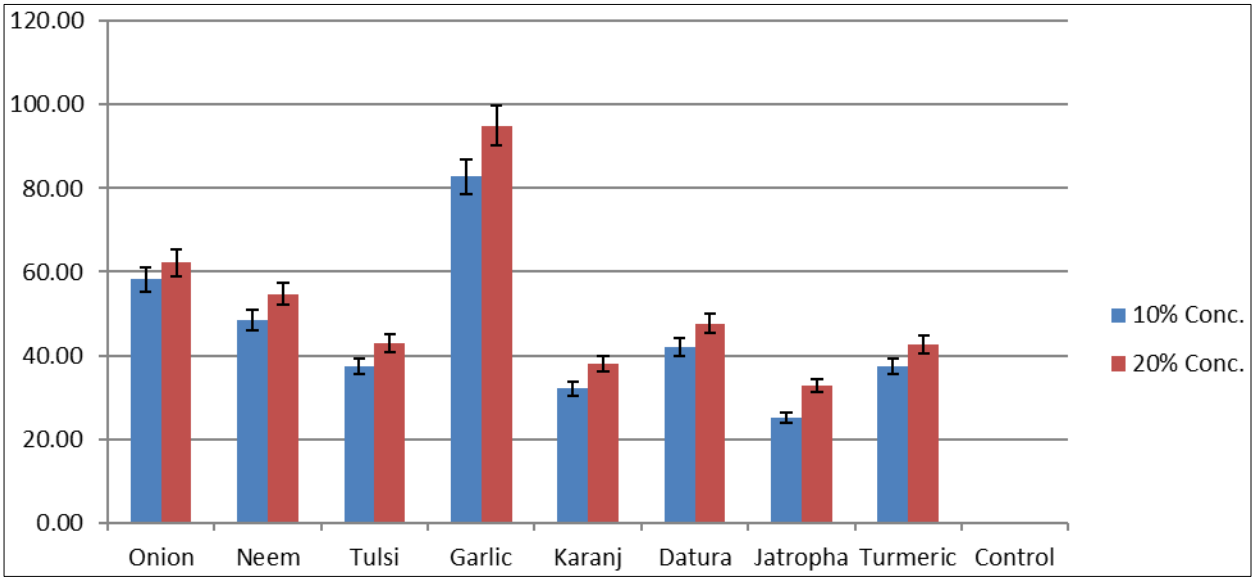

Fig 1: *In vitro* evaluation of botanical against *R. solani* after 120 hours of incubation at different concentration

Table 2: *In-vitro* evaluation of botanical against *R. solani* at 144 hours after inoculations

Treatment	Concentration				Average radial growth (mm)*	Average (%inhibition)
	10%		20%			
	Mean radial growth (mm)*	Percent inhibition	Mean radial growth (mm)*	Percent inhibition		
Onion	37.50	58.25	34.00	62.15	35.75	60.20
Neem	46.33	48.42	40.66	54.74	43.50	51.58
Tulsi	56.33	37.29	51.33	42.86	53.83	40.08
Garlic	15.50	82.75	4.50	94.99	10.00	88.87
Karanj	61.00	32.09	55.66	38.04	58.33	35.07
Dhatura	52.00	42.11	47.00	47.66	49.50	44.90
Jatropha	67.33	25.05	60.33	32.84	63.83	28.94
Turmeric	56.33	37.29	51.50	42.67	53.92	39.98
Control	89.83	0.00	89.00	0.00	89.83	0.00
SEm±	A= 0.358, B= 0.169, A x B= 0.506					
CD @ 5%	A= 1.031, B= 0.486, A x B= 1.458					

*Mean of three replication

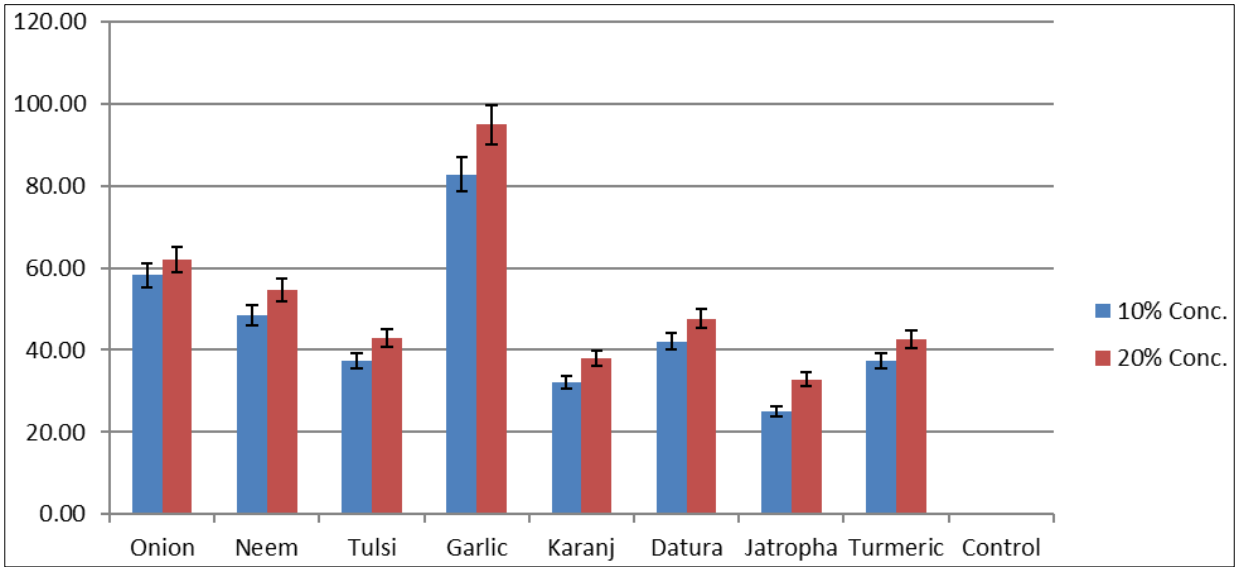

Fig 2: *In vitro* evaluation of botanical against *R. solani* after 144 hours of incubation at different concentration

Discussion and Conclusion

All the eight tested phytoextracts significantly inhibited the growth of *R. solani* under in *vitro* conditions. The maximum percent inhibition (90.16%) in growth of *R. solani* was shown by garlic bulb extract followed by Onion bulb extract where 72.14% inhibition was recorded after 120 hrs of incubation period at 10 percent concentration. On increasing the concentration of phytoextracts from 10 to 20%. The percent inhibition in growth of *R. solani* also increased and maximum inhibition of 96.93% in growth of *R. solani* was recorded by 20% garlic bulb extract. After 144 hrs of incubation, maximum inhibition of 94.99% in growth of *R. solani* was

recorded by 20% garlic bulb extract. However, minimum inhibition of 32.84% was recorded in 20% Jatropha leaf extract. In this way, out of eight phytoextracts tested, three phytoextracts namely Onion bulb, Neem leaf and garlic bulb showed more than 50 per cent inhibition in growth of *R. solani* at 20% concentration after 144 hrs of incubation period. The results obtained in this experiment are close with the findings of Sehajpal *et al*., (2009) [13] where they evaluated forty four plant extracts for their efficacy as antifungal botanicals against *R. solani* and found that clove extract of garlic (*Allium sativum* L.) The results of present findings are also in conformity with the findings of Sinha *et al*., (2009) [14]. In their study, ten botanicals were screened 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) [12] studied phyto toxic effect ofthirteen plant extracts and reported highest growth inhibition of fungus by garlic at 10% concentration. Onion and garlic bulb extracts @10% and 20% significantly inhibited the growth of *R. solani* and can be used for ecofriendly management of web blight of urd bean.

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