The Journal of Plant Protection Sciences, **1**(1) : 25-30, 2009

journal homepage: www.aappbckv.org/journal

Evaluation of plant extracts against *Rhizoctonia solani* causing sheath blight of rice

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A B S T R A C T

The antifungal effect of 44 plant extracts and 8 plant oils against the pathogen *Rhizoctonia solani* was evaluated by disc diffusion method. Out of 44 plants tested, 36 plant extracts showed varied degree of antimicrobial effect at different concentrations against the pathogen whereas 8 plant extracts, viz. *Abrus precatorious*, *Acacia auriculiformis*, *Bougainvillea glabra*, *Convolvulus arvensis*, *Hibiscus rosa-sinensis*, *Morus alba*, *Thevatia peruviana*, and *Withania somnifera* did not exert any effect. Among all the plant extracts, *A. sativum* exhibited strong fungitoxicity even at the lowest concentration, i.e. 100 ppm, with relative magnitude of inhibition 2.0 mm against the pathogen *R. Solani*. With regard to the effect of 8 plant oil samples tested, it was noticed that the oil of *Syzygium aromaticum* showed strong inhibition i.e. 7.5 mm at 1000ppm whereas *Helianthus annus* and *Oryza sativa* were ineffective.

Keywords: Rice, *Rhizoctonia solani*, Sheath blight, plant extracts, plant oils, disc diffusion method, fungitoxicity

Introduction

Rice is an important cereal crop affected by various fungal, bacterial and viral diseases. Sheath blight caused by *Rhizoctonia solani* is emerging as a very destructive disease under favorable weather conditions in rice growing areas of the world which ultimately causes substantial yield losses (Gautam *et al*, 2003). Management of this disease is difficult due to viability of sclerotia in the soil for several years. Use of fungicides to control the disease causes several adverse effects i.e. development of resistance in the pathogen, residual toxicity, pollution in the environment, high cost etc. Therefore, it has become necessary to adopt ecofriendly approaches for better crop health and for yield. In the past, several higher plants have proved their usefulness against a number of fungi (Dixit *et al.* 1983; Singh *et al.* 1983). The systematic search of higher plants for antifungal activity has shown that plant extracts have the ability to inhibit spore germination and mycelia growth in many fungal species (Guerin and Reveille, 1984; Natarajan and Lalithakumari, 1987; Singh and Dwivedi, 1987). During recent years, use of plant extracts particularly neem derivatives for the control of plant diseases is gaining importance due to their antifungal and antibacterial properties (Yin and Cheng, 1998; Mishra *et al*, 2003; Janagiri and Naiik, 2005). Many plant extracts are reported to specifically inhibit the germination of fungal spores (Babu *et al*. 2001). Neem and pungam oil based EC formulations developed by TNAU have been effective against sheath rot disease of rice under field conditions (Narasimhan *et al*. 1998). Hence, in the present study some plant extracts and oils, from locally available plants were tested *in vitro* against *Rhizoctonia solani.*

Material and Methods

Different parts of the plants of economic importance were collected from the Botanical Garden of Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar campus and various plant oils were procured from Chemistry Department, Guru Nanak Dev University, Amritsar to study their antifungal activity. The selected plant parts were thoroughly washed under tap water to remove dust and other impurities. The plant samples were air-dried and ground to make fine powder. A weighed amount of powder was soaked in sterilized distilled water and kept on

shaker for continuous stirring. Supernatant was filtered and dried. Residual portion was repeatedly extracted till leaching out of extract stopped. Air-dried extracts were weighed and transferred into the vials of varying capacities. These vials were kept into the dessicatorf or further use. Antifungal activity of the medicinal plant extracts was carried out by employing disc diffusion method (Bauer *et al.* 1966). Culture suspensions of selected fungal pathogens were made separately in (0.1%) Tween-80 sterile saline solution and uniformly distributed on Potato dextrose agar (PDA) medium in the glass petriplates. The filter paper discs of 4 mm diameter (Whatman paper No. I) impregnated with the plant extracts of different concentrations (100, 200, 300, 500 and 1000 ppm) were placed on the petriplates overlaid with the culture. The plates were incubated at 28°C in incubator and the inhibition zone of the extracts as examined at intervals of 24 hours. Efficacy of extracts through disc diffusion was calculated by employing the following formula:

$$\text{Relative magnitude of inhibition} = \frac{\text{Area defined by zone of inhibition}}{\text{Area defined by filter paper disc}}$$

Results

The effects of plant extracts and oils were categorized as least (0.0-1.9 mm), moderate (2.0-3.9 mm) and strong (4.0-5.9 mm and above). Table 1 shows the effect of different concentrations of plant extracts on the pathogen *R. solani* isolated from paddy. It was observed that *Allium sativum* gave strong inhibition i.e. 5.75 mm at 1000 ppm concentration, followed by *Allium cepa* and *Emblica officinalis* i.e. 3.25 mm of each. However, *Brassica compestris* and *Callistemone lanceolatus* showed least inhibition of pathogen *R. solani* i.e. 1.25 mm. It was further observed that some of the plant extracts viz. *Abrus precatorious*, *Acacia auriculiformis*, *Bougainvillea glabra*, *Convolvulus arvensis*, *Hibiscus rosasinensis*, *Morus alba*, *Thevatia peruviana* and *Withania somnifera* were ineffective in inhibiting the growth of *R. solani*.

Table 1 also shows the fungitoxic effect of plant oils against the pathogen *R. solani*. The order of inhibition of different oils was *Olea europaea* (3.0 mm) > *Azadirachta indica* (2.0 mm) > *Prunus amygdalus* (1.75 mm)> *Emblica officinalis* (1.5 mm). Among the eight plant oils tested, *Syzygium aromaticum* showed strong fungitoxic effect against the test pathogen with 7.5 mm relative magnitude of inhibition at 1000 ppm concentration. *Helianthus annus* oil and *Oryza sativa* oil did not show any fungicidal activity.

Discussion

To explore the fungicidal efficacy of some plant extracts and oils were tested against *R. solani*. The inhibitory activity is categorized as strong (4.0-5.9 mm), moderate (2.0-3.9 mm) and least (0.0-1.9 mm). Thirty-six plant extracts showed fungitoxic potentiality against *R. solani*, out of which *Allium sativum* was strong fungitoxic. It was observed that 24 plant extracts inhibited the pathogens moderately whereas the remaining 11 plant extracts showed least inhibition. Among the plant extracts *Allium sativum* has shown strong fungitoxicity against the test pathogen even at low concentration i.e. 100 ppm, that indicated its broad range of activity as compared to other plant extracts. A maximum inhibition observed with *Allium sativum* may be due to the presence of sulphur compounds and allicin (Kurucheve and Padmavathi, 1998; Singh and Singh, 2005). The findings are in consonance with there of Dutta *et al.* (2004), who reported that 10% concentration of crude *Allium sativum* extract exhibited total inhibition of sclerotial production and 20% concentration showed excellent mycelial inhibition of *Rhizoctonia solani* causing sheath blight of rice. It was further noticed from the results of present study that *Allium cepa* also inhibited the test pathogen significantly but was less fungicidal as compared to *Allium sativum*. The fungicidal property of *Allium cepa* may also be attributed to the presence of sulphur compounds (Dubey and Dwivedi, 1991). *Azadirachta indica* gave moderate effect against the pathogen and its fungitoxic activity may be due to the presence of azadirachtin containing desactylimbin (Narayanan and Ayer, 1967). The antifungal activity of *Terminalia arjuna* might be due to the presence of O-beta-D-glycoside in the extract as reported by Chouksey and Srivastava (2001). *Pongamia glabra*, *Eucalyptus citriodora*, *Lantana camara* and *Lawsonia inermis* have also shown moderate fungicidal response to the test pathogen. Thymol present in *Lantana camara* (Srivastava and Lal, 1997; Thapak *et al.* 2003) and presence of Lawsone i.e. 2-hydroxy-1, 4-naphthaquinone in *Lawsonia inermis* (Natarajan and Lalithakumari, 1987) are responsible. Yadav *et al.* (2005) found that *Withania somnifera* and *Datura stramonium* at 20% concentration gave 38.8 and 44.8% growth inhibition of *Rhizoctonia solani* respectively.

Out of the eight plant oils screened for their antimycotic activity against the selected pathogen, six samples exhibited mycelial growth inhibition. Among the six, *Syzygium aromaticum* showed strong inhibition of mycelial growth of

the selected pathogen. *Rhizoctonia solani* was inhibited moderately by *Azadirachta indica* and *Olea europaea* oils whereas *Brassica compestris*, *Emblica officinalis* and *Prunus amygdalus* oils showed least mycelial growth inhibition. Azadiradione a chemical constituent is known to be antifungal factor in *Azadirachta indica* oil (Govindachari *et al.* 1999; Tripathy *et al.* 2004). Dohroo and Gupta (1995) also reported neem oil to possess inhibitory effect against sclerotia of *Rhizoctonia* sp. and claimed that 0.5% neem oil effectively controlled sheath blight disease caused by *R. solani* (Kandhari and Devakumar, 2003). Essential oils from *Allium sativum* and 3 other plants were promising inhibitors of *Rhizoctonia solani* causing sheath blight of rice (Dhaliwal *et al.* 2003).

Literature Cited

Bauer AW Kirby WMM Sherries JC Turckp M. 1966 Antibiotic susceptibility testing by standard single disc method. *American Journal Clinical Pathology* **115**: 493-96.

Dhaliwal HJS Thind TS Mohan C. 2003 Activity of some essential oils against *Rhizoctonia solani* Kuhn the cause of black scurf of potato. *Journal of Mycology and Plant Pathology* **33**: 399-02.

Dohroo NP Gupta SK. 1995 Neem in plant disease control. *Agriculture Review* **16**: 133-40.

Dutta S Chaudhury A Chaudhury AK Laha SK. 2004 *In vitro* fungitoxicity of plant extracts against *Pyricularia oryzae Rhizoctonia solani* incitant of blast sheath blight of rice. *Indian Phytopathology* **57**: 344.

Pinto CMF Maffia LA Cassali VWD Cardoso AA. 1998 *In Vitro* Effect of Plant Leaf Extracts on Mycelial Growth and Sclerotial Germination of *Sclerotium cepivorum. Journal of Phytopathology* **146**: 421-25.

Gautam K Rao PB Chauhan SVS. 2003 Efficacy of some botanicals of the family compositae against *Rhizoctonia solani* Kuhn. *Journal of Mycology and Plant Pathology* **33**: 230-35.

Govindachari TR Suresh G Masilamani S. 1999 Antifungal activity of *Azadirachta indica* leaf hexane extract. *Fitoterapia* **70**: 417-20.

Guerin JC Reveille HP. 1984 Antifungal activity of plant extracts used in therapy.I. Study of 41 plant extracts against 9 fungi species. *Annales Pharmaceutiques Francaises* **42**: 553-59.

Kandhari J Devakumar C. 2003 Effect of neem oil and its fraction against sheath blight (*Rhizoctonia solani* Kuhn) of rice. *Journal of Mycopathology Research* **41**: 185-87.

Kurucheve V Padmavathi R. 1998 Management of damping - off of chillies with plant products. *Indian Phytopathology* **51**: 379-81.

Natarajan MR Lalithakumari D. 1987 Antifungal activity of the leaf extracts of *Lawsonia inermis* on *Drechslera oryzae*. *Indian Phytopathology* **40**: 390-95.

Singh RK Dwivedi RS. 1987. Effect of oils on *Sclerotium rolfsii* causing foot-rot of barley. *Indian Phytopathology* **40**: 531-33.

Singh M Singh RP. 2005 Management of mushroom pathogens through botanicals. *Indian Phytopathology* **57**: 189-93.

Srivastava AK Lal B. 1997 Studies on biofungicidal properties of leaf extract of some plants. *Indian Phytopathology* **50**: 408-11.

Thapak SK Thrimurty VS Dantre RK. 2003 Sheath rot management in rice with fungicides biopesticides. *International Rice Research Notes* **28**: 41.

Tripathy MK Das BC Mohanty S. 2004 Efficacy of few botanicals against seed beetle (*Carryedon serratus* Oliv) (Bruchidae Coleoptera) infesting stored groundnut under Bhubaneswar condition. *Indian Journal of Agriculture Research* **38**: 15-21.

Yadav VK Zope AV Bainade PS Thrimurthy VS. 2005 Efficacy of some medicinal plant extracts. *Journal of Plant Disease Science* **1**: 123-127.

Table 1
Antifungal effect of different concentrations of plant extracts and oils on the pathogen *Rhizoctonia solani*

Name of plant extracts	**Relative magnitude of inhibition (mm)**				
	100ppm	**200ppm**	**300ppm**	**500ppm**	**1000ppm**
Abrus precatrious L	-	-	-	-	-
Acacia auriculiformis A. Cunn.	-	-	-	-	-
Acacia nilotica (L) Del	-	1.25	2.0	2.25	2.5
Aegle marmelos (L) Carr	-	1.5	1.75	2.0	2.5
Allium cepa L.	1.75	2.0	2.25	3.0	3.25
Allium sativum L.	2.0	3.25	4.25	4.75	5.75
Aloe vera (L) Webb & Berth	1.25	1.5	1.75	2.25	2.5
Alstonia scholaris (L) R.Br.	-	-	-	1.25	1.5
Azadirachta indica A. Juss.	1.25	1.75	2.0	2.5	2.75
Bougainvillea glabra Choisy	-	-	-	-	-
Brassica compestris L.	-	-	-	-	1.25
Butea monosperma (Lamk.) Taub	-	-	-	1.5	2.0
Callistemone lanceolatus DC	-	-	-	-	1.25
Calotropis procera (Ait.) R. Br.	-	1.25	1.5	1.75	2.25
Cannabis sativum, L.	-	-	1.25	1.75	2.0
Cassia didymobotrya Fresen	-	-	1.5	1.75	2.0
Chenopodium album L.	-	-	1.25	1.25	1.5
Citrus lemoni (L) Burm. F	1.25	1.5	2.0	2.25	2.5
Convolvulus arvensis L.	-	-	-	-	-
Coronopus didymus (L) Sm.	-	-	-	1.5	1.75
Datura stramonium L.	-	1.25	1.5	1.5	2.0

Name of plant extracts	Relative magnitude of inhibition (mm)				
	100ppm	**200ppm**	**300ppm**	**500ppm**	**1000ppm**
Emblica officinalis Gaertn.	2.0	2.5	2.75	3.0	3.25
Eucalyptus citriodora Hook	1.25	1.25	1.5	2.25	3.0
Gmelina asiatica Roxb. Hort. Berg	1.25	1.5	1.75	2.0	2.0
Hibiscus rosa-sinensis L.	-	-	-	-	-
Juglans regia L.	-	-	1.25	1.75	2.0
Lantana camara L	1.5	1.75	2.0	2.5	2.75
Launaea asplenifolia (Willd) Hook	-	-	-	1.25	1.75
Lawsonia inermis L.	1.25	1.25	1.5	2.0	2.25
Morus alba L.	-	-	-	-	-
Murraya exotica L.	-	1.25	1.5	2.0	2.75
Murraya koengii (L) Sprenge	-	1.25	1.25	1.5	1.5
Nerium indicum Mill. Gard.	-	1.25	1.25	1.5	1.75
Pongamia glabra Vent.	1.5	1.75	1.75	2.25	2.5
Psidium guajava L.	-	-	1.25	1.5	1.5
Terminalia arjuna (Roxb. ex DC) Wt. & Arn	1.25	1.5	1.75	2.0	2.25
Terminalia bellerica (Gaertn.) Roxb.	-	1.5	1.75	1.75	2.25
Terminalia chebula Retz.	-	1.5	2.0	2.5	3.0
Thevatia peruviana (Pers.) Merr	-	-	-	-	-
Triphla (Plant drug)	-	1.25	1.5	2.0	3.0
Vicoa vestita Benth. ex Hook	-	1.25	1.5	1.75	1.75
Vitex agnus L.	-	1.25	1.5	2.0	2.25
Vitex negundo L.	-	-	-	1.25	1.5
Withania somnifera (L) Dunal	-	-	-	-	-

Name of plant extracts	**Relative magnitude of inhibition (mm)**				
	100ppm	**200ppm**	**300ppm**	**500ppm**	**1000ppm**
Oils					
Azadirachta indica A. *Juss*	-	-	-	1.5	2.0
Brassica compestris L	-	-	-	-	1.25
Emblica officinalis Gaertn.	-	-	1.25	1.25	1.5
Olea europaea L	-	1.25	1.5	2.0	3.0
Prunus amygdalus Batsch.	-	-	-	1.5	1.75
Oryza sativa L.	-	-	-	-	-
Helianthus annus L.	-	-	-	-	-
Syzygium aromaticum (L) Merr. & Perry	3.25	3.75	4.5	5.25	7.5