

MANAGEMENT OF RHIZOCTONIA SOLANI BY USING ANTAGONIST, BOTANICALS AND ESSENTIAL OILS

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ABSTRACT

Different strains of *Trichoderma harzianum*, plant extracts, and essential oils were evaluated against the growth of *Rhizoctonia solani* the causal agent of aerial blight of soybean. The studies revealed that *Th-2* strain of *Trichoderma harzianum* was the best in inhibiting the growth (86.7 %) of the pathogen *R. solani*, while least effective strain was *Th-9* showed only 76.2% inhibition. Amongst the four plant extracts, Onion extract was found most effective in inhibiting (100%) the growth whereas Eucalyptus exhibited minimum inhibition (3.2%) in the growth at 20% concentration. Among the five essential oils tested; *Mentha*, *Citronella* and *Peppermint* showed 100% inhibition in the mycelial growth of the test fungus at both the concentrations i.e. 4 μ L and 8 μ L. The result concluded that the disease can be managed by using plant extracts, essential oils and biocontrol agents which are all ecofriendly ways to manage disease without any harm to environment and non target plants.

INTRODUCTION

Soybean (*Glycine max L. Merrill*) is an important global leguminous crop, providing oil and protein and is considered as a source of complete protein. Soybean is infected by the pathogen at any stage of growth, which causes very rapid defoliation and frequently crop failure (Crispin and Gallegoes, 1963). Among the major diseases of soybean, aerial blight of soybean is important one, caused by *Rhizoctonia solani*. It is a destructive plant pathogen with an almost unlimited host range (Adams, 1988). Patel and Bhargava (1998) reported that symptoms generally appeared at flowering stage and increase with crop canopy and age of the plants. The disease also reduced shoot length, pod and seed formation, total number of seeds and seed weight. Yang et al. (1990) reported that a large number of diseased leaves with small circular lesions caused by microsclerotia in case of web blight but in case of aerial blight, leaf blight and defoliation were major symptoms. It has wide host range, therefore, its management is always challenging under ecological sustainable agriculture farming system. Sharma (1996) evaluated the biocontrol fungi and bacteria against *R. solani*, following dual culture technique in laboratory conditions. The fungal bioagents viz. *T. harzianum* and *T. viride*, *G. virens* and some field isolates of *Trichoderma* species were found highly effective in parasitizing the mycelium of *R. solani* within 10 days. Talanca (1999) reported that in laboratory, *Trichoderma* spp. suppressed the growth of *R. solani* and *Sclerotium rolfsii* upto 62 and 25 per cent, respectively. Melo and Faull (2000) reported that *Trichoderma* is effective in the control of *Rhizoctonia solani*.

Azad et al., 2013 evaluate bio control agent against *Colletotrichum gloeosporioides* and Purohit et al., 2013 evaluated *Trichoderma harzianum* against *Gloeocercospora sorghi*. Sindham et al. (1999) suggested that all the plant extracts viz., Onion, Ginger, Neem, Garlic, Mint, Eucalyptus, Tulsi, Datura, Bougainvillea were inhibitory to the growth of *R. solani*. Ansari (1995) reported fungistatic activity of extracts of *Ocimum sanctum*, *Mentha arvensis* and *Eucalyptus* spp. against *R. solani*. Tangonan et al. (2002) reported that Tuba (*Croton tiglium*) plant extract, Kamantigue (*Impatiens balsmina*) seed powder was found effective as therapeutic control against leaf blight caused by *R. solani*. Meena et al. (2003) reported that bulb extract of Garlic at 5% concentration (w/v) completely inhibited the mycelial growth of the fungus. Sehajpal et al. (2009) evaluated the antifungal effect of 44 plant extracts against the pathogen *Rhizoctonia solani* by disc diffusion method. Out of 44 plants tested, 36 plant extracts showed varied degree of antimicrobial effect at different concentrations against the pathogen. *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. The antifungal activities of some essential oil viz; *Palmarosa* (srivastava et al., 2003), *Citronella*, Lemongrass oil (srivastava et al., 2001), *Ocimum*, *Cardamom*, *Curcuma* and *Mentha* sp were recorded by Handique and Singh, 1990; Gangrade et al., 1991; Singatwadia and Katiwa, 2001). Essential oils from *Allium sativum* and 3 other plants were promising inhibitors of *Rhizoctonia solani* causing sheath blight of rice (Dhaliwal et al., 2003). Hence the present investigation was aimed to

determine the effective management against aerial blight of soybean through ecofriendly methods.

MATERIALS AND METHODS

Evaluation of antagonist

In vitro evaluations of different isolates of *Trichoderma harzianum* (Th-2, Th-3, Th-9, Th-31 and Th-37) against *R. solani* were studied by dual culture technique described by Morton and Stroube (1955) on PDA media. The experiment was replicated thrice at 28 ± 1°C. Observations on the growth of test fungus and antagonist were recorded consecutively for five days to record competitive saprophytic ability of the antagonist

Evaluation of plant extract

Extracts of four different plants viz; Garlic, Onion, Eucalyptus and Turmeric at different concentrations (5%, 10%, 15% & 20%) were evaluated against *R. solani* following the procedure given by Ansari (1995) with a slight modification. The efficacy of selected plant extracts for their antifungal properties were assayed by poisoned food technique on PDA (Groover and Moore, 1962). Three replications were made and observations on mycelial growth diameter (mm) were recorded at 24 hours till check plate was fully covered with the growth of the test fungus 28 ± 1°C.

Evaluation through essential oils

Five oils, viz; *Palmaroza*, *Mentha*, *Citronella*, *Geranium* and *Peppermint* at different concentrations (4 µl & 8 µl) were evaluated against *R. solani* by dual culture technique described by Morton and Stroube (1955) with some modifications and

replicated thrice. Observations as mycelial growth diameter (mm) was recorded at 24 hours at 28 ± 1°C

RESULTS AND DISCUSSION

Biocontrol agent

The dual culture studies revealed that all the five isolates of antagonist inhibited the growth of the pathogen *R. solani* significantly and inhibition zones were visible by 72 hours at 28 ± 1°C. A demarcation line was produced between the fungus and bioagent after 48 hours. After 96 hours (Fig. 1), Th-2 strain was the best in inhibiting the growth (86.7 %) of the test fungus followed by Th-31(83.7%), Th-37(83.3) and Th-3(79.2) respectively, when compared with check, while least effective strain was Th-9 that showed only 76.2% inhibition. After 120 hours of incubation the growth of the test pathogen was overlapped by all the five strains of *T. harzianum* completely (Table 1). The obtained data are agreement with the finding of Sharma and Shankran(1996); and Talanca(1999). Hence due to effective results shown by *Trichoderma harzianum*, it can be used as potential biocontrol agent against *R. solani* and it can be incorporated in Integrated Disease Management (IDM) module in sustainable agriculture as an effective management practice in the field to manage the aerial blight of soybean.

Plant extracts

The present study revealed that all the plant extracts used showed inhibition at all the concentrations against *R. solani*. The result indicated that increase in the per cent inhibition was invariably proportional to the concentration of plant

Table 1: Comparison between the growth and inhibition per cent of *Rhizoctonia solani* due to *Trichoderma harzianum* at 28 ± 1°C

S.No.	Treatments	Colony diameter(mm) and inhibition % of <i>R.solani</i> at different incubation period									
		24 hours		48 hours		72 hours		96 hours		120 hours	
		G	I	G	I	G	I	G	I	G	I
1	Th-2	15.6	37.6	32.6	29.5	29.6	62.3	10.6	86.7	0.00	100
2	Th-3	24.3	2.8	32.3	30.2	32.3	58.9	16.6	79.2	0.00	100
3	Th-9	22.6	9.6	32.3	30.2	32.3	58.9	19.0	76.2	0.00	100
4	Th-31	21.0	16.0	35.6	23.1	31.0	60.5	13.0	83.7	0.00	100
5	Th-37	25.0	0.00	34.3	25.9	33.0	58.0	13.3	83.3	0.00	100
6	Check	25.0	-	46.3	-	78.6	-	80.0	-	80.0	-
	CD at 5%	2.9		2.8		2.0		1.7		-	
	SEm. +	9.7		9.1		6.8		5.7		-	

G = colony diameter, I = Per cent inhibition (%)

Table 2: Effect of different Plant extracts on the growth and inhibition per cent of *Rhizoctonia solani* after 72 hrs at 28 ± 1°C

Sl. No.	Treatments(Botanicals)(extracts)	5% Conc.		10% Conc.		15% Conc.		20% Conc.	
		G	I	G	I	G	I	G	I
1	Onion	63.6	20.5	0.00	100	0.00	100	0.00	100
2	Garlic	65.3	18.3	39.3	50.3	34.3	57.1	20.0	75.0
3	Eucalyptus	77.3	3.3	54.3	32.1	56.3	33.0	51.0	36.2
4	Turmeric	46.3	42.1	39.6	50.5	30.0	62.5	24.3	69.9
5	Check	80	0.00	80	0.00	80	0.00	80	0.00
				CD at 5%		SEm. +			
	For plant extract			2.9		1.0			
	For concentration			2.6		9.2			
	For interaction			5.8		2.0			

G = Average Colony diameter, I = Average Inhibition %

Table 3: Effect of different essential oils on growth and inhibition per cent of *Rhizoctonia solani* after 72 hrs at 28 ± 1°C

S. No.	Treatments(Essential Oils)	Conc. (4µL)		Conc. (8µL)	
		G	I	G	I
1	<i>Palmaroza</i>	28.3	64.6	22.3	70.8
2	<i>Mentha</i>	0.00	100	0.00	100
3	<i>Citronella</i>	0.00	100	0.00	100
4	<i>Geranium</i>	16.6	79.2	0.00	100
5	<i>Peppermint</i>	0.00	100	0.00	100
6	Check	80	-	80	-
		CD at 5%		SEm ±	
	For oil	0.53		.018	
	For concentration	0.34		0.11	
	For oil x concentration	0.76		0.25	

G = Average Colony diameter, I = Average Inhibition %

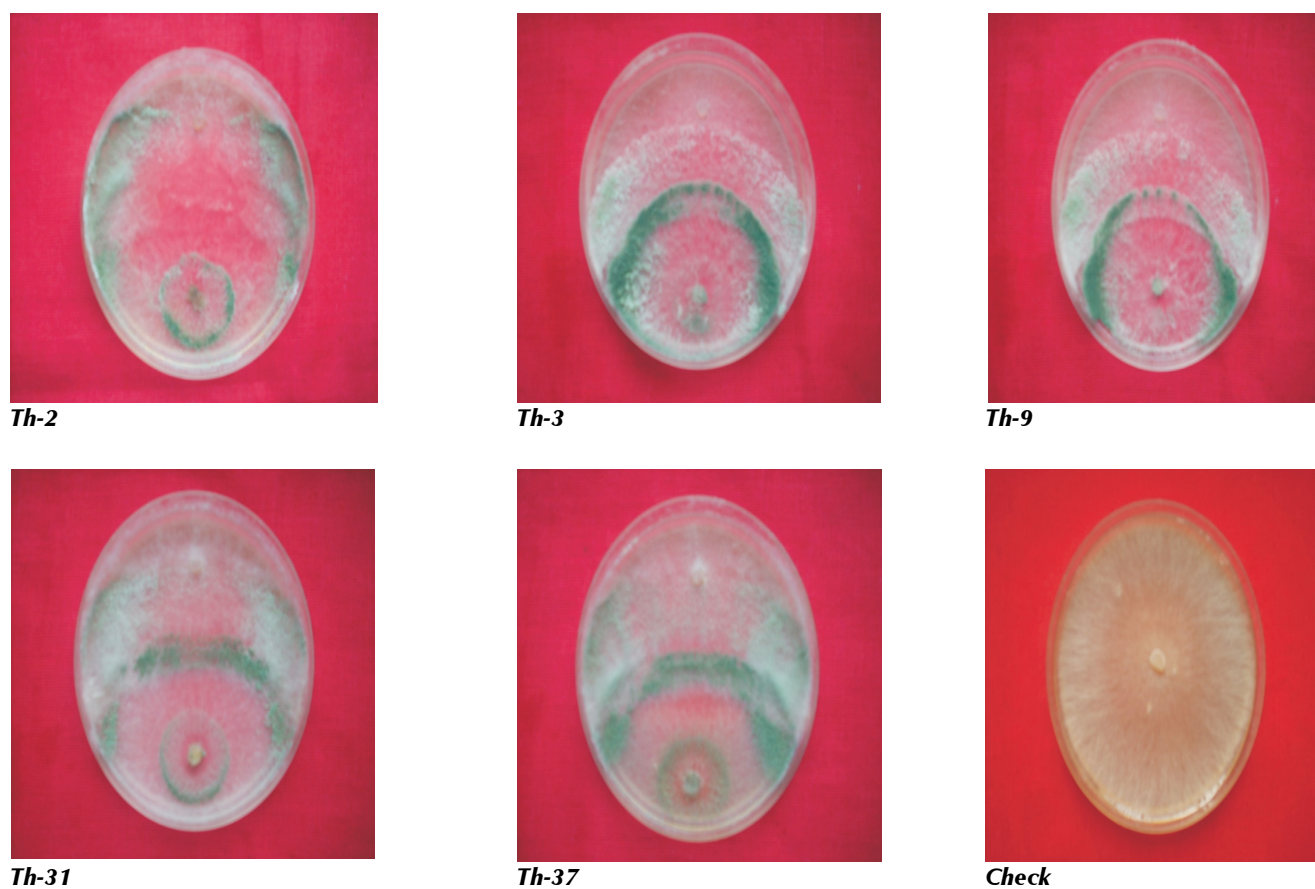
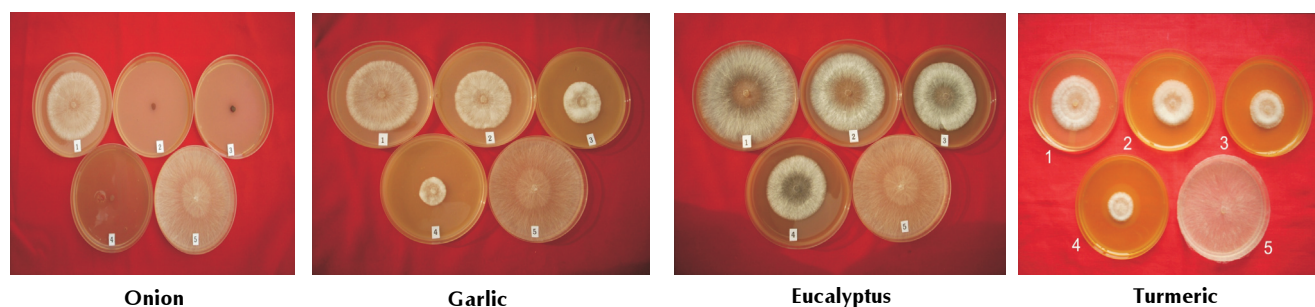
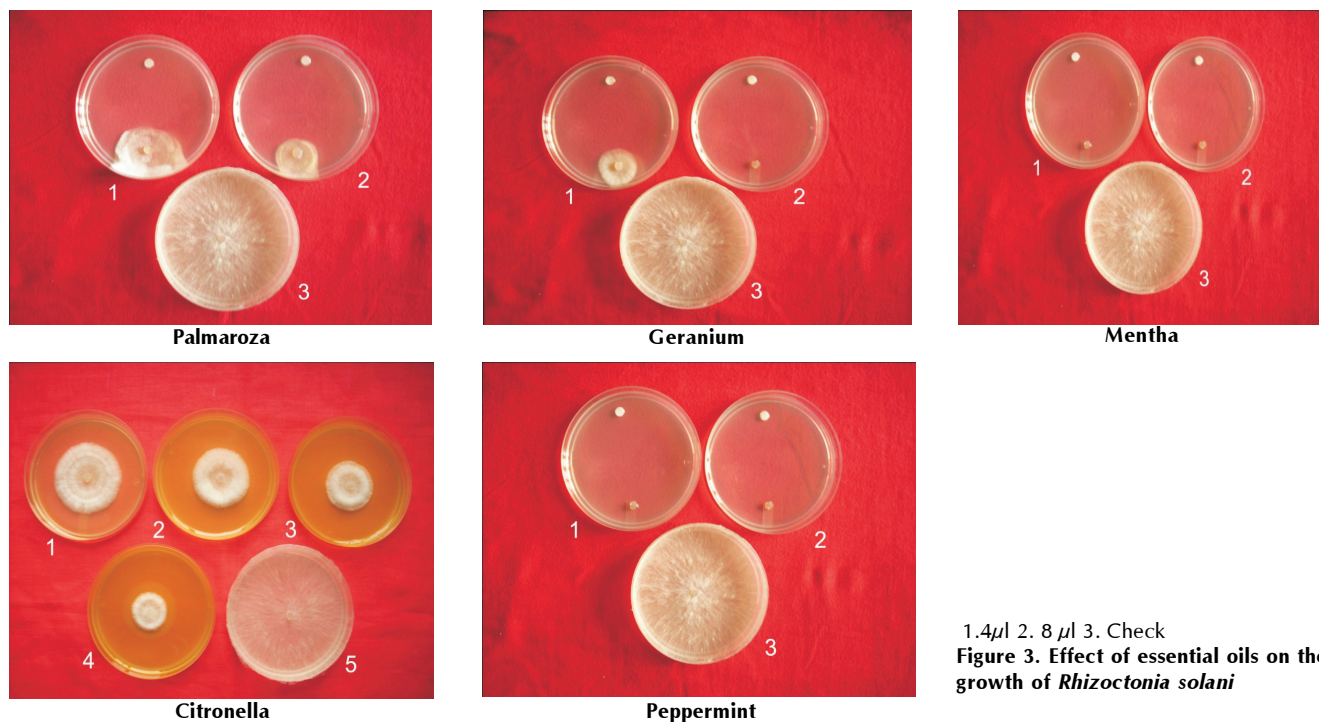


Figure 1: Antagonistic effect of different strains of *Trichoderma harzianum* at 96 hours.



1. 5% 2. 10%; 3. 15% 4. 20%; 5. Check

Figure 2. Effect of plant extract on the growth of *Rhizoctonia solani*



extracts. Out of four extracts: Onion extract was found to be the most effective (100%) followed by Garlic (75%) and Turmeric (69.9%), while Eucalyptus extract was least effective in checking the mycelial growth of *R. solani* (3.2%) at 20% concentration (Table 2 and Fig. 2). The data recorded on colony diameter after 72 hours of incubation were significant among themselves at different plant extracts due to difference in the size of the colony diameter. Ansari (1995) reported fungistatic activity of Eucalyptus extract against *R. solani* and Sindham *et al.* (1999) reported the antifungal activity of garlic against *R. solani*. Thus effectiveness of Onion, Garlic and turmeric extracts against aerial blight of soybean showed that it can be exploited commercially for managing the disease.

Essential oils

The data recorded on colony diameter after 72 hours of incubation at $28 \pm 1^\circ\text{C}$ were significant among themselves for essential oils at different concentrations. The result revealed that out of the five essential oils; *Mentha*, *Citronella* and *Peppermint* showed 100 per cent inhibition of the mycelial growth of the test fungus at both the concentrations, while least inhibition (64.6% and 70.8%) at 4 μ L and 8 μ L respectively was recorded by *Palmaroza* (Table 3 and Fig. 3) Srivastava *et al.* (1993) reported the antifungal activity of *Palmarosa* and in 2001 they reported the antifungal activity of *Citronella*. Nafiseh Katooli *et al.* (2011) evaluated essential oils which suppressed the mycelial growth of *R. solani*.

REFERENCES

- Adams, G. C. 1988. *Thanatephorous cucumeris* (*R. solani*) a species complex of wide host range. In Sidhu, G. S. (ed.) *Advances in Plant Pathology. Genetics of Plant pathogenic fungi*, Academic Press, London. 6: 535-552.
- Ansari, M. M. 1995. Control of sheath blight of rice by plant extracts.

Indian Phytopath. 48: 268-270.

- Azad, C. S., Srivastava, J. N. and Chand, G. 2013. Evaluation of bio-agents for controlling fruit rot/ anthracnose of banana caused by *Colletotrichum gloeosporioides* in-vitro condition. *The Bioscan.* 8(4): 1221-1224.
- Crispin, A. and Gallegos, C. C. 1963. Web blight: A severe disease of beans and soybeans in Mexico. *Plant Dis. Rep.* 47: 1010-1011.
- Dhaliwal, H. J. S., Thind, T. S. and Mohan, C. 2003. Activity of some essential oils against *Rhizoctonia solani* Kuhn the cause of black scurf of potato. *J. Mycology and Plant Pathology.* 33: 399-02.
- Gangrade, S. K., Shrivastava, R. D., Sharma, O. P., Jain, N. K. and Trivedi, K.C. 1991. In vitro antifungal effect of essential oils. *Indian Perfumer.* 35: 46-48.
- Grover, R. K. and Moore, J. D. 1962. Toximetric studies of fungicides against brown rot organisms, *Sclerotia fructicola* and *S. laxa*. *Phytopathology.* 52: 876-880.
- Handique, A. K. and Singh, H. B. 1990. Antifungal action of lemongrass oil on some soil born plants pathogens. *Indians Perfumer.* 232-234.
- Meena, R. L.; Rathore, R. S. and Kusum, M. 2003. Efficacy of biocontrol agents against *Rhizoctonia solani* f. sp. *sasakii* causing banded leaf and sheath blight of maize. *J. Mycology and Plant Pathology.* 33(2): 310-312.
- Melo, J. S-de and Faull, J. L. 2000. Parasitism of *Rhizoctonia solani* by strains of *Trichoderma* spp. *Scientia-Agricola.* 57: 1, 55-59.
- Morton, D. J. and Stroube, W. H. 1955. Antagonistic and stimulatory effect of soil microorganisms upon *Sclerotium*. *Phytopathology.* 45: 417-420.
- Nafiseh Katooli, N., Raheleh Maghsodlo and Seyed Esmaeil R. 2011. Evaluation of eucalyptus essential oil against some plant pathogenic fungi. *J. Plant Breeding and Crop Science.* 3(2): 41-43.
- Patel, B. L. and Bhargava, P. K 1998. Aerial blight of soybean (*Glycine max.*) caused by *Rhizoctonia solani*. *Indian J. Agric. Sci.* 68(5): 277-278
- Purohit, J., Singh, Y., Bisht, S. and Srinivasaraghvan, A. 2013.

- Evaluation of antagonistic potential of *Trichoderma harzianum* and *Pseudomonas fluorescens* isolates against *Gloeocercospora sorghi* causing zonate leaf spot of sorghum. *The Bioscan*. **8(4)**: 1327-1330
- Sehajpal, A., Arora, S. and Kaur, P. 2009.** Evaluation of plant extracts against *Rhizoctonia solani* causing sheath blight of rice. *The J. Plant Protection Sciences*. **1(1)**: 25-30
- Sharma, J. K. and Shankran, V. 1996.** Rhizoctonia web blight of *Albizia falcataria* in India. *European J. Forest Path.* **14**: 261-264
- Sindham, G. S., Indra-Hooda; Parashar, R. D. and Hoodra, I. 1999.** Effect of some plants extracts on the vegetative growth of root rot causing fungi. *J. Mycol. Pl. Pathol.* **29**: 123-125
- Singatwadia, A. and Katewass 2001.** In vitro studies on antifungal activity of essential oil of *Cymbopogon martini* and *Cymbopogon citrates*. *Indian Perfumer*. **45(1)**: 53-55.
- Srivastava, S. and Singh, R. P. 1993.** Antifungal activity of Palmarosa. *Plant Disease*. **22**: 123-125.
- Srivastava, S. and Singh, R. P. 2001.** Antifungal activity of essential oil of *Murraya Koenigii (L)*. Spreng. *Indian Perfumer*. **45(1)**: 49-51
- Srivastava, S. and Singh, R. P. 2003.** Antifungal activity of essential oil of plants .Spreng. *Indian Perfumer*. **48(1)**: 32-41
- Talanca, A. H. 1999.** Utilization of *Trichoderma spp.* microorganism as biological control of plant disease. *Pusat Penelitian Sosial Ekonomi Pertanian, Bogor (Indonesia)*. pp. 326-331.
- Tangonan, N. G. and Cuambat, F. D. 2002.** Controlling leaf blight of durian caused by *Rhizoctonia solani*. *Pest management council of the Philippines*. p. 118.
- Yang, X. B., Berggren, G. T., Jr. and Snow, J. P. 1990.** Types of *Rhizoctonia* foliar blight of soybean in Louisiana. *Plant Disease*, **74**: 501-504.

