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Botanical management of *Rhizoctonia solani* in soybean

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ABSTRACT

Soybean is one of the important most pulse and oilseed crops grown all over the world. The root rot disease of soybean caused by *Rhizoctonia solani* is generally found in the soybean growing area in Maharashtra state. The present investigation was undertaken to study effects of botanical extract on root rot of soybean under glass house condition from pot culture experiment in glass house, it was found that the minimum PDI was observed in seed treatment with botanical extracts *viz*., *Zingiber officinale* L. (31.48) followed by *Allium sativum* L. (35.18) and *Azardirachta indica* (40.18)

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INTRODUCTION

Soybean is world's first rank crop as a source of vegetable oil. In India, soybean is concentrated mostly in the states of Madhya Pradesh, Maharashtra, Rajasthan and Karnataka. The crop is suffered by many fungal diseases of which root rot caused by *Rhizoctonia solani* is one of the most destructive occurs at pre-emergence or post-emergence stage of seedlings and causes significant losses in yield. It is soil borne disease and creates great problems in its management. Apart from soybean, *R. solani* is reported to cause sheath blight of rice, collar rot of passion fruit, banded sclerotial disease of maize, *Rhizoctonia* leaf blight of sunflower and *Rhizoctonia* rot of carrot, etc.

MATERIAL AND METHODS

Isolation of pathogens, pathogenicity test and symptomatology:

Isolation :

The affected portion of stem and root of the samples were cut in to small pieces, washed thoroughly in tap water to remove dirt. The pieces were then disinfected by 1:1000 mercuric chloride solutions for two minutes followed by serial washing in three changes of sterilized water to remove the traces of mercuric chloride. Three to four such pieces were then plated aseptically on sterilized potato dextrose agar medium in each Petriplate. Petriplates were incubated at room temperature of 280 $\pm$ 2^{0}C and the isolated *Rhizoctonia* sp. was purified and stored for further use.

Inoculation (Pathogenicity test) :

The pathogenicity test was conducted by soil inoculation method. Pure culture of *Rhizoctonia solani* was multiplied on sterilized corn meal sand medium. Mycelium suspension from one plate was transferred to 250 ml flasks and placed in an incubator at 26^{0}C and shaken daily for 5 minutes. It was multiplied for 10 days (Rollins *et al.,* 1999) and then uniformly mixed in the sterilized mixture of soil and compost (2:1 by volume) at the rate of 0.5 per cent v/v (Keinath, 1995). Ten pots

were sterilized with 5 per cent copper sulphate solution, out of that a set of five pots was filled with *Rhizoctonia solani* inoculated soil and remaining five pots were filled with sterilized soil served as control and kept for incubation. Twelve seeds of soybean (JS-335) were surface disinfected by dipping in 0.1 per cent mercuric chloride and were sown in each pot.

Reisolation :

The pathogens were reisolated from the roots and stems of artificially inoculated plants showing typical symptoms. Cultures obtained were transferred on potato dextrose agar slants for comparing with original cultures.

Morphological studies and identification :

The fungus was identified upto species levels on the basis of their morphological characters and with the help of "Fungus identification services" at 'Agharkar Research Institute' (Maharashtra Association for the Cultivation of Sciences), Pune (M.S.).

Symptomatology :

Diseased seedlings of soybean were carefully uprooted and symptoms developed on the seedlings stem and underground parts were studied.

Extraction of anti-fungal plant extracts :

The crude extracts were obtained as per the method described by Bambode and Shukla (1973). In this method, Ten g of the plant part were weighed and thoroughly washed. The plant material was ten crushed in the mortar and pestle by adding 10 ml of distilled sterilized water. After that the crushed material was then strained through double layered muslin cloth and filter paper (Whatman No.1) and the filtrate obtained was used in the experiment.

Seeds of soybean were dipped in selected plant extracts, dried under shade and used for sowing in pots having seek soil of *Rhizoctonia solani* in glass house. (Abhilash and Patil, 2006).

Table A : Plants and their parts used for extraction

Sr. No.	Botanical name	Common name	Plant part used
1.	*Curcuma longa* L.	Turmeric	Rhizomes
2.	*Zingiber officinale* L.	Ginger	Rhizome
3.	*Allium sativum* L.	Garlic	Cloves
4.	*Azardirachta indica*	*Neem*	Leaves
5.	*Eucalyptus* sp.*Labill.*	*Nilgiri*	Leaves
6.	*Hibiscus rosa-sinesis*	Jaswand	Leaves
7.	*Lantena camera* L.	Ghaneri (wild)	Leaves
8.	*Ocimum sanctum* L.	*Tulsi*	Leaves
9.	*Vinca rosea* L.	Sadaphuli	Leaves
10.	*Pongimia pinnata* (L.) Pierre	*Karanj*	Seed

Table B : Botanical management of *Rhizoctonia solani* in glass house condition

Symbol used	Botanical used	Rate used per kg of seed
T_1	*Curcuma longa* L.	5%
T_2	*Zingiber officinale* L.	5%
T_3	*Allium sativum* L.	5%
T_4	*Azardirachta indica*	5%
T_5	*Eucalyptus* sp.*Labill.*	5%
T_6	*Hibiscus rosa-sinesis*	5%
T_7	*Lantena camera* L.	5%
T_8	*Ocimum sanctum* L.	5%
T_9	*Vinca rosea* L.	5%
T_{10}	*Pongimia pinnata* (L.) Pierre	5%
T_{11}	Control	No treatment
T_{12}	Control with *thiram*	3g

Observation recorded :

Following observations were recorded at various stages as per schedule.

Germination percentage :

The germination percentage of soybean seed var. JS-335 was determined by roll towel method.

Seedling emergence :

The emergence count was taken 7 days after sowing.

Per cent disease incidence :

Pre-emergence root rot :

Comparing germination percentage with seedling emergence percentage gave the value the pre-emergence root rot.

Post emergence root rot :

The observations on number of infected and healthy seedlings were recorded at 30 days after sowing (DAS).

The per cent disease incidence was calculated by using following formula.

$$\text{PDI} = \frac{\text{Total number of infected seedlings}}{\text{Total number of seedlings (Health + infected)}} \times 100$$

Statistical analysis :

Before analyzing the data, percentages were converted into arcsin values. The data was subjected to statistical analysis by following standard method for analysis of variance. The standard errors for treatment mean and critical difference at 5 per cent level of significance were worked out as per Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

Symptomatology :

Browning and rotting of tissue at collar region of young seedling were noticed in infected plants while at latter stage plant showed brown discolouration at ground level. Affected plant gradually turned yellow with water soaked lesions at basal stem. The affected plants were easily pulled out. The white mycelial growth of *R. solani* with black mustard seed like sclerotial bodies were observed on severely affected roots. The secondary roots were found decayed while tap roots remained unaffected. Similar results were obtained by Celetti *et al*. (1990).

Isolation, pathogenecity and reisolation :

Isolation :

Isolations made from the infected roots showing typical symptoms of rotting which yielded the fungal culture of *Rhizoctonia solani*. The growth of fungi from the infected tissue was distinctly visible after four days in Petri plate containing the potato dextrose agar medium. The pure culture of fungi was obtained by hyphal tip method on potato dextrose agar medium.

Pathogenecity :

The pathogenecity test of *Rhizoctonia solani* was conducted by soil inoculation method. the typical rotting symptoms were drying of plants after 20 days and it resulted in to cent per cent mortality. Pre-emergence and post-emergence mortality observed in soil inoculation was 33.33 per cent and 66.66, respectively results are presented in Table 1.

Reisolation :

The fungus was reisolated from roots of artificially infected plants. The reisolated fungal culture was

Table 1 : Pathogenecity test for *Rhizoctonia solani* on soybean in

Sr. No.	Particulars	Sick soil	Control
1.	No. of seeds sown	12	12
2.	No. of seeds germinated	8	12
3.	No. of non- germinated seeds	4	0
4.	No. of plants root rotted	8	0
5.	No. of days required for root rotting after inoculation	20	-
6.	Per cent mortality	33.33	0
7.	Pre-emergence per cent	66.66	0
8.	Post-emergence per cent	100.00	0

compared with respective original culture and found identical to original culture in all respects which was used for further studies. For the confirmation of the Koch's postulates of the isolated organisms *Rhizoctonia solani* Kuhn. was found pathogenic to soybean and it was in the conformity with the work done by Naik and Ui (1981).

Morphological studies :

Seven days old fungus culture of pathogen grown on potato dextrose agar was found feathery white in colour in the beginning and turned brown to dark blackish with advanced age of culture. Surface of colonies were light brown and dense. Mycelium was branched, septate and hyaline. Hyphal branching was right angle to parent hypae. Mycelium was variable in length and width. Dark brown sclerotia were 162 µm in diameter. These results are in agreement with Singh *et al*. (1973). The Sclerotia in present study were dark brown coloured and 0.5 to 1.5 µm in diameter. (Lakshamanan and Nair, 1985). The identification was confirmed by referring to the Mycologist, Agharkar Research Institute, Pune.

Sclerotial formation :

The sclerotia of *Rhizoctonia solani* Kuhn. were

Table 2 : Effect of botanicals against *Rhizoctonia solani* in glass house

Tr. No.	Plant extracts	PDI*		Total PDI	Per cent disease control
		Pre-emergence	Post- emergence		
T_1	*Curcuma longa* L.	23.33 (28.78)	47.61 (43.63)	70.95	21.78
T_2	*Zingiber officinale* L.	6.66 (12.92)	24.81 (29.82)	31.48	65.29
T_3	*Allium sativum* L.	6.66 (12.92)	28.51 (32.19)	35.18	61.21
T_4	*Azardirachta indica*	13.33 (21.14)	26.85 (31.12)	40.18	55.70
T_5	*Eucalyptus* sp.*Labill.*	13.33 (21.14)	30.55 (33.50)	43.88	51.62
T_6	*Hibiscus rosa-sinesis*	13.33 (17.71)	38.33 (38.25)	51.66	43.04
T_7	*Lantena camera* L.	26.66 (30.78)	49.44 (44.63)	76.11	16.09
T_8	*Ocimum sanctum* L.	16.66 (23.85)	31.48 (33.93)	48.14	46.92
T_9	*Vinca rosea* L.	16.66 (23.85)	56.07 (48.47)	72.73	19.82
T_{10}	*Pongimia pinnata* (L.) Pierre	23.33 (28.78)	34.52 (35.94)	57.85	36.22
T_{11}	Control (No treatment)	33.33 (34.92)	57.38 (49.44)	90.71	0.00
T_{12}	Control with *thiram*	0 (0.00)	13.33 (21.14)	13.33	85.30
	S.E.±	4.47	2.96		
	C.D. (P=0.05)	13.05	8.65		

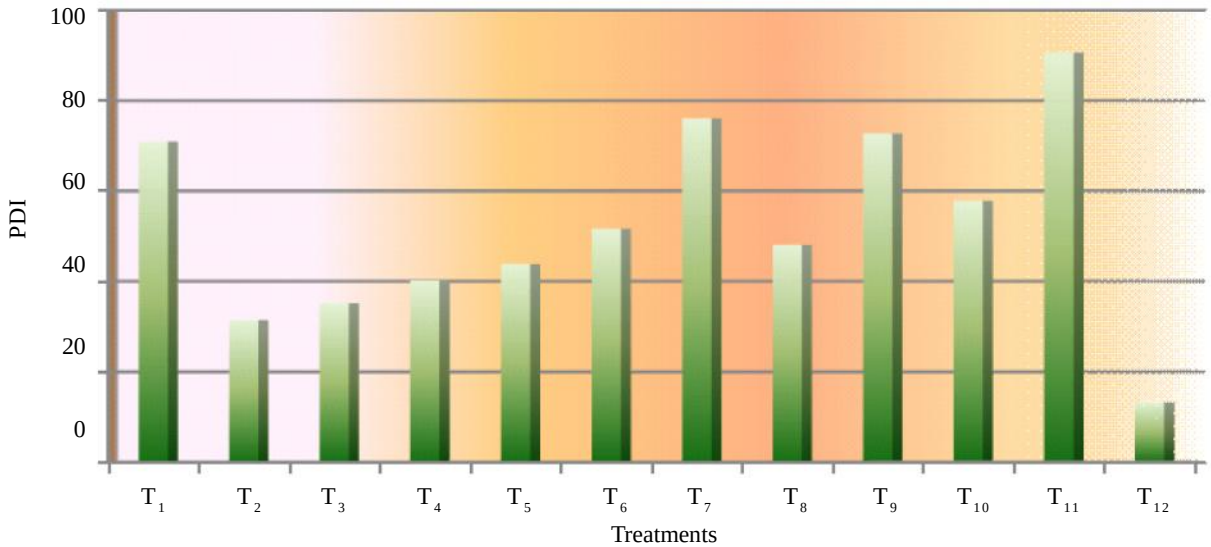

Fig. 1 : Effect of botanical extracts on PDI of root rot of soybean

brownish to dark brown in colour with round to regular shape. The sclerotia formation was started after 6 days of inoculation. The variation in size and shape of sclerotia was also observed. The sclerotia measured about 90 to 210 µm in diameter with average 162 µm.

Botanical management of *Rhizoctonia solani* in glass house:

The experiment on the effect of botanical for control of soybean root rot pathogen was conducted in pots under glass house conditions and the per cent disease incidence (PDI) were recorded at 30 days after sowing and quoted in Table 2 and depicted in Fig 1. The per cent disease incidence was observed at two phases, *i.e.* pre and post-emergence of seeding. It is revealed from the result that all the attempted treatments showed significantly less total PDI than control (no treatment). Minimum total PDI was observed in seed treatment of thiram (13.33) and *Zingiber officinale* L. (31.48) and followed by *Allium sativum* L. (35.18) and *Azardirachta indica* (40.18) which were significantly superior over control (no treatment)(90.71) .

Maximum total PDI was observed in control (no treatment) (90.71) and it was followed by *Vinca rosea* L. (72.68) and *Curcuma longa* L. (70.95). Now days farmers are approaching to various modes of disease control. Among them organic measures play a key role in the management of soil borne diseases. Review of the literature revealed that so far no work has been carried out on the efficacy of selected botanical extract used as seed dresser against *Rhizoctonia solani*. However, their efficacy was reported on other fungi.

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