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Evaluation of Plant Extracts against *Rhizoctonia solani* Causing Agent of Soybean Aerial Blight

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Abstract

In *in-vitro* condition it was revealed that plant extracts significantly inhibited the growth of *R. solani* at the levels of concentration i.e. 10%, 15% and 20%. After 5th and 10th days three botanicals *viz., Datura spp*., *Lantana camara* and *Azadirachta indica* maximum inhibited the fungal growth while maximum growth was recorded in control. These three botanicals were significantly superior over all other tested botanicals. The minimum growth inhibition was recorded in *Tagetes erecta* followed by *Eucalyptus spp.* and *Jatropha curcus*. Among the botanicals tested, *Datura spp* recorded significantly least disease incidence (6.03%). This was followed by *Lantana camara* (6.83%), *Jatroph curcus* (8.53%) and *Azadirachta indica* (9.33%). The maximum disease incidence was recorded in *Tagetes erecta* (11.56%) followed by *Eucalyptus spp.* (10.83%). Significantly highest average grain yield per plant was recorded in *Datura spp.* which was at par with *Lantana camara*, *Jatropha curcus*. Lowest average grain yield kg/ha was recorded in control which was at par with *Tagetes erecta, Eucalyptus spp* and *Azadirachta indica*.

Key words : *Botanicals, soybean, aerial blight, rhizoctonia.*

Introduction

Soybean contains 40-42% protein and 20-22% edible oil on dry weight basis. As well, it contains high level of amino acids such as lysine, leucine, lecithin and huge quantity of phosphorus. Currently, it is being used for manufacture of nutritional product for human being. Soybean is used for preparation of milk, curd, cheese etc. and can be afforded by lower class of people also. It has capability to fix atmospheric nitrogen, with the help of Rhizobium and enhanced soil fertility (1,2). In India, it is cultivated in 11.07 mh with an annual production of 12.49 mt and productivity 1127 kg/ha. In Madhya Pradesh, Soybean is cultivated on 6.1 mh with annual production of 6.4 mt and productivity of 1147 kg/ha in 2017 (3).

Soybean is a known host of a variety of pathogens including fungi, bacteria, viruses, nematodes and mycoplasma. So far, 29 fungal pathogens, 6 bacterial pathogens, 18 viruses, 6 nematodes and 3 mycoplasmal diseases have been recorded on this crop; among this fungal diseases are of regular occurrence (4).

The crop is also affected by many diseases such as yellow mosaic disease (Mungbean yellow mosaic virus), charcoal rot (*Rhizoctonia bataticola*), collar rot (*Sclerotium rolfsii*), Rhizoctonia root rot and Rhizoctonia aerial blight caused by *Rhizoctonia solani.* Rhizoctonia aerial blight is also known as Rhizoctonia foliar blight. Rhizoctonia foliar blight has been reported to cause epiphytotics in soybean throughout the world (5,6,7). In M.P. the disease is gaining importance as the disease is appearing every year in severe form. During Kharif 2016, this disease appeared in severe form on some of genotypes of soybean at Khandwa causing considerable losses (8).

Materials and Methods

***In-vitro* evaluation of plant extract against *Rhizoctonia solani* :** To find out antifungal activity of different plants extract against *Rhizoctonia solani* under *in-vitro* condition by using respective plant leaf extract in different concentrations with dextrose agar medium. Six plants extract *viz., Azadirachta indica*, *Jatropha curcus*, *Lantana camara*, *Datura spp*., *Tagetes erecta*, *Eucalyptus spp.* were used and evaluated by poisoned food technique method. Medium without adding any extract was used as control.

For preparation of leaf extract required quantity (10, 15 and 20 gm) of healthy and fresh leaves of each plant was taken in 100 ml sterile and distilled water and boiled till it became softened. Softened plant leaves were crushed in pestle mortar, and then extract was filtered. Two gm dextrose and two gm agar-agar were mixed in filtered leaf extracts and volume was made up to 100 ml and sterilized in an autoclave. To avoid bacterial contamination, a pinch of Streptomycin sulphate was added at the time of pouring of media in petriplates. Twenty ml media was poured in a sterilized petriplates and allow solidifying. A five mm disc *Rhizoctonia solani*

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was cut from 5 days old culture of test fungus and placed in the centre of medium. Three replications were maintained in each treatment along with control. The inoculated petriplates were incubated at 27ºC ± 2ºC. The observations for mycelial growth were noted after 3 days of inoculation and sclerotia were counted after 8 days of inoculation.

Percent inhibition of mycelial growth was calculated by the following formula,

Inhibition % = C–T/C × 100

Whereas

C = Diameter of fungus colony (mm) in control plate

T = Diameter of fungus colony (mm) in treated plate

***In-vivo* evaluation of plant extract against *Rhizoctonia* aerial blight :** After *in-vitro* evaluation of plant extracts against *Rhizoctonia solani* further evaluated in field against the Rhizoctonia aerial blight disease. The experiments was conducted in Randomized Block Design

Table-1 : Treatments.

Symbol	Treatment
T_1	*Azadirachta indica*
T_2	*Jatropha curcus*
T_3	*Lantana camara*
T_4	*Datura spp.*
T_5	*Tagetes erecta*
T_6	*Eucalyptus spp.*
T_7	Control

with seven treatments and three replications. The microplot size was 1.2M x 1M.

Results and Discussion

***In-vitro* evaluation of plant extract against *Rhizoctonia solani* :** Influence of botanicals at 10%, 15% and 20% concentration on mycelial growth of *R. solani* at *in vitro* condition: A total number of six botanicals viz., *Azadirachta indica*; *Jatropha curcus*; *Lantana camara*; *Datura stramonium*; *Tagetes erecta; Eucalyptus spp.* were evaluated against *R. solani* under *in-vitro* condition. It was revealed from the data presented in the (Table-2) that all the botanicals significantly inhibited the growth of *R. solani* at the levels of concentration i.e. 10%, 15% and 20%. The data summerized in table-2 reveals that after 5th day three botanicals viz., *Datura spp.* (21.12%) followed by *Lantana camara* (28.30%), *Azadirachta indica* (30.26%) maximum inhibited the fungal growth while maximum growth was recorded in control (56.38 mm). These three botanicals were significantly superior over all other tested botanicals. The minimum growth inhibition was recorded in *Tagetes erecta* (40.97%) followed by *Eucalyptus spp.* (40.76%) and *Jatropha curcus* (33.05%). After 10th day the data summerized in Table-3 reveals that the three botanicals viz., *Datura spp.* (51.52%) followed by *Lantana camara* (56.65%), *Azadirachta indica* (63.97%) maximum inhibited the fungal growth while maximum growth was recorded in control (88.84 mm). These three botanicals were significantly superior over all other tested botanicals. The minimum growth inhibition was recorded in *Tagetes erecta* (73.94%) followed by *Eucalyptus spp.* (73.62%) and *Jatropha curcus* (70.15%).

***In-vivo* evaluation of plant extract against Rhizoctonia aerial blight :** The botanicals tested against *Rhizoctonia solani* during *in-vitro* studies were selected and evaluated against Rhizoctonia aerial blight of soybean under field conditions. The field experiment was conducted during Kharif 2018, to evaluate the efficacy of six treatments *viz., Azadirachta indica*; *Jatropha curcus*; *Lantana camara*; *Datura stramonium*; *Tagetes erecta; Eucalyptus spp.* All the treatments were also found effective and recorded significantly reduced diseases incidence and diseases severity over untreated control.

Disease incidence percent: The results, indicated that all the treatments significantly influenced the *Rhizoctonia aerial blight* disease incidence in soybean. The Rhizoctonia aerial blight disease incidence (%) recorded after 1st, 2nd and 3rd spray were ranged from 18.1 (*Datura spp.*) to 34.7 (*Tagetes erecta*), against 48.6 percent incidence in unsprayed control. The mean of *Rhizoctonia solani* disease incidence (%) recorded with all the treatments was ranged from 6.03 (*Datura spp*) to 16.2 (Control). Among the botanicals tested, *Datura spp* recorded significantly least mean disease incidence percent (6.03). This was followed by *Lantana camara* (6.83), *Jatroph curcus* (8.53) and *Azadirachta indica* (9.33). The maximum disease incidence percent was recorded in *Tagetes erecta* (11.56) followed by *Eucalyptus spp.* (10.83).

Results (Table-4) obtained on the percentage reduction in Rhizoctonia aerial blight incidence over untreated control revealed that botanicals, *Datura spp* percentage over control showed highest reduction (62.77) in the disease incidence. This was followed by *Lantana camara* (57.83) and *Jatropha curcus* (47.34). Botanicals *Tagetes erecta*, *Eucalyptus spp.* and *Azadirachta indica* were found least effective which recorded minimum reduction of 28.64, 33.14, 42.40 percent, respectively in disease incidence.

Yield of soybean (kg/ha) : The yield varied among different treatments. The average grain yield kg/ha ranged between 980 kg/ha to 1433.33 kg/ha. Significantly highest average grain yield per plant was recorded in *Datura spp* (1433.33 kg/ha) which was at par with *Lantana camara* (1386.66 kg/ha), *Jatropha curcus* (1373.33 kg/ha). Lowest

Table-2 : Influence of botanicals at 10%, 15% and 20% concentration on mycelial growth of *R. solani* at 5 DAI.

S. No.	Treatments	Mean radial growth (mm) after five days of inoculation						
		10%	Growth inhibition	15%	Growth inhibition	20%	Growth inhibition	Mean A
1.	*Azadirachta indica*	33.33	40.04	30.00	47.97	27.45	50.88	30.26
2.	*Jatropha curcus*	37.34	32.82	32.10	44.33	29.70	46.85	33.05
3.	*Lantana camara*	31.83	42.74	27.75	51.88	25.33	54.67	28.30
4.	*Datura spp.*	26.33	52.63	20.78	63.96	16.25	70.92	21.12
5.	*Tagetes erecta*	45.67	17.84	40.35	30.03	36.89	33.99	40.97
6.	*Eucalyptus spp.*	44.67	19.64	41.60	27.86	36.00	35.58	40.76
7.	Control	55.59	-	57.67	-	55.89	-	56.38
	Mean B	39.25		35.75		32.50		
	Factors				SE(m)		CD at 5%	
	Botanicals (B)				1.17		1.21	
	Concentration (C)				0.29		0.28	
	(B X C)				1.31		1.26	

*Average of three replications.

Table-3 : Influence of botanicals at 10%, 15% and 20% concentration on mycelial growth of *R. solani* at 10 DAI.

S. No.	Treatments	Mean radial growth (mm) after ten days of inoculation						
		10%	Growth inhibition	15%	Growth inhibition	20%	Growth inhibition	Mean A
1.	*Azadirachta indica*	67.34	23.11	63.34	28.72	61.22	31.21	63.97
2.	*Jatropha curcus*	74.67	14.74	69.90	21.34	65.87	25.98	70.15
3.	*Lantana camara*	61.83	29.40	57.00	35.86	51.12	42.56	56.65
4.	*Datura spp.*	56.33	35.68	51.44	42.11	46.78	47.43	51.52
5.	*Tagetes erecta*	74.94	14.43	72.94	17.92	70.94	20.29	72.94
6.	*Eucalyptus spp.*	76.98	12.10	73.23	17.59	70.66	20.60	73.62
7.	Control	87.58	-	88.87	-	89.00	-	88.48
	Mean B	70.58		68.50		64.89		
	Factors				SE(m)		CD at 5%	
	Botanicals (B)				1.28		2.21	
	Concentration (C)				1.02		1.28	
	(B X C)				1.31		2.26	

Table-4 : *In-vivo* evaluation of plant extract against Rhizoctonia aerial blight.

Botanicals	Disease incidence (%)	Mean	Mean reduction(%) over control
Azadirachta indica	28.0	9.33	42.40
Jatropha curcus	25.6	8.53	47.34
Lantana camara	20.5	6.83	57.83
Datura spp.	18.1	6.03	62.77
Tagetes erecta	34.7	11.56	28.64
Eucalyptus spp.	32.5	10.83	33.14
Control	48.6	16.2	0.0
S.E.+			1.22
C.D. (P=0.05)			3.96

*Average of three replications.

average grain yield kg/ha was recorded in control (980 kg/ha) which was at par with *Tagetes erecta* (1026.66 kg/ha), *Eucalyptus spp* (1053.33 kg/ha) and *Azadirachta indica* (1173.33 kg/ha). (Table-5).

***In-vivo* evaluation of plant extract against *Rhizoctonia* aerial blight :** A total number of six botanicals *viz*., *Azadirachta indica*; *Jatropha curcus*; *Lantana camara*; *Datura stramonium*; *Tagetes erecta; Eucalyptus spp.* were evaluated against *R. solani* under *in-vitro* condition. It was revealed that all the botanicals significantly inhibited the growth of *R. solani* at the levels of concentration i.e. 10%, 15% and 20%. After 5th and 10th days three botanicals viz., *Datura spp.* followed by *Lantana camara*, *Azadirachta indica* maximum inhibited the fungal growth while maximum growth was recorded in control. These three botanicals were significantly superior over all other tested botanicals. The minimum growth inhibition was

Table-5 : Effect of botanicals on yield (kg/ha) of soybean.

S. No.	Treatments	Grain yield kg/ha
1.	*Azadirachta indica*	1173.33
2.	*Jatropha curcus*	1373.33
3.	*Lantana camara*	1386.66
4.	*Datura spp.*	1433.33
5.	*Tagetes erecta*	1026.65
6.	*Eucalyptus spp.*	1053.33
7.	Control	980.00
SE(m)		55.89
C.D. (at 5%)		189.80

recorded in *Tagetes erecta* followed by *Eucalyptus spp.* and *Jatropha curcus*. (9) tested the efficacy of medicinal plant extract in-vitro against *Rhizoctonia solani* and reported that out of 950 extract *Acrus calamus* (Butch) was highly effective against *Rhizoctonia solani* at all concentration (1%, 5%, and 100%). (10) also studied phyto-toxic effect of thirteen plant extracts and reported highest growth inhibition of fungus by garlic at (10%) concentration. (11) revealed the effect of plant extracts of *Zizyphus jujuba* and the extracts improved the sheath blight resistance in rice seedlings This effect can be attributed to the direct inhibitory effects of these leaf extracts as well as their ability to elicit systemic resistance against *Rhizoctonia solani*. (12) result was showed that the lowest mycelial growth of *Rhizoctonia solani* was recorded in extract of garlic (*Allium sativum* L.) which was found extensively superior among all the treatment with lowest mycelial growth of pathogen. Results in terms of percent growth inhibition of *Rhizoctonia solani* exposed that clove extract of garlic produced maximum inhibition followed by leaf extract of karanj, bulb extract of onion, leaf extract of jetropha.

The Rhizoctonia aerial blight disease incidence percent was recorded in all the treatments. Among the botanicals tested, *Datura spp* recorded significantly least disease incidence. This was followed by *Lantana camara*, *Jatroph curcus* and *Azadirachta indica*. The maximum disease incidence was recorded in *Tagetes erecta* followed by *Eucalyptus spp*.

The percentage reduction over untreated control, *Datura spp* showed maximum reduction in the disease incidence followed by *Lantana camara* and *Jatropha curcus*. Botanicals *Tagetes erecta*, *Eucalyptus spp.* and *Azadirachta indica* were found least effective which recorded minimum reduction of percent, in disease incidence. The yield varied among different treatments. Significantly highest average grain yield per plant was recorded in *Datura spp* which was at par with *Lantana camara*, *Jatropha curcus*. Lowest average grain yield kg/ha was recorded in control which was at par with *Tagetes erecta*, *Eucalyptus spp* and *Azadirachta indica*. (13) 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%). (14) tested six different plants i.e. *Azadirachta indica, Aloe vera, Ocimum sanctum, Ocimum basilicum, Lantana camara* and *Asparagus*. These plants showed the antifungal activity against the *Aspergillus niger, Aspergillus flavus, Rhizoctonia solani, Rhizoctonia bataticola.* (15) resulted the efficacy of seven botanical extract were tested *in-vitro* and *in-vivo* conditions against *Rhizoctonia solani*. Under *in-vitro* and *in-vivo* conditions, botanical extracts of Garlic was found highly effective showed maximum per cent inhibition in radial growth of the fungus at 5 per cent concentration followed by Madar at 5 per cent concentration. Datura was found least effective than rest of the plant extract.

Conclusions

In *in-vitro* condition, the minimum mycelial radial growth of *Rhizoctonia solani* was recorded in *Datura spp*. and after untreated control maximum mycelial radial growth was recorded in *Tagetes erecta* followed by *Eucalyptus spp.* and *Azadirachta indica.*

In *in-vivo* condition, among the botanicals tested, *Datura spp.* showed significantly least disease incidence and after untreated control maximum disease incidence was recorded in *Tagetes erecta* followed by *Eucalyptus spp*. and *Azadirachta indica*.

Datura spp. showed highest disease incidence reduction percentage over control and *Tagetes erecta* was found least effective which recorded minimum disease incidence reduction percent.

The Significantly highest average grain yield per plant was recorded in *Datura spp.* and lowest average grain yield kg/ha was recorded in control which was at par with *Tagetes erecta*, *Eucalyptus spp* and *Azadirachta indica*.

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