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EFFICACY OF DIFFERENT ANTAGONIST AGAINST THE *SCLEROTIUM ROLFSII, RHIZOCTONIA SOLANI* AND *FUSARIUM SOLANI*

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ABSTRACT
Ten antagonists tested under *in vitro* condition, maximum inhibition in radial growth of *Sclerotium rolfsii* was observed with *P. fluorescens* (71.85%) followed by *T. harzianum* (65.56%), *T. viride* (A) (65.19%) and *G. virens* (A) (61.48%), it was minimum with *G. virens* (P) (31.11%) followed by *T. koningii* (34.81%), *T. viride* (43.33%) and *T. lignorum* (44.81%). All the antagonists were effective in inhibiting the mycelial growth (31.11-71.85%) and sclerotial production (49.37 - 99.46%) over control. In the *Rhizoctonia solani* inhibition of mycelial growth by all ten isolates ranges from 54.81 to 90.74 per cent and 73.68 to 100 per cent inhibition of sclerotial production. All the antagonists were found to be significantly effective over control in inhibiting the mycelial growth of *F. solani*. These antagonists inhibited 62.22 to 87.03 per cent mycelial growth of the fungus. Inhibition of radial growth of *Fusarium solani* was maximum with *T. viride* (Akola isolate), *T. hamatum*, *T. viride* (Parbhani isolate), *A. niger, T. harzianum, T. koningii, P. fluorescens*, *G. virens* (Parbhani and Akola isolate) and *T. lignorum. P. fluorescens*

INTRODUCTION

Soybean (Glycine max) is an important oil seed crop and is grown in several tropical and sub-tropical countries. Sustainable soybean production is continuously challenged by diseases that cause quantitative and qualitative losses in yield. Most wide spread among these are foliar diseases and root diseases. Root rot caused by *R. solani* and *F. solani* is known as one of the major yield reducers and economically important diseases of soybean. In India root rot of soybean caused by *R. solani* first reported by Singh *et al.*(1974) and that caused by *F. solani* by Agarwal and Sarbhoy (1975). This problem further compounds when the disease is incited by more than one pathogen. "Soybean root rot complex" is one of the best examples of such diseases for which three pathogens account *viz. Sclerotium rolfsii* Sacc. *Rhizoctonia solani* and *Fusarium solani* (Maria et *al* 2013; Bharadwaj And Laura, 2007). PGPR including certain *Pseudomonas* spp. have been shown effectively control fungal pathogens like *Fusarium oxysporum, Rhizoctonia solani, Sclerotium rolfsii* (Ganesan and Gananamanicam, 1987) These pathogens cause significant loss in yield and primarily responsible for wide gap in the yield levels in farmers field. Looking to the immense importance of this disease appropriate strategies of management like exploitation of biocontrol need to be formulated. Therefore, present research proposal has been taken up.

MATERIALS AND METHODS

The materials used in the course of present studies and methods followed are given below:

All *in vitro* studies on *Sclerotium rolfsii* Sacc. *Fusarium solani*, *Rhizoctonia bataticola* (Taub.) Butler and *Rhizoctonia solani* Kuhn were conducted during the year 2011-12 in the Department of Plant Pathology, Shri Shivaji College of Horticulture, Amravati and Regional Research Center for Soybean Dr. P.D.K.V. Amravati.

Evaluation of antagonists

Five species of *Trichoderma* (viz., *T. viride, T. hamatum, T. lignorum, T. harzianum and T. koningii*), *Gliocladium virens, Aspergillus niger* and one bacterium, *Pseudomonas fluorescens* were sub-cultured from the stock culture of the department of Plant Pathology post Graduate Institute Dr. PDKV Akola. Also one isolate of each *T. viride* and *G. virens* obtained from Department of Plant Pathology, MAU, Parbhani, Maharashtra were used in the present study. These ten antagonists were evaluated for their antagonistic activity against the test fungi, *S. rolfsii*, *R. solani* and *F. solani*

In vitro testing of antagonists by dual culture technique

Two isolate of *T. viride* (Akola and Parbhani isolate), Two of *G. virens* (Akola and Parbhani isolate), *T. hamatum, T. lignorum, T. koningii, T. harzianum, A. niger* and bacterium,

Table 1: Mycelial and sclerotial inhibition of *Sclerotium rolfsii* by different antagonists (Dual culture technique)

Antagonistic isolate	*Growth (mm) 5 DAI		**Per cent growth inhibition	*Number of sclerotia formed(15 DAI)	**Per cent inhibition of sclerotia production
	Sclerotium rolfsii	Antagonist			
T. viride (A)	31.34	58.67	65.19(53.84)	15.67	95.80(78.24)
T. viride (P)	51.00	39.00	43.33(41.15)	48.33	87.03(68.89)
T. koningii	*58.67*	*31.34*	*34.81(36.14)*	*54.00*	*85.51(67.63)*
T. lignorum	49.67	38.34	44.81(42.01)	41.67	88.82(70.53)
T. harzianum	31.00	59.00	65.56(54.04)	02.00	99.46(86.02)
T. hamatum	43.34	48.00	51.85(46.04)	69.00	81.48(64.54)
G. virens (P)	62.00	70.00	31.11(33.88)	188.67	49.37(44.64)
G. virens (A)	34.67	55.34	61.48(51.62)	20.33	94.54(76.49)
A. niger	*44.00*	*46.00*	*51.11(45.62)*	*38.67*	*89.62(71.20)*
P. fluorescens	25.34	74.67	71.85(57.74)	23.67	93.65(75.39)
Control	90.00	-	-	372.67	
SEm ±			0.4342		0.6788
CD (5%)			1.28		2.00

**Figures in parenthesis are Arcsine transformed values; DAI – Days After Inoculation;* Average of three replication; A – Akola isolates; P – Parbhani isolates

Table 2: Mycelial and sclerotial inhibition of *Rhizoctonia solani* by different antagonists (Dual culture technique)

Antagonistic isolate	*Growth (mm) 5 DAI		**Per cent growth inhibition	*Number of sclerotia formed (15 DAI)	**Per cent inhibition of sclerotia production
	Rhizoctonia solani	Antagonist			
T. viride (A)	34.67	55.34	61.48(51.62)	1.33	89.47(71.10)
T. viride (P)	38.34	51.67	57.41(49.24)	3.33	73.68(59.12)
T. koningii	*39.00*	*51.00*	*56.67(48.81)*	*2.33*	*81.58(65.73)*
T. lignorum	40.00	50.00	55.56(48.17)	1.33	83.47(71.39)
T. harzianum	38.34	51.67	57.41(49.24)	0.00	100.00(89.39)
T. hamatum	36.34	43.67	59.63(50.53)	0.00	100.00(89.39)
G. virens (P)	8.34	81.67	90.74(72.26)	2.67	78.95(62.59)
G. virens (A)	32.00	82.00	64.44(53.38)	0.00	100.00(89.39)
A. niger	*40.67*	*49.34*	*54.81(47.74)*	*0.00*	*100.00(89.39)*
P. fluorescens	12.67	77.34	85.93(67.95)	0.00	100.00(89.39)
Control	90.00	-	-	12.67	
SEm +			0.3814		1.7211
CD (5%)			1.13		5.08

**Figures in parenthesis are Arcsine transformed values; DAI – Days After Inoculation; *Average of three replication; A – Akola isolates; P – Parbhani isolates

P. fluoresces were screened for their antagonistic activity in dual culture on Potato dextrose agar (PDA) in Petri plates. Twenty ml PDA medium was poured in each of the sterilized Petri plates. On solidification, 5 mm disc cut from the 7 days old culture of both the antagonist and the test fungus were inoculated separately on one half of the plate at the same time. For bacterial antagonist, sterilized blotter paper strip dipped in bacterial suspension and place on half medium and kept away. In control, antagonist was replaced with the test fungus. Each treatment was replicated thrice for every pathogen. All the plates were incubated at 25+20C. Observations were made on the radial growth of the test fungus and antagonist when the fungus in control plate reached to rim of the plate. Number of sclerotia formed and their formation type also recorded after 15 days of incubation. The per cent growth inhibition of the test pathogen in presence of antagonist was calculated over control as bellow

$$\text{Growth (\%) Inhibition} = \frac{\text{Growth of test fungus in control plate} - \text{Growth of test fungus in presence of antagonist}}{\text{Growth of test fungus in control plate}} \times 100$$

RESULTS AND DISCUSSION

Dual culture technique (Under laboratory condition)

The antagonistic activity of *Trichoderma* sp., *Aspergillus niger*, *Gliocladium virens* and *Pseudomonas fluorescens* isolated from native soil as well as *G. virens* and *T. viride* from Parbhani was studied under *in vitro* condition against *Sclerotium rolfsii* Sacc., *Rhizoctonia solani* Kuhn and *Fusarium solani*by dual culture technique and the data presented in Table 1, Table 2 and Table 3, respectively.

It is evident from Table 1 that, maximum growth inhibition of *S. rolfsii* was observed with *P. fluorescens* (71.85%) followed by *T. harzianum* (65.56%), *T. viride* (A) (65.19%) and *G. virens* (A) (61.48%), it was minimum with *G. virens* (P) (31.11%) followed by *T. koningii* (34.81%), *T. viride* (43.33%) and *T. lignorum* (44.81%). Significant difference was observed within the treatment. Maximum inhibition of sclerotia production was observed with *T. harzianum* (99.46%) followed by *T. viride* (A) (95.80%), *G. virens* (A) (94.54%), *P. fluorescens* (93.65%) and *A. niger* (89.62%), it was minimum with *G. virens* (P) (49.37%). All the antagonists were effective in inhibiting the mycelial growth (31.11-71.85%) and sclerotial production (49.37 - 99.46%) over control. Bhatia et al. (2005)

Table 3: Effect of different antagonists on radial growth (mm) of *Fusarium solani* by dual culture technique

Antagonistic isolate	*Growth (mm) 8 DAI *Fusarium oxysporum* f.sp. *ciceri*	Antagonist	**Per cent growth inhibition
T. viride (A)	11.67	78.34	87.03(68.88)
T. viride (P)	13.67	76.34	84.81(67.04)
T. koningii	*24.34*	*65.67*	*72.92(58.64)*
T. lignorum	34.00	56.00	62.22(52.06)
T. harzianum	17.00	73.00	81.11(64.23)
T. hamatum	12.67	77.34	85.92(67.95)
G. virens (P)	29.00	61.00	67.77(55.40)
G. virens (A)	34.00	56.00	62.22(52.05)
A. niger	*15.34*	*74.67*	*82.95(65.59)*
P. fluorescens	26.67	75.34	70.36(56.99)
Control	90.00	-	-
SEm ±			0.4683
CD (5%)			1.38

**Figures in parenthesis are Arcsine transformed values; DAI – Days After Inoculation; *Average of three replication; A – Akola isolates; P – Parbhani isolates

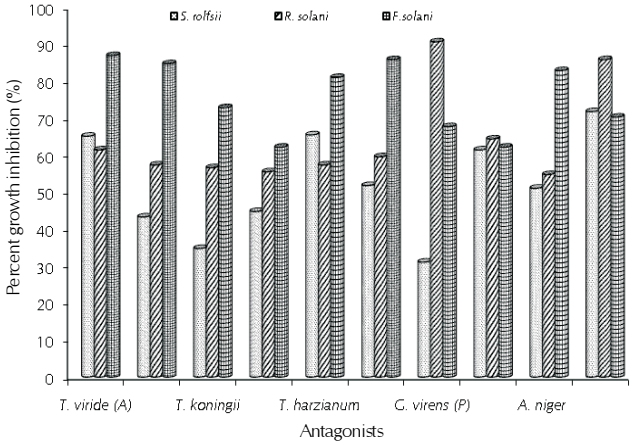

Figure 1: Per cent inhibition of root rot complex pathogens by different antagonists

reported that seed bacterizationwiththestrainsof*fluorescent Pseudomonas* PS I and PS II reduced incidence of collar rot by 69.8 % and 56.9 %, respectively, in *Sclerotium rolfsii* infected soil. (Pandey *et al.,* 2011; Joshi *et al.,* 2010; Nikam *et al.,* 2007; Gade *et al.,* 2007)

Data presented in Table 2 showed that 54.81 to 90.74 per cent inhibition of mycelial growth and 73.68 to 100 per cent inhibition of sclerotial production of *R. solani* were observed with all antagonists tested. Maximum growth inhibition was observed with *G. virens* (P) (90.74%) followed by *P. fluorescens* (85.93%), *G. virens* (A) (64.44%), *T. viride* (A) (61.48%) and *T. hamatum* (59.63%), whereas 100 per cent inhibition of sclerotia production was observed with *P. fluorescens, G. virens* (A), *T. harzianum, T. hamatum* and *A. niger*. (Bhagat and Pan,2010; Belkar and Gade, 2013)

Data (Table 3) revealed that all the antagonists were found to be significantly effective over control in inhibiting the mycelial growth of *F. solani*. These antagonists inhibited 62.22 to 87.03 per cent mycelial growth of the fungus. Maximum growth inhibition was observed with *T. viride* (A) (87.03%), *T. hamatum* (85.92%), *T. viride* (P) (84.81%), *A. niger* (82.95%), *T. harzianum* (81.11%), *T. koningii* (72.92%), *P. fluorescens* (70.36%), *G. virens* (P) (67.77%), *G. virens* (A) (62.22%) and *T. lignorum* (62.22%) . The highest per cent inhibition of mycelial growth (85.10%) was observed in *T.harzianum* followed by *T.viride* (69.40%). The similar results were observed by Bohra and Mathur (2004) andBegum *et al.* (2007) in *Fusarium* spp. causing wilt of soybean. Similar work done by (Asha *et al.*, 2011; Ushamalini *et al.*, 1997; Gupta *et al.*, 2003; Rao and Kulkarni, 2003; Sangle and Bambawale, 2004; Tetarwal *et al.,* 2013).

REFERENCES

Agarwal, D. K. and Sarbhoy, A. K. 1975. *Nectria haematocoa*, aperfect state of *Fusarium solani* (Mart.) Sacc. on soybean from India. *Curr. Sci*. **44:** 602.

Anonymous, 2013. Area, production, productivity of soybean. Press release. The Soybean Processors Association of India. p. 1.

Asha, B. B., Chandra nayaka, S., Udaya shankarc, A., Srinivas, C. and Niranjana, S. R. 2011. Selection of effective bio - antagonistic bacteria for biological control of tomato wilt caused by *Fusarium oxysporum* F. Sp. *Lycopersic. The Bioscan.* **6(2):** 239-244.

Begum, M. M., Sariah, M., Zainal Abidin, M. M., Puteh, A. B. and Rahman, M. A. 2007. Histopathological studies on soybean seeds infected by *Fusarium oxysporum f. sp. glycines* and screening of potential biocontrol agents. *Res. J. Micro.* **2(12):** 900-909.

Belkar, Y. K. andGade, R. M. 2013. Management of Root Rot and Collar Rot of Soybean by Antagonistic Microorganism. *J. Pl. Dis. Sci.* **8(1):** 39-42.

Bharadwaj, S. K. and Laura, J. S. 2007. Antifungal activity of some plant extract s against *Fusarium solani. The Bioscan.* **(2):** 095-098

Bohra Burhanuddin and Mathur, K. 2004. Biocontrol agents and neem formulations for suppression of *Fusarium solani* root rot in soybean *J. Mycol. Pl. Pathol.* **34(2):** 408-409.

Gade, R. M., Zote, K. K. and Mayee, C. D. 2007. Integrated management of pigeon pea wilt using fungicides and bio-agents. *Indian Phytopath*ology. **60(1):** 24-30.

Ganesan, P. and Gananamanicam, S. S. 1987. Biological control of *Sclerotium rolfsii* Sacc. in peanut by inoculation with *Pseudomonas fluorescence. Soil Biol. Bichem*.**19:** 35-38.

Gupta, S. B., Thakur, M. P., Tedia, K., Singh, A. K., Bachkaiya, K. K. and Thakur, K. 2003. Studies on local isolates of *Trichoderma viride* and their relationship with wilt/root rot causing fungi of chickpea. In: Chickpea Research for the Millennium. *International Chickpea* Conference, Raipur, Chhattisgarh, India. January 20-22, 2003. pp.

184-191.

Joshi, B. B., Bhatt, R. P.and Bahukhandi, D. 2010. Antagonistic and plant growth activity of *Trichoderma* isolates of Western Himalayas. *J. Environmental Biol.* **31(6):** 921-92.

Kubicek, C. P., Mach, R. L., Peterbauer, C. K. and Lorito, M. 2001. *Trichoderma*: from genes to biocontrol. *J. Plant Path.* **83:** 11-23.

Maria, M. Diaz A., Leandro, L. F. and Munkvold, G. P. 2013. Aggressiveness of *Fusarium* species and impact of root infection on growth and yield of soybeans. *Phytopath.* **103(8):** 822-832.

Nikam, P. S., Jagtap, G. P. and Sontakke, P. L. 2007. Management of chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceri*. *African J. Agriculture. Research.* **2 (2):** 692-697.

Pandey, P., Ravindra, K. and Mishra, P. 2011. Integrated approach for the management of *Sclerotinia sclerotiorum* (Lib.) de Bary, causing stem rot of chickpea. *Indian Phytopathology*. **64(1):** 190-198.

Piper, C. V. 1914. The name of the soybean: a chapter in its botanical history. *J. American Society of Agronomy*. **6:** 75-84.

Rao, S. N. and Kulkarni, S. 2003. Effect of *Trichoderma* spp. on the growth of *Sclerotium rolfsii* Sacc. *J. Biological Control.* **17(2):** 181-184.

Sangle, U. R. and Bambawale, O. M. 2004. New strains of *Trichoderma* spp. strongly antagonisticagainst *Fusarium oxysporum* f. sp. *sesami*. *J. Mycoogy andPlant Pathology*. **34(1):** 107-109.

Sinclair, J. B. and Shurtleef, M. C. 1975. Compendium of soybean diseases, American Phytopathological Society, St. Paul, Minnesota. p. 69.

Someshwar, B. and Sitansu, P. 2010. Biological management of root and collar rot (*Rhizoctonia solani*) of Frenchbean (*Phaseolus vulgaris*). *Indian J. Agril. Sci.* **80(1):** 42-50.

Tetarwal, J. P., Trivedi, A. and Mathur, K. 2013. Sustainable and eco-friendly management of root rot of soybean caused by *Rhizoctonia solani* and *Fusarium solani*. *Indian Phytopath.* **66(2):** 215-219

Ushamalini, C., Rajappan, K. and Gangadharan, K. 1997. Inhibition of *Macrophomina phaseolina* and *Fusarium oxysporum* f.sp. *tracheiphilum* by antagonist under *in vitro* conditions. *Plant Disease Research.* **12(2):** 168-170.

Singh, R., Shukla, T. N., Dwivedi, R. P., Shukla, H. P. and Singh, P. N.1974. Studies on soybean blight of Rhizoctonia solani. *Indian J. Mycol. Plant Pathol*. **4:** 101-102