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Effect of Root Exudates of Different Cultivars of Chickpea on Growth of Wilt Complex Fungi of Chickpea

A.V. Zope, O.S. Rakhonde and G.K. Awadhiya
Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur 492 006, Chhattisgarh, India.

Abstract **– The present investigation was done to study the influence of root exudates on the sclerotia/conidia germina--tion and growth of the test fungi (*Sclerotium rolfsii*, *Rhizoctonia solani* and *Fusarium oxysporum* f.sp. *ciceri*). For this purpose, root exudates were collected from four chickpea varieties i.e., JG 315 (Resistant), JG 74 (Moderately resis--tant), ICCV 2 (Susceptible) and L 550 (Highly susceptible). Maximum sclerotia/conidia of test fungi germinated in the root exudate of highly susceptible variety (L 550) and it was least in root exudate of resistant variety (JG 315) as compared to control. Similarly in poisoned food technique, the maximum colony diameter of test fungi were recorded on root exudate of highly susceptible variety (L 550) and it was minimum on root exudate of resistant variety (JG 315). This indicated that root exudate of resistant varieties released some toxic chemicals which prevent the growth of wilt complex pathogens.**

Keywords **– Root Exudates, Fungal Growth, Wilt, Chickpea, Root Rot, Collar Rot.**

I. INTRODUCTION

Chickpea (*Cicer arietinum* L.) commonly known as Bengal gram or gram, is an ancient pulse crop, occupying an important place in the pulse cultivation and ranking 3rd amongst the global farming. In India, chickpea occupies an area of 4.9 mha, with production of 3.4 mt having an average productivity of 694 kg/ha (Anonymous, 2004). About 172 pathogens have been reported from 55 countries causing substantial damage in chickpea, out of which 89 pathogens have been reported from India alone. Amongst the serious diseases caused by different fungi are Ascochyta blight (*Ascochyta rabies*), wilt (*Fusarium oxysporum* f.sp. *ciceri*), black root rot (*Fusarium solani*) and wet root rot caused by *Rhizoctonia solani* (Nene and Reddy, 1987). Wilt complex, which manifests itself by vascular wilting or root rots, is one of the most devastating and challenging diseases, which can damage crop at any stage.

Seedling mortality in chickpea due to *S. rolfsii* is the main problem in most of the tropical regions. Similarly *R. bataticola, R. solani* and *F. oxysporum* f.sp. *ciceri* also affects at different stages causing range losses in the standing crop. Prolonged saprophytic survival ability of the pathogen in soil makes chemical control and crop rotation ineffective. Resistant cultivars is the most practicable, feasible, and economical approach for the management of chickpea wilt complex fungi, but only a few sources with low level of genetic resistance are available, so there is a need to identify the resistant sources in chickpea.

II. MATERIALS AND METHODS

Effect of Root Exudates

Surface sterilized seeds of four varieties of namely, L 550, ICCV 2, JG 74 and JG 315 (susceptible to resistant cultivars) were sown in sterilized soil in four different earthen pots. Ten days old healthy seedlings of each variety were taken out gently without root injury and washed with tap water followed by thorough rinsing in sterile water to remove traces of soil. After washing 25 seedlings of each variety were placed separately in 150 ml conical flask containing 50 ml of sterile water with five replications. All the flasks were covered up to neck with carbon paper for development of roots and kept at room temperature for seven days. After seven days, the contents of each flask were filtered separately through Whatman No. 42 filter paper. Filtrate containing root exudates of these four variety were tested for their inhibitory action on the germination of sclerotia/conidia and growth of three fungi, *S. rolfsii, R. solani* and *F. oxysporum* f. sp. *ciceri*.

On Germination of Sclerotia/Conidia

For testing the influence of root exudates on germina--tion of sclerotia/conidia, one drop of root exudates of each variety i.e. L 550, ICCV 2, JG 74 and JG 315 was placed on a plain/cavity slide separately and one drop of spore suspension or single sclerotia was placed on each slide. Spore suspension was prepared by shaking 5 mm disc in 10 ml sterile water. In case of control sterile water was used in place of root exudates. Thus each root exudate was tested for their effect on sclerotia/conidia.

These slides were kept in Petri dishes previously kept with moist blotter papers and incubated at 25 ± 2^0C. The effect of each exudate was observed in terms of the germination of the sclerotia/conidia or not.

On Growth of the Test Fungi

Poisoned food technique method was followed for testing the efficacy of the exudates on test fungus growth. The PDA previously mixed with root exudates in 1:1 ratio of the potato extract and exudates with other ingredients required.

The plates were inoculated with test fungus and observations were recorded when any treatment attained 90 mm radial growth (i.e. 100%) and for sclerotial formation after 15 days. During this period the plates were remained in the incubator at 25 ± 2^0C. The other morpho--logical characters of the growth of test fungus were also recorded.

III. Results and Discussion

Effect of Root Exudates

This experiment was done to study the influence of root exudates on the sclerotia/conidia germination and growth of the test fungi (*S. rolfsii*, *R. solani* and *F. oxysporum* f.sp. *ciceri*). For this purpose, root exudates were collected form four chickpea varieties i.e., JG 315 (Resistant), JG 74 (Moderately resistant), ICCV 2 (Susceptible) and L 550 (Highly susceptible).

Effect of Root Exudates on Sclerotia/ Conidia Germination of Test Fungi

Data presented in Table 1 revealed that, the maximum sclerotia/conidia of test fungi germinated in the exudates of highly susceptible variety L 550 (97-100%) followed by susceptible variety ICCV 2 (92-100%) and moderately resistant variety JG 74 (67-77%), while it was least in the case of resistant variety JG 315 (46, 58 and 59% sclerotia/ conidia of *S. rolfsii, R. solani* and *F. oxysporum* f.sp. *ciceri*, respectively).

Table 1. Effect of root exudates on germination of sclerotia/conidia of associated organisms.

Varieties	Sclerotium rolfsii		*Rhizoctonia solani*		*Fusarium oxysporum* f.sp. *ciceri*	
	Germinated (%)	Not germinated (%)	Germinated (%)	Not germinated (%)	Germinated (%)	Not germinated (%)
JG-315	46	54	58	42	59	41
JG-74	67	33	74	26	77	23
ICCV-2	92	08	100	00	93	07
L-550	100	00	100	00	97	03
Sterilized water	74	26	68	32	69	51

Data based on 100 observation

In control, where only sterilized water was used, the sclerotia/conidia germination per cent of *S. rolfsii, R. solani* and *F. oxysporum* f.sp. *ciceri* were 74, 68 and 69 per cent, respectively and was higher than resistant variety JG 315 and lower than susceptible varieties L 550 and ICCV 2.

Effect of Root Exudates on Mycelial Growth of Test Fungi

Root exudates of these varieties were also tested for its effect on mycelial growth of test fungi by poisoned food technique.

It is clear from the data (Table 2) that, significant difference was observed in the mycelial growth of all test fungi on root exudates of resistant, moderately resistant, susceptible and highly susceptible varieties. Maximum colony diameter of *S. rolfsii* (88.00 mm), *R. solani* (79.40 mm) and *F. oxysporum* f.sp. *ciceri* (90.00 mm) were recorded on root exudate of highly susceptible variety L 550 followed by susceptible variety ICCV 2, while it was minimum 18.60, 25.40 and 51.40 mm, respectively on the root exudate of resistant variety JG 315 followed by moderately resistant variety JG 74. In control with Potato dextrose agar medium, colony diameter of *S. rolfsii* (71.60 mm), *R. solani* (62.60 mm) and *F. oxysporum* f.sp. *ciceri* (67.60 mm) were significantly higher than resistant varieties root exudates (JG 315 and JG 74) and significantly lower than susceptible varieties root exudates (ICCV 2 and L 550) (Plate 1). Similar findings were reported by Agrawal (1984) in case of lentil isolate of *S. rolfsii*, *R. bataticola* and *Fusarium* sp., Mehta *et al.* (1992) and El-Moneem *et al.* (2003) also noticed similar results on *R. solani* on cowpea and *Fusarium* sp. and *S. rolfsii* on groundnut.

Significant difference was also observed in sclerotia formation by the *S. rolfsii* and *R. solani*. These pathogens also formed significantly more number of sclerotia on root exudate of susceptible varieties than PDA, whereas on PDA significantly more number of sclerotia were formed than resistant varieties root exudate. The *S. rolfsii* and *R. solani* did not show any difference in the colony texture and pigmentation on culture medium of different root exudate. Straight sparse mycelial texture with dull white to white pigmentation was produced by both fungi on different root exudate medium. In case of *F. oxysporum* f.sp. *ciceri*, cottony but less compact mycelial texture and abundant sporulation with dark purple pigmentation was produced in susceptible varieties as well as in PDA, while compact mycelial texture and comparatively poor sporulation with purple white pigmentation produced on resistant varieties.

Giri *et al.* (1998) showed antifungal activity of root extract of chickpea variety Vijay. Induction of protease activity was observed only in root extract of Vijay when inoculated with *F. oxysporum* f.sp. *ciceri*. Mandavia *et al.* (2002) analyzed root exudate collected from 10 days old seedlings of chickpea cultivars differing in wilt susceptibility. A significant inverse relationship was found between wilt susceptibility and total phenol content in root exudates of chickpea seedlings. Resistant cultivars of chickpea had the highest amount of phenol followed by moderately resistant and susceptible cultivars.

References

[1] Agrawal, R.K. 1984. Studies on Lentil wilt complex. *M.Sc. Thesis*, JNKVV, Jabalpur.

[2] Anonymous, 2004. Area and Production Data of chickpea. International Crop Research Institute of the Semi-Arid Tropics. p. 15.

[3] El-Moneem, K.M.H.A., Moharam, M.H.A. and El-Sherif, M.M. E. 2003. Role of root exudates of certain peanut cultivars in resistance to root rot disease. *Assiut J. Agril. Sci.* 34 (2): 193-209.

[4] Giri, A.P., Harsulkar, A.M., Patankar, A.G., Gupta, V.S., Sainani, M.N., Deshpande, V.V., Ranjekar, P.K. and Johnson, R. 1998. Association of induction of protease and chitinase in chickpea roots with resistance to *Fusarium oxysporum* f.sp. *ciceri*. *In:* Proc. 7th Int. Congress of plant Pathology, Edinburgh, UK., 9-16 Aug. 47(6): 693-699.

[5] Mandavia, M.K., Gajera, H.P., Khan, N.A., Andani, V.P. and Parameswaran, M. 2002. Total phenols in root exudates of

chickpea varieties. Screening marker for resistance to *Fusarium* wilt. *Indian J. Agril. Biochem*. 15(1-2): 1-6.

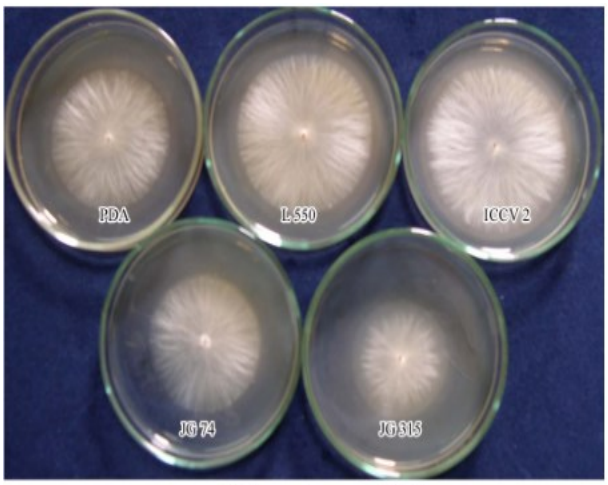
[6] Mehta, S., Sharma, S. and Sindhan, G.S. 1992. Analysis of root exudates of cowpea and their influence on the growth of *Rhizoctonia solani*. *J. Mycol. Pl. Pathol.* 22(3): 227-231.

[7] Nene, Y.L. and Reddy, M.V. 1987. Chickpea disease and their control. *In*: The Chickpea. M.C. Saxena and K.B. Singh, Eds. Common Wealth Agricultural Bureau International, Oxon, England. pp. 233-270.

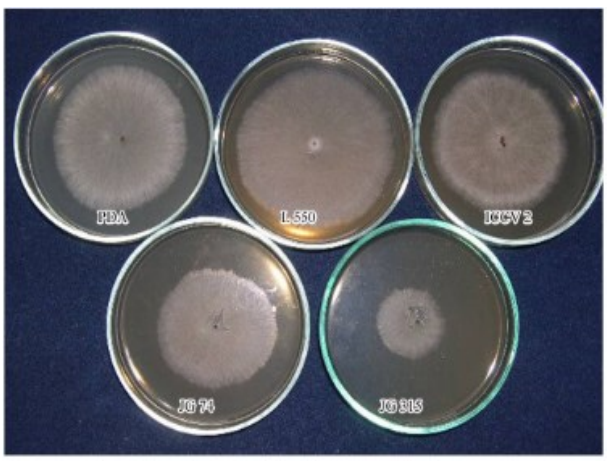
Table 2. Effect of root exudates on radial growth of the three soil borne fungi.

Fungi	Cultural character	PDA	ICCV-2	L-550	JG-74	JG-315	SEm ±	CD (5%)
Sclerotium rolfsii **(4 DAI)**	Colony diameter (mm)	71.60	79.40	88.00	54.40	42.40	**0.754**	**2.22**
	Type of colony	Straight sparse	Straight sparse	Straight sparse	Straight sparse	Straight sparse		
	Pigmentation	White	White	White	Dull white	White		
	Intensity of sclerotia (15 DAI)	48.00 (1.685)	52.60 (1.802)	73.40 (1.832)	58.80 (1.774)	18.60 (1.278)	**0.035**	**0.10**
Rhizoctonia solani **(4 DAI)**	Colony diameter (mm)	62.60	72.00	79.60	41.40	25.40	**0.8414**	**2.48**
	Type of colony	Straight sparse	Straight sparse	Straight sparse	Straight sparse	Straight sparse		
	Pigmentation	White	Dull white	Dull white	Dull white	Dull white		
	Intensity of sclerotia (15 DAI)	41.00 (1.619)	33.40 (1.535)	48.00 (1.687)	29.60 (1.511)	03.60 (1.660)	**0.024**	**0.07**
Fusarium oxysporum **f.sp. *ciceri*** **(7 DAI)**	Colony diameter (mm)	67.60	90.00	90.00	58.40	51.40	**0.419**	**1.24**
	Type of colony	Cottony less compact	Cottony less compact	Cottony less compact	Cottony compact	Cottony compact		
	Sporulation	Abundant	Abundant	Abundant	Medium	Poor		
	Pigmentation	Dark purple	Dark purple	Dark purple	Purple white	Purple white		

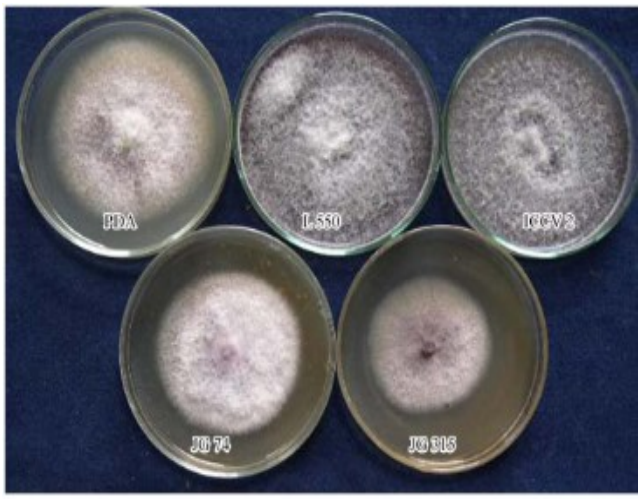
Figures in parenthesis are Log transformed values; Average of five replication; DAI-Days after Inoculation.



a. *Sclerotium rolfsii*



b. *Rhizoctonia solani*



c. *Fusarium oxysporum* f.sp. *ciceri*

Plate 1. Growth variation of wilt complex fungi on different root exudates.