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Effect of Different Temperature on Mycelial Growth of Wilt Complex Fungi of Chickpea

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Abstract **– The *Sclerotium rolfsii* and *Rhizoctonia solani* showed rapid mycelial growth at 30^{0}C and maximum sclerotia production was recorded at 25^{0}C. Both the patho--gens were unable to grow and produce sclerotia at minimum 10^{0}C and maximum 40^{0}C studied. The optimum temperature for the better radial growth of *Sclerotium rolfsii* and *Rhizoctonia solani* ranged between 25 to 35^{0}C, whereas for sclerotial production it ranged from 20 to 30^{0}C for *S. rolfsii* and 25 to 35^{0}C for *R. solani.* The *Fusarium oxysporum* f.sp. *ciceri* showed maximum radial growth at 25^{0}C. The optimum temperature for the growth and sporulation of the fungus ranged from 20 to 30^{0}C.**

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

I. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a major source of human and animal food and the world's third most important pulse crop after beans (*Phaseolus vulgaris* L.) and peas (*Pisum sativum* L.) (Saxena, 1990). Nutritionally chickpea is low in sodium and fats (4.5%), cholesterol free and overall an excellent source of both soluble and insoluble fibre, complex carbohydrates (61.5%), vitamins (especially B vitamins) and minerals (especially potassi--um, phosphorus, calcium, magnesium, copper, iron and Zinc). Therefore, chickpeas are an excellent heart healthy food that may be beneficial to the prevention of coronary and cardiovascular disease and by reducing blood lipids also help some serious complications of diabetes (Anonymous, 2004). Chickpeas are an inexpensive and high quality source of protein (20-25%) i.e. two to three times more than cereals and also cheaper than meat. Hence they are referred as 'Poor mans meat' in developing country like India.

It is the most important pulse crop of India and accounts for approximately 75% of world's chickpea production. This disease has been reported from 33 countries of the world causing 10-15% yield losses annually depending upon the environment condition. Environmental factors such as temperature, water activity and pH have a great influence on fungal development. Variation in the type of carbon and nitrogen sources besides changes in pH, temperature, incubation period, shaking and inoculum size have great influence on the growth of pathogen. Present work depicts the role of different temperature to understand ecological survival of chickpea wilt complex fungi which will be helpful in management strategy in the field.

II. MATERIALS AND METHODS

To determine the favourable temperature for the maximum growth and sporulation or sclerotial production of all the three fungi (*Fusarium oxysporum* f. sp. *ciceris* (Padwick), *Sclerotium rolfsii* Sacc. and *Rhizoctonia solani* Kuhn), inoculated Petri plates were incubated 5, 10, 15, 20, 25, 30, 35 and 40^{0}C till the growth attained complete (90 mm) in any of the temperature. Twenty ml of melted medium was poured into each sterilized Petri plates. Five mm disc of the test fungus were cut with the help of sterilized cork borer from the margin of seven days old culture grown on PDA Petri plate.

One disc was placed in the centre of each Petri plates. There were 3 plates for each temperature and for each of the pathogen. The data on growth were recorded when the fungus reached the rim of the Petri plates (90mm) in any of the temperature. Variation in radial growth, type of fungal growth, pigmentation and/or sporulation were recorded. Number of sclerotia were also noted after 20 days of the incubation.

III. RESULTS AND DISCUSSION

Influence of Temperature on Mycelial Growth of Associated Fungi

The associated fungi were subjected to the eight different temperature conditions to know the optimum temperature for the mycelial growth of the wilt complex fungi (*Fusarium oxysporum* f. sp. *ciceris* (Padwick), *Sclerotium rolfsii* Sacc. and *Rhizoctonia solani* Kuhn).

It is evident from the Table 1, that, the *S. rolfsii* showed rapid mycelial growth at 30^{0}C (90.00 mm), which was significantly superior over rest of the temperature treat--ments. No growth and sclerotial formation were recorded at minimum at 10^{0}C and maximum at 40^{0}C. The optimum temperature for the better radial growth of the fungus ranged between 25 to 35^{0}C (Plate 1a), whereas for sclerotial production it ranged from 20 to 30^{0}C. Highest intensity of sclerotia observed at 25^{0}C, which was statistically significant over other temperatures. The fungus produced straight sparse mycelial growth on culture medium with white pigmentation at 15 to 35^{0}C, only at 30^{0}C fungus showed light yellow pigmentation.

The *R. solani* pathogen similarly responded for temperature condition as *S. rolfsii* for the growth and sclerotial production. Like *S. rolfsii*, *R. solani* rapidly grow at 30^{0}C (90.00 mm) and can't grow at minimum 10^{0}C and maximum at 40^{0}C. The optimum temperature for the better mycelial growth and sclerotia formation by *R. solani* ranged between 25 to 35^{0}C (Plate 1b). Only at 30^{0}C, *R. solani* produced light yellow pigmentation with circle,

otherwise white pigmentation produced by the fungus (Table 1).

The *F. oxysporum* f.sp. *ciceri* showed maximum radial growth at 25^{0}C (81.34 mm) which was significantly superior over the rest of the temperature treatment (Plate 1c). The optimum temperature for the radial growth and sporulation of the fungus ranged from 20 to 30^{0}C and with increase or decrease of the temperature, growth and sporu--lation was affected. Conidia germination and sporulation was not observed at minimum 5^{0}C and maximum at 40^{0}C (Table 1). The fungus produced straight sparse mycelial texture on culture medium with light purple pigmentation at 25^{0}C, but with increase or decrease of temperature fungus showed cottony compactness mycelial texture with light yellow or blue pigmentation, respectively.

Mathur and Sarbhoy (1976) reported maximum growth of *S. rolfsii* of sugarbeet at 30^{0}C and sclerotia formation at 25 to 30^{0}C. Dalvi and Raut (1986) and Prasad *et al.* (1986) observed maximum growth of *S. rolfsii* at 30^{0}C and the excellent sclerotial formation at 25^{0}C. Optimum tempera--ture for the mycelial growth of *R. solani* was 25 to 31^{0}C (Kim *et al.* 1988), 26 to 32^{0}C (Dubey, 1997). Dubey (1997) also reported that *R. solani* was unable to grow 5, 7 and 45^{0}C and sclerotial production was inhibited at 10^{0}C. Ehsan *et al.* (1998) reported that, 25^{0}C temperature was found better for mycelial growth and 30^{0}C for sporulation of *F. oxysporum*. Miao *et al.* (2000) reported optimum temperature for radial growth of *F. oxysporum* f.sp. *vasinfectum* was at 30^{0}C. Disease development of wilt of chickpea was greater at 25^{0}C as compared with 20 and 30^{0}C (Landa *et al.*, 2001). These findings were confirms the results of present investigation.

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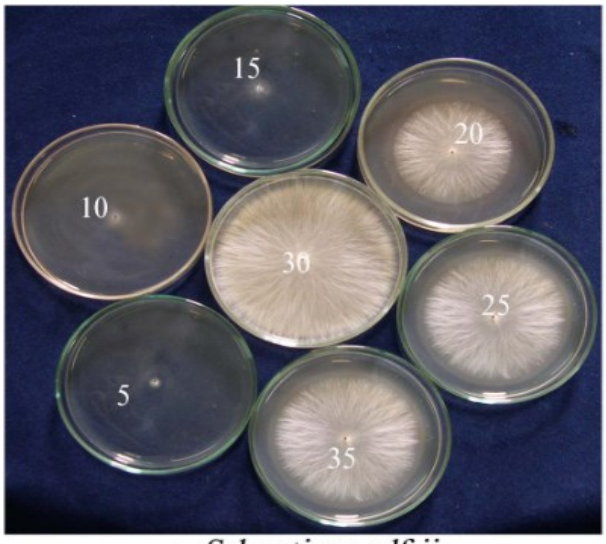
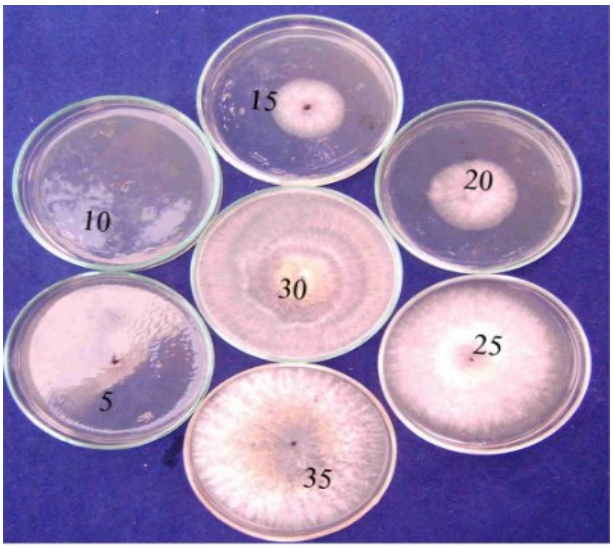
Table 1. Variation in the growth of the three soil borne fungi on different temperature.

Fungi	Cultural character	5^{0}C	10^{0}C	15^{0}C	20^{0}C	25^{0}C	30^{0}C	35^{0}C	40^{0}C	SEm±	CD (5%)
Sclerotium rolfsii **(5 DAI)**	Colony diameter* (mm)	0.00 (0.707)	0.00 (0.707)	02.00 (1.524)	36.67 (6.098)	64.34 (8.050)	90.00 (9.513)	74.67 (8.670)	0.00 (0.707)	**0.126**	**0.38**
	Type of colony	-	-	Straight sparse	Straight sparse	Straight sparse	Straight sparse	Straight sparse	-		
	Pigmentation	-	-	White	White	White	Light yellow	White	-		
	Intensity of sclerotia** (20 DAI)	0.00 (0.00)	0.00 (0.00)	23.67 (1.389)	86.33 (1.941)	173.67 (2.241)	107.33 (2.034)	59.00 (1.776)	0.00 (0.00)	**0.020**	**0.06**
Rhizoctonia solani **(5 DAI)**	Colony diameter* (mm)	0.00 (0.707)	0.00 (0.707)	34.67 (5.93)	42.00 (6.518)	81.67 (9.064)	90.00 (9.513)	88.33 (9.425)	0.00 (0.707)	**0.040**	**0.12**
	Type of colony	-	-	Straight sparse	Straight sparse	Straight but less compact	Straight sparse	Straight sparse	-		
	Pigmentation	-	-	White	White	White	Light yellow with circle	White	-		
	Intensity of sclerotia** (20 DAI)	0.00 (0.00)	0.00 (0.00)	07.67 (0.912)	13.00 (1.141)	38.33 (1.593)	32.33 (1.522)	27.00 (1.447)	0.00 (0.00)	**0.042**	**0.13**
Fusarium oxysporum **f.sp.** ***ciceri*** **(8 DAI)**	Colony diameter* (mm)	0.00 (0.707)	17.34 (4.220)	48.67 (7.011)	72.00 (8.514)	81.34 (9.045)	68.00 (8.275)	58.34 (7.669)	0.00 (0.707)	**0.081**	**0.24**
	Type of colony	-	Cottony compact	Cottony compact	Straight sparse	Straight sparse	Cottony less compact	Cottony less compact	-		
	Sporulation	-	Poor	Medium	Abundant	Abundant	Abundant	Medium	-		
	Pigmentation	-	Light yellow	Light yellow	Light yellow	Light purple	Dark blue at center	Dark blue at center	-		

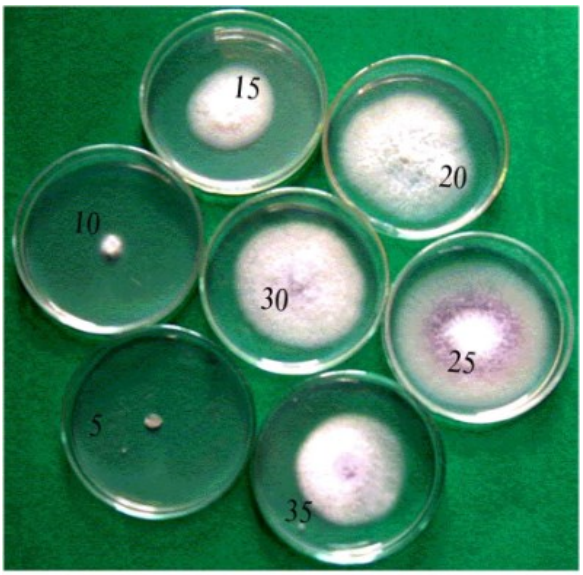
* Figures in parenthesis are Square root transformed values; ** Figures in parenthesis are Log transformed values; Average of three replication; DAI-Days after Inoculation.



a. *Sclerotium rolfsii*



b. *Rhizoctonia solani*



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

Plate 1. Growth variation of wilt complex fungi at different temperature (^{0}C).