J. Mycopathol. Res. ***59(2)*** *: 161-164, 2021;* (ISSN 0971-3719)

Effect of temperature and pH on growth and sclerotial production of *Rhizoctonia solani*

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Received : 10.02.2021 Accepted :10.05.2021 Published : 28.06.2021

Rhizoctonia solani is one of the most serious soil-borne pathogen in the Gangetic alluvial region of West Bengal. Factors such as temperature and pH affects the growth rate and sclerotial production of *R. solani. R. solani* isolated from cabbage showed that the temperature had a significant effect on mycelial growth rate and significantly highest growth rate of all the isolates was observed at 30°C with the optimum being observed for majority of the *R. solani* cabbage isolates between 25°C-30°C. The sclerotial production was found to be highest at 30°C.*R. solani* isolates modified the pH level through their growth and metabolic activity and at extreme acidic pH *i.e.* at pH level 4 and 5 they enhanced the pH level of the media and at moderate alkali level (pH8 to 9), they reduced the pH of the media and all the isolates could able to grow at wide level of pH (4 to 9).

Key words: *Rhizoctonia solani,* mycelial growth, sclerotial production

INTRODUCTION

Rhizoctonia solani Kuhn (teleomorph *Thanatephorus cucumeris* (Frank) Donk) is one of the most serious soil-borne pathogen in the Gangetic alluvial region of West Bengal. *R. solani*produces sclerotia as dormant structure that undergoes direct myceliogenic germination, whereby vegetative hyphae is capable of infecting the host, grow directly out of the sclerotium.

It has also been reported that the mycelia and sclerotia can grow and develop on plant debris for survival in the soil and on seed from one season other (Ritchie *et al*. 2009). Thus, the environmental factors have tremendous influence on survival and pathogenicity of *R. solani*. Therefore, the objective of this study was to investigate the effect of temperature and pH on mycelial growth and sclerotial production of *R. solani* isolated from cabbage.

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MATERIALS AND METHODS

The rate of mycelial growth and sclerotial production of different isolates of *R. solani* infecting cabbage has been calculated at 5 different temperatures (15, 20, 25, 30 and 35°C) at 24 h interval.

The experiment for the rate of mycelia growth and sclerotial production was performed on PDA media and PD broth by maintaining six different levels of pH which were 4.0, 5.0, 6.0, 7.0, 8.0 and 9.0 by the use of digital pH meter.

RESULTS AND DISCUSSION

The growth rate differed significantly in all the isolates of *R. solani* at all the temperature levels (Table1and Fig.1**)**. Temperature had a significant effect on mycelial growth rate on *Rhizoctonia solani* isolated from cabbage. It was observed that temperature between 25°C-30°C was optimum for majority of the *R. solani* isolates. Irrespective of *R. solani* cabbage isolates the mean growth rate was found to be highest on PDA at 30°C followed by at 25°C (Table 1). Irrespective of different tempera

ture levels, significant highest mycelial growth rate was obtained by Cab I-2 (0.097) followed by Cab I-3 (0.084). Thus, the present study indicated wide level of variations in the effect of temperatures on mycelial growth of *R. solani*isolates.Similarly in previous studies it was found that the temperature 30°C was ambient for colony growth of the fungus (Goswami *et al.* 2011; Datta *et al*. 2014). Maximum hyphal growth of some isolates of *R. solani* was reported at 25°C (Grosch and Kofoet, 2003; Kumar *et al*. 2014; Chaudhary *et al*. 2018).

Results of the experiment indicated that irrespective of *R. solani* cabbage isolates, 30°C (45.1) was found to be the best temperature for the production of sclerotia, which was followed by 25°C (35.2) (Table 2). The same levels of temperature favoured mycelial growth of the fungus. It was found that there were variations among the isolates for mycelial growth rate and sclerotia formation on PDA at the same levels of temperature. Early induction of sclerotial formation (within 72 hrs.) was noticed on PDA media at 25°C for Cab I-1 isolate but for Cab I-2 and Cab I-3 the same was observed at 30°C. In the present investigation it was found that different temperatures had different temporal effect on sclerotial formation by *R. solani* isolates.

It has been observed that the effect of different pH level had significant effect on mycelial growth rate of *R. solani* isolated from cabbage. However, irrespective of pH level, growth rate of isolate Cab I-1 was highest followed by CabI-3 and CabI-2. The highest mycelial growth rate of Cab I-2 was observed at pH 8 whereas for the isolates CabI-1 and CabI-3, the mycelia growth rate was highest at pH 7 (Fig.2).It was also observed that the highest mean biomass production was observed at pH 7 (0.91), followed by pH 6 (0.89) and pH 8 (0.88) (Table 3, Fig.3). In the present investigation it was also observed that *R. solani* isolates modified the pH level through their growth and metabolic activity, at extreme acidic pH *i.e*. at pH level 4 and 5 they enhanced the pH level of the media and at moderate alkali level (pH8 to 9), they reduced the pH of the media.

Regardless of the *R. solani* cabbage isolates the highest mean sclerotial number was observed at pH 7 (24.7) followed by pH 6 (23.1) and pH 8 (16.2) (Table 4, Fig.4)however, the effect of these three pH on sclerotial production was found to be statistically at per. The lowest mean sclerotial number was observed at pH 4 (8.4). The isolate Cab I-1 and Cab I-2 produced highest number of sclerotia at pH 7 followed by pH 6, whereas highest sclerotial production of Cab I-*3* was observed at pH 6 (Table 4). It has been reported that wide pH range, with an optimum between pH 5.5 to 8 facoured growth of many fungi (Ritchie *et al*., 2009). It has been reported previously that *R. solani* usually modifies the pH for successful growth on moderately acidic or alkaline media, (Ritchie *et al*., 2009). In the present study, different *R. solani* cabbage isolates grew over a wide pH range, from pH 4 to 9. This corresponds well with the optimum pH range for mycelial growth of other *R. solani* isolates in previous studies. For example, a similar pH range (pH 4 to 9) favoured the mycelial growth of all iso

Table 1: Effect of temperature on mycelia growth rate of *R. solani* isolates of cabbage

	Isolate			
Temperature	Cab I-1	Cab I-2	Cab I-3	Mean
15°C	0.0388	0.0433	0.0482	0.043^{d}
20°C	0.0710	0.0774	0.1147	0.088^{c}
25°C	0.0633	0.1553	0.0753	0.098^{b}
30°C	0.1141	0.1151	0.0913	0.107^{a}
35°C	0.0903	0.0913	0.0900	0.091^{c}
Mean	0.076^{c}	0.097^{a}	0.084^{b}	
SEM (±)	Isolate	0.001065		
CD		0.003084		
SEM (±)	Temperature	0.001374		
CD		0.003981		
SEM (±)	Isolate X Temperature	0.002381		
CD		0.006896		

Table 2: Effect of temperature on sclerotial production of *Rhizoctonia solani* isolates of Cabbage

	Isolate			
Temperature (°C)	Cab I-1	Cab I-2	Cab I-3	Mean
15	0.0 (0.7)*	0.0 (0.7)	0.0 (0.7)	0.0 (0.7)$^{c\ \mu}$
20	42.0 (6.5)	17.7 (4.3)	33.7 (5.8)	31.1 (5.5)^{b}
25	51.7 (7.2)	19.7 (4.5)	34.3 (5.9)	35.2 (5.8)^{b}
30	57.0 (7.6)	24.7 (5.0)	53.7 (7.4)	45.1 (6.6)^{a}
35	3.7 (2.0)	2.3 (1.7)	4.7 (2.3)	3.6 (0.7)^{d}
Mean	30.9 (4.8)^{p}	12.9 (3.2)^{r}	25.3 (4.4)^{q}	
SE(M)±	Isolate		0.133	
CD			0.387	
SE(M)±	Temperature		0.172	
CD			0.499	
SE(M)±	Isolate x Temperature		0.298	
CD			0.864	

*: values in parentheses represent arc sine transformed values;$^{\mu}$: a-d and p-r indicate DMRT ranking

Table 3: Effect of different pH on biomass production by *R. solani* cabbage isolate

pH	Cab I-1	Cab I-2	Cab I-3	Mean
pH 4	0.77	0.73	0.80	0.77^{d}
pH5	0.87	0.84	0.82	0.84^{c}
pH6	0.91	0.82	0.93	0.89^{b}
pH7	0.93	0.87	0.93	0.91^{a}
pH8	0.85	0.89	0.91	0.88^{b}
pH9	0.73	0.75	0.76	0.75^{e}
Mean	0.84^{b}	0.82^{c}	0.86^{a}	
SEM (±)	Isolate		0.0032	
CD			0.0092	
SEM (±)	pH		0.0045	
CD			0.0130	
SEM (±)	Isolate x pH		0.0079	
CD			0.0226	

Table 4: Effect of different pH on sclerotial production by *R.solani* cabbage isolates

pH	Cab I-1	Cab I-2	Cab I-3	Mean
pH4	9.3 (3.1)	6.3 (2.5)	9.7 (3.1)	8.4 (2.9)^{c}
pH5	13.7 (3.7)	15.0 (3.9)	13.7 (3.7)	14.1 (3.7)^{b}
pH6	23.0 (4.8)	23.0 (4.8)	23.3 (4.8)	23.1 (4.7)^{a}
pH7	25.7 (5.1)	25.3 (5.0)	23.0 (4.8)	24.7 (4.9)^{a}
pH8	18.0 (4.2)	14.0 (3.7)	16.7 (4.1)	16.2 (3.9)^{b}
pH9	11.3 (3.4)	10.7 (3.3)	8.7 (2.9)	10.2 (3.1)^{c}
Mean	16.8 (4.0)^{a}	15.7 (3.8)^{c}	15.8 (3.8)^{b}	
SEM (±)	pH		0.1268	
CD			0.3644	
SEM (±)	Isolate * pH		0.2196	
CD			0.6311	

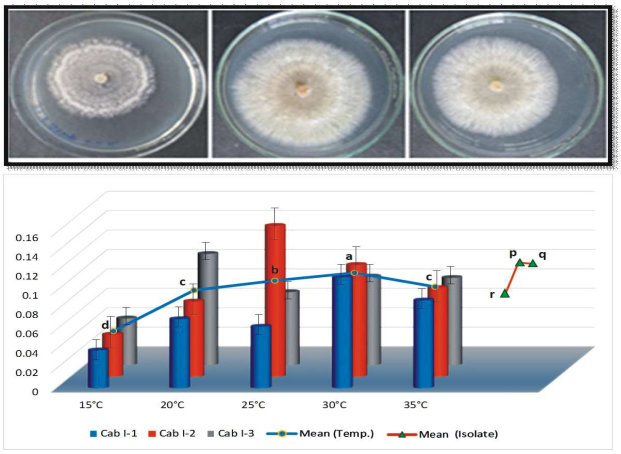

Fig.1: Influence of different temperature on mycelial growth of *Rhizoctoniasolani*. Top picture indicates the comparative growth of *R. solani*in Petri plates at 20, 25 and 30°C from left to right, respectively, whereas the bottom picture shows the graphical representation of three isolates in 5 various temperatures.a-c and p-r represents the DMRT ranking of mean growth (large to small) in respect of temperature and isolate, respectively

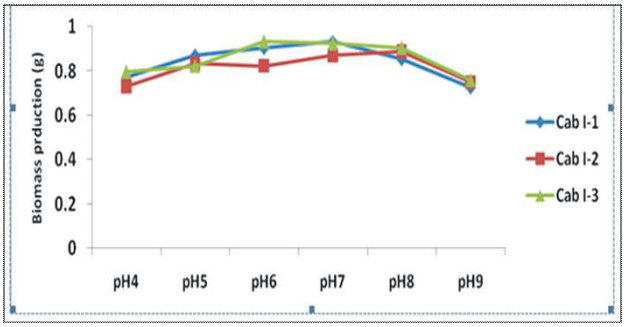

Fig.2: Effect of different pH on mycelial growth of *R.solani* cabbage isolates

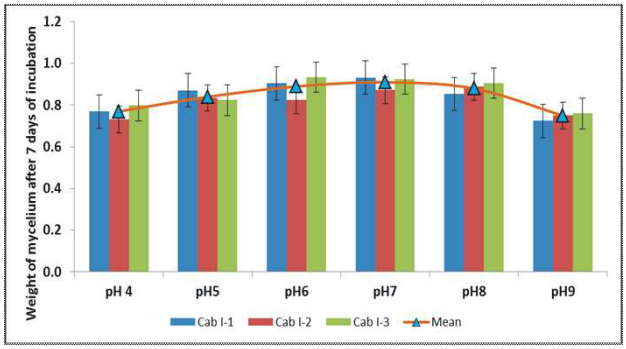

Fig.3: Influence of pH on biomass production by isolates of *R. solani* in infecting cabbage

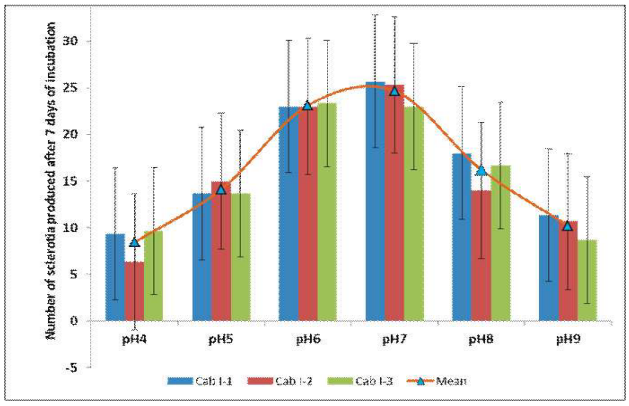

Fig.4: Effect of different pH on sclerotial production of isolates of *R. solani* infecting cabbage

lates of *R. solani* pathogenic to potato (Ritchie *et al*. 2009). Higher growth and metabolic activity was exhibited by *R. solani* at pH 6 (Muhsin and Selman 2013). Kumar *et al.* (2014) reported maximum hyphal growth of *R. solani* at pH 7. Salunkhe *et al*. (2009) reported that there was no significant difference in radial growth in isolates at pH range 5 to 9. All isolates of *R. solani* were able to produce sclerotia over a wide range of pH 4 to 9 and irrespective of *R. solani* isolates pH 6 and 7 was found to be optimum in respect of sclerotial production. Sclerotial production in response to pH have been demonstrated previously on isolates from lupin producing sclerotia between pH 4 to 9. The optimum pH for sclerotial production of different *R. solani*

isolates was reported at pH 6 (Goswami *et al.* 2011, Datta *et al*. 2014).

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