

# PHYSIOLOGICAL STUDIES IN *FUSARIUM SOLANI* CAUSING RHIZOME ROT OF GINGER (*ZINGIBER OFFICINALE* ROSC.)

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## KEY WORDS

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## ABSTRACT

The effect of carbon and nitrogen sources, temperature, pH levels and light spectra on mycelial growth of benomyl sensitive and resistant isolates of *Fusarium solani* (Mart.) Sacc. was investigated. Sucrose was found to be the best source of carbon, whereas calcium nitrate was the best source of nitrogen. The fungus grew at temperatures ranging from 10 to 35°C, with optimum growth at 25°C and no growth was observed at 5°C and 40°C. The most suitable pH level for the growth was 4.5. The growth was reduced under different light spectra when compared to darkness. Resistant isolate had higher growth rate as compared to sensitive isolate.

## INTRODUCTION

Ginger (*Zingiber officinale* Rosc.) is an important crop grown for its aromatic rhizomes, used both as a spice and a medicine. In storage, it is affected by several fungal pathogens (Dohroo, 1993), rhizome rot caused by *Fusarium solani* being the most common (Kumar, 1977), which is generally managed by benomyl. The disease reduced potential yields of ginger to a greater extent in field, storage and market and many losses of even more than fifty percent (Joshi and Sharma, 1980). Ramteke and Kamble (2010) have reported benomyl resistance in *Fusarium solani* causing rhizome rot of ginger. Studies on abiotic factors associated with disease development will contribute to a better understanding of fusarial diseases (Haware, 1993).

No much information is available on the physiological requirements of benomyl sensitive and resistant isolates of *Fusarium solani* isolated from ginger. The present study was therefore undertaken to study the effect of carbon and nitrogen sources, temperature, pH and light spectra on mycelial growth of *F. solani*.

## MATERIALS AND METHODS

**Physiological studies:** Benomyl sensitive (5µg/mL) and resistant (350µg/mL) isolates of *Fusarium solani* were selected for this purpose from previous studies (Ramteke and Kamble, 2010). Studies of the following physiological aspects of *F. solani* were conducted *in vitro*.

### Effect of carbon and nitrogen sources

**Carbon sources:** Five carbon sources viz. sucrose, dextrose, fructose, maltose and lactose were incorporated in Czapek's

Dox agar (Rangaswami and Mahadevan, 2001) medium. Plates without any carbon source treated as control.

**Nitrogen sources:** Four nitrogen sources viz. sodium nitrate, calcium nitrate, potassium nitrate and ammonium nitrate were amended in Czapek's Dox agar (CDA) medium. Plates without any nitrogen source treated as control.

**Effect of temperature:** The sensitive and resistant isolates of *F. solani* were inoculated on CDA medium and incubated under different temperatures viz. 5, 10, 15, 20, 25, 30, 35 and 40°C in BOD incubator.

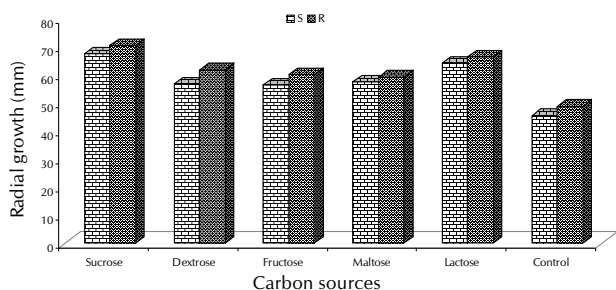
**Effect of different pH levels:** CDA medium was separately prepared and their pH was adjusted to 3.5, 4.5, 5.5, 6.5, 7.5 and 8.5 using hydrochloric acid (0.1N) or sodium hydroxide (0.1N). The pH was measured using electrical pH meter and set before sterilization in autoclave.

**Effect of different light:** Petri plates containing CDA were inoculated with both isolates and wrapped with gelatine sheets of different colours. Plates kept in dark served as control.

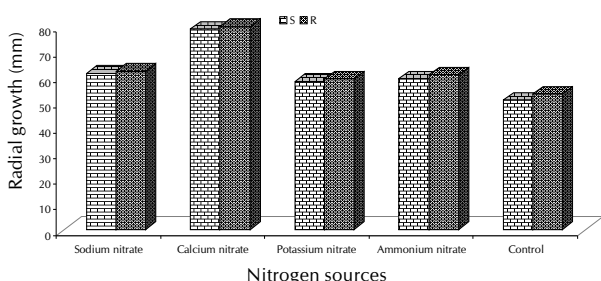
All the experiments were conducted in triplicates. Petri plates were inoculated with 8 mm culture discs taken from the periphery of seven days old cultures of both isolates of *F. solani* and incubated at 26 ± 3°C (except for the study of temperatures). Observations on radial mycelial growth (mm) were recorded after six days in case of effect of carbon and nitrogen sources, whereas effect of temperature, pH and light were recorded after eight days of inoculation.

## RESULTS AND DISCUSSION

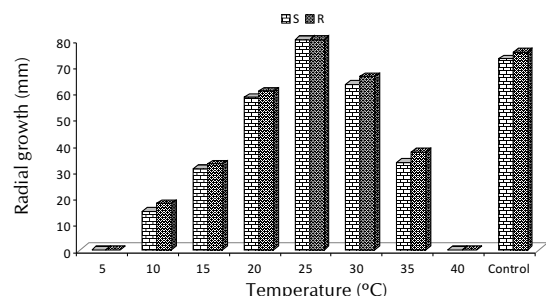
**Effect of carbon and nitrogen sources:** Results presented in



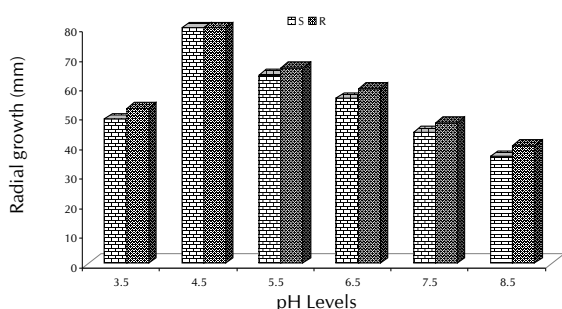
**Figure 1:** Effect of different carbon sources on the radial growth (mm) of benomyl sensitive (S) and resistant (R) isolates of *Fusarium solani* after 6 days



**Figure 2:** Effect of different nitrogen sources on the radial growth (mm) of benomyl sensitive (S) and resistant (R) isolates of *F. solani* after 6 days

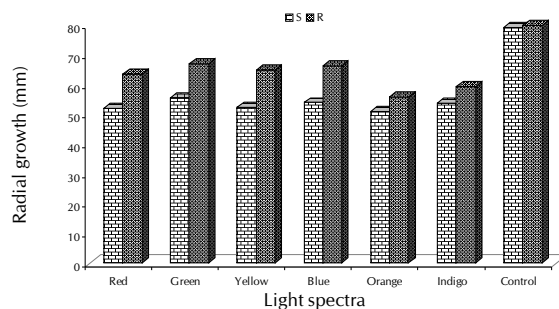


**Figure 3:** Effect of different temperature on the radial growth (mm) of benomyl sensitive (S) and resistant (R) isolates of *F. solani* after 8 days



**Figure 4:** Effect of different pH levels on the radial growth (mm) of benomyl sensitive (S) and resistant (R) isolates of *F. solani* after 8 days

figure (Fig. 1) indicated that all the carbon sources were suitable as compared to control which did not contain carbon compound. However, sucrose was found to be the best carbon source for the growth of sensitive (67.33 mm) and resistant (70.33 mm) isolates of *Fusarium solani*. It was followed by



**Figure 5:** Effect of different light spectra on the radial growth (mm) of benomyl sensitive (S) and resistant (R) isolates of *F. solani* after 8 days

lactose, maltose, dextrose and fructose. These results are similar with Olutiola (1978) in case of source for growth of *F. oxysporum*.

Among the four nitrogen sources tested, calcium nitrate was found to be best source of nitrogen for sensitive (79 mm) and resistant (80 mm) isolates of *F. solani*. It was followed by sodium nitrate, ammonium nitrate and potassium nitrate after six days of inoculation (Fig. 2). Little growth was noticed in control which was devoid of nitrogen. Similar observations were made by Sadd and Hagedorn (1970) in case of *Alternaria tenuis* (Syn. *A. alternata*).

**Effect of Temperature:** In order to know the best temperature for the mycelial growth of sensitive and resistant isolates of *F. solani* eight temperatures varying from 5 to 40°C with an interval of 5°C were tested. Results (Fig. 3) showed that optimum mycelial growth of both sensitive and resistant isolates was obtained at 25°C. The growth of both isolates at 20°C and 30°C was also favourable. However, it was relatively low at 10°C and 35°C. No growth was observed at 5°C and 40°C (Fig. 3). Similarly, Harveson and Rush (1998) reported that *F. oxysporum* f. sp. *betae* has the highest mycelial growth at 25°C. Wakle et al. (2007) have also reported similar findings in case of *F. coeruleum*.

**Effect of pH levels:** The growth of *F. solani* was observed in all the pH level tested but it was maximum at pH 4.5 where it was 80 mm after eight days of inoculation (Fig. 4). Growth of the both isolates decreased by increasing or decreasing the pH level from pH 4.5 level. Similarly, Taber et al. (1968) found that *Alternaria raphani* grew well over a wide pH range of 4.8 to 7.2. Contrary to this, growth of *F. oxysporum* f. sp. *ciceri* was maximum at pH 7 (Farooq et al., 2005).

**Effect of light:** Light had little influence on mycelial growth. Among different light spectra, growth was more under green and blue light. However, under dark conditions, it was found best (Fig. 5). Overall results indicated that there was little variation in mycelial growth under different light. This agrees with the finding of Roy and Pande (2009) in case of *Alternaria alternata*, where the growth rates were decreased by exposure to light.

In all the experiments, resistant isolate had higher growth rate as compared to sensitive isolate of *F. solani*. Similar observations were made by Bollen (1971) in case of *Penicillium* species.

Physiological studies revealed that *F. solani* showed a

maximum growth at 25°C, 4.5 pH and darkness. Sucrose was found to be the best source of carbon, whereas calcium nitrate was the best source of nitrogen. Resistant isolate had higher growth rate as compared to sensitive isolate of *F. solani*.

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