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## Physiological studies of *Alternaria* causing *Alternaria* blight of tomato

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### Abstract

Tomato (*Solanumly copersicum* L.) ranks first among processing crops. Tomato is the world's second most consumed vegetable after potato. *Alternaria* blight of tomato caused by *Alternaria alternata* is one of the most important fungal diseases prevalent in tomato growing areas of India particularly in Rajasthan state and is considered as one of the limiting biotic factor for successful cultivation of tomato. Physiological studies were conducted in the laboratory of Department of Plant Pathology at SKNAU, Jobner on *Alternaria alternata*. Results revealed different levels of relative humidity and temperature play a significant role in mycelial growth of *Alternaria alternata*. *In vitro* studies of different levels of relative humidity reveals that, 90 to 100 per cent relative humidity produce maximum mycelial growth 88.70 mm and 85.10 mm, respectively. In temperature studies maximum mycelium growth of *Alternaria alternata* was observed at 25°C followed by 30 and 35 °C.

**Keywords:** Tomato, *Alternaria* blight, relative humidity, temperature

### Introduction

Tomato (*Solanumly copersicum* L., syn. = *Lycopersicon esculentum* Mill.) ranks first among processing crops. Tomato is the world's second most consumed vegetable after potato. Tomato has very few competitors in the value addition chain of processing. Tomato is a native to Peruvian and Mexican region. Though there are no definite records of when and how it came to India, the Portuguese perhaps introduced it to India. It is a regular kitchen component of Indian diet which is used as raw fruit and also as cooked processed products like soup, ketchup, sauce, pickle, pastes and powder. The pulp and juice of tomato is very digestible, promoter of gastric secretion and blood purifier, additionally it nutrients and metabolites (Folate, potassium, and vitamins A and C) that are important for human health. Tomato seed contains 2.4 percent oil which has great medicinal value. Tomato fruits content about 95 percent water and 5 percent other component mainly carbohydrates and fibers. In India, tomato crop is mainly grown in the states of Odisha, Andhra Pradesh, Madhya Pradesh, Karnataka, West Bengal, Chhattisgarh, Telangana, Bihar, Gujarat, Rajasthan and U.P. etc. In Rajasthan, tomato crop is mainly grown in Jaipur, Dausa, Alwar, Tonk, Dholpur, Bharatpur, Chittorgarh districts etc. In Rajasthan, tomato is cultivated over an area of 0.016 million hectares with an annual production of 1.106 lakh tonnes <sup>[1]</sup>.

Tomato is a herbaceous sprawling plant growing to 1-3 m in height with weak woody stem. The flowers are yellow in colour and the fruits of cultivated varieties vary in size from cherry tomatoes, about 1–2 cm in size to beefsteak tomatoes, about 10 cm or more in diameter. Most cultivars produce red fruits when ripe. Tomato is one of the most important "protective foods" because of its special nutritive value. Tomato is grown for its edible fruits, which can be consumed either fresh or in processed form and is a very good source of vitamin A, B, C and minerals as well as lycopene-natural antioxidant. It has niacin 0.712 mg, calcium 31 mg and water 94.28 g per hundred g weight <sup>[2]</sup>. So tomatoes are called as 'Poor man's fruit'. The crop is grown from almost MSL to an altitude of 1500 m in tropical and subtropical regions, with an annual rainfall of 60-150 cm. Well drained sandy loam soil with high level of organic contents is suitable for tomato cultivation. Soil with high acidity is not suitable for tomato cultivation. Tomato plants are suffered with large number of biotic stresses including insect pests and diseases from the time of emergence to harvest. Tomato suffers with various diseases cited by fungi, bacteria, viruses, nematodes etc. in several countries <sup>[3]</sup>. More than 200 diseases have been reported to infect tomato in the world <sup>[4]</sup>. Large number of fungal diseases such as *Alternaria* blight (*Alternaria alternata*), early blight (*Alternariasolani*),

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Late blight (*Phytophthora infestans*), Septoria leaf blight (*Septoria lycopersici*), Powdery mildew (*Oidiopsisaurica*), Fusarium wilt (*Fusarium oxysporum f. sp. lycopersici*), Collar rot (*Sclerotium rolfsii*), and Damping off (*Pythium sp.*) are causes severe losses in tomato. Among the fungal diseases, early blight caused by *Alternariasolani* is one of the most important and frequent occurring disease of the crop nation and worldwide [5].

## Material and methods

### Collection and isolation of pathogen

*Alternaria* blight infected plant samples of tomato were collected from major tomato growing areas of Rajasthan. Isolations were made from the infected plants showing typical symptoms of *Alternaria* blight. Small pieces of the leaves of cluster bean plant were cut from the diseased portion along with some healthy tissues, surface sterilized for 1-2 minutes in 1.0 per cent Sodium hypochlorite solution followed by three washings with sterilized distilled water. These bits were transferred aseptically to 2 per cent Potato Dextrose Agar in Petri plates separately. Incubation was done at  $25 \pm 1$  °C for 7 days. Sub-culturing from uncontaminated peripheral growth were made on PDA slants. Pathogen was purified by using single spore technique.

### Effect of relative humidity

To study the effect of relative humidity on mycelial growth of *Alternaria alternata*, six different levels of relative humidity i.e. 50, 60, 70, 80, 90 and 100 per cent was maintained in desiccators by using the concentrate sulphuric acid and sterilized distilled water in different proportions. The different relative humidity levels were maintained by the method suggested by [6].

**Table 1:** Compositions of the acid solution used were as follows.

S. No.	Relative humidity (%)	Stock solution (ml)*	Distilled water (ml)
1.	50	514.0	420.0
2.	60	374.0	396.0
3.	70	348.0	510.3
4.	80	294.0	640.0
5.	90	161.0	712.0
6.	100	0.00	Only distilled water

\* 50% v/v solution of concentrate sulphuric acid

Petri plates having PDA medium inoculated with 5mm disc of seven days old fungus culture was kept in desiccators having solution of different level relative humidity and then incubated at  $25 \pm 1$  °C. Observations on radial growth was recorded after 7 days of incubation.

### Effect of temperature

Effect of temperature on growth of *Alternaria alternata* was studied *in vitro*. 20 ml of sterilized potato dextrose agar medium was poured in each in each sterilized petri plate. Inoculation was made with 5 mm disc from 7 days old fungal culture and incubated at 7 different temperatures *viz.*, 15, 20, 25, 30 and 35°C. Observation on radial growth was recorded after 7 days of inoculation.

## Result and Discussion

### Isolation and pathogenicity test of pathogen

Isolation of the pathogen from diseased plants of tomato was

done on potato dextrose agar (PDA) medium. After seven days of incubation at  $25 \pm 1$  °C, growth of fungus was developed. Pure culture of the pathogen, obtained by single spring on PDA, yielded *Alternaria alternata*.

### Effect of relative humidity

To evaluate the effect of atmospheric moisture, the fungus was exposed directly to different level of relative humidity. It was observed (Table 2 and Plate- 1) that all the six humidity levels (50, 60, 70, 80, 90 and 100 per cent) induced the growth of *Alternaria alternata*. Significantly best mycelial growth (88.70 mm) was recorded at 90 per cent relative humidity followed by growth at 100 per cent (85.10 mm) relative humidity level. A significantly decrease in mycelium growth was observed at 80, 70 and 60 per cent humidity level. Minimum mycelium growth was observed at 50 per cent relative humidity level. It can be concluded that high humidity favoured the growth of *A. alternata*.

**Table 2:** Effect of relative humidity on mycelial growth of *Alternaria alternata*

S. No.	Relative humidity (%)	Mycelial growth* (mm)
1	50	40.30
2	60	55.50
3	70	70.20
4	80	78.60
5	90	88.70
6	100	85.10
	SEm+	0.29
	CD (p=0.05)	0.92

\* Average of three replications

In general optimum relative humidity enhances the fungal growth and disease development in plants. *In vitro* studies of different levels of relative humidity reveal that, 90 to 100 per cent relative humidity produced maximum mycelial growth of *Alternaria alternata*. Similar results were reported by [7] studied the weather in relation to *Alternaria* leaf blight disease development in Maharashtra. Temperature of 25.9°C to 33.7°C with a relative humidity of 89 to 95 per cent favoured disease development. Similarly [8-10], have also recorded [11], recorded the maximum mycelial growth and sporulations were observed on potato dextrose agar at 25°C temperature, 100 per cent relative humidity [12]. Reported maximum mycelium growth of *A. alternata* infecting brinjal, at 100 % relative humidity [13]. Reported the conidial germination of *Alternaria tenuiss ma* was maximum at 90 to 100 per cent relative humidity [14]. Observed maximum mycelial growth for *Alternaria alternata* at 25°C and 100 per cent relative humidity on PDA medium *in vitro*.

### Effect of temperature

The temperature ranges for the growth vary for all microorganisms as well as for host pathogen interactions. It is evident from the data presented in table 3 and Plate- 2 that the fungus grew at temperature (15 to 35°C) under study. Maximum mycelial growth (90.00 mm) was observed at 25°C. A sudden fall in mycelial growth was observed at 30 °C, 35 °C, 20 °C and 15 °C. However, 30°C, 20°C and 35°C also favoured good growth of *Alternaria alternata* but differ significantly for growth at 25 °C. It can be concluded that 25 °C is the optimum temperature for mycelial growth of *A. alternata*.

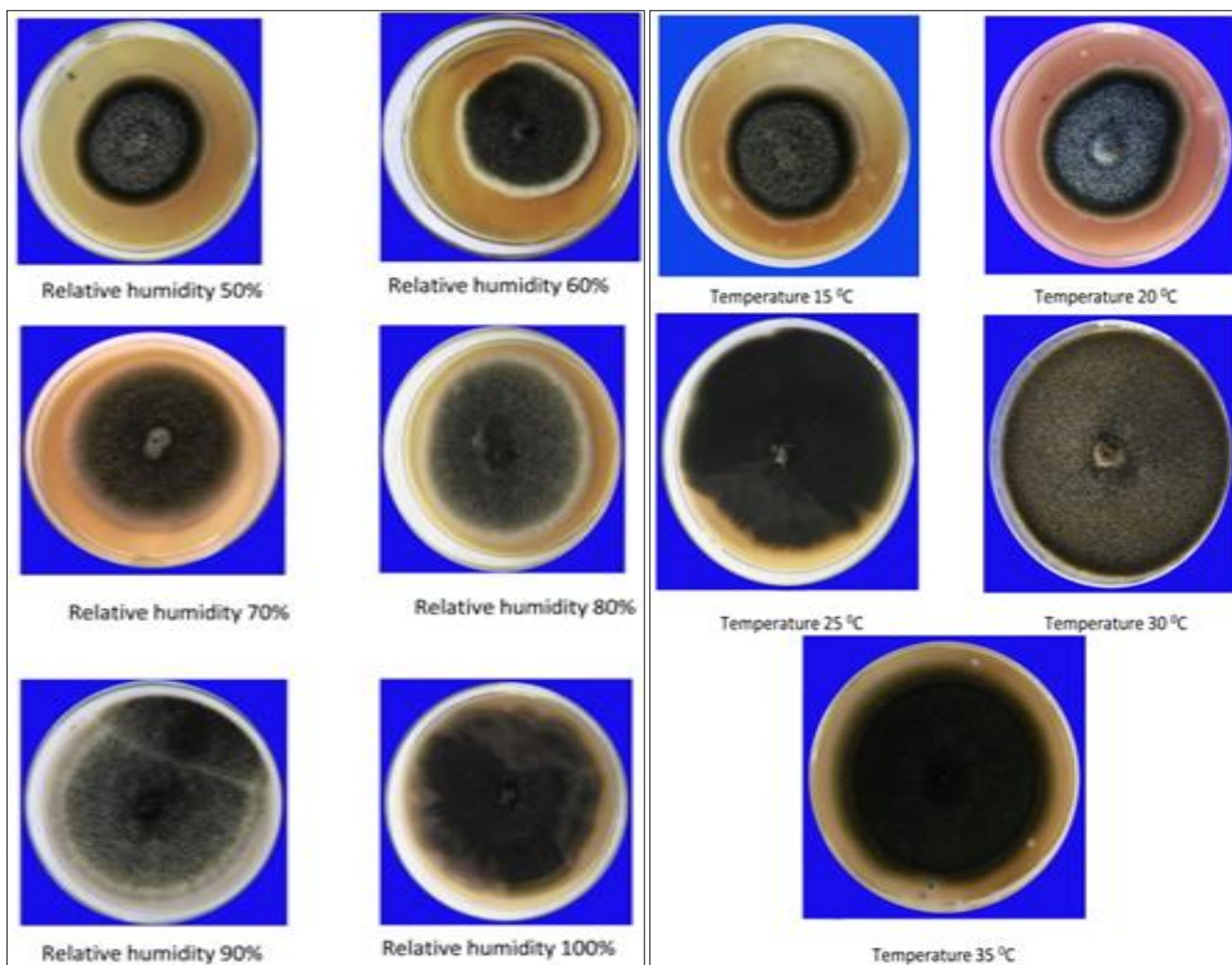
**Table 3:** Effect of different temperature levels on mycelial growth of *Alternaria alternata*

S. No.	Temperature (°C)	Mycelial growth* (mm)
1	15	40.50
2	20	69.20
3	25	90.00
4	30	89.60
5	35	79.30
	SEm <sub>r</sub>	0.38
	CD (p=0.05)	1.22

\* Average of four replications

In general optimum temperatures enhance the fungal growth and disease development in plants. In present study temperature around 25-30 °C was found to increase mycelial

growth of *A. alternata* [15]. Reported that good growth and sporulation of various species of *Alternaria* was observed in temperature range of 23-28°C. In present investigation, maximum mycelium growth of *Alternaria alternata* was observed at 25°C followed by 30, 35 and 20 °C. Similar observations were reported by [16-17]. They observed that optimum temperature for growth and sporulation of *Alternaria* ranged from 25°C to 30±2°C [18]. Observed to be maximum mycelial growth for *Alternaria alternata* was recorded at 25°C on PDA medium *in vitro* and [19] reported favourable temperature for growth of *Alternaria alternata* was 20-25°C and 25 - 30°C, respectively [20]. Studied the effect of temperature on fungal growth and *Alternaria alternata* grew best at 30°C temperature [21-25]. have also been recorded maximum mycelial growth of *Alternaria* spp.

**Plate 1:** Effect of relative humidity on mycelial growth of *Alternaria alternata***Plate 2:** Effect of Temperature on mycelial growth of *Alternaria alternata*

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