

Original Research Article

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**Effect of Temperature and Relative Humidity on the
Development of Blue Mould Rot (*Penicillium islandicum* Sopp.)
on Indian Gooseberry (*Emblica officinalis* Goerth.)**

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To study the effect of weather parameters i.e. temperature and relative humidity on the development of blue mould rot (*Penicillium islandicum* Sopp.) on Indian gooseberry *in vitro* experiment were carried out at Post graduate laboratory, Department of Plant pathology, Chaudhary Charan Singh Haryana Agricultural University, Hisar. An interaction of three temperatures i.e. 10, 20 and 30°C with relative humidity of 40, 60, 80 and 100 % was carried out at five and ten days after inoculation (DAI). Temperature of 30 °C along with cent per cent relative humidity resulted in maximum disease incidence of 87 and 100% in both 5 and 10 DAI, respectively. Minimum disease intensity (15 and 22%) was recorded at 10 °C temperature and 40 per cent relative humidity at 5 and 10 days after inoculation. However, with further increase in temperature and relative humidity, the per cent disease intensity was also increased and it also increased during the period of time (5 and 10 days after inoculation). Thus from the present study, it can be clearly elucidated that low temperature (10 °C) with low relative humidity (40%) is ideal for the post harvest storage of Indian gooseberry.

Introduction

Aonla or Indian gooseberry (*Emblica officinalis* Goerth. Syn. *Phyllanthus emblica* L.) is one of the most important indigenous fruit of Indian sub continent (Baghel *et al.*, 2007). It belongs to family Euphorbiaceae and order Euphorbiales. Aonla has been cultivated in India since time immemorial (Singh *et al.*, 2009). It grows in tropical and subtropical parts of India, China, Indonesia and the Malay Peninsula (Golechha *et al.*, 2012 and

Srivasuki, 2012). The area under aonla cultivation in India is about 103.55 thousand hectares and production 1225.21 thousand MT (Anonymous, 2015). Haryana occupies an area of 2226 hectares under this fruit crop with a production of 12056 MT (Anonymous, 2016). Aonla fruit contains different essential nutrients i.e. carbohydrates, proteins, phenol, calcium, phosphorus, zinc, and vitamin B. It is a rich source of vitamin C ranging from 400-1300 mg/100 gm pulp and vitamin B 300 mg/100 gm pulp (Singh, 2006; Kore *et al.*,

2013). Its constituents serve as important source of food and medicine (Kumar and Singh, 2002). It is probably the only fruit to fill the gap of a stringent food recommended in ayurvedic medicine and balanced diet for sound health (Singh, 2006). *Alternaria* rot, *Penicillium* mould rot and *Aspergillus* black mould rot of citrus caused by *Alternaria alternata*, *Penicillium digitatum*, *Penicillium italicum* and *Aspergillus niger*, respectively have been reported to develop more rapidly at temperature, 15-35°C, 20-25°C and 30-35°C (Fawcett and Barger, 1927; Agrawal and Hasija, 1967; Bhargava, 1972) respectively. Temperature, ranging from 20-35°C is reported to be optimum for the rapid development in case of fruit rot of citrus (Pathak, 1980). Severity of *Penicillium* and *Botryodiplodia* rot of sweet orange caused by *Penicillium italicum* and *Botryodiplodia theobromae*, respectively have been reported to be highest at 100 per cent relative humidity and lowest at 40 per cent relative humidity (Tandon *et al.*, 1975; Godara, 1994). Gupta and Chauhan (1998) reported effect of temperature on the development of soft rot of *Emblica officinalis* caused by *Penicillium citrinum* strains I to VI. They observed that strain VI produced maximum rot (49.5 %) after 24 days at 25°C, while at temperatures 15°C, 20°C, 30°C, 35°C, percentage rot were 17.3, 30.2, 18.3 and 4.8, respectively. Plant diseases including fruit rots were to be more common in humid to wet regions with cool and warm or tropical temperature (Agrios, 2005). The best temperature for growth of *Penicillium* spp. was found to be 23°C, and by decreasing the temperature fungal growth decreased (Agostini *et al.*, 2006). Baghel *et al.*, (2008) studied the effect of temperature and relative humidity on fruit rot of aonla caused by *Penicillium citrinum*. They observed that temperature of 10°C was most effective for preservation of aonla as it showed minimum disease severity. However, temperature of 25 and 20°C showed maximum

disease severity of 87.7 and 71.8% respectively. They also reported that highest disease severity (100%) was observed in the fruits stored at 100 per cent RH. Minimum rotting (47.1%) was recorded when fruits were stored at 50 per cent RH.

Materials and Methods

To evaluate the comparative effect of temperature on disease development, inoculated fruit of aonla were maintained at three different temperatures *viz.* 10°C, 20°C and 30°C. The inoculation was done by well method. Un-inoculated fruits of the same variety were also maintained at each temperature for comparison. Varying relative humidity levels were maintained with potassium hydroxide solution in sterilized desiccators as suggested by Solomon (1951). The inoculated fruits placed in desiccators were stored at room temperature 25±2°C for each experiment.

RH	(KOH gm /200 ml solution)
40	75.90
60	59.00
80	38.50
100	200 ml distilled water

Results and Discussion

Among the external factors temperature and relative humidity are the most important factors which play a important role in influencing growth rate and other metabolic activities of a pathogen. To study the effect of three varying temperature and four relative humidity ranges, observations on disease intensity of blue mould rot were recorded at 5 and 10 days after inoculation. The fruit pulp was removed to a five mm depth and then

inoculated with the disc of culture of the pathogen (7 days old and removed portion was plugged back). Inoculated fruits were placed in desiccators with maintained relative humidity range and incubated at temperature range in B.O.D. Five replications were maintained at 10, 20, 30°C temp. and 40, 60, 80 and 100 per cent RH. levels. Observations for per cent disease intensity were recorded after 5 and 10 days after inoculation. The data presented in Table 1 showed that maximum per cent disease intensity was observed at 30°C temperature with 100 per cent relative humidity and minimum at 10°C temperature with 40 per cent relative humidity. However, with further increase in temperature and relative humidity, the per cent disease intensity was also increased and it also increased during the period of time (5 and 10 days after inoculation). The data clearly showed the disease intensity differed significantly with days after inoculation at all temperatures and humidity levels. A

temperature range of 25 to 30°C and humidity levels of 80 to 100 per cent was observed optimum for maximum infection. A variation on either side significantly reduced the disease. Temperature and relative humidity play a vital role in the development of the post harvest diseases. The per cent disease intensity of aonla varied significantly, when it was stored at different temperature with different relative humidity combinations. Temperature of 10°C with 40 per cent RH was most effective for preservation of aonla as it contracted minimum disease intensity (15%). However, temperature of 30°C with 100 and 80 per cent RH showed maximum per cent disease intensity respectively. The complete decay of aonla fruits was observed at 100 per cent relative humidity with 30°C temperature. The present investigations were very close to the observations of Singh and Sumbali (2007) on *Penicillium* apple rot, Singh and Mandal (2007) on peach fruit rot and Baghel *et al.*, (2008) on aonla.

Table.1 Effect of temperature and relative humidity on the development of blue mould rot on aonla

Temperature (°C) \ Relative Humidity (%)	Disease intensity (%)					
	5 DAI**			10 DAI		
	10	20	30	10	20	30
40	15* (22.76)***	22 (27.94)	35 (36.25)	22 (27.94)	30 (33.16)	50 (44.98)
60	25 (29.97)	35 (36.25)	48 (43.84)	30 (33.19)	40 (39.21)	65 (53.72)
80	35 (36.25)	55 (47.85)	70 (56.77)	42 (40.38)	65 (53.72)	88 (69.74)
100	38 (38.04)	60 (50.75)	87 (68.42)	47 (43.26)	70 (56.78)	100 (89.39)
CD (p=0.05) DAI	0.48					
Temperature	0.59					
Relative humidity	0.68					

*Average of five replications

**Days after inoculation

***Figure in parentheses are angular transformed value

In conclusion, blue mould rot disease intensity was checked when the fruits were stored at temperature of 10°C with 40 per cent relative humidity. However, the most favourable temperature and relative humidity for the blue mould rot was noted at 30°C and 100 per cent relative humidity respectively.

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