# Cross infectivity and survivability of *Colletotrichum gloeosporioides* isolated from Papaya

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## Abstract

*Survivability of Colletotrichum gloeosporioides on papaya petioles was studied under different environmental conditions. Papaya petioles were kept in different places i.e. Attached to the plant and allowing it to fall on the ground, in the laboratory room temperature, at 4 $^0$c in the refrigerator, at 28±1 $^0$c and 30±1 $^0$c in bod incubators. Fungal spores collected from petiole lesions at weekly intervals were mounted on cavity slides to count number of spores per lesion and percentage of spore germination. Mature fruits of papaya, banana, mango, grape and pomegranate were used to assess the cross-infectivity of C. gloeosporioides isolated from papaya. Each fruit was spot inoculated with papaya isolate of C. gloeosporioides. Number of fruits infected and the diameter of lesions were recorded. The cross infectivity of C. gloeosporioides isolated from banana, mango, grape and pomegranate on papaya, was also studied by spot inoculating each isolate into papaya fruits. Spores of C. gloeosporioides were found to be viable under the field condition up to eight weeks since germination percentage was always high in the field, compared to other treatments. The number of conidia produced in petiole lesions was high at 4$^0$c which indicated the ability of the pathogen to survive longer in low temperature conditions. The efficiency of spore production was reduced after the 5$^{th}$ week in all the treatments. C. gloeosporioides isolated from papaya could cross-infect only mango and banana fruits while isolates of banana and mango in turn, cross-infected ripened papaya fruits. The cross infection study has shown that the potential exists for post-harvest cross infection of various hosts by C. gloeosporioides.*

**Keywords**: Papaya, *Colletotrichum gloeosporioides*, cross infectivity, survivability

## Introduction

Papaya is one of the major fruit crops, grown in almost all tropical and sub tropical regions, along with mango, banana, citrus, guava, pineapple, and grapes (Chadha and Pareek, 1993). The commercial papaya production has been hampered worldwide due to high susceptibility of the crop to various diseases. Papaya fruit has very thin skin and thus rough handling leads to heavy losses due to a number of rots caused by fungi and bacteria. Among the diseases, anthracnose caused by *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. is the most serious disease affecting the fruit at the ripening stage. The disease is prevalent wherever papaya is grown (Rawal, 1993) and becomes more prominent during marketing and at the consumer level.

Genus *Colletotrichum* attacks a large number of important tropical and sub-tropical crop species and causes economically significant diseases on cereals, grain legumes, vegetables, forage legumes, fruit crops and perennial crops. The fungus reproduces by means of asexual spores or conidia which are produced in fruiting structures called acervuli. Conidia of *Colletotrichum gloeosporioides* are produced in lesions on petioles and leaves, mummified inflorescences and flower bracts of papaya (Dodd *et al.*, 1992) and can act as continuous sources of inocula, if proper sanitation is not practiced.

Because of the wide host range, the pathogen can also survive longer periods in the absence of papaya. Cross infectivity of *C. gloeosporioides* on different fruit crops has been observed by various authors (Quimio and Quimio, 1975; Cheema, *et al*,. 1976; Alahakoon *et al.*, 1994). Because of this cross infection ability, when papaya is grown closer to other fruit crops, there is ample opportunity for the pathogen to survive in the area for a longer period infecting these fruit crops. The main source of inocula in the field is infected fruits and drying petioles. However, the survivability of the pathogen on papaya petioles was not studied adequately.

In view of the above, a study was undertaken to investigate survivability of *Colletotrichum gloeosporioides* on papaya petioles under different environmental conditions and cross infection potential on different fruit crops.

## Materials and Methods

The experiment was carried out at the Indian Institute of Horticultural Research (IIHR), Hessaraghatta, Bangalore, during May to September 2003.

### Survivability

Papaya petioles were kept in different places *i.e.* attached to the plant and allowing to fall on the ground, in the laboratory room temperature, at 4 °C in the refrigerator, 28±1°C and 30±1 °C in BOD incubators. Survivability of the pathogen was studied by counting the number of conidia present in the petiole lesion and by spore germination technique.

a). Spore germination technique

*C. gloeosporioides* conidia were scraped using a camel hair brush from three petiole lesions of each treatment at weekly intervals and mounted on cavity slides having sterile distilled water, covered with a cover slip and incubated under humid environment. Experiment was replicated thrice and the percentage of spore germination, after 24 hours, was observed under the microscope. Five microscopic fields were selected for each replicate and spore counts were averaged. Experiment was carried for out eight weeks.

b). Spore counting technique

Conidia were harvested from papaya petioles and incubated in different environmental conditions at weekly intervals by gently brushing the lesions with a camel hair brush frequently dipped in distilled water. The brush was rinsed in 5 ml of water and the conidial suspension was vortexed for a few seconds, then diluted with 5 ml of sterilized distilled water. Conidia were counted under a compound microscope using a haemacytometer. Each lesion was used only once to avoid secondary lesion development. The experiment was replicated thrice and five counts of conidia were taken per 1 ml for each replicate. These counts were averaged and multiplied by the total volume of the suspension. Spore count was expressed as no. Of spores per lesion.

### Cross pathogenicity

Fruits of papaya, banana, mango, grapes and pomegranate were used to assess the cross-pathogenicity of papaya isolate of *C. gloeosporioides.* Ten fruits from each crop were harvested and surface sterilized by dipping in 70% alcohol, and after air-drying, were spot inoculated with 7 day old mono-conidial culture of *C. gloeosporioides* isolated from papaya. The inoculated fruits were incubated in moist chambers for 48 hours at 28±1 °C. After 48 hours, fruits were taken out from moist chambers and kept in plastic trays at room temperature

The cross pathogenicity of *C. gloeosporioides* isolated from banana, mango, grapes and pomegranate on papaya was also studied by spot inoculating each of these isolate on papaya fruits as described above. Ten papaya fruits were selected for inoculation with each of these isolate and kept in moist environments for 48 hours. After that, fruits were kept in plastic trays for the symptom development. Number of fruits infected and the diameter of the lesion were recorded in this experiment.

## Results and Discussion

### Survivability

a). Spore germination experiment

Germination percentage of *C. gloeosporioides* with time was reduced in all treatments within one week (Fig. 1). Germination percentage of conidia incubated under field condition became zero at the eighth week and it was reduced by half between third and fourth week. Under laboratory conditions, germination percentage of spores became zero in the fifth week with 50% reduction of germination from its original value between 1[st] and 2[nd] week. Germination percentage of conidia incubated at 28 °C and 30 °C had more or less similar pattern over the study period and became zero at 7[th] and 8[th] week, respectively. Germination percentage of spores on papaya petioles incubated at 4 °C did not reach zero even at the 8[th] week.

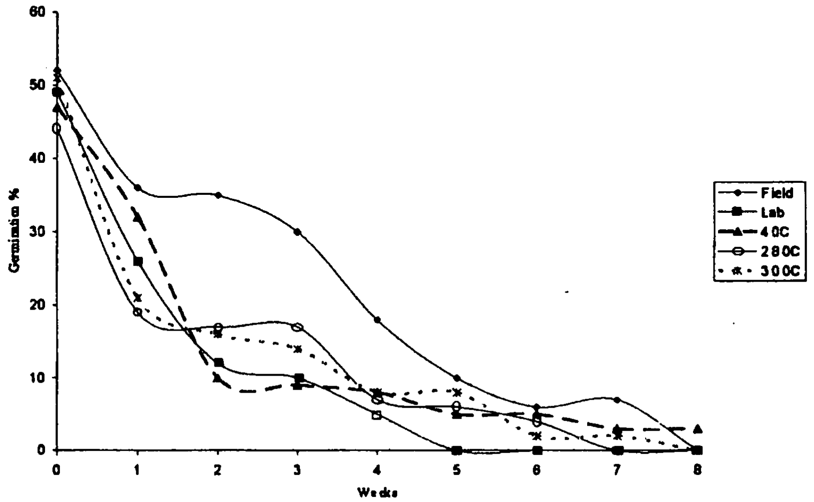


**Fig. 1: Germination percentage of *C. gloeosporioides* conidia on papaya petioles incubated under different environmental conditions**

Percentage of spore germination can be a useful tool to assess the survivability of this pathogen, since effective infection depends on the germination ability of spores. Germination percentage of spores was comparatively high in petioles incubated under field condition and became zero at the eighth week. However, the germination percentage of spores on field-incubated petioles was reduced by half of its original value between third and fourth week during the observation period. It can be concluded that the petiole lesion would act as a source of inocula for nearly two months under field conditions. However, the efficiency of providing inocula for new infections was reduced after the fourth week. Under laboratory conditions, even at the optimum temperature levels, the survivability of conidia has been less compared to field conditions.

b). Spore counting experiment

Conidia production was reduced slowly with time in all treatments up to the 5th week as given in Table 1. Number of conidia per lesion reduced at a slower rate when petioles were kept at 4°C. Under field conditions, number of conidia per lesion was found to be always high, compared to other environmental conditions. At 28 °C and at 30 °C, under laboratory conditions, the number of conidia per lesion was comparatively less at the fifth week.

After the fifth week, the number of conidia produced per lesion declined rapidly in all treatments (Table 1). The number of conidia per lesion in all environmental conditions became zero by eighth week except on petioles kept at 4 °C. Survivability of C. *gloeosporioides* spores was found to be high at 4 °C and the spore production on petioles incubated in the field was also found to be high. It is evident from the above table that the conidial production was high in all treatments up to the 5th week and thereafter, decreased sharply.

Number of conidia per lesion reduced at a slower rate when papaya petioles were incubated at 4 °C, suggesting that survivability increased with decreasing temperature. However, observations on number of spores could not correlate with observations on percentage of germination. There are no sufficient experimental evidences on the survivability of *C. gloeosporioides* of papaya on petiole lesions. Current study will provide baseline information for further studies on survivability of *C. gloeosporioides* on papaya petioles.

**Table 1. Effect of different environmental conditions on number of conidia of *C. gloeosporioides* produced per lesion**

| Time | Number of conidia per lesion | | | | |
|---|---|---|---|---|---|
| (weeks) | Field | Lab | at 4 °C | at 28 °C | at 30 °C |
| 0 | $230\times10^6$ | $225\times10^6$ | $238\times10^6$ | $250\times10^6$ | $235\times10^6$ |
| 1 | $225\times10^6$ | $248\times10^6$ | $235\times10^6$ | $201\times10^6$ | $219\times10^6$ |
| 2 | $318\times10^6$ | $210\times10^6$ | $214\times10^6$ | $212\times10^6$ | $195\times10^6$ |
| 3 | $175\times10^6$ | $75\times10^6$ | $186\times10^6$ | $122\times10^6$ | $50\times10^6$ |
| 4 | $98\times10^6$ | $19\times10^6$ | $165\times10^6$ | $5\times10^6$ | $45\times10^6$ |
| 5 | $80\times10^6$ | $10\times10^6$ | $120\times10^6$ | $15\times10^6$ | $5\times10^6$ |
| 6 | $15\times10^5$ | $25\times10^2$ | $65\times10^4$ | $76\times10^2$ | $49\times10^3$ |
| 7 | $24\times10^1$ | 0 | $43\times10^2$ 0 | $18\times10^1$ | |
| 8 | 0 | 0 | $38\times10^1$ 0. | 0 | |

**Cross infection potential of *Colletotrichum gloeosporioides***

The percentage of infection of mango, banana and papaya fruits by papaya isolate of *C. gloeosporioides* was 100 per cent (Table 2). Only 20 per cent fruit infection was observed in grapes when inoculated with papaya isolate. Average lesion size due to *C. gloeosporioides* isolate was highest (29.0 mm) on papaya fruits followed by mango (26.5mm) and banana (21.0 mm). Papaya isolate could not cause anthracnose symptoms on pomegranate while the same isolate produced fewer symptoms on grapes with average spot size of 7.0 mm.

**Table 2. Percentage of infection and lesion size on various fruits inoculated with *C. gloeosporioides* isolated from papaya**

| Tested fruit | Percentage infection | Average lesion size (mm) |
|---|---|---|
| Mango | 100 | 26.5 |
| Banana | 100 | 21 |
| Grapes | 20 | 7 |
| Pomegranate | 0 | - |
| Papaya | 100 | 29 |

Cross infection potential of mango, banana, grapes and pomegranate isolates of *Colletotrichum gloeosporioides* along with papaya isolate on papaya was also studied in this experiment. Both mango and papaya isolates had 100 per cent infection on papaya fruits (Table 3). Banana isolate could infect only 90 per cent of papaya fruits while grapes and pomegranate isolates could not cause any infection on papaya. Average lesion size on papaya fruits due to infection of mango isolate (19.5 mm) was less than that of papaya isolate (25.4 mm). Banana isolate had 12.8 mm lesion size on papaya.

The pathogenesis of *Colletotrichum* diseases varied, arising from the fundamental nutritional and ecological diversities within the genus. Many species can infect more than one host and readily attack a wide range of plants of commercial value. There was a greater variability in the degree of pathogenicity among different species of *Colletotrichum* different isolates within the species *C. gloeosporioides*. The ability of *C. gloeosporioides* to infect a wide range of fruit crops was also reported by Quimio and Quimio (1975), Cheema *et al.* (1976), Alahakoon *et al.* (1994) and Shabi *et al.*, (1997). The current findings are also in agreement with those reports in which *C. gloeosporioides* was found cross-infecting different hosts with greater variability in the degree of pathogenicity.

**Table 3. Percentage of infection and lesion size on papaya fruits inoculated with *C. gloeosporioides* isolated from other hosts**

| Isolate | Percentage infection on papaya | Average lesion size (mm) |
|---|---|---|
| Mango | 100 | 19.5 |
| Banana | 90 | 12.8 |
| Grapes | 0 | - |
| Pomegranate | 0 | - |
| Papaya | 100 | 25.4 |

The study revealed that papaya isolate could cause more infection on mango, banana and papaya fruits, less infection on grapes and no infection on pomegranate. This also reflected the ability of the pathogen to cause larger spots on the highly susceptible fruits. Banana and mango isolates along with papaya isolate in turn, could infect papaya. Isolates of pomegranate and grapes failed to infect fruits of papaya in the current study. This study has shown that the potential exists for post-harvest cross inoculation of various hosts by *Colletotrichum gloeosporioides*. However, natural cross-infections in the field need to be assessed.

## Conclusions

Spores of *C. gloeosporioides* were found to be viable under the field condition up to eight weeks, although, the efficiency was reduced after 5 weeks. The survivability can be enhanced with decreasing temperature since number of conidia remains in the lesion was high at low temperatures.

*Colletotrichum gloeosporioides* isolated from papaya could cross-infect mango and banana fruits while isolates of banana and mango in turn, cross-infected to ripened papaya fruits. The cross infection potential of papaya isolates on grapes was least, whereas on pomegranate, it was found to be non-infective.

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