

# Anthracnose disease of Mango Caused by *Colletotrichum Gloeosporioides* and its Management by Natural Products: a Review

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### Abstract

Mango (*Mangifera indica*), is an important fruit crop in tropical and subtropical countries of the world and mango tree is affected by a number of disease. The one of the most drastically affected disease is Anthracnose which is caused by *Colletotrichum gloeosporioides*. This fungal disease affected all the parts of the plant and fruit at all the stages of development. It affected the fruit at the pre and post harvested stage which result in the loss of fruit yield and low quality fruit. The disease can be control by a number of chemical fungicides but the use of chemical fungicides is hazardous for environment as well as human beings. So the present study is to minimize the use of chemical fungicides for the welfare of mankind and all living being. This paper review the research and development of Anthracnose and its management by products such as plant extracts.

**Keywords:** Anthracnose Disease, Development, *Colletotrichum Gloeosporioides*.

### Introduction

Mangoes are universally considered as one of the choicest fruits in tropical and subtropical areas of the world are member of the family Anacardiaceae and also known as the cashew nut family (Nakasone and Paull, 1998). Mango is grown in at least 87 countries but no where it is so greatly value as in India. Where 40 percent of total fruit grown in India is only mango. Mango is affected by a number of disease at all the stages of the development right from nursery to postharvest disease. Among the disease that hindered the productivity of mango. Anthracnose caused by *C.gloeosporioides*; is most destructive disease worldwide. Anthracnose attacks flowers, young fruits, leaves and twigs even the disease can also appear in the storage of mature fruits.

### Aim of the Study

To study the Anthracnose fungal diseases of *Mangifera indica* and its control by natural product such as plant extracts biological other means such as nematodes, insects and other biological fungicides. Plant based pesticides which are relatively economical, safe and non hazardous can be used successfully against the plant pathogenic fungi. The present investigation is aimed to study the antifungal activity of some plant extracts against desired pathogen.

### Distribution and Host Range

Anthracnose disease is world wide in distribution and is pathogenic to more than 470 different host plant at various stages of development such as mango, almond, apple, avocado, guava, Arabica, coffee, cassava, dragon fruit, sorghum and strawberry. Among them mango Anthracnose is very important from Indian prospective [34,37,44].

### History of Pathogenic *Colletotrichum Gloeosporioides*

*C.gloeosporioides* is one of the most frequently reported plant pathogens among genus *colletotrichum* in India. The pathogenic *C.gloeosporioides* was reported in Penzing for first time [33]. In India, it was first reported by Butler on coffee. Mccrac reported it as the causal pathogen of mango Anthracnose. *Glomerella cingulata* is the sexual stage (teleomorph) while the asexual stage (anamorph) is called *C.gloeosporioides* [25,42].

**Classification of Pathogen**

Kingdom	Fungi
Phylum	Ascomycota
Class	Ascomycetes
Order	Phyllachorales
Family	Phyllachoraceae

**Symptoms of Anthracnose**

There are numerous oval or irregular vinaceous brown or deep brownish spot of various sizes scattered all over the leaf surface under damp condition. The fungus grows rapidly forming elongated mass brown or mummy brown necrotic areas measuring 20-25 mm in diameter when old become ruptured and blighted[41]. The petiole when affected turn grey or black and the leaves droop down become dry and ultimately fall off having the black scar of the twig. Disease produces elongated black necrotic areas on the twigs.

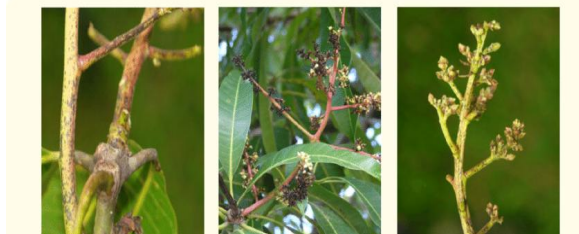
The tip of very young branches is attacked first and then twigs go on drying from the tip downwards. Under humid condition all the branches as well as the main stem of young thin branches are similarly affected on older plants but the big branches are also similarly affected on older plants but the big branches are not attacked (Sattar and malik 1939)[41].

*C. gloeosporioides* infects mango and results in blossom blight (Jeffries et al 1990)[17]. Symptomology of *C. gloeosporioides* infection varies very little between different hosts and is characterized by dark, depressed lesions on ripe fruit often accompanied by pink, slimy spore masses which develop as acervuli mature (Jeffries et al 1990)[17]. Lesions often coalesce to form large necrotic areas frequently along the leaf margins severely affected leaves usually curl. Lesions develop primarily on young tissue and conidia are formed and can be observed in lesions of all the ages. In older leaves lesions do not develop but latent infections are formed and the fungus remains dormant until the tissue senesces. Under favorable conditions conidia are dispersed and invade young twigs causing twig die back in some cases (Ploetz et al 1996). Relative humidity above 95 percent for 12 hrs is essential for infection and development of *C. gloeosporioides* on mango fruit. Infection progresses faster in wounded tissues and in ripe fruits (Prakash 1996) [36].

**Fig.1: Symptom of anthracnose on fruit [32].**



**Fig. 2: Leaf symptom of mango anthracnose**



**Fig. 3: Panicle symptom of mango anthracnose. Product Loss of Mango by Anthracnose**

Loss estimated by the *C. gloeosporioides* pathogen of Anthracnose disease has been reported 60 percent or higher during heavy rainy season [4,13,35]. (Ann et al 1997). Crop losses generally occur in the form of direct reduction in quantity or quality of the harvested produce. The disease incidence from different countries has been reported to be 32 % in south Africa [10], 64.6% in Costa Rica which can reach almost 100% under wet or highly humid condition. 50.28% yield loss caused by Anthracnose has been reported in Gondunglegi in Indonesia and 29.6% post harvest loss has been reported from Himachal Pradesh of India during 1990-92 [32,44].

Anthracnose was recognized as the most important field and post harvest disease of mango world wide. It is major constraint on the expansion of export trade of mango. Crop losses caused by *C. gloeosporioides* generally occur as a direct reduction in quantity or quality of the harvested produce. Prakash et al reported 20-30% rotting of mango fruits caused by *C. gloeosporioides* from Hyderabad. *C. gloeosporioides* also causes reduction in flower set and losses in production of mango and damage, foliage, serious problems may appear under crowded and moist conditions in nurseries and orchards [32,35].

**Resistant Varieties**

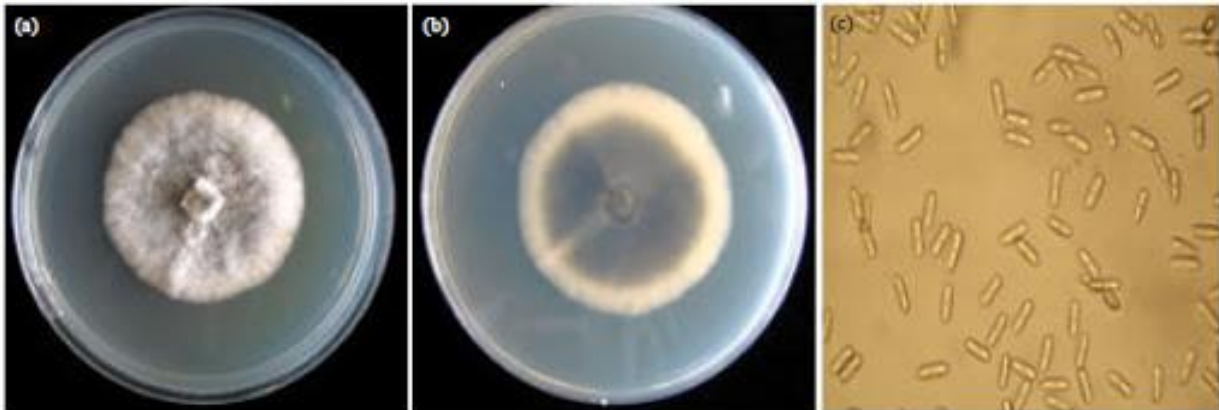
Although all commercial mango cultivars are susceptible to Anthracnose, some are less susceptible than others. The cultivars Tommy Atkins and Keitt are less susceptible than others such as Irwin, Kent or Edward. The popular cultivar Indan is highly susceptible to Anthracnose.

**Morphology of *C. gloeosporioides***

Von Arx (1957) reported that *C.gloeosporioides* had more than 600 synonyms and showed many morphological and physiological variations[46].The morphology of the fungus was described by Palo (1932) where in the spores of fungus was found to be 8.3 to 27.4  $\mu\text{m}$  in length and 2.0 to 6.6  $\mu\text{m}$  in width (mean 14.2  $\times$  4.4  $\mu\text{m}$ ). They were irregular and appear as brown to black dots.The acervuli when mature exude pink masses of conidia under moist conditions (Sattar and Malik 1939).

The acervuli measured 115-467 $\times$ 95- 22 $\mu\text{m}$  (Bose et; al 1973) 80 – 250  $\mu\text{m}$  (Sattar and Malik , 1939)[41].

The conidia were born on distinct well developed hyaline conidiophores.The conidia were straight , cylindrical or oval 8 -20  $\times$  5 – 7  $\mu\text{m}$  hyaline usually with two rarely one oil drops (Sattar and Malik 1939)[41].



**Fig. 4: Colletotrichum gloeosporioides , the causative agent of mango anthracnose (a) top view of colony in a petridish (b) reverse view and (c) microscopic view[9].**

#### **Disease Cycle of Pathogen of Anthracnose Dissemination**

Spores of *C.gloeosporioides* pathogen are dispersed passively by rain splashing or water during irrigation.

#### **Inoculation**

Pathogenic conidia land on the surface of the infection site such as panicles, leaves, branch terminals [32].

#### **Infection and Pathogen Development**

After germination of the spores, they penetrate through the cuticle and epidermis to ramify through the tissues on immature fruits and young tissues.Infection appears after the spores penetrate the cuticle on mature fruits and remain quiescent until ripening of the climacteric fruits begins.

#### **Symptoms and Disease Development**

Rapidly expanding black and sunken lesions develop on affected parts of the plants and fruits.

#### **Pathogen Reproduction**

Sticky masses of conidia are produced in acervuli on symptomatic tissues,especially during rainy or humid weather.Many diseases can occur as the fungus continues to multiply during the season [12,26].

#### **Pathogen Survival**

The pathogen of *C.gloeosporioides* survives between seasons on affected and defoliated branches terminals and on mature leaves[26].

Temperature and Moisture requirements for infection→ *C.gloeosporioides* requires 25- 28 °C temperature ,pH 5.8 -6.5 for better growth.This pathogen is inactive in dry season and switches to active stages when encountered favourable environmental conditions.Pathogen requires free water or relative humidity 95 % for conidial germination.However conidia can survive for 1 to 2 weeks at humidities as low as 62 % and then germinate if placed in 100 % relative humidity[26,32].





*C.gloeosporioides* spore germination could be obtained after application with crude methanol extract of *P.sarmentosum* leaves.

Dawa Dolma (2015) reported the antifungal activity of plant extract against anthracnose disease of banana caused by *Colletotrichum musae*. He founded that *Zingiber officinale* rhizome extract as well as *Polyalthia longifolia* and *Clerodendrum inerme* leaf extracts exhibited more than 80% inhibition of mycelia growth. Total inhibition of spore germination of *C.musae* was recorded in *Z.officinale* and *P.longifolia* extracts at .3 % w/v and .5 % w/v concentration respectively [10].

Maha Laksha Mudiyansele use six plant species *Cassia fistula*, *Lantana camara*, *Moringa oleifera*, *Ocimum tenuiflorum*, *Ricinus communis* and *Solanum torvum* to control the *C.gloeosporioides* causal organism of Papaya Anthracnose disease. He observed methanol extract of *Lantana camara* of 100 µl from the concentration of 50 g ml<sup>-1</sup> resulted in the highest inhibition of mycelia growth and conidia formation (90.71: 70.85 %) followed by *O.tenuiflorum* (45.71 %) and *M.oleifera* ( 44.76 %) against *C. gloeosporioides* out of tested extracts *L.camara* gave the lowest disease severity index at 20 % concentration and maintained optimum quality of Papaya fruits during 7 days experimental period [23]. C E Alcasid et al reported the aqueous and ethanolic plant extract derived from leaves of marigold (*Tagetes patula*), *Lantana* (*Lantana camara*), *Tamarind* (*Tamirandus indica*) and *Cosmos* (*Cosmos sulphureus*) were tested against *C.gloeosporioides*. Results showed that all aqueous extracts did not show any inhibitory effects on the growth of the test fungus in- vitro when compared to Negative (sterile distilled water) and positive (fungicide) control. No reduction in the radial growth of the fungus suggested that the tested aqueous Plant extracts were non fungicidal against the pathogen. However it was observed that ethonolic extracts from tamarind and marigold showed 42 % and 34 % inhibition respectively [3].

Gerefa Sefu et al reported the inhibition of mango anthracnose by the use of Ginger and Cinnamon leaf essential oil. In his study he use the three different concentration levels of each type of essential oil, 0.025, 0.050, 0.075 % cinnamons and .15, .30, .45 % ginger and the control (distilled water). The cinnamons and gingers essential oils at .075 % and .45 % respectively were found to highly effective on the fungal pathogen causing anthracnose disease on mango and can be recommended for the post harvest treatment of mango [43].

Gambari use the extracts of *Azadirachata indica* (Neem) and *Zingiber officinale* (ginger) against the three pathogenic fungi *Penicillium* sp, *Mucor* sp, and *Aspergillus* sp. Which are well known saprophytes of dead plant materials [15].

M.A.Abd AllA et al use some plant essential oil i.e. Basil oil (*Ocimum basilium*) Orange oil (*Citrus sinensis*), Lemon oil (*Citrus medica*) and Mustard oil (*Brassica juncea* L) to reduce postharvest loss induced by *C. gloeosporioides* in Mango fruits. Result of the study showed that orange oil at all the tested

concentrations where a significant reducing the fungal linear growth if compared with other tested essential oils. At low concentration 50 ( µg / ml ) orange oil caused 10.0 % reduction in fungal growth. While at 100 ( µg / ml ) caused 72.2 % and at high tested concentration 150 ( µg / ml ) cause a complete reduction in mycelium linear growth of pathogenic fungus [1].

Kumlachew Alemu et al reported the inhibition of *C.gloeosporioides* in the postharvested mango fruit by the use of 20 plant species. Among the 20 plant species extracted with ethylacetate *Ruta chalepensis* and *Eucalyptus globules* showed the highest activity. Methanol extracts of three plants namely *Datura stramonium*, *Adhatoda schimperiana* and *Eucalyptus globus* also showed remarkable activity. The extracts also significantly inhibit conidial germination of the test fungi over the control [5].

Rehana Nasseer et al reported the antifungal and antioxidant activities of some Agro waste and their phenolic Acid profile. Citrus leaves and pomegranate peel extract showed remarkable antifungal activity compared to other extracts with the maximum zone of inhibition 37 and 35 mm respectively.

Janio Martnez et al reported the in vivo and in vitro activity against *C.gloeosporioides* of the extracts from sawdust of *Brosimum rubescens* Taub. (Moraceae) was evaluated. The extracts of less polarity ( n=hexane and dichloromethane ) displayed the greatest inhibitory effects [24].

V.Mounica reported the antimicrobial activity of mango seed Kernel oil. She found that the antimicrobial spectrum of the kernel extract is more effective against gram negative bacteria and some pathogenic fungi [27].

Adesina reported the inhibition of *Aspergillus niger* and *Penicillium italicum* by seed kernel oil from mango [2].

### Conclusion

Anthracnose disease is a major pre and post harvest disease of mango fruit throughout the world which loss a huge amount of fruit and mango crop. There are many chemicals are available to control the disease but chemical method is not Ecofriendly and also hazardous for health. So there is the another alternative method to control the disease is use of plant extract or botanical to control the disease. Another way is to use *Eucalyptus*, *Neem*, *Ginger*, mango seed kernel oil, etc extracts against the infection caused by *C.gloeosporioides*. Hence at the present time more emphasis is made on other methods of disease management like growing resistant varieties use of plant and natural products, bio control agents and alteration in agronomic practices because they are more economical, Ecofriendly and safe.

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