

conidium; E—mycelium.

7.4. COLLETOTRICHUM

7.4.1. Systematic Position

Aonsworth(1966)

Kingdom	—	Fungi
Division	—	Eumycota
S. Division	—	Deuteromycotina
Class	—	Coelomycetes
Order	—	Melanoconiales
Family	—	Melanoconialaceae
Genus	—	<i>Colletotrichum</i>

Modern System

Kingdom	—	Fungi
Phylum	—	Ascomycota
Class	—	Sordariomycetes
Order	—	Incertae sedis
Family	—	Glomerellaceae
Genus	—	<i>Colletotrichum</i>
Species	—	<i>C. gloeosporiodes</i> (anamorphic form)
Teleomorph	—	<i>Glomerella singulata</i>

7.4.2. Occurrence and Distribution

The genus *Colletotrichum* includes a number of plant pathogens causing diseases of a wide varieties of woody and herbaceous plants. It affects fruit production by causing diseases in strawberry, mango, citrus, avocado and also in banana. Cereals like maize, sugarcane, sorghum are also affected by this pathogen.

Colletotrichum species are primarily described as the cause of anthracnose diseases in woody plants. Other diseases due to this are red rot of sugarcane, coffee berry disease, crown rot of strawberry and banana, brown blotch of cow pea. Most of the crops grown throughout the world are susceptible to one or multiple species of *Colletotrichum*. For this reason the *Colletotrichum* genus has been rated as the 8th most important group of plant pathogenic fungi in the world based on perceived scientific and economic importance.

The most widely studied species of *Colletotrichum* is *C. gloeosporioides* which infects twigs, fruits, inflorescence, leaves and all most all parts of the plant. It is the most frequently reported pathogen of this group. The other species of the genus are :

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|--------------------------|-------------------------|
| <i>C. capsici</i> , | <i>C. caudatum</i> |
| <i>C. lini</i> , | <i>C. cereale</i> , |
| <i>C. falcatum</i> , | <i>C. museae</i> |
| <i>C. crysophyllum</i> , | <i>C. graminicola</i> , |
| <i>C. nigrum</i> , | <i>C. acutatum</i> , |
| <i>C. sansevieriae</i> , | <i>C. truncatum</i> . |

The various symptoms of the diseases caused by the different pathogens of this genus is given in the figure 7.2.

7.4.3. General Features of *C. gloeosporioides*

Since this species is the most widely studied one and occurs most frequently the following descriptions refer to the features of *C. gloeosporioides* unless otherwise mentioned. This species has been taken as a model species for various studies. As already mentioned it is the anamorphic form (asexual stage).

- (i) Mycelium is septate, branched, hyaline and intercellular or intracellular.

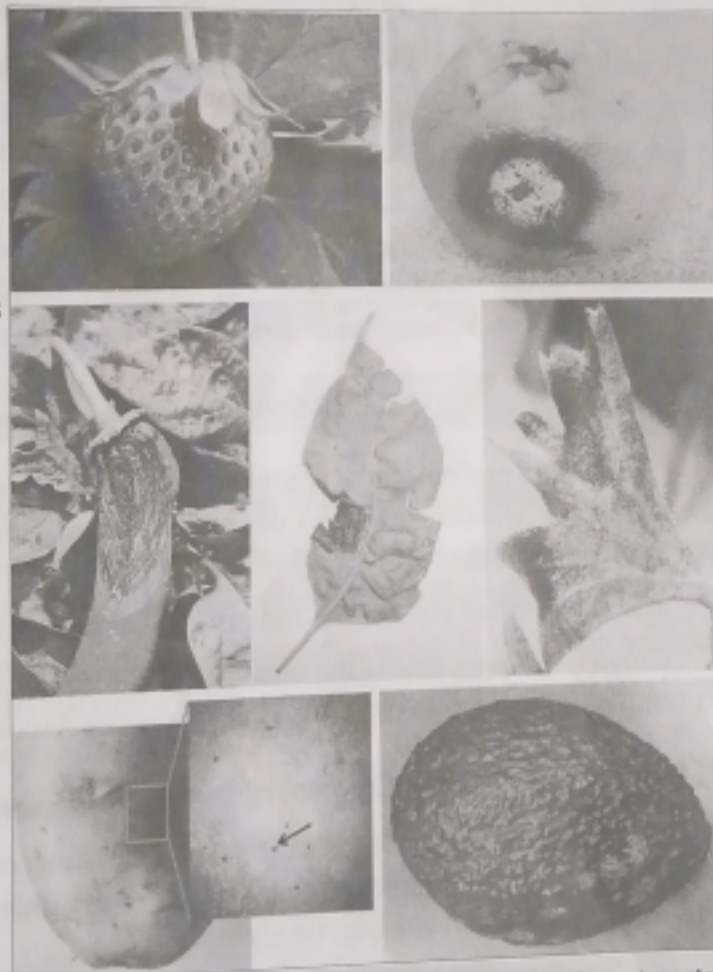


FIG. 7.2. Various disease symptoms on different parts due to *Colletotrichum gloeosporioides*

- (ii) Many oil drops are present in each cell of the mycelium.
- (iii) Mycelium is generally found in the cells or tissues of the parenchymatous pith of the host tissue.
- (iv) The fungus only reproduces asexually by means of conidia and acervulus.
- (v) Conidia develop on conidiophores and both the structures form the fruiting body of the fungus called acervulus. (Fig 7.3)
- (vi) Acervulii are saucer shaped, flat and black velvety structures. In each acervulus, along with conidia and conidiophores many long branched and septate bristles called setae are found.
- (vii) Conidiophores are aseptate and cut many unicellular, falcate, hyaline conidia. Normally the conidia may be oblong with obtuse ends. They germinate to form new mycelia on suitable host or environment.

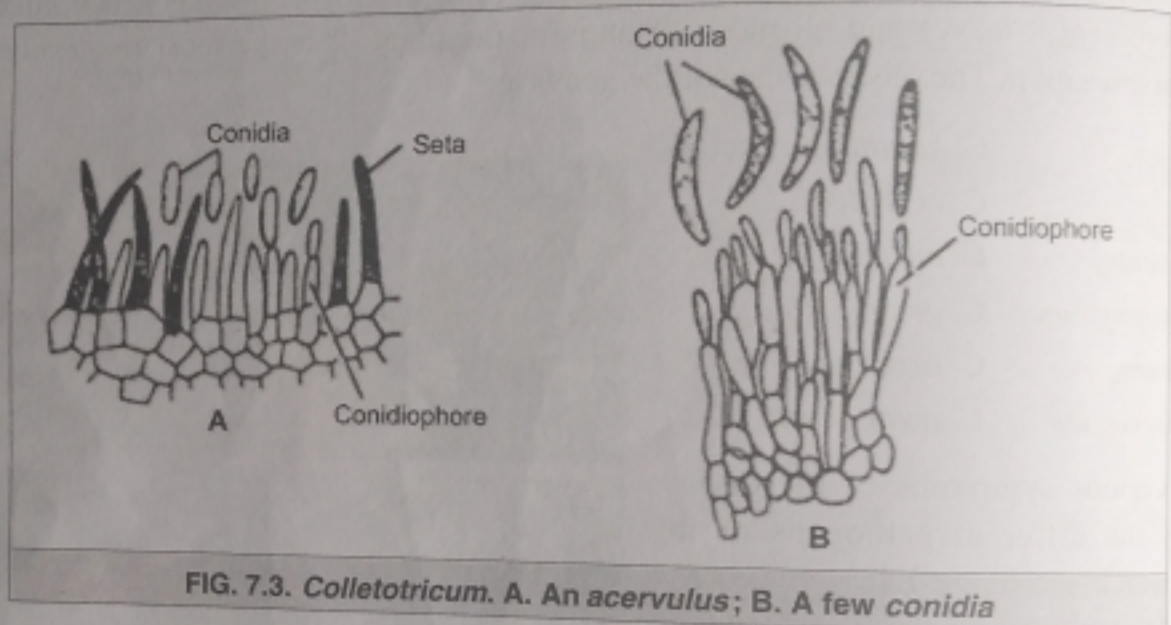


FIG. 7.3. *Colletotricum*. A. An acervulus; B. A few conidia

The fungus prefers warm humid environment for spread of the disease. It primarily invades into the injured or weakened tissues of the host plants, produce various specialized structures such as setae, appressoria, acervulii etc.

The anamorphic state of the fungus is most infectious and is the main cause of the disease.

Glomerella cingulata is the teleomorphic form and is the perfect state which reproduces sexually by production of ascospores as normal species of Ascomycetes.

7.4.4. Life Styles of *Colletotrichum gloeosporioides*

Colletotrichum species exhibit different forms of life style depending on the environmental conditions. The different life styles are—**Necrotrophic style, Biotrophic and Hemibiotrophic style, Quiescent style and Endophytic style.**

- (a) **Necrotrophic life style**—Necrotrophic pathogens are those which actively infect and colonize plant cells leading to cell death. They secrete lytic enzymes to degrade plant

components or secret toxins that kill the plant tissues. The pathogen subsequently survives on the contents of dead or dying cells to complete its life cycle.

Nearly all species of *Colletotrichum* develop a necrotrophic stage at some point in their life cycles except those few which exist entirely as endophytes.

(b) **Biotrophic and Hemibiotrophic life style**—In the biotrophic life style the fungus remains strictly inside the living plant tissues and actively absorbs plant metabolites for its growth without killing the plant cells. The fungus produces specialized structures and remain engaged in suppressing the host defense system in a long term basis. *Colletotrichum* species do not show true biotrophic nature, but can have a biotrophic stage early in their life cycle after which they switch over to necrotrophic style. So they are referred to as hemibiotrophs. The extent of biotrophy and hemibiotrophic style depends on the host development stage and environmental factors.

(c) **Quiescent life style**—It is a life style in which the pathogen exists dormant within the host before it switches to an active state. During this stage the pathogen activities appears to be suspended and there is no growth of the pathogen. *C. gloeosporioides* and *C. acutatum* show quiescent stage before causing post-harvest diseases of fruits.

(d) **Endophytic life style**—In this mode of life style the pathogen lives within the host plant cells as symbionts without causing any apparent disease, while remaining as an endophyte the fungus may switch its mode from mutualism to antagonistic or to pathogenic style depending on the plant physiological status, host genotype and the environment.

Many *Colletotrichum* species have been shown to exist as endophytes for part or most of their life cycle in any groups of plants. Several new *Colletotrichum* species have been identified as endophytes from temperate and tropical grasses. Several endophytes have also been identified from the *gloeosporioides* complex of *Colletotrichum*.

7.4.5. Life Cycle

- (i) The life cycle of the pathogen generally starts with the germination of the conidia.
- (ii) The mycelium formed from the conidium penetrates the host tissues by specialized structures called appressoria. This helps the entry through the host cuticle and epidermal cells.
- (iii) After entering into the host tissues the primary hyphae produce enlarged infection vesicles inside the epidermal and mesophyll cells (in case of leaf infection) or the cortex. At this stage the host cells remain alive and do not exhibit any symptoms.
- (iv) This is called the intracellular hemiautotrophy.
- (v) This is followed next by necrotic phase. In this phase the secondary hyphae grow intracellularly and intercellularly as well as secret cell wall degrading enzymes and kill the host cells.

During the process of infection and establishment, the fungus adopts biotrophic mode and change then to necrotrophic style.

- (vi) Infection of *C. gloeosporioides* was found to be hemibiotrophic in which both intracellular hemibiotrophic and intramural necrotrophic infections are found.
- (vii) Necrotrophic phase begins when the secondary hyphae begin to spread throughout the host tissues.
- (viii) The fungus then starts its reproduction asexually (in anamorphic stage) or sexually (in teleomorphic forms) on the host plant. However, the sexual stage is very rarely seen.
- (ix) The asexual stage is very commonly associated with the disease symptoms.
- (x) Sexual stage for gloeosporioides group has been mostly observed in cultures only.
- (xi) Asexually it reproduces by formation of conidia on conidiophores. Conidiophores are found on fruiting bodies called acervulus. Acervulii are saucer shaped.
- (xii) Conidiophores are aseptate and produce many unicellular conidia which are hyaline, falcate.
- (xiii) Sexual stage is rarely observed in host plants but mostly in cultures. The fungus develops the fruiting bodies called peritheium in which ascospores are formed in the asci (as per standard method of ascospore formation in Ascomycetes.)
- (xiv) Both homothallic and heterothallic strains of *Colletotrichum* have been observed.
- (xv) Asci with ascospores are covered by dark perithecia which provide protection. Under suitable environmental conditions the perithecia break releasing the ascospores which fall on new hosts or perennate in host tissues till suitable environment for germination and infection.
- (xvi) The general pattern of life cycle of *Colletotrichum* is given in figure 7.4.

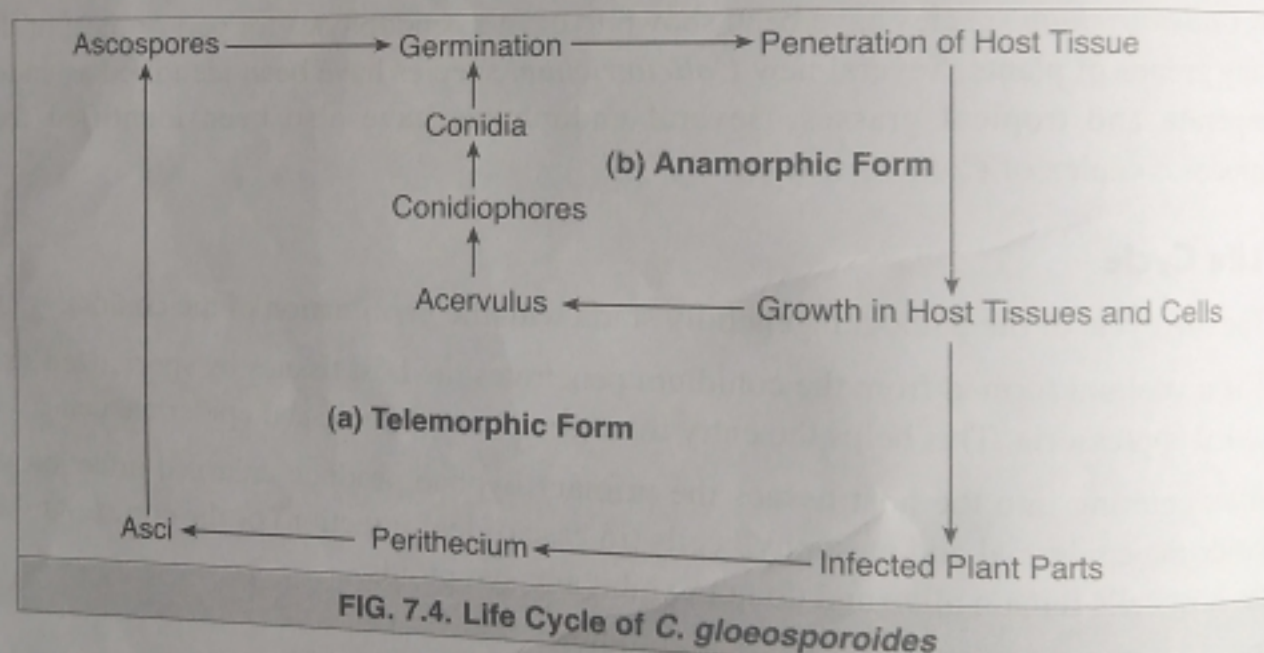


FIG. 7.4. Life Cycle of *C. gloeosporioides*

7.4.6. Disease Management

Colletotrichum species cause great economic loss to our crops, fruits and other economically important plants. Various strains of a single species have also been isolated. Due to their harmful effects the following disease management strategies are followed.

- (i) Use of disease free certified seeds and healthy transplants.

DEUTEROMYCOTINA

- (ii) Disposal of infected plants and rotten fruits properly.
- (iii) Regular weeding and timely pruning of infected parts.
- (iv) Use of disease resistant varieties against *Colletotrichum*.