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Ceratocystis fimbriata - A Threatening Pathogen

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Introduction

Ceratocystis fimbriata belongs to Ascomycota causes wilt-type diseases in many economically important plants. *C. fimbriata* is one of the most aggressive plant pathogens in the genus *Ceratocystis*, causing wilt, canker-stain diseases as well as tissue rot on a wide variety of perennial as well as agronomic crop plants, worldwide (Kile, 1993). It is a large, diverse complex of species with four broad geographic clades, Australasian (AAC), African (AFC), North American (NAC) and Latin American (LAC) Clades. The species as a whole can infect wide variety of hosts, but particular strains are host-specific in nature. Strains (or "types") may be host specific and/or have restricted distributions in some instances. *C. fimbriata* was first reported in sweet potato there it causes black rot on tubers during 1890 (Halsted, 1890).

Morphology

Morphologically, *C. fimbriata* is characterized by perithecia with long necks that taper towards the tips and terminate in 8 to 15 convergent ostiole hyphae.

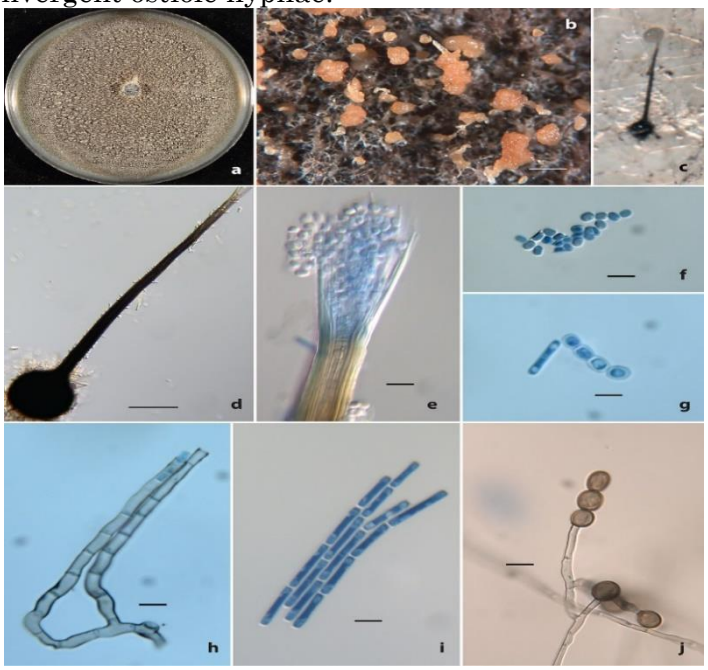

Fig.1
(a)colony morphology
(b) perithecia and ascospore masses.
(c) perithecia with an ascospore mass.
(d) perithecia with a globose base.
(e) divergent ostiolar hyphae with ascospores emerging through the mouth of the neck.
(f) hat-shaped ascospores.
(g) barrel-shaped conidia.
(h) conidiophore with cylindrical conidia released from the phialide.
i) cylindrical conidia.
(j) aleuroconidia.
Scale bar for b = 500 µm, scale bar for d = 100 µm, scale bars for e-j = 10 µm.
Li *et al*., (2015)

Perithecial bases are dark and globose, surrounded by a dense network of hyphae. Asci are evanescent in the early stages of development, while ascospores are characteristically hat-shaped and exuded through the perithecial necks in sticky masses (Hunt, 1956). The fungus also produces chains of cylindrical conidia and aleurioconidia (chlamydospores) that play an important role in the survival of this fungus in the soil (Webster and Butler, 1967). The anamorph of *C. fimbriata* has for many years been accommodated in *Chalara*, but recently, based on a phylogenetic analysis of DNA sequence data, has been recognised as best residing in *Thielaviopsis* (Paulin-Mahady *et al*. 2002).

Host Range

Over 30 types of plants are attacked by the *C. fimbriata* complex. Eight hosts in particular, have been identified as being as highly susceptible to multiple genotypes of the pathogen, these are:

1. Mango.
2. Eucalyptus sp. and their hybrids.
3. Pomegranate.
4. *Acacia* spp.
5. Edible figs (*Ficus*).
6. Taro and other *Araceae* family.
7. *Crolotaria* (genus of herbaceous plants & woody shrubs).
8. Kiwifruit (*Actinidia* sp.).

Biology and Epidemiology

Ceratocystis fimbriata is a complex of soil-borne fungal pathogens, which cause wilt disease in a number of plant species, including kiwifruit (*Actinidia*), by compromising the vascular system. The *C. fimbriata* complex has a wide and unpredictable host range, both as a simple wound coloniser and as an aggressive plant pathogen. In the past 15 years, new host crops and new epidemics of *Ceratocystis* wilt have been reported worldwide, especially in Brazil and Asia.

Habit and Distribution

Ceratocystis fimbriata colonizes wounds and lives necrotrophically on a variety of herbaceous and woody plants, causing wilt diseases, stem cankers, root rots, and vascular discoloration. The pathogen may cause only a local infection or it may cause the death of the entire plant. *C. fimbriata* is an early colonizer of plant wounds but may be quickly overtaken by saprophytic fungi, especially some basidiomycetes (Grosclaude *et al*. 1990). Because it produces thick-walled aleurioconidia, the fungus may survive extended periods or for shorter periods in water (Grosclaude *et al* 1991). The importance of the soil-borne phase of *C. fimbriata* remains largely unexamined. The fungus lives in both tropical and temperate environments and has caused serious epidemics on cacao plantations in Latin America (Iton, 1959), sycamore street trees in Italy (Panconesi, 1981), and almond orchards in California (De Vay *et al*. 1968). The temperate strains of *C. fimbriata* (those attacking stone fruit trees, hickory, etc.) appear to have developed in North America. Latin America seems to be a site of diversification for the tropical strains of this fungus (Harrington, 2000).

Insect Relations

Ceratocystis fimbriata produces a fruity odor that is assumed to be attractive to various scolytid and nitidulid beetles that are associated with the fungus. On cacao, *Xyleborus* spp. (Scolytidae) selectively attack trees infected with *C. fimbriata*, and the insects and fungus are sometimes described as a disease complex (Iton 1966). *Xyleborus* beetles preferentially attack diseased cacao trees, especially preferring trees with deteriorated bark (Saunders, 1964). The adult female beetles bore into the tree perpendicular to the bark, usually at the base of the trunk. Branching tunnels in which eggs are laid form horizontally planar "galleries." *C. fimbriata* and other fungi may live within the galleries (Iton and Conway, 1961).

Management Strategies and Tactics

Wound avoidance is key to management of some diseases caused by *Ceratocystis* spp.

Ceratocystis spp. have been frequently introduced to new areas by human activity, and international quarantines have been considered or are in place. Infected planting stock (especially rooted cuttings or

grafted scions) is the most likely pathway of introduction, but restrictions on the movement of such stock are should be there (Harrington, 2013).

Complete eradication of an exotic *Ceratocystis* sp. from even a limited area is a difficult task, but local introductions may be eliminated if recognized quickly, and sanitation practices have proven effective in managing local epidemics (Harrington, 2013)

Reduction in the root graft transmission of the oak wilt pathogen by the use of root-free zones has been practiced for many years and can be highly effective in reducing losses

Generally, a trench is made to delimit infected from healthy trees.

As with the management of most forest diseases, an integrated approach involving several strategies is necessary to control diseases caused by *Ceratocystis* spp., especially in urban settings.

Disinfection of pruning and grafting tools may help control *C. fimbriata* diseases in *Plantanus*.

Eradication of wilt infected plants has been advocated for the management of pomegranate wilt due to *C. fimbriata*.

Soil drenching around the infected and surrounding healthy plants or of the entire orchard with propiconazole (0.1%) + boric acid (0.5%) + Phosphoric acid (0.5%) (Sharma *et al*., 2010).

The insecticide chlorpyriphos (0.2%) can be used to control shot hole borer and other insect infestations which have seldom been found associated with wilt infections.

Wilt infections in soil having shot hole borer and *C. fimbriata* infestations can be managed by soil application of chlorpyriphos (0.2%) along with carbendazim (0.2%) or propiconazole (0.2%) (Sharma *et al*., 2010).

Soil sterilization with formalin (0.2%) prior to replanting also control wilt disease.

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