



Foliar fungal pathogens associated with middle whorl yellowing symptoms of coconut in southern Kerala

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Coconut palm (*Cocos nucifera* L.), is a major plantation crop in Kerala. It ranks top in the area of cultivation (788000 ha) and production (3992 million nuts per year) of coconut in India (Kumar *et al.*, 2011). However, the productivity is below the national average and that of neighboring states. Among the various factors that reverse the productivity, root (wilt) disease (RWD) is recognized as the most critical constraint on productivity. Recently, severe middle whorl yellowing symptoms is fast spreading in Thiruvananthapuram and nearby districts, which is characterized by rapid mid whorl yellowing, abnormal shedding of immature and mature nuts and flowers, drying of inflorescence and spadix and intense leaf spots and blights on leaves. The affected palms become barren within a few months and often die soon. Although middle whorl yellowing symptom associated with RWD was reported as early as 1937, the disease is now occurring in a devastating and lethal manner destroying coconut trees and causing much concern in these areas. The foliar pathogens associated with these symptoms further aggravate the disease greatly.

In RWD affected palms, leaf rot disease caused by a complex of fungi aggravated the disease severity (Srinivasan *et al.*, 2002; Vrinda, 2002). Studies showed that the incidence and succession of leaf rot pathogens are greatly influenced by weather factors (Srinivasan and Gunasekaran, 1996a). The foliar symptoms that appear on the middle whorl yellowing affected palms show striking difference from that of the typical leaf rot symptoms on RWD affected palms. Hence, the present study was undertaken to elucidate the foliar

fungal pathogens associated with middle whorl yellowing symptoms of coconut palm during three different seasons.

Specimen of symptomatic leaves were collected from the selected diseased palms (purposive sampling) from the Instructional Farm, College of Agriculture, Vellayani during the period from October 2009 to July 2010. The fungal pathogens associated with it were isolated by routine isolation methods.

The infected portions of leaves were cut into small bits and washed in water. The pieces were then surface sterilized with 0.1 per cent mercuric chloride solution and washed in sterile distilled water. These bits were placed on solidified potato dextrose agar (PDA) medium in sterilized Petri dishes and incubated at room temperature. The fungi were isolated in pure culture from the growth on Petri dishes and pathogenicity was proved. The various fungal pathogens isolated were identified based on colony and spore characteristics compared with type culture collections and the details are presented in Table 1.

Associations of several fungal pathogens with leaf rot in RWD affected palms were already established by various workers. These include *Exserohilum rostratum*, *Colletotrichum gloeosporioides*, *Gliocladium vermoeseni*, *Thielaviopsis paradoxa*, *Rhizoctonia solani*, *Mortierella elongata*, *Curvularia* spp., *Acremonium* spp., *Thielavia microspora*, *T. terricola*, *Chaetomium brasiliense*, *Fusarium solani*, *F. moniliforme* var. *intermedium*, *Pestalotiopsis palmarum*, *Cylindrocladium scoparium* (Srinivasan and Gunasekaran, 1994a, 1994b, 1995, 1999;

Table 1. Foliar fungal pathogens associated with middle whorl yellowing symptoms of coconut

Sl. No.	Name of the pathogen
1	<i>Alternaria alternata</i> (Fr.) Keissler.
2	<i>Aspergillus niger</i> Gr.
3	<i>Cephalosporium</i> spp.
4	<i>Chalara fimbriata</i> Ellis & Halst.
5	<i>Colletotrichum gloeosporioides</i> (Penz.) Penz. And Sacc.
6	<i>Curvularia</i> spp.
7	<i>Fusarium verticillioides</i> (Saccardo) Nirenberg.
8	<i>Fusarium semitectum</i> Berk. & Rav.
9	<i>Lasiodiplodia theobromae</i> (Pat.) Griffon & Maubl.
10	<i>Pestalotiopsis maculans</i> (Corda) Nag Raj.
11	<i>Pestalotiopsis palmarum</i> (Cooke) Stey.
12	<i>Phomopsis</i> spp.
13	<i>Arthrimum</i> spp.
14	<i>Verticillium</i> spp.

Srinivasan *et al.*, 1995), *Cephalosporium sacchari*, *Gliocladium roseum*, *Scytalidium* spp. (Vrinda, 2002), *Chalaropsis thielavioides* and *Botryodiplodia theobromae* (Ramesh *et al.*, 2004).

The results of the present study showed that altogether fourteen fungal pathogens were associated with the symptomatic leaves during the summer season (March-May, 2010) while only six pathogens could be detected during the other two seasons (Table 2). The most extensively occurring fungal pathogen was *Lasiodiplodia theobromae* followed by *Pestalotiopsis maculans*, *Colletotrichum gloeosporioides* and *Pestalotiopsis palmarum*. In certain areas of the farm *Phomopsis* spp. showed very extensive occurrence (Table 2).

Table 2. Fungal pathogens associated with the disease during different seasons

Season	Pathogens isolated*
October-January	<i>Colletotrichum gloeosporioides</i> (5), <i>Lasiodiplodia theobromae</i> (7), <i>Fusarium verticillioides</i> (6), <i>Pestalotiopsis maculans</i> (5), <i>Pestalotiopsis palmarum</i> (4), <i>Phomopsis</i> spp. (3)
March-May	<i>Alternaria alternata</i> (2), <i>Aspergillus niger</i> (2), <i>Cephalosporium</i> spp. (2), <i>Chalara fimbriata</i> (2), <i>C. gloeosporioides</i> (4), <i>Fusarium verticillioides</i> (8), <i>Fusarium semitectum</i> (4), <i>L. theobromae</i> (8), <i>Pestalotiopsis maculans</i> (5), <i>P. palmarum</i> (4), <i>Phomopsis</i> spp. (4), <i>Arthrimum</i> spp. (7), <i>Verticillium</i> spp. (1)
June-July	<i>C. gloeosporioides</i> (7), <i>C. fimbriata</i> (1), <i>L. theobromae</i> (5), <i>P. maculans</i> (6), <i>P. palmarum</i> (4), <i>Phomopsis</i> spp. (3)

*Number in parenthesis indicates frequency of occurrence

The study further indicated that the predominant pathogens associated with the middle whorl yellowing symptoms during June-July were *C. gloeosporioides*, *L. theobromae*, *P. maculans* and *P. palmarum* while during October - January, these pathogens as well as *F. verticillioides* were occurring at a high frequency (Table 2). In the summer season, apart from these fungi several other pathogens also infected the leaves due to prevailing favorable environmental conditions and availability of abundant decaying organic matter in the crown of the palm. Similar observations of higher incidence of saprophytic fungi such as *Fusarium* spp. and *Curvularia* spp. at the crown have been reported by several other workers (Srinivasan and Gunasekaran, 1996a; Vrinda, 2002). During the rainy season the most frequently occurred pathogens were *C. gloeosporioides* and *P. maculans* (Table 2). Early reports also indicated that *C. gloeosporioides* is the major pathogen of leaf rot disease during the rainy season (Srinivasan and Gunasekaran, 1996a, 1996b; Vrinda, 2002).

The present study revealed the association of a few hitherto unreported fungal pathogens *viz.*, *Pestalotiopsis maculans*, *Alternaria alternata*, *Chalara fimbriata*, *Fusarium semitectum*, *Phomopsis* spp., *Arthrimum* spp. and *Verticillium* spp. in addition to most of the already reported fungi in RWD affected palms, on the foliage of coconut palms with middle whorl yellowing symptoms. All these foliage pathogens play critical role in aggravating the disease and rapid deterioration of the heath of the palm. Hence strategies need to be evolved for managing these pathogens effectively.

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