Indian Phytopath. 52 (2) : 160-162 (1999)

Fusarium solani and *Fusarium moniliforme* in coconut leaf rot disease

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Key words : Coconut, leaf rot, fungal complex, *Fusarium* spp., pathogenic relation

Leaf rot disease (LRD) of coconut is rampant and widely superimposed on root wilt affected palms in southern districts of Kerala and brings about a rapid deterioration of palms (1). LRD usually appears in the emerging spindle leaves as tiny lesions which enlarge resulting into extensive rotting of tender leaflets (2). Earlier study (3) reported isolation of *Helminthosporium (Bipolaris) halodes*, *Gloeosporium* sp., *Gliocladium roseum* and *Fusarium* sp. from diseased palms and found that except the unidentified species of *Fusarium*, other fungi were pathogenic. The three fungi implicated have been identified as *Exserohilum rostratum* (Drechsler) Leonard and Suggs, *Colletotrichum gloeosporioides* (Penzig) Penzig & Sacc. and *Gliocladium vermoeseni* (Biourge) Thom. and their pathogenicity confirmed (4).

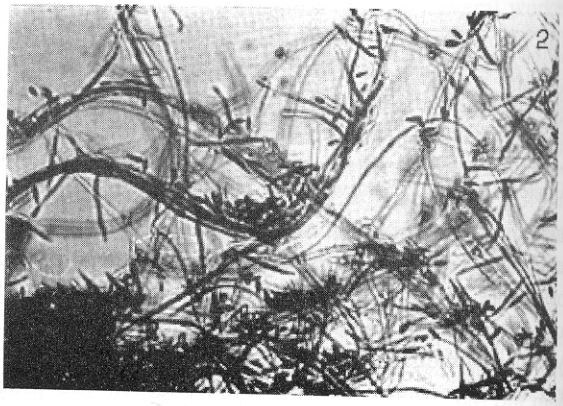
During isolations from LRD affected palms, two Fusarial fungi were frequently observed (5,6,7), besides other species. Hence, the need for reassessing the role of *Fusarium* spp. in the LRD was felt. This paper reports on the results of such a study.

Isolations were performed from spindles showing early symptoms of LRD using potato sucrose agar by conventional method. The Fusarial fungi were purified and got identified from CAB-IMI, United Kingdom as *Fusarium solani* Martius (Sacc.) (IMI 349542) and *F. moniliforme* Sheldon var. *intermedium* Neish & Leggett (IMI 350497b).

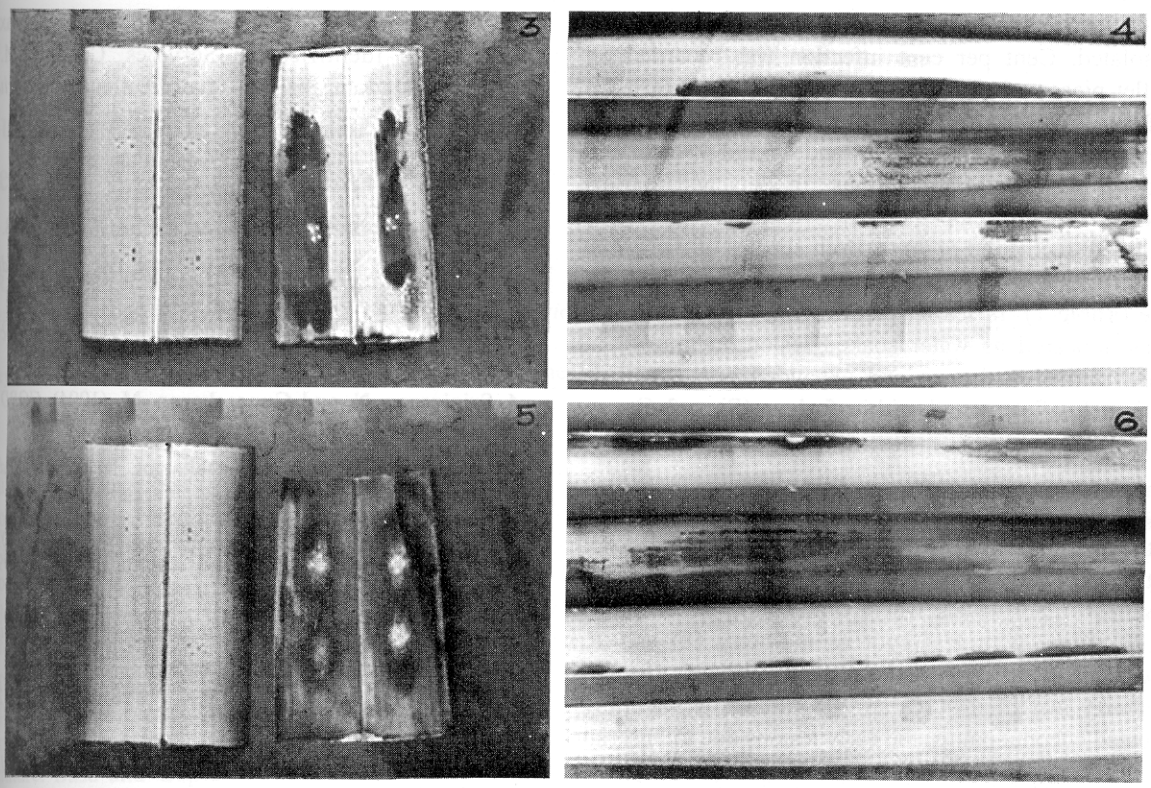
Colonies of *F. solani* were fast growing, aerial mycelium striate, dense. floccose and greyish-white. Abundant microconidia (cylindrical to oval) were produced from lateral phialides. Macroconidia developed from branched conidiophores, inequilaterally fusoid, with the widest point above the centre and commonly 1-9 septate. Chlamydospores present were globose to oval and terminal or intercalary.

F. moniliforme var. *intermedium* was slow growing with dense aerial mycelium, delicately white, vinaceous, floccose with a powdery appearance and in yellowish pink shades. Microconidia aseptate, clavate and formed in chains on simple conidiophores. Macroconidia formed less frequently, 3-5 septate, straight to falcate and the septa usually indistinct. Chlamydospores were absent (Figs. 1 and 2).

Pathogenicity was tested using leaf pieces (ten) or whole leaflets (30) detached from spindle leaves free from leaf rot by the method as described (4).



Figs. 1-2. Photomicrographs (× 100) of *Fusarium solani* (1) and *F. moniliforme* var. *intermedium* (2).



Figs. 3-6. Symptoms in leaflet pieces (left-control)/detached leaflets (bottom-control) : *F. solani* (3, 4) and *F. moniliforme* var. *intermedium* (5, 6).

Leaflet pieces were inoculated either after pinprick injury or without injury. Mixed inoculum of both the species of *Fusarium* was also used for spray inoculation on equal number of leaflets. The inoculated leaflet pieces/leaflets were incubated at 30°C. Development of disease symptoms was monitored. Reisolation of the fungi were attempted. Equal number of healthy leaflet pieces/leaflets were maintained for comparison.

Pathogenicity tests showed that both the species of *Fusarium* developed infection in spindle leaflet

Table 1. Development of leaf rot in leaflet pieces and detached entire leaflets of coconut spindles by two species of *Fusarium* and rate of their reisolations

Fusarial species	Leaflet pieces				Detached leaflets	
	Without pinprick inoculation		With pinprick inoculation		%	%
	% leaflet pieces developed symptoms*	% leaflet bits established fungus in reisolations**	% leaflet pieces developed symptoms*	% leaflet bits established fungus in reisolations**	leaflet developed symptoms@	leaflet bits established fungus in reisolations@@
Fusarium solani	50	45	100	50	76.67	59.41(170
Fusarium moniliforme var. *intermedium*	60	55	100	70	80.00	70.00(190)
Mixed inoculum of the above two species of *Fusarium*	—	—	—	—	80.00	90.00(100)
Control	0	—	0	—	0	—

*0 leaflet pieces each inoculated; **20 leaflet bits each inoculated into medium; @ leaflets each inoculated; @@Figures within the parentheses are No. of leaflet bits each inoculated into medium. In mixed inoculation the leaflet bits showed growth of both species of *Fusarium*.

pieces/leaflets of coconut and the pathogens were reisolated. Cent per cent infection was recorded on leaflet pieces when pin pricked as against 50-60% on uninjured pieces. Recovery percentage with respect to the two fungi were 50 and 70, and 45 and 55 with and without pin prick inoculations. In detached leaflets also, the fungi developed disease symptoms (up to 80%) and were recovered *in vitro*. Both species of *Fusarium* were reisolated from leaflets inoculated with the mixture (Table 1). In leaflet pieces/ intact leaflets, symptoms appeared as water soaked lesions within 48 h, which turned to brown and expanded into extensive rotting. Leaflets rotted within 5 days (Figs. 3-6).

The involvement of *Fusarium* spp. in foliar diseases seems to be relatively rare. In our study, two species of *Fusarium* have been identified and their pathogenicity established. Association of *Fusarium* sp. with top rots/tip break/shoot rot/spear rot of coconut has been reported elsewhere. Pathogenic associations of *F. solani* with leaf spot of mulberry (8) and *F. moniliforme* var. *intermedium* with soyabeans (9) and mulberry leaf blight (10) are determined. In naturally infected coconut palms, the early lesions due to Fusarial infection were seen on the spindle/young newly expanding leaves. These lesions develop into brownish stripes on the leaf surface which extend rapidly leading to (dry) rotting. Incidence of Fusarial fungi in LRD was associated with dryer periods and with high temperature (11). Symptoms developed by Fusarial fungi *in vitro* on excised leaves were comparable to that in field inoculated (12) and in naturally infected palms . This report thus elucidates the role of *Fusarium* spp. in coconut leaf rot complex.

The authors thank Dr. B.C. Sutton, Head of Tax
nomic and Identification Services, C.A.B., I.M.I.
United Kingdom for the identification of *Fusari*
species.

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Received for publication May 15, 1998