



Substantive Evidences of Complex Fungal Etiology of Coconut Leaf Rot Disease

N. Srinivasan, M. Gunasekaran and Alka Gupta

Central Plantation Crops Research Institute, Regional Station,
Kayangulam, Krishnapuram - 690 533, Kerala

Introduction

Crop plants are attacked by diseases leading to huge economic losses. The coconut palm (*Cocos nucifera* L.) is also prone to attack by various pathogens resulting in different diseases. The leaf rot is a major foliar disease which leads to extensive destruction of lamina affecting photosynthetic efficiency of palm and thus its productivity. The disease also renders the affected leaves unsuitable for thatching. Evidences have shown the common occurrence of leaf rot in root (wilt) affected gardens of Kerala (recently in Tamil Nadu also). In fact, the leaf rot assumes as a part of root (wilt) disease complex. Most of the plant diseases usually are caused by single pathogen concerned but rare exceptions of disease complexes do appear. The exceptions probably are less familiar to common man. The leaf rot is one of the rare category and evidences are now accrued on the complex (fungal) aetiology of the disease. While the root (wilt) is due to phytoplasma, the leaf rot symptom is due to fungal complex (i.e. more than one fungi involved). A better understanding of the cause of leaf rot would aid in strategic management of the disease. It was therefore felt it would be useful to provide more information on the etiology of leaf rot to coconut growers.

Fungal Complex Nature of Leaf Rot

The leaf rot usually appears in the developing spindle leaf as minute lesions which coalesce and develop into extensive rotting of tender tissues. The spindle leaf play critically in leaf rot, in its incidence as well as linear

progression of the disease in individual palms - successively emerging spindle also gets infected (Figs. 1 and 2). Since leaf rot generally appears in the spindle leaves, occurrence of associative fungi

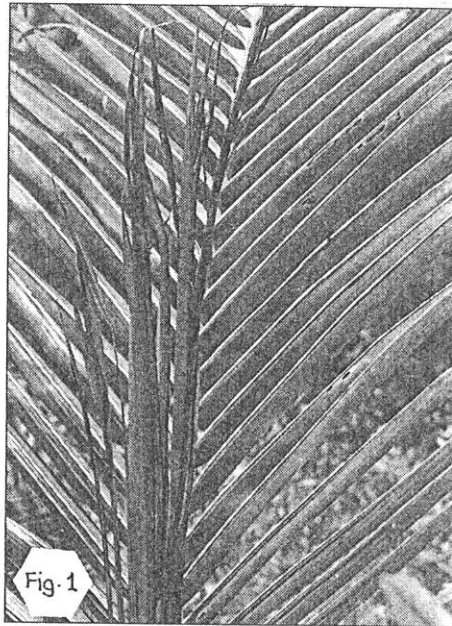


Fig.1
Incidence of leaf rot in spindle leaves

in such infected leaves becomes relevant. Isolations made out from a vast number of infected spindles showed association of various fungi (in different frequencies) with the disease and the fungi were influenced by environmental factors. Out of 14 species of fungi cultured, 10 species have been proved as pathogenic to coconut spindles. The pathogenic fungi

are : *Colletotrichum gloeosporioides*, *Exserohilum rostratum*, *Gliocladium vermoeseni*, *Fusarium solani*, *F. moniliforme* var. *intermedium*, *Thielaviopsis paradoxa*, *Rhizoctonia solani*, *Cylindrocladium scoparium*, *Mortierella elongata* and *Curvularia* sp. Among these pathogens, *C. gloeosporioides* and *E. rostratum* are regarded as the main pathogens of leaf rot (within the disease complex), based on certain scientific evidences (Figs. 3 and 4).

In understanding the etiology of fungal-foliar disease complexes it is worthwhile to know about population levels of various pathogens also in relation to environmental, especially the weather factors. Considerable knowledge on this line has been gained. Among the pathogens of leaf rot, *C. gloeosporioides* is highly active (and its population is higher) during monsoon months (June-November/December) - the period marked with high rainfall and high relative humidity. During such wet



Fig.2
Recurrence of leaf rot in successively emerged leaves - showing linear/vertical spread in affected palm



seasons, this pathogen produces enormous amount of inoculum, disperses fast and rapidly establishes into the host system leading to very severe damage to tissues. Hence *C. gloeosporioides* is pinpointed as the principle pathogen of leaf rot during monsoons. The incidence of *E. rostratum* is less correlated to weather factors; its population is comparatively less than *G. gloeosporioides*; disperses slowly. Another point of interest is that while *E. rostratum* independently is able to induce the disease lesions vigorously (as tested artificially), the natural-higher activity of *C. gloeosporioides* during monsoon months draws significance as the servery of leaf rot in field palms is invariably more during the wet seasons. It should be further noted that population of *Fusarium* spp. and *R. solani* are distinctly higher during dry season (January to May). As these group of fungi are also pathogenic they perpetuate leaf rot in palms during dry seasons, while the activities of fore-mentioned pathogens are subdued. Relatively low incidence of especially *C. gloeosporioides* in dry season points to its quiescent phase; however, it re-emerges aggressively in favourable weather conditions, with the onset of S.W. monsoon.

The incidence of other fungi in leaf rot is not influenced by specific weather factors. However, they may have some role in the disease in certain circumstances even though their significance in the disease may be comparatively lesser. It is also noteworthy that while all other pathogens, including the main fungi, develop wet rotting of tissues upon infection, the fusarial fungi invariably induce dry rotting. This has been experimented appropriately and proved in artificial inoculations. In naturally infected palms also such differential symptoms are seen. In recent years, dry rotting of spindle leaves (due to *Fusarium* spp.) has been also commonly seen among leaf rot affected palms.

Population fluctuations of certain pathogens, availability of inoculum of one or the other species in different seasons (in an year's cycle), etc. provide ample scope for repeated/new infections and hence disease perpetuation in the field. Such a knowledge on the pathogens is vital for overall understanding of the cause of leaf rot and in streamlining its control measures.

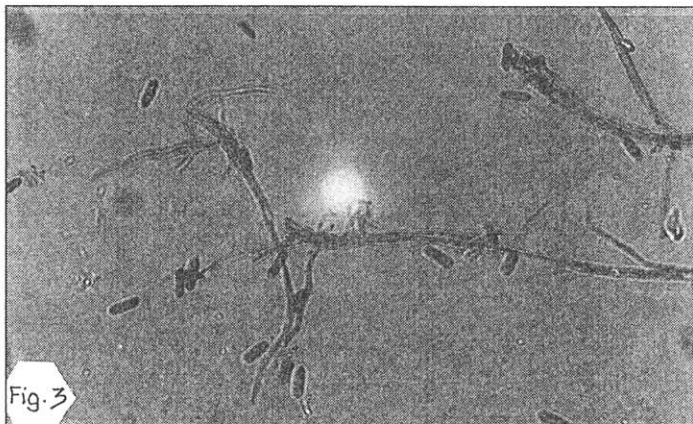
Leaf rot Pathogens : Co-occurrences/Individual Role

Information such as trend of co-occurrences of pathogens in infected

palms, their individual role, etc. is also important for elaborating the complex-aetiology of leaf rot. Therefore, the consolidated data on fungal isolations, gained specially from multiple sampling experiments, are presented in *Tables 1* and *2*.

The fungi co-occurred in 71-77% of infected palms whereas only in 23-29% of infected palms, single fungus was associated (i.e., in greater number of leaf rot infected palms more than one pathogen involved). Perhaps, only under certain conditions the individual occurrence/leadership of single fungus occurs in limited number of palms (*Table 1*). The higher individual occurrences of especially *C. gloeosporioides* and *Fusarium* spp. might be due to the influence of specific season(s) as described earlier. In this conjunction another point of interest is that from lesions, irrespective of early or advanced stage of disease lesions, majority of them (95-96%) yielded individual fungus (*Table 2*). Therefore, the following two points of importance need to be noted :

1. In great majority of leaf rot infected spindles more than one fungus have initiated the disease infection, independently and distinctly at different courts of the leaf.



Conidia of *colletotrichum gloeosporioides* (3) and *Exserohilum rostratum* (4) the main pathogens of leaf rot disease



Table 1. Occurrence of fungi in spindles of leaf rot affected coconut palms (Data represent year aggregate)

	Fungus	% palm showing association in	
		Expt. I*	Expt. II**
(A)	Co-occurrence of fungi (Total) (Observed in different combinations; most common co-occurrences are as in foot note***)	71.2	77.5
(B)	Individual occurrence of fungi		
	<i>Colletotrichum gloeosporioides</i>	3.8	10.8
	<i>Exserohilum rostratum</i>	0.4	0.8
	<i>Gliocladium vermoeseni</i>	3.3	4.2
	<i>Fusarium</i> spp.	17.5	3.3
	<i>Thielaviopsis paradoxa</i>	0.8	2.5
	<i>Cylindrocladium scoparium</i>	0.4	--
	<i>Rhizoctonia solani</i>	2.1	0.8
	<i>Mortierella elongata</i>	0.4	--
	Total of B	28.8	22.5
	Grand Total	100.0	100.0

*Out of 240 palms (20 palms/month; 25 leaf pieces/palm)
 ** Out of 120 palms (10 palms/month; 15 leaf pieces/palm)
 *** Most common co-occurrences :
C. gloeosporioides + *E. rostratum*,
C. gloeosporioides + *Fusarium* spp.,
C. gloeosporioides + *E. rostratum* + *Fusarium* spp.,
G. vermoeseni + *Fusarium* spp.

2. Isolation of fungi most commonly singly from lesions (and particularly from early lesions) scores for their individual/independent role in the disease complex (pathogenic nature of various species of fungi is already described).

A further analysis of data, fungal associations based on monthly averages in an year's cycle, corroborated that on an average *C. gloeosporioides* stands first in the list over the other pathogens. This may be viewed further as to the result of very aggressive role of this pathogen during the months of monsoon. As it occurs most frequently on early lesions (over the advanced lesions) - the point of proof is that *C. gloeosporioides* spreads maximally in the field, increase the infection foci

(with rapid-cyclic infections) during congenial (wet) weather conditions. It is therefore considered with justification that *C. gloeosporioides* has principal role in the causation of leaf rot (during monsoons) while the disease syndrome as such a disease of fungal complex. Any other group of biological agent/microorganism (i.e. other than fungi, as listed) has no role in leaf rot aetiology.

Conclusions

Occurrence of leaf rot disease is common in root (wilt) affected coconut gardens. The root (wilt) is caused by phytoplasma which systemically weakens the palm; the weakened palm becomes vulnerable to leaf rot (root wilt plus leaf rot syndrome develop). The spindle leaf is critical in leaf rot incidence and progression. The root (wilt), as of now, is not amenable to conventional crop protection measures for control or cure. However, control of the leaf rot phase forms an important/integral part in the field management of

Table 2. Association of fungi in leaf rot affected spindles as isolated from different stages of the disease lesions (data represents year aggregate)

	Fungus	% leaf pieces yielding fungi from*	
		Early lesions	Advanced lesions
(A)	Individual isolations		
	<i>Colletotrichum gloeosporioides</i>	49.4	29.0
	<i>Exserohilum rostratum</i>	16.2	16.8
	<i>Gliocladium vermoeseni</i>	7.9	12.6
	<i>Fusarium</i> spp.	16.7	17.0
	<i>Thelaviopsis paradoxa</i>	4.2	4.1
	<i>Rhizoctonia solani</i>	0.8	11.2
	<i>Mortierella elongata</i>	0.1	3.2
	Other fungi	1.1	0.6
	Total	96.4	94.5
(B)	Mixed isolations	3.6	5.5
	Grand Total	100.0	100.0

* From a total of 120 palms



root (wilt) complex in the disease endemic region. As a case, leaf rot is due to complex fungal aetiology, a rare phenomenon. Effective control of leaf rot phase itself demands an integrated approach for which understanding the disease etiology is important.

Ten species of fungi are involved in leaf rot syndrome. Among them, *Colletotrichum gloeosporioides* and *Exserohilum rostratum* are the main pathogens. Various fungi co-occur in a vast majority of leaf rot affected palms even as having their individual role in

the disease initiation. *C. gloeosporioides* is aggressive during monsoon months with primary role in the disease. The population of *E. rostratum* is generally less than that of *C. gloeosporioides* during such wet seasons. Conversely, certain other pathogens such as *Fusarium* spp. and *Rhizoctonia solani* appear predominantly in dry season - aid in leaf rot perpetuation.

Availability of inoculum of one or the other pathogen, in different seasons of any given year, constantly ensures infection courts and disease prevalence/

perpetuation in the field. Therefore, regular monitoring of coconut plantations (with a thrust during monsoons) while adopting control measures is imperative. The use of broad-spectrum, potential fungicide(s) against various pathogens is also important. The details described on nature of fungal complex involved, trend of population fluctuations of pathogens, etc. in the ambit of etiology should be viewed perspectively that would go a long way in the leaf rot management measures.

Brahmi

Brahmi, scientifically known as *Bacopa monnieri* belongs to the family *Scrophulariaceae* and is found in humid and warmer parts of the world. It is a common creeping annual growing in damp or marshy areas. The entire plant is used in indigenous system of medicine as a entire tonic and cure for epilepsy and insanity. It is also being used as diuretic and for treating rheumatism, asthma and hoarseness. Besides this, the brahmi also has got good potency in controlling of cough, fever, diabetes and snake bite. Because of its inherent potential of enhancing memory and vitality, this miracle plant is gaining attention for its commercial cultivation. This plant is considered among one of the "Celestial drugs" (Divya ausadhi), when consumed with milk for six months. In Siddha system of medicine, the plant is useful against painful joints, swelling in joints, peripheral neuritis, constipation and burning urination. It is also used in convulsions, mental retardation, chest congestion and laryngitis. In newly developed memory enhancing drugs brahmi has been used as their main ingredient.

Indian Journal of Arecanut, Spices and Medicinal Plants

DIRECTORY ON COCONUT

The Coconut Development Board has decided to bring out a directory of the progressive coconut farmers, manufacturers of coconut based products, coconut related machinery manufacturers, exporters of coconut related products and manufacturers of coconut based handicrafts. The directory will be an invaluable source of information for anyone connected to the coconut cultivation and industry. Those who are coming under this category can enlist in this directory by sending name, address and bio-data along with telephone, fax or e-mail to :

The Chairman

COCONUT DEVELOPMENT BOARD

(Ministry of Agriculture, Govt. of India)

P.B. No. 1021, Kera Bhavan

Kochi -682 011, Kerala, India.

Phone : 0484- 377266, 377267

Fax : 91 - 0484-377902, Grams : KERABOARD

E-mail : cdbkochi@vsnl.com &

enk_cdrkochi@sancharnet.in

Website : www.coconutboard.nic.in