19

COCONUT
ROOT (WILT) DISEASE
A DISCOURSE

ICAR

Central Plantation Crops Research Institute, Kasaragod.

Technical bulletin - 19

DISCOURSE ON COCONUT ROOT (WILT)

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD - 670 124
KERALA, INDIA.

Compiled and edited by

N.P. Jayasankar
J.J. Solomon
T.S.S. Rawther
Thomas Joseph
A. Muraleedharan

Cover design

A.J. Bhadran

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M.K. Nair,
Director, Central Plantation Crops Research Institute,
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INTRODUCTION

Organised research on the cause and control of the root (wilt) disease - a century old scourge of coconut - started only as early as 1948 with the establishment of the Central Coconut Research Station in Kayangulam under the auspices of the Indian Central Coconut Committee. These modest efforts were fortified in the Second Five Year Plan Scheme in 1958. Well laid out co-ordinated research programmes were initiated in 1966 with the re-organisation of research under the Indian Council of Agricultural Research (ICAR). In 1970, with the establishment of the Central Plantation Crops Research Institute, this efforts acquired a multidisciplinary approach and a definite goal. The process of achiement to contain and control the disease in this perennial crop has been streneous, laborious and expensive. However, the initial trickle of information has collected into a sizeable body which has enabled us to plan different strategies for containing the disease, to live with the disease and to control the disease. Thus, slowly this debilitating disease is coming into the grip of the farmers.

This publication, incorporating all the relevant information accrued from the research of this disease, has been up-dated and it is hoped that like its precedecessor, would prove useful to coconut growers, students and all others concerned about the coconut root (wilt) disease.

1. When and from where was coconut root (wilt) disease first reported?

The earliest record of the disease is around 1874. The disease became significantly manifested after the great flood of 1882 at Erattupettah (Meenachil Taluk, Kottayam District, Kerala). Within about ten years, the disease was independently reported from Kaviyoor-Kallooppara (Thiruvalla Taluk, Alleppey District) and Karunagappally Taluk (Quilon District).

2. Is root (wilt) disease different from root disease?

The disease commonly known as 'Root (wilt)' today, was first called 'The Coconut Palm Disease'. Since root rot was noticed in the diseased palms it was termed 'Root disease'. Later, when foliar symptoms resembling 'wilt' condition were noticed, it also came to be called 'wilt' disease. The more usually used name 'Root (wilt) disease' and 'root disease' are the same.

3. What is the extent of area affected by root (wilt) disease, and how much loss does it cause?

The disease is now prevalent in a more or less contiguous manner in 410,000 ha in the eight Southern districts of Kerala stretching from Trivandrum to Trichur. It is also observed in isolated pockets in the northern districts of Kerala and in the adjoining districts of Kanyakumari and Coimbatore of Tamil Nadu. The intensity of the disease varies in different districts, the highest being in Kottayam (75.63%), followed by Alleppey (70.69%), tapering towards Trichur (2.60%) in the North and Trivandrum (1.52%) in the South (See map). Today, even about 100 years after the appearance of the disease, it is restricted to a contiguous area with exceptional isolated occurrence. A survey on the intensity and production loss due to root (wilt) disease conducted during 1984 has revealed that it causes an annual loss of 968.09 million nuts. If the damage to leaves and the impact of the disease on coir industry are also taken into account the eventual loss is higher than the loss due to reduced yield. The loss in husk is around 26% and that of copra/oil per nut is 9.0/11.3 per cent. The loss in yield/revenue from leaves per palm is 60%.

4. What are the symptoms of coconut root (wilt) disease?

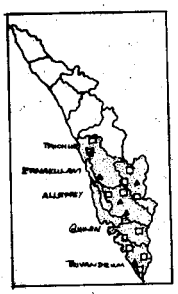
Leaflets become flaccid, i.e. they curve inwards resembling ribs of mammals, outer leaves turn yellow and leaflets show marginal necrosis. Other important symptoms are shedding of buttons and immature nuts, rotting of roots and reduction in leaf number and leaf area. The crown size gets reduced in the advanced stage of disease. However, the diagnostic symptom is "inward bending" or ribbing of the leaflets (Flaccidity) (See Figure).

SURVEY ON PRODUCTION LOSS OF COCONUT DUE TO ROOT (WILT) DISEASE

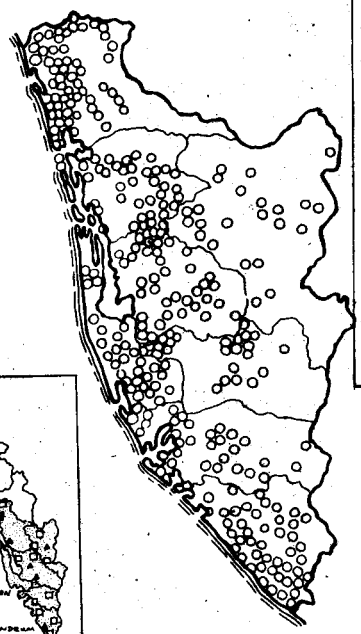
1984 - 85

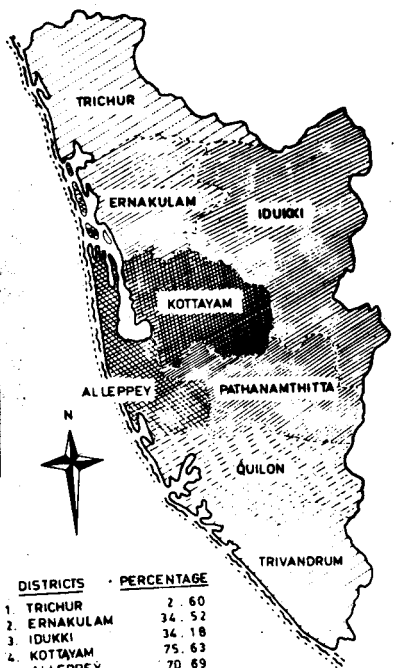
- AREA SURVEYED
- ▲ HEAD QUARTERS OF REVENUE DISTRICTS
- □ HEAD QUARTERS OF AGRICULTURAL SUB DIVISIONS
- ○ VILLAGES

NAMES OF SUB DIVISIONS	NUMBER OF VILLAGES	NUMBER OF CLUSTERS
1. NADAKKANGHERY	21	126
2. TRICHUR	23	138
3. IRINJALAKUDA	23	188
4. ALWAYE	21	126
5. PERUMBAVOOR	9	54
6. MOOVATTUPUZHA	19	114
7. PEERMEDU	8	48
8. ADIMALI	6	36
9. THODUPUZHA	9	54
10. KADUTHURUTHY	9	54
11. KOTTAYAM	14	84
12. PALAI	12	72
13. ALLEPPEY	18	108
14. MAVELIKARA	15	90
15. CHENGANNUR	13	78
16. ADOOR	20	120
17. QUILON	15	90
18. KOTTARAKARA	17	102
19. ATTINGAL	22	132
20. KEDUMANGAD	10	60
21. NEYYATTINKARA	14	84



INTENSITY OF INCIDENCE OF COCONUT ROOT (WILT) DISEASE IN THE CONTIGUOUSLY AFFECTED DISTRICTS OF KERALA STATE





DISTRICTS	PERCENTAGE
1. TRICHUR	2.60
2. ERNAKULAM	34.52
3. IDUKKI	34.18
4. KOTTAYAM	75.63
5. ALLEPPEY	70.69
6. PATHANAMTHITTA	38.22
7. QUILON	28.55
8. TRIVANDRUM	1.52

5. Are foliar yellowing and buttom shedding the result of root (wilt) disease?

Not always. Leaves may turn yellow also because of the deficiency of magnesium and certain other nutrients in soil and due to drought or high water table.

Bud rot, infestation by insects like red weevil/cockchafer may also cause yellowing of leaves.

Button shedding may result from drought, inadequacy of nutrients, Mahali disease and infestation by coreid bug. Some palms shed buttons as a hereditary trait.

Shedding of a few buttons to avoid exhaustion due to overbearing is natural and need not cause alarm.

6. Can the difference in intensity of disease be attributed to topography of land and soil type?

The disease occurs in all kinds of land and soil types.

7. What is the effect of the disease on the yield of palms?

Diseased palms generally yield fewer nuts. The extent of decline in yield is 43% in diseased early palms and 74% in diseased advanced palms, over root (wilt) free palms. The oil content in the root (wilt) free, diseased early and diseased advanced palms is respectively, 69.7%, 68.3% and 67.5%. The loss in husk per nut of diseased palm is around 25.8% and that of copra is 9%. While 92.7% of leaves in the root (wilt) free palms are plaitable, only 27.4% and 0.4% are plaitable in diseased early and diseased advanced palms respectively.

8. Is there any device to diagnose the disease before the appearance of visual symptoms?

A sero-diagnostic test has been perfected to detect the disease six to eight months before the appearance of visual symptoms. A physiological test based on stomatal resistance conforms the sero-diagnostic test.

9. How early does the root (wilt) disease appear?

Palms of all age are susceptible to the disease. The diagnostic symptom has been observed 18 months after transplanting one-year-old WCT coconut seedlings in new plantations in diseased tracts.

10. What causes the root (wilt) disease?

Exhaustive studies have ruled out the role of any physiological or nutritional disorders as the primary cause of the malady. Several biotic agents like fungi, bacteria and nematodes have been found associated, but none could produce the characteristic symptoms either individually or in combination. Rods and particles reported to be associated with the disease have been proved to be non-viral in nature. Recent studies revealed that Mycoplasma-like organisms (MLO) detected in tissues of diseased palms are the causal agents of the disease.

11. What makes the association of MLO more significant than that of the other, earlier reported biotic agents?

Mycoplasma-like organisms (MLO) cause diseases in plants. They are consistently present in the valcular tissues of root (wilt) affected palms and conspicuously absent in the disease-free palms. None of the other biotic agents was detected in the tissues of root (wilt) affected palms. MLO from the root (wilt) diseased coconut palms have been transmitted through a vegetative vector (dodder) to an indicator host plant (periwinkle) and from periwinkle to periwinkle. Inoculation of infective lace bug on experimental coconut seedlings rendered them disease and yielded evidence on transmission of MLO. Remission of symptoms in antibiotic treated diseased palms further confirmed a mycoplasmal etiology of the disease.

12. What are MLO? Why are they called Mycoplasma-like organisms?

Mycoplasmas are the smallest and simplest cellular organisms known. They are made out only when magnified several thousand times under electron microscope. They have no cell wall but are bound by a unit membrane. Therefore they have no definite shape. They are observed as round bodies or filaments. A well defined nucleus is wanting. DNA strands constitute the genetic material.

Mycoplasmas were known to produce diseases in animals and human beings towards the close of the last century. In 1967, Japanese workers located organisms similar to mycoplasmas in diseased plant tissues. Since mycoplasmas were till then not known to occur in plants, they came to be called 'mycoplasma-like' organisms. This terminology is still employed because they could not yet be characterised for determining their genera and species. In order to be classified as true mycoplasmas, the organism must grow in culture media and then undergo an array of diagnostic tests for growth requirements and serological affinities. Since MLO associated with plant diseases including coconut root (wilt) have defied cultivation attempts, they are called mycoplasma-like organisms (MLO). Today more than 150 plant diseases, believed earlier as virus diseases, have been recognised to be caused by MLO.

13. How are MLO transmitted in nature?

In nature, they are transmitted by insects much the same way as mosquitoes transmit malaria and filariasis in man. Conventional insect vectors of MLO diseases are leaf hoppers and plant hoppers. Ability of other insects which are phloem feeders to transmit MLO is also on record.

Experimentally, MLO diseases are transmitted through dodder and grafting.

14. Which is the insect that transmits coconut root (wilt) disease?

The lace bug (*Stephanitis typica*) outnumbers all other insect visitors of coconut foliage. It is present in all areas where the coconut root (wilt) disease is prevalent. It is more abundant on diseased palms than in the healthy. The higher colonisation precedes incidence of the disease. It is present in increasing numbers in tender leaves where MLO population is higher than in older leaves. The bug can feed from phloem, the seat of

MLO. The acquisition of MLO is evidenced by their detection in the salivary gland of the insect allowed to feed on diseased material, while the organisms are absent in the bugs from disease free areas. For these reasons and based on positive results obtained in transmission trials, the lace bug is considered to transmit the root (wilt) disease.

15. With the current understanding on the cause of coconut root (wilt) disease, is it possible to prescribe a remedy to cure the malady?

No, it is not possible to suggest a chemical remedy which will cure and render the palms free of the characteristic symptoms of root (wilt). Application of Tetracycline-group of antibiotics has shown a temporary remission of symptoms in plant diseases including root (wilt) disease induced by the Mycoplasma like organisms. But because of the repetitive nature of application resulting in possible environmental hazards and high cost, the antibiotic cannot be used just to keep the population of MLO at a low level.

On the other hand, an economic control of root (wilt) disease may perhaps be possible by suppressing the insect vectors transmitting the MLO by insecticidal application or biological control methods. Experiments are in progress.

16. Is there any difference between root (wilt) and leaf-rot diseases?

Yes. Leaf-rot disease is generally found superimposed on about 30% of palms affected by root (wilt) disease. This hastens the decline of the palms. Occurrence of leaf-rot independent of root (wilt) is very rare.

Leaf rot is caused by the fungus *Drechslera* (= *Bipolaris*) *halodes*. This can be effectively controlled by regular fungicidal spraying.

17. Is the coconut root (wilt) disease infectious?

Yes. Surveys conducted in 1952, 1972 and 1984 have brought out the disease prevalence, respectively, in 16,000, 250,000 and 410,000 ha. The disease affected gardens are distributed in the eight southern districts of Kerala contiguously. Sparse incidence of the disease was also observed in northern districts of Kerala as well as the adjoining districts of Kanyakumari and Coimbatore of Tamil Nadu.

18. Is there any way of arresting the further spread of the disease?

Eradication of three diseased palms in an isolated garden at Shenkotta in 1971 prevented recurrence of the disease. With the objective of containing the disease within the continuously infected tract, similar programmes in a massive way followed by surveillance started in areas north of Karuvannur river in Trichur district, which is the northern boundary of the diseased tract, also indicated the possibility of containing the disease by preventing its spread to newer areas. Removal of the entire source of infection is the strategy for preventing the spread of disease in gardens in the border areas between disease-prevalent and disease-free tracts.

19. Is coconut root (wilt) disease related to poor nutrient status of soils?

Neither the major nor minor nutrients has any direct role in the incidence of the disease. However, addition of Mg reduced the prebearing age of palms by nearly nine months and substantially increased the productivity of palms. The beneficial influence of Mg was more pronounced in the root (wilt) affected plantations.

20. Why does root (wilt) disease persist in coconut palms which are regularly fertilized and sprayed with fungicides?

The recommended fungicidal sprays control fungal diseases like leaf rot. They are not meant to control root (wilt) disease. However, fungicidal sprays are recommended on root (wilt) - infected palms in order to slow down the rate of deterioration of such palms on account of superimposition by leaf rot disease. Fertilizers do not cure the disease either.

21. Is there any advantage of manuring root (wilt) affected palms?

Manuring the palms in the early stage of the disease has been found to increase the yield by 42 per cent. It may not be economical in the advanced stage of the disease.

22. Do fungicidal sprays provide any benefit to palms not affected by root (wilt) disease?

In root (wilt) disease affected tracts there will be palms not showing visual symptoms but harbouring the pathogen. Such palms are prone to leaf-rot infection. Protective fungicidal spraying is therefore beneficial. Sequential spraying with Bordeaux mixture (1%), Dithane M-45 (0.3%) and Fytolan (0.3%) ensures effective control of leaf rot.

23. Is there any advantage of intercropping/mixed cropping and mixed farming in root (wilt) affected coconut gardens?

Intercropping/mixed cropping has no deleterious effect on the yield of palms, provided component crops are properly managed. Yield enhancement to the extent of 27 to 25 per cent is possible due to mixed cropping with Cocoa and 28 to 62 per cent due to mixed farming (maintenance of milch cows on intercropped fodder grass and recycling of organic matter). Moreover, these practices have the additional advantage of bringing higher income and employment potential for the farmer.

24. What are the recommendations for managing root (wilt) affected coconut gardens?

In mildly infected areas all disease affected palms should be removed to eliminate the foci of infection. For heavily infected areas the following management practices should be adopted.

1. Remove all diseased advanced and uneconomic palms and replant with healthy hybrid seedlings or pre-potent (elite) mother palms, if enough space is available.

2. Remove all juvenile palms showing symptoms of root (wilt) disease irrespective of its intensity.
3. Spray the leaves with 0.01% Nuvacron/Endosulfan before felling the palms to kill the infectious vectors. Also ensure proper disposal of the felled stems to prevent build up of pests and other pathogens.
4. Apply balanced doses of fertilizers (1000 g urea, 1700 g Super phosphate, 1700 g muriate of potash and 3000 g magnesium sulphate per palm per year in two splits 1/3 during April-May and 2/3 during Sept.-Oct. for rainfed palms and in four splits during January, April, July and October for irrigated palms).
5. Apply 50 Kg farm yard manure per palm per year.
6. Grow green manure crops preferably *Pueraria phaseoloides* in basin during the period April to Sept. and incorporate along with the Sept.-Oct. application of fertilizers.
7. Control leaf rot as already indicateed under Qn. 22.
8. Fill the inner leaf axils of palms below 20 years with BHC 5% - sand mixture (1:1 by volume) to control red palm weevil and rhinoceros beetle.
9. Irrigate the palms during summer months at the rate of 600 to 900 lit. water per basin once in four to six days.
10. Avoid waterlogging by providing proper drainage.
11. Restructure the canopy of other perennial crops to provide maximum light for the coconut palms.
12. Raise intercrops in rotation or adopt mixed cropping or mixed farming with recycling of organic matter.

25. How do the hybrid coconuts respond to coconut root (wilt) disease?

The reaction of several coconut cultivars and hybrids to root (wilt) disease is under study and none has so far been found to be resistant/tolerant to the disease. In a heavily diseased area, CDO x WCT hybrids under good management with a fertilizer dose of 500, 300, 1000g N, P_2, O_5, K_2O, respectively, and 500 g MgO per palm per year yielded higher number of nuts compared to the WCT palms of identical age in the early years of production. The cumulative yield per palm aged 15 years was 620 and 265 nuts for the CDO x WCT and WCT palms respectively. The percentage of disease incidence was 41.1 for the CDO x WCT palms and 62.2 for WCT palms.

26. Why do some palms growing in root (wilt) affected gardens remain free of the disease?

Occurrence of disease-free coconut gardens in heavily diseased tracts and of symptomless palms yielding heavily over several years in disease-prealent gardens is not uncommon. The reason for this kind of behaviour is not known.

27. Is there any harm in conveying coconut seedlings raised in diseased areas to healthy areas for planting?

Yes. This will result in the transmission of the root (wilt) pathogen as also the insect vector to the disease-free areas. The movement of seedlings from the diseased areas should be totally restricted.

28. What is the future thrust on coconut root (wilt) research?

The emphasis is on the identification of a resistant cultivar. The resistance may be against the pathogen or its vector. A massive screening programme is under way in heavily diseased areas at the Kayamkulam Kayal Farm. It is envisaged to plant more than 100 accessions, each in three replications of 16 seedlings to monitor the incidence of the disease. A survey of the 'hot spot' (heavily diseased) areas is in progress to locate disease-free palms which are free of mycoplasma-like organisms in tissues and negative to the diagnostic tests and use them for future breeding programmes. Vigorous attempts will also be made to culture coconut root (wilt) pathogen. The already available technology of Tissue Culture of coconut will be made us of for the *in vitro* screening for locating resistant lines.

29. How reliable are the several claims made by various people and firms from time to time that they have developed effective methods for controlling coconut root (wilt) disease?

There are as yet no effective methods for curing the coconut root (wilt) disease. Several of such claims so far made by various individuals and firms have been tested by the CPCRI and none of them was found effective. The coconut cultivators are advised not to be carried away by such false claims.

30. What are the sources of correct technical advice/information on various aspects of coconut cultivation and diseases?

Central Plantation Crops Research Institute, Kasaragod-670 124 (Plant production, plantation management and post harvest technology) and CPCRI Regional Station, Kayangulam, Krishnapuram-690 533 (Plant protection aspects); Directorate of Agriculture, Kerala, Vikas Bhavan, Trivandrum-695 034; Kerala Agricultural University, Vellanikara, Trichur-680 657; and Coconut Development Board, Ernakulam, Cochin-682 011; offer free advisory services.

Informative and authoritative popular style articles are published from time to time in *Indian Coconut Journal*, 'Kerala Karshakan', 'Kalpadhenu', 'Indian Nalikera Journal' etc.

Farm Information Bureau, Trivandrum gives out useful hints on coconut cultivation through radio, Trivandrum Doordarshan programmes and write-ups in newspapers.