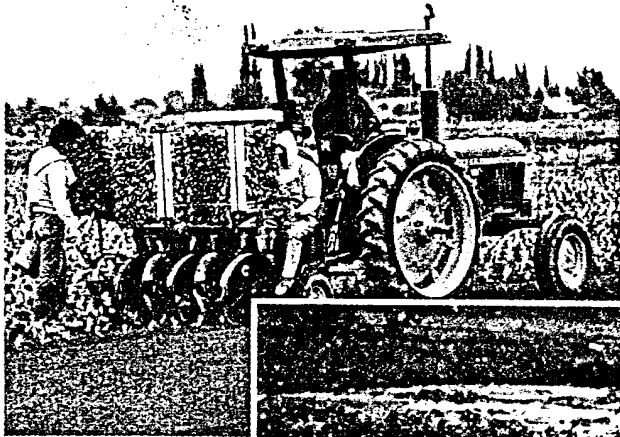


# ROLE OF RESISTANCE IN INTENSIVE AGRICULTURE



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## Chapter-9

# Possibilities of Evolving an Arecanut Variety Tolerant to Yellow Leaf Disease

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R.Chandra Mohanan and K.U.K. Nampoothiri

### ABSTRACT

Yellow leaf disease (YLD) is the most serious malady affecting arecanut in Kerala and Karnataka States. The disease causes qualitative and quantitative loss. Phytoplasma is the causal organism of YLD and the plant hopper, *Proutista moesta* is the vector. Detailed studies were conducted on disease transmission, antibiotic therapy, vector control and screening of varieties and hybrids. Criteria for effective screening of field tolerant palms have been formulated and YLD-free elite palms in hot spots have been identified. Multiplication of YLD-free elite palms to establish nucleus seed gardens is in progress.

### Introduction

Yellow leaf disease of arecanut (*Areca catechu* L.) is the most serious problem of areca growers in Kerala and Karnataka states. Though the disease first made its appearance as early as in 1914 in Central Kerala (Nambiar, 1949), there is no solution to tackle this malady till today. Now, yellow leaf disease (YLD) is prevalent in all districts of Kerala, five districts of Karnataka and some parts of Tamil Nadu and Maharashtra causing heavy economic loss to the growers. Yellow leaf disease affects the normal growth and vigour of palms. Reduction in yield upto 50 % within a period of three years after the onset of the disease has been observed (Nair, 1994).

### Symptoms

As the name of the disease indicates characteristic yellowing of leaves is the most important symptom. Initial symptom of yellowing occurs on one or more leaves of the outermost whorl. Yellowing starts from the tips of leaflets on either side of the leaf and gradually extends to the base. At this stage the foliar yellowing is characterised by abrupt demarcation between green and yellow region. When the yellowing extends from the tip to the basal portion of leaflets there will be a clear band of green tissue adjacent to the mid rib. During dry periods, the tips of the chlorotic leaflets become necrotic and eventually dry up. In the advanced stage of the disease, the leaves become reduced in size, stiff, closely bunched and abnormally puckered. Thus the crown becomes very much reduced in size. Immature nut fall, kernel discolouration and extensive root rot are the other major symptoms of the disease. Blackish discolouration of the kernel (endosperm) of immature and mature fruits is a common symptom of the disease. As a result the whole kernel becomes unfit for chewing. On drying, the chali

(dried nut) is shrivelled and of poor quality. Thus the disease causes qualitative and quantitative loss (Rawther, 1976; Chadra Mohanan, 1979; Nair, 1994). Some anatomical changes in the leaves, stem, inflorescence and roots due to YLD were also reported (Nair and Aravindakshan, 1970; Nair, 1976).

### Etiology

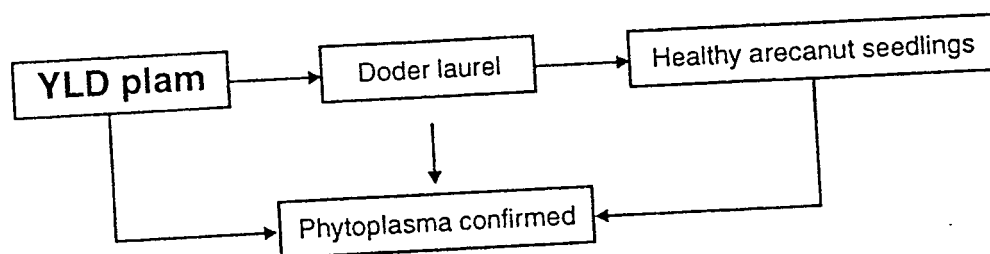
Extensive studies conducted on the role of fungi, bacteria, nematodes, viruses and nutritional disorders in causing this malady clearly revealed that none of these can cause YLD.

Electron microscopic studies showed the presence of Phytoplasma in the young sieve elements of YLD affected palms (Nair and Seliskar, 1978). This has been confirmed by further detailed studies. E.M. Examination of root tissues of YLD affected palms invariably showed the presence of Phytoplasma whereas they were totally absent in the roots of healthy palms from disease free area. Protozoan flagellates, viruses, fungi or bacteria were not observed in the tissues examined (Anonymous, 1985 and 1986).

Phytoplasmas are generally transmitted by leaf hoppers and plant hoppers. Detailed investigations on possible putative vectors of the disease have revealed the constant association of a plant hopper *Proutista moesta* (Westwood) (Homoptera : Derbidae) with arecanut palms. The ability of the plant hopper to acquire and sustain the mollicutes was assessed. On E.M. examination, Phytoplasmas were observed in the salivary gland tissues of plant hopper subjected to 30 – 41 days acquisition and incubation period on YLD affected palms while Phytoplasmas were totally absent in the salivary glands of laboratory reared plant hoppers as well as the insects collected from healthy area. Transmission of the disease and vector role of *P. moesta* were confirmed by observing YLD symptoms on arecanut seedlings inoculated with *P. moesta* which was given 5 days acquisition access to diseased palms and 25 – 36 days incubation period (Ponnamma *et al.*, 1991 & 1997). These results lend further support to Phytoplasma etiology.

The presence of Phytoplasma and its transmission were established also by dodder transmission (Anonymous, 1991)

#### E. M. Examination of plants subjected to dodder transmission (Dodder laurel – *Cassytha filiformis*)



Antibiotic therapy against YLD was carried out in two localities. Disease index tabulated after 2 years of initiation of the antibiotic therapy revealed marked improvements in the foliar condition in neomycin, ledermycin, oxytetracycline (OTC), gentamycin and hostacycline treated palms. Contrastingly, palms in the penicillin treatment showed increase in disease intensity. Thus the antibiotic therapy further confirmed the phytoplasmal etiology (Anonymous, 1990 and 1991)

**Antibiotic therapy : at two locations**

Antibiotics	% improvement in disease conditions (After two years)
*1. Neomycin 0.5 g a.i.	90
*2. Lcdermycin 2 g a.i.	89
3. O.T.C. 1 g a.i.	80
4. Gentamycin 2 g a.i.	80
5. Hostacycline 2 g a.i.	60
6. Pencillin 20 lakh units	Increase in D.I.

\* Phytotoxic

As YLD was found to be transmitted by a planthopper, attempts were made to control the insect vector, *P. moesta* and thereby checking the fresh incidence and spread of YLD. But, even monthly application of insecticides like endosulfan and monocrotophos could not prevent the incidence of the disease (Anonymous, 1990). The reasons for this may be attributed to the large scale multiplication of the plant hopper and its occurrence in arecanut garden throughout the year.

**Effect of insect control on fresh incidence of YLD**

## Treatments

1. Endosulfan	0.1 %	monthly spray
2. ..	..	quarterly spray
3. Monocrotophos	0.1 %	monthly spray
4. .. ..		quarterly spray
5. Untreated control		
[Phorate 10G @ 2g/sachet in leaf axils, Phorate 10G @10g/plant for soil application in all treatments]		
Even monthly application of insecticides could not prevent the incidence of YLD		

**Screening of varieties**

Since phytoplasmal diseases are not amenable to control by conventional plant protection measures, a lasting solution to this malady is to evolve disease tolerant/resistant variety. Though studies on varietal reaction to YLD was initiated as early as in 1960, more emphasis was given to this line of investigation with the confirmation of phytoplasmal etiology. Earlier studies indicated that all the 52 germplasm collections (both exotic and indigenous) succumbed to YLD though in varying degrees of intensity (Nampoothiri, 1982). Therefore, 88 varietal hybrids of different cross combination were screened against YLD. They were also susceptible to the disease (Anonymous, 1985, 1988, 1990 and 1994).

### Identification of field tolerant elite palms

As no positive result on disease tolerance was obtained even after screening 140 genotypes, it has been decided to identify field tolerant/resistant palms, which are high yielding. Hence, the present investigations were undertaken to identify field tolerant/resistant elite palms in hot spots of YLD affected areas in Kerala state.

The criteria for selection of elite disease escape palms were :

1. More than 90 % of the surrounding palms should be affected by YLD
2. The palms should have a minimum age of 20 years.
3. Disease free nature of the palms should be confirmed by light microscopic tests.
4. Selected palms should yield a minimum of 200 nuts/palm/year under neglected conditions (Farmers neglect the garden when YLD incidence is very high)
5. Selected palms should be generally free from major pests and diseases.

A survey was conducted in hot spots of Thrissur and Ernakulam districts of Kerala State to identify disease escape palms. The disease escape palms identified were monitored for disease incidence and yield for two years. Thus, a total of 5 palms in Thrissur dist. and 10 palms in Ernakulam dist. were identified as YLD symptom free elite palms. An arecanut garden consisting of 52 palms, raised by the farmer using the seed nuts collected from a single YLD free high yielding palm of about 30 years old, occurring in the middle of all other YLD affected palms, was also identified in the hot spots of Ernakulam dist. during the survey. These 52 palms are now more than 20 years old. Though they were raised from open pollinated seed nuts of YLD symptom free elite palm, none of these palms were showing symptoms of YLD except three palms exhibiting kernel discolouration. Thus, there were 49 palms (second generation) without any symptoms of YLD. These 49 palms were also monitored for disease incidence for two years. None of the palms have exhibited any YLD symptom, so far.

All the 67 palms (52 palms of second generation + 10 disease escape palms in Ernakulam dist. and 5 disease escapes in Thrissur dist.) were subjected to histological staining techniques using Dienes' stain (Deeley *et al.*, 1979). For this, three root samples with root tip were collected from each palm and fixed in FAA. Simultaneously root samples were collected from 5 healthy palms in a YLD free area and 5 palms with typical YLD symptoms occurring in hot spots of Ernakulam dist. Seed nuts of 3 arecanut varieties (Mangala, Sumangala and Dakshina Kannada local) were collected from a disease free area and seedlings were raised under insect proof cages. Root samples were also collected from these seedlings. All the samples collected were fixed in FAA.

Transverse sections of all the samples fixed in FAA were taken and stained with 0.2% solution of Dienes' stain for 10 min. Then the sections were washed in distilled water, mounted in D.W. and examined under a microscope. Thus, the reaction of root tissues of YLD symptom-free palms in hot spots to Dienes' stain was compared with that of YLD affected palms and healthy palms/seedlings. The phloem of root sections of all YLD affected palms exhibited a distinct blue colour but the phloem of healthy root sections remained unstained. Based on such reaction to Dienes' stain the disease escapes identified in hot spots were categorised into healthy and infected palms.

The 10 YLD symptom free elite palms in Ernakulam dist. were negative in their reaction to Dienes' stain. Out of the 5 palms identified in Thrissur dist. only one palm was found to be negative to staining reaction. Out of the 52 palms identified as second generation YLD symptom free palms (including 3 palms with kernel discolouration) in Ernakulam dist., 33 palms were negative in their reaction to Dienes' stain. Among these 33 palms, 24 palms were identified and marked as elite palms based on yield evaluation. Thus, 34 palms in Ernakulam dist. and one palm in Thrissur dist. were selected as YLD free elite palms in Kerala state for production of seed nuts by selfing and interse mating. These palms will be monitored every year for disease incidence and disease free nature will be confirmed by light microscopic test.

Seedlings raised from open pollinated seed nuts of 'second generation' YLD free elite palms in Ernakulam dist. are being evaluated for their susceptibility to YLD by interplanting them in arecanut gardens with more than 90 % YLD affected palms. Selfing of inflorescence of these 24 second generation elite palms is also in progress.

### Future thrust

Identification of more disease free elite palms in hot spots of Kerala and Karnataka states and their utilization in breeding programmes will be undertaken to evolve disease tolerant/resistant high yielding population. The YLD free elite palms available in hot spots will be multiplied by selfing and interse mating. The seedlings raised from these palms will be planted in large areas in the disease prevalent tracts of Kerala and Karnataka states to utilize them as nucleus seed source, after screening against YLD. Concurrently, the YLD tolerant/resistant palms can be used for future disease resistance breeding programmes by utilizing selected palms in the nucleus seed gardens to evolve a high yielding variety fully resistant to YLD. It will be a boon to farmers in Kerala and Karnataka states to have YLD tolerant/resistant high yielding arecanut variety to alleviate the loss due to yellow leaf disease.

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