

# **ARECANUT YELLOW LEAF DISEASE**

Editors

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## VARIETAL REACTION

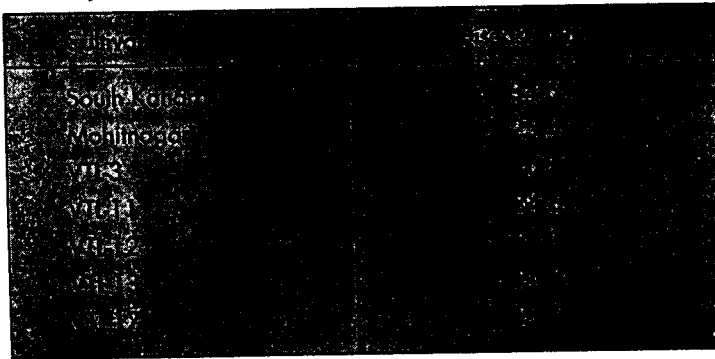
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Yellow leaf disease, a malady of Phytoplasmal etiology, is not amenable to control by conventional plant protection measures (Ponnamma *et al.*, 1997). As management practices did not yield any positive results, the only other practical solution available for controlling this malady is to evolve resistant/tolerant varieties. During the past three decades, considerable work has been done on this aspect.

### Screening of varieties and hybrids

In a multi location trial conducted during 1970's, six promising cultivars such as VTL-3 (released as Mangala) , VTL-11 ( released as Sumangala), VTL-12, VTL-13, VTL-17(released as Sreemangala) and Mõhitnagar with South Kanara local as check were evaluated and the results indicated that all of them were susceptible (Table 1). The disease index varied from 6.7

**Table 1. Reaction of promising cultivars to yellow leaf disease.**



(VTL-3) to 34.6 (South Kanara). Nampoothiri (1982) reported that 52 arecanut collections derived from both exotic and indigenous sources also succumbed to YLD with varying degrees of intensity. Further, large scale screening of germplasm collection/ varietal hybrids, hybrids produced from disease escapes, inter-se/selfed progenies of different collections involving 88 different cross combinations comprising of 2,328 palms during 1976-1993 (Table 2) were undertaken in YLD affected belt. All of them were highly susceptible and 18 genotypes showed less than 25 per cent of disease incidence (Table 3). The succeeding account reveals the results of these experiments.

The 21 diallel cross combinations planted at CPCRI, Palode in 1976 have contracted the disease within a period of three years .The disease incidence varied from 63.9 to 100 per cent (Table 4). Maximum incidence was noticed in VTL-3 x VTL-13, VTL-11 x VTL-13,

**Table 2. Screening of hybrids / Inter-se materials against yellow leaf disease.**

| Year of planting | Varietal hybrids | Hybrids involving disease escapes | Inter-se | Self | Total |
|------------------|------------------|-----------------------------------|----------|------|-------|
| 1976             | 6                | -                                 | -        | -    | 6     |
| 1981             | -                | 6                                 | -        | 1    | 7     |
| 1983             | 9                | -                                 | -        | -    | 9     |
| 1984             | 8                | -                                 | -        | -    | 8     |
| 1985             | -                | 7                                 | 1        | -    | 8     |
| 1986             | 3                | 3                                 | -        | 1    | 7     |
| 1986             | 1                | 6                                 | -        | -    | 7     |
| 1988             | 3                | -                                 | 5        | -    | 8     |
| 1989             | 2                | -                                 | 5        | -    | 7     |
| 1990             | 5                | -                                 | 2        | -    | 7     |
| 1991             | 4                | -                                 | 3        | -    | 7     |
| 1993             | -                | -                                 | 6        | 1    | 7     |
| Total            | 41               | 22                                | 22       | 3    | 88    |

**Table 3. Reaction of varieties/ hybrids screened against YLD from 1976-1993**

| Varieties/ Hybrids               | Total screened | Disease incidence (%) |       |       |          |
|----------------------------------|----------------|-----------------------|-------|-------|----------|
|                                  |                | 100                   | 50-99 | 25-49 | Below 25 |
| Varietal hybrids                 | 41             | 23                    | 9     | 0     | 9        |
| Hybrids involving tolerant palms | 22             | 11                    | 4     | 4     | 3        |
| Inter-se                         | 22             | 11                    | 2     | 4     | 5        |
| Self                             | 3              | 0                     | 1     | 1     | 1        |
| Total                            | 88             | 45                    | 16    | 9     | 18       |

VTL-11 x Thirthahalli, VTL-13 x VTL-17 and VTL-17 x Thirthahalli (100%) and minimum in VTL 12 X Thirthahalli (63.9 %). The hybrid combinations between Hirehalli dwarf mutant and promising cultivars (VTL-3, VTL-11, VTL-13, Mohitnagar and Thirthahalli) planted in 1976 exhibited certain degree of tolerance in the initial years (Anon., 1981). However, all succumbed to YLD within a period of 6-8 years (Table 5). The disease incidence was highest in Thirthahalli x Dwarf (62.9 %) and least in Dwarf x VTL-11 (18.1%).

The most promising results were obtained from the trial laid out in 1981 at CPCRI Research Centre, Palode with field tolerant palms. Even though all the progenies of Saigon x Mangala

**Table 4. Reaction of diallel cross combinations to yellow leaf disease.**

| Hybrids                   | No. of palms tested | No. of palms diseased | Per cent of incidence | Mean disease index |
|---------------------------|---------------------|-----------------------|-----------------------|--------------------|
| VTL-3 x VTL-11            | 12                  | 11                    | 91.7                  | 25.90              |
| VTL-3 x VTL-12            | 15                  | 10                    | 66.7                  | 14.60              |
| VTL-3 x VTL-13            | 8                   | 8                     | 100                   | 21.40              |
| VTL-3 x VTL-17            | 11                  | 10                    | 90.9                  | 20.10              |
| VTL-3 x Mohitnagar        | 13                  | 10                    | 76.6                  | 11.80              |
| VTL-3 x Thirthahalli      | 15                  | 13                    | 86.7                  | 20.40              |
| VTL-11 x VTL-12           | 12                  | 10                    | 83.3                  | 18.50              |
| VTL-11 x VTL-13           | 12                  | 12                    | 100                   | 23.40              |
| VTL-11 x VTL-17           | 14                  | 13                    | 92.9                  | 17.60              |
| VTL-11 x Mohitnagar       | 10                  | 7                     | 70.00                 | 13.00              |
| VTL-11 x Thirthahalli     | 20                  | 20                    | 100                   | 25.60              |
| VTL-12 x VTL-13           | 23                  | 19                    | 82.6                  | 21.70              |
| VTL-12 x VTL-17           | 11                  | 10                    | 90.9                  | 21.40              |
| VTL-12 x Mohitnagar       | 18                  | 16                    | 88.90                 | 24.40              |
| VTL-12 x Thirthahalli     | 11                  | 7                     | 63.90                 | 15.30              |
| VTL-13 x VTL-17           | 13                  | 13                    | 100                   | 31.30              |
| VTL-13 x Mohitnagar       | 8                   | 6                     | 75.00                 | 8.70               |
| VTL-13 x Thirthahalli     | 19                  | 17                    | 94.10                 | 23.00              |
| VTL-17 x Mohitnagar       | 12                  | 10                    | 83.30                 | 16.90              |
| VTL-17 x Thirthahalli     | 2                   | 2                     | 100.                  | 32.50              |
| Mohitnagar x Thirthahalli | 17                  | 13                    | 84.60                 | 21.20              |

**Table 5. Incidence of yellow leaf disease on arecanut hybrids after 8 years of planting (planted in 1984).**

| Hybrids                        | No. palms | No. palms contracted disease | Disease incidence (%) | Mean disease index |
|--------------------------------|-----------|------------------------------|-----------------------|--------------------|
| Mangala x Hirehalli dwarf      | 21        | 9                            | 42.8                  | 9.3                |
| VTL-13 x Hirehalli dwarf       | 30        | 14                           | 46.6                  | 15.4               |
| Mohitnagar x Hirehalli dwarf   | 27        | 11                           | 40.7                  | 15.5               |
| Thirthahalli x Hirehalli dwarf | 27        | 17                           | 62.9                  | 23.8               |
| Hirehalli dwarf x VTL-11       | 11        | 2                            | 18.1                  | 15.0               |
| Mangala                        | 16        | 7                            | 43.7                  | 21.6               |
| Hirehalli dwarf                | 31        | 16                           | 51.6                  | 10.3               |

did not show resistance to the disease, hybrids between two palms No. 300 (Saigon) and No.125 ( Mangala) exhibited high level of tolerance. The disease index in this combination was only 2.8 per cent (averaged over nine years) with an average yield of 9.19 kg/palm/year (Table 6). One of the palms belonging to this combination did not show any symptom even after 13 years. Since the yield of this palm was also high (14.3 kg), it can be considered as a very promising breeding material and can be successfully used in future breeding programme for YLD tolerance.

A field trial involving nine varietal hybrids and Mangala and South Kanara as control initiated during 1984 at CPCRI Research Centre, Palode indicated that all of them contracted the disease within a period of three years except VTL-12 x South Kanara combination (Table 7). Later, this combination also succumbed to the disease. Another experiment laid out at Kannara

**Table 6. Reaction of hybrids, planted in 1981, to yellow leaf disease and their yield potential.**

| Hybrids                        | Mean no. of nuts/ palm | Fresh weight of ripe nuts (Kg) | Disease index |
|--------------------------------|------------------------|--------------------------------|---------------|
| 300 Saigon x 108 Mangala       | 159*                   | 5.43                           | 2.3           |
| 300 Saigon x 125 Mangala       | 251                    | 9.19                           | 2.8           |
| 28 Aryankavu x 115 Mangala     | 192                    | 4.97                           | 4.9           |
| 159 Peechi x 122 Mangala       | 83                     | 2.87                           | 3.6           |
| 105 Mangala x 299 Saigon       | 206                    | 6.04                           | 4.7           |
| 105 Mangala x 108 Mangala      | 123                    | 3.57                           | 8.1           |
| 28 Aryankavu x 28 Aryankavu    | 107                    | 2.81                           | 9.5           |
| SE                             | 28.8                   | 1.00                           | 1.1           |
| CD (5%)                        | 88.7                   | 3.10                           | 3.5           |
| * Mean for 9 years (1985-1993) |                        |                                |               |

**Table 7. Reaction of varietal hybrids, planted in 1984, to yellow leaf disease**

| Cross combination        | No. of palms | No. of palms diseased | Percentage <sup>1</sup> of disease incidence | Mean disease index |
|--------------------------|--------------|-----------------------|--|--------------------|
| Hirehalli dwarf x VTL-3  | 27           | 2                     | 7.4  | 4.0                |
| VTL-3 x Hirehalli dwarf  | 27           | 1                     | 3.7  | 5.0                |
| South Kannara x VTL-12   | 26           | 3                     | 11.5   | 1.3                |
| VTL-12 x South Kannara   | 27           | 0                     | 0  | 0*                 |
| VTL-12 x VTL-3           | 16           | 2                     | 12.5   | 7.5                |
| VTL-12 X Hirehalli dwarf | 25           | 4                     | 16.0   | 2.5                |
| VTL-12 x Sreevardhan     | 20           | 2                     | 10.0   | 17.5               |
| VTL-3 x South Kannara    | 19           | 1                     | 5.3  | 17.0               |
| Hirehalli xVTL-17        | 27           | 2                     | 7.4  | 3.5                |
| Mangala                  | 25           | 4                     | 16.0   | 11.0               |
| South Kannara            | 27           | 2                     | 7.5  | 17.5               |

<sup>1</sup>Data recorded in 1987

\* Succumbed to disease in 1990

in 1986 involving hybrids from disease escapes and Mangala and South Kanara local as check showed that more than 50 per cent of palms in all combinations were susceptible to the disease (Table 8). The hybrids 96-M x 260 and 172 x 71 M gave satisfactory yield of 5.42 and 6.15 kg nut weight respectively with 217 and 268 mean number of nuts. All other combinations were poor yielding with a mean weight of 2.38 kg and less than 80 nuts/palm.

**Table 8. Reaction of hybrids derived from disease escapes to yellow leaf disease.**

| Cross combinations       | Percentage of disease incidence | Mean disease index | Mean no. of nuts | Mean yield (Ripe fresh nut in Kg) |
|--------------------------|---------------------------------|--------------------|------------------|-----------------------------------|
| 8 M x 25 A               | 91.60                           | 32.40              | 75               | 1.978                             |
| 31 M x 260               | 75.00                           | 18.80              | 79               | 2.260                             |
| 96 M x 260               | 83.30                           | 22.70              | 217              | 5.418                             |
| 414 x 34 M               | 95.80                           | 32.90              | 28               | 0.758                             |
| 172 x 71 M               | 95.80                           | 28.90              | 268              | 6.151                             |
| 149 X 177                | 100                             | 40.70              | 40               | 1.143                             |
| Hirehalli dwarf x VTL 13 | 50.00                           | 5.70               | 35               | 1.400                             |
| Mangala                  | 54.10                           | 10.50              | 79               | 2.381                             |
| South Kanara             | 95.80                           | 29.80              | 14               | 0.462                             |

Among the exotic types and species planted in 1968 at Kannara, only two genotypes (Indonesian II and British Solomon Islands I) have remained disease free. In the experiment in which "true" Mangala and segregants were planted to study the intensity of YLD, 24 per cent segregants contracted the disease in the fourth year after planting compared to four per cent in true Mangala (Anon., 1993). Even after 18 years of field experimentation, none of the hybrids or varieties were completely resistant.

### Field tolerant elite palms

As no variety or hybrid was found to be disease tolerant, it was appropriate to search for field tolerant elite palms in 'hot spot' of YLD affected areas in Kerala State.

The criteria for selection of elite disease escape palms were :

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

From an intensive survey in 'hot spot' areas conducted during 1985-1987 in 13 districts of Kerala involving 1,32,750 palms, 70 healthy/disease escapes were identified. They were further subjected to light microscopic examination and six of them were disease free (Table 9). A recent survey conducted in 1998 led to identification of five disease free elite palms in Thrissur and 10 palms in Ernakulam districts. Further, an arecanut garden consisting

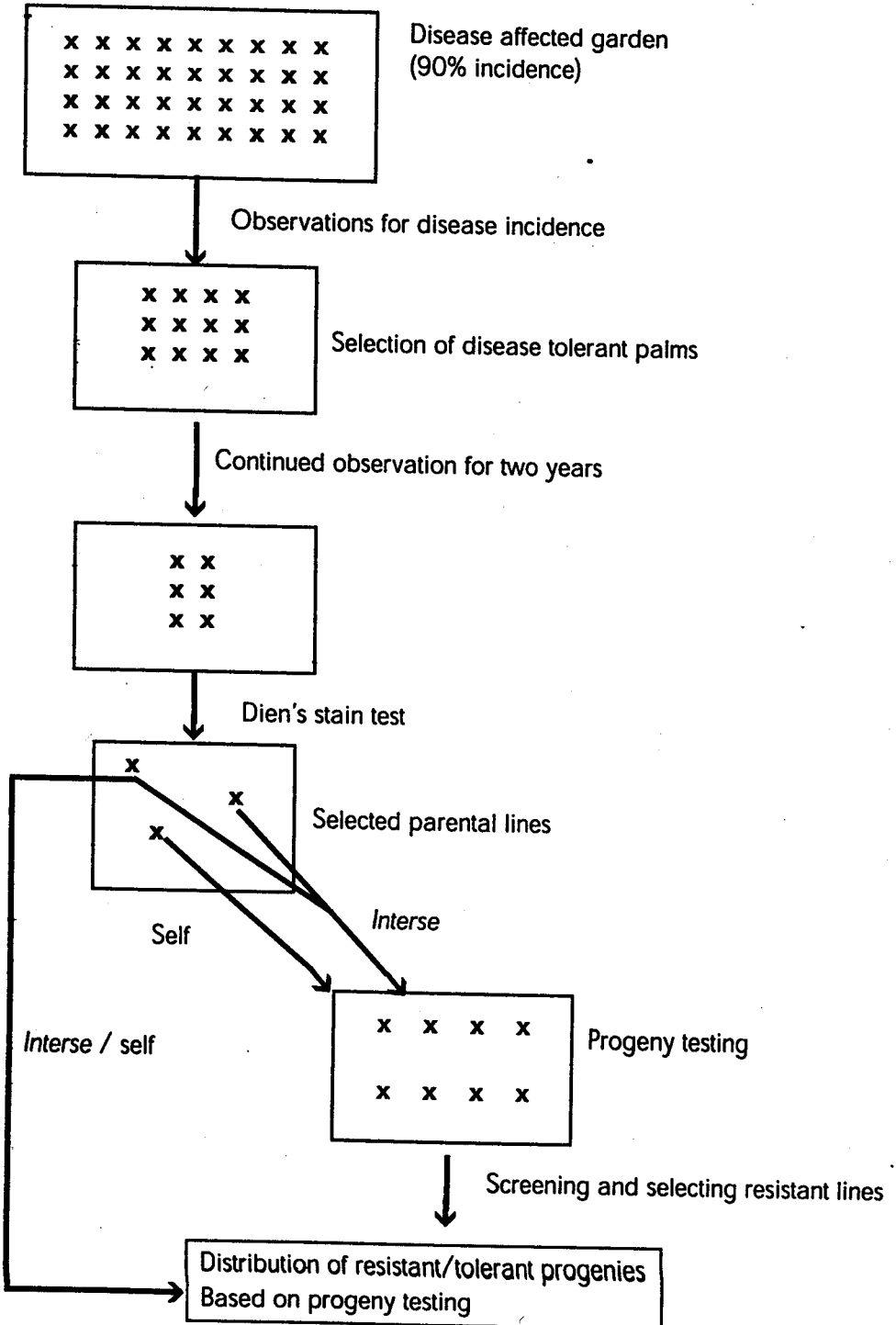
**Table 9. Details of 'hot spot' survey conducted in 13 districts of Kerala**

| District           | Year of Survey | No. gardens visited | Total no. of palms | No. of disease free palms | No. of tolerant palms identified |
|--------------------|----------------|---------------------|--------------------|---------------------------|----------------------------------|
| Thiruvananthapuram | 1985           | 28                  | 12,678             | 0                         | —                                |
| Kollam             | 1985           |                     |                    |                           |                                  |
| Pathinamthitta     | 1985           |                     |                    |                           |                                  |
| Kottayam           | 1986           | 13                  | 11,994             | 3                         | 1                                |
| Alappuzha          | 1986           | 7                   | 17,857             | 2                         | 0                                |
| Ernakulam          | 1986           | 29                  | 12,071             | 3                         | 0                                |
| Idukki             | 1986           | 20                  | 14,433             | 5                         | 0                                |
| Thrissur           | 1986           | 13                  | 11,310             | 11                        | 4                                |
| Palaghat           | 1986           | 11                  | 11,875             | 1                         | 0                                |
| Malappuram         | 1986           | 10                  | 8,967              | 0                         | 0                                |
| Kozhikode          | 1986           | 10                  | 8,950              | 36                        | 0                                |
| Wynad              | 1986           | 8                   | 9,615              | 0                         | 0                                |
| Kannur             | 1987           | 25                  | 13,000             | 9                         | 1                                |
| <b>Total</b>       |                | <b>174</b>          | <b>1,32,750</b>    | <b>70</b>                 | <b>6</b>                         |

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 middle of all other YLD affected palms, was also identified in the 'hot spots' of Ernakulam district 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. None of the palms exhibited any YLD symptom so far. All the 67 palms (52 palms of second generation and 15 disease escapes from Ernakulam and Thrissur districts) were subjected to histological staining using Diene's stain (Deelay *et al.*, 1979). Based on reaction to Diene's stain, the disease escapes identified in 'hot spots' were categorised into healthy and infected palms. The 10 YLD symptom free elite palms in Ernakulam district were negative in their reaction to Diene's stain. Out of the 5 palms identified in Thrissur district, one palm was negative to staining reaction. Among the 52 second generation YLD free palms in Ernakulam district, 33 palms exhibited negative reaction to Diene's stain. Of these 33 palms, 24 palms were identified and marked as elite palms based on yield evaluation. Thus, 34 palms in Ernakulam district and one palm in Thrissur district were selected as YLD free elite palms in Kerala state for production of seed nuts by selfing and *inter-se* mating. These palms would be monitored every year for disease expression and disease free palms will be confirmed by light microscopic technique.

Seedlings raised from open pollinated seed nuts of second generation YLD free elite palms identified in Ernakulam district are being evaluated for their reaction to YLD by interplanting them in arecanut gardens with more than 90 per cent of YLD affected palms. Selfing of inflorescences of these 24 second generation elite palms is also in progress. A schematic diagram depicting breeding for YLD tolerant arecanut palms is given in Fig. 1 (Chandra Mohanan and Nampoothiri, 2000).

**Fig. 1 Evolving YLD tolerant arecanut lines**



## Future strategy

Identification of disease resistant/tolerant palms and screening of these progenies should be a continuous process in the search for tolerant genotypes for YLD. As breeding for resistance in tree crops like arecanut is a slow process, early predictive tests for resistance are needed to accelerate the breeding process. Assessing resistance to YLD using biotechnological tools can be tried to shorten the breeding cycle. Screening the materials against the disease with dodder and insect vector and early disease detection aids using ELISA would accelerate the identification of resistance. PCR based molecular fingerprints can be exploited for determination of genetic diversity in arecanut germplasm and tagging resistant genes. Pathogen derived resistance mechanisms need to be employed to produce transgenics to resolve this stalemate.

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