

Note

Field resistance to lethal yellowing disease in some coconut varieties in Nigeria

J.O. Odewale¹, R.V. Nair² and Louis Enaberue³

Nigerian Institute for Oil Palm Research, P.M.B. 1030, Benin City, Nigeria

Lethal Yellowing Disease (LYD) is globally recognized as a serious threat to the cultivation of coconut. Planting of resistant varieties is the only practical solution for the management of this disease. The reaction to LYD in five coconut varieties, viz., West African Tall (WAT), Malayan Yellow Dwarf (MYD), Malayan Orange Dwarf (MOD), Chowghat Green Dwarf (CGD), and Malayan Green Dwarf (MGD) planted in the isolated coconut seed garden in NIFOR, Benin City, Nigeria, were evaluated under natural field conditions where the disease occurs in epidemic proportions. Observations on the incidence and intensity of LYD were recorded in April and November 2003. West African Tall had 86.0% disease incidence, followed by MYD (71.8%) and MOD (64.3%) during November 2003. All the palms of CGD and MGD were free from the disease, indicating that these two green dwarf varieties are highly resistant to the disease. Observations on the progression of disease during the interval of six months indicated that the disease progressed rapidly in all the susceptible varieties. Identification of the high resistance of CGD and MGD paves the way for the rehabilitation of the coconut industry in the disease-prevalent tracts of Nigeria, by undertaking large-scale replanting programmes using these green dwarf varieties of coconut. Resistance of green dwarf varieties of coconut to LYD in Nigeria is reported for the first time in this paper.

Keywords: Coconut; Lethal Yellowing Disease; Field resistance

In Nigeria, coconut cultivation is not widespread except in Lagos State. Vast scope exists for expanding coconut cultivation due to favourable agro-climatic conditions. Lethal Yellowing is a very serious disease of coconut in the Caribbean, Latin American, and African countries. In Nigeria, the disease was first noticed in 1917 in the Awka area of the then Eastern Nigeria, now known as Anambra State (Maramorosch, 1964). Since then, the disease has been contiguously spreading to other areas, resulting in drastic reduction in nut yield. The disease was earlier known as Awka wilt disease of coconut in Nigeria. Symptoms of this disease are similar to Lethal Yellowing Disease (LYD) as observed in the Caribbean and African

countries (Maramorosch, 1964). The disease is caused by phytoplasma and can be transmitted by insect vectors (Howard *et al.*, 1983).

Control measures such as cutting down affected palms has not been effective in checking its spread. The vast majority of the local West African Tall (WAT) palms have succumbed to the disease in the disease-prevalent coconut-growing regions of Nigeria. Palms belonging to the Chowghat Green Dwarf (CGD) and Malayan Green Dwarf (MGD) varieties of coconut were found to remain unaffected by the disease.

Experiences of other nations suggest that breeding for resistance is the only practical method for the management of phytoplasmal diseases in coconut (Steer, 1997; Nair *et al.*, 2000; Nair *et al.*, 2004). In regions where the disease is prevalent in epidemic proportions, any successful coconut variety must have the gene for resistance or tolerance. Incidences of LYD among different coconut varieties, planted in Field No. 42 (isolated coconut seed garden) in Nigerian Institute for Oil

¹Nigerian Institute for Oil Palm Research (NIFOR), Coconut Research Substation, Badagry, Lagos State, Nigeria

²Corresponding author: Central Plantation Crops Research Institute, Regional Station, Kayamkulam, Kerala - 690 533, India

³ NIFOR, Benin, Nigeria

Palm Research (NIFOR) Benin City, Nigeria, were evaluated and the results are presented in this paper.

Materials and Methods

Five coconut varieties, viz., WAT, Malayan Yellow Dwarf (MYD), Malayan Orange Dwarf (MOD), CGD (Indian), and MGD were planted in field No. 42 in the Main Station of NIFOR, Nigeria, in 1987 as an isolated seed garden to produce different types of Dwarf × Tall hybrids. The parent, WAT palms, were selected from palms that originated from the different coconut-growing geographical locations in Nigeria. These locations included areas where LYD has burnt out in the past. They were planted in rows at regular intervals between two rows of different varieties of dwarf. The dwarf varieties were planted in a mixed fashion with each row consisting of varying number of palms of different dwarf varieties. The varieties were identified by typical characteristics as described by Ratnambal *et al.* (1995). The palms were grown in a triangular spacing of 7.5 m × 7.5 m under prevailing cultural practices. The soil of the experimental field was of clayey loam with high soil fertility. The number of palms studied for each variety are given in Table 1.

Observations were done under natural conditions in the field where this disease occurs in epidemic proportions with more than 74% of the susceptible variety, viz., WAT showing symptoms at various levels of LYD.

Data regarding the incidence and intensity of the disease were recorded in April and November 2003. The percentage of disease incidence in November was calculated on the basis of the ratio of the number of diseased palms to the total number of trees planted. The intensity of symptoms on palms was determined using a disease index

scale from 0 to 5 to determine the progression of intensity of disease under conditions in Nigeria. The index scale follows:

0, No disease, healthy; 1, Premature nut fall, blackening of inflorescence: leaves still green; 2, Yellowing of leaves, less than half of the canopy leaves still green; 3, Most of the leaves yellow with few green leaves; 4, Total yellowing/bronze colour of all leaves; and 5, Wilting/decapitation.

Results and Discussion

The results suggest that the coconut varieties included in the study differ very significantly in their level of resistance. It also indicated the possibility of breeding for resistance to LYD in coconut.

Incidence of LYD among the five coconut varieties, as recorded in April and November 2003 are given in Table 1. During November 2003, WAT showed the highest percentage of disease incidence (86%), followed by MYD (71.8%) and MOD (63.8%). All the palms of MGD and CGD were free from any symptoms of LYD, indicating that these two varieties were highly resistant or practically immune to the disease. Absolute resistance of MGD and CGD to LYD in Nigeria is reported for the first time in this paper. Even though there were only 10 palms of MGD planted in the experiment, MGD, like other dwarf varieties observed in Nigeria, is considered to be relatively more homogeneous for various traits, (compared to WAT) since they are largely self-pollinated. Therefore, small population size need not be a limiting factor, especially viewed in the background of reported resistance of MGD to LYD in Ghana (Dery *et al.*, 1997). Harries *et al.* (1970–71) reported Malayan Dwarfs resistant to LYD in Jamaica. Bourdeix (1999) observed that a Sri Lankan Green Dwarf (SGD) reported from

Table 1 Percentage incidence of Lethal Yellowing Disease on coconut varieties between April and November 2003

Variety	Total no. of palms	No. of diseased palms		No. of healthy palms		Disease incidence (%)	
		Apr. 03	Nov. 03	Apr. 03	Nov. 03	Apr. 03	Nov. 03
WAT	400	296	344	104	56	74.0	86.0
MYD	444	275	319	169	125	61.9	71.8
MOD	138	69	88	69	50	50.0	63.8
MGD	10	0	0	10	10	0	0
CGD	86	0	0	86	86	0	0
Total	1078	640	751	438	327	0	0

WAT, West African Tall; MYD, Malayan Yellow Dwarf; MOD, Malayan Orange Dwarf; MGD, Malayan Green Dwarf; and CGD, Chowghat Green Dwarf

Ghana and a CGD appeared to be similar. It is quite possible that CGD reported from Nigeria in this study and SGD reported from Ghana, a neighbouring country, may be very similar.

The LYD re-entered the field in 2000–2001 and was very devastating because it was the second cycle of entry into the field. The intensity of disease among coconut varieties were also recorded at the seven-months interval between April and November 2003, to determine the progression of disease under conditions in Nigeria and the varietal response to the various stage of pathogenesis (Table 2). The progression of disease during the seven-months period from April to November was rapid in the case of all the three susceptible varieties, viz., WAT, MYD, and MGD (Figure 1). This rapid progression is characteristic of Lethal Yellowing. Similar results on disease progressions were also reported from studies on coconut varieties in Ghana (Dery *et al.*, 1997).

After several cycles of LYD outbreak, 8 out of a population of 684 WAT stood out as resistant to LYD. This will serve as the base population for breeding for resistance to LYD in Nigeria.

The MYD and MOD were found to be susceptible in this study, therefore, these two varieties cannot be used as cultivars in the disease prevalent tracts of Nigeria, because of the manner of spread and lethal nature of the disease. Vanuatu Tall (VTT) is reported to have high level of resistance to LYD in Ghana. Hybrids of MGD × VTT were also reported to be resistant to LYD. In Ghana, SGD, VTT, MYD × VTT, and SGD × VTT have been recommended for large-scale replanting to rehabilitate the coconut industry in Ghana (Dery *et al.*, 1997).

The resistance of MGD to LYD has been well proven in Jamaica, and hence it has been incorporated in the large-scale rehabilitation programme of the country (Steer, 1997). In Jamaica, where the disease ravaged the entire country especially since 1961, the coconut industry withstood and survived the onslaught of the disease mainly due to the extensive use of MGD seedlings. Malayan Green Dwarf is both highly resistant to LYD and precocious in terms of number of nuts, and thus out-yielded Jamaican Tall in total copra and oil yield per hectare with good quality of oil (Harries *et al.*, 1970–71).

Schuling *et al.* (1992) reported that all exotic varieties including Malayan Dwarfs which were resistant in Jamaica were susceptible in Tanzania. Kullaya *et al.* (1997) attributed this to differences in the strain of phytoplasma.

In India, CGD has been reported to be resistant to root (wilt) disease which is another phytoplasmal disease of coconut (Nair *et al.*, 2002). Hybrids of CGD with resistant West Coast Tall (WCT) palms, were found to be high-yielding and also tolerant to root (wilt) disease (CPCRI, 2003). Consequently efforts are underway for large-scale production of quality planting materials which are resistant or tolerant to root (wilt) disease in India (Nair *et al.*, 2001).

Osagie and Asemota (1997) reported that in Nigeria, Dwarf Green variety of coconut showed 38.3% LYD incidence from observation on varieties planted in the same field (No. 42) at NIFOR. But no mention was made of the specific name of Green Dwarf variety, MGD/CGD or another green dwarf variety, which showed that there may be lapses in the identification of dwarf varieties.

Table 2: Number of palms in different varieties under different levels of disease indices between April and November 2003

Variety	No. of palms under different disease indices												Total
	0 (Healthy)		1		2		3		4		5		
	Apr. 03	Nov. 03	Apr. 03	Nov. 03	Apr. 03	Nov. 03	Apr. 03	Nov. 03	Apr. 03	Nov. 03	Apr. 03	Nov. 03	
WAT	104	56	6	16	5	4	9	8	30	24	246	292	400
MYD	169	125	19	15	11	14	15	10	30	19	200	261	444
MOD	67	4	2	1	2	1	2	3	5	3	60	126	138
MGD	10	10	0	0	0	0	0	0	0	0	0	0	10
CGD	86	86	0	0	0	0	0	0	0	0	0	0	86

WAT, West African Tall; MYD, Malayan Yellow Dwarf; MOD, Malayan Orange Dwarf; MGD, Malayan Green Dwarf; and CGD, Chowghat Green Dwarf

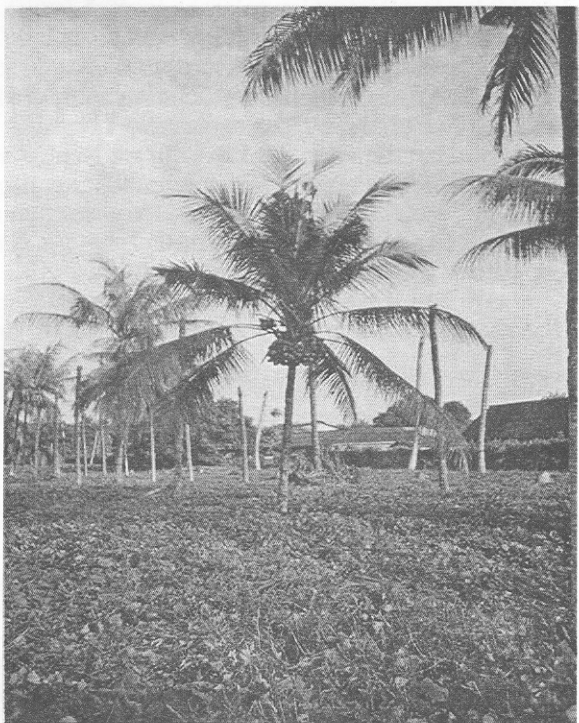
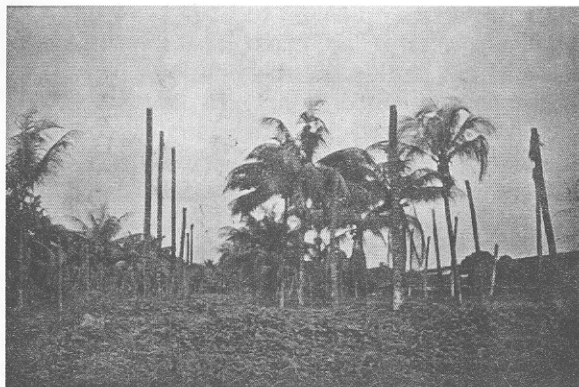


Figure 1 Photograph. 1, Coconut field at Nifor, Benin City, Nigeria affected by Lethal Yellowing Disease Photograph 2, Healthy palm of CGD variety in the midst of Lethal Yellowing Disease affected palms; Photograph 3, Healthy CGD palm in the midst of diseased palms

Studies by Nair (unpubl. data) confirmed the unaccuracy which was upheld by Osagie and Asemota (pers. commun., 2003).

Been (1981) suggested an influence of quantitative genes on the expression of the resistance trait. Harries (1995) suggested co-dominant locus (additive) with some minor modifier gene loci (polygenic) for resistance to LYD. Ashburner and Been (1997) estimated narrow-sense heritability between 0.72 and 0.79 for the resistance trait based on studies on the Jamaican population. High narrow-sense heritability suggested significant additive gene action governing expression of resistance to LYD.

In Nigeria, especially in the disease-prevalent areas, coconut is cultivated largely as a compound crop in homesteads. The MGD and CGD by virtue of their high yield in terms of total number of nuts, dwarf habit, early-bearing, and relatively smaller crown are very suitable to be planted as compound crop, even though they are deficient in certain characteristics such as short life span (40 years), small size of the nut, and the copra. Identification of high resistance of CGD and MGD opens possibilities for the rehabilitation of coconut industry in the disease-prevalent tracts in Nigeria. This finding will be complimented with the eight WAT found to be resistant to LYD in the field.

Acknowledgements

The authors thank Dr Umoru Omoti, Director, NIFOR, Benin City, Nigeria, for facilities, and Dr (Mrs) C.O. Okwuagwu, Head, Biology and Crop Production Department, NIFOR, Goddey Odiowaya (Research Officer 1), and Emmanuel Adeeyo (Agricultural Superintendent in charge of coconut in NIFOR) for their various contributions to the success of this investigation.

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