

YELLOW LEAF DISEASE OF ARECANUT : BIOLOGY OF FOLIAR YELLOWING

N. SRINIVASAN*

Plant Pathology Laboratory, Central Plantation Crops Research Institute, Regional Station, Vittal 574 243

ABSTRACT : In arecanut affected with yellow leaf disease, the contents of chlorophyll (chlorophyll *a*, *b* and total chlorophyll) in leaves were reduced. On the other hand the contents of carotene and xanthophyll were elevated in the infected palms. Consequent to serious derangements in the major plant pigments the foliar yellowing appeared and this symptom seems to be expressed systematically in diseased palms.

Keywords : Arecanut, Pigments, Symptoms, Yellow leaf disease

The yellow leaf of arecanut (*Areca catechu* L.) is a serious disease, prevalent in Kerala and Karnataka States of South India (Radha Menon, 1962). In infected palms foliar yellowing is the prominent/principal aerial symptom of the disease (Nayar and Seliskar, 1978; George *et al.*, 1980; Seliskar and Wilson, 1981). Since the yellowing of leaf in affected palms appeared due to pathological derangements (Srinivasan, 1982), the contents of plant pigments like chlorophyll, carotene and xanthophyll were estimated. The possible relationship of these pigments with the expression of foliar yellowing was assessed. The results of a comprehensive study are presented in this paper.

MATERIALS AND METHODS : In yellow leaf infected palms, the yellowing initially appears at tips of older leaflets, progresses towards midrib and appears later in younger leaves also. Therefore, typically diseased and healthy palms having comparable age and number of leaves were selected for the study. The chlorophyll contents (chlorophyll *a*, *b* and total chlorophyll) were estimated by the modified method of Smith and Benitez (1955). Two g of leaf material was homogenized with acetone in a glass mortar. The supernatant was decanted through Whatman No. 42 filter paper. The chlorophyll in residue was completely extracted with 80 per cent acetone. The filtrate was collected in 100 ml volumetric flask and the volume was made up with 80 per cent acetone. From this solution 5 ml was pipetted into a 50 ml volumetric flask and the volume was made up with 80 per cent acetone. The optical density (OD) of the chlorophyll extract was measured in a ECIL spectrophotometer at 645, 663 and 652 nm against 80 per cent acetone solvent blank. The amount of chlorophyll present (mg/g) in the extract was calculated according to the following equations :

Chlorophyll *a* : $12.7 \text{ (OD at 663 nm)} - 2.69 \text{ (OD at 645 nm)}$

$$\times \frac{50}{1000} \times \frac{100}{5} \times \frac{1}{2}$$

*Present address : Central Plantation Crops Research Institute, Regional Station, Kayangulam, Krishnapuram, Kerala 690 533.

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Chlorophyll *b* : 22.9 (OD at 645 nm)—4.68 (OD at 663 nm)

$$\times \frac{50}{1000} \times \frac{100}{5} \times \frac{1}{2}$$

Total chlorophyll : $\frac{\text{OD at 652 nm}}{34.5} \times \frac{50}{1000} \times \frac{100}{5} \times \frac{1}{2}$

Xanthophyll and carotene were estimated by following the method of Snell and Snell (1937). Three healthy and 3 diseased palms were analyzed independently at the rate of 8 leaves (youngest through oldest) per palm. The content of all the pigments was calculated and presented in mg/g of leaf sample and the data was analyzed appropriately. The quantity of pigments in all the leaves of infected palms was critically compared with appropriate healthy leaves and their possible relation in expression of foliar yellowing was assessed.

RESULTS : Leaves from yellow leaf infected palms showed decreased chlorophyll contents with elevated levels of carotene and Xanthophyll (Fig. 1).

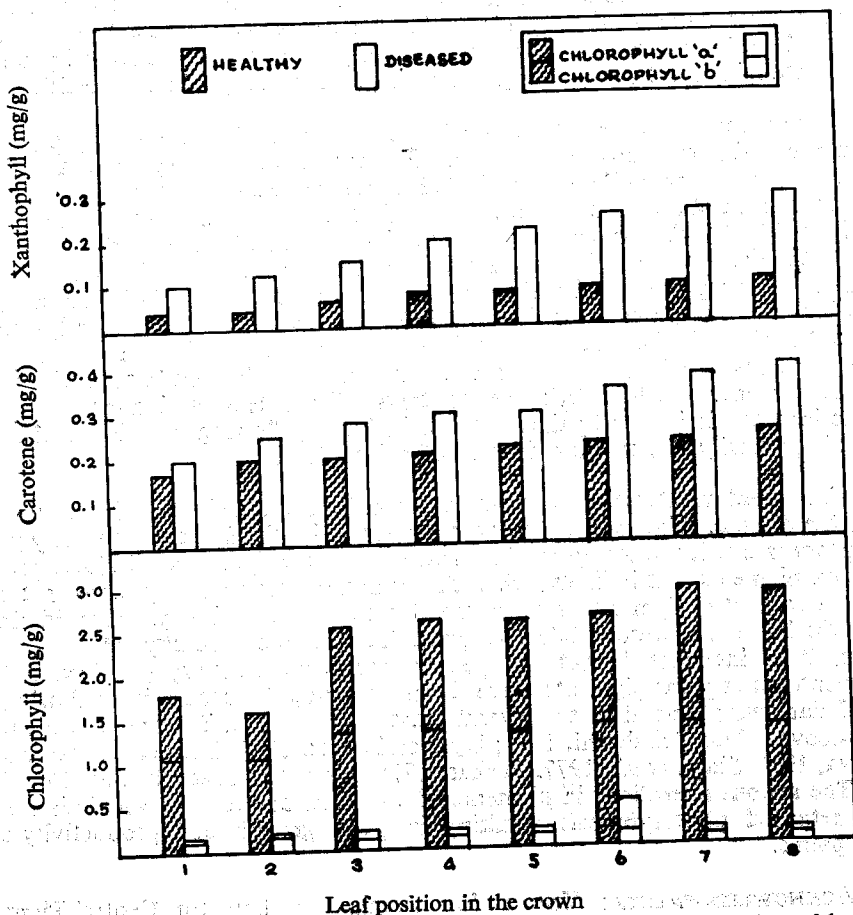


Fig. 1. Contents of pigments in different leaves (youngest through oldest) in crown of healthy and yellow leaf disease infected arecanut palms (mg/g).

Chlorophyll : In all leaves of severely infected palm the contents of chlorophyll *a*, *b* and total chlorophyll were less than in healthy palms. The reduction was relatively higher in older leaves as compared to younger ones. The greatest reduction of chlorophyll *a* (89.22 per cent), chlorophyll *b* (89.38 per cent), and total chlorophyll (89.29 per cent) was in the oldest leaf. The total chlorophyll in the infected palm was found destroyed on an average of 83.67 per cent. The diseased palm had a mean of 15.58 per cent chlorophyll *a* and 18.09 per cent chlorophyll *b* only that of healthy palm. It indicates the serious effect of the disease on the components of chlorophyll.

Carotene : In infected palm leaves the carotene content was higher than in comparable healthy leaves. The per cent increase was maximum in older leaves (as high as 65.22 per cent) but least in youngest leaf (17.65 per cent). Such increase in general, was related with oldness of leaves. The diseased palm showed a mean carotene content of 0.31 mg/g of leaf as compared to 0.21 mg/g in healthy revealing an increase of 47.62 per cent due to the disease.

Xanthophyll : In infected palm leaves the xanthophyll content was also higher than that in comparable healthy leaves. Such increase was greatest in oldest leaf (190%) and least increase in youngest leaf (150 per cent). The diseased palm on an average contained 185.71 per cent higher xanthophyll in comparison to healthy palm.

DISCUSSION : The results revealed that changes took place among pigments in arecanut leaves due to yellow leaf disease. Foliar yellowing is reported as principal symptom of the disease (George *et al.*, 1980) and the discolouration appear in leaves progressively from oldest through youngest leaf (Nayar and Seliskar, 1978; Seliskar and Wilson, 1981). The present investigation has furnished evidence that leaf yellowing due to the disease results in serious alterations in contents of major plant pigments. Srinivasan (1982) reported earlier a general decline of total chlorophyll in consequence to pathological derangement in yellow leaf infected palms. The present study established that both chlorophyll *a* and *b* were reduced in all the diseased palm leaves exhibiting severe yellow leaf symptom with a concomitant reduction in total chlorophyll. Unlike the contents of chlorophyll, the contents of carotene and xanthophyll were found to increase in infected palms. As such, foliar yellowing in yellow leaf infected arecanut is primarily due to the reduction of chlorophyll.

The greatest alterations of pigments in older leaves might be due to the direct effect of the disease. This point of view is supported by the fact that the early yellowing symptom is usually observed in older leaves there the disease would have protracted effect on pigments. It is likely, when the symptom progressively appear through younger leaves, the pigments in them are also altered accordingly. Considering the fact that the leaves in severely infected palm had altered quantity of major plant pigments, it is interpreted that the yellow leaf symptom is expressed systemically. Altered contents of plant pigments have been reported to result in yellowing and related foliar symptoms due to several plant diseases (e.g., Paulech and Haspelova Horvatovicova, 1970; Takahashi, 1971; Dyer and Scott, 1972; Haspel-Horvatovic and Horickova, 1975; Singh *et al.*, 1977; Farkas, 1978; Haspel-Horvatovic and Horickova, 1981). The serious alterations in pigments of arecanut, due to yellow leaf disease may lead to retarded photosynthesis resulting in poor growth and productivity of the diseased palms.

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