H\textsuperscript{+}-ATPase as a biochemical marker for early detection of root (wilt) disease in coconut palms (Cocos nucifera L)

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H\textsuperscript{+}-ATPase activity in leaves and roots of coconut palms growing in 'root wilt disease-prevalent areas' was compared with that of coconut palms growing in 'disease-free areas'. The activity was found to be significantly less in the leaves and roots of palms in the disease-prevalent zone as compared to that in disease-free zone. Histochemical examination of the leaves showed results that corroborated the biochemical findings. The possible application of H\textsuperscript{+}-ATPase activity as a marker for the early detection of wilt disease in coconut palms is suggested.

Root (wilt) disease of coconut palm has been a puzzling problem of coconut growers of Kerala\textsuperscript{1}. Detection of resistant coconut palms from diseased area and application of specific control measures are two major issues faced by the farmers. In root (wilt) affected areas, the diseased palms show a centrifugal appearance of visual symptoms like ribbing, yellowing and marginal necrosis from the inner whorl of the crown foliage\textsuperscript{2}. Palms lacking any visual symptoms and yet carrying the disease are often unevenly distributed in the diseased pockets and neighbouring areas. Efforts for an early diagnosis of the disease in such palms has been a subject of investigation for a long time\textsuperscript{3,4}. The present study was undertaken to quantify the activity of H\textsuperscript{+}-ATPase, in leaf and root tissues of coconut palms in disease prevalent and disease free areas for possible application in field for early detection of root (wilt) disease.

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diseased palms, the terminal portion of the root showed disorganised irregular rough surface with electron dense regions (Fig. 2(a), (b)). The internal cells exhibited a disintegrated pattern without conspicuous cell boundary. Root tissues of healthy palms displayed a normal smooth surface with intact internal cells indicating the absorptive nature (Fig. 2(c), (d)). Fig. 3(a) shows the occurrence of opened stomata in leaf samples of diseased palms collected at night against the closed stomata in healthy leaf Fig. 3(b). The role of H⁺-ATPase in regulating the swelling and shrinkage of guard cells leading to the opening and closure of stomata are well understood. The observed opened stomata in leaf samples of diseased palms indicate the possible failure or lack of H⁺-ATPase in leaf system. Histopathological studies on roots and stomata in leaf samples of diseased palms were reported earlier. However, SEM observations on disorganised root surface and abnormal stomatal nature in leaf samples of diseased palms have not been reported before.

Fig. 4(a) shows the distribution of H⁺-ATPase activity in tender, mature and old leaves collected from inner, middle and outer whorls of healthy and diseased palms. In healthy palms, a gradual reduction of H⁺-ATPase activity was noticed depending on the physiological maturity of the leaf. Marked depletion in H⁺-ATPase activity was seen in leaf samples of diseased palms when compared to healthy palms characterized by a sharp decline from tender to mature leaves and slowing down to minimum level in the old leaves. Gradual reduction of H⁺-ATPase from tender to old leaf in healthy palms shows the physiological activeness of tender leaf. A sharp decrease in activity of H⁺-ATPase from tender to peripheral leaf is possibly due to impaired metabolism.
Fig. 2—SEM micrograph of root tip of diseased palm; (a): surface view; (b): sectional view; (c): root tip of healthy palm-surface view; (d): sectional view.

Fig. 4—Distribution of H⁺-ATPase activity (units/g tissue) (a): in leaf samples of healthy (H) and diseased (D) palms; (b): in root samples of healthy (H) and diseased (D) palms; (c): in leaf samples of healthy (H), apparently healthy (AH) and diseased (D) palms.

H⁺-ATPase activity of leaf samples of coconut palms distributed in disease prevalent and disease free areas are shown in Fig.4(c). The palms of diseased area are categorised into two—palm with visual symptoms of disease and apparently healthy palms. H⁺-ATPase activity of each palm is the mean value of
tender, mature and old leaf samples. Large variation in activity of H+-ATPase (50 to 65%) was noticed between palms of diseased and disease free areas. Moreover, H+-ATPase activity varied in healthy and apparently healthy palms suggesting that even in the absence of visual symptoms of the disease those palms may be susceptible to the disease. Thus H+-ATPase activity may serve as a useful parameter for distinguishing apparently healthy palms and palms in the early phase of the root (wilt) disease.

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References
7. Falk RH (1980) Scanning Electron Microscopy pp 79-87, SEM Inc AMFO'Hare (Chicago) II 6066 USA