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Electron microprobe X-ray microanalysis of diseased coconut (*Cocos nucifera*) roots

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Key words XMA localization

Summary Electron microprobe X-ray analysis of root (wilt) diseased and healthy coconut roots were scanned for the deposition of metal ions to implicate the involvement of these metal toxicity in the root (wilt) disease of coconut. The results indicated that a high concentration of Al, Mn, Cu and Co ions localised in the disease roots compared to healthy palms. The chemical analysis of tissue samples and soils also confirmed the results of XMA.

Introduction

The root (wilt) disease in coconut is causing a serious concern to the researchers to identify the actual causal factors. Radha and Lal[9] described the diagnostic symptom of this disease as flaccid nature of the leaflets along with foliar yellowing and marginal necrosis. This is also associated with spindle rotting and root decay. The involvement of biotic factors such as fungus[12], enterobacter[8], virus[11], nematodes[7] has been implicated in the incidence of root (wilt) disease of coconut which needs further confirmation. Since the disease is of debilitative nature, the involvement of some chemical factors in the expression of root (wilt) disease has been suspected. Thus, the use of XMA technique has been employed in the present study.

Biddappa *et al.*[1,2] studied the mode of entry and localisation of Cd and Pb in rice roots by this technique. Chino[3], Chino and Hidaka[4], and Chino and Baba[5] had demonstrated the wider applicability of this technique in soil and plant research.

The present paper aims to demonstrate the utility of XMA technique in studying the localization and metal toxicity of root (wilt) diseased coconut palms.

Materials and methods

Representative coconut roots were collected from healthy and root (wilt) diseased palms at CPCRI farm for this study. Thin sections were prepared from the root tissues just 1 cm above the growing point, which were subsequently chilled under liquid nitrogen. The root sections were mounted on prechilled SEM grids for XMA analysis. The analysis was carried out by employing SEM model JEOL 35. The topography of specimen was observed through secondary electron image with an accelerating voltage of 25 KV attached with an energy dispersive X-ray detector. The selected area of root was irradiated with an electron beam and the intensity of the characteristic X-ray generated from the metals were integrated and detected. The diacid (nitric:perchloric acid) digested leaf tissues and DTPA and HNO_3 extractable soil metals were also estimated.

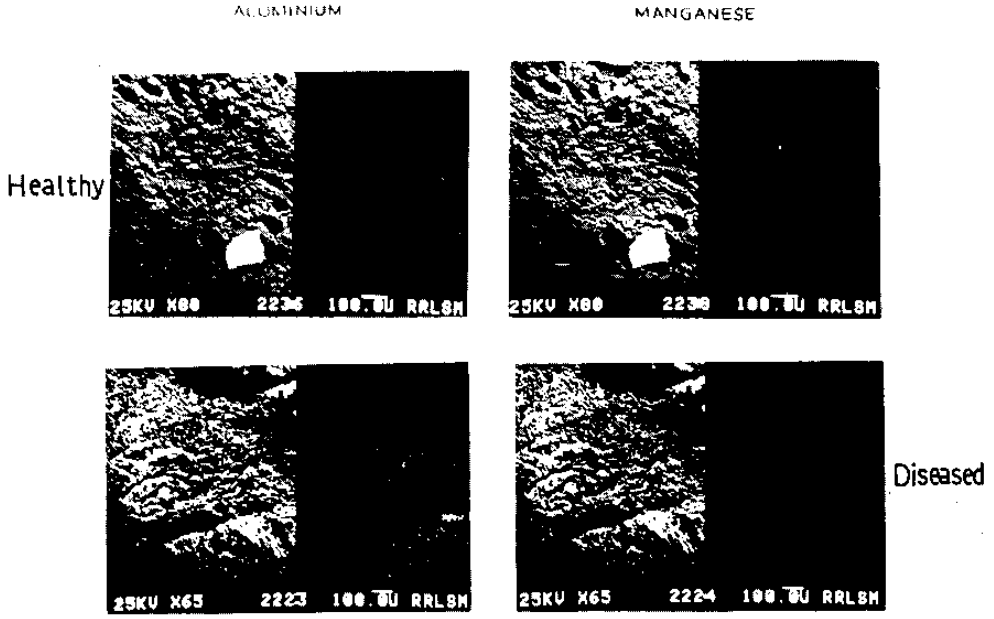

Fig. 1. Localisation of aluminium and manganese.

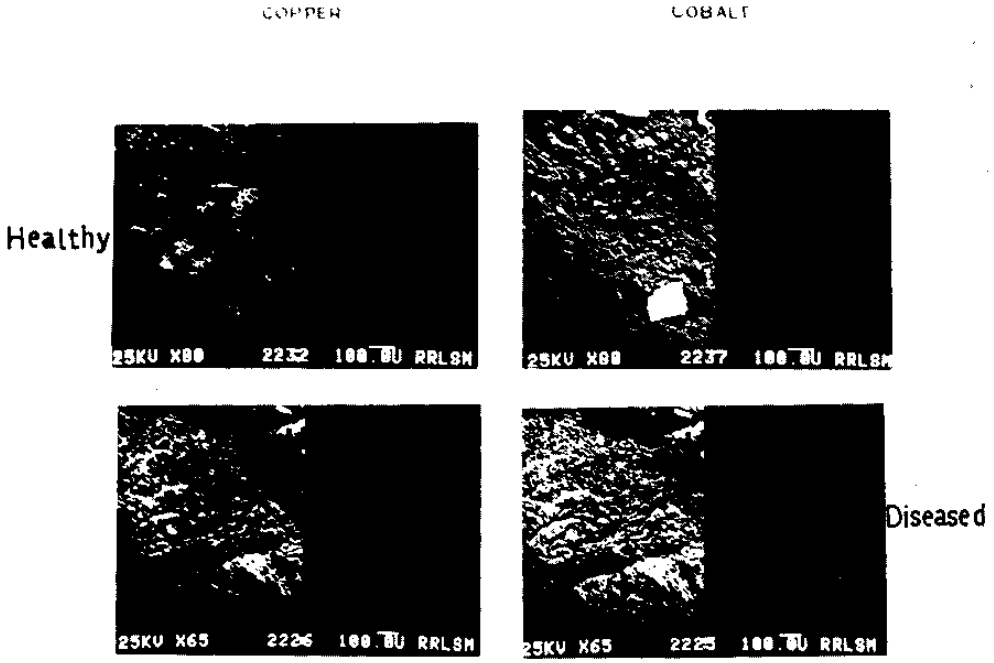

Fig. 2. Localisation of copper and cobalt.

Results and discussion

Fig. 1 shows the relative intensity of Al deposition in deased and healthy roots. The deposition intensity of Al was marked in the diseased roots. A similar finding was also reported by Rasmussen[10] where he demonstrated the Al deposition in maize roots by this technique. The localisation of Mn, Cu and Co also followed similar trend as that of Al (Fig. 2).

All the metals under investigation in the present study showed more localization in the

Table 1. Content of Al, Mn, Cu and Co in the sandy soil collected from healthy and diseased palms (ppm)

Depth	Extraction	Condition	Al	Mn	Cu	Co
0–50	DTPA	H	55	1.80	0.66	0.11
		D	60	2.90	0.91	0.09
	HNO_3	H	108	1.85	2.83	0.135
		D	206	6.22	1.14	0.093
		H	48	1.32	0.63	0.113
50–100	DTPA	D	69	0.56	1.28	0.048
		H	91	1.23	2.89	0.16
	HNO_3	D	172	1.04	1.28	0.060

Table 2. Concentration Al, Mn, Cu and Co in the 9th and 14th leaves of coconut sampled from healthy and diseased palms (μg/g)

	9th		14th	
Elements	H	D	H	D
Al	178.00	107.00	405.00	116.00
Nn	238.00	147.00	278.00	192.00
Cu	20.70	10.00	19.30	7.30
Co	4.00	0.80	4.60	0.80

diseased roots than the healthy ones. This suggests, probably, the impeded translocation of these metals from the roots to the leaves due to some metabolic alterations. Since the vascular browning is the common phenomenon of root (wilt) diseased palms[6], the normal translocation properties of vascular bundles might have been affected.

The chemical analysis of soils and tissue samples (Tables 1 and 2) also support the XMA findings. The concentration of DTPA and HNO_3 extractable metal ions from the soils collected from diseased palms was generally higher than that of healthy ones. A reverse trend was noticed in the concentrations of these metals in the leaf tissues wherein the diseased palm recorded a low concentration of all metal ions. This also supports the impeded translocation of these metals from the root to the leaf tissues.

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