IDENTIFICATION OF HEAVY METAL DEPOSIT IN THE CABBAGE TISSUES OF DISEASED COCONUT PALMS (*COCOS NUCIFERA* L.) BY USING ELECTRON MICROPROBE X-RAY MICRO-ANALYSER

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ABSTRACT

The deposition of Cr, Ti, Cu, Pb, Bi and Ga in the cabbage tissue of root (wilt) diseased coconut palms were investigated by employing scanning electron x-ray microprobe analyser. The x-ray oscillogram and back scattered electron image of specimen indicated the high deposition of Cr, Ti, Cu, Pb, Bi and Ga in the cabbage of diseased palms which were absent in the healthy ones. This was also confirmed in the chemical analysis of a large number of tissue and soil samples under identical conditions.

INTRODUCTION

VARIOUS biotic factors such as fungi[1], bacteria[2,3], nematodes[4], etc are implicated in the incidence of root (wilt) disease of coconut, which are still to be confirmed. Recently, metal deposit in the roots of the diseased coconut palms has also been studied by using X-MA technique[5]. This technique has been successfully employed in studying the mode of entry and localisation of different heavy metals in the rice crops[6-10]. Rasmussen[11] and Libanati and Tandler[12] observed the deposition of phosphate by aluminium and lead respectively.

The present investigation was undertaken to elucidate the deposition of heavy metals in the cabbage tissues of root (wilt) diseased coconut palms by using X-MA technique.

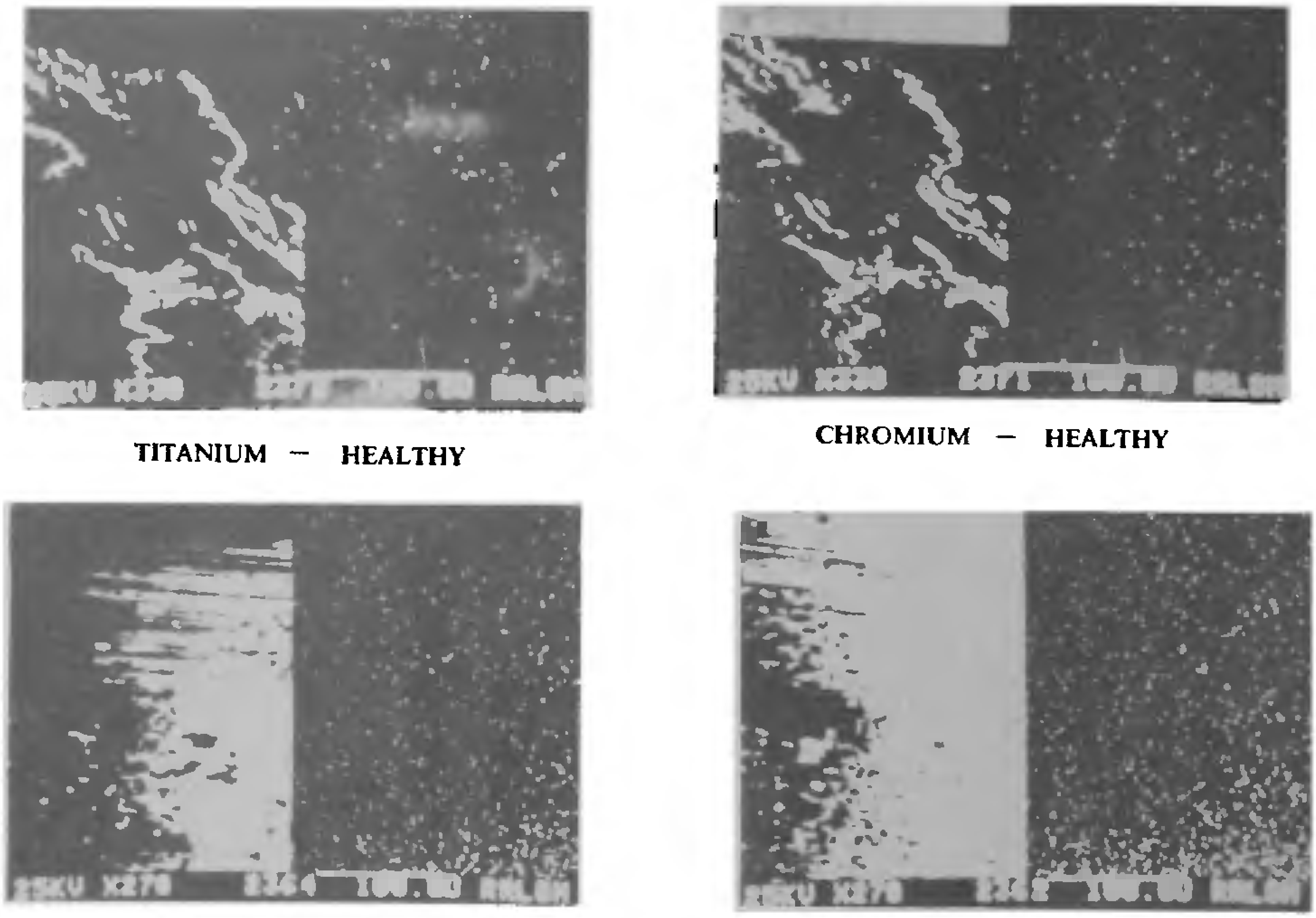
MATERIALS AND METHODS

Cabbage tissues (young meristematic) have been collected from healthy and root (wilt) diseased coconut seedlings for this study. The tissue samples were chilled and thin sections were prepared. The tissue sections were mounted on pre-cooled electron microscope grids and further chilled immediately in liquid nitrogen at $-170°C$ before X-MA analysis. The electron microprobe analysis was carried out in SEM model JEOL 35. The topography of specimen was observed through secondary electron image with accelerating voltage of 25 KV attached with energy dispersive x-ray detector. The selected area was irradiated with an electron beam and the intensity of the characteristic x-ray generated from each metal was integrated and detected. The soil was extracted with DTPA, and 0.1 N HNO_3 and the cabbage tissue samples were digested in a di-acid mixture ($HNO_3 + HClO_4$). The heavy metals in the extract and digest were estimated using atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Results pertaining to the back scattered electron image and x-ray oscillogram for Cr, Ti, Cu, Pb, Mn, Bi and Ga in the cabbage tissue of diseased palms have been illustrated in figures 1 and 2. The X-MA photograph presented in figure 1 reveals the dense distribution of x-ray in the diseased cabbage tissue compared to the healthy suggesting a higher concentration of Cr in the diseased tissue. The intensity of x-ray oscillogram for Ti in the diseased (figure 1) cabbage tissue is far greater than the healthy revealing the accumulation of Ti in the diseased palms. Similar results were also recorded for Pb, Bi, Ga, Mn and Cu where the contents in the diseased tissues were high while the same could not be detected in the healthy cabbage (plants). Though Cu is one of the essential micronutrients for coconut, its concentration in the cabbage tissue of healthy palm was in the range of non detectable range whereas the diseased tissue showed high x-ray intensity for Cu suggesting that Cu is also being accumulated in large amounts under diseased conditions.

Further, the chemical analysis of soil and tissue samples from diseased and healthy palms also revealed a similar phenomenon. The results furnished in table 1 show the contents of heavy metals at two depths of soils collected from healthy and diseased palms. The HNO_3 soluble fraction of Bi, Cr, Pb and Ga was high in the diseased soils while that of Cu and Ti showed a



TITANIUM — HEALTHY

CHROMIUM — HEALTHY

TITANIUM — DISEASED

CHROMIUM — DISEASED

Figure 1. Deposition of titanium and chromium.

Table 1 *Concentration of heavy metals in soils* ($\mu g/g$)

Extractant	Depths (cm)		Elements					
			Cu	Bi	Cr	Pb	Ti	Ga
0.1N HNO_3	0–50	H	2.80	0.17	0.16	0.51	0.21	tr
		D	1.14	0.19	0.19	1.30	0.15	tr
	50–100	H	2.90	0.15	0.15	0.65	0.20	tr
		D	1.28	0.82	0.15	0.03	1.00	0.12
0.005M DTPA	0–50	H	0.66	tr	0.13	0.14	0.33	0.22
		D	0.91	tr	0.05	1.52	tr	0.45
	50–100	H	0.63	tr	0.10	0.40	0.22	0.51
		D	1.28	tr	0.05	1.01	tr	0.35

(H = Healthy; D = Diseased)

reverse trend. On the other hand, the DTPA extractable Cu, Pb and Ga were high for the diseased soils. However, Bi was not detected in the DTPA extract of the soils at both the depths. The results of heavy metal concentration in the leaves (table 2) showed a significant difference between the diseased and healthy palms. The content of all the heavy metals is higher in the diseased tissue compared to the healthy palms. The

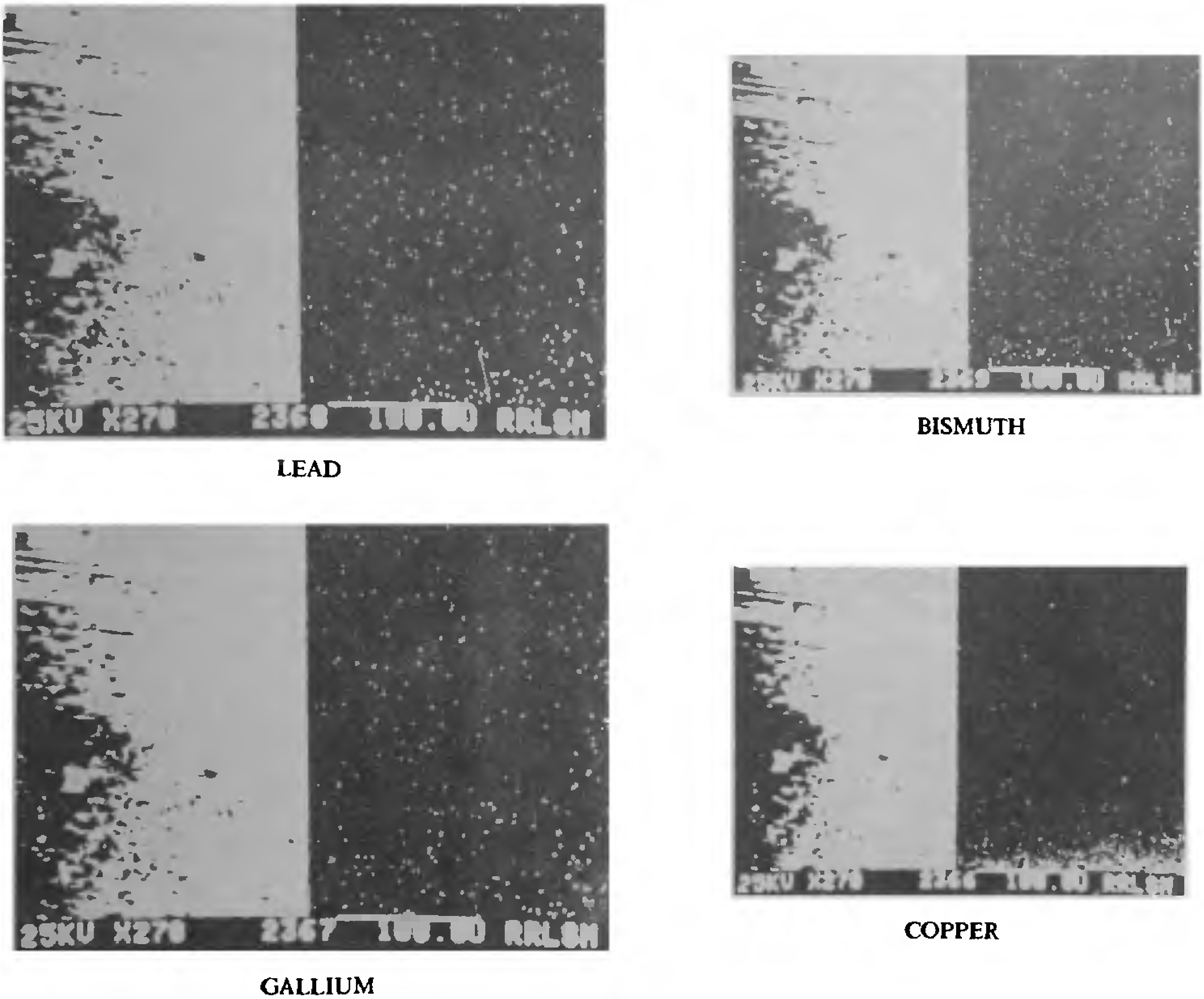


Figure 2. Deposition of lead, bismuth, gallium and copper in diseased tissues only.

Table 2 *Heavy metals concentration in cabbage tissue* ($\mu g/g$)

	Cu	Bi	Cr	Pb	Ti	Ga
H	21	7	6	tr	12	10
D	20	19	34	2.8	17	29

(H = Healthy; D = Diseased)

differences are more pronounced with respect to Bi, Cr, Pb and Ga. This strongly supports the findings of X-MA results where high concentration of localisation of Cu, Bi, Cr, Pb, Ti and Ga in the cabbage tissues of the diseased palms have been detected.

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1. Thomas, J., *Curr. Sci.*, 1978, **47**, 586.
2. Mathew, G., Potty, V. P. and Jayasankar, N. P., *Curr. Sci.*, 1976, **45**, 677.
3. Srivatsava, D. N., Shekhawat, G. S. and Rao, Y. P., *Indian J. Agric. Sci.*, 1969, **39(A)**, 395.

4. Khan, E., Seshadri, A. R., Welsher, B. and Mathen, K., *Indian J. Nematol.*, 1971, **1**, 116.
5. Biddappa, C. C. and Cecil, S. R., *Plant Soil*. 1984, **79**, 445.
6. Biddappa, C. C., Chino, M. and Kumazawa, K., *Oryza*, 1981, **18**, 1.
7. Biddappa, C. C. and Chino, M., *Soil Sci. Plant Nutri.*, 1981, **27**, 93.
8. Chino, M., *Jaro*, 1977, **11**, 129.
9. Chino, M. and Hidaka, H., *Soil Sci. Plant Nutri.*, 1977, **23**, 195.
10. Chino, M. and Baba, A., *Soil Sci. Plant Nutri.*, 1976, **22**, 445.
11. Rasmussen, H. P., *Planta (Berl)*, 1968, **81**, 28.
12. Libanati, O. M. and Tandler, C. J., *J. Cell Biol.*, 1969, **42**, 754.

NEWS

PAPER-THIN BATTERY

. . . "Matsushita Electric Industrial Co. [Japan] recently made a battery as thin as a postage stamp, and roughly the same dimensions, that could power a microchip *inside* a credit card for up to five years. The slim cell is part of a rapidly emerging class of batteries that use lithium as a main ingredient—and is slowly ushering in one of the biggest technological changes in the staid field this century. Smaller, lighter, and longer-lasting than many conventional batteries, Lilliputian lithium cells are being used in such things as watches, cameras, and computers. Now rechargeable versions are being developed that, enthusiasts claim, might make your 'dustbuster,' flashlight, or power tools whine and shine longer between 'boosts.'"

[(Scott Armstrong in *Christian Science Monitor* 26 Feb 85, p. 21-2). Reproduced with permission from Press Digest, *Current Contents*®, No. 17, April 29, 1985, p. 7 (Published by the Institute for Scientific Information®, Philadelphia, PA, USA.)]

WHAT HUMANS CAN LEARN FROM OTHER PRIMATES

. . . "Roger Fouts [Central Washington U. (CWU), Ellensburg] is an expert on the communications and interpersonal behavior of chimpanzees. At a laboratory in the CWU psychology building, Fouts conducts what he calls 'observational, noninvasive' research with five chimps, watching what they do with sign language. [I] first heard of Fouts because of publicity he received working as consultant on the film 'Greystoke: The Legend of Tarzan, Lord of the Apes.' 'He was hired . . . to help the actors learn to act like apes. [I was] intrigued by the idea that humans might learn something about their own emotional and interpersonal processes through observing, imitating, and working with the Greystoke actors, we were just tapping into an element that was there and teaching them to express what I think we all feel. By getting into the ape characters the actors lost some of their human English cultural overlay that has a taboo against the overt expression of aggression. We humans accept subtle aggression much more readily than we accept obvious aggression. It hits verbal before it goes to the physical. . . . At one level that's good and at another level, if taken too far, it's bad. We do need control. And even the chimpanzees have rules. But they are different. It may sound like one of them is going to get killed—running around, screaming, hitting, pulling, poking, biting. But the most that will happen is a fingernail will get lost or a piece of ear will get chewed. Nobody gets killed.'"

[(Stephen Kelso (State of Washington Dept. of Social & Health Services) in *Public Welfare* 43(1): 33-8, Winter 85) Reproduced with permission from Press Digest, *Current Contents*®, No. 12, March 25, 1985, p. 19, (Published by the Institute for Scientific Information®, Philadelphia, PA, USA.)]