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MINERAL COMPOSITION OF COCONUT LEAVES IN RELATION TO ROOT (WILT) DISEASE*

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ABSTRACT

The major nutrient composition of coconut leaves from healthy and root (wilt) affected palms was studied and the role of major nutrients and their balance on the incidence of disease was evaluated. The N, P, and K content did not differ between healthy and diseased palms. The Ca and Mg content of healthy palms were significantly higher than those of apparently healthy or diseased palms. Evaluation of nutrient element balance indicated that the palms in the root (wilt) affected areas are in a state of unbalanced nutrition.

INTRODUCTION

THE root (wilt) disease of the coconut palm in Kerala State (India) is believed to have made its appearance nearly a century ago in isolated pockets in south central Kerala and to have accentuated after the great floods of 1882 when the land was under water and remained waterlogged for a considerable period (Verghese, 1959). Since then, the disease has been spreading slowly in all directions, and, at present, more than 2,50,000 ha of coconut plantations in Kerala are estimated to be affected by this disease. The disease occurs on all types of soil, but the rate of spread is higher in sandy, sandy loam, and reclaimed marshy soils of the low lying areas as compared to upland regions with laterite soil (Gopinathan Pillai, Lal, and Shanta, 1973). The disease is reported to be pathogenic, but its etiology is still unknown. The symptoms are complex and variable. Among the various symptoms, foliar yellowing is considered as 1 delayed expression of nutrient deficiency Radha and Lal, 1972). The nutrition of the palm appears to have much influence on the susceptibility to the disease (Robert Cecil, (969). The major nutrient composition of leaves from healthy and root (wilt) affected palms is reported in this paper.

MATERIALS AND METHODS

Five middle-aged palms, having nearly identical vegetative growth and yield and growing under similar conditions, were selected as a sampling unit for collecting leaf samples. Ten median leaflets from the 14th leaf of each of the five palms were collected and all the 50 leaflets thus obtained were made into one composite sample. The procedure used was that of Ziller and Prevot (1961). Such 12 composite samples were collected from each of the following categories of palms : (1) Healthy palms from healthy areas—designated 'healthy' palms here ; (2) Healthy palms from root (wilt) affected gardens—designated 'apparently healthy' palms here ; and (3) Root (wilt) affected palms in the early stage of disease—designated 'diseased' palms here.

The samples were analysed for N, P, K, Ca, and Mg. Kjeldahl method was employed for the estimation of N, P and Ca were estimated volumetrically as ammonium phosphomolybdate and calcium oxalate, respectively (AOAC, 1955), after dry ashing. The gravimetric cobalti-nitrite method (Piper, 1966) was used for the estimation of K. Mg was estimated by the volumetric method of Handy (cf., Wright, 1939).

RESULTS AND DISCUSSION

The data relating to the concentrations of nutrient elements (milli-equivalents/100 g dry matter) and nutrient ratios of the leaf samples from all the three categories of palms were analysed statistically. The results are presented in Tables I and II.

The N, P, and K contents did not differ significantly among the three categories of palms (Table I). Soil analytical studies

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TABLE I

Nutrient composition of leaf samples from healthy and root (wilt) affected palms (Results expressed as m.e./100 g dry matter)

Nutrient elements	Means			SE	Significance	CD at 5%	Conclusion
	Healthy (T_1)	Apparently healthy (T_2)	Diseased (T_3)				
N	137·95	138·41	128·09	3·834	N.S.	..	..
P	6·411	7·146	6·917	0·621	N.S.	..	..
K	31·523	28·817	34·013	3·091	N.S.	..	..
Ca	23·943	18·473	15·611	1·300	S**	3·757	T_1. $\overline{T_2 . T_3}$
Mg	24·039	14·447	9·734	1·358	S**	3·925	T_1, T_2, T_3
N+P	144·36	145·57	135·03	3·878	N.S.	..	..
K+Ca+Mg	79·51	61·76	59·36	3·020	S**	8·73	T_1, $\overline{T_2, T_3}$

S**—Significant at 1% level.

conducted so far have not also shown any real differences between the N, P, and K contents of soils from healthy and root (wilt) affected areas (Sankarasubramoney, Pandalai, and Menon, 1954, 1955, 1956 ; Annual Report, CCRS, Kayangulam, 1963). Continued applications of N (upto 1·362 kg N/tree/year), P (upto 0·908 kg P_2O_5/tree/year), and K (upto 2·724 kg K_2O/tree/year) in factorial combinations were not effective either in curing the diseased conditions of adult palms or in preventing fresh incidence on young healthy palms (Cecil, unpublished data). Hence, it is inferred that deficiency of N, P, or K is not associated with the incidence of root (wilt) disease of the coconut palm.

The Ca and Mg contents of healthy palms were significantly higher than those of apparently healthy and diseased palms (Table I). Compared to the critical levels of IRHO standards (Ca—0·5% ; Mg—0·3%, i.e., 25 m.e./100 g.), the Ca and Mg contents of samples collected from root (wilt) affected areas were considerably lower.

Pillai (1959) also reported a lower contents of Ca and Mg in leaves of root (wilt) affected palms as compared to healthy palms. Soil studies by Pandalai, Sankarasubramoney, and Menon (1958 a, 1958 b) showed that compared to soils from healthy areas, the soils from root (wilt) affected areas had lower values for total Ca, total exchangeable metal ions, percentage metal ion saturation, and pH. The percentage Ca-saturation of soils from root (wilt) affected areas was also considerably lower than that from healthy areas (Pandalai *et al.*, 1958 b). The differences between total Mg contents of soils from healthy and root (wilt) affected areas were not consistent in the different types of soils studied by Pandalai *et al.* (1958 a). As fas as exchangeable Mg was concerned, soils from root (wilt) affected areas showed a lower content except in sandy soils. The Ca and Mg contents of the coconut soils of Kerala are generally very low (Verghese, 1966). The 185 soils examined by him gave an average CaO content of only 0·04% and MgO content of 0·11%.

The Ca and Mg levels of apparently healthy palms were significantly lower than those of healthy palms as well as of the critical levels of IRHO standards. This suggests that even though the apparently healthy palms do not exhibit any visible foliar symptoms of the disease, they suffer from a deficiency of both Ca and Mg, probably in a state of hidden hunger. The visual symptoms of deficiency usually appear long after internal deficiency is experienced (Prevot and Ollagnier, 1963).

The foliar conditions of root (wilt) affected palms, especially the yellowing of outer whorls of leaves, improved markedly when the palms were sprayed with 2·0% $MgSO_4 \cdot 7H_2O$ solution at quarterly intervals (*Annual Report*,

TABLE II

Nutrient element balance in leaf samples from healthy and root (wilt) affected palms

Nutrient balance	Means			SE	Significance	CD at 5%	Conclusion
	Healthy (T_1)	Apparently healthy (T_2)	Diseased (T_3)				
N/P	23·04	21·61	20·23	1·990	N.S.	..	..
N/K	4·483	5·477	4·327	0·443	N.S.	..	..
N/Ca	5·840	8·631	9·135	0·936	S*	2·705	$T_1, \overline{T_2, T_3}$
N/Mg	5·919	10·170	17·612	1·696	S**	4·901	$\overline{T_1, T_2}, T_3$
P/K	0·210	0·303	0·243	0·044	N.S.	..	..
P/Ca	0·271	0·415	0·453	0·033	S**	0·095	$T_1, \overline{T_2, T_3}$
P/Mg	0·270	0·528	0·970	0·109	S**	0·314	$\overline{T_1, T_2}, T_3$
K/Ca	1·328	1·754	2·300	0·210	S*	0·608	$T_1, \overline{T_2, T_3}$
K/Mg	1·348	2·162	4·939	0·543	S**	1·569	$\overline{T_1, T_2}, T_3$
Ca/Mg	1·016	1·419	2·220	0·234	S**	0·676	$\overline{T_1, T_2}, T_3$
N+P/K+Ca+Mg	1·830	2·430	2·333	0·109	S**	0·314	$T_1. \overline{T_2, T_3}$

S*—Significant at 5% level.
S**—Significant at 1% level.

CCRS, Kayangulum for 1966). The application of lime as well as Ca– and Mg– salts over a basal dose of NPK fertilisers had improved the conditions of root (wilt) affected palms and increased their yields (Davis, 1966; Lal, 1966 ; Nair and Radha, 1959). The present leaf analysis data indicate that Ca and Mg are lacking in adequate levels in the tissues of palms growing in the root (wilt) affected areas pointing to a deficiency of these elements in the tissues.

It is widely known that an inbalance of nutrients, rather than absolute amounts of each nutrient, usually favours disease development in plants. The evaluation of nutrient element balance (Table II) in the present study shows that, in general, palms in the root (wilt) affected areas are in a state of unbalanced nutrition as compared to healthy palms. It is interesting to note that the Mg content of apparently healthy palms was significantly lower than that of healthy palms, but the ratios N/Mg, P/Mg, K/Mg, and Ca/Mg did not differ significantly between these two categories of palms, whereas these ratios of diseased palms were significantly higher, indicating a lower content of Mg as compared to all other nutrients in the diseased palms.

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