NUTRITIONAL STATUS AND RELATED CHANGES IN SOIL ENVIRONMENT WITH REFERENCE TO THE INCIDENCE OF YELLOW LEAF DISEASE OF ARECANUT PALMS

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ABSTRACT

The nutritional aspects and the related changes in soil environment associated with the Yellow Leaf Disease of arecanut palms were examined. It was found that this malady is due to the existence of Fe-Mn antagonism possibly triggered by the multiple soil nutritional stress of K, P and N in the affected gardens. These results are very much in conformity with an identical disorder in rice plants grown under similar soil conditions.

INTRODUCTION

The Yellow Leaf Disease of arecanut palm (*Areca catechu* Linn.) was first reported during the early years of this century[10]. This malady which reduces the yield moderately is prevalent mainly in the southern and central parts of Kerala State, India.

The main symptom is yellowing of leaves with abrupt demarkation of yellow and normal green areas. As the water table rises with the onset of monsoon, yellowing begins to appear from the apex of leaflets of lowermost leaves and gradually spreads to the entire pinna. In majority of the cases, necrosis is seen at the tips of these leaflets along with small necrotic spots all over the leaf blade. The total foliar intensity of yellowing fades considerably as the water table goes down towards the end of rainy season. The impaired palm shows retarded growth, reduced number of leaves and often produces sterile inflorescence and also discoloration and shedding of nuts. Roots often turn black and the main stem tapers.

Entiology of YLD (Yellow Leaf Disease) however, is not yet known, though investigations from various angles are under way [8, 14, 18]. Very often these soils are acidic (pH 4.5 to 5.5), ill drained[6] and affected by the excessive water from the adjacent hills and slopes, the soils of which are high in Fe content. Preliminary results of the experiments done so far have indicated the need to examine the role of Fe and Mn as a possible cause of this malady[5].

Materials and methods

Leaf samples were collected from 13 years old arecanut palms during the month of July (beginning of monsoon) when the foliage symptoms are fully expressed. Leaflets from the middle portion of the third oldest leaf were obtained[17] from the disease-free tract—Vittal (South Kanara district) and from the diseased palms of the disease prone tract—Palode (Trivandrum district). Matured rootlets 2 feet away from the base of the palm and 1½ feet deep in the soil from all the four sides of the basin were collected. Ten palms each were selected for his study. After over drying and grinding, the samples were stored in air-tight containers for analysis. Fe, Mn and Al in the acid-digested leaf samples were estimated colorimetrically[1, 12].

TABLE : *Fe, Mn and Al Status of Healthy and Yellow Leaf Disease Affected Arecanut Palm Leaf and Root Tissues*

	Leaf		Root		Ratio of the elements in leaf versus root	
	H	D	H	D	H	D
	ppm	ppm	ppm	ppm		
Fe	440	589*	1555*	1201	0.28	0.48
Mn	190	158	58	51	3.27	3.05
Al	420	403	508*	470	0.83	0.56
Fe/Mn ratio	2.3	3.7				

* Significant at 5% level. H : Healthy. D : Diseased.

Results

The data in Table show that Fe content of leaves in the diseased palms is higher than in the healthy leaves. However, Al content did not show any difference. It is further seen that the roots of healthy palms have accumulated a higher quantity of Fe than the diseased ones. However, the accumulation of Mn did not show any difference. Al content also was high in the roots of healthy palms compared to the diseased ones.

The Fe/Mn ratio (Table) in the leaf tissue was high in the diseased leaves (3.7) than the healthy (2.3).

The ratio of Fe, Mn and Al in leaf versus root are given in Table. Though Mn is higher in the healthy palms, the increase is not significant. Similarly, Al also shows a higher amount in the healthy palms than in the diseased ones.

Discussion

The results of the studies by Yadava *et al*[19] and Mohapatra *et al*[9] on the plant and soil nutritional status are suggestive of a soil-nutritional strees existing in the YLD affected arecanut gardens. In paddy, Ottow *et al*[11] have reported the existence of similar nutritional stress leading to the development of Fe toxicity symptoms which develop in paddy grown in submerged conditions. The symptoms in arecanut also appear when the water table in the garden is very high (10 to 20 cm) during heavy rainfall.[5]

The inherently deficient levels of N, P, K and Ca in the soils of arecanut gardens[9] is considered to increase the availability of Fe and Al, as in paddy[11]. However, increased supply of these major nutrient elements did not correct the foliar symptoms completely in arecanut. A comparatively reduced foliar yellowing and increased productivity was observed in those of the affected arecanut palms which received foliar applications of Mn and Zn and soil applications of cattle manure and lime, in addition to the major nutrients [5,6].

The YLD affected arecanut has been known to accumulate metabolic compounds of low molecular weights eg., soluble sugars, within the plant system due to deranged metabolism[20]. Similar tendency has been reported in bronzing or yellowing rice plants which are predominantly K deficient[3].

K and Ca are known to be involved in the membrane permeability of all the plants and a deficiency of both increases the permeability and enhances the metabolic leakage from plant tissues[16]. Thus the affected cells will leak out metabolites. Washing away of the accumulated metabolites by water during rainy season is quite possible. The effect of such washings on the appearance of symptoms of YLD during rainy season is worth studying.

Twyman[15] had observed that symtoms of Mn deficiency could be induced in a plant system when Fe concentrations in the medium is increased along with a constant Mn supply. Higher value of Fe clearly shows that more of this element has been translocated to the shoots in the affected palms and less of Mn. Excess Fe is known to reduce the capacity to check the mobility of Mn in a plant system[4] and this could also be a reason for the lower Mn content in the affected arecanut palm plantations.

Holmes[2] observed from the leaf dipping experiments that diseased arecanut leaves were tolerant to higher doses of Mn whereas even lower concentrations of Fe were found to be toxic. This is perhaps the reason for the manifestation of the disease symptoms which could be that of Mn deficiency. The conditions existing in the soil system of the affected arecanut gardens must have resulted in the widening of Fe/Mn ratio. Though this disorder appears also related to Mn deficiency, a comparatively high Fe content in the affected plants indicate the existence of Fe-Mn antagonism. It is also of interest to see the first sign of a higher Fe-Mn ratio in soybean, as described by Somers and Shive[13], resembles that of YLD of arecanut.

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