

## CROWN CHOKING DISORDER OF COCONUT: A CASE OF BORON DEFICIENCY

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### ABSTRACT

Crown choking is a serious disorder of coconut and is taking a heavy toll of the crop, particularly young palms in Assam and West Bengal. The symptomatology of the disorder was studied and soil and leaf samples were analysed to determine the nutrient deficiency. It was found that the boron status of soil was much less in diseased area compared to that of healthy area. The concentration of boron was also less in the diseased palms in comparison to the healthy palms. The Ca/B ratio was much less in healthy palms of diseased as well as healthy area when compared to diseased palms. These observations along with the symptomatology and alleviation of the disease by application of borax confirm the possible role of boron deficiency in the crown choking disorder of coconut.

### INTRODUCTION

The crown choking disease of coconut was first reported in 1964 at Kahikuchi in Assam. Chakrabarty et al. (1970) reported that 134 out of 1000 palms were affected in one garden and the disease was more in palms of the age group of 3 to 6 years. The occurrence of disease has been reported from Jalpaiguri and Darjeeling in West Bengal (Anonymous, 1988). A survey conducted in 1984 indicated that the incidence of the disease was 5 to 10 per cent in some parts of Assam. Possible association of B deficiency with this disorder has been reported by Chakrabarty et al. (1970), and they indicated recovery of affected

palms after 9 applications of 20 gm of borax per palm. The present studies are aimed at confirming the association of boron deficiency with this disorder by chemical analysis and also for ascertaining the effect of field application of borax and subsequent recovery of affected palms.

### MATERIALS AND METHODS

Soil and leaf samples were collected during the month of May 1985 from 16 locations for healthy and 19 locations for diseased palms from Gauhati, Assam; 14 locations each for healthy and diseased palms from Jalpaiguri, West Bengal. Soil samples were collected from

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0–25 cm and 25–100 cm depths. For each palm, leaf samples were collected representing frond number  $N/2$  or  $(N+1)/2$ , where  $N$  refers to the total number of fronds on the palm. Soils (2mm fraction) were analysed for pH, organic carbon, exchangeable Ca and Mg, available P, K and B as per standard procedures (Jackson, 1967). Available Cu, Zn, Mn and Fe were extracted by the DTPA procedure of Lindsay and Norvell (1969). Washed leaf samples were dried in an oven at  $65 \pm 5^\circ\text{C}$  and powdered in a Wiley mill with steel blades. Total N in the leaf samples (0.5 mm fraction) was estimated by microkjeldahl method (Jackson, 1967). The powdered leaf samples were digested in a 1:2 perchloro-nitric acid mixture. P (vanadomolybdate) and K (flame photometry) were estimated following Jackson (1967). Boron in leaf samples were extracted after ashing it in a muffle furnace (Jackson, 1967). Cu, Zn, Fe and Mn were estimated by using a Varian Techtron Atomic Absorption Spectrophotometer. Boron was estimated by the curcumin method as described by Jackson (1967).

#### *Field application of borax*

Fifty grams of borax were applied in the soil at 1 to 1.25 m away from the bole in circular trenches of 25 cm wide and 25 cm deep. Borax was applied during the months of May–June, 1986. Palms in which improvement was not seen, were supplied with a second dose of 50 g of borax during November, 1986. Observations were taken in the month of February, June, September, and December, 1987 and improvement in the condition of the affected palms

was recorded by seeing the emergence of healthy spindle and leaves. A total of 28 palms in Jalpaiguri, and 25 palms in Kahikuchi, were treated with borax.

## RESULTS AND DISCUSSION

### *Symptomatology*

The symptoms appear first on the spindle, the tips of which becomes blunt and necrotic. The first observable symptom in young palms of 2–3 years age is the emergence of shorter leaf with scorched tips in pinna. This is followed by the emergence of still smaller leaves. Crowding of leaves around the apex results in choking of the crown (Fig. 1). In some cases the petiole of the new leaf becomes very thick and forms a tubular structure enclosing the entire space at the apex. In palms of 3–10 years the crowding of leaves may not occur immediately after the emergence of the first reduced leaf with scorched tips. The tip of the leaves become hooked. The hook may be corrugated, with corrugation affecting both the midrib and lamina. Hooks are mostly seen on the terminal pinna, although they may occur in any position on the frond. In slightly advanced stage of the disorder, folding and general distortion may occur at any point on the pinna. The midrib may show one or more acute bends usually at an angle greater than  $90^\circ$ , which give the lamina a zig-zag out line (Fig. 2).

In advanced stage of the disease there is gradual loss of leaflets. Leaves without pinna give stick-like appearance. In acute cases the young abnormal leaves crowd around the bud giving a choked appearance (Fig. 3). In choked

Fig. 1. Two year old coconut palm showing chocking of crown



condition of the palm, the bud gradually dies. Mealy bugs are often found associated with the disorder in advanced stage of the disease.

Deformation of leaves around the crown and the arrest of apical growth

are some of the symptoms associated with Boron deficiency in cauliflower, sugarbeet (Stiles, 1961), and oil palms (Rajaratnam, 1972 a,b). It has been shown that shortage of boron typically affects the meristem or actively dividing tissues resulting in deformed growth of leaves

**Fig. 2.** Eight year old coconut palm showing leaves with distorted and fasciated pinna giving the lamina a zig-zag appearance



and death of apical growing points in stem (Stiles, 1961).

No bacteria or fungi were found associated with the disease. A similar observation was made by Chakrabarty et al. (1970), who did not find any role of virus in the disorder.

#### *Chemical analysis*

Results of the analysis of leaf samples collected from Assam (Table I) indicated that excepting for P, Ca, Mg and B concentration there was no significant difference between healthy and diseased palms. The diseased palms had higher content of N, P, Ca, Mg, Fe, Zn and Mn whereas B, Cu and K were less in diseased palms. Though the dise-

ased palms had lower number of leaves than the healthy palms, the difference was not significant.

From samples collected from West Bengal, though the trend of nutrient content in healthy and diseased palms is similar to that in samples collected from Assam, significant differences were observed only for B and total number of leaves. When the pooled values were analysed, significant differences were noticed for N, P, K, Ca, Mg, B and total number of leaves. Keeping in view the 'concentration effect' (Jarrel and Beverly, 1981) that would operate in deficient/diseased palms, as also indicated by the lesser number of leaves in diseased

**Fig. 3.** Young leaves crowded together and condensed leaving no space for emergence of new spindle in a 8 year old palm



Table I. Leaf nutrient concentration of healthy and diseased palms

Sample	N	P	K (%)	Ca	Mg	Fe	Zn	Mn (ppm)	Cu	B	Total no. of leaves
<i>ASSAM</i>											
Healthy	1.68	0.12	1.45	0.35	0.27	184	25	103	10.7	6.9	18
Diseased	1.78	0.13	1.20	0.49	0.40	196	29	150	9.6	4.7	16
t' value	NS	2.302*	NS	3.085**	3.11**	NS	NS	NS	NS	3.645**	NS
<i>W. BENGAL</i>											
Healthy	1.70	0.13	1.66	0.37	0.18	232	37	153	8.2	7.9	17
Diseased	1.78	0.14	1.46	0.35	0.22	202	34	180	8.2	6.3	11
t' value	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.288**	3.007*
<i>POOLED</i>											
Healthy	1.69	0.12	1.55	0.36	0.23	207	30	127	9.5	7.4	18
Diseased	1.78	0.13	1.31	0.43	0.33	199	31	162	9.0	5.4	14
t' value	2.061*	2.526*	2.235*	2.247*	3.159**	NS	NS	NS	NS	4.210**	2.491**

NS—Not significant \* Significant at 5% level \*\* Significant at 1% level

palms, the presence of higher amounts of nutrients in diseased palms is justifiable. The only nutrients that are low in diseased palms in spite of 'concentration effect' are K and B.

Comparison of leaf B levels of samples collected from diseased area with that of healthy area (Table II) indicates that leaf B concentration is much less in diseased area than in palms

Table II. Leaf B concentration of palms in healthy and diseased areas

Sample	Leaf rank	Leaf B content (ppm)	
<i>Diseased area</i>			
Healthy palms	N/2 or (N+1)/2	7.4	A
Diseased palms		5.4	B
<i>Healthy area</i>			
Healthy palms	N/2 or (N+1)/2 14th leaf	9.4 10.2	

A and B are significantly different at 5% level

of healthy area, thereby suggesting that B might be a factor in crown choking disorder of coconut.

Plants grow normally only when a certain balance exists in the intake of Ca and B. The Ca/B ratio (expressed in equivalent weights of the two elements) for the leaf rank N/2 or (N+1)/2 is significantly lower for healthy palms when compared with diseased palms (Table III). It is interesting to note that the Ca/B ratio of palms in healthy area is much lower as compared to the same ratio for palms in diseased area.

Analysis of soil samples collected from West Bengal, on the other hand, indicated that the soils of diseased palms had lower content of all the available nutrients when compared with the nutrient contents of soils of healthy palms, the differences were significant

Table III. *Ca/B ratio of healthy and diseased palms*

Sample	Leaf rank	Ca/B ratio in equivalent weights
<i>Diseased area</i>		
Healthy palms	N/2 or (N+1)/2	95 A
Diseased palms		145 B
<i>Healthy area</i>		
Healthy palms	N/2 or (N+1)/2	71

A and B are significantly different at 1% level

only for P, K, Cu, Zn, Mn and Fe (Table IV). The high rainfall in Assam and northern parts of West Bengal and consequent leaching of soil B must be responsible for low content of boron in soils of these areas (Kanwar and Randhawa, 1967).

In Assam, 22 out of 25 palms recovered after application of 50g of borax. In West Bengal, 14 out of 28 palms recovered completely. The rest of the palms either did not show any improvement or died because they were in very advanced stage of the disorder. The recovery was also facilitated by the incising the hardened portion and loosening the crowded leaves at the crown.

Based on the symptomatology, chemical analysis of soil and leaf samples and recovery of the diseased palm by borax application, it is concluded that crown choking in coconut is a symptom of B deficiency.

Table IV. *Available nutrient content of soils collected from healthy and diseased palms*

Sample	Organic C (%)	Available		Exchangeable		Available					pH
		P (ppm)	K (ppm)	Ca (meq/100g)	Mg (meq/100g)	Cu	Zn	Mn (ppm)	Fe	B	
Healthy	1.15	128.9	111.4	1.6	0.4	2.3	3.6	5.3	76.8	0.22	5.0
Diseased	1.11	65.9	53.3	1.0	0.3	0.9	0.8	2.1	43.1	0.19	4.9
t' value	NS	2.37*	2.68*	NS	NS	2.24*	2.16*	2.98**	3.00**	NS	NS

NS—Not significant

\* Significant at 5% level

\*\* Significant at 1% level

#### *Management of the disease*

Soil application of borax at the rate of 50g per palm just after the appearance of the disorder, resulted in recovery of the palms. In slightly advanced stages of the disease, two applications of borax (50g) at an interval of 3-4 months were found necessary for the redemption of the disorder.

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