BORON DEFICIENCY IN COCONUT

DIAGNOSIS AND CORRECTION

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

REGIONAL STATION, KAYANGULAM - 690 533, KERALA, INDIA

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Boron deficient adult palm

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Boron deficiency in coconut (*Cocos nucifera* L.) - Diagnosis and Correction

INTRODUCTION

Boron is an essential micronutrient for plants. In nature boron is moderately rare and occurs principally as borates of calcium and sodium. It occurs in soils in the form of tourmaline. Its availability is maximum within the pH range 5-7. Boron is less available above 7.5 pH. Excessive liming aggravates boron deficiency.

Boron helps in the division and multiplication of meristematic tissues. It helps the metabolism of protein, synthesis of pectin, maintenance of water relations, translocation of sugars, fruiting process, growth of pollen tube and in the development of flowers and fruits.

In coconut palms, deficiency of boron causes malformations of various types and shapes in the leaf as well as of the nuts resulting in stunted growth and low productivity. Studies conducted at Central Plantation Crops Research Institute, Regional Station, Kayangulam showed that coconut can exhibit various types of boron deficiency symptoms in leaves, inflorescence or in nuts separately or in combination. All the symptoms may not appear on a single palm at any given time. The identification of different types of symptoms of boron deficiency in the field is very important for the coconut cultivators. The various symptoms associated with this deficiency is discussed below.

SYMPTOMS

A. Symptoms common to both seedlings and adult palms

The deficiency symptoms are manifested by unopened and crinkled leaves. Even the midribs and petiole shows crinkling (figs 1,2 &3).

Fig 1. Unopened crinkled leaf

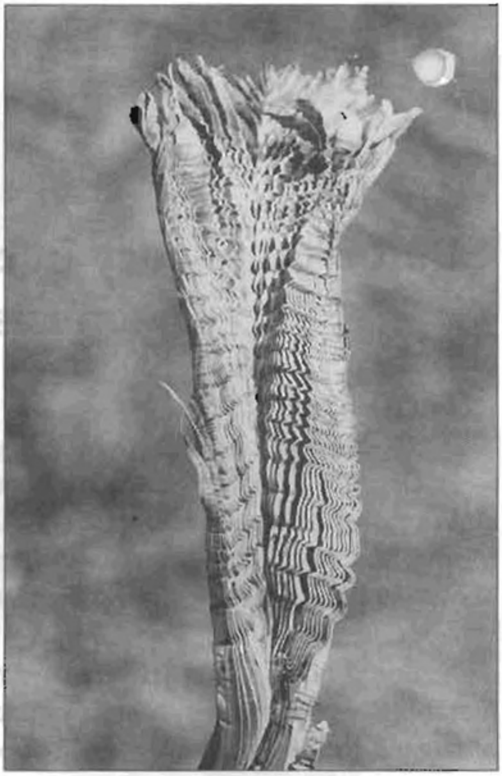


Fig 2. Crinkled leaf -lamina

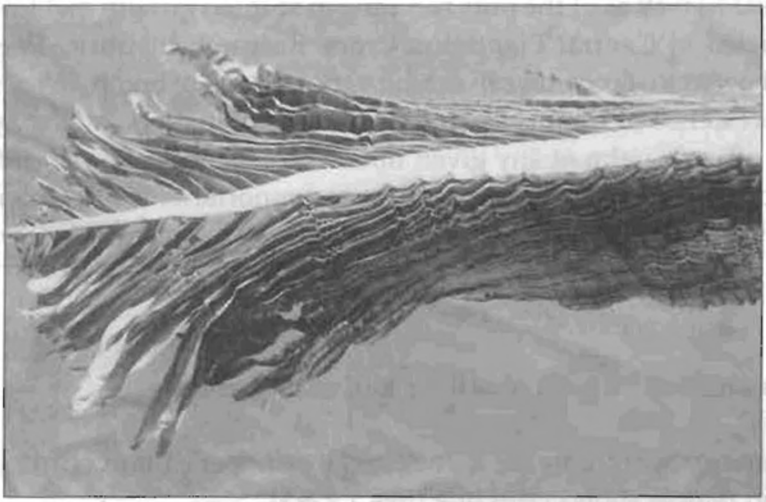


Fig 3. Crinkled leaf showing the crinkled petiole

Sometimes the length of the petiole and the number of leaves on the crown are reduced (figs 4 & 5).

Fig 4. Palm with short petioles

Fig 5. Adult palm with reduced number of leaves

Petiole without any leaflets (stick like appearance)(fig 6) is common. Some times the petiole gets thickened, abnormally elongated and the tip of the tubular leaf becomes whipped (fig 7).

Leaflets show hook like symptoms on single side alone with or without gummosis (figs 8,9 &10).

Fig 6. Petiole without any leaflets

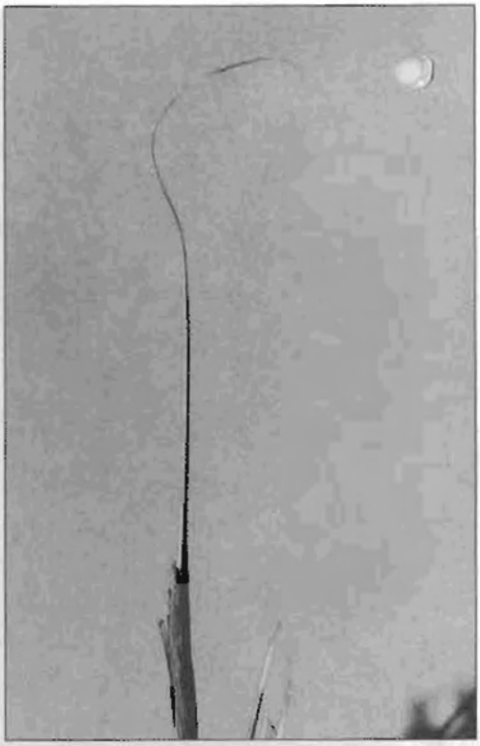


Fig 7. Whipped leaf

Fig 8. Hooked leaf with gummosis

Fig 9. Single hooked leaf

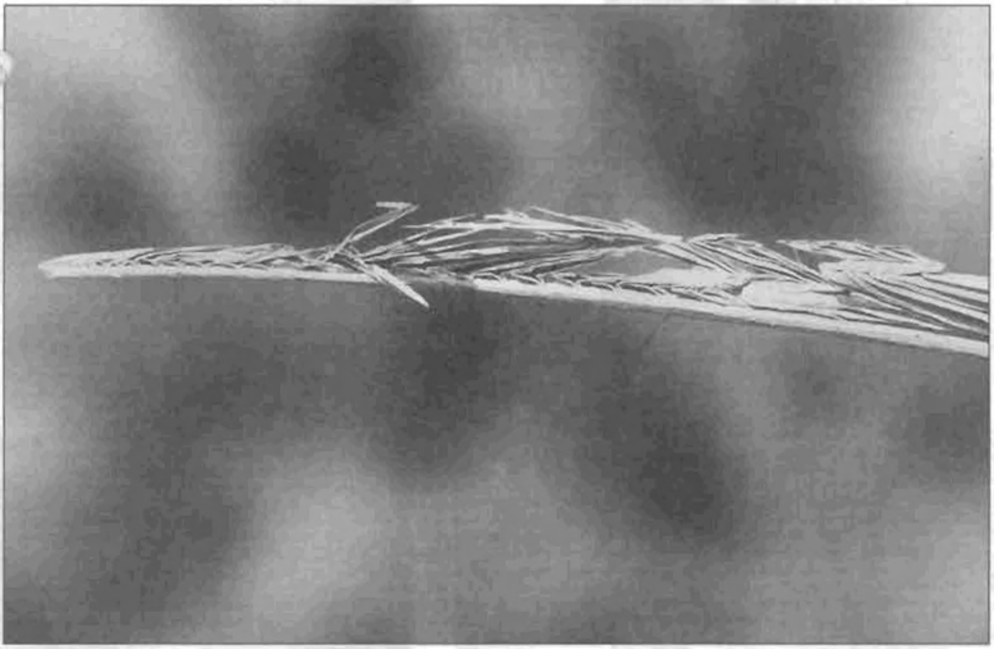


Fig 10. Single sided leaf with double hook like symptoms and without gummosis

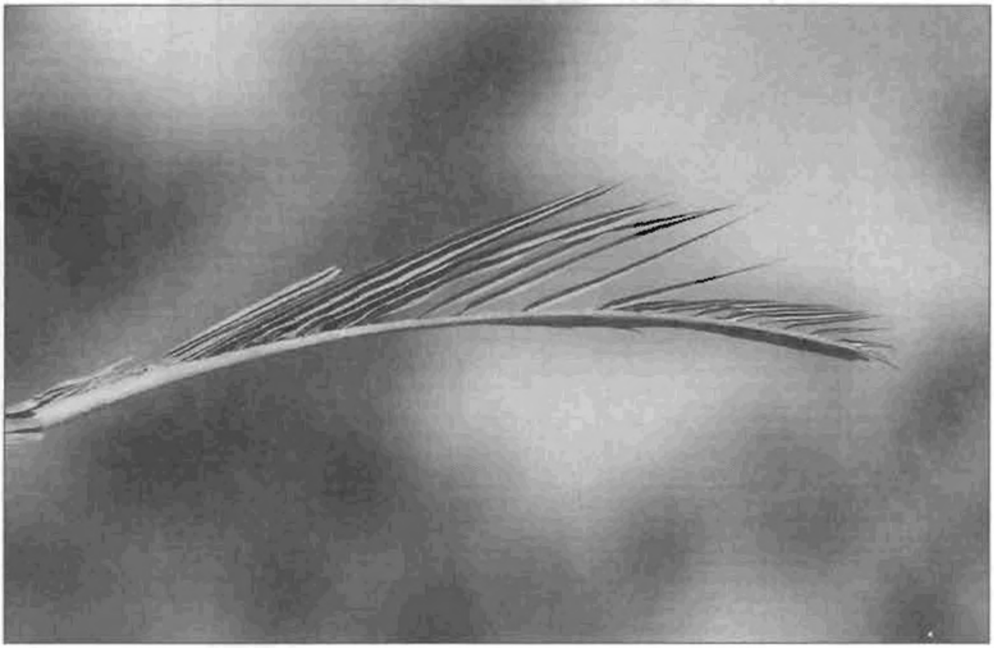
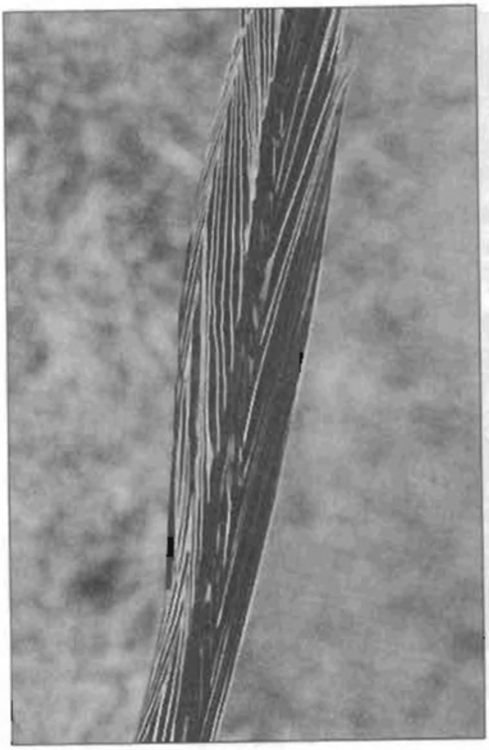


Fig 11. A leaf with leaflets on a single side of petiole



Figs 12 &13. Hooked leaflets on both sides of the petiole

Fig 14. Palm with crowded crown

Fig 15. Fan like appearance of leaf

Fig 16. Boat shaped appearance of leaf

Fig 17. Fan like appearance of leaf in an adult palm

Fig 18. Fish bone appearance of leaf

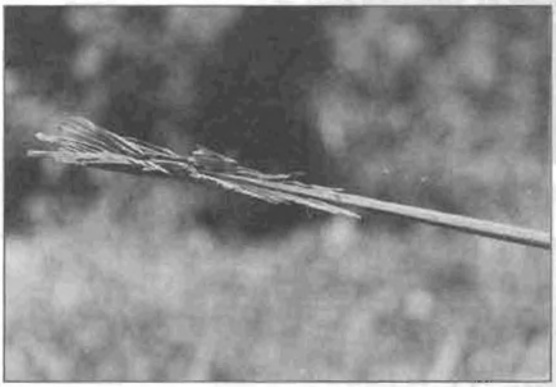


Fig 19. Bare leaf stalk with fused leaflets at the tip

Fig 20. Broom like appearance of leaf

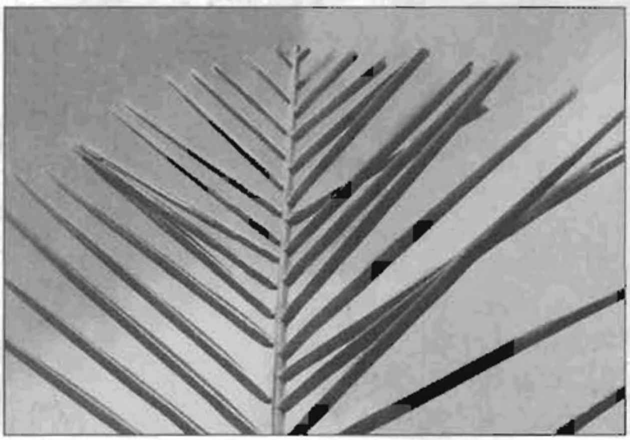


Fig 21. Asymmetric arrangements of leaflets with wider space between leaflets

Fig 22. Fully necrotic terminal bud

Fig 23. Petiole with hardened bract

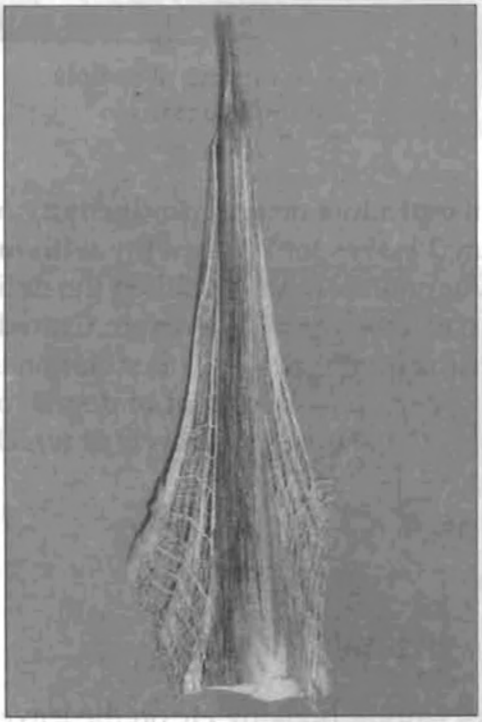


Fig 24. Petiole without leaflets showing tip necrosis and longitudinal cracking

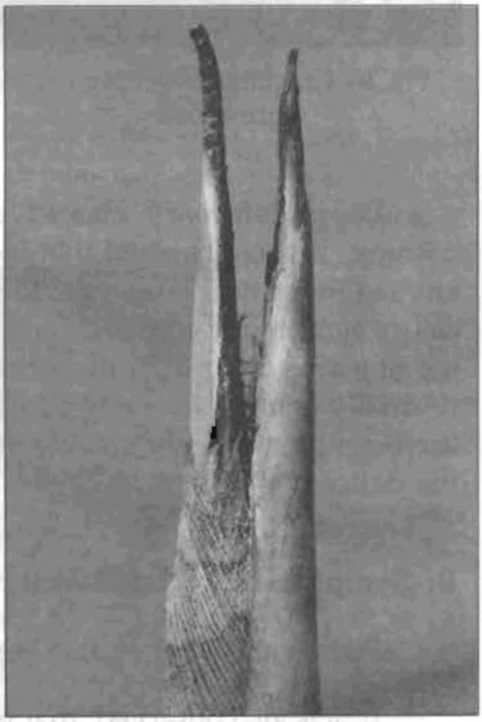


Fig 25. Petiole with tip necrosis without cracking/leaflets

Longitudinal or transverse cracking along the petiole with or without gummosis were also observed (figs 26 & 27).

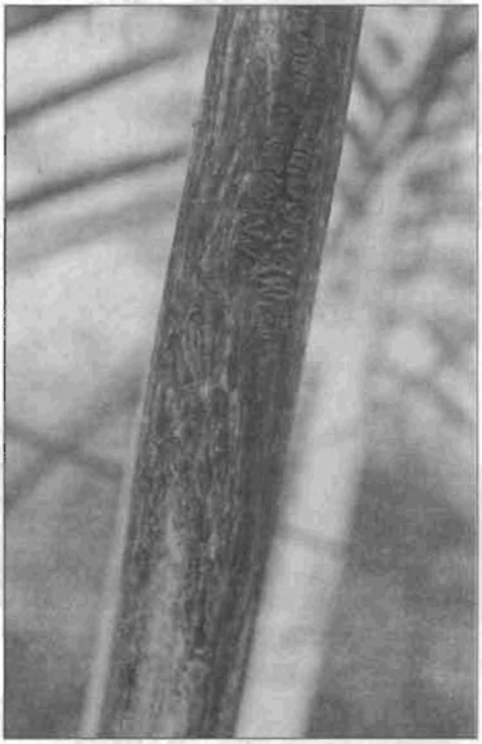


Fig 26. Cracking of petiole with gummosis

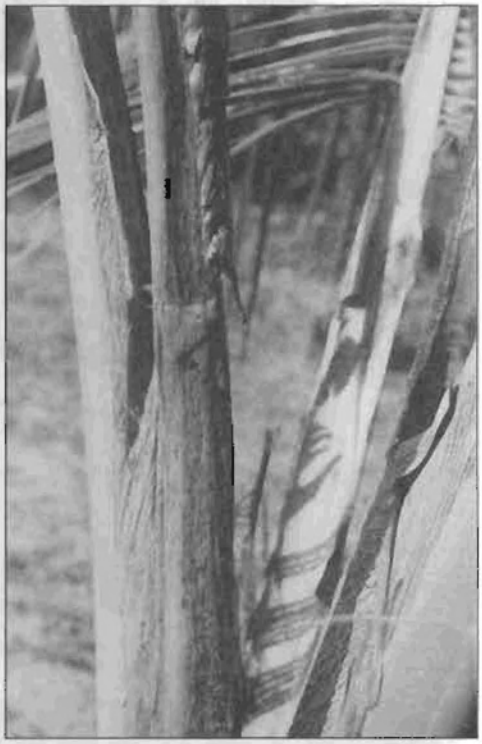


Fig 27. Cracking of petiole without gummosis

Boron deficiency also adversely affects the production and productivity of coconut. It was observed that older and matured leaves looked healthy without any malformation . However the younger leaves on the crown exhibited the deficiency symptoms like fasciations, hooking of leaves, crowding of leaves etc. Crowding of leaves around the apex resulted in a choking of the crown. This situation is normally referred as 'crown choking' disease of coconut. The extent of degree of each symptom depends on the time and stage of the plant growth cycle at which the deficiency occurs.

B. Symptoms associated with bearing palms

Button shedding is also seen associated with boron deficiency.

It was also observed that without any fasciations, hooking etc on the leaves of certain palms have produced aborted inflorescence (Fig 28).

Fig 28.Palm with aborted inflorescence

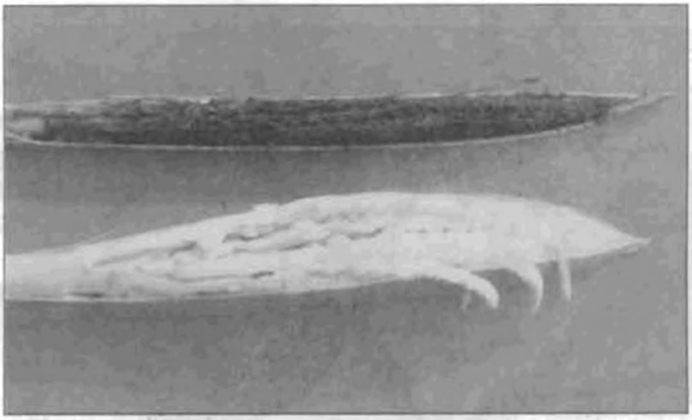


Fig 29. Necrotic Inflorescence (above)
compared with healthy (below)

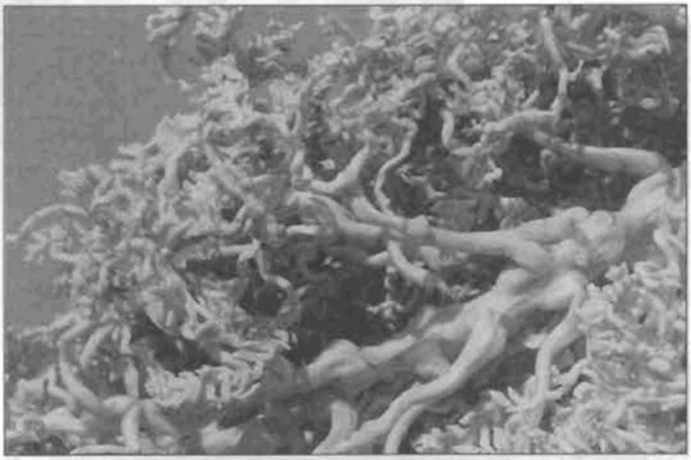


Fig 30. Inflorescence with branched spikelets

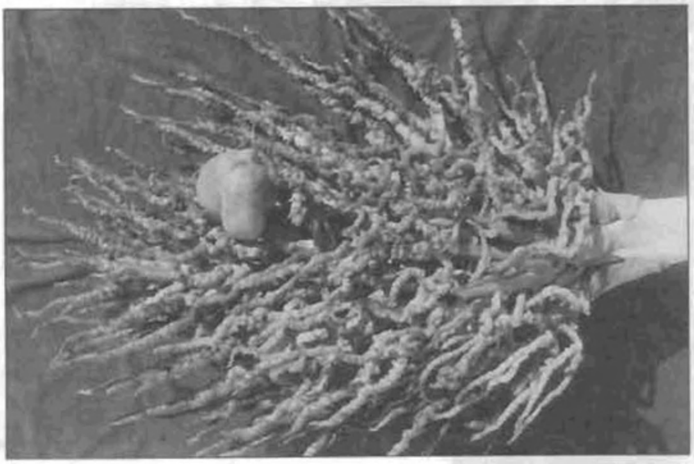


Fig 31. Inflorescence with very few female flowers

Fig 32. Nuts with uneven kernel development

Fig 33. Nut with partial kernel developed

Fig 34. Nut without any kernel

Certain palms without any of the above visible symptoms were found to produce nuts looking healthy and showed no abnormalities externally. However, the dehusked nuts were found to have longitudinal cracks from the basal end of the shell of the fruit on one side covering three fourth portion of the nut ending in transverse cracks. Meat of the nut (kernel) was seen protruding outwards. The longitudinal section of the nut showed decaying of the pith near the eye emitting rotten smell. This portion appeared brown with small patches. Cracks seen externally were not extended in the kernel inside (Figs 37 & 38).

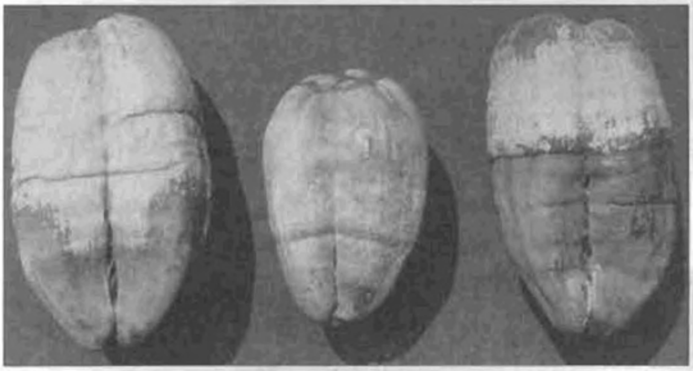


Fig 35. Cracking on the husk

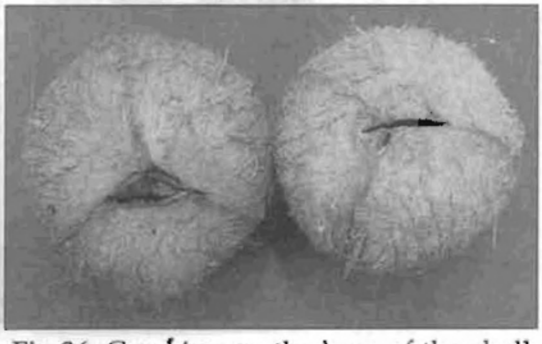


Fig 36. Cracking on the base of the shell

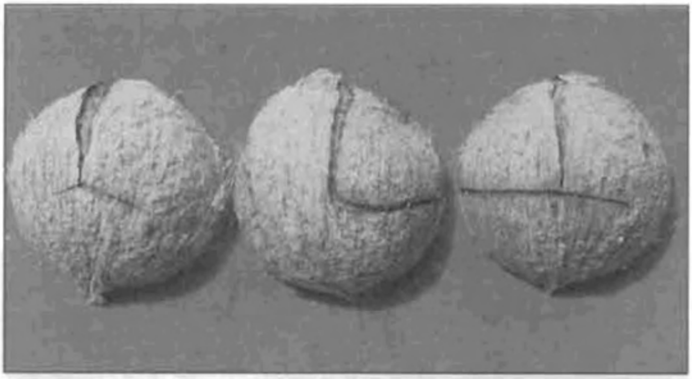


Fig 37. Longitudinal cracking on the shell

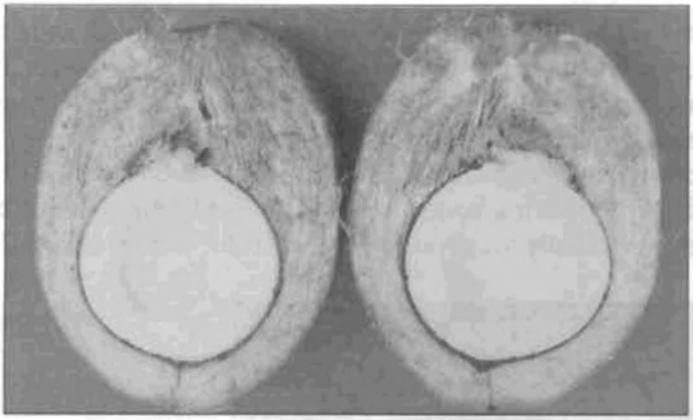


Fig 38. Protrusion of kernel towards mesocarp

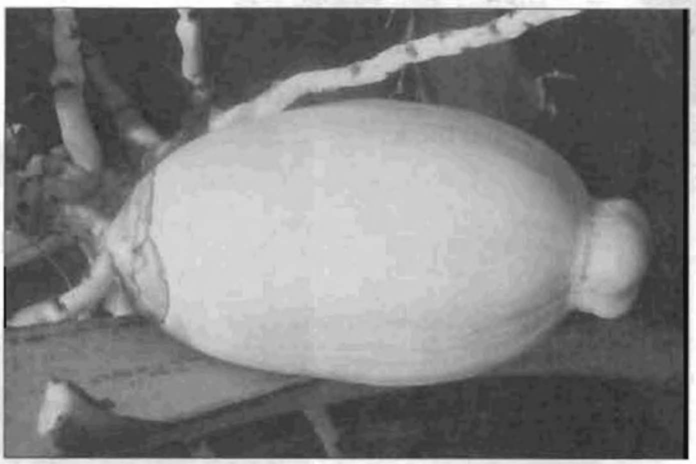


Fig 39. Bulging at the distal end of the nut

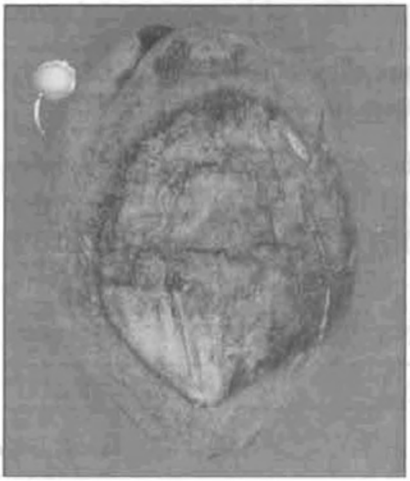


Fig 40. Black patches on the surface of the husk

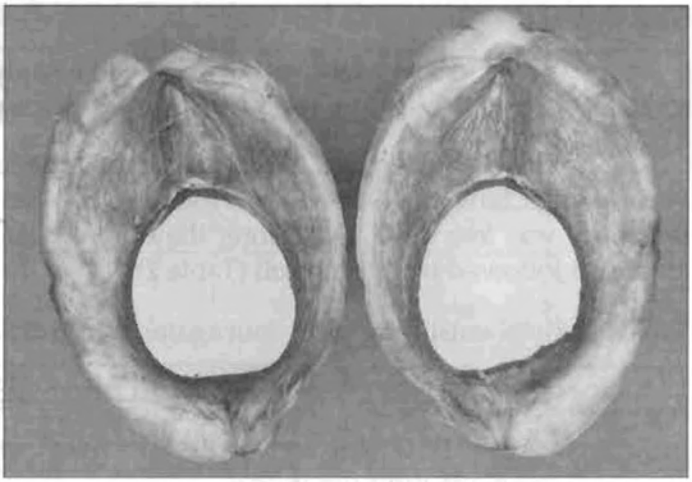


Fig 41. Discolouration of the mesocarp

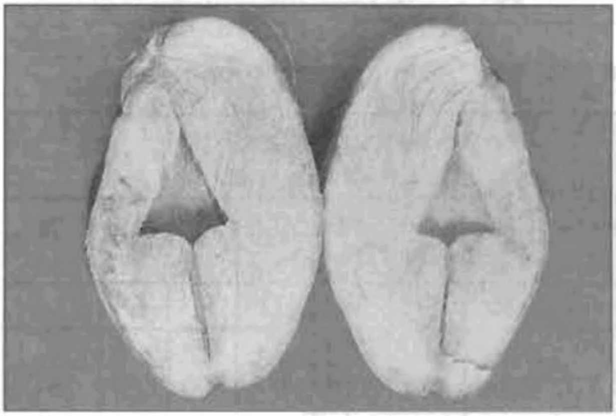


Fig 42. Nuts showing cavity (Shell development is lacking)

Fig 43. Coconut bunch showing hen & chicken symptom

Fig 44. Dead palm due to acute boron deficiency

SURVEY

A survey on boron deficient palms in laterite,sandy loam, alluvial,kari and coastal sandy soils at Kollam,Pathanamthitta and Alappuzha districts was conducted during 1997-98.

The data showed that among different varieties of coconut the extent of disorder was more in Chawghat Green Dwarf followed by West Coast Tall (Table 1). The percentage incidence was less in COD. Among the different soil types it was maximum in sandy loam soil followed by laterite soil (Table 2).

Table 1.Varietal sensitivity of coconut against boron deficiency disorders in sandy loam soils

Variety	% Disorder
WCT	12
DXT	8
TXD	7
COD	6
CGD	13

Table 2. Survey for the boron deficiency symptoms of coconut

Soil type	No. of bearing palms				No. of bearing palms								%
	< 3 years		>3 years		<7 years		7-15 years		16-50 years		>50years		
	H	D	H	D	H	D	H	D	H	D	H	D	
Sandy loam	1600	414	1700	453	1650	513	1800	480	2000	483	500	75	26.0
Laterite	1515	350	1800	416	2000	463	2000	400	1600	355	650	65	21.4
Alluvial	1750	350	2000	384	1600	365	1700	380	1850	365	750	55	19.6
Kari	2000	360	1800	350	1550	355	1800	315	1900	380	585	60	18.8
Coastal sandy	1900	413	1500	350	1600	413	1950	363	2000	400	610	75	21.0

H= Healthy D=Diseased

MANAGEMENT

Table 3 shows the yield and yield attributes of deficient palms before and after treatment with borax. It was found that borax application had improved all the attributes to a significantly higher level. In seedlings the leaf emerging after six months of boron application was found to be free from any malformation. But an adult palm would normally take about 8 to 10 months to show the improvement in the symptoms. In seedlings below five years of age , application of borax was found to be effective in reducing the symptoms of leaf rot disease and this needs more investigation.

Table 3. Yield & yield attributes of deficient palms before and after treatment with borax

	Total leaves/palm	Fused leaves/palm	No of bunches/palm	No. of Female flowers/palm	No. of nuts/palm	Setting %
Before treatment	27	12	11	190	25	10.6
After 3 years of treatment	33	0	13	344	41	19.0
% increase	22.2	100	18.1	81	64	79

The deficiency could be completely cured by applying 300 & 500 g borax for seedlings and adult palms respectively in 2 split doses along with the recommended dose of fertilizers. It was found that application of borax had improved the boron concentration in different ranks of leaves (Fig. 45). Schedule of fertiliser application along with boron for different aged palms is given in Table 4.

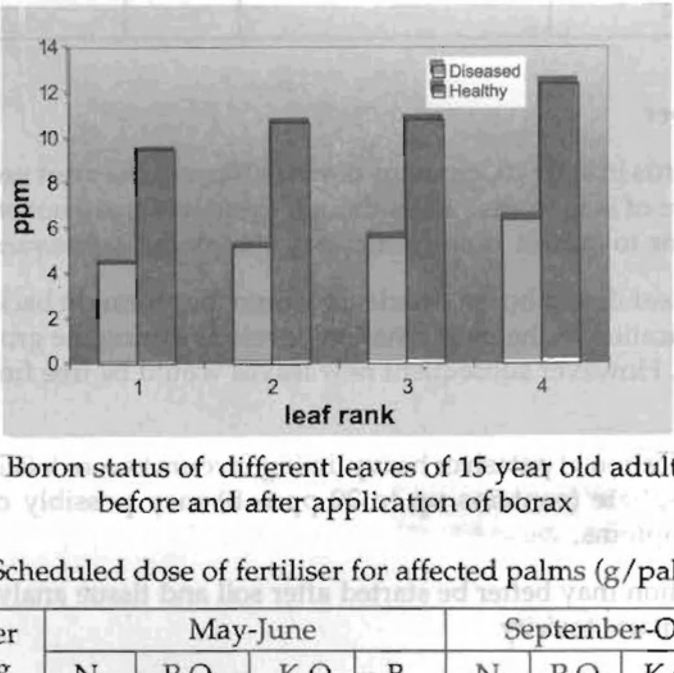


Fig 45. Boron status of different leaves of 15 year old adult palms before and after application of borax

Table 4. Scheduled dose of fertiliser for affected palms (g/palm/year)

Year after planting	May-June				September-October			
	N	P_2O_5	K_2O	B	N	P_2O_5	K_2O	B
1st		Planting			50	30	100	3.0
2nd	50	30	110	3.0	110	70	220	8.0
3rd	110	60	220	7.0	220	140	440	15.0
4th	170	100	300	11.0	330	200	700	22.0
5th onwards	170	100	300	19.0	330	200	700	38.0

APPENDIX

1. Sources of Boron

Sl. No.	Sources	Formula	B (%)	Quantity to be applied/palm/year (g)	
				Seedlings	Adult palm
1	Sodium decca hydrate	$Na_2 B_4 O_7.10 H_2O$	11.3	300	500
2	Sodium penta hydrate	$Na_2 B_4 O_7. 5H_2O$	14.8	230	380
3	Sodium tetraborate	$Na_2 B_4 O_7. 4H_2O$	20.0	170	280
4	Boric acid	H_3BO_3	17.5	190	320
5	Disodium octaborate tetrahydrate	$Na_2B_8O_{13}.4H_2O$	20.9	160	270

2. Tips to remember

1. Low boron status in soil (<0.3ppm) or tissue (<10ppm) does not necessarily result in the appearance of symptoms. Even though these levels are not strictly critical the plants are prone to exhibit boron deficiency symptoms subsequently.

2. A malformed leaf due to boron deficiency cannot be brought back to normal shape by boron application as the malformation develops during the growth phase of that particular leaf. However subsequent new leaves would be free from any deficiency symptoms.

3. Intensive application of potash or heavy liming favours boron deficiency. Application of super phosphate (contains up to 20 ppm B) may possibly correct the boron deficiency symptoms.

4. Boron application may better be started after soil and tissue analysis. Heavy boron application imparts toxicity.

5. Irrigation must be followed after application of boron during summer.

6. Boron containing compounds could be applied along with other fertilizers/ insecticides in the basin of the palms.

Boron deficient seedling

Same seedling after boron application

Crown choking due to boron deficiency