

## MICRONUTRIENT MANAGEMENT IN ARECANUT-COCOA ECOSYSTEM

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Arecanut and cocoa are predominantly grown on laterite soils which are characterized by high rainfall, undulating topography, leaching of potassium (K<sup>+</sup>) and calcium (Ca<sup>2+</sup>), phosphorus (P) fixation and high zinc (Zn) fixing capacity. The cultivation of arecanut was extended to clay soil belt in non-traditional areas during 1980s. Clay soils pose a problem to monocot palm due to water stagnation, poor soil aeration and drainage. The serious concerns in arecanut cultivation are huge yield gap of 191 %, large nutrient requirement and low nutrient use efficiency. Thus, maintaining appropriate levels of soil fertility is of paramount importance to sustain the growth and yield of arecanut. Micronutrients like Iron, Zinc, Boron, Manganese, Copper, Molybdenum and Chlorine are essential for normal growth and development of the plant, but are required in

relatively small quantities. Among these, zinc and boron are commonly found deficient in traditional arecanut and cocoa growing regions, whereas, iron and manganese deficiency is observed in alkaline/calcareous soils.

Soil testing is important to avoid deficit or excess presence of nutrients in soil. Excess soil fertility status is more dangerous. Due to antagonistic nutrient interactions in soil, plant nutrient uptake will be affected. Soil sampling should be done at 50-60 cm distance from the trunk/stem of arecanut palm on two sides up to a depth of 30 or 45 cm. Auger or spade can be used for soil sampling. If the land is level, soil sample should be collected from at least 3-4 palm basins covering entire garden. In case of sloppy lands, samples should be collected separately from top, middle and low levels of the garden. All the samples should be mixed

**Table 1: Optimum micronutrient level and total micronutrient uptake by arecanut**

Nutrient	Optimum nutrient level (mg/kg)		Total uptake by high yielding palms	
	Optimum concentration (mg/kg)	Optimum range (mg/kg)	Per palm	Per ha
Iron	145	100-190	15.13 g	20 kg
Manganese	56.5	15-95	1586 mg	2 kg
Copper	2.6	1.4-4.0	883 mg	1.5 kg
Zinc	45.8	26-65	645 mg	840 g
Boron	39.5	25-55	698 mg	907 g

(Bhat and Sujatha, 2012; Bhat and Sujatha, 2013)

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thoroughly, dried under shade and a representative sample of half kg should be taken for soil testing.

of disorders was more in clay soil regions than traditional laterite soil belt. Disorders are associated with symptoms like short and brittle

**Table 2: Soil nutrient limits for arecanut grown on laterite soil (mg/kg)**

Nutrient	0-30 cm soil depth		30-60 cm soil depth	
	optimum concentration (mg/kg)	optimum range (mg/kg)	optimum concentration (mg/kg)	optimum range (mg/kg)
Iron	37	24-49	18.8	6-34
Manganese	88	59-116	60	23-96
Copper	26	17-35	7	1.5-12.6
Zinc	5.5	3.5-7.4	1.9	1-3
Boron	1.37	0.7-2.0	1.6	0.3-2.9

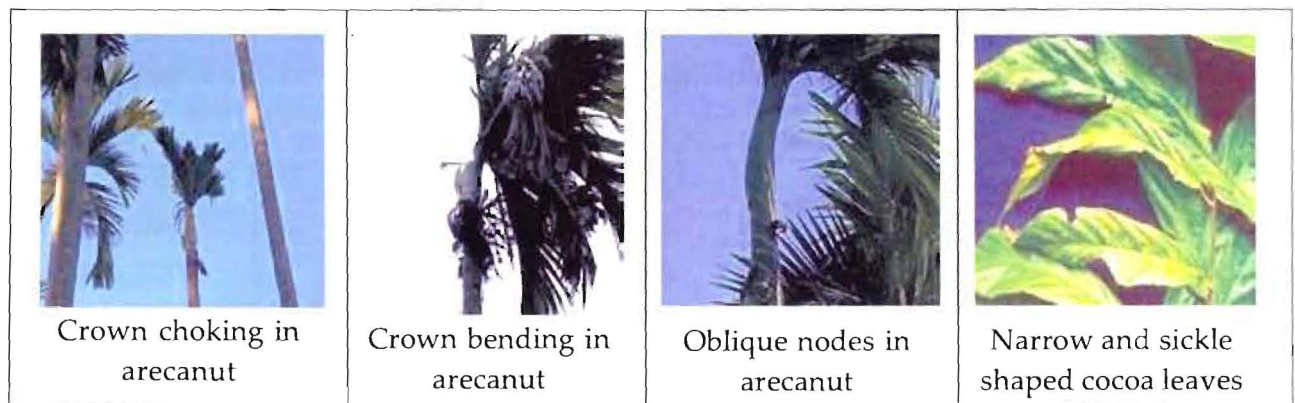
(Bhat *et al.*, 2012)

**Zinc:**

Zinc is the main building part of some important enzymes and their activity is dependent on zinc concentration in the plant. Since zinc can't be transferred to younger tissues from older tissue, its deficiency symptoms appear on the young leaves of plants. When zinc deficiency developed, the yield is more affected than dry matter. This may be due to damage to the pollen fertility by zinc deficiency.

In the recent past, disorders like crown choking, crown bending, shortened internodes and oblique nodes in arecanut are increasingly noticed in Karnataka and Kerala. The incidence

leaves with dark green color, reduced internodal length, tapering of the stem and failure of inflorescence production (Bhat and Sujatha, 2014). Zinc is essential for tryptophan synthesis, which is a prerequisite for auxin formation, therefore amount of auxin decreases by zinc deficiency. Hence, symptoms like shortening of internodal length and reduction in leaf size can be observed. In cocoa, deficiency of zinc causes chlorosis of the leaves, vein-banding, mottling and crinkling of leaves with wavy margin, and the younger leaves become narrow and sickle shaped. Twigs show shortened internodes or rosette appearance.



**Management:** Even though clay soils have higher total zinc in the soil, their uptake is reduced due to high phosphorous and clay content in the soil. Hence, soil testing is very important in gardens showing deficiency symptoms. If phosphorus is found high, skipping phosphorous fertilizers for two years and reducing nitrogenous sources can be followed. Soil application of  $ZnSO_4$  @ 10-15 g/ arecanut palm and 25 g/cocoa tree and improving soil aeration is recommended. In soils with high phosphorous, chelated form of zinc can be applied. Foliar spray of zinc sulphate (5g /litre) especially on the younger leaves will help in producing normal new leaves.

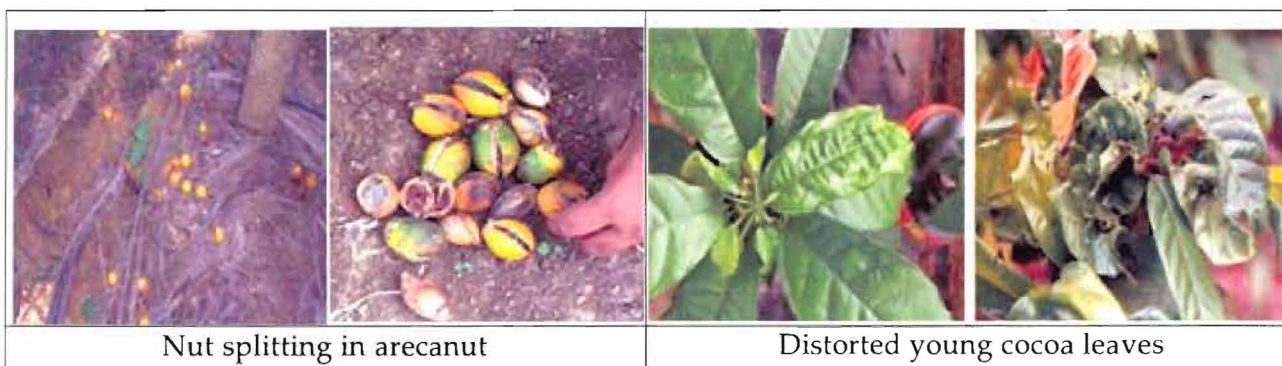
**Boron:**

Boron impacts cell development, sugar and starch formation and translocation; hence, the first symptoms appear in the new growth under deficiency condition. Stunted and small plants with misshapen, thick and brittle leaves are common symptoms. Boron is not transferred easily from older to younger (upper) leaves, so younger leaves show symptoms first. Boron is very mobile in soil and can be leached from the root zone. It is important to maintain optimum boron in the soil as it is needed for flowering and fruit setting. However, excess application should be avoided as there is narrow range

between boron deficiency and toxicity. Under boron deficiency condition, the fruits will be smaller in size. At an advanced stage, there will be death of growing point. Nut splitting is also seen when boron is deficient in palms. In cocoa, boron deficiency affects younger leaves. They grow smaller and the leaf tips become cupped, distorted and scorched. It will also cause poor bean quality and reduced yield.

**Management:** Application of borax @ 2 g per litre of water (0.2 % spray) on leaves, and soil application of borax (20 g per palm) to the affected plants can be followed.

**Nut splitting in arecanut:** The growth of pericarp does not keep pace with the development of inside kernel and thus causing the splitting up of the pericarp and distal end. It is called as '*Andu adakke roga*' in Kannada and '*Achikeeral*' in Malayalam. This abnormality is seen in patches in individual gardens and is common in young palms. Premature yellowing of nuts followed by the cracking of fruits are other symptoms observed. Cracks develop near the perianth end or at the base or at both sides. Kernel also at times exhibit splitting. The split nuts drop. Infection of bacteria and fungus of the exposed kernel after splitting renders the nuts useless. Deficiency of boron and potassium is one of the important reasons for this disorder.

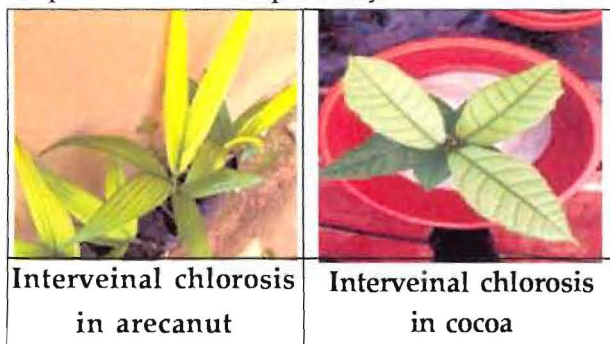


**Management:** Application of borax @ 2 g per litre of water (0.2 % spray) on bunches, soil application of borax (20 g per palm) and muriate of potash (235 g per palm for medium yielders and 350 g per palm for high yielders) or sulphate of potash (280 g per palm for normal yielders and 420 g per palm for high yielders in alkaline soil), improving drainage and regular irrigation during summer can be followed to reduce nut splitting in arecanut.

**Iron:**

Iron is an important element in crops as it is essential for many important enzymes and synthesis of chlorophyll. Because iron is not translocated in the plant, deficiency symptoms appear on the new growth first. Iron deficiency on individual plants is characterized by yellow leaves with dark green veins (interveinal chlorosis). Normally, iron deficiency is not noticed in arecanut and cocoa grown in laterite soil which is plenty in it. However, high manganese in soil may interfere with the uptake of iron. Moreover, iron deficiency is commonly observed in soils with high pH. In cocoa, iron deficiency causes darker green veins in younger leaves against paler green background. Narrow marginal and tip scorching in older leaves can also be observed.

**Management:** Spray 1% aqueous Ferrous Sulphate solution repeatedly.



**Manganese:**

Manganese is important for photosynthesis and other processes in the plant. Its deficiency is a serious, widespread plant nutritional disorder in dry, well-aerated and calcareous soils, as well as in soils containing high amounts of organic matter. Symptoms are observed in fully developed and medium leaves. In cocoa, under deficiency condition, yellow green or yellow interveinal chlorosis is observed in leaves. Network of dark green veins remain visible.



**Interveinal chlorosis in cocoa**

**Management:** Spray 0.2% aqueous Manganese Sulphate solution on foliage.

Micronutrients are often underestimated. Farmers tend to be mostly concerned with the application of macronutrients such as nitrogen, phosphorus, and potassium. Furthermore, many farmers only apply micronutrients upon initial evidence of symptoms of deficiencies. This action may result in lower yields and reduced quality. Now-a-days, less importance is given for applying compost/vermicompost/de-oiled cakes which contain micronutrients, thus resulting in lower micronutrients in the soil. Good farm management is important, from the beginning to the end of the crop's life cycle. Providing the crops with micronutrients based on soil test values is beneficial and integral in producing higher yields.

**References:**

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