



Managing boron in coconut palms

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From the soil **solution**, boron is passively absorbed in the form of boric acid and this process is primarily influenced by the factors such as soil acidity, structure, texture, soil water status and **clay and organic matter** status.



Fig 1. Typical wavy patterns on the leaves of young palms in the nursery

Often the nutrient management systems emphasize upon major nutrients such as N, P and K, forgetting the fact that at least 24 minerals are essential for proper plant cell development. This is particularly important when higher doses of major nutrients are applied leading to toxicity in soil as well as plant systems and complications related to chelation and poor availability of minor nutrients or low nutrient use efficiency at cellular levels. Boron is such a victim of higher doses of nitrogen application especially during summer months.

Generally, boron is immobile within the plant system and the transportation to the growing point is purely guided through the osmotic potential generated out of evapotranspiration. Summer being the season of restricted water availability, evapotranspiration rates should be lesser and hence the absorption and mobility of boron in the plant system may be affected. Moreover, under higher nitrogen levels within the cells, the use of absorbed boron by the cells will be severely hampered. From the soil solution, boron is passively absorbed in the form of boric acid and this process is primarily influenced by the factors such as soil acidity, structure, texture, soil water status and clay and organic matter status. Molecules such as iron and

aluminum oxides, magnesium hydroxide and calcium carbonate adsorb boron on their surface, reducing the availability to plants. Hence, it may be noted that excess lime application for mitigating soil acidity may act, as a contributory to lower boron availability and is equally problematic with excess nitrogen application.

Strengthening the cell wall and plasma membrane is the supreme function of boron molecules within the cells. The *cis*-diol molecules originating from boron protect cells from destructive peroxidation effects of free oxygen radicals. Under boron deficiency, cell membranes develop holes and cellular functions including proton pumping will be deactivated. This condition could be



Fig. 2. Initial symptoms of drying of young leaves

better assessed with enhanced levels of phenols and polyphenol oxydase enzyme within the cells. Also the levels of anti-oxidants such as vitamin C will come down drastically.



Fig. 3. Mortality of growing buds in acute boron deficiency

Boron is essential for the normal growth and development of coconut palms aging from 2 months to 14 years. In coconut nurseries raised in



Figure 4. Series of inverted 'V' shaped truncations on leaf

nitrogen rich soils during summer, boron deficiency symptoms are obvious. Initially the symptoms appear as poor unfurling of young leaves. Later these leaves show



Fig. 5. Tight fusion and poor unfurling of newly emerged leaves

typical wavy patterns on the leaflet midribs (Fig. 1). Advance stages lead to drying of young leaves from the tip (Fig. 2) and finally the mortality of growing buds (Fig. 3). In young



Fig. 6. Multiple unopened spear leaves at crown apex

coconut plants, symptoms may also be manifested in many other ways such as series of inverted 'V' shaped truncations on each leaf (Fig. 4). These truncations could be separate representatives of temporary deficiencies. The newly emerging spear leaves may be tightly fused

throughout the length or fusion may be restricted to basal or distal parts of the spear leaves (Fig. 5). At



Fig. 7. The Hook Leaf symptom

chronic state, multiple unopened spear leaves may be visible at crown apex (Fig. 6). The sharply bent leaflet tips called 'hook leaf' is yet



Fig. 8. Characteristic unidirectional bending of the crown

another typical chronic boron deficiency symptom (Fig. 7).

In palms aged up to 14 years, the entire crown could be dark green with leaflets showing typical spiraling pattern, poorly developed leaves, very few inflorescence with no nut set and subsequent leaves showing gradually reducing sizes. Later the entire crown tempts to bend in one direction (Fig. 8). This is one form of epinasty that may also cause twisting of leaves and petioles. This is caused by decreased IAA oxidase activity in the absence of boron leading to excessive auxin concentrations within the leaves. A few nuts, if set, will show characteristic markings (Fig. 9) and premature shedding (Fig. 10) due to

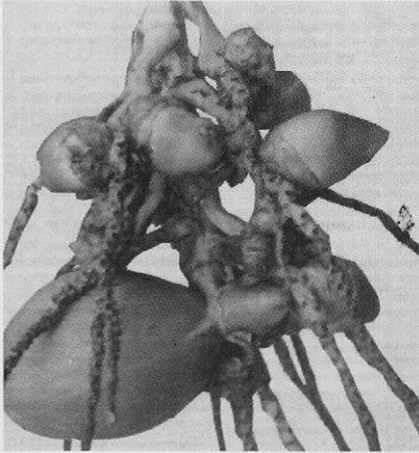


Fig 9. Markings on the developing nuts and bunch drying starting from the tips

excessive necrosis of **bunch**, starting from the tips.

Boron deficiency at nursery stage could be corrected through 0.2 per

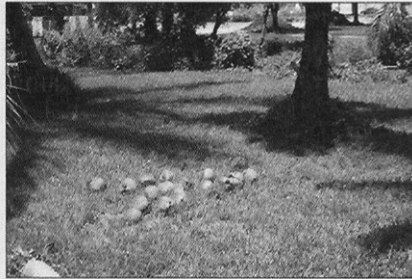


Fig. 10. Premature shedding of nuts due to boron deficiency

cent foliar sprays with Solubor 20 WP given in combination with 0.1 per cent adhesive Teepol, three times at weekly intervals. In nursery and for young palms, proper irrigation should be ensured especially during summer months. After field planting, there should be rational use of nitrogen as well as lime. Yearly basin application of 50g borax/ palm could save the palms from boron deficiency. Adult palms showing deficiency could be corrected with 1 per cent root feeding and 0.4 per cent foliar sprays.

Soap Making

Soap is made by mixing oil with a solution of caustic soda in water. When the caustic soda is mixed with oil, a chemical reaction occurs and all the component fatty acids of the oil are changed into sodium salts, known familiarly as 'soap'.

The oil, caustic soda and water used to make the soap have to be mixed together in correct proportions to ensure that the finished soap contains no excess caustic soda which would give a burning action on the skin. The oils used for soap making fall into two categories. In the first category are oils which are obtained from the kernels of different types of palms. The most commonly known oils in this category are coconut oil and palm kernel oil. They are known as 'lauric oils' because lauric acid is the major fatty acid that they contain. These fats make hard soap which produces fast foaming lather.

The second category comprises semi-solid oils such as palm oil and tallow. The oils of this group produce lather more slowly than the lauric oils but the foam is longer lasting.

To make soap by the cold process follow the following steps. Weigh one kilo of NaOH and two kilos of water, and pour the NaOH flakes in water and stir constantly until dissolved. Note that the mixture will get very hot and avoid inhaling the vapour over the hot solution. Set aside for cooling to a temperature of about 96°F.

Prepare six kilos of coconut oil and slowly pour this to the caustic soda solution, while constantly stirring the mixture in one direction. The mixture is kept stirred until it thickens to a desired consistency, approximately after 40 minutes to 1.75 hours. Add any desired color or essence. Stir and immediately pour into moulders and leave for about 24 hours for saponification.

Cut into desired sizes and dry or

age for at least one week to complete the chemical reaction. Wrap if desired and use the soap only after one week of aging.

To ensure good results, it is important that all ingredients, be measured as accurately as possible. A little extra oil may be allowed to ensure that all caustic soda is used. However, too much oil will give an oily residue, while too little oil will yield a soap which will contain free NaOH that is harmful to the skin.

NaOH is corrosive, so avoid using aluminum containers. Stir the mixture constantly in one direction to prevent the NaOH to solidify. Stirring less than the time required is not good for saponification while stirring more than the time required is not good for the moulding process. If you desire to have a harder soap, add one-half to one kilo sodium silicate to the above formula.

Source: The Cocommunity