Role of Magnesium in Coconut Cultivation

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All plants require nutrition in required quantities for proper functioning and development. The plants uptake the nutrients present in different forms in the soil. These nutrients play specific and combined roles in the metabolism/ various activities of the plant. The essential elements are classified as primary, secondary and micronutrients in the light of the roles they play in plant metabolism. Only the combined effects of these nutrients in adequate quantities with other favourable environmental and soil conditions including moisture availability, can facilitate maximum output. This is a brief compilation of studies related to role of magnesium in coconut cultivation.

Essential elements in coconut nutrition and role of magnesium

Coconut is a perennial plant with commercial importance. The rhizosphere of coconut is very limited compared to its biomass production and the palm extracts more nutrients from the limited soil volume to meet the year-round vegetative and reproductive growth in its life span of more than 60 years. Hence, if not properly manured, decline in productivity is often observed.

Potash has been found to be most important in coconut cultivation, followed by nitrogen. Taking into account the nuts, fallen leaves, spathes and the stem growth Pillai and Davis (1963) computated the annual exhaust of 65.6, 29.7, 84.5, 47.4 and 20.3 kg of N, P_2O_5, CaO and MgO, respectively from one hectare of 173 palms in sandy loam soil and observed the quantitative order of requirement of major nutrients for adult bearing palm as K>N>Ca>Mg>P. The leaves contain 75% of total calcium and 53% of total magnesium.

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Coconut is being cultivated in red, lateritic and sandy soils, in general, which are naturally poor in soil fertility. Secondary and micronutrient deficiencies are emerging as potential yield limiting nutrients for coconut. Among these, supply of magnesium, sulphur, boron and zinc are very important since they are generally in short supply in many of the coconut growing tropical soils. In India, both magnesium and sulphur are either deficient or tending towards deficiency in most of the soils in Kerala, Karnataka, Maharashtra and North Eastern States of India.

Magnesium deficiency is caused by insufficient Mg in the soil. Magnesium is readily leached from sandy soils and other soils having little cation exchange capacity. Mg deficient chlorosis is very common in most of the high rainfall regions. Mg is said to be deficient in coconut when the leaf Mg level goes below 0.2%.

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Correlation of Mg with other elements

Magnesium has positive and antagonistic effects with other elements in nutrient uptake by palms. Potassium is the most important element a coconut palm needs. Magnesium brings out full benefit of K-fertilization. However, liberal application of potash interferes with Mg uptake. A depressive effect on Mg content of copra was observed on potassium chloride application, due to K:Mg antagonism (J. Ohler).

Inadequate supply of magnesium adversely affects the translocation of phosphorus from roots to shoots which leads to delayed flowering. With calcium, a depressive effect of potassium and magnesium fertilizer was observed. The uptake of K, Mg and Na by coconut is often antogonised by very high availability of Ca in coral soils. Application of kieserite increased Mg contents in the husk and albumen. The shell does not contain P, Ca or Mg. Chlorine enhances better absorption of potash, phosphate and magnesium. Deficiencies of calcium, magnesium and potassium in the nutrient solution may also cause iron deficiency (Ohler).

The importance of balanced nutrition for better productivity in coconut is revealed from the observations by Mathewkutty et al. (1997) that continuous use of conventional fertilizers in middle aged WCT palms have lead to a stage of negative response owing to the deficiency of non recommended/applied elements like Mg and S and excess of Ca, Fe and Mn limits coconut yield.

The varietal differences on Mg sensitivity were also observed. Dwarf coconuts are more sensitive to magnesium deficiency than talls and hybrids (Ohler).

Under HDMSCS or coconut–grass and coconut–cocoa, where recycling of organic wastes was carried out, the results showed a decline with respect to Mg over the period (Bavappa and Jacob 1982, Biddappa et al. 1993). Similarly, a decrease in available Ca, Mg, Mn, Cu and Zn was observed in mixed farming system, though organic carbon, N, P, K and Fe status of soil has improved. (Maheswarappa et al. 1998 and Subramanian *et al*. 2014).

It does not mean that intercropping/ mixed cropping is detrimental to coconut. The elements are taken by different crops based on several conditions and they have to be supplemented properly.

Deficiency symptoms

In general, Mg forms the central atom of chlorophyll and hence has important role in photosynthesis. Hence, the deficiency causes chlorosis. As Mg is mobile in nature, the chlorophyll in older leaves are broken down and transported to younger ones which have greater photosynthetic needs. Hence, chlorosis due to Mg deficiency appears first in old leaves which later resembles in younger leaves as the deficiency progresses. Decrease in Mg levels in plants lead to decrease in photosynthetic and enzymatic activity within the plants as magnesium also acts as an activator for many critical enzymes, including those enzymes essential for carbon fixation. Magnesium is also crucial in stabilizing ribosome structures, hence, lack of magnesium causes depolymerization of ribosomes leading to premature aging of the plant.

As far as coconut is concerned, Mg deficiency may be one of the reasons for reduced yields. Visual symptoms alone are usually sufficient to diagnose Mg deficiency. Magnesium deficiency is characterized by chlorotic bands observed along the margins with the central portion of the leaves remaining distinctly green in the oldest leaves of palms. In severe cases leaflet tips may become necrotic. Older leaves become bronzed and dry in appearance. Leaflets show necrosis and turn to reddish brown with translucent spots. Yellowing starts at the tip and spreads to the base. The youngest leaves remain green. Mg deficient leaves are more sensitive to sunlight. The yellowing occurs principally in those parts of the leaves exposed to sunlight, the shaded parts rarely showing chlorosis.

The Mg and K deficiency can be differentiated that discoloration in K- deficient leaves is usually orange to bronze, shading gradually to green at the base of the leaf, whereas Mg- deficient leaves have distinctly green leaf centers and bright lemon yellow to orange margins.

However, the deficiency symptoms are visible only after a long time of the shortage of Mg and the negative impacts might have started much earlier. Monitoring of mineral contents in the palm is therefore imperative for good management. The three main systems used to determine fertilizer needs are leaf analysis, soil analysis and fertilizer

experiments. Leaf nutrient testing will be a promising tool to identify the existing crop nutrition related constraints in the perennial plantations like coconut and site-specific nutrient management options to improve the crop productivity. A critical level of 0.2% Mg (frond 14) under West Coast condition of India (Cecil, 1981, 1988); 0.24 to 0.25 % for the coastal sandy soil track of Odisha (Acharya and Dash, 2006) 0.30% for the West African Tall palms (by IRHO, Thampan 1982) have been worked out.

Management and other corrective measures

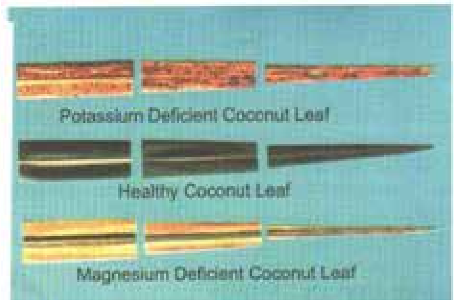
Growth and yield potential of palms is related to availability of the most limiting nutrient. The plant nutrient limitation may occur through the low nutrient content in soil or the antagonisitc effect of the high content of other nutrients. Therefore, sufficient supply of all the nutrients depends on the balanced nutrient status in the soil.

Coconut responds very well to judicious fertilizer application and irrigation. Soil and leaf analysis of palms under different cultural and fertilizer treatments strongly suggests that for satisfactory growth and productivity of palms in the red sandy loam soil, mere cultural treatments alone cannot improve the nutritional status of palms and supplementing the nutrition with inorganic fertilizer and organic manures is necessary to sustain productivity (Khan *et al.* 1996).

Soil application of $MgSO_4$ @ 1-2 kg/palm/year or Root feeding of 200 ml of 0.2% $MgSO_4$ twice a year is recommended by Tamil Nadu Agricultural University. Application of 1 kg lime or dolomite during April-May, 0.5 kg magnesium sulphate during August-

A coconut frond with Magnesium deficiency

A close view of coconut leaflets with Magnesium deficiency



Comparison of Potassium and Magnesium deficient coconut leaves with healthy coconut leaf

September and organic matter during June-July per palm per year is also recommended. Application of magnesium @ 500 g MgO per palm is also reported to be advantageous for the management of root (wilt) diseased palms to restore palm vigour and sustain the productivity. Foliar application of 2% $MgSO_4$ solution at quarterly intervals is also recommended in some cases. Micronutrient mixtures containing Magnesium also are available in the market.

A coconut palm with green leaves in upper part and yellowing in lower part

Maheswarappa *et al.* (2013) observed that fully organic nutrient management with recycling biomass (vermicompost) + biofertilizer + green manuring + vermiwash+ husk burial + mulching coconut basin could produce comparably similar yield of inorganic fertilized plots and the highest economic return. Gopal *et. al.* 2007 observed that coconut leaf vermiwash is alkaline and contains N, P, K, Ca, Mg, Zn, Mn in appreciable quantities.

Chemical fertilizers are normally recommended for application when sufficient moisture is available in the soil. In case of rainfed cultivation, application of fertilizers in two split doses, i.e. 1/3 at the time of onset of monsoon showers and 2/3 at the end of monsoon. Application of fertilizers in three or four equal doses in April-May, August-September, December and February-March can be adopted in case of irrigated conditions. The fertilizers and manures are to be applied in circular basins in the active root zone i.e. at a radius of 2.0 m from the base of the palm and 10 cm deep, opened after the onset of monsoon. Magnesium sulphate is dissolvable in water and can very well be applied through fertigation also.

Achieving and sustaining higher productivity and profitability from coconut farming is the primary objective of an enterprising farmer. The price fluctuation, declining fertilizer response owing to the deteriorating soil health, increasing cost of fertilizers and lack of availability of organic manures are few of the major factors challenging the farmers to meet the objectives. The site specific soil management strategies with judicious utilization of resources, cropping systems and external application of nutrients in required quantities can improve the coconut yield in a holistic way. ■

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