IS COMMON SALT AN ALTERNATIVE TO POTASSIUM NUTRITION IN COCONUT?

M.G. Bopaiah, *C.C.* Biddappa and V. Rajagopal
Central Plantation Crops Research Institute, Kasaragod - 671 124, Kerala, India

With rising price of various fertilizers in recent times, the innovative coconut farmers who are aware of the favourable effects of potassium on coconut production are seriously thinking of switching over to some alternative source which would replace potassium. Use of common salt is an age old practice in coconut cultivation. Fremond (1964) reported the result from young coconuts in the early stages of production and showed that the application of sodium chloride could increase significantly the number of inflorescences, bunches and nuts per tree. Experiments conducted in the Philippines revealed that soil application of common salt increased flower bunches, nut production, copra weight per nut and copra yield per tree, but not oil content (Magat *et al*, 1988). Although studies have been carried out on the quantity, time and the method of application of common salt on coconut, no definite recommendations are available. An attempt has been made to bring out certain realities of application of sodium chloride (common salt) in this article.

Sodium does not seem to be an essential element for any crop, even for salt march plants. Yet certain crops andoubtedly grow better in the presence of sodium than in their absence (Russel, 1973). Sodium in these cases appear to carry out some of the functions that potassium usually fulfils. The role of sodium in the nutrition of plants that need this element for optimum growth is not fully known, though one of its effects is to increase the succulence of the plant, i.e. the amount of water held by unit dry weight of leaf tissue. This may be the reason why it appears to increase the drought resistance of these plants (Russel, 1973). It is also found to increase the leaf area of sugar beet. Sodium prevents accumulation of other cations that may be toxic to the plant, for deficiency of one cation leads to accumulation of others. Therefore, there is a reduction in the extent of wilting and increase in the rate of leaf expansion. In roots, selective K and Na transport is a consequence of K stimulated Na efflux. It is opined that sodium may have an intermediate position and possesses an ambivalent character whereby it is a major element for sodium loving plants such as members of the Chenopodiaceae and a minor element for the non-sodium-loving plants (Hunter, 1975).

The role of potassium in protein and oil metabolism is well known in the plant system besides in photosynthesis, respiration and transport of assimilates. Potassium is clearly the most abundant cation in plant tissues and biochemical processes including photosynthesis. Potassium deficient leaves, generally accumulate soluble sugars and have reduced rates of assimilate export before photosynthetic rates are reduced as a result of the mineral deficiency. The mechanism of stomatal opening and closure is known to depend on K fluxes in guard cells. Thus K-deficient plants may have altered stomatal responses and thus water balance in the tissues. K plays a key role in the activation of enzymes and in plant growth and development. In all organisms it is known that more than 60 important enzymes are activated by K. Although many studies have shown the effect of varying potassium fertilization on yield, few studies have shown the effect of K on oil content or fatty acid composition of the seeds (Menon and Pandalai, 1960). Potassium removal by the coconut palm is exceptionally high because the husk is rich in K.

Chlorine is strongly considered by some workers as a macronutrient to two important tropical vegetable oil bearing crops i.e. oil palm and coconut (Ollagnier and Ochs, 1971). Chlorides are taken up by most plants except coconut and oil palm in small quantities. There is no strong evidence that chloride has any specific effect on plant growth, though it may sometimes hasten maturity. At nursery stage, only chlorine application improved the growth of the seedlings. From fifth year onwards CI application consistently increased nut production, copra weight per nut and copra yield/tree (Magat and Margate, 1990). Its main function is as an osmotic pressure regulator and a cation balancer. It seems that the stomata of coconut leaves deficient in chlorine do not function properly. Chlorine deficient palms have lower leaf production and lower number of leaves with slower growth than normal palms. Chlorine seems to have less influence on the number of nuts produced than on the size of the nuts. According to Von Uexkull (1985), coconut trees low in chloride have been associated with (i) a decreased growth rate (ii) a decreased number of nuts set (iii) a greatly decreased nut size (iv) a decreased N content in the foliage (v) droopy leaves and signs of moisture stress (vi) severe moisture stress resulting in frond breakage and (vii) a high incidence of leaf diseases especially grey leaf blight.

From the foregoing, it is clear that potassium has a direct role to play in the metabolic activities of the plant system involving enzyme activation, transport, photosynthesis, nitrogen regulation etc. Sodium and chlorine have to play their role in the transportation, cell turgidity, electron transfer and osmotic pressure regulation. With this back ground information, it is worth reviewing the work done in this country and elsewhere using sodium and potassium on coconut under field condition.

A field experiment on coconut palms using two levels of common salt (4.5 kg and 6.8 kg per palm per year) was conducted at CPCRI, Kasaragod (Ramanandan, 1977). The experiment was continued for six years in sandy, sandy loam and laterite soils. The results showed that increase in yield of nuts was not statistically significant. The possibility of moisture conservation in three coconut soils under the influence of common salt at two levels and potassium chloride at one level was determined through moisture per cent in soil. Analysis of the data revealed that the salts at the levels studied had no effect on the soil to retain more moisture though there was clear indication of difference in the mean moisture contents between the soils and depths. In the above experiment, the entire quantity of fertilizers were applied in the post monsoon period (August-Sept.).

An experiment was conducted for ten years in the Regional Agricultural Research Station of Kerala Agricultural University, Pilicode. Four levels of potassium as potassium chloride and sodium chloride were applied in a laterite soil on 24 year-old TxD palms.

The data revealed that yield of the palms increased continuously with time and the maximum increase was in 50 per cent substitution of potassium by sodium (as chloride). Though there was an increase in yield in comparison with control, the difference was not statistically significant (Prema *et al*, 1987). The treatments did not differ significantly in their influence on the copra weight per nut. Prema *et al* (1987) recorded antagonism between K and Na in leaves. It was reported that the moisture retention characteristics like field capacity, wilting coefficient and the percentage of available water in the soil were not significantly influenced by the substitution of potassium chloride by sodium chloride.

Recently another field trial on 20 year old coconut palms was laid out in CPCRI Kasaragod, in lateritesoil, with six treatment combinations of potassium and sodium with recommended nitrogen and phosphorous supply. According to the available results, nut yield, female flower production, nuts set per cent and number of leaf production per palm were not significantly affected by any of the treatment (Anon, 1994). However, application of 100 per cent K (1200 g K_2O) produced highest female flowers and nut yield per palm which was statistically significant. A maximum leaf chloride content of 0.52 per cent was recorded in 75 per cent K + 25 per cent Na treatment. With regard to leaf water potential (LWP) the palms under treatment with 100 per cent K tended to show high LWP, while there was only marginal difference in other treatments. Lipid peroxidation was higher in control palms and lower in other treatments particularly 100 per cent K. These findings show the beneficial effects of K on water relations of palms under rainfed conditions. Adverse effects of common salt on soil pH and salt content were not noticed upto 2.0kg salt application. With regard to the time of application in the first trial at CPCRI the entire dose of fertilizers were applied in the month of Sept-Oct. In the second trial, the fertilizers including sodium chloride were applied in two split doses (1/3rd and 2/3rd) at the soil surface and forked into the soil in May-June and Sept-October respectively.

Though the studies conducted in India have not yielded statistically significant results to prove the benefits of sodium chloride application with or without potassium chloride (muriate of potash), there are indications that a small portion of potassium chloride can be substituted by sodium chloride application as seen in the study conducted at Kasaragod and Pilicode, where moderate increase in nut yield in adult palm and increase in leaf number in young palm were recorded compared to other treatments (Table 1).

However, superiority of muriate of potash cannot be ruled out for higher productivity of coconut.

Reports from Philippines and other countries do show that sodium chloride application upto 7 kg per palm increases production and leaves no harmful effect (Magat *et al.*, 1988). The reason lor the above results could be attributed to enrichment of chlorine in the soil and higher leaf concentration of the same. The results of the experiments conducted in Kasaragod which is nearer to the sea coast could not support the above mentioned findings. The Philippine workers (Magat and Margate, 1990) have fixed leaf Cl content of 0.55 per cent as critical

Table 1. Mean values of coconut yield, nut set, leaf number and leaf production (Kasaragod 1994)

Treatments	Coconut yield (No./palm)	Fe. flowers (Nos.)	Nut set (%)	Leaf/ yr. (No.)	Total leaf/ palm
T1 100% K+O+Na	76.8	211.7	36.5	10.3	24.8
T2 75% K + 25% Na	60.8	184.6	33.8	10.9	23.2
T3 50% K + 50% Na	56.3	202.7	26.1	10.7	23.9
T4 25%K + 75% Na	71.4	186.7	39.5	10.3	23.6
T5 O-K + 100% Na	63.1	191.7	33.9	10.0	22.2
Control (N&P only)	51.6	146.7	37.4	10.6	21.4
C.D at 5%	13.58	N.S.	N.S.	N.S.	N.S.

limit which is also recorded in the trials conducted at CPCRI Kasaragod.

Some workers consider chlorine (CI) as a macronutrient for coconut and oil palm (Ollangnier and Ochs, 1971, Von Uexkull, 1985). The CI application on oil palm in the form of potassium chloride improved the yield appreciably accompanied by increased leaf Cl and not K. This indicates that chloride deficiency exists and yield is positively correlated with leaf Cl. Studies on coconut in the Philippines clearly demonstrated the need for Cl. Such studies in Sri Lanka has also shown positive relationship of chlorine with coconut yield. It is also observed that the sodium chloride application could increase the number of inflorescences, bunches and nuts per palm significantly. Now it is clearly established that coconut palms require large quantities of potassium and chlorine. Coconuts grown on coastal sands and sandy loam will be deficient in K and adequately supplied with chlorine, whereas coconuts grown in inland areas are likely to be deficientin chlorine. In general, where potassium and chlorine are deficient, application of N and K are ineffective. However, it is difficult to discriminate between effects of potassium and chlorine at this juncture. Further study in the inland areas and under controlled conditions will generate valuable information on the role of sodium and chlorine on coconut.

References

Anonymous, 1994. Annual Report of the Central Plantation Crops Research Institute, Kasaragod, Kerala. p.66-67.

Fremond, 1964. The contribution of IRHO to the mineral nutrition of the coconut palm. Proc. Second Session. FAO Tech. Wkg. Pty. Cocon. Prod. Prot & Proc. Colombo, Sri Lanka.

Hunter, D.G. 1975. Sodium as a plant nutrient, World Crops, 27(6): 251.

Magat, S.S., L.M. Alforja and L.G. Oguls. 1988. An estimation of critical and optimum levels of leaf chlorine in bearing coconuts. A guide for foliar diagnosis. The Philippine Journal of Coconut Studies. 13(2):6-10.

Magat, S.S. and R.Z. Margate, 1990. The chlorine needs of coconuts. CORD VI: 30-51.

Menon, K.P.V and Pandalai, K.M. 1960. The coconut palm - A monograph. Times of India Press, Bombay, India. p.156.

Ollagnier, M and Ochs R. 1971 The chlorine nutrition of oil palm and coconut. Oleagineaux 26(6): 367-372.

Prema, D., A.I. Jose and P.K. Narayanan Nambiar, 1987. Effect of sodium chloride on growth and yield of coconut palms in laterite soil. Agri. Res. J. Kerala. 25(1) pp.66-73.

Ramanandan, P.L. 1977. Nutritional studies in coconut soils and coconut palm. Thesis submitted to the University of Kerala in fulfilment of the requirements for the degree of Doctor of Philosophy.

Russell, E.W. 1973. The individual nutrients needed by plants. In: Soil conditions and plant growth p.31-48.

Von Uexkul, H.R. 1985. Potassium nutrition of some tropical plantation crops. Proc. of an Intl. Symp. on Potassium in Agriculture held 7-10 July 1985 in Atlanta. p.929-954.

MULTI-NUTRIENT VALUE OF ASH

Though ash is primarily looked upon as a potassic manure it is sometimes rich in other nutrients such as phosphoric acid, calcium and magnesium. Because of its high calcium content it can be a very effective liming material in acid soils. Again, ash may contain all the other mineral elements including trace elements depending upon the original composition of the material from which it is derived and these may be of considerable value in correcting trace element deficiencies, if any, in the soil. It is probably because of these other advantages that ash has given sometimes better results than pure inorganic form of potash when applied on equivalent potash basis.