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Effect of long term application of graded levels of NPK fertilizers on soil and leaf micronutrient status of hybrid coconut

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Coconut is grown in an area of 1.91 million ha in India with an annual production of 12141 million nuts and a productivity of 6345 nuts / ha. The coconut palm is versatile in its adaptability to a wide range of soil and climatic conditions (Khan *et al.*, 1994). Large-scale fertilizer demonstration trials conducted in WCT palms showed that application of 340:340:680 g of N, P_2O_5 and K_2O/palm/year resulted in increased yield. A quantity of 560:320:1200 g N, P_2O_5 and K_2O /palm/year is recommended for adult tall coconut palms under Tamil Nadu conditions (Anon, 1999). Chandrasankara, a hybrid (COD x WCT) was released during 1985 for cultivation in Kerala, Tamil Nadu and Karnataka. However, not much information is available on the micronutrient status of the soil cultivated to hybrid coconut and the plant nutrient status when NPK fertilizers are continuously applied to palms under Tamil Nadu conditions. Hence, the present study was undertaken in an ongoing NPK experiment.

A field experiment was conducted from 1988-89 to 1999-2000 at the Coconut Research Station, Aliyarnagar under the All India Coordinated Research Project on Palms to study the effect of graded levels of NPK fertilization on coconut hybrid, Chandrasankara (COD x WCT). The seedlings of Chandrasankara were planted during December 1988. The experimental site has sandy loam soil and analysed low, medium and high in available N (160 kg/ha), P_20_5 (11.5 kg/ha) and K_20 (410 kg/ha) with pH of 7.7 and EC of 0.14 dSm/m. The treatments comprised of three levels of N (0, 500, 1000 g/palm/year), three levels of P_2O_5 (0, 250, 500 g/palm/year) and K_2O (0,1000 and 2000 g/palm/year), which formed 27 treatment combinations. The experiment was laid out in 3^3 confounded design with two replications.

The fertilizers were applied in two splits during June and December as per treatment schedule in circular basins of 1.8 m radius around the bole and incorporated. During April 2000, soil samples were collected as per conventional procedure, 1 m away from the base of the palm from three locations at different depths and were pooled depth wise. The samples were air-dried and 2 mm fraction of the soil was analysed for pH, available micronutrient status (Lindsay and Norwell, 1978) in a Varian atomic absorption spectrophotometer. Leaf samples were collected from the 14^{th} leaf (Prevot and Bachy, 1962) starting from first fully opened leaf and the di-acid extract was analysed for micronutrients.

The results revealed that the soil available Zn, Cu, Fe and Mn were not statistically different among the NPK levels even after continuous application of NPK fertilizers for a period of 12 years (Fig.1). However, the Zn content numerically increased from 1.07 (N_0) to 1.18 ppm (N_2 level) at 0-25 cm depth. The zinc content was 1.19 ppm in the soil, which received 500 g/palm/year. Annual application of fertilizers led to increase in levels of available P which decreased Zn from 1.19 to 1.00 ppm at 0 – 25 cm depth and 1.10 to 0.93 ppm at 25 –50 cm depth. Increased levels of potassium also slightly increased the available Zn status. At all levels of added N, the Cu content of the soil also slightly decreased with depth. The Cu content slightly increased at 250 g level of P at 0-25 cm depth but it slightly, decreased with added levels of P at 25 –50 cm depth. Similarly the Cu content slightly increased with additional levels of K at 0 – 25 cm depth and it slightly decreased with added levels of K in the 25 – 50 cm layer.

The Fe content decreased with the added level of N at 0 – 25 cm depth but slightly increased in the second

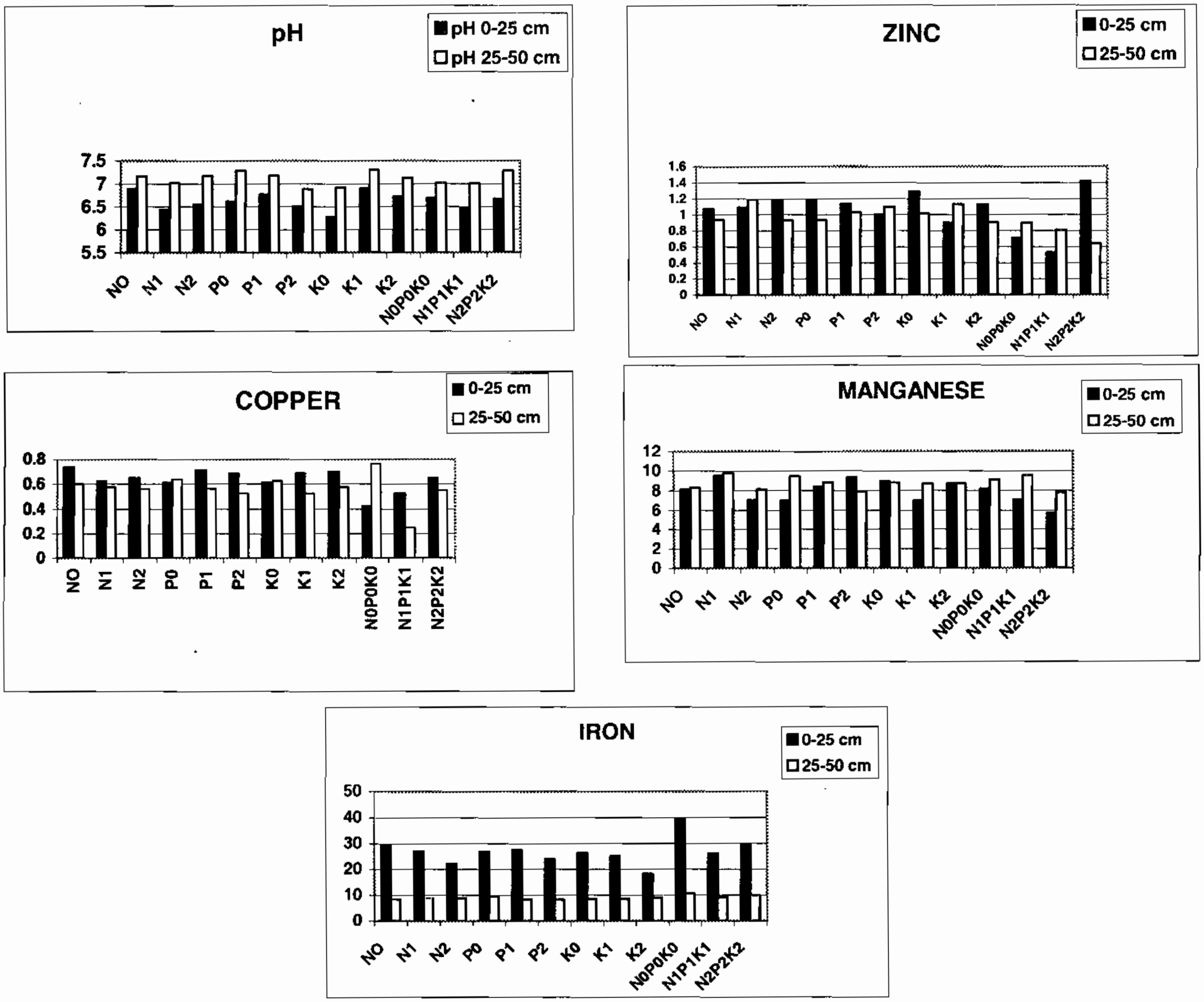

Fig.1 Effect of graded levels of fertilizers on the soil available micronutrient status (ppm)

layer. The difference in the availability of Fe between surface (0 – 25 cm) and sub-soil layer (25-50 cm) was high. Added levels of P decreased the Fe content of 27.5 to 24 ppm at 0 – 25 cm depth and from 9.42 to 8.33 ppm at 25 – 50 cm depth. Levels of K in soil also slightly decreased the available Fe. Among the levels on N in soil, the available Mn was higher at all the depths at 500 g N application. It was 9.47 and 9.74 ppm at 0-25 and 25-50 cm, depth, respectively. Levels of P increased the available Mn in the surface. The available Mn increased from 6.97 to 9.32 ppm in the first layer. The available Mn content decreased at K_1 level in both the layers.

Added levels of NPK fertilizers decreased the available Zn content from 1.42 ($N_0P_0K_0$) to 0.58 ($N_2P_2K_2$) at 0 – 25 cm depth and similar decrease was also observed at 25 –50 cm depth. However, the available Cu content slightly increased with increased level of NPK fertilizers at 0 –25 cm depth. The available Fe content decreased from 39.7 to 24.5 ppm with increasing levels of NPK fertilizers at 0-25 cm depth. The Mn content also decreased from 8.2 to 5.7 ppm with increasing levels of NPK fertilizers at 0 –25 cm depth. However, Khan *et al.* (1986) reported slight increase in soil micronutrients Zn, Cu, Fe and Mn after 18 years of application in a red sandly loam soil in the high rainfall zone of west coast of India.

Application of N @ 500 g/palm/year recorded a maximum Zn content of 61 ppm in the index leaf (Table 1). At very high level of N (1000 g per palm) the leaf Zn content decreased to 54 ppm almost equal to that recorded in palms not receiving added N. The Zn content of leaf decreased with increased levels of P. The leaf Zn content increased with increased levels of K and increased from 52 ppm to 65 ppm. The leaf Cu content and Fe content decreased with increased levels of N. Fe decreased from 465 ppm to 405 ppm at 500 g N level. The Fe content of the index leaf slightly decreased with increased levels of P. However, the K levels did not influence the Fe content very much. The leaf Mn content decreased with increased levels of N and it decreased to 119 ppm of Mn with 500 g N compared to 137 ppm with N_0 application. Khan *et al.* (1986) reported that there were changes with the leaf Cu, slight decrease in Zn, no change in Fe and Mn content with the continuous fertilizer application for 18 years. Increased levels of NPK decreased the leaf Zn, Fe and Mn, whereas the Cu contents increased in the leaf. Leaf Zn content decreased from 43 ppm at $N_0P_0K_0$ level to 33 ppm at 1000 g $N_1P_1K_1$ level. The leaf Mn content decreased from 211 ppm at $N_0P_0K_0$ to 99 ppm at 1000 g $N_2P_2K_2$ level. Leaf Fe content decreased from 452 ppm at $N_0P_0K_0$ level to 385 ppm at 1000 g $N_2P_2K_2$ level. Increase in the Cu content was observed from 19 ppm to 30 ppm with added levels of NPK. Application of N, P_2O_5 and K_2O @ 500:250:1000 g/palm/year did not cause any deficiency in the coconut leaf and all the micronutrients were at sufficient level.

Table 1. Effect of graded levels of NPK on the leaf micronutrient status (ppm)

NPK levels	Zinc (Zn)	Copper (Cu)	Iron (Fe)	Manganese (Mn)
N_0	55	28	465	137
N_1	61	27	405	119
N_2	54	25	414	126
P_0	64	25	439	115
P_1	62	29	436	139
P_2	45	26	410	128
K_0	52	28	427	130
K_1	54	26	423	145
K_2	65	26	435	107
CD(P=0.05) N	10	NS	41	19
$N_0P_0K_0$	43	19	452	211
$N_1P_1K_1$	38	30	433	109
$N_2P_2K_2$	33	30	385	99

Based on the critical limit of DTPA micronutrients in soil established elsewhere (Krishnasamy *et al.*, 1994), Zn and Cu were found to be deficient while Fe and Mn were sufficient in the soil. But the observed plant nutrient levels of Zn, Cu, Fe and Mn were adequate and in the sufficiency range (Campbell, 2000). Hence, application of micronutrients may be done considering the available soil micronutrient status and nutrient concentration in the diagnostic leaf (14th leaf). Based on the results it can be concluded that application of N, P_2O_5 and K_2O @ 500:250:1000 g/palm/year is optimum to maintain adequate levels of Zn, Cu, Fe and Mn in the hybrid palm, Chandra Sankara. There is also a need to establish optimum micronutrient concentrations in soil especially for Fe, Mn, Zn, Cu and B.

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