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EFFECT OF PHOSPHORUS SKIPPING ON THE YIELD AND NUTRITION OF COCONUT PALM (*COCOS NUCIFERA* L.)*

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ABSTRACT

The skipping phosphorus fertiliser application to adult coconut palms has resulted in the reduction of soil available P from 84 to 59 ppm at 0–30 cm depth and 24 to 13 ppm at 30-60 cm depth in the coconut basins. Neither a reduction in soil available phosphorus nor an increase consequent to fertiliser application at two levels for the past six years has significantly influenced foliar P levels and yield. The possibility of skipping application of phosphatic fertilisers to adult coconut groves in soil where available P is around 24 ppm at 30 to 60 cm depth is outlined. The usefulness of foliar P levels as a guide to fertiliser application seems to be doubtful.

INTRODUCTION

The beneficial role of phosphorus on adult coconut palms has always been a debating question. Eden, Gowert and Salgado, (1963) in Sri Lanka, Pandalai and Marar, (1964) in India, Smith (1966) in Jamaica, Uexkull (1972), Barile and Azuceana (1972) in the Philippines did not obtain much improvement in the yield of adult coconut palms due to the application of phosphorus fertilisers. As phosphates are non-renewable resources and the present energy crisis has revived interest in phosphate release studies from unavailable forms, it is worthwhile to examine the possibility of utilizing accumulated P reserves in soil in the economic management of adult coconut gardens. Wahid, Kamaladevi and Haridasan, (1977) suggested the possibility of skipping phosphorus in adult coconut gardens following regular application of phosphatic fertilisers. This study examines the possibility of such an approach in phosphorus management of adult coconut gardens.

MATERIALS AND METHODS

The experiment was laid out in May 1975 in a randomised block design with six treatments and seven single palm replications on 22 year old West Coast Tall palms growing on a red sandy loam soil. The pH of soil in the coconut basin varied from 4.1 to 5.2 and organic carbon from 0.65 to 0.14 per cent with depth. The available P status (Bray–1) was 84 – 88 ppm at 0–30 cm depth and 24 – 34 ppm at 30 – 60 cm

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depth and the available K varied from 65 to 360 ppm in the basins. The experimental treatments consisted of three levels of phosphorus at 0, 160 g and 320 g P_2O_5 per palm per year as superphosphate and two levels of slaked lime at 0 and half the lime requirement over a basal application of 500 g N as urea and 1200g K_2O as muriate of potash. The slaked lime application was withdrawn after two years leaving only three treatments. The soil and leaf nutrient status was monitored annually from the commencement of the treatments. Periodical observation on yield was also recorded.

Soil at three depths (0–30, 30–60, 60–90 cm) were collected from the coconut palm basins at a distance of 1.00 to 1.20 m from the palm. Air dried and sieved samples (2 mm) were analysed for available phosphorus (Bray-1).

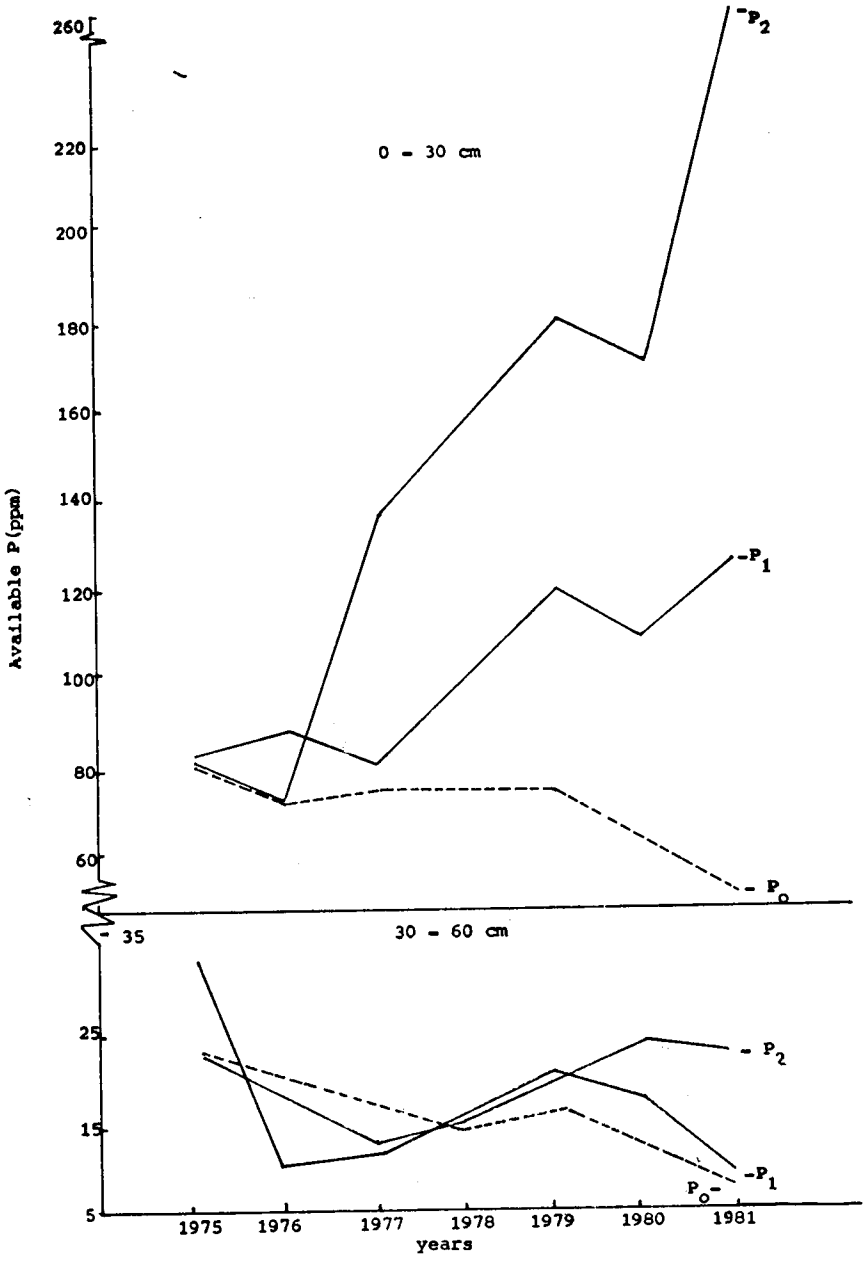
Leaf samples taken from 14th frond (Prevot and Bachy, 1962) of each palm were dried, ground and analysed for P (Venadomolybdate method) and K (flame photometry) after digestion with 1:2 perchloric-nitric acid mixture. Nitrogen was determined by micro Kjeldahl procedure.

RESULTS AND DISCUSSION

As a result of regular annual application of phosphorus for the last 22 years, there was a considerable build up of available phosphorus in the basins of coconut palms. Prior to commencement of the experiment, the available P status in the 0–30 cm and 30–60 cm were in the range of 84–88 ppm and 24–34 ppm respectively (Fig. 1). The discontinuation/skipping of application of phosphorus fertiliser has resulted in the reduction of soil available P from an initial status of 84 ppm to 59 ppm (a reduction of 29.7%) whereas annual application has increased the available P level from 88 to 133 ppm at 160 g P_2O_5 per palm per year (an increase of 51.3%) and from 84 to 266 ppm at 320 g P_2O_5 per palm per year (an increase of 216.6%). While lowering of soil available P was observed in the 30–60 cm depth in the P skipped treatment, mobility of applied P to a certain extent to the lower depths was noticed in the P applied and P skipped treatment basins. The trend was not very consistent (Fig. 1). A reduction in soil available P was also observed in the 0–30 cm depth in the P skipped treatment over years, but such a change in the 30–60 cm depth is considered as an index to P skipping in view of the fact that majority of the roots are observed in this layer (Kushwah et al., 1973) and it is logical to assume that nutrients to a certain extent are taken from this zone. A slight mobility of applied P is observed in this soil to lower depths even in P skipped treatment. Thus the accumulated P reserves in the surface layer is of value in the long term P management in these soils. However, better utilization of applied P by coconut can be obtained if deeper placement (below 30 cm) of phosphorus is resorted to in the fertiliser application practice.

Wahid et al., (1975) observed no reduction in either soil or foliar P levels when phosphorus fertilization was discontinued for one year. However, in the present investigation a gradual

FIG. 1. INFLUENCE OF PHOSPHORUS SKIPPING (P_0) AND FERTILIZATION (P_1, P_2) ON AVAILABLE P - PPM



reduction of soil available Phosphorus at the rate of two ppm (Bray-1 extractable) in the 30-60 cm depth in the basin is observed when an overall picture of six years was examined.

The pre treatment N levels in the diagnostic leaf was in the range of 1.5 to 1.6%; P 0.090 to 0.100% and that of K in the range of 1.1 to 1.3% indicating that K is above critical level (Fremond, 1966) and that of N and P are near sufficiency range. The discontinuation of P fertiliser application for six years had no significant effect on foliar P levels (Table I) indicating the efficiency of accumulated residual P reserves in soil in supplying the P needs of the palm. Despite the fact that skipping P fertiliser application has reduced soil available P status from 24 to 13 ppm at 30-60 cm depth, the annual application of P at two levels and consequent enhancement of available P in the basins also has neither influenced the foliar P levels (Wahid et al; 1975; Kamala Devi, Velayutham and Haridasan 1983) nor yield. This suggests that application of P beyond a certain level on these soils has no beneficial influence on adult coconut groves. Probably to get an indication of the limiting influence of P we may have to wait for some more years under the frame work of this experiment.

The critical level for P was proposed as 0.100 per cent and has been revised to 0.120 per cent (Manciot, Ollagnier and ochs 1979). In the present study neither skipping P nor annual application of phosphatic fertiliser has significantly influenced foliar P levels eventhough a slight increase is observed at P_2 level (360 g P_2O_5) of fertiliser application. It is also to be noted that even after continuous fertiliser application for the past 28 years, the foliar P levels did not reach the critical level of 0.120 per cent. The stable foliar levels of P under the influence of annual P dressings on one hand (P_1 and P_2) and annual skipping of phosphorus application (P_0) on the other suggests that an equilibrium is likely to be established when a particular concentration in the soil available P is attained.

An yield distribution of 77 - 116 nuts (Table II) were observed for foliar levels in the range of 0.092 per cent to 0.105 per cent. The non-significant correlation coefficient (r = 0.004)

Table I. *Effect of phosphorus skipping (P_0) and fertilization (P_1 and P_2) on the leaf phosphorus status (%) of coconut palms*

Treatments	Year						
	1975	1976	1977	1978	1979	1980	1981
	leaf phosphorus (%)						
P_0	0.093	0.096	0.103	0.098	0.098	0.098	0.097
P_1 (160 g P_2O_5/palm/Yr)	0.092	0.084	0.107	0.100	0.095	0.096	0.098
P_2 (320 g P_2O_5/palm/Yr	0.096	0.092	0.110	0.105	0.101	0.101	0.105

Table II. *Influence of phosphorus skipping (P_0) and fertilization (P_1 and P_2) on yield of palms (Nuts/Year)*

Treatments	Year						Pooled yield
	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1976-77 to 1980-81
P_0	103.2	71.6	111.2	107.1	107.4	99.2	496.4
P_1 (160 g P_2O_5/palm/Yr.)	101.1	81.7	103.5	108.6	102.5	84.9	478.2
P_2 (320 g P_2O_5/palm/Yr.)	99.6	78.6	116.3	133.3	107.2	99.4	520.5
SE/Plot	-	20.8	20.5	49.6	30.5	26.1	91.5
General mean	-	77.3	110.3	116.3	105.6	93.4	498.3
CV%	-	26.9	18.6	42.7	28.8	27.9	18.3

suggests that the foliar levels are not related to the yield and the reliability of foliar levels of P in yield judgement is of doubtful value. These observations suggest that the foliar critical levels of P cannot be relied upon as a guide for fertiliser application or yield enhancement.

The study outlines the possibility of utilising the accumulated reserves of phosphorus in soil in situations where high available P of more than 24 ppm in the 30-60 cm depth is observed in coconut basins. Under such situations application of phosphatic fertilisers can be profitably skipped atleast for six years without reduction in yield provided recommended levels of N and K fertilisers are applied. This also has an economic bearing in the management of adult coconut groves.

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