

Effect of N, P & K nutrients on the growth of coconut seedlings

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NITROGEN (N), Phosphorus (P) and Potassium (K) as major nutrients have been the subject of several studies with reference to manuring of field crops. Such studies have been conducted in detailed manner on oil palms, by French workers. The role of potash as a fertilizer in coconut cultivation has been discussed by Salgado (1953) and Pandalai and Menon (1957). Employing leaf analysis as the technique for nutrient requirement studies, Balakrishnan Nambiar and Pandalai (1959) have discussed the role of the nutrients on the growth of coconut seedlings with special reference to deficiency symptoms. A pot culture experiment on similar lines was conducted at Central Coconut Research Station, Kayangulam, with a view also to study whether the disease syndrome of Root (wilt) disease of coconut palms has got any similarity, with deficiency symptoms of these major nutrients. The present paper deals with the results of these studies conducted under controlled conditions.

EXPERIMENTAL

Fiftysix one-year old coconut seedlings of the green dwarf variety were used for this study. The seedlings were raised in the nursery and were transplanted to bitumin coated clay pots (size 35.5 cm. x 35.5 cm. x 39.0 cm.). This type of pots has been used at Long Aston and other places for large scale sand culture experiments (Hewitt, 1952). Coarse river sand, washed thoroughly with water was used as the growth medium. When the seedlings got fully established in the pots they were arranged in a pot culture house in a randomised position and application of nutrients started.

Nitrogen, Phosphorus and Potassium were supplied to the seedlings in the form of urea, sodium pyrophosphate and potassium chloride respectively, in aqueous solution. They were given at the rate of 1/40th of the field dose, the field dose being N-0.75 lb., P₂O₅-0.75 lb. and K₂O-1.5 lb. per tree per year.

The treatments consisted of all possible combinations of N, P and K in 2³ factorial design with seven replications for each treatment. The treatments (T) were as follows:—

T1 - N ₀ P ₀ K ₀ (Control)	T5 - N ₁ P ₁ K ₀
T2 - N ₁ P ₀ K ₀	T6 - N ₁ P ₀ K ₁
T3 - N ₀ P ₁ K ₀	T7 - N ₀ P ₁ K ₁
T4 - N ₀ P ₀ K ₁	T8 - N ₁ P ₁ K ₁

The seedlings were supplied with nutrients once in every week. Weekly doses of nutrients were calculated as:

Urea	—	0.351 gm.	per seedling
Sodium pyrophosphate	—	0.514 gm.	„ „
Potassium chloride	—	0.518 gm.	„ „

Stock solutions of these nutrients were prepared and preserved for subsequent use. The pH of the stock solution was adjusted between 6-7. Every week 25 ml. of the stock solution was diluted to 1000 ml. with distilled water and applied to the treatment concerned. The control seedlings were given 1000 ml. distilled water alone. After one year of the first application of nutrients the level of the nutrients was raised to 1/20th of the field dose. Besides, at this stage all the seedlings were treated with 1/40th of the field dose of all the micronutrients. These changes were thought worthwhile in order to meet the requisite amounts of nutrients for the growing seedlings.

At the end of two years morphological observations like girth at collar, number of leaves produced and total height were recorded and representative leaf samples collected from the seedlings were analysed for N, P and K. The analysis of N, P and K in the leaves was conducted as per the method described by Piper (1944).

RESULTS

Observations on the seedlings revealed that nitrogen deficiency produced yellowing while necrosis of foliage tips was noted in the case of potassium deficiency. The data on growth characters are presented in Table 1. It may be observed that the seedlings have responded favourably to treatments NPK, NK and NP as reflected on the growth characters such as girth at collar, height of seedling and number of leaves produced. Seedlings receiving NPK treatment showed better growth than all the others. Of

the NP and NK treatments there is no marked difference between them in their growth characters. In the case of PK treatment the response of the seedlings is not as good as in the case of NP or NK treatments.

The individual effects, of nutrients based on the statistical analysis, are separately shown in Table 2. As may be observed from the table, nitrogen has produced better effects on all the growth characters of the seedlings than P or K. While phosphorus effected increase in girth and number of leaves, potassium helped to increase only the girth (at collar) of the seedlings.

As regards nutrient status in the leaf, it may be seen, that the application of nitrogen enhances its status in the leaf and depresses the level of potassium, significantly. Phosphorus application increases the potassium content of the leaf significantly, although its own status as well as that of nitrogen is not markedly affected. On the other hand, the application of potassium increases its status in the leaf significantly, and decreases the status of phosphorus and nitrogen to a considerable extent.

DISCUSSION

An interesting result obtained from this experiment is the significant role of nitrogen on the growth of coconut seedlings when this element is applied singly or in combination with phosphorus or potassium. Similar results have been reported earlier by Balakrishnan Nambiar and Pandalai (1959). Besides, the coconut seedlings seem to show maximum response when all these three elements (N, P and K) are supplied to them.

Nitrogen, singly or in combination with phosphorus has depressed the potassium content of the leaf although the growth characters of the seedlings have significantly improved. This gives the indication that the demand of coconut seedlings for potassium is comparatively little as against that of nitrogen. Balakrishnan Nambiar and Pandalai (1959) have reported an increase in the phosphorus content of the leaf when P is added. However, it may be observed from the present studies that phosphorus applied singly or in combination with other elements has not increased the phosphorus content of the leaf significantly (Table 2). Moreover, potassium either singly or in combination has significantly decreased the phosphorus content of the leaf. Even when NP and NPK treatment effected marked increase in the growth of seedlings, phosphorus content of the leaves is not significantly changed.

The addition of potassium either alone or in combination with nitrogen increases the potassium content of the leaf. It may also be noted that the potassium content of the leaf in the case of NPK treatment is greater than that of NK treatment. These results indicate that the role of phosphorus is indirect as far as the growth of the seedlings is concerned.

Evidences to show that phosphorus is closely linked with the uptake of potassium in plants have been reported by several workers (Scott, 1945; Courie, Roberts and Roberts, 1949; Mullius, 1949; Roberts, Roberts and Courie, 1949). The present studies also seem to indicate such a role of phosphorus in coconut seedlings, as may be observed from Table 2. It may be that while playing its significant role in the carrier system of plant metabolism, potassium is closely associated with the phosphorylation for the formation of its salts (Courie, Roberts and Roberts; *Loc. cit.*).

SUMMARY

A statistically laid out sand culture experiment was conducted to study the effect of N, P and K nutrients on the growth of coconut seedlings. Results reveal that the role of nitrogen in the growth of coconut seedlings is much more significant than that of phosphorus or potassium. The role of phosphorus seems to be only indirect in that this element probably enhances the uptake of potassium. The seedlings showed maximum response to the treatment of N, P, K combinations, as compared to other combinations. In general, no similarity could be observed between the disease syndrome characteristic of Root (wilt) disease and the deficiency symptoms of N, P and K nutrients on the seedlings.

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TABLE 1

Showing the percentage of nutrients in the leaves of the treated seedlings and the growth characters of the seedlings (average of seven replications).

Treatment	N%	P ₂ O ₅ %	K ₂ O%	Girth at collar in cm.	No. of leaves produced	Height of seedlings in cm.
N	2.28	0.68	0.58	18.4	20	119.7
P	0.69	0.66	1.07	18.1	17	106.8
K	0.70	0.45	1.70	19.1	17	107.5
NP	2.09	0.71	0.96	20.7	21	127.1
NK	1.79	0.52	1.77	20.1	20	125.0
PK	0.75	0.64	2.81	19.0	18	112.1
NPK	2.08	0.66	1.99	22.7	20	144.0
Control	0.69	0.73	1.23	16.9	17	103.0

TABLE 2

The main effects of different treatments on the growth characters and nutrient status of seedlings

FACTORS	GROWTH MEASUREMENTS			NUTRIENT STATUS		
	Girth in CMS	Height in CMS	No. of leaves	N%	P ₂ O ₅ %	K ₂ O%
N ₀	18.27	107.5	17.1	0.706	0.615	1.701
N ₁	20.48	128.9	20.2	2.058	0.644	1.349
P ₀	18.64	113.8	18.2	1.363	0.598	1.356
P ₁	20.11	122.6	19.1	1.401	0.661	1.694
K ₀	18.52	114.2	18.6	1.436	0.690	0.966
K ₁	20.23	122.2	18.7	1.328	0.569	2.084
General	19.38	118.2	18.7	1.382	0.630	1.525
mean S.E.	0.344	2.604	0.197	0.023	0.020	0.057
C.D. at 1% level	1.315	9.944	0.754	0.088	0.076	0.219

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Year	Author	Journal	Volume	Page	Notes
1959	Balakrishnan Nambian and Pandolai, K. M.	Proc. First Conference of Coconut Research Workers in India.			
1949	Courie, O. B., Roberts, R. B. and Roberts, I. Z.	J. Cellular Comp. physiol.	34	243-57	
1952	Hewitt, E. J.	Tech. Comm. No. 22 of the C. B. of Hort. and Plantation Crops.			
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1957	Pandolai, K. M. and Mepon K. P. V.	Indian Coconut J.	10	12-28	
1944	Piper, C. S.	Soil and Plant Analysis, Univ. Adelaide, Waite, Agri. Res. Inst. Monograph.			
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1953	Salgado, M. L. M.	Oleagineux	8	297-98	
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1951	Robertson, R. N.	Inorganic Plant Nutrition. Ann. Rev. Plant Physiol	2	1-34	Quoted from