RESPONSE OF HIGH YIELDING COCONUT GENOTYPES TO FERTILISER LEVELS UNDER RAINFED CONDITIONS

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ABSTRACT

A field experiment was conducted to determine the NPK fertiliser requirement of three coconut genotypes viz. West Coast Tall progenies of high yielders, Dwarf × Tall and Tall × Dwarf and evaluate their performance under three levels of fertiliser application. The genotypes did not differ in their response to 'no fertiliser' treatement. When NPK fertiliser was applied, the D × T hybrid outyielded the Tall and the reciprocal hybrid T × D. Contrary to expectation, the response of the Tall was found linear, at the higher level of fertilisers. The response to the higher level of fertilisers by the hybrids was negligible. The D × T yielded higher, showed higher efficiency in utilising applied nutrients and attained earlier bearing, than the other two genotypes. Higher level of fertiliser application reduced the prebearing age.

Under rainfed condition, significant response to fertiliser application by D × T and T × D hybrids was recorded upto 500 g N + 500 g P_2O_5 + 1000 g K_2O while the high yielding West Coast Tall responded positively even at 1000 g N + 1000 g P_2O_5 + 2000 g K_2O/palm/year.

INTRODUCTION

In recent years through breeding and selection in coconut, genotypes possessing high yield potential have been evolved. Fertiliser requirement of the ordinary Tall coconut under rainfed conditions has been worked out by Muliyar and Nelliat (1971). They reported that the response to the levels of fertilisers employed in the experiment was negligible in the case of palms yielding over 50 nuts/year indicating that palms with high yield potential probably needed a higher level of fertilisers. Marar (1962) had observed differential response to fertiliser application in different yield groups. As no information on the nutritional requirement of such

high yielders was available, it had become imperative to take up the study on the fertiliser (NPK) requirements of such genotypes.

This experiment was initiated in 1965 with the main objective of determining the NPK fertiliser requirement of the promising genotypes from the early stages of growth and assessing the effect of different fertiliser levels on the growth characters, nutritional status of tissues and yield under rainfed conditions. Nelliat and Muliyar (1971) reported the effect of fertiliser levels on the growth characters of these genotypes during the prebearing age. Effect of fertiliser treatments on the tissue status of major and micronutrients and on the soil fertility status were studied by Devi *et al.* (1974 & 1976). The performance of these genotypes with regard to their growth characters and yield during the early bearing stage as influenced by the fertiliser levels are reported in this paper.

Material and Methods

These investigations were carried out in the experimental farm attached to the Central Plantation Crops Research Institute, Kasaragod. Soil is sandy loam, deep and well drained. The available major nutrient status was N 90 ppm, P_2O_5 12 ppm and K_2O 50 ppm. The pH of the soil was 5.6.

Genotypes

Three genotypes of coconut viz. progenies of high yielding West Coast Tall, Dwarf × Tall hybrid and Tall × Dwarf hybrid were selected for this experiment. D × T hybrid seedlings were obtained from the nursery raised with open pollinated Chowghat Dwarf Orange seednuts. The open pollinated progenies of known high yielding West Coast Tall palms were used as the tall. T × D hybrid seedlings of known parents were utilised. In each genotype, seedlings of uniform growth and vigour were selected.

Fertiliser levels

The fertiliser treatments consisted of three levels of NPK mixture as follows:

m_0 Control—No fertiliser
m_1 NPK mixture at the lower level
m_2 NPK mixture at the higher level (double m_1 level)

The nutrient sources for N, P and K were ammonium sulphate, super phosphate (ordinary) and muriate of potash, respectively. The young palms were given graded dose of fertilisers, increasing with age as shown in Table 1.

Table 1. *Fertiliser nutrients applied* (g/palm/year)

Year	Treatment m_1			Treatment m_2			Remarks
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	
1966	60	30	90	120	60	180	single application Aug.–Sept.
1967	120	60	180	240	120	360	„
1968	180	90	270	360	180	540	„
1969	240	120	360	480	240	720	„
1970 onwards	500	500	1000	1000	2000	2	split applications 1/3 in May and 2/3 in September.

Randomised block design with three replications was adopted. Treatments consisted of combinations of three genotypes and three fertiliser levels. The plot size was 6 palms in a row, spaced 7.9 m^2. One year old seedlings were planted in July 1965. No fertiliser or manure was applied at the time of planting. Shading and watering were carried out during the first three summers. The first dose of fertilisers was applied at the end of one year, in August 1966.

Observations

The biometric observations on the young palms were recorded before planting and in June in subsequent years. Observations on leaf production and number of functional leaves on the crown are being continued while that on length of leaf, length of petiole, length and breadth of leaflet and number of leaflets per leaf were recorded yearly upto June 1975, the tenth year of planting.

Date of first flowering, female flower production and yield of individual palm were recorded.

Results and Discussion

Growth Character

Data on the growth measurements recorded are summarised in Table 2.

Production of leaves

Genotypes differed significantly in the total number of leaves produced. D × T hybrid recorded the highest mean leaf production (123), followed by the Tall (112) and T × D hybrid (109). Difference between the latter two genotypes was not significant. Effect of fertiliser levels on the production of leaves was significant. Highest mean production of leaves (128) was recorded in the palms receiving m_2 treatment. Mean number of leaves produced by palms receiving m_1 and m_0 treatments were 120 and 96, respectively. The genotype x fertiliser interaction was non significant.

Functional leaves

The genotypical difference in the number of functional leaves was not significant. There was marked increase in the number of functional leaves due to fertiliser application. Between the two fertiliser treatments m_1 and m_2, there was slight difference. The interaction between genotypes and fertiliser levels was not significant.

Length of leaf

Genotypes did not differ significantly for this character. But the fertiliser levels had significant effect. The length of leaf increased with the fertiliser level; and the difference between the two levels of fertiliser was also significant. The interaction between genotypes and fertiliser levels was not significant.

Length of petiole

Genotypes as well as fertiliser treatments did not have any significant differential effect on the length of petiole.

Length of Leaflet

Although the mean length of leaflets of the hybrid was greater

Table 2. *Response of coconut genotypes to levels of fertilisers—growth characters*

Treatments	Production of leaves (1977)	Number of functional leaves (1977)	Petiole length (cm) (1975)	Leaf length (cm) (1975)	Leaflet length (cm) (1975)	Leaflet breadth (cm) (1975)	Leaflet number (1975)
Coconut genotypes							
Tall (T)	112.1	27.1	126	391	113	6.1	221
D×T	123.4	26.8	128	392	121	6.3	224
T×D	108.6	26.5	132	393	121	6.1	226
F test	Sig.	NS	NS	NS	NS	NS	NS
SE	2.48	0.72	3.3	4.4	5.5	0.13	3.2
CD (0.05)	7.44	—	—	—	—	—	—
Levels of fertilisers							
m_0 (0-0-0)	96.3	23.1	126	369	116	5.6	217
m_1 (500-500-1000)	119.8	28.3	129	395	120	6.6	226
m_2 (1000-1000-2000)	127.9	29.0	131	413	120	6.3	228
F test	Sig.	Sig.	NS	Sig.	NS	Sig.	NS
SE	2.48	0.72	3.3	4.4	5.5	0.13	3.2
CD (0.05)	7.44	2.15	—	13.4	—	0.40	—

than that of the Tall, the difference was not significant. The fertiliser treatments also did not have marked influence on this character.

Breadth of leaflet

The genotypes were on a par in respect of this character. The fertiliser application either at m_1 or at m_2 level had significantly increased (7 to 10 mm) the breadth of leaflet over m_0 (no fertiliser).

Number of leaflets

The genotypes did not show significant difference in this character which was also not affected by the fertiliser treatments.

Yield

Female flower production

The number of female flowers produced during each year from 1972 to 1977 are furnished in Table 3. Among the genotypes, D × T produced significantly higher number of female flowers (607) compared to the other two genotypes which were on a par. The fertiliser treatments showed highly significant difference in the number of female flowers produced, but between the two levels of fertilisation, the difference was not significant. The trend was similar in respect of individual years. The interaction was also significant in some years.

Setting percentage

The genotypes did not differ significantly in the number of female flowers set, which ranged between 28.6% and 22.7% (Table 3). The difference in the percentage set of female flowers was also found to be not significantly influenced by fertiliser levels.

Yielding palms

The number of palms that yielded during each year from 1972 to 1977 is given in Table 4, and graphically depicted in Fig. 1. The data for individual years 1974 to 1977 showed significant difference in the number of yielding palms among the genotypes. The effect of fertiliser levels was also significant during all the four years. However, the interaction between genotypes and fertiliser levels, was significant only during the last two years.

Table 3. *Response of coconut genotypes to levels of fertilisers—female flower production and setting percentage*

Treatments	Female flower production						Total 1972-77	Setting percentage 1972-77
	1972	1973	1974	1975	1976	1977		
Coconut genotypes								
Tall (T)	4.6	34.8	54.0	103.0	151.7	93.5	441.0	22.7
D×T	1.6	58.4	115.0	146.0	187.0	99.6	607.3	28.6
T×D	0	8.4	38.0	80.0	125.8	87.2	339.9	24.3
F test	—	—	Sig	Sig	Sig	NS	Sig	NS
SE	—	—	15.0	14.0	12.8	7.9	50.4	2.3
CD (0.05)	—	—	46.0	42.0	38.4	—	150.9	—
Levels of fertilisers								
m_0 (0-0-0)	0	0	0	15.0	24.7	25.4	65.6	23.4
m_1 (500-500-1000)	2.3	44.5	98.0	138.0	199.6	110.1	592.9	27.0
m_2 (1000-1000-2000)	4.0	57.2	108.0	176.0	240.3	144.7	729.9	25.2
F test	—	—	Sig.	Sig.	Sig.	Sig.	Sig.	NS
SE	—	—	15.0	14.0	12.8	7.9	50.4	2.3
CD (0.05)	—	—	46.0	42.0	38.4	23.5	150.9	—

Table 4 *Effect of levels of fertilisers on the number of yielding palms*
(No. of palms/treatment 6×3=18)

Genotype	1972				1973				1974				1975				1976				1977			
	m_0	m_1	m_2	Total	m_0	m_1	m_2	Total	m_0	m_1	m_2	Total	m_0	m_1	m_2	Total	m_0	m_1	m_2	Total	m_0	m_1	m_2	Total
Tall	0	1	2	3	0	4	6	10	0	6	13	19	4	14	17	35	4	16	18	38	6	16	18	40
D×T	0	0	2	2	0	12	15	27	1	17*	18	36	7	17*	18	42	15	17*	18	50	16	17*	18	51
T×D	0	0	0	0	0	2	2	4	1	8	9	18	2	13	15	30	4	15	18	37	5	16	18	39
Total	0	1	4	5	0	18	23	41	2	31	40	73	13	44	50	107	23	48	54	125	27	49	54	130

1. Interaction was significant during 1976 and 77

*One palm died of bud rot

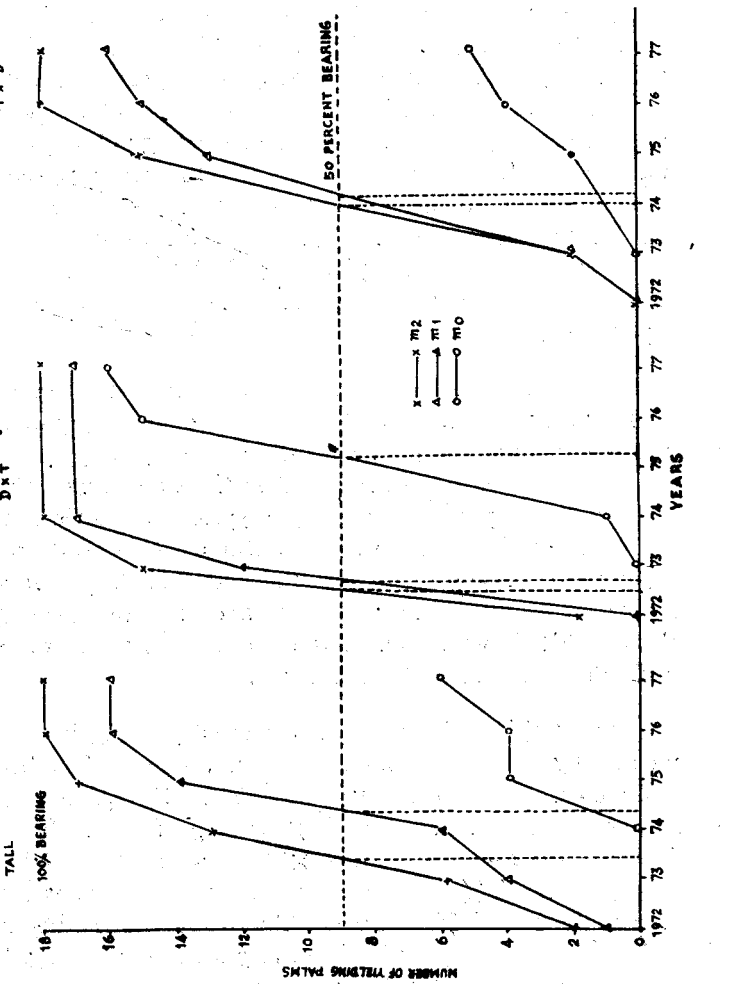

FIG.1. EFFECT OF LEVELS OF FERTILISERS ON THE NUMBER OF BEARING PALMS (OUT OF A TOTAL OF 18)

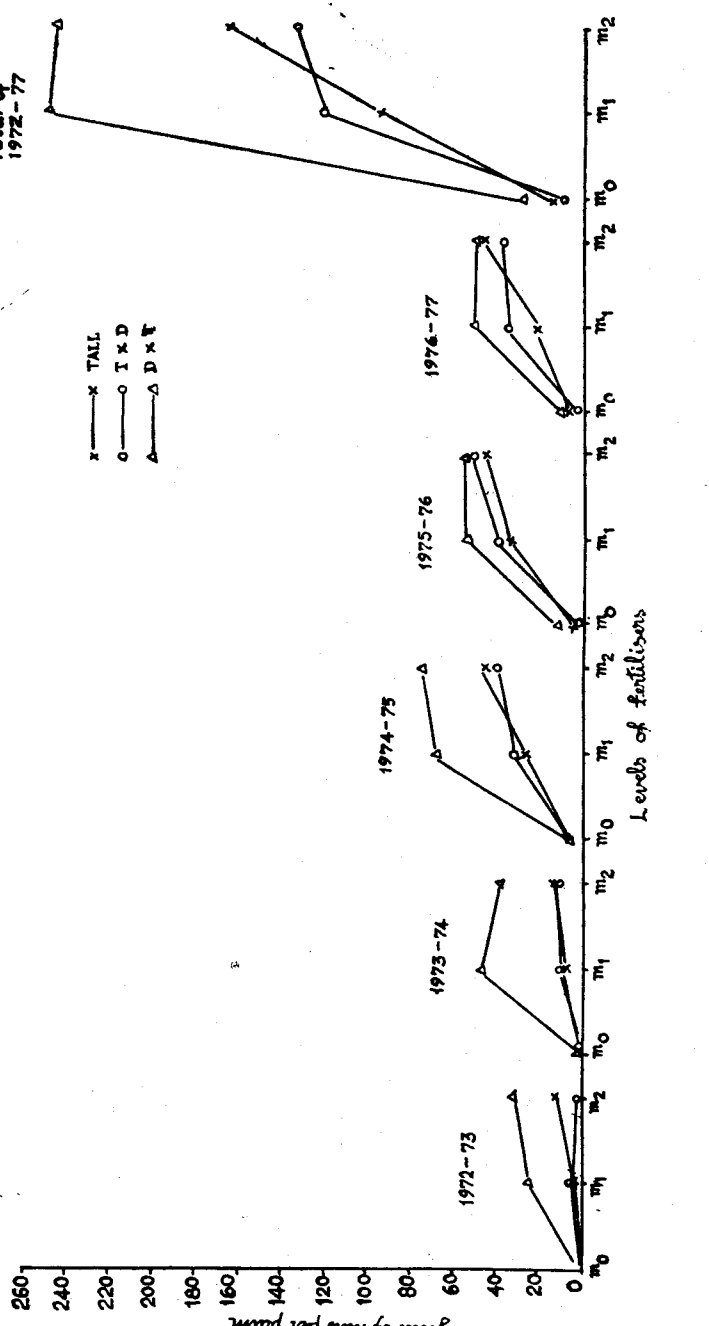

Fig. 2. Effect of levels of fertilisers on yield of coconut genotypes from 1972 to 1977

levels was significant in all years, except in 1976, indicating that the performance of the genotypes was different at different levels of fertilser application.

The yield of D×T palms was two and four times that of WCT and T×D respectively, at m_0 fertilser treatment. The D×T palms out yielded the other two genotypes at m_1 and m_2 levels, the difference being wider at m_1 level. At m_1 level the yield performance of Tall and T×D did not differ significantly and the mean total yield per palm was only 38% and 49% respectively, of that of D×T. At m_2 level, the mean yield of Tall and T×D was 67% and 54% respectively, of that of D×T, showing considerable improvement in the performance of the Tall.

Response in terms of yield of the Tall genotype, at all the three levels of fertiliser application, was significantly different and showed an almost linear trend in the productivity of the palm. Both the hybrids, on the contrary, showed a significant increase, in yield upto the m_1 level of fertiliser application over 'no fertiliser' and the difference in yield at the m_1 and m_2 levels did not attain the level of statistical significance. It was also observed that the yield of D×T hybrid at m_1 level of fertilisation was far higher than the highest yield of Tall recorded at m_2 level of fertiliser application.

Yield trend for the individual years was also similar to the total yield of the six years, except that the interaction was not significant in 1976.

Rao and Koyamu (1952) reported the hybrid vigour in D×T crosses and Satyabalan (1956) comparing the performance of Natural Cross Dwarf (D×T) with Tall×Dwarf and West Coast Tall found that the former showed precocity and was potentially a good bearer. Ninan (1960), and Ninan and Satyablan (1964) also found that the 'offtype' progenies of Chowghat Dwarf Orange (D×T) were very economic yielders. The present study establishes the superior performance of the D×T hybrid over those of selected high yielding Tall and T×D hybrid. The high yield obtained in the D×T at the m_1 level compared with that of high yielding Tall and T×D hybrid also established that this hybrid is a more effi-

cient utiliser of nutrients than the other genotypes. Efficiency in utilising the available resources is also indicated by its better performance under the 'no fertiliser' treatment, where the mean yield of the three genotypes D×T, T×D and Tall were 28, 13, and 7 respectively. The D×T hybrid also attained the bearing stage two to three years earlier than the others.

Contrary to the expectation, the high yielding Tall variety continued to show significant increase in yield with increase in the fertiliser level which is in conformity with the findings of Muliyar and Nelliat (1971). The two hybrids, however, did not show favourable response to the higher level of fertiliser application in terms of yield under rainfed condition.

REFERENCES

DEVI, C.B.K., NELLIAT, E. V., AND PILLAI, N. G. 1974. Nutritional studies on high yielding coconut genotypes *J. Plant. Crops* 1 (Suppl.): 67-69.

DEVI, C.B.K., VELAYUTHAM, M., AND HARIDASAN, M. 1976. Soil and leaf analysis in relation to the nutrition of high yielding coconut genotypes. Paper presented at the *International Symposium on Coconut Research and Development*, Kasaragod, Kerala. India.

MARAR, M.M.K., 1962. Introductory papers on coconut soils-*Indian Cocon. J.* **15**: 113-150.

MULIYAR, M. K., AND NELLIAT, E. V. 1971. Response of coconut palms (*Cocos nucifera* Linn) to N, P and K fertiliser application on the West Coast of India *Oleagineux* **26**: 687-691.

NELLIAT, E. V., AND MULIYAR, M. K. 1971. Response to different levels of NPK by young coconut palms of high yielding types. *Proc. International Symp. on Soil Fertility Evaluation* N. Delhi 575-583.

NINAN, C. A. 1960. Promising varieties and hybrids in coconuts, *Cocon. Bull* **14**: 289-691.

NINAN, C. A., AND SATYABALAN, K. 1964. A study of the natural, self and cross (Dwarf and Tall) progenies of Dwarf coconuts of west coast of India and its bearing on the genetics of Dwarfs and the putative hybridity of their off type progenies. *Caryologia* **17**: 77-91.

RAO, M. B., AND KOYAMU, K. 1952. Hybrid vigour in coconut seedlings. *Indian Cocon. J.* **6**: 41-44.

SATYABALAN, K. 1956. A note on the performance of the Natural Cross Dwarf (Dwarf female, Tall male coconut). *Indian Cocon J.* **9**: 166-173.