

Response of coconut palm to fertilizer levels in coastal sand of Orissa

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Coconut (*Cocos nucifera* L.) palm responds well to manuring and irrigation. Any neglect in the application of fertilizers and irrigation adversely effects the growth and yield, resulting in a loss to the growers (Thampan, 1975). Keeping in view, an experiment was conducted to study the effect of fertilizer treatments on growth characters of coconut palm during the pre-bearing stage and also on the early flowering habit.

Planting of seedlings of cv. Sakhigopal tall, was done in September, 1976 with a spacing of 7.5 × 7.5 m. The soil of the Research Station represents a typical coastal sand with a mechanical composition of sand 89.6-92.6%, silt 0.8-3.8% and clay 6.6%. The soil contains available N, P₂O₅ and K₂O of 7.2-14.8, 2.0-2.3 and 50-76 ppm, respectively; organic carbon 0.18-0.37 per cent and soil pH 5.6-6.6. The treatments comprising of three levels of each of N (500, 1000, 1500 g/palm/year), P₂O₅ (250, 500, 750 g/palm/year) and K₂O (750, 1200, 1750 g/palm/year) were taken in a 3³ factorial design with one replication in three blocks. Besides 27 different treatment combinations, three additional treatments of N₀P₀K₀, N₁P₁K₁+Ca+Mg and N₃P₃K₃+Ca+Mg were included in each block. The annual dose of fertilizer was applied in two splits as 1/3 in June and 2/3 in December. Calcium (CaO 150 g/palm/year) and Magnesium (MgO 300 g/palm/year) were applied once in a year. Number of palms taken in each treatment was six. In the initial years till 1986, palms were maintained under rainfed conditions. The biometric observations on growth and yield characters were recorded once in a year.

Data presented in Table 1 revealed that there was no significant difference in plant height, girth and the presence of functional leaves on the crown among the treatments. However, maximum height, girth and the functional leaves were

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Table 1. Effect of fertilizers on growth and yield attributes of coconut palm for the year 1989.

Treatment	Height of palm (ftm)	Girth (cm)	No. of palm function- leaves on crown	No. of leaves produced during the year/ palm	No. of leaves produced/ palm till 1989	No. of inflorescence /palm /year	No. of female flowers/ palm/ year	Percent of fruit- set/palm /year	Yield of palm/ nuts/ year	Total female flowers /palm till 1989	Cumulative yield of nuts/ palm (2 year)
N ₁	7.4	124.7	20.8	8.8	90.2	6.4	41.6	25.7	2.0	98.1	4.7
N ₂	7.3	118.3	22.1	8.9	90.3	6.9	51.3	21.2	5.4	112.1	6.9
N ₃	7.2	122.0	19.6	8.7	87.0	5.9	51.9	17.4	2.2	112.1	3.7
C. D at 5%	N.S	N.S	N.S	0.1	1.8	N.S	N.S	5.1	N.S	N.S	N.S
P ₁	6.9	111.8	20.3	8.2	88.4	5.6	29.8	20.5	1.7	63.5	2.8
P ₂	7.4	127.9	21.2	9.0	89.4	6.8	47.7	22.6	2.8	99.3	4.8
P ₃	7.6	125.1	21.1	9.0	89.7	6.8	67.3	21.1	3.2	159.5	7.7
C. D at 5%	N.S	N.S	N.S	0.1	N.S	1.0	17.7	N.S	N.S	46.9	N.S
K ₁	7.2	117.6	21.5	8.7	90.5	6.1	50.4	20.1	2.2	114.2	5.2
K ₂	7.3	124.8	20.6	8.8	88.1	6.9	44.9	21.5	2.1	93.6	4.2
K ₃	7.4	122.5	20.4	8.8	88.9	6.2	49.5	22.7	3.3	114.6	5.9
C.D. at 5%	N.S	N.S	N.S	N.S	1.8	N.S	N.S	N.S	N.S	N.S	N.S
N ₀ P ₀ K ₀	4.3	83.8	11.2	4.2	70.5	0.0	0.0	0.0	0.0	0.0	0.0
N ₁ P ₁ K ₁ + Ca+Mg	7.4	123.4	19.0	8.7	88.4	6.2	36.4	12.3	0.4	78.7	1.5
N ₃ P ₃ K ₃ + Ca+Mg	7.9	125.5	22.6	9.5	90.8	8.8	81.1	15.9	3.1	202.3	8.9

N.S=Not significant

recorded in $N_3P_3K_3+Ca+Mg$ treated palms, followed by $N_1P_1K_1+Ca+Mg$ treatment. More number of leaves were observed in fertilised plants. The effect of N, P and interaction effects of $N \times P$, $N \times K$ and $P \times K$ were also significant on production of leaves during the year. Highest leaf production during the year was observed in $N_3P_3K_3+Ca+Mg$ treated palms as against the lowest in untreated control during the same period. The effect of N was highly significant on number of leaves produced till 1989. The effect of K and interaction effect of $P \times K$ were also significant for the same character. Data, presented in Table 2 on some of vegetative traits, revealed that the palms reacted well to fertilizer application in later stages only after receiving irrigation after 1986 as compared to rainfed conditions of initial years.

When the yield attributing characters were studied, the effect of P was significant on production of inflorescence. Application of NPK along with Ca and Mg increased the production of inflorescence. Maximum inflorescence (9.75) was produced in $N_3P_3K_3+Ca+Mg$ treated plants in a year against the plants, yet to flower in control. Statistical data revealed that the effect of P was highly significant on production of annual as well as total female flowers per palm. P_3 level produced more female flowers as compared to P_2 and P_1 levels. Except the effect of $N \times K$ interaction, none of the treatment effect was found significant so far as the percentage of fruit-set was concerned. None of the main effects and the interactions manifested significant differences on annual yield or on cumulative yield, comprising the yield of last two years. However, as compared to control, application of fertilizer increased the yield.

Though the experiment was carried out since 1976, only 58 per cent of total population showed flowering till 1989. Palms are now gradually starting yielding, but percentage of fruit-set and yield are very low. This might be due to unavailability of both macro-and micro-nutrients to the plants due to leachig loss in purely littoral sands. The experimental palms also faced severe moisture stress during hot summer months and drought conditions mostly in every alternate years (Table 3). Irrigation minimised the desiccation effect and induced better root activity, thereby, resulting a very high response to manuring (Table 2) (Vijaya-lakshmi and Marar, 1969 : Marar, 1962). Venkitesan (1973) found that irrigation during hot summer months improved female flower production and arrested button shedding, resulting increased yield. The high yielding tall varity continued to show increase in yield with increase in fertilizer level which is in confirmity with the finding of Mular and Nelliatt (1971).

Table 2 Effect of fertilizers on the growth characters of coconut palm.

Charactor/Year	Treatment	1977	1980	1983	1986	1989
Plant height (m)	$N_0P_0K_0$	1.32	1.82	2.86	4.14	4.29
	$N_1P_1K_1$	1.66	4.08	5.26	6.18	6.50
	$N_2P_2K_2$	1.36	3.26	4.48	6.08	7.27
	$N_3P_3K_3$	1.43	3.38	5.46	6.63	7.97
Girth of palm (cm)	$N_0P_0K_0$	22.60	34.00	66.44	76.22	83.80
	$N_1P_1K_1$	30.00	73.50	98.50	102.83	110.50
	$N_2P_2K_2$	25.50	68.50	91.50	107.67	113.00
	$N_3P_3K_3$	27.40	63.00	99.50	120.83	127.10
No. of functional leaves on crown/palm	$N_0P_0K_0$	6.13	9.07	9.94	10.22	11.16
	$N_1P_1K_1$	7.60	13.10	18.50	19.00	18.00
	$N_2P_2K_2$	6.50	11.80	16.16	19.00	23.33
	$N_3P_3K_3$	7.00	10.60	17.00	16.33	18.00
No. of total leaves produced/palm till 1989	$N_0P_0K_0$	16.09	33.44	46.77	57.94	70.50
	$N_1P_1K_1$	18.90	39.12	60.13	76.80	89.50
	$N_2P_2K_2$	16.97	35.96	53.12	66.63	88.00
	$N_3P_3K_3$	16.50	34.98	54.81	70.81	87.40

Table 3. Rainfall (mm) in Orissa from 1975 to 1987 with natural calamities

Period	Normal rainfall (mm)	Actual rainfall (mm)	Difference of actual rainfall from normal (mm) (%)		Natural calamities
1975	1482.2	1305.6	-156.6	-10.57	Flood
1976	1482.2	1002.9	-469.3	-31.66	Severe drought
1977	1482.2	1326.9	-155.3	-10.48	Flood
1978	1482.2	1261.3	-220.9	-14.90	Hail-storm, whirl-wind, and tornado.
1979	1482.2	950.7	-531.5	-35.86	Severe drought
1980	1482.2	1321.7	-160.5	-10.83	Flood and drought
1981	1482.2	1187.4	-294.8	-19.89	Tornado, whirl-wind, flood and drought.
1982	1482.2	1179.9	-302.3	-20.40	Severe drought, flood, and cyclone
1983	1482.2	1374.1	-108.1	-7.29	—
1984	1482.2	1302.8	-179.4	-12.10	Drought
1985	1482.2	1606.8	+124.6	+8.41	Flood
1986	1482.2	1566.1	+83.9	+5.56	Mid-season drought
1987	1482.2	1040.8	-441.1	-29.78	Severe drought

Source : 1. Board of Revenue, Orissa

2. Directorate of Agriculture and Food Production, Orissa.

Hence, it can be presumed that supplementation of organic sources with inorganic fertilizers is beneficial to coconut during establishment period in the coastal sandy soils. It is possible that the enhanced buffering capacity of these littoral sands through the influence of organics in the slow and steady supply of

nutrients and moisture and indirect effects of organic matter might have contributed to the enhanced vegetative and reproductive characters, observed.

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