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FINAL REPORT

1. Institute Code No.  
Agr.III(231) Experiment 2
2. ICAR Code No.  
P1-68/2-ICI-P12/0311
3. Name and Address of Research Institute/Centre  
Central Plantation Crops Research Institute  
Kasaragod - 670 124 Kerala
4. Project Title  
Cultural cum spacing trials  
2. Long term effects of cultivation, herbicide  
and manuring
5. Name and Designation of Project Leader  
1. Shri AF Sunny, Farm Assistant (1970-1972)  
2. Shri EV Welliat Head, Division of Agronomy  
(1973-1974)  
3. Shri P Thomas Varghese, Scientist S1  
(1975-1982)
6. Names and Designations of Project Associates including Project Leader and work to be done

<u>S.No.</u>	<u>Name &amp; Designation</u>	<u>Time spent</u>	<u>Work done/ Remarks</u>
1.	Shri AF Sunny Farm Assistant	1970-1972	Leader
2.	Shri BL Kushwaha Research Assistant	1970-1972	Associate
3.	Shri MP Sankaranara- yanan, Asst.Chemist	1970-1971	Associate
4.	Shri CA Kunhiraman Farm Assistant	1972	Associate

- |    |  |           |           |
|----|--|-----------|-----------|
| 5. | Shri EV Nelliat<br>Head, Division of<br>Agronomy | 1973-1974 | Leader    |
| 6. | Shri P Thomas Varghese<br>Scientist S1           | 1975-1982 | Leader    |
| 7. | Shri P Gopalasundaram<br>Scientist S1            | 1978-1980 | Associate |
| 8. | Shri K Sivaraman<br>Scientist S1                 | 1981      | Associate |

7. Location of Research Project with complete address:

Division of Agronomy  
Central Plantation Crops Research Institute  
Kasaragod - 670 124, Kerala.

8. Date of start: 1979

9. Date <sup>of</sup> termination: 1982

10 (a) Objectives:-

To find out the long-term effect of cultivation (tillage), fertilizers alone, fertilizers with organics, weed control only using herbicides and 'neglect', on the performance of coconut palm and on the physico-chemical properties of soil.

(b) Practical utility uncluding background information:

(i) The plots serve as visual demonstration for coconut growers stressing the need for regular inter-cultivation and manuring for obtaining high and sustained yields.

(ii) These are also of considerable scientific value as information on the changes and differences in the physical and chemical properties of soil in these plots.

(iii) The growth and yield of palms are of immense value in the study of coconut nutrition and soil management.

#### 11. Technical Programme:

The long-term experimental plots are maintained since the year 1919 in an area of 0.52 ha under rainfed condition. The experiment was initiated with palms aged about 23-28 years and under neglected condition. The soil type was very deep, red sandy-loam with water table going down to about 7 m below ground level during summer. Initially there were three treatments and they were modified slightly during 1933. As the palms had become senile, under planting was done in 1967. Each plot was subdivided into two in 1972 and revised treatments were imposed. The treatments applied during the different periods are summarised in Table 1. The old palms were removed in 1983.

#### PERIOD I (1919-1932)

##### a) Digging round and manuring:

Basins were opened to a radius of 1.2 m from the base of the palms and about 2.3 kg of fish guano, 18 kg of wood ash and 18 kg of green manure per palm per year were applied. The rest of the area did not receive any inter-cultivation and weeds were left to grow and dry up in the plot itself.

##### b) Digging round but no manuring:

The soil was dug up once a year with spade to a radius of 1.2 m from the base and to a depth of about 30 cm in the south-west monsoon period and the rest of the area did not receive any inter-cultivation.

c) No cultivation and no manuring:

Palms were allowed to grow almost in a wild state without any manuring or cultivation.

#### PERIOD II (1933-1971)

From 1932 onwards the entire area in plots I and II were inter-cultivated by working the iron plough and/or planet junior hoe 2-3 times an year, as required to keep the plots weed free. From sixties tractor ploughing with disc harrow and cultivator was done. Manuring though done regularly in plot 1 according to the recommendations from time to time, the dosage and forms of manures were sometimes changed due to exigencies. Also, immediately following the transfer of the Station to the Indian Central Coconut Committee in 1947, plots 1 and 2 were not given the scheduled treatments for a couple of years. Consequent to the modifications in the management practices, the plots were renamed as given in Table 1.

From 1950 onwards, when fertilizers became available, palms in plot 1 were manured with 1.36 kg ammonium sulphate, 0.9 kg muriate of potash and 20 kg green leaf per palm per year. The revised fertilizer dose of 500 g N + 320 g  $P_2O_5$  + 1200 g  $K_2O$  per palm per year was adopted from 1968 and urea, ultraphos and muriate of potash were used as the sources of N, P and K, respectively.

As the palms were getting older, under-planting with West Coast Tall coconut seedlings was done in August, 1967. The performance of the under-planted young palms is not included in this report.

### PERIOD III (1972-1982)

During 1972, each of the three existing plots were subdivided into two as detailed in Table 1 and the treatment schedules were revised, with a view to gathering more comprehensive information from the plots.

The cultivation operation consisted of two harrowings in September and October. The general fertilizer recommendation of 500 g N + 320 g P<sub>2</sub>O<sub>5</sub> + 1200 g K<sub>2</sub>O per palm per year was adopted for the plots receiving inorganic fertilizers. The organic manuring consisted of 50 kg green leaf per palm annually. In plot III, fertilizers were spread uniformly on the surface in a circular area of 1.8 m radius around the palm and forked into the soil. Chemical weed control involved spraying 0.5% Gramaxone and 0.5% Fernoxone as a tank mixture.

Many old palms in plots 5 and 6 had died due to senility by the year 1982. Almost all the underplanted young palms receiving fertilizer application had started bearing in 1982; but all the old palms in those plots were yielding. However, it was felt that retention of old palms in these plots will seriously affect the performance of the underplanted palms. Hence, all the old palms were cut and removed in February 1983.

#### 12. Final Report:

##### e) GROWTH CHARACTERS

The mean annual increase in the height of trunk and the number of leaves in the crown had been summarised and reported by Marar and Pandalai (1959). (Table 2). The data clearly showed the favourable effects of cultivation and manuring on the growth of the coconut palm. The data

also show that during the Period I, when palms in plot 2 received only digging round in an area of 1.2 m, the actual increase in the height of trunk was less compared to the palms in plot 3, which did not receive any tillage. However, this trend was reversed during Period II, when the entire field was ploughed.

#### b) ROOTING PATTERN

Rooting pattern of the coconut palms in the permanent observation plots had been studied (Kushwah et al, 1973). Palms receiving regular cultivation and manuring produced the highest number of roots (4016); palms receiving regular cultivation alone and no cultivation produced 2992 and 3248 roots, respectively. The percentage of roots found in the top 30 cm layer soil was quite negligible. Over 82% of the roots in the cultivated and manured plot (Plot 1), was found in the 31-120 cm depth and only 8.7 per cent of the roots went below 120 cm. In plot 1, 74 per cent of the roots emerging from the bole did not extend beyond 2 m lateral distance. It was seen that 68 per cent of the roots of the palm in the 'cultivation alone' plot and 84 per cent of the roots in the neglected plot did not extend beyond 2 m from the bole. The data also showed that regular cultivation and manuring had induced increased root production and that the surface rooting of coconut had been considerably reduced by the regular cultural operations.

#### c) YIELD

Data on the yield of nuts per palm per year during different periods are furnished in Tables 4-6. The mean yield for two consecutive years under different treatments is also presented in Figures 1-3.

### Period I (1922-1932)

The pre-treatment yield of palms in different plots was reported to be similar (Marar and Pandalai, 1959). By 1922 there was a tremendous spurt in the yield of palms which received regular manuring and tillage. These palms (Plot 1) maintained the highest yield level till the end. Digging round the trunk to a distance of 1.2 m only (plot 2) gave only a slightly higher yield compared to neglect (plot 3) and hence digging a small area around the base appeared to be not of much practical value in increasing the nut yield. The mean yield during this period was 37.1, 10.2 and 6.5 nuts per palm per year in plots 1, 2 and 3, respectively. Marar and Pandalai (1959) also reported that though the seasonal conditions affected all the treatments in the same manner, the effect was more in the neglected plot (as indicated by a CV of 76.5% in plot 3) than in plots which received only cultivation (CV 43.1%) and both cultivation and manuring (CV 27.8%).

### Period II (1933-1972)

Palms receiving cultivation and manuring continued to record higher yield (58.0 nuts/palm/year) than the palms receiving cultivation alone (44.1 nuts) or under neglect (15.8 nuts). The most conspicuous feature, however, was that palms receiving cultivation alone recorded higher increase in productivity (an increase of 33.9 nuts/palm/year) during the period II, compared to palms receiving cultivation and manuring (20.9 nuts increase) and the palms under neglect (9.3 nuts increase). The data showed that cultivation without manuring had increased the yield by 28.3 nuts over no cultivation and no manuring (neglect); compared to this, manuring with cultivation increased the yield by only 13.9 nuts over cultivation alone.

Marar and Pandalai (1959) opined that the beneficial effects of inter-cultivation such as improvement in physical and chemical conditions of soil, moisture conservation, weed control and better root growth were the probable reasons for the increased productivity of palms in plots 1 and 2 during the period II. As the yield level in plot 1 was already pushed up during the period I by manuring, inter-cultivating the entire area could improve the yield only to a lesser extent. But, no acceptable explanation for the increase in yield in plot 3 is possible.

There was a sharp reduction in the nut yield of palms in plots 1 and 2 during 1949-1954. The mean annual nut yield of palms during 1949-1954 was only 36.9, 35.2 and 17.8 in plots 1, 2 and 3, respectively. This yield reduction was attributed to the non-adoption of treatment schedules for a few years after 1949 in plots 1 and 2 due to some misunderstanding about the treatment schedules, after handing over the Station to the Indian Central Coconut Committee. After the cultivation and manuring, treatments were reimposed, the yield was again raised to pre-1949 level in plot 1. This observation is of great practical importance and clearly establishes that discontinuance of the recommended package of practices will lead to a sharp reduction in the yield of coconut palm and yield levels can be restored only by adopting good management practices.

Careful examination of the mean yield data for the first and last 16 years of the period II revealed some interesting results. During 1933-48, the mean annual yield of palms in plot 1 was 63.9 nuts as against 51.7 in plot 2. One of the probable reasons for the very low response to manuring (12.2 nuts) during that period

might be that the organic manures applied were not sufficient for the expression of the full yield potential of the palms. Application of chemical fertilizers was started in the year 1950. During the period 1957-1972, the response to manuring was also greater (20.7 nuts/palm/year).

The economic bearing age of Tall coconut palms had been reported to be about 50 years (Menon and Pandalai, 1960). Palms in these plots were more than 60 years old in 1956. Mean annual yield of coconut palms in plot 1 declined from 63.9 nuts per palm during 1933-1948 to 59.6 nuts during 1957-72; but, palms in plot 2 recorded a higher yield reduction (from 51.7 to 38.9 nuts). This reduction in yield might have been due to the senility and old age of the palms. The reduction in yield was marginal in plot 1 and hence we may assume that good management especially manuring will help to extend the productive bearing age of coconut palms. The mean yield of palms in the neglected plot was 14.1 nuts during 1933-1948 and 16.6 nuts during 1957-1972 ie. no decline in yield. This indicates that an annual yield level of about 15 nuts/palm may be assumed as the minimum level of productivity under natural conditions.

#### Period III (1973-1982)

Each plot was subdivided into two plots and revised schedule of treatments were imposed in the year 1972. Hence, to compare the performance of these palms during 1973-1982, the yield before revising the treatments (1967-1972) was taken into consideration.

In general, the palms showed a gradual decline in yield mainly because of senility and also due to the competition from the under-planted young palms, many of which had started yielding in the seventies. Before the revision of treatments, palms which were grouped in plots I and II showed only marginal difference in the yield (1.9 nuts). But during 1973-1982, palms receiving organics, inorganic fertilizers and cultivation (plot I) yielded 5.9 nuts more than those getting inorganic fertilizers and tillage (plot II). The reduction in yield during 1973-1982 was 16.4 nuts/palm/year in plot I compared 20.4 nuts in plot II. The smaller decline in yield in plot I could be attributed to the addition of organic matter only. However, this inference is not in conformity with the results of earlier field experiments (Maliyar and Nelliatt, 1971).

Before 1972, palms in plot III and IV were receiving only cultivation. During 1973-1982, palms in plot III which received fertilizer application and forking basins showed a mean yield reduction of 8.7 nuts/palm/year compared to the yield before revision. But palms which continued to receive only cultivation showed a higher decline in yield (-17.1 nuts/palm/year).

Palms in plot V, which started getting chemical weed control instead of 'neglect', recorded an increase in yield of 5.2 nuts per palm per year during 1973-1982 compared to the yield before the revision of treatments. Palms in plot VI (neglect) showed a small reduction in the mean yield.

During 1973-1982, many of the unfertilized palms had died due to senility. Between 1972 and 1983 (when all remaining palms were cut and removed) one palm out of 14 in plot I, one out of 12 in plot II, 5 out of 10 in plot IV, 5 out of 12 in plot V and 2 out of 5 in plot VI had died. Hence, to get a correct idea about the yield one can anticipate under different management levels, the per hectare yield of nuts for the different plots was calculated based on the total yield of nuts obtained per plot and the area of the plot. The data are presented in Table 7. It is worth noting that though the nut yield per palm in plot VI (neglect) was as high as 30.8% of that of plot I during 1979-82, the yield on per hectare basis was only 5.1%.

The number of palms in different yield groups during the period 1933-1970 was worked out (Table 8). The data showed that under good management (cultivation and manuring) nearly half of the total number of palms were in the medium yield group giving 40 to 79 nuts per palm per year. In plot 2 (cultivation alone), the number of palms in low and medium yield groups was almost equal and together they accounted for 92% of the palms. Under neglected condition (plot 3), 80% of the palms were in the low yield group and the number of palms giving more than 80 nuts was negligible.

#### D. YIELD COMPONENTS

During period I, palms under 'Digging round and manuring' had produced 3 to 4 times the number of female flowers produced by palms in the other two treatments (Table 9). The increased female flower production in

plot 1 was mainly due to the increase in the number of bunches produced. Setting percentage was more in plot 2, which received digging alone without manuring. Number of bunches with nuts and number of nuts per bunch were more and the number of barren axils were less in plot 1 than in the other two. On the whole the higher female flower production in plot 1, resulted in higher yield.

During the period 1933-1958, the yield components such as number of female flowers produced, number of bunches produced with nuts, and number of nuts per bunch were the highest in plot receiving 'regular cultivation and manuring'. Setting percentage in all the three plots was similar. The number of barren axils was maximum in the plot under 'no cultivation and no manuring'. During this period also the differences in the yield of nuts were mainly due to the differences in female flower production.

Data on the number of bunches produced, yield of nuts, number of female flowers produced and setting percentage for the years 1959-1971 is presented in Table 10. The data clearly showed the superiority of cultivation and manuring over cultivation without manuring and no cultivation and no manuring. The number of bunches harvested per palm per year was similar in plots receiving cultivation + manuring and cultivation without manuring.

#### E. NUT CHARACTERS

Sample nuts were collected from all the plots in the summer of 1978 and nut characters like circumference, volume and weight of husked and unhusked nuts and copra

content were estimated. Palms receiving organics, inorganic fertilizers and cultivation (plot I) recorded the best nut characters. In general, copra content of palms receiving fertilizer application was higher than the copra content of palms which did not receive fertilizer application (Table 11).

#### F. SOIL PHYSICAL CHARACTERISTICS

Soil samples were collected at 3 depths (0-30, 30-60 and 60-90 cm) from all the six plots in the year 1982 and subjected to the analysis of physical parameters and water retention parameters. The cultivation alone plot showed the lowest water holding capacity (29.6%) and highest bulk density (1.44 g/cc). The values for cultivation + organics + inorganic fertilizers plot (32.2% and 1.39 g/cc) were comparable with the 'no cultivation and no manuring' plot (35.7% and 1.37 g/cc). The available water capacity was also the lowest in the cultivation alone plot (2.30%). The plot receiving cultivation, organics and inorganic fertilizers had the highest available water capacity (2.91%). The uncultivated and unmanured plot had 2.60% available water capacity. The values for other treatments ranged in between. Even with respect to water retained at various tensions, cultivation alone plot showed lowest values.

#### G. SOIL FERTILITY STATUS

Earliest report about the nutritional status of soil of these plots was that of samples collected in December 1957. The results indicated that available  $P_2O_5$  and  $K_2O$  were comparatively more in the regularly cultivated plot than in the neglected plot. Soil fertility status of

these plots was again studied in 1961-62 and the data are presented in Table 12. Organic carbon, total nitrogen and total  $K_2O$  contents were the highest in the neglected ('no cultivation and no manuring') plot. The build up of organic carbon in this plot was attributable to the unrestricted growth of weeds in this plot. The plot receiving cultivation and manuring had higher contents of organic C, Total N and Total  $K_2O$  than the plot getting cultivation only. The total  $P_2O_5$  content of the soil at that time was not influenced by the management practice followed. The plots 1 (cultivation and manuring) and 2 (cultivation only) had higher CEC and higher available  $P_2O_5$  than the neglected plot. But the neglected plot had more available  $K_2O$  than the other two plots.

Soil samples were collected during April 1980 from the fertilizer basin area of the palms and interspaces in all the six plots and available N and K contents were determined. The available N status was not influenced by the management practices. The available nitrogen content of the basin of palms which did not receive fertilizer application (plots IV, V and VI) was comparable to that of palms receiving regular fertilizer application (Plots I, II and III). The available nitrogen status of the basin area and interspaces was similar. Application of fertilizers resulted in a remarkable increase in the available K status of fertilizer basins. The available K level in the interspaces was similar to the K level in the basin area of unfertilized palms.

### G. LEAF NUTRIENT STATUS

Leaf samples were collected from the standard leaf (14th leaf or the middle leaf) of the palms in the summer of 1980 and the concentration of N, P and K in the leaf tissue was determined. The data (Table 14) clearly showed that the concentration of nutrients in the leaf tissue of palms which did not receive manuring (plot IV, V and VI) was very low and much below the critical levels for N (1.8-2.0%), P(0.12%) and K(0.8-1.0%). The N status of leaf tissue of palms in plot I and II was observed to be in the range of sufficiency. But in plot III, though the nitrogen content was increased, it was below the critical level. This may be due to the fact that palms in that plot started receiving fertilizer application very late in their life (only from 1972). Phosphorus concentration of palms in plot II alone has reached the critical level and it was lower in all other plots. Leaf K level in all the palms receiving fertilizer application was found to be well above the critical level.

13. Approximate expenditure incurred in the project:

Not available

14. Publications and material:

a) Research papers

1. Krishna Marar MM and Pandalai KM (1959)  
Observations from some long term  
experimental plots on the coconuts.  
Indian Cocon. J.XIII(1): 1-24.
2. Ramanandan PL and Pillai NG (1974) Effect  
of continuous cultivation and manuring  
on the leaf nutrient composition and  
soil nutrient status of coconut palms  
J.Plant.Crops 2(2): 1-3.

3. BL Kushwah, EV Nelliath, VT Markose and AF Sunny (1973). Rooting pattern of coconut. Indian J. Agron. XVIII(1): 71-74.

4. Nelliath EV and Gopalasundaram P (1984) Input management for obtaining targetted yield in coconut. Indian cocon. J. XV(3&4): 41-45.

b) Popular articles: Nil

c) Reports : Nil

d) Seminars and workshops (Relevant to the project) in which the scientists have participated:

Details not available.

e) Materials developed such as new varieties of crops or breeds of animals, implements, products, etc.

Not applicable

15. Details of Field/Laboratory Note books and final material and their location:

Two bound registers and project file containing all the data collected are available at the Division of Agronomy, CPCRI, Kasaragod.

16. Comments/suggestions of Project Leader regarding possible future line of work that may be taken up arising of this project.

This experiment with the young palms under-planted in 1967 is continuing. It is suggested that in addition to the data on growth characters and yield, systematic studies on the changes occurring in the soil, soil nutrient status and leaf nutrient concentration may be taken up at regular intervals. Detailed studies on the nut characters including copra and oil contents may also be carried out.



Table 1: Treatment schedules during the different periods

Plot No.	Area (m <sup>2</sup> )	Treatments		Plot No.	Area (m <sup>2</sup> )	Treatment
		Period I (1919-1932)	Period II (1933-1971)			
1	1578	Digging round and manuring	Cultivation and manuring	I	810	Cultivation + Inorganic fertilizers + organic manures
				II	768	Cultivation + Inorganic fertilizers
2	2100	Digging round, but no manuring	Cultivation, but no manuring	III	996	Inorganic manuring + forking in
				IV	1104	Cultivation alone
3	1639	No cultivation, no manuring	No cultivation, no manuring	V	847	Chemical weed control using herbicides only
				VI	792	No weed control, no manuring

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Table 2. GROWTH CHARACTERS

Treatment	Mean annual increase in trunk height		No. of leaves on the crown		
	1922-1932 (cm)	1933-1958 (cm)	1922	1932	1952
Plot 1	17.5	13.0	32.2	37.7	27.1
Plot 2	11.4	10.4	28.1	28.7	23.4
Plot 3	12.2	9.4	26.0	24.3	20.4

Source: Merar and Pandalai, 1959.

Table 3. Root distribution (percentage) of coconut palms under different management situations (PERIOD II)

Management situation	PILOT 1 Regular cultivation and manuring					PILOT 2 Regular cultivation only					PILOT 3 Neglected				
	Near the bole	1m	2m	3m	3.5m	Near the bole	1m	2m	3m	3.5m	Near the bole	1m	2m	3m	3.5m
Distance from the bole	9.1	1.5	3.1	1.9	1.9	12.9	-	2.1	2.1	1.1	10.3	6.4	2.5	-	-
0-30 cm	37.0	11.5	7.1	3.6	1.5	34.2	15.5	8.0	2.7	2.1	51.7	16.2	5.9	1.5	0.5
31-60 cm	28.2	11.5	5.9	1.9	1.5	24.6	13.9	9.1	9.6	4.3	18.7	1.0	2.0	2.0	1.5
61-90 cm	16.7	13.9	5.1	3.9	2.4	20.3	8.0	9.1	6.4	0.5	12.8	6.9	3.9	3.0	0.5
91-120cm	8.7	8.7	4.3	3.5	1.5	8.0	15.0	3.2	4.8	3.2	6.4	3.9	1.5	1.5	1.5
121-150cm	100.0	47.0	26.0	15.0	9.0	100.0	52.0	32.0	26.0	11.0	100.0	34.0	16.0	8.0	4.0
Total															

% of roots

Depth from surface

Source: Kushwah, BL, Nelliat EV., Markose VT and Sunny AF 1973.  
Indian J. Agron. 18(1): 71-74.

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Table 4. Mean yield of nuts per palm per year  
 Period I (1922-1932)

Year	Plot 1	Plot 2	Plot 3
1922	42.7	15.0	13.1
1923	37.6	14.8	11.7
1924	36.8	10.1	7.4
1925	40.9	8.9	2.7
1926	49.9	15.0	11.9
1927	23.6	4.1	2.4
1928	53.2	8.4	2.3
1929	38.8	11.3	12.6
1930	30.6	1.6	0.3
1931	18.0	9.6	1.7
1932	35.8	13.1	5.0
Mean	37.1	10.2	6.5

Table 5. Mean yield of nuts per palm per year  
 Period II (1933-1972)

Year	Plot 1	Plot 2	Plot 3
1933	50.6	20.9	12.9
1934	70.4	35.6	4.4
1935	66.7	62.7	10.7
1936	70.0	45.7	12.9
1937	77.8	75.1	12.7
1938	71.7	63.1	24.0
1939	73.9	50.7	17.4
1940	48.6	54.1	21.6
1941	63.4	54.9	12.1
1942	52.8	45.0	11.6
1943	70.1	60.1	10.3
1944	49.3	45.6	9.3
1945	86.8	71.1	20.4
1946	36.9	32.7	8.9
1947	65.0	50.4	8.9
1948	67.7	59.4	27.7
1949	46.1	37.9	13.1
1950	54.9	46.7	28.1
1951	27.7	27.9	9.3
1952	42.4	44.0	30.0
1953	33.2	30.7	18.3
1954	44.3	38.1	13.1
1955	50.0	46.9	14.3
1956	50.2	40.7	15.0

contd...

Table 5 (contd.)

Year	Plot 1	Plot 2	Plot 3
1957	51.4	34.3	14.3
1958	67.9	51.7	14.3
1959	53.6	38.4	22.9
1960	59.3	42.7	14.1
1961	56.8	35.5	19.6
1962	57.1	32.6	13.2
1963	59.0	32.3	18.3
1964	60.9	36.8	18.0
1965	50.1	30.1	18.3
1966	64.0	46.0	17.0
1967	66.0	51.0	16.0
1968	63.0	37.0	9.6
1969	68.0	44.0	10.2
1970	55.0	36.0	18.6
1971	51.0	30.0	16.0
1972	65.9	44.2	25.0
Mean	58.0	44.1	15.8

Table 6. Yield of nuts per palm per year  
 Period III (1973-1982)

Year	Plot I	Plot II	Plot III	Plot IV	Plot V	Plot VI
1967-1972*	62.7	60.8	40.5	40.8	15.0	11.7
1973	59.4	48.0	34.9	29.0	16.0	11.2
1974	38.9	48.4	36.3	22.3	10.6	10.6
1975	56.5	49.6	44.6	28.0	30.6	12.4
1976	49.0	42.2	29.4	23.8	29.5	10.6
1977	62.2	58.0	46.3	34.9	26.1	7.0
1978	48.1	40.4	28.1	28.7	16.8	7.6
1979	55.9	50.2	36.1	24.4	22.2	6.4
1980	18.3	13.3	14.2	12.6	13.1	4.0
1981	38.9	33.5	23.0	18.2	14.3	8.3
1982	35.8	20.1	25.4	14.8	22.6	14.7
Mean	46.3	40.4	31.8	23.7	20.2	9.3

\*Mean yield of nuts for the palms before subdividing the plots and revising the treatment schedule.

Table 7 Mean yield of nuts per hectare per year during period III

Year	Plot I	Plot II	Plot III	Plot IV	Plot V	Plot VI
1969-						
1972 *	10503	9287	5532	3401	2267	931
1973-74	8488	7533	4749	2224	1883	688
1975-76	8463	7168	5206	2002	3908	726
1977-78	9852	7689	5231	2015	2532	461
1979-80	5957	4870	3534	1173	1800	278
1981-82	5994	3841	3404	829	1523	436

\* Before revising the treatments

Table- 8 Mean number of palms in different yield groups  
(1933 - 1970)

Yield Group	<u>% of palms in the yield group</u>		
	Plot 1	Plot 2	Plot 3
Low (< 40 nuts)	34.1	46.4	80.2
Medium (40 - 79 nuts)	48.8	45.7	18.8
High (80 nuts & above)	17.2	7.9	1.0

Table 9: Yield and yield components

Treatments	No. of female flowers produced	Setting percentage	No. of bunches produced with nuts	No. of nuts per bunch	No. of barren axils
Period I (1922-1932)					
Digging round and manuring	169.2	27.8	8.2	4.8	3.5
Digging round, but no manuring	43.6	34.4	3.7	2.4	6.9
No cultivation and no manuring	57.3	27.7	2.6	1.8	7.4
Period II (1933-1958)					
Regular cultivation and manuring	274.5	29.4	10.7	5.5	0.6
Regular cultivation, but no manuring	188.0	29.7	9.8	4.8	0.8
No cultivation and no manuring	98.0	28.9	4.4	2.9	4.6

Source: Krishna Marar MM and Pandalai KM(1959)

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Table 10 Influence of management practices on yield and yield attributes 1959-1971

Treatment	No. of bunches/ palm/year	Yield (nuts/palm/ year)	Female flowers produced (No/palm/year)	Setting %
Plot 1	10.5	58.8	150.0	39.8
Plot 2	10.1	37.9	123.1	31.1
Plot 3	6.3	16.1	62.2	26.2

Table . 11

NUT CHARACTERS OF SAMPLE NUTS COLLECTED FROM  
PERMANENT OBSERVATION PLOTS - 1978.

Period. III

Plot	Circumference mm		Unhusked nut		Husked Nut		Coprs weight (g)
	Polar	Equato- rial	Weight (g)	Volume (cc)	Weight (g)	Volume (cc)	
Plot I	612	558	952	3062	478	652	198
Plot II	575	515	837	2415	442	568	187
Plot III	574	523	815	2617	418	553	166
Plot IV	527	448	612	1570	316	472	143
Plot V	512	463	654	1880	352	544	148
Plot VI	554	481	668	2164	324	496	151

Table 12. Soil fertility status(0-100 cm depth) of the plots in 1961-62

Period II

Character	Plot 1	Plot 2	Plot 3
Organic carbon (%)	0.143	0.129	0.338
Total nitrogen (%)	0.0348	0.0261	0.0457
Total P <sub>2</sub> O <sub>5</sub> (%)	0.0420	0.0438	0.0428
Total K <sub>2</sub> O (%)	0.1934	0.1867	0.2650
Available nitrogen (%)	0.0056	0.0064	0.0076
Available P <sub>2</sub> O <sub>5</sub> (%)	0.0015	0.0019	0.0007
Available K <sub>2</sub> O (%)	0.0020	0.0017	0.0034
CEC (me/100g)	3.32	3.66	1.95

Source: MP Sankaranarayanan, CPCRI; unpublished data

Table 15 Nutrient status of soil (1-90 cm depth) in the fertilizer basins and in interspaces- 1980

Period III

Treatment	Available N (ppm)		Available K (ppm)	
	Fertilizer basin	Interspaces	Fertilizer basins	Interspaces
Plot I	71.4	74.2	148.3	43.3
Plot II	63.0	69.1	246.7	36.7
Plot III	76.5	58.1	155.0	35.0
Plot IV	70.0	59.7	31.7	25.0
Plot V	81.7	88.7	35.0	36.7
Plot VI	73.7	66.3	26.7	20.0

Table 14: Leaf nutrient concentration in the standard leaf - 1980

Treatment	N%	P%	K%
Plot I	1.82	0.100	1.35
Plot II	1.99	0.118	1.70
Plot III	1.62	0.085	1.35
Plot IV	1.34	0.085	0.20
Plot V	1.15	0.053	0.15
Plot VI	0.95	0.046	0.20

FIG.1. MEAN YIELD OF PALMS DURING PERIOD I (1922 - 1932)

- PLOT 1 ( Digging around and manuring )
- PLOT 2 ( Digging around but no manuring )
- PLOT 3 ( No cultivation and no manuring )

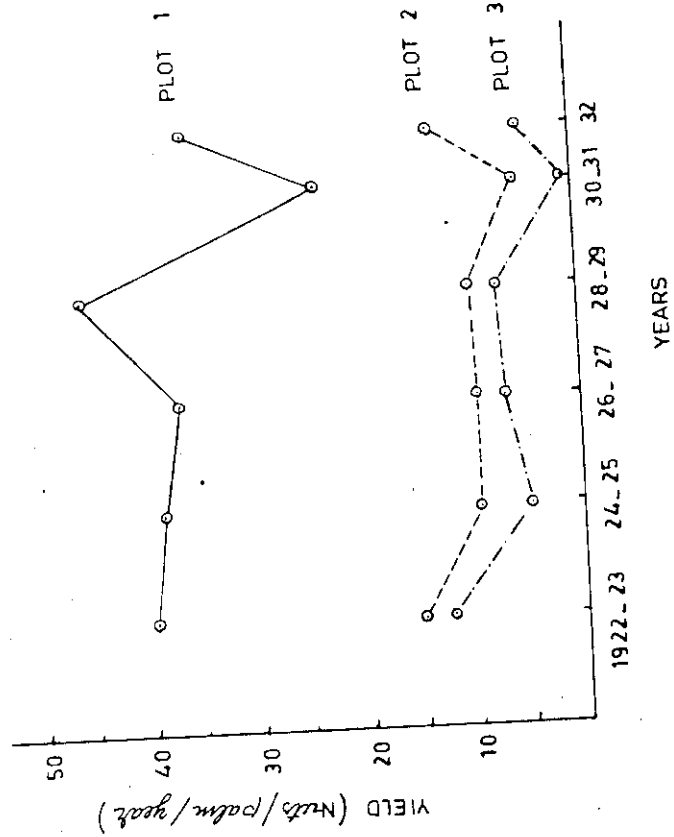


FIG. 2. MEAN YIELD OF PALMS DURING PERIOD II (1933 - 1972)

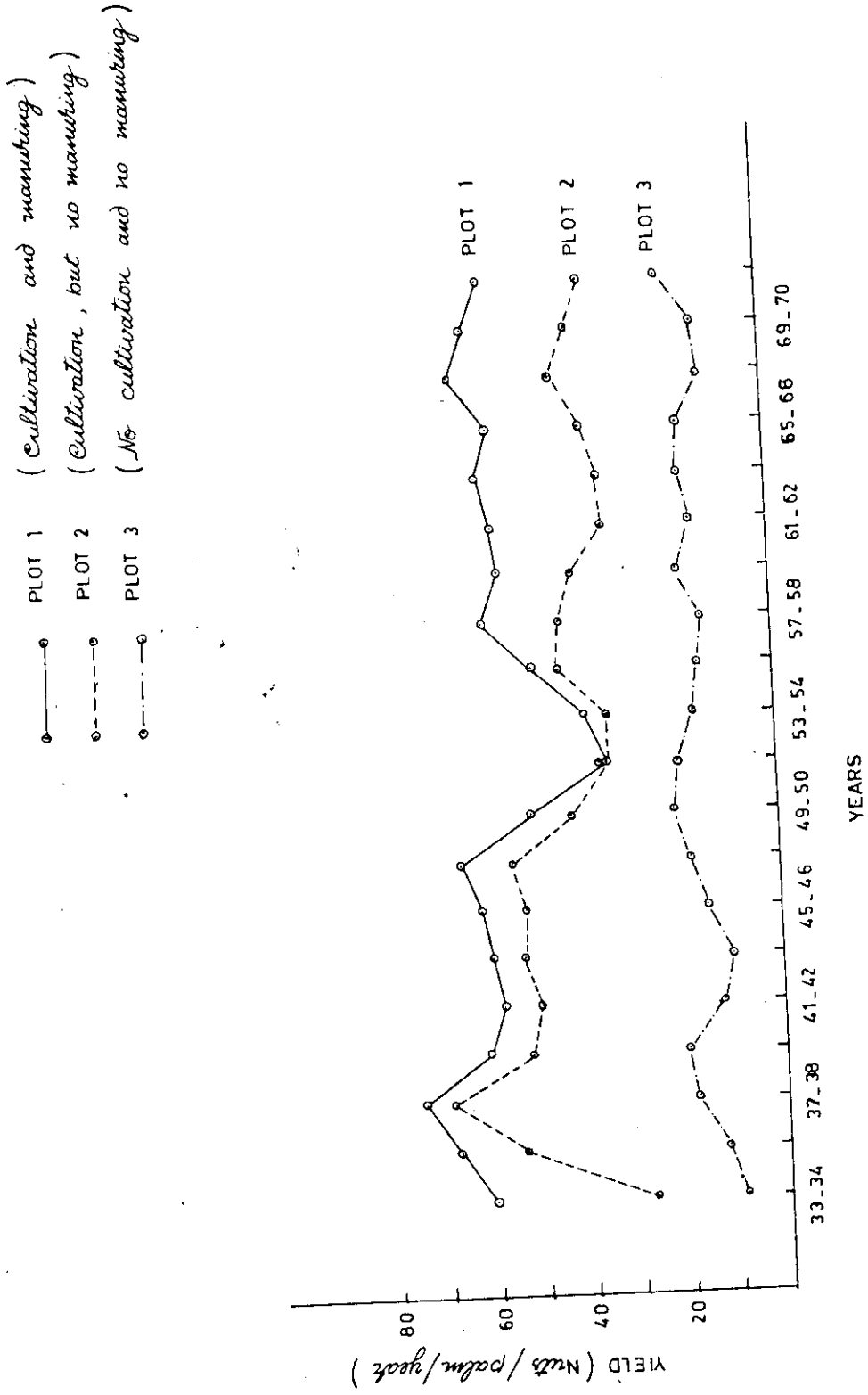


FIG 3. MEAN YIELD OF PALMS DURING PERIOD III (1973 - 1982)

