

# A comparative study of certain morphological and physiological characters associated with productivity of coconut (*Cocos nucifera* L.) and oil palm (*Elaeis guineensis* Jacq.)

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Coconut and oil palm are of considerable economic importance in the world trade of edible oils. In the requirement of soil and climatic factors for optimum growth and productivity, these two are similar (Table 1). Both are cultivated in the wet tropics of Africa and South East Asia and exhibit wide variability in growth and productivity.

Basic physiological studies in tree crops like coconut and oil palm are often rendered difficult due to the large size, long life and slow growing characteristics. Hence literature on the subject is scanty. While in oil palm investigations on aspects of production physiology were initiated in early sixties such studies in coconut were started in seventies only. In the present paper the productivity of both the crops are discussed in the light of the morphology and physiology of the crops known hitherto.



Fig. 1 Oil palm



Fig. 2 West Coast Tall coconut palm

## MATERIALS AND METHODS

Studies on photosynthesis, leaf area, and dry matter production in seedlings and adult west coast tall (WCT) coconut palms are in progress at the Central Plantation Crops Research Institute, Kasaragod. The data presented in this paper are collected from the observations recorded after destructive analysis of 30 - 35 year old Tall palms, and other observations recorded in the Monograph by Menon & Pandalai (1958). The relative values are estimated for two yield groups viz. 50 nuts / palm / year and 200 nuts/palm/year. Data on the various characteristics of oil palm presented are compiled from the book by Corley *et al* (1976) and Hartely (1976). While in the coconut, the data pertains to palms in the age group of

30-35 years, in oil palm this is for the age group of 8-10 years, as the coconut palm commences bearing much later (7-10 years of age) than that in oil palm (2-3 years).

## RESULTS AND DISCUSSION

### 1. Growth and morphology :

Certain plant characters that are related to productivity in the two crops are presented in Table 2. While in oil palm the first flowering is attained at the age of 2-4 years, in coconut this is observed at 6-10 years of age. Consequently, the first flowering occurs at 20-24<sup>th</sup> leaf axil in oil palm as against 45-55<sup>th</sup> leaf axil in the coconut palm. The annual rate of leaf production is also higher in oil palm as compared to that in the coconut palm. Thus, in oil palm

the stabilization of yield is attained in 7-9 years of age while this is postponed to 15-20 years in coconut. The period for maturation of nut is 5-6 months in oil palm as against 10-12 months in coconut. The above comparison shows that the rate of growth of oil palm is much higher than that of coconut.

The data on leaf characteristics are presented in Table 3. Although the oil palm has smaller leaflets, the number of these leaflets is significantly higher than that for coconut. This has afforded higher area per frond in the oil palm than that in coconut. However, in the number of leaves on the crown there is very little difference between in the two crops. There is wide variability in the bunch production in oil palm as compared to coconut (Table 2). According to Corley *loc cit*; the vegetative growth in oil palm is often more than that required. Under average management the bunch production is more steady in coconut than that in oil palm.

### 2. Photosynthesis :

In oil palm, the net assimilation rate (NAR) calculated from the ratio of crop growth rate (CGR) to leaf area index (LAI), ranges from 11.3 to 14.2 gm<sup>-2</sup> week<sup>-1</sup>. However, in coconut the relative assimilation rate (RAR) determined by a subsampling method (Ramadasan *et al*, 1982) ranges from 2.5 to 5.8 gm<sup>-2</sup>week<sup>-1</sup> only. The values are hence not comparable.

Nevertheless, data on limited studies on net photosynthesis conducted in both the crops are available. In oil palm net photosynthesis ranges from 11.1 to 19.5 mg CO<sub>2</sub> dm<sup>-2</sup> h<sup>-1</sup> as against 8.0-15.0 mg in coconut. The rates compare well with those of other slow growing woody trees:

### 3. Leaf area index (LAI) and dry matter partitioning :

In the attainment of optimum LAI, both the crops are similar (Table 4). The annual dry matter production in oil palm is greater than that in coconut palm; but in the partitioning of dry matter to the economic produce calculated as the ratio of annual dry matter of the economic produce to the annual production of total dry matter, the coconut palm is more efficient than the oil palm. The higher ratio, higher termed as the annual productivity index (API), in coconut is due to less annual vegetative dry matter production which is more than the requirement in oil palm. This also implies that there is vast scope for improvement of economic produce in oil palm by regulating the vegetative growth. Studies on such possibilities are already in progress.

### 4. Abortion of spadices :

Both in coconut and oil palm the first formed inflorescence primordia are aborted before attaining the specific age of commencement of flowering, which is 20-24 leaf axil in oil palm and about the 45th leaf axil in the Tall variety of coconut. Even after commencement of flowering, abortion of female inflorescences in oil palm has been observed, which according to Corley (1976) may be due to inadequate supply of photosynthates to the developing inflorescence. In coconut, such abortion of inflorescence in adult stage is rare and is attributed only to environmental stresses. In oil palm, application of GA<sub>3</sub> reduces abortion while in coconut in preliminary studies, the same treatment has been shown to prepone the commencement of flowering in the Tall variety.

The production of edible oils by certain oilseed crops are presented in Table 5. The mean annual yield of oil from oil palm plantation is reported as about 5t/ha with the maximum attaining to 6t/h, while the maximum yield of oil attained in coconut so far

is only 4t/ha with a mean range of yield in India from 0.6t/h to 1t/h.

The wide difference in the production of oil from these crops may be due to variability in the production of nuts. Besides, the seed which is the source of oil also accounts for this (Table 6). In coconut, the source of oil is the kernel only, which accounts for 20-30% of the nut, while in oil palm seed, both the mesocarp and kernel form the source for oil. Higher yields of oil are obtained from the mesocarp in oil palm seed than from its kernel which accounts for only 8% of the dry weight of seednut. This difference is reflected in the oil yields per nut, which is 60-70% in oil palm as against 15-20% only in coconut. Thus on economic considerations on industrial scale the oil palm is more remunerative than coconut. However, due to its intricate post-harvest requirement the oil palm is beyond the reach of the small farmers who form the bulk of the rural population in India. Coconut with an end use for its every part has more potential as an integral part of small farms in the tropics.

### References

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**Table 1.**  
**Climate and Soil**

	Oil Palm	Coconut
Rainfall	2000° mm or more	1000-2250mm
Temperature	22° C-33° C	20° C-33° C
Sunshine	Min. 5hr./day	4-8hr/day
Soil	Wide range excepting coastal sandy soil	Wide range including coastal sandy soil
Soil pH.	4-7	3-7

**Table 2.**  
**Growth and morphology**

	Range of Values	
	Oil palm	Coconut
Age at first flowering	2-4 Yr	6-10 Yr
Leaf no. at which first flowering occurs	20-24	45-55
Annual rate of leaf production	20-25	12-14
Mean no. of bunches/year	6-15	10-14
Duration for nut maturity from anthesis to harvest (months)	5-6m	10-12 m
Age at stabilisation of yield (years)	7-9	15-20
Density of planting (palms/ha)	125-350	175-220

**Table 3.**  
**Leaf characteristics**

Characters.	Oil Palm	Coconut
Mean no. of leaves/palm	27-40	30-40
Area/leaf (m <sup>2</sup> )	7.8-10.5	2.4-4.9
No. of leaflets/leaf	310-350	207-310
Mean length of leaflet (cm)	57.0-64.0	78.0-102
Mean width of leaflet (cm)	3.2-3.7	4.5-6.5

**Table 4.****Leaf area and dry matter partitioning**

	Range of Value	
	Oil palm	Coconut
Leaf area index (LAI)	3.0-5.0 (120-150 palms per ha)	2.8-4.9 (175 palms per ha)
Annual vegetative dry matter production kg/palm/year	104-110	30-52
Annual productivity index (API)	0.40-0.43	0.5-0.69
Oil yield (t/ha)	3.0-6.0	0.6-4.0

**Table 5.****Recorded yields of certain oil yielding crops**

	t/ha/year
Soybean	2
Rape seed	2
Olive	3
Sunflower	4
Coconut	4
Oil palm	5

**Table 6.****Seed characters**

	Oil palm	Coconut
Mesocarp/fruit (%)	60-80	40-60
Kernel / fruit (%)	8.0	20-30
Shell/fruit (%)	12-32	15-25
Oil/mesocarp (%)	76	nil
Oil/fruit (%)	60-70	15-20