

## TOWARDS AN IDEAL PLANT TYPE CONCEPT IN COCONUT

RD IYER, EVV BHASKARA RAO,  
CK SUKUMARAN AND PM JACOB

*Central Plantation Crops Research Institute,  
Kasaragod-670 124, Kerala*

### ABSTRACT

The average yield of coconut in India is 35 nuts/palm/year, whereas some of the elite palms are reported to have yields ranging from 200 nuts to over 600 nuts under apparently little or no management. A survey of these elite palms indicated that they are free from disease, although growing in diseased environment for two or more decades. All these elite palms conform to a spherical or hemispherical canopy, the other being the large number of leaves showing a slower rate of senescence, and well-supported (non-buckling) bunches which become ready for harvest at regular intervals. A large number of vegetative and floral characters have been recorded for the inclusion in a model for an ideal plant type in coconut.

The seedling progenies raised from the elite palms have been studied using a cumulative indexing procedure and compared with seedling progenies of certain pre-potent palms which show a high rate of yield transmitting ability. Some progenies appeared more uniform than others, thus bearing a close resemblance to those of the prepotent palm. They have been planted both in healthy and disease-affected areas for analysing their further behaviour. Details of above study are discussed in this paper.

### INTRODUCTION

Coconut with its 1.1 million hectares of area and an annual production of 5830 million nuts, contributes to an extent of one per cent GNP of our country. Although it is the sixth major oil-yielding crop, its full potential as a source of vegetable oil has not yet been exploited. A major drawback in effecting genetic improvement in this crop through well-defined plant breeding objectives, is the very little or scanty information available on the yield

components. Some attempts have been made in the past to predict adult palm performance on the basis of juvenile characters (Liyange and Abeywardena, 1957; Satyabalan, *et al.*, 1975). Correlations between adult palm characters and yield have been reported by Patel (1938), Liyanage (1953), Liyanage and Abeywardena (1957) and Satyabalan *et al.*, (1972). More recently, the direct and indirect contributions of some of the adult palm characters towards yield have been studied (Sukumaran, *et al.*, 1981).

A survey of natural populations was undertaken during the past five years (1977 to 1981) to identify elite palms exhibiting unusually high yield potential compared with the base average yield of the particular area. A brief report of the survey was reported earlier by Iyer *et al.* These palms have now been evaluated in relation to the measurable phenotypic parameters as well as seedling progeny behaviour and the details of this study are discussed in this paper.

#### MATERIALS AND METHODS

For the present study single palms yielding over 200 nuts annually were identified as elite palms on the basis of first hand information obtained from farmers. At the time of the initial survey, general information on the ecological conditions, cultural practices if any, habitate and source of planting material were gathered. Vegetative characters such as plant height, canopy shape, number of leaves on the crown, leaf length, petiole length, number of leaflets and leaf scars per meter length of trunk were recorded. The reproductive characters recorded include number of bunches with nuts, number of nuts per bunch, number of opened and unopened spathes, number and distribution of female flowers in fully open spathes. The annual yield was estimated on the basis of the average number of nuts per bunch and the total number of bunches produced in an year, and the nuts were counted only when they had attained the fist-size. The annual growth rate was estimated on the basis of the number of leaf-scars in one metre length of trunk and the annual leaf production.

For a preliminary evaluation of progeny performance of these elite palms, the nursery characters of open-pollinated seedling

progenies were compared with those of prepotent WCT progenies. The cumulative nursery index was computed as per procedure outlined by Bhaskara Rao and Jacob Mathew (1981).

#### RESULTS AND DISCUSSION

In this preliminary survey, 18 elite palms yielding over 200 nuts/year were located in Kerala State. Six growing in root (wilt) disease-free zone in North and the remaining 12 in the South where the root (wilt) disease is rampant. The yield per palm of 200 nuts/annum and above was fixed arbitrarily on the basis of available average yield figures for the State which is 32 nuts/palm/year and still lower in the root (wilt) zone. In a well-managed farm, the Tall coconut cultivars have a potential of producing 60 nuts/palm/year under rainfed conditions. Since the national average yield is around 35 nuts/palm/year (Thampan, 1976), the palms giving over 200 nuts/year were taken as elite palms for the purpose of our study. However, in areas where average yields are higher, the basal limit for elite palm yields should also be fixed at correspondingly higher levels. By our definition, elite palms should yield unusually high number of nuts, in comparison to other palms in that particular area.

All the elite palms located in the survey are growing in relative isolation either inside house compounds or along the field bunds mostly on built-up soil and not in regular plantations, except those recorded in CPCRI experimental plots. This has given the added advantage of least competition from other palms, in addition to the availability of a regular water source. In most cases, the elite palms never received any chemical fertilizers, but were getting a regular supply of organic inputs such as FYM, oilcakes, leaf manure or ash and kitchen wastes. The soil analysis showed 0.43 to 1.6% organic carbon. Even though the palms located on field bunds were not being manured separately, their root systems which may extend into the plots (mostly rice) might be in contact with sufficient water and nutrients. Nevertheless, the extraordinarily high yields recorded in these elite palms, cannot entirely be attributed to their locational advantages. In almost all cases, there were many other palms growing in the vicinity of the elite ones with the same habitat and ecology, but showing very poor yields. Another distinct

feature of the elite palms located in the root (wilt) affected areas, is their healthy appearance with no symptoms of the disease whatsoever. It is difficult to conceive of a palm escaping disease for several decades in an area where every other palm is diseased. Therefore, it has been presumed that these elite palms have superior genotypic potential that could perhaps be exploited in coconut improvement.

Available correlations between adult palm characters and yield are listed in Table 1. The height of the palm shows significant and positive correlation with yield (Patel, 1938; Satyabalan *et al.* 1972). In the present survey the palms studied are of different age groups ranging from 12 to over 40 years. In all of them, it was apparent that there was a very fast growth rate in early stages, as can be made out from a study of the internodal distance and or number of leaf scars per unit length (Table 2). Even when the palm is 12 to 16 years old, the height was over 15 m and the internodal distance was also high. Usually, in the Tall cultivars 16-17 leaf scars are present per metre length of trunk. When there was rapid growth of trunk, only 10 to 12 leaf scars were noticed as in the Ernakulam elite palm (SP III). This is contrary to the obser-

Table 1. Correlation coefficients of adult palm characters with yield

Characters	Correlation coefficient	Reference
Height of palm	.. 0.581 to 0.686	Satyabalan <i>et al.</i> , (1972)
Number of leaves	.. 0.392 to 0.680	-do-
Female flower production	.. 0.7	-do- (1969)
Leaf production	.. 0.385	Liyanage (1967)
Length of stem	.. 0.346 to 0.517	Patel (1938)
Total number of leaves	.. 0.549 to 0.599	-do-
Number of leaflets	.. 0.161	-do-
Flowering period (Yield of nuts)	.. 0.4957	Liyanage and Abeywardena (1967)
Flowering period and yield of Copra	.. 0.6236	-do-

variations that longer internodal distance has negative effect on yield (Sukumaran, *et al.* 1981). However, in others, the slower trunk growth was compensated by a higher leaf production. In such cases, there were 20 to 31 leaf scars per metre length as in Chengala (SP-I) and Thazhava (SP-V) palms.

Table 2. Vegetative and reproductive characters in Elite Palms

Characters	Mean	Range	Palm showing the best expression
Palm height (m)	—	10-16	Ernakulam palm-SP. III 15 m at 12 years.
No of leaf scars in 1 m length	17.75	12-31	SP. III with higher trunk growth, 10 leaf scars/m Chengala palm SP. I and Thazhava SP. V with 20-31 leaf scars.
No. of leaves on the crown	39.4	34-50	Champakulam SP. VIII, with 50 leaves.
Leaf length (m)	5.73	5-6.2	CPCRI WB/169 with 6.2.
Petiole length (m)	1.46	1.3-1.8	Ezhom palm SP. II, SP. III, 1.8.
Crown shape	—	Spherical to hemispherical	SP. II, Bunches well supported by the subtending leaf petioles.
Annual spathe production	16.35	12-34	SP. III with 34.
Annual female flower production	439.5	273-843	SP. V with 843.
Female flower distribution	—	0-9 buttons per rachilla	SP. III, SP. VII with 0, 1 or 2 only/rachilla.
Setting percentage	55.5	33.77	SP. IX with 77.
Annual yield of nuts	240	155-470	SP III with over 470 nuts.

The average leaf number on the crown is significantly correlated with yield (Table 1) and the elite palms exhibited greater uniformity for this character. The leaf number varied between 35-46 and in one palm growing near Champakulam in South Kerala, there were over 50 leaves. The important feature here is perhaps the longer retention and slower senescence of the leaves. In general, about 8 to 9 leaves with harvested bunches were recorded in the elite palms as against 5 to 6 normally seen in WCT palms. The rate of production was also high, averaging about 18, with a maximum of 22 in the Thazhava elite palm (SP-V) as compared to 12 to 14 recorded in different age groups (Anonymous, 1980).

The crown shape in elite palms conformed to either hemispherical (Fig. 3) or spherical (Fig. 1) types of canopy, which are usually associated with high yielders, as against the drooping or angular crown (Menon and Pandalai, 1958; Bavappa and Nampoothiri 1974). The angle of emergence of the bunch also varied among the elite palms; in the hemispherical crowns (Fig. 3) the bunches are well supported by the subtending leaf petioles preventing their bucking (e.g. Ezhom Palm SP-II and Krishnapuram Palm SP-VI). The age at flowering was reported to be 5 to 6 years in most of the cases, which is about a year earlier than in normal WCT palms.

Among reproductive characters, the number of bunches, female flower production and setting percentage were correlated with yield (Nambiar and Ravindran, 1974; Anonymous, 1976; Sukumaran *et al.*, 1981). In the elite palms, the average bunch production was 16.5, number of female flowers were 443 and the setting percentage ranged from 33 to 77. The maximum bunch production was noted in the Ernakulam palm (34 bunches/year) with an average of 13 nuts/bunch. Nambiar and others (1970) while studying the inheritance of nut production in coconut, concluded that 1 or 2 female flowers per rachilla (Fig. 2) contributed maximum towards setting percentage and this was also a highly heritable trait. However, in the present study, a wide range of variation in female flower distribution among the elite palms has been noted. Even within a palm, the female flower distribution varied in different seasons. The Ezhom Palm (SP-III) and Kalavoor Palm (SP-III) did, however, show a greater consistency for this character, with only 0 or 1



female flower/rachilla, which is perhaps an ideal distribution (Table 2).

In WCT palms, the setting percentage ranged from 36 in poor yielders (< 30 nuts/palm/year) to 45 in high yielders (> 80 nuts/palm/year). In the elite palms the setting percentage ranged from 33 to 77 with an average of 50.5 and in the Thazhava Palm (SP-V) it was only 21, possibly due to the very high female flower production. The average number of female flowers was 440/year in elite palms, whereas the Thazhava Palm has recorded 843 female flowers/year. In contrast, the high yielding WCT palms produce only 256 female flowers/year (Anonymous, 1976). It may be mentioned here that even though it was reported that the threshold values for yield of nuts and copra/nut were 163 (Bavappa and Sukumaran, 1976), there was no appreciable reduction in nut size or copra content in the elite palms.

#### Nursery Evaluation

Based on nursery characters of open-pollinated, one year old seedling progenies of elite palms, a preliminary evaluation was carried out to identify the probable prepotents among them. The seedling characters reported to be correlated with yield, such as height, girth at collar leaf number and sprouting period (Liyanage and Abeywardena, 1975; Satyabalan *et al.*, 1975) were scored along with  $L \times B$  and petiole length of leaves. The elite palm progenies were compared with those of established prepotent palms, using the nursery index method (Bhaskara Rao and Jacob Mathew, 1981). It was observed that the progenies of two elite palms viz., Ezhom (SP-II) and WB-179 (T  $\times$  D) were superior to prepotent palms for seedling characters.

The results obtained so far in this investigation give only a preliminary indication of the superior/ideal characters exhibited in these elite palms. However, no single palm can be considered to be possessing all the best characters together. Some of the palms possess characters normally known to exhibit negative effects on yield, such as the longer internodes in the Ernakulam palm (SP-III), and the high female flower distribution recorded in the Thazhava (SP-V). It, therefore, seems possible that some characters could be complementary to each other. No information is

available at present on the interaction of these characters or their direct/indirect effects on the production physiology of these palms. Further investigations along these lines are envisaged.

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