PLANTING MATERIAL FOR COCONUTS

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The proper selection of planting material is a standard practice in agriculture. In a perennial crop like coconuts (*Cocos nucifera L.*) that can be propagated only with seeds, without any known methods of vegetative multiplication, planting material should indeed be judiciously selected.

Since coconuts were cultivated on a plantation scale, plant-breeders and agriculturists alike have used the simplest technique in breeding and their main theme has been to collect seednuts from the best individuals, notwithstanding the fact that palms are cross-fertilised. It is the purpose of the present article to discuss this age-old practice and consider improved methods for seednut production.

Methods of Mass Selection

A programme of selection work on coconuts was initiated in 1931 by Mr. W. V. D. Peiris, former Geneticist. He advocated selection at two levels : seednut and seedling stages.

Seednuts were collected either from individual high-yielding mother palms or high-yielding blocks. The main criteria for the selection of mother-palms were yield of nuts and copra, besides numerous other characters like shape and size of nut, length of bunch stalks, orientation of the crown, etc. ; palms that gave 100 nuts and 50 lb. of copra per year were selected.

The high-yielding blocks have been classified as those giving at least 4,000 nuts per acre, under average environmental conditions The palms in high-yielding blocks were harvested, and round, medium sized nuts were taken for seed.

Seednuts collected from mother palms and high-yielding blocks were planted in a nursery and the seedlings were issued for transplantation after a very rigid selection based on

(*a*) early sprouting
(*b*) vigour of seedling and
(*c*) resistance to pests and diseases.

The period taken for sprouting of seednuts varies considerably, generally between 12 to 25 weeks from the date of planting. Current nursery practice is to reject all seednuts that do not germinate within 20 weeks. Vigour is determined from the girth at the base of the shoot ; size, spread and colour of the leaves ; rapidity of growth and sturdiness of the seedling. A good seedling has a stout stem, dark green, broad leaves with strong midribs. A poor seedling is 'leggy' with a thin weak stem, pale green narrow leaves and thin midribs. On these standards about 40 to 60 per cent of the seedlings may have to be discarded as rejections.

Fortunately, there is some experimental evidence to assess the value of these methods of selection.

In a statistically designed field trial laid down in 1939, selected and unselected seedlings raised from seednuts collected from mother-palms and high-yielding blocks were compared.

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Seednut Selection

As far as seednut selection is concerned on the methods outlined above, there were no significant differences during the first few years of bearing whether seeds were taken from individual mother-palms or high-yielding blocks. The average yield for each category was approximately the same.

Average yield per acre per year (1951-53)

Type of Seednut	*Nuts**	*Copra (lb.)*†
From high-yielding blocks (Seedlings selected)	2,689	1,261
From individual mother palms (Seedlings selected)	2,677	1,249
Difference	12	12

*Critical difference = 246 nuts (P = 0.05)
†Critical difference = 221 lb. (P = 0.05)

Seedling Selection

On the other hand, selection of seedlings had a profound influence on the performance of the adult palms. They have given significantly higher yields of nuts and copra over unselected seedlings during the first few years of bearing (fig. 1).

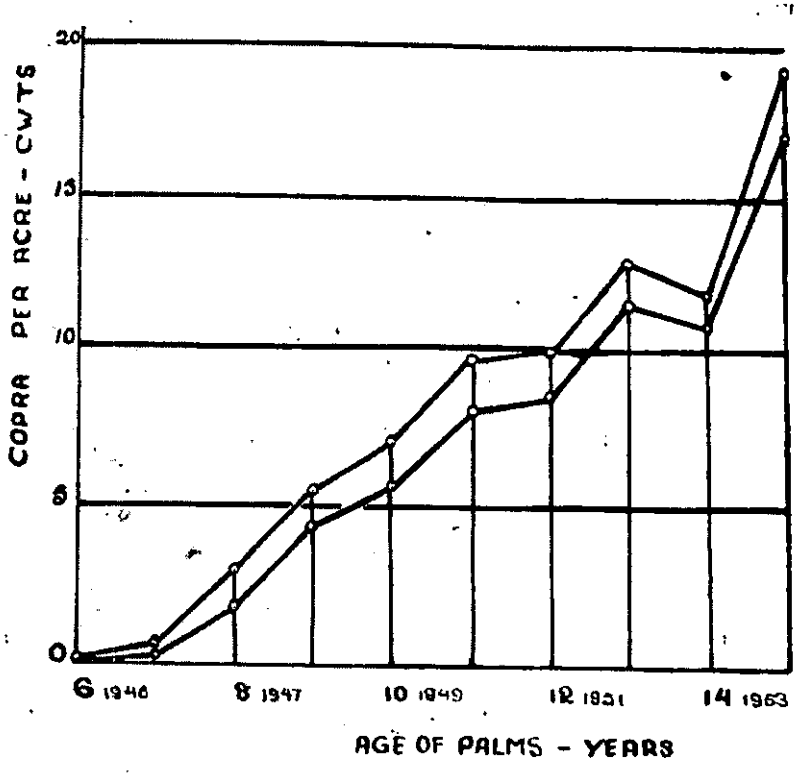

Fig. 1. The yield of copra of palms raised from selected and unselected seedlings. Upper curve for selected seedlings and the lower for unselected seedlings.

It was mentioned earlier that one of the criteria considered in the selection of seedlings was early sprouting of seednut. There is a positive correlation between periods taken for sprouting of seednuts and flowering of palms ($r = +0.437$, $P = 0.04$) and a negative correlation between sprouting and yield ($r = -0.424$, $P = 0.05$) ; i.e. when seednuts sprout early, they give rise to palms that flower in a shorter period and are more productive than those that are grown from seednuts that sprout late. These correlations are of considerable practical value (fig. 2).

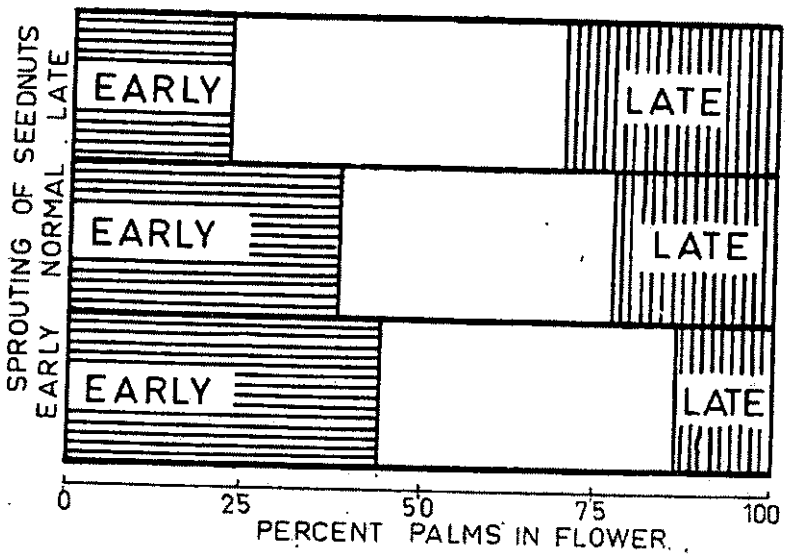

Fig. 2. Relationship between periods taken for sprouting of seed-nuts and flowering of palms.

The yield of nuts from the palms derived from selected seedlings has been significantly higher than those derived from unselected seedlings. The increase in crop in there nuts or copra during the first five years of bearing (1945-49) has been over 25 per cent and subsequently (1950-54) more than 12 per cent.

In 1954, the fifteenth year of the plantation, the plots with selected seedlings have given 3,762 nuts (3.8 candies of copra) per acre against 3,383 nuts (3.4 candies of copra) per acre from the unselected groups, a difference of 379 nuts per acre.

I have indicated that there is a response to seedling selection but not to seednut selection. The latter phenomenon has to be explained.

The formation of a nut involves the fusion of male and female gametes and naturally the quality of a seednut would depend on the nature of both these organisms.

In coconuts the floral phases have been so adjusted that the female flowers of one palm are pollinated with pollen from another palm.

Inflorescences open successively at intervals varying between 22 to 30 days, depending the age of the palm and environmental conditions.

From the second to the nineteenth day after the opening of the inflorescence, the male flowers open and liberate pollen. During this period the female flowers remain closed and on the twenty-second day become receptive by which time the male phase has been completed. Thus cross-fertilization occurs. Exception to this rule is that sometimes the inflorescences open at shorter intervals, every twenty-fourth day, so that the female phase of the older inflorescence overlaps with the male phase of the younger one, leaving room for selfing.

In the selection of mother-palm nuts, only the female parent is selected and the male parent is from the general stand of palms. All of us are aware that in this general population, there are a large number of poor palms. In a five acre block at Bandirippuwa giving a yield of 3,750 nuts per acre per year, one-third of the palms have contributed 45 per cent of the total crop, another one-third 35 per cent of the crop and the remaining third only 20 per cent.

Therefore, with such a heterogeneous collection of palms differences due to the two methods of seed selection outlined above would be negligible. In fact selection of the female parent only with a perennial cross-fertilized species is of little value. It is necessary to limit the male parent to desirable types as far as possible. This can be achieved only partially as far as the immediate seed supplies are concerned.

High yielding blocks should be selected—the high yield should be due to genetical characters of the population and not to favourable environments. Within this population all low-yielding palms and those with undesirable characters should be periodically emasculated so that their pollen would not contaminate the block; seednut collection should be restricted only to the good palms within the block after leaving out guard rows. Here again the male parent is only partially controlled and much better results could be achieved by opening up isolated seed gardens for coconuts.

Seed Garden

Already we have acquired 200 acres from the Ambakalle forest reserve, near Chilaw and work is in progress. We are artificially crossing selected high-yielding palms, and selected seedlings derived from the hand pollinated nuts are to be planted in the above block. This will form our first seed garden.

The seed garden is surrounded by forest vegetation at least 40 chains wide all round. The jungle is sufficiently wide to prevent any pollen from unknown palms in the village gardens, reaching the seed garden and contaminating the palms within it. Palms in the seed garden will all be of the desirable types, they will freely interpollinate and the resultant nuts will be distributed as planting material. The seed garden is the main solution for mass production of quality seednuts for the industry.

Hybrid Vigour

Another very fertile field of plant breeding is the production of hybrids between varieties of coconuts. Coconut palms have been classified into five main varieties and each of them into a number of forms or types. Some varieties and forms are not of much economic importance however they have certain characters that are useful, e.g. the Dwarf palm is early flowering and short in habit, the King-coconut has a high setting of female flowers, etc.

In 1949, and subsequently, a few crosses were done using a number of varieties and forms of coconuts and nearly 300 first generation progenies are under observation.

The varieties and forms are easily crossable, the progenies do not exhibit abnormalities in the formation of sex cells, the early flowering character of the dwarf variety is dominant and in certain combinations there is an expression of marked hybrid vigour. Therefore, there is no doubt that with proper selection of the parental palms, strains that are commercially useful could be evolved.

A very promising cross is that between the *Tall* × *Dwarf*. The palms are vegetatively very vigorous, with broad stems and large number of leaves; 82 per cent of the progenies flowered in less than 4½ years. Most of them flowered in 1954, and the developing nuts are large and heavy, and copra is of good quality. This cross seems to be of commercial value (fig. 3).

Fig. 3. *Tall* × *Dwarf* hybrid palm. 4½ years old.

Another promising line of work appears to be the production of double hybrids between Tall × Dwarf, i.e. a hybrid × hybrid, involving four parents (fig. 4).

Fig. 4. A palm suspected to be a double hybrid between *Tall* and *Dwarf* varieties. 4½ years old.

Eight progenies are available from a single cross between *King Coconut* and *Dwarf*; all the palms have flowered and the mean period for flowering was 44 months from the date of sprouting of seednuts. Five of the palms were in full bearing in 1954, the fifth year after planting and the mean yield per palm for that year was 142 nuts with a husked nut weight of 1.1 lb. The copra is thin and leathery. Since the nuts are small, and the copra of poor quality this cross is of little commercial value at least in the first generation (fig. 5).

Fig. 5. *King Coconut* × *Dwarf* hybrid palm 5 years old.

Systematic hybridization work relative to coconut is yet in its infancy, due to many difficulties involved, not only in this country but elsewhere too. Nevertheless, we have worked out suitable techniques and controlled pollination work is now in full swing at the Institute and it would not be long before quality seednuts would be available to the Industry.