



Coconut: Hybridization Technique and Quality Seedling Production

Sunil R¹ and Arun Chandran R P²

^{1,2} College of Agriculture, Kerala Agricultural University, Ambalavayal, Wayanad

doi.org/10.5281/TrendsInAgriculture.20588060

The coconut palm (*Cocos nucifera*; $2n=2x=32$) is a member of the family Arecaceae is a monotypic genus and there are no wild forms and hence variability exists only within local types or populations. The genus name *cocos* and the popular name coconut are derived from Spanish word *Coco* meaning “monkey face” – a probable reference to the 3 scars on the shell resembling 2 eyes and a nose on monkey’s face.

There are two types of palm cultivars, tall and dwarf. Tall are predominantly cross-pollinated, whereas the dwarfs are predominantly self-pollinated. Inflorescence is monoecious bearing both staminate and pistillate flowers in each spadix. The male flowers are the first to open (protandrous), beginning at the top of each spikelet and proceeding towards the base. Although both wind and insects bring about pollination, insect pollination is more predominant.

Breeding of coconut mainly focus on yield improvement, drought tolerance, resistance/ tolerance to root (wilt) diseases, pest resistant cultivars and quality improvement. Knowledge on flowering and pollination biology will be of significance for optimizing the pollination techniques, production of vigour hybrids and also to design efficient conservation strategies in coconut gene banks.

Cultivars of Coconut:

a. Dwarf varieties

- Shorter in stature
- Life span is short as compared to the tall
- Height: 5-7 m
- Average life span: 40-50 years
- Bearing starts from 3-4 years after planting
- Nuts are smaller and the copra soft, leathery and low in oil content.

- Grown mainly for establishing parent material in hybrid seed production and for the tender coconuts.

Eg. Chowghat Orange Dwarf (COD), Chowghat Green Dwarf (CGD), Chowghat Yellow Dwarf (CYD), Malayan Green Dwarf (MGD), Malayan Orange Dwarf (MOD), Malayan Yellow Dwarf (MYD) and Ganga Bondam (GB).

b. Tall varieties

- Taller in stature
- Life span is longer as compared to dwarf
- Height: 15-18 m
- Average life span: 60-80 years
- Bearing starts from 7-10 years after planting
- Good quality copra, oil and fiber
- Cultivars named after the place where they are largely cultivated

Eg. West Coast Tall (WCT), East Coast Tall (ECT), Laccadive Ordinary (LO), Laccadive micro, Tiptur Tall, Kappadam, Komadan and Andaman Ordinary (AO).

c. Hybrids

- The intervarietal crosses of two morphological forms of coconut
- Earliness in flowering
- Increased yield, higher quantity and better quality of copra and oil when compared to the parents
- Tall x Dwarf (T x D): Tall – female palm & dwarf - male parent
- Dwarf x Tall (D x T): Dwarf - female parent & tall - male parent

Floral biology

Inflorescence

Inflorescence is an axillary spadix with male and female flowers produced in the same palm (monoecious). One spadix is produced in each leaf axil. A spadix has a main axis with 30-40 branches (spadix). Each spike has numerous (200-300) male flowers and 1 or 2 female flowers, covered by a boat shaped spathe when immature.



1. Splitting of spathe; 2. Completely opened inflorescence

Male flowers

The inflorescence consists of many flower bearing spikelets situated on the spike the central axis. The number of spikelets varies from 30 to 35. On the spikelets, the male flowers are located at the distal end and the female flowers towards the base. The number of male flowers may vary from 250-300 per spikelet and there may be about 8000 to 10000 male flowers per inflorescence.



Male flowers

Male flowers have six perianth in two whorls of three, the outer three being small and the inner ones larger (three times). Inside there are six hammer shaped stamens and a rudimentary pistil. An inflorescence contains about 180 to 360 million pollen grains. The pollen output per anther in a flower of a healthy palm is estimated to be 111,000 to 221,000 pollen grains.

Female flowers

Unlike the male flowers, the female flowers are comparatively few in number in an inflorescence. They may vary from 20 to 40 in tall palms. Dwarf palms, generally, carry a large

number of female flowers in a spadix than that of tall palms. However, a few tall varieties also contain much more female flowers, even up to 100 female flowers per inflorescence.



Female flowers

At the time of opening of the spathe, the female flower is a small spherical body about 1.3 cm in diameter with great resemblance to a small nut and is popularly known as button. The female flowers, like male flowers, consist of six tepals that are thicker, imbricately arranged and tightly folded over the inner parts of the flower completely enveloping the spherical pistil. The ovary is tricarpellate and each carpel has a single ovule. Normally, only one ovule develops while the other two either abort or degenerate. But in exceptional cases bicarpellate and even tricarpellate fruits are also produced.

The stigmas are sessile. When the stigmas are receptive (ready to receive pollen), nectar is secreted at the base of the stigmas and at the three pores on the pericarp towards the top of the ovary. When the female flowers become receptive, it opens at the apex and the three stigmas protrude from it like a three-pointed star. At this stage, the stigmas are ivory in colour.

Anthesis

Tall palms

In tall palms there are three distinct phases. Male phase starts with the opening of the spathe marked by the opening of the male flower which proceeds from tip downwards. Opening of the flower starts early morning (6.00 a.m. onwards) and continues till evening. Each anther sheds large amount of pollen grains. The male phase lasts for about three weeks; the maximum being around 15 days. This is followed by an interphase which is for 4-5 days. Then comes the female phase during which the female flowers become receptive. This is marked by the divergence of the stigmatic lobes which will be white in colour and with the exudation of nectar. This phase is for about 7 days. The stigma can remain receptive for 1-2 days.

Dwarf palms

In dwarf palms the order of phase is the same (i.e male phase starts first followed by

female phase). Here the interphase is often absent rather there is an overlapping of these two phases.

Commercial production of hybrids

I. Mother palm selection

- Regular bearing
- Yield not less than 80 nuts/annum
- Age – Dwarf - 5 years after reaching full bearing capacity; Tall - 20 years or more
- More than 30 fully opened leaves
- Bearing 12 bunches of nuts
- Shape of crown : Spherical or semi-spherical
- Petioles: short and stout and be able to give effective support to the coconut bunches
- Bunch stalks: short and strong and should not have the tendency of droop down

Avoid palms which have the following characteristics

- Long, thin and pendulous inflorescence stalks
- Long, narrow, small sized or barren nuts
- Alternate bearing tendency
- Immature nuts shedding in large numbers
- Grown under unfavorable environmental conditions
- Diseased and pest attacked palms

II. Emasculation and Bagging

Emasculation is the process of removal of male flowers from the female parental palm. Emasculation is usually done by cutting the spikelets 5 cm above the female flowers using a scateur/ knife. The male flowers seen in between or near the female flowers should be removed by hand. Dwarf parental palms have to be emasculated within 3-5 days of opening of the inflorescence. Bagging is done to prevent pollination in emasculated inflorescence by natural means and is done a few days before the female flowers become receptive. Bagging is done 3-4 days before the initiation of female phase in an inflorescence. Usually done in December to May.

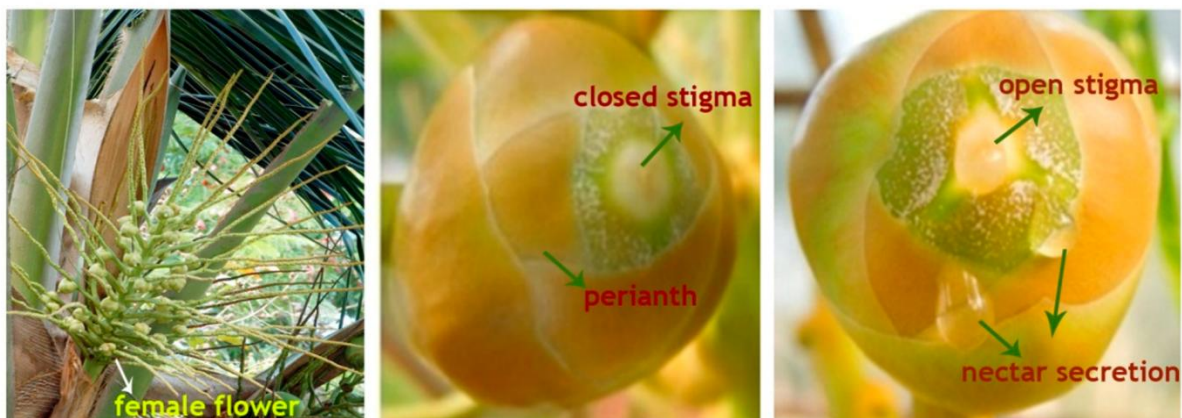
III. Pollen collection and storage

For collecting pollen the spikes in mid male phase are taken and the pollen grains are shaken out over a white paper. It is shade dried for one or two days and stored in a desiccator. This keeps them viable for one week. It is also found that coconut pollen over dried at 40°C for 40 hours can be stored over 35% sulphuric acid at room temperature for 3 weeks. Pollen can

be freeze dried and stored under vacuum for one year or more. Freeze dried pollen can be transported at ordinary temperature and will retain its viability for four months.

IV. Artificial pollination

Pistillate flowers become receptive during early morning hours which shows a reflexed moist stigmatic surface and the nectar is secreted at the base of the stigma and pericarp. Pollen which is mixed with talc powder in 1:9 ratio is applied through pollen applicator. The most ideal time for carrying out artificial pollination is during the morning hours, 6 am to 11 am since maximum stigmatic exudation occurs during that time. After 3-5 days, when all the buttons in an inflorescence turns brown and the secretion of nectar stops the pollination bag should be removed and the bunch should be labeled. Mature nuts can be harvested 11 months after pollination in dwarf palms and 12 months after pollination from tall parental palms.



V. Quality seedlings production

a. Selection & preparation of site

- Well drained; Light textured soil; Not too much shade

b. Selection of seed nut

- Nuts of medium size and oblong shape
- Age – above 11 month old
- Husked nuts more than 600g weight
- Mean copra content 150g per nut or more

c. Collection of seed nuts

- Time: Vary from region to region according to the seasonal conditions
- Ideal time - December to May
- Lowering of bunches by ropes

d. Storage of seed nuts

- Do not sow immediately after harvest
- To get better quality seedlings, the seed nuts of tall and hybrid are to be air cured for one month followed by sand curing
- Store for 60 days till the husk becomes dry
- Storing - prepare 8cm sand layer, keep seed nuts with stalk end up and cover with sand

e. Bed preparation

- Width: 1.5 m
- Length: Convenient
- Space between beds: 75 cm
- Spacing between rows: 30 cm
- Spacing between nuts: 30 cm
- Number of rows per bed: 4-5
- Sow in trenches @ 25-30 cm deep
- Method of planting: two types vertical and horizontal
- Time of sowing: May-June

f. Care and management of nursery

- Keep nursery beds free of weeds
- Irrigation – once in two days
- Termite attack – dust soil and nuts with chlorpyrifos
- Fungal infection – spray 1% bordeaux mixture/copper fungicide

g. Selection of good quality seedling

- 9-12 month old seedling
- At least four leaves for 9 month old seedling
- Six to eight leaves for 10-12 month old seedling
- Early germination, rapid growth & seedling vigour
- Collar girth: 10-12 cm
- Early splitting of leaves
- Remove seed nuts do not germinate within 6 months after sowing
- Percentage of recovery: 60-65 per cent

Released varieties

Kalpa Raksha, Kalpa Sree, Kalpa Jyothi, Kalpa Surya, Kalpa Dhenu, Kalpa Mitra, Kalpa Pratibha, Chandra Kalpa, Kera Chandra, Kalpa Tharu, Kalpa Haritha.

Hybrids

Kalpa Sreshta (MYD x TPT), Chandra Sankara (COD x WCT), Kera Sankara (WCT x COD), Chandra Laksha (LCT x COD), Kalpa Samruthi (MYD x WCT), Kalpa Sankara (CGD x WCT).