METHOD OF ARTIFICIAL POLLINATION OF COCONUT PALMS

By M.A.P.P. MANTHIRIRATNE and D.V. LIYANAGE
Coconut Research Institute.

In a previous article, methods of controlled pollination of coconut palms were described (The Ceylon Coconut Quarterly, Vol. 5, No. 3, 1954). Since then, the techniques have been considerably improved on and this article describes completely the new methods of pollination and pollen storage.

The Inflorescence

The coconut inflorescence is a massive structure about 36 inches long and 34 inches across when open. Towards the upper half of the central axis of the inflorescence are a large number of spikelets with male and female flowers (Fig. 1).

Fig. 1 Coconut inflorescence

The female flowers are the spherical bodies situated towards the base of each spikelet and above them are a large number of male flowers closely arranged. Generally there are only one to two female flowers per spikelet; a pair of male flowers are usually attached to the base of the female flower.

Inflorescences open successively at intervals varying from 22 to 30 days depending on the age of the palms and environmental conditions. From

the second to the nineteenth day after opening of the spathe, the male flowers open, liberate pollen and fall off. During this period the female flowers remain closed and become receptive on about the twenty-third day, when the stigmatic surface protrudes through the perianth lobes which were covering it earlier. The stigmatic surface is whitish in colour with three furrows running into the tissue and it is wet due to nectar secreted by three nectaries (Fig. 2). The receptive stage on each female flower lasts for about two days and that for the whole inflorescence lasts from two to five days.

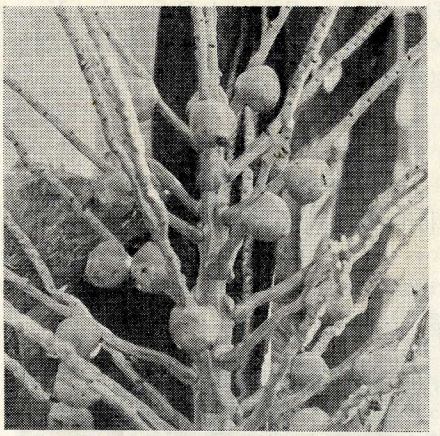

Fig. 2 Female flowers at receptivity

Selection of Parents

Parent palms should be selected on lines advocated in Coconut Research Institute Leaflet No. 1. The selected palms should consistently yield more than 100 nuts and 50 lb. of copra per year.

The ideal would be to use 'proved' parents, *i.e.* palms that are known to give high-yielding progenies through progeny tests. But for immediate work this would not be possible as progeny testing with coconuts takes decades. These factors can be overcome to a certain extent for we know that the yield depends on two basic factors, (*a*) the germ plasm of the plant and (*b*) the environment; if good yielders are selected under average conditions of environment, then the chances are that at least some of the high-yielding potentialities of the palm are due to its germ plasm.

Preparation of Parents

Husks are tied onto the stems of the parent palms at intervals of about two feet (Fig. 3) to assist the pollinator to climb the palm. As the selected palms are heavy bearers it may be necessary to remove one or two

bunches from the lowest whorl to help the pollinator to get to the crown. Further it may be advantageous to remove old bunch stalks, persistent butt ends, etc., as these when aggregated become breeding places for rats and squirrels which attack the pollination bags and even the immature nuts.

Fig. 3 Type of palm used as a female parent
(Note: Husks tied to facilitate climbing)

An accurate record must be kept of dates of opening of spathes on each palm. The success of all subsequent pollination work on the palm will depend to a large measure on a correct recording of the date of opening of the spathe, which is taken as the day on which the sheath (spathe) enclosing the flowers bursts open.

Collection of Pollen

The best period for the collection of pollen is from the third to the eighth day after the opening of the inflorescence. During other times, very little pollen is available from the male flowers either because they are too premature or too old. The quantity of pollen that can be collected varies from palm to palm and probably also varies from season to season.

The spikelets are cut about two inches above the female flowers. They are brought to the laboratory, the cut ends dipped in water in test tubes mounted on a stand and left in an inclined position over black cartridge paper. The spikelets are completely covered over with a box which is made up of a wooden frame 22″ × 19″ × 13″ (height) with brown paper pasted over the sides (Fig. 4). A large quantity of pollen would have fallen on the cartridge paper in about 18 — 24 hours. The pollen grains are collected with a fine camel hair brush sifted from debris and small insects and transferred into small vials 3″ × 3/8″ and plugged with cotton wool. Collection of pollen should be limited to palms where the inflorescences are free from pollen mites as these insects are injurious to pollen and often aggregate the pollen into lumps.

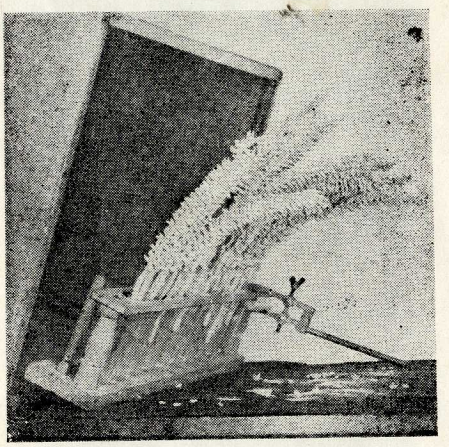

Fig. 4 Collection of pollen

The collection of pollen is done inside a closed room to minimise contamination with air-borne pollen. All apparatus used above including the paper should be sterilised with 10 per cent Formalin before they are used again.

Storage of Pollen

Pollen grains remain viable only for two days under atmospheric conditions. Generally it is necessary to keep pollen viable for 12 to 15 days for ordinary work, and for much longer periods (up to seven or eight months or even more) when pollen collection is restricted to pre-potent palms and the maximum use has to be made of this pollen. Two methods of pollen storage are described in this article. Either method could be adopted depending on the availability of equipment. The first method is relatively simple; store the vials containing the pollen over 43.4 per cent

Sulphuric Acid in a desiccator at room temperature. By this method pollen remains viable for about 15 days. The Sulphuric Acid in the desiccator should be changed once a fortnight.

The second method is more efficient but somewhat expensive, as it requires a refrigerator with a deep freeze section, gas and bunsen burners or a kerosene pressure stove and lengths of glass tubing. Nevertheless, the method is described in detail as it is efficient and the results obtained to date are very satisfactory.

Glass tubing (3 — 4 mm. external diameter, wall thickness 0.05 to 1 m.m.) is cut into six-inch lengths and kept for 3 to 4 days in a cleaning solution (the composition of which is indicated in Appendix B-6). The lengths of tubing are then removed and washed in running water for about 8 hours followed by a final rinsing in distilled water after which the tubes are air dried and then dried in an oven to expel all traces of moisture. One end of each tube is heated over a bunsen flame and drawn out to seal it completely. The tubes thus prepared are stored in dust free glass jars ready for use. Pollen collected in the usual way is mixed with Lycopodium powder in the ratio 1 of pollen to 5 of Lycopodium to increase quantity of pollen. The mixture is spread on a filter paper kept in a petridish and small quantities are carefully introduced into the glass tubes. The pollen introduced should be sufficient for pollinating about 30 female flowers on one occasion. The walls of the tube are freed from adhering pollen by working up and down a plug of cotton wool attached to a stout wire.

A small slip of paper which contains the necessary data regarding the pollen sample, i.e. sample number, palm number, and date of collection is introduced into the tube. The tubes containing the pollen are then left in a desiccator for 3 to 4 hours with the sealed ends dipping in 43.4 per cent Sulphuric Acid, after which they are taken out of the desiccator (one at a time with the open end closed) and the open ends hermetically sealed with the least possible delay. The sealed tubes are then left in a refrigerator, in the deep-freeze section. Judging by the results obtained to date, pollen stored in this manner remains viable for at least a year. When required for pollination the end of the tube is broken and the pollen tipped into a test-tube 3″ × 3/8″ and taken to the crown of the palm.

We have organised a Pollen Bank with pollen collected from pre-potent palms and limited supplies are available for issue to private estates doing their own programmes of controlled pollination.

Pollination Bags

Bags are made of cheap grey cloth with a transparent plastic window (Fig. 5 A). The dimensions are indicated in Fig. 5.

The cloth used should be of a sufficient texture to prevent foreign pollen passing through. Attached to one side of the transparent window is a small

plastic pouch (Fig. 5 B), 3″ × 1½″ in which the glass vial containing pollen is kept during pollination. Below the transparent window, on one side of the bag is a cloth pouch 11″ × 7″ (Fig. 5 C) so attached that its upper end is in communication with the cavity of the bag.

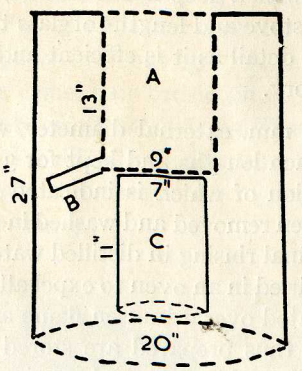

Fig. 5 Diagram of cloth bag used in pollination work

Trials are in progress where bags made of alkathene film are being used instead of cloth bags. It was observed that the temperature within the cloth bags was 5 to 10°C higher than the prevailing atmospheric temperature. This probably accounts for the lower setting of female flowers with controlled pollination when compared with natural pollination. The temperature within the alkathene bags is very much lower and they have an added advantage that they are relatively cheap and easily prepared by heat sealing. However, the bags are easily damaged by insects particularly the scissor insect (*Chellisoches morio*).

Bagging

The inflorescence is examined on the 18th day after the opening of the spathe and the date of receptivity of the female flowers is carefully noted. Generally the female flowers are receptive on the 23rd day, but in areas like Mundel and Madipola and also during dry spells they are receptive on about the 26th day. Three days prior to the date of receptivity, the spikelets are cut about 3 inches above the female flowers and any remaining male flowers are removed (Fig. 6).

The bag is now introduced, a layer of cotton waste is spread round the stalk of the inflorescence, and the bag is tied over the cotton waste with twine, enclosing the female flowers. The number of female flowers on each inflorescence should be thinned to 30.

It is useful to cover the pollination bag with a piece of jute hessian to prevent scorching of the female flowers through the transparent window and to reduce the temperature inside the pollination bag.

Fig. 6 Emasculated inflorescence before bagging

The pollinator must be able to climb trees skilfully and carry out the delicate process of pollination intelligently. He should be able to note the probable date of receptivity, the number of pollinations possible, and the earliest possible date of the removal of the bag.

Pollination

Pollen from the selected male palm is introduced to the female flowers when they are receptive. The receptive stage can be easily recognised by examining the female flowers through the transparent window of the bag enclosing the inflorescence. Generally the female flowers are receptive by about the twenty-second day after opening of the spathe. Each female flower is receptive for a day or two and the receptive phase of the whole inflorescence lasts from 2 to 5 days. This is only the general pattern of behaviour; there may be variations between palms and between environments.

Fig. 7 Method of pollination

The glass vial containing the pollen is taken through the large cloth pouch (Fig. 5 C) and placed in position in the small plastic pouch (Fig. 5 B). A fine brush (camel hair No. 2) is introduced through the large pouch, dipped into the pollen sample and the adhering pollen dusted on to the stigmatic surface of receptive female flowers (Fig. 7). After pollinating the female flowers, the brush and pollen sample are withdrawn and the pouch firmly tied to prevent entry of insects. It may be necessary to pollinate the female flowers every other day on two occasions or every day on three consecutive days depending on the pattern of receptivity of the female flowers. Pollination should be done either early in the morning or late in the evening. The bag is removed on the third day after the last pollination and the seed nuts will be ready for harvesting eleven to twelve months later.

A. *Equipment necessary for Controlled Pollination Work.*

1. Pollination bags of cheap grey cloth with plastic window, etc.
2. Test tubes 15 cm. × 2 cm. for dipping spikelets.
3. Test tubes — soda glass 3″ × 3/8″ for pollen collection.
4. Two desiccators (5½″ diameter).
5. Filter papers (11 cm. diameter).
6. Pair of 9″ secateurs.
7. Cotton waste.
8. Surgical cotton wool.
9. Camel hair brushes (Reeves No. 2).
10. Wooden test tube stands.
11. Wooden frames 22″ × 19″ × 13″ covered with brown paper.
12. Cartridge paper (black).
13. Retort clamps.
14. Sulphuric Acid 43.4 per cent.
15. Formalin 10 per cent.
16. Rectified spirits.

B. In addition to the above the following equipment will be necessary if the second method of pollen storage is adopted.

1. Refrigerator with deep-freeze compartment.
2. Bunsen burner with gas supply or kerosene pressure stove, or blow lamp.
3. Desiccator 8″ diameter, height 8″.
4. Petridishes 2″ diameter.
5. Glass tubing (3 — 4 mm. external diam. wall thickness 0.05 — 0.1 mm.).
6. Cleaning solution made up of 10 gms. Potassium dichromate, 10 gms. of conc. Sulphuric Acid in 100 c.c. of water.
7. Lycopodium powder.