

A modified pollination method for hybrid production in coconut (*Cocos nucifera* L.)

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ABSTRACT

The coconut palm (*Cocos nucifera* Linn.) is one of the most useful palms in the world. It is essentially a tropical plant growing mostly between 20°N 20°S latitudes. Enhancing productivity through cultivation of improved varieties including hybrids is one of the major strategies suggested to make coconut farming more remunerative. Pollination work in coconut for hybrid production requires skilled climbers and is a laborious process that involves climbing the palm many times. Any alternative method that reduces the number of climbing will reduce the labour and make the whole process more cost effective by way of economizing labour component. A study was conducted to find the suitability of detached whole spike with intact male flowers in pollination. A detached whole spike was observed in laboratory condition for seven days. Pollen shed from the spike was quantified and tested for germination. It was observed that pollen release increased gradually and then decreased. Pollen germination was up to 80% on the first day which reduced to 20% after six days. For field validation of the positive results from laboratory, a field experiment was conducted to find out setting of fruit when whole spike was used for pollination. West Coast Tall (WCT) and Chowghat Orange Dwarf (COD) cultivars were used in the study. Fruit set up to 30% could be observed which was on par with the traditional method. Whole spike method developed here will reduce the number of climbing required for pollen application to one instead of five required in traditional pollination. Moreover, pollen processing required in the present method can be completely avoided.

Keywords: Coconut, hybrid, pollination, spike.

INTRODUCTION

The coconut palm (*Cocos nucifera* Linn.) is one of the most useful palms in the world. Every part of the tree is useful to human life for some purpose or the other. Hence, the coconut palm is endearingly called 'kalpavriksha' meaning the tree of heaven. The most extensively used part being the endosperm and its derivatives. The coconut palm is found to grow under varying climatic and soil conditions. It is essentially a tropical plant growing mostly between 20°N 20°S latitudes. However, a rainfall of about 2000 mm per annum, well distributed throughout the year, is ideal for proper growth and maximum production. Coconut is propagated through seedlings raised from selected seed nuts.

Enhancing productivity through cultivation of improved varieties including hybrids is one of the major strategies suggested to make coconut farming more remunerative. Reports on manifestation of hybrid vigour in coconut palms, first came from India in 1937 (Patel, 1937). Dwarfs,

because of their precocity and slow upward growth, are mostly utilized as one of the parents. Genetically distant, tall populations possessing stable yield, tolerance to adverse conditions and resistance to pest and diseases are usually used as the other parent. Hybrid between dwarf and tall coconut exhibit heterosis for yield and are semi-tall in stature (Arunachalam and Rajesh, 2008). Production of seed nut of hybrids requires controlled pollination and this technique has been standardized (Niral *et al.*, 2009; Manthriratna *et al.*, 1960). Pollination work in coconut requires skilled climbers proficient in breeding behaviour to climb the palm and pollinate the flowers. Inflorescence with 25-30 female flowers takes five to ten days to complete female phase depending on the variety. During the female phase a climber has to climb the palm 3-5 times to pollinate the flowers. Male flowers collected are processed to extract pollen, which is dusted on the female flowers. Extracted pollen stored at room temperature should be used for pollination within 3-4 days before losing viability. The whole process of processing and extraction of pollen takes two days.

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Hybrid seed production in coconut is a laborious process that involves climbing the palm many times. Any alternative that reduces the number of climbing will make the whole process more cost effective. Among the various steps of crossing, pollen extraction and application can be modified to make the whole process more economic. The present work was conducted to find the suitability of detached whole spike with intact male flowers in pollination thereby avoiding pollen extraction and reducing 3-4 climbing needed for pollination.

MATERIALS AND METHODS

Pollen viability in detached male spike (Fig. 1a) was tested in an experiment set up in laboratory. Detached male spike, the cut end moistened by covering with wet cotton, was placed inside a pollination bag under room temperature (Fig. 1b). The pollen released inside the bag was collected in butter paper placed below the male spike (Fig. 1c). Spikelets with different maturity were collected on alternate days from opened bunch. Two spikelets, one with single opened flower and other with 5-10 opened flowers are collected on the first day and one spikelet with 5-10 opened flowers is collected on the third day. The male spike was observed on daily basis for number of opened male flowers, number of shed male flowers, quantity of shed pollen and germination of pollen. Spikelet from the same bunch was used to pollinate in the field by tying it to an emasculated bunch of the female parent at the time of bagging. Pollen released from the detached male spike tied on to the female parent bunch pollinated the female flower. Effectiveness of pollination was measured by observing setting of fruit after three months following fertilization. The rest of the male spikes from the bunch were processed by normal pollen processing method involving separating unopened male flowers, pressing and drying, and sieving to collect pollen. The pollen collected by normal process was also tested for germination.



Fig. 1a: Male spike



Fig. 1b: Spike covered with bag



Fig. 1c: Pollen collected on butter paper

Study was done in two cultivars WCT and COD, since they are parents in many of the released hybrids. The work was done for two consecutive years at ICAR-CPCRI Kasaragod during 2015-17. Data analysis was done using statistical software, SPSS.

RESULT AND DISCUSSION

Female flowers in an inflorescence of coconut takes 3-5 days in the case of tall varieties and 7-10 days in the case of dwarf varieties to complete receptivity (female phase of inflorescence), so pollination also continues that many days in an inflorescence (Menon and Pandalai 1958). In coconut crossing programmes, artificial pollination is carried out 3-7 days and that many climbing depending on the variety. Reducing the number of climbing without affecting pollination will appreciably bring down the cost of hybrid production. Normally pollen collected and stored (Whitehead, 1962; Manthirathna, 1965) is used for pollination. Processing male flower for pollen collection is also laborious. It involves collection of male spikes, separation of male flowers, drying of male flowers, sieving dried flowers in a three tier sieve, collecting and storing pollen (Samsudeen *et al.*, 2016). Any method that will circumvent these steps in hybrid production will also reduce the cost of production. Reduction of number of climbing as well as avoidance of pollen extraction was the aim of this experiment.

Release and viability of pollen from male flower in a detached male spike was tested in an experiment set up in the laboratory. Quantity of pollen released and germination for ten days following collection of male spike from inflorescence were observed in two varieties. Male flowers in the detached spike continued opening up to ten days. The sepal of the male flower is attached more firmly to the spikelet axil in COD compared to the WCT. A slight disturbance may cause even the unopened WCT flowers to fall off. At the same time very less flowers shed from even a completely dried spikelet of COD. About 75% of male flowered opened by sixth day after collection of spike. Quantity of pollen released increased gradually up to seven days then started declining in both the varieties. Germination of pollen released was above 20% till seventh day of spike collection in COD while in WCT it was till eighth day of spike collection. Pollen extracted through normal method showed germination above 20% till fourth day of extraction (Table 1). Male flower opening, release of pollen and germination continued till 14 to 15 days after collection of spike albeit in a reduced scale.

Table 1: Quantity and germination of pollen

Day	Weight of released pollen (g)	Released pollen germination (%)	Extracted pollen germination (%)
COD (mean)	0.0069	26.75	21.23
1	0.0038	40.94	46.52
2	0.0037	42.91	37.40
3	0.0083	35.81	39.11
4	0.0061	27.09	26.33
5	0.0046	28.11	14.88
6	0.0085	24.84	10.25
7	0.0101	22.26	11.27
8	0.0112	14.92	10.38
9	0.0071	14.44	3.25
10	0.0060	11.45	0.80
WCT (mean)	0.0111	33.59	15.56
1	0.0051	48.06	28.87
2	0.0054	45.37	30.99
3	0.0093	50.00	23.22
4	0.0132	51.43	31.77
5	0.0144	41.69	18.97
6	0.0156	35.12	9.38
7	0.0119	26.66	9.58
8	0.0178	22.43	7.82
9	0.0105	16.68	2.80
10	0.0085	12.88	2.40

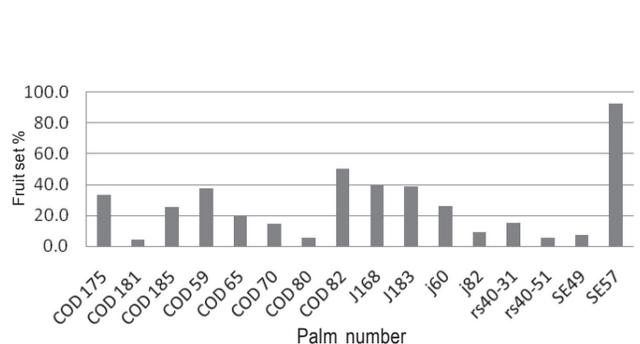
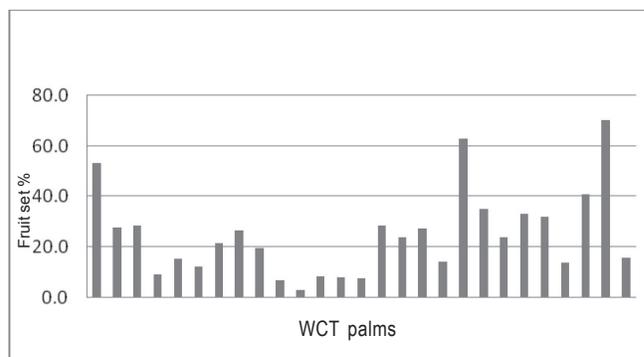
The detached spike continued to release viable pollen up to ten days though there was reduction in percentage of germination. There was slight difference between COD and WCT varieties. The WCT pollen was viable for more number of days compared to COD. In coconut hybrid production WCT and COD are both used as male and female parents. Female phase, duration of female flowers in an inflorescence are receptive, of COD is more than that of WCT. In the experiment, it was seen that male flowers of WCT release viable pollen for number days. This factor will help to cover the longer female phase in COD when WCT male spike is used for pollination. Male flower

**Fig. 2:** Emasculated inflorescence with tied male spike

behaviour in the detached spike of male parent was complementary to the female phase of female parent. All these indicated that detached male spikes could be used in pollination for crossing WCT and COD.

Laboratory experiment that gave positive results were followed up with field experiment where detached male spike was tied to emasculated inflorescence and observed for fruit development. One or two male spikes was tied to the inflorescence and bagged (Fig.2). The bag was removed after ten days in WCT and after 12 days in COD. Fertilization and fruit set was confirmed after three months by counting fist sized fruit developed. Seasonal influence on fruit set was more pronounced in COD compared to WCT. In general fruit set was low in during monsoon season. During monsoon season the quantity of pollen obtained as well as pollen germination was low compared other seasons in both COD and WCT. The seasonal influence on production of pollen in individual male flowers as well as total production of pollen in the inflorescences was reported earlier (Gangolly *et al.*, 1961).

In 23 COD palms this method was tested, the average female flowers per palm were 34 and average fruits set per palm were 4.5 per palm. In 28 COD palms this method was tested, the average female flowers per palm were 22.4

**Fig. 3a:** COD fruit setting %**Fig. 3b:** WCT palm number setting %

and average fruits set per palm were 5.3 per palm (Table 2). The percentage of fruit set among palms of both varieties varied. In COD it varied from zero to 92 percentage. In WCT it varied from zero to 70 percentage (Fig. 3a & Fig. 3b). In normal pollination programmes, the percentage of fruit set is between 25 and 30. In this modified pollination method, the fruit set was less than the normal method. Though the method was successful in getting fruit set, refinement in the method is suggested to improve the efficiency.

Table 2: Fruit set obtained in COD and WCT palms pollination using male spike

Variety	F. flowers/ palm	Fruit set (no)/ palm	Fruit set %
COD (23 palms)	34.2	4.5	18.8
WCT (28 palms)	22.4	5.3	23.0

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