

# GENETIC IMPROVEMENT OF COCONUT PALM- COMBINING ABILITY OF PALMS IN DWARF × TALL HYBRIDS

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## ABSTRACT

Seedlings of eight combinations of Dwarf female × Tall male obtained from crosses between five Dwarf genotypes and three Tall genotypes were studied to identify the parental combination which would yield maximum number of hybrids. The palms were selected on the basis of nut characters like shell and copra content in the husked nuts of dwarf palms and husk and copra content in the fruits of tall palms. The seedlings obtained from these combinations were scored for heterotic hybrids on the basis of petiole colour and vigorous growth of the seedlings in the nursery. The study has indicated that to obtain maximum number of hybrid seedlings, it is preferable to select dwarf palms which yield nuts having a low shell content (less than 20 per cent of husked nut weight) as pistillate parents and tall palms which yield nuts which have less husk content (less than 50 per cent of the weight of fruit) and a high copra content per nut (above 150 gm per nut) as pollen parents. It may be possible to identify individual palms in both the parents which when combined may yield a large number of hybrid seedlings. Seedlings of the best combiners should be utilized for laying out hybrid seed gardens for large scale production of hybrids.

## INTRODUCTION

In coconut, West Coast Tall female × Chowghat Dwarf male hybrids are found to be early bearing and high yielding. But all combinations of Tall as female parent and Dwarf as male parent are not promising. It has been observed that there is considerable variation in the yield of hybrids obtained from different matings and that some combinations are very promising while others are of only average merit. In the Tall female and Dwarf male combination,

the hybrids in the nursery can be identified only on the basis of the vigorous growth of the seedlings as there is no colour marker to identify them. On the other hand in the reciprocal combination of Dwarf female × Tall male, the hybrids are identified in the nursery by the petiole colour of the seedling which resembles the colour of the petiole of the seedling of the male parent as the petiole colour of the seedling of the dwarf female parent is of distinct colour yellow, orange or red. Besides the petiole colour, the

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vigorous growth of the seedling is also noted to identify the hybrids. In this combination also there is considerable variation in the number of hybrids obtained. The percentage of hybrids obtained from Chowghat Dwarf Orange  $\times$  West Coast Tall combination is about 30 in the hybrid nuts sown but the percentage varies from nil to 100 in the different palms, presumably due to the differential combining ability of the parents. Hence for large scale production of promising Dwarf female  $\times$  Tall male hybrids, both the male and female parents have to be identified. The palms can be identified only on the basis of nut and copra characters. Under the Emeritus Scientists' Scheme of the Indian Council of Agricultural Research a study was undertaken to identify the nut and copra characters in both the male and female parents which when combined would yield a large number of hybrids. The parents for the study were selected from the palms of different dwarf types and from the palms of the local and exotic tall cultivars to identify the best combination from which a large number of hybrids could be obtained and the results are presented in this paper.

#### MATERIALS AND METHODS

The dwarf female parents selected for the study were: Malayan Dwarf Yellow (MDY) and Malayan Dwarf Orange (MDO) introduced directly from Malaysia, Kulashekham Dwarf Yellow (KDY) and Kulashekham Dwarf Orange (KDO) which are similar to Malayan Dwarfs but introduced from a secondary source—from a private estate in Kulashekham, Kerala—and the local Chowghat Dwarf Orange (CDO) available at the

Central Plantation Crops Research Institute, Kasaragod. Selected palms from the local West Coast Tall (WCT) and the two exotic cultivars Kenya Tall and Zanzibar Tall maintained at the Institute were utilised as male parents. A detailed study of the nut and copra characters of the selected palms indicated considerable variation not only between the dwarf types but also between the palms of the same type. The palms of the tall cultivars also differed considerably in their nut and copra characters. Based on the fruit analysis data, the selected palms in the dwarf types were classified into four groups on the basis of shell and copra content in relation to husked nut weight while the tall palms were classified into two groups on the basis of husk and copra content in the fruit. In the dwarf palms the first group (G I) consisted of palms the nuts of which have shell content of less than 20% of the husked nut weight and yield copra of less than 150g per nut. The second group (G II) consisted of palms which yield nuts having a shell content of less than 20% husked nut weight but yield of copra more than 150g per nut. The third group (G III) consisted of palms which yield nuts having a shell content of more than 20% of husked nut weight and yield copra of less than 150g per nut and the fourth group (G IV) consisted of palms which yield nuts having a shell content of more than 20% of husked nut weight and yield of copra more than 150g per nut. Tall palms were classified into two groups based on husk and copra contents. The first group (T<sub>1</sub>) consisted of palms which yield nuts having a husk content of less than 50% of the fruit weight and yield more

than 150g of copra per nut and the second group (T<sub>2</sub>) consisted of palms which also yield nuts which have a husk content of less than 50% of the fruit weight but yield copra of less than 150g per nut.

The pollination work was done during the months January to May 1982. Each inflorescence of a dwarf palm was pollinated with a different male parent to identify the combination which yielded maximum number of hybrids. During this period 2148 female flowers in 89 bunches of 13 dwarf palms in the first group, 2602 female flowers in 52 bunches of 10 dwarf palms in the second group, 1261 female flowers in 22 bunches of 3 dwarf palms in the third group and 430 female flowers in 13 bunches of 4 dwarf palms in the fourth group were pollinated with pollen from tall palms of the two groups. The first pollinated bunch was harvested in November 1982 and the nuts were sown in the nursery in December, 1982. Since then one bunch of well matured pollinated nuts was harvested each month from the dwarf palms and the nuts were sown in the nursery without much delay. In all 1303 pollinated nuts of eight combinations *viz.*, GI × T<sub>1</sub>, GI × T<sub>2</sub>, GII × T<sub>1</sub>, GII × T<sub>2</sub>, GIII × T<sub>1</sub>, GIII × T<sub>2</sub>, GIV × T<sub>1</sub> and GIV × T<sub>2</sub>, of Dwarf × Tall were sown in the nursery. In each combination the hybrids obtained were identified in the nursery on the basis of their petiole colour and vigorous growth. The observations were continued till the last week of September 1983.

#### RESULTS AND DISCUSSION

Details of nut analysis of palms

selected in the dwarf and tall varieties classified under the different groups are presented in Table I. Nut and copra characters of 12 dwarf palms under Group I, of 8 palms under Group II, of 3 palms under Group III and of 3 palms under Group IV under the different dwarf types are given in the table. The data on the nut and copra characters of 7 tall palms of group T<sub>1</sub> and of 4 palms of group T<sub>2</sub> are also given in the table. These data indicate the variation in the characters of the palms selected as parents. In the dwarf in the first group (GI), the percentage of shell in the husked nut weight varied from 14.8 to 19.3 and the weight of copra per nut from 84.0 to 144.0g. In the second group (GII) the percentage of shell in husked nut weight varied from 16.7 to 19.1 and the weight of copra per nut from 150.3 to 212.7g. In the third group (GIII) the percentage of shell in husked nut weight varied from 21.3 to 31.0 and the copra weight from 79.0 to 136.6g per nut while in the fourth group (GIV) the percentage of shell in the husked nut weight varied from 22.3 to 30.5 and the copra weight from 160.3 to 183.0g per nut. It is evident from the data that there is considerable variation in the nut and copra characters not only in the palms of different dwarf types but also between the palms of the same type. Studies on the nut and copra characters of Malayan Dwarf Yellow and Orange or Red reported from other countries also show wide variations in the different regions of a country and between different countries. Data on the 7 palms of the tall cultivar of the first group (T<sub>1</sub>) indicate that the percentage of husk content in fruit weight varied from 36.6 to 49.3

Table I. Details of fruit analysis of Dwarf and Tall parents selected for production  
(A) Dwarfs: (Pistillate parents)

Palm No.	Wt. of fruit (g)	Wt. of husked nut (g)	% of husk in fruit	% of kernel in husked nut	% of water in husked nut	% of shell in husked nut	Wt. of copra per nut (g)
<b>Group I: No. of palms 12</b>							
<i>1. Kulashekharam Dwarf Yellow</i>							
1)	81	731.3	469.0	64.2	55.2	27.7	17.1
2)	87	696.7	448.0	63.8	58.2	24.7	17.1
3)	88	785.0	513.0	65.3	51.1	31.9	16.9
4)	89	717.5	530.0	73.8	57.1	25.5	17.5
5)	97	1217.0	535.8	44.0	38.8	43.8	17.4
6)	99	672.5	431.8	64.0	54.5	28.7	16.9
7)	112	671.5	431.7	64.3	48.0	34.7	17.2
<i>2. Kulashekharam Dwarf Orange</i>							
8)	135	1396.5	680.7	48.8	46.1	37.4	16.6
<i>3. Malayan Dwarf Yellow</i>							
9)	176	750.0	500.0	66.6	50.8	29.8	19.4
10)	178	865.0	515.0	59.5	50.5	34.7	14.8
11)	186	760.0	518.0	68.1	47.9	35.3	16.7
<i>4. Chowghat Dwarf Orange</i>							
12)	13	793.0	596.0	75.1	53.4	27.3	19.3
<b>Group II: No. of palms: 8</b>							
<i>1. Kulashekharam Dwarf Yellow</i>							
13)	65	1050.0	776.8	74.0	46.6	35.3	18.1
14)	69	970.0	745.0	76.7	43.1	38.8	18.1
<i>2. Kulashekharam Dwarf Orange</i>							
15)	121	1281.7	824.0	64.2	48.4	34.8	16.7
16)	124	1010.7	722.5	71.5	54.7	27.2	18.1
<i>3. Malayan Dwarf Orange</i>							
17)	160	1039.4	688.2	66.2	49.3	33.3	17.4
18)	211	1280.4	790.7	61.7	50.2	30.8	19.0
<i>4. Chowghat Dwarf Orange</i>							
19)	218	860.1	598.2	69.5	30.9	20.8	17.9
20)	80	1356.2	757.2	55.8	47.1	33.8	19.1
<b>Group III: No. of palms 3</b>							
<i>1. Kulashekharam Dwarf Yellow</i>							
21)	60	1034.6	796.6	76.9	48.6	29.7	21.6
<i>2. Kulashekharam Dwarf Orange</i>							
22)	128	1497.7	649.3	43.3	35.1	43.6	21.3
<i>3. Chowghat Dwarf Orange</i>							
23)	3	792.3	460.3	58.1	45.6	23.4	31.0
<b>Group IV: No. of palms: 3</b>							
<i>1. Kulashekharam Dwarf Yellow</i>							
24)	94	663.8	487.3	73.4	60.8	16.9	22.3
<i>2. Kulashekharam Dwarf Orange</i>							
25)	308	1046.3	698.8	66.7	45.2	30.0	24.7
<i>3. Chowghat Dwarf Orange</i>							
26)	50	1179.0	571.0	48.4	48.5	21.0	30.5

## of Dwarf × Tall hybrids

## (B) Talls: (Pollen parents)

Sl. No.	Palm No.	Cultivar	Wt. of fruit (g)	Wt. of husked nut (g)	Percentage of husk in fruit	Copra content per nut (g)
Group I: No. of palms: 6 (T 1)						
1	205	West Coast Tall	954.6	509.8	46.6	170.5
2	189	"	1034.0	545.2	47.5	182.1
3	842	"	1416.6	637.7	48.4	190.9
4	41	Kenya Tall	1181.0	598.8	49.3	175.1
5	39	"	1160.4	666.4	42.8	216.6
6	57	Zanzibar Tall	1156.8	714.5	38.3	207.5
7	21	"	781.3	495.6	36.6	174.6
Group II: No. of palms: 4 (T 2)						
8	138	West Coast Tall	825.7	433.8	47.5	144.3
9	315	"	839.9	451.0	46.4	149.6
10	346	"	767.0	406.8	47.1	133.3
11	837	"	847.0	471.1	44.3	149.8

indicating that the husk content is less than 50% of the fruit weight and their copra content per nut varied from 170.5 to 216.6g. In the 4 palms of the second group (T2) the percentage of husk in fruit weight varied from 44.3 to 47.5 which again indicated that the husk content in the fruit was less than 50% of fruit weight but their copra content varied from 133.3 to 149.8g per nut. Out of 89 bunches pollinated in the palms of Group I, 441 nuts were obtained from 73 bunches pollinated with palms from T1 group and 127 nuts were obtained from 16 bunches pollinated with palms from T2 group. In Group II out of 52 bunches pollinated, 303 nuts were obtained from 40 bunches pollinated with palms from T1 group and 124 nuts from 12 bunches pollinated with palms from T2 group. In group III out of 22 bunches pollinated, 155 nuts were obtained from 14 bunches pollinated with palms from T1 group and 47 nuts from 8 bunches

pollinated with palms from T2 group. Out of 13 bunches pollinated in the palms of Group IV, 78 nuts from 9 bunches pollinated with T1 palms and 28 nuts from 4 bunches pollinated with T2 palms were obtained. In all 441 nuts of GI×T1, 127 nuts of GI×T2, 303 nuts of GII×T1, 124 nuts of GII×T2, 155 nuts of GIII×T1, 47 nuts of GIII×T2, 78 nuts of GIV×T1 and 28 nuts of GIV×T2 combinations were sown in the nursery. Detail of bunches harvested, nuts sown and germinated in the nursery and hybrids obtained in each combination of Dwarf×Tall are presented in Table II. The data indicate that in the five types of dwarfs pollinated with tall, the percentage of hybrid nuts sown varied from 36.8 in CDO×Tall to 55.2 in MDY×Tall combinations. Malayan Dwarf Yellow as pistillate parent has yielded more number of hybrids than other dwarf types. In order to identify which of the pollen parent groups T1 or T2 in combina-

Table II. *Details of bunches harvested, nuts sown and germinated and hybrids obtained from combinations of different Dwarf types × Tall*

Sl. No.	Combinations	No. of bunches harvested	No. of nuts sown	No. of nuts germinated	No. of hybrids obtained	percentage of hybrids of nuts sown
1	KDY X Tall	59	436	219	199	45.6
2	KDO X Tall	52	298	160	128	42.9
3	MDY X Tall	17	105	61	58	55.2
4	MDO X Tall	18	124	75	59	47.6
6	CDO X Tall	30	340	150	125	36.8

tion with the dwarf types had yielded more number of hybrids, details of bunches harvested, nuts sown and germinated and percentage of hybrids obtained from the different dwarf types with the two groups of pollen parents were separately gathered. The data presented in Table III indicate that except in the case of Chowghat Dwarf Orange, the combination of T<sub>1</sub> group of tall parents with the other dwarf types has yielded more number of hybrids than with T<sub>2</sub> group. Here also MDY × T<sub>1</sub> combination has yielded the maximum

percentage of 60.2 hybrids in the nuts sown.

To identify further the nut and copra characters in both the parents which could combine well to yield maximum number of hybrids in the different dwarf types, data on the number of nuts sown and germinated and number of hybrids obtained in combinations where a minimum number of 25 pollinated nuts had been sown were collected. The data presented

Table III. *Details of bunches harvested, nuts sown and germinated and hybrids obtained from different dwarf types with two groups of tall*

Sl. No.	Combinations	No. of bunches harvested	No. of nuts sown	No. of nuts germinated	No. of hybrids obtained	Percentage of hybrids of nuts sown
1	KDY × T <sub>1</sub>	45	339	178	161	47.5
	„ × T <sub>2</sub>	14	97	41	38	39.2
2	KDO × T <sub>1</sub>	41	241	127	112	46.5
	„ × T <sub>2</sub>	11	57	33	16	28.1
3	MDY × T <sub>1</sub>	15	93	59	56	60.2
	„ × T <sub>2</sub>	2	12	2	2	16.7
4	MDO × T <sub>1</sub>	14	92	58	45	48.9
	„ × T <sub>2</sub>	4	32	17	14	43.8
5	CDO × T <sub>1</sub>	21	212	91	75	35.4
	„ × T <sub>2</sub>	9	128	59	50	39.1

in Table IV show that it is preferable to select dwarf palms which yield nuts having a low shell content (less than 20% of husked nut weight) as in GI and GII groups as pistillate parents and tall palms which yield nuts with husk content of less than 50% of the fruit weight and having a copra content of more than 150g per nut as pollen parents to obtain a large number of hybrids. In the data presented, combination GII × T<sub>1</sub> in KDY × Tall, GI × T<sub>1</sub> in MDY × Tall and GI × T<sub>1</sub> in CDO × Tall have yielded more hybrids (60% and above of the nuts sown) than other combinations. It may be possible to identify individual palms in both the dwarfs and the tall

from the different groups which when combined should throw out a large number of hybrids. Satyabalan (1982) has stressed the need to select parent palms among the population of dwarfs and tall for producing promising hybrids. The progenies of the selected parent palms should be utilised for laying out hybrid seed gardens for large scale production of hybrids.

#### ACKNOWLEDGEMENT

This study formed part of the work done under the Emeritus Scientists' Scheme of the Indian Council of Agricultural Research during the period July 1981 to September 1983 at the

Table IV. *Details of nuts sown and germinated and number of hybrids obtained in combinations where a minimum of 25 nuts had been sown in the nursery*

Sl. No.	Combinations	No. of nuts sown	No. of nuts germinated	No. of hybrids obtained	Percentage hybrids of nuts sown
1.	<i>KDY × Tall</i>				
	GI × T <sub>1</sub>	243	118	104	42.9
	GI × T <sub>2</sub>	83	38	35	42.2
	GII × T <sub>1</sub>	43	35	34	79.1
	GIII × T <sub>1</sub>	45	18	16	35.6
2.	<i>KDO × Tall</i>				
	GI × T <sub>1</sub>	80	52	45	56.3
	GII × T <sub>1</sub>	84	45	42	50.0
	GIII × T <sub>1</sub>	31	4	2	6.5
3.	<i>MDY × Tall</i>				
	GI × T <sub>1</sub>	93	59	56	60.2
4.	<i>MDO × Tall</i>				
	GII × T <sub>1</sub>	92	58	45	48.9
	GII × T <sub>2</sub>	32	17	14	43.8
5.	<i>CDO × Tall</i>				
	GI × T <sub>1</sub>	25	21	17	68.0
	GII × T <sub>1</sub>	84	28	24	28.6
	GII × T <sub>2</sub>	71	28	24	33.8
	GIII × T <sub>1</sub>	79	29	22	27.8

Central Plantation Crops Research Institute, Kasaragod, Kerala. The senior author is grateful to the Standing Committee of the Emeritus Scientists' Scheme of the Council for appointing him as Emeritus Scientist under the Scheme and the Council for the grant of financial assistance. We are indebted to the Director, Central Plantation Crops Research Institute, Kasaragod for all the facilities provided during this period. Our thanks are due to all the members of the staff of the Institute for their valuable help.

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