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GENETIC IMPROVEMENT OF THE COCONUT PALM - PREPOTENCY STUDIES

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ABSTRACT

A comparative study of two growth characters *viz.*, collar girth and leaf production at the fifth month from germination of 1190 open pollinated progenies of 43 high yielding mother palms and 224 open pollinated progenies of 10 high yielding mother palms has indicated that the progenies of only five palms are superior to those of others in the nursery. In these palms 60% and above of their progenies have growth characters above the general mean of 1414 progenies of 53 palms. Three of these mother palms come under the first and third groups and are stable high yielders, yielding more than 80 nuts per palm per year and give a copra outturn of more than 15 kg per palm per year. The fourth one belongs to the second group, the copra outturn of which is low, and hence not considered. The fifth one belongs to the second lot of the fifth group of stable high yielders. The growth of the progenies of the selected four palms at the fifth month from the time of germination is in general more vigorous irrespective of the months of harvest and germination when compared to others. These palms which show a high rate of transmission of growth characters to their progenies can be considered as likely prepotents. In another study, of 146 F2 open pollinated progenies derived from three high yielding prepotent palms indicated that prepotency is not transmitted to all the open pollinated second generation progenies.

INTRODUCTION

In coconut estimates of heritability for yield of nuts by different workers have shown that it is about 0.5 (Lakshmanachar, 1959; Liyanage and Sakai, 1960; Nambiar and Nambiar, 1970) indicating that selection of mother palms on the basis of yield of nuts alone is not likely to give the expected results. The mean weight of copra per nut and the weight per husked nut have high heritability values of 0.67 and 0.95 respectively (Liyanage and sakai, 1960)and studies have indicated the necessity for exercising selection pressure towards weight of copra per nut and oil percentage in addition to number of nuts (Bavappa and Sukumaran, 1983). Harland (1957) advocated the identification of genetically superior (prepotent) palms among the high yielders as he felt that only such palms possess sufficient dominant genes to ensure that their progenies are also high yielders and suggested that such prepotent high yielders could be identified from a comparative study of sufficiently large number of progenies from open pollinated mothers. A prepotent palm is

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one where the gene combinations tend to cohere but do not recombine resulting in the 'enbloc' transmission of parental characters to the progeny even under random–mating leading to some sort of functional homozygosity. The concept of prepotency used by animal breeders has been extended to coconut where each palm represents a gene complex. In progeny studies, Ninan and Pankajakshan (1961) found that some high yielders showed markedly superior progeny performance than others in the nursery. Ninan, Pankajakshan and Abdu (1964) reported highly significant differences between families in vigour and growth rate when compared to variation within families. Satyabalan, Namboothiri and Jacob Mathew (1975) indicated the possibilities of identifying prepotent palms based on progeny performance in the nursery. Satyabalan and Jacob Mathew(1983)found the possibility of identifying palms of superior genetic value even at the fifth month from the time of germination. Further detailed studies of progenies have also showed high and positive correlation of growth characters like collar girth and leaf production from the fifth month after germination with those of later months (Satyabalan, 1984). A systematic study was made to establish the validity of the earlier findings so that the seedling indexing method of locating the prepotents in the natural population of West Coast Tall variety could be routinely used. An attempt has also been made to ascertain whether the open pollinated second generation progenies of such palms identified earlier as likely prepotents continue to maintain their superiority and whether prepotency is transmitted to all the second generation progenies.

MATERIALS AND METHODS

In 1981, 43 high yielding mother palms of West Coast Tall variety grown at Central Plantation Crops Research Institute, Kasaragod were selected based on their mean yield of nuts per palm per year during the last 20 years and their annual copra outturn. The selected palms were classified into five groups based on C. V. for yield of nuts and copra outturn (Table I).

Table I. *C. V. of yield of nuts and copra outturn in five groups of selected palms*

Group	C. V. for yield of nuts	Copra outturn/ palm
I	Less than 20%	More than 15kg
II	Less than 20%	Less than 15kg
III	More than 20%	More than 15kg
IV	More than 20%	Less than 15kg
Va	Less than 20%	Not available
Vb	More than 20%	Not available

Seednuts harvested every month during December 1981 to May 1982 from each of selected palms were marked separately before they were stored in sand under shade. A total of 1684 seed nuts of 53 palms under five groups were planted in June 1982, in the vertical position palmwise and monthwise in the central two rows of the four row bed, while seednuts of other mother palms not included in the study were planted in the first and the last rows of the bed. The date of germination of each nut was noted and observations continued till December 1982. From the data, the germination percentage, the number of seedlings

available for study and percentage of seedlings to nuts sown in the nursery in the case of each palm were worked out. Observation on collar girth and leaf production for each seedling at each month from the time of germination upto fifth month was recorded. The mean values of collar girth and leaf production in seedlings of each palm under the different groups at the fifth month from the time of germination were taken to compare the progeny performance of each palm with that of the general mean of all the available 1414 seedlings and to determine the percentage of progenies having growth characters above the general mean in each palm. The palms whose progenies have both the growth characters above the general mean were identified and considered as genetically superior if 60% and more of their progenies had growth characters above the general mean.

Eleven to sixteen open pollinated seednuts of each of the five first generation open pollinated progenies EB 33 to 37 of palm 29S/346, 11 to 15 of each of the three first generation open pollinated progenies EB 41, 44 and 45 and EB 70 to 72 of palms 39.2.1/205 and 29N/367 respectively were collected, stored and sown in the nursery as described earlier. Palms 29S/346, 39.2.1/205 and 29N/367 have been identified earlier as prepotent palms. Observations on collar girth and leaf production on the five month old second generation open pollinated seedling progenies of these prepotent palms were also recorded. They were compared with the general mean of all the 146 second generation open pollinated progenies of 11 F1 palms, to identify those palms 60% and more of the progenies of which had both the growth characters above the general mean.

RESULTS AND DISCUSSION

The data for all the 53 palms under five different groups, on mean yield of nuts for 20 years, C. V. for yield, approximate annual outturn of copra, germination percentage and seedlings available for this study, girth at collar and number of leaves at fifth month from the time of germination and percentage of vigorous seedlings in the case of each palm, identified on the basis of both the growth characters above the general mean of all the 1414 seedlings of 53 palms, are presented in Table II. The data indicate that the percentage of germination varied from 68.2 to 97.0 in Group I, from 71.1 to 100.0 in Group II, from 79.9 to 100.0 in Group III, from 82.6 to 100.0 in Group IV, from 64.3 to 100.0 in Group Va and from 85.7 to 100.0 in Group Vb. Palm numbers 4 (Group I 27S/886), 10 (Group II–VIII/69), 20 (Group III 39/3B/556), 27 (Group III 29S/359) and 52 (Group Vb 27S/815) had 60% and more of the progenies with both the growth characters above the general mean of 8.2cm of collar girth and 4.5 leaves, at the fifth month, from the time of germination.

Based on stability of yield, copra outturn and progeny growth, palms 27S/886, 39/3B/566 and 29S/359 could be considered as superior. Palm VIII/69 has a low copra content of 122g per nut and a copra outturn of 11.2 kg

Table II. *Details of the palms selected for the study, germination of seednuts and growth characters of seedlings*

Group	Yield of nuts		Approx. copra outturn (kg)	Germination percentage	Seedlings available	Girth at collar (cm)	No. of leaves	Vigorous* % of seedlings
	Mean	CV						
I	107.2	19.3	15.5	95.4	21	8.1	4.6	33.3
	83.7	18.6	17.6	96.0	24	8.8	4.6	41.7
	100.9	19.1	17.6	90.6	28	8.3	4.5	44.5
	98.3	19.3	16.6	97.0	32	8.7	4.8	62.5
	175.1	11.5	19.8	68.2	28	8.1	4.1	32.1
	88.9	19.8	15.4	94.1	30	7.8	4.4	26.7
II	80.8	19.7	8.5	83.7	39	8.2	4.8	46.2
	108.5	16.4	14.9	85.6	21	8.5	4.1	33.3
	101.5	14.2	13.5	97.3	36	8.3	4.8	44.4
	91.9	11.7	11.2	78.3	18	8.9	4.9	66.7
	88.9	17.0	12.5	92.3	47	8.3	4.5	36.2
	86.5	19.3	10.2	93.8	29	7.9	4.6	31.0
	89.5	10.5	12.3	100.0	21	8.3	4.6	42.9
	98.8	15.4	12.9	94.4	34	7.9	4.5	20.6
	86.8	17.3	10.3	92.9	12	7.9	4.1	8.3
	100.3	10.9	13.4	76.0	19	8.1	4.4	10.5
	93.9	13.8	12.7	88.5	22	8.6	4.5	40.9
	127.4	18.9	14.6	71.1	20	7.5	4.2	10.0
III	96.4	29.1	15.1	92.9	38	8.3	4.6	36.8
	91.7	20.3	16.5	93.2	51	8.4	4.9	62.8
	120.4	27.6	21.3	97.6	40	8.3	4.3	30.0
	96.9	22.4	17.6	93.9	44	8.4	4.4	31.8
	105.6	28.9	17.6	84.6	37	7.7	4.8	24.8
	121.9	20.6	20.4	100.0	13	8.4	4.3	38.5
	100.4	24.3	18.4	97.9	45	7.8	4.1	15.6
	113.5	41.9	17.7	95.2	40	8.1	3.9	15.0
	91.9	21.3	18.3	84.2	15	9.4	4.7	60.0
	112.5	37.6	17.0	79.9	18	8.2	4.7	38.9
IV	97.7	26.9	13.4	92.0	22	8.5	4.7	45.5
	81.4	26.3	14.4	94.4	17	8.6	4.4	42.6
	88.1	20.1	13.1	97.9	47	8.8	4.7	47.0
	98.6	33.2	14.8	100.0	13	8.4	4.5	38.5
	88.1	28.3	14.0	100.0	25	8.3	4.5	28.0
	108.3	27.8	13.3	96.2	22	7.9	3.7	18.2
	106.3	38.9	13.9	82.6	17	8.-	4.5	47.6
	88.1	28.3	14.0	94.1	29	8.3	4.9	51.7
	84.8	22.2	8.2	89.5	32	8.2	4.6	34.4
	105.9	20.4	12.5	85.0	15	7.1	4.3	0
	91.6	29.4	14.3	86.2	24	7.4	4.4	12.5
	93.6	23.1	11.7	93.5	29	8.2	4.3	20.7
	87.3	23.4	13.5	100.0	28	8.1	4.4	17.8
	100.5	23.6	10.6	100.0	24	8.1	4.5	29.2
	83.2	21.8	11.3	92.3	24	8.5	4.7	54.2
Va	91.0	14.0	–	90.3	26	8.0	4.6	19.2
	106.0	19.9	–	100.0	32	8.5	4.6	40.6
	80.7	19.3	–	64.3	17	8.7	4.4	23.5
	83.9	15.1	–	100.0	16	8.0	5.0	31.3
Vb	89.0	26.1	–	94.7	17	7.9	3.8	5.9
	108.2	22.6	–	100.0	21	8.0	4.0	14.3
	82.2	21.5	–	92.9	13	7.9	4.2	23.1
	90.1	20.8	–	100.0	25	8.6	4.6	40.0
	82.5	20.4	–	97.1	34	8.6	4.9	73.5
	82.2	39.6	–	85.7	23	8.4	5.0	52.2
Mean						8.2	4.5	34.9

* Seedlings with both the growth characters above the general mean

only and hence deleted. Palm 27S/815 can be considered superior on the basis of stability, germination percentage and progeny growth though its copra output is not available. The data on growth characters of the seedlings of the palms identified as likely prepotents indicate a high rate of transmission of growth traits to their progenies, and that the growth of their progenies at the fifth month from the time of germination is in general more vigorous than those of others irrespective of the month of harvest or month of germination. In others though the mean data is comparable to the general mean, the seedlings had vigorous growth only in certain months. The data on one palm in each from the identified and unidentified palms are presented in Table III. These

Table III. *Growth characters of seedlings at the fifth month from the time of germination in relation to the months of harvest and germination of seednuts of one palm each from the identified and unidentified ones for comparison*

Palm no.	Month of harvest and no. of seednuts		Month of germination	No. of seedlings	Collar girth	No. of leaves
					at 5th month from the time of germination	
Palm identified						
27S/886	December	4	September	3	8.0	4.3
			October	1	9.0	5.0
	January	9	September	7	8.9	4.6
			October	1	9.2	5.0
			November	1	9.8	6.0
	February	7	September	4	8.7	4.8
			October	3	8.7	5.0
	March	6	September	5	9.2	5.2
			October	1	9.0	5.0
	April	6	September	3	8.1	4.0
			October	3	8.1	5.0
	Mean			32	8.7	4.8
Palm unidentified						
41/489	February	7	September	2	7.6	4.0
			October	3	8.6	4.7
			November	2	8.9	5.0
	March	9	September	2	7.9	4.0
			October	4	8.5	4.5
			November	3	8.2	5.3
	April	9	September	5	7.8	4.0
			October	3	8.5	5.0
			November	1	7.5	4.0
	May	3	October	1	9.5	5.0
			November	2	8.4	4.5
	Mean			28	8.3	4.5

studies show that only certain palms among the high yielders have progenies of superior growth characters which are correlated with yield and such palms can be identified by comparison of growth characters of the progenies even at the fifth month from the time of germination. Such palms seem to be few in a population and this accounts for the low percentage of high yielders in a population. The progenies of such palms only can bring about population improvement.

The data on the growth characters of 146 open pollinated F2 progenies of 11 open pollinated F1 progenies derived from three palms 29S.346, 39.2.1/205 and 29N/367 identified earlier as prepotents are presented in Table IV. The data indicate that only in the progenies of palm E. B. 34, (F1 open pollinated progeny of palm 29S.346) and in the progenies of palms E. B. 41 and E. B. 45 (F1 open pollinated progenies of palm 39.2 .1/205), 60% and above had growth characters above the general mean of 146 F2 progenies. The study has shown that prepotency is not transmitted to all the open pollinated F2 progenies of the prepotent palms identified earlier.

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Table IV. *Growth of open pollinated progenies of first generation palms of earlier identified prepotent high yielders in the nursery*

Earlier identified prepotent parent palm No.	First generation progeny palm No.	Mean yield during the last 10 years 1971-1980	Mean growth characters of progeny at 5th month and No. of progenies		No. and % of progenies having growth characteristics above general mean	
			Collar girth (cm)	No. of leaves		
29S/346	E. B. 33	105.8	8.2	4.7 (15)	4	26.7
	E. B. 34	96.7	9.5	5.0 (13)	12	92.3
	E. B. 35	97.8	8.9	4.7 (16)	9	56.3
	E. B. 36	112.4	8.5	4.7 (11)	4	36.4
	E. B. 37	104 2	7.9	4.5 (14)	3	21.4
39.2.1./205	E. B. 41	99.6	9.0	4.6 (11)	7	63.6
	E. B. 44	126.4	7.9	4.1 (11)	0	0.0
	E. B. 45	99.7	8.5	4.9 (15)	9	60.0
29N/367	E. B. 70	117.8	8.7	5.0 (14)	8	57.1
	E. B. 71	131.2	7.8	4.5 (15)	3	20.0
	E. B. 72	153.1	7.5	4 1 (11)	0	0.0
	Mean		8.4	4.6 (146)	59	40.4

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