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Segregation, phenotypic and genotypic variance and heritability in the F_2 population of coconut (*Cocos nucifera*)*

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Coconut (*Cocos nucifera* L.) populations have two main diverse groups, the tall palms, *C. nucifera* var. *typica* and the dwarf palms, *C. nucifera* var. *nana*. Intervarietal hybridization in coconut gained popularity following the first report of 'heterosis' in coconut by Patel (1937) in an intervarietal cross between tall (WCT) and dwarf (GD) variety of coconut. The heterosis of the F_1 generation in coconut is well studied. However, the research on the behaviour of F_2 generation of the hybrids has not received much attention and there are only few reports (Fernando and Perera 1994) on studies in the F_2 generation in coconut. The study of the segregation pattern in the F_2 population of D × T hybrid crosses will provide information about the consequences of selfing on characters of economic importance and determine the possibility of developing lines combining the favourable characters of dwarf and tall varieties to produce a viable alternative to the hybrid.

The present study was undertaken in F_2 populations developed from three dwarf × tall (Chowghat Orange Dwarf × West Coast Tall) coconut hybrids to ascertain the extent of segregation and to assess the phenotypic and genotypic variance and heritability for vegetative and reproductive characters. The dwarf × tall hybrid (Chowghat Orange Dwarf × West Coast Tall) was released for commercial cultivation by CPCRI as Chandrasankara during 1985. Eighty one F_2 palms of three F_1 families of COD × WCT (HB 96, HB 111 and HB 136) planted in a randomized block design with three replications and a plot size of 9 palms during 1992 at CPCRI, Kasaragod were used for the study. Recommended package of practices were followed for all experimental palms.

*Short note

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Vegetative character. viz. stem height, stem girth, length of 10 leaf scars, number of leaves on the crown, total leaves produced, length of petiole, length of leaflet bearing portion, number of leaflets on one side, length of leaflet and breadth of leaflet were recorded as outlined by Ratnambal *et al.* (1995, 2001). Reproductive characters, viz length of inflorescence, length of inflorescence stalk, length of spikelet bearing portion, girth of inflorescence stalk, number of spikelets/inflorescence, length of spikelet, number of female flowers/inflorescence, annual nut yield, setting percentage, length of male phase (days), length of female phase (days) and gap between male and female phases (days) were recorded as outlined by Ratnambal *et al.* (1995, 2001). The mean values for all the characters in the three F_1 families were subjected to statistical analysis. The mean, standard error and coefficient of variation were calculated according to Panse and Sukhatme (1961).The analysis of variance was carried out as per the methods suggested by Panse and Sukhatme (1961). The genotypic and phenotypic variance and heritability were based on methods described by Serle (1971), Falconer (1981), Jain (1982), Steel and Torrie (1984).

The data on evaluation of F_2 populations for vegetative and reproductive characters are presented in Tables 1, 2 respectively. There was significant variation among F_2 families for number of leaves on the crown, total number of leaves produced, length of leaflet, length of inflorescence, number of spikelets, nut yield and inter spadix overlapping of male and female phase. Within each family, there was considerable variation for each vegetative and reproductive character.

In the present study, transgressive segregation in both parental directions was observed for many of the characters studied and for some of the characters, viz stem girth, length of leaflet bearing portion, leaflet length and breadth, length of inflorescence stalk, length of spikelet bearing portion, stalk girth, length of spikelet, number of female flowers and yield implying the possibility of selection of better plant types in the segregating population. The tendency for

Table 1 Evaluation for vegetative characters in F_2 populations of D×T coconut hybrids

	HB 96	HB 111	HB 136	Mean	Range	CV %	CD (P = 0.05)	σ_G^2 Genotypic variance	σ_P^2 Phenotypic variance	h^2 Heritability
Stem height (cm)	269.93	279.63	252.85	267.47	127–390	6.21	ns	149.59	2 810.13	5.32
Stem girth (cm)	74.71	73.79	73.97	74.16	61–98	4.72	ns	0.00	59.07	0.00
Length of 10 leaf scars on the stem (cm)	53.44	63.70	56.26	57.80	29–101	8.95	ns	38.99	251.70	15.49
No. of leaves on the crown	26.67	25.37	23.07	25.04	16–33	3.68	1.432	5.98	11.55	51.85
Total leaves produced (1992–2001)	102.74	98.85	97.96	99.85	82–112	1.63	3.727	10.20	41.71	24.46
Petiole length (cm)	141.22	142.33	146.85	143.47	115–189	3.60	ns	0.00	202.50	0.00
Length of leaflet bearing portion (cm)	400.30	407.44	400.19	402.64	329–456	2.11	ns	0.00	8 433.72	0.00
No. of leaflets on one side of the rachis	108.00	109.74	110.07	109.27	93–124	1.82	ns	0.24	30.34	0.79
Length of leaflet (cm)	118.35	121.38	119.82	119.85	98–153	1.09	1.896	0.00	119.56	0.00
Breadth of leaflet (cm)	5.77	5.88	5.66	5.77	4.0–7.5	5.56	ns	0.00	0.49	0.00

Table 2 Evaluation for inflorescence characters in F_2 populations of D×T coconut hybrids

	HB 96	HB 111	HB 136	Mean	Range	CV %	CD p0.05	σ_G^2 Genotypic variance	σ_P^2 Phenotypic variance	h^2 Heritability
Length of inflorescence (cm)	86.7	78.7	81.04	82.14	55–121	5.08	7.71	16.43	238.84	6.88
Length of inflorescence stalk (cm)	47.4	42.7	44.22	44.78	29–64	5.58	ns	5.63	82.38	6.83
Length of spikelet bearing portion (cm)	39.3	36.0	36.81	37.36	21–57	5.73	ns	1.64	56.36	2.91
Girth of inflorescence stalk (cm)	9.15	8.72	8.56	8.81	6.2–10.1	2.77	ns	0.13	0.74	17.58
No. of spikelets/ inflorescence	38.5	35.47	32.47	35.49	21–49	4.28	4.74	15.34	47.54	32.27
Length of spikelet (cm)	45.4	43.09	41.04	43.17	21–62	6.06	ns	1.93	65.13	2.96
No. of female flowers/inflorescence	28.7	20.58	19.92	23.07	3.7–82	18.11	ns	31.80	153.62	20.07
Annual nut yield	74.4	50.44	26.71	50.51	2.22–185.72	23.19	32.84	996.41	1 712.59	58.18
Length of male phase (days)	19.4	19.66	19.19	19.4	13.28	6.16	ns	0.00	7.72	0.00
Length of female phase (days)	3.85	3.89	3.46	3.73	2-8	7.29	ns	0.04	1.03	3.40
Gap between male phase and female phase (days)	1.23	1.86	1.37	1.49	0–5	36.32	ns	0.00	0.00	0.00
Intra-spadix over-lapping (days)	1.02	0.85	0.91	0.93	0–5	38.72	ns	0.00	0.00	0.00
Inter-spadix over-lapping (days)	1.07	0.72	0.44	0.75	0–8	75.94	0.28	0.00	0.00	0.00

maintaining hybridity in the F_2 generation was also recorded for some traits viz., stem girth, length of leaflet bearing portion, number of leaflets, length and breadth of leaflet, length of inflorescence, length of stalk, length of spikelet bearing portion and number of female flowers. Fernando and Perera (1997) reported that the pollination pattern of the palms showed segregation in the F_2 family (selfed F_1). Similar observations were recorded in the present F_2 population with certain palms showing inter/intra-spadix overlapping of male and female phases promoting self pollination and certain palms showing well separated and non-overlapping male and female phases. Further, the overall range of production of inflorescence in the segregating population of the three F_1 families of D × T coconut hybrids varied from 3 to 16. This feature directly provides a tool for selection in the coconut breeding programme. The production of 0–4 sterile inflorescences/year in some of the palms in the F_2 populations could be due to the negative effect of selfing, indicating that F_2 populations derived from F_1 hybrid palms are not a suitable source for commercial seed nut production.

For many of the vegetative characters, viz height of the stem, petiole length, length of leaflet bearing portion and leaflet length (Table 1); reproductive characters viz., length of inflorescence, number of female flowers/inflorescence, average female flowers produced/year (Table 2) the genotypic variance was negligible and the phenotypic variation was high. Both the genotypic and phenotypic variance were low for vegetative characters, viz girth, length of ten leaf scars on the stem, leaves on the crown, total leaves produced, number of leaflets (left/right) and leaf breadth (Table 1) and negligible for the reproductive characters (Table 2), viz girth of inflorescence stalk, male phase, female phase, gap between male and female phase, intra- and inter-inflorescence over lapping of male and female phases indicating the limited scope for selection for these traits.

The estimates of phenotypic variance being higher in magnitude than genotypic variance indicate that the apparent variation is not due to genotype alone but also due to influence of the environment. It was observed that both phenotypic and genotypic variance were high for number of female flowers produced annually and for nut yield, indicating that these characters are more variable than the other characters studied in F_2 populations of D × T hybrids in coconut. Hence selection for these characters will be possible in the F_2 generation. However, due to the higher phenotypic variance component, the heritability of the trait cannot be guaranteed. In the F_2 palms of D × T hybrid coconut, total leaves on the crown, nut yield and number of spikelets in an inflorescence showed higher heritability as compared to other characters. Hence selection based on these characters would be rewarding in the breeding programme.

SUMMARY

The three F_2 populations of D × T coconut hybrid showed wide segregation for different vegetative and reproductive traits and appearance of transgressive segregants for many of the characters studied indicating the possibility of selection from the F_2s. However, owing to the wide variation in annual nut yield and yield related traits among the palms in the F_2 populations, it is suggested that progenies of F_1 hybrid palms cannot be directly utilized for commercial seed production.

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