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Correlation and path coefficient analysis in the F_2 populations in coconut

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ABSTRACT

An experiment was conducted to study the correlation among vegetative, reproductive and fruit component characters in the F_2 populations of Dwarf x Tall (Chowghat Orange Dwarf X West Coast Tall) coconut hybrids. The traits *viz.*, number of leaves on the crown, total leaves produced, number of spikelets, number of female flowers per inflorescence, total number of inflorescences produced, number of fertile inflorescences produced and per cent nut set after 90 days of pollination exhibited significant positive correlation with nut yield and could be considered as major contributing characters. The characters *viz.*, length of ten leaf scars on the stem and petiole length showed significant negative correlation with nut yield. Path analysis indicated the high direct positive effects on nut yield by number of fertile inflorescences produced, setting percentage after 90 days and moderate positive direct effect of number of female flowers per inflorescence. Length of ten leaf scars, petiole length and spikelet number showed a low negative direct effect on nut yield. Nut yield was moderately affected indirectly by number of fertile inflorescences produced and leaves on the crown, total leaves produced and number of female flowers per inflorescence.

Key words: Coconut, correlation, path analysis, F_2 populations.

INTRODUCTION

Coconut (*Cocos nucifera* L.) is a monocotyledon belonging to the order *Palmae*. It is the sole species in the genus *Cocos* within the tribe *Cocoidae*. The wide diversity available in coconut has been widely used in the crop improvement programmes and resulted in the production of superior varieties and hybrids with maximum heterosis. The heterosis of the F_1 generation in coconut is well studied. But the research on the behaviour of F_2 generation of the hybrids has not received much attention and there are only few reports on studies in the F_2 generation in coconut. These studies have revealed segregation with respect to pollination behaviour, fruit component characters etc. The segregation for vegetative, reproductive and yield characters of the palms is of great importance with regard to selection for utilization in further breeding. The study of the segregation pattern in the F_2 populations of Dwarf x Tall (D x T) hybrids will provide information about the consequences of selfing on the characters of economic importance and determine the possibility of developing lines combining the favourable characters of dwarf and tall varieties in order to produce a viable alternative to the hybrid. The present study was conducted to assess the correlation among vegetative, reproductive and fruit component characters in the F_2 populations of D x T [Chowghat Orange Dwarf (COD) x West Coast Tall (WCT)] coconut hybrids.

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MATERIALS AND METHODS

The study was carried out at Central Plantation Crops Research Institute (CPCRI), Kasaragod in the F_2 populations of Dwarf x Tall (Chowghat Orange Dwarf x West Coast Tall) coconut hybrids. The Dwarf x Tall hybrid was released by CPCRI in the name of Chandrasankara during 1985. Eighty one F_2 palms of three F_1s of COD x WCT (D x T) were used for the study. These progenies were obtained by selfing three D x T (F_1) palms, HB 96, HB 111 and HB 136. The progenies of these three F_1s were planted in a randomized block design with three replications and a plot size of 9 palms in each replication during 1992 and used for the study. Recommended package of practices were followed for all the experimental palms. The observations on vegetative and reproductive characters were recorded on all 81 palms (27 x 3) and the data were subjected to statistical analysis. Monthly observations on flowering were recorded from January 2003 to December 2003. The details of inflorescences emerging, number of female flowers present at the time of the opening, number of nuts set after open pollination and number of nuts harvested from each inflorescence were recorded. Fruit component characters were recorded on four mature nuts per palm. The nuts were harvested during the month of March and two weeks after the harvest, the nuts were used for the study. The data were subjected to statistical analysis (Singh and Narayanan, 9; Dewey and Lu, 1).

RESULTS AND DISCUSSION

Correlation coefficient (r) was worked out for thirty nine characters (11 vegetative, 12 reproductive and 16 fruit component characters) in the F_2 populations of D x T hybrids to determine the association existing among these traits. Among the characters studied, leaves on the crown, total leaves produced, number of spikelets, number of female flowers per inflorescence, total number of inflorescences produced, number of fertile inflorescences produced and per cent set after 90 days exhibited significant positive correlation with nut yield (Table 1).

Some of the characters *viz.*, length of ten leaf scars on the stem and petiole length exhibited significant negative correlation with nut yield. The height of the stem, breadth of the leaflet, length of inflorescence stalk, length of spikelet bearing portion, length of inflorescence, fruit length to breadth ratio and shell thickness showed positive non-significant correlation with yield. The girth of the stem, length of leaflet bearing portion, number of leaflets-left/right, length of leaflet, number of sterile inflorescences produced, fruit weight, fruit length, fruit breadth, thickness of the husk at top, middle and bottom, weight of husked nut, kernel thickness, weight of kernel plus shell, weight of nut water, weight of shell, weight of kernel, weight of copra and weight of husk showed negative non-significant correlation with nut yield.

The correlation coefficient of four vegetative and four reproductive traits (selected on the basis of significant r values) on nut yield were partitioned into direct and indirect effects by path coefficient analysis (Table 2). The path coefficient analysis showed that five traits had positive direct effect on the nut yield. The highest direct effect was recorded by number of fertile inflorescences produced followed by per cent set after 90 days. The number of female flowers per inflorescence had moderate direct effect on nut yield, while the leaves on the crown and total leaves produced showed negligible direct effects. Three characters showed direct negative effect on nut yield, *viz.*, length of ten leaf scars on the stem, spikelet number and length of petiole. However, only the length of ten leaf scars on the stem had low direct effect on nut yield while the other two traits had negligible direct effects. The residual effect was 0.555 and therefore path matrix explains only the rest of the effect of these traits on yield. Among the characters studied, number of fertile inflorescences and leaves on the crown, total leaves produced and number of female flowers per inflorescence showed moderate positive indirect effects on nut yield. Number of fertile inflorescences and length of petiole (-0.2058) together showed a moderate negative indirect effect on nut yield. The indirect effect for the rest of the characters was negligible.

Nut yield in coconut is a complex character and the knowledge of the association between nut yield and other biometrical traits themselves will greatly help in effecting selection for high yield. Characters *viz.*, leaves on the crown, total leaves produced, number of spikelets, number of female flowers per inflorescence, total number of inflorescences produced, number of fertile inflorescences produced and per cent set after 90 days exhibited significant positive correlation with nut yield. Therefore, a palm producing more leaves will produce more inflorescences and these inflorescences with higher number of spikelets and greater number of female flowers coupled with higher setting percentage will naturally produce larger number of nuts. Hence, these characters could be considered

Table 1. Correlation coefficient of different characters for nut yield in the F_2 populations.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
X1	1.000	-0.010	-0.146	0.469**	-0.049	-0.100	-0.147	-0.121	-0.215	-0.285*
X2		1.000	0.507**	-0.171	0.440**	0.290*	0.415**	0.448**	0.182	0.483**
X3			1.000	-0.231**	0.424**	0.325**	0.557**	0.567*	0.009	0.499**
X4				1.000	-0.173	-0.182	-0.408**	-0.404**	-0.128	-0.382**
X5					1.000	0.400**	0.373**	0.351**	0.123	0.385**
X6						1.000	0.325**	0.384**	-0.325**	0.383**
X7							1.000	0.958**	0.118	0.696**
X8								1.000	0.079	0.722**
X9									1.000	0.352**
X10										1.000

*, ** Significant at 5 and 1% level, respectively.

X1 Length of 10 leaf scars, X2 Leaves on the crown, X3 Total leaves produced, X4 Petiole length, X5 Number of spikelets, X6 Number of female flowers per inflorescence, X7 Total number of inflorescence, X8 Number of fer inflorescences, X9 Per cent set after 90 days and X10 Nut yield

as major contributing characters to the nut yield. It is also important that some of the characters *viz.*, length of ten leaf scars on the stem and petiole length exhibit significant negative correlation with nut yield indicating its importance in selection.

Prabhakaran *et al.* (10) have also reported that the number of leaves is the major contributing factor for variation in the nut yield in coconut and the selection of palms for nut yield could be done effectively on the basis of number of functional leaves. Liyanage (4) observed positive significant correlation between number of leaves produced during the first 40 months and the yield of copra at the age of 13-14 years and suggested that the selection of palms on the basis of high leaf number is a quick method of identifying palms of high breeding value. Narashimhayya and Sukumaran (6) observed positive and significant correlation between cumulative yield of nuts and number of functional leaves on the plant 19 years after planting. Nampoothiri *et al.* (5) reported that collar girth and number of leaves in the coconut seedlings had a positive significant relation with the yield of adult coconut palms. Narayanan Kutty and Gopalakrishnan (7) also showed that the number of leaves and length of leaves significantly influenced the yield in coconut.

In the present study, among the reproductive characters, number of spikelets, number of female flowers per inflorescence, total number of inflorescences produced, number of fertile inflorescences produced and per cent set after 90 days exhibited positive and significant correlation with the nut yield. The number of inflorescences produced showed positive and significant correlation with number of leaves produced. Patel (8) reported significant positive correlation for number of inflorescences produced and nut yield in coconut. Kalathiya and Sen (3) also reported that the nut yield in dwarf coconut is significantly and positively correlated with number of inflorescences produced and that the number of leaves produced showed significant correlation with number of inflorescences produced. They further reported that the number of female flowers per spadix is significantly and positively correlated with length of spadix, which is in agreement with the observations in the present study. Satyabalan *et al.* (11) observed a positive correlation between yield and female flower production except when the female flower production was high. The length of ten leaf scars on the stem showed significant negative correlation with yield and also negative non-significant correlation with percentage of set after 90 days. This observation is in contrast to the report by Jerard (2) that the leaf scars per one metre of stem exhibited positive, significant correlation with setting percentage. This may be due to the differential nature of materials used, as Jerard (2) had used different genotypes for the study, while in the present study, the segregating F_2 populations obtained by selfing F_1 hybrids were used.

Path analysis for nut yield indicated high direct positive effects of number of fertile inflorescence produced, setting percentage after 90 days, while number of female flowers per inflorescence showed moderate direct effect. The length of ten leaf scars on the stem showed negative direct effect for nut yield, while the negative direct effect of petiole length and spikelet number on nut yield was negligible. The indirect effects for most of the characters studied were negligible. The indirect effects of number of fertile inflorescences, leaves on the crown, total leaves produced and number of female flowers per inflorescence on nut yield was positive and moderate. Further, the number of fertile inflorescences together with number of spikelets had a low positive indirect effect on yield, while number of female flowers per

Table 2. Path coefficient values for direct and indirect effects of selected characters on nut yield in the F_2 populations.

	X1	X2	X3	X4	X5	X6	X7	X8
X1	**-0.1099**	0.0011	0.0161	-0.0515	0.0132	0.0110	0.0236	0.0054
X2	-0.0009	**0.0865**	0.0439	-0.0148	0.0387	0.0250	0.0157	0.0381
X3	-0.0103	0.0357	**0.0705**	-0.0163	0.0399	0.0229	0.0006	0.0299
X4	-0.0027	0.0010	0.0013	**-0.0057**	0.0023	0.0010	0.0007	0.0010
X5	-0.0614	0.2278	0.2883	-0.2058	**0.5089**	0.1953	0.0403	0.1786
X6	-0.0245	0.0712	0.0798	-0.0447	0.0943	**0.2458**	-0.0800	0.0982
X7	-0.0755	0.0640	0.0032	-0.0449	0.0279	-0.1144	**0.3518**	0.0432
X8	0.0005	-0.0041	-0.0040	0.0016	-0.0033	-0.0037	-0.0011	**-0.0093**

Residual effect = 0.5550.

X1 Length of 10 leaf scars on stem, X2 Leaves on the crown, X3 Total leaves produced, X4 Petiole length, X5 Number of fertile inflorescence, X6 Number of female flowers per inflorescence, X7 Per cent set after 90 days and X8 Number

inflorescence together with per cent nut set after 90 days showed a low negative effect on nut yield. Sindhumole and Ibrahim (12) reported that vegetative characters had higher direct effect on coconut yield as compared to reproductive characters. However, in the present study reproductive characters showed higher direct effect on nut yield. Sukumaran *et al.* (13) also reported that the yield of nuts during the stabilized period is influenced directly or indirectly by average number of female flowers produced, number of functional leaves and internodal distance at fixed mark, total leaf production upto three years after sowing and time taken for flowering. In the present study, the length of ten leaf scars on the stem showed direct negative effect in contrary to the observations by Sukumaran *et al.* (13). This contradiction may be due to the type of materials handled and the wide segregation for stem height in the F_2 populations. The characters, number of inflorescences, leaves on the crown and per cent set after 90 days showed positive and indirect effect on the nut yield. Based on the path analysis, it appears that selection for types producing higher number of inflorescence and higher number of female flowers coupled with higher setting percentage will give higher yield. Therefore, selection based on these criteria will help in obtaining high yielding palms.

REFERENCES

1. Dewey, O.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheatgrass seed production. *J. Agron.* **57**: 515-18.
2. Jerard Augustine. 2002. Studies on the mean performance, variability, association analysis, stability and genetic diversity of coconut (*Cocos nucifera* L.) genotypes. Ph.D. thesis submitted to Tamil Nadu Agricultural University, Coimbatore.
3. Kalathiya, K.V., and Sen, N.L. 1991. Correlation among floral and yield characteristics in coconut, variety Dwarf Green. **In:** *Coconut Breeding and Management* (Eds., Silas, E.G., Aravindakshan, M. and Jose, A.I.), pp. 116-117.
4. Liyanage, D.V. 1967. Identification of genotype of coconut suitable for breeding. *Expl. Agric.* **3**: 205-210.
5. Nampoothiri, K.U.K., Satyabalan, K. and Mathew, J. 1975. Phenotypic and genotypic correlations of certain characters with yield in coconut. FAO Technical Working Party on Coconut Production and Processing, Kingston, Jamaica.
6. Narasimhayya, G. and Sukumaran, C.K. 1978. Characterisation of W.C.Tall variety in coconut. Paper presented at the *4th Workshop of All India Coordinated Coconut and Arecanut Improvement Project, Panaji,* Goa, 21-23 Sept. 1978.
7. Narayanan Kutty, M.C. and Gopalakrishnan, P.K. 1991. Yield components in coconut palm. In: *Coconut Breeding and Management* (Eds., Silas E.G., Aravindakshan, M., and Jose, A.I.). : Kerala Agricultural University, Trichur, India. pp. 94-96.
8. Patel, J.S. 1938. *The Coconut: A monograph.* Madras Government Press, p. 313.
9. Singh, P. and Narayanan, S.S. 1993. *Biometrical Techniques in Plant Breeding.* Kalyani Publishers, Ludhiana, pp. 52-53.
10. Prabhakaran, P.V., Nair, G.K.B., Thampi, A.P., Pillai, K.S., Nair, V.R., Nair, G.M. Pushpangadan, K., Sukumaran, K.M., Pillai, G.R. and Koshy, E.P. 1991. Forecast of coconut yield using biometric characters of young palms. **In:** *Coconut Breeding and Management* (Eds., Silas, E.G., Aravindakshan, M. and Jose, A.I.). pp. 243-46.
11. Satyabalan, K., Sankar, N. and Ratnam,T.C. 1969. Studies on bearing tendency of the coconut palm (*Cocos nucifera* Linn) II- Factors affecting variation in annual yield of palm. *Trop. Agric. Trin.* **46**: 353-57.
12. Sindhumole, P. and Ibrahim, K.K. 2000. Path analysis of nut yield in cultivars of coconut (*Cocos nucifera* L.). *South Indian Hort.* **48**: 1-6, 160-62.
13. Sukumaran, C.K., Narasimhayya, G. and Vijayakumar, G. 1981. Path coefficient analysis in coconut. *Proc. PLACROSYM IV.* pp. 191-99.

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