PATH COEFFICIENT ANALYSIS IN COCONUT

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ABSTRACT

Yield in coconut is a complex character dependent upon a large number of components and their interactions. Path coefficient analysis was carried out to know direct and indirect effects of characters influencing yield. The correlation coefficients were partitioned into direct effects (path coefficients) and indirect effects in order to pinpoint the direct and indirect effects of these associations.

In 43 progenies of eight high yielding 'W.C.T.' palms of known parentage, planted at CPCRI, Kasaragod in 1953, 12 vegetative as well as reproductive characters observable at different stages of growth till yield stabilization were observed. The age of plants was calculated from the date of sowing of nuts.

Path coefficient analysis was carried out for two yield characters namely, (1) yield of nuts during stabilized period, (2) cumulative yield upto 24 years after sowing, taking two sets of yield contributing characters. Seven yield contributing characters were kept common in these two analyses.

The analysis for yield of nuts during stabilized period showed that the major contributing characters which influenced directly or indirectly were average number of female flowers, number of functioning leaves at 19 years, and internodal distance at fixed mark. These characters influenced yield negatively indicating their value in selection.

INTRODUCTION

Yield in coconut is a complex character dependent upon interaction of a large number of components. For achieving a reasonable improvement in yield, an understanding of character correlations would be very useful. Earlier Pieris (1934), Patel (1937, 1938), Narayana & John (1942), Liyanage (1953), Liyanage and

Abeywardana (1957) and Satyabalan *et al.* (1972) had worked out phenotypic correlations between various characters. The reports on genetic correlations are those of Liyanage and Sakai (1960) and Liyanage (1957). Although correlations are helpful in determining the components of a complex trait like yield, they do not provide an exact picture of the relative importance of direct and indirect influences of each of the complex characters towards this trait. For the first time in coconut path coefficient analysis was carried out to know the direct and indirect effects of characters upon yield. The correlation coefficients were partitioned into direct effects (Path coefficients) and indirect effects in order to pinpoint the effects of these associations. The results of path coefficient analysis of components of yield in West Coast Tall coconut are presented in this paper. Path coefficient analysis was carried out for two yield characters namely (1) yield of nuts during stabilized period, and, (2) cumulative yield of nuts 21 to 24 years after sowing, taking two sets of yield contributing characters, seven of them being kept common in these two analyses.

Materials and Methods

In 43 progenies of eight high yielding West Coast Tall palms of known parentage planted at CPCRI, Kasaragod in 1953, the following characters observable at different stages of growth til yield stabilization, were observed :

X_1 Internodal distance at fixed mark at 19 years
X_2 Number of leaf scars/meter above fixed mark at 19 years
X_3 Total leaf production up to 3 years from sowing
X_4 Total leaf production at 11 years
X_5 Number of functional leaves at 19 years
X_6 Maximum breadth of leaf at 19 years
X_7 Number of leaflets on one side
X_8 Average number of bunches at 21 to 24 years
X_9 Average number of female flowers at 21 to 24 years
X_{10} Height of plant in 3rd year
X_{11} Time taken for flowering in months
X_0 Average yield of nuts at 21 to 24 years
X_{01} Cumulative yield of nuts at 21 to 24 years.

The age of plant was calculated from the date of sowing of nuts. Path coefficient analysis was carried out according to the method of Dewey and Lu (1959).

Results and Discussion

Path coefficients contributing to cumulative yield of nuts in 21 to 24 years after sowing and path coefficients contributing to average yield of nuts during stabilized period in W. C. Tall coconut are presented in Tables I and II and Figs. 1 and 2.

Path analysis for yield of nuts during stabilized period indicated that direct effects of average number of female flowers (0.64), number of functional leaves at 19 years (0.52) and internodal distance at fixed mark (0.45) were positive and high. The indirect effects of all these characters in majority of the cases were low and negative. The large negative effects are probably due to negative interrelationships between these characters at genotypic level. It is also seen that correlation coefficients (r) of these characters with stabilized yield are high 0.94, 0.71 and —0.57.

Path analysis for cumulative yield revealed that average number of female flowers at 21 to 24 years (0.81), total leaf production up to 3 years (0.49) and time taken for flowering (—0.62) had the maximum direct effects. The correlation coefficients of these characters are also maximum 0.93, 0.60 and —0.42. These characters influenced the yield most and are important characters contributing to the cumulative yield. The indirect effect of all these characters were low and negative. These results are in conformity with the results of earlier workers.

Nambiar and Nambiar (1970) revealed that there is substantial additive genetic variation available for selection for yield and other associated characters like number of female flowers and percentage set. Menon and Pandalai (1958) stated that high yields are the resultant effect of abundant female flowers and high setting percentage. According to Patel (1938), yield of nuts depends on the number of spadices opened, the number of female flowers produced and the number of female flowers that set and developed into nuts. Satyabalan *et al.* (1969) observed a positive correlation

Table 1. Path coefficients contributing to average yield of nuts during the stabilized period in West Coast Tall Coconut

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	r
X_1	..	**—0.45**	—0.08	0.03	0.26	—0.18	0	0.10	0.06	—0.32	—0.57
X_2	..	0.21	**0.17**	—0.02	—0.16	0.23	—0.22	—0.04	—0.07	0.48	0.99
X_3	..	0.41	0.08	**—0.03**	—0.36	0.43	0.07	—0.05	—0.07	0.50	0.99
X_4	..	0.31	0.07	—0.03	**—0.38**	0.33	0.04	—0.08	—0.10	—0.58	0.74
X_5	..	0.15	0.08	—0.03	—0.24	**0.52**	—0.08	0.04	—0.06	0.36	0.71
X_6	..	0	—0.11	—0.01	—0.05	—0.122	**0.33**	0.07	—0.01	0.23	0.33
X_7	..	—0.45	0.06	0.02	0.28	0.21	0.21	**0.10**	—0.10	0.02	0.36
X_8	..	0.25	0.11	—0.02	—0.33	0.28	0.03	0.09	**—0.11**	0.44	0.72
X_9	..	0.22	0.13	—0.03	—0.34	0.26	0.12	0	—0.08	**0.64**	0.94

Path coefficient of residual factors : 0.18. R^2 : 96%.

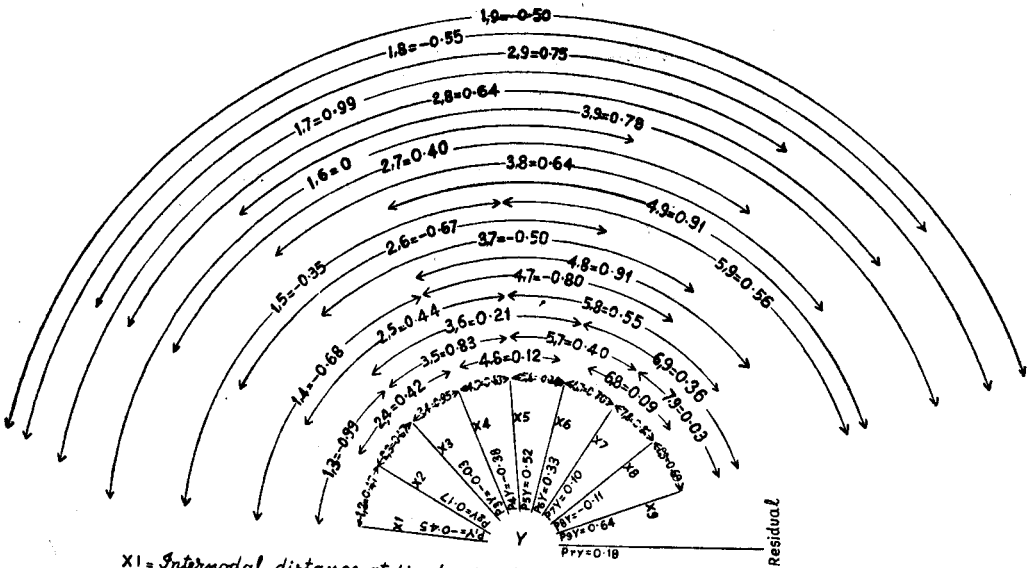
Table 2. Path coefficients contributing to cumulative yield of nuts from twenty-one to twenty-four years after sowing

		X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	r
X_3	..	**0.49**	—0.15	0	—0.23	0.05	—0.12	0.60	—0.03	0	0.60
X_4	..	0.21	**—0.35**	0	—0.08	0.05	—0.11	0.42	0.10	0.52	0.76
X_5	..	0.21	—0.22	**0.01**	0.04	0.10	—0.18	0.73	—0.08	0.13	0.72
X_6	..	—0.32	0.08	0	**0.35**	0.09	—0.02	0.29	—0.03	—0.09	0.35
X_7	..	0.17	—0.14	0	0.22	**0.14**	—0.18	0.03	0.04	0.32	0.60
X_8	..	0.30	—0.19	0	0.03	0.12	**—0.20**	0.56	0.01	0.05	0.66
X_9	..	0.36	—0.18	0	0.12	0	—0.14	**0.81**	—0.05	—0.01	0.93
X_{10}	..	—0.11	—0.26	0	—0.07	0.04	0.01	—0.30	**0.13**	0.65	0.10
X_{11}	..	—0.14	0.31	0	0.05	—0.07	0.17	0.02	—0.14	**—0.62**	—0.42

Bold figure values are direct effects.

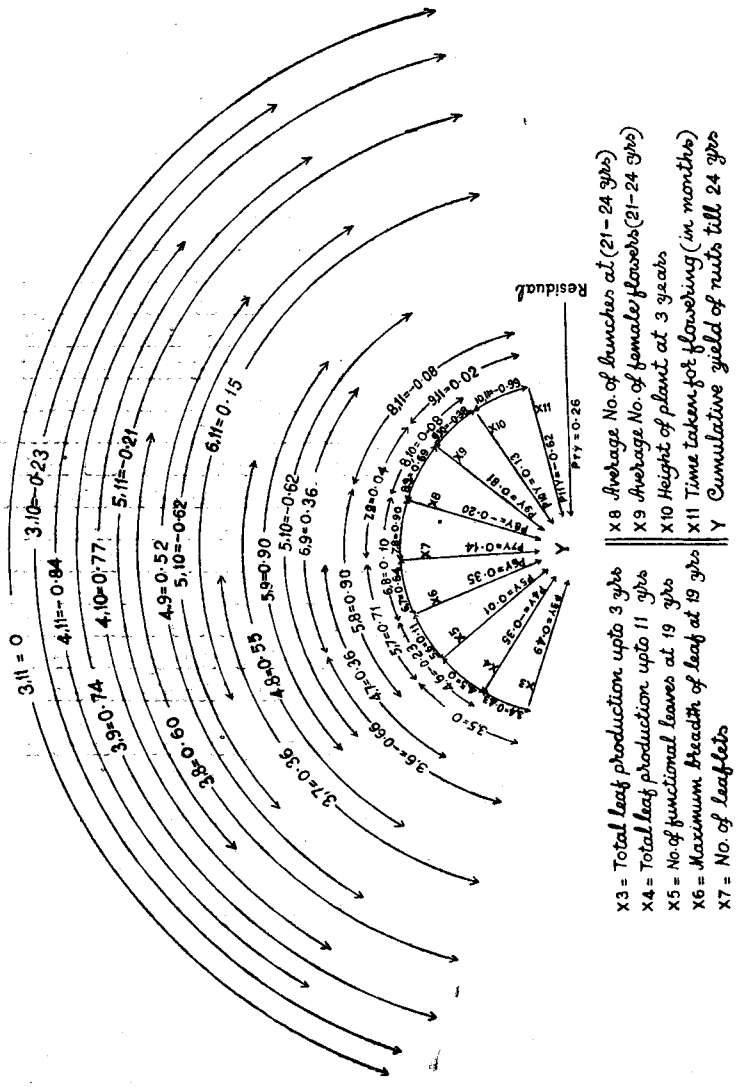
Path coefficient of residual factors : 0.26. R^2 : 88%.

FIG. 1. DIAGRAMMATIC REPRESENTATION OF FACTORS INFLUENCING STABILIZED YIELD IN COCONUT (W. C. TALL)



X1 = Internodal distance at fixed mark at 19 yrs.
X2 = No. of leaf scars/m. above fixed mark at 19 yrs.
X3 = Total leaf production upto 3 yrs
X4 = Total leaf production - 11 yrs
X5 = No. of functional leaves at 19 yrs
X6 = Maximum breadth of leaf at 19 yrs
X7 = No. of leaflets
X8 = Average No. of bunches - (21 to 24 yrs)
X9 = Average No. of female flowers (21 to 24 yrs)
Y = Average yield of nuts during stabilized period

FIG. 2. DIAGRAMMATIC REPRESENTATION OF FACTORS INFLUENCING CUMULATIVE YIELD OF NUTS TILL TWENTY FOUR YEARS AFTER SOWING COCONUT (W.C. TALL)



between yield and female flower production except when the female flower production was high. The variation in female flower production appeared to be related more to the number of opened spadices than to the number of female flower per bunch. Liyanage (1967) has stated that leaf production during the first 40 months of growth may be related to the breeding value for yield of the palm. Patel (1938) stated that trees with large number of leaves commence their reproductive phases earlier than the trees having a lower number of leaves. Thus the number of leaves appear to be significantly and positively correlated to early flowering and high yield. Narashimhayya and Sukumaran (1978) worked out heritability values for average number of female flowers (0.49), number of functional leaves (0.51), internodal distance at fixed mark (0.61), total leaf production up to three years (0.60), and time taken for flowering (0.58). They observed positive and significant correlation (0.72) between the cumulative yield of nuts and the number of functional leaves on the plant at 19 years after sowing. The direct effect of functional leaves is almost negligible whereas the indirect effect of this character through average number of female flowers after yield stabilisation, is quite considerable. A closer observation of table 2 would also indicate that almost all the indirect effects of the other characters, through functional leaves, on cumulative yield approximate to zero. This means that the functional leaves are expressing their contribution to yield through other characters, the maximum being through number of female flowers.

It is evident from the path analysis that average number of female flowers at 21 to 24 years, number of functional leaves at 19 years, internodal distance at fixed mark, total leaf production up to 3 years after sowing and time taken for flowering are important components that showed largest influence directly on cumulative yield and average yield. They also showed a higher heritability than other components there by suggesting that these characters are important in selection programme. It may also be suggested that correlation studies alone do not give complete information but this study in conjunction with path coefficient studies will give a better picture of the cause-effect relationship existing between different pairs of characters.

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