Path Analysis in Arecanut (*Areca catechu* L.)

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Abstract

The study on direct and indirect effects of seed weight, days taken for germination, seedling girth, seedling height, number of leaves, time taken for flowering on the yield characters of arecanut by path analysis suggested that the selection of heavy nuts (35 g and above) plays a major role for raising better seedlings resulting in higher yield. The seedling which comes to early flowering (less than 4½ years) resulted in better yield. The thinner seedlings must substantiate with early flowering for better yields.

Introduction

Plant yield, in general is the resultant of growth functions of several yield components, mainly the plant morphology. Whenever the number of such components in a crop is more, it becomes essential to measure the contribution of each component to the observed correlation and partition the correlation coefficient into components of direct and indirect effects. Such studies are done in various crops (Chang and Lal, 1971; Dewey and Lu, 1959; Miller *et al.* 1958; Povilaitis, 1965; Venkatarao *et al.* 1973) but so far no attempt has been made in arecanut.

Materials and Methods

Progenies of the 50 selected nuts from each of the six selected mother palms were considered for the study. Morphological data on seed weight (X_1), time taken for germination (X_2), seedling height (X_3), seedling girth (X_4), number of leaves (X_5) and time taken for flowering (X_6) were recorded. Yield data viz., number of nuts and wet weight of nuts were collected for four years (1972-73 to 1975-76) and the average yield was considered for fitting a multiple regression equation with the morphological characters.

Two models of regression viz., (i) linear model of the form $Y = \alpha + \sum_{i=1}^{6} \beta_i X_i$ and (ii) exponential model of the form $Y = \alpha \prod_{i=1}^{6} (X_i^{\beta_i})$ were fitted.

Taking into consideration the exponential model of regression, path interrelation coefficients were obtained from the partial regression values of the multiple regression between the yield and morphological characters, using the genotypic variances and covariances, according to Tukey(1954). These were represented as P_{iy}, where i=1,2 .. ... 6. All the residual factors were represented by P_{xy} which is calculated as $P_{xy} = \sqrt{1-R^2}$, where R^2 is the multiple correlation coefficient.

Results and Discussion

Large variation was found to exist in all the characters under study excepting for seedling girth and number of leaves. The

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mean values and range of all the characters studied are given in Table 1.

Table 1. Mean values and range of characters

Character	Mean	Range
Seed weight (g)	35.40	24.0-56.0
Time taken for germination (days)	60.69	32.0-93.0
Girth of 3 month old seedling(cm)	0.99	0.8-1.4
Height of 3 month old seedling (cm)	41.40	20.0-65.0
No. of leaves of 3 month old seedling	2.31	2.0-3.0
Time taken for flowering (years)	4.47	3.3-6.2
No. of nuts (averaged for 1972-76)	141.85	4.4-437.0
Wt. of nuts in kg (averaged for 1972-76)	5.14	0.1-18.0

Both the models of regression were fitted separately for both the yield data viz., (i) number of nuts and (ii) wet weight of nuts and found that the exponential model of regression was quite satisfactory (R^2 values being 49.83% for number of nuts and 78.42% for wet weight of nuts). The exponential model regression equations and R^2 values for both the yield characters are given in Table 2.

Table 2. Yield-morphology relationship and R^2

Dependent Characters	Equation	R^2(%)
No. of nuts	$Y=1.61\ X_1^{1.02}\ X_2^{0.18}\ X_3^{-1.77}\ X_4^{0.30}\ X_5^{0.09}\ X_6^{-0.55}$	49.83*
Wt. of nuts	$Y=1.68\ X_1^{1.67}\ X_2^{0.34}\ X_3^{-1.24}\ X_4^{0.45}\ X_5^{0.09}\ X_6^{-0.48}$	78.42**

*Significant at P=0.05 **Significant at P=0.01

The estimates of genotypic correlations (Table 3) between the yield and the morphological characters, revealed that the yield has significant positive correlation with the seedweight and is negatively correlated with the seedling girth and time taken for flowering. The remaining characters did not show significant correlations. Two characters viz., days taken for germination and seedling height, because of their poor correlations with the yield, were deleted for further calculation of path interrelation coefficients in order to give more emphasis for the strongly related characters.

The path interrelation coefficients of different characters and residual factors are presented in Figure 1.

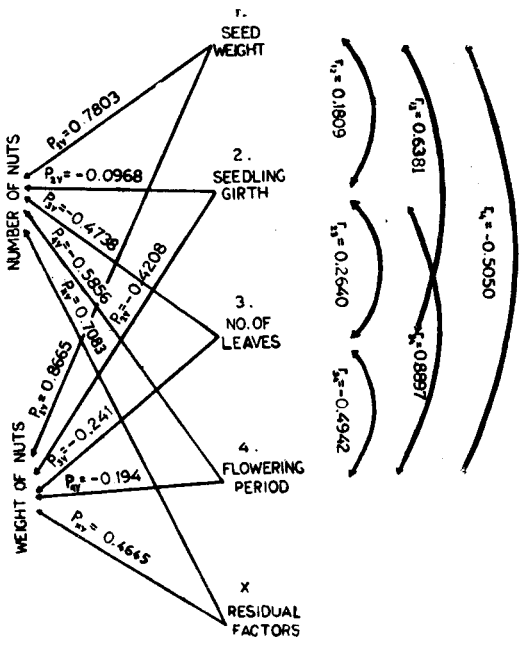

FIG. 1. PATH DIAGRAM OF FACTORS INFLUENCING ARECANUT YIELD

The direct and indirect effects of individual characters on the yield are presented in Table 3.

Table 3. Genotypic correlations, direct and indirect effects of morphological characters on yield characters

Morphological characters	Particulars	Yield characters: No. of nuts	Yield characters: Wt. of nuts
Seed weight			
	Genotypic correlation	0.7562**	0.7346*
	Direct effect	0.7803	0.8665
	Indirect effect through seedling girth	-0.0175	-0.0761
	Indirect effect through no. of leaves	-0.3023	-0.1537
	Indirect effect through time taken for flowering	0.2957	0.0980
Seedling girth	Genotypic correlation	-0.6017**	-0.5002*
	Direct effect	-0.0968	-0.4208
	Indirect effect through seed weight	0.1411	0.1567
	Indirect effect through number of leaves	-0.0251	-0.0636
	Indirect effect through time taken for flowering	-0.5210	-0.1725
Number of leaves	Genotypic correlation	0.0879	0.2967
	Direct effect	-0.4738	-0.2410
	Indirect effect through seed weight	0.4979	0.5530
	Indirect effect through seedling girth	-0.0256	-0.1111
	Indirect effect through time taken for flowering	0.2894	0.0959
Time taken for flowering	Genotypic correlation	-0.8316**	-0.8868**
	Direct effect	-0.5856	-0.1940
	Indirect effect through seed weight	-0-3941	-0.4377
	Indirect effect through seedling girth	-0.0861	-0.3743
	Indirect effect through number of leaves	0.2342	0.1191

*Significant at P=0.05 **Significant at P=0.01

Seed weight *vs.* yield

The results show that the correlation coefficient between seed weight and yield is almost equal to its direct effect, thereby explaining the true relationship that a direct selection through this trait will be effective.

Number of leaves *vs.* yield

Although the number of leaves is positively correlated with the yield, it shows negative direct effect and its indirect effect through seed weight is high. This suggests that number of leaves need not be taken as a causal factor and instead more emphasis may be given for the seed weight in the role of selection.

Time taken for flowering *vs.* yield

The direct effect of time taken for flowering is considerably low and negative, when compared to its correlation with the yield. Whereas its indirect effect through seed weight is considerably high but negative revealing that large sized nuts might nullify this indirect effect and the early flowering factor becomes one of the causal factors for the better yield.

Seedling girth *vs.* yield

Though the seedling girth had a significant negative correlation, its indirect effect is slightly less in the case of weight of nuts and negligible in the case of number of nuts. The indirect effect through time taken for flowering is high and negative, thereby revealing that selection of seedlings with thinner girth must be compensated by the early flowering for getting better yield.

In all it can be said that the selection of heavy nuts (say 35g and above) is one of the important causal factors for getting better yield. The time taken for flowering (less than 4½ years) also plays a major role in improving the yield.

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References

CHANG, E. Y. and LAL, D C. 1971. Genotype, phenotype correlation and Path-coefficient analysis of six important characters in tobacco crosses. *Agr. Ass. China J.* **76**: 15-22.

DEWEY, D. R. and LU, K. H. 1959. A correlation and path co-efficient analysis of components of crested wheat grass seed production. *Agron. J.* **51**: 515-518.

MILLER, P. A., WILLIAMS, V. C., ROBINSON, H.F. and COMSTOCK, R.E. 1958. Estimates of genotypic and environmental variances and co-variances in upland cotton and their implications in selection. *Agron. J.* **50**: 126-131.

POVILAITIS, B. 1965. Genotypic correlations among certain quantitative characters in tobacco. *Canad. J. Genet. Cyto.* **7**: 523-529.

TUKEY, J. W. 1954. Causation, regression and path analysis. Statistics and Mathematics in Biology, PP. 47-53 Kempthorne, O. (Ed.). The Iowa State College Press, Ames, Iowa.

VENKATARAO, C., NARASIMHAYYA, G. and APPARAO, K. 1973. Path analysis in Flue-cured tobacco *(Nicotiana tobacum). Indian J. Agric. Sci.* **43**: 198-210.

Discussions

T Krishnappa:

It has been suggested that nuts weighing 35 g and above should be selected. Does it apply to a particular variety?

Bhagavan:

The study was restricted to the South Kanara variety. (Chairman suggested that the work may be extended to *Mangala* also)

KUK Nampoothiri:

What is the stage at which weight of nuts is recorded?

Bhagavan:

Immediately after harvest.

KVJ Mohan:

What is the advantage of selecting for yield on the basis of seedling girth?

Bhagavan:

The thinner seedlings substantiate with early flowering.

M K Muliyar:

Is there any additional information regarding the weight of nuts other than what is already recommended in the package of practices?

Bhagavan:

The results of the present study obtained from path analysis corroborate the earlier findings.