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Correlation and path coefficient analysis for some morphological and biochemical constituents of jackfruit genotypes

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ABSTRACT

A study was conducted to assess the correlation among fruit weight and its components and path coefficient analysis to provide adequate genetic background for direct and indirect effect of various characters on fruit weight of jackfruit. The results revealed that genotypic and phenotypic correlation were positively significant between fruit weight of edible part (0.980 and 0.977), fruit and rind weight (0.976 and 0.971), and number of stones and flakes (0.999 and 0.999). The path coefficient analysis indicated that weight of edible part had positive direct effect on fruit weight both at genotypic (0.459) and phenotypic (0.451) levels. Hence, at the time of selection of jackfruit genotypes, one has to put emphasis on the characters like weight of edible part, rind weight, flake and stone numbers.

Key words: Jackfruit, correlation, path coefficient analysis.

INTRODUCTION

The efficiency of selection is generally more effective for characters with high heritability. Jackfruit (*Artocarpus heterophyllus* Lamk.) is a highly heterozygous and cross-pollinated fruit and as such seedlings exhibit a wide range of variations which provide a scope for selection of the superior desirable genotypes. Selection is made on the basis of phenotypes, although phenotypic superiority is not solely dependent on gene action as it is produced by the interaction of genotypes and environment, and improvement in the performance of selected lines over the original population. Where direct selection is not sufficient, it may require indirectly in case of characters with low heritability. Correlation and path analysis measures the mutual relationship of types and helps in selection based on determination of yield components, and path analysis further splits the correlation coefficient into the measures of direct and indirect effects of types on yield (Dewey and Lu, 1). It provides more reliable information of favourable and unfavourable association among the characters. In the present study, an attempt was made to obtain information on correlation of yield with its components and their direct and indirect effects on yield estimates by the analysis of path coefficient of the four selected jackfruit genotypes.

MATERIALS AND METHODS

The materials for the present study comprised 44 selected elite genotypes which were grown under different agro-climatic regions of West Bengal. Observations on metric traits *viz.,* spine density, stone weight, number of stones, weight of edible part, rind weight, rind/flake ratio, rachis weight, number of flakes, fruit yield/tree, fruit weight, total soluble solids, total sugar, titrable acidity, vitamin C and TSS/acid ratio were recorded. Estimates of correlation coefficient (genotypic and phenotypic) were computed for all the variables in all possible combinations (Johnson *et al*., 6; Jibouri *et al.,* 5). Estimates of path coefficient (genotypic and phenotypic) analysis for direct and indirect effects of various component characters on fruit weight was estimated following the methods suggested by using correlation coefficients.

RESULTS AND DISCUSSION

The result reveals that spine density showed significant and positive genotypic correlation with TSS (0.312), followed by total sugars (0.283) while stone weight showed negative genotypic correlation (-0.222). The weight of edible part showed very high positive and significant genotypic correlation with fruit weight (0.980) and rind weight (0.940) followed by rachis weight (0.794) and number of flakes (0.587). However, fruit weight showed negative genotypic correlation with TSS (-0.261), total sugars (-0.269) and TSS/acid ratio (-0.246) but titrable acidity and vitamin C (0.139 and 0.167) showed positive genotypic correlation.

Association between physical and biochemical characters of fruit revealed that phenotypic correlations were positive and significant between fruit weight and weight of edible part (0.977), fruit and rind weight (0.971) followed by rachis weight (0.792) and number of flakes (0.595). It showed negative correlation with

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Table 1. Genotypic correlation coefficient among different fruit characters of jackfruit.

Character	Spine density	Stone weight	No. of stones	Weight of edible part	Rind weight	Rind : flake ratio	Rachis weight	No. of flakes	Fruit yield/tree	Fruit weight	TSS	Total sugars	Titrable acidity	Vitamin C	TSS: acid ratio
Spine density	1.000														
Stone weight	-0.222*	1.000													
No. of stones	0.141	-0.354**	1.000												
Weight of edible part	0.046	0.137	0.594**	1.000											
Rind weight	0.107	0.234**	0.567**	0.940**	1.000										
Rind/flake ratio	0.055	0.349**	-0.192*	-0.284**	-0.105	1.000									
Rachis weight	0.008	0.143	0.470**	0.794**	0.785**	-0.173*	1.000								
No. of flakes	0.130	-0.354**	0.999**	0.597**	0.566**	-0.192*	0.468**	1.000							
Fruit yield/tree	-0.109	0.301**	-0.167	-0.234**	-0.179*	0.776**	-0.127	-0.167	1.000						
Fruit weight	0.083	0.177**	0.625**	0.980**	0.976**	-0.203*	0.851**	0.625***	-0.200*	1.000					
TSS	0.312**	-0.214	-0.150	-0.234**	-0.250**	-0.134	-0.278**	-0.142	-0.231**	0.261**	1.000				
Total sugars	0.283**	-0.249**	-0.110	-0.250**	-0.262**	-0.129	-0.268**	-0.101	-0.232**	-0.269**	0.985**	1.000			
Titrable acidity	0.016	0.332**	-0.024	0.099	0.087	0.023	0.296**	-0.026	-0.175*	0.139	-0.220*	-0.259**	1.000		
Vitamin C	-0.109	-0.154	0.298**	0.253**	0.148	-0.259**	-0.111	0.311**	-0.142	0.167	0.215*	0.231**	-0.183*	1.000	
TSS : acid ratio	0.103	-0.296	-0.117	-0.209**	-0.210*	-0.078	-0.328**	0.111	-0.201*	-0.246**	0.657**	0.669**	-0.787	0.227**	1.000

*and ** significant at P = 0.05 and 0.01 levels, respectively.

Table 2. Phenotypic correlation coefficient among different fruit characters of jackfruit.

Character	Spine density	Stone weight	No. of stones	Weight of edible part	Rind weight	Rind : flake ratio	Rachis weight	No. of flakes	Fruit yield/ tree	Fruit weight	TSS	Total sugars	Titrable acidity	Vitamin C	TSS : acid ratio
Spine density	1.000														
Stone weight	-0.220*	1.000													
No. of stones	0.141	-0.353**	1.000												
Weight of edible part	0.046	0.135	0.592**	1.000											
Rind weight	0.105	0.233**	0.562**	0.924**	1.000										
Rind/flake ratio	0.055	0.342**	-0.187*	-0.285**	-0.079	1.000									
Rachis weight	0.009	0.142	0.470**	0.792**	0.777**	-0.168*	1.000								
No. of flakes	0.130	-0.353**	0.999**	0.595**	0.561**	-0.187*	0.467**	1.000							
Fruit yield/tree	-0.108	0.300**	-0.167	-0.233**	-0.178*	0.759**	-0.127	-0.167	1.000						
Fruit weight	0.082	0.176**	0.624**	0.977**	0.971**	-0.193*	0.850**	0.624**	-0.199*	1.000					
TSS	0.310**	-0.213*	-0.149	-0.233**	-0.248**	-0.132	-0.278**	-0.142	-0.230**	0.260**	1.000				
Total sugars	0.271**	-0.240**	-0.103	-0.240**	-0.247**	-0.109	-0.259**	-0.096	-0.222*	-0.257**	0.951**	1.000			
Titrable acidity	0.016	0.330**	-0.024	0.099	0.087	0.023	0.295**	-0.026	-0.174*	0.140	-0.218*	-0.249**	1.000		
Vitamin C	-0.109	-0.153	0.297**	0.252**	0.142	-0.260**	-0.111	0.310**	-0.143	0.165	0.214*	0.222*	-0.183*	1.000	
TSS : acid ratio	0.102	-0.294	-0.116	-0.207**	-0.206*	-0.075	-0.327**	-0.110	-0.200*	-0.244**	0.654**	0.646**	-0.786**	0.227**	1.000

*and ** significant at P = 0.05 and 0.01 levels, respectively.

Table 3. Phenotypic path coefficient analysis of different fruit characters for fruit weight in jackfruit.

Character	Spine density	Stone weight	No. of stones	Weight of edible part	Rind weight	Rind: flake ratio	Rachis weight	No. of flakes	Fruit yield/tree	TSS	Total sugars	Titrable acidity	Vitamin C	TSS:acid ratio	Phenotypic correlation with fruit weight
Spine density	0.014	-0.008	0.064	0.021	0.040	-0.001	0.001	-0.048	0.000	-0.004	0.002	0.000	0.000	0.002	0.082
Stone weight	-0.003	0.038	-0.159	0.061	0.090	-0.004	0.020	0.129	0.001	0.003	-0.002	0.006	0.000	-0.005	0.176*
No. of stones	0.002	-0.013	0.451	0.267	0.216	0.002	0.067	0.366	-0.001	0.002	-0.001	0.000	-0.001	-0.002	0.624**
Weight of edible part	0.001	0.005	0.267	0.451	0.356	0.003	0.113	-0.218	-0.001	0.003	-0.002	0.002	0.000	-0.004	0.977**
Rind weight	0.001	0.009	0.253	0.416	0.385	0.001	0.111	-0.206	-0.001	0.003	-0.002	0.002	0.000	-0.004	0.971**
Rind/flake ratio	0.001	0.013	-0.084	-0.128	-0.031	-0.011	-0.024	0.069	0.003	0.002	-0.001	0.000	0.000	-0.001	-0.193*
Rachis weight	0.000	0.005	0.212	0.357	0.299	0.002	0.143	-0.171	0.000	0.004	-0.002	0.006	0.000	-0.006	0.850**
No. of flakes	0.002	-0.013	0.451	0.268	0.216	0.002	0.067	-0.366	-0.001	0.002	-0.001	0.000	-0.001	-0.002	0.624**
Fruit yield/tree	-0.001	0.011	-0.075	-0.105	-0.068	-0.009	-0.018	0.061	0.003	0.003	-0.001	0.003	0.000	-0.003	-0.199*
TSS	0.004	-0.008	-0.067	-0.105	-0.096	0.002	-0.040	0.052	-0.001	-0.014	0.006	-0.004	0.000	0.011	-0.260**
Total sugars	0.004	-0.009	-0.047	-0.108	-0.095	0.001	-0.037	0.035	-0.001	-0.013	0.007	-0.005	0.000	0.011	-0.257**
Titrable acidity	0.000	0.012	-0.011	0.045	0.034	0.000	0.042	0.010	0.001	0.003	-0.002	0.019	0.000	-0.013	0.140
Vitamin C	-0.001	-0.006	0.134	0.114	0.055	0.003	-0.016	-0.114	0.000	-0.003	0.001	-0.003	-0.002	0.004	0.165
TSS : acid ratio	0.001	-0.011	-0.052	-0.093	-0.080	0.001	-0.047	0.040	-0.001	-0.009	0.004	-0.015	0.000	0.017	0.244**

Residual effect = 0.0014, Diagonal values are direct effects; * and ** significant at P = 0.05 and 0.01 levels, respectively.

Table 4. Genotypic path coefficient analysis of different fruit characters for fruit weight in jackfruit.

Character	Spine density	Stone weight	No. of stones	Weight of edible part	Rind weight	Rind: flake ratio	Rachis weight	No. of flakes	Fruit yield/tree	TSS	Total sugars	Titrable acidity	Vitamin C	TSS:acid ratio	Genotypic correlation with fruit weight
Spine density	0.014	-0.009	0.069	0.021	0.040	-0.001	0.001	-0.053	0.000	-0.010	0.007	0.000	0.000	0.002	0.083
Stone weight	0.003	0.038	-0.173	0.063	0.088	-0.004	0.020	0.144	0.001	0.007	-0.006	0.007	0.000	-0.006	0.177*
No. of stones	0.002	-0.014	0.490	0.273	0.214	0.002	0.066	-0.405	-0.001	0.005	-0.003	-0.001	-0.001	-0.002	0.625**
Weight of edible part	0.001	0.005	0.291	0.459	0.355	0.003	0.111	-0.242	-0.001	0.007	-0.006	0.002	-0.001	-0.004	0.980**
Rind weight	0.001	0.009	0.277	0.431	0.377	0.001	0.110	-0.230	-0.001	0.008	-0.006	0.002	0.000	-0.004	0.976**
Rind/flake ratio	0.001	0.013	-0.094	-0.130	-0.040	-0.011	-0.024	0.078	0.003	0.004	-0.003	0.000	0.001	-0.001	-0.203*
Rachis weight	0.000	0.005	0.230	0.365	0.296	0.002	0.140	0.190	0.000	0.009	-0.006	0.006	0.000	-0.006	0.851**
No. of flakes	0.002	-0.014	0.489	0.274	0.213	0.002	0.066	-0.406	-0.001	0.005	-0.002	-0.001	-0.001	-0.002	0.625**
Fruit yield/tree	-0.002	0.012	-0.082	-0.107	-0.068	-0.009	-0.018	0.068	0.004	0.007	-0.006	0.004	0.000	-0.004	-0.200*
TSS	0.004	-0.008	-0.073	-0.108	-0.094	0.001	-0.039	0.058	-0.001	-0.032	0.024	-0.005	-0.001	0.013	-0.261**
Total sugars	0.004	-0.010	-0.054	-0.114	-0.099	0.001	-0.038	0.041	-0.001	-0.031	0.024	-0.005	-0.001	0.013	-0.269**
Titrable acidity	0.000	0.013	-0.012	0.046	0.033	0.000	0.041	0.011	0.001	0.007	-0.006	0.021	0.001	-0.015	0.139
Vitamin C	-0.002	-0.006	0.146	0.116	0.056	0.003	-0.016	-0.126	-0.001	-0.007	0.006	-0.004	-0.003	0.004	0.167
TSS : acid ratio	0.001	-0.011	-0.057	-0.096	-0.079	0.001	-0.046	0.045	-0.001	-0.021	0.016	-0.017	-0.001	0.019	0.246**

Residual effect = 0.0013, Diagonal values are direct effects; * and ** significant at P = 0.05 and 0.01 levels, respectively.

fruit yield (-0.233), TSS (-0.233), total sugars (-0.240) and TSS: acid ratio (-0.207). However, other characters were negatively correlated but number of stones per fruit showed highly significant, positive and strong correlation with number of flakes (0.999). The number of flakes per fruit showed positive and significant correlation with fruit weight (0.624) followed by vitamin C (0.310). Non-association of some of the yield contributing traits with fruit weight indicated that these traits could be improved independently without each other. All the genotypic and phenotypic correlation coefficient between various pairs of characters showed higher values in most characters than phenotypic correlation coefficient or *vice versa*. On the contrary, it is indicated that the mentioned characters had complementary influence on each other to a greater extent and not a single character influences the fruit weight. This result is in accordance with the findings on jackfruit (Maiti *et al.*, 8; Maiti and Mitra, 9), papaya (Ghanta and Mondal, 4; Magdalite *et al.*, 7), banana (Sundaram *et al*., 12) and litchi (Dwivedi and Mitra, 3).

Genotypic and phenotypic path coefficient analysis of different fruit characters in relation to fruit weight were partitioned into direct and indirect relationships. It is evident from the data (Tables 3 & 4) that fruit weight in jackfruit is the result of weight of edible part, stone number per fruit, number of flakes, rind weight, rachis weight, total soluble solids and spine density as revealed from the direct and indirect effects of individual character based on correlation. Direct effect of individual character towards fruit weight was found higher for weight of edible part (0.459 and 0.451) at both genotypic and phenotypic levels, followed by number of stones and rind weight. The characters showing negative direct effects were number of flakes (-0.406), TSS (-0.032) and vitamin C (-0.003) but showed significant positive correlation with fruit weight. It was also found that the residual effect only (G = 0.0013, P = 0.0014) infers that 99.99% of the variability in fruit weight has been governed by the other characters covered. Similar results have been reported in acid lime (Prasad and Rao, 11), litchi (Dwivedi and Mitra, 2), and jackfruit (Mitra,10). Therefore, correlation and path analysis are viewed together, which indicated that number of stones and weight of edible part as well as rind weight and flake numbers are important characters showing maximum direct and indirect effects on fruit weight and it may help in selecting superior genotypes in jackfruit.

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