CHARACTER ASSOCIATION AND PATH ANALYSIS IN ORCHIDS

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***ABSTRACT**: The present study was designed with the objectives to find out the interrelationships between important characters of orchids and the direct and indirect effect of flowers per plant on important characters of orchids. For this purpose, investigation was done on ten important characters in twenty five orchids of 8 years old, which were obtained from various places of Bangladesh including commercial orchid farms. The results of correlation analysis as shown by their coefficients of correlation revealed that flowers per plant showed significantly strong positive correlation with the number of spikes per plant (r =0.379**), indicating that direct selection of spikes per plant would ultimately improve flowers per plant. Vertical spread of flower made significantly strong positive correlation with flower weight (r=0.762**) and horizontal spread of flower (r =0.895**). Path coefficient analysis revealed that plant height had the highest positive direct effect (0.9510) on flowers per plant followed by spikes per plant (0.4831) and flower weight (0.3103), suggesting that direct selection of orchids through plant height, spikes per plant and flower weight could be proved useful.*

Key words: Correlation, direct and indirect effect, orchids

INTRODUCTION

Orchidaceous is the most abundant and has been considered as second biggest group of flowering plants in the plant kingdom. Considering the genera and species, about 788 genera and 25,000 to 30,000 species of orchids have been recognized around the world [1]. These orchids create interest for botanists, naturalists, and ecologists since the time immemorial due to their wider range of diversity in shape, size, and colour of flowers. This highly advanced family of monocots is composed of mostly herbaceous plants which can be characterized by distinct floral morphology, pollination mechanism and minute seeds [2]. Correlation in crop plants can be genetic or environmental [3]. Phenotypic correlation involves both genetic and environmental effects. It can be directly observed from measurements of the two characters in a number of individuals in a population. Genetic correlation is the association of breeding values (i.e., additive genetic variance) of the two characters. Both measure the extent to which degree the same genes or closely linked genes cause co-variation in two different characters. Path analysis permits the partitioning of the correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable upon its response variable; the second component being the indirect effect(s) of a predictor variable on the response variable through another predictor variable. [4] studied that in gladiolus spike length exhibited significant positive correlation with plant height, number of florets per spike and floret size. Corm weight and size showed strong negative correlation with days to sprout, days to basal floret opening and average weight at both phenotypic and genotypic levels. [5] also studied that association among various characters and the direction and magnitude of contribution from different characters towards the number of flowering stems per plant in 20 genotypes of carnation grown over four locations in Himachal Pradesh, India. The study revealed that number of flowering stems per plant showed significant positive correlation with number of flower buds per plant and it was also positively associated with plant height; spike length and days to flower bud opening. Correlation and path coefficients have been used to develop selection criteria for various traits in several flowering species of economic importance. Therefore, the current investigation was undertaken to find out the correlation and path coefficient among various traits so that better selection criteria can be developed in orchids for further selection programs.

MATERIALS AND METHODS

Estimation of correlation

Correlation and path coefficient analyses were carried out using the 10 important morphological characters. The present study of correlation and path coefficient analysis involved twenty five orchids for the information of interrelationship among flower and other important components and to partition the observed phenotypic correlation into their direct and indirect effects through other characters which could be used as selection criteria in the breeding program in future. To estimate the degree of relationship among traits of economic importance genotypic and phenotypic correlations were determined according to methods described by [6] while matrix method of computing path coefficient analysis as shown by [7] was used.

Estimation of direct and indirect effect of different characters on yield (flowers per plant)

In this study, an attempt was made to study the direct and indirect influences of some important characters adopting correlation and path coefficient analysis. The path and correlation analyses were conducted by following the methods of [8].

Calculation of residual effect

Table 1. Coefficients of correlation among ten characters of orchids.

Traits	1	2	3	4	5	6	7	8	9
1	**								
2	0.765**	**							
3	-0.082	0.091	**						
4	-0.225	-0.174	-0.218	**					
5	0.113	0.056	-0.359	0.324	**				
6	0.724**	0.445	-0.353	-0.127	0.021	**			
7	0.577*	0.569*	-0.319	0.211	0.394	0.322	**		
8	0.113	0.030	0.040	0.142	0.785**	-0.106	0.129	**	
9	0.072	0.039	-0.017	0.212	0.762**	-0.353	-0.037	0.895**	**
10	-0.191	0.065	0.379**	-0.098	-0.380	0.122	-0.150	-0.288	-0.201

1. Plant height (cm), 2.Leaf area (cm), 3.Spikes/plant, 4.Spike length (cm), 5.Flower weight, 6.Roots/plant, 7.Root length (cm), 8. Horizontal spread of flower (cm), 9.Vertfical spread of flower (cm), 10.Flowers per plant

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Table 2. Path analysis showing direct (diagonal values) and indirect effect (off diagonal values) of independent characters considering flowers per plant as dependent character.

Traits	1	2	3	4	5	6	7	8	9
1	**0.9510**	0.7323	-0.0860	-0.2187	0.1046	0.6847	0.5516	0.1046	0.0757
2	-0.2784	**-0.3616**	-0.0325	0.0614	-0.0216	-0.1627	-0.2061	-0.0108	-0.0144
3	-0.0386	0.0434	**0.4831**	-0.1062	-0.1739	-0.1690	-0.1545	0.0232	-0.0166
4	-0.0531	-0.0393	-0.0508	**0.2312**	0.0739	-0.0300	0.0585	0.0323	0.0585
5	0.0341	0.0262	-0.1117	0.1031	**0.3103**	0.0120	0.1210	0.2451	0.2358
6	0.1338	-0.0836	0.0750	0.0241	-0.0037	**-0.1859**	-0.0649	0.0204	0.0750
7	-0.2226	-0.2188	0.1228	-0.0806	-0.1497	-0.1228	**-0.3838**	-0.0590	0.0253
8	-0.0605	-0.0251	-0.2230	-0.0808	-0.4349	0.0605	-0.0715	**-0.5506**	-0.4955
9	-0.0123	-0.0047	0.0022	-0.0234	-0.0849	0.0411	0.0047	-0.1005	**-0.1117**

(Residual effect= 0.7632), Name of characters: 1. Plant height, 2. Leaf area, 3. Spikes per plant, 4. Spike length, 5. Flower weight, 6. Roots per plant, 7. Root length, 8. Horizontal spread of flower, 9. Vertical spread of flower.

After calculating the direct and indirect effect the residual effect was calculated using the formula suggested by [7].

RESULTS

Correlation analysis

The results of correlation analysis as shown by their coefficients of correlation (Table-1) revealed that flowers per plant showed significantly strong positive correlation with the number of spikes per plant (r =0.379**) whereas vertical spread of flower established significantly strong positive association with flower weight (r=0.762**) and horizontal spread of flower (r =0.895**). Horizontal spread of flower was correlated positively with flower weight (r=0.785**) while root length was positively associated with leaf area (r = 0.569*). Number of aerial roots per plant (r = 0.724**) and leaf area (r = 0.765**) showed strong positive correlation with plant height. The obtained results might be used to adopt selection criteria in further studies.

Path analysis

The importance of path coefficient analysis is to provide an effective means of revealing direct and indirect effect or causes of association. It also helps to examine what is responsible for producing a given correlation and also help to measure the relative importance of each causal factor. In the path coefficient analysis of this study (Table-2) revealed that plant height had the highest positive direct effect (0.9510) on flowers per plant followed by spikes per plant (0.4831) and flower weight (0.3103). On the other hand, horizontal spread of flower (-0.5506), root length (-0.3838), leaf area (-0.3616), roots per plant (-0.1859) and vertical spread of flower (-0.1117) had negative direct effect on number of flowers per plant. Spike length had also positive direct effect on number of flowers per plant but its indirect effect on other characters was mostly negative, which consequently resulted to negative correlation with number of flowers per plant. Flower weight had positive direct effect and negative indirect effect on number of flowers per plant. Roots per plant had positive indirect effect (0.6847) on plant height. Residual effect indicated 24 % variation and 76 % resemblance among characters

DISCUSSION

Correlation measures the degree of association between the characters. Information on correlation between the important economic traits are of considerable help in the selection program, because correlation ensures simultaneous improvement in one or two or more variables and negative correlation bring out the need to obtain a compromise between the desirable traits. Correlation between the characters may be due to either pleiotrophy or genetic linkage [2; 9]. The positive correlation between flowers per plant and spikes per plant might be related to specific orchid, negative correlation of flowers per plant with plant height and spike length indicated that the orchids with long spikes and plant height produce less number of flowers which was also due to genetic makeup and environmental influence. The fact that weight of flower and number of flowers per plant were negatively correlated indicated that by selecting for maximum number of flowers per plant one is indirectly selecting light weighted flowers. Since there was significant association among spikes per plant, horizontal spread of flower, flower weight and root length with plant height and leaf area, and leaf area was positively correlated with plant height such characters should be selected whenever maximum number of flowers is the objective. Similar observations were noted by [4; 10; 11; 12; 13]. The path coefficient analysis revealed that the poor association between spikes per plant and leaves per plant was largely due to indirect effect through increase of plant height. The fact that spikes per plant was positively correlated with flowers per plant with relatively large direct effects indicated that these characters are also important when selecting for maximum number of flowers per plant. [5 ; 13 ; 14] also observed that number of flowers per spike had positive direct effect than their significant positive correlation with spike length and number of leaves.

CONCLUSION

It is concluded that flowers per plant made significantly strong positive correlation with the number of spikes per plant, signifying that direct selection of spikes per plant would ultimately improve flowers per plant. Path coefficient analysis revealed that plant height had the highest positive direct effect on flowers per plant followed by spikes per plant and flower weight, suggesting that direct selection of orchids through plant height, spikes per plant flower weight can be used as best selection criteria.

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