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LINKING TRAITS ACROSS VARIOUS ORCHID CULTIVARS

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Abstract

The correlation coefficients amongst the different characters at phenotypic and genotypic levels revealed that the number of spikes per year yield and per plot had a significantly positive association with plant height, number of pseudostems per plant, number of florets/spike, and spike length, whereas a significant positive correlation was observed with days to first harvest. Spike length had a positive association with plant height, leaf length and width, number of pseudostems, and number of florets/spike, whereas its negative correlation with days to first harvest was observed. The number of florets per spike had a positive association with plant height, leaf length and width, and number of pseudostems, while its negative correlation was found with days to first harvest. Days to first harvest had a negative correlation with all the traits observed in the present study. Plant height showed a significant and positive association with leaf length and width, and number of pseudostems per plant. Spike length had a very high positive direct effect and the number of pseudostems per plant had a high positive direct effect on the number of spikes per plant per year. The present findings showed that selection should be made on the basis of spike length and number of pseudostems per plant which may have the highest positive direct effect considering other traits while making improvement in orchids for number of spikes per plant per year.

Introduction

ORCHIDS ARE one of the most distinctive plants of nature and are highly priced in the international flower trade due to their incredible range of diversity in size, colour, shape, forms, appearance, and long lasting qualities of flowers, even after harvesting. These belong to the family Orchidaceae; one of the largest families of flowering plants representing 693 genera distributed in 29,481 species (POWO, 2025; WFO, 2023). Orchids have a very wide range of distribution. These are found to occur in all parts of the world except Antarctica. India is known for its rich biodiversity, and one of its dominant plant families is Orchidaceae, consisting of about 1256 orchid species under 155 genera in the country (Singh *et al.,* 2019).

NorthEast India is rich in genetic diversity and one of the eight mega biodiversity in the world which hosts nearly 70 per cent of the orchid taxa in India (Kataki *et al*., 1984). The Eastern Ghats of Andhra Pradesh are also considered one of the rich biodiversity hot spots for many terrestrial and epiphytic orchids. In peninsular India, there are about 200 species, out of which 67 are found in the state of Andhra Pradesh (Pullaiah, 1997). Later Raju *et al*. (2008) reported 77 orchid species from Andhra Pradesh and Rao *et al*. (2009) reported 56 orchids from the Eastern Ghats of Andhra Pradesh with 11 from the Talakona sacred grove. Padma and Rajkumar (1997) reported 19 epiphytic and 14 terrestrial orchids from the Eastern Ghats of Andhra Pradesh.

According to Singh (2005), the yield is a composite character determined by several component characters. In any crop, augmentation in yield is, however, feasible only through the selection of the desired constituent characters. To assess the number of spikes per plant per year as potential of any cultivar of orchid, it is requisite to consider all the yield contributing characters. It is fundamental to evaluate the degree of relationship of a range of quantitative traits so that it would be possible to initiate an effective selection programme. For this purpose, knowledge of the association amongst the diverse plant characters with yield and amongst themselves is required so that a balanced choice of traits for selection may be utilized.

A simple measure of the correlation of traits does not quantify the complete input of fundamental factors to the final yield. As the constituent traits themselves are mutually dependent, they over and over again affect their direct association with the yield and as a result, these confine the dependability of selection indicators which depend upon correlation coefficients. The path analysis permits the partition between direct and indirect effects in the course of additional related characters by partitioning the genotypic correlation coefficients. Correlation and path coefficient analyses together give a clear-cut picture of interrelationships and the relative contribution of independent characters on dependent variables which enable a plant breeder to apply suitable selection procedures for crop improvement. Keeping in view the above, the present investigation was undertaken on linking traits across various orchid

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cultivars so as to find out the major spike yield contributing traits in orchids.

Material and Methods

A field experiment was carried out at horticultural research station, Dr. YSR Horticultural University, Chintapalli, Andhra Pradesh, under 50% shade net conditions during 2018-19, 2019-20, and 2020-21 so as to estimate genetic variability, correlation, and path analysis amongst the various orchid cultivars. The location falls under the agro-climatic zone of high altitude and tribal zone with an average rainfall of SouthWest monsoon of more than 1400 mm, temperature ranging from maximum (17-35°C) and minimum (6-24°C), and an altitude of 933m amsl. The geographical situation is 17.87°N latitude and 82.35°E longitude (Sivakumar *et al*., 2020). The experiment was laid out in a randomized block design with six orchid hybrids *i.e*., Sonia-17, New Pink, Queen Pink, Apricot, Venus, and Anna in four replicates. Fifteen months old healthy rooted tissue culture raised plants were taken for the experimentation. The plants were planted in 1 square feet coconut husk blocks by keeping four plants in a block. Observations on growth and yield characters were recorded from 5 plants selected at random. In each treatment and for each replicate, the pooled replicated mean values of each character were used for statistical analysis as per the method given by Panse and Shukhatme (1985).

The analysis of variance of all characters was carried out as per the procedure suggested by Verma *et al.* (1987). Genotypic and phenotypic correlation coefficients were calculated as per the formulae given by Johnson *et al*. (1955). The significance of the phenotypic and genotypic correlation coefficients was calculated by the formula given by Snedecor and Cochran (1967). Path coefficient analysis as suggested by Dewey and Lu (1959) was applied to separate the direct and indirect effects of the genotypic correlation coefficients of the number of spikes per year.

Results and Discussion

The results revealed that the number of spikes per year yield per plot had a significantly positive association at phenotypic and genotypic levels with the plant height, number of pseudostems per plant, number of florets/spike and spike length, whereas a significantly positive correlation was found with days to first harvest. The correlation coefficients amongst the different characters at phenotypic and genotypic levels are presented in Table 1. Spike length had a positive association with plant height, leaf length and width, number of pseudostems and number of florets per spike, whereas negative correlation was observed with days to first harvest. The number of florets per spike had a positive association with plant height, leaf length, leaf width, and number of pseudostems, while negative correlation was recorded with days to first

Table 1. Phenotypic (P) and Genotypic (G) correlation coefficients for various characters in orchid cultivars.

		PH	LL	LW	NPS	DFH	NFS	SL	NSY
PH	P	1.000							
	G	1.000							
LL	P	0.424*	1.000						
	G	0.649**	1.000						
LW	P	0.627**	0.583**	1.000					
	G	0.876**	0.943**	1.000					
NPS	P	0.912**	0.477*	0.637**	1.000				
	G	0.992**	0.863**	0.916**	1.000				
DFH	P	-0.513*	-0.409*	-0.456*	-0.619**	1.000			
	G	-0.589**	-0.842**	-0.639**	-0.713**	1.000			
NFS	P	0.889**	0.483*	0.620**	0.880**	-0.577**	1.000		
	G	0.987**	0.936**	0.990**	0.998**	-0.628**	1.000		
SL	P	0.872**	0.517**	0.716**	0.831**	-0.532**	0.907**	1.000	
	G	0.986**	0.933**	0.913**	0.992**	-0.585**	0.994**	1.000	
NSY	P	0.682**	0.163	0.274	0.759**	-0.587**	0.735**	0.699**	1.000
	G	0.996**	0.991**	0.849**	0.995**	-0.774**	0.989**	0.995**	1.000

PH, Plant height; LL, Leaf length; LW, Leaf width; NPS, Number of pseudostems; DFH, Days to first harvest; NFS, Number of florets/ spike; SL, Spike length; NSY, Number of Spikes/year.

Table 2. Genotypic path coefficients (direct and indirect effects) of various traits on yield per hectare in orchid cultivars.

	PH	LL	LW	NPS	DFH	NFS	SL
PH	-0.172	-0.097	-0.386	0.473	0.204	-0.216	1.237
LL	-0.112	-0.149	-0.415	0.411	0.291	-0.205	1.170
LW	-0.151	-0.141	-0.440	0.436	0.221	-0.221	1.145
NPS	-0.171	-0.129	-0.403	0.477	0.247	-0.227	1.287
DFH	0.101	0.125	0.281	-0.340	-0.346	0.138	-0.734
NFS	-0.170	-0.139	-0.445	0.493	0.217	-0.219	1.276
SL	-0.170	-0.139	-0.402	0.489	0.202	-0.223	1.254

PH, Plant height; LL, Leaf length; LW, Leaf width; NPS, Number of pseudostems; DFH, Days to first harvest; NFS, Number of florets/ spike; SL, Spike length; NSY, Number of Spikes/year.

harvest. Interestingly, the days to first harvest always had a negative correlation with all the traits observed during the present study. Plant height showed a significant and positive association with leaf length and width and number of pseudostems per plant. Such a correlation between the characters may be due to either pleiotrophy or genetic linkage as suggested earlier by Pridgeon *et al.* (1999). The positive correlation between number of spikes per year and plant height, number of pseudostems indicated that the plants with tall plants with more number of pseudostems produced more number of spikes per plant per year which may probably be due to genetic makeup and environmental influence. Similar observation was earlier made by Tanveer *et al*. (2015).

The path coefficient analysis provides an effective means of finding out the direct and indirect effect of association and permits a critical examination of specific forces acting to produce a given correlation and also to measure the relative importance of each factor. The direct and indirect effects of different characters on yield at the genotypic level are presented in Table 2. Lenka and Mishra (1973) have suggested scales for path coefficients with values 0.00 to 0.09 as negligible, 0.10 to 0.19 as low, 0.20 to 0.29 as moderate, 0.30 to 0.99 as high, and more than 1.00 as very high path coefficients.

During the present study, the spike length had a very high positive direct effect and the number of pseudostems per plant had a high positive direct effect on the number of spikes per plant per year. Days to first harvest and leaf width had a high negative direct effect on the number of spikes per plant per year, whereas plant height and leaf length had a low direct negative effect and the number of florets per spike had a moderate direct negative effect on number of spikes per plant per year. These findings indicated that selection of the cultivars should be made on the basis of spike length and number of pseudostems per plant which may have the highest positive direct effect taking other traits into consideration while making crop improvement in orchids for the number of spikes per plant per year.

Conclusion

It may be concluded that number of spikes per plant made significantly strong positive correlation with the number of pseudostems per plant, number of florets per spike, and spike length, signifying that direct selection of these traits may improve number of spikes per year. Path coefficient analysis revealed that spike length had the highest positive direct effect on number of spikes per year followed by number of pseudostems per plant, suggesting thereby that direct selection of orchids through number of spikes per year and number of pseudostems per plant may be used as best selection criteria.

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