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Genetic variability studies in *Phalaenopsis* orchids

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Abstract
Ten genotypes of *Phalaenopsis* having good market value and cut flower qualities were evaluated using completely randomized design. The analysis of variance revealed that significant difference exists among the parental genotypes with respect to the majority of biometric characters studied. Vegetative characters such as leaf area, plant height, number of leaves and leaf width exhibited the highest estimates of variance at both genotypic and phenotypic levels. Among the floral traits, length of inflorescence, number of flowers per inflorescence, vase life, internodal length of the peduncle and days to first flower opening from inflorescence emergence showed the highest genotypic and phenotypic variances. Floral characters like length of inflorescence, flower longevity on the plant, days to first flower opening from inflorescence emergence, length of flower, width of the flower and internodal length of peduncle as well as vegetative characters like plant height, leaf width and leaf area showed high heritability. High heritability (>70%) combined with high genetic advance (>20%) was exhibited by majority of the characters under study indicating additive gene action for these characters and it provides a scope for further improvement of these traits in advance generations.

Keywords: Orchids, *Phalaenopsis*, GCV, PCV, heritability, genetic advance

1. Introduction
Orchids are the most beautiful plants and are without doubt an elegant creation with their unpredictable blossoms and stunning magnificence. The family Orchidaceae, is the biggest in the plant realm with around 600-800 genera, more than 25,000 species and more than a lakh and half man-made cross breeds. Taxonomically they are the most highly evolved monocotyledons. There occurs large variability in the floral characters in orchids exhibiting a wide range of flower colours and patterns, size and shape of the flowers. Despite the great diversity in orchids, only a very few genera *viz*., *Dendrobium, Cattleya, Phalaenopsis, Cymbidium, Aranda, Vanda, Mokara, Aranthera, Oncidium* and a couple of others have commercial significance. *Phalaenopsis* orchids or commonly called moth orchids are an important cut flower and potted plant orchid. These plants are referred to as 'Phals' and have high value in floriculture because of their charming and long lasting flowers. The genus *Phalaenopsis* consists of about 60 species and contributes over 40,000 man-made hybrids, which is nearly 25 percent of the total orchid hybrids. The cultivation of *Phalaenopsis* is gaining popularity due to the ease in cultural practices, diverse flower colour, shape, size and delicacy [3]. Orchids are now dominating the cut flower and potted plant commerce due to its long lasting charm, high productivity, seasonal blooming, convenient packing and transportation [2]. When the genetic variability is high the chances for the selection of better genotypes are greater and the estimates of genetic parameters like genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) gives an account of the extent of variability present in the plant population. Also genetic parameters like heritability and genetic advance help the plant breeder in selecting elite genotypes from.
heterogeneous populations. There is a wide range of variation for most of the traits studied, these genotypes can be utilised further for the production of novel *Phalaenopsis* hybrids.

2. Materials and Methods
The research programme was undertaken in the Department of Plant Breeding and Genetics, College of Agriculture, Vellayani. The parent materials for the study were meristem cloned cultures maintained in the green house and observations on vegetative and floral characters were taken. The experiment was laid out in Completely Randomized Design (CRD) with ten genotypes of *Phalaenopsis* orchids namely King Car Purple Queen, Lianher Happy Song, Fullers Rabbit, Lianher Orange, Fullers, Taisuco Fire Bird x King Hisang Rose, Reyoung Gold, Jiuhbao Venus, Wang Lin Rose and Young Home Golden. Important cultural practices were carried out from time to time. The selected materials were evaluated by recording observations on their vegetative and floral characters. The co-efficient of variations were computed using standard measures. Estimates of heritability and genetic advance as percentage of mean were also calculated.

3. Results and Discussion

The analysis of variance revealed significant differences among the ten *Phalaenopsis* orchid genotypes. The coefficients of variation at genotypic and phenotypic levels were studied. The vegetative characters such as leaf area (GCV= 22.09%, PCV= 22.23%), plant height (GCV= 12.49%, PCV= 13.39%), number of leaves (GCV= 10.86, PCV= 29.37%), leaf width (GCV= 10.87%, PCV= 11.76%) and length of leaf (GCV= 2.12, PCV= 9.27) in the decreasing order exhibited the highest estimates of variance at both genotypic and phenotypic levels. Among the floral traits, length of inflorescence (GCV= 34.52%, PCV= 35.61%), number of flowers per inflorescence (GCV= 24.89%, PCV= 31.59%), vase life (GCV= 22.17%, PCV= 26.86%), internodal length of the peduncle (GCV= 20.15%, PCV= 23.28%) and days to first flower opening from inflorescence emergence (GCV= 20.35%, PCV= 22.79%) showed highest genotypic and phenotypic variances in the decreasing order. The phenotypic coefficient of variation was found to be higher than the genotypic coefficient of variation for all the characters studied indicating significant influence of environment in the expression of these characters.

Heritability per cent was categorized as suggested by Allard as low (<30), moderate (30-70) and high (>70) [1]. On that account floral characters like length of inflorescence, flower longevity on the plant, days to first flower opening from inflorescence emergence, length of flower, width of the flower and internodal length of peduncle and vegetative characters like plant height, leaf width and leaf area exhibited high heritability (>70%) indicating additive gene action for these characters. This suggests that improvement could be attained by practicing selection on the above traits. Moderate heritability was exhibited by the floral characters like vase life and number of flowers per inflorescence. A wide range of values were observed for the characters under study for genetic advance. According to Robinson *et al.*, characters with values >20% were considered to have high genetic advance [8]. Majority of the characters exhibited high genetic advance. The highest value was observed for days to first flower emergence from inflorescence opening (88.85%) followed by flower longevity on the plant (58.63%). High heritability (>70%) combined with high genetic advance (>20%) was exhibited by majority of the characters studied like days to first flower opening from inflorescence emergence, flower longevity on the plant and vase life . Moderate heritability with high genetic advance was observed for plant height, leaf area, length of flower and width of flower.

Table 1: Components of variance and genetic parameters for different vegetative and floral characters

S. No.	Characters	GCV	PCV	Heritability (%)	Genetic advance (%)
1	Plant height	12.49	13.39	86.90	30.87
2	Number of leaves per plant	10.86	29.37	13.67	18.20
3	Length of leaf	11.17	35.48	19.91	18.86
4	Width of leaf	10.87	11.76	85.41	26.49
5	Leaf area	20.15	23.28	74.93	45.63
6	Days to first flower opening from inflorescence emergence	34.52	35.61	93.94	88.85
7	Vase life	22.17	26.86	68.15	57.82
8	Number of inflorescence	10.07	10.39	93.93	25.93
9	Length of inflorescence	24.89	31.59	62.10	55.32
10	Number of flowers per inflorescence	2.12	9.27	52.20	12.92
11	Internodal length of peduncle	2.70	7.87	71.36	14.99
12	Diameter of peduncle	7.79	8.81	78.31	16.18
13	Length of flower	12.36	12.68	94.94	32.06
14	Width of flower	20.35	22.79	79.69	47.71
15	Flower longevity on the plant	22.09	22.23	98.82	58.63

A detailed study regarding the vegetative and floral characters is significant for understanding the diversity found in the genus *Phalaenopsis* and for selecting the parents for a successful hybridization programme. McDonald stated that vigorous hybrids result in bigger, better blooms and more floriferous nature with greater flower substance thus emphasizing the importance of vegetative vigour [5]. General health and superior vegetative characters are important while selecting parents for a hybridization programme. A wide range of variation for vegetative characters was observed among the genotypes. The results obtained in the present study were in conformity with the findings of Rahi [7]. The wide range of variations may be because of the fact that the genotypes employed in the study are higher order monogeneric, bigeneric or multigeneric hybrids [6]. Hurst had reported that in orchids higher order multigeneric hybrids showed a wider range of character variation as compared to lower order primary hybrids [4]. High phenotypic and genotypic coefficients of variation were observed for leaf area and indicating high variability for these characters which is similar in several monopodial orchid genera [10]. The important floral characters under study were length of inflorescence, number of flowers per inflorescence, length of flower, diameter of the peduncle and flower longevity in the plant. These characters exhibited a significant variation in quantitative floral characters which was in conformity with the reports of De *et al*. [3]. High genotypic and phenotypic coefficients of variation were observed among the genotypes studied for number of flowers per inflorescence and vase life which was found in conformity with the results of Thomas in monopodial orchids [9]. Most of the characters in the present study exhibited high heritability and genetic advance which was in conformity with the reports in several monopodial orchid genotypes [10].

4. Conclusion

From the preliminary analysis, it is evident that a wide range of variation exists among the ten genotypes of *Phalaenopsis* studied, for most of the vegetative and floral characters evaluated. Considering their heritability and genetic advance, the genotypes can be selected and utilized as parents in several breeding programmes for developing improved hybrids.

5. References

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