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GENETIC VARIABILITY AND CORRELATION STUDIES IN BIRD OF PARADISE GENOTYPES FOR FLOWER AND YIELD PARAMETERS DURING 2011

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ABSTRACT
Experiment was conducted to study the genetic variability and association among the yield component traits in Bird of paradise. All the genotypes showed considerable amount of variation in their mean performances with respect to the characters studied, indicates presence of sufficient variability and scope for further selection and breeding superior and desirable genotypes. Large differences between GCV and PCV were observed in flower stalk girth (19.73 and 23.15%), vase life (19.92 and 21.71%) and number of bracts (39.04 and 42.64%), indicating the role of environment in expression of these traits. The magnitude of variability parameters were all high for suckers/hill (2.80 and 3.44) compared to flowers/hill (0.57 and 1.07), indicating wide variability for suckers/hill. All flowering characters exhibited high heritability coupled with high genetic advance over per cent mean indicating the predominance of additive components. Thus direct selection helps in improving the characters. Number of flowers per hill showed positive and significant correlations with plant height (0.478 and 0.293), stem girth (0.283 and 0.172), leaf width (0.204 and 0.162), leaf length (0.568 and 0.291), number of leaves per plant (0.640 and 0.275) and number of suckers per hill (0.766 and 0.976) at genotypic and phenotypic levels. Among the genotypes studied, number of suckers exhibited significantly high positive association with number of flowers. Thus, suggesting the possibility of simultaneous selection for this character.

INTRODUCTION

Bird of paradise (*Strelitzia reginae*) is an evergreen perennial herbaceous plant, grown in the regions having moderate subtropical climate. It is highly prized as cut flower due to brilliant colour and unusual appearance of the spectacular flower. Therefore, the crop is cultivated in many parts of the world in order to produce cut flowers for both domestic and international market. They are gaining popularity among the flower growers of India owing to the fact that they can be successfully grown with little care and attention and they do fairly well under partial shade also. For any crop improvement programme, selection of superior parents is an essential prerequisite especially for the traits showing higher heritability and genetic advance for various traits. The adequate information on extent of variability parameters may be helpful to improve the yield by selecting the yield component traits because yield is a complex trait, whose manifestation depends on the component traits. Generally, the estimates of heritability (h^2) of traits are environment specific (Shimelis and Rhandzu, 2010). These estimates should be incorporated and specifically applied only to the population and environment sampled. Thus, selection of traits based on h^2 and genetic advance as percent of mean is of great importance to the breeder for making criteria for improvement in a complex character. A positive genetic correlation between two desirable traits makes the job of the plant breeder easy for improving both traits simultaneously. With these considerations in mind, the present study focuses on assessment of the genetic variability and correlation studies for yield and yield component traits in bird of paradise.

MATERIALS AND METHODS

The present investigation was carried out at the Horticulture Research Station, Kanabargi Farm (Belgaum), UHS, Bagalkot (Karnataka) during 2011, involving hundred genotypes of bird of paradise to find to the nature and extent of genetic variability and correlation studies for flowering and yield parameters. The seedling population of bird of paradise was planted during 2004 *Kharif*. The variability was observed between the clones of this population. Among the variable population of bird of paradise of seed origin hundred plants were selected. These were tagged and observations were recorded to study the genetic variability existing among these population. Here each clone was considered as one entry and seasons as replications for calculating genetic parameters. The data were collected on various parameters at flowering and yield phase during different seasons (2011-2012). Data were put to statistical analysis as per Panse and Sukhatma (1967). Genetic

parameters like genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) were estimated according to Burton (1952), heritability as suggested by Falconer (1981) and genetic advance as per cent over mean by Johnson *et al*. (1955). The correlations at genotypic and phenotypic levels between all the possible pairs of characters were calculated as proposed by Al Jibouri *et al*. (1958).

RESULTS AND DISCUSSION

The range of variation and the estimate of genetic parameters which include heritability in broad sense, coefficient of variation (GCV and PCV), h^2 and genetic advance are presented in Table 1. The range was highest for flower stalk length (33.50-83.00 cm) followed by spathe length (15.50-23.75 cm), vase life (7.50-13.50 days), number of suckers per hill (6.03-20.93), number of bracts (2.00-7.50), Flower stalk girth (2.30-6.45 cm) and number of flowers per hill (1.65-5.25).

The PCV was higher than GCV for all the characters studied showing that all the traits were highly influenced by environment. Similar results were obtained by ArunKumar (2013) in sorghum, Suhel *et al*. (2013) in mung bean and Ravishanker *et al*. (2013) in ginger. The difference among the phenotypic variance (PV) and genotypic variance (GV) were very low for flower stalk girth, spathe length, vase life and number of bracts indicating the low effects of environment on the expression of these characters or less genotype x environment interactions. Whereas, flower stalk length showed large differences between phenotypic variance and genotypic variance (238.82 and 286.57, respectively), indicating the role of environment in expression of these traits. So, careful selection may be practiced for improvement of characters. The phenotypic coefficient of variability (PCV) was higher than the genotypic coefficients of variability (GCV) for the flowering characters studied (Table 1). It is obvious because PCV embodies variability due to genotypes, environment and genotype and environment interaction. The differences among the phenotypic coefficients of variations and genotypic coefficients of variations was very less for spathe length (14.18 and 13.01%) which indicates less role of environment or contribution of genetic variability towards total variance. Whereas, large differences between GCV and PCV were observed in flower stalk girth (19.73 and 23.15%), vase life (19.92 and 21.71%) and number of bracts (39.04 and 42.64%), indicating the role of environment in expression of these traits. Hence, careful selection may be practiced for improvement of characters. The effectiveness of selection for any character depends, not only on the extent of genetic variability but also in the extent to which it will be transferred from one generation to the other generation. In the present study, all flowering characters *i.e.,* flower stalk length, flower stalk girth, spathe length, vase life, number of bracts exhibited high heritability coupled with high genetic advance over per cent mean indicating the predominance of additive components. Thus direct selection helps in improving the characters.

Table 1: Estimates of mean, range, components of variance, heritability and genetic advance for flowering and yield parameters in bird of paradise population during 2011

Sl. no	Character	Mean ± S.Em	Range	GV	PV	GCV	PCV	h^2 (%)	GA	GAM (%)
	Flowering parameters									
1	Flower stalk length (cm)	54.85 ± 4.89	33.50-83.00	238.82	286.57	28.18	30.86	83.34	29.06	52.99
2	Flower stalk girth (cm)	4.96 ± 0.42	2.30-6.45	0.96	1.32	19.73	23.15	72.65	1.72	34.65
3	Spathe length (cm)	19.60 ± 0.78	15.50-23.75	6.51	7.73	13.01	14.18	84.21	4.82	24.60
4	Vase life (days)	10.08 ± 0.61	7.50-13.50	4.03	4.78	19.92	21.71	84.20	3.79	37.65
5	Number of bracts	4.43 ± 0.54	2.00-7.50	2.99	3.57	39.04	42.64	83.82	3.26	73.63
	Yield parameters									
6	Number of flowers per hill	3.19 ± 0.50	1.65-5.25	0.57	1.07	23.66	32.40	53.32	1.14	35.59
7	Number of suckers per hill	12.74 ± 0.73	6.03-20.93	19.80	21.39	34.93	36.31	92.55	8.82	69.21

GV- Genotypic variance; PV- Phenotypic variance; GCV- Genotypic co-efficient of variation; PCV- Phenotypic co-efficient of variation; h^2- Broad sense heritability; GA- Genetic advance; GAM- Genetic advance as per cent over mean

Table 2: Genotypic correlations among number of flowers per hill and component characters in bird of paradise genotypes during 2011

@	1	2	3	4	5	6	7	8	9	10	11	12
1	1.000	0.082	0.683**	0.358**	0.353**	0.289**	0.023	0.224**	0.049	0.039	0.188*	0.478**
2		1.000	0.239**	0.065	-0.036	0.146*	0.297**	0.040	0.038	-0.024	0.044	0.283**
3			1.000	0.480**	0.275**	0.303**	0.007	0.070	-0.025	0.018	0.197*	0.568**
4				1.000	0.250**	0.149*	-0.013	0.138	0.246**	0.092	0.225**	0.204**
5					1.000	0.320**	-0.028	0.065	0.129	-0.197*	-0.085	0.640**
6						1.000	0.104	0.234**	-0.003	0.006	0.067	0.766**
7							1.000	0.099	0.027	-0.087	-0.116	0.165*
8								1.000	-0.104	0.057	0.027	0.364**
9									1.000	-0.288**	0.169*	-0.050
10										1.000	0.011	0.045
11											1.000	-0.175*
12												1.000

Critical r at 1% = 0.1835, 5% = 0.1396 * Significant at p = 0.05 probability ** Significant at p = 0.01 probability ; @ Characters ; 1. Plant height (cm); 2.Stem girth (cm); 3.Leaf length (cm); 4.Leaf width (cm); 5.Number of leaves per plant; 6.Number of suckers per hill; 7. Flower stalk length (cm); 8.Flower stalk girth (cm);9.Spathe length (cm); 10.Vase life (days);11.Number of bracts;12.Number of flowers per hill

Table 3: Phenotypic correlations among number of flowers per hill and component characters in bird of paradise genotypes during 2011

@	1	2	3	4	5	6	7	8	9	10	11	12
1	1.000	0.082	0.646**	0.340**	0.285**	0.265**	0.021	0.182*	0.039	0.041	0.166	0.293**
2		1.000	0.223**	0.063	-0.032	0.137	0.261**	0.024	0.029	-0.024	0.034	0.172*
3			1.000	0.434**	0.188*	0.278**	-0.011	0.072	-0.040	0.010	0.162*	0.291**
4				1.000	0.209**	0.142*	-0.015	0.098	0.216**	0.082	0.204**	0.162*
5					1.000	0.272**	-0.048	0.035	0.088	-0.157*	-0.052	0.275**
6						1.000	0.083	0.158*	-0.012	0.028	0.078	0.976**
7							1.000	0.060	0.021	-0.071	-0.086	0.053
8								1.000	-0.039	0.059	0.044	0.133
9									1.000	-0.208**	0.170*	0.004
10										1.000	0.015	0.039
11											1.000	0.097
12												1.000

Critical r at 1% = 0.1835, 5% = 0.1396 * Significant at p = 0.05 probability ** Significant at p = 0.01 probability; @ Characters; 1.Plant height (cm); 2.Stem girth (cm); 3.Leaf length (cm); 4.Leaf width (cm); 5.Number of leaves per plant; 6.Number of suckers per hill;7.Flower stalk length (cm); 8.Flower stalk girth (cm); 9.Spathe length (cm);10.Vase life (days); 11.Number of bracts; 12.Number of flowers per hill

Similar results were obtained by Soorianthasundaram and Nambisan (1991) and Bichoo *et al*. (2002) and Bhujabal *et al*. (2013) in gladiolus.

Yield parameters also exhibited high genetic variability for most of the characters (Table 1), indicating the adequate amount of genetic variability existed in the material. Estimates of PV were higher compared to GV indicating the role of environment in the expression of character. The magnitude of variability parameters were all high for suckers/hill (2.80 and 3.44) compared to flowers/hill (0.57 and 1.07), indicating wide variability for suckers/hill. There is an ample scope for selection in the variable population. However, the difference among PCV and GCV was very less for number of suckers per hill (34.93 and 36.31%), indicating the contribution of genetic variability to the total variability. Similar results were found by Janakiram and Rao (1991) in African marigold for total flower yield per plant, Misra and Saini (1997) in dahlia and Katwate *et al*. (1990) in gladiolus. High heritability along with high genetic advance as percent over mean (GAM) was estimated for number suckers per hill (92.55% and 69.21%, respectively), predicts that there is role of additive gene action. This will help for improving the characters based on direct selection. Similar results were reported by Singh and Sen (2000) and Mathad *et al*. (2003) and Misra and Saini (1997) in dahlia, Sheikh *et al*. (1995) and Katwate *et al*. (1990) in gladiolus. Whereas, number of flowers per hill showed moderate h^2 (53.32%) and high GAM (35.59%).

Yield is a complex character determined by several other characters. Hence, the association of these characters with yield and among themselves is of paramount importance in framing effective selection. Knowledge regarding the association of various characters among themselves and with yield is necessary for making indirect selection for improvement of yield characters. The expression of a character in a plant is the consequence of a chain of interrelationship between characters either directly or through other events. Character association on correlation is a measure of the degree of association between two characters.

Plant height had positive correlation at both genotypic and phenotypic levels with leaf length (0.683 and 0.646), leaf width (0.358 and 0.340), number of leaves per plant (0.353 and 0.285), number of suckers per hill (0.289 and 0.265), flower stalk girth (0.224 and 0.182) and number of flowers per hill (0.478 and 0.293). Number of bracts (0.188) was positively correlated with plant height at genotypic level only. Similar result were obtained by Raghava *et al*. (1992), Mathad *et al*. (2003) in marigold, Misra and Saini (1997), Anuradha (1990) in gladiolus and Radhakrishna *et al*. (2004) in tuberose. This suggests that selection of these characters would be effective in improving total yield per plant (Table 2 and 3).

Significant and positive correlations of stem girth among genotypes were seen with leaf length (0.239 and 0.223), flower stalk length (0.297 and 0.261) and number of flowers per hill (0.283) both at genotypic and phenotypic levels. Number of suckers per hill (0.146) was positively correlated at genotypic level only. Leaf length had positive correlation with plant height (0.683 and 0.340), stem girth (0.239 and 0.223), leaf width (0.480 and 0.434), number of leaves per plant (0.275 and 0.188), number of suckers per hill (0.303 and 0.278), number of bracts (0.197 and 0.162) and number of flowers per hill (0.568 and 0.291) at both genotypic and phenotypic levels. During 2011, leaf width was positively correlated with plant height (0.358 and 0.340), leaf length (0.480 and 0.434), number of leaves per plant (0.250 and 0.209), number of suckers per hill (0.149 and 0.142), spathe length (0.246 and 0.216), number of bracts (0.225 and 0.415) and number of flowers per hill (0.204 and 0.162) at both the levels. Similar trend was reported by Nazia (2007) in heliconia.

Positive correlations were observed for number of leaves per plant with plant height (0.353 and 0.250), leaf length (0.275 and 0.275), leaf width (0.250 and 0.209), number of suckers per hill (0.320 and 0.272) and number of flowers per hill (0.861 and 0.822) at both genotypic and phenotypic levels. The results are in accordance with Sahana (2010) in gladiolus and Raghava *et al*. (1992), Mathad *et al*. (2003) in marigold. Number of suckers per hill was related positively with plant height (0.289 and 0.265), leaf length (0.303 and 0.278), number of leaves per plant (0.320 and 0.224) and number of flowers per hill (0.766 and 0.976) at both levels. Whereas, flower stalk girth (0.234) was significant and positively correlated with number of suckers per hill at genotypic level only. As bird of paradise is a popular cut flower, flower stalk length has an important role to play. At genotypic and phenotypic levels, positive correlation was found with stem

girth (0.297 and 0.261). Positive and significant correlation was found with number of flowers per hill (0.165) at genotypic level. Similar trend was observed by Nazia (2007) in heliconia, Patil *et al*., (2004) in carnation Flower stalk girth during 2011, had positive correlation with plant height (0.224 and 0.182), number of suckers per hill (0.234 and 0.158) at both the levels and number of flowers per hill (0.364) at only genotypic level. This is in accordance with findings of Nazia (2007) in heliconia. Among genotypes, spathe length during 2011, showed positive correlation with leaf width (0.246 and 0.216, respectively) and number of bracts (0.169 and 0.170). Positive correlations of number of bracts were observed with leaf length (0.197 and 0.162), leaf width (0.225 and 0.204) and spathe length (0.169 and 0.170) at both the levels. The results are in confirmatory with Sheela *et al*. (2006) and Nazia (2007) in heliconia and Radhakrishna *et al*. (2004) in tuberose.

Yield is the ultimate parameter for which the investigation is aimed at. Number of flowers per hill during 2011 showed positive correlations with plant height (0.478 and 0.293), stem girth (0.283 and 0.172), leaf width (0.204 and 0.162), leaf length (0.568 and 0.291), number of leaves per plant (0.640 and 0.275) and number of suckers per hill (0.766 and 0.976) at genotypic and phenotypic levels. Whereas characters like flower stalk length (0.165) and flower stalk girth (0.364) showed positive and significant correlation at genotypic level only. Similar observations were made by Radhakrishna *et al*. (2004) in tuberose, Rakeshkumar and Santoshkumar (2010) in snapdragon, Nazia (2007) and Sheela *et al*. (2006) in heliconia and Bhanupratap (1999) in marigold. Among the genotypes studied, number of suckers exhibited significantly high positive association with number of flowers. Thus, suggesting the possibility of simultaneous selection for this character.

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