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GENETIC CORRELATION AND PATH COEFFICIENT ANALYSIS IN DAHLIA (*DAHLIA VARIABILIS* L.) GENOTYPES UNDER HILL ZONE OF KARNATAKA

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ABSTRACT
The correlation and path coefficient analysis were studied in twenty five genotypes of dahlia for thirteen different quantitative and qualitative characters. The results indicated a significant and desirable correlation between flower yield per hectare with the characters like plant height at 120 DAT (0.614), number of branches per plant at 120 DAT (0.806), internodal length at 120 DAT (0.239), duration of the crop (0.195), flower weight (0.206), flower diameter (0.224), stalk length (0.549), number of tubers per plant (0.537), tuber weight (0.453) and vase life (0.234). This provides a knowledge regarding association of various characters among themselves and to estimate the inherent association between genes. Path analysis has shown that number of flowers per hectare had high positive direct effect with plant height at 120 DAT (0.962), number of days taken to first flowering (0.646), flower weight (1.034), stalk length (0.253), number of tubers per plant (0.353), tuber weight (0.194) and vase life (0.285) at genotypic level. Thus, these characters have maximum contribution towards the number of flowers per hectare.

INTRODUCTION

Dahlia (*Dahlia variabilis* L.) belongs to the family Asteraceae, occupies a place of pride in any garden at any place. Dahlia originated in Mexico, which received its name by Cavanilles in the year 1791, to commemorate the work of a Swedish Botanist Dr. Andreas Dahl, a pupil of Linneaus (Smith, 1971). It is easy to grow both in field and pots. It is extensively used for exhibition, garden display and home decoration. Tubers of this plant contain significant amount of insulin and fructose and small quantities of medicinally active compounds such as phytin and benzoic acid. The root exudate is nematotoxic and the mortality of the nematode increases with increase in the concentration of root exudates (Bailey and Bailey, 1977). It is highly cross pollinated crop with high natural cross pollination contributing to its variability.

Before taking up the different breeding programmes like selection, hybridization and mutation in dahlia crop improvement, it is essential to know the importance and inter association of various components and their association with the yield, so it will help in simultaneous selection for more than one character (Mahajan *et al*., 2011). Thus, knowledge of correlation coefficient on various plant characters becoming an important factor for selection of desirable characters under a breeding programme. A study on correlation alone is not enough to give an exact figure of relative importance of direct and indirect influence of each of the component traits on flower yield. In such case, path coefficient analysis is an important technique for partitioning the correlation coefficient into direct and indirect effect of independent variables on dependent variable.

Genetic variation and genetic relationship among genotypes is an important consideration for classification, utilization of germplasm resources and breeding (Kumar *et al*., 2013). The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme (Bhujbal *et al*., 2013). Apart from this, correlation as well as path coefficient are important tools for the selection of desirable traits and to enhance the productivity of dahlia. The main objective of plant breeder is to evolve high yielding varieties of dahlia suitable for cut flower purpose. It is therefore, desirable for plant breeder to know the extent of relationship between yield and its various components, which will facilitate selection based on component traits (Prasad *et al*., 2011). Keeping in view the above facts, the present investigation was undertaken with an objective to analyze and determine the traits having greater inter-relationship with flower yield utilizing the correlation and path analysis and to help breeders in improvement of dahlia.

MATERIALS AND METHODS

The experimental material comprised of twenty five genotypes of dahlia (*Dahlia variabilis* L.) procured from Indian nursery, Kolkatta, West Bengal. Genotypes were grown in randomized complete block design during December 2014 - April 2015. Thirty days old rooted cuttings were transplanted on the main field with a spacing of 60 cm between the rows and 40 cm

between the plants at the department of Floriculture and Landscape Architecture, College of Horticulture - Mudigere. Observations were recorded on five randomly selected plants in each replication for thirteen traits such as plant height at 120 DAT, number of branches at 120 DAT, internodal length at 120 DAT, crop duration (days), number of days taken to first flowering, number of days taken for complete flowering, duration of flowering (days), flower weight (g), flower diameter (cm), stalk length (cm), tuber number, tuber weight (g) and vase life (days). Correlation coefficients were computed using the method elucidated by Al-Jibouri *et al*. (1958). The direct and indirect effects of component characters on yield were estimated through path analysis technique (Wright, 1921) further it was illustrated by Dewey and Lu in crested wheat grass seed production (1959).

* DAT : Days After Transplant

* g : gram

* cm : centimeter

*ha : hectare

RESULTS AND DISCUSSION

A complex association exists among different plant characters and character themselves do not exist in isolation. These characters are often correlated with each other, either due to pleiotropy or due to genetic linkage (Harland, 1939). For rational approach towards the improvement of yield, selection will be more rewarding when it is based on the components of the yield. In the present study twenty five genotypes were evaluated to know the genotypic and phenotypic correlation coefficient for growth and yield parameters (Table 1 and 2). Thirteen characters (enlisted in material and methods) were recorded and the relation among the characters with yield was examined using genotypic and phenotypic correlation analysis. The results revealed that the genotypic correlations were higher than the phenotypic correlations for the characters studied, indicating the high heritable nature of the characters. The genotypic correlation of flower yield per hectare was significant and had a desirable correlation with the plant height at 120 DAT (0.614), number of branches at 120 DAT (0.806), internodal length at 120 DAT (0.239), duration of the crop (0.195), flower weight (0.206), flower diameter (0.224), stalk length (0.549), number of tubers per plant (0.537), tuber weight (0.453) and vase life (0.234). The association of these characters with flower yield per hectare are in desirable direction and selection of these may ultimately improve the yield. Therefore, it is suggested to select genotypes performing well for yield attributing characters. These results are in agreement with the earlier reports of Suman *et al*. (1991) and Beura *et al*. (1995) in dahlia, Mathad *et al*. (2005), Kavitha and Anburani (2010) in African marigold.

Duration of flowering showed negative and significant association (-0.358) with the flower diameter, and this result is in line with the findings of Vikas *et al*. (2011). This is because, correlation between two characters is not a simple relationship but is rather the product of interaction of the direct and indirect cause.

The correlation value decides the nature and degree of association between pair of characters. Hence, it is necessary to partition the correlation of component characters. In the present investigation, the estimation on path analysis was worked to find out the direct and indirect effects of growth and yield related trait on flower yield per hectare (Table 3 and 4).

Results of genotypic path analysis revealed that the number of flowers per hectare had a positive direct effect with the plant height at 120 DAT (0.962), number of days taken to first flowering (0.646), flower weight (1.034), stalk length (0.253), number of tubers per plant (0.353), tuber weight (0.194) and vase life (0.285). This might be due to the more regional adaptability and growth habit of some of the genotypes resulting in higher proportion of morphological growth as well as reproductive growth leading to increased flower yield. These results are in conformity with the findings of Patil and Rane (1995), Mathew *et al*. (2005), Singh and Singh (2005), Bharati *et al*. (2014) in marigold.

Number of branches showed high negative direct effect (-0.3856) on number of flowers per hectare. This could be also due to the nature of certain genotypes in showing lesser regional adaptability and growth habit, resulting in a higher proportion of morphological growth than the reproductive

Table 1: Genotypic correlation among different characters on number of flowers per hectare in dahlia genotypes

Character	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	0.779**	0.549**	-0.081	-0.014	0.016	-0.187	0.364**	0.511**	0.355**	0.620**	0.527**	0.045
2		1	0.530**	-0.051	0.095	0.111	-0.362**	0.352**	0.385*	0.528**	0.607**	0.519**	0.116
3			1	0.201	0.227	0.21	-0.354**	0.29	0.231	-0.082	0.574**	0.136	-0.352**
4				1	0.21	0.243	-0.305*	0.334**	0.019	0.022	0.406**	-0.013	-0.339**
5					1	0.986**	-0.825**	-0.121	-0.016	-0.065	0.416**	-0.115	0.204
6						1	-0.835**	-0.106	0.012	-0.063	0.418**	-0.115	0.207
7							1	-0.143	-0.313*	-0.102	-0.48	-0.031	-0.179
8								1	0.853**	0.484*	0.387*	0.673**	-0.124
9									1	0.495*	0.377*	0.643**	0.145
10										1	0.300*	0.501**	0.285
11											1	0.369*	-0.054
12												1	0.146
13													1
Flower yield /ha	0.614	0.806	0.239	0.195	0.052	0.060	-0.358	0.206	0.224	0.549	0.537	0.453	0.234

; * & ** indicates significant @ 5 % and 1 % level respectively. 1. Plant height at 120 DAT; 2.Number of branches at 120 DAT; 3.Internodal length at 120 DAT; 4.Crop duration (days); 5.Number of days taken to first flowering; 6. Number of days taken for complete flowering; 7. Duration of flowering (days); 8. Flower weight (g); 9. Flower diameter (cm); 10. Stalk length (cm);11. Tuber number; 12. Tuber weight (g); 13. Vase life (days)

Table 2: Phenotypic correlation among different characters on number of flowers per hectare in dahlia genotypes

Character	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	0.685 **	0.408*	-0.084	-0.008	0.004	-0.181	0.317*	0.457**	0.321*	0.548**	0.425*	0.053
2		1	0.461**	-0.033	0.087	0.098	-0.325*	0.295*	0.328*	0.459**	0.536**	0.380*	0.11
3			1	0.191	0.174	0.183	-0.263	0.228	0.141	-0.091	0.499**	0.166	-0.261
4				1	0.206	0.223	-0.284*	0.290*	0.039	0.016	0.391*	-0.008	-0.309
5					1	0.984**	-0.813**	-0.067	-0.027	-0.055	0.364*	-0.1	0.19
6						1	-0.806**	-0.064	-0.003	-0.064	0.353*	-0.084	0.178
7							1	-0.196	-0.25	-0.087	-0.404*	-0.031	-0.149
8								1	0.715**	0.412*	0.293*	0.515**	-0.1
9									1	0.407*	0.327*	0.469**	0.15
10										1	0.304*	0.417*	0.253
11											1	0.389*	-0.033
12												1	0.121
13													1
Flower yield /ha	0.582	0.721	0.145	0.176	0.045	0.060	-0.335	0.159	0.195	0.510	0.516	0.429	0.214

Critical r value 1% = 0.361, 5% = 0.278; * & ** indicates significant @ 5 % and 1 % level respectively; 1.Plant height at 120 DAT ; 2.Number of branches at 120 DAT ; 3.Internodal length at 120 DAT; 4.Crop duration (days) ; 5.Number of days taken to first flowering; 6. Number of days taken for complete flowering ; 7. Duration of flowering (days); 8. Flower weight (g); 9. Flower diameter (cm); 10. Stalk length (cm); 11. Tuber number; 12. Tuber weight (g); 13. Vase life (days)

Table 3: Genotypic path coefficient analysis among different characters for number of flowers per hectare in dahlia genotypes

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	rG
1	0.962	0.75	0.528	-0.078	-0.013	0.015	-0.18	0.35	0.492	0.341	0.597	0.508	0.043	0.614
2	-0.3	-0.385	-0.204	0.019	-0.036	-0.042	0.139	-0.135	-0.148	-0.204	-0.234	-0.2	-0.045	0.806
3	-0.216	-0.208	-0.393	-0.079	-0.089	-0.082	0.139	-0.114	-0.091	0.032	-0.225	-0.053	0.138	0.239
4	0.019	0.012	-0.048	-0.242	-0.051	-0.059	0.074	-0.081	-0.004	-0.005	-0.098	0.003	0.082	0.195
5	-0.009	0.061	0.147	0.136	0.646	0.647	-0.533	-0.078	-0.01	-0.042	0.268	-0.074	0.132	0.052
6	-0.032	-0.223	-0.424	-0.49	-2.014	-2.011	1.679	0.213	-0.024	0.127	-0.842	0.233	-0.416	0.06
7	0.349	0.677	0.661	0.57	1.54	1.559	-1.867	0.267	0.587	0.191	0.897	0.059	0.334	-0.358
8	0.376	0.364	0.299	0.345	-0.125	-0.109	-0.148	1.034	0.882	0.501	0.4	0.695	-0.129	0.206
9	-0.961	-0.724	-0.435	-0.035	0.03	-0.023	0.59	-1.604	-1.881	-0.931	-0.71	-1.211	-0.272	0.224
10	0.089	0.134	-0.02	0.005	-0.016	-0.016	-0.026	0.122	0.125	0.253	0.076	0.126	0.072	0.549
11	0.219	0.214	0.203	0.143	0.147	0.148	-0.169	0.136	0.133	0.106	0.353	0.13	-0.019	0.537
12	0.102	0.1	0.026	-0.002	-0.022	-0.022	-0.006	0.13	0.125	0.097	0.071	0.194	0.028	0.453
13	0.012	0.033	-0.1	-0.096	-0.058	0.059	-0.051	-0.035	0.041	0.081	-0.015	0.041	0.285	0.234

Diagonal values indicates direct effect; Residual = 0.066 rG Genotypic correlation with flowers per hectare ; 1.Plant height at 120 DAT; 2.Number of branches at 120 DAT; 3.Internodal length at 120 DAT; 4.Crop duration (days) ; 5.Number of days taken to first flowering ; 6. Number of days taken for complete flowering; 7. Duration of flowering (days); 8. Flower weight (g) ;9. Flower diameter (cm);10. Stalk length (cm)11. Tuber number;12. Tuber weight (g);13. Vase life (days)

Table 4: Phenotypic path coefficient analysis among different characters for number of flowers per hectare in dahlia genotypes

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	rP
1	0.26	0.178	0.106	-0.022	-0.002	0.011	-0.047	0.082	0.119	0.083	0.142	0.118	0.013	0.582**
2	0.26	0.38	0.175	-0.012	0.033	0.037	-0.124	0.112	0.125	0.174	0.204	0.144	0.042	0.721 **
3	-0.094	-0.106	-0.231	-0.044	-0.04	-0.042	0.06	-0.052	-0.032	0.021	-0.115	-0.385	0.06	0.145
4	-0.02	-0.008	0.046	0.243	0.05	0.054	-0.069	0.07	0.009	0.003	0.095	-0.002	-0.075	0.178
5	0.008	-0.085	-0.17	-0.201	-0.975	-0.959	0.793	0.066	0.026	0.053	-0.355	0.097	-0.185	0.045
6	0.001	0.034	0.064	0.078	0.347	0.353	-0.284	-0.022	-0.001	-0.022	0.124	-0.03	0.062	0.06
7	0.121	0.217	0.175	0.189	0.543	0.538	-0.667	0.13	0.167	0.058	0.27	0.021	0.099	-0.335
8	-0.072	-0.067	-0.052	-0.066	0.015	0.014	0.045	-0.229	-0.164	-0.094	-0.067	-0.118	0.023	0.159
9	-0.143	-0.103	-0.044	-0.012	0.008	0.001	0.078	-0.224	-0.313	-0.127	-0.102	-0.147	-0.047	0.195
10	0.053	0.077	-0.015	0.002	-0.009	-0.01	-0.014	0.069	0.068	0.169	0.051	0.07	0.042	0.510**
11	0.101	0.099	0.092	0.072	0.067	0.065	-0.074	0.054	0.06	0.056	0.189	0.072	-0.006	0.516**
12	0.097	0.087	0.038	-0.001	-0.023	-0.019	-0.007	0.118	0.108	0.096	0.089	0.23	0.027	0.429**
13	0.008	0.017	-0.04	-0.048	0.029	0.027	-0.023	-0.015	0.023	0.039	-0.005	0.018	0.155	0.214

Diagonal values indicates direct effect Residual = 0.384 rP Phenotypic correlation with flowers per hectare; ** indicates Significant @ 1 % level.1.Plant height at 120 DAT; 2.Number of branches at 120 DAT; 3.Internodal length at 120 DAT; 4.Crop duration (days) ; 5.Number of days taken to first flowering ; 6. Number of days taken for complete flowering; 7. Duration of flowering (days);8. Flower weight (g);9. Flower diameter (cm) ;10. Stalk length (cm);11. Tuber number; 12. Tuber weight (g);13. Vase life (days)

growth leading to reduced flower yield. However, the increased number of branches per plant after a certain limit produces more number of flowers with reduced flower size, but it limits the overall marketable flower yield. In marigold, Mathad *et al*. (2005), Bharati *et al*. (2014) observed high negative direct effect of branches per plant and internodal length on number of flowers per hectare. This negative effect was nullified by high positive effects of days taken to first flowering.

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