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Correlation studies in carnation (*Dianthus caryophyllus* L.)

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ABSTRACT

Eight genotypes of carnation were evaluated for phenotypic and genotypic correlation coefficient between flower yield and 23 quantitative traits, to understand the association between these characters and their relative contribution to flower yield. The aim was to bring about rational improvement in carnation. Genotypic correlation coefficients were higher than phenotypic correlation coefficients for most of the characters studied. Flower yield per square meter showed highly significant association with number of branches, nodes per stalk and nodes per plant; stem girth, number of leaves, leaf area, total dry matter and duration of flowering. Significant association was found with plant spread, girth of flower and flower length, and, negative correlation was seen with days taken to flower bud initiation, first harvest and peak flowering, at the genotypic level. Whereas the number of nodes per plant and duration of flowering exhibited positive and highly significant correlation with yield, only significant correlation was found with plant spread, number of branches, nodes per stalk; stem girth, number of leaves and vase life, at the phenotypic level. These traits may serve as effective selection parameters for carnation improvement.

Key words: Carnation, crop improvement, genotypic correlation, phenotypic, Correlation

INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) is a popular cut-flower, holding an important position among the top ten cut-flowers in the International cut-flower trade. Carnations are preferred to roses and chrysanthemums in several exporting countries on account of their excellent keeping quality, wide array of colour and forms, ability to withstand long distance transportation, and remarkable ability to rehydrate after continuous shipping. From the medicinal point of view, carnation flowers are considered to be cardio-tonic, diaphoretic and alexiteric (Shiragur *et al*, 2004).

In India, carnation cultivation covers over 600 ha while, in Karnataka, it is grown in an area of 40 ha, with production of 51 lakh cut flowers accounting for revenue Rs. 85 lakh per annum during 2008-09 (Anon., 2009).

A clear assessment of association and relative contribution of yield components is of utmost importance in optimizing yield for any crop. It is essential for plant breeders to estimate the type of variation available in a collection of germplasm. Also, available information on variability and correlation among traits in carnation is very scanty. Hence, the aim of the present investigation was to ascertain the nature and extent of correlation present in vegetative and flowering character in eight genotypes of carnation, and, to identify elite genotype to be used in hybridization programmes to bring about desired improvement in cut-flower yield in this crop.

MATERIAL AND METHODS

An experiment was carried out at Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere, Karnataka, from July 2011 to June 2012. The experimental material comprised of eight genotypes of standard carnation, viz., Dona, White Dona, Harish, Big Mama, Soto, Liber, Golem and Big Net, procured in pro-trays with coco peat media from M/S Florence Flora Ltd., Bengaluru, grown under naturally-ventilated polyhouse. The experiment was laid out in Randomized Complete Block Design (RCBD), with three replications. Carnation plants were grown on raised beds of 30cm height, one meter width and a distance of 20cm between rows and 15cm between plants, following standard cultivation practices. Data was collected from five randomly selected plants, after 30 days of pinching, from each genotype in each replication on various biometrical parameters and analyzed as per Panse and Sukhatme (1967). Simple correlation coefficients pertaining to phenotypic and genotypic variation for various characters in carnation genotypes were computed as per Singh and Choudhary (1979). Values for correlation coefficient (r) were calculated and the test of significance was applied as per Fisher and Yates (1963). Observations were made on genotypic and phenotypic correlation between qualitative and quantitative traits in different genotypes of carnation.

RESULTS AND DISCUSSION

Phenotypic and genotypic correlation coefficients were computed between character pairs for all the twenty three parameters studied, i.e., flower yield v/s ten vegetative, eight qualitative and four flowering traits in eight carnation genotypes, and results are presented in Tables 1, 2 and 3, respectively. Correlation coefficient analysis measures mutual relationship between various plant characters, and, determines the component characters on which selection can be based for genetic improvement with reference to a particular character (Robinson *et al*, 1949). Positive correlation between desirable characters is favourable to a plant breeder, as, it helps simultaneous improvement in both the characters.

In the present study, genotypic correlation coefficient was higher in magnitude than the corresponding phenotypic correlation coefficient for most of the characters studied, indicating a strong, inherent association between various characters, and was masked by the environmental component with regard to phenotypic expression, as reported by Johnson *et al* (1955). In several cases, genotypic and phenotypic correlations were very close, indicating a lesser degree of environmental influence.

Genotypic correlation for flower yield per square meter exhibited positive and highly significant correlation with number of branches, nodes per stalk and nodes per plant; stem girth, number of leaves, leaf area, total dry matter and duration of flowering, and, significant association with plant spread, girth of flower and flower length, at the genotypic level; whereas, at the phenotypic level, number of nodes per plant and duration of flowering exhibited positive and highly significant association with yield, and, significant association with plant spread, number of branches, number of nodes per stalk, stem girth, number of leaves and vase life, at the phenotypic level. Similar results were also obtained by Lal *et al* (1982) in rose for flower diameter, and by Sirohi and Behera (2000) for vase life in chrysanthemum. Hence, selection on the basis of these characters may not be effective, as, these are controlled by non-additive gene action.

With respect to qualitative parameters, length of flower stalk exhibited positive and highly significant

Table 1. Genotypic and phenotypic correlation between vegetative and flower yield parameters in different genotypes of carnation

Trait		1	2	3	4	5	6	7	8	9	10	11
Plant height (cm)	G	1	0.84**	0.67*	0.83**	0.83**	0.41	0.67*	0.88**	0.94**	0.87**	0.58
	P	1	0.70*	0.59	0.69*	0.76*	0.36	0.63*	0.73*	0.71*	0.85**	0.56
Plant spread (cm)	G		1	0.94**	0.61	0.81**	0.66*	0.75*	0.98**	1.06**	0.90**	0.75*
	P		1	0.79*	0.52	0.67*	0.55	0.64*	0.65*	0.67*	0.79*	0.65*
Number of branches	G			1	0.58	0.85**	0.64*	0.80**	0.90**	0.95**	0.89**	0.87**
	P			1	0.44	0.74*	0.56	0.73*	0.78**	0.76*	0.82**	0.77*
Number of nodes/stalk	G				1	0.91**	0.66*	0.24	0.84**	0.94**	0.79**	0.80**
	P				1	0.74*	0.59	0.24	0.54	0.55	0.70*	0.72*
Number of nodes/plant	G					1	0.64*	0.56	1.02**	1.10**	0.91**	0.90**
	P					1	0.59	0.45	0.85**	0.79**	0.85**	0.84**
Stem girth (mm)	G						1	0.09	0.61	0.64*	0.72*	0.82**
	P						1	0.12	0.55	0.56	0.66*	0.72*
Internode length (cm)	G							1	0.71*	0.66*	0.66*	0.48
	P							1	0.59	0.54	0.64*	0.42
Number of leaves	G								1	0.99**	0.94**	0.94**
	P								1	0.96**	0.80**	0.72*
Leaf area (cm^2)	G									1	1.00	0.97**
	P									1	0.78*	0.65
Total dry matter (g/plant)	G										1.00	0.79**
	P										1.00	0.77
Flower yield/m^2	G											1.00
	P											1.00

***Significant @ 5%, ****Significant @1 % G = Genotypic, P = phenotypic

Table 2. Genotypic and phenotypic correlation between qualitative and flower yield parameters in different genotypes of carnation

Trait		1	2	3	4	5	6	7	8	9
Length of flower stalk (cm)	G	1	0.23	0.63*	0.91**	1.04**	0.87**	0.77*	-0.11	0.32
	P	1	0.22	0.57	0.84**	0.81**	0.72*	0.75*	-0.11	0.32
Girth of flower stalk (mm)	G		1	0.11	0.25	0.29	0.65*	0.52	0.75*	0.67*
	P		1	0.05	0.17	0.25	0.56	0.48	0.64*	0.62
Flower bud diameter (cm)	G			1	0.78*	0.74*	0.62*	0.85**	0.12	0.32
	P			1	0.63	0.47	0.47	0.72*	0.09	0.28
Flower diameter (cm)	G				1	0.95**	0.90**	0.86**	0.02	0.42
	P				1	0.74*	0.72*	0.78*	0.02	0.41
Number of petals/flower	G					1	0.95**	0.94**	-0.21	0.27
	P					1	0.62*	0.68*	-0.16	0.11
Flower Length (cm)	G						1	0.84**	0.41	0.77*
	P						1	0.68*	0.35	0.59
Flower weight (cm)	G							1	0.14	0.46
	P							1	0.18	0.44
Vase life (days)	G								1	0.88
	P								1	0.75*
Flower yield/m^2	G									1
	P									1

***Significant @ 5%, ****Significant @1 %, G = Genotypic, P = phenotypic

correlation with flower diameter, number of petals and flower length, and, significant association with flower-bud diameter and flower weight, at the genotypic level. However, there was positive and highly significant association with flower diameter and number of petals, and, significant correlation with flower length and weight, at the phenotypic level. Girth of flower stalk had positive and significant association with flower length, vase-life and yield, at the genotypic level, whereas, significant association was observed with vase-life at the phenotypic level.

Flower-bud diameter exhibited positive and highly significant correlation with flower weight and significant correlation with flower diameter, number of petals and flower length at the genotypic level, whereas, significant association was observed with flower weight at the phenotypic level. Diameter of flower had positive and highly significant association with number of petals, flower length and flower weight at the genotypic level, and the same character showed significant correlation with the above parameters at the phenotypic level too.

Number of petals per flower exhibited positive and highly significant association with flower length and flower weight at the genotypic level; whereas, there was positive and significant association of petal number with flower length and flower weight at the phenotypic level. Flower length showed positive and highly significant association with flower weight, and significant correlation with yield at the genotypic level, while, significant association was found here with flower weight at the phenotypic level. None of the characters showed significant association with flower weight at both genotypic and phenotypic levels. Vase-life exhibited positive and significant correlation with yield at the phenotypic level. These results are in line with findings of Shyamal and Kumar (2002) in dahlia.

Table 3. Genotypic and phenotypic correlation between flowering and flower yield parameters in different genotypes of carnation

Trait		1	2	3	4	5
Days taken to bud initiation	G	1	0.99**	-0.63	0.97**	-0.83
	P	1	0.98**	-0.61	0.95**	-0.81
Days taken to flower opening	G		1	-0.67	0.99**	-0.85
	P		1	-0.66	0.93**	-0.81
Duration of flowering (days)	G			1	-0.64	0.94**
	P			1	-0.64	0.91**
Days taken for peak flowering	G				1	-0.85
	P				1	-0.8
Flower yield/m^2	G					1
	P					1

***Significant @ 5%, ****Significant @1 %,
G = Genotypic, P = phenotypic

Days to flower-bud emergence exhibited positive and highly significant association with days to flower opening and days to peak flowering at the genotypic and phenotypic levels, respectively. Days to flower opening had positive and highly significant association with days to peak flowering at both genotypic and phenotypic levels. Duration of flowering showed positive and highly significant association with yield both at the genotypic and phenotypic levels. None of the characters showed significant association with days taken to peak flowering at both the genotypic and phenotypic levels. These results are in accordance with those of Anuradha and Narayana (2002) in gerbera.

Vegetative parameters like plant height exhibited positive and highly significant association with plant spread, number of nodes per stalk and per plant, number of leaves, leaf area and total dry matter; however, these exhibited significant association with number of branches and internodal length at the genotypic level; whereas, plant spread showed positive and highly significant association with number of branches, number of nodes per plant, number of leaves, leaf area, total dry matter, and, showed significant association with stem girth, internodal length and yield, at the genotypic level. Number of branches exhibited positive and highly significant association with number of nodes per plant, internodal length, number of leaves, leaf area, total dry matter and yield, whereas, it showed significant association with stem girth. Similar heritability estimates were reported by Barigidad *et al* (1992) in chrysanthemum.

Number of nodes per stalk exhibited positive and highly significant correlation with number of nodes per plant, number of leaves, leaf area, total dry matter and yield, while, it correlated significantly with stem girth, at the genotypic level. Number of nodes per plant exhibited positive and highly significant correlation with number of leaves, leaf area, total dry matter and yield at both genotypic and phenotypic levels and had significant correlation with stem girth, at the genotypic level. Stem girth showed positive and highly significant association with leaf yield and was significantly correlated to leaf area and total dry matter, at the genotypic level. Internodal length exhibited positive and significant correlation with number of leaves, leaf area and total dry matter. Number of leaves showed positive and highly significant association with leaf area, total dry matter and yield, at the genotypic level. Leaf area exhibited positive and highly significant association with yield, at the genotypic level. However, total dry matter showed highly significant relationship with yield, at the genotypic level. These results are supported by Mahesh (1996) in carnation. This reveals that indirect selection for any one of these characters can lead to concomitant increase in cut-flower yield.

Flower yield per square meter exhibited positive and highly significant correlation for most of the characters, both at the phenotypic and genotypic levels. It had interdependent relationship with vegetative parameters like number of branches, number of nodes per stalk and per plant, stem girth, number of leaves, leaf area, total dry matter production. This may have resulted in production of superior flower quality parameters like flower length, flower girth (thereby, bud and flower diameter), and, number of petals per flower and number of flowers per plant, due to extended duration of flowering. Owing to all these positive and significant interrelationships, flower yield per square meter increased. This clearly indicates, that, all the above characters were interrelated and interdependent for enhancing cut-flower yield in carnation. This is evidenced by highly positive and significant correlation observed at the phenotypic and genotypic levels (Table 1, 2 and 3). These results were corroborated by findings of Banupratap *et al* (1999) in marigold.

Flower yield in carnation showed good positive relationship with vegetative parameters like number of branches, nodes per stalk and nodes per plant; stem girth, number of leaves, leaf area and total dry matter production. This may have resulted in production of superior flower quality parameters like flower length and flower girth, thereby, bud and flower diameter and number of petals per flower; and, ultimately, increased number of flowers per plant. Hence, selection of the above, stable characters will help improve flower yield. These characters should be accorded emphasis in selection for improvement in carnation.

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