Biological Forum – An International Journal **16(7): 200-203(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Assessment of Genotypic and Phenotypic Correlation coefficient in Thirty Seven Genotypes of Rose (*Rosa* spp.)

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(Received: 04 May 2024; Revised: 22 May 2024; Accepted: 14 June 2024; Published: 15 July 2024)
(Published by Research Trend)

ABSTRACT: The association between 15 vegetative and floral parameters along with their magnitude towards number of flowers per plant was studied among 37 germplasm of rose. Correlation revealed that number of flowers per plant had a the positive and highly significant association with number of primary branches per plant, plant spread in NS direction, plant spread in EW direction, plant height, leaf area per leaflet, number of leaves per plant, number of secondary branches per plant, leaf area index, stalk length, stem girt, inter-nodal length, thorn density per 15 cm shoot and leaf length both at phenotypic and genotypic level. Since these characters had highly significant and positive correlations with number of flowers per plant so a direct selection from genotypes will be more effective for improvement if this crop.

Keywords: correlation coefficient, genotypic, phenotypic, rose.

INTRODUCTION

Rose (*Rosa* spp.) belongs to the family Rosaceae with chromosome number 2n = 2x = 14. Among all the cut flowers, rose ranks first in the international flower market. It is one of the natures beautiful creations and is universally known as "Queen of Flowers" due to its great aesthetic value and magnificent flowers (Bose *et al*., 2002). Modern roses (*Rosa hybrida*) have evolved from extensive hybridization of wild rose species (Matsumoto *et al*., 1998). The first modern roses were the Hybrid Tea roses, which were derived from crosses between Hybrid Perpetual and Tea roses (Marriott *et al*., 2003) and thus contained genes from *R. damascena*, *R. moschata*, *R. chinenesis*, *R. gigantea* and *R. gallica.* Hybrid Tea roses are grown specifically by commercial flower growers for the cut flower market and they are also used for landscaping.

A rose is a woody perennial flowering plant. The plants are erect shrubs with stems that are often armed with sharp prickles. Flowers are solitary, vary in size and shape and are usually large with varied colours. The leaves are borne alternately on the stem of 5 to 15 cm long, pinnate with leaflets and basal stipules, the leaflets usually have a serrated margin and often a few small prickles on the underside of the stem. The aggregate fruit of the rose is a berry like structure called a rose hip. Rose fruit is highly nutritious and it has been estimated that every 100 gm of rose hips syrup contains 150 mg of ascorbic acid compared to only 50 mg present in raw orange juice (Pal, 1966). Roses are insect pollinated in nature. Roses are regarded as day neutral plants but some varieties are quantitative long day while some other cultivars are short day plant. High relative humidity in the air for the longer duration is a big hurdle in the cultivation of roses.

There are many varieties of rose having beautiful flower in large range of colours, different shades, size and wide range of No. of petals per flower. Genetic variation and Genetic relationship among genotypes are an important consideration for classification and utilization of germplasm resources in breeding programmes". "The magnitude of genetic variability in gene pool is the pre-requisite of the breeding programme". "Correlation measures the degree and direction of association between two or more variables and mutual relationship between various plant characters and determines the component character on which selection is based for genetic improvement for a particular character. Thus, association of yield with yield attributing characters is of great importance for planning and executing breeding programme. As correlation provides information about yield contributing characters. This information is useful to plant breeders in selection of elite genotypes from diverse genetic populations" (Johnson *et al*., 1955). "Mass selection has been used to improve grain yield in several crops through indirect selection for highly traits which are associated with yield and hence, the present experiment was conducted to study the genotypic and phenotypic correlation coefficient of 37 genotypes of rose for their different vegetative and flowering traits.

MATERIAL AND METHODS

The experimental materials for the present investigation consisting of 37 genotypes of rose were planted at Hi-tech Horticulture Unit, Department of horticulture, University of Agricultural Sciences, Dharwad during the years 2019-20 and 2020-21, which is located in Northern Transitional Zone (Zone No. 8) of Karnataka with latitude of 15°28′ 45.0″ North, longitude of 74°58′52.2″ East and altitude of 678 m above mean sea level (MSL). The experiment was conducted in Randomized block design (RBD) with two replications with the spacing 60 cm × 60 cm in Zig-zag double row system. All the recommended agronomic practices and management were followed to grow a successful crop. Data were recorded for growth, flowering and yield traits *viz*., Plant height, Plant spread in EW direction, Plant spread in NS direction, Number of primary branches per plant, Number of secondary branches per plant, Number of leaves per plant, Intermodal length, Leaf length, Leaf area per leaflet, Leaf area index, Thorn density per 15 cm shoot, Stem girth, Stalk length, Days to first flower bud initiation and Number of flowers per plant. The software used for the statistical analysis was R-Studio application and OP Stat.

RESULTS AND DISCUSSION

Estimates of correlation coefficient among yield contributing character in a population of 37 genotypes of rose at genotypic and phenotypic levels are presented in (Tables 1 and 2).Number of flowers per plant had the positive and highly significant association with number of primary branches per plant (r_g0.88; r_p0.64), plant spread in EW direction (r_g 0.77; r_p0.61), plant spread in NS direction (r_g 0.65; r_p0.63), number of leaves per plant (r_g 0.62; r_p 0.58), leaf area per leaflet (r_g 0.62; r_p0.58), plant height (r_g 0.62; r_p0.59), number of secondary branches per plant (r_g 0.57; r_p0.53), leaf area index (r_g 0.56; r_p0.52), stalk length (r_g 0.52; r_p0.50), stem girth (r_g 0.49; r_p0.44), inter-nodal length (r_g 0.42; r_p0.38), thorn density per 15 cm shoot (r_g 0.39; r_p0.37) and leaf length (r_g 0.37; r_p0.33). Negative and highly significant correlation was observed for days to first flower bud initiation (r_g -0.64; r_p-0.55) at both genotypic and phenotypic correlation coefficient among different characters. Present investigation revealed that in general genotypic coefficient of correlation were having higher values for most of the characters than that of phenotypic correlation coefficient. Similar observations were reported by various workers including Singh *et al.* (2000); Panwar *et al*. (2012); Prajapati *et al*. (2014); Cheng *et al*. (2020) in rose.

A. Plant height

The character plant height displayed positive significant correlation at both phenotypic and genotypic levels with traits primary branches per plant (r_g0.99; r_p0.75), stalk length (r_g0.91; r_p0.89), plant spread in NS direction (r_g 0.91; r_p0.86), plant spread in EW direction (r_g 0.89; r_p0.86), leaf area index (r_g 0.87; r_p0.79), number of leaves per plant (r_g0.85; r_p0.82), leaf area per leaflet (r_g 0.83; r_p0.80), leaf length (r_g 0.71; r_p0.68), stem girth (r_g 0.68; r_p0.64), number of secondary branches per plant (r_g 0.67; r_p0.59), thorn density per 15 cm shoot (r_g 0.51;r_p0.46) and inter-nodal length (r_g 0.31; r_p0.28) and significant and negative correlation at genotypic level with trait days to first flower bud initiation (-0.235). Similar results were also drawn by Panwar *et al*. (2012); Prajapati *et al*. (2014).

B. Plant spread in EW direction

Plant spread in EW direction showed positive and significant association with number of primary branches per plant (r_g 1.09; r_p0.80), plant spread in NS direction (r_g 0.93; r_p 0.86), leaf area index (r_g 0.87; r_p0.80), number of leaves per plant (r_g0.87; r_p0.83), stalk length (r_g0.81; r_p0.78), leaf area per leaflet (r_g0.81; r_p 0.79), stem girth (r_g0.79; r_p0.73), number of secondary branches per plant (r_g0.72; r_p0.65), leaf length (r_g0.68; r_p0.66) and thorn density per 15 cm shoot (r_g 0.52; r_p0.49). Only one character has been recorded significantly negative correlation that is days to first flower bud initiation (r_g-0.29; r_p0.25). Singh and Katiyar (2014); Jogdande *et al*. (2017) had also reported coinciding results in rose.

C. Plant spread in NS direction

Plant spread in NS direction recorded positive and significant correlation with number of primary branches per plant (r_g 1.13; r_p0.76), leaf area per leaflet (r_g 0.87; r_p0.83), leaf area index (r_g 0.86; r_p0.83), number of leaves per plant (r_g 0.80; r_p0.76), stalk length (r_g 0.79; r_p0.75), leaf length (r_g 0.75; r_p0.70), stem girth (r_g0.71; r_p0.66), number of secondary branches per plant (r_g0.67; r_p0.57), thorn density per 15 cm shoot (r_g 0.52; r_p0.47) and inter-nodal length (r_g 0.41; 0.30) and the trait days to first flower bud initiation (r_g -0.37; r_p0.33) had the significant and negative association. Similar results were also observed by Verma *et al.* (2013) ; Prajapati *et al*. (2014) in rose.

D. Number of primary branches per plant

Number of primary branches per plant had positive and significant association with leaf area index (r_g 1.02; r_p0.70), number of leaves per plant (r_g 1.01; r_p0.73), leaf area per leaflet (r_g 0.98; r_p0.73), stem girth (r_g0.91; r_p0.67), leaf length (r_g 0.86; r_p0.62), stalk length (r_g 0.86; r_p0.67), number of secondary branches per plant (r_g0.81; r_p0.56), thorn density per 15 cm shoot (r_g0.67; r_p0.42) and inter-nodal length (r_g 0.34; r_p0.25). While, the character days to first flower bud initiation (r_g-0.38; r_p-0.32) had the significantly negative association at both genotypic and phenotypic level. These results are supported by Jogdande *et al.* (2017); Cheng *et al*. (2020) in rose.

E. Number of secondary branches per plant

Number of secondary branches per plant had positive and significant association with number of leaves per plant (r_g 0.73; r_p0.66), leaf area index (r_g 0.65; r_p0.58), stem girth (r_g 0.58; r_p0.48), stalk length (r_g 0.56; r_p0.50), leaf area per leaflet (r_g 0.55; r_p0.49), leaf length (r_g 0.49; r_p0.42) and thorn density per 15 cm shoot (r_g0.25; r_p0.23), while, inter-nodal length (r_g 0.16; r_p0.21) showed positive and non significant correlation at both genotypic an phenotypic level. Only one trait that is days to first flower bud initiation (r_g-0.22; r_p-0.18) had non significantly negative correlation. Similar results were also drawn by Prajapati *et al.* (2014); Jogdande *et al.* (2017).

F. Number of leaves per plant

Number of leaves per plant recorded positive and significant association with leaf area index (r_g 0.91; r_p0.83), leaf area per leaflet (r_g 0.86; r_p0.84), stem girth (r_g 0.83; r_p0.75), stalk length (r_g 0.76; r_p0.74), leaf length (r_g 0.69; r_p0.65) and thorn density per 15 cm shoot (r_g 0.49; r_p0.47), and the trait inter-nodal length (r_g 0.20; r_p0.15) showed positive and non significant correlation. The trait days to first flower bud initiation (r_g -0.13; r_p-0.14) had the negative and non significant association. These similar findings are in close accordance with outcomes of Verma *et al.* (2013); Prajapati *et al.* (2014) in rose.

G. Inter-nodal length

Inter-nodal length had positive and significant association with leaf area index (r_g 0.28; r_p0.25) and stalk length (r_g 0.25; r_p0.22). The trait days to first flower bud initiation (r_g -0.43; r_p-0.30) recorded the significantly negative correlation. Similar trend was reported by Jogdande *et al.* (2017); Singh and Sinha (2020).

H. Leaf length

Leaf length had positive and significant association with leaf area index (r_g 0.89; r_p0.79), leaf area per leaflet (r_g 0.78; r_p0.75), stem girth (r_g 0.76; r_p0.67), stalk length (r_g 0.63; r_p0.60) and thorn density per 15 cm shoot (r_g 0.34; r_p0.31) and the trait days to first flower bud initiation (r_g -0.24; r_p-0.21) showed significantly negative association.

I. Leaf area per leaflet

Leaf area per leaflet had positive and significant association with leaf area index (r_g0.90; r_p0.83), stalk length (r_g 0.77; r_p0.76), stem girth (r_g 0.71; r_p0.68) and thorn density per 15 cm shoot (r_g 0.54; r_p0.50), while, days to first flower bud initiation (r_g -0.23; r_p-0.22) had negative and significant association.

J. Leaf area index

Leaf area index showed positive and significant association with stem girth (r_g 0.82; r_p0.74) stalk length (r_g 0.80; r_p0.74) and thorn density per 15 cm shoot (r_g 0.54; r_p0.49), and days to first flower bud initiation (r_g -0.24; r_p-0.19) had significantly negative and non significantly negative at both genotypic and phenotypic level respectively.

K. Thorn density per 15 cm shoot

Thorn density per 15 cm shoot showed positive and significant association with stem girth (r_g 0.64; r_p0.56) and stalk length (r_g 0.59; r_p0.56), but days to first flower bud initiation (r_g -0.04; r_p-0.01) recorded negative and non significant association at both genotypic and phenotypic level respectively. These are in close agreement with the outcomes of Verma *et al.* (2013); Prajapati *et al.* (2014).

L. Stem girth

Stem girth had positive and significant correlation with stalk length (r_g 0.59; r_p0.56), and days to first flower bud initiation (r_g -0.20; r_p-0.15) recorded negative and non significant association.

M. Stalk length

Stalk length had negative and non significant association with days to first flower bud initiation (r_g -0.12; r_p-0.10).

N. Days to first flower bud initiation

The genotypic and phenotypic correlation coefficient on number of flowers per plant had negative and non significant association with days to first flower bud initiation (r_g -0.55; r_p-0.55).

Table 1: Genotypic correlation coefficient among 15 traits in rose genotypes.

Sr. No.	Characters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
1.	**X_1**	**1.0000**	0.8991**	0.9159**	0.9961**	0.6763**	0.8527**	0.3161**	0.7130**	0.8330**	0.8743**	0.5134**	0.6874**	0.9173**	-0.2350*	**0.6203****
2.	**X_2**		**1.0000**	0.9332**	1.0960**	0.7293**	0.8760**	0.1947	0.6879**	0.8166**	0.8768**	0.5294**	0.7998**	0.8184**	-0.2929**	**0.6536****
3.	**X_3**			**1.0000**	1.1346**	0.6788**	0.8029**	0.4141**	0.7587**	0.8718**	0.8666**	0.5258**	0.7185**	0.7972**	-0.3745**	**0.7113****
4.	**X_4**				**1.0000**	0.8110**	1.0160**	0.3476**	0.8661**	0.9802**	1.0268**	0.6740**	0.9158**	0.8614**	-0.3883**	**0.8832****
5.	**X_5**					**1.0000**	0.7321**	0.1694	0.4955**	0.5591**	0.6535**	0.2545*	0.5832**	0.5618**	-0.2210	**0.5750****
6.	**X_6**						**1.0000**	0.2092	0.6943**	0.8694**	0.9144**	0.4985**	0.8383**	0.7628**	-0.1324	**0.6260****
7.	**X_7**							**1.0000**	0.2411*	0.2562*	0.2840*	0.1101	-0.0422	0.2549*	-0.4314**	**0.4215****
8.	**X_8**								**1.0000**	0.7803**	0.8922**	0.3445**	0.7667**	0.6329**	-0.2482*	**0.3720****
9.	**X_9**									**1.0000**	0.9019**	0.5417**	0.7180**	0.7734**	-0.2387*	**0.6227****
10.	**X_{10}**										**1.0000**	0.5447**	0.8261**	0.8016**	-0.2443*	**0.5643****
11.	**X_{11}**											**1.0000**	0.6482**	0.5936**	-0.0424	**0.3933****
12.	**X_{12}**												**1.0000**	0.5944**	-0.2005	**0.4907****
13.	**X_{13}**													**1.0000**	-0.1234	**0.5272****
14.	**X_{14}**														**1.0000**	**-0.6478****

***Significant at 5 % level = 0.2287 ** significant at 1 % level = 0.2977**

Note : X_1 : Plant height, X_2 : Plant spread in EW direction, X_3 :Plant spread in NS direction, X_4 : Number of primary branches per plant, X_5 : Number of secondary branches per plant, X_6 : Number of leaves per plant, X_7 : Intermodal length, X_8 : Leaf length, X_9 : Leaf area per leaflet, X_{10} : Leaf area index, X_{11} : Thorn density per 15 cm shoot, X_{12} : Stem girth, X_{13} : Stalk length, X_{14} : Days to first flower bud initiation and X_{15} : Number of flowers per plant

Table 2: Phenotypic correlation coefficient among 15 traits in rose genotypes.

Sr. No.	Characters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
1.	**X_1**	**1.0000**	0.8650 **	0.8640 **	0.7584 **	0.5990 **	0.8202 **	0.2818 *	0.6845 **	0.8073 **	0.7960 **	0.4676 **	0.6433 **	0.8974 **	-0.2071	**0.5970****
2.	**X_2**		**1.0000**	0.8676 **	0.8086 **	0.6511 **	0.8335 **	0.1889	0.6649**	0.7910 **	0.8033 **	0.4999 **	0.7348 **	0.7884 **	-0.2531 *	**0.6170****
3.	**X_3**			**1.0000**	0.7603 **	0.5735 **	0.7662 **	0.3010 **	0.7051 **	0.8354 **	0.7843 **	0.4713 **	0.6636 **	0.7543 **	-0.3322 **	**0.6336****
4.	**X_4**				**1.0000**	0.5683**	0.7374 **	0.2577 *	0.6284 *	0.7356 **	0.7043 **	0.4212 **	0.6717 **	0.6720 **	-0.3249 **	**0.6451****
5.	**X_5**					**1.0000**	0.6660**	0.2121	0.4288**	0.4962 **	0.5840 **	0.2368 *	0.4854 *	0.5092 **	-0.1893	**0.5337****
6.	**X_6**						**1.0000**	0.1581	0.6591**	0.8415 **	0.8365 **	0.4769 **	0.7521 **	0.7416 **	-0.1428	**0.5871****
7.	**X_7**							**1.0000**	0.2056	0.2091	0.2511*	0.0977	-0.0453	0.2293	-0.3061 **	**0.3804****
8.	**X_8**								**1.0000**	0.7533**	0.7930 **	0.3101 **	0.6731 **	0.6055 **	-0.2105	**0.3365****
9.	**X_9**									**1.0000**	0.8304**	0.5034 **	0.6800 **	0.7614 **	-0.2263	**0.5886****
10.	**X_{10}**										**1.0000**	0.4939**	0.7422 **	0.7414 **	-0.1965	**0.5202****
11.	**X_{11}**											**1.0000**	0.5636**	0.5619 **	-0.0136	**0.3789****
12.	**X_{12}**												**1.0000**	0.5610**	-0.1526	**0.4480****
13.	**X_{13}**													**1.0000**	-0.1076	**0.5073****
14.	**X_{14}**														**1.0000**	**-0.5560****

*** Significant at 5 % level : 0.2287 ; ** significant at 1 % level : 0.2977**

Note : X_1 : Plant height, X_2 : Plant spread in EW direction, X_3 :Plant spread in NS direction, X_4 : Number of primary branches per plant, X_5 : Number of secondary branches per plant, X_6 : Number of leaves per plant, X_7 : Intermodal length, X_8 : Leaf length, X_9 : Leaf area per leaflet, X_{10} : Leaf area index, X_{11}: Thorn density per 15 cm shoot, X_{12} : Stem girth, X_{13} : Stalk length, X_{14} : Days to first flower bud initiation and X_{15} : Number of flowers per plant

CONCLUSIONS

Based on the above investigation, it can be concluded that cultivars were having substantial variability for most of the characters. A promising rose cultivar with number of flowers per plant could be obtained by selection on the basis of plant height, plant spread, number of primary and secondary branches per plant, leaf area index, and stem length. Therefore, selection should be based on plant height, stem length and number of flowers per plant for better cultivars. Further studies on correlation among the characters and its relation with plant height, plant spread, number of primary and secondary branches, stalk length and number of flowers per plant are recommended for better information and understanding the improvement process.

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How to cite this article: Ashwini and S.G. Angadi (2024). Assessment of Genotypic and Phenotypic Correlation coefficient in Thirty Seven Genotypes of Rose (*Rosa* spp.). *Biological Forum – An International Journal, 16*(7): 200-203.