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Research Article

Correlation and Path Analysis for Quality and Yield Traits in Gillyflower (*Matthiola incana* L.) Genotypes

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Abstract

The character association and path analysis in eleven distinct gillyflower genotypes were studied during the academic year 2022–2023 at the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere. The character association studies revealed that plant height (0.885), leaf length (0.700), leaf area (0.670) and number of florets per stalk (0.691) with stalk length showed a significant positive correlation, whereas plant height (-0.782), number of leaves (-0.657), leaf length (-0.778), leaf area (-0.874), intermodal length (-0.767) and stalk length (-0.686) showed significant negative correlation with days taken for stalk emergence. Path analysis revealed that the number of cut flowers per m2 exhibited a highly positive direct effect with the plant height (0.479), leaf area (1.001), number of florets per stalk (0.417) and stalk girth (0.448). This suggests that these are the potential traits in improving the earliness, stalk quality and marketable flower yield. Therefore, greater emphasis is given to these traits while selecting the genotypes for crop improvement.

Keywords: Gillyflower; Stock; Correlation; Path Analysis; Cut Flower; Stalk Length

Introduction

Gillyflower or Stock (*Matthiola incana* L.) is an annual or biennial plant flowering in terminal clusters. It is native to Southern Europe and is naturalized in the western part of the Mediterranean region and belongs to the cabbage family Brassicaceae with the chromosomal number 2n = 14 [5]. It exists in both single and double forms but the double-flowered kinds are the most popular ones. These have been evolved through the changing of stamens into petals and are valued for fragrant flowers that can be used as fresh or dried cut flowers and also as summer beddings. Gillyflowers are a most valuable race of garden plants for they are easy to grow and can be in bloom during the greater part of the year. They are excellent pot plants for the greenhouse in Winter and Spring and provide good cut flowers. Flowers are well arranged on a long

column and the colours are variable from white to rose, crimson, purple, yellow, mauve, pink, etc. The highly fragrant flowers are used as a garnish, especially with sweet desserts [9].

Knowledge regarding association of various characters among themselves and economic characters is necessary for making indirect selection for improvement. The expression of a character in a plant is the consequence of a chain of inter-relationships between characters either directly or through other events. Character association or correlation is a measure of the degree of association between two characters. Correlation studies helps to know the association prevailing between highly heritable characters with most economic characters and gives better understandings on the contribution of each trait in building up of the genetic makeup of the crop. Genotypic correlations provide an estimate of inherent association between genes controlling any two characters. Hence, it is of greater significance and could be effectively utilized in formulating an effective selection scheme [5].

Since there is often a confusing correlation between different components and yield, path coefficient provides a much more accurate interpretation of the factor at play. Therefore, it is essential to employ the path analysis technique, which enables analysis of correlation as a system of related variables [5].

The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme [2]. Apart from these correlations as well as path coefficient are important tools for the selection of desirable traits and to enhance the quality and yield of the gillyflower. The main objective for a plant breeder is to evolve the varieties of high quality and yield. It is therefore, desirable for plant breeder to know the extent of relationship between quality, yield and its various components, which will facilitate selection based on component traits [8]. Keeping in view the above facts present investigation was undertaken with an objective to analyze and determine the traits having greater interrelationship with quality and flower yield utilizing the correlation and path analysis and to help breeders in improvement of gillyflower [8].

Material and Methods

The experiment consisted of 11 genotypes viz., Early Arrow White, Arrow White, Quartet Deep Yellow, Early Iron White, Early Iron Yellow, Early Iron Deep Yellow, Early Iron Marine, Early Iron Pink, Stock Katz Ruby, Stock katz Blue and Stock Katz Purple, which were replicated thrice in a Randomized Complete Block Design (RCBD) which was carried out under naturally ventilated polyhouse at College of Horticulture, Mudigere, under Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga during 2022-2023. The objective of this investigation was to study the character association and path analysis for quality and yield traits of different gillyflower genotypes which represent diverse characters. One month old seedlings were transplanted raised beds in the polyhouse with spacing of 25×25 cm. Observations were recorded for best 5 plants in each genotype for plant height (cm), Number of leaves per plant, leaf length (cm), leaf width (cm), leaf area (cm2 per plant), internodal length (cm), days taken for stalk emergence, number of florets per stalk, floret diameter (cm), stalk length (cm), stalk girth (mm), stalk weight (g), vase life (days), longevity in plants (days) and number of cut flowers per m2. The observations were recorded at an interval of 30 days from transplanting till completion of harvest.

The recorded data were analyzed statistically using variability package in R Studio software for correlation (two tail T test) and path analysis.

Results

Association analysis

Correlation means the association of one character with the other characters. The genotypic correlation coefficients between different characters in gillyflower are presented in Table 1 and Figure 1.

1. Growth parameters

The association analysis revealed that the plant height exhibited a highly significant positive correlation with leaf length (0.867) and stalk length (0.885) while, a significant positive correlation was noticed with leaf area (0.665). The number of leaves per plant recorded a significant positive correlation with leaf length (0.653) and leaf area (0.678). Leaf length observed a highly significant positive correlation with plant height (0.867) and leaf area (0.780) while a significant positive correlation was noticed with the number of leaves per plant (0.653), stalk length (0.700) and longevity (0.608). Leaf area showed a highly significant positive correlation with leaf length (0.780) and longevity (0.834) while, significant positive correlation was noticed with plant height (0.665), number of leaves per plant (0.678) and stalk length (0.670).

2. Flowering parameter

The days taken for stalk emergence had a significant positive correlation with stalk girth (0.627) and stalk weight (0.610). It showed highly significant negative correlation with Plant height (-0.782), leaf length (-0.778), leaf area (-0.874), internodal length (-0.767) and longevity (-0.880) whereas, significant negative cor-

Table 1: Genotypic correlation coefficients for growth, flowering, quality and yield characters in Gillyflower (*Matthiola incana* L.) genotypes.

	PH	NL	LL	LW	LA	IL	DE	NF	FD	SL	SG	SW	VL	LO	Y
PH	1 **	0.459	0.867 **	0.061	0.665 *	0.540	-0.782 **	0.596	0.241	0.885 **	-0.688*	-0.401	0.578	0.458	-0.096
NL		1 **	0.653 *	-0.123	0.678 *	0.396	-0.657 *	-0.027	-0.227	0.395	-0.485	-0.712*	0.249	0.424	-0.004
LL			1 **	0.135	0.780 **	0.492	-0.778 **	0.263	0.224	0.700 *	-0.388	-0.560	0.322	0.608*	-0.004
LW				1 **	-0.046	0.097	-0.176	-0.073	-0.189	-0.273	-0.033	-0.043	0.135	0.356	-0.196
LA					1 **	0.420	-0.874 **	0.132	-0.085	0.670 *	-0.449	-0.386	0.217	0.834**	-0.397
IL						1 **	-0.767 **	0.117	-0.155	0.543	-0.501	-0.621 *	0.414	0.590	-0.190
DE							1 **	-0.196	0.120	-0.686 *	0.627 *	0.610 *	-0.501	-0.880 **	0.438
NF								1 **	0.396	0.691 *	-0.249	-0.056	0.494	0.022	-0.105
FD									1 **	0.144	0.434	-0.065	0.255	-0.120	0.048
SL										1 **	-0.619 *	-0.310	0.448	0.435	-0.191
SG											1 **	0.356	-0.598	-0.316	0.364
SW												1 **	-0.665 *	-0.414	0.154
VL													1 **	0.309	-0.522
LO														1**	-0.634*
Y															1 **

Where, * & ** indicates significant @ 5% and 1% level, respectively.

PH: Plant Height (cm); NL: Number of Leaves/Plant; LL: Leaf length (cm); LW: Leaf Width (cm); LA: Leaf Area/plant; IL: Internodal length (cm); DE: Days Taken to Stalk Emergence; NF: Number of Florets Per Stalk; FD: Floret Diameter (cm); SL: Stalk Length (cm); SG: Stalk Girth (cm); SW: Stalk Weight (g); VL: Vase Life (days); LO: Longevity in Plants (days); Y: Cut Flower per m2

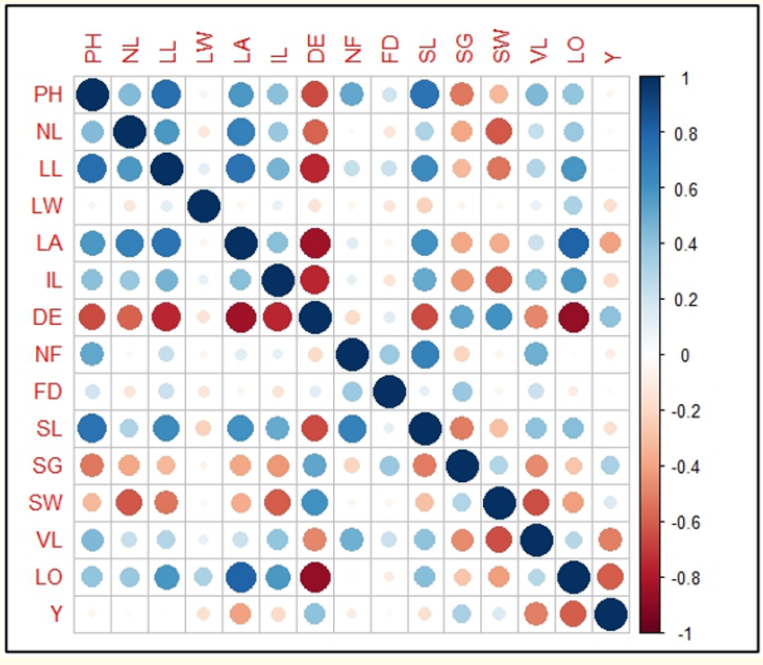

Figure 1: Genotypic correlation diagram (corrplot) for growth, flowering, quality and yield characters in Gillyflower (*Matthiola incana* L.) genotypes.

relation with number of leaves per plant (-0.657) and stalk length (-0.686).

3. Flower quality and yield parameters

Number of florets per stalk had a significant positive correlation with stalk length (0.691). Stalk length showed a highly positive correlation with plant height (0.885) whereas significant correlation with leaf length (0.700), leaf area (0.670) and number of florets per stalk (0.691). Stalk girth had a significant positive correlation with days taken for stalk emergence (0.627) whereas, a negative significant correlation with plant height (-0.688) and stalk length (-0.619). Longevity in plants recorded a highly significant positive leaf area (0.834) while, a significant positive correlation with leaf length (0.608). A highly significant negative correlation was noticed with days taken for stalk emergence (-0.880) and a significant negative correlation on yield per square meter (-0.634).

The number of cut flowers per square meter had a significant negative correlation with longevity (-0.634) whereas, correlations with other characters were non-significant. Whereas, stalk yield hasn't shown a significant correlation with any traits at the genotypic level.

Path analysis

Yield is a complex character and is composed of component characters which subsidize directly as well as indirectly through each other. The study of correlation alone when measured on the criteria for selection for high yield would be ambiguous. Since a character may not be directly correlated with yield but may depend on other characters, by path analysis it is possible to find out the direct and indirect influence of component characters on the yield. The path analysis technique is easier to split the correlation coefficients into the direct and indirect contributions of different characters to the yield [4,10]. The correlation coefficient of gillyflower was apportioned into direct effects and indirect effects by path analysis and the results are presented in table 2.

Table 2: Genotypic path coefficient analysis for fourteen different characters on number of stalks per m2 of Gillyflower genotypes (*Matthiola incana* L.).

	PH	NL	LL	LW	LA	IL	DE	NF	FD	SL	SG	SW	VL	LO	rG
PH	0.479	-0.487	0.080	0.010	0.666	-0.020	1.323	0.248	-0.087	-0.640	-0.308	0.459	-0.655	-1.163	-0.096
NL	0.220	-1.060	0.060	-0.021	0.679	-0.014	1.110	-0.011	0.082	-0.286	-0.217	0.814	-0.281	-1.077	-0.004
LL	0.415	-0.692	0.092	0.023	0.781	-0.018	1.315	0.110	-0.081	-0.507	-0.174	0.640	-0.365	-1.543	-0.004
LW	0.029	0.130	0.012	0.170	-0.046	-0.004	0.298	-0.031	0.068	0.198	-0.015	0.049	-0.153	-0.903	-0.196
LA	0.318	-0.719	0.072	-0.008	1.001	-0.015	1.478	0.055	0.031	-0.485	-0.201	0.441	-0.246	-2.118	-0.397
IL	0.258	-0.420	0.045	0.017	0.421	-0.036	1.296	0.049	0.056	-0.393	-0.225	0.710	-0.470	-1.498	-0.190
DE	-0.374	0.696	-0.072	-0.030	-0.875	0.028	-1.691	-0.082	-0.043	0.497	0.281	-0.698	0.568	2.233	0.438
NF	0.285	0.028	0.024	-0.012	0.133	-0.004	0.331	0.417	-0.143	-0.500	-0.112	0.064	-0.561	-0.055	-0.105
FD	0.115	0.240	0.021	-0.032	-0.085	0.006	-0.202	0.165	-0.360	-0.104	0.194	0.074	-0.289	0.306	0.0481
SL	0.423	-0.419	0.065	-0.047	0.671	-0.020	1.159	0.288	-0.052	-0.724	-0.277	0.354	-0.508	-1.105	-0.191
SG	-0.329	0.514	-0.036	-0.006	-0.450	0.018	-1.059	-0.104	-0.156	0.448	0.448	-0.407	0.678	0.803	0.364
SW	-0.192	0.755	-0.052	-0.007	-0.386	0.023	-1.032	-0.023	0.023	0.224	0.160	-1.143	0.754	1.051	0.154
VL	0.277	-0.263	0.030	0.023	0.217	-0.015	0.847	0.206	-0.092	-0.324	-0.268	0.760	-1.134	-0.785	-0.522
LO	0.219	-0.450	0.056	0.061	0.835	-0.021	1.487	0.009	0.043	-0.315	-0.142	0.473	-0.351	-2.539	-0.634*

Where, * & ** indicates significant @ 5% and 1% level, respectively.

Residual effect: 0.0623

PH: Plant Height (cm); NL: Number of Leaves/Plant; LL: Leaf length (cm); LW: Leaf Width (cm); LA: Leaf Area/plant; IL: Internodal length (cm); DE: Days Taken to Stalk Emergence; NF: Number of Florets Per Stalk; FD: Floret Diameter (cm); SL: Stalk Length (cm); SG: Stalk Girth (cm); SW: Stalk Weight (g); VL: Vase Life (days); LO: Longevity in Plants (days); rG: Regression Coefficient

The characters chosen for the path analysis were suitable, as evidenced by the path analysis's minimal residual effect (0.0623).

Assessment of direct and indirect effects of characters on stalk yield through path analysis indicated the maximum positive direct effect of total leaf area (1.001) followed by plant height (0.479), leaf length (0.092), leaf width (0.170), number of florets per stalk (0.417) and stalk girth (0.448). while, the number of leaves per plant (-1.060), internodal length (-0.036), days taken to stalk emergence (-1.691), floret diameter (-0.360), stalk length (-0.724), stalk weight (-1.143), vase life (-1.134) and longevity (-2.539) were negatively contributed towards yield.

Discussion and Conclusion

Correlation analysis

Correlation analysis helps in examining the possibility of improving quality and yield through indirect selection of its component traits which are highly correlated with quality and yield. For the majority of the studied characters, the genotypic correlation was typically higher than the phenotypic correlation. In order to create a successful selection strategy, genotypic correlation provides an estimate of the inherent association between the genes controlling any two characters. Further, the phenotypic expression of correlation is reduced due to the influence of environment.

On the basis of the result revealed, plant height, internodal length, leaf length, number of leaves and leaf area showed a significantly positive correlation with important cut flower quality traits like stalk length, number of florets per stalk, vase life and longevity in plants while those traits showed significantly negative correlation with days taken for stalk emergence [1,3,6,7].

Path coefficient analysis

Path analysis for stalk yield per plant revealed that the plant height, leaf length, leaf width, leaf area, number of florets per stalk and stalk girth have direct positive effects indicating the possibility of increasing stalk yield by selecting these characters directly [1,6,8].

Conclusion

On the source of results obtained and evidence mentioned, plant height, leaf length, leaf width, leaf area per plant, stalk length and number of florets per stalk are the potential traits which should be taken into consideration while selecting the genotypes for crop improvement with respect to earliness, stalk quality and yield in gillyflower.

Future Scope

Further scope for experiment to utilize the promising genotypes in the crop improvement programme.

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Conflict of Interest

None.

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