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Character association and path analysis in glory lily (*Gloriosa superba* L.)

Rajagopal Chitra*, Kandhasamy Rajamani

Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore-641 003.
* Corresponding author: R. Chitra, E-mail: chitra.varadharaj@gmail.com

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ABSTRACT

Gloriosa superba L. is a medicinal climber, its seeds and tubers contain valuable alkaloids viz., colchicine and colchicoside as the major constituents, which are used to treat gout and rheumatism. The growing demand for the seeds of *G. superba* in the international market and the wider popularity it has gained among the farmers necessitates attempts to induce new variability with high yield, high colchicine content, dwarf stature and leaf blight resistant of the plant as well. In the present study, eighteen glory lily genotypes were used to estimate character association and generate a path analysis for 13 morpho-economic traits. Plant height, number of leaves per plant, number of branches per plant, days to 50% flowering, number of flowers per plant, number of pods per plant, number of seeds per plant, fresh seed weight per plant, fresh seed yield per plant and fresh seed recovery were found to have positive association with dry seed yield per plant. Fresh seed yield per plant had highest positive effect on seed yield followed by number of pods per plant and fresh seed weight per pod. These associated yield components suggested that it may be good selection criteria to improve seed yield of glory lily crop.

Key Words: *Gloriosa superba; character association; path co-efficient.*

INTRODUCTION

Gloriosa superba L. (Colchicaceae) is a perennial herbaceous vine growing 3.5 to 6.0 meters in length. *G. superba* is a native of tropical Africa and is found growing naturally in many countries of tropical Asia including Bangladesh, India, Sri Lanka, Malaysia and Myanmar. Seeds and tubers contain valuable alkaloids, *viz*., colchicine and colchicoside as the major constituents, which are used to treat gout and rheumatism. Due to the action of colchicoside on spindle fiber formation during cell division, the plant has been identified as a potential anti-cancerous drug (Sivakumar and Krishnamurthy, 2002). In the Indian systems

of medicine, the tubers are used as tonic, antiperiodic, anthelmintic and also for snake bites (Gupta et al., 2005).

Gloriosa was only found in the wild a decade back but now it has been domesticated for economic gain and all parts of the plant are utilized in Indian Medicine. Though *G. superba* has an extensive natural distribution, the species has become endangered due to over exploitation of its tubers and low percent germination. The growing demand for the seeds of *G. superba* in the international market and the greater interest by farmers necessitates development of higher yielding plants with high colchicine content, dwarf stature, and leaf blight resistance. Hence, to get a better insight into the cause and effect relationships between different pairs of characters, a study of correlation in conjunction with path analysis was made on glory lily genotypes.

MATERIALS AND METHODS

Eighteen accessions collected from different regions of the important *Gloriosa* growing Indian states, *viz*., Tamil Nadu and Andhra Pradesh, were grown in the field in a randomized block design with three replications at the Medicinal Plants Unit, Botanical Garden, Tamil Nadu Agricultural University, Coimbatore. Each plot consisted of three 5 m long rows with inter and intra row spacing of 150 cm and 30 cm, respectively. For each accession the agro-morphological characteristics measured on five randomly selected plants in each replication were plant height (cm), number of leaves per plant, number of branches per plant, days to flowering, days to 50% flowering, number of flowers per plant, number of pods per plant, number of seeds per pod, fresh seed weight per pod (g), fresh seed yield per plant (g), fresh seed recovery (%), dry seed recovery (%) and dry seed yield per plant (g). Phenotypic and genotypic correlation coefficients (Johnson et al., 1955) and path coefficient analysis (Dewey and Lu, 1959) were determined. The genotypic correlation significance was estimated by Pearson correlations method.

RESULTS AND DISCUSSION

Phenotypic and genotypic correlations among yield and yield component characters in glory lily are presented in Table 1. Most of the genotypic correlation coefficients were slightly higher than the phenotypic correlation coefficients. This may be due to effect of environment in modifying the total expression of genotypes, thus altering the phenotypic expression. This agrees with previous findings of Shanmugasundaram (1998) in turmeric; Ramaprasad et al. (2007) in *Phaseolus vulgaris* and Singh et al. (2008) in Safed musli. An apparent negative association at the genetic level would have arisen from repulsion linkage of gene(s) controlling the direct and indirect effects. Conversely the positive correlation may be attributed to the coupling phase of linkage (Lal et al., 1986; Geetha and Prabhakaran, 1987).

The correlation analysis revealed positive and highly significant associations for number of leaves per plant, number of branches per plant, number of flowers per plant, number of pods per plant, fresh seed weight per pod and fresh seed recovery percentage per plant, with dry seed yield per plant. Hence, it may be concluded that these traits are important yield factors in *G. superba*. These results coincide with the findings of Dayal et al. (1983) in potato; Data et al. (2005) in fenugreek; Golani et al. (2007) in hyacinth bean and Ramaprasad et al. (2007) in French bean.

Regarding interrelation of the yield components, most traits had highly significant positive correlations with each other. The characters plant height, number of leaves per plant and number of branches per plant had non-significant associations with days to flowering but had highly significant positive correlations with other characters. Days to 50% flowering had significant negative correlations with all other characters. Plant height, number of leaves per plant and number of branches per plant had highly significant positive correlation with

characters except days to flowering. The inter correlation between various yield traits were estimated previously Singh et al. (2000) in *Mentha arvensis*; Ram et al. (2005) in *Silybum marianum*; Panesar and Jadeja (2008) in cumin and Jotshi et al. (2008) in *Abrus precatorius*. Their conclusions generally parallel the results of the present study. This suggests that increasing seed yield may also improve the glory lily productivity.

Table 1. Estimates of genotypic (G) and phenotypic (P) correlations among thirteen traits in glory lily (*Gloriosa superba* L.)

Characters		Plant height	No.of leaves/ plant	No. of branches /plant	Days to flowering	Days to 50% flowering	No. of flowers /plant	No of pods /plants	No. of seeds/ plant	Fresh seed weight /pod	Fresh seed yield /plant	Fresh seed recovery	Dry seed recovery	Dry seed yield /plant
Plant height	G	1.000	0.951**	0.896**	-0.358	-0.944**	0.829**	0.814**	0.738**	0.982**	0.807**	0.971**	-0.394	0.814**
	P	1.000	0.951**	0.893**	-0.341	-0.908**	0.828**	0.811**	0.726**	0.977**	0.806**	0.866**	-0.303	0.811**
No. of leaves/plant	G		1.000	0.929**	-0.333	-0.958**	0.943**	0.932**	0.810**	0.975**	0.929**	1.001**	-0.451*	0.931**
	P		1.000	0.926**	-0.318	-0.922**	0.942**	0.930**	0.798**	0.970**	0.927**	0.889**	-0.355	0.927**
No. of branches/plant	G			1.000	-0.354	-0.901**	0.878**	0.897**	0.631**	0.933**	0.900**	0.928**	-0.568*	0.897**
	P			1.000	-0.331	-0.857**	0.874**	0.892**	0.624**	0.924**	0.895**	0.812**	-0.455*	0.889**
Days to flowering	G				1.000	0.453*	-0.374	-0.371	-0.289	-0.329	-0.356	-0.165	-0.301	-0.375
	P				1.000	0.404*	-0.358	-0.354	-0.257	-0.308	-0.338	-0.156	-0.210	-0.360
Days to 50% flowering	G					1.000	-0.918**	-0.909**	-0.879**	-0.970**	-0.912**	-0.950**	0.314	-0.925**
	P					1.000	-0.881**	-0.873**	-0.830**	-0.929**	-0.877**	-0.812**	0.217	-0.890**
No. of flowers/plant	G						1.000	0.995**	0.838**	0.891**	0.992**	0.897**	-0.454*	0.991**
	P						1.000	0.993**	0.825**	0.885**	0.991**	0.797**	-0.361	0.989**
No. of pods/plant	G							1.000	0.816**	0.878**	0.997**	0.880**	-0.477*	0.995**
	P							1.000	0.802**	0.869**	0.996**	0.781**	-0.381	0.994**
No. of seeds/plant	G								1.000	0.766**	0.806**	0.785**	-0.196	0.819**
	P								1.000	0.748**	0.793**	0.646**	-0.153	0.803**
Fresh seed weight/pod	G									1.000	0.880**	0.991**	-0.414*	0.886**
	P									1.000	0.877**	0.908**	-0.351	0.877**
Fresh seed yield/plant	G										1.000	0.887**	-0.490*	0.999**
	P										1.000	0.796**	-0.393	0.997**
Fresh seed recovery	G											1.000	-0.511*	0.889**
	P											1.000	-0.423*	0.788**
Dry seed recovery	G												1.000	-0.454*
	P												1.000	-0.346
Dry seed yield/plant	G													1.000
	P													1.000

* Significant at 5% level; ** Significant at 1% level; G – Genotypic correlation; P – Phenotypic correlation

The results of path analysis (Table 2) revealed that direct significant positive effect of plant height (0.0189), number of leaves per plant (0.0788), days to 50% flowering (0.0112), number of pods per plant (0.1410), number of seeds per plant (0.0124), fresh seed weight per pod (0.1150), fresh seed yield per plant (1.3045) and dry seed recovery (0.0281) on seed yield. These results are in conformity with Bajpal (2001) in opium poppy, Schluter and Punja (2002) in american gingeng, Yadav et al., (2007) in safed musli, Ramana et al., (2008), Yadav (2007), Mishra (2002) and Jain (1990) in soybean. In the present study, the number of branches per plant (–0.1321), days to flowering (–0.0119), number of flowers per plant (–0.5095) and fresh seed recovery (-0.0414) showed negative direct effect on seed yield. But number of branches per plant, number of flowers per plant and fresh seed recovery had positive association with seed yield indicating that this may be due to indirect effects of other yield component traits through number of branches per plant, days to flowering, number of flowers per plant and fresh seed recovery.

To improve seed yield in glory lily, selection should focus on number of branches per plant, number of flowers per plant, number of pods per plant, number of seeds per plant and dry seed recovery. These characters have positive associations and positive direct effects on seed yield.

Table 2. Direct and indirect effects between yield and its components at genotypic level in glory lily (*Gloriosa superba* L.)

Characters	Plant height	No. of leaves /plant	No. of branches /plant	Days to flowering	Days to 50% flowering	No. of flowers /plant	No. of pods /plants	No. of seeds /plant	Fresh seed weight /pod	Fresh seed yield /plant	Fresh seed recovery	Dry seed recovery
Plant height	**0.0189**	0.0750	-0.1184	0.0043	-0.0105	-0.4224	0.1140	0.0092	0.1130	1.0821	-0.0402	-0.0111
No. of leaves/plant	0.0180	**0.0788**	-0.1227	0.0040	-0.0107	-0.4803	0.1306	0.0101	0.1122	1.2448	-0.0415	-0.0127
No. of branches/plant	0.0170	0.0732	**-0.1321**	0.0042	-0.0101	-0.4473	0.1257	0.0078	0.1073	1.2060	-0.0384	-0.0160
Days to flowering	-0.0068	-0.0262	0.0468	**-0.0119**	0.0051	0.1905	-0.0520	-0.0036	-0.0378	-0.4769	0.0068	-0.0085
Days to 50% flowering	-0.0179	-0.0755	0.1191	-0.0054	**0.0112**	0.4678	-0.1274	-0.0109	-0.1116	-1.2225	0.0394	0.0088
No. of flowers/plant	0.0157	0.0743	-0.1160	0.0045	-0.0103	**-0.5095**	0.1394	0.0104	0.1025	1.3300	-0.0371	-0.0128
No. of pods/plant	0.0154	0.0734	-0.1185	0.0044	-0.0102	-0.5069	**0.1401**	0.0101	0.1010	1.3362	-0.0364	-0.0134
No. of seeds/plant	0.0140	0.0638	-0.0834	0.0035	-0.0098	-0.4268	0.1144	**0.0124**	0.0882	1.0805	-0.0325	-0.0055
Fresh seed weight/pod	0.0186	0.0768	-0.1233	0.0039	-0.0108	-0.4538	0.1230	0.0095	**0.1150**	1.1797	-0.0410	-0.0117
Fresh seed yield/plant	0.0153	0.0732	-0.1189	0.0043	-0.0102	-0.5055	0.1397	0.0100	0.1012	**1.3405**	-0.0367	-0.0138
Fresh seed recovery	0.0184	0.0789	-0.1226	0.0020	-0.0106	-0.4568	0.1233	0.0098	0.1140	1.1889	**-0.0414**	-0.0144
Dry seed recovery	-0.0075	-0.0355	0.0750	0.0036	0.0035	0.2312	-0.0668	-0.0024	-0.0477	-0.6565	0.0212	**0.0281**
Correlation with dry seed yield/plant	0.814**	0.931**	0.897**	-0.375	-0.925**	0.991**	0.995**	0.819**	0.886**	0.999**	0.889**	-0.454*

Bold, diagonal values indicate direct effects; ** = Significant at 1% level; Residual effect = 0.0224

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