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Path coefficient analysis in gladiolus

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Abstract
An investigation was carried out to study their performance of gladiolus cultivars under Nilgiris conditions. It also aims to study the genetic variability and correlation of the different morphological characters influencing the flower yield in different genotypes of gladiolus. The experimental material comprised of twelve varieties *viz.*, Arka Amar, Arka Kesar, Arka Swarna, Arka Shobha, Arka Sapna, Aarthi, Poonam, KumKum, Pusa Sagun, Dharshan, Arka Gold and Arka Sagar were evaluated in Randomized Block Design with three replications during Kharif 2016-2017 at Horticultural Research station, Tamil Nadu Agricultural University, Ooty. The observations were recorded on plant height, days to sprouting of corms, leaf width, number of leaves per plant, days to emergence of spike, days to flowering, rachis length, number of spikes per plant, vase life in water, number of corms per plant, weight of single corm, diameter of corm, number of cormels per plant, weiht of single cormel and diameter of cormel. From the present investigation, it can be concluded that among the genotypes Poornima and Kamini recorded maximum flower yield and number of flowers per plant. Path co-efficient analysis showed that rachis length, diameter of cormel, number of corms per plant, number of florets pr spike and weight of cormel may be considered for further improvement. However, Floret length and floret breadth may also be considered as a criterion for selection.

Keywords: Gladiolus, yield, path analysis

Introduction
Gladiolus (*Gladiolus floribundus* L.) is a bulbous ornamental plant belongs to family Iridaceae. It is an elegant cut flower grown for its magnificent spikes. With changing life style and increased urban affluence, floriculture has assumed a definite commercial status in recent times and it has emerged as an important agribusiness venture. In this regard gladiolus has gained much importance as it is the 'Queen of bulbous flowers'. The latin word 'Gladius' means sword and hence, it is often called as 'sword lily' because of the shape of its leaves. Gladiolus was also called 'xiphium' based on the Greek word 'Xiphos' also meaning sword. So we have here what might appear to be pretty war like flower.The crop has wide range of varietal wealth which exhibit a huge range of variability. Gladiolus is known as queen of the bulbous plant is very popular as cut flower, both with the consumer and florist alike because of its many spike forms, color and color combinations, an advantage in every floral arrangement (Bushman,1990) [3]. It is useful for both cut flowers and garden display. As a cut flower, it has great potentialities for the export to European countries during the winter months to earn the valuable foreign exchange

In India, its germplasm has been screened but the information on the performance for the higher yield of the cut flower and yield contributing parameters of gladiolus is meager. In spite of varietal development there is needed to evaluate the varieties/ genotypes for better yield, quality and their adaptation under different environment. Because a variety may perform well only in a particular environment and therefore the genetic potentiality of different genotypes and their interaction with environmental condition are to be established and according to their performance, selection of best growth and flowering traits genotype needs to be done.

The path coefficient analysis deals with the direct and indirect relationship of predicted variable with the responsible variables which help in assessing the relative influence of significant traits on the ultimate yield. Therefore, the present investigations were carried out to generate such information for gladiolus.

Materials and Methods
The experiment was conducted in a open condition at Horticultural Research Station, Tamil Nadu Agricultural University, Ooty during 2016-17 for one year.

The Nilgiris which is located at 11.4025'N Latitude, 76.735' E Longitude and at an Altitude of 2635 m above Mean Sea Level. The mean annual rainfall of The Nilgiris is 1632 mm. The average maximum and minimum temperature is 26.0 ºC and 2 ºC respectively. The average relative humidity is 75 per cent. The soil of the experimental plot was laterite in texture with 0.5 to 1.5 m depth. The land was thoroughly pulverized and enriched with red earth, sand and well decomposed farm yard manure at 2:1:1 proportion. The experiment was laid out in a randomized block design with three replication. Twelve cultivars with uniform sized corms were planted at 5 cm depth, planted at a spacing of 30 x30 cm. Uniform package of practices are followed to grow a successful crop. Five plants from each cultivar in each replication were used as tester for recording biometric characters on plant height(cm), days taken for flowering, number of spikes per plant, spike length (cm), spike weight (g), flower diameter(cm),days to corm sprouting, corm weight (g), number of corms, cormel diameter (cm) and vase life in water(days). path analysis were computed as per method as suggested by Al-Jibouri *et al*. (1958) [1], Miller *et al*. (1958) [1] and Dewey and Lu (1959) [4].

Results and Discussion

During 2016-17, twelve varieties of Gladiolus were evaluated and studied their performance under Nilgiris. The data were analysed statistically and is presented in Table.1. a.&1.b. Cultivar Kum Kum recorded minimum plant height (62.4 cm) and considered as dwarf, whereas, cultivar Darshan recorded plant height of 127.2 cm and were considered as tall cultivar. Among these cultivars, earliest flowering cultivars are Arka Shobha (70.6 days), KumKum (71.0days) and Arka Swarna (80.4 days).They took 70-80 days for flowering after planting while late flowering genotypes are Arka Sapna (100.0days), Poonam (102.8 days), Pusa Shagun (105.1days), Arka Gold (101.8days) and Dharshan (101.7days) which flowered in >100-105 days after planting. Patil *et al*., (1994) [10] evaluated exotic gladiolus. Maximum spike length was recorded in Arka Kesar (100.2 cm) followed by Arka Sapna (97.2 cm). The Lowest spike length (50-60 cm) was recorded in Arka Swarna (62.0 cm). The maximum rachis length of 84.2 cm was registered in Arka Shobha and minimum of 40.4 cm was recorded in Pusa Shagun. while number of florets per spike were maximum in Arka Sapna (17.3) followed by and Arka Kesar (16.3). Rao and Jankiram (2006) worked on the performance of gladiolus cultivars and observed that the spike length and rachis length were maximum in Dhiraj while maximum floret was in Kumkum. Maximum vase life was recorded in Arka Kesar, Arka Shobha and Kum Kum (11.0days) while minimum vase life was recorded by Arka Gold (5.0days). The number of spikes per plant ranged from 1.0 to 1.8. The variations among the floral characteristic has been observed by Lal *et al*., (1984) [6].

The data recorded on corm and cormel production of gladiolus has been presented in Table 1.b. No. of corms ranged from 0.80 to 2.33.The individual weight of corm ranged between 16.0g and 32.0g.Perusal of data revealed that maximum number of corms per plant was produced by cv. Poonam (2.33) and minimum corm production was recorded by cv. Darshan (0.80).similarly, the highest weight of corm was recorded in Arka Keasr (32.0g) and the lowest weight of 15.0g noticed in Arka Shobha. Regarding cormel production of gladiolus cultivars, maximum weight of cormels 11.2g per plant was measured by Arka Sagar, However, minimum cormel weight of 1.8 g was noticed in cv. Arka Sapna. The highest number of cormels was observed in Arka Kesar (11.2) and minimum in Arka Amar (2.4). The diameter of corm was maximum in Pusa Shagun (2.0 cm) Arka Kesar (2.0cm) and minimum in Arka Sagar (0.9cm). Among the twelve varieties of Gladiolus Arka Kesar, Arka Shobha and Arka Sapna performed well under Nilgiris.

Table 1a: Performance of Gladiolus cultivars under Nilgiris

Variety	Plant height (cm)	Days to spike initiation	Spike length (cm)	Rachis length (cm)	No. of florets /spike	Vase life (days)	No. of spikes /plant
1.Arka Amar	88.6	86.2	72.1	41.0	15.2	10.0	1.0
2.Arka Kesar	110.5	97.4	100.2	81.2	16.3	11.0	1.2
3.Arka Swarna	90.5	80.4	62.0	71.3	10.4	8.0	1.4
4.Arka Shobha	72.0	70.6	91.0	84.2	15.8	11.0	1.2
5.Arka Sapna	103.9	100.0	97.2	48.4	17.3	10.0	1.2
6.Aarti	125.3	94.6	67.0	49.1	8.9	7.0	1.0
7.Poonam	83.6	102.8	81.1	53.0	9.3	10.0	1.0
8.Kum Kum	62.4	71.0	64.3	76.3	8.4	11.0	1.8
9.Pusa Shagun	78.2	105.1	83.5	40.4	12.3	6.2	1.2
10.Arka Gold	111.4	101.8	82.0	61.0	11.4	5.0	1.0
11.Darshan	127.2	101.7	95.0	72.1	7.2	6.0	1.0
12.Arka Sagar	80.8	90.2	69.7	59.3	8.4	7.0	1.0
SED	19.1	4.8	16.0	13.1	3.0	2.8	3.0
CD@5%	9.3	2.3	8.3	6.4	1.5	1.3	1.1

Table 1b: Performance of Gladiolus cultivars under Nilgiris

Variety	No. of corms /plant	Wt. of one corm (g)	Diameter of corm (cm)	No. of cormels /plant	Wt. of cormels (g)	Diameter of cormel (cm)
1. Arka Amar	1.15	22.0	2.5	2.4	2.1	1.1
2. Arka Kesar	2.0	32.0	4.1	11.2	2.0	2.0
3. Arka Swarna	1.32	25.0	3.1	7.6	2.6	1.0
4. Arka Shobha	1.17	15.0	4.0	5.6	3.4	1.6
5. Arka Sapna	1.21	20.0	2.9	4.8	1.8	1.0
6. Aarti	2.0	29.2	4.1	3.4	3.8	1.6
7. Poonam	2.33	23.0	5.2	8.2	5.2	1.9
8. Kum Kum	1.25	16.4	3.8	6.1	9.6	1.7
9. Pusa Shagun	1.30	30.1	4.7	3.4	5.2	2.0

10. Arka Gold	0.95	27.2	3.3	9.2	3.4	1.2
11. Darshan	0.80	21.0	3.2	5.6	8.2	1.3
12. Arka Sagar	0.95	16.0	4.1	6.5	11.2	0.9
SED	2.1	10.3	5.1	5.8	3.2	2.5
CD@5%	0.52	5.2	2.1	2.5	1.8	1.2

Path co-efficient analysis

Path coefficient analysis has been used to organize the relationship between independent variable and responsible variables. To understand the direct and indirect effects of each character on flower yield, partitioning of correlation coefficient into direct and indirect effects through path coefficient analysis is very important. The data on direct and indirect effects of different characters on commercially important characters viz., spike length, number of florets per spike, floral diameter and number of daughter corms are presented in Tables.2

Knowledge of degree of association of yield with its components is of great importance. because yield is not an independent character. But it is the resultant of the interactions of a number of component characters among them selves as well as with the environment in which the plant grows. Further each character is likely to be modified by action of genes present in the genotypes of plant and also by the environment and it becomes difficult to evaluate this complex character directly. Therefore, correlation study of yield with its component trait has been executed to find out the yield contributing traits.

Among all the characters studied rachis length (1.493) showed highest positive direct effect on flower yield per plant followed by days to spike initiation (1.249), diameter of cormel (0.496), number of corms per plant (0.443)., number of florets per spike (0.320),weight of cormel (0.259) and weight of individual corms (0.016).Whereas negative direct effect was executed by diameter of corm (-0.1.077),plant height (-0.988), spike length (-0.850) and number of cormels per plant (-0.519). The significant and positive correlations between different characters were previously reported by Sirohi (2000) [13] and Maurya (2011) [7]. Residual effect was found to be (0.534). The results are in line with the finding of Kumar *et al*. (2012).

Hence, rachis length, diameter of cormel, number of corms per plant, number of florets pr spike and weight of cormel may be considered for further improvement. However, Floret length and floret breadth may also be considered as a criterion for selection.

Table 2: Path analysis of gladiolus

Characters	Plant height	Days to spike initiation	Spike length	Rachis length	No. of florets /spike	No. of corms /plant	Diameter of corm	Wt. of one corm (g)	No. of cormels /plant	Diameter of cormel	Wt. of cormels	No. of spikes /plant
Plant height	-0.988	0.667	-0.263	-0.263	-0.034	0.054	0.319	0.008	0.014	-0.060	-0.078	-0.988
Days to spike initiation	-0.528	1.249	-0.335	-1.017	-0.034	0.085	-0.218	0.009	-0.017	0.074	-0.040	1.249
Spike length	-0.306	0.493	-0.850	0.217	0.167	-0.013	0.017	0.001	-0.139	0.121	-0.087	-0.850
Rachis length	0.174	-0.850	-0.123	1.493	-0.022	-0.034	0.016	-0.006	-0.312	0.066	0.041	1.493
No. of florets /spike	0.104	-0.134	-0.443	-0.101	0.320	0.008	0.365	0.001	-0.001	0.000	-0.203	0.320
No. of corms /plant	-0.121	0.238	0.026	-0.115	0.006	0.443	-0.620	0.008	-0.198	0.297	-0.092	0.443
Diameter of corm	0.293	0.253	0.013	-0.022	-0.108	0.255	-1.077	0.003	-0.186	0.355	0.067	-1.077
Wt. of one corm (g)	-0.480	0.731	-0.079	-0.509	0.027	0.210	-0.202	0.016	-0.098	0.224	-0.134	0.016
No. of cormels /plant	0.027	0.041	-0.228	0.898	0.000	0.169	-0.386	0.003	-0.519	0.158	0.000	-0.519
Diameter of cormel	0.119	0.185	-0.207	0.199	0.000	0.266	-0.771	0.007	-0.165	0.496	-0.027	0.496
Wt. of cormels	0.296	-0.192	0.286	0.237	-0.250	-0.158	-0.277	-0.008	0.000	-0.051	0.259	0.259
	Residual Effect= 0.534303											

Plant height had positive direct effect on days to spike initiation, number of corms per plant, diameter of corms, weight of single corm, number of cormels per plant. Days to spike initiation showed negative direct effects on plant height, spike length, number of florets per spike, diameter of corm, number of cormels per plant and weight of cormels per plant. Similarly, spike length had positive effects via days to spike initiation, rachis length, number of florets per spike, diameter of corm, weight of corm and diameter of corm. Rachis length showed positive direct effect plant height, diameter of corm, diameter of cormel and weight of cormel. Rachis length showed negative effect via days to spike initiation, spike length, number of florets per spike, weight of one corm and number of cormels per plant. Similar results were reported by Anuradha (1990).Positive and highly significant phenotypic correlation of spike length with plant height and rachis length were mainly due to their respective high direct effects.

Number of florets per spike showed positive direct effect via plant height, number of cormsper plant, diameter ofcorm, weight of single corm and diameter of cormel. Number of corms per plant showed negative effect through plant height, rachis length, diameter of corm, number of cormel per plant and weight of cormel. Diameter of corm registered positive effect through plant height, days to spike initiation, spike length, number of corms per plant, weight of one corm, diameter of cormel and weight of cormel. Whereas weight of one corm showed positive effect through days to spke initiation, number of florets per spike, number of corms per plant and diameter of cormel

Number of cormels per plant showed negative effect via spike length, and diameter of cormel. Diameter of cormel exerted positive effect via plant height, days to spike initiation, rachis length, number of floretsper spike, number of cormsperplant, weight of corm, diameter of cormel. Weight of cormel showed positive direct effect through plant height, spike length, rachis length, number of cormels per plant, and weight of cormels.

whereas plant height, spike length, diameter of corm and number of cormels per plant, had showed negative correlation with number of spike per plant. Days to spike initiation, rachis length, number of florets per spike,number of corms per plant, weight of corm, diameter of cormel and weight of cormel showed positive correlation with number of spikes per plant,

The results is in accordance with Anuradha (1990) for rachis length. Misra and Saini (1990) for number of florets open at one time, plant height and weight of daughter corm. This results are in accordance with the findings of Patra, and Mohanty. 2015. This also indicates that their positive and significant correlations at the phenotypic levels due to their high direct effects.

Improvement in gladiolus thus may be enhanced through the direct selection of genotypes to be used in breeding programmes for the above mentioned characters exhibiting high positive direct and indirect effects with positive correlations. While, intervarietal crossing programmes for the desired characters on the basis of the traits having negative direct effect ultimately results in a combination of characters.

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