

**RESEARCH ARTICLE :**

Studies on genetic variability, heritability and genetic advance in lisianthus [*Eustoma grandiflorum* (Raf.) Shinners]

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SUMMARY : The study was conducted on genetic variability, heritability, genetic advance and correlation co-efficient for vegetative and floral characters of 12 cultivars of Lisianthus which exhibited significant differences in all the characters studied. The cultivar Echo Pink exhibited maximum plant height (93.43 cm) and number of shoots per plant (5.27) during harvest, while minimum was observed in Echo Lavender (51.86 cm) and Shallot Green (2.13). The co-efficient of variation was found to be higher in number of buds per plant (GCV= 43.24, PCV= 43.60) and minimum for bud diameter (GCV = 6.62, PCV = 8.27). Heritability estimates were high for all the characters studied. The highest heritability was noticed for number of buds per plant ($h^2 = 98.35$). High genetic advance as per cent mean was exhibited by number of buds per plant (88.35) while the minimum of 10.43 was noticed in bud diameter. High heritability coupled with high genetic advance was noted for traits namely days taken for bud initiation ($h^2 = 98.20$, GA = 39.86) and number of buds per plant ($h^2 = 98.35$, GA = 25.03) indicating the possible role of additive gene action which suggested that improvement of these traits would be effective for further selection of superior genotypes.

KEY WORDS :

Lisianthus,

Variability,

Heritability,

Genetic advance

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BACKGROUND AND OBJECTIVES

The species *Eustoma grandiflorum* (Raf.) Shinners (syn. *Lisianthus russelianus*), known as Prairie gentian, Lisianthus, Texas blue bell, Tulip gentian, Blue bells or Lira de san pedro, is a herbaceous annual, interesting as a new species for the cut flower market (Pertwee, 2000). *Eustoma grandiflorum* (lisianthus) hybrids have continued to gain acceptance as new cut flowers, bedding plants

and potted flowering plant since their introduction promoted the floriculture trade in the early 1980 (Halevy and Kofranek, 1984). Since there is huge demand for this crop, genetic improvement is essential. For that, the idea of mean performance, magnitude of genetic variability, heritability and genetic advance is necessary, because of their frequent application in plant breeding. Comparison of variation of different traits in

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same population as well as variation of the same character expressed by different population can be known by the coefficient of variation. Heritability gives the additive genetic variance and phenotypic variance (Nyquist, 1991). So the study was taken upto estimate genetic variability, heritability and genetic advance in *Lisianthus*.

RESOURCES AND METHODS

The study was carried out at Horticultural Research Station, Udhamandalam, Tamil Nadu Agricultural University during 2012 - 2013 in a Randomized Block Design with three replications. Totally 12 double type *Lisianthus* cultivars viz., Bolero White, Minuet Dark Purple, Echo Lavender, Echo Pink, Art Marine, Art Peach, Shallot Green, Purple Flamingo, Nightingale, Blue Picotee, Papillon Rose Pink and Gavotte Yellow were

employed and were planted at a spacing of 15 cm x 15 cm. Five plants per replication were selected for observation and data was recorded on 11 growth and yield related parameters. The co-efficient of variation was calculated by using method proposed by Burton (1952). Heritability (h^2) was computed following the method of Lush (1940) and expressed in per cent and was categorized as suggested by Robinson *et al.* (1949). The expected genetic advance was computed following Johnson *et al.* (1955).

OBSERVATIONS AND ANALYSIS

Analysis of variance revealed highly significant difference among genotypes for all the characters studied (Table 1). This suggested the presence of wide range of variability for different characters studied. Genetic

Table 1 : Analysis of variance for growth and yield related traits in *Lisianthus (Eustoma grandiflorum)*

Source of variance	d.f.	MSS										
		Plant height (cm)	Internodal length (cm)	Time taken for bud initiation (days)	Time taken from bud initiation to flowering (days)	Number of buds per plant	Bud length (cm)	Bud diameter (cm)	Number of petals per flower	Stem girth (cm)	Number of flowers per plant	Number of shoots per plant (yield)
Replication	2	10.54	0.143	2.53	28.58	1.24	0.006	0.008	0.355	0.033	0.766	0.030
Treatment	11	474.6 **	1.34 **	1151.0 **	171.8 **	452.8 **	0.889 **	0.407 **	51.86 **	0.186 **	25.97 **	3.01 **
Error	22	3.49	0.118	6.98	4.95	2.51	0.035	0.071	1.97	0.017	0.863	0.180

** indicate significance of value at P=0.01

Table 2 : Mean performance of *Lisianthus* genotypes for various growth and flowering traits

Genotypes	Plant height (cm)	Internodal length (cm)	Time taken for bud initiation (days)	Time taken from bud initiation to flowering (days)	Number of buds per plant	Bud length (cm)	Bud diameter (cm)	Number of petals per flower	Stem girth (cm)	Number of flowers per plant	Number of shoots per plant (yield)
Bolero white	76.31	7.47	107.33	35.33	20.97	4.43	4.97	16.47	1.88	8.43	4.73
Minuet dark purple	72.97	6.88	123.67	44.33	60.31	3.13	5.75	22.85	2.14	17.09	4.13
Echo lavender	51.86	6.21	165.67	52.67	24.95	3.85	5.25	28.61	2.44	09.57	4.33
Echo pink	93.43	8.49	134.67	35.33	28.35	4.43	5.34	22.53	2.15	10.79	5.27
Art marine	62.55	6.44	166.67	39.33	21.18	4.50	5.12	19.27	2.29	07.30	4.53
Art peach	57.41	6.28	164.33	41.67	34.83	4.24	4.66	20.73	2.02	11.17	4.20
Shallot green	59.10	6.37	156.00	50.33	29.89	3.11	4.35	13.03	1.93	08.64	2.13
Purple flamingo	75.15	7.18	156.67	48.67	20.24	3.83	5.32	22.02	2.37	09.42	3.33
Nightingale	67.07	6.59	150.67	46.33	17.50	3.06	5.39	15.33	2.41	06.20	2.67
Blue picotee	90.82	7.63	135.00	32.33	23.08	4.38	5.09	19.70	2.03	06.60	4.93
Papillon rose pink	74.23	7.04	163.33	54.33	40.82	3.65	5.49	16.50	2.74	11.98	2.93
Gavotte yellow	73.37	6.99	166.33	52.33	17.86	3.90	5.17	21.22	2.35	08.42	3.00
Mean	71.19	6.96	149.19	44.42	28.33	3.88	5.16	19.86	2.23	09.64	3.85
S.E.±	1.53	0.281	2.16	1.82	1.29	0.154	0.209	1.15	0.106	0.759	0.347
C.D.(P=0.05)	3.17	0.582	4.47	3.77	2.68	0.318	0.433	2.37	0.219	1.57	0.719

parameters like genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV), heritability and genetic advance are useful biometrical tools for determination of genetic variability (Aditya *et al.*, 2011).

The data presented in Tables 2 and 3 revealed a high range in plant height (51.86 - 93.43), time (days) taken for bud initiation (107.33-166.70), number of buds per plant (17.50- 60.31), number of petals per flower (13.03- 28.61) and number of flowers per stem (6.20-17.09). Narrow differences were observed between the estimates of phenotypic co-efficient of variation and the corresponding genotypic co-efficient of variation, were mainly due to genetic make-up and there is a less environmental influence on the expression of these traits. Similar results were also reported by Misra and Saini (1990) and John *et al.* (2002) in gladiolus. The high estimates of PCV and GCV were recorded for the traits *viz.*, number of buds per stem (GCV= 43.24, PCV = 43.60), number of flowers per stem (GCV= 30.02, PCV = 31.53), number of shoots per stem (GCV= 25.23, PCV = 27.54) and number of petals per flower (GCV= 20.54, PCV = 21.72) as observed from Table 3, suggesting that, these characters are under genetic control and have ample scope for improvement. Similar results were noticed for number of flowers per stem in China aster as reported by Ravikumar and Patil (2003) and Namita *et al.* (2008) in French marigold and number of florets per spike in gladiolus as reported by Kispotta *et al.* (2017). Moderate PCV and GCV estimates were noticed for the characters such as, plant height, time taken for bud initiation, time taken from bud initiation to flowering, bud

length and stem girth. The above results are in line with the findings of Sujatha *et al.* (2003) in gerbera and Balaram and Janakiram (2009) in gladiolus.

The magnitude of heritable variability is the most important aspect of genetic constitution of the genetic material which is one of the basic criteria for the selection of variety/genotype (Panse, 1957). High heritability with high genetic advance indicates that the character is governed by the additive gene action and for this simple selection is advocated. In the present study, estimates of high heritability coupled with high genetic advance were observed for all the traits studied (plant height ($h^2 = 97.82$, GA = 25.54), number of buds per stem ($h^2 = 98.35$, GA = 25.03) and time (days) taken for bud initiation ($h^2 = 98.20$, GA = 39.86)) except internodal length, bud diameter and stem girth, in which high heritability was combined with moderate genetic advance. Findings of this study suggest the enough scope of improvement of these characters through selection. The results are in line with the findings of Singh and Kumar (2008) in marigold for number of flowers per plant and plant height. The results obtained are in accordance with the findings of Dhiman *et al.* (2015) in Asiatic hybrid lily, Bichoo *et al.* (2002) in gladiolus, Sheikh and John (2005) in iris for plant height and in gladiolus for number of floret per spike (Ramzan *et al.*, 2016) and number of flowers per plant in chrysanthemum (Baskaran *et al.*, 2009). Whereas, high heritability coupled with high genetic advance was reported by John *et al.* (1994) in zinnia and Mishra *et al.* (2006) in spray chrysanthemum for the time taken for bud initiation.

Table 3 : Estimates of genetic parameters for growth and flowering traits in Lisianthus genotypes

Characters	Range	Genotypic co-efficient of variation (GCV)	Phenotypic co-efficient of variation (PCV)	Heritability (%)	Genetic advance	Genetic advance as per cent of mean
Plant height (cm)	51.86 - 93.43	17.60	17.80	97.82	25.54	35.87
Internodal length (cm)	6.21- 8.49	9.15	10.39	77.46	1.15	16.58
Time taken for bud initiation (days)	107.33-166.70	13.09	13.21	98.20	39.86	26.72
Time taken from bud initiation to flowering (days)	32.33- 54.33	16.80	17.53	91.84	14.73	33.16
Number of buds per plant	17.50- 60.31	43.24	43.60	98.35	25.03	88.35
Bud length (cm)	3.11- 4.50	13.75	14.58	88.95	1.04	26.71
Bud diameter (cm)	4.35- 5.75	6.62	8.27	61.15	0.54	10.43
Number of petals per flower	13.03- 28.61	20.54	21.72	89.43	7.95	40.01
Stem girth (cm)	1.88- 2.74	10.66	12.14	77.09	0.43	19.27
Number of flowers per plant	6.20- 17.09	30.02	31.53	90.65	5.68	58.89
Number of shoots per plant (yield)	2.13- 5.27	25.23	27.54	83.96	1.83	47.63

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