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Evaluation of genetic variability, correlation and path co-efficient analysis for cut flower attributing traits in medium decorative dahlia (*Dahlia variabilis* L.)

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Abstract
The experiment laid out in Randomized Block Design, which was replicated thrice with 15 cultivars of medium decorative dahlia to study the genotypic and phenotypic coefficients of variation, heritability, expected genetic advance, correlation among the cut flower attributing traits and their effect in medium decorative dahlia. The PCV values were slightly higher than GCV, indicating little influence of environment in character expression. High heritability coupled with high genetic advance and high GCV were observed for plant height, stalk length, leaf area and cluster weight of tubers indicating the multitude of additive gene action. Results of genotypic and phenotypic correlation co-efficient showed significant positive correlation for vase life, flower diameter, self-life and cluster weight of tubers per plant, plant height, and days to flower bud emergence from planting and stalk diameter with each other and other yield attributes. The component characters and path-coefficient analysis revealed positive direct effect of days to flower bud emergence from planting, days to full bloom from flower bud emergence and plant height at full bloom had direct positive effect. The analysis suggests that the above mentioned parameters are sufficient for direct selection of cultivars for cut flower attributing traits in medium decorative dahlia. However, the high residual effect and relatively moderate level of genetic parameters are revealing the requirement of more no of cut flower attributing parameters under consideration for improvising in crop breeding pipeline of medium decorative dahlia.

Keywords: Dahlia, correlation, variability, heritability, genetic advance

Introduction
Growth and yield of any flower crop is influenced by various factors like variety, season, environment etc. Among these factors, varieties, they contribute much to the evolution of any flower crop. Dahlia (*Dahlia variabilis* L.) belongs to the family Asteraceae, occupies a place of pride in any garden at any place. Dahlia is a valuable species in a group of flowering plants, used in landscape architecture (Smith, 1971) [11]. Dalia is very popular because it has a very wide variety of shapes and colours and this diversity is impossible to match by other plants. Wild species are generally with simple flower shape, it has a more limited variety and the colour of flower is usually pink, purple or red-orange. It is highly cross pollinated crop with high natural cross pollination contributing to its variability. Information on genetic association under a particular environment helps in formulating the most effective breeding programme and simplifies the approach for selection. The correlation coefficient is helpful for selection of desirable characters under a breeding program as it determines the knowledge of association of plant characters. Thus measurements of correlation coefficient between characters are a matter of considerable importance in selection indices and also permit the prediction of correlated response (Al-Jibouri *et al.* 1958) [1]. The information on the nature of association between yield and its components helps in simultaneous selection for many characters associated with yield improvements (Mahajan *et al.*, 2011) [5]. Genetic relationship and genetic variation among cultivars is an important consideration for classification, utilization of germplasm resources and for breeding (Kumar *et al.*, 2013) [14]. The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme (Bhujbal *et al.*, 2013) [13]. Keeping all these points in view, the present investigation was undertaken to evaluate the genetic variability, correlation and path coefficients analysis for cut flower attributing traits in 15 cultivars of medium decorative dahlia.

Materials and Methods

The experiment was carried out at Horticultural Research Station, Mondouri of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal in well drained sandy loam soil with spacing of 40 × 30cm and pH 6.5. The experiment laid out in Randomized Block Design, which was replicated thrice with 15 treatments in open field condition. Recommended Agro techniques were followed and observations were made on the vegetative and floral parameters. Treatments details are as follows cultivar J.Pee Jee (T_1), Mother Teresa (T_2), Prabhuji (T_3), A. Humbley (T_4), Black Out (T_5), Sachin (T_6), Arab Queen (T_7), Pagal Thakur (T_8), Ankita (T_9), Dhoni (T_{10}), Bhu Sona (T_{11}), Bharati (T_{12}), Chitchor (T_{13}), Agni (T_{14}), Aditya (T_{15}). The data regarding various characters were statistically analysed according to the Fishers analysis of variance technique as given Panse and Sukhamte (1985).

Results and Discussions

Observations on growth parameter

Plant height at flower bud emergence (cm): The plant height at flower bud emergence ranged from 17.13cm to 52.25cm. The genotypic, phenotypic and environmental coefficients of variation were 47.70%, 51.31% and 3.61% respectively. Considerably high heritability of plant height (0.93%) associated with higher genetic advance mean (42.60%) was observed at flower bud emergence (table-1).

Plant height at full bloom (cm): The plant height at full bloom ranged from 37.88cm to 78.25cm. The estimates of genotypic, phenotypic and environmental coefficients of variation this character were 78.37, 83.56 and 5.19% respectively. Considerably high heritability of plant height (0.94%) associated with moderate genetic advance mean (30.67%) was observed at full bloom.

Leaf area (cm^2): The leaf area of the crop at peak stage of growth ranged from 81.30 to 274.55cm. This character showed very high genotypic (1579.59%), phenotypic (1847.14%) and environmental (267.54%) coefficients of variation. Moderate heritability (0.86%) associated with very high genetic advance mean (52.74%) was recorded (table-1).

Flowering attributes and Quality parameters

Days to flower bud emergence (FBE) from Planting: Days to flower bud emergence from planting ranged 62.75 to 105.81 days. This character showed high genotypic (118.80%), phenotypic (126.29%) and environmental (7.49%) coefficient of variation and considerably very high heritability (0.94%) with moderate genetic advance (28.81%) was observed (table-1).

Days to attain 75 percent bloom from FBE: Days to attain 75% bloom from flower bud emergence ranged from 17.44 to 23.19 days. Low values of genotypic (1.97%), phenotypic (2.45%) and environmental (0.48%) coefficient of variation were recorded. The moderate heritability (0.80%) with lower genetic advance (12.91%) was observed.

Days to attain full bloom from FBE: Days to attain full bloom from flower bud emergence ranged from 20.69 to 27.19 days. Lower values of genotypic, phenotypic and environmental coefficient of variation of this character were (2.51%), (3.23%) and (0.73%) recorded respectively. The moderate heritability (0.78%) with low genetic advance (12.18%) was observed (table-1).

Flower diameter (cm): The flower diameter ranged from 12.13 to 15.75cm. This character showed low genotypic, phenotypic and environmental coefficient of variation (1.12%), (1.17%) and (0.05%) respectively. Very high heritability (0.95%) associated with lower genetic advance (15.87%). *Stalk length (cm):* The stalk length ranged from 22.97 to 57.00cm. It recorded high genotypic (70.08%), phenotypic (73.82%) with moderate environmental (3.74%) coefficient of variation. This character showed very high heritability (0.95%) with high genetic advance (43.44%).

Stalk diameter: Stalk diameter ranged from 0.38 to 0.72cm. The estimates of genotypic, phenotypic and environmental coefficient of variation of this character were (0.01%), (0.01%) and (0.00%) respectively. Considerably high heritability (0.95%) associated with moderate genetic advance (29.72) were recorded (table-1).

Flower weight (g): Flower weight ranges from 21.50 to 40.33g. It recorded medium genotypic (28.87%), phenotypic (31.87%) and environmental (3.00%) coefficient of variation. The heritability value was high (0.91%) followed by medium genetic advance of (34.61%).

Self-life (days): The self-life ranged from 3.50 to 4.25 days. This character established very low genotypic, phenotypic and environmental coefficient of variation (0.00%), (0.02%) and (0.02%) respectively. Considerable low heritability (0.15%) associated with low genetic advance (1.14%) were recorded (table-1).

Vase life (days): The vase life ranged from 2.67 to 3.67 days. This character exhibited low genotypic (0.03%), phenotypic (0.08%) and environmental (0.05%) coefficient of variation. This character showed low heritability (0.33%) with low genetic advance mean (6.20%).

Cluster weight of tubers (g): Cluster weight of tubers ranged from 0.10 to 3.80g. Lower values of genotypic, phenotypic and environmental coefficient of variation of this character were (1.58%), (1.60%) and (0.01%) recorded respectively. The high heritability (0.99%) associated very high genetic advance (149.77%) was observed (table-1).

Genetic Variability

On perusal of Table-1, it was revealed that for all the characters phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV), so it is evident that in expression of the characters mainly governed by the genotypes itself along with little effect of environment. The difference among genotypic coefficient variance and phenotypic coefficient variance was very less for stalk diameter, self-life, vase life, flower diameter, stalk length and cluster weight of tubers indicating the fact that these characters are not much influenced by the environmental factors. This also suggests that presence of sufficient genetic variability, which can be exploited by practicing pure line selection. Mishra *et al.* (1997) [16] obtained similar results in dahlia for number of leaves per plant. The genotypic coefficient of variation and phenotypic coefficient of variation for growth parameters relieved that the differences were high for leaf area, days to flower bud emergence from planting, plant height at flower bud emergence, plant height at full bloom. These results are in

accordance with results obtained by Rao and Negi (1988) [8] in China aster and Mishra *et al*. (2001) [7].

Heritability and Genetic Advance

In the present investigation heritability in broad sense was calculated for all characters under study and is presented in table-1. Heritability is classified as high (above 60%), medium (30%-60%) and low (below 30%). Most of the characters exhibited moderate to high heritability percent which indicates that the character are less influenced by environmental effects and are effectively transmitted to progeny. Heritability and genetic advance for growth characters varied considerably. Higher heritability indicates the effectiveness of selection through phenotypic performance, but it does it does not mean a high genetic gain. In the present investigation, high heritability estimates with high genetic advance was suggested that real progress in improvement through selection could be made for cut flower and associated traits viz., plant height at flower bud emergence, stalk length, stalk diameter, flower weight and cluster weight of tubers, which indicates additive gene effects for these characters would be effective. Results were in conformity with plant height and number of leaves observed by Barigagad *et al.* (1992) [2] in chrysanthemum and number of flowers per plant in dahlia by Singh (2003) [10]. High heritability with high genetic advance for plant height in China aster was reported by Negi *et al.* (1983).

Correlation Coefficient

The genotypic and phenotypic correlation coefficients were worked out among 13 characters [Table-2]. The values of genotypic correlation coefficients were lesser than the values of phenotypic correlation coefficients for most of the characters, which indicated there by a less inherent association between various traits that were quite influenced by the environment. The phenotypic correlation coefficient among the traits revealed positively significant relation of cut flower with vase life, flower diameter, self-life and cluster weight of tubers per plant as well as significantly negative correlation among flower weight, leaf area. The genotypic correlation coefficient among the traits showed significant positive relationship of cut flower with days to flower bud emergence from planting, plant height at flower bud emergence, stalk diameter and vase life as well as significantly negative correlation among days to full bloom from flower bud emergence, plant height at full bloom and stalk length. The vase life and cluster weight of tubers are significant positively correlated and flower weight is significant negatively correlated in both phenotypic and genotypic correlation co efficience. There is negatively significant genotypic correlation of flower weight with stalk length. Vase life is positively correlated with stalk diameter and negatively correlated with days to 75% bloom from flower bud emergence, days to Full bloom from flower bud emergence. Table-3 shows environmental and simple correlation of parameters among the medium decorative dahlia cultivars. The positive environmental correlation was found in plant height at full bloom with days to flower bud emergence from planting and vase life with plant height at full bloom and cluster weight of tubers with stalk diameter. This revealed a little influence of environment factor.

Effects of Component Characters

The effects of component characters on the cluster weight of tubers (gm)/plant of medium decorative dahlia cultivars is presented in table-4. The estimate of residual effect reflects the adequacy and appropriateness of the character chosen for path analysis. In the present study the residual value was 0.0657, which showed that the characters studied contributed 99.35% variation towards cluster weight of tubers (gm)/plant and only 0.65% variation remained unaccounted. Among all the characters studied days to flower bud emergence from planting (1.27), days to Full bloom from flower bud emergence (1.53) and plant height at full bloom (1.46) had direct positive effect cluster weight of tubers. The most negative effect was observed in stalk length and days to 75% bloom from flower bud emergence. The residual effect was obtained less than 0.5, suggesting that some of the characters have not been included in the present investigation, which may be responsible to enhance the cluster weight of tubers.

Table 1: Estimation of mean, range and genetic parameters of different characters in medium decorative dahlia cultivars

Particulars	Range		Mean sum square			GCV	PCV	ECV	h^2 (%)	GAM
			Replication	Treat	Error					
	Maximum	Minimum	df = 2	df =14	df =28					
1	105.81	62.75	0.79	363.90	7.49	118.80	126.29	7.49	0.94	28.81
2	23.19	17.44	0.02	6.40	0.48	1.97	2.45	0.48	0.80	12.91
3	27.19	20.69	0.74	8.25	0.73	2.51	3.23	0.73	0.78	12.18
4	52.25	17.13	5.48	146.71	3.61	47.70	51.31	3.61	0.93	42.60
5	78.25	37.88	4.93	240.31	5.19	78.37	83.56	5.19	0.94	30.67
6	15.75	12.13	0.06	3.41	0.05	1.12	1.17	0.05	0.95	15.87
7	57.00	22.97	0.94	213.98	3.74	70.08	73.82	3.74	0.95	43.44
8	0.72	0.38	0.00	0.02	0.00	0.01	0.01	0.00	0.95	29.72
9	4.25	3.50	0.00	0.03	0.02	0.00	0.02	0.02	0.15	1.14
10	3.67	2.67	0.03	0.13	0.05	0.03	0.08	0.05	0.33	6.20
11	40.33	21.50	1.59	89.61	2.99	28.87	31.87	3.00	0.91	34.61
12	274.55	81.30	1775.49	5006.32	267.54	1579.59	1847.14	267.54	0.86	52.74
13	3.80	0.10	0.07	4.76	0.01	1.58	1.60	0.01	0.99	149.77

PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, ECV = Environmental coefficient of variation, h^2 = Heritability, GAM = Genetic advance as percentage mean

1: Days to flower bud emergence from planting 2: Days to 75% bloom from flower bud emergence 3: Days to Full bloom from flower bud emergence 4: Plant height at flower bud emergence (cm) 5: Plant height at full bloom (cm) 6: Flower diameter (cm) 7: Stalk length (cm) 8: Stalk Diameter (cm) 9: Self life (days) 10: Vase life (days) 11: Flower weight (gm) 12: Leaf area (cm^2) 13: Cluster weight of tubers (g)

Table 2: Genotypic and phenotypic correlation co-efficient among different cut flower attributing traits in medium decorative dahlia

Particulars	1	2	3	4	5	6	7	8	9	10	11	12	13	GCC= Genotypic correlation coefficient
1	1.00	0.23	0.22	0.43	0.34	-0.30	0.48	0.27	-0.49	0.02**	0.11	-0.13	0.66	
2	0.19	1.00	0.99	0.09*	0.11	0.08*	0.32	0.42	0.73	-0.01**	-0.22	-0.23	0.17	
3	0.17	0.98	1.00	0.11	0.12	0.11	0.32	0.39	0.67	-0.02**	-0.29	-0.24	0.18	
4	0.40	0.11	0.12	1.00	0.68	0.15	0.63	0.43	0.39	0.21	0.15	0.12	0.01**	
5	0.32	0.13	0.15	0.66	1.00	0.50	0.92	0.49	-0.11	0.57	0.17	0.10	-0.03**	
6	-0.27	0.04**	0.07*	0.12	0.45	1.00	0.39	0.30	0.20	0.84	0.35	0.08*	-0.43	
7	0.45	0.30	0.28	0.62	0.91	0.35	1.00	0.37	0.00***	0.50	-0.04**	-0.22	0.06*	
8	0.24	0.33	0.29	0.39	0.44	0.29	0.34	1.00	0.13	0.01**	0.52	0.59	-0.20	
9	-0.17	0.09*	0.03**	0.13	-0.01**	-0.01**	0.12	0.12	1.00	0.54	-0.17	-0.30	-0.61	
10	0.04**	-0.03**	-0.02**	0.05*	0.32	0.52	0.27	0.00***	-0.10	1.00	0.60	0.03**	0.21	
11	0.10*	-0.26	-0.30	0.12	0.16	0.34	-0.04**	0.48	-0.01**	0.28	1.00	0.63	-0.06*	
12	-0.08*	-0.27	-0.30	0.07*	0.05*	0.09*	-0.22	0.54	-0.03**	0.08*	0.62	1.00	-0.11	
13	0.64	0.15	0.16	0.01**	-0.03**	-0.42	0.06*	-0.19	-0.25	0.12	-0.06*	-0.11	1.00	
PCC= Phenotypic correlation coefficient														

Note: * Significant at 10% level of probability, ** significant at 5% level of probability and *** significant at 1% level of probability. Critical r, (P< 0.1) = 0.30, critical r (P<0.05) =0.36 and critical r (P<0.01) = 0.46.

1: Days to flower bud emergence from planting 2: Days to 75% bloom from flower bud emergence 3: Days to Full bloom from flower bud emergence 4: Plant height at flower bud emergence (cm) 5: Plant height at full bloom (cm) 6: Flower diameter (cm) 7: Stalk length (cm) 8: Stalk Diameter (cm) 9: Self life (days) 10: Vase life (days) 11: Flower weight (gm) 12: Leaf area (cm^2) 13: Cluster weight of tubers (g)

Table 3: Simple and environmental correlation co-efficient among different cut flower attributing traits in medium decorative dahlia

Particulars	1	2	3	4	5	6	7	8	9	10	11	12	13	SCC= Simple correlation coefficient
1	1.00	0.21	0.20	0.42	0.33	-0.29	0.47	0.26	-0.28	0.03**	0.11	-0.11	0.66	
2	-0.09*	1.00	0.99	0.10	0.12	0.07*	0.31	0.39	0.33	-0.02**	-0.23	-0.25	0.16	
3	-0.15	0.94	1.00	0.11	0.13	0.09*	0.31	0.36	0.27	-0.02**	-0.29	-0.27	0.17	
4	-0.10	0.33	0.27	1.00	0.67	0.14	0.63	0.42	0.22	0.13	0.14	0.10	0.01**	
5	0.03**	0.29	0.37	0.33	1.00	0.48	0.92	0.47	-0.05*	0.44	0.17	0.08*	-0.03**	
6	0.16	-0.29	-0.27	-0.38	-0.31	1.00	0.38	0.30	0.07*	0.67	0.35	0.08*	-0.43	
7	-0.19	0.14	0.06*	0.41	0.68	-0.45	1.00	0.36	0.06*	0.38	-0.04**	-0.22	0.06*	
8	-0.16	-0.41	-0.44	-0.23	-0.50	0.08*	-0.15	1.00	0.11	0.01*	0.51	0.57	-0.20	
9	0.05*	-0.41	-0.46	-0.09*	0.16	-0.44	0.56	0.33	1.00	0.10	-0.07*	-0.13	-0.37	
10	0.12	-0.05*	-0.02**	-0.30	0.01**	0.23	-0.06*	-0.02**	-0.30	1.00	0.43	0.05*	0.16	
11	-0.06*	-0.53	-0.44	-0.26	-0.03**	0.32	-0.16	-0.11	0.18	-0.21	1.00	0.63	-0.06*	
12	0.34	-0.49	-0.56	-0.37	-0.41	0.26	-0.26	0.15	0.24	0.19	0.52	1.00	-0.11	
13	0.07*	-0.01**	-0.03**	-0.04**	-0.03**	0.19	-0.17	0.03**	-0.16	-0.05*	0.05*	-0.11	1.00	
ECC= Environmental correlation coefficient														

Note: * Significant at 10% level of probability, ** significant at 5% level of probability and *** significant at 1% level of probability. Critical r, (P< 0.1) = 0.30, critical r (P<0.05) =0.36 and critical r (P<0.01) = 0.46.

1: Days to flower bud emergence from planting 2: Days to 75% bloom from flower bud emergence 3: Days to Full bloom from flower bud emergence 4: Plant height at flower bud emergence (cm) 5: Plant height at full bloom (cm) 6: Flower diameter (cm) 7: Stalk length (cm) 8: Stalk Diameter (cm) 9: Self life (days) 10: Vase life (days) 11: Flower weight (gm) 12: Leaf area (cm^2) 13: Cluster weight of tubers (gm)

Table 4: Effects of component characters on the cluster weight of tubers (gm)/plant of medium decorative dahlia cultivars

	1	2	3	4	5	6	7	8	9	10	11	12	Path coefficients
1	1.27	-0.24	0.33	-0.25	0.49	0.10	-0.63	-0.23	-0.13	0.01	-0.01	-0.06	1.27
2	0.29	-1.04	1.52	-0.05	0.17	-0.03	-0.42	-0.37	0.19	-0.01	0.02	-0.11	-1.03
3	0.28	-1.03	1.53	-0.06	0.18	-0.04	-0.42	-0.34	0.18	-0.01	0.03	-0.12	1.53
4	0.55	-0.09	0.16	-0.58	0.99	-0.05	-0.82	-0.37	0.10	0.07	-0.01	0.06	-0.58
5	0.43	-0.12	0.18	-0.39	1.46	-0.17	-1.19	-0.42	-0.03	0.19	-0.02	0.05	1.46
6	-0.38	-0.09	0.17	-0.08	0.73	-0.35	-0.51	-0.26	0.05	0.28	-0.03	0.04	-0.35
7	0.61	-0.33	0.49	-0.37	1.34	-0.14	-1.30	-0.32	0.00	0.17	0.00	-0.11	-1.30
8	0.34	-0.44	0.60	-0.25	0.71	-0.10	-0.48	-0.86	0.03	0.00	-0.05	0.29	-0.86
9	-0.62	-0.75	1.03	-0.22	-0.16	-0.07	0.00	-0.11	0.26	0.18	0.02	-0.15	0.26
10	0.02	0.02	-0.03	-0.12	0.84	-0.29	-0.65	-0.01	0.14	0.33	-0.05	0.01	0.33
11	0.14	0.22	-0.44	-0.09	0.25	-0.12	0.05	-0.45	-0.04	0.20	-0.09	0.31	-0.09
12	-0.16	0.24	-0.37	-0.07	0.14	-0.03	0.29	-0.51	-0.08	0.01	-0.06	0.49	0.49

Residual effect is 0.0657

1: Days to flower bud emergence from planting 2: Days to 75% bloom from flower bud emergence 3: Days to Full bloom from flower bud emergence 4: Plant height at flower bud emergence (cm) 5: Plant height at full bloom (cm) 6: Flower diameter (cm) 7: Stalk length (cm) 8: Stalk Diameter (cm) 9: Self life (days) 10: Vase life (days) 11: Flower weight (gm) 12: Leaf area (cm^2)

Conclusion

A wide range of medium decorative dahlia cultivars were employed and it resulted in the greater amount of variability. High variation was observed in traits such as days to flower bud emergence from planting, days to 75% bloom from flower bud emergence, days to Full bloom from flower bud emergence, plant height at full bloom, stalk length and stalk diameter

However, the heritability, genetic advance and path analysis with high residual effect clearly indicates that more no of cut flower attributing traits must be incorporated along with a higher genetic diversity for truly understanding cut flower traits. In this investigation, the incorporated traits proved to be sufficient for direct selection of cultivars and more no of traits could also be followed for varietal improvement pipeline.

References

1. Al-Jibourie HA, Miller PA, Robinson HV. Genotypic and Environmental variance and co-variances in a upland cotton cross of interspecific origin. Agron. J. 1958; 50:633-536.
2. Barigagad H, Patil AA, Nalawadi UG. Variability studies in chrysanthemum. Prog. Hort. 1992; 24(1-2):55-59.
3. Bhujbal GB, Chavan NG, Mehetre SS. Evaluation of genetic variability heritability and genetic advances in gladiolus (*Gladiolus grandiflorus* L.) genotypes. The Bioscan. 2013; 8(4):1515-1520.
4. Kumar M, Parthiban S, Saraladevi D, Ponnuswami V. Genetic diversity analysis of acid lime (*Citrus aurantifolia* Swingle) cultivars. The Bioscan. 2013; 8(2):481-484.
5. Mahajan RC, Wadikar PB, Pole SP, Dhuppe MV. Variability, correlation and path analysis studies in sorghum. Res. J Agric. Sci. 2011; 2(1):101-103.
6. Mishra YK, Joshi RP, Solanki SS. Genetic variability in dahlia (Dahlia variabilis). Prog. Hort. 1997; 29(1/2):61-64.
7. Mishra M, Mohanty CR, Mahapatra K. Genetic variability with respect to floral traits in dahlia. J Ornamental Hort., New Series. 2001); 4(2):79-82.
8. Negi SS, Rao TM, Ramachandran N. Annual Report for 1988, Indian Institute of Horticultural research, Hesaraghatta, Bangalore, 1988.
9. Rao TM. Studies on genetic variability and correlation in China aster. (*Callestephus chinensis*). M.Sc. (Agri) Thesis, Univ. Agric. Sci., Bangalore, 1982
10. Singh RK. Variability studies in dahlia for quantitative traits. J. Ornamental Horti. 2003; 7(1):58-60.
11. Smith AW. In: A Gardener's Dictionary of Plant Names. Cassell and Company Ltd, London, 1971, 390.