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Morphological characterization of different genotypes of adenium

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ABSTRACT

Adenium is recently gaining popularity as high value pot plant in the ornamental plant industry. Research on *Adenium obesum* with the basic objective for genetic improvement is being conducted at advance technology centre of soilless system, NAU, Navsari. As a component of breeding work, a study was conducted for morphological characterization of thirty three different genotypes of adenium that comprised of ten selected from local collection and the remaining twenty three from their crosses. Significant variation with regard to plant height, number of leaves, number of flowers, leaf and petal thickness, flower diameter, number of branches, corolla diameter and length, flower longevity, flower weight, flowers per cluster and number of flower flushes in a year were observed. Among all 33 genotypes, considering vegetative traits, Taiwan Dwarf showed significant dwarfness with more number of branches and smaller leaves while plant spread was observed maximum in Cross 14 and number of leaves in Cross 15. Further, fourteen genotypes were found suitable for flowering traits out of which two genotypes (Cross 2 and Cross 23) had flowers with 15 petals and eight genotypes (Cross 5,8,11,14,16,20,21 and DSH) had 10 petals while all others had five petals. Further, Cross 20 for large flower size, Cross 15 for number of flowers per cluster, flower longevity as well as for bearing maximum flowers in a year and Cross 18 and Cross 22 for more number of flower flushes in a year have been identified. These genotypes, can be further exploited for commercial application as well as for breeding work in floriculture industry.

Key words: *Adenium obesum*, flowering trait, germplasm, morphological characters.

INTRODUCTION

Adenium obesum (Forssk.) Roem. & Schult, is recently gaining high popularity as pot plant, although until recently it was being considered a relatively new flowering plant in the ornamental plant industry (Sindhuja *et al*., 13, Singh *et al.,*14, Singh *et al.,*15, Hastuti *et al*., 7). Belonging to the family Apocynaceae, it is a native from Africa such as Ethiopia, Kenya, Senegal, Somalia, Sudan and Tanzania, also found in Oman, Saudi Arabia and Yemen as wild plant. Owing to its beautiful sculptural caudex, good branching habit and tolerance to drought stress (Paul *et al.,*10), its market demand is increasing (Wannakrairoj, 19). It is now in cultivation in many tropical countries (Chavan *et al*., 2, Chavan *et al*., 4, Colombo *et al*., 5 and Colombo *et al*., 6).

Adeniums are cross pollinated plants and are highly heterozygous in nature. Research in Adenium towards selecting or breeding superior horticultural forms has been inadequate (Chavan *et al*.,3, Singh *et al*., 15, Singh *et al*., 16). Work on genetic improvement employing hybridization and selection in *Adenium obesum* with the objective of introducing novelty in flower colour and flower form, flowering habit, *etc*., is being carried out at Advance Technology Centre of soilless system, at Department of Floriculture and Landscape Architecture, NAU, Navsari. In this context, present study was undertaken for morphological characterization of thirty three different genotypes of adenium that comprised of ten selected from local collection and the remaining twenty three from their crosses.The investigation aimed atestimation of variation with respect to various vegetative and flowering traits among thirty three genotypes of adenium which could be utilized in crop improvement programme.

MATERIALS AND METHODS

The present study was carried out at the Advance Technology Centre for production of various crops in soilless systems, Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari-396450, Gujarat during 2017-2019. The experiment was laid out in randomized block design with three replications comprising of ten selected from local collection *viz*., Sudarshan (S), Arrogant(A), Mung Siam (MS), Harry Potter (HP), Mor Lok Dok (MLD), Picottee (P), Taiwan Dwarf (TD), Deang Udam Sap (DUS), Double Sweet Heart (DSH), Vithoon's White (VW) and the remaining twenty three from their crosses *viz*., C-1 (S × DUS), C-2 (S × DSH), C-3 (S × VW), C-4 (A × DUS), C-5 (A × DSH), C-6 (A

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× VW), C-7 (MS × DUS), C-8 (MS × DSH), C-9 (MS × VW), C-10 (HP × DUS), C-11 (HP × DSH), C-12 (HP × VW), C-13 (MLD × DUS), C-14 (MLD × DSH), C-15 (P × DUS), C-16 (P × DSH), C-17 (P × VW), C-18 (TD × DUS), C-19 (TD × DSH), C-20 (HP × DSH), C-21 (MLD × DSH), C-22 (S × DUS) and C-23 (HP × DSH). Observation on different morphological traits were recorded from five randomly selected plants from each genotype in each replication. The data was recorded for two years *i.e.* 2017-18 and 2018-19 and was pooled. Observations were taken on vegetative traits like plant height (cm), caudex circumference (cm), number of branches per plant, plant spread (cm), leaf length (cm), number of leaves per plant,leaf length (cm) and leaf width(cm), leaf area (cm^2) by digital leaf area meter andleaf thickness (mm) were recorded. Further, flower diameter (cm), length of corolla tube (cm), diameter of corolla tube (cm), number of petals per flower, petal thickness (mm), *in-situ* longevity by counting number of days from flower bud opening till the day of flower senescence, number of flower buds and flower per cluster, weight of flower (g), number of flowers blooming once,length of anther appendages (cm), number of days of blooming, number of flushes per year, number of days from bud initiation to senescence from flower bud initiation till the day of flower senescence and total number of flowers per plant per year were recorded as flowering traits. The data of two years were pooled and analysed statistically in CRD using OP Stat software (Sheoran *et al*., 12).

RESULTS AND DISCUSSION

All the genotypes showed variation in different vegetative parameters (Table1). Maximum plant height (49.64 cm) was recorded in genotype Cross 21 which was followed by Cross 11 while minimum plant height (23.33 cm) was recorded in Taiwan Dwarf. Maximum number of branches per plant (5.07) were observed in Taiwan Dwarf followed by Sudarshan and Cross 13 and minimum in Harry Potter. Caudex circumference was found maximum (19.38 cm) in Cross 16 which was statistically at par with Cross 17, Cross 15, Cross 5, Cross 6, Cross 18 and Cross 8. Plant spread was observed maximum (31.50 cm) in Cross 14 that was followed by Cross 15 while minimum plant spread (14.57 cm) was recorded in Taiwan Dwarf. Further, leaves were maximum (80.00) in Cross 15 and minimum (30.67) in Mung Siam. Maximum leaf length was recorded in Cross 3 and minimum in Taiwan Dwarf. Leaf width was maximum in Cross 6 and minimum in Sudarshan. Leaf area was maximum in Cross 5 followed by Cross 14, whereas it was minimum in Taiwan Dwarf. Leaf thickness was found maximum in Cross 13 whereas Mung Siam showed lowest leaf thickness (Table 1). Taiwan Dwarf has shown exclusively reduced plant height along with more branching as well as smaller leaves with minimum leaf area. Genetic makeup of the germplasm along with the management factors and environmental conditions govern the overall plant growth. It is the genetic factor that expresses morphological differences when different germplasm collections are grown under identical conditions under same management practices. Thus, variation observed in plant height, branching habit, number of leaves, etc., among different germplasm can be attributed to differences in genetic makeup. These results are in agreement with the earlier observations of Dimmitt (7), Varella *et al*. (18) and Singh *et al*. (15) in Adenium.

Variation in flowering traits was highly significant in different genotypes of adenium as depicted in table 2 and 3. Maximum flower diameter (9.69 cm) was recorded in Cross 20 followed by genotype Cross 10 whereas minimum flower diameter (5.63 cm) was observed in Taiwan Dwarf. Maximum length of corolla tube was observed in Cross 5 and Cross 20 while it was minimum in Taiwan Dwarf. Maximum diameter of corolla tube was recorded in Cross 23 followed by Cross 13 while, minimum diameter of corolla tube was observed in Taiwan Dwarf. Maximum petal thickness was recorded in Vithoon's White, flower weight in Cross 23, length of anther appendages in Cross 17 and *in-situ* longevity in Cross 15 and Cross 13. Number of petals per flower is very important flower parameter that represents aesthetic plant value and affects its commercial value. Ten genotypes showed multipetalous flower form bearing more than 5 petals in each flower, wherein, Cross 2 and Cross 23 had flowers with 15 petals and eight genotypes *viz*., Cross 5,8,11,14,16,20,21 and DSH had 10 petals while all others had five petals. Observations depicting variation in number of petals in different germplasm have also been earlier recorded in adenium (Sindhuja *et al.,* 13 and Singh *et al.,* 14) and chrysanthemum (Srilatha *et al*., 17, Roopa *et al*., 11). Variation in different floral characters might be owing to the divergence in these genotypes or wide range in nature of growth as also suggested by Varella *et al.* (18) and Singh *et al.*(15) for Adenium. Further, these crosses were obtained from DSH as male parent which showed bearing of multipetalous flowers having ten petals in each flower, this character was thus transmitted in the crosses. Heritability of multipetalous flowering character from parent has been previously observed in adenium (Singh *et al*., 16).

Maximum number of flower buds and flowers per cluster were recorded in Cross 7 followed by

Table 1. Variation in growth parameters of adenium genotypes.

Name of the genotype	Plant height (cm)	Caudex circumference (cm)	Number of branches per plant	Plant spread (cm)	Number of leaves per plant	Leaf length (cm)	Leaf width (cm)	leaf area (cm^2)	Leaf thickness (mm)
Sudarshan	29.06	17.04	2.53	20.58	35.20	7.96	1.84	20.93	0.35
Arrogant	30.34	17.26	2.27	22.23	33.93	10.01	4.63	30.64	0.35
Mung Siam	37.97	17.00	2.17	22.72	30.67	9.38	4.34	28.97	0.24
Harry Potter	40.19	17.10	1.47	22.60	34.83	10.02	4.41	28.21	0.34
MorLokDok	39.38	16.98	2.37	21.36	35.77	9.61	3.23	20.96	0.38
Picottee	34.90	16.10	2.27	23.46	44.17	9.65	2.73	18.93	0.28
Taiwan Dwarf	23.33	16.30	5.07	14.57	49.97	5.86	3.32	18.67	0.41
Deang Udam Sap	39.07	16.84	2.30	23.12	74.70	9.72	3.53	26.10	0.39
Double Sweet Heart	39.00	16.97	1.57	22.02	58.90	10.92	4.70	25.13	0.41
Vithoon's White	41.82	16.98	2.07	22.40	61.83	10.90	3.35	22.61	0.32
C-1 (S × DUS)	40.66	17.75	2.00	22.61	63.30	10.71	3.32	24.71	0.35
C-2 (S × DSH)	38.79	17.45	1.63	20.78	44.60	11.77	4.16	25.23	0.48
C-3 (S × VW)	39.68	18.30	1.97	26.34	48.07	13.56	2.83	24.79	0.33
C-4 (A × DUS)	38.78	18.01	1.77	23.20	43.70	10.83	4.68	32.00	0.40
C-5 (A × DSH)	40.61	18.77	1.67	25.63	42.70	11.91	4.79	39.45	0.38
C-6 (A × VW)	44.02	18.76	1.60	23.84	51.90	8.90	5.55	32.03	0.41
C-7 (MS × DUS)	39.21	17.32	1.60	23.24	48.73	10.13	4.43	27.11	0.31
C-8 (MS × DSH)	38.90	18.33	1.70	22.35	41.20	9.05	4.53	21.44	0.30
C-9 (MS × VW)	42.40	18.16	1.97	23.08	66.73	9.71	4.94	24.91	0.36
C-10 (HP × DUS)	37.80	17.87	1.90	21.54	62.47	9.48	3.84	21.82	0.30
C-11(HP × DSH)	45.02	15.92	2.30	24.59	65.00	7.50	4.29	24.79	0.33
C-12 (HP × VW)	36.32	16.96	2.00	22.78	64.27	8.58	4.14	23.23	0.38
C-13 (MLD × DUS)	30.82	17.53	2.53	22.27	38.83	10.25	3.88	24.08	0.53
C-14 (MLD × DSH)	40.03	18.15	2.07	31.50	60.90	11.27	4.31	33.31	0.36
C-15 (P × DUS)	37.61	19.16	2.13	26.55	80.00	10.90	3.88	22.88	0.35
C-16 (P × DSH)	39.91	19.38	1.70	25.62	67.37	10.85	5.08	25.59	0.33
C-17 (P × VW)	39.31	19.26	2.00	25.75	64.53	11.80	4.18	28.95	0.40
C-18 (TD × DUS)	37.62	18.59	2.13	24.53	69.43	10.04	3.74	24.42	0.32
C-19 (TD × DSH)	40.81	18.07	2.07	25.48	62.50	10.77	4.88	24.47	0.32
C-20 (HP × DSH)	38.04	16.98	1.53	21.92	46.17	10.11	4.91	25.18	0.29
C-21 (MLD × DSH)	49.64	17.50	1.87	26.04	61.27	11.74	3.71	24.04	0.36
C-22 (S × DUS)	37.43	17.80	1.97	25.35	32.40	10.23	4.42	25.16	0.37
C-23 (HP × DSH)	37.97	15.47	1.67	21.69	34.87	10.70	4.81	24.93	0.46
S.Em.+	0.89	0.37	0.08	0.55	0.49	0.08	0.06	0.42	0.006
C.D. at 5%	2.52	1.06	0.23	1.56	1.38	0.22	0.17	1.18	0.018
C.V. %	5.69	5.21	9.80	5.78	2.29	1.88	3.57	3.98	4.25

Table 2. Variation in floral parameters of adenium genotypes.

Name of the genotype	Flower diameter (cm)	Length of corolla tube (cm)	Diameter of corolla tube (cm)	Petal thickness (mm)	Weight of flower (g)	Length of anther appendages (cm)
Sudarshan	5.78	2.66	1.63	0.14	0.77	2.13
Arrogant	6.36	3.29	1.77	0.13	1.43	2.72
Mung Siam	6.02	3.10	1.79	0.19	0.91	2.98
Harry Potter	7.83	2.79	1.69	0.13	1.18	3.55
MorLokDok	6.16	2.85	1.55	0.24	0.84	3.31
Picottee	7.05	3.47	1.51	0.17	0.70	3.13
Taiwan Dwarf	5.63	1.96	1.24	0.19	0.52	3.17
DeangUdam Sap	8.17	3.42	1.97	0.27	1.60	3.42
Double Sweet Heart	7.36	3.12	1.47	0.18	1.96	3.35
Vithoon's White	6.97	3.47	1.49	0.29	0.90	2.74
C-1 (S × DUS)	9.00	3.65	1.85	0.17	1.66	3.06
C-2 (S × DSH)	8.07	3.54	2.06	0.14	2.83	3.23
C-3 (S × VW)	6.85	3.41	1.30	0.24	1.39	2.38
C-4 (A × DUS)	8.87	3.23	1.51	0.13	1.99	3.95
C-5 (A × DSH)	8.14	4.02	1.86	0.16	2.33	3.07
C-6 (A × VW)	8.25	3.88	1.90	0.17	1.30	3.37
C-7 (MS × DUS)	7.34	3.12	1.54	0.14	1.16	3.09
C-8 (MS × DSH)	6.89	2.97	1.96	0.19	1.32	2.50
C-9 (MS × VW)	7.95	3.06	1.64	0.20	1.27	2.96
C-10 (HP × DUS)	9.02	3.30	1.92	0.14	1.49	3.42
C-11(HP × DSH)	7.26	3.15	2.06	0.15	2.14	3.13
C-12 (HP × VW)	7.85	3.20	1.81	0.13	1.04	2.66
C-13 (MLD × DUS)	8.58	3.08	2.29	0.16	1.29	3.57
C-14 (MLD × DSH)	6.79	3.25	1.46	0.12	1.59	3.44
C-15 (P × DUS)	7.29	3.08	1.39	0.13	1.24	3.04
C-16 (P × DSH)	8.13	3.86	1.65	0.13	1.65	4.47
C-17 (P × VW)	7.87	3.30	1.40	0.11	1.14	4.91
C-18 (TD × DUS)	8.99	3.54	1.41	0.21	1.18	3.13
C-19 (TD × DSH)	8.31	3.49	1.62	0.12	1.14	3.60
C-20 (HP × DSH)	9.69	4.01	1.80	0.15	2.68	4.03
C-21 (MLD × DSH)	7.14	3.54	1.98	0.12	1.56	3.14
C-22 (S × DUS)	5.78	2.66	1.45	0.26	1.20	3.37
C-23 (HP × DSH)	7.28	3.29	2.74	0.20	2.95	3.27
S.Em.+	0.03	0.03	0.03	0.005	0.026	0.03
C.D. at 5%	0.09	0.08	0.08	0.015	0.073	0.08
C.V. %	1.06	2.13	4.14	7.54	4.31	2.24

Table 3. Variation in number of flower buds and flowers per cluster, number of days from bud initiation to senescence (days), number of days of blooming, *in-situ* longevity (days), number of flushes per year and total number of flowers per plant per year in different genotypes of adenium.

Name of the genotype	Number of flower buds and flowers per cluster	Number of days from bud initiation to senescence (days)	Number of days of blooming	*In-situ* longevity (days)	Number of flushes per year	Total number of flowers per plant per year	Number of petals per flower
Sudarshan	6.30	16.90	39.23	7.57	4.00	56.40	5.00
Arrogant	3.93	19.57	41.70	9.57	3.00	27.40	5.00
Mung Siam	3.23	17.50	45.98	7.50	3.00	21.90	5.00
Harry Potter	9.17	18.60	45.45	8.60	2.00	41.07	5.00
MorLokDok	10.87	17.57	46.85	8.23	3.00	101.20	5.00
Picottee	9.13	18.73	43.80	8.73	3.00	79.00	5.00
Taiwan Dwarf	8.87	18.93	36.23	6.90	2.00	41.73	5.00
DeangUdam Sap	11.40	21.93	36.45	9.97	3.00	111.70	5.00
Double Sweet Heart	8.43	21.60	45.25	8.93	4.00	109.07	10.00
Vithoon's White	9.50	18.23	54.30	8.97	4.00	93.60	5.00
C-1 (S × DUS)	11.63	26.07	63.80	17.03	5.00	197.50	5.00
C-2 (S × DSH)	10.23	27.03	65.30	14.97	3.97	105.37	15.00
C-3 (S × VW)	9.07	21.97	36.88	11.93	3.00	65.50	5.00
C-4 (A × DUS)	11.37	25.30	65.33	10.90	3.93	139.83	5.00
C-5 (A × DSH)	6.60	23.27	47.63	11.97	4.93	85.10	10.00
C-6 (A × VW)	14.47	23.20	43.90	13.20	5.00	191.00	5.00
C-7 (MS × DUS)	16.63	22.13	41.43	12.13	3.93	157.27	5.00
C-8 (MS × DSH)	6.30	20.90	51.57	11.60	5.00	81.83	10.00
C-9 (MS × VW)	15.00	20.00	51.17	11.47	4.00	145.33	5.00
C-10 (HP × DUS)	7.37	18.97	44.07	9.83	3.00	69.10	5.00
C-11(HP × DSH)	6.50	21.23	60.70	13.47	2.03	33.33	10.00
C-12 (HP × VW)	13.60	23.50	52.30	16.27	4.00	140.00	5.00
C-13 (MLD × DUS)	11.77	26.80	52.32	18.33	5.00	141.50	5.00
C-14 (MLD × DSH)	9.53	22.47	55.57	12.47	4.00	137.33	10.00
C-15 (P × DUS)	15.20	28.33	52.45	18.63	5.00	258.50	5.00
C-16 (P × DSH)	9.03	23.47	53.47	13.50	5.00	154.67	10.00
C-17 (P × VW)	10.47	21.47	53.63	14.37	4.00	107.47	5.00
C-18 (TD × DUS)	10.27	23.47	44.93	15.30	6.00	198.40	5.00
C-19 (TD × DSH)	9.10	19.97	53.22	11.23	3.00	92.20	5.00
C-20 (HP × DSH)	5.23	28.73	54.48	14.73	5.00	89.50	10.00
C-21 (MLD × DSH)	6.70	19.83	53.62	10.17	4.00	64.93	10.00
C-22 (S × DUS)	9.70	26.27	46.50	16.80	6.00	152.40	5.00
C-23 (HP × DSH)	4.83	24.73	48.47	13.50	4.00	49.47	15.00
S.Em.+	0.19	0.19	1.54	0.18	0.02	3.28	
C.D. at 5%	0.54	0.54	4.36	0.51	0.06	9.28	
C.V. %	4.99	2.12	7.72	3.69	1.34	7.50	

Cross 15, number of days from bud initiation to senescence Cross 20 and Cross 15, number of days of blooming in Cross 4, Cross 2 and Cross 1. Number of flushes per year recorded maximum (6) in Cross 18 and Cross 22. Total number of flowers per plant per year were recorded maximum in Cross 15 followed by Cross 18 and Cross 1. The variation in flowering and yield characters in genotype is due to genetic nature. Here, agro climatic condition being the same, varietal differences for yield potential may have attributed to the significant difference. Similar observations have also been earlier recorded in adenium (Singh *et al.,* 14). Difference in number of flowers per plant, flower clusters per plant, number of days from bud initiation to senescence and *in-situ* longevity in different varieties have been earlier reported in various ornamental plants *viz.,* chrysanthemum (Srilatha *et al*., 17 and Roopa *et al*., 11), marigold (Lohar *et al*., 9) and china aster (Aditya *et al*., 1).

In conclusion, this research endeavour revealed fourteen genotypes out of 33 genotypes as highly suitable for flowering traits. Considering vegetative traits, Taiwan Dwarf showed significant dwarfness with more number of branches and smaller leaves while Cross 14 for higher plant spread and cross 15 for number of leaves have been identified. Further, fourteen genotypes were found suitable for flowering traits out of which two genotypes (Cross 2 and Cross 23) had flowers with 15 petals and eight genotypes (Cross 5,8,11,14,16,20,21 and DSH) had 10 petals while all others had five petals. Further, Cross 20 for large flower size, Cross 15 for number of flowers per cluster, flower longevity as well as for bearing maximum flowers in a years and Cross 18 and Cross 22 for more number of flower flushes in a year have been identified. These genotypes, can be further exploited for commercial application as well as for breeding work in floriculture industry.

AUTHORS' CONTRIBUTION

Conceptualization of research (AS), Designing of the experiments (AS, AJB); contribution of experimental materials and Execution of field/ lab experiments, data collection (MS, AS, AJB); analysis of data and interpretation (MS, AS, AIP) preparation of the manuscript (MS, AS, HP, VBP).

DECLARATION

The authors declare no conflict of interest

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