The Pharma Innovation Journal 2022; 11(5): 1988-1991

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(5): 1988-1991

www.thepharmajournal.com
Received: 01-02-2022
Accepted: 08-04-2022

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Genetic variability parameters of commercially superior *Anthurium andreanum* varieties and hybrids

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Abstract
Anthurium andreanum, belongs to the family Araceae is one of the most important cutflower crop in the world and is having a high commercial value. This study was conducted with the objective in identifying the commercially superior Anthurium genotypes, through genetic variability parameters. For the present investigation, twenty commercially significant Anthurium genotypes were considered. The characters examined for the study included both vegetative and floral characters *viz*., number of spadices, spathe size, spathe length, number of flowers per spadix etc. On analysing the analysis of variance, significant variations were observed for all the characters studied. The character, spadix length and size were noticed to be the highest in the genotype Acropolis White and the genotype Ordinary Orange recorded the highest mean value for the character, number of flowers per spadix. The phenotypic coefficient of variation (PCV) of all characters were found to exhibit a higher value than genotypic coefficient of variation (GCV) indicating the influence of environmental factors. The character, number of suckers/plants recorded high PCV and GCV value. High heritability coupled with high Genetic advance was noticed in the characters spathe size and number of flowers per spadix which indicates that these characters are under additive gene action and are less affected by environmental factors. Selection based of phenotype can be advised for the improvement of these characters.

Keywords: Anthurium PCV GCV heritability genetic advance

1. Introduction
Anthurium andreanum is the second most sold cutflower in the world, belonging to the family Araceae and it has more than 100 genera and over 1500 species. (Higaki *et al*., 1994; Coelho, 2004) [5, 3] They are gaining popularity due to its beautiful and attractive longlasting flowers and also because of the reason that the flowers fetch higher returns per unit area. Due to the rising demand for the cut flowers in the world market, large number of novel Anthurium varieties are being developed. Inorder to boost this process, knowledge of the genetic parameters like heritability and genetic advance are inevitable.
Therefore, identification of suitable varieties that serve high quality, better yielding Anthurium flowers under this agroclimatic condition is essential and thus establishing a basement for crop improvement programmes in Anthurium. Through the genetic variability studies, exploitation of the highly heritable characters for selection of superior parents for hybridization can be carried out, and consequently resulting in attainment of superior hybrids. In this context, the present investigation was undertaken to evaluate superior genotypes among the twenty commercially available Anthurium genotypes for the identification of the essential characters that could be utilized for further breeding programmes.

2. Materials and Methods
The investigation was carried out in the Department of Plant Breeding and Genetics, College of Agriculture, Vellayani, Thiruvananthapuram. For the study, 20 commercially important genotypes were analysed and maintained in greenhouse conditions The genotypes for the study included thirteen varieties and seven hybrids of Anthurium (Table 1). A total of 11 characters were evaluated for the present investigation which included both floral and vegetative characters. The characters evaluated were Plant height (PH), Internode length (IL), Number of suckers per plant (NS), Number of leaves per plant (NL), Number of days from emergence to maturity of leaves (DEML), Days from emergence to maturity of inflorescence (DEMF), Spadix size (SS), Spadix length (SL), No. of flowers per spadix (NF), Days from initiation of female phase (DIF), Duration of male phase (DM). The design for the study was CRD (completely randomized design) with 3 replications for each of the genotype.

Management and fertilizer application were undertaken as per Package of Practices Recommendations of Kerala Agricultural University (KAU, 2016) [7]. For the identification of best genotype/s from the 20 genotypes under study, statistical analysis was carried out. The observations recorded for the vegetative and floral traits based on scales and visual evaluation were subjected to Analysis of Variance (ANOVA). Statistical analysis of the recorded observations for the various characters were performed using the softwares, GRAPES (Gopinath *et al*., 2020) [4] provided by Kerala Agricultural University (critical difference (CD) at 5 per cent level of significance). The estimation of genotypic and phenotypic coefficients of variation, heritability and genetic advance was carried out using the formula suggested by Singh and Chowdhury (1977) [12].

Table 1: Anthurium genotypes included in the study are given below

SL. No.	Genotypes	
1	LR x DT	Liver Red x Dragon's Tongue
2	PR x DT	Pompon Red x Dragon's Tongue
3	OG x LR	Orange Glory x Liver Red
4	HR x LJ	Honduras Red x Lady Jane
5	LJ x KR	Lady Jane x Kalympong Red
6	HR x KR	Honduras Red x Kalympong Red
7	LW	Lima White
8	GW	Geisha White
9	AW	Acropolis White
10	J	Jewel
11	CW	Cascade White
12	HO	Hawaiian Orange
13	DT	Dragon's Tongue
14	O	Ordinary Orange
15	P	Pistache
16	LP	Lucia Pink
17	CW x DT	Dragon's Tongue
18	Pr	President
19	B	Boroque
20	MW	Merengue White

3. Results and Discussion

The characters exhibited expressed significant variations for all the genotypes under study. For the character, plant height the highest value was observed for the genotype HR X KR and lowest value was exhibited by the genotype GW. The genotype OG X LR recorded the highest value while the genotype LJ X KR recorded the lowest value for the character, internode length. The highest value for the character, number of suckers per plant were noticed in the genotype HO.

For the character, number of leaves per spadices, the highest mean value was observed for the genotype CW and HR X KR and the lowest value was exhibited by the genotype B. The genotype J recorded the highest value and the genotype P recorded the lowest value for the character, days from emergence to maturity of leaves. The highest and lowest value for both of these characters, spathe size and spathe length were noticed in the genotypes GW and AW respectively. The genotype O noted the highest value for the character number of flowers per spadix. The highest mean value for the character days from initiation of female phase was noticed in the genotype CW X DT and the lowest average value was obtained for the genotype GW for the character days from initiation of female phase and male phase.

Table 2: The mean values of the characters under study for the twenty genotypes of *Anthurium andreanum*

SL No.	Genotypes	PH	IL	NS	NL	DEML	DEMF	SS	SL	NF	DIF	DM
1	LW	29.667	0.833	0	6.333	28	28.333	86.267	5.967	380.667	5.667	6
2	AW	26.333	1	0.667	5.333	29.667	32.333	113.733	6.467	440.333	6.333	6.333
3	GW	30	0.9	0	5.667	31.667	28.667	53	4.1	267.667	4.333	4.667
4	J	27.667	0.867	0	5.333	34.667	29.667	78.667	6.1	407.333	8.333	8.667
5	CW	30	1	0	6.667	29.667	29.667	79.9	5.6	446.667	8.333	6.667
6	HO	36.667	0.933	1.333	5	31	28.667	77	6.1	414.333	6.667	6.333
7	O	41.667	1.067	1	5	29.667	29.667	82	5.867	470.333	7.667	7.667
8	DT	35.667	1.067	0	4.667	32	28.333	76	5.867	460.333	7	7.667
9	P	36.333	0.9	0.333	5	27.667	30.667	74.333	4.4	271	6.333	7
10	LP	35	1	1	4.333	31.333	32	75	5.367	377.333	8.333	8
11	Pr	39	1	0	4.333	30.667	27.333	89.867	5.6	281	6	5.667
12	B	37	1	0.667	2.667	31	32	78	5.533	273.333	7.667	6.333
13	MW	39.333	1	0.333	4.333	29.667	30.667	72	5.1	318	6	5.667
14	LR x DT	33.667	0.9	0.333	6	29	30	79.667	5.467	311.667	7.333	7.333
15	PR x DT	28.667	1.167	1	5	31.667	27.667	82.933	5.133	317	7	6.667
16	OG X LR	34	1.667	0.667	4.333	30.667	26.667	76.3	5.3	412	7	6.333
17	HR X LJ	36.667	1	0	5	30	27	74.5	4.567	380.333	6	8
18	LJ x KR	38.333	0.633	1	4.667	30	30	76.7	5.333	393.333	7.667	7.333

19	HR x KR	46	0.967	0.333	6.667	31.333	27.333	81.533	4.5	288.333	7.333	6.667
20	CW x DT	36.333	0.8	1	5.333	32.333	31	74.667	5.567	272.333	11	8.333
S.E(m)		3.070	0.101	0.211	0.422	0.934	0.833	3.160	0.268	13.415	0.637	0.568
CD (5%)		8.773	0.288	0.603	1.260	2.669	2.382	9.032	0.765	38.342	1.820	1.622

Phenotypic coefficient of variation (PCV), and Genotypic coefficient of variation (GCV), which are the relative measures of variation were used for comparison among the characters, were computed and presented in table 3. For all the eleven characters studied, the genetic parameter, PCV was found to be greater than GCV in magnitude, which indicated that environment has significant role in expression of these characters. PCV values ranged between 111.992 per cent to 6.542 per cent. The highest PCV value was recorded in the observation Number of suckers per plant (111.92%) followed by number of leaves/ spadices (27.467%), internode length (24.729%), days from initiation of female phase (23.075%) and the lowest PCV value was recorded in the observation, days from emergence to maturity of leaves (6.542%). This was in accordance with the findings of Pravin (2004) [10], Reshma (2016) [11] and Anand (2019) [2].

GCV values ranged between 82.759% to 2.896%. The highest GCV value was noted in the character, number of suckers per plant (82.759%) followed by number of flowers per spadix (19.362%), internode length (17.089%), days from initiation of female phase (17.059%) and the lowest GCV value was recorded in the character, days from emergence to maturity of leaves (2.896%).

The genetic parameter heritability is a good index for transmission of characters from parents to offspring. According to Johnson *et al.* (1955) [6] classification, if heritability is less than 30%, it is low heritability, if heritability is within the range 30-60%, medium heritability and if the heritability is more than 60%, it indicates high heritability. In the present study, high heritability were noted in the characters, number of flowers per spadix (90%) and spadix size (78.3%). Medium heritability was noticed in the characters, plant height (35.5%), internode length (47.8%), number of suckers per plant (54.6%), days from emergence to maturity of inflorescence (52.5%), spadix length (59.6%), days from initiation of female phase (54.7%). Low heritability was noticed in the characters, number of leaves per spadices (17.7%), Days from emergence to maturity of leaves (19.6%) and duration of male phase (21.9%). This was similar to the findings of Madhurkar (2010) [8], Smera (2020) [13], Reshma (2016) [11].

Genetic advance is a measure of the genetic gain under selection. Johnson *et al* (1955) [6], classified the genetic advance as per centage of mean as to; low (<10%), moderate (10-20%) and high genetic advance (>20%). High genetic advance was observed in the characters, internode length (24.326%), Number of suckers per plant (125.981%), spadix size (23.917%), number of flowers per spadix (37.831%), days from initiation of female phase (25.981%). Moderate genetic advance was recorded for the characters, number of leaves per spadices (17.7%), plant height (13.883%), spadix length (16.578%). Low genetic advance was noted in the characters, days from emergence to maturity of leaves (2.640%) and duration of male phase (9.584%), days from emergence to maturity of inflorescence (7.709%). Similar findings were also reported by Premna (2013) [9] and Anand (2019) [2].

High heritability and high genetic advance were observed in the characters, number of flowers per spadix and spadix size. It was in accordance with the findings of Anand (2017) [1] and Smera (2020) [13]. This suggests that selection can be carried out based on phenotypic performance of these characters as high heritability coupled with high genetic advance indicates additive gene action.

Table 3: The PCV, GCV, Heritability and Genetic Advance as percentage of mean of the characters under study are given below.

SL No	Character	PCV	GCV	Heritability	Genetic Advance as percentage of mean
1	Plant height	18.972	11.307	35.5	13.883
2	Internode length	24.729	17.089	47.8	24.326
3	Number of suckers/plant	111.992	82.759	54.6	125.981
4	No. of leaves per spadices	27.467	11.563	17.7	10.028
5	Days from emergence to maturity of leaves	6.542	2.896	19.6	2.640
6	Days from emergence to maturity of inflorescence	7.127	5.165	52.5	7.709
7	Spadix size	14.837	13.125	78.3	23.917
8	Spadix length	13.511	10.427	59.6	16.578
9	No. of flowers/spadix	20.415	19.362	90.0	37.831
10	Days from initiation of female phase	23.075	17.059	54.7	25.981
11	Duration of male phase	21.272	9.948	21.9	9.584

4. Conclusion

It is concluded from the present investigation that significant variations are exhibited among the genotypes for the characters selected under study. The characters, number of flowers per spadix and spadix size can be exploited for further breeding and crop improvement programmes in Anthurium as these characters exhibited both high heritability and genetic advance.

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