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RESEARCH ARTICLE

ESTIMATION OF VARIABILITY AND CORRELATION BETWEEN THE QUANTITATIVE MORPHOLOGICAL FEATURES OF SIX TAXA OF *BRUGMANSIA* Pers. AND FIVE TAXA OF *DATURA* L. FROM KERALA AND TAMIL NADU.

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Abstract

Genetic variability and correlation studies were made on the quantitative morphological features of six taxa of *Brugmansia* Pers. and five taxa of *Datura* L. from Kerala and Tamil Nadu. Pedicel length, acuminal peak length and fruit length showed higher values PCV and GCV reflecting a high degree of variability for these characters. ECV values were not high suggesting less environmental influence in the origin of such variations. All the flower and fruit characters studied showed a high percentage of heritability, above 85%. Maximum heritability (98%) was observed for fruit length, followed by 97% for corolla diameter and interacuminal peak length. Majority of the floral characters except calyx length, free filament length and fruit breadth showed higher values above 60%. Lamina length was found to be highly correlated genotypically to all the other foliar and floral characters studied at 1% level. The pedicel, calyx and corolla traits were highly correlated to most of the floral characters except fruit breadth

Introduction:-

Brugmansia Pers. and *Datura* L. are two important genera under the Solanaceae, a very large family of trees, shrubs and herbs including 96 genera and 3000 species distributed all over the tropics, with Central and South America forming the chief centers of distribution (D' Arcy, 1991; Hunziker, 2001). *Brugmansia* Pers. (Angel's Trumpet) is a small genus which includes six species, one subspecies and five hybrids (*The Plant List*, 2013). The members are small trees or large shrubs, of which three have been reported from South India. The flowering is profuse with very large attractive pendulous flowers of bright colors and unarmed, long spindle shaped or short egg-shaped capsules. *Datura* L. (Thorn Apple, Jimson weed) is well known as a genus of drug plants with several weedy species. The genus comprises of glabrous or minutely pubescent shrub-like herbs, with large, entire and sinuate or deeply-toothed leaves, large, solitary, white or purple erect flowers and armed, globose capsules. According to *The Plant List* (2013), the genus comprises of 12 species distributed in the tropical and temperate regions of the world, of which three have been reported from South India.

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Assessment of genetic variability and inter-relationship between important quantitative characters and their heritability is a significant prerequisite for evaluating the potentiality of plants to respond to plant improvement programmes. Although this often centers on morphological traits, data from other sources (viz. dermal, anatomical, cytological etc.) have also time and again provided supplementary clues in elucidating systematic interrelationships between members of a plant group. This attains more significance in the case of medicinal plants, where the necessity for plant improvement assumes paramount importance. This paper deals with the variability among different characters, phenotypic, genotypic and environmental coefficients of variation (PCV, GCV and ECV), heritability, expected genetic gain and phenotypic, genotypic and environmental correlation coefficients of quantitative morphological characteristics in six taxa of *Brugmansia* Pers. and five taxa of *Datura* L.

Materials and Methods:-

Six taxa of *Brugmansia* and five taxa of *Datura* were collected from different parts of Kerala and Tamil Nadu. A detailed morphological study was conducted collecting data from the foliar and floral parts of fresh plants. The members studied are listed below:

1. *Brugmansia*x *candida* Pers. 'Charleston'
2. *Brugmansia*x *cubensis* (V.R.Fuentes) V.R.Fuentes 'Dr.Seuss'
3. *Brugmansia sanguinea* (Ruiz &Pav.) D. Don 'MishaTora'
4. *Brugmansia sanguinea* (Ruiz &Pav.) D. Don 'Oroverde'
5. *Brugmansia suaveolens*(Humb. &Bonpl. exWilld.) Bercht& J. Presl. 'Remembrance'
6. *Brugmansia suaveolens*(Humb. &Bonpl. exWilld.) Bercht& J. Presl. 'Valley White'
7. *Daturainoxia*Mill.
8. *Daturametel* L. var. *fastuosa*(L.) Saff.
9. *Daturametel* L. var. *metel*
10. *Datura metel* L. var. *rubra*
11. *Datura stramonium*L.

A detailed morphological study was conducted collecting data from the foliar and floral parts of fresh plants. Voucher specimens of the taxa studied are deposited in the herbaria at the Research and Post-Graduate Department of Botany, Sree Narayana College, Kollam (SNCH), Department of Botany. The twenty-two quantitative morphological characters studied are listed below.

Internode length
Lamina length
Lamina breadth
Lamina area(cm^2)
Lamina perimeter
Petiole length
Pedicel length
Calyx length
Calyx mouth breadth
Corolla length
Corolla diameter
Corolla lobe breadth
Acuminal peak length
Anther length
Filament length from base
Free filament length
Stigma length
Style length
Ovary height
Ovary diameter
Fruit length
Fruit breadth

The quantitative morphological data assembled were analyzed statistically for assessing their coefficient of variation (Panse & Sukhatme, 1978), heritability (%) in the broad sense (Jain, 1982), genetic gain expressed as percentage of mean (Singh & Chaudhary, 1985) and phenotypic, genotypic and environmental correlation coefficients (Snedecor & Cochran, 1980).

Results and Discussion:-

(i) Genotypic and phenotypic coefficient of variation

The genotypic and phenotypic coefficients of variation (GCV and PCV) were computed for only twenty two quantitative morphological characters as shown in Table 1. The remaining characters showed only very low values of expression or remained constant. Values of GCV and PCV above 30 % suggest a high degree of variability among taxa with regard to the characters studied. In the present study, most of the characters studied showed values above 30 for GCV and PCV, except internode length, lamina parameters, petiole length, calyx length, filament

length from base and fruit breadth. The GCV and PCV values were above 80 % for acuminal peak length and above 60 % for pedicel length and fruit length.

(ii) Heritability

Heritability in the broad sense was calculated for twenty-two quantitative morphological characters which showed sufficient magnitude of expression, and the results are given in Table 1. Higher values above 60% show that the genotypic variance and phenotypic variance are very close, suggesting that the phenotypic variability is mainly due to the genotypic effect itself and the environmental component has got little effect on the phenotype. Values below 60% reveal the influence of the environment on the phenotype. In the present study, all the flower and fruit characters studied showed a high percentage of heritability, above 85%. Maximum heritability (98%) was observed for fruit length, followed by 97% for corolla diameter and interacuminal peak length. Heritability percentages were 95-96 for pedicel length, corolla diameter, anther length, filament length from base, style length and ovary height. But the vegetative morphological characters relating to the internode and lamina showed lower percentages of heritability below 60%.

(iii) Genetic gain

The values for genetic gain expressed as percentage of mean were computed for only twenty two quantitative morphological characters as shown in Table 1. Higher values of genetic gain reflect greater potential for improvement of a particular character over generations by various plant breeding procedures. In the present study, majority of the floral characters except calyx length, free filament length and fruit breadth showed higher values above 60%. Here also the vegetative morphological characters relating to the internode and lamina showed lower percentages of mean values for genetic gain.

(iv) Genotypic and phenotypic correlation

Correlation is a statistical technique used to measure and describe the simultaneous variation between two or more variables. Correlation between different traits has been attributed to the presence of linked genes and espistatic effect of different genes. Genetic and environmental causes of correlation combine together and give phenotypic correlation. The dual nature of phenotypic correlation makes it clear that the magnitude of genetic correlation cannot be determined from phenotypic correlation (Saleem et al 2006).

The genotypic and phenotypic correlations between pairs of selected quantitative morphological characters are summarized in Tables 2 a-c. High correlations above 0.26 and 0.33suggest high genetic association between the two characters at 5% and 1% levels of significance. In the present study lamina length was found to be highly correlated genotypically to all the other foliar and floral characters studied at 1% level. The pedicel, calyx and corolla traits were highly correlated to most of the floral characters except fruit breadth. Significant positive genotypic correlations were observed between the following character combinations at 5% * and 1% ** levels of significance.

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Table 1:- Phenotypic, genotypic and environmental coefficients of variation, heritability and genetic gain of quantitative morphologica**l** characters of eleven taxa of Brugmansia Pers. and Datura L.

Sl.No	Characters	Phenotypic coefficient of variation (PCV)	Genotypic coefficient of variation (GCV)	Heritability (%)	Genetic gain (%)
1	Internode length	44.76	24.35	0.30	27.29
2	Lamina length	21.41	14.84	0.48	21.20
3	Lamina breadth	21.29	10.74	0.25	11.16
4	Lamina area	33.21	18.21	0.30	20.57
5	Lamina perimeter	23.43	17.97	0.59	28.40
6	Petiole length	33.61	24.92	0.55	38.08
7	Pedicel length	69.46	67.99	0.96	137.08
8	Calyx length	31.07	29.77	0.92	58.77
9	Calyx mouth breadth	38.16	35.32	0.86	67.34

10	Corolla length	36.44	35.67	0.96	71.94
11	Corolla diameter	51.18	50.38	0.97	102.14
12	Corolla lobe breadth	54.14	52.44	0.94	104.64
13	Interacuminal peak length	86.72	85.61	0.97	174.08
14	Anther length	52.22	51.07	0.96	102.90
15	Filament length from base	29.00	27.94	0.93	55.44
16	Free filament length	37.31	36.42	0.95	73.23
17	Stigma length	57.52	54.19	0.89	105.16
18	Style length	31.44	30.67	0.95	61.64
19	Ovary height	52.43	51.37	0.96	103.68
20	Ovary diameter	38.06	35.95	0.89	70.03
21	Fruit length	61.93	61.41	0.98	125.45
22	Fruit breadth	27.19	25.04	0.85	47.49

Table 2a:- Phenotypic, genotypic and environmental correlation coefficients of quantitative morphological characters in eleven taxa of *Brugmansia* Pers. and *Datura* L. (* significant at 5% level ** significant at 1% level)

Characters		**Internode length**	**Lamina length**	**Lamina breadth**	**Lamina area**	**Lamina perimeter**	**Petiole length**	**Pedicel length**	**Calyx length**	**Calyx mouth breadth**	**Corolla length**	**Corolla diameter**
Internode length	P	1.0										
	G	1.0										
	E	1.0										
Lamina length	P	-0.4450	1.0									
	G	-0.9067	1.0									
	E	-0.1704	1.0									
Lamina breadth	P	0.3124*	-0.2262	1.0								
	G	0.6433**	-0.4964	1.0								
	E	0.1875	-0.0845	1.0								
Lamina area	P	-0.3298	0.6200**	-0.0850	1.0							
	G	-0.4031	0.5938**	0.5294**	1.0							
	E	-0.2987	0.6542**	-0.3205	1.0							
Lamina perimeter	P	-0.0479	0.2936*	0.4485**	0.2469	1.0						
	G	-0.0364	0.4901**	0.4096**	0.7598**	1.0						
	E	-	0.071	0.523	-	1.0						

		0.0607	2	6**	0.1355							
Petiole length	P	-0.0171	0.2140	0.0990	0.1435	0.1784	1.0					
	G	-0.2242	0.4140**	0.2174	0.4831**	0.3416**	1.0					
	E	0.1303	0.0024	0.0305	-0.0943	-0.0371	1.0					
Pedicel length	P	-0.3273	0.4413**	-0.2662	0.2931*	0.0134	0.0624	1.0				
	G	-0.6519	0.6276**	-0.5917	0.5460**	0.0124	0.0791	1.0				
	E	0.1148	0.1048	0.1467	0.0003	0.0312	0.0363	1.0				
Calyx length	P	-0.5030	0.2972*	-0.3260	0.0507	-0.2624	-0.0567	0.6343**	1.0			
	G	-0.9234	0.4933**	-0.6794	0.1330	-0.3850	-0.0775	0.6614**	1.0			
	E	-0.0901	-0.1482	0.0099	-0.0801	0.1123	-0.0087	0.2380	1.0			
Calyx mouth breadth	P	-0.3613	0.5574**	-0.2253	0.3021*	0.0650	0.2168	0.7998**	0.5411**	1.0		
	G	-0.6787	0.8416**	-0.5679	0.6331**	0.0721	0.2823*	0.8647**	0.5607**	1.0		
	E	-0.0617	0.0636	0.1218	-0.0608	0.0570	0.0908	0.2123	0.4043**	1.0		
Corolla length	P	-0.5599	0.5229**	-0.3764	0.1742	-0.1566	0.1196	0.6621**	0.8426**	0.6617**	1.0	
	G	-1.0461	0.7502**	-0.7879	0.3202*	-0.2461	0.1734	0.6915**	0.8999**	0.7355**	1.0	
	E	-0.0159	0.0933	0.0722	0.0134	0.2163	-0.0462	-0.0109	-0.0287	-0.0611	1.0	
Corolla diameter	P	-0.5178	0.4418**	-02726	0.1717	-0.0810	0.1944	0.4038**	0.7649**	0.3839**	0.8440**	1.0
	G	-0.9997	0.6470**	-0.5325	0.3120	-0.0861	0.2909*	0.4156**	0.8010**	0.4164**	0.8828**	1.0
	E	0.1172	0.0026	-0.0535	0.0225	-0.1411	-0.1514	0.0948	0.1859	0.0680	-0.1832	1.0

Table 2b:- Phenotypic, genotypic and environmental correlation coefficients of quantitative morphological characters in eleven taxa of Brugmansia Pers. and Datura L. (* significant at 5% level ** significant at 1% level)

Characters		Internode length	Lamina length	Lamina breadth	Lamina area	Lamina perimeter	Petiole length	Pedicel length	Calyx length	Calyx mouth breadth	Corolla length	Corolla diameter
Corolla lobe breadth	P	-0.5503	0.4673**	-0.2492	0.2067	-0.0322	0.2067	0.3982**	0.7847**	0.4242**	0.8410**	0.9509**
	G	-1.0556	0.6784**	-0.5229	0.3413**	-0.0499	0.2743*	0.4342**	0.8217**	0.4646**	0.8937**	0.9852**
	E	0.0285	0.0651	0.0296	0.1222	0.0304	0.0583	-0.2646	0.3098*	0.0817	-0.1278	0.2666*
Interacuminal peak length	P	-0.4340	0.2224	-0.1665	0.1498	-0.0274	-0.0606	0.4671**	0.7373**	0.1949	0.6532**	0.7955**
	G	-0.7704	0.3220*	-0.3536	0.2803*	-0.0549	-0.0878	0.4800**	0.7776**	0.2132	0.6648**	0.8193**
	E	-0.1510	0.0176	0.0692	-0.0148	0.1380	0.0336	0.1032	0.0366	0.0019	0.3286**	-0.0162
Anther length	P	-0.5476	0.3690**	-0.4015	0.0399	-0.2516	0.0592	0.4911**	0.8436**	0.4028**	0.9006**	0.8789**
	G	-1.0315	0.5638**	-0.7927	0.0608	-0.3274	0.0861	0.5115**	0.8851**	0.4425**	0.9314**	0.9121**
	E	0.0070	-0.0883	-0.0574	0.0415	-0.0450	-0.0232	0.0341	0.2363	0.0292	0.2058	0.0230
Filament length - base	P	-0.3908	0.3420**	-0.3404	0.0313	-0.3652	-0.0328	0.5475**	0.7198**	0.6768**	0.7927**	0.5333**
	G	-0.7009	0.5241**	-0.7482	0.0859	-0.5338	0.0156	0.5851**	0.7830**	0.7679**	0.8402**	0.5553**
	E	-0.1043	-0.0416	0.0998	-0.0624	0.1694	-0.2439	-0.0763	-0.0383	-0.0765	0.0065	0.1446
Free filament length	P	0.1461	0.0090	-0.0908	0.0822	-0.2615	-0.0428	0.5169**	0.1367	0.5137**	0.1267	-0.2224
	G	0.2547	-0.0008	-0.1981	0.1224	-0.3575	-0.0685	0.5435**	0.1647	0.5792**	0.1235	-0.2167
	E	0.0596	0.0608	0.0360	0.0919	0.0446	0.0465	-0.0537	-0.2787	-0.1162	0.1956	-0.3681
Stigma	P	-	0.463	-	0.130	0.0755	0.175	0..382	0.490	0.393	0.724	0.753

length		0.4036	5**	0.2317	5		9	8**	3**	0**	7**	7**
	G	-0.9185	0.7466**	-0.5925	0.3369**	0.0927	0.2192	0.3906**	0.5158**	0.4426**	0.7811**	0.7879**
	E	0.2381	-0.0996	0.1722	-0.1552	0.0398	0.1013	0.3301**	0.2570	0.0553	0.0634	0.3897**
Style length	P	-0.4265	0.3732**	-0.4231	0.0548	-0.4124	0.0462	0.5982**	0.8017**	0.6443**	0.8815**	0.6525**
	G	-0.8289	0.5469**	-0.8571	0.0391	-0.5322	0.0553	0.6267**	0.8711**	0.7366**	0.9185**	0.6938**
	E	0.0721	0.0209	-0.0070	0.1845	-0.1004	0.0417	-0.0027	-0.2008	-0.2490	0.0959	-0.3486
Ovary height	P	-0.4044	0.4927**	-0.3582	0.2390	-0.0002	0.0307	0.9298**	0.6710**	0.7856**	0.6913**	0.4335**
	G	-0.7694	0.7169**	-0.7079	0.4258**	0.0317	0.0260	0.9626**	0.7226**	0.8601**	0.7326**	0.4418**
	E	0.0334	0.0395	-0.0484	0.0612	-0.1871	0.0884	0.1640	-0.1293	0.0747	-0.2790	0.2111
Ovary diameter	P	0.1750	0.0561	-0.1812	-0.0204	-0.1654	-0.0634	0.4373**	0.0058	0.4728**	-0.0009	-0.3541
	G	0.3041*	0.1285	-0.3166	0.3670**	-0.1649	-0.1350	0.4708**	0.0165	0.5620**	0.0112	-0.3730
	E	0.0682	-0.1194	-0.1070	-0.0472	-0.2182	0.1422	0.0271	-0.0978	-0.1510	-0.1702	-0.1234
Fruit length	P	-0.4524	0.3883**	-0.4080	0.0467	-0.0462	-0.0839	0.7100**	0.7873**	0.4449**	0.7361**	0.6870**
	G	-0.8592	0.5682**	-0.8111	0.1006	-0.0649	-0.1167	0.7270**	0.8274**	0.4822**	0.7652**	0.7036**
	E	0.1019	-0.0258	-0.0199	-0.0746	0.0385	0.0218	0.1672	0.0265	0.0472	-0.2577	0.0123
Fruit breadth	P	0.3001*	0.0658	-0.0997	-0.0659	0.0019	-0.0703	0.1771	-0.2157	0.2551	-0.2157	-0.4549
	G	0.5520**	0.0062	-0.1801	-0.2029	-0.0163	-0.0916	0.1844	-0.2348	0.3011	-0.2455	-0.5010
	E	0.0723	0.2200	-0.0477	0.1119	0.0537	-0.0297	0.1370	-0.0767	-0.0100	0.0709	-0.0132

Table 2c:- Phenotypic, genotypic and environmental correlation coefficients of quantitative morphological characters in eleven taxa of Brugmansia Pers. and Datura L. (* significant at 5% level ** significant at 1% level)

Characters		Corolla lobe breadth	Acuminal peak length	Anther length	Filament length-base	Free filament length	Stigma length	Style length	Ovary height	Ovary diameter	Fruit length	Fruit breadth
Corolla lobe breadth	P	1.0										
	G	1.0										
	E	1.0										
Interacuminal peak length	P	0.7670**	1.0									
	G	0.8037**	1.0									
	E	-0.0366	1.0									
Anther length	P	0.8461**	0.7390**	1.0								
	G	0.9038**	0.7561**	1.0								
	E	-0.1938	0.2692*	1.0								
Filament length - base	P	0.5555**	0.2933*	0.6439**	1.0							
	G	0.5883**	0.2919*	0.6673**	1.0							
	E	0.0993	0.3661**	0.2719*	1.0							
Free filament length	P	-0.2281	-0.1762	-0.1478	0.4448**	1.0						
	G	-0.2315	-0.1831	-0.1471	0.4970**	1.0						
	E	-0.1709	0.0043	-0.1631	-0.3865	1.0						
Stigma length	P	0.6831**	0.5242**	0.7412**	0.3930**	-0.2526	1.0					
	G	0.7579**	0.5613**	0.7932**	0.4552**	-0.2655	1.0					
	E	-0.1023	0.0418	0.1480	-0.2223	-0.1165	1.0					
Style length	P	0.6690**	0.4311**	0.7705**	0.9080**	0.3872**	0.4820**	1.0				
	G	0.7157**	0.4499**	0.8071**	0.9805**	0.3720**	0.5385**	1.0				
	E	-	-	0.010	-	0.689	-	1.0				

		0.1337	0.0591	0	0.2251	2**	0.1733					
Ovary height	P	0.4600**	0.4362**	0.5501**	0.5883**	0.4048**	0.3793**	0.6454**	1.0			
	G	0.4830**	0.4538**	0.5832**	0.6223**	0.4181**	0.4130**	0.6728**	1.0			
	E	0.0333	-0.0868	-0.2093	0.0185	0.1144	-0.0286	0.0556	1.0			
Ovary diameter	P	-0.3451	-0.3736	-0.2387	0.3582**	0.8397**	-0.2608	0.2489	0.4120**	1.0		
	G	-0.3781	-0.3931	-0.2540	0.3907**	0.9094**	-0.2951	0.2629*	0.4378**	1.0		
	E	0.0122	-0.1319	-0.0575	0.0295	0.0119	0.0174	0.0907	0.1020	1.0		
Fruit length	P	0.6616**	0.7679**	0.7875**	0.4320**	-0.0016	0.5682**	0.5912**	0.7837**	0.0043	1.0	
	G	0.6918**	0.7902**	0.8196**	0.4608**	-0.0034	0.6101**	0.6090**	0.7973**	0.0036	1.0	
	E	-0.0917	-0.2676	-0.2748	-0.2351	0.0590	-0.0403	0.0726	0.3543**	0.0215	1.0	
Fruit breadth	P	-0.4800	-0.4865	-0.4164	0.1011	0.6580**	-0.3261	-0.0033	0.1569	0.8195**	-0.1295	1.0
	G	-0.5285	-0.5338	-0.4544	0.1186	0.7309**	-0.4130	-0.0035	0.1773	0.9347**	-0.1453	1.0
	E	-0.0900	-0.0208	-0.0889	-0.0389	0.0123	0.2457	-0.0015	-0.0392	0.0480	0.0619	1.0

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