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GENETIC VARIABILITY OF *COLOCASIA ESCULENTA* (L.) SCHOTT.

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Abstract

Studies on the nature and extent of variability of aqua edible aroids cultivars, *Colocasia esculenta* (L.) Schott. revealed significant differences and wide range of variations among the accessions and cultivars. Genotypic variances and coefficient of variation for most of the characters were remarkably higher than their corresponding variances due to environment which also indicate the existence of variation in genotypic origin. Plant height, petiole length, leaf length, each stolon weight, total stolon weight, stolon length and corm length expressed high heritability with moderate to high genetic advance signaled heritable in nature.

Colocasia esculenta (L.) Schott. commonly called Panikachu is a major vegetable crop belonging to the family Araceae. The edible species are referred to as edible aroids (Hossain *et al.* 1983, Zettler *et al.* 1989) in Bangladesh. The underutilized crop, panikachu is the staple food in many countries e.g. Hawaii, PNG, Fiji and important secondary food over the Africa and Asian countries. Panikachu plays a significant role for nutrient status, medicinal and industrial values (Rashid and Daunisht 1979). In Bangladesh the economic parts of panikachu are the corms, stolons and flowers as well as the leaves and the variety latiraj released by BARI (1988) which has high potentiality for yielding good quality lati. At the advent of modern agriculture introducing high yielding crop varieties in the country, the underutilized crops like aroids are pushed under the threat of extinction and their merits as well as their proper taxonomic position were not properly determined. In spite of tremendous potentialities what they hold the existing panikacu edible aroids are running in vulnerable condition without being properly and scientifically evaluated. Any breeding program for improving the genetic pattern of crop plant depends upon the nature and magnitude of variability and the extent to which the desirable characters are heritable (Dudley and Moll 1969). The genetic variability in a population along with heritability gives a reliable idea of the genetic advance to be ejected from selection for a given character (Burton 1952, Johnson *et al.* 1955). The present study therefore was undertaken to find out and establish suitable selection criteria for higher corm yield through study of variability in edible aqua aroids. The main objectives were to estimate the variation through in depth study on gross morphological characters, the phenotypic and genotypic variability present in different characters, contributing to yield per plant and to estimates of heritability and genetic advance for yield per plant and its components of these edible aroid cultivars.

A total of 485 aroid accessions were collected from aroid growing 13 districts as Rajshahi, Satkhira, Jessore, Bogra, Joypurhat, Munshiganj and Joydebpur of Dhaka, Mymensingh and Barisal in Bangladesh in 2005-2006. Collected propagules were maintained at the experimental farm of the Institute of Biological Sciences research field at Rajshahi University, Rajshahi during the onset of rainy season on same year. All recommended agricultural practices were followed. The experiment was set up in a RCB design with three replications. In each experimental plot plantlets were planted with row to row spacing 0.75 m and plant to plant spacing was 0.60 m. The plantlets were sown on March, 2006. Two healthy propagules were planted per hill during

plantation and finally a single healthy plant was maintained. When the vegetative growth is in climax then the agro-morphological data were collected and the quantitative yield parameters were recorded after when plant vegetative growth was very stunted, leaves became yellowish, dry and dropping. The data of characters such as plant height (PLH), petiole length (PEL), petiole breadth (PEB), leaf length (LEL), leaf breadth (LEB), leaf Number (LEN), leaf area index (LAI), inflorescence number, inflorescence length (IFL), peduncle length (PDL), spathe length (SPL), spathe breadth (SPB), corm length (CRL*),* corm breadth (CRB), corm weight (CRW), stolon number (STN), stolon length (STL), stolon breadth (STB), single stolon weight (SSTW), stolon weight per plant (SWPP) and yield per plant (YPP) were recorded following descriptions of Taro with necessary modifications **(**IPGR 1999). The collected data were analyzed following the biometrical techniques of analysis developed by Mather (1949) based on mathematical model of Fisher *et al.* (1932) using the SPSS and MS excel software. The analysis of variance, critical differences, coefficient of variability at phenotypic, genotypic and environmental levels and broad sense heritability of three edible aroid cultivars for each character under the study was performed following Singh and Chaudhary (1977).

Mean performances of the characters along with the corresponding C.D. values are presented in Table 1. Analysis of variances for 21 yield and yield contributing characters were made to test the significant differences of different sources of variation. Analysis of variances was computed and mean squares of ANOVA are shown in Table 2. Genetic parameters along with range are shown in Table 3. Of the three cultivars shola kachu showed highest PLH (160.46 cm), PEL (133.50 cm), LEL (48.86 cm), SSTW (74.30 g.) and total stolon weight (1138.47 g). On the other hand narikel kachu cultivar exhibited best performances for SPL (26.56 cm), SPB (6.08 cm), STN (18.8), single stolon length (86.86 cm), STB (3.43 cm), CRL (46.9 cm), CRB (33.87 cm), CRW (2.19 kg) and yield per plant (3.13 kg). Table 2 revealed that the main item cultivars were significant in respect of all characters except LAI, which was non significant. As shown in Table 3 the ranges for the characters PLH (70-180 cm), PEL (50 -148 cm), PLB (4-11.33 cm), LEL (25 - 56 cm), LEB (13-36 cm), LEN (4-7), LAI (0.005-0.80 m^2), inflorescence number (1- 4), IFL (39-75 cm), PDL (22-67 cm), SPL (16 - 32 cm), SPB (3-8), STN (7-24), each stolon weight (35-100 g), total stolon weight (336-1980 g), STL (32-203 cm), STB (2-5 cm), CRL (14-65 cm), CRB (15-42 cm), CRW (0.250-3.25 kg) and YPP (0.635-4.33 kg) which pronounced the existence of wide scale variability. Phenotypic variances (σ^2_p) for all the characters were found higher than their corresponding genotypic (σ^2_g) and environmental variances (σ^2_e) as expected. Maximum highest values of σ^2_p and cv_p were observed than the σ^2_g and cv_g together with lower σ^2_e and cv_e than the σ^2_g and cv_g for all characters indicate that though the variations for these characters are genotypic in nature but the major portion of the phenotypic variances are contributed by the effect of interaction of genotypes with different levels mainly interaction. Higher σ^2_p together with lower σ^2_e than σ^2_g for these characters though suggested the existence of genetic variability but the phenotypic variations were also moderately influenced by the environment as well as interactions at different levels. Heritability (in broad sense) and genetic advance as per cent of mean were highest for almost all the characters studied.

Therefore these characters can be improved through simple selection. Chand *et al*. (1987) studied the analysis of variance for nine characters and revealed highly significant differences between genotypes and found wide range of variation for plant height, number of suckers per plant and corm size in taro. They also observed high phenotypic and genotypic coefficients of variation for number of suckers per plant and yield per plant. Pandey *et al*. 1996 observed wide range of variability among 31 genotypes for yield/plant, weight of mother cormels, weight of cormels and high heritability coupled with high genetic advance for weight of mother cormels, weight of

Table 1. Mean performance of yield and yield contributing characters of three cultivars of *Colocasia esculanta*.

Cultivars	PLH (cm)	PEL (cm)	PEB (cm)	LEL (cm)	LEB (cm)	LEN	LAI	IFN	IFL (cm)	PDL (cm)	SPL (cm)	SPB (cm)	STN	SSTW (g)	TSTW (g)	STL (cm)	SRB (cm)	CRL (cm)	CRB (cm)	CRW (kg)	YPP (kg)
1. Shola kachu (latikachu)	160.46	133.50	9.05	48.86	22.63	5.40	0.0939	3.10	57.53	50.33	25.13	5.53	15.2	74.30	1138.47	71.03	3.00	39.8	27.97	1.40	2.55
2. Kalo kachu (small)	89.86	67.13	5.61	32.86	21.36	5.03	0.049	1.560	52.86	30.36	23.66	5.46	10.5	45.03	466.9	83.63	2.78	19.2	19.47	0. 394	0.851
3. Narikel kachu greenlati	95.17	72.26	6.22	35.26	24.73	6.10	0.0914	1.730	56.03	31.63	26.56	6.08	18.8	50.36	945.87	86.86	3.43	46.9	33.87	2.19	3.13
Mean	115.1	90.97	6.96	39.00	22.91	5.51	0.078	2.133	55.48	37.44	25.11	5.694	14.83	56.59	850	80.51	3.073	35.31	27.10	1. 33	2.181
±S.E	3.62	3.31	0.183	0.890	0.399	0.093	0.009	0.101	0.888	1.11	0.353	0.101	0.455	1.80	39.40	3.88	0.079	1.50	0.751	0.090	0.116
S.D.	34.32	31.39	1.736	8.445	3.782	0.877	0.844	0.092	8.43	10.53	3.345	0.956	4.32	17.05	373.6	36.8	0.749	14.24	7.12	0.857	1.10
C.D. at 0.05	11.11	10.16	0.562	2.732	1.225	0284	0.027	0.310	2.726	3.408	1.084	0.310	1.397	5.526	120.9	11.91	0.243	4.605	2.306	0.276	0.356
0.01	17.34	15.85	0.877	4.263	1.911	0.443	0.043	0.484	4.254	5.317	1.691	0.484	2.179	8.622	188.7	18.58	0.378	7.185	3.597	0.431	0.556

PLH=Plant height, PEL= Petiole length, PEB = Petiole breadth, LEL= Leaf length, LEB = Leaf breadth, LEN= Leaf Number, LAI=Leaf area Index, Inflorescence number, IFL= Inflorescence length, PDL= Peduncle length, SPL= Spathe length, (SPB) = Spathe breadth, CRL= Corm length, CRB= Corm breadth, CRW =Corm weight, STN=Stolon number, STL= Stolon length, STB = Stolon breadth, SSTW = Single stolon weight, (SWPP = Stolon weight per plant and YPP = Yield per plant.

Table 2. Mean squares of ANOVA for yield and yield contributing characters of three cultivars in *Colocasia esculanta*.

Sources of variation	df	Mean squares																			
		PLH	PEL	PEB	LEL	LEB	LEN	LAI	IFN	IFL	PDL	SPL	SPB	STN	SSTW	TSTW	STL	STB	CRL	CRB	CRW	YPP
Cultivars	2	46382 **	40902 **	101.62 **	2233.6 **	146.14**	8.81 **	0.019 ns	21.23 **	170.29*	3749.8 **	63.08	3.48 *	519.70 **	7324.45 **	3587145 **	31909.7 **	3.297 **	6242.5 **	1572.1 **	24.53 **	42.39 **
Block	2	691.2 **	352.3 **	0.353 ns	40.93 ns	86.74 **	0.677 ns	0.011 ns	0.63 ns	240.84*	12.41 ns	1.244 ns	3.11 *	10.00 ns	277.74 ns	227311*	2099.5 *	0.232 ns	14.2 ns	14.8 ns	0.115 ns	0.64 ns
Interaction	4	10.742 **	342.6 **	1.129 ns	29.98 ns	20.68 ns	1.73*	0.005 ns	0.17 ns	304.58 **	7.04 ns	12.727 ns	1.27 ns	10.60 ns	167.78 ns	138432*	2366.4 **	0.622 ns	10.80 ns	16.00 ns	0.136 ns	0.44 ns
Error	81	78.9	47.1	0.737	20.73	8.95	0.525	0.007	0.47	52.83	28.59	10.07	0.78	6.85	123.29	52331	531.9	0.498	67.90	15.70	0.194	0.26
Total	89	48227.5	41644	103.83	2324.64	263.81	11.74	0.042	22.50	768.53	37.97	87.12	8.63	547.14	7893.25	4005219	36907.5	4.650	6335.4	1618.60	24.965	43.72

*Significant at 0.05 level. **Significant at 0.01 level.

Table 3. Estimates of range and genetic parameters for yield and yield contributing characters of three cultivars of *Colocasia esculanta*.

Genetic parameters	PLH	PEL	PEB	LEL	LEB	LEN	LAI	IFN	IFL	PDL	SPL	SPB	STN	SSTW	TSTW	STL	STB	CRL	CRB	CRW	YPP
Range	70-184	50-148	4.00-11.33	25-56	13-36	4-7	0.005-0.80	1-4	39-75	22 - 67	16-32	3-8	7-24	35-100	336-1980	32-203	2-5	14-65	15-42	0.250-3.25	0.635-4.33
σ^2_p	15513.5	13665.40	34.37	758.35	54.68	3.29	0.011	7.39	91.97	1268.99	27.74	1.68	177.79	2523.67	1230602.33	10991.16	1.431	2126.10	534.5	8.30	14.298
σ^2_g	15434.6	13618.3	33.63	737.62	45.73	2.76	0.004	6.92	39.15	1240.41	17.66	0.901	170.95	2400.38	1178271.33	10459.26	0.933	20.58.20	518.8	8.11	14.043
σ^2_e	78.9	47.1	0.737	20.73	8.948	0.525	0.0068	0.47	52.83	28.59	10.07	.779	6.85	123.29	52331	531.9	0.498	67.9	15.7	0.194	0.255
CV_P	108.14	128.50	84.20	70.61	32.27	32.90	134.11	127.45	17.29	95.15	20.97	22.75	89.91	88.77	130.509	130.22	38.93	130.58	85.31	216.61	173.37
CV_g	107.87	128.28	83.63	69.63	29.52	30.16	80.88	123.33	16.49	94.07	16.73	16.67	88.16	86.57	127.70	127.2	31.43	128.48	84.04	214.12	171.82
CV_e	7.71	7.544	12.33	11.67	13.05	13.15	105.45	32.11	13.10	14.28	12.64	15.49	17.65	19.62	26.92	28.64	22.96	23.33	14.62	33.11	23.15
h^2(bs)	99.80	99.80	99.30	98.60	91.50	91.60	60.30	97.00	95.40	98.90	79.80	73.30	98.90	97.50	97.80	97.50	80.70	98.40	98.80	98.90	.98.80
GA	256.06	240.33	11.99	55.93	13.94	3.42	0.13	5.42	18.84	72.57	8.65	1.96	27.17	100.89	2234.93	210.56	1.99	93.46	47.05	5.87	7.696
GA %	222.33	267.18	172.22	143.41	60.84	62.07	166.17	254.14	33.95	193.83	34.47	34.24	183.17	178.28	262.93	261.53	64.72	264.68	173.61	441.35	352.86

cormels and yield per plant. Pandey and Singh (Personal communication) estimated variance, heritability and genetic advance for 18 characters in taro. He reported the gcv was highest in cormel number per plant, heritability and genetic advance were also high for cormel number per plant and cormel weight per plant. Among the accessions and cultivars of this species for all characters showed significant variations.

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