Indian Res. J. Genet. & Biotech, 8(3) : 220-227 (Aug. 2016)

Genetic Variability and Character Association Studies in Indigenous Edible Aroids of Nagaland

Thejazhanuo Lulu Mezhii[1], Sapu Changkija[2] and H. P. Chaturvedi[3]

Department of Genetics and Plant Breeding, Nagaland University, SASRD, Medziphema- 797106

(Received : May, 2016 : Revised : June, 2016 : Accepted : July 2016)

Abstract

High estimates of GCV and PCV were recorded for number of inflorescence, breadth of corm and number of cormels indicating the presence of ample variation for these traits in the present material. High heritability coupled with high genetic advance as percent of mean was recorded for Length of corm, Corm girth, Breath of corm, Number of cormels, Leaf length, Number of inflorescences per plant, Number of suckers, Corm weight, Cormel weight, Plant height, Petiole length and Yield per plant. Thus simple selection based on phenotypic performance for these traits would be effective as these are apparently under the control of additive gene action. The corm yield per plant exhibited significant positive correlation with Cormel weight and corm weight indicating relative utility of this trait for selection. Cormel weight and corm weight exerted maximum positive direct effect and exhibited significant positive correlation with yield indicating a true relationship among the traits.

Key words: Genetic variability, Correlation, Path coefficient, Aroids

Introduction

Until recently, Colocasia has been a vegetable of minor importance .However, now different cultivars of Colocasia are being grown throughout the tropics, sub-tropics and to some extent in the temperate regions. The corms and the cormels are usually consumed after boiling, curing or frying. Occasionally, the petioles and runners are used as vegetables and considered as a rich source of carbohydrates, proteins, minerals and vitamins. They are a good source of thiamin, riboflavin, iron, phosphorus, zinc and a very good source of vitamin B6, vitamin C, niacin, potassium, copper, and manganese. The digestibility of Colocasia starch is quite good and considered equal to that of potato starch. Development of an effective breeding programme is dependent upon the existence of genetic variability. In Nagaland, a wealth of diverse genetic material has been observed. Till now, no systematic study has been carried out to determine the extent of genetic variation present in landraces of Taro germplasm in Nagaland. Therefore attempt has been made in the present investigation to analyse the genetic variability present in landraces of Taro germplasm in Nagaland.

Materials and Methods

The present investigation entitled “Genetic Variability and Character Association Studies in Indigenous Edible Aroids of Nagaland” was carried out during Kharif season of two consecutive years, 2008 and 2009, in the Experimental Farm of Department of Genetics and Plant Breeding, Nagaland University, School of Agricultural Sciences and Rural Development using a total of 50 genotypes of Taro (*Colocasia esculenta* (L.)Schoot) comprising of local germplasm of Nagaland which were laid out in Randomized Block Design with three replications. Other edible aroids namely two Xanthosoma species, two Alocasia species and one Amorphophallus species were also documented. All the recommended agronomic practices were followed for raising

Corresponding Author’s E-mail : hpchaturvedi68@gmail.com
Published by Indian Society of Genetics, Biotechnology Research and Development,
5, E Biotech Bhawan, Nikhil Estate, Mugalia Road, Shastripuram. Sikandra, Agra 282007
Online management by www.isgbrd.co.in, www.irigbt.co.in

a good crop. Observations were recorded on five plants sampled randomly in each replication for fourteen morphological and yield traits viz, Plant height, Petiole length, Leaf Length, Leaf width, Number of inflorescence, Number of suckers, No of leaves, Corm weight, Number of cormels, Cormel weight, Corm girth, Length of corm, Breath of corm, Yield per plant. Analysis of variance was done by using the standard statistical procedure. Heritability (broad sense) was estimated according to Allard (1960). Genotypic and phenotypic coefficients of variation were estimated following Burton (1952). Genetic advance as per cent of mean was estimated according to Johnson et al. (1955). Genotypic and phenotypic correlation coefficients for all possible comparisons were computed by formulae suggested by Al- Jibouri et al. (1958). The partitioning of genotypic correlation coefficient of traits into direct and indirect effects was carried out using the procedure suggested by Dewey and Lu (1959).

Result and Discussion

Variability analysis revealed highly significant difference among the genotypes for all the characters. The present study revealed Highest mean for yield per plant was recorded from the local cultivar Lijalanii during 2008(549.34g) followed by Bei I(520.00g) and Thegabeizii (491.67g) and Bei I during 2009(815.34g) followed by Beidimai (671.67g) and Sama (528.67g). Among the quantitative characters, number of inflorescence gave the highest estimates of both genotypic and phenotypic coefficient of variation for both the year, during 2008 (246.53 and 278.6 respectively) followed by breath of corm (88.96 and 89.61) and during 2009 (189.92 and 247.65) followed by breath of corm (73.74 and 78.54). Higher estimates of GCV and PCV were recorded for Number of inflorescence, breadth of corm, number of cormels and number of suckers; medium estimates for corm girth, length of corm and cormel weight. This finding is in agreement with those recorded by Akorda (1984), and Bhattacharjee et. al.(2014).

High estimates of heritability coupled with high genetic advance as percent of mean was recorded for Length of corm, Corm girth, Breath of corm, Number of cormels, Leaf length, Number of inforesence per plant, Number of suckers, Corm weight, Cormel weight, Plant height, Petiole length and Yield per plant, showing possibility for improvement of these traits through selection. Rhishi *et al*. (1984) reported high estimates of heritability for leaf area and tuber yield per plant in *Dioscorea deltoidea*.

Correlation coefficient studies reveal that yield per plant was positively and significantly correlated with only cormel weight, and corm weight. The path analysis revealed that cormel weight and corm weight exerted positive direct effect and also exhibited significant positive correlation with yield at genotypic level indicating a true relationship among the traits. Mohankumar *et al*. (1990) also reported that leaf area and cormel weight had a positive direct effect on yield in taro. This suggested that the direct selection for cormel weight and corm weight would likely be effective in increasing seed yield.

Table 1. Estimates of Mean, range, Genotypic Co-efficient of variance(GCV), Phenotypic Coefficient of variance(PCV),Heritability in broad sense(h^2bs) and Genetic advance(GA) as percentage of mean during 2008

Characters	Mean±S.E	Range	Variance			GCV (%)	PCV (%)	(h^2bs)	GA%
			GV	PV	EV				
Plant height	61.03±2.62	29.97 - 145.87	355.76	426.69	70.74	30.9	33.86	83.38	58.13
Petiole length	46.08±2.52	23.10 - 86.80	179.77	240.4	60.62	29.09	33.65	74.78	51.84
Leaf length	34.58±2.33	8.73 - 51.27	104.2	148.2	44.06	29.52	35.21	70.28	50.98
Leaf width	28.09±2.11	17.87 - 42.00	22.05	51.84	29.78	16.71	25.62	42.54	22.46
Number of inflorescence	0.19±0.45	0.13 - 2.60	0.21	0.27	0.06	246.53	278.6	78.30	449.39
Number of suckers	1±0.81	0.13 - 3.53	0.58	1.20	0.63	75.38	108.9	47.91	107.48
Number of leaves	4.75±0.52	4.00 - 6.1	0.11	0.22	0.11	6.83	9.83	48.26	9.78
Corm weight	144.89±0.92	72.00 - 354.67	3259	4196.37	937.37	39.4	44.71	77.66	71.53
Number of cormels	4.01±6.66	0.10 - 14.73	10.49	11.58	1.09	80.61	84.69	90.59	158.05
Cormel weight	163.8±1.46	28.33 - 292.22	4514.11	7463.68	2949.57	41.01	52.74	60.48	65.71
Corm girth	8.13±0.54	3.77 - 21.73	10.64	17.41	6.77	40.09	51.29	61.11	64.57
Length of corm	6.08±0.53	2.00 - 18.40	17.08	17.21	0.13	67.97	68.24	99.23	139.49
breath of corm	3.22±0.53	1.33 - 14.50	8.21	8.33	0.12	88.96	89.61	98.55	181.92
yield per plant	307.22±7.23	156.67-520.00	8294.18	12394.38	4100.2	29.64	36.24	66.92	49.95

Note: High GCV(%) and PCV(%) in Number of inflorescence is due to flower formation in only 13 genotype out of the total 50 genotypes.

Table 2. Estimates of Mean, range, Genotypic Co-efficient of variance(GCV), Phenotypic Coefficient of variance(PCV),Heritability in broad sense(h^2bs) and Genetic advance(GA) as percentage of mean during 2009.

Characters	Mean±S.E	Range	Variance			GCV (%)	PCV (%)	(h^2bs)	GA%
			GV	PV	EV				
Plant height	71.75±8.52	37.46-145.833	339.51	449.72	110.21	25.68	29.56	75.49	45.97
Petiole length	56.77±8.48	26.43-122.33	277.09	385.08	107.99	29.32	34.57	71.96	51.24
Leaf length	32.56±3.20	19.40-55.67	58.71	74.08	15.37	23.53	26.43	79.25	43.15
Leaf width	23.52±2.53	12.83-38.27	29.64	39.25	9.6	23.15	26.63	75.53	41.44
Number of inflorescence	0.32±0.42	0.10-3.33	0.38	0.65	0.27	189.92	247.65	58.81	300.03
Number of suckers	1.22±0.50	0.13-4.60	1	1.37	0.37	81.67	95.57	73.02	143.75
Number of leaves	4.75±0.27	4.00-6.06	0.1	0.22	0.11	6.91	9.83	49.42	10
Corm weight	144.21±34.56	32.67-340.00	4093	5885.38	1791.94	44.36	53.19	69.55	76.23
Number of cormels	5.86±1.67	0.13-13.87	16.87	21.06	4.19	70.05	78.27	80.11	129.17
Cormel weight	194.35±50.97	37.33-478.33	6149.42	10046.66	3897.24	40.35	51.57	61.21	65.02
Corm girth	13.88±1.49	4.20-25.73	35.97	39.28	3.31	43.21	45.15	91.58	85.18
Length of corm	6.35±3.02	2.47-20.00	14.76	28.47	13.71	60.52	84.04	51.86	89.78
Breath of corm	3.55±0.78	1.50-13.73	6.85	7.77	0.92	73.74	78.54	88.15	142.62
Yield per plant	338.7±72.81	144-815.33	14663.21	22614.16	7950.96	35.75	44.39	64.84	59.3

Note: High GCV(%) and PCV(%) in Number of inflorescence is due to flower formation in only 13 genotype out of the total 50 genotypes.

Table: 3. Estimates of Genotypic and Phenotypic correlation coefficients for 14 characters in Colocasia during 2008.

Characters		Plant height (cm)	Petiole length (cm)	Leaf length (cm)	Leaf width (cm)	Number of inflore sence	Number of suckers	Number of leaves	Corm weight (g)	Number or cormels	Cormel weight (g)	Corm gorth (cm)	Length of corm (cm)	Breath of corm (cm)	Yield per plant (g)
Plant height (cm)	G	0.95**	0.29*	0.46**	0.53**	0.55**	-0.18	0.144	-0.10	-0.01	-0.12	0.29*	0.03	0.10
	P	0.93**	0.27*	0.32**	0.42**	0.39**	-0.03	0.113	-0.09	0.03	-0.07	0.26*	0.03	0.09
Petiole length (cm)	G		0.35**	0.47**	0.54**	0.61**	-0.24*	0.22	-0.13	-0.06	-0.03	0.27*	0.04	0.09
	P		0.30*	0.29**	0.41**	0.41**	-0.04	0.15	-0.10	-0.03	0.05	0.23*	0.04	0.07
Leaf Length	G			0.35**	0.20	0.32*	-0.23*	0.02	0.21	-0.02	-0.18	-0.09	-0.02	0.01
	P			0.50**	0.19	0.44**	-0.18	0.06	0.18	-0.03	-0.12	-0.72**	-0.01	0.02
Leaf width (cm)	G				0.40**	0.16	-0.19	0.05	0.14	0.58**	0.01	0.08	-0.05	.50**
	P				0.34**	0.40**	-0.13	0.08	0.08	0.27*	-0.01	0.05	-0.03	0.27*
Number of infloresence	G					-0.26*	-0.32*	0.32*	-0.32*	0.20	-0.08	0.43**	-0.08	0.29*
	P					-0.14	-0.15	0.27*	-0.27*	0.11	-0.06	0.37**	-0.07	0.25*
Number of suckers	G						0.04	0.03	0.36**	0.06	-0.03	-0.16	-0.15	0.07
	P						0.02	0.07	0.24*	0.07	-0.01	-0.11	-0.10	0.11
Number of leaves	G							-0.07	0.21	-0.13	-0.05	-0.23	-0.09	-0.20
	P							0.03	0.15	-0.04	-0	-0.15	-0.06	- 47**
Corm weight (g)	G								-0.39**	0.07	0.22	0.52**	0.34**	65**
	P								-0.29*	0.03	0.13	0.46**	0.31*	.60**
Number of cormels	G									0.21	-0.03	-0.35**	-0.27*	-0.11
	P									0.21	-0.02	-0.33**	-0.25*	-0.01
Cormel weight (g)	G										0.25*	0.01	-0.47**	80**
	P										0.16	0.01	-0.36**	81**
Corm girth girth(cm)	G											0.14	0.16	.33**
	P											0.11	0.13	0.21
Length of corm (cmv)	G												0.44**	.33**
	P												0.43**	0.27*
Breath of corm (cm)	G													-0.13
	P													-0.01
Yield per plant (g)	G													
	P													

*, ** Significant at 5 and 1% levels

Table: 4. Estimates of Genotypic and Phenotypic correlation coefficients for 14 characters in Colocasia during 2009

Characters		Plant height (cm)	Petiole length (cm)	Leaf length (cm)	Leaf width (cm)	Number of inflorescence	Number of suckers	Number of leaves	Corm weight (g)	Number or cormels	Cormel weight (g)	Corm gorth (cm)	Length of corm (cm)	Breath of corm (cm)	Yield per plant (g)
Plant height	G	0.99**	0.19	0.20	0.17	0.20	-0.07	0.21	-0.07	0.25*	-0.14	0.43**	0.05	0.25*
(cm)	P	0.97**	0.12	0.14	0.12	0.14	-0.06	0.12	-0.0	0.18	-0.11	0.32*	0.03	0.16
Petiole		G	0.20	0.20	0.09	0.18	-0.07	0.13	-0.08	0.16	-0.20	0.41**	0.05	0.15
length (cm)		P	0.13	0.15	0.09	0.13	-0.07	0.03	-0.27*	-0.07	-0.52**	0.10	0.12	-0.06
Leaf Length			G	0.97**	0.01	-0.18	-0.25*	0.05	-0.37**	-0.08	-0.60**	0.10	0.14	-0.05
(cm)			P	0.94**	-0.02	-0.12	-0.15	0.03	-0.19	-0.05	-0.47**	0.09	0.12	-0.04
Leaf width				G	0.02	-0.14	-0.31*	0.04	-0.27*	-0.05	-0.55**	0.08	0.16	-0.03
(cm)				P	0.01	-0.07	-0.19	0.10	-0.10	0.17	0.07	0.08	-0.15	0.17
Number of					G	-0.02	0.09	-0.02	-0.08	0.25*	0.12	0.13	-0.21	0.16
inflorescence					P	-0.01	0.01	-0.09	0.38**	0.16	0.25*	-0.11	-0.17	0.05
Number of						G	0.05	-0.13	0.54**	0.27*	0.28*	-0.12	-0.21	0.08
suckers						P	0.08	-0.27*	0.12	-0.04	-0.08	-0.09	-0.02	-0.17
Number of							G	-0.47**	0.25	-0.09	-0.13	-0.16	-0.07	-0.30*
leaves							P	-0.27*	0.12	-0.05	-0.08	-0.09	-0.02	-0.17
Corm								G	-0.24*	0.44**	0.44**	0.50**	0.40**	.81**
weight(g)								P	-0.15	0.43**	0.38**	0.29*	0.29*	.80**
Number of									G	0.19	0.41**	-0.08	-0.23*	-0.0
cormels									P	0.30*	0.38**	-0.05	-0.22	0.12
Cormel										G	0.55**	0.32*	-0.28*	.88**
weight (g)										P	0.48**	0.16	-0.23	0.88**
Corm girth											G	0.044	-0.045	0.60**
(cm)											P	0.009	-0.046	0.52**
Length of												G	0.438	.46**
corm (cm)												P	0.294	0.26*
Breath of													G	0.03
corm (cm)													P	-0.01
Yield per														G
plant (g)														P

*, ** Significant at 5 and 1% levels

Table: 5. Direct and indirect effects of different characters on corm yield per plant at genotypic level in colocasia during 2008.

Characters	Plant height (cm)	Petiole length (cm)	Leaf length (cm)	Leaf width (cm)	Number of inflore sence	Number of suckers	Number of leaves	Corm weight (g)	Number or cormels	Cormel weight (g)	Corm gorth (cm)	Length of corm (cm)	Breath of corm (cm)	Yield per plant (g)
Plant height (cm)	**0.00086**	0.20398	0.00886	-0.02884	-0.07657	-0.09649	0.00744	0.08865	-0.0009	-0.00468	0.00333	-0.01016	0.00095	0.10
Petiole	0.00082	**0.21458**	0.01078	-0.0298	-0.07849	-0.10738	0.01242	0.13356	-0.00119	-0.05439	0.00084	-0.0094	0.0013	0.09
Leaf Length (cm)	0.00025	0.0749	**0.0309**	-0.02214	-0.02843	-0.056	0.01181	0.01166	0.00198	-0.01883	0.00501	0.00311	-0.00067	0.01
Leaf width (cm)	0.00039	0.10152	0.01086	**-0.06298**	-0.05804	-0.02792	0.00963	0.02986	0.00129	0.49473	-0.00052	-0.00266	-0.00156	0.50**
Number of inflorescence	0.00045	0.11546	0.00602	-0.02506	**-0.14588**	0.04626	0.01657	0.19698	-0.00301	0.10187	0.00239	-0.01505	-0.00264	0.29*
Number of suckers	0.00047	0.13037	0.00979	-0.00995	0.03818	**-0.17674**	-0.00191	0.01985	0.00337	0.05929	0.00073	0.00572	-0.00528	0.07
Number of leaves	-0.00012	-0.05193	-0.00711	0.01181	0.04708	-0.00657	**-0.05134**	-0.04004	0.00193	-0.11112	0.00142	0.00796	-0.00306	-0.20
Corm weight (g)	0.00012	0.04642	0.00058	-0.00305	-0.04655	-0.00568	0.00333	**0.61736**	-0.00363	0.05518	-0.00621	-0.01848	0.01155	0.65**
Number of cormels	-0.00008	-0.02718	0.00652	-0.00863	0.04667	-0.06338	-0.01052	-0.23841	**0.0094**	0.17601	0.00082	0.01241	-0.00905	-0.11
Cormel weight (g)	0	-0.01364	-0.00068	-0.03642	-0.01737	-0.01225	0.00667	0.03983	0.00193	**0.85545**	-0.00703	-0.00014	-0.0161	0.80**
Corm girth (cm)	-0.0001	-0.00631	-0.00545	-0.00115	0.01227	0.00452	0.00256	0.13488	-0.00027	0.21153	**-0.02842**	-0.0049	0.00557	0.33**
Length of corm (cm)	0.00025	0.05723	-0.00273	-0.00475	-0.0623	0.02871	0.0116	0.32383	-0.00331	0.0033	-0.00395	**-0.03523**	0.01489	0.33**
Breath of corm (cm)	0.00002	0.0082	-0.00061	0.0029	0.01135	0.0275	0.00463	0.20989	-0.0025	-0.40553	-0.00466	-0.01545	**0.03397**	-0.13

Residual= 0.06

Table: 6. Direct and indirect effects of different characters on corm yield per plant at genotypic level in colocasia during 2009.

Characters	Plant height (cm)	Petiole length (cm)	Leaf length (cm)	Leaf width (cm)	Number of inflore sence	Number of suckers	Number of leaves	Corm weight (g)	Number or cormels	Cormel weight (g)	Corm gorth (cm)	Length of corm (cm)	Breath of corm (cm)	Yield per plant (g)
Plant height (cm)	**0.11156**	0.10322	-0.01515	0.00854	0.00165	-0.00752	0.00053	0.10801	-0.00082	0.17024	0.00133	-0.00658	0.00099	0.25*
Petiole	-0.11077	**0.10396**	-0.01537	0.00874	0.00081	-0.00701	0.00053	0.0691	-0.00087	0.10562	0.00192	-0.00639	0.00098	0.15
Leaf Length (cm)	0.02141	0.02024	**-0.07894**	0.0419	0.00008	0.00693	0.00185	0.02641	-0.00411	-0.05593	0.00568	-0.0016	0.00261	-0.05
Leaf width (cm)	-0.02208	0.02106	-0.07668	**0.04314**	0.00023	0.00532	0.00229	0.02306	-0.00297	-0.03312	0.00522	-0.00116	0.00285	-0.03
Number of inflorescence	-0.01922	0.00884	-0.00064	0.00105	**0.00957**	0.00093	-0.00069	-0.00967	-0.00084	0.1725	-0.0011	-0.00208	-0.00386	0.15
Number of suckers	-0.0218	0.01894	0.01423	-0.00597	-0.00023	**-0.03847**	-0.00036	-0.067	0.00597	0.18234	-0.00265	0.00187	-0.00396	0.08
Number of leaves	0.00792	-0.0073	0.01947	-0.01317	0.00087	-0.00182	**-0.00751**	-0.24641	0.00276	-0.06177	0.00122	0.00239	-0.00129	-0.30*
Corm weight (g)	-0.02317	0.01381	-0.00401	0.00191	-0.00018	0.00495	0.00356	**0.52014**	-0.0027	0.29863	-0.00413	-0.00764	0.00719	0.81**
Number of cormels	0.00831	-0.00819	0.0293	-0.01156	-0.00073	-0.02075	-0.00187	-0.12712	**0.01107**	0.12673	-0.00385	0.0012	-0.00433	0
Cormel weight (g)	-0.0279	0.01613	0.00649	-0.0021	0.00242	-0.0103	0.00068	0.22818	0.00206	**0.68073**	-0.00521	-0.00498	-0.00511	0.88**
Corm girth (cm)	0.01572	-0.02121	0.04764	-0.02391	0.00112	-0.01082	0.00098	0.22822	0.00453	0.37654	**-0.00941**	-0.00068	-0.00083	0.60**
Length of corm (cm)	-0.04779	0.04326	-0.00824	0.00327	0.00129	0.00469	0.00117	0.25896	-0.00087	0.22065	-0.00042	**-0.01535**	0.00796	0.46**
Breath of corm (cm)	-0.00609	0.00559	-0.01137	0.00678	-0.00203	0.0084	0.00053	0.20596	-0.00264	-0.19172	0.00043	-0.00673	**0.01815**	0.03

Residual= 0.03

References

Al-Jibouri N. A., P. A. Miller and H. F. Robin. 1958. Genotypic and environmental variances, co-variances in an upland cotton cross of inter-specific origin. Agron. J. 50 : 633—637.

Allard R. W. 1960. Principles of plant breeding. John Wiley and Sons Inc, New York, USA.

Akorda, M.O. 1984 .Variability, repeatability, character correlation and path analysis in yellow yam. *Theor. Appl. Genet.* **69** (2) : 227 - 232.

Bhattacharjee, M., Tarafdar J. and Sadhukhan, R. 2014. Assessment of Genetic Diversity of some Indigenous collections of Upland Taro [Colocasia esculenta var. antiquorium (L) Schott] for selection of Genotypes Aiming at improvement in Breeding Programme. IOSR J. of Agri. And Vety. Sc., Vol. 7 Ver. I, 31-43.

Burton G. W. 1952. Quantitative inheritance in grasses. Proc. 6th Int. Grassland Cong. 1 : 227—283.

Dewey D. R. and K. H. Lu. 1959. Correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 57 : 515— 518.

Johnson H. W., H. F. Robinson and R. E. Comstock. 1955. Estimates of genetic and environmental variability in soybean. Agron. J. 47: 314—318.

Mohan Kumar C.R., Saraswathy, P. and Sadanandan, N. 1990. Correlation and path coefficient analysis on yield and yield components in Taro. *J. Root Crops.* 16 (2): 140 – 141.

Rishi, A.N., Bhan, M.K. and Dhar, P.L. 1984. Genetic variability and component analysis for tuber yield of *Dioscorea deltoidea*. Herha Hungarica.23(1):43 - 51.