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Genetic Diversity Analysis in Indigenous Edible Aroids of Nagaland

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Abstract

The nature and magnitude of genetic divergence were assessed in 50 genotypes of Taro (*Colocasia esculenta* (L.)Schoot) germplasm of Nagaland. Based on the relative magnitude of D^2 values, 50 genotypes were grouped into ten clusters for the year 2008 and nine clusters for the year 2009. The analysis revealed maximum contribution of corm girth, corm yield per plant and number of cormels towards genetic divergence. The clustering patterns indicate that geographic diversity has impact on genetic diversity.

Key words : Cluster, D^2 values, Genetic divergence, Taro

Introduction

Genetic diversity in the available gene pool is the source of variation, which is raw for the improvement work. For effective conservation and utilization of colocasia genetic resources, a clear understanding of genetic diversity and relationships of varieties is essential. Precise information on the nature and degree of genetic divergence of the parents is the prerequisite for an effective breeding program. Nagaland is rich in genetic diversity of colocasia owing to its ecological diversity offered by its dense forest and hilly tracts/terrains. Farmers cultivate several locally adapted landraces of colocasia. These landraces are not only numerous, fulfilling a varieties of needs and adapted to different conditions, but also genetically viable. To efficiently conserve, manage and use such germplasm resources, an understanding of structure and dynamics of local landraces variation is required. Studies carried out by workers to examine the genetic variation of colocasia of the region is very limited and little or no information is available so far on how genetic diversity is structured within a given landraces. Therefore, the present investigation was undertaken to gather knowledge on the diversity among the local landraces

Materials and Methods

The present investigation entitled "Study of genetic divergence 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 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. The genetic divergence among genotypes was computed by

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means of Mahalanobis D^2 technique (Mahalanobis, 1936) and the genotypes were grouped into different clusters following Tocher's method (Rao, 1952).

Result and Discussion

Analysis of variance revealed significant variation among the 50 genotypes for all the characters. Several measures of distance have been proposed to suit various objectives of which Mahalanobis's generalized distance (Mahalanobis, 1930, 1936; Rao, 1952) had occupied a unique place in plant breeding. Using this technique, 50 genotype of colocasia were classified into 10 clusters for the year 2008 and 9 cluster for the year 2009.The distribution of entries in various clusters showed that there was considerable amount of genetic divergence among the genotypes for all the character studied. During 2008, Out of the 10 clusters, Cluster VI had maximum number of 19 genotypes followed by cluster II with 13 genotypes, cluster IV with 6 genotypes, cluster I,III,V,VII,VIII with 2 genotypes and cluster IX and X had 1 genotype each. During 2009, out of the 9 clusters, Cluster VIII had maximum number of 21 genotypes followed by cluster VII with 14 genotypes, cluster I,II,III,IV,V and IV with 2 genotypes, cluster I,III,V,VII,VIII with 2 genotypes and cluster IX and X had 1 genotype each.

The inter-cluster distance were greater than intra-cluster distances revealing considerable amount of genetic diversity among the genotypes studied for both the years. The results are in agreement with the previous reports Singh et al.(1995) and Rahman et al. (1997). During 2008, the intra cluster distance was maximum in cluster IV (D =20.4). The divergence at inter cluster level was maximum between cluster I and III (D=50.65), followed by cluster I and V (49.51) indicating greater diversity between these clusters. Choosing of genotypes belonging to distant clusters was expected to produce highly variable population. The minimum inter cluster distance was recorded between I and IX (D =5.17), III and V(D =5.47), VII and VII(D =6.45), V and X(D =7.64), VI and X(D =8.68), V and VII(D =9.56) and clusters III and X(D=9.77). The genotypes in these clusters are genetically very close.

During 2009, the intra cluster distance was maximum in cluster IX (D=11.65). The divergence at inter cluster level was maximum between cluster III and IX (D=14.58), followed by cluster VI and IX (D=13.94) indicating greater diversity between these clusters. Choosing of genotypes belonging to distant clusters was expected to produce highly variable population. The minimum inter cluster distance was recorded between I and IV (D^2 = 3.18), I and II (D^2 =3.92), V and IV (D^2 =3.21), V and V (D^2 =3.28), VI and VI(D^2 =3.49), III and VI (D^2 =4.18) and clusters II and IV(D^2 =4.89). The genotypes in these clusters are genetically very close.

During 2008, the maximum cluster mean value was observed in cluster IV for leaf width, number of cormels, cormel weight, and yield per plant. Cluster VIII also have the highest mean for plant height, petiole length, number of inflorescence and length of corm. Cluster V consisted of genotypes with maximum number of leave. Cluster IX consisted of genotypes with maximum Corm weight and Corm girth.

During 2009, the maximum cluster mean value was observed in Cluster IX for plant height, petiole length, Corm weight, length of corm and breath of corm. Cluster III consisted of the genotype with maximum number of suckers, cormel weight and corm girth. Cluster VI consisted of the genotype with maximum Number of inflorescence and number of cormel. Cluster II consisted of the genotype, among others with longest leaf length and leaf width. Cluster V consisted of the genotypes with maximum number of leaves and Number of inflorescenc contributed the least towards the total genetic divergence.

In several instances, clusters aggregated cultivars that are highly likely to be genetically distant, such as varieties with or without stolons, branched or unbranched, variegated or non-variegated. Singh *et al*. (2008) also reported similar result.

The selection and choice of parents mainly depends upon contribution of characters towards divergence. Among the characters studied the maximum contribution towards divergence among the local land races was corm yield per plant during 2008.This was followed by Length of corm, Number of cormels, Breath of corm, Cormel weight, Corm girth, Leaf length, Corm weight, Plant height, Leaf width, Petiole length, Number of leaves, Number of suckers. During 2009, the maximum contribution towards divergence among the landraces was corm girth .This was followed by Number of cormels, Breath of corm, Cormel weight, Number of suckers, Plant height, Number of inflorescence, Corm weight, Length of corm, Leaf length, Number of leaves, Leaf width and Petiole length(0.16%) contributed the least towards the total genetic divergence. Bhattacharjee *et al*. (2014) also reported similar findings.

Therefore character such as corm yield per plant, Length of corm, Number of cormels, Breath of corm, Cormel weight, Corm girth, Leaf length, Corm weight, Plant height, Leaf width can be used for selecting parents from distinctly placed clusters to obtain high yielding genotypes.

Table 1. : Clustering pattern of 50 genotypes on the basis of genetic divergence in Colocasia during 2008.

Clusters	No of genotypes	Genotypes	Place of collection of genotypes with number
I	2	Waipong,Tejongnii	Peren(1), Mokokchung(1)
II	13	Chugoma, Bei I, Beithola, Dziirinuo I, Tephfii dziinuo, Ati, Obei, Dziinuo I, Thegabeizii, Beidimai I, Loudoubei, Wasii nii, Chuyali,	Zunheboto(2), Peren(3), Phek(1), Kohima (5) Dimapur(1), Mokokchung(1)
III	2	Dziirinuo II, Tong I	Dimapur(1), Mon(1)
IV	6	Dzii Dziinuo, Manie I,Dziinuo II,Thupela,Tino III,Tong II	Dimapur(2), Wokha(1), Kohima(1), Tuensang(1),Mon(1)
V	2	Beyo, Pajo	Phek(1) , Wokha(1)
VI	19	Dziinuo III,Keriila,Sama,Dziinuo IV, Bei II,Tefiidzii,Chiicha,Lijalanii,Beidimai II,Dziirinuo III,Manie II,Banu sam sam,Bao,Aiie,wolikhuo,Tinopang, Kotaknii,Tino I,Tino II	Dimapur(3), Kohima(5), hek(1), Mokokchung(2), Peren(1),Wokha(1), Kiphira(2),Zunheboto(1),Longleng(1), Tuensang(2).
VII	2	Manyii, Tong III	Mokokchung(1),Mon(1)
VIII	2	Dziinuo VI ,Atsantu	Dimapur(1),Kohima(1)
IX	1	Beizo	Phek(1)
X	1	Dziiti	Dimapur(1)

Table 2. : Clustering pattern of 50 genotypes on the basis of genetic divergence in Colocasia during 2009.

Clusters	No of genotypes	Genotypes	Place of collection of genotypes with number
I	2	Wasiinii, Chuyali	Mokokchung(1),Zunheboto(1)
II	2	Tinopang, Kotaknii	Longleng(1), Mokokchung(1)
III	2	Manie I, Tong I	Wokha(1), Mon(1)
IV	2	Manyii,Tong III	Mokokchung(1), Mon(1)
V	2	Obei, Dziinuo I	Dimapur(1),Kohima(1)
VI	2	Ati, Dziinuo II	Dimapur(1),Kohima(1)
VII	14	Waipong, Chugoma, Bei I, Beithola, Dziirinuo I, Tephfii dziinuo, Thegabeizii, Beidimai I, Loudoubei, Dzii Dziinuo, Dziirinuo II, Thupela, Sama, Banu sam sam	Peren(3), Zunheboto(1),phek(1), Kohima(5), Dimapur(3), Kiphire (1)
VIII	21	Dziinuo III, Keriila,Sama,Beyo, Dziinuo IV,Tefiidzii,Chiicha, Lijalanii, Pajo, Beidimai II, Dziirinuo III, Manie II,Bao,Aiie, Wolikhuo,Kotaknii,Tino I,Tino II, Tino III,Dziinuo V,Atsantu,Tong II,	Dimapur(4)Kohima(5), Phek(1),Mokokchung(2), Wokha(2), Peren(1),Kiphire(1), Zunheboto(1),Tuensang(3), Mon(1)
IX	3	Tejongnii, Beizo, Dziitii	Mokokchung(1),Phek(1), Dimapur(1)

Table 3. : Average intra and inter Cluster distance in Colocasia during 2008

Cluster No.	I	II	III	IV	V	VI	VII	VIII	IX	X
I	3.93	2205.16	2565.57	2056.18	2451.39	1917.13	1981.79	1308.52	26.72	2096.85
	(1.98)	(46.96)	(50.65)	(45.34)	(49.51)	(43.79)	(44.76)	(36.17)	(5.17)	(45.79)
II		387.99	241.48	375.43	240.67	323.19	218.86	1469.06	2061.61	274.24
		(19.69)	(15.54)	(19.38)	(15.51)	(17.98)	(14.79	(38.33)	(45.41)	(16.56)
III			14.178	286.99	29.91	237.98	111.32	1838.82	2441.52	95.4
			(3.77)	(16.94)	(5.47)	(15.43)	(10.55)	(42.88)	(49.41)	(9.77)
IV				404.162	296.31	318.44	238.97	1327.87	1922.61	349.42
				(20.14)	(17.85)	(17.85)	(15.46)	(36.44)	(43.85)	(18.69)
V					22.015	223.45	91.35	1818.79	2329.95	58.35
					(4.69)	(14.95)	(9.56)	(42.65)	(48.27)	(7.64)
VI						271.26	178.72	1309.39	1787.34	243.62
						(16.47)	(13.37)	(36.19)	(42.27)	(15.61)
VII							41.82	1361.49	1828.69	75.34
							(6.45)	(36.89)	(42.76)	(8.68)
VIII								156.26	1098.97	1801.12
								(12.5)	(33.15)	(42.44)
IX										1974.09
										(44.43)
X										0
										0

D values are in parenthesis.

Table 4. : Average intra and inter Cluster distance in colocasia during 2009

Cluster No	I	II	III	IV	V	VI	VII	Viii	IX
I	3.936	15.338	104.968	10.094	100.366	105.969	116.086	68.672	130.263
	(1.984)	(3.916)	(10.245)	(3.177)	(10.018)	(10.294)	(10.774)	(8.287)	(11.413)
II		6.13	100.902	23.89	118.342	101.738	133.299	70.527	141.332
		(2.476)	(10.045)	(4.888)	(10.879)	(10.087)	(11.546)	(8.398)	(11.888)
III			9.829	126.771	38.681	17.484	73.628	87.55	212.44
			(3.135)	(11.259)	(6.219)	(4.181)	(8.581)	(9.357)	(14.575)
IV				10.318	118.245	131.765	128.425	79.491	146.405
				(3.212)	(10.874)	(11.479)	(11.332)	(8.916)	(12.1)
V					10.772	33.815	72.942	97.611	189.875
					(3.282)	(5.815)	(8.541)	(9.88)	(13.78)
VI						12.144	76.156	87.633	194.339
						(3.485)	(8.727)	(9.361)	(13.941)
VII							102.727	115.225	189.242
							(10.135)	(10.734)	(13.757)
VIII								95.914	173.654
								(9.794)	(13.178)
IX									134.883
									(11.654)

D values are in parenthesis.

Table 5. Cluster wise mean value of 14 characters in Colocasia during 2008.

Cluster no	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 of cormel	Cormel weight (g)	Corm girth (cm)	Length of corm (cm)	Breath of corm (cm)	Yield per plant (g)
I	59.8	45.883	34.083	26.41	0	0.917	4.783	199.33	1.767	46.667	9.027	12.367	14.317	246
II	55.305	41.246	36.679	26.585	0.29	0.777	4.815	154.05	4.195	160.637	8.228	5.154	2.172	309.177
III	45.11	35	43.867	30.6	0.133	1.5	4.467	90.667	5.5	148	6.817	3.033	1.483	238.667
IV	52.031	36.972	31.794	32.889	0	0.794	4.8	137.83	6.311	259.333	6.672	6.089	2.294	397.167
V	59.417	43.583	31.233	21.1	0	1.033	5.067	87.833	3.433	92.667	6.2	3.05	1.8	181.333
VI	70.196	53.935	34.044	29.375	0.16	1.451	4.793	138.43	4.479	166.021	8.815	5.561	2.904	304.428
VII	50.817	37.867	24.4	25.433	0.1	0.133	4.733	141.17	0.2	170.667	7.083	4.633	2.683	310.167
VIII	70.5	55.767	42.817	25.933	0.967	0.233	4.35	181.03	0.7	205.333	9.133	16.817	3.133	386.333
IX	61.967	45.3	33.233	25.667	0	0.167	4.267	256.33	0.133	36.667	10.733	12.567	13.433	293
X	53.467	39.6	28.6	19.267	0.133	0.133	4.367	128.33	0.1	28.333	5.033	2.467	3.633	156.667

Table 6. : Cluster wise mean value of 14 characters in Colocasia during 2009.

Cluster no	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 of cormel	Cormel weight (g)	Corm girth (cm)	Length of corm (cm)	Breath of corm (cm)	Yield per plant (g)
I	73.467	58.5	34.2	25.1	0.317	0.45	4.633	122.333	0.383	121.833	6.433	3.933	2.833	250.333
II	74.633	60.75	41.433	29.5	0.167	1.167	4.567	92.7	4.65	144.667	4.7	4.683	3.3	237.367
III	61.667	47	30.967	25.05	0.167	2.733	4.5	109.833	11.583	268.722	18.922	5.25	2.217	378.555
IV	62.9	49.633	38.767	25.4	0.15	0.1	4.733	135	0.15	172.5	7	4.05	2.783	307.5
V	53.333	37	20.067	12.96	0	0.9	4.883	66.6	7	122	17.27	3.7	3.017	188.6
VI	72.75	61.167	30.467	24.433	0.5	1.45	4.617	111.888	13.08	210.278	17.897	3.9	2.567	322.167
VII	65.61	49.681	28.692	21.046	0.463	1.286	4.829	168.984	6.562	243.119	18.92	7.017	3.819	412.674
VIII	77.779	62.734	35.139	25.033	0.337	1.359	4.803	142.7	6.005	195.452	12.244	6.722	2.895	337.473
IX	79.3	65.744	32.267	23.644	0.033	0.344	4.489	190.444	0.489	43.111	9.167	9	9.9	233.889

Table 7. : Contribution of characters to divergence during 2008 & 2009 respectively

Character	Contribution %	Contribution %
Plant height	1.14	4.00
Petiole length	0.90	0.16
Leaf length	1.39	1.88
Leaf width	1.06	1.06
Number of infloresence	0.33	2.53
Number of suckers	0.41	4.98
Number of leaves	0.65	1.71
Corm weight	1.31	2.29
Number of cormels	12.41	15.27
Cormel weight	3.02	7.76
Corm girth	2.29	31.92
Length of corm	21.06	1.96
Breath of corm	8.16	8.25
Yield per plant	45.88	16.25
Total	100.01	100.02

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