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PHENOTYPIC DIVERSITY OF COCONUT GERMPLASM CONSERVED AT DIFFERENT STATIONS OF BARI

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Abstract

Diversity of coconut germplasm being conserved at different Regional and Sub-stations of the Bangladesh Agricultural Research Institute (BARI) was estimated during 2001-2002. Diversity indices (D^2) ranged from 1068.96 to 171.93. Maximum diversity was observed between BARI Narikel-2 and Rahmatpur Yellow Dwarf. Genotypes of Regional Agricultural Research Station, Jessore and BARI Narikel-2 were found morphologically similar. Population under conservation at Jamalpur and lshwardi stations were found close to BAR! Narikel-l. Similar relationships among the genotypes were reflected when they were grouped into several clusters. Out of six clusters, the members of cluster II were homogenous, while that of cluster IV showed heterogenicity.

Key Words: Phenotypic diversity, coconut germplasm.

Introduction

Tall type cross-pollinated coconut is widely cultivated in Bangladesh (Ahmad, 1982). Due to cross-pollination and human selection, variations are noticed in coconut germplasm of Bangladesh. The yield of nut is very low (21 nut/plant/year) as compared to many other coconut growing countries in the world (BBS, 2002). With a viev to improving coconut, Bangladesh Agricultural Research Institute (BARI) collected germplasm from home and abroad during early 60s (Tabibullah and Ahmed, 1976). After a long and systematic evaluation, BARI recommended two of them fbr cultivation throughout the country in 1996 (BARI, 2000). However, the amount and extent of diversity within the collection are not yet known. Characterization, documentation, and evaluation of germplasm are essential for initiating any programme on development of coconut. Hence, the study was undertaken to estimate phenotypic diversity of the conserved coconut germplasm of BARI.

Materials and Method

The study was conducted on 9 populations at 6 Research Stations of BARI during 2001 -2002. The populations were named according to the conservation sites. Data on stem, leaf, flowers, fruit (whole nut and dehusked nut, liquid endosperm), solid endosperm (kernel) were recorded from 30 sampled palts followed by IPGRI

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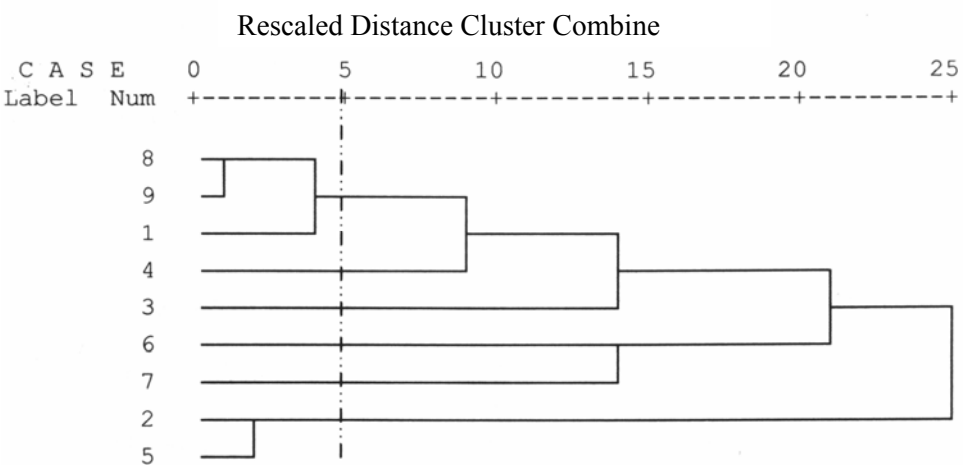
(1996) manual. The collected data were summarized and subjected to diversity analysis by SAS 6.12 and SPSS-9.5 computer packages. Principal component analysis (PCA) and clustering were carried to assess the pattern of morphological variation. To assess cohesiveness of the population, a dendrogram of the populations was developed (Fig. 1). Locations of the populations with cultivar names are presented in Table 1.

Table 1. Coconut germplasm conserved at different stations of BARI.

Population name	Other /ethnic name	Population size (no.)	Location	Year of plantation
BAR1 Narikel-1	Deshi Narikel	400	RARS, Rahmatpur Barisal	1965
BARI Narikel-2	Malayan Tall	1200	RARS, Rahmatpur Barisal	1966
Rahmatpur Tall	Singhalcse Tall	700	RARS, Rahmatpur Barisal	1966
Rahmatpur Yellow Dwarf	Chandina/ Barodagia	200	RARS, Rahmatpur Barisal	1966
Khairtala Tall	Khairtala Tall	300		1969
Hathazari Tall	Hathazari Tall	200	ARS, Raikhali	1967
Hathazari Red Tall	Bini Narikel/ Shundhi Narikel	35	RARS, Rahmatpur Barisal	1967
JamalpurTall	Deshi Narikel	150	RARS, Hathazari, Chittagong	1968
lshurdi Tall	Deshi Narikel	200	RARS, Jamalpur	1966

Results and Discussion

The estimated D^2 values for all possible combinations between pairs of genotypes ranged from 171.93 (between Jamalpur Tall and Ishurdi Tall) to 1068.96 (between BARI Narikel-2 and Rahmatpur Yellow Dwarf) (Table 2). Diversity index of BARI Narikel-2 (2) ranged from 223.393 to 1068.96 with respect to other genotypes. The minimum distance between BARI Narikel-2 and Khairtala Tall (5) implies that they might be developed from the same source of planting materials. Jamalpur Tall (8) found closer to Ishurdi Tall (9) although they are located in different agro-ecological zones (AEZ). Non-corresponding distribution of germplasm to geographical locations also reported by Nadaf *et al.* (1986) Shewe *et al.* (1972) and Shunmugam *et al.* (1982). Similar patterns of relationship of genotypes reflected in dendrogram (Fig. 1).



Legend:

l. BARI Narikel-1	6. Hathazari Tall
2. BARI Narikel-2	7. Hathazari Red Tall
3. Rahmatpur Tall	8. Jamalpur Tall
4. Rahmatpur Yellow Dwarf	9. Ishurdi Tall
5. Khairtala Tall	

Fig. 1. Dendrogram using average linkage between the conserved genotypes at different station of BARI.

Table 2. Estimated D2 values of coconut germ plasm conserving at different BARI stations.

Genotype	1	2	3	4	5	6	7	8
1	498.345	459.058	577.276	377.492	434.655	513.945	358.754	248.423
2		740.371	1068.962	223.393	555.904	858.377	829.762	690,929
3			690.881	563.765	744.861	844.143	504.253	463.855
4				945.697	784.296	606.655	293.842	432.120
5					555.241	763.925	704.013	571.655
6						539.509	661.339	576.608
7							606.767	592.646
8								171.929
9								

First three principal components accounted for 71% of the total diversity (Table 3). According to PCA, ten variables were selected for cluster analysis as they significantly contributed to the total diversity (Table 4). The populations were grouped into six clusters at 1-5 scale of dendrogram (Table 5). In cluster II the characters having the highest intra-cluster means were fruit weight, nut

weight and liquid endosperm weight. In cluster III, husk weight was the higher contributing character to divergence. Meat weight and endosperm thickness had the maximum intra-cluster means in cluster V. Number of spikelets with female flower as well as number of female flowers, shell weight, nut weight without liquid endosperm and total soluble solids (TSS) of kernel in cluster VI was found maximum (Table 6). So, the characters of the clusters are important for selecting parents of hybridization programme and also recommending as varieties for cultivation (Jagadev and Samal, 1991).

Table 3. Eigenvalues of Covariance Matrix of 10 principal components for quantitative characters of conserved coconut genotypes of BARI.

Component	Eigenvalue	Difference	Proportion	Cumulative
PRIN1	5.221	0.773	29.008	29.008
PRIN2	4.448	1 .25	24.7 13	53.721
PRIN3	3.198	0.491	17.765	71.486
PRIN4	2.707	1.266	15.037	86.523
PRIN5	1.441	0.863	8.006	*94.528*
PRIN6	578	0.21	3.2 12	97.740
PRIN 7	368	0.329	2.046	99.786
PRIN8	039	.039	214	100.000

Table 4. Eigenvectors of 17 characters in first nine principal components.

Characters	Component				
	1	2	3	4	5
Bole at trunk (cm)	.514	.154	-.618	.480	.245
Bole at girth (cm)	.762	.241	-.09 1	.452	.292
Length of 11 internodes (cm)	.070	.755	.488	-.0 12	.397
No. of leaf-let	.415	.304	.102	-.781	.288
Length of inflorescence stalk (cm)	-.551	.567	-.518	.064	-.315
No. of spike-let with ♂ flower	-.207	.458	.825	.183	.045
No. of spike-let w/o ♀ flower	-.161	.582	.284	.542	-.454
Total no. of spike-lets	-.164	.578	.701	.331	-.109
No. of female flowers	.366	.516	.039	-.764	.028
Fruit wt (g)	.399	.730	-.466	-.193	-.070
Husk wt (g)	-.296	.578	-.465	-.262	.207
Nut wt (g)	728	.497	-.232	.064	-.366
Shell wt (g)	.928	.094	.211	-.029	-.237
Liquid endosperm wt	-.1 87	.890	-.106	.008	-.094
kernel wt(g)	.201	.118	-.326	.722	.512
Endosperm thickness (cm)	.776	-.042	.567	.016	.228
TSS of meat (%)	.736	-.551	.184	-.008	-.248

(Bold figures indicate highest loading of each character under different components)

The inter-cluster distances found greater than intra-cluster distances (Table 7). Highest intra-clustcr distances were measured in cluster IV and it was lowest in cluster II. So, the results indicated that BARI Narikcl-2 and Khairtala Tall of

cluster II were identical. On the other hand, Yellow Dwarf might contribute maximum intra -cluster diversity in IV. It can be stated here that dwarf coconuts might grow as high as of a Tall cultivar but many distinct vegetative and reproductive characters sustained throughout the life. Cluster V was found significantly different from all other clusters, although only one genotype included in that cluster. However, maximum diversity was measured between II & IV (878.08). According to Tabibullah and Ahmed (1976), the member of cluster III is Sri Lankan origin.

Table 5. Coconut germplasm in different clusters.

Cluster number	Genotype serial number	Total genotypes	Genotype
I	1,9	2	BARI Narikel-1, Ishurdi Tall
11	2, 5	2	BARI Narikel-2, Khairtala Tall (KHAT)
III	3	1	Rahmatpur Tall
IV	4,8	2	Rahmatpur Yellow Dwarf (RHYD), Jamalpur Tall (JAMT)
V	7	1	Hathazari Red Tall (HART)
VI	6	1	Hathazari Tall (HART)

Table 6. Cluster means of 12 characters of BARI conserved coconut germplasm.

Character	Cluster					
	1	2	3	4	5	6
Girthatbole(cm)	143.30	148.60	136.30	109.60	153.80	119.30
Girth at trunk (cm)	92.20	100.60	89.10	76.50	109.50	92.10
Height of 11 internodes (cm)	35.00	39.90	34.00	30.80	32.70	40.00
No. of spikelets with female flowers	11 .00	11.20	9.50	10.90	11 .60	17.90
No. of spikelets without female flowers	20.20	24.00	14.70	17.20	18.10	17.70
Total spikelet	31.20	35.20	24.20	24.20	29.50	35.60
No of female flowers	22.00	24.20	21.10	16.80	12.00	32.20
Fruit wt. (g)	1432.00	1796.00	1500.50	1009.00	1192.00	1487.50
Husk wt. (g)	546.50	651.70	866.00	388.50	25 1 .50	420.00
Nut wt. (g)	881 .00	1139.70	624.00	609.00	879.50	997.00
Shell wt. (g)	188.50	251.90	133.00	121.00	283.00	335.00
Liquid endosperm wt (g)	312.50	437.20	178.50	206.00	101.50	184.00
Nut wt. without liquid endosperm (g)	569.00	703.00	446.00	403.00	778.00	813.00
Meat wt. (g)	349.50	343.00	309.50	247.50	495.00	109.65
Endosperm thickness (cm)	4.00	4.00	4.00	4.00	12.00	11.90
Total soluble solid (%)	3.90	4.30	4.50	4.20	7.10	7.30

(Highest values with bold figure in column indicating important characters of the cluster)

Hathazari Red Tall and Rahmatpur Tall were grouped separately in V and III, respectively. Khairtala Tall and BARI Narikel-2 were grouped in cluster V, while BARI Narikel-l and Ishurdi Tall were grouped in I. Similarity in mary phenotypic characters of the genotypes brought them in a particular group. The observed diversities in the collections might be resulted from natural and human intervention (Foale, 1992).

Table 7. Intra (bold) and inter-cluster D^2 values.

Cluster	I	11	III	IV	V	VI
1	123.839	520.268	444.227	363.659	540.134	*495.055*
II		111.200	*648.155*	878.080	804.125	543.689
111			0	586.104	843.779	744.484
IV				144.762	*587.954*	709.912
V					0	*539.074*
VI						0

From the study, it can be concluded that substantial variation existing in coconut germplasm conserving at various stations of BARI. Khairta!a Tall and BARI Narikel-2 might be the same genotype. Ishurdi Tall and BARI Narikel-l appeared genetically alike. Further collection of germplasm form home and abroad needed to enrich diversity for further development of coconut in Bangladesh.

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References

Ahmad, K. U. 1982. Gardener's Book of Production and Nutrition. Vol 1 (lS ed.). Mrs Mumtaj Kamal, Bungalow 2., Krishi Khamar Sharak Farm Gate, Dhaka-15. Bangladesh. pp. 273-275.

BARI. 2000. Krishi Projukti Hatboi (Handbook on Agro-technology), 2nd edition, Bangladesh Agricultural Research Institute, Gazipur 1701, Bangladesh. 303-304.

BBS. 2002. Statistical Year Book of Bangladesh 1998. Bangladesh Bureau of Statistical Division, Ministry of Planning and Evaluation, Government of Bangladesh. pp. 668.

Foale, M.A. 1992. Coconut Diversity-Present knowledge and future research needs. Paper of the IBPGRI Workshop on Coconut Genetic Resources, Cipanas, Indonesia. International Crop Network Series No. 8. IPGRI, Rome, Italy.

Jagadev, P. N. and K.L. Samal. 1991. Multivariate analysis in niger *(Guizoticahyssinicu cass.). Indian J. Genet*. **5 1**(4): 392-394.

Islam, M. N and A. K. M. Amzad Hossain. 2000. National coconut program in Bangladesh. COGENT Newsletter **4** (2): 10.

Nadaf, H. L., A. F. Habib and J. V. Gouds. 1986. Analysis of genetic divergence in bunch groundnut. *J. Oliseeds Res.* **3** (1): 37-45.

IPGRI. 1996. Manual on standardized techniques in coconut research. IPGRI-APO. P.O. Box 236 (JPM Post Office, 43400 Serdang, Selangor Darul Ehsan, Malaysia. P. 46.

Shanmugam A. S and S. R. S. Rangasamy. 1982. Multivariate analysis of genetic divergence in black gram. *Madras Agric. J.* **69**(11): 701-706.

Shew, W. H., 13. R. Murthy, H. B. Singh and V. M. B. Rao. 1972. Genetic divergence in recent elite strains of soybean and groundnut. *Indian J. Genet.* **32:** 285-298.

Tabibullah, M. and K. U. Ahmad. 1976. Performance of two exotic and typica coconut cultivars as compared with a local one. *Bangladesh Hort.* **4** (2): 11-I 7.