International Journal of Agricultural Sciences, Vol. 7 Issue 2 (June, 2011) : 321-324

Genetic diversity in direct seeded aerobic rice

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ABSTRACT

The nature and magnitude of genetic divergence was estimated in 22 aerobic rice varieties using Mahalanobis's D^2-stastics.The cultivars were grouped into six clusters showing considerable amount of genetic diversity among the varieties. The clustering pattern showed no correspondence between clustering pattern and geographical origin of the varieties .Cluster IV and VI showed maximum inter-cluster distance while cluster II exhibited maximum intra-cluster cluster divergence. Cross combinations showing high D2 matrix value like Bala x Sattari, Bala x Heera, Sattari x Vandana and Kalinga-II x Bala may produce high magnitude of heterosis or desirable segregants. All minimum and maximum cluster mean values were distributed in relatively distant clusters. Traits like days to 50% flowering,1000-grain weight, plant height, grain length and grain breadth were the major contributors to the genetic divergence.

Bose, L.K., Singh, O.N., Subudhi, H.N. and Rao, G.J.N. (2011). Genetic diversity in direct seeded aerobic rice. *Internat. J. agric. Sci.*, **7**(2): 321-324.

Key words : Aerobic rice, Genetic divergence, Cluster, Yield components

INTRODUCTION

Water is becoming a looming crisis in agriculture, more particularly in rice cultivation. By 2025, per capita water availability in many Asian countries is likely to decline by 15-54% as compared with 1990. On the other way, to meet the global demand of rice, 800 million tons of rice needs to be produced by 2025. 'Aerobic rice' cultivation is one of the promising water saving rice production technologies where the amount of irrigation water meets the demand for evaporation from soil and transpiration by the crops. However, to sustain high yields under this condition requires varieties ideal for limited water stress condition along with improved crop management. To save irrigation water, researchers are developing some alternative cultivation methods, which can help to save water and enhance water productivity in rice cultivation. Therefore, considerable efforts are being focused at CRRI Cuttack, India to develop aerobic rice genotypes. The study of diversity of rice genotypes for aerobic condition may lead towards enhancing grain and water productivity.

The estimation of genetic divergence in the available germplasm is important for successful selection of parents for hybridization purpose. The divergent lines belonging to different and distantly located clusters have a higher probability of giving heterotic hybrids or superior progenies than those parental lines belonging to the same cluster or group possessing low genetic distance. Several workers have emphasized the importance of genetic divergence for selection of desirable parents (Murthy and Arunachalam, 1966; Sinha *et al.*, 1991; Pradhan and Mani, 2005 and Bose and Pradhan, 2005).Looking into the importance of varietal development in aeobic rice, the present investigation was undertaken to assess the magnitude of genetic divergence among the collected varieties.

MATERIALS AND METHODS

The experimental materials comprised of 22 aerobic rice genotypes collected from different breeding centres of the country were direct seeded at aerobic experimental plot developed at CRRI Cuttack, India in alpha lattice design with three replications in wet season, 2006 and 2007. The plot size comprised of 5 rows, each of 3 meter length and 15cm apart. Plant to plant spacing was maintained at 15cm. Recommended agronomic practices and need based plant protection measures were followed in order to raise good crop. Observations on days to heading, plant height, total tillers/plant, ear bearing tillers/ plant, panicle length, panicle weight, grains/panicle, seed test weight, plot yield (t/ha), grain length and grain breadth. Mean data were subjected for Mahalanobis's D2 statistics as suggested by Rao(1952).

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes for all the eleven studied characters (Table 1). The results indicated high magnitude of variances for majority of the characters might favour selection and further utilization in future recombination

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Table 1 : Analysis of variance for 11 characters of 22 aerobic rice genotypes (Mean sum of square)

Characters	Sources of variation		
	Replication (2)	Genotypes (21)	Error (42)
Days to 50% flowering	0.136	469.985**	1.105
Plant height	15.11	1244.271**	6.742
Total tiller/plant	9.365	30.592**	6.430
EBT/plant	3.766	25.949**	3.291
Panicle length (cm)	0.856	29.289**	0.940
Panicle weight (g)	0.139	1.001**	0.039
Grain/panicle	345.905	2084.942**	64.304
Seed test weight (1000)	0.071	23.217**	0.100
Yield (t/ha)	0.781	0.814**	0.081
Grain length (mm)	0.034	2.246**	0.019
Grain breadth (mm)	0.019	0.199**	0.004

** Significant at 1% level probability

breeding programme.

The 22 aerobic rice varieties were grouped into six clusters (Table 2 and Fig. 1). Cluster I ess the largest cluster comprising of 13 varieties followed by cluster II containing five genotypes. Rest four clusters were of monogenotypic only. The clustering pattern showed no correspondence between clustering pattern and geographical origin of the varieties. In cluster I, varieties from Orissa, Uttar Pradesh and Bihar were found to club together. Thus, the distribution of genotypes into different clusters was not associated with their geographic origin. Similar findings of non-correspondence of genetic divergence with geographic diversity were reported in rice by De and Surya Rao (1987), Vivekanandan and Subramanian (1993), Kumari and Rangaswami (1997) and Kandhala and Panwar (1999). Murty and Arunachalam (1966) stated that genetic drift and selection in one environment could cause greater diversity than geographic distances.

Table 2 : Clustering pattern of 22 aerobic rice genotypes

Cluster no.	No. of genotypes	Name of genotypes
I	13	Neela, Ghante, Kalinga-II, Kalinga-I, Tara,Govind, Narendra-I, Tripti, Pathara, Anjali, Dhala Heera, Vandana, Vanaprava
II	5	Rudra, Sankar, Sneha, Sattari, Heera
III	1	Parijat
IV	1	Kalinga-III
V	1	Kalyani-II
VI	1	Bala

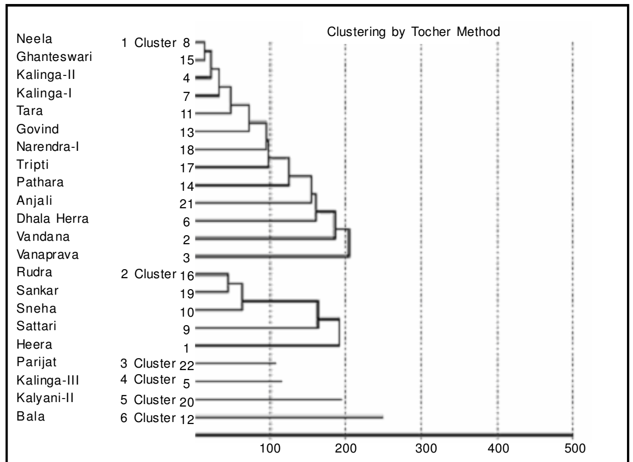

Fig. 1 : Clustering of aerobic rice varieties by Tocher method

The intra and inter-cluster distance is presented in (Table 3). The intra-cluster distance revealed that the maximum divergence was observed in cluster II (13.56) followed by cluster I (12.22). It is reported that genotypes within the cluster with high degree of divergence would produce more desirable breeding materials for achieving maximum genetic advance. Therefore, due emphasis should be given on the members of the cluster II and I for selection of parents for hybridization program. The minimum intra-cluster value exhibited by cluster III, IV, V and VI indicated negligible genetic diversity among the genotypes of each character as only a single genotype is accommodated in each cluster.

Table 3 : Average intra (bold) and inter cluster D^2 values

	I	II	III	IV	V	VI
I	12.22	19.86	16.72	16.01	19.45	21.54
II		13.56	23.57	18.47	23.30	30.88
III			0.00	22.26	30.74	21.39
IV				0.00	16.53	31.75
V					0.00	29.00
VI						0.00

The maximum inter-cluster divergence was observed between cluster IV and VI (31.75) followed by cluster II and IV (30.88). Highly divergent genotypes would produce a broad spectrum of variability enabling further selection and improvement. The hybrids developed from these genotypes within the limits of compatibility of these clusters may produce high magnitude of heterosis or desirable transgressive segregants, which would be rewarding for successful breeding program for lowland situations. Thus, hybrid developed from highly divergent parent combination showing high D^2 matrix value like

Table 4 : Cluster means of characters in D2 analysis

Cluster	Days to 50% flowering	Plant height (cm)	Total tiller/ plant	EBT/ plant	Panicle length (cm)	Panicle weight (g)	Grain / panicle	Seed test weight (1000)	Yield (t/ha)	Grain length (mm)	Grain breadth (mm)
I	70.05	95.99	16.41	13.77	25.02	3.35	194.46	24.64	2.78	8.66	2.57
II	53.33	70.15	16.59	12.54	20.33	2.67	167.71	21.99	2.07	7.84	2.70
III	88.33	82.47	16.63	13.23	20.63	2.30	156.67	20.50	2.67	7.90	2.05
IV	56.33	118.87	18.50	14.00	24.70	2.73	178.87	22.17	2.38	9.48	2.38
V	49.00	116.17	11.20	11.50	26.20	2.80	125.67	29.83	2.53	9.67	2.78
VI	91.00	86.47	20.67	16.27	17.27	1.98	132.00	28.90	1.83	7.40	2.80

Bala x Sattari, Bala x Heera, Sattari x Vandana and Kalinga-II x Bala may produce high magnitude of heterosis or desirable transgressive segregants which would facilitate successful breeding in lowland rice environment. Pradhan and Ray (1990), Rahman *et al.* (1997) and Bose and Pradhan (2005) have also reported that selection of parents for hybridization should be done from two clusters having wider inter-cluster distances to get maximum variability in the segregating generations.

The cluster means for all the eleven characters are presented in Table 4. Cluster I exhibited long panicle, high panicle weight, more grains/panicle and more plot yield as compared to other clusters. Cluster II showed only desirable features like very early flowering and low plant height. Cluster III contains plant with low plant height, more yield and low grain breadth. Cluster IV exhibited high mean values for total tiller per plant, ear bearing tillers/ plant, grains/panicle, grain length and low grain breadth. Cluster V contains desirable features like very early duration, long panicle, more panicle weight, high grain weight and long grained as compared to other clusters. Cluster VI exhibited desirable features like more tiller/ plant, more ear bearing tillers/plant and high seed test weight. These observations suggested that none of the clusters contained genotypes with all desirable traits, which could be directly selected and utilized. Interestingly, most of the minimum and maximum cluster means were distributed in relatively distant clusters. The hybridization between genotypes of different clusters is necessary for the development of desirable genotypes. Recombination breeding between genotypes of different clusters has also been suggested by Sinha *et al.* (1991), Singh *et al.* (1996) and Bose and Pradhan (2005).

The data in Table 5 indicated that traits like days to 50% flowering,1000-grain weight, plant height, grain length and grain breadth were the major characters contributing to the genetic divergence among the genotypes and these traits could be used as parameters in selecting genetically diverse parents. Rahman *et al.* (1997), Pradhan and Mani (2005) and Bose and Pradhan (2005) also identified some of these characters as the major contributing traits in rice.

Table 5 : Character contribution to the genetic divergence

Character	% contribution to total divergence
Days to 50% flowering	39.83
Plant height	17.75
Total tiller/plant	0.00
EBT/plant	0.00
Panicle length (cm)	0.00
Panicle weight (g)	1.30
Grain/panicle	0.00
Seed test weight (1000)	26.41
Yield (t/ha)	0.43
Grain length (mm)	9.96
Grain breadth (mm)	4.33

In the present investigation it is suggested that hybridization among divergent clusters having highly diversed parental combinations like Bala x Sattari, Bala x Heera, Sattari x Vandana and Kalinga-II x Bala are expected to give promising and desirable recombinants in the segregating generations. Also, traits like days to 50% flowering, 1000-grain weight, plant height, grain length and grain breadth were the major characters contributing to the genetic divergence among the genotype may be useful in selecting genetically diverse parents.

REFERENCES

Bose, L.K. and Pradhan, S.K. (2005). Genetic divergence in deep water rice genotypes. *J. Central Europian Agric.*, **6**(4):635-640.

De, R.N. and Surya Rao, A.V. (1987). Genetic divergence in rice under low land situation. *Crop Improv.*, **14**:128-131.

Kumari, R.V. and Rangasamy, P. (1997). Studies on genetic diversity in international early rice genotypes. *Ann. Agric. Res.*, **18**:29-33.

Kandhala, S. S. and Panwar, D. V. S. (1999). Genetic divergence in rice. *Ann. Biol., Ludhiana*, **15**:35-39.

Mahalanobis, P.C. (1936). On the generalized distance in statistics. *Proc. Nat. Sci. (India),* **2** : 49-55.

Murty, B.R. and Arunachalam, V. (1966). The nature of genetic divergence in relation to breeding system in some crop plants. *Indian J. Genet.,* **26** : 188-198.

Pradhan, S.K. and Mani, S. C. (2005). Genetic diversity in Basmati rice. *Oryza,* **42** : 150-152.

Pradhan, K. and Ray, A. (1990). Genetic divergence in rice. *Oryza*, **27** (4):415-418.

Rahaman, M., Acharya, B., Sukla, S.N. and Pande, K. (1997). Genetic divergence in low land rice germplasm. *Oryza*, **34**(3):209-212.

Rao, C.R. (1952). *Advanced statistical methods in biometrical research*. John Wiley and Sons, Inc. New York.

Singh, A.K., Singh, S.B. and Singh, S.M. (1996). Genetic divergence in scented and fine genotypes of rice (*Oryza sativa*). *Ann. Agric. Res.*, **17**:163-166.

Sinha, P.K., Chauhan, V.S., Prasad, K. and Chauhan, J.S. (1991). Genetic divergence in indigenous upland rice varieties. *Indian J. Genet.*, **51**:47-50

Vivekanandan, P. and Subramanian, S. (1993). Genetic divergence in rainfed rice. *Oryza*, **30**:66-72.

Received : January, 2011; Accepted : April, 2011