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Research Note

Genetic Diversity for Grain Yield and its Components in Local Rice (*Oryza sativa* L.) Genotypes under Submergence

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Abstract
Genetic diversity among 49 local rice genotypes was worked out using Mahalanobis D^2 statistic under submergence. On the basis of genetic distance, these genotypes were grouped into six clusters. Cluster I was the largest, consisting of 20 genotypes, while two genotypes present in cluster II, eight genotypes present in cluster III, twelve genotypes present in cluster IV, four genotypes present in cluster V and three genotypes present in cluster VI. There was no parallelism between genetic diversity and geographical distribution. The maximum inter cluster distance was between Cluster III and cluster V. Among the different characters studied, harvest index, straw yield/ plant (g) and grain yield/ plant (g) contributed significantly for the genetic diversity. The cluster II was characterized by maximum mean value for majority of these characters, hence ,Doddiga and Hasuli may be used a parents in future breeding programme. Genotypes of Cluster III and cluster V may be intercrossed to achieve wider segregation under submergence.

Key words: Rice, Genetic diversity, submergence, clusters, contribution.

Genetic improvement mainly depends upon the amount of genetic variability present in the population. In any crop, the germplasm serves as a valuable source of base population and provides scope for wide variability. Information on the nature and degree of genetic divergence would help the plant breeder in choosing the right parents for breeding programme (Vivekananda and Subramanian, 1993). The yield level of rainfed lowland rice is, on average, around 2.3 t ha^{-1}, much lower than that of the irrigated systems of about 4.9 t ha^{-1}, which is largely due to many abiotic stresses such as drought, submergence, salinity, etc. Rainfed lowland rice grows in bunded fields that become flooded for at least part of the cropping season to depths that do not exceed 50 cm for more than ten consecutive days (IRRI, 1993), but also suffers water deficit at various stages of development due erratic rainfall. From a survey of researchers in eastern India, submergence is identified as the third most important of 42 biotic and abiotic stresses (Widawsky and O'Toole, 1990). There is an urgent need to identify high yielding genotypes suitable for submergence condition. Therefore in the present investigation, 49 local rice genotypes were evaluated to assess the genetic diversity among these genotypes under submergence.

The material for the present study consisted of 49 local rice genotypes drawn from the rice germplasm maintained at Zonal Agricultural Research Station (ZARS), Mudigere. The investigation was carried out at Zonal Agricultural Research Station (ZARS), Mudigere, Gandhi Krishi Vignana Kendra (GKVK), University of Agricultural Sciences (UAS), Bangalore. Thirty days old seedlings of long duration genotypes were transplanted in the main plot in Simple Lattice Design with two replications during *kharif* 2012. A spacing of 20 cm between rows and 10 cm between plants within a row was maintained. From a day after transplanting, the crop was in the submergence condition for 10 days without draining the water. After ten days, excess water is drained out and recommended cultural operations were taken up to ensure uniform and healthy crop stand as per package of practice. Observations on various characters were recorded on five randomly selected plants from the two central rows of each plot. Multivariate analysis of Mahalanobis' (1936) and grouping of genotypes was done as per the procedure given by Rao (1952).

The analysis of variance revealed the presence of significant variability among red rice genotypes for all the characters studied. Based on relative magnitude of D^2 estimates, 49 genotypes were grouped into six clusters (Table 1). Cluster I was the largest, consisting of 20 genotypes, two genotypes present in cluster II, eight genotypes present in cluster III, twelve genotypes present in cluster IV, four genotypes present in cluster V and three genotypes present in cluster VI. The pattern of group constellations raveled that significant variability existed among the genotypes.

A wide range of variation was observed in cluster means for all the characters studied (Table 2). Cluster I had lowest mean value for days to 50 per cent flowering, days to maturity and mortality per cent. The cluster II was characterized by maximum mean value for plant height, number of productive tillers per plant, number of nodes per plant, panicle exsertion, spikelet fertility, grain yield and straw yield per plant. Genotypes of this cluster viz., Doddiga and Hasuli may be used a parents in future breeding programme. Cluster III has high mean value for panicle length and panicle weight. Hence these genotypes could be involved in the hybridization to identify productive recombinants for submergence condition.

The selection and choice of parents mainly depends upon contribution of characters towards divergence (Dushyantha kumar ,2008 and Nayak *et al.,* 2004). Differences in proportion of contribution of each character to total D^2 statistics were observed. They are presented in Table 4. Harvest index contributed (32.40) per cent to the divergence of genotypes. This was followed by Straw yield/plant (19.73) and grain yield per plant (13.78).

The average D^2 values of intra and inter clusters distances are given in Table 3. Maximum differences among the accessions within the same cluster were shown by cluster III (10.52) followed by cluster V (10.23). The genotypes included in cluster III are most divergent than other clusters. Among clusters, cluster III and cluster V showed maximum inter cluster distance (11.54) (Table 2). Hence, genotypes of Cluster III and cluster V may be selected for inter crossing with each other to achieve wider segreation under submergence.

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Table1. Clustering Pattern of 49 local rice cultivars

Clusters	No. of Entries	Genotypes
I	20	P. Doddi, Doppa valya, Kirwana, Siddasale, Jaddu battha, Nergoltiga, Alugidda, Kagu, Puttabatta, Karihasali, Doddi, Purichipiga, Guja gunda, Mundoni, Uduramallige, Dappavalya, Biliakki, Bolumallige, Rathna chudi, Hemavathi.
II	2	Doddiga, Hasuli
III	8	Akkalu, PuB, Kanakasali, Bettasanna, Halugidda selection, Balgodu selection, KHP-9, KHP-5.
IV	12	BKB, Urulachipiga, Bilikanhegme, Nati bata, Sampigedala, Kesari, Sampigebatta, P. Kirwana, Biliya, Mattalaga, Masale putta batta, Bilihasudi.
V	4	Holabatta, Neergoli, Sharavathi, Kaggali Kirwana.
VI	3	PUBM-8, BKBM:23, INTAN

Table 2. Cluster means for 16 characters in characters in local rice cultivars

Clusters	I	II	III	IV	V	VI
Days to 50 per cent flowering	143.35	145.5	149.5	147.71	148.5	146.33
Days to maturity	175.4	177.75	180.75	179.38	180.63	179.5
Plant height (cm)	112.05	118.05	105.83	114.09	116.4	111.3
Number of productive tillers/plant	6.59	6.8	6.25	6.18	6.18	6
Number of nodes	2.58	2.95	2.38	2.75	2.78	2.5
Internodal length (cm)	45.2	40.33	45.58	42.44	43.68	47.06
Panicle length (cm)	23.06	23.4	23.6	23.41	22.24	22.47
Panicle weight (g)	3.62	3.46	3.84	3.76	3.54	3.7
Panicle exsertion (cm)	1.85	4.71	2.69	3.05	3.28	2.52
Number of spikelets/panicle	128.15	106.85	145.64	134.08	109	155.4
Spikelet fertility (%)	85.14	90.88	84.72	86.44	87.72	83.2
Test weight (g)	25.74	28	24.04	25.65	29.11	21.94
Mortality (%)	10.43	11.25	12.06	13.75	12.88	11.17
Straw yield/plant (g)	12.02	13.61	11.1	11.07	11.16	12.05
Harvest Index	13.54	16.81	12.62	13.51	13.33	14.78
Grain yield/plant (g)	0.47	0.45	0.47	0.45	0.47	0.45
Over all score	48	43	64	59	71	61
Rank	2	1	5	3	6	4

Table 3. Average Inter and intra cluster distances in characters of local rice cultivars

Clusters	I	II	III	IV	V	VI
I	**8.69**	7.99	9.77	9.35	10.04	9.36
II		**3.20**	9.70	8.00	7.42	9.03
III			**10.52**	10.09	11.54	9.86
IV				**9.74**	10.01	9.75
V					**10.23**	11.07
VI						**9.89**

Table 4. Contribution of each character to the divergence in rice genotypes

Character	Contribution (%)
HI	32.40
Straw yield/plant (g)	19.73
Grain yield/plant (g)	13.78
Number of spikelets/ panicle	7.57
Test weight (g)	6.29
Panicle exsertion (cm)	6.12
Panicle weight(g)	4.34
Number of productive tillers/ plant	2.81
Mortality (%)	2.47
Plant height(cm)	1.87
Spikelet fertility (%)	1.70
Panicle length(cm)	0.51
Days to 50% flowering	0.26
Days to maturity	0.09
Number of nodes	0.09
Internodal length(cm)	0.00