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Studies on Genetic Divergence for Yield, Yield Components and Quality Characters in Promising Rice Varieties of Andhra Pradesh

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Twenty-five rice varieties were evaluated for their genetic diversity with regards to grain yield, yield components and grain quality characters. The varieties were classified into six clusters, based on Mahalanobis D^2 statistics. Geographical and genetic diversity were observed to be unrelated, as varieties from diverse geographical regions were placed in the same cluster, while varieties from the same centre were grouped into different clusters. Results on inter-cluster distances revealed maximum diversity between varieties of cluster V and VI. Intra-cluster distance was maximum for cluster III, indicating the existence of variability within the cluster for the characters studied. A perusal of the results on cluster means revealed higher grain yield per plant, more number of productive tillers and number of filled grains per panicle for cluster II, while long panicle length and high head rice recovery were noticed for cluster VI, indicating the desirability of selection of varieties from these clusters for improvement of grain yield and the above yield and quality traits. Further, days to maturity and 1000 seed weight, together had accounted for 70.33 per cent of the total genetic divergence indicating their importance in the choice of parents for hybridization programmes.

Key words: D^2 analysis, Genetic divergence, Quality characters, Rice, Yield, Yield components

Rice is one of the principle food crops and one third of the world population and two thirds of the Indian population utilizes rice as staple food. Study of genetic divergence is an important tool to the plant breeders for efficient selection of diverse parents for use in hybridization programmes aimed at improvement of rice production (Kwon *et al.* 2002). In this direction, the present study was undertaken to classify and understand the nature and magnitude of genetic diversity among rice varieties of different rice research stations of the erstwhile Andhra Pradesh state of India using Mahalanobis D^2 statistics (Mahalanobis, 1936).

Materials and Methods

The present investigation involved 25 released rice varieties from different rice research stations of the erstwhile Andhra Pradesh state, India. These varieties were grown in a randomized block design with three replications during *Kharif* 2013. Thirty days old seedlings of each variety were transplanted in four rows, each of 4m length by adopting a spacing of 20cm between rows and 15cm within the row. All recommended package of practices were adopted to raise a healthy crop. Observations were recorded for grain yield per plant ; yield components, namely days to maturity, plant height, number of productive tillers per plant, panicle length, number of filled grains per panicle, 1000 seed weight and harvest index; and quality traits, namely, head rice recovery and amylose content. The observations on plant height, productive tillers per plant, panicle length and number of filled grains per panicle were recorded for five randomly selected plants for each entry in each replication. However, days to maturity and grain yield were recorded on plot basis. In contrast, observations for 1000 grain weight, head rice recovery and amylose content were obtained from a random grain sample drawn from each plot in each entry and replication. The data obtained was then subjected to standard statistical procedures. Genetic diversity in the material was analyzed using Mahalanobis D^2 statistics described by Rao (1952) and the varieties were grouped into different clusters according to Tocher's method.

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Results and Discussion

Analysis of variance revealed highly significant differences for grain yield, yield component characters and the quality traits studied, indicating the existence of sufficient variability for effective selection. Further, 25 varieties studied were grouped into six clusters (Table 1), based on the relative magnitude of D^2 values. Among the six clusters, cluster I consisted of maximum varieties (13), representing collections from different centers of the erstwhile Andhra Pradesh state, namely, Bapatla, Jagtial, Nellore, Nandyal, Rajendranagar and Rudrur; while cluster III had five varieties from

Table 1. Distribution of 25 rice varieties into different clusters

Cluster Number	Number of varieties	Varieties	Source
I	13	BPT 2295, JGL 384, JGL 3855, JGL 11470, NDLR 7, NDLR 8, NLR 3083, NLR 34449, NLR 40024, RDR 992, RNR 2354, RNR 6378, RNR 15048	Bapatla, Jagtial, Nellore, Nandyal, Rudrur, Rajendranagar
II	4	JGL 1798, JGL 11118, JGL 19621, RNR 15038.	Jagtial, Rajendranagar
III	5	BPT 3291, NLR 145, RGL 11414, RGL 2332, RNR 2458	Bapatla, Nellore, Ragolu, Rajendranagar,
IV	1	BPT 5204	Bapatla
V	1	JGL 11727	Jagtial
VI	1	NLR 3042	Nellore

Bapatla, Nellore, Ragolu and Rajendranagar; and cluster II had four varieties from Jagtial and Rajendranagar; while clusters IV, V and VI were monogenotypic and comprised of varieties from Bapatla, Jagtial and Nellore, respectively. The distribution pattern of varieties into different clusters revealed no parallelism between genetic and geographic diversity as varieties chosen from same eco-geographical region were observed to be present in different clusters as well as in the same cluster, while varieties from diverse geographical regions were included in the same cluster. Similar results were reported in rice by earlier workers (Madhavilatha *et al.* 2005). The production of greater diversity by genetic drift and selection, compared to that produced by geography was also observed in the present study. Varieties from Bapatla were observed to be distributed over three clusters (Cluster I, III and IV), while varieties from diverse geographical regions of the state were placed in the same cluster. Similar results were reported earlier by Murthy and Arunachalam, 1966.

Table 2. Average inter and intra cluster distances for 25 rice varieties

Cluster	I	I	I	IV	V	VI
I	59.88	195.46	183.26	153.41	278.63	166.57
II		66.52	373.52	180.18	262.48	513.55
III			120.12	310.73	209.13	243.26
IV				0.00	227.31	498.21
V					0.00	584.70
VI						0.00

An analysis of the inter and intra cluster distances (Table 2) revealed maximum inter-cluster distance between cluster V and VI (584.70) followed by II and VI (513.55) and IV and VI (498.21) indicating that varieties from these clusters were highly divergent meriting their due consideration in selection of parents for hybridization. Rajesh *et al.* (2010) had also reported greater diversity between varieties from different clusters based on their inter-cluster distance. Minimum inter-cluster distance was observed between cluster I and IV (153.41) indicating their close relationship and similarity with regards to the characters studied for most of the varieties in the two clusters. Further, intra-cluster distance was observed to be minimum for cluster I (59.88) and maximum for cluster III (120.12), while it was zero for the monogenotypic clusters, namely, cluster IV, V and VI as they included only single variety. The varieties included in cluster III exhibiting maximum intra-cluster distance are inferred to be more divergent than those in other clusters with regards to the characters studied.

Table 3. Cluster means for yield, yield components and quality characters in 25 rice varieties

Cluster	Days to maturity	Plant height (cm)	Productive tillers per plant	Panicle length (cm)	No.of filled grains per panicle	1000 Seed weight (g)	Harvest index (%)	Grain yield per plant (g)	Head rice recovery (%)	Amylose content (%)
I	136.89	112.78	9.64	24.53	220.16	15.94	36.83	29.94	65.42	20.81
II	124.67	114.85	10.92	24.84	249.10	16.07	43.68	36.16	62.17	19.64
III	140.83	119.40	8.64	25.78	218.92	21.59	40.21	35.22	61.50	22.28
IV	134.00	100.27	9.07	19.33	190.53	16.56	43.74	25.53	61.33	22.85
V	131.67	110.33	6.87	22.37	244.13	25.22	40.50	36.05	66.33	22.53
VI	144.33	120.07	8.13	29.27	244.13	14.54	25.93	24.00	66.67	22.18

A perusal of the results on cluster means for yield and yield components (Table 3) revealed considerable differences between the clusters for all characters under study. High grain yield, productive tillers per plant and number of filled grains per panicle were noticed for cluster II, while high harvest index and amylose content were noticed for Cluster IV. However, high 1000 grain-weight was recorded for cluster V, while cluster VI recorded more number of days to maturity, plant height, panicle

Table 4. Relative contribution of characters studied towards genetic divergence in rice

Character	Times ranked 1st	Contribution (%)
Days to maturity	114	38.00
Plant height	14	4.67
Productive tillers per plant	6	2.00
Panicle length	25	8.33
Number of filled grains per panicle	21	7.00
1000 Seed weight	97	32.33
Harvest Index	3	1.00
Grain yield per plant	0	0.00
Head rice recovery	19	6.33
Amylose content	1	0.33

length and head rice recovery, indicating the importance of selection of varieties from the corresponding clusters in hybridization programmes for effecting improvement of the respective traits.

Information on the relative contribution of various plant characters towards divergence has been reported to aid the breeder in the choice of parents for hybridization and effective selections (De *et al.* 1988). In the present study, days to maturity contributed maximum (38.00%) followed by 1000 grain weight (33.00%) towards the total divergence (Table 4). Similar results were reported by Senapathi and Sarkar (2005) and Ramesh Chandra Pradhan *et al.* (2007). Contribution of the remaining characters to the total divergence was however, relatively low. Therefore, days to maturity and 1000 seed weight, contributing 70.33 per cent of the total divergence need to be stressed in selection of parents for hybridization.

The study revealed existence of genetic diversity among the varieties for grain yield, yield components and the quality traits studied. However, no relation was observed between geographic and genetic diversity. Further, days to maturity and 1000 seed weight were observed to contribute more than 70 per cent of the total genetic divergence, indicating their importance in the choice of parents.

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