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Clustering Pattern of some Indigenous Rice (*Oryza sativa* L.) Accessions from Chhattisgarh

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The current scenario in the food and agriculture sector marks the sudden increase in concerns towards conservation of genetic biodiversity in rice production. Chhattisgarh state in India is home to a large number of indigenous rice varieties, which may serve a valuable genetic resource for future crop improvement to meet the ever increasing demand for food production. The preliminary characterization of five accessions of clustered spikelet rice germplasm was carried out at IGKV, Raipur during *kharif* 2012 to 2013. The data on qualitative and quantitative descriptors were recorded using standard evaluation system for rice (IRRI, 2002) descriptor for 18 traits. The accessions studied exhibited good variability in both qualitative and quantitative traits. Ama Ruthi showed maximum variation for all the traits *viz.*, basal leaf sheath colour, collar colour, culm interned colour, apiculus colour and high fertility percentage observed in accession Chhind Guchhi (97.24%) followed by Ama Jhopa (97.11%), Nariyal Phool (96.63%), Koudi Dhul (95.51%) and Ama Ruthi (92.18%). So, this study will be useful for breeder and researcher to identify valuable germplasm and their conservation as well as utilization in rice improvement programme.

Key Words: Cluster, Germplasm, Rice accessions, Spikelets

Introduction

Rice is one of the oldest crop domesticated about 10,000 years ago and during this long period, transition from gathering to growing of plants occurred (Choudhury *et al*., 2013). In this process a wide array of crop variability got generated by natural means and through both conscious and unconscious selection. Gradually a new wealth of variability also got generated/adopted and diversified by crop introduction in the exotic environment or through migration of human population. The wealth of land races, which could not even be called varieties and which the farmers grew earlier are gradually disappearing due to fast spread of semi dwarf high yielding rice varieties (Swaminathan, 1984). A collection and study of these has revealed that these exhibit many useful genes and can help in crop improvement programmes (Sahu, 2006). One can thus understand the need for collection and conservation of plant genetic diversity. Its value in the future will be much more than what can be imagined at present considering the diversified crop improvement programmes, technologies and human needs. Considering these facts, a systematic collection of rice germplasm from Madhya Pradesh which included Chhattisgarh was done under leadership of Late Dr RH Richharia during 1972 to 1981. Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) is presently maintaining comparatively quite large number of accessions of rice germplasm (over 22000 nos).

Keeping in view these facts, the present investigation was planned to characterize a set of clustered rice accessions of Chhattisgarh, to understand variability of different agro-morphological traits.

Materials and Methods

The experimental material consisted of five rice germplasm accessions namely, Amajhopa, Koudidhul, Chhindguchhi, Nariyal phool and Amaruthi collected during 1972-81 by Late Dr RH Richharia and his associates at Raipur. The trials were conducted during the *kharif* seasons of 2012 and 2013 in randomized block design with three replications. The observations were recorded on 18 characters at specified stages of crop growth period when characteristics under study had full expression (IRRI, 2002). Among the 18 morphological characteristics studied, 11 where visually assessed and 7 were measured. Similarity matrix was generated using the SimQual programme NTSYS-pc software version 2.02 (Rohlf, 1998). The similarity coefficients were used in cluster analysis and dendrogram was constructed by Unweighted Pair-Group Method with Arithmetic Average (UPGMA).

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Results and Discussion

The branches of rice panicle generally bear solitary spikelets. Rare forms in which spikelets occur in clusters of 2-7 have been recorded in India, Ceylon and North Vietnam (Coyaud, 1950). The cluster habits appear to result mainly from a reduction in pedicel length. In IGKV, Raipur (C.G.) indigenous rice germplasm collection, some cultivars are available having clustered spikelets (Richharia, 1979). The agro-morphological and quality characteristics of some of the clustered accessions are presented in Table1, whereas, frequency distribution of spikelet cluster/panicle are presented in Table 2.

Amajhopa (A: 200), IC390769: It was collected from block Deobhog, Gariyaband district (Chhattisgarh). Its lemma-palea colour was and kernel colour was white and translucent. Clustered spikelets found in the range of 2 to 6 grains in most of the panicles however, clustering of 3 grains was found in large frequency (41.1%) followed by 2 grains (30.2%) in each panicle. A minimum frequency of clustering was observed for 6 grains (1.4%). Total number of grains observed was 208 divided in to 73 spikelet clusters (Table 2).

Koudidhul (K: 1849), IC390770: It was collected from block Dharamjaygarh, Raigarh districts of Chhattisgarh. Its lemma-palea colour was straw and kernel colour was deep red. Range of clustering in most of the panicles recorded was 2 to 8 grains however, occasionally clustering of 10 grains was also found in some of the panicles. Clustering of 3 grains is observed in large frequency (42%) followed by 2 & 4 grains (15% each). A minimum frequency of clustering was recorded for 8 grains (2.5%). Total number of grains recorded was 156 divided into 40 spikelet clusters (Table 2). In this accession solitary spikelet was absent in the panicle (Table 2).

Chhindguchhi (C: 739), IC390771: This accession was collected from block Bhanupratappur, Kanker district (Chhattisgarh). Its lemma-palea colour was reddish to light purple and kernel colour was white and translucent. The clustering of spikelets was recorded in the range of 2 to 4 grains whereas, occasionally clustering of 7 grains was also found in some of the panicles. Three grains clustering was observed in large frequency (33.7%) followed by 2 grains (29.4%). A minimum frequency of clustering was recorded for 4 grains (4.4%). A total number of spikelets/panicle recorded was 145, which was divided into 68 spikelet clusters (Table 2). In this accession solitary spikelets were also found in large frequency (32%) (Table 2).

Nariyal Phool (N: 796), IC390772: Place of collection was block Saraipali, Mahasamund district (Chhattisgarh). Its lemma-palea colour was gold and gold furrows on straw and kernel colour was white and translucent. In this accession clustering of spikletes recorded in broad range *i.e.* 2 to 10 grains amongst all clustered accessions available in IGKV rice germplasm. Whereas, clustering of 3 grains was found in large frequency (35.4%) followed by 4 grains (20%). A minimum frequency of clustering

Table 1. Agro-morphological and quality characteristics of some of the rice cultivars with clustered spikelets

S.No.	Name of Variety	Acc. No.	Agro-morphological traits																
			BLSC	LBC	CC	AC	CmIC	ApC	SgC	An	DF	PH (cm)	Til. No.	LmpC	ScC	TW (gm)	GRL (mm)	GRW (mm)	L/W	GT
1	Ama Ruthi	A: 643	Light purple	Green	Purple	Purple	Purple line	Purple	Purple	Absent	142	160.00	5.66	straw	White	28.80	7.70	3.50	2.20	Medium Medium
2	Koudi Dhul	K: 1849	Green	Green	Green	Green	Green	White	White	Absent	132	116.66	6.66	straw	Red	18.00	7.00	2.70	2.60	Short Medium
3	Chhind Guchhi	C: 739	Green	Green	Green	Green	Green	White	White	Short & Partially awned	138	156.66	5.66	Reddish to light purple	White	35.10	9.60	2.80	3.42	Long Slender
4	Ama Jhopa	A: 200	Green	Green	Green	Green	Green	White	White	Absent	138	152.66	5.66	Straw	White	24.50	8.30	2.80	2.96	Medium Medium
5	Nariyal Phool	N: 796	Green	Green	Green	Green	Green	White	White	Absent	144	136.66	10.00	Gold and gold furrows on Straw	White	19.00	8.50	2.60	3.26	Medium Slender

Note: BLSC: Basal leaf sheath colour, LBC: Leaf blade colour, CC: Collar colour, CmIc: Culm internode colour, ApC: Apiculus colour, SgC: Stigma colour, An: Awning, DM: Day to maturity, PH: Plant height, Til No.: Tiller number, LmpC: Lemma-palea colour, ScC: Seed coat (kernel) colour, TW (100 g): Test weight, GRL: Grain length, GRW: Grain width, L/W: length/width Ratio, GT: Grain type.

Table 2. Frequency distribution of spikelet clusters in accessions with clustered spikelets

Ama Jhopa		Koudi Dhul		Chhind Guchhi		Nariyal Phool		Ama Ruthi	
No.of spikelets occurred in cluster	Frequency of spikelet-clusters*	No.of spikelets occurred in clusters	Frequency of spikelet-clusters	No.of spikelets occurred in clusters	Frequency of spikelet-clusters*	No.of spikelets . of spikelet-clusters	Frequency of spikelet-clusters*	No.of spikelets occurred in clusters	Frequency of spikelet-clusters*
1	6.8	1	0	1	32	1	5	1	4.2
2	30.2	2	15	2	29.4	2	10.75	2	18.4
3	41	3	42	3	33.7	3	35.4	3	35.2
4	16.5	4	15	4	4.4	4	20	4	21
5	4.1	5	10	5	0	5	9.5	5	17
6	1.4	6	10	6	0	6	3	6	2.1
		7	4.75	7	0.5	7	4.6	7	2.1
		8	2.5			8	4.6		
		9	0			9	4.6		
		10	0.75			10	2.55		
Filled grains/ panicle: 202		Filled grains/ panicle: 149		Filled grains/ panicle: 141		Filled grains/ panicle: 262		Filled grains/ panicle: 224	
Unfilled grains/ panicle: 06		Unfilled grains/ panicle: 07		Unfilled grains/ panicle: 04		Unfilled grains/ panicle: 10		Unfilled grains/ panicle: 19	
Total grains/ panicle: 208		Total grains/ panicle: 156		Total grains/ panicle: 145		Total grains/ panicle: 272		Total grains/ panicle: 243	
No. of spikelet clusters : 73		No. of spikelet clusters: 40		No. of spikelet clusters : 68		No. of spikelet clusters : 65		No. of spikelet clusters : 71	
Spikelet fertility percentage: 97.11		Spikelet fertility percentage: 95.51		Spikelet fertility percentage: 97.24		Spikelet fertility percentage: 96.63		Spikelet fertility percentage: 92.18	

* Percentage; Average of three panicles

observed was 10 grains (2.55%). A total number of spikelets/panicle recorded is 272, which was distributed into 65 spikelet clusters in the panicle (Table 2).

Amaruthi (A: 643), IC390773: It was collected from block Antagarh, Bastar district (Chhattisgarh). Its lemma-palea colour is straw and kernel colour was white and chalkiness was present. Clustered spikelets found in the range of 2 to 7 grains whereas, clustering of 3 grains was found in large frequency (35.2%) followed by 4 grains/cluster (21%). A minimum frequency of clustering recorded was 7 grains/cluster (2.1%). A total number of spikelets/panicle recorded was 243, which was distributed into 71 spikelet clusters in the panicle (Table 2).

On average across all genotypes, high spikelets fertility was observed which was ranged from 92.18 to 97.24. Highest were observed in Chhind Guchhi (97.24%) followed by Ama Jhopa (97.11%), Nariyal Phool (96.63%), Koudi Dhul (95.51%) and Ama Ruthi (92.18%). The various morphological traits recorded among rice genotypes with clusterd spikelets are furnished in Table 1. The basal leaf sheath colour for rice genotypes varied from green to light purple. Genotypes Koudi Dhul, Chhind Guchhi, Ama Jhopa and Nariyal Phool had green basal leaf sheath colour while Ama Ruthi exhibited light purple. Leaf blade colour in all genotypes was green. Collar colour was found absent in all the genotypes except Ama Ruthi. Auricle colour was observed green in the genotypes Koudi Dhul, Chhind Guchhi, Ama Jhopa and Nariyal Phool, whereas it was purple in Ama Ruthi. Culm internode colour was absent in all the genotypes except Ama Ruthi. Apiculus and Stigma were colourless in four genotypes *viz.*, Koudi Dhul, Chhind Guchhi, Ama Jhopa and Nariyal Phool while, Ama Ruthi exhibited purple colour for both traits. Awning was absent in the spikelets of all genotypes except Chhind Guchhi; which exhibited short and partially awned spiklets. Lemma palea colour was recorded straw in genotypes Ama Ruthi, Koudi Dhul and Ama Jhopa while, Chhind Guchhi showed reddish to light purple colour and Nariyal Phool exhibited gold and gold furrows on straw lemma palea colour. Seed coat colour was white in all genotypes except Koudidhul which exhibited red colour. Day to maturity observed for Ama Ruthi and Nariyal Phool was late while, other three genotypes were recorded under

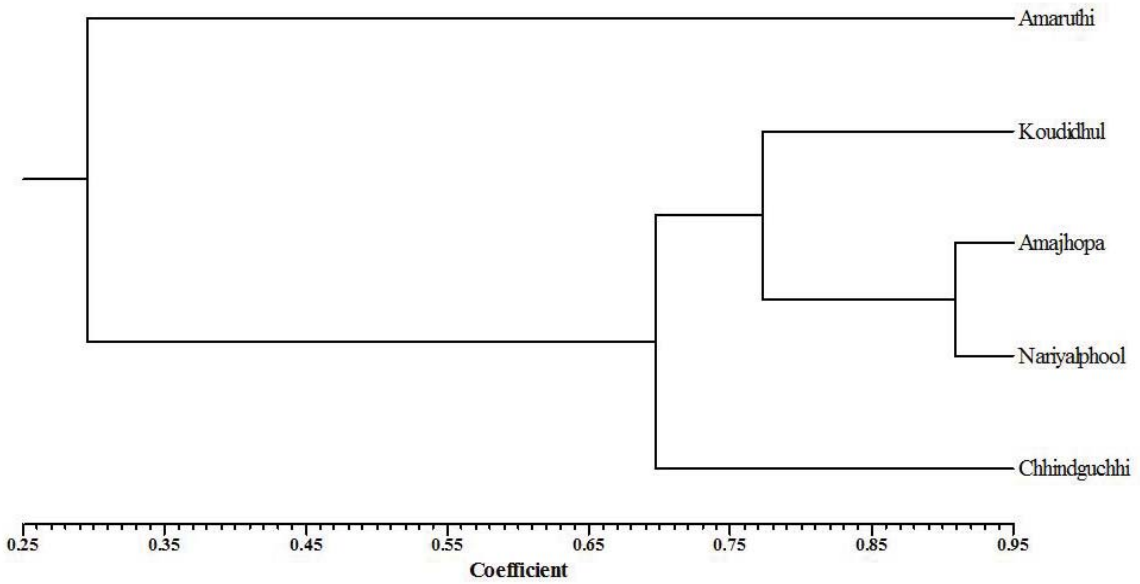


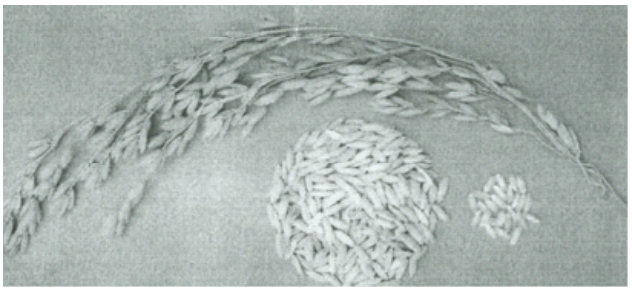
Fig. 1. Dendrogram of rice germplasm accessions based on morphological markers

medium duration. Height of plant recorded tall in all the genotypes except Koudi Dhul, which was observed as intermediate. Medium grain type was recorded in genotypes Ama Ruthi and Ama Jhopa; while Koudi Dhul exhibited short medium; long slender grain type was observed in Chhind Guchhi while, medium slender grain was recorded for the genotype Nariyal Phool.

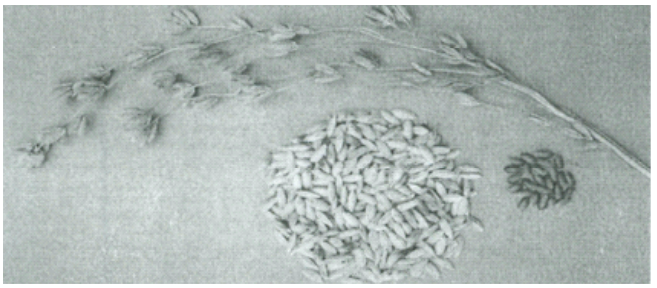
UPGMA cluster analysis was performed using SM similarity coefficient matrices calculated from morphological data to generate a dendogram for five rice genotypes (Fig. 1). The genotypes were grouped into two clusters. The similarity coefficient ranged from 0.29 to 0.91. In pair-wise comparison, the maximum similarity was obtained between Ama Jhopa and Nariyal Phool with a similarity index of 0.91, whereas Ama Ruthi showed least similarity with other genotypes (similarity index 0.29). Cluster I consisted of genotypes Ama Ruthi having 29% similarity whereas, cluster II consisted of Koudi Dhul, Ama Jhopa, Nariyal Phool and Chhind Guchhi having 70% similarity among them. Cluster II again partitioned into two sub-clusters in which one sub-cluster had Chhind Guchhi with 71% similarity, whereas another sub-culster had Koudi Dhul, Ama Jhopa and Nariyal Phool with 77% similarity among them. The basic objective of varietal characterization is to test occurrence of traits that helps in identifying a particular genotype.

As a prerequisite for efficient utilization of the germplasm, it must be properly evaluated, characterized and documented so that it could be easily retrieved and used in breeding programme (Elangovan *et al.*, 2013). The present study revealed sufficient genetic variability for most of the trait observed. Moreover response to selection is directly proportional to the genetic variability present in the material. In rice germplasm only limited accessions is available with clustered (spikelets) with vary distinct variation. Since number of filled grains/ panicle in clustered genotypes is comparatively more than other genotypes with solitary spikelets. Spikelets fertility percentage/panicle was high which can be exploited for developing superior varieties and breaking the yield plateau already fixed by the hybrid varieties. Therefore, a gene pool can be generated by crossing the germplasm lines of interest which can be further used as source material to develop high yielding varieties. These unique accessions bearing special trait of interest can be further investigated to understand its inheritance pattern. The morphological dendrogram generated for similarity or genetic distance matrices has provided an overall pattern of variation as well as the degree of relatedness among rice accessions also found by Tiwari *et al.* (2013). All the five rice accessions used in the present investigation have showed the distinct (clustered pattern) from the existing high yielding varieties which are one of the most important criteria for release of variety and also in the context of PPV&FR Act, 2001. The present accessions having the unique (clustering pattern) trait can be registered in NBPGR for future use.

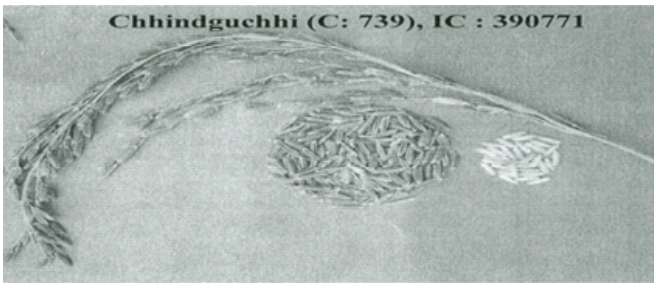
Amajhopa (A: 200), IC390769



Koudidhul (K: 1849), IC390770

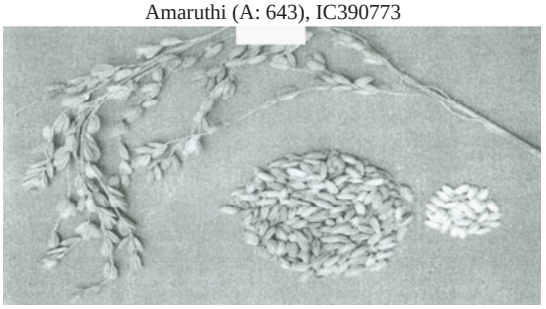


Chhindguchhi (C: 739), IC390771



Nariyal Phool (N: 796), IC390772

Amaruthi (A: 643), IC390773



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