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To Study the Agro Morphological Variation and Genetic Variability in Rice Germplasm

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Abstract: Landraces are precious genetic resources, because they contain huge genetic variability which can be used to complement and broaden the gene pool of advanced genotypes. Knowledge of the genetic diversity and population structure of germplasm collections is an important foundation for crop improvement. On the basis of pigmentation on 12 plant parts, the 100 genotypes were classified into 26 groups. On the basis of plant habit the rice germplasm was divided into three groups and three groups were also made on the basis of awning character. The dendrogram by (UPGMA) revealed six main cluster groups of the germplasm evaluated. The clusters identified varied in the number of varieties falling into each cluster with the cluster having the lowest number being 3 and the highest having 40 rice germplasm and within cluster there is hundered percent similarity morphologically in rice germplasm. The high magnitude of genotypic coefficient of variation coupled with phenotypic coefficient of variation was obtained for number of unfilled spikelets, number of total spikelets, number of filled spikelets and seed yield per plant.

Key words: Rice germplasm, Genotypic coefficient of variation · Phenotypic coefficient of variation · Agromorphological variation · Dendrogram

INTRODUCTION

The cultivated rice of Asia *(Oryza sativa* L.) is supposed to have originated in the South and/ or South East Asia. India forms a major part of this region Thus, it is traditionally rich in the diversity of rice including the wild progenitors of cultivated rice [1]. Importance of genetic variability in any breeding material is a pre-requisite as it provides not only a basis for selection, but also some valuable information regarding selection of diverse parents for use in a hybridization programme. Singh (1989) also reported that, reduced genetic variability underscores the need to collect landraces for *ex situ* conservation and to characterize them for future rice breeding programs at morphological and molecular levels because the evaluation of phenotypic diversity usually reveals important traits of interest to plant breeders [2]. The field results on rice accessions will help to create useful genetic database for future breeding programs, geared towards genetic improvement of local rice varieties for increased food production at house-hold level. Chhattisgarh is full of old traditional local landraces of rice which are being grown by the tribal since many decades. Therefore, the present investigation was undertaken to study the genetic parameters and agro-morphological characterization of local land races. (Table 1)

MATERIALS AND METHODS

The experimental materials consisting of 97 indigenous rice germplasm accession with three checks. These accessions were collected from different regions/ parts of Chhattisgarh were grown during *kharif* season in a randomized block design having two replications at Research Farm of Department of Genetics and Plant Breeding, IGKV, Raipur. A fertilizer dose of 80 N: 50 P: 30 K kg/ha was applied. The entire dose of phosphorus and potassium along with half dose of nitrogen was applied as basal dose at the time of field preparation. Observations were recorded on five randomly selected plants for fourteen morphological characters viz., Basal leaf sheath color (BLS), Leaf blade color (LBC), Leaf tip color (LTC), Leaf margin color (LMC), Juncture color (JC), Ligule color (LC), Auricle color (AC), Plant habitat (PH), Internode

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Table 1: List of Germplasm/Landraces

S.No	Germplasm	SNo	Germplasm
1	Laldhan	51	Churlai
2	Sathiya	52	Gantaichur
3	Kanhari	53	Kansari
4	Sikar	54	birhuli
5	Hard guhi dahi	55	Karhani
6	Baladhani	56	Jejne
7	Teen pakhiyan dhan	57	Janjne
8	Makhi dahi	58	dhouri
9	Bhaya	59	Chingd mouri
10	Sariya bhaya	60	Lalat
11	Godadani	61	Tendu mudi
12	Pode	62	Goda dhan
13	Dani goda	63	karhani
14	Alsanga	64	Birhuli
15	Goda dani	65	Bisunbhog
16	Chingar chinga	66	khirsar
17	Kariya	67	Goda dhan
18	Bhuri dahi	68	Baljer
19	Sindur chinga	69	Batasi
20	Lalat	70	Jharra(lal)
21	Kansari	71	Kala thaarra
22	Bala	72	I.T.
23	Veerhuli	73	Kaveri
24	Sikki	74	Kalinga
25	Nando	75	Lahondi

Table 1: Continued

S.No	Germplasm	SNo	Germplasm
26	Nago	76	Lohandi
27	Saina Goda	77	Ratuwa
28	Jani jane	78	Bisunbhog
29	Dhawari	79	Bhata phool
30	Lal dhan	80	Bans boota
31	Shankar chini	81	Birhuliya
32	Newari	82	Rathua
33	Chirpoti	83	rajga
34	Sarya	84	Karhani
35	Shakachar	85	Sanchuriya
36	Rajga	86	Karhani
37	Nunga	87	Kansari
38	Bilai lungi	88	Narpati
39	surjot	89	Nunga
40	Raichuri	90	Kalam
41	Lusari	91	Gurmatiya
42	Chhinmouri	92	Bhulo
43	Kheersagar	93	Barhi
44	Lohandi	94	Bako
45	Gurmatiya	95	Ganga prasad
46	Baiku	96	Chhinmouri
47	Jeeraphul	97	Jeeraphul
48	Jhingi	98	MTU1010
49	Jaldubi	99	Poornima
50	Jhingi paras	100	Swarna

Table 2: Details of Agromorphological characters

S. No.	Characters	Growth stage of recording*	Categories or type	Symbols
1.	Basal leaf sheath colour (BLSC)	Vegetative (3-5)	Green	Gr
			Purple	Pr
			Light purple	Ltpr
2.	Leaf blade colour (LBC)	Vegetative (4-6)	Light green	Ltgr
			Green	Gr
			Dark green	Dgr
			Purple	Pr
3.	Leaf tip colour (LTC)	Vegetative (4-6)	Green	Gr
			Purple	Pr
4.	Leaf margin colour (LMC)	Vegetative (4-6)	Green	Gr
			Purple	Pr
5.	Junctura color	Vegetative (4-5)	Green	Gr
			Purple	Pr
6.	Ligule colour (LGC)	Vegetative (4-5)	White	Wh
			Light purple	Ltpr
			Purple	Pr
7.	Auricle colour (AC)	Vegetative (3-4)	Light green	Ltgr
			Purple	Pr
8.	Plant habit (PH)	Vegetative (7)	Erect	Er
			Semi-erect	Se
			Spreading	Spr
9.	Internode colour (IC)	Reproductive (7)	Green	Gr
			Purple lines	Prli
			Purple	Pr
10.	Node colour (NC)	Reproductive (7-9)	White	Wh
			Red	R
			Purple	Pr

Table 2:Continued

S. No.	Characters	Growth stage of recording*	Categories or type	Symbols
11.	Apiculus colour	Reproductive (7-9)	White	Wh
			Red	R
			Purple	Pr
12.	Stigma colour (SC)	Reproductive (7-9)	White	Wh
			Red	R
			Purple	Pr
13.	Sterile glume colour (SGC)	Reproductive (7-9)	White	Wh
			Purple	Pr
14.	Awning	Reproductive (7-9)	Awnless	Nil
			Awn	Awning
			Tipped awn	TD

*The characters were scored at different growth stages=like:
1. Germination, 2. Seedling 3.Tillering 4. Stem elongation, 5. Booting, 6. Heading,
7. Milk stage, 8. Dough stage 9. Maturity stage.

color (IC), Node color (NC), Apiculus color (APC), Stigma color (SC), Sterile glume color (SGC) and Awning (AW) (Table 2).

The statistical analysis was done by unweighted pair group method of average linkage (UPGMA) were used to classify the 100 germplasm into groups (clusters). UPGMA was performed using the Numerical Taxonomic and Multivariate Analysis System statistical software (NTSYS, version 2; [3]. The Coefficient of variation was computed by the formula as suggested by [4].

RESULTS AND DISCUSSION

On the basis of pigmentation on 12 plant parts, the 100 genotypes were classified. Such classification of rice varieties on the basis of pigment distribution was also made by several earlier plant breeders [5]. In the present study for basal leaf sheath color 81 genotypes were found green and 16 were purple and 3 were light purple. For leaf blade color, purple, dark green and green were found in 3, 4 and 93 genotypes, respectively.

In Leaf tip color green and purple was found in 90 and 10 genotypes respectively. Leaf margin was found green in 91 genotypes and purple in 9 genotypes. Junctura color was found green in 90 and purple in 10 genotypes. Ligule color was found light purple, purple and white in 86, 10 and 4 genotypes, respectively.

In 87 genotypes auricule color was found light green and for 13 genotypes it was purple in color. For internode color 78 were green, 10 were purple line and 12 were purple. Node color was found green and purple in 72 and 28 genotypes, respectively. Apiculus color was found white in 49 genotypes, red in 18 genotypes and purple in 23 genotypes. Stigma color was found white in 83 genotypes, light green in 2 genotypes and purple in 15 genotypes. Sterile glume color was found white and purple in 90 and 10 genotypes, respectively Fig. 1.

The certain plant parts such as apiculus and stigma were more frequently pigmented than other whereas, leaf blade was found pigmented for only few accessions. Ramiah (1953) reported that both linkage and pleiotropy are responsible for simultaneous occurrence of

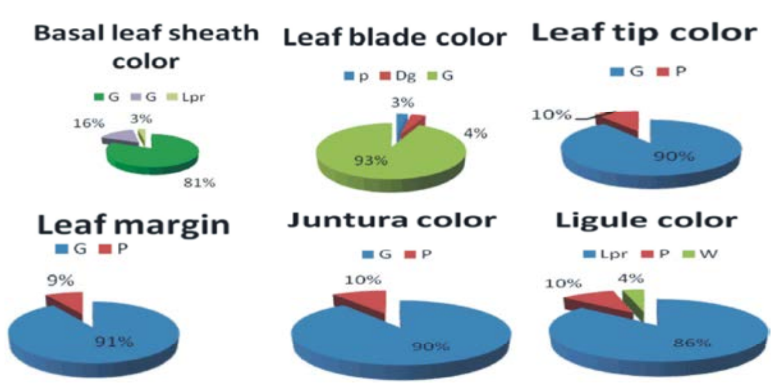

Fig. 1: Frequency distribution of genotypes on the basis of Agro-morphlogical characterization.

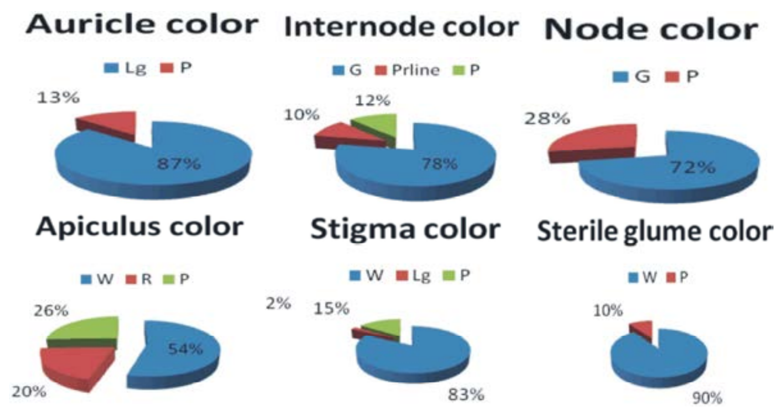

Fig. 1: Frequency distribution of genotypes on the basis of Agro-morphlogical characterization.

Table 3: Characterization and grouping of rice germplasm on the basis of plant habit

Character	Group	Entry No.	Total No.
Plant Habit	G_1 (Erect=E)	1, 2, 5, 7, 8, 9, 11, 19, 20, 26, 27, 28, 29, 31, 32, 33, 34, 35, 37, 38, 41, 47, 51, 52, 55, 57, 59, 62, 63, 65, 68, 69, 70, 74, 75, 76, 81, 82, 90, 91, 94, 98, 99, 100	45
	G_2 (Semi-erect=Se)	3, 4, 6, 10, 12, 14, 15, 18, 21, 23, 24, 25, 30, 36, 40, 42, 43, 44, 45, 46, 48, 53, 54, 56, 58, 60, 61, 64, 66, 67, 71, 72, 73, 77, 78, 79, 80, 83, 84, 86, 88, 89, 92, 93, 95, 97	45
	G_3 (Spreading= Spr)	13, 16, 17, 22, 39, 49, 50, 85, 87, 96	10

Table 4: Characterization and grouping of rice germplasm on the basis of awning

Character	Group	Entry No.	Total No.
Awning	G_1 (Awned=AN)	18, 24, 79	3
	G_2 (Awn less=Al)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,17, 19,20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70,71, 72, 73, 74, 75, 76, 77, 78, 80, 81, 82, 83, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	95
	G_3(Tipped Awn =TA)	52, 84	2

anthocynin in different plant parts [5]. Characterization and grouping of rice germplasm on the basis of anthocyanin pigmentation was also carried out by [6] in glutinous rice germplasm of Assam and [7] in wild rices of Raipur. The entire rice germplasm (100) were grouped into three categories on the basis of plant habit, i.e. erect, semi-erect and spreading. Amongst 100 entries 45 were erect type, 45 were semi-erect type and only 10 were spreading type (Table 3).

On the basis of awning out of 100 germplasm entries 95 were awnless, three entries having awning and 2 entries having short awn (tipped awns) (Table 4).

Using relatively fewer characters, classification of rice varieties was also attempted by [8]. Das *et al*. (1981) while classifying ahu rice germplasm in Assam has explained the relevance of broad categorization of characters and choice of a few than several characters in varietal characterization [9].

Clustering of the 100 rice germplasm (UPGMA) based on morpho-agronomic similarity. The dendrogram revealed six main cluster groups of the germplasm evaluated see Fig. 2.

The clusters identified varied in the number of varieties falling into each cluster with the cluster having the lowest number being 3 and the highest having 40 rice germplasm and within cluster there is hundred percent similarity between germplasm (Table 5).

Thus to identify genetic diversity in germplasm line having hundred percent similarity within cluster there is need to linked molecular markers. Evaluation of genetic diversity within rice varieties using agglomerative hierarchical clustering (AHC) gave six clusters based on the variations in morphological properties. The dendrogram generated from similarity matrices provided an overall pattern of variation as well as the degree of relatedness among the 100 germplasm.

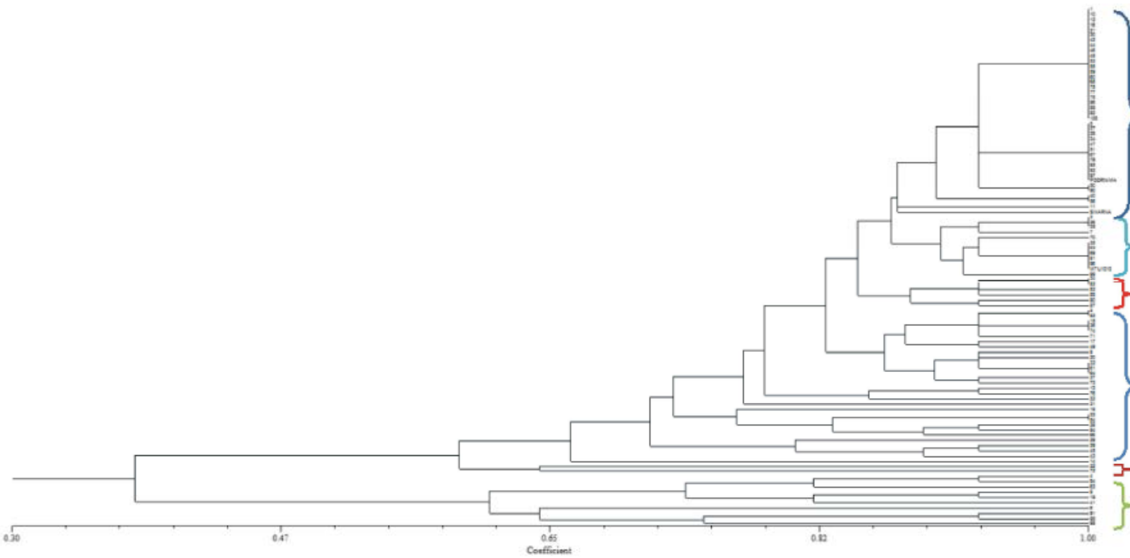

Fig. 2: Dendrogram based on agromorphological characters

Table 5: Cluster Analysis: Agro-morphological data

Cluster	Entry No.
I	98, 95, 91, 6, 41, 19, 9, 63, 94, 4.
II	14, 22, 72.
III	43, 45, 39, 29, 66, 84, 38, 54, 23, 18, 31, 33, 76, 13, 73, 37, 37, 37, 64, 61, 32, 20, 8, 49, 17, 71,74, 36, 15, 83, 3.
IV	87, 80, 88, 52, 82, 24.
V	99, MTU 1010, 81, 69, 62, 25, 70, 7, 36, 26, 2.
VI	Swarna, 11, 56, 40, 90, 50, Poornima, 97, 93, 85, 79, 67, 51, 47, 34, 28, 27, 5, 100, 92, 89, 86, 78, 77, 75, 65, 60, 59, 55, 53, 48, 46, 44, 42, 30, 21, 16,12, 10, 1.

Table 6: Genetic parameters of variation for quantitative traits

S. No.	Characters	Mean	Range Min.	Range Max.	GCV (%)	PCV (%)
1	Days to 50% flowering	78.80	58	101	7.95	8.24
2	Plant height (cm)	129.40	78.15	175.80	12.81	13.36
3	Panicle length (cm)	24.86	17.50	32.00	9.92	10.19
4	Number of tillers	6.61	4.10	9.90	19.61	24.08
5	Number of filled spikelets	127.98	18.72	271.30	28.61	30.16
6	Number of unfilled spikelets	22.25	3.00	81.65	65.04	72.36
7	Number of total spikelets	149.93	68.90	296.55	29.80	30.98
8	Hundred seed weight (g)	2.22	1.05	3.05	18.30	19.31
9	Biological yield per plant (g)	25.34	15.40	35.50	17.56	20.89
10	Harvest index (%)	50.77	31.50	66.20	11.80	13.84
11	Seed yield per plant (g)	12.80	6.85	19.05	18.39	22.41

The morphological characters are mostly subjected to environmental influences [10], there is the need to conduct molecular studies to gather more evidence on the distinctiveness of the varieties from each cluster.

In the present study, for the yield attributing characters, the high estimates of phenotypic (PCV) and genotypic (GCV) coefficient of variations were observed for number of unfilled spikelets, number of total spikelets, number of filled spikelets (Table 6).

Similar findings for number of unfilled spikelets have been reported by [11-13]. High estimates of genotypic coefficient of variation and phenotypic coefficient of variation for number of filled spikelets have been reported by [14, 15]. High genotypic and phenotypic coefficient of variation has also been recorded for number of total spikelets by [4, 16]. Moderate estimate of PCV and GCV were found for number of tillers which was in confirmation with the findings of [8, 17] and, For 100 seed weight

Table 7: Desirable genotypes for the important traits

Characters	I	II	III
Number of tillers	Karhani (55)	Karhani (63)	Kalinga (74)
Number of filled spikelets	Jeeraphool (47)	Jeeraphool (97)	-
Hundred seed weight	Barhi (93)	Bala (22)	Nunga (37)
Harvest index	Kaveri (73)	Kansari (21)	I.T. (72)
Seed yield per plant	Veerhuli (23)	Jaldubi (49)	Lahondi (75)
Panicle length	Lahondi (75)	Jaldubi (49)	Bilai Lungi (58)

moderate PCV and GCV were found, however high genetic coefficient of variation have been observed for 100 seed weight by [18]. The list of desirable genotypes of quantitative characters (Table 7).

CONCLUSION

In present era genetic markers are very important and all breeders are continuously looking for genetic markers that will enable them to identify specific parental material for specific traits and also to improve upon through selection. In this regard morphological characterization seems to be the widely range of variation from light pink to dark purple and certain plant parts such as apiculus, inter node and stigma were move frequently pigmented than others whereas, leaf blade color was found pigmented in few accessions. Cluster analysis based on plant morphology suggested that the accessions could be grouped. Such groupings are useful to breeders in identifying possible landraces that may be used as parents in breeding for any of the morphological traits that were studied. In the germplasm a wide range of variation was observed in plant habit, while, awning was not a common character. Morphological characterization criteria that has been formulated may be used in the marker aided selection of rice genotypes.

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