Plant Archives Vol. 14 No. 2, 2014 pp. 695-700 *ISSN 0972-5210*

CHARACTERIZATION OF PARENTAL LINES OF HYBRID RICE

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Abstract

Characterization and quantification of genetic diversity has been a major goal in evolutionary biology. Information on the genetic diversity within and among closely related genotypes is essential for a rational use of genetic resources. Characterization of one twenty five parental lines of hybrid rice was done using thirty eight morphological traits according to the UPOV guidelines of rice (1985) during *kharif* season of 2012 and 2013 at Seed Breeding Farm, JNKVV, Jabalpur. Out of the thirty eight characters, penultimate leaf pubescence, ligule shape, ligule length, flag leaf angle, secondary branching, panicle exsertion, panicle type, panicle axis, awning, plant habit, culm length, panicle length culm angle, culm strength, seed colour, seed width, seed type, beak shape, decorticated seed length, decorticated seed width, decorticated seed shape, husk pubescence, panicle threshability and panicle shattering had sufficient amount of variability. This study will be useful for breeders, researchers and farmers to identify and choose the restoration and conservation of beneficial genes for crop improvement.

Key words : Characterization, parental lines, UPOV.

Introduction

Rice is one of the most important cereal crops of the world meeting the dietary requirements of the people living in the tropics and sub-tropics. However, being the staple food of the population in India, improving its productivity has become a crucial importance (Subbaiah *et al*., 2011). There is still a large gap between production and demand. To meet this challenge there is need to develop rice varieties with higher yield potential and greater stability (Khush, 2006). Quantum jump in yield improvement has been achieved in rice with the development of high yielding heterotic hybrids under commercial cultivation. Hybrid rice is considered as a viable alternative technology for breaking the present yield ceiling of modern varieties. Hybrid rice has clearly shown a yield advantage of 1-1.5 tones ha^{-1} (20 to 30%) over conventionally bred modern varieties (Virmani *et al.*, 2003).

The selection of parental lines plays a vital role in developing ideal hybrid combination. Therefore, it is essential to study the relationship and diversity among parental lines in hybrid rice. Morphological characterization is an important methodology for studying diversity. It is the most basic and important step in the process of evaluation and cataloguing of germplasm. It is essential for its evaluation, judicious use and protection against illegal utilization. Characterization of several agro-morphological traits is helpful in tracing correlation and linkages between different traits. The characters assessed must be related to the need of the breeders for its proper utilization in breeding programmes. Genotypes can be grouped on the basis of characterization, by which diverse parent can be selected for the development of high hetrotic hybrid. Empirical evidences have indicated that establishment of divergent maintainer and restorer groups are the key for success of hybrid breeding programs using the CMS system (Mahalingam *et al*., 2013). Careful selection of maintainer and restorer lines on the basis of their diversity may lead to the development of hybrids with higher yield potential than parents and standard check varieties (Julfiquar *et al.*, 1985). Keeping in view the above perspectives, the present investigation is carried out to characterize one twenty five parental lines of rice germplasm for different morphological traits and identify the variability available in the collection.

Materials and Methods

One twenty five parental lines (including 85 restorer, 25 maintainer and 15 CMS lines) of hybrid rice were

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planted at the Seed Breeding Farm, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.), India. The material was grown in a complete randomized block design with three replications during *Kharif* 2012 and 2013. Each entry was sown in three rows of 2m length at spacing of 20 cm between rows and 20 cm between plants. Crop was raised following recommended package of practices. Observations were recorded on five randomly chosen plants of each genotype per replication for thirty eight morphological and agronomical traits according to the UPOV guidelines of rice (1985). The traits under study were basal leaf sheath colour, seedling foliage colour, leaf colour, leaf pigmentation, penultimate leaf pubescence, leaf sheath colour, collar colour, ligule colour, ligule shape, ligule length, auricle colour, internode colour, flag leaf angle, node base colour, stigma colour, secondary branching, panicle exsertion, panicle type, panicle axis, awning, awn colour apiculus colour, plant habit, culm length, panicle length, culm angle, culm strength, seed colour, seed length, seed width, seed type, beak shape, decorticated seed length, decorticated seed width, decorticated seed shape, seed coat pubescence, panicle threshability and panicle shattering.

Results and Discussion

Characterization and quantification of genetic diversity has been a major goal in evolutionary biology. Information on the genetic diversity within and among closely related genotypes is essential for a rational use of genetic resources. It contributes to monitor the germplasm. All genotypes showed no variation for the characters i.e. basal leaf sheath colour, seedling foliage colour, leaf colour, leaf sheath colour, collar colour, internode colour and node base colour. However all genotypes exhibited green colour with no pigmentation, whitish ligule, pale green auricle colour and white stigma colour. Variations in degree of pigmentation suggest few or more gene controlling above traits. Chang (1979) also suggest that purple pigmentation of rice plants had been lost during the process of evolution and genotypes with green types were evolved ones. Similar findings for stigma colour was also observed by Ahmed and Sharma (1990), whereas, in contrast Rao *et al.* (2001) found variability on stigma colour. During investigation Klakhaeng *et al.* (1991), Rao *et al.* (2001) and Nair (2011) observed considerable variations for leaf colour, Singh *et al.* (1998), Thimmanna *et al.* (2000), Rao *et al.* (2001), Tiwari (2013) for leaf sheath colour.

The genotypes under study showed weak penultimate leaf pubescence (58.40%) followed by medium (33.60&) and strong (08.00%), whereas in case of seed coat pubescence, it was found to be medium (38.40%) for most of the genotypes followed by weak (56.80%) and strong (4.80). None of the genotype showed glabrous leaf and seed coat pubescence. Similar findings were also observed by Sharma (2010) and Nair (2011). The seed coat and penultimate leaf pubescence restrict the insect to feed on the grains and its landing on the leaves. Long (67.20%) ligule possessed by most of the genotypes followed by medium (32.00%) and short (00.80%). Similar findings were also observed by Sharma (2010) and Nair (2011). Majority of genotypes exhibited two cleft ligule shape (87.20%) followed by acute to acuminate (12.80%). Singh *et al.* (1998), Thimmanna *et al.* (2000), Motiramani *et al.* (2001) and Tiwari (2013) also observed considerable variations for ligule shape.

Flag leaf angle in most of the genotypes were intermediate (52.80%) followed by erect (37.60%) and horizontal (09.60%). Similar findings were also reported by Thimmanna *et al.* (2000), Nair (2011) and Tiwari (2013), in contrast Rao *et al.* (2001) and Sharma (2010) found horizontal and erect type, respectively. Most of the genotypes had moderately well exserted panicles (50.40%) followed by well exserted (24.80%) and just exserted (24.80%). In previous findings considerable variation for panicle exsertion were also observed by Sasikumar and Sardana (1987), Thimmanna *et al.* (2000) and Rao *et al.* (2001). As regards to the character, secondary branching of panicle, most of genotypes had light (59.20%) followed by heavy (40.80%). Intermediate panicle axis (77.60%) possessed by most of the genotypes followed by droopy (21.60%) and straight (00.80%). Majority of the genotypes had bunchy type of panicles (57.60%) followed by lax (28.00%) and compact panicles (14.40%). Watt (1892) opined that during the process of evolution change in panicle type resulted in transformation of lax panicle to compact type. Considerable variation for panicle type was also observed by Sasikumar and Sardana (1987), Klakhaeng *et al.* (1991), Thimmanna *et al.* (2000), Motiramani *et al.* (2001) and Nair (2011), in contrast, Rao *et al.* (2001) recorded open type of panicle.

Majority of the genotypes in present investigation were awned (48.00%) following short tipped (44.00%) and awnless (08.00%) with straw colour. Similar findings were also reported by Singh *et al.*. (1996), Thimmanna *et al.* (2000) and Nair (2011), in contrast, Ahmed and Sharma (1990) observed all awnless. The awned genotypes are primitive and well adapted to adverse environment factors *viz.*, drought, salinity and low temperature as reported by Chandraratna, 1964. As regards the colour of the awns purple colour may be

Table 1: Frequency distribution of morphological characters in parental lines observed during 21-25 DAS.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Basal leaf sheath colour	Green	125	100.00
	Purple	00	00.00
	Light purple	00	00.00
2. Seedling foliage colour	Pale green	00	00.00
	Green	125	100.00
	Dark green	00	00.00
	Purple tips	00	00.00
	Purple margins	00	00.00

Table 3 : Frequency distribution of morphological characters in parental lines observed during boot just visible.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Penultimate leaf pubescence	Glabrous	00	00.00
	Weak	73	58.40
	Medium	42	33.60
	Strong	10	08.00
2. Flag leaf angle	Horizontal	12	09.60
	Intermediate	66	52.80
	Erect	47	37.60

Table 4 : Frequency distribution of morphological characters in parental lines observed during anthesis midway stage.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Stigma colour	Yellow	125	100.00
	Brown	00	00.00
	White	00	00.00
	Pigmented	00	00.00

primitive traits which gradually changed during the course of evolution from red to gold and straw (Chang, 1979).

Genotypes were characterized for plant habit which showed that majority of them were compact (76.00%) followed by open (24.00%) and none of them was laying/ deep watered. Similar findings were also reported by Sharma (2010) and Tiwari (2013). Erect culm angle (73.60%) possessed by most of the genotypes followed

Table 2 : Frequency distribution of morphological characters in parental lines observed during boot stage.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Leaf colour	Pale green	00	00.00
	Green	125	100.00
	Dark green	00	00.00
	Purple	00	00.00
2. Leaf pigmentation	Absent	125	100.00
	On tips	00	00.00
	On margins	00	00.00
	In blotches	00	00.00
	Uniform	00	00.00
3. Leaf sheath colour	Green	125	100.00
	Dark green	00	00.00
	Purple	00	00.00
4. Collar colour	Green	125	100.00
	Pale	00	00.00
	Purple	00	00.00
5. Ligule colour	Whitish	125	100.00
	Light purple	00	00.00
	Purple	00	00.00
6. Ligule shape	Two cleft	109	87.20
	Truncate	00	00.00
	Acute to acuminate	16	12.80
7. Ligule length	Short	01	00.80
	Medium	40	32.00
	Long	84	67.20
8. Auricle colour	Pale green	125	100.00
	Light brown	00	00.00
	Purple	00	00.00
9. Internode colour	Green	125	100.00
	Light purple	00	00.00
	Purple lines	00	00.00
	Purple	00	00.00

by intermediate (26.40%). The genotypes were characterized on the basis of culm strength showed moderately strong (28.80%) followed by strong (39.20%), intermediate (12.80%), weak (09.60%) and very weak (09.60%). Semi dwarf culm length (40.80%) exhibited

Table 5 : Frequency distribution of morphological characters in parental lines observed during milk stage.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Node base colour	Pale green	00	00.00
	Green	125	100.00
	Light purple	00	00.00
	Purple	00	00.00
2. Secondary branching	Absent	00	00.00
	Light	74	59.20
	Heavy	51	40.80
	Clustering	00	00.00
3. Panicle exsertion	Well exserted	31	24.80
	Moderately well exserted	63	50.40
	Just exserted	31	24.80
4. Awn colour	Straw	125	100.00
	Gold	00	00.00
	Red	00	00.00
	Purple	00	00.00

Table 6 : Frequency distribution of morphological characters in parental lines observed during dough stage.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Apiculus colour	Yellow	00	00.00
	Straw	125	100.00
	Brown	00	00.00
	Black	00	00.00
	Reddish brown	00	00.00
	Purple	00	00.00
2. Plant habit	Compact	95	76.00
	Open	30	24.00
	Laying	00	00.00
3. Culm angle	Erect	92	73.60
	Intermediate	33	26.40
	Open	00	00.00
	Procumbent	00	00.00
4. Culm length	Dwarf	33	26.40
	Semi dwarf	51	40.80
	Tall	41	32.80
5. Panicle type	Compact	18	14.40
	Bunchy	72	57.60
	Lax	35	28.00
6. Awning	Awned	60	48.00
	Short tipped	55	44.00
	Awnless	10	08.00

by most of the genotypes followed by tall (32.80%) and dwarf (26.40%), whereas long culm length was showed by 68.80% of the genotypes followed by medium (31.20%). None of the genotype showed small panicle length.

Most of the genotypes showed yellow seed colour (37.60%) followed by straw (33.60%), golden (24.80%) and brown (04.00%). None of the genotypes showed black and reddish brown colour. Considerable variation for seed colour was also observed by Singh *et al.* (1998), Rimpi *et al.* (2008) and Nair (2011). All the genotypes showed straw apiculus colour. During the process of evolution, the coloured genotypes evolved to lighter colour like straw and yellow. Further as the process of evolution goes on the coloured genotypes changes to white type (Watt, 1892).

All the genotypes belonged to extra long category of seed length. Similar findings were also reported by Sharma *et al.* (2010), whereas, in contrast Thimmanna *et al.* (2000), Rimpi *et al.* (2008) and Nair (2011) found considerable variations for seed length. Most of the genotypes possessed medium width (62.40%) followed by high (1920%) and narrow (18.40%). Similar findings also reported by Thimmana *et al.* (2000), Rimpi *et al.* (2008), Sharma (2010) and Nair (2011). Long bold seed type (73.60%) was exhibited by most of the genotypes followed long slender (26.40%). Most of genotypes showed slightly curved beak shape (54.40%) followed by straight (28.00%) and curved (17.60%). Long decorticated seed length (84.00%) possess by most of the genotypes followed by medium length (16.00%). Most of the genotypes exhibited medium decorticated seed width (49.60%) followed by bold (48.80%) and narrow (01.60%). Similar finding was also reported by Rimpi *et al.* (2008). Majority of the genotypes showed half spindled decorticated shape (48.00%) followed by spindled (28.80%), very spindled (14.40%), semi round (08.00%) and round (00.80%).

Panicle threshability in most of the genotypes was easy (56.80%) followed by intermediate (56.80%) and difficult (08.00%). Similar finding was also reported by

Table 7 : Frequency distribution of morphological characters in parental lines observed during ripening phase.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Culm strength	Strong	36	28.80
	Moderately	49	39.20
	Strong		
	Intermediate	16	12.80
	Weak	12	09.60
	Very weak	12	09.60
2. Panicle length	Short	00	00.00
	Medium	39	31.20
	Long	86	68.80
3. Panicle axis	Straight	01	00.80
	Intermediate	97	77.60
	Droopy	27	21.60
4. Seed coat pubescence	Glabrous	00	00.00
	Weak	48	38.40
	Medium	71	56.80
	Strong	06	04.80
	Very strong	00	00.00
5. Seed colour	Yellow	47	37.60
	Golden	31	24.80
	Straw	42	33.60
	Brown	05	04.00
	Black	00	00.00
	Reddish brown	00	00.00
6. Seed length	Extra long	125	100.00
	Long	00	00.00
	Medium	00	00.00
	Short	00	00.00
7. Seed width	High	24	19.20
	Medium	78	62.40
	Narrow	23	18.40
	Very narrow	00	00.00
8. Seed type	Long slender	33	26.40
	Long bold	92	73.60
	Short slender	00	00.00
	Medium slender	00	00.00
	Short bold	00	00.00
9. Beak shape	Straight	35	28.00
	Slightly curved	68	54.40
	Curved	22	17.60
10. Decorticated seed length	Long	105	84.00
	Medium	20	16.00
	Short	00	00.00
11. Decorticated seed width	Bold	61	48.80
	Medium	62	49.60
	Narrow	02	01.60
12. Decorticated seed shape	Round	01	00.80
	Semi round	10	08.00
	Half spindled	60	48.00
	Spindled	36	28.80
	Very spindled	18	14.40

Table 8 : Frequency distribution of morphological characters in parental lines observed during post ripening phase.

Character	Classes	Number of entry/ frequency	Percentage of entry
1. Panicle threshability	Difficult	10	08.00
	Intermediate	44	35.20
	Easy	71	56.80
2. Panicle shattering	Very low	09	07.20
	Low	94	75.20
	Moderate	22	17.60
	Moderately high	00	00.00
	High	00	00.00

Sasikumar and Sardana (1987). Low panicle shattering (75.20%) was exhibited by most of the genotypes followed by moderate (17.60%) and very low (7.20%).

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