Indian J. Plant Genet. Resour. 34(2): 251–257 (2021)
DOI 10.5958/0976-1926.2021.00024.3

RESEARCH ARTICLE

Characterisation of Exotic Rice Germplasm for Qualitative Traits

Maqsoodullah[1], Jiji Joseph*[1], M Latha[2], Rose Mary Francies[1] and P Sindhumole[1]
[1]*College of Agriculture, Kerala Agricultural University, Thrissur-680656, Kerala, India*
[2]*ICAR-NBPGR Regional Station Thrissur-680656, Kerala, India*

(Received: 20 August, 2020; Revised: 13 July, 2021; Accepted: 14 July, 2021)

Characterization of exotic germplasm of rice for qualitative traits was done in the Department of Plant Breeding and Genetics, College of Agriculture, Kerala Agricultural University during 2019. Eighty-nine exotic rice accessions received from IRRI, Philippines were characterized along with five check varieties. The experiment was set in augmented block design with five blocks. Accessions were characterized for qualitative traits as per DUS descriptor. Out of the 25 qualitative traits observed, eight each had one and two character states. The traits flag leaf attitude, lemma and palea colour, colour of apiculus, distribution of awns, panicle attitude of main axis, panicle exsertion, and pericarp colour were having three character states. Colour of awns and caryopsis shape had four classes. Qualitative traits, less affected by environment can be used as morphological marker for identifying genotypes. Twenty-two accessions with superior characteristics like erect leaf, erect flag leaf, erect and strong culm and well exserted panicle were identified.

Key Words: Characterization, Exotic rice germplasm, Qualitative traits

Introduction

Genetic diversity in rice, the most ancient and major food crop of the world far exceeds that in any other crops as it is highly adaptable to its environment of growth. Today rice is cultivated in all parts of the world except Antarctica (Priya *et al*., 2019). This diversity can be used in breeding programmes. In order to provide superior lines for plant breeding programmes, agro-morphological characterization of germplasm accessions is one of the most essential aspects. Evaluation of germplasm collections is essential for assessing the variability, maintenance of the diversity and identification of valuable genes. Numerous morphological features acts as crucial aspect of rice grain yield. Plant height, tillering and panicle morphology are significantly associated with grain production in rice. Hence, the present study has been taken up to evaluate exotic germplasm of rice based on qualitative traits and to identify accessions with superior plant ideotype.

Materials and Methods

Characterization of exotic germplasm of rice (*Oryza sativa* L.) for qualitative traits was done in the Department of Plant Breeding and Genetics, College of Agriculture, during June 2019 to October 2019. Eighty nine exotic accessions of rice received from IRRI, Philippines at NBPGR Regional Station Thrissur were evaluated along with check varieties, Jyothi, Jaya, Thulasi, Vaishak and Manurathna. The experiment was set in augmented block design with 5 blocks; each block consisted of 20 exotic accessions and check varieties in plots of $5m^2$ at a spacing of 20 cm x 15cm. Plants were raised as rainfed crop in upland condition. Observations were recorded from five plants of each line for the qualitative traits as per DUS descriptor by Rani *et al*., 2006 at appropriate stage.

Results and Discussion

Among the 25 qualitative traits observed, coleoptile, auricle, ligule, collar and sterile lemma were colourless in all the accessions. Anthocyanin colouration of leaf sheath, distribution of anthocyanin colouration on the leaf blade and shape of ligule were same in all the accessions. Threshability was intermediate in all accessions. Rao *et al*., 2013 and Islam *et al*., 2018 also observed green basal leaf in majority of accessions. Among the 64 farmer varieties Rao *et al*., 2013 studied, two varieties were having green coleoptile, while, one variety had purple coleoptile,while others were colourless. They observed that 56 out of 65 farmer varieties were having no anthocyanin colouration on leaf sheath. As per their study three classes of auricle colouration was observed with majority being colourless (83.07%). Five varieties

*Email: jiji.joseph@kau.in

had light purple auricle, while 6 varieties had purple auricle.

Basal leaf sheath colour of the accessions were categorized as green and purple. Out of 89 accessions, eleven accessions exhibited purple colour and the rest seventy-eight accessions and check varieties had green coloured basal leaf sheath. (Table 1). Rao *et al.,* 2013 and Islam *et al*., 2018, also observed majority of germplasm having green basal sheath colour, while a few had coloured basal leaf sheath. Based on these studies it can be assumed that purple colour of basal leaf is a trait which is present only in a few genotypes and hence, can be used as a marker for identification of genotypes.

On the basis of leaf blade attitude, eighteen accessions and check variety Jaya were having semi-erect leaf blade attitude and the rest seventy-one accessions and other four check varieties were having erect leaf blade attitude as presented in Table 1. Twenty accessions and one check variety exhibited erect flag leaf attitude, five accessions showed horizontal type flag leaf attitude and the rest sixty-four accessions along with four check varieties were having semi-erect flag leaf attitude. Burgess *et al.,* 2015 suggested that reduced susceptibility to photo inhibition and reduced risk of overheating was observed with erect leaf stature. According to Tafere and Irie 2019, erect leaf angles lead to improvement in whole day carbon gain by enhancing light absorption at low solar angles under dense canopies. There was a positive correlation between flag leaf angle and photosynthesis material translocation which increases spikelets fertility and grain yield in rice. Jennings *et al*., 2003, reported that modifications of leaf angle and flag leaf angle have been emphasized by many investigators as a means to obtain better light utilization. Hence, the accessions with erect leaf and flag leaf might have more light use effiency.

Observation on culm habit showed that thirty-nine accessions were having semi-erect and the rest fifty accessions and five check varieties were having erect culm habit. There was no open and spreading culm habit among the accessions. Islam *et al*., 2018 observed culm angle as erect in 29 per cent of the genotypes, while intermediate types of culm was seen in 60 per cent and open types in 11 per cent of the genotypes they studied. Tafere and Irie. (2019), reported that short culm erect cultivar produced significantly higher photosynthesis rate, poor stomatal conductance, maximum PAR, higher canopy photosynthesis and grain yield than short culm open cultivar. Hence, accessions with erect stem may have these advantages over other accessions

Culm lodging resistance observed in accessions showed that four accessions had weak culm and the rest 85 accessions and five check varieties were recorded with strong culm. According to Rani *et al*., 2017, lodging of the rice crop is the major limiting factor to rice productivity. Lodging not only reduces the yield but also it deteriorates grain quality, impedes mechanical harvesting, increases harvesting and drying costs. Lodging resistance is a complex trait influenced by environment and structural properties of the stem. Hence, the accessions showing lodging resistance can be used in breeding programme.

Stigma colour visually observed showed that fourteen accessions and two check varieties possessed purple stigma colour and the rest seventy-five accessions and three check varieties had white stigma colour. Manjunatha *et al*., 2018, observed purple stigma in 62 per cent of land races, while in three per cent of landraces it was light green and in 35 per cent of cultivars it was white when they evaluated 60 landraces of rice. Islam *et al*., 2018, based on their studies in 113 aromatic rice varieties observed that 88.49 per cent of genotypes had white colour of stigma and 5.31, 6.19 per cent of accessions had light purple and purple coloured stigma, respectively. All these studies points to the fact that stigma colour can be used to morphologically distinguish between genotypes.

Eleven accessions exhibited brown spots on lemma and palea, twenty-two accessions had golden straw colour and the rest fifty-six accessions and five check varieties had straw colour for lemma and palea. Manjunatha *et al*., 2018 observed six states of expression for lemma and palea colour among 60 landraces they evaluated. They were straw, gold and gold furrows on straw background, brown spots on straw, brown furrows on straw, brown and purple black. Islam *et al*., 2018, observed nine different types for lemma and palea colour. They were gold, brown furrows on straw, brown, reddish to light purple, purple spots on straw, purple furrows on straw, purple and black. Being a qualitative trait showing wide variability and not influenced by environment, this can be used for identification of specific genotypes.

According to the observations recorded, two accessions possessed strong colour for apiculus, thirty-nine accessions along with two check varieties exhibited

Table 1. Qualitative traits of exotic accessions as per DUS criteria

Genotype	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
EC 207747	1	1	1	0	3	1	1	3	1	3	3	1	1	1	5	1	1	0	0	7	5	7	2	5	3
EC 204847	1	1	1	0	3	1	1	3	1	3	3	1	5	4	5	1	9	1	4	5	5	7	2	1	3
EC 204863	1	1	1	0	3	1	1	3	1	3	3	1	1	4	7	1	9	5	4	5	5	5	2	5	3
EC 204865	1	1	1	0	3	1	1	3	1	3	1	1	5	4	1	1	9	1	4	5	5	5	2	5	1
EC 204868	1	1	1	0	1	1	1	3	1	3	1	1	5	1	5	1	9	5	4	5	5	5	2	5	1
EC 204928	1	1	1	0	3	1	1	3	1	1	1	1	5	1	5	1	9	1	1	5	5	7	2	6	1
EC 204970	1	1	1	0	3	1	1	3	1	1	3	1	5	3	1	1	9	1	1	5	5	7	2	5	1
EC 204991	1	1	1	0	3	1	1	3	1	3	3	3	1	3	1	1	1	0	0	2	5	5	2	5	3
EC 204999	1	1	1	0	3	1	1	3	1	1	3	1	1	1	5	1	1	0	0	2	5	7	2	5	1
EC 205001	1	1	1	0	3	1	1	3	1	5	3	1	1	3	5	1	9	5	4	5	5	7	2	1	3
EC 205042	1	1	1	0	3	1	1	3	1	3	3	1	1	3	1	1	9	3	4	5	5	7	2	5	3
EC 205047	1	1	1	0	1	1	1	3	1	1	2	1	1	3	1	1	9	5	4	5	5	5	2	1	1
EC 205070	1	1	1	0	3	1	1	3	1	5	3	1	1	3	5	1	9	5	1	7	5	7	2	5	3
EC 205072	1	1	1	0	3	1	1	3	1	3	1	1	1	3	1	1	9	5	1	5	5	7	2	5	3
EC 205128	1	3	1	0	1	1	1	3	1	3	1	1	1	3	1	1	1	0	0	2	5	5	2	6	3
EC 205192	1	1	1	0	3	1	1	3	1	1	1	1	1	3	1	1	9	5	1	5	9	7	2	5	2
EC 205205	1	1	1	0	1	1	1	3	1	1	1	1	1	1	5	1	1	0	0	5	5	5	2	5	2
EC 205223	1	1	1	0	1	1	1	3	1	1	3	1	1	3	1	1	1	0	0	5	5	7	2	6	1
EC 205252	1	1	1	0	1	1	1	3	1	1	3	1	1	3	1	1	9	1	1	2	9	7	2	6	1
EC 205264	1	1	1	0	3	1	1	3	1	5	3	1	5	1	1	1	9	1	1	2	5	7	2	5	3
EC 205269	1	1	1	0	1	1	1	3	1	1	3	1	1	3	1	1	1	0	0	5	5	5	2	6	1
EC 205275	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	1	0	0	5	5	5	2	5	1
EC 205305	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	1	0	0	5	5	5	2	6	2
EC 205314	1	1	1	0	1	1	1	3	1	3	1	1	1	4	1	1	1	0	0	5	5	5	2	1	3
EC 205321	1	3	1	0	1	1	1	3	1	5	1	1	5	1	1	1	9	1	4	5	9	7	2	1	3
EC 205333	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	9	1	1	5	5	7	2	6	3
EC 415392	1	1	1	0	1	1	1	3	1	1	1	1	1	1	5	1	1	0	0	5	5	5	2	1	4
EC 415393	1	1	1	0	1	1	1	3	1	3	1	1	1	3	1	1	9	5	1	5	5	5	2	1	3
EC 415394	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	9	1	1	5	5	5	2	1	4
EC 415396	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	9	1	1	5	5	5	2	1	4
EC 415397	1	3	1	0	1	1	1	3	1	3	3	1	5	1	1	1	9	1	4	5	5	7	2	1	3
EC 415399	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	5	2	1	3
EC 415401	1	1	1	0	1	1	1	3	1	3	1	1	1	3	1	1	9	1	1	5	5	5	2	6	3
EC 415402	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	9	5	1	5	5	5	2	1	3
EC 415403	1	1	1	0	1	1	1	3	1	1	1	1	1	1	5	1	9	5	1	5	5	7	2	1	3
EC 415404	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	7	2	1	3
EC 415405	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	1	0	0	5	5	7	2	1	4
EC 415406	1	1	1	0	1	1	1	3	1	1	1	1	1	1	1	1	1	0	0	5	5	5	2	1	3
EC 415407	1	1	1	0	1	1	1	3	1	1	1	1	1	1	5	1	1	0	0	5	5	7	2	1	3
EC 415408	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	9	1	1	5	5	5	2	1	3
EC 415409	1	1	1	0	1	1	1	3	1	5	3	1	1	4	5	1	1	0	0	5	5	5	2	1	3
EC 415410	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	5	2	1	3
EC 415411	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	9	5	1	5	5	7	2	1	3
EC 415412	1	1	1	0	1	1	1	3	1	3	3	1	1	1	1	1	1	0	0	5	5	7	2	1	4
EC 415413	1	1	1	0	1	1	1	3	1	1	1	1	1	1	5	1	9	3	1	5	5	7	2	1	3
EC 415414	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	9	1	1	5	5	5	2	5	3
EC 415415	1	1	1	0	1	1	1	3	1	3	3	1	1	1	1	1	1	0	0	5	5	7	2	5	3
EC 415416	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	1	0	0	5	5	5	2	1	3
EC 415417	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	9	1	1	2	5	5	2	1	3
EC 415420	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	1	0	0	5	5	7	2	1	3
EC 415421	1	1	1	0	1	1	1	3	1	1	1	1	1	4	5	1	9	1	1	5	5	7	2	1	3
EC 415422	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	7	2	1	3
EC 415423	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	1	0	0	7	5	5	2	1	3

Genotype	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
EC 415425	1	1	1	0	1	1	1	3	1	3	3	1	1	1	1	1	1	0	0	5	5	5	2	1	3
EC 415426	1	3	1	0	1	1	1	3	1	1	1	1	1	1	1	1	1	0	0	7	5	7	2	1	3
EC 415427	1	1	1	0	1	1	1	3	1	3	1	1	5	1	1	1	9	1	4	5	5	5	2	1	3
EC415428	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	7	2	1	1
EC 415429	1	3	1	0	1	1	1	3	1	3	3	1	5	1	1	1	1	0	0	5	5	7	2	1	3
EC 415431	1	1	1	0	1	1	1	3	1	3	3	1	1	1	1	1	1	0	0	5	5	5	2	1	4
EC 415433	1	3	1	0	1	1	1	3	1	3	3	1	5	1	1	1	9	3	4	5	5	5	2	1	3
EC 415434	1	3	1	0	1	1	1	3	1	3	3	3	5	1	1	1	9	5	1	5	5	5	2	1	3
EC 415435	1	3	1	0	1	1	1	3	1	3	3	3	1	1	1	1	1	0	0	5	5	5	2	1	3
EC 415436	1	1	1	0	1	1	1	3	1	3	3	3	1	1	5	1	1	0	0	5	5	3	2	1	4
EC 415437	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	1	0	0	5	5	5	2	1	3
EC 415438	1	3	1	0	1	1	1	3	1	3	1	1	5	1	5	1	1	0	0	5	5	5	2	1	3
EC 415439	1	3	1	0	1	1	1	3	1	3	1	1	5	1	1	1	9	5	4	7	9	5	2	1	4
EC 415441	1	1	1	0	1	1	1	3	1	3	3	1	1	4	5	1	9	3	1	5	5	5	2	1	3
EC 415442	1	1	1	0	3	1	1	3	1	3	1	1	1	1	5	1	9	5	1	7	5	5	2	1	1
EC 415444	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	9	5	1	5	5	5	2	1	3
EC 415445	1	1	1	0	1	1	1	3	1	3	1	1	1	1	5	1	9	5	1	5	5	5	2	1	4
EC 415446	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	9	1	1	5	5	5	2	1	3
EC 415448	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	5	2	1	3
EC 415449	1	1	1	0	1	1	1	3	1	3	1	1	1	4	5	1	9	1	1	2	5	5	2	1	4
EC 415450	1	1	1	0	1	1	1	3	1	3	3	1	1	1	5	1	1	0	0	5	5	5	2	1	4
EC 415451	1	1	1	0	3	1	1	3	1	3	1	1	1	4	1	1	1	0	0	5	5	5	2	1	3
EC 415452	1	3	1	0	1	1	1	3	1	1	1	1	1	3	1	1	1	0	0	5	5	5	2	1	4
EC 415454	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	1	0	0	5	5	7	2	1	3
EC 415455	1	1	1	0	1	1	1	3	1	3	1	1	1	3	1	1	9	3	1	5	5	7	2	1	3
EC 415456	1	1	1	0	3	1	1	3	1	3	3	1	1	3	1	1	1	0	0	5	5	7	2	1	3
EC 415458	1	1	1	0	1	1	1	3	1	1	1	1	1	1	1	1	1	0	0	5	5	7	2	1	3
EC 415459	1	1	1	0	1	1	1	3	1	1	1	1	1	4	5	1	9	3	2	7	5	5	2	1	2
EC 415460	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	1	0	0	5	5	7	2	1	1
EC 415461	1	1	1	0	1	1	1	3	1	3	1	1	1	1	1	1	9	1	1	7	5	7	2	1	4
EC 415462	1	1	1	0	1	1	1	3	1	1	3	1	1	3	1	1	1	0	0	5	5	5	2	1	3
EC 415463	1	1	1	0	1	1	1	3	1	3	1	1	1	3	1	1	1	0	0	5	5	5	2	1	3
EC 415464	1	1	1	0	3	1	1	3	1	3	1	1	1	3	1	1	1	0	0	5	5	7	2	1	3
EC 415465	1	1	1	0	1	1	1	3	1	3	3	1	1	3	1	1	1	0	0	5	5	7	2	1	3
EC 415468	1	1	1	0	1	1	1	3	1	3	1	1	1	3	1	1	9	1	1	5	5	5	2	1	3
EC 415470	1	1	1	0	1	1	1	3	1	3	3	1	1	3	1	1	1	0	0	5	5	7	2	1	3
Check Varieties																									
Jyoti	1	1	1	1	1	1	1	3	1	3	1	1	1	1	1	1	9	5	1	5	5	5	2	5	3
Jaya	1	1	1	1	2	1	1	3	1	3	1	1	5	1	5	1	9	3	1	4	3	5	2	5	3
Thulasi	1	1	1	1	1	1	1	3	1	1	1	1	5	1	1	1	9	5	1	5	5	5	2	5	3
Vaisakh	1	1	1	1	1	1	1	3	1	3	1	1	1	1	1	1	1	0	0	5	5	7	2	5	3
Manurathna	1	1	1	1	1	1	1	3	1	3	1	1	1	1	5	1	1	0	0	5	5	5	2	5	3

A-coleoptile colour; **B-** basal leaf sheath colour; **C-** leaf sheath anothocyanin colouration; **D-**leaf blade distribution of anthocyanin; **E-** leaf blade attitude; **F-** auricle colour; **G-** colour of collar; **H-** ligule shape; **I-** ligule colour; **J-** flag leaf attitude; **K-** culm habit; **L-** culm lodging resistance; **M-** stigma colour; **N-** lemma and palea colour; **O-** lemma colour of apiculus; **P- s**terile lemma colour; **Q-** presence of awns; **R-** distribution of awns; **S-** colour of awns; **T-** panicle attitude of main axis; **U-** panicle attitude of branches; **V-** panicle exsertion; **W-** panicle threshability; **X-** caryopsis pericarp colour; **Y-** caryopsis shape.
Numbers indicate the character state in the descriptor

medium colour and the rest forty-eight accessions and three check varieties did not have any colour. Islam *et al*., 2018 observed five classes in colour of apiculus in 113 aromatic rice lines they evaluated. This polymorphic trait also can be used in identification of rice genotypes.

Forty-six accessions along with two check varieties were without awns and forty-three accessions and three check varieties exhibited the presence of awns. Islam *et al*., 2018 observed awns in about one third of the accessions they studied. According to Guo *et al*., 2018, awns, which are derived from floral structures in grasses,

Table 2. Exotic accessions of rice with superior qualitative traits

Accession	Erect Leaf	Erect flag leaf	Erect culm	Strong culm	Well exsetred panicle	Total score
EC 204928		√	√	√	√	4
EC 205192		√	√	√	√	4
EC 205205	√	√	√	√	√	5
EC 205223	√	√		√	√	4
EC 205252	√	√		√	√	4
EC 205333	√		√	√	√	4
EC 415392	√	√	√	√		4
EC 415403	√	√	√	√	√	4
EC 415405	√		√	√	√	4
EC 415406	√	√	√	√		4
EC 415407	√	√	√	√	√	5
EC 415411	√		√	√	√	4
EC 415413	√	√	√	√	√	5
EC 415420	√		√	√	√	4
EC 415421	√	√	√	√	√	5
EC 415426	√	√	√	√	√	5
EC 415452	√	√	√	√		4
EC 415454	√		√	√	√	4
EC 415455	√		√	√	√	4
EC 415458	√	√	√	√	√	5
EC 415460	√		√	√	√	4
EC 415461	√		√	√	√	4

are known to be critically important for photosynthesis and transpiration. However, domestication and human selection resulted in awnless types to facilitate grain harvesting, handling and storage (March, 2015).

In the present study 21 accessions along with two check varieties had awns on the grains which are present on tip of the panicle. Six accessions and one check variety possessed awns on the grains towards the upper half of the panicle. Sixteen genotypes exhibited awns on whole length of panicle and the rest forty-six accessions and two check varieties were awn-less. Islam *et al*., 2018, characterized 36 aromatic rice germplasm of Bangladesh and found that among 13 genotypes having awn, in nine genotypes awns were present only in the tip and in remaining four it was present in the upper half of panicle. With domestication awns become eliminated from the genotypes or became restricted to a limited portion of the panicle facilitating easy harvest and threshing.

The colour of awn recorded at ripening stage showed that thirty accessions and three check varieties had yellowish white awns, only one genotype showed yellowish awn, twelve accessions had reddish brown and the rest forty-six accessions with two check varieties were awnless as indicated in Table 1. Mondal *et al*., 2014 observed colour of awn as a polymorphic trait.

The panicle attitude of main axis was determined by curvature of panicle base. Seven accessions had semi-straight panicle, while, eight accessions had deflexed drooping and seventy-four accessions along with check varieties had drooping deflexed panicle attitude of main axis. According to Xu *et al*., 2005, one of the parameters of rice ideal panicle type for Liaoning province of China was neck-panicle curvature <40°. In the present study majority of the accessions had this more than 40° an ideal character.

According to Liang *et al*., 2017, erect panicle type is an important characteristic for japonica super rice and plays a significant role in enhancing yield. The erect panicle type can be considered as a genetic ideotype resource to japonica super rice group by virtue of its agronomic advantages such as grain number per panicle and biomass. Also erect panicle optimizes canopy structure. Rice plants with drooping panicle can be lodged easily. However, when the panicle is heavy there will always be a tendency for drooping. Hence, the axis of panicle suitable for different situation may vary and breeder has to choose the best type.

Attitude of panicle branches was characterized by the compactness of the panicle and was classified with respect to its mode of branching, angle of primary branches and spikelet density. Only four accessions

were observed to have spreading panicle and the rest eighty-five accessions along with check varieties showed semi-erect type of panicle attitude of branches. Rice breeders selectively breed for compact panicle type and open panicle type is selected against, for maximizing crop grain production and harvest (Fageria, 2007). Semi erect panicle observed in the present study is an indication that some amount of breeding intervention might have happened in the accessions with respect to branching attitude of panicle.

Panicle exertion was recorded at near ripening stage. On the basis of observations recorded there was only one accession having partly exserted panicle, thirty-nine accessions along with one check variety exhibited well exserted panicle, the rest forty-nine accessions and four check varieties were having mostly exserted panicle. Manjunatha *et al*., 2018 and Islam *et al.,* 2018 observed exerted or well exerted panicles in majority of accessions. If upper internode of panicle is short lower panicle branches remain enclosed, spikelets in that branches become sterile or partially filled and are often blackened by secondary pathogens, resulting in yield losses (Jennings *et al*.,1979). For better yield and for enhancing crossing in hybrid rice programme well exerted panicle is essential.

Eight accessions exhibited red pericarp colour, sixteen accessions along with five check varieties showed light red colour and the rest of sixty-five accessions were having white pericarp colour. Manjunatha *et al*., 2018, observed red pericarp colour in 50 per cent of landraces from Kerala,while, Islam *et al*., 2018 observed white pericarp colour in 61 per cent of Bangladesh accessions. Colour of pericarp is considered as a grain quality of commercial importance. In Kerala, people prefer red kernelled rice and that might have resulted in rice germplasm rich in red pericarp colour as observed by Manjunatha *et al*., 2018. However, as the present study was carried out in exotic germplasm we could observe more white kernelled accessions.

The observations recorded based on the length to width ratio of grain showed that out of 89 accessions ten were short slender, four had short bold grains, six were long bold and rest sixty-nine along with five check varieties were medium slender. Mondal *et al*., 2014 observed highest polymorphism for decorticated grain shape. Manjunatha *et al*., 2018 observed five states of expression for decorticated grain shape. Being highly polymorphic, this trait also can be used in identification of genotypes and seed certification programmes.

Grouping of Aaccessions based on Ideal Plant Characteristics

Accessions were grouped based on superior characteristics such as erect angle of leaf and flag leaf, strong and erect culm with well exserted panicle and is given in Table 2. Qualitative traits less affected by the environment can be used as a robust marker for identifying genotypes. Erect attitude of leaf and stem has a positive effect on yield through high photosynthesis. Hence, accessions EC204928, EC205192, EC205205, EC205223, EC205252, EC205333, EC415392, EC415403, EC415405, EC415406, EC415407, EC415411, EC415413, EC415420, EC415421, EC415426, EC415452, EC415454, EC415455, EC415458, EC415460 and EC415461 were identified as superior with erect leaf, flag leaf, erect and strong culm and fully exserted panicle. These can be utilized in breeding programmes to transfer superior traits

References

Burgess, AJ, R Retkute, MP. Pound, J Foulkes, SP Preston and OE Jensen (2015). High-resolution three-dimensional structural data quantify the impact of photoinhibition on long-term carbon gain in wheat canopies in the field. *Plant Physiol.* **169:** 1192-1204.

Fageria, NK (2007). Yield physiology of rice. *J. Plant Nutr.,* **30:** 843-879.

Guo, ZY, MS Zhao, JC Roder, MWReif, Dc Ganal, Chen and T Schnurbusch (2018). Manipulation and prediction of spike morphology traits for the improvement of grain yield in wheat. *Sci. Rep.* 8. Article number: 14435 (2018).

Islam MZ, N Akter, T Chakrabarty, A Bhuiya, MA Siddique and M Khalequzzaman (2018) Agro-morphological characterization and genetic diversity of similar named aromatic rice (*Oryza sativa* L.) landraces of Bangladesh *Bangladesh Rice J*. **22(2):** 41-54.

Jennings PR, LE Berrio, E Torres and E Corredor (2003). A breeding strategy to increase rice yield potential. http://www.ciat.cgiar.org/biotechnology.

Jennings, PR, WR Coffman and HE Kauffman (1979) Rice improvement. IRRI P. 186.

Liang T, G Hong, H Yoshihiro, H Koki, N Tetsuya, L Tian-sheng, S Tatsuhiko and X Zheng-jin (2017). Erect panicle super rice varieties enhance yield by harvest index advantages in high nitrogen and density conditions *J. Integrative Ag.* **16(7):** 1467-1473

Mach J. (2015). Domesticated versus wild rice? bring it awn !. *The Plant Cell,* **27:** 1818

Manjunatha GA, CR Elsy, P Rajendran, J Joseph, RM Francies and S Krishnan (2018). DUS Characterization of rice (*Oryza*

sativa L.) landraces of Wayanad, Kerala. *Electronic J. of Plant Breed*, **9(2):** 617-630

Mondal, BS, P Singh and DC Joshi (2014). DUS characterization of rice (*Oryza sativa* L.) using morphological descriptors and quality parameters. Outlook on agriculture, June 2014.

Priya RTS, A Raeboline, LE Nelson, K Ravichandran and U Antony (2019). Nutritional and functional properties of coloured rice varieties of South India: a review. *J. Ethn. Foods* **6(11)**: https://doi.org/10.1186/s42779-019-0017-3.

Rani, SN, SLV Rao and BC Viraktamath (2006), 'National guidelines for the conduct of tests for distinctness, uniformity and stability: rice (*Oryza sativa* L) – Zero Draft', Directorate of Rice Research, Rajendranagar, Hyderabad, Andhra Pradesh.

Rani, MG, PV. Satyanarayana, M L Ahmed, AY Rani, VS Rao and Jhansirani (2017). Breeding strategies for lodging resistance in rice. In. *J. Bio-resource and Stress Management* **8(6):** 895-903.

Rao, LV, G. Prasad, M.Chiranjivi, U Chaitanya and R Surendhar (2013) DUS Characterization for farmer varieties of rice IOSR *J. of Ag.* and *Vet. Sci.* **4(5):** 35-43.

Tafere C and K Irie (2019). Growth response of culm habit near-isogenic lines rice (O*ryza sativa* L.) to different planting densities and nitrogen regimes. In*. J. Re. and Review*. **6(12):** 72-184.

Xu Z, W Chen, L Zhang and S Yang (2005). Design principles and parameters of rice ideal panicle type. *Chinese Sci. Bulletin* **50:** p 2253-2256.