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DUS characterization of rice genotypes

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ABSTRACT

Characterization of 45 genotypes of rice was done using fifty agro-morphological traits following Distinctiveness, Uniformity and Stability test (DUS) during Sali seasons of 2012 and 2013 at the Instructional cum Research farm of Assam Agricultural University, Jorhat. Out of 50 characters studied, 6 characters were monomorphic in nature. The rest of 44 characters, 12 characters were dimorphic and 32 were polymorphic in nature which could be used to identify the genotypes. This study will be useful for breeders, researchers and farmers to identify and choose the restoration and conservation of beneficial genes for crop improvement and also to seek protection under Protection of Plant Varieties and Farmer's Rights Act.

Key words: *DUS test, characterization, descriptors and PPV & FR Act*

Rice is a staple food for more than 50% people of the world (Vanniarajan *et al*. 2012). India is the second largest producers of rice in the world next to China. The basic objective of varietal characterization is to know the presence of traits that helps in identifying a particular variety. The characters that are used to distinguish cultivars should have the ability of precise description and recognition and is considered important only when they are not altered due to environmental influences. Thus, the ability to identify and distinguish between varieties is a fundamental component. This benefits the certification authorities as well as the farmers in ensuring supply and distribution of genetically pure seeds.

Being signatory to the general agreement on Trade and Tariffs, Government of India has enacted its sui-generis system, *i.e.*, Protection of Plant Varieties and farmers' Right Act (PPV&FRA), 2001 for providing protection to plant varieties based on distinctiveness, uniformity and stability (DUS) test, apart from novelty. Therefore, the characterization of a variety is a prerequisite and identification of plant varieties of common knowledge is essential for the protection of new plant varieties. Article 15.3(b) of the PPV&FRA states that the new variety must be clearly distinguishable by one or more essential characters from any variety whose existence is a matter of common knowledge at the time of seeking protection. The uniqueness of a variety is to be established by following standard DUS testing guidelines.

The genuineness of a cultivar can be assessed by means of heritable morphological, physiological, biochemical and DNA based markers. The tests are mainly based on morphological and physiological characters called descriptors obtained by growing the varieties side by side. Qualitative characters are considered as marker characters in the identification of landraces, which are less influenced by environmental fluctuations. The work on inheritance and linkage studies of qualitative characters was reviewed by Raut (2003).

Keeping in view these facts, the present investigation was planned to characterize a set of 45

rice genotypes to understand in situ variability of different agro morphological traits and inter-relationship among them. The genotypes were grown in RBD with three replications during Sali season, 2012 and 2013 to characterize them as per DUS guidelines given by Protection of Plant Variety and Farmers Rights Authority (PPV & FRA), GOI, New Delhi (2001).

Forty five genotypes of rice were grown in a RBD design with three replications at the ICR farm, Assam Agricultural University, Jorhat 785013, India. The experimental site was situated at 26^0 46' N latitude and $94^0$16' E longitude with an altitude of 86.6 m above mean sea level.

Each genotype was grown in ten rows of 2.4 m long with 20 x 20cm spacing. Each hill was planted with single seedling. Recommended package of practices for Assam (Anon. 2009) was followed to raise a good crop. All the morpho-physiological characters were recorded as per DUS guidelines of PPV&FR Authority, Govt. of India, New Delhi. The assessment of distinctiveness and stability observations were made on 30 plants or parts of 30 plants, equally divided into 3 replications (10 plants per replication). The assessment of uniformity of characteristics on the plot as a whole (visual assessment by a single observation of a group of plants or parts of plants) and a population standard of 0.1 per cent with an acceptance probability of at least 95 per cent was applied.

To establish distinctiveness among rice cultivars, 50 characters have been used. Qualitative characters are considered as morphological markers in the identification of rice genotypes, because they are less influenced by environmental changes (Raut 2003). In respect of the basal leaf sheath colour, there were distinct variations of the rice genotypes starting from green to uniform purple. Basal leaf sheath colour of Badal was uniform purple whereas IET 20800, Teraboli, Swarna-Sub1, Jalashree, Koimurali, Joria, Kmj 13A 6-1-2, Kopilee, Kmj 1-19-1, IR 58025B, IR 68888B, IR 68897B, IR 10198 and IR 21567 were green. Others were having either light purple or purple lined colour. The genotypes could be classified into 4 groups, 2.22% with uniform purple, 31.11% were green, 33.33% with purple line and 33.34% were light purple. Intensity of green colour of leaves was dark in 21 genotypes (46.67%), medium in 20 genotypes (44.44%) and light in 4 genotypes (8.89%). The intensity of green colour was found to be a useful trait to characterize the genotypes. However, it will not be reliable for identification of cultivars, because the intensity of green colour of many cultivars gets bleached when the plants are left in the field to dry in sun or as a result of influence of fertilizers and environmental conditions (Kooistra 1964). Out of 45 cultivars, only one cultivar (Bahadur) had leaf anthocyanin colouration on tips of leaves. Anthocyanin colouration in leaf sheath was observed in 9 cultivars (20%), out of which, only Badal had strong, Kopilee, IR 46 and LGRU 2 had medium and other 5 had weak intensity of anthocyanin colouration. Four genotypes (Ranjit, IET 19916, IET 21480 and IR 36) were found to be distinct for having strong pubescence (8.89%), while 9 genotypes were marked for weak pubescence (20%) on leaf blade. Leaf auricle and leaf collar were found to be monomorphic characters, as all the genotypes were having auricles and leaf collar. One genotype (IET 20800) was marked for having purpled coloured auricle. Out of 45 cultivars, one genotype (Ranjit) was distinguished for having anthocyanin colouration of leaf collar. Regarding leaf ligule shape, all the varieties had split shaped ligule. One genotype (IET 21480) was distinguished for having purple coloured (2.22%) ligule, 12 genotypes having light purple coloured (26.67%) and others (71.11%) were having white coloured ligule.

Cultivars namely Longai, Joria, Kopilee and Jayamati were having long leaf length (8.89%), 28 genotypes having medium (64.44%) and 12 genotypes having short (26.67%) leaf length. Broad leaf breadth was recorded only in two genotypes (Ranjit and IET 19916) (4.44%) and others (95.56%) were having medium leaf breadth. There were 15 genotypes (33.33%) with erect and 18 genotypes (40%) with semi-erect and one (2.22%) with spreading and rest (24.45%) with open type of culm attitude. In case of time of heading, 17 cultivars (37.78%) were distinguished for early category, while 17 cultivars (37.78%) showed late and rest (24.44%) were medium duration for this character. There were 8 genotypes (17.78%) with flag leaf of semi-erect blade attitude, 2 genotypes (4.44%) with drooping, one (2.22%) with horizontal and rests (75.55%) were erect type of flag leaf attitude in early observation. In case of density of pubescence on lemma of spikelets, it was absent in 7 cultivars (15.55%)

namely, Manoharsali, Kmj 13S 3-1-3, Kolong, Chilarai, Luit, Kmj 13A 1-12-3 and Kmj 1-19-1 but it was medium in 14 genotypes (31.11%) and weak in 24 genotypes (53.33%). Male sterility was absent in all the genotypes. Regarding anthocyanin colouration on lemma of spikelet, 2 cultivars (4.44%) namely Kopilee and Jayamati had strong colouration on keel, 3 cultivars (6.67%) like Kopilee, Jayamati and IR 32809 had strong colouration at the area below apex. Cultivar Badal could be distinguished for having purple coloured stigma.

In case of stem thickness and length, the genotype with thick and long stem was for Badal. On the other hand, Longai, Bahadur, IET 19916, Kmj 13S 3-1-3, IET 20771 and IET 21850 were distinguished for having thick stem with short stem length. Anthocyanin colouration was found on node in 2 genotypes namely, Badal and IR 32809 among which Badal had strong colouration.

In explaining the panicle features, 11 cultivars (24.44%) namely Dhirendra, Bahadur, Ranjit, PIET 19916, IET 20800, Joria, Kopilee, Kolong, Jayamati, IR 79156B, IR 32809 were distinguished for having long panicle length. But the rest (75.66%) were having medium panicle length. Attitude of flag leaf blade was erect in 31 genotypes (68.89%), semi erect in 8 genotypes (17.78%), deflexed in 3 genotypes (6.67%) and horizontal in 3 genotypes (6.67%). Curvature of main axis of panicle was deflexed in 14 genotypes (31.11%), drooping in 9 genotypes (20%), semi-straight in 20 genotypes (44.44%) and straight in 2 genotypes (4.44%). Panicle numbers per plant was few in 21 genotypes (46.67%) and the rest (53.33) were medium.

A large amount of variations could be observed in the colouration of lemma and palea. Awn was present in 6 cultivars (13.33%) but the rest 39 cultivars (86.67%) were lacking this trait. Variations were recorded for colouration of the awn starting from yellowish white to light red. Awns were distributed on whole length in IR 58025B, only on upper half in Joria, IR 63883-41-3-2-2-2R and IR 46 and only on tips in the rest of the awned cultivars. Secondary branching was present in all the genotypes studied. Out of 45 genotypes, 17 genotypes (37.78%) had clustered, 15 genotypes (33.33%) with strong and the rest with weak secondary branching of panicle. Attitude of branches of panicle was found ranging from semi-erect to spreading types.

Full exsertion of panicle was found in almost all genotypes except two (IET 21480 and IET 20771) where panicles were found to be not fully exerted. Genotypes (31.11%) like Longai, Jalkunwari, Dhirendra, Badal, Manoharsali, Bahadur, Ranjit, IET 18648, IET 21480, Kmj 13S 3-1-3, IET 20771, Jalashree, IET 21850 and IET 19189 were distinguished for very late for time of maturity, while 15 genotypes (33.33%) namely Koimurali, IR 36, Dikhow, Joria, Kmj 13a 6-1-2, Kopilee, Kolong, IR 64, Luit, Kmj 13A 1-12-3, IR 58025B, IR 68888B, IR 68897B, IR 79156B and IR 65483-14-1-4-1-3R were distinguished for early in time of maturity. Leaf senescence was early in 2 genotypes (4.44%) *i.e.*, Teraboli and IR 32809, while it was late in 30 genotypes (66.67%). Genotypes like Jalkunwari, Dhirendra, Badal, Manoharsali, Bahadur, IET 20771, Jalashree, Dikhow, Joria, Kmj 13A 6-1-2, Kolong, IR 68897B and IR 65483-14-1-4-1-3R had intermediate (28.89%) leaf senescence. Sterile lemma colour was found red in genotypes like Joria and Kopilee, whereas gold colour was recorded in genotypes like Kolong and IR 58025B. One genotype was purple coloured sterile lemma and the rest were straw coloured. Data on 1000-grain weight showed that the genotype Kmj 1-19-1 had the very high, whereas genotype IET 21480 had very low seed weight. The rest were ranged from low to high for this character.

Grain length was long in Kmj 1-19-1 but short in Longai, Jalkunwari, Dhirendra, Bahadur, Ranjit, IET 19916, Teraboli, Kmj 13S 3-1-3, IET 20771,Swarna Sub 1, Jalashree, IET 21850, IET 19189, Koimurali, Joria, Kmj 13A 1-12-3 and IR 65483-14-1-4-1-3R genotypes. The rest were intermediate in grain length. Grain breadth was recorded very broad in 2 genotypes (Badal and Jalashree), whereas narrow in Dikhow, IR 58025B, IR 79156B and IR 65483-14-1-4-1-3R. The rests were either broad or medium in breadth. Decorticated grain length was extra long in genotypes Jayamati, IR 58025B, IR 68897B and IR 79156B, whereas Basmati type long grain was recorded in IET 19189, IR 36, IR 64, IR 68888B, IR 80555B, IR 63883-41-3-2-2-2R, IR 65515-56-1-3-19R, IR 69715-123-1-3R, IR 46, IR10198, IR 21567, IR 32809 and LGRU 2. Decorticated grain breadth was narrow in genotypes like IR 58025B and IR 79156B, whereas broad was recorded in Jalkunwari, Dhirendra, Badal, Bahadur, Ranjit, IET 18648, IET 19916, IET 21480, Kmj 13S 3-1-3, Swarna Sub 1,

Jalashree, IET 21850, Koimurali, Dikhow, Joria, Kmj 13A 6-1-2, Kopilee, Kolong, Chilarai, Luit, Kmj 13A 1-12-3, Kmj 1-19-1 and IR 65483-14-1-4-1-3R. The rests were medium in breadth. Decorticated grain shape in lateral view was recorded as extra long slender for 4 genotypes (8.89%) namely Jayamati, IR 58025B, IR 68897B and IR 79156B. Thirteen genotypes (28.89%) were basmati type grain shape and the rests were short bold (26.67%), long bold (28.89%) or medium slender (2.22%) types.

Out of 50 characters studied, 6 characters (leaf collar, leaf ligule, shape of leaf ligule, male sterility and presence of secondary branches) were monomorphic in nature. The rest of 44 characters, 12 characters were dimorphic and 32 were polymorphic in nature which could be used to identify the genotypes. Patra *et al.* (2010) also reported 26 characters as monomorphic, 11 characters dimorphic and 7 characters polymorphic out of 46 visually assessed characters used for characterizing 18 basmati rice varieties and indicated potential for varietal characterization and distinctiveness. In the present investigation, no off type plants were observed. Hence, these characters were considered to be uniform. Expression of each characteristic was found to be stable in both the two years for the respective varieties, thus confirming their consistency and stability. The stability of visually assessed characteristics can be attributed to a low genotype x environment interaction in their expression. This is due to the fact that most of the visually assessed characters are controlled by single or two genes with simple dominant or recessive relationship. Kumar *et al.* (2006) reported similar views for the morphological characterization of jute varieties over three years of study. Thimmanna *et al*. (2000) suggested that the traits like leaf length and width, pubescence of leaf, colour , leaf angle, ligule shape and colour, auricle colour, internodes colour, panicle type, secondary branching, exertion, awning, seed length and width and 100-grain weight could be used in differentiating the parental lines of rice hybrids.

Thus, it is concluded that out of 50 characters studied, 6 characters were monomorphic 12 characters were dimorphic and 32 were polymorphic in nature, which could be used to identify the genotypes. This study will be useful for breeders, researchers and farmers to identify and choose the restoration and conservation of beneficial genes for crop improvement.

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