ORIGINAL RESEARCH ARTICLE OPEN ACCESS

Morphological Characterization of Advanced Lines of Rice (*Oryza sativa* L.) Derived from Swarna x Ranbir Basmati at Seedling Stage

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Received: 27th January, 2017 Accepted: 5th May, 2017

Abstract

The present investigation entitled "Morphological characterization in advanced lines of rice (*Oryza sativa* L.) derived from Swarna x Ranbir basmati at seedling stage" was carried out during *kharif* 2016 at AICRIP, Agricultural Research Station, Mugad, UAS Dharwad. Segregation was observed in 30 different characters viz, basal leaf: sheath colour, Leaf: intensity of green colour, Leaf: anthocyanin colouration, Leaf: distribution of anthocyanin colour, Leaf sheath: anthocyanin colouration, Leaf sheath: intensity anthocyanin colouration, Leaf: pubescence of blade surface, Leaf: anthocyanin colouration of auricles, Leaf: colour of ligule, Leaf: length of blade, Culm: attitude, Flag leaf: attitude of blade, Spikelet: density of pubescence of lemma, Lemma: anthocyanin colouration of keel, Lemma: anthocyanin colouration of area below apex, Lemma: anthocyanin colouration of apex, Spikelet: colour of stigma, Stem: thickness, Stem: length and anthocyanin colourarion of internodes. There was no variation observed with respect to coleoptile: colour, Leaf: auricles, Leaf: collar, Leaf: anthocyanin colouration of collar, Leaf: ligule, Leaf: shape of ligule, Time of heading, Stem anthocyanin colouration of nodes and tem anthocyanin colouration of internodes.

Keywords: DUS, Ranbir Basmati, Swarna, morphological traits

Introduction

Rice (*Oryza sativa* L.) is the world's most important food crop and a primary food source for more than one third of world's population (Singh and Singh, 2008) Asia can be considered as 'Rice Basket' of the world, as more than 90 per cent of the rice is produced and consumed in Asia, a region with high population density. As the existing UPOV models of plant variety protection were not suitable for Indian requirements, the Government of India enacted our own legislation on the "Protection of Plant Varieties and Farmers Act" (PPV&FRA) in 2001 for providing protection to plant varieties based on distinctiveness, uniformity and stability (DUS) test apart from novelty. This is a unique and model act which gives equal importance to the farmers and breeders and treats them as partners in their efforts for sustainable food security (Patra, 2000). The concept of distinctness, uniformity and stability are thus fundamental to the characterization of a variety as a unique creation. Registration is allowed for three types of plant varieties viz., new varieties developed by breeders, extant varieties and farmer's varieties subject to their fulfilling the conditions of Distinctness, Uniformity, Stability and Novelty in case of breeder's variety. The uniqueness of a particular variety is to be established by the test called DUS.

Cultivar characterization is recommended based on the variations in seed and plant morphological characters, their response to chemical tests. In all cultivated crops, including agricultural and horticultural species varietal characterization was attempted by several researchers either for crop registration or to fix their utility in breeding and certification programmes. In a country like India, where contract farming is practiced at many places for seed production, with the active participation of private sector (Mishra *et al.*, 1996), monitoring of genetic purity at each stage of seed production becomes necessary and also cumbersome. In view of this, the study on varietal characterization is highly essential. Characterization 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 morphological traits is helpful to develop distinctiveness among the genotypes.

Materials and Methods

The field experiment in 2016 was laid out at Agricultural Research Station, Mugad. It is situated at North latitude of 15^0 50′ and the East longitude of 75^0 40′, with an altitude of 697 m above mean sea level. The experimental material comprised of Swarna is a popular high yielding semi dwarf variety derived from cross between Vasistha x Mahsuri having low iron and zinc content (2.93 mg 100 g^{-1} and 2.28mg 100 g^{-1} respectively). While, Ranbir basmati selection from Basmati 370 possess high iron and zinc content of 4 mg 100^{-1} g and 5 mg 100^{-1} g respectively (details of the parents used are presented in Table 2). 160

segregating population were used as experimental material, were grown in a randomized complete block design with two replications to conduct DUS characterization during *kharif*, 2016, at All India Co-ordinate Rice Improvement Project (AICRIP, Mugad), University of Agricultural Sciences, Dharwad. Each entry was sown in three rows of two meter length at spacing of 20 cm between rows and 15 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 one morphological traits. The essential characters considered for the present study are mentioned in Table 1.

Table 1. Essential characters along with descriptor

Sl. No.	Characteristics	States	Note
1	Coleoptile: Colour	Colourless Green Purple	1 2 3
2	Basal leaf: Sheath colour	Green Light purple Purple lines Uniform purple	1 2 3 4
3	Leaf: Intensity of green colour	Light Medium Dark	3 5 7
4	Leaf: Anthocyanin Colouration	Absent Present	1 9
5	Leaf: Distribution of anthocyanin colour	On tips only On margins only In blotches only Uniform	1 2 3 4
6	Leaf Sheath: Anothhocyanin colouration	Absent Present	1 9
7	Leaf sheath: Intensity of anthocyanin colouration	Very weak Weak Medium Strong Very strong	1 3 5 7 9
8	Leaf: Pubescence of blade surface	Absent Weak Medium Strong Very strong	1 3 5 7 9
9	Leaf: Auricles	Absent Present	1 9
10	Leaf: Anthocyanin colouration of auricles	Colourless Light purple Purple	1 2 3
11	Leaf: Collar	Absent Present	1 9
12	Leaf: Anthocyanin colouration of collar	Absent Present	1 9
13	Leaf: Ligule	Absent Present	1 9
14	Leaf: Shape of lligule	Truncate Acute Split	1 2 3
15	Leaf: Colour of ligule	White Light purple Purple	1 2 3
16	Leaf: Length of blade	Short (<30 cm) Medium(30-45 cm) Long (>45 cm)	3 5 7
17	Leaf: Width of blade	Narrow (<1 cm) Medium (1-2 cm) Broad (>2 cm)	3 5 7
18	Culm: attitude	Erect Semi-erect Open Spreading	1 3 5 7
19	Time of heading (50% of plants with panicles) days	Very early (<71 days) Early (71-90 days) Medium (91-110 days) Late(111-130 days) Very late (> 131 days)	1 3 5 7 9
20	Flag leaf: Attitude of blade (early observation)	Erect Semi-erect Horizontal Drooping	1 3 5 7
21	Spikelet: Density of pubiscence of lemma	Absent Weak Medium Strong Very strong	1 3 5 7 9
22	Male sterility	Absent Present	1 9
23	Lemma: Anthocyanin colouration of keel	Absent or very weak Weak Medium Strong Very strong	1 3 5 7 9
24	Lemma: Anthocyanin colouration of area below apex	Absent Weak Medium Strong Very strong	1 3 5 7 9
25	Lemma: Anthocyanin colouration of apex	Absent Weak Medium Strong Very strong	1 3 5 7 9

26	Spikelet: Colour of stigma	White Light green Yellow Light purple Purple	1 2 3 4 5
27	Stem: Thickness	Thin (<0.40 cm) Medium (0.40-0.55 cm) Thick (>0.55 cm)	3 5 7
28	Stem: Length (excluding panicle; excluding floating rice)	Very short(<91 cm) Short (91-110 cm) Medium(111-130 cm) Long (131-150 cm) Very long(>150 cm)	1 3 5 7 9
29	Stem: Anthocyanin colouraiton of nodes	Absent Present	1 9
30	Stem : Anthocyanin colouration of internodes	Absent Present	1 9

Results and Discussion:

Qualitative and quantitative characters of rice seedlings derived from Swarna × Ranbir basmati are presented in Table 3. Among 160 rice inbred lines variation was observed, the characters coleoptile: colour was green in all 160 lines. Basal leaf: sheath colour showed segregation, of which 106 green, 19 light green, 33 purple lines and 2 lines showed unifrm purple colour. Similar results were obtained by Das and Ghosh (2010) they studied 431 traditional rice cultivars and reported that considerable variability was recorded for basal leaf sheath colour, awning and auricle colour. Characters like leaf blade colour, panicle excertion, stigma colour *etc*. showed moderate variability. Leaf: intensity of green colour showed segregation of which 28 light, 122 medium and 10 lines showed dark colour. Leaf: anthocyanin colouration was absent in 148 lines and present in 12 lines. Leaf: distribution of anthocyanin colour was observed on margins only in 9 lines, in blotches only in 3, uniform on 1 line and remaining all other lines were devoid 0f anthocyanin colour. Leaf sheath: anthocyanin colouration was absent in 113 and present in 47 lines. Leaf sheath: intensity anthocyanin colouration was weak in 2, medium in 39, strong in 5, very strong in 2 lines and absence of intensity anthocyanin colour in remaining lines. Leaf: pubescence of blade surface was weak in 1, medium in 61, strong in 63 and very strong in 35 lines. Leaf: anthocyanin colouration of auricles was colourless in 159 and purple in 1 line. Leaf: colour of ligule was white in 140, light purple in 19 and purple in 1 line. Leaf: length of blade was short (<30 cm) in 61, medium (30-45cm) in 78 and long (>45cm) in 21 lines. Rajanna *et al.*, (2011) observed more variation among the parents (IR-58025A, IR-58025B, KMR-3R, IR- 68897A, IR- 68897B, and DR-71-1-2R) and hybrids (KRH-2 and DRRH-2) for the characters such as leaf length and days to 50 per cent flowering exhibited. Leaf: width of blade was narrow (<1cm) in 119 and medium (1-2cm) in 41lines. Culm: attitude was erect in 32, semi erect in 80, open in 46 and spreading in 2 lines. Flag leaf: attitude of blade (early observation) was erect in 51, semi erect in 78 and horizontal in 31 lines. Spikelet: density of pubescence of lemma was absent in 29, weak in 125, medium in 5 and strong in 1 line. Male sterility was absent in 159 and present in 1 line. Lemma: anthocyanin colouration of keel was absent or very weak in 147, weak in 12 and medium in 1 line. Lemma: anthocyanin colouration of area below apex was absent in 136, weak in 21 and medium in 3 lines. Lemma: anthocyanin colouration of apex was absent in 117, weak in 1, medium in 20, strong in 19 and very strong in 3 lines. Spikelet: colour of stigma was white in 110, light green in 2, yellow in 47 and light purple in 1 line. Stem: thickness was thin (<0.40cm) in 52, medium (0.40-0.55cm) in 92 and thick (>0.55cm) in 16 lines. Stem: length (excluding panicle; excluding floating rice) was very short (<91 cm) in 83, short (91-110 cm) in 43, medium (111-130 cm) in 29 and long (131-150 cm) in 5 lines. Stem: anthocyanin colourarion of nodes was absent in 160 lines.

There was no variation observed with respect to coleoptile: colour was green in all 160 lines. Leaf: auricles were present in all 160 lines. Leaf: collar was present in 160 lines. Leaf: anthocyanin colouration of collar was absent in 160 lines. Leaf: ligule was present in 160 lines. Leaf: shape of ligule split ligule was observed in 160 lines. Time of heading (50% of plants with panicles) was very late (>131 days) in 160 lines. Stem: Intensity of anothocyanin colouration of nodes was not abserved in all 160 lines. Stem: anthocyanin colourarion of internodes was absent in

Table 2: Details of the parents used in the presents study

Sl. No.	Genotypes	Parentage	Grain type	50% Flowering	Iron content (mg/kg of brown rice)	Zinc content (mg/kg of brown rice)	Yield (t ha-1)	Year of release
1	Swarna (MTU 7029) IET 7041 Notif. 2103 (E) Dt.12/08/1980	Vasistha x Mahsuri	MS	125	7.8	22.8	3.5	1979
2	Ranbir Basmati IET 11348 Notif. 1(E) Dt. 01/01/1996	Selection from Basmati 370	LS	95	13.3	29.6	2.7	1994

Table 3: Qualitative and quantitative characters of rice seedlings derived from Swarna × Ranbir basmati

SN	Genotype	Coleoptile: Colour	Basal Leaf: Sheath	Leaf: Intensity of green	Leaf: Anthocyanin colouration	Leaf: Distribution of anthocyanin colour	Leaf Sheath: Anothhocyanin colouration	Leaf sheath: Intensity of anthocyanin colouration	Leaf: Pubescence of blade surface	Leaf: Auricles	Leaf: anthocyanin colouration of auricles	Leaf: collar	Leaf: Anthocyanin colouration of collar	Leaf: Ligule	Leaf: Shape of lligule	Leaf: Colour of ligule	Leaf: Length of blade	Leaf: Width of blade	Culm: attitude	Time of heading (50% of plants with panicles) days	Flag leaf: Attitude of blade (early observation)	Spikelet: Density of pubiscence of lemma	Male sterility	Lemma: Anthocyanin colouration of keel	Lemma: Anthocyanin colouration of area below apex	Lemma: Anthocyanin colouration of apex	Spikelet: Colour of stigma	Stem: Thickness	Stem: Length (excluding panicle; excluding floating rice)	Stem: Anthocyanin colouraiton of nodes	Stem: Intensity of anothocyanin colouration of nodes	Stem : Anthocyanin colouration of internodes
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	SR-F7 -1	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	5	9	3	1	1	1	1	1	1	5	7	1	–	1
2	SR-F7 - 2	2	3	3	1	–	9	5	5	9	1	9	1	9	3	1	5	3	1	9	1	3	1	1	3	5	5	7	1	1	–	1
3	SR-F7 - 3	2	3	5	1	–	9	5	7	9	1	9	1	9	3	1	7	3	1	9	3	1	1	1	3	3	1	5	3	1	–	1
4	SR-F7 - 4	2	3	5	1	–	9	3	7	9	1	9	1	9	3	1	5	3	1	9	1	1	1	1	1	5	5	3	1	1	–	1
5	SR-F7 - 5	2	3	5	1	–	9	5	7	9	1	9	1	9	3	1	5	3	1	9	3	3	1	1	1	7	5	5	1	1	–	1
6	SR-F7 - 6	2	3	5	1	–	9	5	5	9	1	9	1	9	3	2	5	3	5	9	1	3	1	1	1	1	1	5	3	1	–	1
7	SR-F7 - 7	2	3	5	1	–	9	5	7	9	1	9	1	9	3	1	7	3	3	9	1	3	1	1	3	7	5	3	5	1	–	1
8	SR-F7 - 8	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	5	9	3	1	1	1	3	1	5	5	5	1	–	1
9	SR-F7 - 9	2	1	7	1	–	1	–	7	9	1	9	1	9	3	1	3	3	5	9	3	1	1	1	1	1	1	5	1	1	–	1
10	SR-F7 - 10	2	3	5	1	–	9	5	7	9	1	9	1	9	3	2	5	3	1	9	3	1	1	1	1	1	1	5	3	1	–	1
11	SR-F7 - 11	2	3	5	1	–	9	5	7	9	1	9	1	9	3	2	7	3	3	9	5	3	1	1	3	7	5	5	7	1	–	1
12	SR-F7 - 12	2	3	5	1	–	9	5	7	9	1	9	1	9	3	1	3	5	3	9	1	1	1	1	5	5	1	3	1	1	–	1
13	SR-F7 - 13	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	3	9	1	1	1	1	1	1	1	5	5	1	–	1
14	SR-F7 - 14	2	3	5	1	–	9	7	5	9	1	9	1	9	3	2	7	3	5	9	1	3	1	1	1	5	5	5	1	1	–	1
15	SR-F7 - 15	2	3	5	1	–	9	5	5	9	1	9	1	9	3	2	5	5	5	9	3	3	1	1	1	5	5	5	1	1	–	1
16	SR-F7 - 16	2	3	5	1	–	9	5	7	9	1	9	1	9	3	1	7	5	5	9	5	3	1	1	1	5	5	7	5	1	–	1
17	SR-F7 - 17	2	3	5	1	–	9	5	5	9	1	9	1	9	3	1	5	5	1	9	3	1	1	1	1	5	5	5	5	1	–	1
18	SR-F7 - 18	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	1	3	1	1	1	1	1	3	1	1	–	1
19	SR-F7 - 19	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	1	3	1	1	1	1	1	3	1	1	–	1
20	SR-F7 - 20	2	1	7	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	1	1	5	3	1	–	1
21	SR-F7 - 21	2	3	7	1	–	9	7	5	9	1	9	1	9	3	1	3	3	3	9	5	3	1	1	1	5	1	3	3	1	–	1
22	SR-F7 - 22	2	1	7	1	–	1	–	7	9	1	9	1	9	3	1	3	3	5	9	3	3	1	1	1	1	1	3	1	1	–	1
23	SR-F7 - 23	2	1	7	1	–	1	–	7	9	1	9	1	9	3	1	3	3	5	9	3	3	1	1	1	1	1	5	1	1	–	1

24	SR-F7 - 24	2	1	7	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	1	1	5	1	1	–	1
25	SR-F7 - 25	2	3	5	1	–	9	5	5	9	1	9	1	9	3	1	5	5	5	9	3	1	1	1	1	5	5	3	3	1	–	1
26	SR-F7 - 26	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	1	1	5	3	1	–	1
27	SR-F7 - 27	2	3	5	1	–	9	5	5	9	1	9	1	9	3	1	5	5	3	9	1	1	1	1	1	5	5	5	1	1	–	1
28	SR-F7 - 28	2	3	5	1	–	9	5	7	9	1	9	1	9	3	1	5	5	3	9	1	1	1	1	1	5	5	5	1	1	–	1
29	SR-F7 - 29	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	5	9	1	3	1	1	1	1	1	3	1	1	–	1
30	SR-F7 - 30	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	5	3	9	1	1	1	1	3	1	1	5	5	1	–	1
31	SR-F7 - 31	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	7	3	3	9	1	1	1	1	3	1	3	3	1	1	–	1
32	SR-F7 - 32	2	3	5	9	3	9	5	9	9	1	9	1	9	3	2	3	3	5	9	3	3	1	1	3	5	5	5	3	1	–	1
33	SR-F7 - 33	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	3	9	1	3	1	1	1	1	1	3	3	1	–	1
34	SR-F7 - 34	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	5	5	9	1	1	1	1	1	1	5	3	1	1	–	1
35	SR-F7 - 35	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	5	7	9	1	1	1	1	7	1	1	–	1
36	SR-F7 - 36	2	2	5	1	–	9	5	7	9	1	9	1	9	3	1	5	3	5	9	3	3	1	1	1	1	1	3	1	1	–	1
37	SR-F7 - 37	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	5	5	9	3	3	1	1	1	1	1	5	1	1	–	1
38	SR-F7 - 38	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	5	5	9	1	1	1	1	1	1	1	7	1	1	–	1
39	SR-F7 - 39	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	5	5	9	3	3	1	1	1	1	1	3	1	1	–	1
40	SR-F7 - 40	2	1	7	1	–	1	–	9	9	1	9	1	9	3	1	5	5	5	9	1	1	1	1	1	1	1	3	1	1	–	1
41	SR-F7 - 41	2	3	5	1	–	9	5	5	9	1	9	1	9	3	2	7	3	5	9	3	3	1	1	1	7	5	7	5	1	–	1
42	SR-F7 - 42	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	7	5	5	9	3	3	1	1	1	1	1	5	5	1	–	1
43	SR-F7 - 43	2	3	5	1	–	9	5	7	9	1	9	1	9	3	2	3	3	5	9	3	3	1	1	1	1	1	5	5	1	–	1
44	SR-F7 - 44	2	3	5	9	2	9	7	7	9	1	9	1	9	3	2	3	3	3	9	3	3	1	1	1	7	5	7	3	1	–	1
45	SR-F7 - 45	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	1	1	1	1	1	1	1	7	3	1	–	1
46	SR-F7 - 46	2	3	7	1	–	9	5	7	9	1	9	1	9	3	2	3	3	5	9	1	3	1	3	5	7	5	5	1	1	–	1
47	SR-F7 - 47	2	3	5	1	–	9	5	9	9	1	9	1	9	3	1	7	5	5	9	3	1	1	1	3	1	1	7	5	1	–	1
48	SR-F7 - 48	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	7	5	3	9	1	3	1	1	1	5	5	5	7	1	–	1
49	SR-F7 - 49	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	5	5	3	9	1	3	1	1	1	1	1	3	1	1	–	1
50	SR-F7 - 50	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	1	1	5	5	1	–	1
51	SR-F7 - 51	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	5	5	3	9	3	1	1	1	1	1	1	3	5	1	–	1
52	SR-F7 - 52	2	3	5	1	–	9	5	9	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	9	5	5	7	1	–	1
53	SR-F7 - 53	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	3	1	1	3	1	1	–	1
54	SR-F7 - 54	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	3	9	5	1	1	1	1	1	1	5	3	1	–	1
55	SR-F7 - 55	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	5	3	1	–	1
56	SR-F7 - 56	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	5	9	1	3	1	1	1	1	1	5	3	1	–	1
57	SR-F7 - 57	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	5	1	1	–	1
58	SR-F7 - 58	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	3	9	1	3	1	1	1	1	1	5	5	1	–	1
59	SR-F7 - 59	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	5	1	1	–	1
60	SR-F7 - 60	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	5	5	3	9	1	3	1	1	1	1	1	5	3	1	–	1
61	SR-F7 - 61	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	3	1	9	3	3	1	1	1	1	1	5	1	1	–	1

62	SR-F7 - 62	2	3	5	1	–	9	5	5	9	1	9	1	9	3	2	5	3	3	9	3	3	1	1	1	7	5	5	3	1	–	1
63	SR-F7 - 63	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	5	3	3	9	5	3	1	1	1	1	1	5	5	1	–	1
64	SR-F7 - 64	2	4	5	9	4	9	9	9	9	3	9	1	9	3	3	5	5	3	9	1	3	1	5	5	9	5	5	1	1	–	1
65	SR-F7 - 65	2	3	5	9	3	9	5	9	9	1	9	1	9	3	2	5	3	3	9	5	3	1	1	1	1	1	3	5	1	–	1
66	SR-F7 - 66	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	3	3	1	–	1
67	SR-F7 - 67	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	3	1	1	–	1
68	SR-F7 - 68	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	1	9	3	3	1	1	1	1	5	5	1	1	–	1
69	SR-F7 - 69	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	1	9	1	1	1	1	3	1	1	3	1	1	–	1
70	SR-F7 - 70	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	1	9	3	3	1	1	1	1	1	3	1	1	–	1
71	SR-F7 - 71	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	1	9	5	3	1	1	1	1	1	5	3	1	–	1
72	SR-F7 - 72	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	5	1	9	3	3	1	1	1	1	1	5	3	1	–	1
73	SR-F7 - 73	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	3	3	9	1	3	1	1	1	1	1	3	1	1	–	1
74	SR-F7 - 74	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	5	1	1	–	1
75	SR-F7 - 75	2	2	5	1	–	1	5	5	9	1	9	1	9	3	1	5	5	5	9	5	3	1	3	3	7	5	5	1	1	–	1
76	SR-F7 - 76	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	1	9	1	3	1	1	1	1	1	3	1	1	–	1
77	SR-F7 - 77	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	1	9	3	3	1	3	1	1	1	5	3	1	–	1
78	SR-F7 - 78	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	7	5	1	9	3	3	1	3	1	1	1	5	5	1	–	1
79	SR-F7 - 79	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	5	3	1	1	1	1	1	3	1	1	–	1
80	SR-F7 - 80	2	2	5	1	–	9	5	5	9	1	9	1	9	3	2	3	3	5	9	3	3	1	3	1	1	1	3	1	1	–	1
81	SR-F7 - 81	2	1	7	1	–	1	–	5	9	1	9	1	9	3	1	3	3	5	9	3	3	1	1	1	1	1	5	1	1	–	1
82	SR-F7 - 82	2	2	5	1	–	9	5	7	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	7	1	1	–	1
83	SR-F7 - 83	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	5	1	1	–	1
84	SR-F7 - 84	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	3	1	1	3	1	1	1	3	1	1	–	1
85	SR-F7 - 85	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	7	3	1	9	3	3	1	3	1	1	1	5	3	1	–	1
86	SR-F7 - 86	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	1	9	3	5	1	1	3	1	1	5	5	1	–	1
87	SR-F7 - 87	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	3	3	1	3	1	1	1	3	3	1	–	1
88	SR-F7 - 88	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	1	9	5	3	1	1	1	1	1	5	3	1	–	1
89	SR-F7 - 89	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	5	5	1	1	1	1	1	5	5	1	–	1
90	SR-F7 - 90	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	3	3	9	1	5	1	1	1	1	1	3	1	1	–	1
91	SR-F7 - 91	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	3	3	1	9	5	3	1	1	1	1	1	3	1	1	–	1
92	SR-F7 - 92	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	7	3	3	9	5	3	1	1	1	1	1	3	5	1	–	1
93	SR-F7 - 93	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	7	3	3	9	1	3	1	1	1	5	5	5	5	1	–	1
94	SR-F7 - 94	2	1	7	1	–	1	–	9	9	1	9	1	9	3	1	5	5	3	9	1	3	1	1	1	1	1	3	1	1	–	1
95	SR-F7 - 95	2	2	5	1	–	9	5	9	9	1	9	1	9	3	1	7	3	3	9	5	3	1	3	1	7	5	5	3	1	–	1
96	SR-F7 - 96	2	2	5	1	–	9	5	9	9	1	9	1	9	3	1	5	3	3	9	5	3	1	1	1	7	5	3	1	1	–	1
97	SR-F7 - 97	2	2	5	1	–	9	5	9	9	1	9	1	9	3	1	7	3	1	9	5	3	1	1	1	5	5	5	3	1	–	1
98	SR-F7 - 98	2	2	5	1	–	9	5	9	9	1	9	1	9	3	2	7	3	3	9	3	3	1	1	1	7	5	3	7	1	–	1
99	SR-F7 - 99	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	7	3	3	9	1	5	1	1	1	1	1	5	1	1	–	1

100	SR-F7 - 100	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	7	3	1	9	1	3	1	3	3	1	3	5	1	1	–	1
101	SR-F7 - 101	2	2	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	5	3	1	1	1	1	1	5	1	1	–	1
102	SR-F7 - 102	2	1	3	1	–	9	5	9	9	1	9	1	9	3	1	3	3	5	9	5	3	1	1	1	7	5	5	3	1	–	1
103	SR-F7 - 103	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	3	5	9	1	3	1	1	1	1	5	3	1	1	–	1
104	SR-F7 - 104	2	2	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	5	9	3	3	1	1	1	1	1	7	3	1	–	1
105	SR-F7 - 105	2	2	5	9	2	9	5	7	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	5	5	5	1	1	–	1
106	SR-F7 - 106	2	2	3	1	–	1	–	9	9	1	9	1	9	3	1	5	3	3	9	5	3	1	1	1	7	5	5	1	1	–	1
107	SR-F7 - 107	2	1	5	1	–	1	–	9	9	1	9	1	9	3	1	5	3	1	9	3	3	1	1	1	7	7	5	5	1	–	1
108	SR-F7 - 108	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	3	1	1	3	3	1	1	5	3	1	–	1
109	SR-F7 - 109	2	1	3	1	–	1	–	9	9	1	9	1	9	3	1	5	3	3	9	3	3	1	3	3	1	1	5	3	1	–	1
110	SR-F7 - 110	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	5	1	9	1	3	1	1	1	1	1	3	3	1	–	1
111	SR-F7 - 111	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	5	9	1	3	1	1	1	1	1	3	1	1	–	1
112	SR-F7 - 112	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	1	9	1	5	1	1	1	1	1	7	1	1	–	1
113	SR-F7 - 113	2	2	3	1	–	1	–	5	9	1	9	1	9	3	1	3	5	3	9	3	3	1	1	1	1	1	5	1	1	–	1
114	SR-F7 - 114	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	1	9	5	3	1	1	1	9	5	5	3	1	–	1
115	SR-F7 - 115	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	1	3	1	1	1	1	1	5	1	1	–	1
116	SR-F7 - 116	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	5	1	1	–	1
117	SR-F7 - 117	2	2	3	1	–	1	–	7	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	1	1	1	3	1	1	–	1
118	SR-F7 - 118	2	1	3	1	–	9	5	9	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	3	3	1	–	1
119	SR-F7 - 119	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	1	3	1	1	1	1	1	3	1	1	–	1
120	SR-F7 - 120	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	3	3	1	1	3	7	5	5	5	1	–	1
121	SR-F7 - 121	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	3	7	9	3	3	1	1	1	1	1	3	1	1	–	1
122	SR-F7 - 122	2	3	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	3	1	1	1	1	1	1	7	5	1	–	1
123	SR-F7 - 123	2	2	5	1	2	9	7	7	9	1	9	1	9	3	2	5	3	3	9	1	1	1	1	1	7	5	5	1	1	–	1
124	SR-F7 - 124	2	2	5	1	–	9	5	3	9	1	9	1	9	3	1	5	3	3	9	1	1	1	1	1	7	5	5	1	1	–	1
125	SR-F7 - 125	2	1	5	1	–	9	3	5	9	1	9	1	9	3	1	5	3	3	9	5	3	1	1	1	1	1	5	3	1	–	1
126	SR-F7 - 126	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	1	3	1	1	1	1	1	5	3	1	–	1
127	SR-F7 - 127	2	4	3	1	–	1	–	7	9	1	9	1	9	3	1	3	3	5	9	1	3	1	1	1	1	1	5	1	1	–	1
128	SR-F7 - 128	2	1	5	9	3	9	9	5	9	1	9	1	9	3	2	3	3	3	9	3	3	1	1	1	5	5	3	3	1	–	1
129	SR-F7 - 129	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	3	1	1	–	1
130	SR-F7 - 130	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	5	9	1	3	1	1	1	1	1	5	1	1	–	1
131	SR-F7 - 131	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	1	3	1	1	1	1	1	3	1	1	–	1
132	SR-F7 - 132	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	3	1	1	–	1
133	SR-F7 - 133	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	5	3	5	9	3	3	1	1	1	1	1	7	3	1	–	1
134	SR-F7 - 134	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	5	1	1	–	1
135	SR-F7 - 135	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	5	9	5	3	1	1	1	1	1	7	3	1	–	1
136	SR-F7 - 136	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	1	9	1	3	1	1	1	1	1	5	1	1	–	1
137	SR-F7 - 137	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	1	9	1	3	1	1	1	1	1	5	1	1	–	1

138	SR-F7 - 138	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	3	1	1	–	1
139	SR-F7 - 139	2	1	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	5	3	1	1	1	5	5	3	1	1	–	1
140	SR-F7 - 140	2	1	3	1	–	1	–	7	9	1	9	1	9	3	1	3	3	5	9	5	3	1	1	1	1	1	5	1	1	–	1
141	SR-F7 - 141	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	5	9	3	3	1	1	1	1	1	3	1	1	–	1
142	SR-F7 - 142	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	1	1	1	1	1	7	5	3	1	1	–	1
143	SR-F7 - 143	2	3	5	9	2	9	7	9	9	1	9	1	9	3	1	5	3	3	9	3	1	1	1	1	7	5	5	3	1	–	1
144	SR-F7 - 144	2	3	3	1	–	1	–	5	9	1	9	1	9	3	2	3	3	1	9	5	3	1	1	3	1	5	5	5	1	–	1
145	SR-F7 - 145	2	2	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	5	3	1	1	3	1	1	5	3	1	–	1
146	SR-F7 - 146	2	2	3	1	–	1	–	5	9	1	9	1	9	3	1	3	3	3	9	5	3	1	1	3	1	1	5	1	1	–	1
147	SR-F7 - 147	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	3	3	9	1	3	1	1	3	1	1	3	1	1	–	1
148	SR-F7 - 148	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	5	3	9	3	3	1	1	1	1	1	5	3	1	–	1
149	SR-F7 - 149	2	3	5	9	2	9	5	5	9	1	9	1	9	3	1	5	3	1	9	1	3	1	1	1	1	1	5	1	1	–	1
150	SR-F7 - 150	2	1	3	1	–	1	–	7	9	1	9	1	9	3	1	3	3	3	9	3	3	1	1	1	1	1	3	1	1	–	1
151	SR-F7 - 151	2	3	5	1	–	1	–	5	9	1	9	1	9	3	1	5	3	3	9	5	3	1	1	1	1	5	7	5	1	–	1
152	SR-F7 - 152	2	3	5	9	2	9	5	5	9	1	9	1	9	3	2	3	3	3	9	5	3	1	1	1	5	5	5	1	1	–	1
153	SR-F7 - 153	2	3	3	1	–	1	–	7	9	1	9	1	9	3	1	5	5	1	9	3	3	1	1	1	1	1	5	5	1	–	1
154	SR-F7 - 154	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	1	9	3	3	1	1	1	1	1	5	5	1	–	1
155	SR-F7 - 155	2	1	5	9	2	9	5	5	9	1	9	1	9	3	1	5	3	1	9	3	3	1	1	1	1	5	5	3	1	–	1
156	SR-F7 - 156	2	1	5	9	2	9	5	9	9	1	9	1	9	3	1	7	3	7	9	5	3	1	1	1	5	5	5	5	1	–	1
157	SR-F7 - 157	2	2	5	9	2	9	5	7	9	1	9	1	9	3	2	7	3	3	9	3	3	1	1	1	1	5	5	5	1	–	1
158	SR-F7 - 158	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	5	3	9	3	3	1	1	1	1	1	5	3	1	–	1
159	SR-F7 - 159	2	1	5	1	–	1	–	7	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	1	1	5	3	1	–	1
160	SR-F7 - 160	2	1	5	1	–	1	–	5	9	1	9	1	9	3	1	5	5	5	9	3	3	1	1	1	1	1	7	1	1	–	1

SR-F7: F_7 population derived from the cross Swarna x Ranbir basmati

160 lines. Based on the study done by Mehla and Kumar (2008) on various morphological characters responsible for identification of rice cultivars, they concluded that existstance of wide variation among the rice cultivars in respect to morphological characters viz. awn length, panicle length, leaf blade colour and leaf sheath colour, node base colour, awning, distribution of awns, stigma colour, anthocyanin colouration of stem nodes and internodes, hence, these characters can be used for identification of rice cultivars. Nethra *et al* (2005) observed polymorphism for traits of panicle awns, apiculus and node anthocyanin pigmentation, and stigma colour. Yan *et al.,* (2007) also observed polymorphism for the traits days to 50% flowering, plant height, awn type, plant type, colour of lemma and palea, pubescence of lemma based on 1,790 entries sampled from 114 countries.Thimmanna *et al.,* (2000) observed the characters such as leaf length and width, pubescence of leaf, colour, leaf angle, ligule shape and colour, auricle colour, internode colour, panicle type, secondary branching, exertion, awning, seed length and width, 1000 grain weight and suggested the usefulness in differentiating the parental lines of rice hybrids.

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