Plant Archives Vol. 20, Supplement 2, 2020 pp. 1262-1269 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

AGROMORPHOLOGICAL CHARACTERS OF AROMATIC RICE GERMPLASM

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Abstract

Rice feeds more than half of the global population inhabiting the earth. Since time immemorial, human beings are consuming rice as one of the staple food and it lead to the propagation and maintenance of huge germplasm in thousands based on their preferred grain quality. Of these, aromatic rice is unique for its pleasant aroma, is popular among rice consumers and provides attractive economic benefit to farmers. Crop improvement programmes have been conducting dedicated efforts to further improve the aroma and yield. Hence, this study aimed to record the DUS characters of aromatic rice germplasm, 552 accessions. The germplasm was cultivated under the same conditions at the research farm of ICAR-IIRR, Hyderabad, during wet season 2013. Wide diversity was observed among the germplasm for most of the DUS characters.

***Keywords*:** Aromatic rice, Germplasm, Crop improvement, DUS characters.

Introduction

Rice is a traditional staple food in many countries of the world, importantly in Asian countries, therefore rice consumption is determined by the population needs in food. Rice (*Oryza sativa* L.) is a monocot grass species and belongs to Gramene family and *Oryza* genus which originated at least 130 million years ago (Khush, 1997). Domestication of rice simultaneously (probably) observed in north east part of India and southern region of china about 800 years ago (Sang and Ge, 2007). The genus *oryza* includes two cultivated species, *Oryza glaberrima* (African rice) and *Oryza sativa* (Asian rice) along with 21 wild species (Londo *et al.,* 2006). It has several important syntenic relationships with other cereal crops and is a model plant for cereals (Shimamoto and Kyojuka, 2002). Rice has a diploid genome. It is the first completely sequenced cereal crop with an accurate genome sequence of 389 Mb size (IRGSP, 2005).

Aroma is considered as one of the top grain quality traits in rice and is a key reason in determining market price as well as related to regional and international identity (Fitgerald, 2009 and Bhattacharjee 2002). The Indian subcontinent has the 'natural gift' of Basmati rice that has been accepted as the best scented, long slender grain in the world market and fetches high price. In addition, silent majority of the indigenous aromatic rice cultivars are small and medium grained (Singh *et al*. 2000a). The tarai region of Himalayan belt of Bihar and Uttar Pradesh of India are the probable places of origin for aromatic rice. Approximately, India has over 70,000 accessions of rice germplasm with a significant number of wild forms still to be collected and conserved (Siddiq, 1992). As a part of civilization, thousands of indigenous adapted aromatic rice genotypes have evolved as a result of human and natural selection. These landraces are the genetic pool of useful alleles. Traditional varieties have been replaced by modern and high yielding varieties reportedly in the irrigated rice ecosystem resulting to reduced genetic base and thus increased genetic vulnerability. In past few decades, growth in share of high yielding varieties and depletion in the area of local varieties have been reported in India (Hore 2005; Patil and Patil 1994; Rana *et al*. 2009) as well as in several other countries (Bhatti 1998; Chaudhary *et al*. 2006; Itani 1993; Juma 1989).

Aromatic rice accessions in general are tall with thin stem, contain less number of panicles, high stem weight, lower yields and susceptible in lodging due to more plant height. Glaszmann (1987) revealed that aromatic rice accessions fall into a separate group from that of the typical indicas and stated that these two groups are incompatible causing inter-group hybrid sterility. More than 100 volatile compounds have been reported in aromatic rice varieties, but the main compound responsible for the characteristic aroma is 2-Acetyl-1-pyrroline (2AP) (Paule, 1989 and Buttery 1982). Accumulation of 2AP is occurs due to the presence of a non-functional Betaine aldehyde dehydrogenase 2 (BADH2) gene (Bradbury *et al*., 2005, 2008). The non-functional BADH2 interferes in pollen tube development and this could be the reason for the less yield in aromatic varieties (Bradbury *et al*., 2008).

Based on this background, for improvement of aromatic rice germplasm of India and for gaining insights about aroma, 552 indigenous and exotic aromatic rice germplasm was collected and in the present study, their Distinctiveness, Uniformity and Stability test (DUS) characters were taken for evaluation.

Materials and Method

Collection of aromatic rice germplasm and multiplication

For this study, 552 aromatic accessions (Table 1) were collected from different parts of India Viz., ANGRAU Rajendranagar, TNAU Tamilnadu, IARI New Delhi, PAU Ludhiana, SVBUUAT Nagina, GBPUAT Pantnagar, IGKV Raipur, AAU Nawagam. The collection includes both Basmati and non- Basmati aromatic accessions. Which contain various short, long grain aromatic traditional land races, semi-dwarf high yielding varieties and elite lines of indigenous and exotic accessions. The germplasm grown at IIRR during kharif season 2013 and purified them by removing the mixtures and off types. Each accession was sown in three rows of 2m length at spacing of 20 cm between

rows and 15 cm between plants. Crop was raised following recommended package of practices.

Data recording and analysis

DUS characters were taken based on the guidelines given by PPV&FRA, 2007 (Protection of Plant Varieties and Farmer's Rights Authority, Govt. of India). All the observations were recorded on five random representative plants and quality analysis was done at grain quality lab IIRR, Hyderabad following standard protocols (DRR, 2013).

The 40DUS characters are, 1) Basal leaf sheath colour 2) Leaf pubescence of Blade surface 3) Leaf auricles 4) Leaf anthocyanin colouration of auricles 5) Ligule shape 6) Ligule colour 7) Days to 50% flowering 8) Flag leaf attitude of blade early obs 9) Spikelet density of pubescence of lemma 10) Lemma anthocyanin colouration of area below apex 11) Spikelet color of stigma12) Stem length 13) Stem anthocyanin colouration of nodes 14) Panicle Length 15) Flag leaf attitude of blade late obs 16) Panicle curvature of main axis 17) Spikelet colour of tip of lemma 18) Panicle awns 19) Panicle color of awns late obs 20) Panicle distribution of awns 21) Panicle attitude of branches 22) Panicle exertion 23) Sterile lemma colour 24) Decorticated grain length 25) Decorticated grain width 26) Decorticated grain shape 27) Decorticated grain color 28) Endosperm presence of amylose 29) Decorticated grain aroma 30) Vegetaive vigour 31) Tillering ability 32) Productive tillers/Plant 33) Plant Height 34) Panicle threshability 35) Phenotypic acceptability 36) Spikelet number/plant 37) Fertile Grains/ Plant 38) Sterile grains /Plant 39) Plot Yield in gms 40) 100 Grain weight.

Results and Discussion

The 556 aromatic rice germplasm was subjected to qualitative and quantitative DUS characters. Except for ligule shape all the characters showed wide diversity in this germplasm. Basal leaf sheath colour was green in majority of the accessions while few lines contain purple lines, light purple or purple colour (Table 2). Auricles were observed in most of the accessions and they were mostly colourless. Leaf ligule was in split shape in all the accessions and it was white in colour followed by light purple and purple. Flag leaf was erect in more than half of the aromatic accessions followed by semi-erect and horizontal. While semi-erect type of blade of the flag leaf was higher followed by horizontal and erect (Figure 1). In the case of panicle, heading time ranged from early to very late, main axis length was long followed by medium and very long and most of them have erect to semi-erect. Awns were seen in 188 accessions and were spread whole length followed by tip and upper half. Most of the awns were in black colour (Table 3). Panicle was well excerted in more than half of the accessions and was enclosed in two of the 556 accessions.

In spikelet (Table 4), pubescence of lemma was weak to strong in majority of the accessions, lemma colour was absent in 90 accessions, tip of lemma was in yellowish or brown in colour in more than half of the accessions and white colour stigma was dominant over other colours. Spikelet number, fertile grain number and sterile grain number in the panicle ranged from 63 to 258, 40 to 212 and 12 to 212 respectively. Five whole plant observations i.e., Vegetaive vigour, Tillering ability, Plant Height, Panicle threshability and Phenotypic acceptability were shown in Table 5. For the germplasm, Productive tillers/Plant ranged from 2 to 40, Spikelet number/plant ranged from 63 to 258, Fertile Grains/ Plant ranged from 40 to 212, Sterile grains /Plant ranged from 12 to 121, Plot Yield in gms. ranged 4 to 439 gms. and 1000 Grain weight ranged from 22.97 to 84.75 mg. Whereas quality characters ranges were Decorticated grain length, width and shape ranges from 1 to 7. Endosperm presence of amylose and Decorticated grain aroma ranged from 1 to 9 and another quality character Decorticated grain color ranges 1-5 according to PPV and FRA guidelines on rice.

Varieties differ in blade length, width, area, shape, color, angle, and pubescence. Auricles are small, paired, ear-like appendages borne on either side of the base of the blade. Culm is the jointed stem with nodes and internodes. Distinctness, Uniformity and Stability, or "DUS test" is the major component of the examination of new/existing varieties of plants. However, as the gene expression is influenced by environment, distinctness can change with the environment (Liu *et al*., 2012). In addition, the distinctness is also narrow or very less between the existing and newly developed varieties due to the repeated usage of few parent lines whose characters are widely accepted by the consumers. Considering the wide popularity and acreage of the mega varieties, random mutation strategy, treatment with chemical mutagens like EMS, was employed to identify the lines with better properties like resistance to one or more diseases, further enhancement in yield, plant-type, etc., without affecting the other accepted characteristics of the variety

Table 1: List of germplasm evaluated for DUS characters.

S. No	Accession Name	S. No	Accession Name	S. No	Accession Name	S. No	Accession Name
1	BANSPATRI -1	277	CHATIANAKI	139	KAPOOSAR	415	BASMATI 6131
2	GANGABARU	278	DHANA PRASAD-3	140	BANSPATRI-2	416	BASMATI 802
3	KALIMUCHH	279	GANGA BALLI	141	CHINIKAPOOR	417	BASMATI 6141 -2
4	MOONGPHALI B	280	HEERAKANI-2	142	BAGMUCHH	418	BASMATI 381
5	DINDLI	281	JAIPULLA	143	KALIKAMOD	419	BAS SUFAID 187
6	DHURIAWA	282	KH SAKANI	144	CHHATRI	420	BAS SURKH 112
7	MODAK B	283	KARPURA BASA	145	ATMASHITAL	421	BASMATI 11
8	KANKJEER A	284	LEELA BATI	146	SHAMJIRA	422	BASMATI 127A
9	DHANIA - B2	285	TULSI PHOOLA	147	JIRADHAN	423	BASMATI 138
10	RAU 3061	286	SARAGA DHULLI	148	DHAWARA SAWA	424	BASMATI 93 -2
11	RAU 3055	287	MUIGAI	149	CHINOOR	425	HBC 46
12	RAU 3036	288	AYEPYAUNG	150	SUKALAPHOL	426	BASMATI -3
13	RAU 3048	289	BINIRHEN	151	ELAYACHI	427	VALLABH BASMATI 22
14	RAU 3041 -1	290	BONGCAY-1	152	GANGA BARU	428	VALLABH BASMATI 24

15	RAU 3043	291	BONGCAY -2	153	JAI GUNDI	429	HARYANA BASMATI -1
16	RAU 3044	292	C-4-63-G -1	154	SHYAM JIRA	430	PANT SUGANDH DHAN - 15
17	MAGURAPHULLA	293	C-4-63-G -2	155	ANTERVED	431	UPRI 93-101
18	NANU -1	294	D-66	156	TULSI PRASAD	432	KHAZIA DHAN
19	DEULABHOG	295	DAW LEUANG	157	KUBRIMOHAR	433	LAL BASMATI
20	TULASIPHULLA	296	DU THOM THAI BINH HAI PHONG	158	BHAINSA PUNCHHI	434	BASMATI 386 -1
21	GANJEIKALLI-1	297	GUINATA	159	LOKTIMACHI(Muchhi)	435	SEOND BASMATI
22	DHOIABANKOI	298	HUNG-MI-HSIANG-MA-TSAN -1	160	KERAGUL	436	SANWAL BASMATI
23	NALIDHAN	299	HUNG-MI-HSIANG-MA-TSAN -2	161	SAMUDRATAN	437	PUSA BASMATI 1121 -1
24	BARIKUNJA	300	HAWM LAO	162	FUNDRI	438	RAJENDRA BASMATI
25	JALA	301	HAWN JAN	163	JAYPHOOL	439	IMPROVED PUSA BASMATI
26	BHATAGUNDI	302	KHAOJAO HAWM	164	LALSUMBHOG	440	PUSA 44
27	SEETAKESHARI	303	KHAO MALI	165	NAWAB BHOG	441	PUSA 834
28	BANSADHAN	304	KALIMOOCH	166	JAYASHANKAR	442	PUSA BASMATI -1
29	BASUABHAVA	305	LUA NHE	167	SHRIKAMAL	443	INDIRA SUGANDH DHAN
30	ATHMA SHITAL-1	306	LUA NHE DEN	168	MAHARAJI	444	PUSA 677
31	PARIJATAK	307	LONGKU LABAT	169	TILKASTURI	445	PUSA BASMATI - 6
32	MAHULAKUCHI	308	MILFOR 6	170	VISHNU BHOG	446	PUSA SUGANDH - 5
33	THAKURA BHOG	309	MAJOR DJAMBON	171	DUBRAJ-1	447	IET 21959 (PUSA 1509-03-1-7-2)
34	KARPURA KALLI	310	NIAW PING	172	SHITAL BHOG	448	IET 21960 (1509-03-3-9-5)
35	SEETABHOG	311	NEPALI JOHA	173	SAMUNDCHINI	449	IET 21953 (UPR 3506-7-1-1)
36	JUHIBENGAL -A	312	NIIAW HAWM	174	TEDESI	450	IET 22289 (1592-06-05-2)
37	SONACHOOR	313	PADI BAWANG	175	MAIDUBRAJ	451	1601-105-1-46-1-1
38	GANGA BARUD	314	POPOT	176	BANTHA PHOOL-3	452	IET 22290 (1612-07-6-5)
39	ATHMA SHITAL-2	315	XIANG GENG LI	177	RNR -2465 (SUGANDA SAMBA)	453	IET 22778 (1609-09-4-3)
40	AMRIT BHOG-1	316	CALROSE 76	178	SUMATI	454	IET 22778(1596-121-148-24-11)
41	JIRAPHOOL	317	DELLA	179	CHITTI MUTYALU(SMALL GRAIN)	455	P 1568 -05-6-4-154
42	RAU 3056-1	318	DULHA BHOG	180	CHITTI MUTYALU(BOLD GRAIN)	456	P 1568 -05-6-4-153
43	KANKJEER	319	HBC 30	181	GODAVARI ISUKALU	457	RNR-2354
44	RAU 3073	320	MIL GROSA	182	KRISHNA KAMOD-1	458	BASMATI 386 -2
45	RAU 3076	321	IET 12017	183	PANKHALI - 203	459	TYPE 3
46	KB-13	322	MALAGKIT SUNG SONG	184	GR-101	460	KASTURI -1
47	RAU 3079	323	KALIA	185	GR-102	461	HARYANA BASMATI -2
48	RAU - 3043	324	VALLABH BASMATI 21	186	GR- 104	462	PUNJAB BASMATI
49	RAU 3056-2	325	CSR - 30	187	GAR - 1	463	MAHI SUNGANDHA
50	AMBEMOHAR -157	326	PUSA SUGANDH -2	188	GR -6	464	PUSA BASMATI -2
51	KANIKABHOG	327	PANT SUGANDH DHAN - 17	189	NWGR -3042	465	PUSA BASMATI 1121 -2
52	HEERAKANI-1	328	PANT SUGANDH DHAN - 21	190	NWGR -3045	466	MUGADSUGANDH
53	BASNA PARIJAT	329	TAPOVAN BASMATI	191	NARMADA	467	YAMINI (BASMATI CSR 30)
54	JALAKA	330	BASMATI 385 -1	192	LECTIMACHI	468	VASUMATI
55	KALAJUVAN	331	BASMATI 370 -1	193	Sheetal kani	469	SUGANDHA MATI -1
56	LECTIMANCHI -A	332	PUNJAB BASMATI - 2	194	R-1498-778-388-1-1	470	HBC- 45
57	PIMPUDIBASA	333	SUPER BASMATI	195	BADSHAHA	471	HBC- 85 -1
58	KARPURA KRANTI	334	RYT 3267	196	KANAK JEERA	472	HBC -47
59	CHHABISWA	335	RYT 3275	197	DHANIYA-2	473	IMPROVED PUSA BASMATI-1
60	KHEERSAI	336	PUNJAB MEHEK - 1	198	RAU 3041-2	474	HBC 34
61	IGSR -3-1-5	337	RANBIR BASMATI -1	199	SHABANMASI	475	HBC- 85 -2
62	IGSR 2-1-6	338	BASMATI 564	200	BISHNU BHOGA-1	476	HBC 98
63	NDR IRRI 67	339	CHIMBALATE BASMATI	201	TATUN BHOG	477	IET 12014
64	GANJEKALLI	340	BASMATI 370 -2	202	Kalajeera	478	HKR 240 IET 12021
65	NEELABATI-1	341	BASMATI 217	203	IGSR-2-1-46-2	479	HARYANA GAURAV
66	HANKESH	342	RANBIR BASMATI -2	204	RB 2816	480	IET 12601
67	BASMATI -1	343	TARAORI BASMATI	205	GANJEIKALLI-2	481	PUSA 169
68	KALANAMAK-1	344	BASMATI 136	206	KANAK JEER-3	482	DUDHSAR

69	AS GPC - 12	345	BASMATI 93 -1	207	AMRIT BHOG-2	483	KUSUMA
70	AS GPC - 14	346	BASMATI BAHAR	208	NEELABATI-2	484	MUGAD SUGANDHA
71	AS GPC - 19	347	BASMATI 106 -12 -1	209	BADSHAH BHOG-2	485	SUGANDHA MATI -2
72	AS GPC -38	348	BASMATI 6129 -1	210	NANU-2	486	KASTURI -2
73	BAYASA BHOG	349	BASMATI 6129 -2	211	CHITTI MUTYALU	487	UPRI 93-63-2
74	DHUBA MUA	350	BASMATI SUFAID 106	212	DUBRAJ-2	488	UPR 3375-8-1-1
75	DUDAGA	351	BAS KAMON	213	RANDHUNI PAGAL-1	489	UPR 2886-10-1-2
76	DUDH NAG	352	BASMATI 397	214	TULASI KANTHI	490	UPR 3565-10-1-1
77	GANJO	353	BAS SURKH 89-15	215	TULASI GHANTI	491	UPR 2828-7-2-1
78	RAJINI 2	354	KHAD JOO HAWN	216	JGL 11609	492	UPR 3519-18-1-1
79	TULSI BHOG	355	BASMATI SUFAID 100	217	NDR 8022	493	UPR 3606-15-1-1
80	RAJA BHOG	356	BASMATI 213 -1	218	R-1498-747-358-2-1	494	UPR 3429-2-1-1
81	TENDU PHOOL	357	BASMATI 242	219	PDKB SHRIRAM	495	RP 36444-1-9-5-5
82	SONTH	358	BASMATI 124-10	220	KHASAKANI	496	IET 13548
83	R-1462-243-100-7-1-1	359	BASMATI SATHI	221	RRB 2005-1	497	IET 14131
84	IGSR-2-1-46-1	360	BASMATI 334	222	HUR -ASG-MJ 72505	498	IET 15392
85	ADAM CHINI B	361	BASMATI KOTA	223	R 1432-261-105-2-1-2	499	IET 15831
86	KANAK JEER-1	362	BASMATI 443	224	NDR 8399-2	500	IET 15832
87	DHANIYA-1	363	BASMATI MEHTRAH	225	DHANA PRASAD-1	501	IET 15833
88	LOUNG CHOOSI A	364	BASMATI -427	226	NDR 8497-2	502	IET 15834
89	LOUNG CHOOSI B	365	BASMATI JAMUNA	227	PTB 13	503	IET 15835
90	KANAK JEER-2	366	BASMATI 122	228	ACHARAMATI-1	504	IET 16325
91	BANTHA PHOOL-1	367	BASMATI 5888	229	AKITIKARI	505	IET 17025
92	BANTHA PHOOL-2	368	GEETANJALI	230	JEERA KASALA	506	IET 16327
93	CHAMPARAN BASMATI 1	369	PUSA SUGANDH -2	231	RD 1205	507	IET 17278
94	CHAMPARAN BASMATI 2	370	PUSA SUGANDH -5	232	MUSKAN	508	IET 17281
95	CHAMPARAN BASMATI 3	371	PAKISTAN BASMATI	233	MAYUR KRANTI	509	IET 18033
96	CHAMPARAN BASMATI 4	372	R 1475-468-564-2-1	234	TULSI MANJARI-2	510	IET 18990
97	BOGA JOHA	373	KARNAL LOCAL	235	KHASKANI	511	IET 22787
98	BORA DHAN 1	374	BASMATI KAMON	236	MOHAN BHOG	512	IET 22788
99	DUBRAJ (RAIPUR)	375	PUSA SUGANDH -3	237	RANDHUNI PAGAL-2	513	IET 21665
100	GOVIND BHOG-1	376	PUSA BASMATI 6	238	DANAGURI	514	BAS 837
101	KAMOD	377	BASMATI RAVI	239	KALAMUNIYA	515	BASMATI NEPAL
102	KAMOD 119	378	BASMATI 37	240	BADSHA BHOG	516	KDML 105
103	KON JOHA 1	379	BASMATI TALL	241	BR-34	517	DOMSIAH
104	KOLA JOHA 1	380	BASMATI NAROT 439	242	KEDA GAURI	518	JASMINE SCENTED
105	KON BOGI JOHA	381	BASMATI 134	243	GAYASU	519	HAWM MALI
106	KHORIKA JOHA	382	BASMATI 372 -1	244	TULASIFUL	520	IR 841 - 85 - 1-1-2
107	KRISHNA JOHA	383	BASMATI TYPE 3	245	GOPAL BHOG	521	JAO MALI
108	KAMINI JOHA	384	BASMATI -2	246	DUDHKHASA	522	BASMATI LAMO
109	KOLA JOHA	385	BASMATI MAHON 381	247	KOLIJOHA	523	CHANAN
110	KALI KAMOD	386	BASMATI 410	248	KRISHNA KAMOD-2	524	JJ 92
111	MONGARA PHOOL	387	BASMATI 377	249	BEGAMI T 1	525	IR 60164 - 122- 3-2-1
112	TARUR BOGA	388	BASMATI 405	250	BEGAMI S-7	526	IR 62871 -138-5
113	Kalijira 8-1	389	BASMAT 140	251	BEGAMI 2-8	527	IR 62871 - 549-3-1
114	RAMBHOG B	390	BASMATI 502	252	BEGAMI -41	528	IR 62871-549-3-5
115	CHINOOR B	391	BASMATI 370 -3	253	KALIMOOCH (RAIPUR)	529	IR 62871-549-3-6
116	KALANAMAK(NICHI)	392	BASMATI 370 -4	254	KARPUR BHOG	530	IR 62873-224-1-6
117	DHANA PRASAD-2	393	BASMATI 6141 -1	255	DANGAR CHUDI	531	IR 62873-227-1-16
118	KALANAMAK-2	394	BASMATI MAHAN	256	RAMACH ANDRA BOITA	532	IR 62873-227-2-5
119	KALANAMAK-3	395	BASMATI 1-1-A	257	RATAN CHUDI	533	IR 62873-238-2-3
120	JEERAGA SAMBA	396	BASMATI 442	258	KALA BHUTIA	534	IR 62873-244-2-2
121	GANDHA SALA	397	BASMATI 107	259	BAHURUPI	535	IR 62873-244-2-5
122	CO ACC 167 (T 167)	398	BASMATI 208	260	NAGRA	536	BARAH
123	CB 06550	399	BASMATI 213 -2	261	RANI KAJAL	537	HASAN SERAI
124	TILAK CHANDAN-1	400	BASMATI 372 -2	262	MACCHA KANTA	538	KHAO DAWK MALI 105
125	BINDLI	401	BASMATI 106 -12 -2	263	HALDI CHUDI	539	IET 12016
126	HANSRAJ	402	BASMATI 376	264	KOLIHA	540	UPRBS 98/69-7-2-2
127	TILAK CHANDAN-2	403	Basmati 388	265	HARI SHANKAR	541	IR 74717-3-3-1-3
128	BINDALI	404	BASMATI 433	266	BASTUL	542	IR 74718-1-1-3-2
129	IMPROVED SARBATI	405	BASMATI T - 370	267	LAL GORI	543	IR 74719-23-3-2-2
130	LALDHAN	406	BASMATI SURKH 161	268	GOVIND BHOG-3	544	IR 74720-13-1-2-2
131	KALANAMAK-4	407	BASMATI 140	269	LILAVATI	545	IR 74721-47-3-2-2

132	SATHI	408	BASMATI 150	270	KERALA SUNDARI	546	IR 74724-82-2-2-3
133	UPRI 1840 - 31-1-1-16	409	BASMATI 385 -2	271	PKV HMT	547	IR 74725-115-3-3-3
134	GOVIND BHOG-2	410	BASMATI 5836	272	PKV MAKARAND	548	IR 74728-134-1-1-3
135	KADAM PHOOL	411	BASMATI 385	273	RAJENDRA SWETHA	549	IR 75251-34-1-2-2
136	TULSI MANJARI-1	412	BASMATI 5853	274	ACHARAMATI-2	550	IR 75428-6-3
137	BADSHAH BHOG-1	413	BASMATI 5854	275	BISHNU BHOGA-2	551	RT 1117
138	KARIGILAS	414	BASMATI 5874	276	BASMATI BHOGA	552	RT 1121

Table 2: DUS characteristics of stem and leaf

S. No.	DUS Characteristics	State	Observation
1	Basal leaf sheath colour	Green	539
		Purple lines	6
		Light purple	3
		Purple	4
2	Pubescence of Blade Surface	Glabrous	389
		Intermediate	91
		Pubescent	70
3	Auricles	Absent	6
		Present	546
4	Auricle colour	Colourless	532
		Light purple	11
		Purple	3
5	Ligule shape	Truncate	0
		Acute	0
		Split	549
6	Ligule colour	White	441
		Light purple	103
		Purple	5
7	Flag leaf attitude	Erect	313
		Semi-erect	143
		Horizontal	90
		Drooping	2
8	Flag leaf attitude of blade (Late Observation)	Erect	155
		Semi-erect	207
		Horizontal	187
		Deflexed	3
9	Stem length	Very short	138
		Short	109
		Medium	143
		Long	142
		Very long	20
10	Stem anthocyanin colouration of nodes	Absent	545
		Present	4

Table 3: DUS characteristics of panicle

S. No.	DUS Characteristics	State	Observation
1	Heading time	Early	67
		Medium	189
		Late	153
		Very late	138
2	Length of main axis	Very short	9
		Short	11
		Medium	132
		Long	291
		Very long	109
3	Curvature of main axis	Straight	188
		Semi straight	161
		Deflexed	116
		Drooping	87
4	Awns	Present	188
		Yellowish White	35
		Brown	37

		Light purple	2
		Purple	4
		Black	110
		Tip only	62
		Upper half only	20
		Whole length	106
5	Branches	Erect	182
		Erect to semi-erect	1
		Semi erect	179
		Semi-erect spreading	102
		spreading	13
6	Exsertion	Enclosed	2
		Partly	83
		Just	1
		moderate	127
		Well	339

Table 4: DUS characteristics of spikelet

S.No	DUS Characteristics	State	Observation
1	Pubescence of lemma	Absent	3
		Weak	192
		Medium	154
		Strong	197
		Very strong	2
2	Lemma colour	Absent	90
		Weak	222
		Medium	144
		Strong	87
		Very strong	5
3	Stigma colour	White	518
		Light green	3
		Yellow	1
		Light purple	1
		Purple	25
4	Colour of tip of lemma	White	10
		Yellowish	205
		Brown	197
		Red	2
		Purple	54
		Black	81
5	Sterile lemma colour	Straw	61
		Gold	11
		Red	1
		Purple	3

Table 5: DUS characteristics of Whole plant

1	Vegetative vigour	Extra vigorous	172
		Vigorous	269
		Normal	107
		Weak	2
		Very week	1
2	Tillering ability	Very high (>25)	38
		Good (20-25)	444
		Medium (10-19)	63
		Low (5-9)	2
		Very low (<5)	1
3	Plant height	Semi-dwarf (90-110 cm)	160
		Intermediate(110-130cm)	269
		Tall (>130cm)	121
4	Panicle threshability	Difficult (<1%)	4
		Moderately difficult (1-5%)	57

		Intermediate (6-25%)	261
		Loose (26-50%)	195
		Easy (51-100%)	30
5	Phenotypic Acceptability	Excellent	115
		Good	201
		Fair	215
		Poor	16
		Unacceptable	1

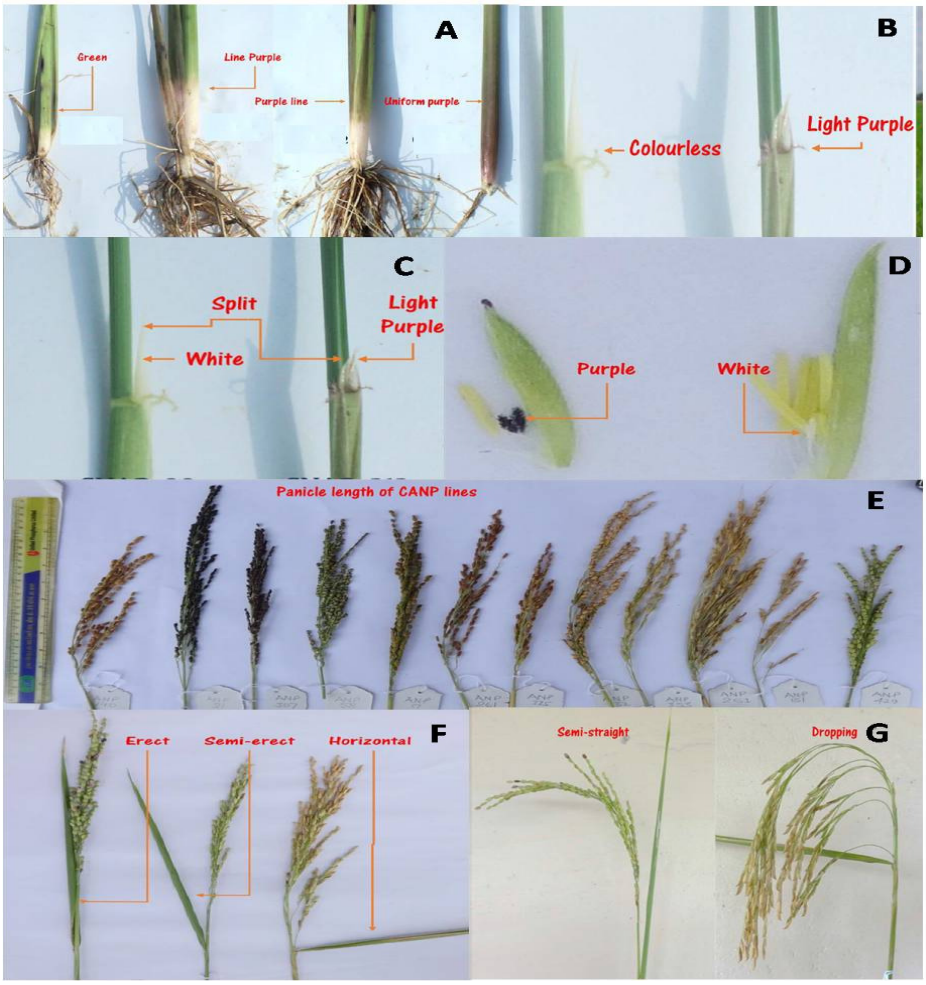

Fig. 1: A)Basal leaf sheath colour B)Auricle colour C)Ligule colour D)Stigma colour E)Panicle length variation F)Flag leaf attitude G) Panicle curvature

Acknowledgements

The authors acknowledge the Department of Biotechnology (DBT), New Delhi, India for providing funds for carrying out the research work. Sathish Kumar P Thank Dr. P. Sudhakar and Dr. A. Krishna Satya, Department of Biotechnology, Acharya Nagarjuna University (ANU), Guntur, India for the Ph.D. registration.

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