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Conglomeration of farmers' varieties of rice in Madhya Pradesh using DUS guideline by PPV&FR

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Abstract

High yield potential rice varieties are not fit for daily consumption as compare to farmers' varieties. Farmer's varieties are also important source of genes for various biotic and abiotic stress resistance mechanism and quality traits. In the light of above information, an experiment was conducted on 70 farmers' varieties at College of Agriculture, JNKVV, Jabalpur. The aim of the experiment was to systemic study and characterization of farmers' varieties based on twenty six morphological traits. Most of the traits were polymorphic except presence of leaf auricles, presence of leaf collar, presence of leaf ligule, shape of ligule and presence of secondary branching. Purple ligules and intensity of leaf sheath anthocyanin coloration was found very strong in only a variety *i.e.*, Luchai-3. Similarly, a single line 'Jarga' showed yellowish brown awn and another single line 'Nawari-2' showed reddish brown awn. According to DUS guideline some of qualitative characters are considered as candidate traits or morphological markers which are used as important tool in varietal identification process, can be utilized for further candidate variety development also. The line namely 'Dharudhan' showed horizontal type of flag leaf attitude of blade, this characteristics are rarely modified by the environment so crop breeders usually selectively breed for an horizontal type of flag leaf attitude of blade, for reasons of maximizing crop grain production and harvest. This investigation will be useful for breeders, researchers and farmers for further use in varietal improvement to meet demands of beneficial genes.

Keywords: characterization, farmer's varieties, rice, pigmentation

Introduction

Rice is self pollinated, semi-aquatic annual grass which serves as the staple food throughout much of the world. It is grown under a wide range of climatic and geographical conditions on all five continents (Bajwa *et al.*, 2016) [2]. Among all the Asian countries India is home to wide range of rice cultivars, landraces and many lesser known varieties that have been under cultivation since ages by farmers as well as local entrepreneurs (Pachauri *et al.*, 2013) [8].

A farmer's variety is a wild relative /land race / a primitive variety which has been traditionally cultivated and evolved by the farmers in their fields (PPV&FR Act 2001). Farmer's varieties have been known by their local known dialect names and hence no or not many records of the hereditary nature and foundation of such variety are accessible. Key point of plant breeding lies in the creation of genetic variation which is a pre requisite for crop improvement (Rao *et al.*, 2013) [10]. Hence Farmers' varieties/wild relatives have great significance in the crop improvement programme due to presence of important genes for various pest and diseases, stresses tolerance and mostly quality traits. In present situation, irreversible increase in population is further putting pressure on the limited resources and demanded for new sources of genetic variation to fulfill the further demand. Therefore, it is necessary to conserve these farmers' varieties and wild relatives for future use.

Many of the quality rice varieties have been developed in India from the traditional varieties but high yield potential varieties replaced these varieties throughout the time. It is well observed and found that high yield potential varieties are not fit for daily consumption as compare to farmer's varieties or landraces. Systemic study and characterization of such primitive landraces or farmer's varieties is not only important for utilizing the appropriate trait based donors, but also essential in the present area for protecting the unique rice. According to Parikh, 2012 [9], this type of study also provides huge information on the distances among farmer's varieties and distinctness among same named landraces in different niche environment. So the present study was conducted in the light of above context, to characterize different morphological attributes of seventy farmer's varieties of rice and identify the diversity available in the collection.

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Material and Method

The field experiment was conducted at Seed Breeding Farm Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur, Madhya Pradesh, India. Seventy farmer's varieties of rice collected from various places of Madhya Pradesh were sown separately in raised bed nursery. Twenty five days old seedling was transplanted in randomized complete block design thrice. Each block comprised of four rows having three meter length

at spacing of 20 cm between rows and 15 cm between plants. All the mandatory precautions were taken to maintain uniform plant population of every genotype per replication. Observations were taken according to National Test Guideline for DUS test in rice which was developed by Directorate of Rice Research, Rajendranagar, Hyderabad with some of modifications. Qualitative characters which are studied along with their descriptors are presented in the table 1.

Table 1: Qualitative traits along with descriptors and stage of observation

S.N.	Qualitative Traits	Descriptors	Stage of Observation
1	Basal leaf : Sheath colour	Green (1), Light Purple (2), Purple line (3), Uniform Purple (4)	Booting
2	Leaf : anthocyanin colouration	Absent (1), Present (9)	Booting
3	Leaf : distribution of anthocyanin colouration	On tips only (1), On margins only (2), In blotches only (3), uniform (4)	Booting
4	Leaf sheath : anthocyanin colouration	Absent (1), Present (9)	Booting
5	Leaf sheath : intensity of anthocyanin colouration	Very weak (1), Weak (3), Medium (5), Strong (7), Very strong (9)	Booting
6	Leaf : auricles	Absent (1), Present (9)	Booting
7	Leaf : anthocyanin colouration of auricles	Colourless (1), Light Purple (2), Purple (3)	Booting
8	Leaf: collar	Absent (1), Present (9)	Booting
9	Leaf: anthocyanin colouration of collar	Absent (1), Present (9)	Booting
10	Leaf : ligule	Absent (1), Present (9)	Booting
11	Leaf : shape of ligule	Truncate (1), Acute (2), Split (3)	Booting
12	Leaf : colour of ligule	White (1), Light Purple (2), Purple (3)	Booting
13	Flag leaf : attitude of blade (early observation)	Erect (1), Semi-erect (3), Horizontal (5), Drooping (7)	Beginning of anthesis
14	Lemma : anthocyanin colouration of keel	Absent (1), Weak (3), Medium (5), Strong (7), Very Strong (9)	Half Anthesis
15	Lemma : anthocyanin colouration of area below apex	Absent (1), Weak (3), Medium (5), Strong (7), Very Strong (9)	Half Anthesis
16	Lemma : anthocyanin colouration of apex	Absent (1), Weak (3), Medium (5), Strong (7), Very Strong (9)	Half Anthesis
17	Spikelet : colour of stigma	White (1), Light green (2), Yellow (3), Light purple (4), Purple (5)	Half Anthesis
18	Spikelet : colour of tip of lemma	White (1), Yellowish (2), Brown (3), Red (4), Purple (5), Black (6)	Half Anthesis
19	Panicle : curvature of main axis	Straight (1), Semi-straight (3), Deflexed (5), Drooping (7)	Terminal Spikelet Ripened
20	Lemma and Palea : colour	Straw (1), Gold and Gold furrows on straw background (2), Brown spots on straw(3), Brown furrows on straw (4), Brown(tawny) (5), Reddish to light purple (6), Purple spots/furrows on straw (7), Purple (8), Black (9)	Terminal Spikelet Ripened
21	Panicle: awns	Absent (1), Present (9)	Terminal Spikelet Ripened
22	Panicle : colour of awns	Yellowish white (1), Yellowish brown (2), Brown (3), Reddish Brown (4), Light Red (5), Red (6), Light Purple (7), Purple (8), Black (9)	Terminal Spikelet Ripened
23	Panicle : distributions of awns	Tip only (1), Upper Half only (3), Whole length (5)	Terminal Spikelet Ripened
24	Panicle : presence of secondary branching	Absent (1), Present (9)	Terminal Spikelet Ripened
25	Panicle : secondary branching	Weak (1), Clustered (2), Strong (3)	Terminal Spikelet Ripened
26	Panicle : attitude of branches	Erect (1), Erect to semi-erect (3), Semi-erect (5), Semi-erect to spreading (7), Spreading (9)	Terminal Spikelet Ripened

Result and Discussion

Non polymorphic traits

In the present investigation seventy farmer's varieties were characterized by using twenty six qualitative characters as per DUS norms. Out of these twenty six characteristics, five qualitative traits were non polymorphic i.e., presence of leaf auricles, presence of leaf collar, presence of leaf ligule, shape of ligule and presence of secondary branching. Sinha and Mishra (2013) [12], Gour *et al.* (2018) [5] and Kujur *et al.* (2019) [7] also reported those traits to non polymorphic.

Polymorphic traits

Remaining 22 qualitative traits were polymorphic traits which showed variability in different varieties under study. Frequency distribution of different traits is also represented in

this research study (Figure Plate 1).

Characterization of leaf characters revealed that of 70 farmer's varieties (Table 2) only 5 varieties showed purple line type, 3 varieties showed light purple type and 3 varieties showed uniform purple type basal leaf sheath colour. During the search of this colour factor we found that the purple pigmentation of rice plants had been lost during the process of evolution and genotypes and the green types were evolved ones. It is a few supporting concept but better study is required (Gour *et al.*, 2019 [6] and Parikh *et al.*, 2012 [9]).

Whereas, only 9 farmer's varieties out of seventy have showed the presence of leaf anthocyanin coloration and anthocyanin coloration distributed on margins only. This type of purple margin leaf blade traits can be better utilized for developing rice varieties with tolerant to leaf surface related

insects and diseases (Ahmed *et al.*, 2016) [1]. Among 70 varieties studied only 8 varieties showed presence of leaf sheath anthocyanin colouration and intensity of leaf sheath anthocyanin colouration was weak for 2 varieties, medium for 1, strong for 4 and very strong for only 1 variety *i.e.* Luchai-3. Seventy farmer's varieties are categorized into three categories based on trait leaf: anthocyanin colouration of auricles namely colourless, light purple, purple which comprised of sixty seven, two and one varieties, respectively. Whereas, 3 out of 70 varieties recorded presence of collar anthocyanin colouration. The ligules expressed light purple color for 3 lines and purple for only one line 'Luchai-3'. Here it can be observed that a specific line 'Luchai-3' is showing uniqueness regarding such coloration point of view. According to DUS guideline this type of uniqueness can be utilized for further candidate variety development. Among seventy farmers' varieties, flag leaf attitude of blade was observed at early stage *i.e.* beginning of anthesis and 23 lines showed erect type, 46 lines showed semi-erect type, a single line 'Dharudhan' showed horizontal type of flag leaf attitude of blade. According to Fonseca *et al.* (2002) [4], the angles of the flag leaf are characteristics inherent to the cultivar and are rarely modified by the environment. In case of lemma, anthocyanin colouration of keel was categorized into 5 categories namely absent, weak, medium, strong and very strong with each group having 54, 7, 4, 3 and 2 lines, respectively. Similarly in case of anthocyanin colouration of area below apex lines categorized into categories absent, weak, medium, strong and very strong which comprised of 62, 1, 2, 3 and 2 lines out of seventy farmer's varieties but anthocyanin colouration of apex were found absent in 48 lines, weak in 2, medium 9, strong 9 and very strong. For colour of stigma 44 lines shown white, 6 were of light green, 2 were of light purple and 18 were of purple colour. Similar result found by the Gour *et al.* (2019) [6]

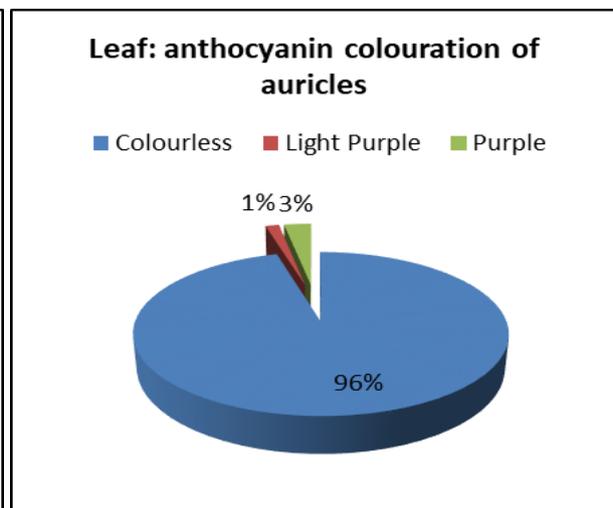
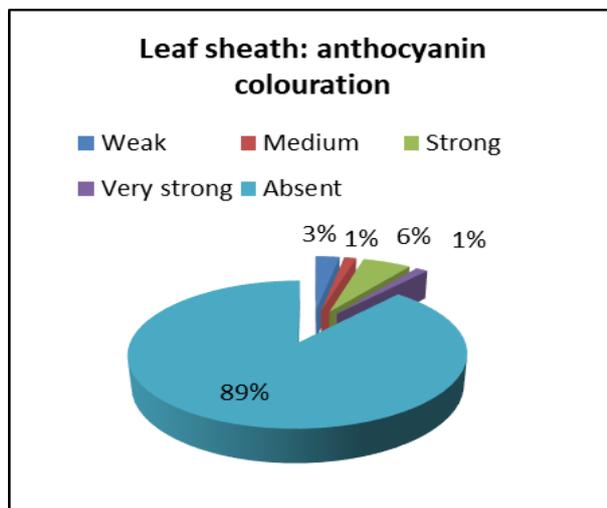
and Parikh *et al.* (2012) [9] For the character panicle : curvature of main axis, 5 lines were of straight, 33 lines were of semi straight, 24 lines were of deflexed and 8 lines were of drooping type. Colour of tip of lemma was found yellow in 51 lines, Brown in 13 and white in 6 lines. For the character lemma and palea colour among 70 lines studied, 43 lines were recorded under straw category, 16 lines under gold and gold furrows on straw background category, 2 lines under brown spots on straw category, 6 brown furrows on straw category, 2 lines under brown (tawny) category and only 1 line 'Tendhaniya dhan' under black category. In the present collection most of the accessions were awnless (Figure plate 2). Awns were found only in 10 out of 70 farmer's varieties, out of these 10 lines, 8 showed yellowish white, 1 line 'Jarga' showed yellowish brown and 1 line 'Nawari-2' showed reddish brown. Whereas awn distributed on tip only in 5 lines, upper half only in 3 line and whole length type of distribution in 2 lines. Gour *et al.* (2019) [6] stated that awns appear to be equipped with physiological and biological buffers that enable plant to adjust according to changes in the environment although many farmers consider it a nuisance during milling. All the 70 lines exhibited secondary branching, among these 7 were of weak, 18 were of clustered and 45 were of strong type secondary branching. The panicle attitude of branching was found erect in 8 lines, erect to semi erect in 27 lines, semi erect in 15 lines, semi erect to spreading in 14 lines and spreading in 6 lines. Crop breeders usually selectively breed for an erect panicle type; spreading panicle type is actively selected against, for reasons of maximizing crop grain production and harvest. Hence the genotypes with compact panicle types can be used in breeding programmes for the purpose of increasing rice production. Similar studies was concluded by Rao *et al.* (2013) [10], Chakrabarty *et al.* (2012) [3] and Gour *et al.*, (2019) [6].

Table 2: Characterization table of farmers' varieties as per DUS guidelines

S.N.	Variety	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	z	
1	Jhuri	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	5	2	2	1	-	-	9	3	5	
2	Luchai-4	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	7	2	1	1	-	-	9	2	5	
3	Usha	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	9	1	5	2	1	1	-	-	9	3	5	
4	Rameshwar	1	1	-	1	-	9	1	9	1	9	3	1	1	9	9	5	5	5	3	3	1	-	-	9	3	1	
5	Jamunsurkhi	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	5	3	5	1	-	-	9	2	3	
6	Culture	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	1	-	-	9	3	9	
7	Luchai-1	1	1	-	1	-	9	1	9	1	9	3	1	1	3	5	1	1	3	2	1	1	-	-	9	2	5	
8	Lohandi-1	3	1	-	1	-	9	1	9	1	9	3	1	1	1	1	7	5	1	1	1	1	-	-	9	1	5	
9	Lal Dhan	1	1	-	1	-	9	1	9	1	9	3	1	1	3	1	5	5	5	3	4	1	-	-	9	2	9	
10	Nawari-1	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	7	5	3	2	1	1	-	-	9	3	5	
11	Bhaisan	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	3	2	2	1	-	-	9	2	5	
12	Luchai-2	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	2	1	-	-	9	2	1	
13	Luchai-3	4	9	2	9	9	9	1	9	1	9	3	3	1	1	1	7	5	3	2	1	1	-	-	9	2	1	
14	Gurmatiya	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	5	5	3	2	1	1	-	-	9	3	5	
15	Nawari-2	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	5	2	1	9	4	3	9	2	7	
16	Kshatriya	3	1	-	1	-	9	1	9	1	9	3	1	1	1	1	7	5	3	1	1	1	-	-	9	2	9	
17	Faram	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	3	5	1	-	-	9	2	1	
18	Kariya parvat	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	5	2	2	1	-	-	9	3	3	
19	Karonda Bhudh	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	2	7	2	1	1	-	-	9	3	3	
20	Tharribhag	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	2	3	2	2	1	-	-	9	3	5	
21	Basmati Purani	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	2	1	9	1	5	9	2	3	
22	Tinpakhia	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	3	2	1	1	-	-	9	2	5	
23	Butnagar	4	9	2	9	7	9	2	9	9	9	3	1	3	1	1	5	5	3	2	1	1	-	-	9	2	3	
24	Methichoor	2	9	2	9	3	9	1	9	1	9	3	1	1	1	9	9	9	5	1	2	2	1	-	-	9	3	1
25	Bagri	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	1	3	3	4	1	-	-	9	2	3
26	Bharaphool	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	7	5	5	2	1	9	1	3	9	2	3	
27	Jeeraphool	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	1	5	2	1	1	-	-	9	3	3

28	Nadwal	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	7	2	1	1	-	-	9	3	5
29	Hanskana	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	7	2	1	9	1	1	9	2	5
30	Doodh Newari Choupal	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	7	2	2	9	1	1	9	3	3
31	Lal Luchai Rosar	3	9	2	9	5	9	1	9	1	9	3	2	3	5	5	5	5	1	1	1	1	-	-	9	2	1
32	Karanphool	3	9	2	9	7	9	3	9	9	9	3	2	1	1	1	5	4	3	2	2	1	-	-	9	2	3
33	Jarga	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	9	2	3	9	2	3
34	Sinduri Mado	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	1	-	-	9	2	5
35	Dihula Kala	1	1	-	1	-	9	1	9	1	9	3	1	1	3	3	3	1	1	2	2	1	-	-	9	2	3
36	Sonkharchi	2	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	2	9	1	1	9	2	9
37	Bedhaar	1	1	-	1	-	9	1	9	1	9	3	1	3	3	1	3	1	7	2	3	1	-	-	9	2	7
38	Dihula	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	2	2	1	-	-	9	2	7
39	Lohandi-2	4	9	2	9	7	9	2	9	9	9	3	1	1	1	1	1	4	1	2	1	1	-	-	9	3	1
40	Kailari Papra	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	2	1	1	-	-	9	2	7
41	Lohandi Lalitpur	1	1	-	1	-	9	1	9	1	9	3	1	1	7	1	1	1	5	2	2	1	-	-	9	2	7
42	Geeta	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	2	1	-	-	9	1	3
43	Birajphool	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	3	2	2	1	-	-	9	1	3
44	Brajbhog	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	1	1	1	-	-	9	2	3
45	Kailari	2	9	2	9	3	9	1	9	1	9	3	1	3	5	1	5	5	5	2	2	1	-	-	9	1	3
46	Dhaur	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	2	1	1	-	-	9	2	7
47	Kardhana Baldev	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	2	5	2	1	1	-	-	9	3	7
48	Dhammu Dhani	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	9	1	5	9	2	7
49	Sikia Vishwanath	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	3	1	1	1	-	-	9	1	3
50	Sikia Kallu	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	3	2	1	1	-	-	9	1	3
51	Mula Pardhan	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	2	1	1	-	-	9	2	9
52	Thoothdhan	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	1	-	-	9	1	3
53	Tendhaniya dhan	1	9	2	1	-	9	1	9	1	9	3	1	3	7	7	7	5	7	3	9	1	-	-	9	2	9
54	Dhooth	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	1	-	-	9	2	3
55	Dharudhan	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	5	2	1	1	-	-	9	2	7
56	Sikiya	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	3	2	1	1	-	-	9	2	3
57	Janki	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	2	3	2	1	1	-	-	9	2	3
58	Chapti	3	9	2	9	7	9	1	9	1	9	3	2	1	1	1	7	5	5	2	1	1	-	-	9	2	5
59	Chhindphool	1	1	-	1	-	9	1	9	1	9	3	1	1	7	7	1	1	3	3	5	1	-	-	9	2	3
60	Shera 2	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	3	1	1	-	-	9	2	3
61	Janki	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	1	-	-	9	2	3
62	Ratua	1	1	-	1	-	9	1	9	1	9	3	1	3	1	1	1	1	5	3	5	1	-	-	9	2	3
63	Khuddi	1	1	-	1	-	9	1	9	1	9	3	1	1	5	7	1	1	7	1	1	1	-	-	9	2	7
64	Shrijot	1	1	-	1	-	9	1	9	1	9	3	1	1	3	1	7	5	5	3	1	1	-	-	9	3	5
65	Sellow Dhan	1	1	-	1	-	9	1	9	1	9	3	1	1	3	1	5	5	3	3	2	1	-	-	9	2	7
66	Amagaur	1	1	-	1	-	9	1	9	1	9	3	1	3	5	1	5	5	3	3	5	9	1	1	9	3	7
67	Kardhana	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	2	5	2	1	1	-	-	9	2	7
68	Ponga	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	7	5	5	2	1	1	-	-	9	3	7
69	Soorag	1	1	-	1	-	9	1	9	1	9	3	1	1	1	1	1	1	3	2	1	9	1	1	9	2	3
70	Pisso	1	1	-	1	-	9	1	9	1	9	3	1	3	3	1	1	2	3	3	5	1	-	-	9	2	1

a-Basal leaf: sheath colour, b-Leaf: anthocyanin colouration, c-Leaf: distribution of anthocyanin colouration, d- Leaf sheath: anthocyanin colouration, e-Leaf sheath: intensity of anthocyanin colouration, f-Leaf : auricles, g-Leaf: anthocyanin colouration of auricles, h-Leaf: collar, i-Leaf: anthocyanin colouration of collar, j-Leaf: ligule, k-Leaf : shape of ligule, l-Leaf : colour of ligule, m-Flag leaf : attitude of blade (early observation), n-Lemma : anthocyanin colouration of keel, o-Lemma : anthocyanin colouration of area below apex, p-Lemma : anthocyanin colouration of apex, q-Spikelet : colour of stigma, r-Panicle : curvature of main axis, s-Spikelet : colour of tip of lemma, t-Lemma and Palea : colour, u-Panicle: awns, v-Panicle : colour of awns, w- Panicle : distributions only, x- Panicle : presence of secondary branching, y- Panicle : secondary branching, z-Panicle : attitude of branches



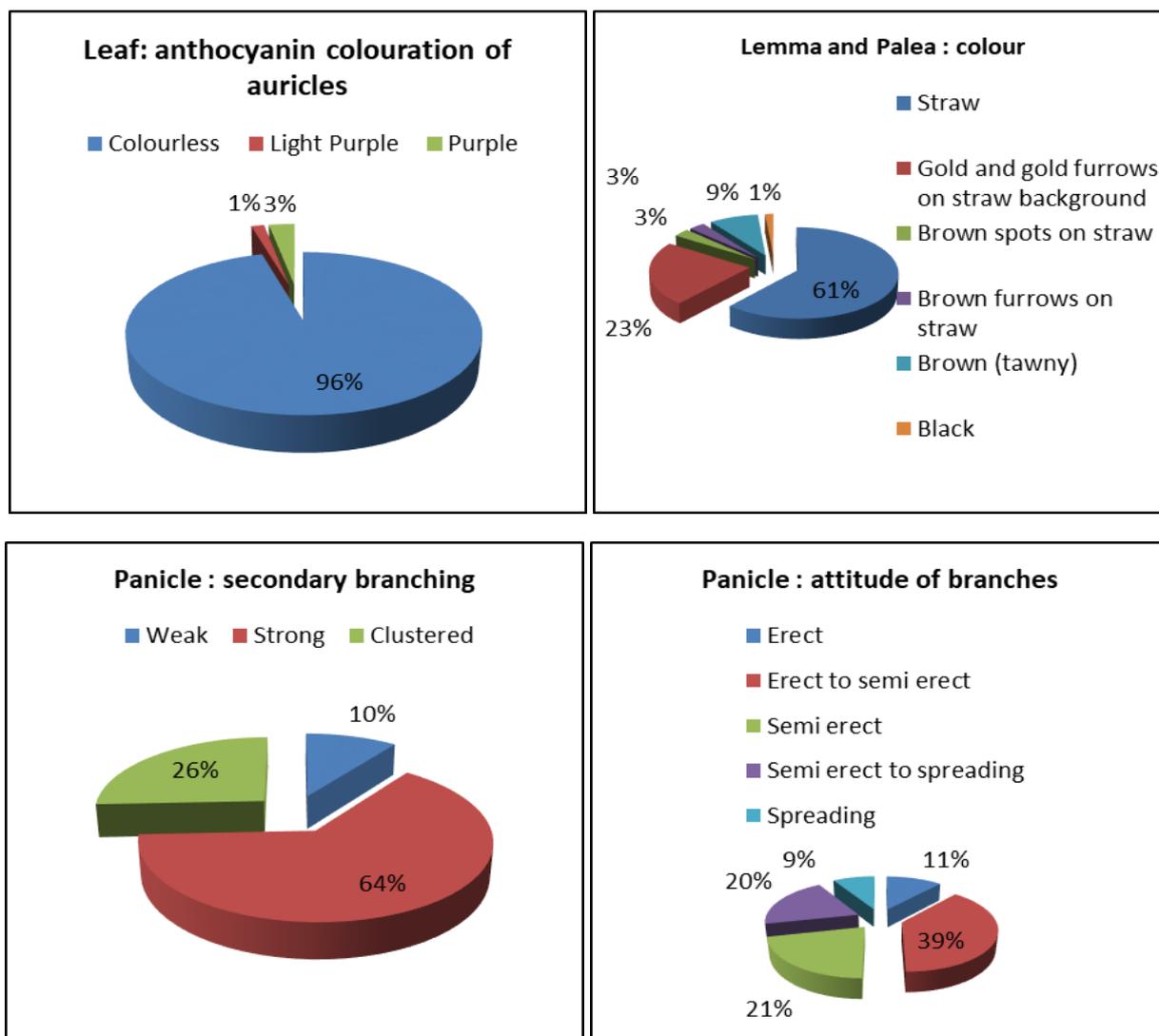


Fig Plate 1: Frequency distribution percentage of different morphological traits showing diversity. Conglomeration of Farmers’ varieties with respect to pigmentation present in various plant parts

The occurrence as well as distribution of anthocyanin pigmentation in different part of the rice plant are very variable and are a striking feature of the crop. Anthocyanin accumulation plays role in many physiological functions such as modulation of hormone response, protection from damage by UV radiation and defense response biotic and abiotic stress (Gour et al, 2018) [5]. Such morphological variants with distinct phenotypic expression and simple inheritance pattern can be used to establish linkages and for indirect selection if found associated with useful traits (Reddy et al. 2008) [11]. This feature has been the subject of interest for several earlier studies by Gour et al. (2019) [6]; Parikh et al. (2012) [9]. On the basis of pigment distribution in 13 plant parts, the entire germplasm was categorized into 23 groups, with group I, II, III, IV and V having pigmentation in 1 plant part and group XXII and XXIII with pigmentation in 8 plant parts (Table 3). Group VIII contained highest genotype (4) showing pigmentation in lemma, anthocyanin colouration of apex and colour of stigma. Group I included one germplasm expressing

pigmentation for only one trait basal leaf sheath colour. Last group XXIII included one genotype showing colouration for overall 8 various traits (basal leaf sheath colour, leaf anthocyanin colouration, leaf sheath anthocyanin colouration, leaf auricle colour, leaf collar colour, leaf ligule colour, lemma anthocyanin colouration of apex and colour of stigma).

A total 15 group contained one genotype in each while 5 group contained 2 genotypes in each and 2 group contained 3 genotype in each. Group I, II, III and V contained one genotype in each with expressing colouration for only one trait each i.e. basal leaf sheath green colour, lemma anthocyanin colouration of keel, lemma anthocyanin colouration of apex and color of awns respectively. Nawari-2 variety possessed colouration in only one part i.e., colour of awns. Pigmentation in awns was present in only Nawari-2 among all the 70 farmer’s varieties studied. Thus this feature makes Nawari-2 distinct from other genotypes.

Table 3: Grouping genotypes on the basis of pigment distribution

S.N.	Variety	A	B	C	D	E	F	G	H	I	J	K	L	M
I	Sonkharchi	+	-	-	-	-	-	-	-	-	-	-	-	-
II	Lohandi Lalitpur	-	-	-	-	-	-	+	-	-	-	-	-	-
III	Usha	-	-	-	-	-	-	-	-	+	-	-	-	-
IV	Bagri, Shera 2	-	-	-	-	-	-	-	-	-	-	+	-	-
V	Nawari- 2	-	-	-	-	-	-	-	-	-	-	-	-	+
VI	Bedhar	-	-	-	-	-	-	+	-	+	-	-	-	-
VII	Luchai-1, Khuddi	-	-	-	-	-	-	+	+	-	-	-	-	-
VIII	Nawari-1,Gurmatiya, Bharaphool, Poonga	-	-	-	-	-	-	-	-	+	+	-	-	-
IX	Jamunsurkhi, Faram, Ratua	-	-	-	-	-	-	-	-	-	-	+	+	-
X	Lohandi-1, Kshatriya	+	-	-	-	-	-	-	-	+	+	-	-	-
XI	Dihula Kala	-	-	-	-	-	-	+	+	+	-	-	-	-
XII	Pisso	-	-	-	-	-	-	+	-	-	-	+	+	-
XIII	Chhindphool	-	-	-	-	-	-	+	+	-	-	+	+	-
XIV	Lal Dhan, Shrijot, Sellow Dhan	-	-	-	-	-	-	+	-	+	+	+	-	-
XV	Rameshwar	-	-	-	-	-	-	+	+	+	+	+	-	-
XVI	Amaguar	-	-	-	-	-	-	+	-	+	+	+	+	-
XVII	Lohandi-2	+	+	+	+	+	-	-	-	-	+	-	-	-
XVIII	Luchai-3, Chapti	+	+	+	-	-	+	-	-	+	+	-	-	-
XIX	Methichoor, Kailari	+	+	+	-	-	-	+	-	+	+	-	-	-
XX	Butnagar,	+	+	+	+	+	-	-	-	+	+	-	-	-
XXI	Tendhaniya dhan	-	+	-	-	-	-	+	+	+	+	+	+	-
XXII	Lal Luchai Rosar	+	+	+	-	-	+	+	+	+	+	-	-	-
XXIII	Karanphool	+	+	+	+	+	+	-	-	+	+	-	-	-

+ Pigmented, - Non pigmented, A- Basal leaf sheath colour, B- Leaf anthocyanin colouration, C- Leaf sheath anthocyanin colouration, D- Auricle colour, E- Collar colour, F- Ligule colour, G- leamm anthocyanin colouraion of keel, H- lemma anthocyanin colouration of area below apex, I- lemma anthocyanin colouration of apex, J- Colour of stigma, K- Colour of tip of lemma, L- Lemma and palea colour, M- colour of awns.





Fig Plate 2: Morphological characterization of different traits as per DUS guidelines

Conclusion

In the present investigation seventy farmer's varieties were characterized by using twenty six qualitative characters as per DUS norms. Out of these twenty six characteristics, five qualitative traits were non polymorphic and remaining 22 qualitative traits were polymorphic traits which showed variability in different varieties under study.

During characterization of all 70 farmer's varieties we found various colour presenting traits. The concept available for the variation and presence of various purple coloring traits is that, the purple pigmentation of rice plants had been lost during the process of evolution and genotypes and the green types were evolved ones. The anthocyanin accumulation plays role in many physiological functions such as modulation of hormone response, protection from damage by UV radiation and defense response biotic and abiotic stress. Such morphological variants with distinct phenotypic expression and simple inheritance pattern can be used to establish linkages and for indirect selection if found associated with useful traits.

Purple ligules, Intensity of leaf sheath anthocyanin colouration was very strong for only a variety *i.e.*, Luchai-3, similarly, a single line 'Jarga' showed yellowish brown awn and another single line 'Nawari-2' showed reddish brown awn. Awns appear to be equipped with physiological and biological buffers that enable plant to adjust according to changes in the environment. According to DUS guideline some of qualitative characters are considered as candidate traits or morphological markers which are used as important tool in varietal identification process, can be utilized for further candidate variety development also.

Some of characteristics are rarely modified by the environment like, flag leaf attitude of blade. It was observed at early stage *i.e.* beginning of anthesis and a single line 'Dharudhan' showed horizontal type of flag leaf attitude of blade. Crop breeders usually selectively breed for an erect panicle type; spreading panicle type is actively selected against, for reasons of maximizing crop grain production and harvest. Hence the genotypes with compact panicle types can

be used in breeding programmes for the purpose of increasing rice production.

Hence systemic characterization may be utilized for further maintaining the genetic purity of seed by also recognizing and removing off-types. The entire study will be rewarding for breeders, researchers, seed growers and farmers to arrange future demands of varietal improvement, preservation and conservation of beneficial genes.

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