Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7494

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2019) *7*(5), 237-245

Research Article

Indian Journal of Pure & Applied Biosciences

Assessment of Genetic Variability for Qualitative and Quantitative Traits in Local Rice Cultivars of Gudalur Valley of the Nilgiris

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Received: 13.05.2019 | Revised: 25.06.2019 | Accepted: 8.07.2019

ABSTRACT

In the present study, characterization of 21 local rice genotypes was carried out for 16 DUS characters. The leaf and leaf sheath anthocyanin coloration was absent in all the genotypes. A total of eight traits viz., leaf pubescence of blade surface, leaf length of blade, leaf width of blade, flag leaf, panicle awns, panicle presence of secondary branching, panicle secondary branching and panicle exertion were dimorphic. Three traits basal leaf sheath colour, leaf intensity of green colour, culm attitude were found to be trimorphic. Remaining three traits namely flag leaf attitude of blade, panicle curvature of main axis and panicle attitude of branches were found to be tetramorphic. The genotype mundamaranellu was found to be distinct for erect culm, erect flag leaf and presence of awns and these genotypes can be used as donor for rice breeding program. The cultivars Thondi and mullampunchan (106 days) were found to be early on days to 50% flowering among all the genotypes evaluated. All genotypes exhibited significant differences for eight quantitative traits. The high PCV and GCV was recorded for plant height, number of productive tillers and single plant yield. The highest heritability and high genetic advance as per cent of mean was observed in plant height, number of panicles per plant, number of productive tillers, 1000grain weight, single plant yield and these characters could be further improved by following simple selection procedure.

Keywords: *Local cultivar, Characterization, Variability, Morphological traits, Rice*

INTRODUCTION

Rice is an ancient grain crop and a staple food for people due to it being high in carbohydrates, low in fat and rich in proteins, vitamins and minerals. It has been used as a major food for over ten thousand years. It has been cultivated in 113 countries. It is estimated that half of the world's population subsists wholly or partially on rice. Globally, rice is now being cultivated in 160 m. ha with an annual production of around 650 m.t of rough rice and average productivity of 4.18 t/ha. More than 90% of the rice is produced and consumed in Asian countries. In India, rice is cultivated in an area of 44m.ha with a production of 103.41 m.t of paddy and an average productivity of 2.35 t/ha milled rice or 3.52 t/ha rough rice.

Cite this article: Kumaresan, D., & Manonmani, S. (2019). Assessment of Genetic Variability for Qualitative and Quantitative Traits in Local Rice Cultivars of Gudalur Valley of the Nilgiris, *Ind. J. Pure App. Biosci. 7*(5), 237-245. doi: http://dx.doi.org/10.18782/2320-7051.7494

The present population of 1.22 billion Indians is expected to reach 1.30 to 1.53 billion by 2020 and 2030. So, to support such a huge population, rice production has to be increased by at least 70 per cent over next three decades to meet growing demand (Balkunde et al., 2013). The increasing purchasing power and changing food pattern of consumers preferring on cereals and processed foods, envisages a still higher demand for rice and rice products. Decreasing land area under rice makes the situation still worse and hence warrants higher productivity from unit land area. Increasing concern about the sustainability of the fragile rice ecosystem directs more challenges towards rice improvement front to have viable and eco-friendly strategies for attaining and maintaining higher yields.

The rice germplasm is an important valuable reservoir of useful genes and the plant breeders can utilize these genes for crop improvement program (Yadav et al., 2013). The only way to ensure food security for future generations is to exploit the present day genetic diversity of different crops and to identify the promising one for future breeding programs. Knowledge of genetic variability present in a given crop species for the character under improvement is of paramount importance for success of any crop improvement program for broadening the gene pool of the crops (Ahmad, 2011). A present study was conducted to characterize local cultivars of rice for 16 qualitative traits along with a study on genetic variability parameters for yield and yield contributing traits.

MATERIALS and METHODS

A total of 21 local rice cultivars were sown separately in raised bed nursery. Thirty days old seedlings of each genotype were transplanted in 3 rows of 3m length by adapting a spacing of 20cmx20cm in a randomized block design with three replications. Normal cultural practices were followed as per standard recommendations to get a good crop stand. Visual observations were recorded on five randomly selected plants on each genotype for 16 DUS characters namely basal leaf sheath colour, leaf intensity of green colour, leaf anthocyanin coloration, leaf sheath anthocyanin coloration, leaf sheath intensity of anthocyanin coloration, leaf pubescence of blade surface, leaf length of blade, leaf width of blade, culm attitude, flag leaf, flag leaf attitude of blade, panicle curvature of main axis, panicle awns, panicle presence of secondary branching, panicle secondary branching, panicle attitude of branches and panicle exertion. Data was also recorded on five randomly selected plants on each genotype in each replication for eight quantitative characters namely days to first flowering, days to 50% flowering, number of productive tillers, number of panicles per plant, panicle length, plant height, 1000 grain weight and single plant yield. The replicated mean data of each character was subjected to analysis of variance following (Panse & Sukatme, (1985). The phenotypic and genotypic coefficients of variation, heritability and genetic advance were estimated by the formula suggested by Burton et al. (1952) and Johnson et al. (1955).

RESULTS and DISCUSSION

Studies on genetic variability are important in selection of parents for hybridization[5] since crop improvement largely depends on magnitude of genetic variability present in base population[1]. Analysis of variance (Table 1) exhibited significant differences among all the traits taken for the study which indicates the presence of considerable genetic variability in the experimental material.

The PCV, GCV, heritability and genetic advance for yield and yield related attributes are presented in Table 2. High GCV and PCV was recorded for plant height, number of productive tillers and single plant yield. Similar results were reported by Ukaoma et al. (2013), Moderate GCV and PCV was observed in number of panicles per plant and 1000 grain weight. The values of GCV and PCV was low in days to first flowering and days to 50% flowering. The values of PCV was slightly higher than GCV

for all the characters studied *viz*., days to first flowering, days to 50% flowering, plant height, number of panicles per plant, number of productive tillers per plant, panicle length, 1000 grain weight and single plant yield which indicates some degree of environmental influence on the phenotypic expression of these characters. Similar results was earlier reported by Osman et al. (2012) and Kumar et al. (1999). The characters namely plant height, number of panicles per plant, number of productive tillers, 1000 grain weight and single plant yield exhibited high heritability coupled with high genetic advance which indicates predominance of additive gene action in the inheritance of these characters and these traits can be further improved by following simple selection procedure. The high heritability and low genetic advance was recorded in days to 50% flowering which indicated the preponderance of non additive gene effects.

Based on mean performance (Table 3), the cultivars Thondi and mullampunchan (106 days) was found to be early on days to 50% flowering among all the genotypes evaluated. The genotypes *viz*., Thaiching, Adukan, Kalyani, Uma and Jaya were short in nature and it can withstand lodging, so these genotypes may be used as donor for the trait lodging resistant. Adukan had more number of productive tillers. Maximum single plant yield (62.3g) and panicle length (28.1cm) was observed in Kodavilayan.

The availability of morpho-genetic variation in agronomic characters of a crop would be of considerable importance in determining the best method to improve the yield in rice. Varietal characterization is useful to plant breeder to identify and exploit a wide range of genetic diversities for further crop improvement to increase the productivity as reported by Ishwarya Lakshmi et al. (2018). Morphological traits are qualitative in nature and are stable over generation, which is used as a reliable markers for the characterization of varieties[11]. Characterization and frequency distribution for 16 agro morphological characters in 21 local cultivars of rice are presented in Table 4 and Fig.1. Among them, two characters *viz*., absence of leaf anthocyanin coloration and absence of leaf sheath anthocyanin coloration were common in all the genotypes. Remaining characters were unique and distinct among the genotypes. With respect to leaf characteristics, the basal leaf sheath colour was green in 17 genotypes (81%), light purple in three genotypes and purple in a genotype of Thaiching. The intensity of green colour on leaves was medium in 18 genotypes (86 %), dark green colour in Athira1 and Kodavilayan and light green colour in Kothandan. A total of nine genotypes had medium length of leaf blade and 12 genotypes recorded long length of leaf blade whereas 20 genotypes observed medium width of leaf blade and a genotype kurukot with narrow width of leaf blade. The pubescence of blade surface on leaves was weak in 16 genotypes (76%) and absent in Jaya, Uma, Kothandan, Kayumma and Kurukot.

Regarding culm type, out of 21 genotypes evaluated, 14 genotypes exhibited erect culm, five having semi erect culm and the cultivars Kerala kandhagasala and mullampunchan were found to have open spreading type. The genotype having erect culm type can withstand and this character will be useful for development of rice varieties with lodging resistance. With respect to flag leaf at early stage, it was erect in 14 genotypes (67%) and semi erect in seven genotypes (33%). Whereas flag leaf attitude of leaf blade on late observation, it was erect seven genotypes and seven in semi erect and six in horizontal and one in deflexed state. About panicle curvature of main axis, 10 genotypes recorded deflexed nature, six in semi straight, four genotypes Kerala kandagasala, Kayumma, Thondi and Adukkan were in drooping panicle and one genotype Maranellu had straight panicle. The genotypes Maranellu, Thondi, Athira-2, Kodavilayan, IR-20 Red, Varisurian, Uma having erect flag leaf which can be used as donors for improvement in rice breeding programmes.

For panicle awn, the awn was present in six genotypes *viz*., Mundamaranellu, Athira -1, Kodavilayan, Varisurian, Kalyani and Kayumma recorded the presence of awn whereas absent in the remaining 15 genotypes. On panicle presence of secondary branching, twenty genotypes were showed secondary branching in panicle and it was absent in Thondi. The genotype Kurukot had strong panicle secondary branching and the remaining 20 genotypes were noted as weak panicle secondary branching. In relation to panicle attitude of branches, a total of 10 genotypes exhibited semi erect panicle, six genotypes had semi erect to spreading type, four observed spreading and one genotype in erect panicle. With regard to panicle exertion, 12 genotypes were observed well exerted panicle (57%) and remaining nine genotypes showed mostly exerted panicle (43%).

In the present study, it was concluded that the highest PCV and GCV was exhibited by plant height, number of productive tillers and single plant yield. The traits namely plant height, number of panicles per plant, number of productive tillers per plant, 1000 grain weight and single plant yield observed high heritability and high genetic advance. These characters can be improved by following simple selection. With respect to characterization of rice genotypes for 16 DUS characters two traits were found to be monomorphic, eight were dimorphic and three each were tri and tetromorphic.

Table 1: Analysis of variance for yield and yield contributing traits in 21 local rice cultivars

S.No.	Characters	Mean sum of squares		
		Replication (d.f.=2)	Treatment (d.f.=20	Error (d.f.=40)
1	Days to 1st flowering	13.77	61.61*	15.57
2	Days to 50% flowering	1.15	62.68*	0.52
3	Plant height	0.95	1563.01*	8.09
4	No. of panicles per plant	0.44	47.08*	3.27
5	No. of Productive tillers	1.53	70.34*	1.60
6	Panicle length	2.62	18.87*	2.78
7	1000 grain weight	1.84	73.65*	2.63
8	Single plant yield	5.09	408.49*	7.91

* significant at 5% level

Table 2: Genetic variability parameters for eight quantitative traits in 21 local rice cultivars

S.No	Characters	PCV (%)	GCV (%)	Heritability (%)	Genetic advance (%)
1	Days to 1st flowering	5.10	3.59	49.62	5.21
2	Days to 50% flowering	3.97	3.93	97.53	7.99
3	Plant height	24.08	23.89	98.46	48.84
4	No. of panicles per plant	19.66	17.77	81.67	33.08
5	No. of Productive tillers	39.14	37.84	93.45	73.35
6	Panicle length	11.53	9.35	65.83	15.63
7	1000 grain weight	19.84	18.83	89.98	36.79
8	Single plant yield	28.58	27.77	94.40	55.58

Table 3: Mean performance of local rice cultivars for important yield and yield contributing characters

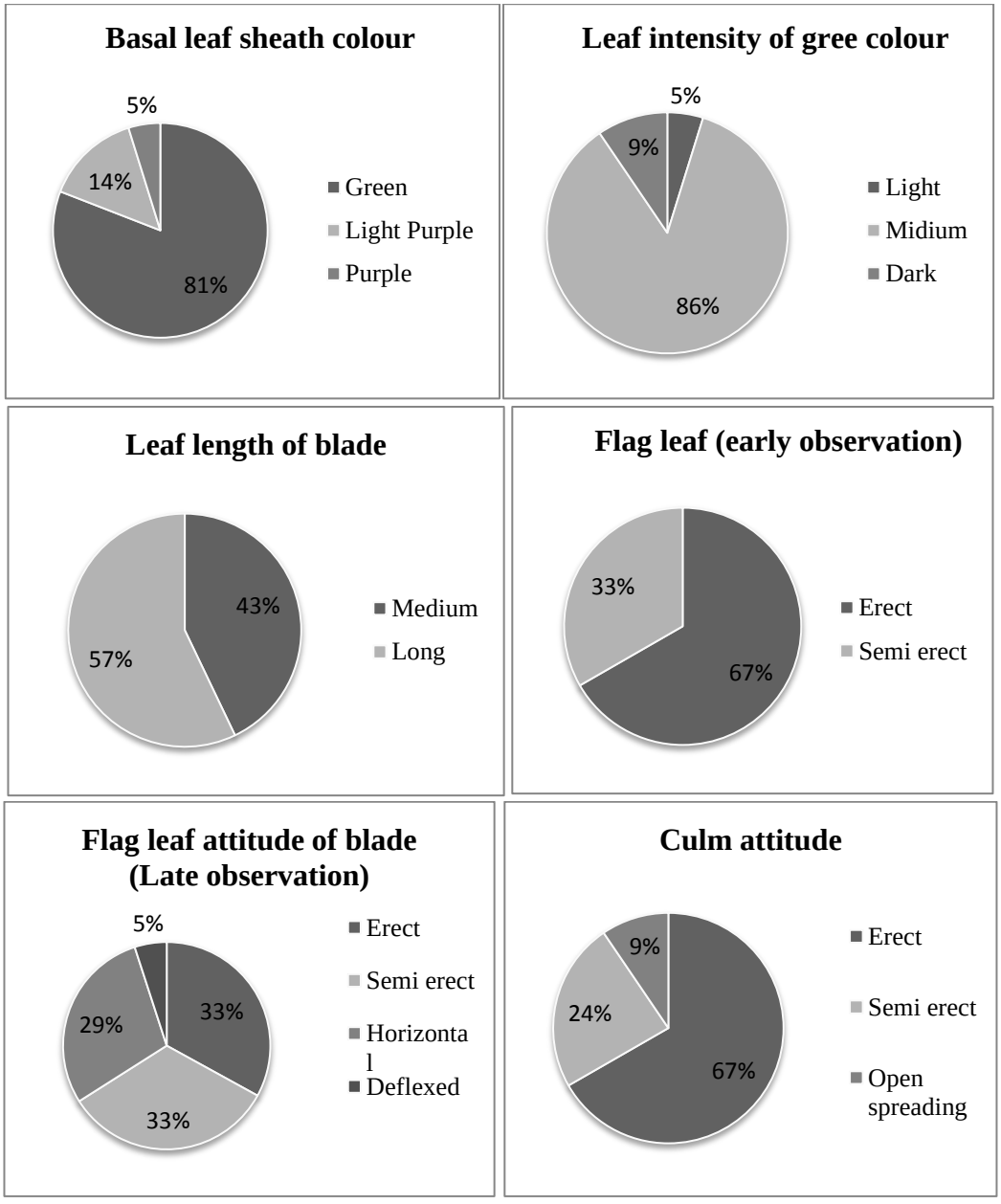
	Entry Name	Days to 1st flowering	days to 50% flowering	No. of productive tillers	No. of panicles per plant	Panicle length (cm)	Plant height (cm)	1000 grain weight (g)	Single plant yield (g)
1	Kerala kandagasala	106	114	9	23	31.0	132.6	30	30.3
2	Maranellu	112	119	17	22	24.0	120.1	30	28.2
3	Thondi	104	106	10	19	23.0	106.9	25	36.5
4	Manvilayan	116	121	9	26	27.0	101.3	35	32.8
5	Athira-2	111	116	8	19	28.4	99.8	35	17.2
6	Mundamaranellu	109	114	8	20	23.0	108	30	51.2
7	Athira -1	110	115	10	16	22.4	84.2	30	40.8
8	Kodavilayan	108	122	8	19	28.1	105.9	25	62.3
9	IR-20 Red	113	120	20	21	22.5	119.4	30	50.7
10	Jaya	112	116	10	22	22.1	66.7	35	49.2
11	Varisurian	113	123	9	22	25.6	79.5	35	60.0
12	Mullampunchan	99	106	11	24	26.0	115.8	20	53.5
13	Uma	112	120	12	14	23.4	59.5	20	37.0
14	Kothandan	113	117	11	22	20.5	115.2	30	56.2
15	Kalyani	113	120	22	24	25.2	58.9	25	41.3
16	Kayumma	99	111	14	18	25.9	110.2	25	48.0
17	Kurukot	107	116	19	32	23.0	76.8	30	30.7
18	Chinthamani	106	115	13	28	25.8	104.4	30	38.5
19	Adukan	111	118	23	18	26.0	64.3	35	34.3
20	Kalavai	108	115	8	20	23.2	107.7	25	21.7
21	Thaiching	108	113	14	22	23.5	63.6	35	38.7
	Mean	109.0	115.8	12.6	21.5	24.7	95.2	25.8	41.6
	Mean value Min.	99	106	8	14	20.5	59.5	20.0	17.2
	Mean value Max.	116	123	23	32	31.0	132.6	35.0	62.3
	CV	3.6	0.6	10.0	8.4	6.7	2.9	6.2	6.7
	SE(d)	3.2	0.5	1.0	1.4	1.3	2.3	1.3	2.2
	CD (P=0.05)	6.4	1.1	2.0	2.9	2.7	4.6	2.6	4.6

Table 4: Characterization of 21 local rice cultivars for agro morphological traits

S.No	Characteristics	States	No. of genotypes	Frequency %	Germplasm entries
1	Basal leaf sheath colour	Green	17	81	Kerala kandagasala, Maranellu, Thondi, Athira-2, Mundamaranellu, Athira -1, Kodavilayan, Jaya, Varisurian, Mullampunchan, Kothandan, Uma, Kalyani, Kayumma, Chinthamani, Kurukot, Adukan
		Light purple	3	14	Manvilayan, IR-20 Red, Kalavai
		Purple	1	5	Thaiching
2.	Leaf intensity of green colour ,	Light	1	5	Kothandan
		Medium	18	86	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Kalyani, Kayumma, Chinthamani, Kurukot, Adukan, Kalavai, Thaiching
		Dark	2	9	Athira -1, Kodavilayan,
3.	Leaf anthocyan in coloration	Present	0		
		Absent	21	100	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Kalyani, Kayumma, Chinthamani, Kurukot, Adukan,

					Kalavai, Thaiching, Athira -1, Kodavilayan, Kothandan
4.	Leaf sheath anthocyan in coloration	Present	0		
		Absent	21	100	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Kalyani, Kayumma, Chinthamani, Kurukot, Adukan, Kalavai, Thaiching, Athira -1, Kodavilayan, Kothandan
5.	Leaf Pubescence of blade surface	Absent	5	24	Jaya, Uma, Kothandan, Kayumma, Kurukot
		Weak	16	76	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Varisurian, Mullampunchan, Kalyani, Chinthamani, Adukan, Kalavai, Thaiching, Athira -1, Kodavilayan
		Medium	0	0	
		Strong	0	0	
		Very strong	0	0	
6.	Leaf: length of blade	Short (<30cm)	0	0	
		Medium (30-45cm)	9	43	Thondi, Athira-2, Athira -1, Kodavilayan, Jaya, Uma, Kothandan, Kalyani, Kalavai,
		Long (>45cm)	12	57	Kerala kandagasala, Maranellu, Manvilayan, Mundamaranellu, IR-20 Red, Varisurian, Mullampunchan, Kayumma, Kurukot, Chinthamani, Adukan, Thaiching,
7.	Leaf : width of blade	Narrow (<1cm)	1	5	Kurukot
		Medium (1-2cm)	20	95	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Kalyani, Kayumma, Chinthamani, Adukan, Kalavai, Thaiching, Athira -1, Kodavilayan, Kothandan
		Broad (>2cm)	0	0	
8.	Culm attitude	Erect	14	67	Maranellu, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Uma, Kalyani, Chinthamani, Adukan, Kalavai, Athira -1, Kodavilayan
		Semi erect	5	24	Thondi, Kalyani, Kayumma, Kurukot, Thaiching
		Open spreading	2	9	Kerala kandagasala, Mullampunchan
9.	Flag leaf (early observation)	Erect	14	67	Maranellu, Thondi, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Adukan, Kalavai, Athira -1, Kodavilayan, Kothandan
		Semi erect	7	33	Kerala kandagasala, Manvilayan, Kalyani, Kayumma, Kurukot, Chinthamani, Thaiching
		Horizontal	0	0	
		Drooping	0	0	
10	Flag leaf attitude of blade (Late observation)	Erect	7	33	Maranellu, Thondi, Athira-2, Kodavilayan, IR-20 Red, Varisurian, Uma
		Semi erect	7	33	Manvilayan, Mundamaranellu, Jaya, Adukan, Kalavai, Athira -1, Kothandan
		Horizontal	6	29	Kerala kandagasala, Mullampunchan, Kalyani, Kayumma, Chinthamani, Kurukot,
		Deflexed	1	5	Thaiching,
11.	Panicle curvature of main axis	Straight	1	5	Maranellu,
		Semi straight	6	28	Manvilayan, Athira-2, Mundamaranellu, Jaya, Uma, Kothandan
		Deflexed	10	48	IR-20 Red, Varisurian, Mullampunchan, Kalyani, Chinthamani, Kurukot, Kalavai, Thaiching, Athira -1, Kodavilayan,
		Drooping	4	19	Kerala kandagasala, Thondi, Kayumma, Adukan,
12.	Panicle : awns	Present	6	29	Mundamaranellu, Athira -1, Kodavilayan, Varisurian, Kalyani, Kayumma,
		Absent	15	71	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, IR-20 Red, Jaya, Mullampunchan, Uma, Chinthamani, Kurukot, Adukan, Kalavai, Thaiching, Kothandan
13.	Panicle: presence of secondary branching	Present	20	95	Kerala kandagasala, Maranellu, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Kalyani, Kayumma, Chinthamani, Kurukot, Adukan, Kalavai, Thaiching, Athira -1, Kodavilayan, Kothandan
		Absent	1	5	Thondi,

14.	Panicle secondary branching	Weak	20	95	Kerala kandagasala, Maranellu, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Jaya, Varisurian, Mullampunchan, Uma, Kalyani, Kayumma, Chinthamani, Adukan, Kalavai, Thaiching, Athira -1, Kodavilayan, Kothandan, Thondi,
		Strong	1	5	Kurukot,
		Clustered	0	0	
15.	Panicle : attitude of branches	Erect	1	5	Maranellu,
		Erect to semi erect			
		Semi erect	10	48	Kerala kandagasala, Manvilayan, Athira-2, Mundamaranellu, IR-20 Red, Varisurian, Uma, Athira -1, Kodavilayan, Kothandan
		Semi erect to spreading	6	28	Jaya, Mullampunchan, Kalyani, Kayumma, Adukan, Kalavai,
		Spreading	4	19	Thondi, Chinthamani, Kurukot, Thaiching
16.	Panicle: exertion	Partly exerted	0	0	
		Mostly exerted	9	43	Athira -1, Kodavilayan, Uma, Adukan, IR-20 Red, Jaya, Varisurian, Kothandan, Kalavai,
		Well exerted	12	57	Kerala kandagasala, Maranellu, Thondi, Manvilayan, Athira-2, Mundamaranellu, Mullampunchan, Kalyani, Kayumma, Chinthamani, Kurukot, Thaiching,



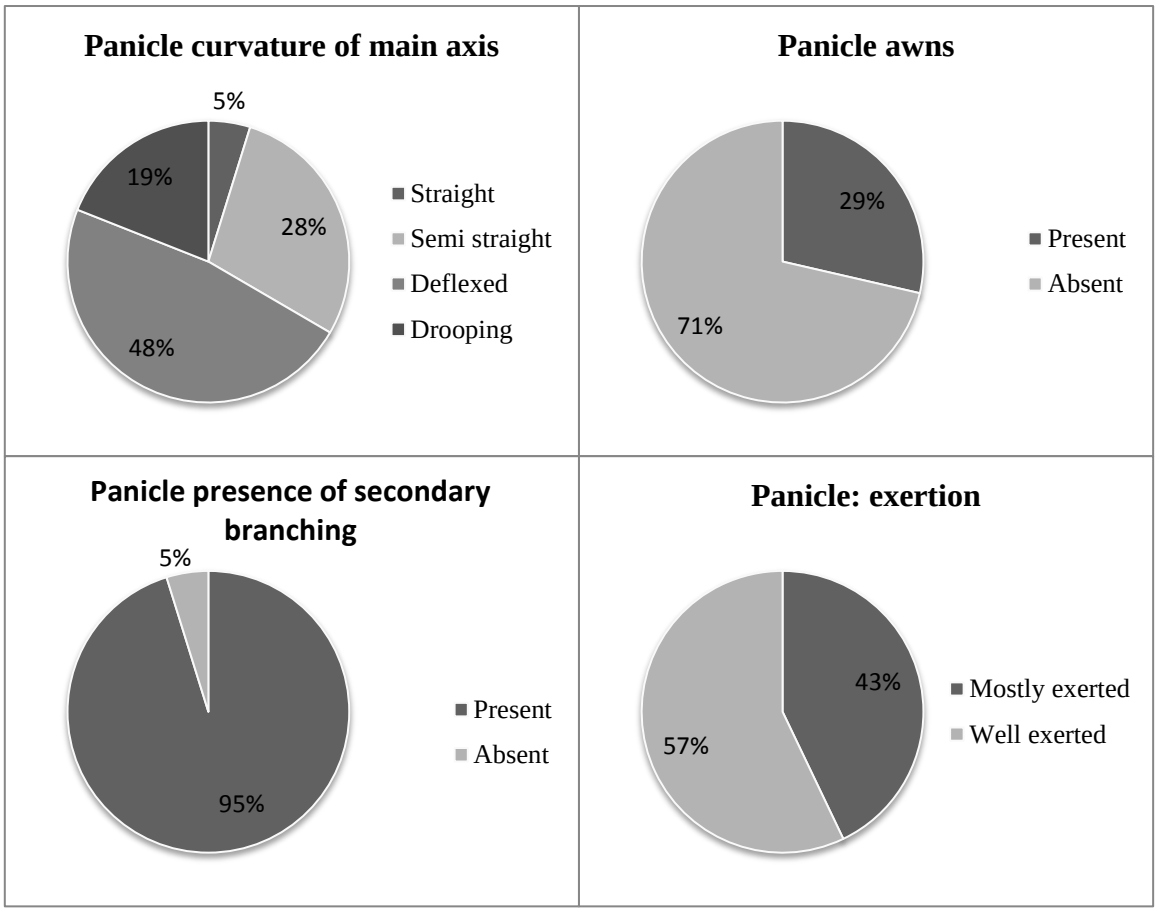


Fig. 1: Frequency distribution of local rice cultivars for an important morphological traits

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