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Assessment of genetic variability for quantitative and qualitative traits in Rice Germplasm Accessions (*Oryza sativa* L.).

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ABSTRACT
Plant genetic resources in rice crops and their wild relatives are of immense value to mankind. The plant breeders require reservoir of genetic variation for crop improvement. The larger reservoirs of variation are better chances of finding the particular characters, such as resistance genes for diseases and adaptation to wider ecological amplitudes and stress conditions. the process of genetic erosion necessitates measures that germplasm must be conserved in such a manner that there are minimal losses or changes in genetic variability of the population. the present paper objective is Assessment of genetic variability for quantitative and qualitative traits in Rice Germplasm Accessions (Oryza sativa L.).
keywords: Genetic variability, Oryza sativa, Stress

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Introduction

Rice (*Oryza sativa* L.), the world's most important cereal crop, is the primary source of food and calories for about half of the human population. Taxonomically, rice is classified in the family *Poaceae* and subfamily *Oryzoideae*. India ranks 1st in area (43.95 million ha) and 2nd in production (103.61 million tonnes), after China (2nd advance estimate, 2015-16, Department of Agriculture, Cooperation and Farmer's Welfare, Ministry of Agriculture, GOI), and productivity of 2462 Kg/ha (Anonymous, 2015). Rice, being the staple food for more than 70 per cent of the population and the source of livelihood for 120-150 million rural households, is the backbone of the Indian agriculture.

Plant genetic resources in rice crops and their wild relatives are of immense value to mankind. The plant breeders require reservoir of genetic variation for crop improvement. The larger reservoirs of variation are better chances of finding the particular characters, such as resistance genes for diseases and adaptation to wider ecological amplitudes and stress conditions. However, in the wake of increase of high yielding varieties, this genetic variability comprising landraces is steadily getting eroded resulting in the large scale depletion of variability. This situation thus demands priority action to conserve such germplasm (Sarawgi *et al.*2013). Further, the process of genetic erosion necessitates measures that germplasm must be conserved in such a manner that there are minimal losses or changes in genetic variability of the population.

MATERIALS AND METHODS

The material for the present investigation consisted of 24 rice germplasm accessions received from NBPGR, New Delhi during Kharif 2016 at IGKV, Raipur. Each entry was sown in a plot comprising three rows having three meter length at spacing of 20 cm between rows and 15 cm between plants. The recommended agronomical practices were followed to raise good crop in the season. Observations were recorded on five randomly chosen plants of each accession for twenty four morphological and sixteen agronomical traits. The traits studied were Coleoptile colour, Seedling colour, Basal leaf sheath colour, Leaf colour, Auricle, Collar, Ligule, Leaf margin colour, Stigma colour, Leaf intensity of green colour, Leaf anthocyanin colouration, Leaf distribution of anthocyanin colour, Leaf pubescence of blade surface, Leaf auricle, Leaf anthocyanin colouration of auricle, Leaf collar, Leaf anthocyanin colouration of collar, Ligule, Shape of ligule, Colour of ligule, Flag leaf attribute of blade, Stem anthocyanin colouration of nodes, Stem anthocyanin colouration of internodes, Panicle awn, Coleoptile length (cm), Seedling length (cm), Leaf length (cm), Leaf width (cm), Plant height (cm), Panicle length (cm), No. of tillers per plant, No. of

effective tillers per plant, Biological yield (g), Grain yield (g), Harvest index, Filled spikelets per panicle, Unfilled spikelets per panicle, 100 Grains weight (g), Grain length (mm) and Grain width (mm). Accessions were characterized using morpho-agronomic descriptors according to DUS guidelines (DRR, 2006). Frequency distribution was computed to categorize the accession into different classes. Simple statistics (means, ranges) was calculated to have an idea of the level of variation.

Results and Discussion

(A) Morphological characterization:

Qualitative characters are important for plant description and mainly influenced by the consumers preference, socioeconomic scenario and natural selection (Ismaeel et al., 2016). Frequency distribution for 26 qualitative traits is depicted in Table 1.1 and its graphical representation of frequency distribution showed in Figure 1. Most of the morphological characters showed variation in different accessions except Coleoptile colour, Auricle colour, Collar colour, Leaf auricle, Leaf anthocyanin colouration of auricle, Leaf collar, Leaf anthocyanin colouration of collar, Ligule, Shape of ligule, Colour of ligule, Stem anthocyanin colouration of nodes, Stem anthocyanin colouration of internodes and panicle awns. A majority of accessions were found to possess Seedling colour (dark green 21%),Basal leaf: sheath colour (96% green), leaf margin colour (96 absent), Stigma colour (8% purple), Leaf intensity of green colour (38% dark green), Leaf anthocyanin colouration (96% absent), Leaf distribution of anthocyanin colouration (96 % margin only), leaf pubescence of blade surface (strong 42%) and Flag leaf attitude of blade (4% horizontal). Similar type of work was also reported by Bisne and Sarawgi (2008), and Ahmed et al. (2016). Based on the morphological descriptors 24 accessions were classified for 24 characters presented in table 1. The quantitative characters of twenty four (24) rice germplasm line including three varieties (Checks) were analyzed using Randomized Block Design (RBD). To take the observation for the characters five plant per row in each replication (three replications) were taken.

(B) Agronomical characterization:

Rice accessions were evaluated for agronomical traits viz., Coleoptile length (cm), Seedling length (cm), Leaf length (cm), Leaf width (cm), Plant height (cm), Panicle length (cm), Number of tillers per plant, Number of effective tillers per plant, Biological yield (g), Grain yield (g), Harvest index, Filled spikelets per panicle, Unfilled spikelets per panicle, 100 Grains weight (g), Grain length (mm) and Grain width (mm).

The descriptive statistics were employed to assess the magnitudes of genetic variation and Analyses Of Variance are presented in Table 2.1 and Table 2.2 respectively.

The analysis of variance revealed that the mean sum of square for the rice germplasm lines were significant for all characters except Coleoptile length, Leaf width, Biological yield, Grain yield, 100 grains weight, Grain length and Grain width. This is the indication of sufficient variability present among the germplasm and varieties under study.

The character Coleoptile length (cm) varied between 0.100 (cm) to 0.533 (cm) with a mean of 0.292 and having standard error mean 0.038. The highest mean performance was recorded for line IC75845 (0.100 cm) whereas the lowest mean performance was recorded for line IC216606 (0.533 cm). Coleoptile length in rice is a multifaceted character (Cheema *et al*., 1987).

The character Seedling length (cm) varied between 6.333 (cm) to 12.667 (cm) with a mean of 8.403 cm and having standard error mean 0.505. The highest mean performance was recorded for line IC75839 (12.667 cm) whereas the lowest mean performance was recorded for line IC540584 (6.333 cm).

The character Leaf length (cm) varied between 31.600 (cm) to 70.467 (cm) with a mean of 51.419 and having standard error mean 3.513. Line IC216606 showed the highest mean performance and line IC75845 showed lowest mean performance for this trait.

Leaf width had mean of 1.610 (cm) and having minimum range of 1.033(cm) and maximum range of 2.100 cm. ARC 10550 showed highest mean 2.100 (cm) and line IC75845 showed lowest mean 1.033 (cm) performance for this trait.

Plant height and Seedling length in rice is a complex character and is the product of several genetically controlled factors called internodes (Cheema *et al*., 1987). The character Plant height (cm) varied between 77.367 (cm) to 152.700 (cm) with a mean of 108.332 cm and having standard error mean 2.666. The highest mean performance was recorded for line IC75839 (152.700 cm) whereas the lowest mean performance was recorded for line IC540584 (77.367 cm). Plant height in rice is a complex character and is the product of several genetically controlled factors called internodes (Cheema *et al*., 1987).

Plant height in rice is a multifaceted character and the end product of a number of genetically controlled factors called internodes (Cheema *et al*., 1987). Reduction in plant height may develop their resistance to lodging and reduce substantial yield losses associated with this trait (Abbasi *et al*., 1995). Hien *et al*., (2007) reported that improvement of aromatic rice cultivars also should focus on both decreasing the plant height and increasing the culm strength.

The mean performance of Panicle length (cm) is 24.804 cm and varied between 21.70 and 29.633 with a standard error mean 0.767. Panicle length showed the highest mean performance of (29.633 cm) for line IC75874 and line IC216563 (21.70 cm) showed the lowest mean value. Panicle length contributes positively yet maximum panicle length is not the only factor responsible for higher grain yield. Abbasi *et al*., (1995) observed that the rice variety DR-39 had maximum panicle length but due to lower grain fertility exhibited lower grain yield. So panicle length alone does not determine the high grain yield as traits such as grain size, grain shape, higher numbers of tillers/plant, longer panicles and greater number of grains/panicle ultimately contribute to higher grain yield.

Number of tillers per plant had mean of 24.18058 with a standard error mean 4.079 and having minimum range 8.667 and maximum range 67.667. Line IC75767 showed highest mean performance (67.667), however the lowest mean value of this particular trait was recorded in ARC 10550 (8.667) tillers per plant

Number of effective tillers per plant varied between 8.333 to 67.667 having standard error mean 3.637 with mean average of 22.93. For this character line IC75767 (67.667) showed the highest mean performance however the lowest mean performance for this particular character was showed by ARC 10550 (8.667). Biological yield had mean value 0.157 (g) and having minimum range 0.063(g) and maximum range 0.281(g). IC75767 showed highest mean 0.282 (g) and line IC216612 showed lowest mean 0.063 (g) performance for this trait.

Grain yield had mean value 0.041 (g) and having minimum range 0.012(g) and maximum range 0.093(g). IC75795 showed highest mean 0.093 (g) and line IC75889 showed lowest mean 0.013 (g) performance for this trait. Harvest index having mean value 27.151 and varied in range of 9.07 to 45.69. The character Filled spikelets per panicle with a mean of 175.9167 varied between 77.333 to 265.333 and having standard error mean 6.179. Line IC 217509 showed the highest mean performance and line IC75874 showed lowest mean performance for this trait.

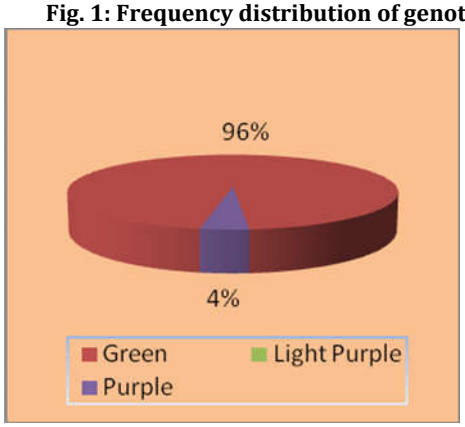
Unfilled spikelets per panicle varied between 23 to 216 with a mean of 59.125 and having standard error mean 3.11. Line IC216609 showed the highest mean performance and line IC75889 showed lowest mean performance for this trait. The trait 100 grains weight of rice having ranges 1.63 (g) and 3.08 (g) with average 2.21 (g). The character Grain length having ranges in between 5.8 (mm) and 9.9 (mm) with an average 8.45 (mm). Grain width having mean value 2.556 (mm) and varied in ranges of 2.03 to 3.3(mm).

Table1.1: Description of morphological and qualitative characters

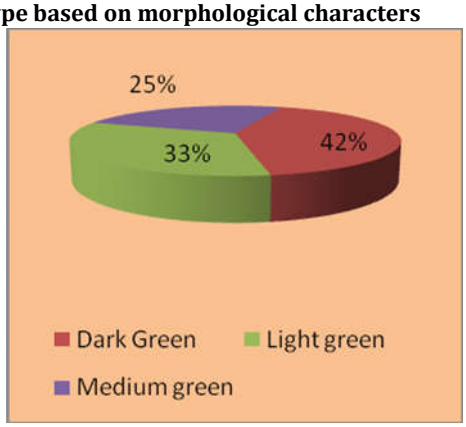
S. No.	Characteristics	States	No. of genotype	Frequency %
1	Coleoptile colour	White	24	100
		Green	0	0
		Purple	0	0
2	Seedling colour	Dark green	5	21
		Green	4	16
		Light green	11	46
		Yellow	4	17
3	Basal leaf sheath colour	Green	23	96
		Light Purple	0	0
		Purple	1	4
4	Leaf colour	Dark green	10	42
		Light green	8	33
		Medium green	6	25
5	Auricle	Green	24	100
6	Collar	Pale Green	24	100
7	Ligule	Split	24	100
8	Leaf margin colour	Absent	23	96
		Present purple	1	4
9	Stigma colour	White	22	92
		Purple	2	8
10	Leaf intensity of green colour	Dark green	9	38
		Light green	8	33
		Green	2	8
		Medium green	5	21
11	Leaf anthocyanin colouration	Absent	23	96
		Present	1	4
12	Leaf distribution of anthocyanin colour	Tip margin	1	4
		On Tip only	0	0
		On margin only	23	96

		In blotches only Uniform	0 0	0 0
13	Leaf pubescence of blade surface	Medium Strong Week	7 10 7	29 42 29
14	Leaf auricle	Present Absent	24 0	100 0
15	Leaf anthocyanin colouration of auricle	Colourless Light purple Purple	24 0 0	100 0 0
16	Leaf collar	Absent Present	0 24	0 100
17	Leaf anthocyanin colouration of collar	Absent Present	24 0	100 0
18	Ligule	Absent Present	0 24	0 100
19	Shape of ligule	Truncate Acute split	0 0 24	0 0 100
20	Colour of ligule	White Green	24 0	100 0
21	Flag leaf attribute of blade	Erect Semi erect Horizontal	10 13 1	42 54 4
22	Stem anthocyanin colouration of nodes	Absent Present	24 0	100 0
23	Stem anthocyanin colouration of internode	Absent Present	24 0	100 0
24	Panicle awn	Absent Present	24 0	100 0

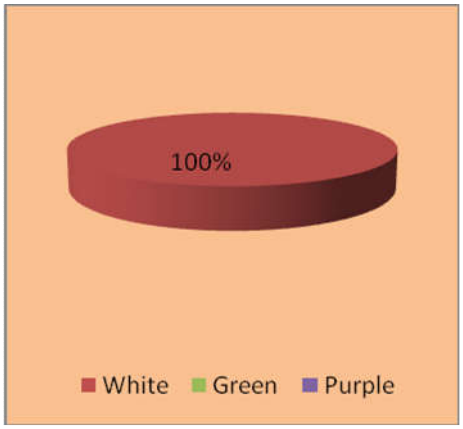
Fig. 1: Frequency distribution of genotype based on morphological characters



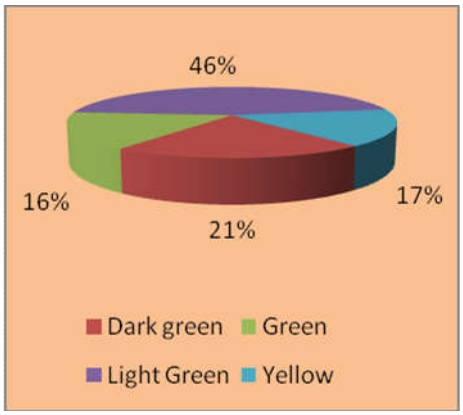
Basal Leaf Sheath Colour



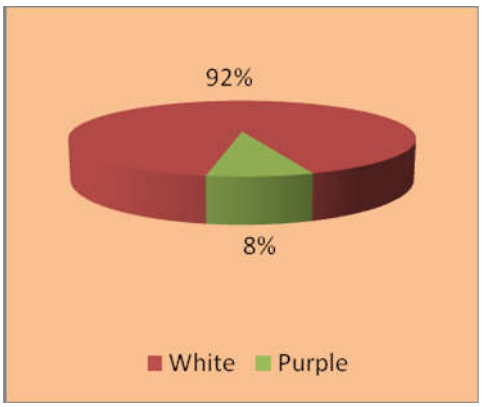
Leaf Colour



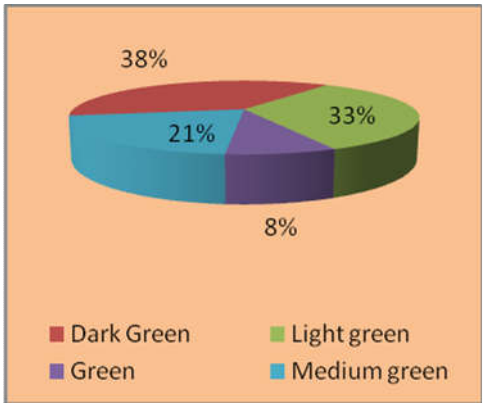
Coleoptile Colour



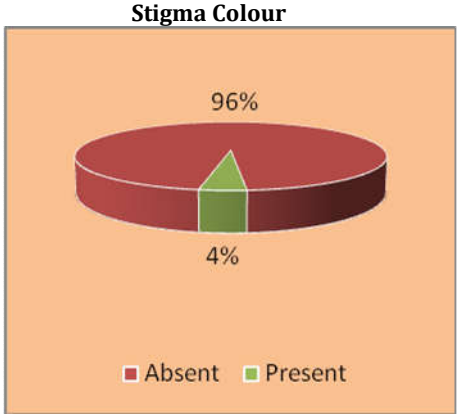
Seedling Colour



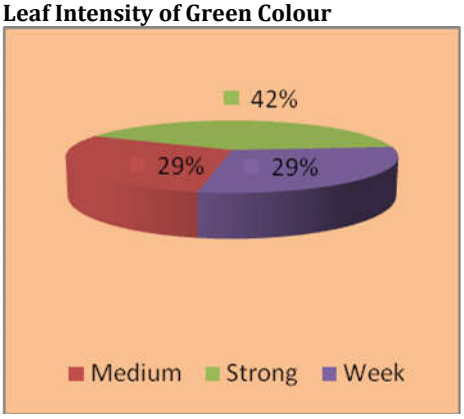
Stigma Colour



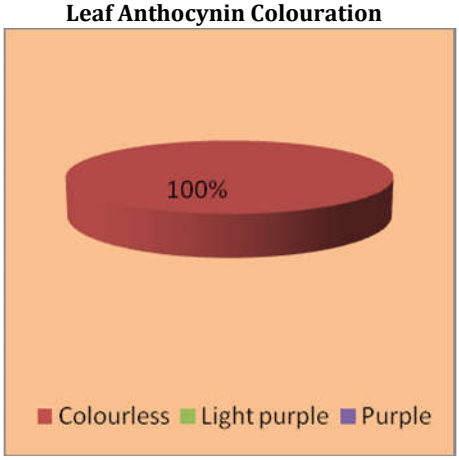
Leaf Intensity of Green Colour



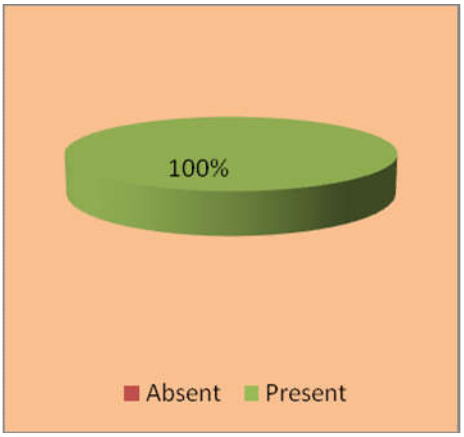
Leaf Anthocynin Colouration



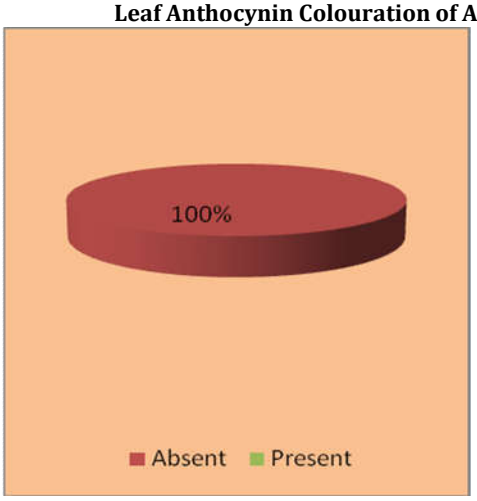
Leaf Pubescence of Blade Surface



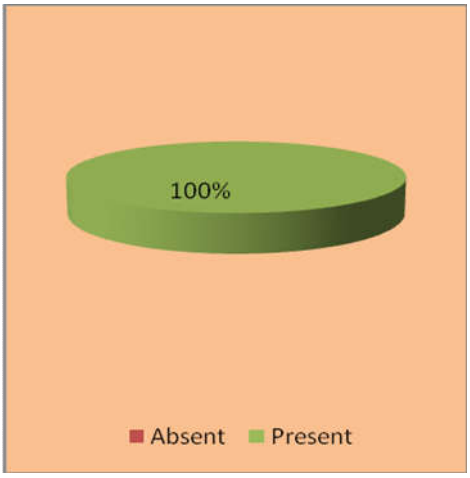
Leaf Anthocynin Colouration of Auricle



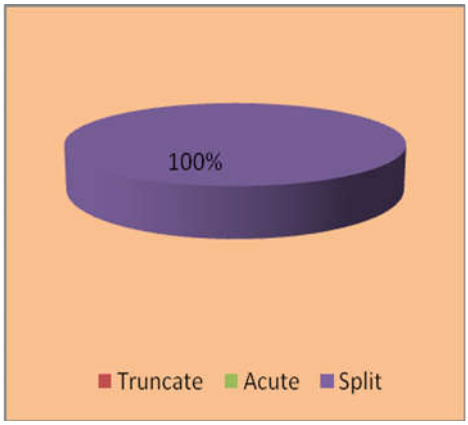
Leaf Collar



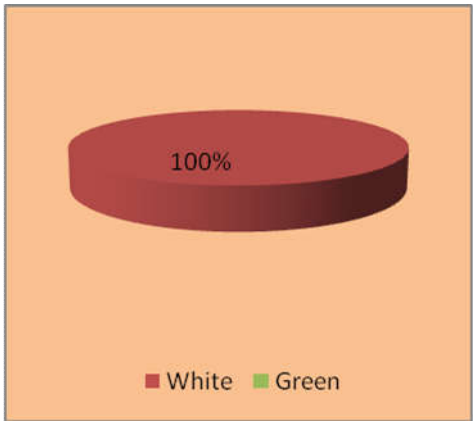
Leaf Anthocynin Colouration of Collar



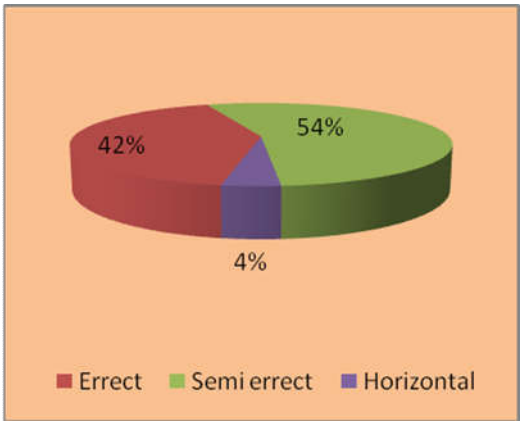
Ligule



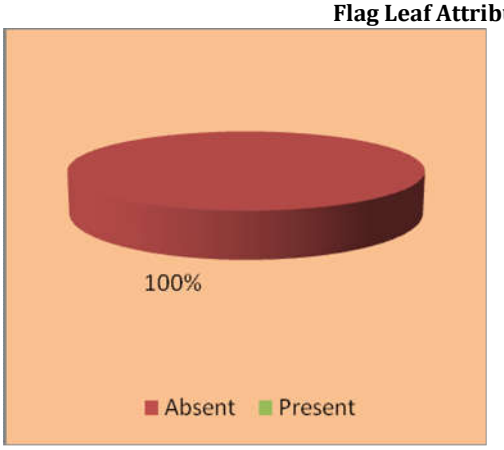
Shape of Ligule



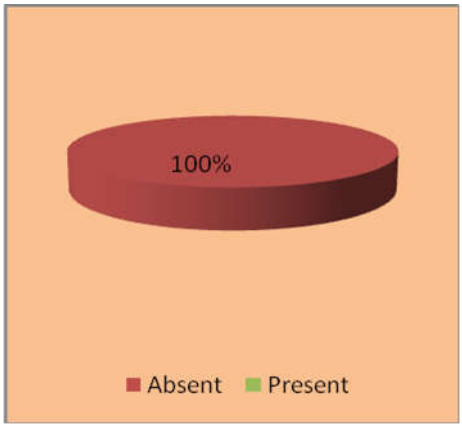
Colour of Ligule



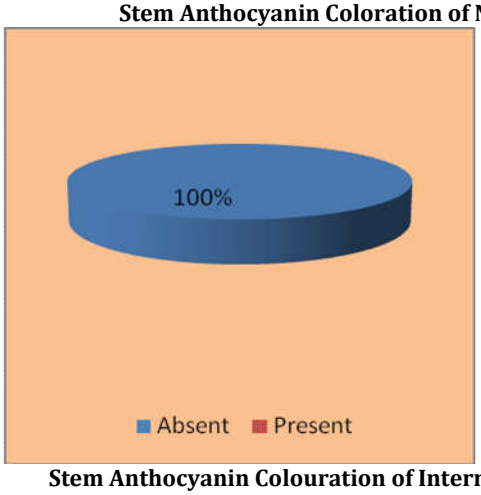
Flag Leaf Attribute of Blade



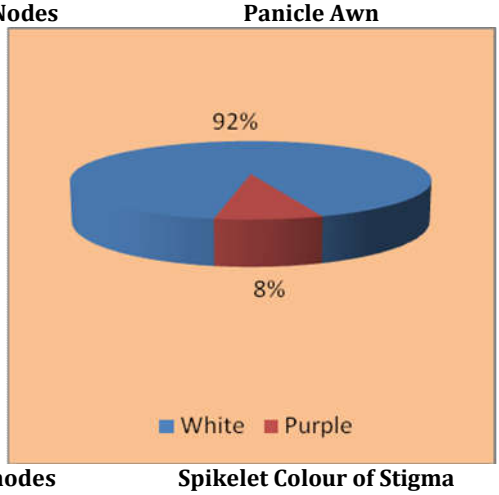
Stem Anthocyanin Coloration of Nodes



Panicle Awn

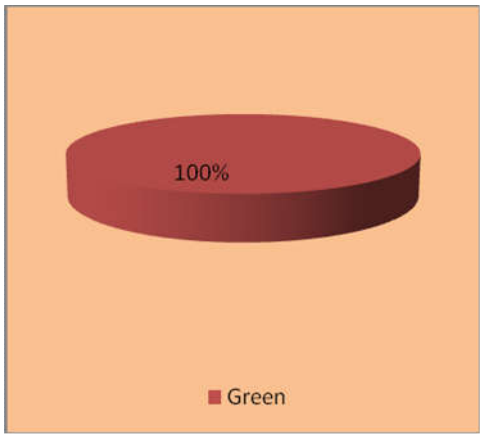


Stem Anthocyanin Colouration of Internodes

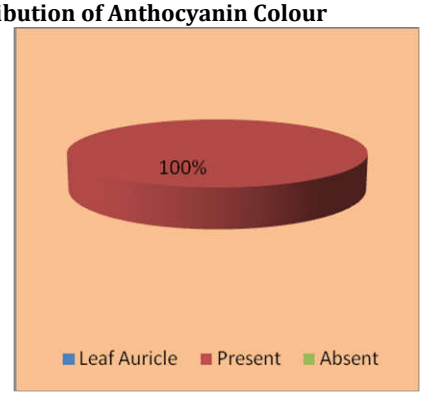


Spikelet Colour of Stigma

Leaf Distribution of Anthocyanin Colour



Auricle



Leaf Auricle

Table: 2.1- Descriptive statistics of 24 rice germplasm accessions

S. No.	Characters		Range		C.D.	SE(m)	SE(d)	C.V.
		Mean	Min.	Max.				
1	Coleoptile length (cm)	0.292	0.1	0.533	0.11	0.038	0.054	22.842
2	Seedling length (cm)	8.403	6.33	12.66	1.441	0.505	0.714	10.471
3	Leaf length (cm)	51.419	31.6	70.46	10.032	3.513	4.968	11.832
4	Leaf width (cm)	1.61	1.03	2.1	0.358	0.125	0.177	13.49
5	Plant height (cm)	108.332	77.36	152.7	7.613	2.666	3.77	4.262
6	Panicle length (cm)	24.804	21.7	29.63	2.19	0.767	1.085	5.355
7	No. of tillers per plant	24.181	8.66	67.66	11.648	4.079	5.768	29.216
8	No. of effective tillers per plant	22.931	8.33	67.66	10.386	3.637	5.143	27.471
9	Biological yield (g)	157	63	281	0.016	0.006	0.008	6.125
10	Grain yield (g)	41	12	93	4.435	1.553	2.196	9.906
11	Harvest index	27.151	9.07	45.69	0.007	0.003	0.004	10.508
12	Filled spikelets per panicle	175.917	77.33	265.33	17.646	6.179	8.738	6.084
13	Unfilled spikelets per panicle	59.125	23	216	8.884	3.111	4.4	9.114
14	100 Grains weight (g)	2.216	1.63	3.08	0.064	0.022	0.032	1.749
15	Grain length (mm)	8.451	5.83	9.9	0.174	0.061	0.086	1.247
16	Grain width (mm)	2.556	2.03	3.3	0.151	0.053	0.075	3.586

Table: 2.2- Analysis of variance for 24 quantitative characters

Characters	Mean sum of squares		
	Replication (d.f.= 2)	Treatment (d.f.= 23)	Error (d.f.= 46)
1-Coleoptile length (cm)	0.001	0.053	0.004
2-Seedling length (cm)	0.847	7.796*	0.789
3-Leaf length (cm)	0.11	307.669**	37.018
4-Leaf width (cm)	0.062	0.236	0.047
5-Plant height (cm)	54.279	2,035.99**	21.32
6-Panicle length (cm)	0.602	12.43**	1.765
7-No. of tillers per plant	3.097	664.55**	49.909
8-No. of effective tillers per plant	15.681	635.825**	39.681
9-Biological yield(g)	0.002	0.011	0.006
10-Grain yield (g)	0.001	0.001	0.004
11-Harvest index	1.152	353.908**	7.234
12-Filled spikelets per panicle	76.792	4,664.24**	114.531
13-Unfilled spikelets per panicle	12.542	5,209.88**	29.034
14-100 Grains weight (g)	0.002	0.35	0.002
15-Grain length (mm)	0.014	1.976	0.011
16-Grain width (mm)	0.007	0.284	0.008

** Significant at 1% and * Significant at 5%

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