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RESEARCH ARTICLE

CHARACTERIZATION AND CORRELATION ANALYSIS FOR YIELD AND YIELD CONTRIBUTING TRAITS IN MEDIUM DURATION GERMPLASM ACCESSIONS OF RICE (*ORYZA SATIVA* L.)

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ABSTRACT

Undomesticated crops species acquire huge possible and most precious gene which can be successfully utilized in crop improvement to develop high yielding rice varieties. The two hundred fifty eight rice germplasm accessions were used in present study. Simple statistics (means, ranges, standard deviation and coefficient of variation) was measured to have a reflection of the level of genetic variability. Frequency distributions of qualitative traits were short out the genotypes into diverse classes. In quantitative traits, days to 50% flowering and days to maturity readily exist C.V. value not much than 10%. On the other hand, most of the characters cover high C.V. values over 10% and prominent to 28.56% for leaf length. Leaf length ($r=0.238$ at $p<0.05$) and effective tiller ($r=0.375$ $p<0.05$, 0.01) shows significant positive correlation with grain yield. As tillering in rice is a important determinant for panicle production and as a result, it affects total yield. In view of all desirable traits four rice germplasm i.e. IC 377061IC 300784, IC 376585, and. IC 145381, accessions were identified.

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INTRODUCTION

Rice (*Oryza sativa* L.) is the world's very important food crop gathered and a foremost resource of food for more than half the world's population and forms the cheapest foundation of food, energy and protein. Land races acquire high protein content than high yielding varieties which were developed mainly to optimize yield and not the nutritional value (Sindhumole, 2012). Landraces serve various desirable genes. Breeders can hold the potential and most precious gene and effectively utilized in the breeding programmes to expand high yielding rice varieties with quality, biotic and abiotic stresses. Ultimate assessment of the levels and patterns of genetic diversity can be priceless in crop breeding for various applications in concert with (1) analysis of genetic variability in landrace genotype (Cox *et al*., 1986), (2) identifying various parental combinations to generate segregating progenies with maximum genetic variability for further assortment (Barret & Kidwell, 1998), and (3) introgressing advantageous genes from assorted germplasm into the existing genetic base (Thompson *et al*.,1998). Qualitative traits have been recognized as the worldwide undoubted descriptors for germplasm characterization.

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A major purpose of varietal characterization is to establish the distinctiveness between the germplasm and also to establish their unique detection profiles on the basis of grouping individuality prescribed by Distinctness Uniformity Stability (DUS) guidelines. Morphological description is the first step for classification and evaluation of the germplasm. It is an essential tool for selecting varieties or lines based on agronomical, morphological, genetic or physiological characters. The present investigation is based on the characterization and correlation analysis for two hundred fifty eight, medium duration rice germplasm accessions for different morphological trials and identify the better accessions for further breeding programme.

MATERIALS AND METHODS

The investigational resources comprised of 258 rice germplasm accessions (landraces) received from NBPGR, New Delhi. These genotypes were evaluated in augmented design (Federer 1961) with six checks *viz*., Pusa Basmati, Jaya, NDR97, Annada, Swarna and IR64 during *Kharif* 2012 at Research cum Instructional farm, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh. Twenty two days old seedlings were transplanted. Each plot consisted of three rows of 3 m length, with the spacing of 20 x 15 cm and the standard packages of practices were followed for growth of

crop. Phenotypic data were collected for eighteen qualitative traits *viz.*, coleoptile colour, early plant vigour, basal leaf sheath colour, leaf blade colour, leaf pubescence, flag leaf angle, ligule shape, auricle colour, panicle exertion, panicle type, stigma colour, apiculus colour, awning, hull colour, sterile lemma colour, seed coat colour, aroma and threshability at the suitable growth stage of rice germplasm accessions. A total of eleven quantitative traits i.e. leaf length (cm), leaf width (cm), days to 50% flowering, number of effective tillers, plant height (cm), panicle length (cm), days to maturity, L/B ratio, 100 seed weight (g), grain yield/plant (g), and seedling height (cm), were measured with five random healthy plants from inside rows were tagged from each plot for data collection at suitable stage of rice plant. Simple statistics (means, ranges, standard deviation and coefficient of variation) was considered for calculating the level of genetic diversity.

Table 1. Mean ± S.E. range, Coefficient of variation and standard deviation with important yield and yield attributing traits of rice germplasm accessions

Traits	Range	Mean ± SE	SD	CV%
1	31.96 - 80.06	41.77 ± 0.73	11.93	28.56
2	0.80-2.33	1.30 ± 0.017	0.28	21.58
3	79.0 -110	102.51 ± 0.19	3.18	3.10
4	4.0 - 9.0	7.67 ± 0.073	1.19	15.51
5	78.0 - 176.0	137.67 ± 0.98	15.97	11.6
6	20.0 - 36.0	24.17 ± 0.19	3.23	13.36
7	109.0 - 145.0	132.51 ± 0.20	3.40	2.56
8	2.0 - 5.83	2.93 ± 0.04	0.73	24.91
9	2.10 - 4.90	3.04 ± 0.02	0.37	12.17
10	10.85 - 38.0	23.84 ± 0.39	6.41	26.88
11	11.0 -29.0	17.74 ± 0.17	2.72	15.33

Note: 1. Leaf length (cm), 2. Leaf Width (cm), 3.Day to 50% Flowering, 4.Effective Tiller/plant 5. Plant Height (cm), 6.Panicle Length (cm), 7.Days to Maturity (Days), 8. L/B Ratio, 9.100 Grain Weight (gm), 10.Grain Yield/Plant (gm), 11. Seedling height (cm)

Table 2. Correlation coefficient among eleven quantitative traits of rice germplasm

Traits	1	2	3	4	5	6	7	8	9	10	11
1	1	0.275**	0.127	0.125	0.351**	0.026	0.115	- 0.069	- 0.054	0.238**	-0.0174
2			0.099	0.092	0.240	0.383**	0.978	- 0.282	- 0.070	0.302**	0.002
3				0.140	0.248*	0.152	0.980	0.035	0.156	0.098	-0.051
4					0.170	0.125	0.146	- 0.113	0.060	0.375**	-0.189
5						0.143	0.241*	0.022	0.138	0.390**	-0.041
6							-0.148	0.054	0.095	0.049	0.013
7								0.0117	0.148	0.103	-0.052
8									0.033	-0.215*	-0.028
9										0.117	0.073
10											0.027
11											1

Note: 1. Leaf length (cm), 2. Leaf Width (cm), 3.Day to 50% Flowering, 4.Effective Tiller/plant 5. Plant Height (cm), 6.Panicle Length (cm), 7.Days to Maturity (Days), 8. L/B Ratio, 9.100 Grain Weight (gm), 10.Grain Yield/Plant (gm), 11. Seedling height (cm)

Correlation coefficients were also computed among various characters and also frequency distributions were computed for the genotypes identification into diverse classes.

RESULTS AND DISCUSSION

In current study, essential statistical parameters apply for the eleven quantitative traits i.e., seedling height (cm), days to 50% flowering, days to maturity, grain length (mm), grain width (mm), paddy L/B ratio, 100 seed weight (g), plant height (cm), panicle length (cm), number of productive tillers and grain yield/plant (g) (Table 1). The success of plant breeding programs relies heavily on the existence of genetic variability in plants for a particular trait (Fakruddin *et al.,* 2015). There is adequate genetic variations ware recorded and evaluated in various traits.

Days to 50% flowering and days to maturity readily present C.V. value not more than 10%. Frequency distribution of well known 11 quantitative traits which present in Fig. 2. The identified germplasm accessions may be used to genetic source for crop improvement.

Assessment of quantitative traits of rice germplasm accessions

Leaf Length (cm): Leaf Length exhibit high coefficient of variation of 28.56% with range of 31.96 cm.-80.06 cm and mean of 41.77cm. More than 50% of accessions came in the range of 46-60cm fig. 2. The highest leaf length ware measured in accession IC 377499 (80.06 cm). The average of leaf width is 1.301 cm which range from 0.80-2.33 cm. IC 301206 shows maximum leaf width and with significant grain yield i.e. 30 gm. per plant. The result of present study is similar to Sangeeta Das and Amitav Ghosh (2010). Maximum variability was found in Leaf blade. The evenly distributed narrow and short leaves can reduces proficient use of light.

Days to 50% flowering (Days): Days to 50% ranges from 79-110 days with the average of 102.5. The trait was categorized into five groups **i.e.** Very early (<71 days), Early (71-90 days),

Medium (91-110 days), Late (111-130 days) and Very Late (>130 days). In present study all accessions belongs to medium duration i.e. 92-105 days (excluding commercial check varieties). The variation is considerably low (3.0%) may be because of most of germplasm accessions are belong to one group.

Number of effective/Productive tiller

No of productive tillers/plant showed 5.51% coefficient of variation Ali *et al.,* 2000 have also recorded high coefficient of variability for this traits. The maximum effective tillers were recorded in IC 376585 (18 tillers/plant) while the minimum effective tillers per plant were recorded in IC 377812 (9 tillers/plant) with grain yield 38.0gm and 21.6 gm per plant correspondingly. The Effective tillers/plant in rice crop is a major determinant for panicle production (Miller *et al*., 1991, Smith *et al*., 2003), this traits affects total yield (Gallagher *et al.,* 1978). Similar finding were also reported by Dutta *et al*., 2002.

Plant height

The mean value of plant height was measured 137.67 cm with the ranges from 78.0 to 176.0 cm and its coefficient of variation is 11.60%. The plant height was considered into five groups ***viz.***, very short (< 91 cm), short (91-110 cm), medium (111-130 cm), long (131-150 cm), very long (>150 cm) in which one accession i.e. IC 145351 showed very short, two accessions (IC 145446 and IC 145361) recorded short plant height, while generally the accessions belongs to Medium(30 accessions), long (147 accessions) and very long (76 accessions) group respectively. More than 50% of the accessions ranges from 132-159 cm. Plant height in rice is generally considered to be controlled by both qualitative and quantitative genes (Huang *et al*., 1996). Ashrafuzzaman *et al*., 2009 also considered that, this trait mainly governed by genetic constitute of the genotypes, but the ecological factors also influence the plant height.

Panicle length

Adequate quantity of variation was found in panicle length and it ranges from 20-36 cm. and average panicle length was measured 24.17 and coefficient of variation was found 13.36 cm. The maximum and minimum panicle length was recorded in IC 1454379 (36 cm) and IC 145392 (27.4 cm) with the maximum grain yield of 27.4 and 16.4 gm. per plant respectively. While it contribute positively yet maximum panicle length is not due only factor accountable for higher grain yield (Abbasi *et al.,*1995). The panicle length alone does not conclude the high grain yield because traits such as grain size, grain shape higher number of tiller/plants ultimately to higher grain yield (Akram *et al*., 1994).

Days to maturity

In present investigation maturity was ranges from (109-145 days) along with coefficient of variation 2.56%. Environmental factors mainly temperature were influence the rice flowering and maturity. The days to maturity was categorized into five groups i.e. Very early (<100 days), Early (101-120 days), Medium (121-140 days), Late (141-160 days) and Very Late (>160 days). In present study all accessions (excluding commercial check varieties) belongs to medium duration i.e. 122-135 days. High yield desirable traits and achieve by growing of early maturing varieties because it would more efficient to daily production of carbohydrates and more efficient utilization of land (Anon, 1971). Similarly, early maturing varieties increased grain production per day, increased water use efficiency, required closed spacing to achieve yield potential, while late maturing varieties were adapted to low fertility conditions (Yoshida, 1977).

Paddy L/B ratio

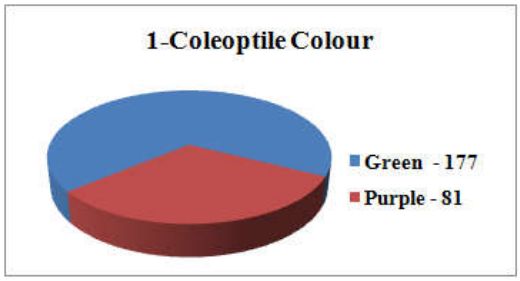
In the present material paddy grain L/B ratio ranges from 2.0-5.83 with grand mean of 2.93 and coefficient of variation 24.91. The maximum and minimum L/B ratio was measured in IC 377531 (5.3 mm) and IC 300147 (2.7 mm) with grain yield 8.8 gm/plant and 29.6 gm/plant respectively. Similarly, Akram *et al,* 1995 also reported that rice grain can be classified into extra long, long medium and short group.

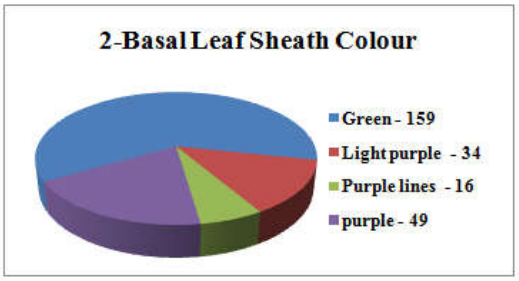
100 grain weight

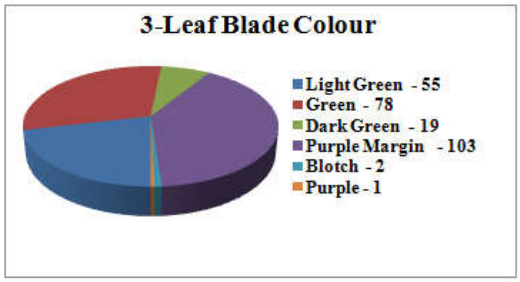
In present investigation IC 377621 were measured maximum 100 grain weight 4.90 gm. and ranges from 2.10-4.90 and the coefficient of variation was recorded 12.17 Ali *et al*., 2000 observed maximum variation for 100-grain weight in rice ranging from 2.80 to 4.68 g.

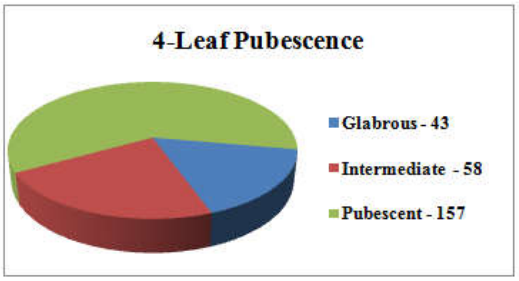
Assessment of qualitative (Agro- morphological) traits of rice germplasm accessions

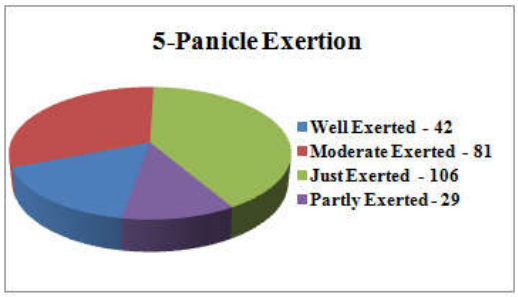
Qualitative traits are important for plant description (Kurlovich, 1998) and germplasm characterization can be at species, variety and cultivar levels. Characterization of rice germplasm accessions for different morphological and agronomic traits to identify the variability available in the collection Sarawgi *et al.* 2013Frequency distribution for eighteen qualitative traits is given in Fig. 1. Large amount of variability has been reported in rice for productivity and quality traits and most of the studies indicated considerable differences between genotypic and phenotypic variability indicating the influence of environment (Dhanwani *et al*., 2013). In coleoptile colour had 177 accessions found green coleoptile colour while 81 with purple coleoptile. A series of morphological characters accountable for identification of rice cultivars exposed that plant morphological characters *viz*, awn colour, leaf blade colour and leaf sheath colour were the most important morphological characters for varietal identification. In the present study, Out of 258 germplasm basal leaf sheath colour showed green colour accessions in most prominent in germplasm accessions. Out of 258 accessions, 159 accession noted green basal leaf sheath colour where as purple line, light purple and purple colour were exhibited by 16 accessions, 34 accessions and 49 accessions respectively. The leaf blade colour classified in to light green colour 55 accessions green78 accessions dark green 19 accessions, purple margin 103 accessions, purple blotch 02 accessions and purple colour 01 accessions.

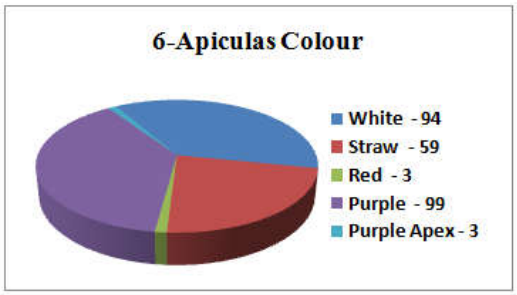

1-Coleoptile Colour
Green - 177
Purple - 81

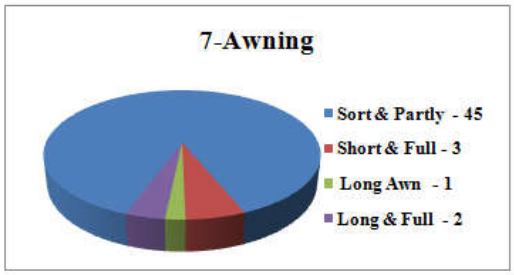

2-Basal Leaf Sheath Colour
Green - 159
Light purple - 34
Purple lines - 16
purple - 49

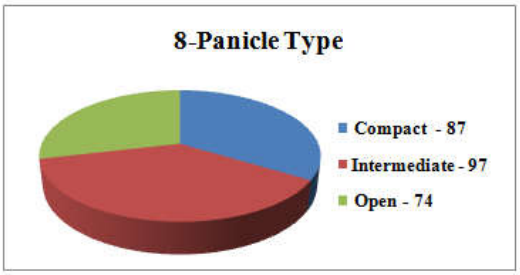

3-Leaf Blade Colour
Light Green - 55
Green - 78
Dark Green - 19
Purple Margin - 103
Blotch - 2
Purple - 1

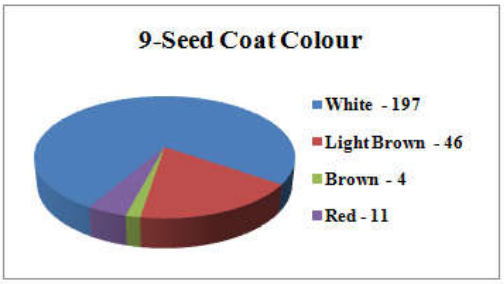

4-Leaf Pubescence
Glabrous - 43
Intermediate - 58
Pubescent - 157

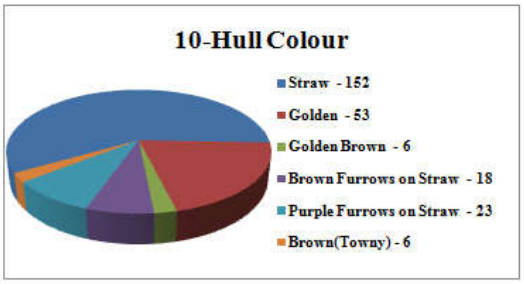

5-Panicle Exertion
Well Exerted - 42
Moderate Exerted - 81
Just Exerted - 106
Partly Exerted - 29


6-Apiculas Colour
White - 94
Straw - 59
Red - 3
Purple - 99
Purple Apex - 3

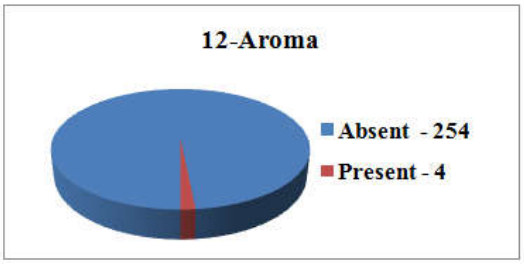

7-Awning
Sort & Partly - 45
Short & Full - 3
Long Awn - 1
Long & Full - 2


8-Panicle Type
Compact - 87
Intermediate - 97
Open - 74


9-Seed Coat Colour
White - 197
Light Brown - 46
Brown - 4
Red - 11


10-Hull Colour
Straw - 152
Golden - 53
Golden Brown - 6
Brown Furrows on Straw - 18
Purple Furrows on Straw - 23
Brown(Towny) - 6


11-Threshability
Easy - 127
Intermediate - 69
Difficult - 62


12-Aroma
Absent - 254
Present - 4

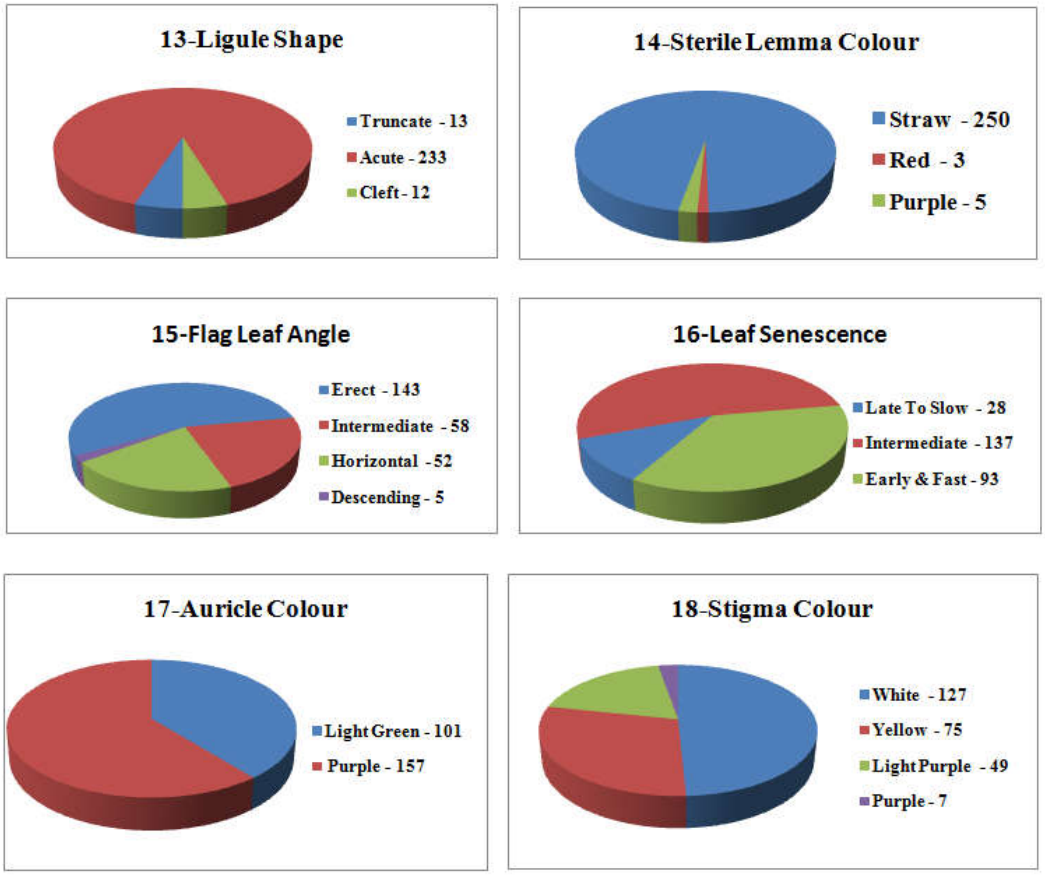
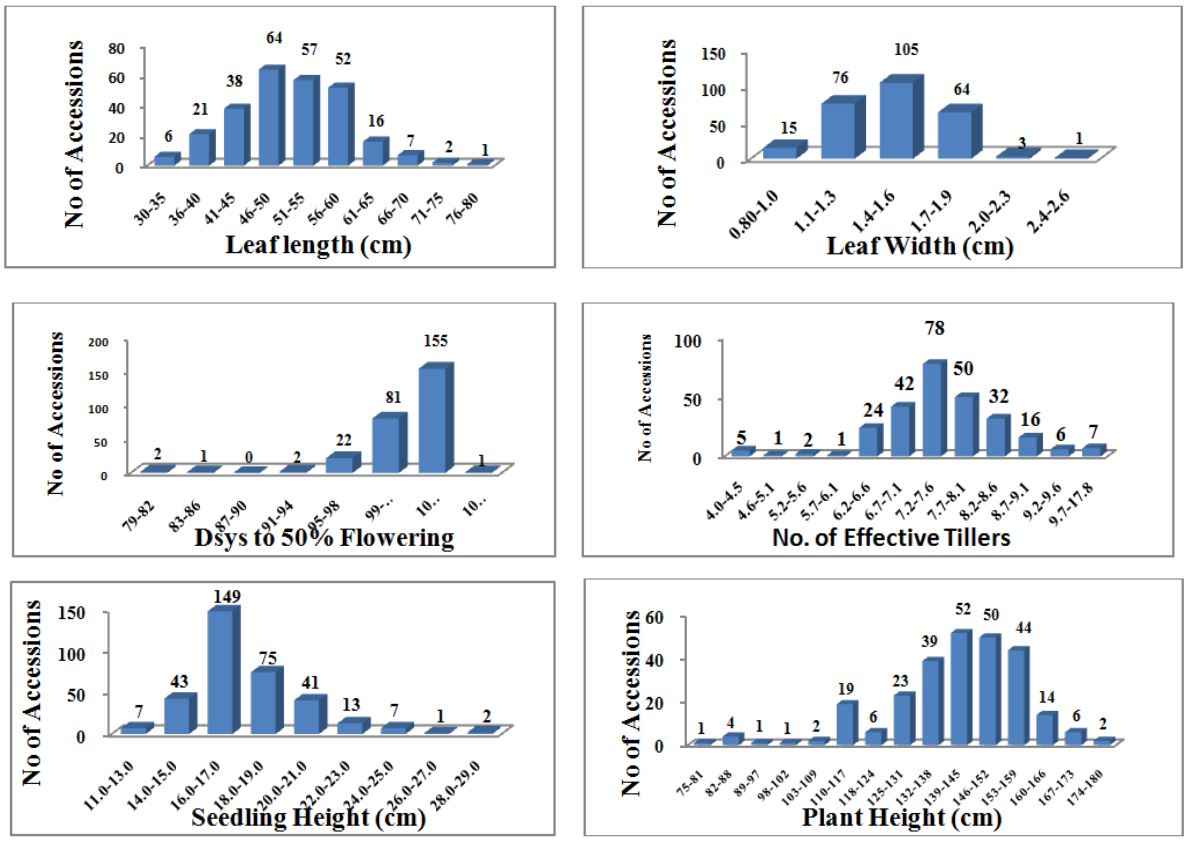


Fig. 1. Frequency distribution for nineteen qualitative traits in landrace genotypes of rice evaluated



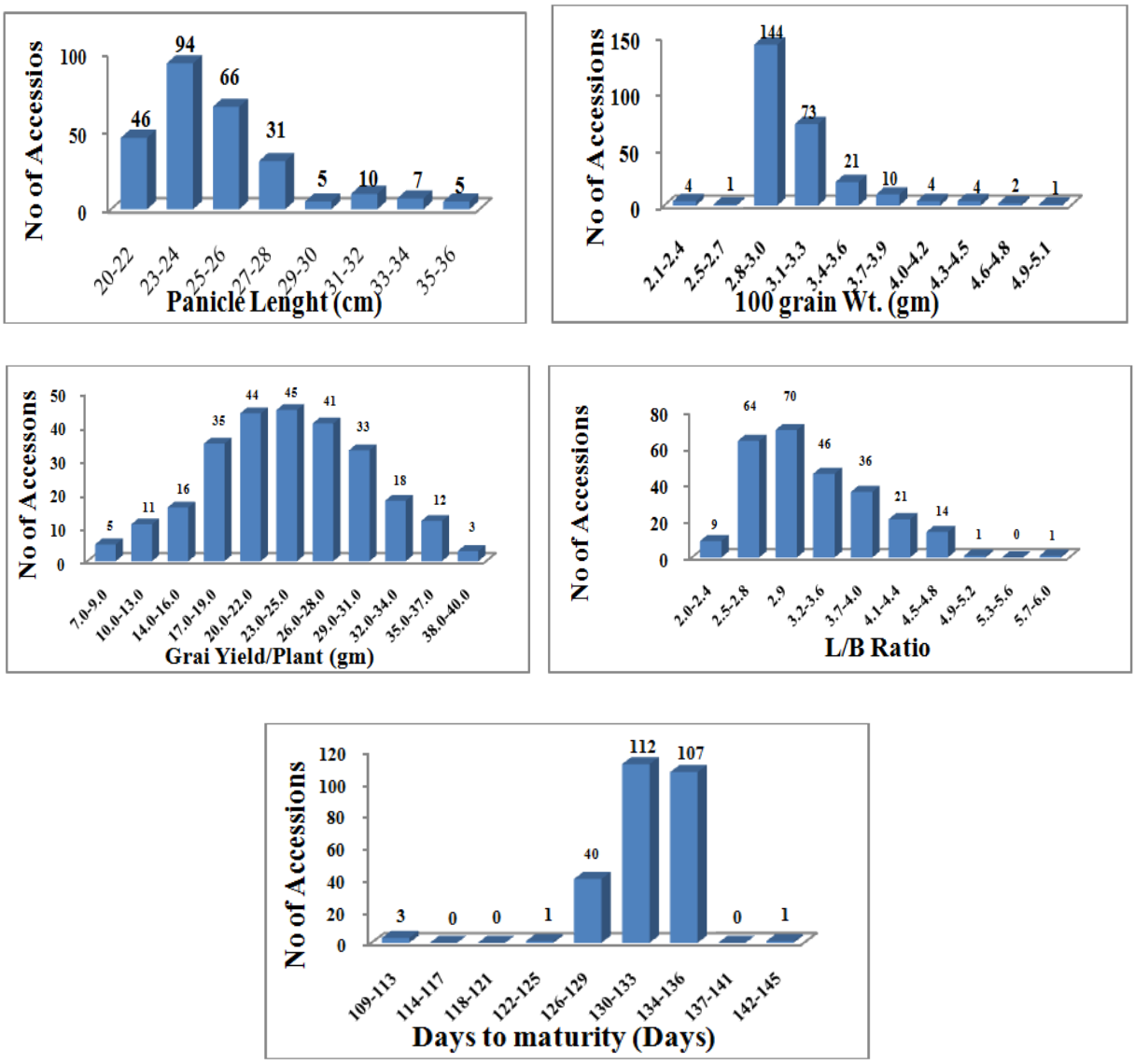


Fig.2. Frequency distribution of eleven quantitative traits in indigenous germplasm of rice

In leaf pubescence, pubescence type was more prominent i.e. 157 followed by intermediate pubescence 58 and glaborous type 43 accession. Ilhamuddin *et al*. (1988) found that panicle exertion was the most conspicuous character for identification of the rice cultivars. Panicle exertion have 42 well exerted, 81 accessions moderate exerted, Just exerted 106 accessions and partially exerted 29 accessions. Stigma colour with white colour has 127 accessions followed by 75 for yellow colour, 49 light purple, colour and purple 07. In Apiculus colour, out of 258 accessions, 94 accessions were white apiculus colour, 59 accessions Straw colour, 03 accession red colour, 99 accession purple and 03 accessions are with purple apex.

Out of 258 accessions, 207 accessions had awnless and 51 accessions have awns. The awns are distributed consequently short partial 45, Short full 03, long awn 01 and long full 02 accessions. Acharya *et al*. (1991) stated that awns appear to be equipped with physiological and biological buffers that enable them to adjust to changes in the environment. Awn color also exhibited wide variation ranging from straw to different shades of brown color. While variation was high in panicle type in which compact type has 87 accessions intermediate type 97 and 74 accessions were found opened type panicle. Seed coat colour/Kernel colour had white colour for 197 accessions, 46 accessions has light brown 4 accession has brown colour accession and 11showed red seed coat colour. Hull colour exhibited considerable variation, out of 258 accessions 152 has straw colour, golden colour has 53 accession followed by purple furrow on straw 23 accession, brown furrow on straw has 18 accession, golden brown 06 and 06 accessions showed brown tawny. Threshability classified in to easy, intermediate and difficult. Out of two hundred fifty eight accessions, 127 accessions easy, intermediate 69 accessions and difficult 62 accessions. Aroma is absent in most of the accessions i.e. absent in 254 accession and present 04 accessions. The ligule shapes had 13 acute, cleft 233 and truncate 12 accessions. Flag leaf angle classified as erect, intermediate, horizontal and drooping. The wider angle more spread of leaves for light

interception, especially in the lower leaves in present study flag leaf angle had 143 accession erect type, intermediate 58, horizontal 52 accession and drooping 05 accession. Leaf senescence; were categorized in three groups i.e. early, intermediate and late, out of two hundred fifty eight accessions, 28 late & slow in which leaves were natural green, intermediate 137 accession in this yellowing for on upper leaves and early type &fast was 93 accession, in which all yellow or dead. Slow leaf senescence is a desirable trait in nitrogen responsive plant types (Beachell, 1964).Out of 258 accessions, sterile lemma were exhibited; straw colour 250 accessions and remaining red and purple 03 accessions, 05 accessions respectively.

Auricle colour

Light green in auricle colour had found in 157 and purple colour 101 accessions. The morphological characters *viz*., grain colour, colour of sterile lemma, awns, was also helpful and paddy varieties could be grouped into distinct classes on the basis of each of these traits. On the other hand, they may be altered by external factors. These traits should be used as secondary diagnostic characters.

Correlation

Correlation is a measure of the degree to which variable vary together or calculate of intensity of association. The correlation coefficient among ten quantitative traits of rice germplasm had been studied (Table 2) in which leaf length was positive and significant correlation to leaf width ($r=0.275$ at $p < 0.05, 0.01$), plant height ($r=0.351$ at $p<0.05, 0.01$) and also with grain yield ($r=0.238$ at $p<0.05$). Leaf width show positive correlation with panicle length $r=0.383$ $p<0.05, 0.01$) and grain yield ($r=0.302$ $p<0.05, 0.01$), however days to flowering shows only significant positive correlation with plant height ($r=0.248$, $p<0.05$) Sawant *et al*., 1995 also find significant positive correlation with plant height Similar results were reported by Deepa Sankar *et al*. (2006) and Singh *et al*. (2006). Effective tiller shows significant positive correlation with grain yield ($r=0.375$ $p<0.05, 0.01$). The finding of present investigation is agreement with the earlier worker *viz*., Venkata Laxmi *et al.,* 2014, Deepa Shankar *et al.*, 2006 and Ravindra babu *et al.*, 2012; they have also recorded the positive correlation of effective tiller with yield per plant. Plant height positive and significant to days to maturity ($r=0.24, p <0.05$) and grain yield ($r=0.390$, $p<0.05,0.01$) similar finding were also recorded positive and significant association with grain yield per plant by the Yadav *et al*., 2011. L/B ratio shows negative significant correlation with grain yield ($r= -0.215$ $p<0.05$). Venkata Lakshmi *et al.,* 2014 L/B ratio had also recorded non-significant association with grain yield per plant for character of L/B ratio.

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