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# Assessment of Variability of Aromatic Rice Using Agro-Morphological Characterization

**Nidhi Kujur, Sandeep Bhandarker, Yogita Shrivas and Alice Tirkey***

Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, College of Agriculture, Raipur- 492012, Chhattisgarh, India
**Corresponding author*

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**A B S T R A C T**

The present investigation was carried out to characterize 47 rice genotype accessions on the basis of 31 morphological traits. Most of the morphological characters showed variation in different accessions except coleoptile: colour, Leaf: auricle, Leaf: anthocyanin colouration of auricles, Leaf: collar, Leaf: anthocyanin colouration of collar, Leaf: ligule, Panicle: presence of secondary branching and decorticated grain: aroma. A significant amount of variation was displayed for most of the agronomical traits examined.

## Introduction

Rice (*Oryza sativa* L. 2n=24) is one of the most important cereal crop that has been referred as "Global Grain" because of its use as prime staple food in about 100 countries of the world. In world, rice has occupied an area of 160.6 million hectares, with a total production of 738.20 million tones and productivity 3424.41 kg/ha (FAO, 2015). India being the second largest producer of rice after china, has production of 105.48 million tones with productivity 3020 kg/ha (FAO, 2015). Central India is well known for its native wealth of rice genetic resources and among these the large number of indigenous short grained, scented varieties cultivated in different pocket of Madhya Pradesh and Chhattisgarh state. Chhattisgarh popularly known as "Rice Bowl of India" occupies an area around 37.73 lakh hectares with the production of 60.28 lakh tones and productivity 1597 kg/ha (Anon, 2015).

The Indian aromatic rice, often called Basmati is nature's gift to the sub-continent and human kind at large (Ahuja *et al.*, 1995). With growing demand for aromatic rice in international market high emphasis was placed till now on improvement of basmati types. The improvement of indigenous small and medium grained aromatic rice, which possess outstanding quality like aroma, kernel elongation after cooking and taste were somewhat neglected as they lacked export value. Almost every state of the country has

its own set of aromatic rice that performs well in native areas. Aroma and taste of short grained aromatic rice specially Badshahbhog and Dubraj is known to be superior to Basmati types (Hossain *et al.,* 2009).

The fine grain aromatic rice is considered high quality rice and fetch a high price in the national and international trade. However, yield per unit area of aromatic rice is very low due to tall plant habit and late maturity. So, broadening the genetic base of rice is an essential requirement for aromatic rice improvement programme.

Scented rice is very much liked to its unique aroma, grain dimension, cooking quality and palatability etc. Most of the information we have so far is about common varieties and our knowledge about aromatic rice is still incomplete. In every increasing global demand for aromatic rice has been noted in the recent times. Therefore, in this context an attempt is made to characterize a set of aromatic rice for different morphological and agronomic traits and to identify the variability available in the collection.

## Materials and Methods

The present study was conducted using about 47 aromatic genotypes of rice were selected for this study including 3 popular checks viz., Kalanamak, Badshahbhog and Indira Sugandhit Dhan-1 in a Randomized Block Design (RBD) with two replications. Each genotype was grown in on plot size was 5m X 2m with row to row distance was 20 cm and plant to plant distance was 15 cm. These genotypes were received from DRR Hyderabad. The recommended agronomical practices were followed to raise good crop in the season.

Five random plants from each of the plot were chosen for recording 29 morphological and 11 agronomical characters. The studied were Coleoptile: colour, Basal leaf: sheath colour, Leaf: intensity of green colour, Leaf: anthocyanin colouration, Leaf sheath: anthocyanin colouration, Leaf sheath: intensity of anthocyanin colouration, Leaf: pubescence of blade surface, Leaf: auricles, Leaf: anthocyanin colouration of auricles, Leaf: collar, Leaf: anthocyanin colouration of collar, Leaf: ligule, Leaf: shape of ligule, Leaf: colour of ligule, Leaf: length of blade, Leaf: width of blade, Culm: attitude, Time of heading (50% of plants with panicles), Flag leaf: attitude of blade, Spikelet: density of pubescence of lemma, Spikelet: colour of stigma, Stem: length, Stem: anthocyanin colouration of nodes, Stem: intensity of anthocyanin colouration of nodes, Stem: anthocyanin colouration of internodes, Panicle: length of main axis, Panicle: number effective tillers per plant, Lemma and palea: colour, Panicle: awns, Panicle: presence of secondary branching, Panicle: attitude of branches, Panicle: exsertion, Grain: weight of 1000 fully developed grains, Grain: length, Grain: width, Decorticated grain: length, Decorticated grain: width, Decorticated grain: colour and Decorticated grain: aroma. Frequency distribution was computed to categorize the accession into different classes.

## Results and Discussion

### Morphological characterization

Qualitative characters are important for plant description (Kurlovich, 1998) and mainly influenced by the consumers preference, socioeconomic scenario and natural selection (Hien *et al.,* 2007).

Frequency distribution for 29 qualitative traits is depicted in Table 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, Leaf: auricle, Leaf: anthocyanin colouration of auricles, Leaf: collar, Leaf: anthocyanin colouration of collar, Leaf: ligule, Panicle: presence of secondary branching, and decorticated grain: aroma.

A majority of accessions were found to possess Basal leaf: sheath colour (97.87% green), Leaf: intensity of green colour (44.68% light green), Leaf: anthocyanin colouration (85.10% absent), Leaf sheath: anthocyanin colouration (97.87% absent), Leaf sheath: intensity of anthocyanin colouration (97.87% very weak), Leaf: pubescence of blade surface (40.42% medium), Leaf: shape of ligule (91.48% split), Leaf: colour of ligule (97.87% white), Culm: attitude (61.70% semi erect), Flag leaf: attitude of blade (80.85% semi erect), Spikelet: density of pubescence of lemma (78.72% absent), Spikelet: colour of stigma (95.74% white), Stem: anthocyanin colouration of nodes (97.87% absent), Stem: intensity of anthocyanin colouration of nodes (97.87% weak), Stem: anthocyanin colouration of internodes (97.87% absent), Lemma and palea: colour (70.21% straw), Panicle: awns (82.97% absent), Panicle: attitude of branches (78.72% semi erect to spreading), Panicle: exsertion (74.46% well exserted) and decorticated grain: colour (97.87% white). Some of the unique accessions with distinct features are presented in Table 2.

## Agronomical characterization

Rice accessions were evaluated for 11 agronomical traits viz., Leaf: length of blade, Leaf: width of blade, time of 50% heading, Stem: length, Panicle: length of main axis, Panicle: number of effective tillers per plant, Grain: weight of 1000 fully developed grains, Grain: length, Grain: width, Decorticated grain: Length and Decorticated grain: width from five competitive plants of middle row of each entry.

### Leaf length (cm)

Leaf length ranged from 31.02 to 57.68 with a mean performance of 43.65cm.

The maximum leaf length (57.68) recorded for HUR 1307 and minimum leaf length (31.02) was recorded for PAB 9527.

### Leaf width (cm)

Leaf width ranged from 0.73 to 1.42, with a mean performance of 0.95cm. The maximum leaf width (1.42) recorded for Indira Sugandhit dhan-1 and minimum leaf width (0.95) was recorded for CN1643-3.

### Days to 50% flowering

Days to 50% flowering ranged from 76 to 125 days with a mean performance of 102 days. CR 2947-1-1-5 (125 days) recorded maximum days for 50% flowering, while CSAR 10210 required 76 days for 50% flowering.

### Plant height (cm)

In experimental material plant height was ranged from 92.80 to 198.90 cm with a mean plant height of 126.15 cm. The maximum plant height was recorded in Kalanamak (RC) (198.90cm) and the minimum plant height (92.80cm) was observed in R1656-1146-5-513-1. Ali *et al.,* (2000) have observed relatively greater range in plant height than the other characters. Plant height in rice is a complex character and is the end product of several genetically controlled factors called internodes (Cheema *et al.,* 1987). Reduction in plant height may improve their resistance to lodging and reduce substantial yield losses associated with this trait (Abbasi *et al.,* 1995).

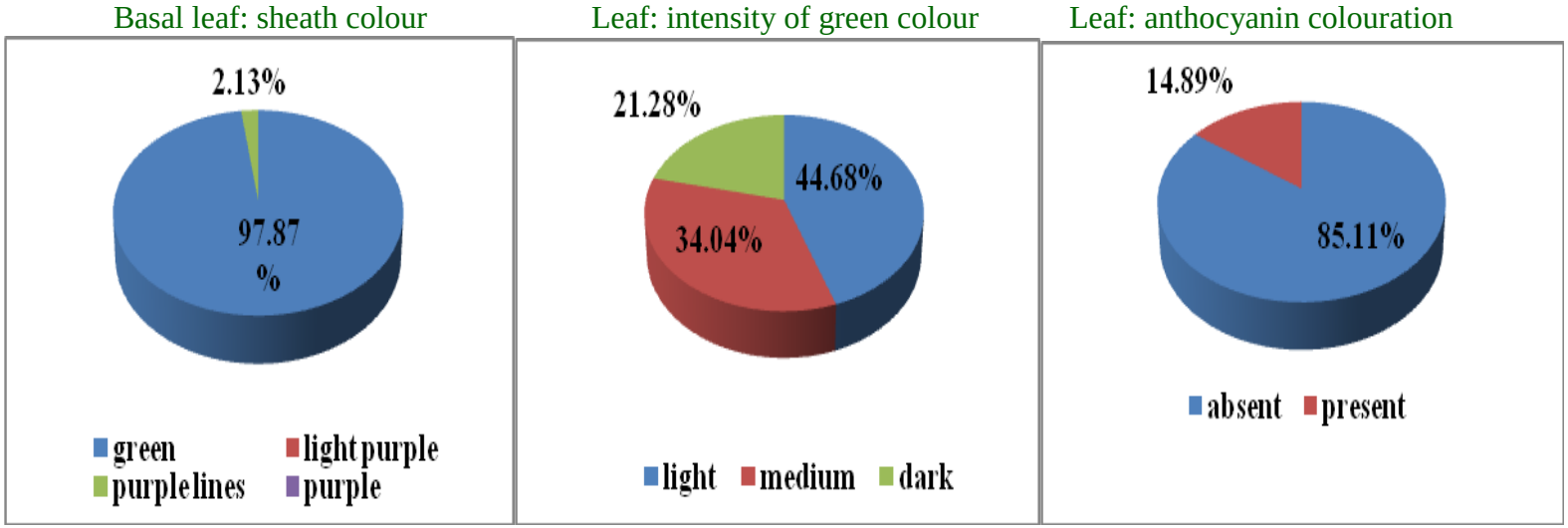
**Table.1** Frequency distribution for morphological characters in rice

| S. No. | Characteristics | Colour pattern/ type | Frequency |
|---|---|---|---|
| 1 | Coleoptile: colour | colourless | 47 |
| | | green | Nil |
| | | purple | Nil |
| 2 | Basal leaf: sheath colour | green | 46 |
| | | light purple | Nil |
| | | purple lines | 1 |
| | | purple | Nil |
| 3 | Leaf: intensity of green colour | light | 21 |
| | | medium | 16 |
| | | dark | 10 |
| 4 | Leaf: anthocyanin colouration | absent | 40 |
| | | present | 7 |
| 5 | Leaf : distribution of anthocyanin colouration | on tips only | 7 |
| | | on margins only | Nil |
| | | in blotches only | Nil |
| | | uniform | Nil |
| 6 | Leaf sheath: anthocyanin colouration | absent | 46 |
| | | present | 1 |
| 7 | Leaf sheath : intensity of anthocyanin colouration | very weak | 46 |
| | | weak | Nil |
| | | medium | Nil |
| | | strong | 1 |
| | | very strong | Nil |
| 8 | Leaf: pubescence of blade surface | absent | Nil |
| | | weak | 17 |
| | | medium | 19 |
| | | strong | 11 |
| | | very strong | Nil |
| 9 | Leaf : auricles | absent | 47 |
| | | present | Nil |
| 10 | Leaf: anthocyanin colouration of auricles | colourless | 47 |
| | | light purple | Nil |
| | | purple | Nil |
| 11 | Leaf: collar | absent | Nil |
| | | present | 47 |
| 12 | Leaf: anthocyanin colouration of collar | absent | 47 |

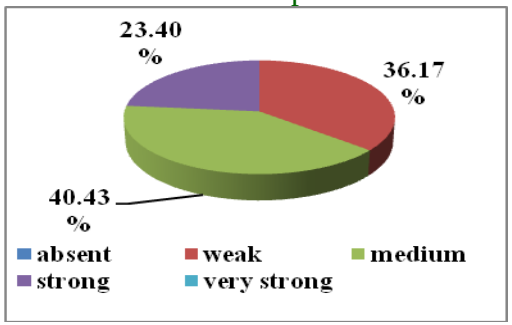
| | | | |
|---|---|---|---|
| | | present | Nil |
| 13 | Leaf: ligule | absent | Nil |
| | | present | 47 |
| 14 | Leaf: shape of ligule | truncate | Nil |
| | | acute | 4 |
| | | split | 43 |
| 15 | Leaf: color of ligule | white/green | 46 |
| | | light purple | 1 |
| | | purple | Nil |
| 16 | Culm: attitude | erect | 13 |
| | | semi-erect | 29 |
| | | open | 3 |
| | | spreading | 2 |
| 17 | Flag leaf: attitude of blade | erect | 9 |
| | | semi-erect | 38 |
| | | horizontal | Nil |
| | | deflexed | Nil |
| 18 | Spikelet: density of pubescence of lemma | absent | 37 |
| | | weak | 6 |
| | | medium | Nil |
| | | strong | 4 |
| | | very strong | Nil |
| 19 | Spikelet: colour of stigma | white | 45 |
| | | light green | Nil |
| | | yellow | Nil |
| | | light purple | Nil |
| | | purple | 2 |
| 20 | Stem: anthocyanin colouration of nodes | absent | 46 |
| | | present | 1 |
| 21 | Stem : intensity of anthocyanin colouration of nodes | weak | 46 |
| | | medium | 1 |
| | | strong | Nil |
| 22 | Stem: anthocyanin colouration of internodes | absent | 46 |
| | | present | 1 |
| 23 | Lemma and Palea: colour | straw | 33 |
| | | gold and gold furrows on straw background | 1 |
| | | brown spots on straw | Nil |
| | | brown furrows on straw | 2 |
| | | brown (tawny) | 8 |

| | | | |
|---|---|---|---|
| | | reddish to light purple | Nil |
| | | purple spots on straw/ purple furrows on straw | Nil |
| | | purple | Nil |
| | | black | 3 |
| 24 | Panicle : awns | absent | 39 |
| | | present | 8 |
| 25 | Panicle: colour of awns (late observation) | yellowish white | 7 |
| | | yellowish brown | Nil |
| | | brown | Nil |
| | | reddish brown | Nil |
| | | light red | Nil |
| | | red | Nil |
| | | light purple | Nil |
| | | purple | 1 |
| | | black | Nil |
| 26 | Panicle: presence of secondary branching | absent | Nil |
| | | present | 47 |
| 27 | Panicle: secondary branching | weak | Nil |
| | | strong | 47 |
| | | clustered | Nil |
| 28 | Panicle: attitude of branches | erect | Nil |
| | | erect to semi-erect | Nil |
| | | semi-erect | 10 |
| | | semi-erect to spreading | 37 |
| | | spreading | Nil |
| 29 | Panicle: exsertion | partly exserted | Nil |
| | | Just exserted | 12 |
| | | well exserted | 35 |
| 30 | Decorticated grain: colour (seed coat colour) | white | 46 |
| | | light brown | Nil |
| | | variegated brown | Nil |
| | | dark brown | Nil |
| | | light red | Nil |
| | | red | 1 |
| | | variegated purple | Nil |
| | | purple | Nil |
| | | dark purple | Nil |
| 31 | Decorticated grain: aroma (Aroma test) | absent | Nil |
| | | present | 47 |

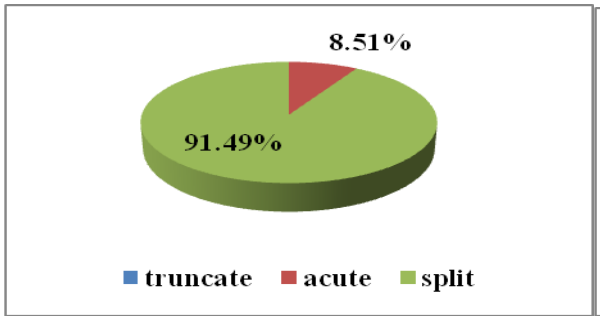
**Fig.1** Frequency distribution of important morphological characters



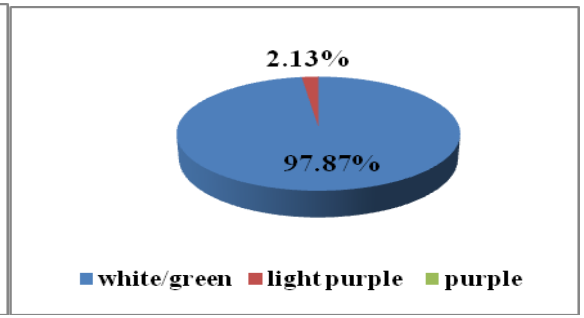
Leaf: pubescence of blade surface



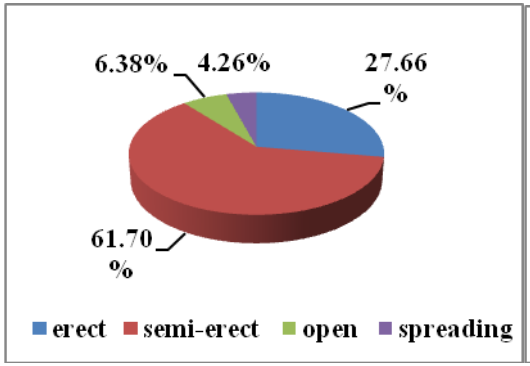

Leaf: shape of ligule



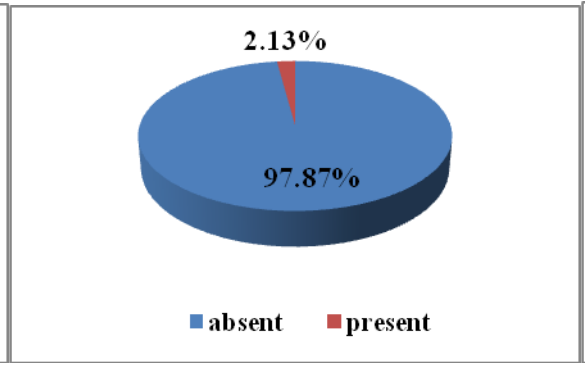

Leaf: color of ligule



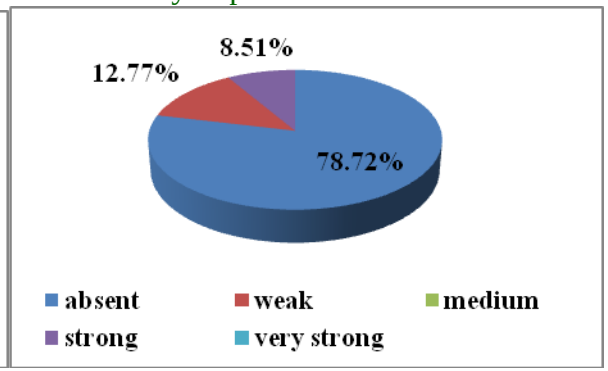

Culm: attitude



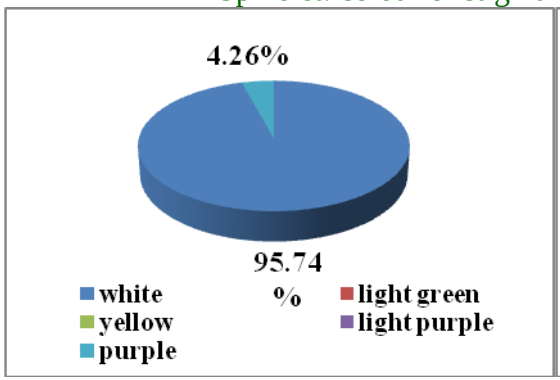

Stem: anthocyanin colouration of nodes



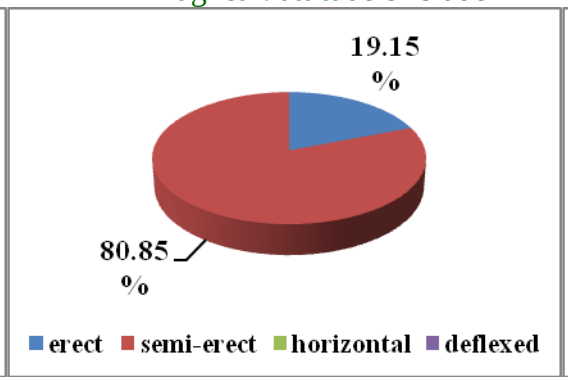

Spikelet: density of pubescence of lemma



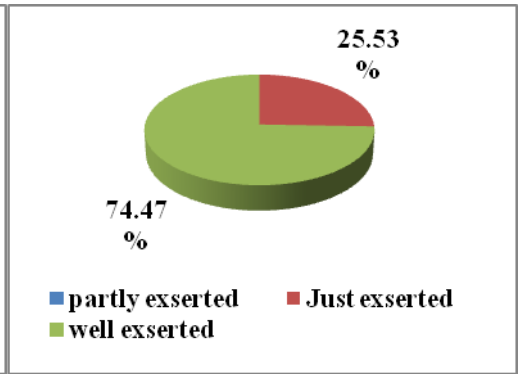

Spikelet: colour of stigma



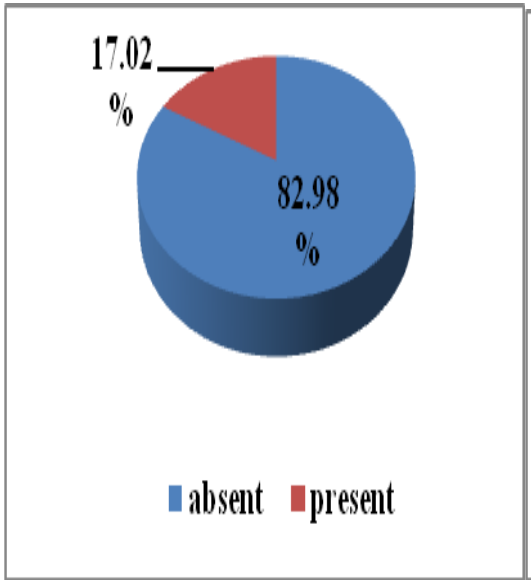

Flag leaf: attitude of blade



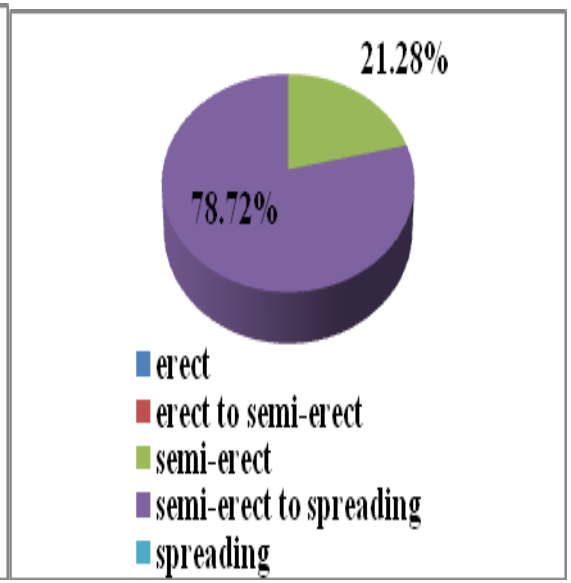

Panicle: exsertion



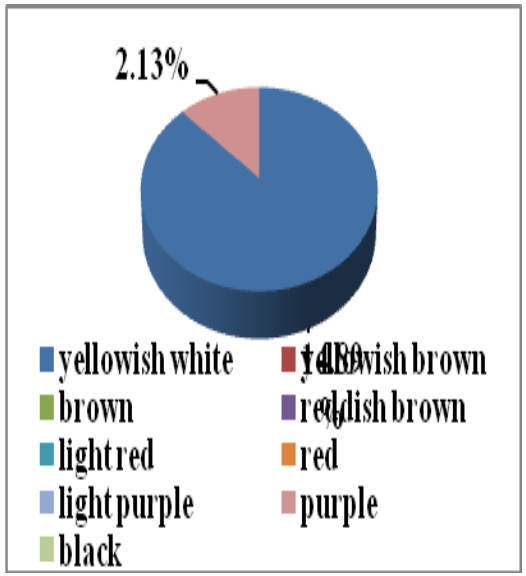
Panicle: awns



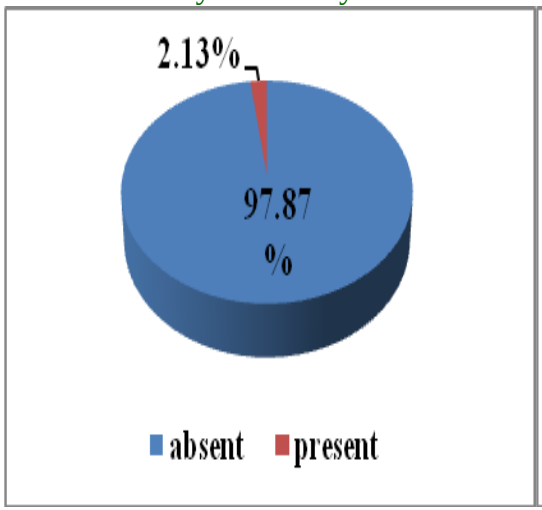

Panicle: attitude of branches



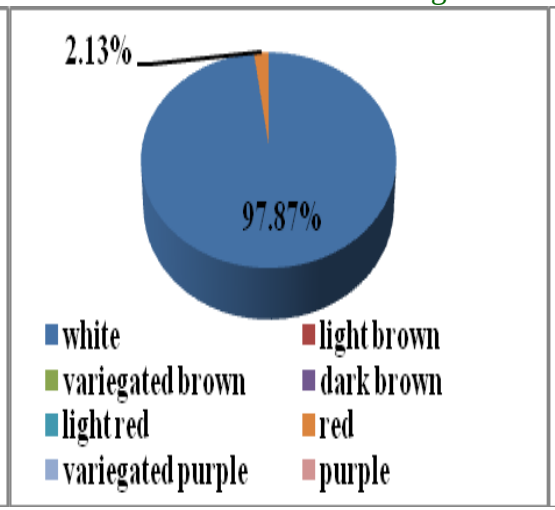

Panicle: colour of awns (late observation)




Stem: intensity of anthocyanin colouration of node




Decorticated grain: colour




Lemma and Palea: colour

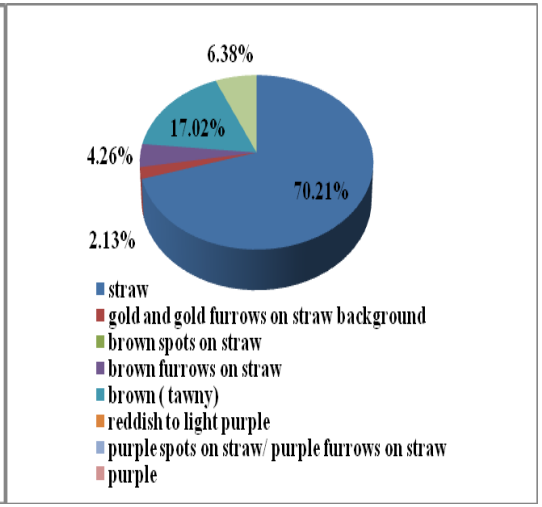
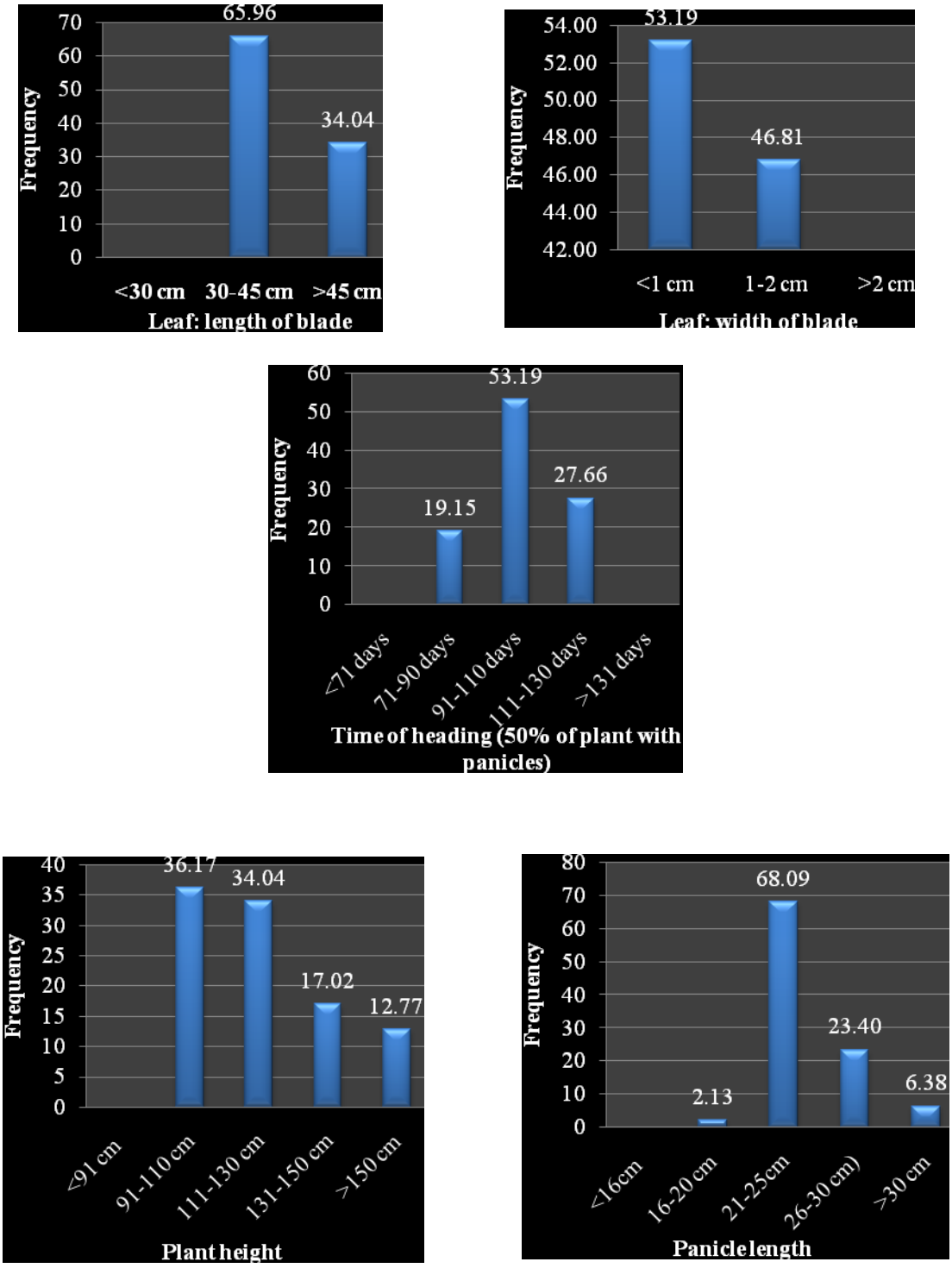
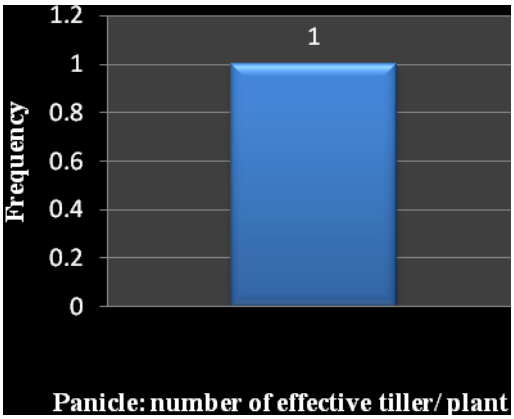
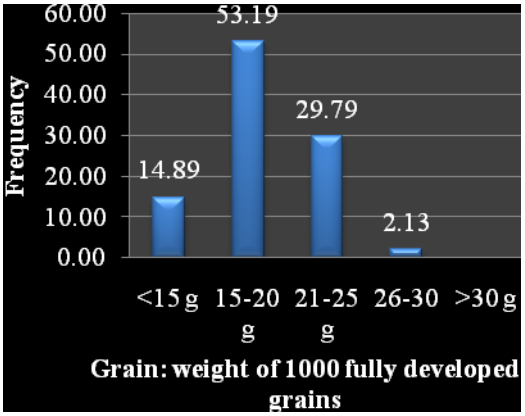
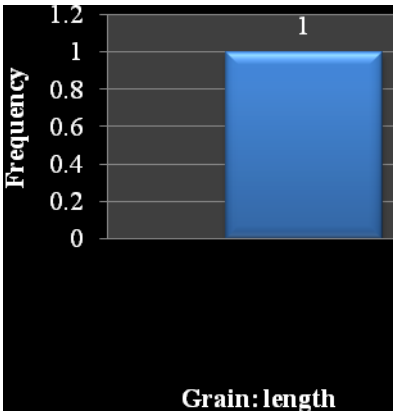


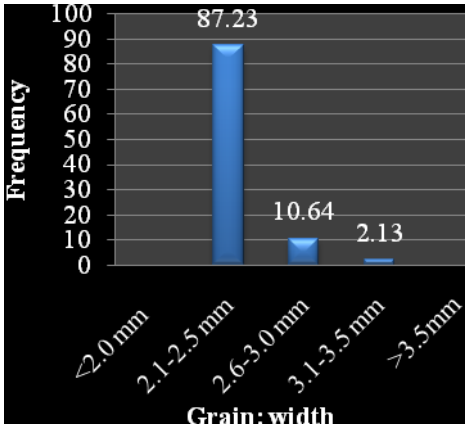
**Fig.2** Frequency distribution of eight quantitative traits in rice accessions






## Panicle length (cm)

It exhibited reasonable amount of variation with range values of 20.80 cm to 33.70 cm. The average panicle length was 25.56 cm long. Most of the accessions fall under the range of 26-30 cm panicle length. The highest panicle length was recorded in Kalanamak (33.70cm). However, the minimum panicle length was recorded in HUR-917 (20.80 cm). Although it contributes positively yet maximum panicle length is not the only factor responsible for higher grain yield (Abbasi *et al.*, 1995). So panicle length alone does not

determine the high grain yield as traits such as grain size, higher number of tillers/plant, longer panicles and greater number of grains/panicle ultimately contribute to higher grain yield (Akram *et al.,* 1994).

## Number of effective tillers per plant

It is another yield attributing trait (Abbasi *et al.,* 1995). The range for number of effective tillers per plant varied from 3 to 9 with an overall mean of 6.74. The highest effective tillers per plant was recorded in Indira Sugandhit Dhan-1 (9) and the minimum effective tillers per plant was recorded in NDR6357 (3).

## 1000 seed weight (gm)

It is also a yield-attributing trait (Abbasi *et al.,* 1995). 1000 seed weight ranged from 9.40 to 26.55 g with an average weight of 17.96 g. Genotype with maximum 1000 seed weight recorded in CN 1268-5-7 (26.55 g) and the minimum 1000 seed weight was recorded in Badshahbhog (9.40 g).

## Grain length (cm)

Grain length is an important quality parameter. Rice grain can be classified as extra-long, long, medium and short (Akram *et al.,* 1994). Grain length ranged from 0.58 to 1.07 with a mean performance of 0.78 cm.

The maximum grain length (1.07) recorded for HUR 1307 and minimum grain length (0.58) was recorded for HUR 1309.

## Grain width (cm)

Grain width ranged from 0.21 to 0.31 with a mean performance of 0.24 cm. The maximum grain width (0.31) recorded for R-1521-950-6-843-1 and minimum grain width (0.21) was recorded for CR 2938-6.

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