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Documentation of the grain morphological variation within some traditional aromatic rice (*Oryza sativa* L.) varieties of West Bengal

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Abstract

With the introduction of high-yielding varieties, price incentives and research inclinations towards modern varieties of non-aromatic rice to achieve self reliance, cultivation of several indigenous scented rice varieties have been neglected. A large number of traditional scented rice has already been lost and many are on the verge of extinction. It is more so for the small and medium-grained non Basmati aromatic rice than the long-grained Basmati types which form the bulk of rice export. Even though the cultivation of traditional aromatic rice varieties in prime areas is fast declining, their aroma and grain quality is highly appreciated by local communities and they are used in several rituals and customs. Future progress in the improvement of scented rice largely depends on immediate documentation, evaluation, conservation of the extant scented rice genetic resources and their effective utilization. The present study is on the documentation and evaluation of some of the aromatic rice germplasm of West Bengal.

Keywords: Non Basmati rice, small grained, traditional aromatic rice.

Introduction

Aromatic rice is an important commercial commodity. The Indian sub continent is a home for aromatic rice diversity. The quality of aroma quality in scented rice germplasm is a crucial component in the international market (Nayak et al*.,* 2002). Long slender aromatic rice of superfine quality is preferred by the consumers all over the world because of its scent and palatability. There is an enormous variation in the grain and kernel morphological features among the aromatic rice varieties.

Scented rice has played an important role in many regional economies. The long slender Basmati rice has been the favorites of kings, religious heads, royalty and the elite of society. Basmati rice command premium prices, typically two to three times higher than lower quality rices in both domestic and international markets (Bhasin, 2000). The traditional Indian aromatic and quality rice germplasm is comprised of small-, medium-, and long grain types with mild to strong aroma (Singh et al., 2000a, b). The variation among the aromatic germplasm could be an excellent source of genetic variation for utilization in breeding of high yielding aromatic rice varieties and hybrids.

India abounds with scores of indigenous aromatic short grain cultivars and land races, grown in pockets in various states. Most of these rice are highly area specific; hence each Indian state has its own special scented rice varieties (Ahuja et al., 2008). Many states have a collection of native popular scented varieties which are known for their adaptation and cultivation and particularly Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, West Bengal and Assam have a wealth of genetic diversity of short grain aromatic types (Shobha Rani et al., 2006). With the exception of shorter grain length and shape, they possess aroma, specific adaptation and excellent cooking and eating quality traits similar to Basmati rices. Due to lack of export potential, they are widely used by local consumers for making *kheer* (sweet rice) for religions and festive occasions.

A large number of scented rice has already been lost and many are on the verge of extinction. It is more so for the small and medium-grained non Basmati aromatic rice than the long-grained Basmati types which form the bulk of rice export. Even though the cultivation of indigenous scented rice varieties in prime areas is fast declining, their aroma and grain quality is highly appreciated by local communities as they are used in several rituals and customs. In West Bengal there are several traditional non Basmati aromatic rice varieties. They are mostly of the small – medium grained type. They are used in local rituals and festivals. Many of these aromatic traditional varieties like Gobindobhog, Sitabhog or Badshabhog are used to prepare 'payesh' in West Bengal. Among these scented rice there is variation in terms of grain morphology. There is an urgent need to collect, exploit, and evaluate these underutilized germplasm.

Future progress in the improvement of scented rice largely depends on immediate documentation, evaluation, conservation of the extant scented rice genetic resources and their effective utilization. The systematic study and characterization of the traditional non Basmati varieties is not only important for utilizing the appropriate attribute based donors, but also essential in the present era for conserving the unique rice genotypes. In this context, the present investigation is an attempt to characterize a set of non Basmati aromatic rice germplasm of West Bengal for different grain morphological traits and document the variability available in the collection.

Materials and Methods

1. Plant material

A total of 8 (eight) aromatic rice genotypes were used in this study. 7 (seven) non Basmati aromatic rice folk varieties of West Bengal (A WBL) that were used were adapted to varied climatic and edaphic conditions of West Bengal. 1 (one) evolved Basmati (EB) varieties was taken as the check. These 7 indigenous aromatic varieties of West Bengal, studied under field conditions for two consecutive years.

The details of the rice genotypes are given in Table 1.

2. Experimental design

The rice genotypes were grown in a randomized block design (RBD) with three replicates of 40 plants each. Seeds were sown in the seed bed on the last week of June and one healthy seedling/hill was transplanted after 30 days at a row x plant spacing of 25cm x 15cm. Normal agronomic practices were followed. Harvesting was done at 85% maturity of the seeds.

3. Assessment of grain morphological variation

A total of 10 grain morphological traits were measured using the Standard Evaluation System (SES) for rice developed by the International Rice Research Institute, (IRRI, 2002). These trait characterization were viz., 10 grain morphological trait characterization viz. 1) Awning (An), 2) Awn Color (AnC), 3) Apiculus colour (Apc), 4) Aroma (Aro), 5) Lemma and Palea Colour (LmPC), 6) Lemma and Palea Pubescence (LmPb), 7) Sterile Lemma Colour (Slmc), 8) Sterile Lemma Length (Slml), 9) Sterile Lemma Actual Length (Sllt), 10) Seed Coat (bran) Color (SCC).

Trait characterization was carried out using either of the following methodology.

Descriptive codes

These codes are used for traits that have more or less discontinuous genetic variation or for traits whose nature of expression is not easily translated into numerical units.

Actual measurements

These actual measurements or counts are used for characteristics that are continuous (e.g., ligule length, sterile lemma length etc.).

Methodology for the ascertaining the grain morphological traits

A total of 10 well-developed grains per plant were attached to a 5.5 X 2.5cm^2 double-sided tape on a 7X4 cm^2 black chart paper. A dissecting microscope (Olympus) was used to note the grain morphological characters. Three replications per variety were used in this study.

Results

The aromatic rice genotypes under study showed wide range of variability for all the morphological traits as well as the grain morphological characteristics studied. This result is similar to the research work of (Singh et al., 2010) where plants as well as kernels of these aromatic varieties showed wide diversity with regard to various morphological and biometrical characteristics.

In this study the 8 (eight) aromatic varieties showed considerable variation in the grain morphological parameters. These aromatic folk varieties of West Bengal (A WBL) were the non Basmati type the grain length was Short (S), which is less than 7.66mm according to the Standard Evaluation System (SES) for rice developed by the International Rice Research Institute, (IRRI, 2002). The evolved Basmati check (EB), Pusa Basmati- 1 which was extra long (EL) grain length of more than 10.31mm.

A total of 10 grain morphological characters were taken and the genetic diversity of the aromatic rice genotypes estimated. Results are given in Table II. The grain of these folk rice varieties showed a high degree of variation. The Lemma and Palea Colour (LmPC) of the aromatic folk varieties of West Bengal (A WBL) varieties used in this study was straw with the exception of Kalonunia with black Lemma and Palea Colour (LmPC). But considerable variation was found in the apiculus colour (Apc). 6 (six) genotypes had straw coloured apiculus. Kalonunia had a black apiculus. Mohonbhog had a black apex in the region of the apiculus. Rahunipagol had a red apiculus. The Basmati check had long straw coloured awn (An) but amongst the genotypes used in this study only Kalonunia had awn, which was black in colour. The other genotypes did not have any awn.

Table 1. The rice genotypes used in this study : genotype name, place of adaptation/ source and type of cultivar.

Sl no.	Folk rice varieties and checks	Place of adaptation/ source	Origin	Type of cultivar
1	BADSHAHBHOG	CHAKDAH, NADIA	CL, SF	A WBL
2	CHINIATAP	HILLI, COOCH BEHAR	CL, SF	A WBL
3	GOBINDOBHOG	PURULIA	CL, SF	A WBL
4	KALONUNIA	COOCH BEHAR	CL, SF	A WBL
5	KATARIBHOG	CHAKDAH, NADIA	CL, SF	A WBL
6	MOHANBHOG	RANGABELIA, GOSABA	CL SF	A WBL
7	RADHUNIPAGOL	CHAKDAH, NADIA	CL SF	A WBL
8	PUSA BASMATI-1	IARI, NEW DELHI, INDIA	Pusa150/ Karnal Local	EB
A WBL = Aromatic West Bengal landrace, CL = collection line, EB = evolved Basmati, SF = self-fertilized.				

Table 2. Morphological variation of grain within the aromatic rice genotypes.

Sl no	Names of cultivars	An	AnC	ApC	Aro	LmPC	LmPb	SLmc	SLmL	SLm lnl (mm)	SCC
1	BADSHAHBHOG	0	0	2	1	0	4	1	1	1.4	1
2	CHINIATAP	0	0	2	1	0	4	1	3	2	1
3	GOBINDOBHOG	0	0	2	1	0	4	1	1	1.3	1
4	KALONUNIA	7	6	8	1	10	4	3	5	3	1
5	KATARIBHOG	0	0	2	1	0	4	1	3	2.2	1
6	MOHANBHOG	0	0	7	1	0	4	4	3	2	1
7	RADHUNIPAGOL	0	0	4	1	0	3	3	1	1.3	1
8	PUSA BASMATI-1	9	1	2	1	0	4	1	5	3.5	1

Discussion

There has been considerable research on the genetic diversity analysis among indigenous Indian rice germplasm in recent years (De, 2014; Rana et al., 2010; Parikh et al., 2012; Subba Rao et al., 2001). Classification and grouping of aromatic genotypes following Numerical Taxonomic analysis revealed different classes of genotypes and their characterization provided useful information about their relatedness and possible use in crop improvement programme (Singh et al., 2010). Even though the small –medium grained indigenous aromatic rice varieties do not fetch much foreign revenue when compared to the Basmati variety they have considerable impact in the domestic market.

Conclusion

From the present study considerable amount of variation is observed in the grain morphological characters among the aromatic folk varieties studied. Future progress in the improvement of scented rice largely depends

on immediate documentation, evaluation of other traits viz., grain/kernel dimensions, agronomic traits, panicle traits. Simultaneously conservation of the extant scented rice genetic resources and their effective utilization must be of top priority.

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