Dwindling Treasures of the Rice Fields of West Bengal

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Abstract

Rice is one of the very few crop species endowed with rich genetic diversity. The genus *Oryza* has extensive intra-specific variation, differentiation into subspecies *(sativa* and *japonic*a) and further differentiation into different cultivar groups as folk varieties, landraces, breeding lines, and modern varieties. More than natural selection, the selection imposed by farmers makes folk varieties or landraces significant with their social, cultural and religious ties in farming communities. These folk varieties, grown in subsistence agriculture, are diverse and generally carry a great amount of genetic variability in their populations. These genetic treasures are silently being eroded from our fields following the onslaught of the High Yielding Varieties (HYVs).

Keywords: Folk rice variety, genetic wealth, West Bengal, genetic erosion

1. Introduction

Rice (*Oryza sativa* L.) is an economically important crop that has gradually become the principal staple food in most parts of the world, feeding more people than any other crop in the whole world. India alone produces nearly one fourth (22%) of the rice in the world, next only to China. It is one of the very few crop species endowed with rich genetic diversity which account over 100,000 landraces and improved cultivars and makes it one of the most

researched crop with a wealth of scientific literature on all its aspects. Rice genetic resources constitute an important human heritage.

The genus *Oryza,* belongs to the family Poaceae. Several workers[1, 2] employed Sokal's correlation coefficient of characters to rearrange the section sativa and subdivided it into 2 groups. The first group includes the cultivated species O. *sativa* L., 2n = 24 with AA genome and its allied wild species, while the other group consists of the cultivated species *O. glaberrima* Steud., 2n = 24 with AA genome, grown on a limited scale in West Africa. The wild species have either 2n = 24 or 2n = 48 chromosomes and AA, BB, CC, BBCC, CCDD, EE, FF, GG and HHJJ genomes[3, 4]. Now this genus comprises more than 22 species distributed through the tropical and sub-tropical regions of Asia, Africa, Central and South America and Australia, of which, there are only two cultivated species viz. *Oryza glaberrima* (Steud) and *Oryza sativa* (L.)[5]. This crop requires high temperature and humidity for its growth and is cultivated both in tropical and subtropical zones extending from 36°S to 55°N latitudes. Variation within this crop species is so extensive, due to its adaptation to a wide range of geographical and ecological niches, that cultivated lines were organized into three subspecies; *indica*, *japonica* and *javanica*[4]. The subspecies *javanica* is now known as tropical *japonica*. Rice breeders exploit the high degree of heterosis that results from crosses between combinations of the three subspecies leading to the development of improved varieties[6]. Through domestication, *O. sativa* has evolved into many different cultivars that are adapted to the wide range of conditions such as different water regimes, and a wide range of soils.

Rice is the most intensively evaluated and one of most polymorphic cereal crop species with the largest *ex situ* germplasm in the world[7]. The genus has extensive intraspecific variation, differentiation into subspecies *(sativa* and *japonic*a) and further differentiation into different cultivar groups as folk varieties, landraces, breeding lines, and modern varieties. Folk varieties, landraces are most often heterogeneous with a blend of different individual plants maintained by farmers in a local environment and constitute a significant portion of the cultivated rice genepool in Asia[8].

2. Folk Rice Varieties or Rice Landraces

A large number of *Oryza sativa* L. cultivars have been developed in 'primitive' agriculture by human and natural selection, over a long period of time and they remain relatively unmodified, despite generations of selection by farmers and have become adapted to different human and environmental influences. Landraces are the heterogeneous crop populations that humans deliberately cultivate (Harlan 1975) and are not the product of modern plant breeding. Landraces are crop populations selected and maintained by farmers within the natural system of evolution[9]. More than natural selection, the selection imposed by farmers makes landraces significant with their social, cultural and religious ties in farming communities. These are the genetic resources of the agricultural crops that sustain the world's growing population, and the genetic building blocks for more productive crop varieties. These cultivars, grown in subsistence agriculture, are diverse and generally carry a great amount of genetic variability in their populations, which contrast with improved cultivars whose populations are exceedingly homogenous.

Moreover, landraces are understood to differ from improved cultivars in adaptation to soil types, sowing and ripening period, nutritive value and show high yield stability, especially in regions where seasons are unpredictable. They also constitute a good source of unique genes for stress tolerance, and are well adapted to their environments. These landraces constitute a conspicuous source of variation for crop improvement[10]. They are passed from generation to generation of farmers and are exposed to natural and human selections in a local environment. These landraces are the only resource available in a resource-poor environment and this genetic variation could be exploited in rice breeding where access to new technology is difficult[11].

3. Selection Criteria for Folk Rice Varieties

Three different types of values for the selection and cultivation of landraces can be distinguished: direct, indirect and option value. Direct or use value is the simplest and

obvious one that refers to harvest and uses of crop varieties. Socioeconomic and cultural (food security, market, religious and cultural uses) and adaptive traits, which jointly represent 'use value' of variety determine the existence of these landraces on-farm. Farmers value certain aspects in the varieties—either socioeconomic or adaptive traits or both and the comparative advantages of their preference directly determine the area coverage and the number of households cultivating these landraces at community level. Indirect values refer to the environmental services or ecological health to which the crop varieties contribute, but farmers may not observe or notice the relationship. Option values refer to future use of crop varieties[12].

4. Folk Rice Varieties of West Bengal

According to Chang [13] the greatest diversity of cultivated rice is found in a belt from North East India to South East China. West Bengal, a state of India in this belt has rich rice genetic wealth[14]. The heterogeneous environmental conditions and the diverse cultural history of West Bengal people made the state rich in crop diversity. These landraces have adapted to the different soil types and micro-climate of West Bengal. A number of Bengal varieties (including present day Bangladesh varieties) were enlisted by Hector[15].

Breeding for agronomic traits markedly reduced this diversity resulting in narrowed genetic base which could lead to genetic vulnerability. A large number of landraces used by farmers are forced into extinction due to the adaptation of high yielding varieties (HYVs). At present significant numbers of the West Bengal rice landraces are on the verge of being eroded[14, 16]. Many aromatic folk rice varieties are cultivated in West Bengal for their aroma and grain quality which is highly appreciated by local communities and they are used in several rituals and customs[17]. Survival of many scented rice landraces in West Bengal is very often due to on-farm conservation of rice which is governed by cultural diversity[18].

Documentation and awareness of the still extant ecological, agronomic and cultural importance of the West Bengal rice landraces is necessary. This wealth of genetic resources as found in rice will provide the base for future progress in rice improvement in the face of shrinking resources both biological and physical[19]. Importance on genetic diversity is also valued for the management of germplasm and for evolving conservation strategies.

5. Material and Methods

5.1 Plant Materials.

A total of 233 West Bengal rice landraces (WBL) collected from different districts of the state of West Bengal, India. They were maintained at the Madhyamgram Experimental Farm of Bose Institute and screened for quality traits and yield. The rice landraces included aromatic rice landrace (A WBL) and non-aromatic rice landrace (NA WBL). A non-aromatic, multiple-seeded rice landrace (MS WBL) was collected and maintained too.

5.2 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. Fertilizer application to the soil was at the rate 80:50:50 kg of N:P:K per hectare (as Urea, Single Super Phosphate and Muriate of Potash) for semi-dwarf genotypes, and at the rate of 25:50:50 kg of N:P:K per hectare for traditional tall genotypes. Fertilizer was applied in three split doses, 50% at land preparation and the rest in two equal splits at maximum tillering and boot stage. Insects, pests and diseases were controlled as and when necessary by appropriate chemical sprays. Harvesting was done at 85% maturity of the seeds.

5.3 Documentation

The Standard Evaluation System[20] was used for characterization of the following traits, with few modifications. The different types of values for the selection and cultivation of the folk rice varieties or landraces were noted at the time of collection.

6. Results

The rice landraces were collected from different districts of West Bengal where there are distinct eco-geographic variations. So though all the rice genotypes belonged to *Oryza sativa*

L. an enormous amount of variation was reflected during the characterization. This variation reflects the capability of the indigenous farmers for developing and sustaining diverse landraces. These landraces or folk varieties were developed by innovative farmer experiments on the substratum of available genetic diversity[21]. Novel genotypes showing distinct phenotypic variation among the agronomic and morphological characters are shown in Table I.

Table I. Phenotypic variation among the agronomic and morphological characters of folk rice varieties of West Bengal

Serial No.	**Phenotype**	**SES code**	**SES Code value**	**Phenotypic variation**	**Name of the folk rice showing this trait**
1	Phenotypic Acceptability	PAcp	1	Very good Phenotypic Acceptability	Sonajhuli
2	Tillering ability	Ti	3	High Tillering ability	Raghusail
3	Auricle colour	AC	2	Purple Auricle colour	Bochi, Kalamocha, Agniban
4	Basal leaf sheath colour	BLSC	2	Purple line	Dudhkalma
5	Basal leaf sheath colour	BLSC	3	Light purple	Khirabichi, Bhimsail
6	Basal leaf sheath colour	BLSC	4	Purple	Latasail
7	Collar colour	CC	3	Purple	**Kalamocha, Bochi**

8	Culm internode colour	CmlC	3	Purple lines	**Bombaimughi, Birala**
9	Culm internode colour	CmlC	4	Purple	**Bochi**
10	Ligule colour	LgC	3	Purple	Bhimsail
11	Stigma colour	SgC	3	Yellow	Balam
12	Stigma colour	SgC	4	Light Purple	Gheus, Latasail
13	Stigma colour	SgC	5	Purple	**Bombaimughi, Tulsibhog, Chottonunuia, Malabati, Ramsail**
14	Multiple seeded	MS	2	Two kernels	**Jugal**
15	Multiple seeded	MS	3	Three kernels	**Dui satin**

7. Discussion

Agriculture is the one important sector of West Bengal's economy and plays a vital role in terms of food security and economic growth. However, growth rate in agriculture is much less than population growth rate. . Fast changes are taking place in landscapes, farming systems and individual crops as well as peoples' lifestyles. That means actual and potential

threats are progressing from different directions thereby affecting the sustainability of traditional farming systems. The changes are in the forms of expansion of agricultural land to more marginal and fragile lowlands as well as steep slopes which were previously used as pasture and forest lands; shrinkage and fragmentation of farm holdings, reduced farmers' ability to practice crop rotation and fallowing; replacement of local seed system by formal seed system, expansion of use of improved varieties, shifting from organic to inorganic fertilization of farms. Moreover, West Bengal the agricultural sector comprises heterogeneous environmental conditions with diverse agro-ecological settings representing different farming systems with different potentials and constraints. The crops grown are diverse and reflect the complicated mosaic of agro-ecologies derived from different soil types. Evaluation of phenotypic diversity usually reveals important traits of interest to plant breeders. The effective utility and conservation management of the valuable genetic diversity in the rice gene pool rely significantly on a clear understanding of the evolutionary relationships of rice species and subsequently the development of a natural classification of the genus *Oryza*[22].

The knowledge of agro-morphological diversity and the distribution pattern of variation among conserved accessions could be an invaluable aid in germplasm management and crop improvement strategies[23] (Sanni, 2008). The negative lesson learnt from the Green Revolution is that it has accelerated genetic erosion and undermined farmers' efforts to conserve, improve and utilize their traditional varieties, endangering long term food security. This is partly due to lack of information regarding the traditional ways of life using farmers' varieties and partly because of the ambition to fill gaps in food security. However, farmers have a wealth of knowledge on seed selection, storage and farm management. They know how to reduce risk and contribute to resilience, food security, and income generation under the subsistence farming systems. Equally important as genetic erosion of farmers' varieties is the loss of biodiversity in natural habitats due to the expansion of commercial agricultural production that are based on few improved varieties into the remote and virgin areas. Identifying local crop varieties and associated wild relatives that are lost or are on the verge of extinction, play crucial role in designing and implementation of conservation policies. The rice fields of West Bengal contain many genetic treasures many of which are silently eroded.

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