International Journal of Experimental Research and Review (IJERR)

ISSN: 2455-4855 (Online) ***Original Article***
Received: 21st June, 2021; **Accepted:** 23rd July, 2021; **Published:** 30th August, 2021
DOI: https://doi.org/10.52756/ijerr.2021.v25.001a

Variation in agronomic characters among traditional rice varieties of Cooch Behar, West Bengal: A Case Study

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Abstract

The expertise of agro-morphological variability within a crop and its dispersion across agro-ecological areas may be very useful in managing the crop's germplasm and developing improved methods. Crop failure is guarded against through genetic variety. However, dwindling genetic wealth erodes the capacity to maintain and enhance agricultural productivity. West Bengal has rich rice genetic wealth. But this genetic wealth is being silently depleted due to the onslaught of the high-yielding varieties (HYVs) and neglect The 10 traditional rice varieties were collected from the Cooch Behar district of West Bengal, India. The present study aimed to characterize the rice genotypes using agronomic characters. The assessment was done following the Standard Evaluation System (SES) for rice developed by the International Rice Research Institute. Even though all the ten local rice varieties were adapted to the Cooch Behar district, a fair amount of diversity was found among the rice genotypes.

Keywords: Cooch Behar, genetic diversity, Standard Evaluation System (SES), Traditional rice variety.

Introduction

The issue of food security is significant today in light of climate change. Constraints, including prolonged droughts, severe weather events, population growth, and urbanization persist even if there are many ways to increase food security (Qian et al., 2016; Zeng et al., 2017). With an understanding of the crop's agro-morphological diversity, farmers will have a more remarkable ability to use the crop's germplasm, which will benefit crop improvement methods (Odjo et al., 2017).

Crops' genetic diversity provides the basis for the creation of new kinds that are more sustainable. An insurance policy must guard against crop failure via genetic variety (Subba Rao et al., 2001). However, plant genetic resources are among the most vulnerable of all non-renewable natural resources. Once lost, they are lost forever. There have been studies on the genetic diversity analysis among rice germplasm over the years (Singh et al., 2010, Parikh et al., 2012). Farmers, scientists, politicians, and environmentalists have been concerned about the continuing

loss of rice cultivar genetic biodiversity (Singh et al., 2000; Singh et al., 2010). West Bengal has a lot of rice genetic diversity. However, owing to the assault of high-yielding varieties (HYVs) and neglect, this genetic richness is being quietly destroyed (De, 2014). The ability to sustain and improve agricultural production is eroding due to dwindling genetic richness. The issue is not the extinction of a particular species, such as wheat or rice, but the loss of variety within a species population.

Agronomic Characters

Agronomy is the science and technology of producing and using plants in agriculture for food. Desirable agronomic characteristics are different for different crops. Agronomic features are plant characteristics that are linked to crop production and are often detected during plant growth.

Characterization of germplasm

It is essential to have a complete and comprehensive germplasm analysis to assist in plant breeding initiatives (Lin, 1991). For farmers, genetic diversity implies the presence of many distinct cultivars. When growing contemporary varieties of produce vs landrace crops, the decision to farm at a certain level is influenced by many supply and demand variables.

The purpose of the current research was to investigate the different rice varieties based on agronomic characteristics.

Material and Methods

Study Area

The town of Cooch Behar is both the namesake of the district as well as the district itself. Cooch Behar is situated in the north-easternmost portion of the state and bordered by Jalpaiguri district in the north, Alipurduar district in the east, and Dhubri and Kokrajhar districts of Assam in the south. The area of Cooch Behar has a flat southern section, and its major rivers run in an easterly direction through the region. The highlands are mostly exclusively located in the Sitalkuchi region, whereas the lowlands are almost solely found in the Dinhata region. This is often true of the rivers in the Cooch Behar area since they tend to flow from northwest to southeast. Teesta, Jaldhaka, Torsha, Kaljani, Raidak, Gadadhar, and Ghargharia are six rivers that cut through the area. It comprises part of the Terai zone of West Bengal, part of the Great Indian Peninsula. In Fig. 1 & 2, the location map is shown.

Experimental design

Three replicates of 40 plants each were used in an RBD design to produce different rice genotypes. On the final week of June, seeds were put in the seedbed. After 30 days, one healthy seedling/hill was transplanted. All common agricultural techniques were used. Harvesting was done when the seeds had reached 85% maturity.

Plant Material

The rice germplasm used in this study consisted of 10 traditional rice varieties of West Bengal collected from Cooch Behar of West Bengal. Table 1 the local name of all the traditional rice genotypes, place of adaptation, origin and type of cultivar. All the ten traditional rice varieties were non-aromatic.

Characterization for Agronomic traits

The evaluation was carried out using the International Rice Research Institute's Standard Evaluation System (SES) for rice (IRRI, 2002).

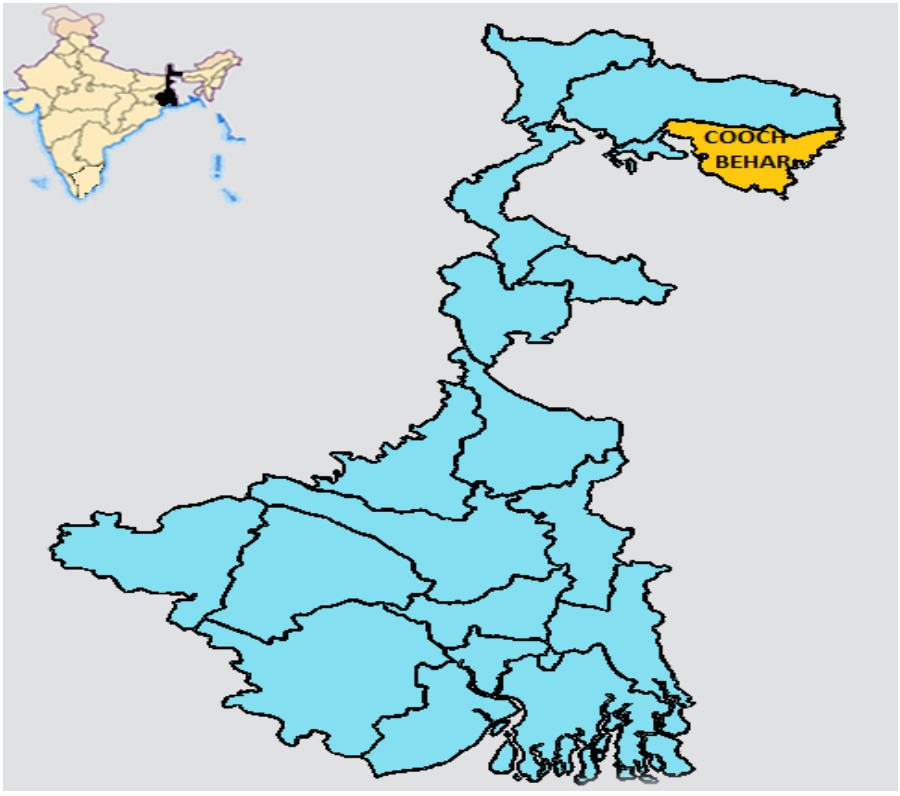

Fig. 1. Map of West Bengal showing Cooch Behar district, West Bengal, India.
(Source: www.veethi.com/places/west-bengal-state-28)

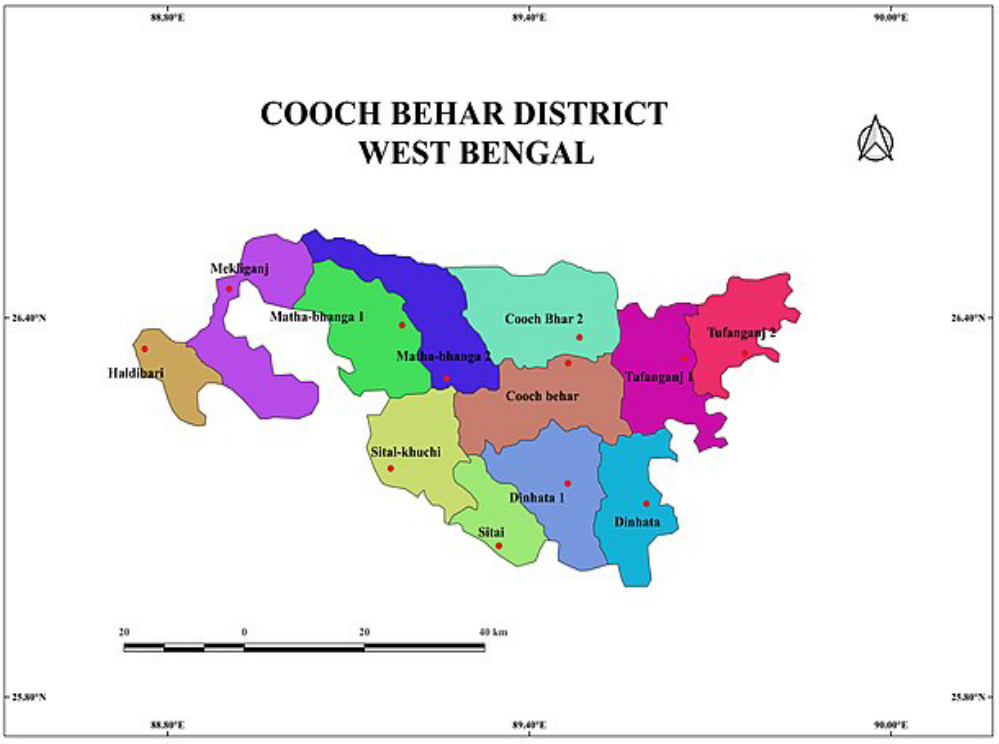

Fig. 2. Detailed map of Cooch Behar district, West Bengal, India.
(Source: http://www.en.wikipedia.org)

Table 1. Local name of the traditional rice genotypes, place of adaptation, origin and type of cultivar.

SL NO.	LOCAL NAME OF RICE GENOTYPES	PLACE OF ADAPTATION / SOURCE	ORIGIN	TYPE OF CULTIVAR
1	PARI	COOCH BEHAR	CL, SF	NA WBL
2	MAGURSAIL	COOCH BEHAR	CL, SF	NA WBL
3	TULSIBHOG	COOCH BEHAR	CL, SF	NA WBL
4	KAJALDEKHI	COOCH BEHAR	CL, SF	NA WBL
5	CHOTTONUNIA	COOCH BEHAR	CL SF	NA WBL
6	BOCHI	COOCH BEHAR	CL, SF	NA WBL
7	JOSHOA	COOCH BEHAR	CL, SF	NA WBL
8	FULPANKHARI	COOCH BEHAR	CL, SF	NA WBL
9	PANKHARI	COOCH BEHAR	CL, SF	NA WBL
10	MALSHIRA	COOCH BEHAR	CL, SF	NA WBL
CL = collection line, NA WBL = Non aromatic West Bengal landrace, SF = self-fertilized				

A total of 6 (six) agronomic characters using descriptor codes were used for this investigation. Table II shows the list of agronomic characters and their respective classes used to evaluate genetic diversity among the traditional rice varieties.

Descriptor Codes used for the qualitative assessment

Qualitative characteristics are essential for plant identification and are affected chiefly by consumer preferences, socioeconomic factors, and natural selection (Hien et al., 2007). Some morphological characters could be grouped into distinct classes based on each of these characteristics.

Result

For this evaluation, the International Rice Research Institute (IRRI, 2002) established the Standard Evaluation System (SES) for rice. These traditional rice landraces were collected from the Cooch Behar district of West Bengal, where there are distinct eco-geographic variations. Though all the rice genotypes belonged to *Oryza sativa* L., the present study revealed sufficient genetic divergence for various agronomic traits (Table 2).

Discussion

Six agronomic traits were used in this investigation. For Culm Strength, there was a wide variation among the ten rice genotypes. There were 5 descriptor codes for Culm Strength viz. 1, 3, 5, 7 and 9. The ten traditional rice varieties under investigation could be characterized by just three codes viz. 1, 3 and 7. Culm strength is rated by gently pushing the tillers back and forth a few times. Final observation is made to record the standing position of plants. Culm strength is related to lodging incidents. Leaf senescence could be characterized using just three descriptor codes viz., 1, 5 and 9. Only 1 and 5 were observed. Leaf senescence is an important agronomic trait and is said to affect the grain yield directly. There were 3 descriptor codes for lodging incidence viz., 1, 5 and 9. All the three descriptors could be used for these ten traditional rice varieties. Lodging incidence often determines the yield loss due to lodging during rough weather.

Table 2. List of agronomic characters and their respective classes used to evaluate genetic diversity among the traditional rice varieties.

SL. NO	TRAIT	ABV.	GROWTH STAGE	METHOD OF SCORING	CODE	DESCRIPTION
1	**Culm Strength**	*Cs*	Dough stage to mature grain stage	By gently moving the tillers back and forth a few times, the culm strength may be determined. The standing posture of plants is recorded in the last observation.	1	Strong (no bending)
					3	Moderately strong (most plants bending)
					5	Intermediate (most plants moderately bending)
					7	Weak (most plants nearly flat)
					9	Very weak (all plants flat)
2	**Leaf Senescence**	**LSen**	Mature grain stage	Observation via sight. The majority of plants in the plot are used to determine the rating.	1	Late and slow (leaves have natural green colour
					5	Intermediate (upper leaves yellowing)
					9	Early and fast (all leaves yellow or dead)
3	**Lodging Incidence**	**Lg**	Heading to mature grain stage	Observation via the visual. Rate is determined by the percentage of plants in the plot	1	Non lodging
					5	Partly lodging
					9	Highly Lodging
4	**Phenotypic Acceptability**	**PAcp**	Milk stage to mature grain stage	Visual observation	1	Excellent
					3	Good
					5	Fair
					7	Poor
					9	Unacceptable

5	**Panicle Exsertion**	**PExs**	Milk stage to mature grain stage	After anthesis, ocular evaluation of panicle exsertion above the flag leaf sheath. The majority of plants in the plot are used to determine the rating.	1	The panicle base is highly exserted (it extends far beyond the flag leaf blade's collar).
					3	Exserted to a moderate degree (the panicle base is above the collar of the flag leaf)
					5	Just exserted (the panicle coincides with the collar of the flag leaf)
					7	Partly exserted (the panicle base is Slightly beneath the collar of the flag leaf blade)
					9	Enclosed (the panicle is partly or entirely enclosed within the leaf sheath of the flag leaf).
6	**Tillering Ability**	**Ti**	Booting stage	The number of tillers per plant was tallied, with each plot scored depending on the number of tillers found in each of the plots.	1	Very high (more than 25 tillers/plant)
					3	Good (20/25 tillers/plant)
					5	Medium (10-19 tillers/plant)
					6	Low to moderate (Some plants in the plot have the moderate tillering ability and some have the low tillering ability.
					7	Low (5-9 tillers/plant)
					9	Very low (less than 5 tillers/plant)
ABV. = Abbreviation; SL. NO= Serial number						

Table 3. Agronomic characters of the 10 traditional rive varieties listed with their respective descriptor codes.

Sl. No.	Variety Name	Cs	LSen	Lg	Pacp	PExs	Ti
1	PARI	1	5	1	5	1	5
2	MAGURSAL	7	1	9	7	1	5
3	TULSIBHOG	1	1	1	5	7	5
4	KAJALDEKHI	7	5	5	5	1	5
5	CHOTTONUNIA	1	1	1	3	3	6
6	BOCHI	7	1	5	5	1	6
7	JOSHOA	7	1	5	5	1	5
8	FULPANKHARI	7	1	5	7	1	5
9	PANKHARI	3	5	1	7	7	6
10	MALSHIRA	7	5	9	7	1	5

Phenotypic acceptability varies from area to area and from farmer to farmer. This agronomic trait is scored by visual observation. There are 5 (five) descriptor codes viz. 1, 3, 5. 7 and 9. They ranged from excellent to unacceptable. Results hovered between 3, 5 and 7. No traditional variety understudy came under the two extreme descriptor codes viz., 1 & 9. There are 5 descriptor codes for panicle exertion and the results showed that they fitted to mainly two descriptor codes viz., 1, 7 and there was a lone variety, Chottonunia, which fitted to 3 of the descriptor code under the Standard Evaluation System (SES). The last agronomic trait was tillering ability. The number of tillers per plant was counted. The score was representing most plants within each plot. There were 6 (six) descriptor codes present in the SES. There are 6 (six) descriptor codes for this trait, and the number of tillers per plant was counted, with score representing most plants within each plot. All the ten local varieties studied could be described by just two descriptor codes. So, among these six agronomic traits considerable variation has been observed.

Though the rice genotypes were collected from one single district of West Bengal, there is considerable variation among them. This could be due to differences among the climatic and edaphic conditions within Cooch Behar district. These varied conditions probably gave rise to distinct rice genotypes that contributed to this crop plant's genetic diversity.

The importance of traditional varieties in agriculture cannot be overstated since the development of current varieties is dependent on favourable genes that are only found in landraces and wild types (Shiva, 1991). Rice (*Oryza sativa* L.) diversity data collected across time and place has proven helpful to communities, scientists, and policymakers in developing and implementing in situ, on-farm, and ex situ conservation and management strategies for genetic resources. However, due to the increasing adoption of high-yielding rice varieties (HYVs), rice germplasm has been biologically depleted since indigenous rice types have been replaced with contemporary kinds (Pant, 2010). Currently, many West Bengal rice landraces are on the brink of extinction (Deb, 2000, 2005).

Conclusion

Even though all the ten local rice varieties were adapted to Cooch Behar district, a fair amount of diversity was found among the

rice genotypes. The genetic diversity among these rice folk varieties is the only resource available for future rice improvement. So measures must be undertaken to conserve the rice genetic resources; before they are lost forever.

Acknowledgement

The authors give thanks to the Director, Bose Institute, Kolkata and Dr. Tapas Kumar Ghose of Bose Institute for providing the laboratory and experimental garden infrastructure.

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