Diversity and some phenotypic characters of *Joha rice (Oryza sativa L.)* varieties cultivated in Bongaigaon district of Assam, India

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Abstract

Farmers in different localities of Bongaigaon area still cultivate traditional rice varieties in their farming system. Besides different rice varieties, the farmers also cultivate Joha rice, commonly known as 'Bhog dhan'. To see the diversity of Joha rice and its phenotypic characters, a field study was made. Seven different Joha rice varieties were seen which are being cultivated in different localities. In the present study, 16 different phenotypic characters were studied along with protein concentration. It was found that though all the seven varieties of Joha rice were more or less similar but each variety showed some unique characteristics which may be utilized for identification of different varieties.

Key words: Joha rice, Bongaigaon, Phenotypic characters

INTRODUCTION

The North-east India, including Assam, is recognized as a centre of the origin of rice and is endowed with exceptionally rich rice diversity. The indigenous germplasm of North-east India represents a wealth of valuable gene systems (Sharma *et al.* 1971). Variation in ecological conditions, ethnic diversity, diverse cultural practices and different quality preferences contribute to the diversity present in different types of rice. Assam is particularly rich in rice germplasm. About 70 % of total agricultural land of Assam is used for rice cultivation (Das *et al.* 2010). The four categories of rice classified on the basis of the amount of rainfall and zonal distribution are *Ahu* rice (autumn rice), *Sali* rice (winter rice), *Boro* rice (summer rice), and *Bao* rice (deep water rice). Among different categories of rice, scented rice enjoys a special demand and are highly valued. The North-eastern Region is also home to a large number of aromatic and other good quality rice varieties (Choudhury *et al.* 2013). This scented or aromatic rice of Assam is a unique class under *Sali* rice traditionally known as '*Joha*'. The characteristic odor in scented rice is due to a compound named 2-acetylc-1-pyrroline (Buttery *et al.* 1982). Due to this aroma this class of rice has high demand in domestic market and is used mainly for preparation of special dishes like *kheer* and *pulao*. It cooks non-sticky and tasty meals. Aroma of *Joha* rice is as appreciable as for the goodness of *Basmati* rice.

Joha rice is known for its super fine grain, good cooking qualities and excellent deliciousness. The yield from traditional varieties are low but farmers still continue to cultivate, even as they adopt newer varieties, because compared to modern varieties the yield from traditional varieties are reliable and prevents the risk of yield failure (Harwood 1979). The yield of *Joha* rice is also low.

Bongaigaon (26°28'22" N and 89°9'62" E) is an agriculturally rich district of Assam, India (Figure 1). The average annual rainfall is about 4632.2 mm (BGR, IOCL 2010). The large

Figure 1. Location map of the Study Area [Paddy fields at: S1. Deohati; S2. Srijangram; S3. Poporagaon; S4. Adalaguri; S5. Khagarpur; S6. Shankarghola; S7. Nankargaon; S8. Dangtol; S9. Chitkagaon; S10. Kabaitari; S11. Kayethpara; S12. Dashimapara; S13. Sonakhuli; S14. Tengaigaon; S15. Meshpara; S16. Hatiutra; S17. Saonagaon; S18. Dolaigaon; S19. Kokila; S20. Sukani; S21. Tulungia; S22. Chaparakata; S23. Shakomura; S24. Nimagaon; S25. Talguri; S26. Bidyapur; S27. Jogighopa; S28. Nigamghola; S29. Kasharpara; S30. Kakragaon; S31. Barghola; S32. Panchapur; S33. Lalmati; S34. Shingimari; S35. Kahidoba]

area of paddy fields in the district is the primary earning source for the villagers. Bongaigaon district is also housing a large number of ethnic communities engaged in practicing various types of rice cultivation. Along with *Ahu*, *Sali* and *Bora*, the farmers of this region cultivate a number of *Joha* rice varieties which are commonly known as '*Bhog dhan*' in different localities. This rice plays an important role in different rituals of these localities and becomes an integral part in the local communities' culture. In order to see the diversity and phenotypic variation of characters in *Joha* rice varieties, a field study was conducted during the years 2011 to 2013.

MATERIALS AND METHODS

The period of study was restricted to November, December and January (rice harvesting periods) of 2011 to 2013. Thirty five localities of Bongaigaon district were selected randomly and named as S1, S2, S3,, S35. Along with regular field visits, farmers of different localities were approached and information was gathered about the local names and uses of different *Joha* rice varieties. Rice grains and plants of different *Joha* rice were collected from all these localities and some phenotypic and biochemical characteristics were studied. The parameters included in the present study were:

- Height of plant,
- Length of panicle,
- Presence or absence of awn and their length,
- Length, breadth and width of the grain with husk and without husk,
- Weight and volume of 1000 grains with husk and without husk,
- Colour [standard DULUX colour chart] of the grains with husk and without husk; and
- Protein concentration.

RESULT AND DISCUSSION

During field survey seven different *Joha* rice varieties viz. *Kalabhog*, *Ghagubhog*, *Benibhog*, *Tulsibhog*, *Katharibhog*, *Kewabhog* and *Shialbhog* cultivated in different localities of Bongaigaon district were recognised and collected. All these 7 different varieties in the present study exhibited distinct variations in their phenotypic as well as bio-chemical characteristics.

The height of the plant ranged between 109.22 ± 9.45 cm to 147.54 ± 6.64 cm. *Tulsibhog* was found to be the longest (109.22 ± 9.45 cm) cultivar which was followed by *Kalabhog*, *Ghagubhog*, *Shialbhog*, *Benibhog* and *Kewabhog*. *Katharibhog* was the shortest (147.54 ± 6.64 cm) height cultivar of this region.

Similarly, the length of the panicle also varied according to varietal type that ranged from 20.37 ± 4.02 cm to 28.53 ± 5.49 cm. The longest spike was found in *Tulsibhog* (28.53 ± 5.49 cm) and shortest in *Ghagubhog* (21.35 ± 4.92 cm).

Number of grains per panicle is also one important variable character for these varieties. The highest number of grains per spike was found in case of *Shialbhog* (130.2) and lowest number of grain per spike was found in *Katharibhog* (79.75). Except *Ghagubhog* and *Tulsibhog*, the grains of other varieties are with distinct awn with length ranged from 0.5 cm to 5.3 cm. *Kalabhog* was found to have the longest (5.3 cm) awn (Table 1).

Table 1. Numerical assessment of some important phenotypic characters in different *Joha rice* cultivated in different localities of Bongaigaon district

Varietal name	Height of plant (cm)	Panicle length (cm)	Number of grain/panicle	Awn length (cm)
<i>Kalabhog</i>	132.89±9.53	23.32±4.88	93.82±25.47	5.3
<i>Ghagubhog</i>	129.65±7.72	21.35±4.92	100.02±25.52	Absent
<i>Benibhog</i>	125.06±8.45	20.37±4.02	95.42±21.22	Absent, rarely present
<i>Tulsibhog</i>	147.54±6.64	28.53±5.49	112.49±18.02	Absent
<i>Katharibhog</i>	109.22±9.45	23.66±6.71	79.75±25.02	5.0
<i>Kewabhog</i>	112.22±10.45	21.67±6.75	85.75±25.02	0.5
<i>Shialbhog</i>	127.02±9.73	22.5±4.01	130.2±623.28	0.2

The *Joha* rice grains in Bongaigaon district were found to be short to medium and slender. The length of the grain (with husk) does not exceed 0.827 mm. Similarly, the lengths of the grain (without husk) in all the varieties were less than 0.65 mm. The longest grain (with husk) was observed in *Kalabhog* (0.827±0.06 mm), where the ratio of length: breadth: width was 0.827 : 0.274 : 0.221. Shortest grain (with husk) was observed in *Tulsibhog* (0.590±0.025 mm), where the ratio between length: breadth: width was 0.590:0.224:0.173.

The longest grain (without husk) was observed in *Kalabhog* (0.636±0.055 mm) and the ratio of length: breadth: width was 0.636 : 0.254 : 0.035. On the other hand, shortest grain (without husk) was observed in *Tulsibhog* (0.438±0.032 mm) and the ratio of length: breadth: width was 0.438:0.227:0.015 (Table 2).

Table 2. Phenotypic characters of grains (with and without husk) of different *Joha rice* varieties cultivated in Bongaigaon district

Varietal Name	Grain Length (mm) with husk	Grain breadth (mm) with husk	Grain width (mm) with husk	Grain length (mm) without husk	Grain breadth (mm) without husk	Grain width (mm) without husk
<i>Kalabhog</i>	0.827±0.060	0.274±0.010	0.221±0.007	0.636±0.055	0.254±0.035	0.264±0.011
<i>Ghagubhog</i>	0.622±0.048	0.282±0.006	0.242±0.022	0.454±0.051	0.257±0.009	0.231±0.013
<i>Benibhog</i>	0.703±0.045	0.217±0.017	0.166±0.018	0.499±0.046	0.189±0.029	0.149±0.007
<i>Tulsibhog</i>	0.590±0.025	0.224±0.014	0.173±0.025	0.438±0.032	0.227±0.015	0.151±0.003
<i>Katharibhog</i>	0.796±0.061	0.223±0.011	0.168±0.021	0.622±0.040	0.252±0.033	0.251±0.008
<i>Kewabhog</i>	0.806±0.056	0.228±0.025	0.210±0.012	0.572±0.044	0.228±0.022	0.188±0.023
<i>Shialbhog</i>	0.788±0.040	0.283±0.30	0.195±0.011	0.615±0.060	0.216±0.015	0.196±0.008

The average 1000 grain (with husk and without husk) weight also varied according to different *Bhog dhan* varieties. The grain of *Kewabhog* showed the highest weight i.e., 20.00 g (with husk). On the other hand, *Tulsibhog* showed the lowest grain weight of 12.30g (with husk). Similarly highest and lowest weight of 1000 grain (without husk) was observed in *Katharibhog* (14.30 g) and *Ghagubhog* (09.03 g) respectively.

Highest and lowest volume of 1000 grain (with husk) was observed in *Katharibhog* (24.80 cc) and *Shialbhog* (10.00 cc) respectively. Similarly highest and lowest volume of

1000 grain (without husk) was observed in *Katharibhog* (10.60 cc) and *Ghogubhog* (08.00 cc) respectively.

The colour of the grain (with husk) was found to vary from variety to variety. *Kalabhog* and *Tulsibhog* were found to have dark green grains. Mid-buff coloured grains were found in *Benibhog*, *Katheribhog* and *Shialbhog*. In *Ghogubhog*, it was Golden brown with mid buff shade. In *Kewabhog* the colour was dark mushroom.

Similarly the colour of the grain (without husk) also differed greatly in all these 7 varieties. It was pista, antique-white in *Ghogubhog*, raw silk in *Benibhog* and *Shialbhog*, fresh sprout in *Tulsibhog*, sandal wood in *Katheribhog*, cascade green in *Kewabhog* (Table 3).

Table 3. Weight, volume and color of grain (with and without husk) of different *Joha rice* cultivated in Bongaigaon district of Assam

Varietal Name	1000 grains weight with husk (gm)	1000 grains weight without husk(gm)	Volume of 1000 grains with husk (cc)	Volume of 1000 grains without husk(cc)	Husk colour	De-husked grain colour
<i>Kalabhog</i>	15.50	14.10	15.2	10.5	Dark green	Pista
<i>Ghogubhog</i>	12.50	09.03	10.3	08.0	Golden brown with mid buff shade	Antique white
<i>Benibhog</i>	12.90	10.50	15.0	09.8	Mid buff	Raw silk
<i>Tulsibhog</i>	12.30	10.70	18.5	10.0	Dark green	Fresh sprout
<i>Katharibhog</i>	18.40	14.30	24.8	10.6	Mid buff	Sandal wood
<i>Kewabhog</i>	20.00	16.00	15.0	10.0	Dark mushroom	Cascade green
<i>Shialbhog</i>	19.90	11.00	10.0	10.2	Mid buff	Raw silk

Table 4. Protein concentration (mg/ml) of grain and uses of different *Joha rice* cultivated in Bongaigaon district of Assam

Varietal type	Protein Concentration (mg/ml)	Preferred uses
<i>Kalabhog</i>	1.25	For preparation of table rice and sweet dishes
<i>Ghogubhog</i>	0.43	Sweet dishes
<i>Benibhog</i>	0.78	Sweet dishes
<i>Tulsibhog</i>	0.85	Table rice and sweet dishes
<i>Katharibhog</i>	0.74	Table rice and sweet dishes
<i>Kewabhog</i>	0.18	Flat rice and sweet dishes
<i>Shialbhog</i>	0.39	Sweet dishes

In case of Protein concentration, highest amount was observed in *Kalabhog* which was followed by *Tulsibhog*, *Benibhog*, *Katheribhog*, *Ghogubhog*, *Shialbhog* and then *Kewabhog* (Table 4). Regarding the uses it was observed that due to its super fine de-

husked and deliciousness all the varieties are used in preparation of some special dishes like *kheer* and *pulao*. Besides, sweet dishes like *Kalabhog*, *Tulsibhog* and *Katheribhog* were found to use in preparation of table rice while *Kewabhog* in preparation of flatted rice (compressed rice) to take as *Jalpan*.

CONCLUSIONS

After conducting a study of seven different varieties of *Joha* rice growing in the Bongaigaon district of Assam; it was observed that even though all these varieties are more or less similar, each of them possess some unique characteristics which may be helpful in their identification. Again, due to some inherent property, though the *Joha* rice is highly valued but population pressure and ever increasing demand of higher crop production may lead the farmers to discontinue the practice of cultivating these rice varieties due to poor yield. Therefore, there is an urgent need for characterization and encouraging the farmers to grow these varieties which could help in the *in situ* on-farm conservation of these important traditional varieties of Bongaigaon.

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