Characterization of Ahu Rices of Assam for Quality Traits

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A study on characterization of Ahu rices of Assam for quality traits showed wide variability with respect to 12 quality traits and grain yield amongst 147 entries. Coefficient of variation was observed highest for alkali digestion value which was followed by grain yield and water uptake number. Observation on physical grain quality and cooking quality attributes revealed that Ahu varieties were mostly of long bold grain type with poor alkali digestion (high gelatinisation temperature) value, low volume expansion, water uptake and kernel elongation. These varieties, thus, differs in quality from the rices normally preferred by consumers. A few varieties, on the other hand, exhibited desirable values for individual quality traits. However, the desirable physical grain quality attributes were observed to be associated with undesirable cooking qualities and vice versa. Kernel elongation exhibited positive and significant association with grain yield. Basantbahar, identified as the best superfine-grained variety had very poor cooking quality, while another variety Betguti I having highest kernel elongation and volume expansion exhibited very poor physical grain quality. Breeding effort for breaking these undesirable associations is necessary to improve qualities of Ahu rices of Assam.

Key Words: Ahu rice, Characterization, Quality traits

Introduction

Traditional photoinsensitive early maturing rice varieties of Assam grown during Feb-March to June-July as either dry broadcast or transplanted are popularly known as Ahu rices. Attempts for evaluation of this group of rice germplasm have been very much limited. Although earlier workers evaluated some of the varieties in this group with respect to yield and yield components (Das *et al.*, 1981), drought tolerance and grain dormancy (Kalita *et al.*, 1990; Kalita and Baruah, 1993) and pigmentation pattern (Sarma *et al.*, 2003) the varieties have not been evaluated for quality traits. It is generally accepted that Ahu rices are not only poor in yield but also low in quality as compared to normal winter rices for which, these traditional varieties have suffered from gradual extinction from cultivation. It is the general practice that Ahu rices are used after parboiling to enhance consumer acceptability. It is, therefore, important to carry out complete characterization of Ahu rice germplasm with respect to yield, quality and other morpho-agronomic and adaptive traits. As a part of this, the present report entails evaluation of a set of 147 Ahu varieties for important quality traits.

Materials and Methods

The materials for the present investigation comprised of 147 Ahu rice genotypes of Assam procured from the Regional Rice Research Station, Titabar, Assam and B.N. College of Agriculture, Biswanath Chariali, Assam. The genotypes were grown in three row plots of two meter length with a spacing of 15 x 20 cm during wet season, 2001. Observation on 12 traits related with quality, *viz.*, grain length (GL), grain breadth (GB), grain length-breadth ratio (L:Bg), kernel length (KL), kernel breadth (KB), kernel length-breadth ratio (L:Bk), kernel elongation ratio (KR), breadth-wise expansion of kernel (BE), water uptake number (WU), volume expansion (VE), alkali digestion value (AD) and chalkiness of endosperm (CH) along with grain yield /plant (GY) were recorded following standard evaluation system (IRRI, 1996). Modification of scale was made wherever standard system was not satisfied. Variability parameters, *viz.*, mean, range, standard deviation, coefficient of variation, skewness and kurtosis were calculated for each of the quality traits under study following Panse and Sukhatme (1989). Frequencies of genotypes in different classes were worked out and represented in column diagram. Varieties were further classified into five grain shapes, *viz.*, long slender (>6.0 mm length, >3.9 L:B), long bold (>6.0 mm length, <3.0 L:B), short slender (<6.0 mm length, >3.0 L:B), medium slender (4.5-6.0 mm length, 2.5-3.0 L:B) and short bold (<5.0 mm length, < 2.5 L:B) and four kernel shapes, *viz.*, slender (>3.0 L:B), medium (2.1-3.0 L:B), bold (1.1-2.0 L:B) and round (<1.1 L:B). Simple linear

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correlation coefficients amongst different quality traits and grain yield were estimated.

Results and Discussion

A wide range of variation was observed for grain quality attributes along with grain yield plant^{-1} in the Ahu rice genotypes under study (Table 1). Considerable range of variation was observed for all the traits under study indicating wide spectrum of variation in Ahu rice germ plasm for various traits under study. Highest coefficient of variation (CV) was observed for alkali digestion value (55.37%) followed by grain yield plant^{-1} (32.36%) and water uptake number (21.89%). Among the traits under study, lowest variation was exhibited by kernel elongation ratio (8.55%). Based on the coefficient of variation, it could be visualized that among the grain quality traits, alkali digestion value, volume expansion, water uptake number and length breadth ratio of grain and kernel were most likely to contribute to the diversity in Ahu rices. Considerable diversity in Ahu rices with respect to grain yield was earlier reported by Das *et al.* (1981) and Baruah *et al.* (1994). Their observation revealed that panicle weight and panicle number/plant reasonably accounted for the yield variation in Ahu rices.

Frequency distribution against different classes for all the traits under study are presented in Fig.1. Observations on grain and kernel shape and size as revealed from length, breadth and length: breadth ratios, indicated that most of the entries had long bold grains and medium kernel. Forty two varieties had long slender grains, while slender kernel was observed only in 8 entries. Siddiq (1982) observed that kernel length 7 mm or above and breadth less than 2 mm were highly remunerative in international trade. Among the Ahu rice varieties under study, only one variety, Basantbahar, satisfied this norm. Pericarp colour is also a important feature of physical quality of rice kernel determining market acceptance. In the same set of genotypes, Sarma *et al.* (2003) reported that most of the Ahu varieties had pigmentation in pericarp, intensity varying from light brown to red and, thus, differed from rices normally preferred by consumers. Frequency distribution of chalkiness of endosperm showed that majority of the varieties had none to small (<10%) chalky areas in the endosperm, while the others had medium to large chalky areas. Chalkiness is an important consideration for breeding quality rice (Jennings *et al.*, 1979). The consumer preference goes in favour of a clear endosperm against the chalky types and pays a premium price for it.

Cooking quality in rice is normally determined by water uptake, volume expansion and kernel elongation which are primarily influenced by amylose content and alkali digestion value (Tomar and Nanda, 1982). In the present study, water uptake ranged from 187.3 to 458.1, volume expansion from 2.13 to 5.1 and kernel elongation from 1.23 to 2.12. Moreover, breadth-wise expansion is also another important cooking quality criterion. Thinner the cooked kernel, better is the demand (Sarkar *et al.*, 1994). Breadth-wise expansion ranged from 1.08 to 2.38, majority of the varieties being in the lower range for the trait. Relative frequencies against different classes for these traits revealed that Ahu rices are mostly poor in alkali digestion, volume expansion and kernel elongation. Consumer preference in a large part of India is for rice, which is non-sticky but soft after cooking. Low alkali digestion value indicates high gelatinisation temperature (GT), which is not common in Indian rices (Bhattacharya *et al.*, 1980). Contrary to this, Ahu rices as observed in the present study are mostly of high GT type. In the study of Bhattacharya *et al.* (1980), the varieties from Assam belonged to normal winter rice group. Two of the exceptions were the varieties CH 63 from Assam and NC 324 from West Bengal, having very high GT (Low AD). Interestingly, the variety CH 63 which is a Chinese

Table 1. Variability parameters for grain quality traits and grain yield in Ahu rices

	GL(mm)	GB (m)	L:Bg	KL (mm)	KB (mm)	ER	L:Bk	VE	WU (ml)	BE	AD	CH	GY (g)
Range:													
Min	4.92	1.99	1.67	3.25	1.62	1.23	1.33	2.13	187.33	1.08	1.00	8.10	6.23
Max.	9.06	3.55	4.46	7.85	3.24	2.12	4.35	5.10	458.10	2.35	7.00	25.30	27.48
Mean	6.94	2.58	2.76	5.54	2.37	1.52	2.39	3.59	309.96	1.52	2.98	14.56	14.32
Variance	0.65	0.14	0.31	0.47	0.11	0.02	0.22	0.61	4599.36	0.05	2.74	11.41	21.48
Standard deviation	0.80	0.37	0.56	0.69	0.33	0.13	0.47	0.78	67.82	0.23	1.65	3.38	4.63
CV(%)	0.12	0.14	0.20	0.12	0.14	0.09	0.20	0.22	0.22	0.15	0.56	0.23	0.32
Sem (±)	0.07	0.03	0.05	0.06	0.03	0.01	0.04	0.07	5.71	0.02	0.14	0.28	0.39
Skewness	-0.10	0.04	0.67	0.44	0.47	0.78	1.14	0.48	0.12	0.78	1.30	0.60	0.66
Kurtosis	-0.06	-1.25	0.09	1.22	-0.66	2.25	3.00	-0.51	-1.07	0.75	0.18	0.69	-0.14

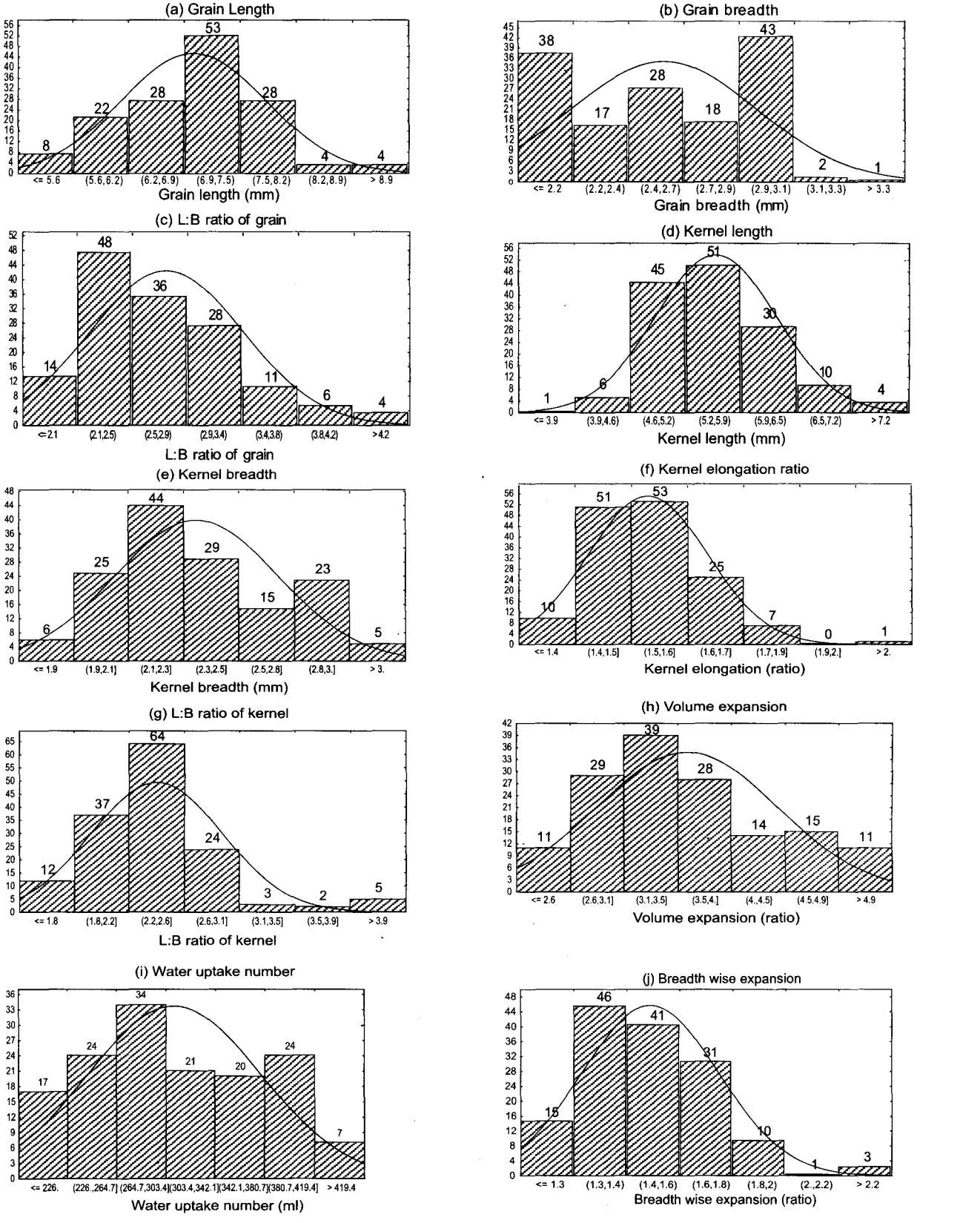

Fig. 1: Frequency distribution for various traits in Ahu rices (a) Grain length, (b) Grain breadth, (c) L:B ratio of grain, (d) kernel length, (e) Kernel breadth, (f) Kernel elongation ratio, (g) L:B ratio of kernel, (h) Volume expansion

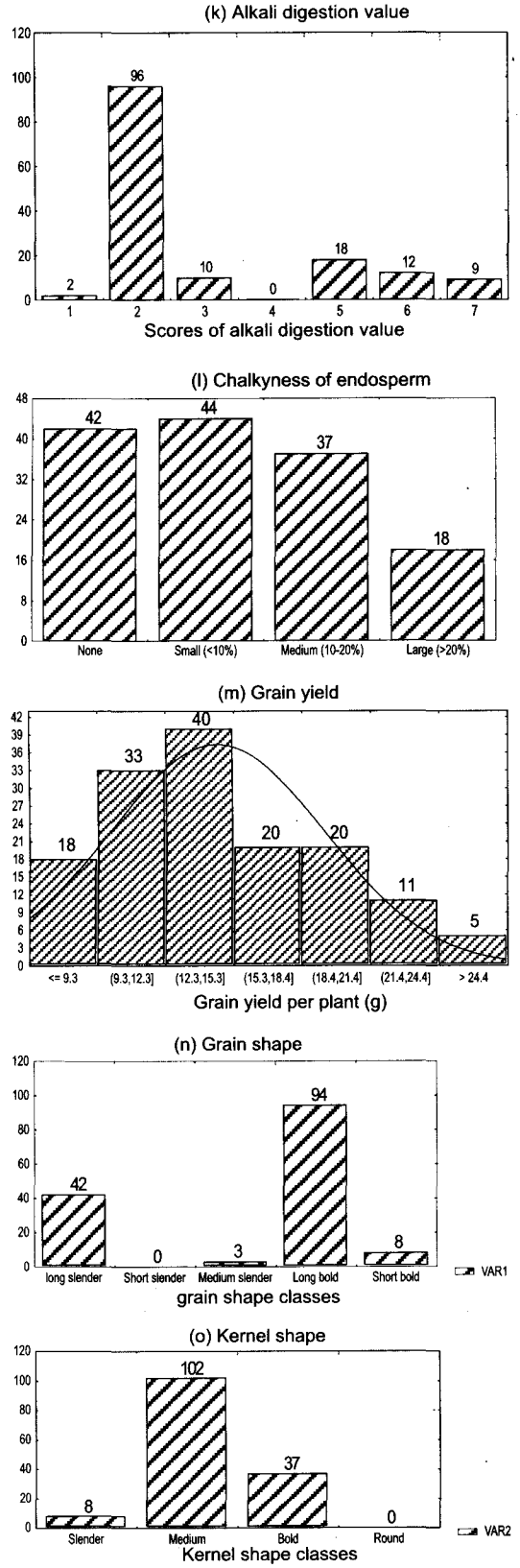

Fig. 1 (Contd.): (i) Water uptake number, (j) Breadth wise expansion, (k) Alkali digestion value, (l) Chalkiness of endosperm, (m) Grain yield, (n) Grain shape, and (o) Kernel shape

introduction is presently one of the popular Ahu varieties of Assam and was also included in the present study; exhibited very low (2.0) alkali digestion. This gives a clear indication that the Ahu rices are quite different than the other groups of Assam rice varieties in terms of quality.

A few varieties were identified excellent for individual quality features. Highest kernel elongation and volume expansion was exhibited by Betguti I, which is a short bold- seeded variety having very low alkali digestion value. Basantabahar was identified as the best superfine grain-type variety which exhibited highest L:Bg L:Bk and lowest grain breadth. However, cooking quality of this variety was observed to be poor associated with low kernel elongation and high breadth wise expansion. A number of varieties were observed having desirable alkali digestion value and non-chalky endosperm. However, no one of them was observed to possess other desirable attributes as well. Grain yield plant^{-1} was observed along with the quality traits. Significant variability was observed for this trait as well ranging from 6.23 to 24.48 g plant^{-1}. However, a large number of varieties were poor yielders. The best three Ahu rice varieties identified for grain yield plant^{-1} were Padumoni II, Ikra II and Khoijoi. An insight into the quality of these three varieties indicated that the first two varieties were very poor in alkali digestion value, kernel elongation, and volume expansion and water uptake number in comparison to the third one. The variety Khoijoi, however, had intermediate alkali digestion value and also comparatively higher values for volume expansion, water uptake and kernel elongation. All of them had long bold grains with red pericarp.

Correlation studies (Table 2) revealed that GL and KL was positively and significantly correlated with L:Bg, L:Bk, AD and CH. Kernel length, on the other hand, was negatively correlated with kernel elongation. This indicated that long grained varieties tended to have high AD values and high degree of endosperm chalkiness along with poor kernel elongation. Highly significant correlation of the length-breadth ratio of grain and kernel were observed with VE, BE, AD and CH. Thus, it was realized that the desirable physical quality was associated with many of the undesirable cooking qualities like higher grain chalkiness, lower gelatinisation temperature, higher breadth-wise expansion and poor kernel elongation. Kernel elongation, volume expansion and water uptake were observed to be significantly and positively correlated with each other. Tomar and Nanda (1982) also reported similar result with regard to these traits. Grain yield

Table 2. Correlation matrix for 12 quality traits and grain yield in Ahu rices

	GB	L:Bg	KL	KB	ER	L:Bk	VE	WU	BE	AD	CH	GY
GL	-0.17*	0.72**	0.52**	-0.24**	-0.02	0.52**	0.15	0.08	0.16	0.22	0.28**	0.09
GB		-0.79**	-0.18*	0.39**	0.21*	-0.41**	-0.14	-0.18*	-0.26**	-0.12	-0.13	0.10
L:Bg			0.46**	-0.43**	-0.14	0.63*	0.19*	0.17*	0.28**	0.24	0.27**	-0.01
KL				-0.12	-0.20*	0.74**	-0.26**	-0.27**	0.03	0.18	0.17*	0.07
KB					-0.06	-0.73**	-0.55**	-0.48**	-0.58**	-0.14	-0.09	0.05
ER						-0.07	0.41**	0.34**	0.07	-0.08	0.01	0.17*
L:Bk							0.20*	0.14	0.40**	0.23	0.18*	0.03
VE								0.84**	0.68**	0.22	0.19*	0.02
WU									0.60**	0.09	0.14	-0.03
BE										0.13	0.11	0.01
AD											0.80*	0.10
CH												0.16

* Significant at P= 0.05, **Significant at P=0.01

exhibited significant positive correlation with kernel elongation but did not show significant relationship with any other quality traits under study.

From the above results, it appeared that the Ahu rices in general do not confer the generally acceptable quality norm of Indian rices with respect to the major quality attributes. Inhabitants of the native region might have adapted with the rice type, developing their own system of use and processing. In order to improve the grain quality of Ahu rices, crossing programme may be undertaken to bring different desirable traits distributed in the varieties in a common background. Consideration of the grain yield and related traits along with the quality parameters would be beneficial in formulating breeding programmes for improving Ahu rices for yield and quality together. Many undesirable associations between the physical quality traits and cooking quality attributes would limit direct selection of varieties for simultaneous improvement of multiple traits. Therefore, it would be necessary to undertake breeding programme to break these undesirable linkages for bringing about improvement in Ahu rices in terms of quality attributes.

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