Indian J. Genet., **57** (3): 246–254 (1997)

CHARACTERIZATION AND IDENTIFICATION OF GORA RICES USING PHYSICO CHEMICAL TRAITS

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(Received: July 29, 1991; accepted: August 22, 1994)

ABSTRACT

Variation for ten quality characters were studied in 57 gora (upland) rice (*Oryza sativa* L.) accessions from plateau region of Bihar. Of the three groups, brown, white and black; brown and black gora rices appeared to be highly variable. A total of 25 accessions could be identified based on kernel size, shape, colour, amylose content, gelatinization temperature, kernel elongation, phenol test and leaf blast reaction. However, three genotypes differing in their flowering duration could not be separated by these tests, suggesting that morphological, physiological and physico-chemical characteristics should be simultaneously considered in the varietal identification studies. Quality characteristics of gora rices have also been presented.

Key words: Gora rice, *Oryza sativa* L., quality characters, upland.

Rainfed uplands of plateau region of Bihar are called *tanr* lands and traditional rice varieties grown in such lands are called gora, a word equivalent to upland in Mundari dialect of this region. Except for variation in lemma-palea colour, most of the gora varieties appear alike causing difficulties in identification of duplicates. No systematic effort has been made to characterize and classify this group of rices. Morphological, seed and seedling characters have generally been used as keys in cultivar identification of different crops [1–4]. But in gora collections, the situation is complicated by the limited variability in morphological traits of plant and grain [5]. This warranted the use of physico-chemical characteristics of the grain and chemical tests in characterizing this group. In the present investigation attempts have been made to study the extent of variation in some quality attributes and to characterize gora rices.

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MATERIALS AND METHODS

Fifty seven gora rice accessions from different ecological regions of plateau region of Bihar were grown in four-row plots during 1988 wet season. Rows were 3 m long and spaced 20 cm apart. The fertilizers (N, P, K) were applied at the rate of 40 : 7 : 13 kg/ha, respectively. The method of sampling and recording of various traits : grain size, shape, colour, hulling, milling, head-rice recovery, amylose content, gelatinization temperature appearance of milled kernel, volume expansion and kernel elongation were essentially the same as described elsewhere [6]. The range, mean and coefficient of variability (C.V.) were computed to assess the extent of variation in the quality traits.

The accessions were classified into different grain types based on milled kernel length and shape (L : B ratio), i.e. long slender, long bold, short bold and medium slender. Based on amylose content, they were grouped into high (> 25%), intermediate (20–25%) and low (<20%) amylose types. Gelatinization temperature (GT) measured in terms of alkali digestion value was further used to study variability within sub- groups — low GT (7–9 alkali score), intermediate GT (5–6 score), intermediate–high GT (4 alkali score) and high GT (1–3 alkali score). Based on kernel elongation the accessions were classified as low (< 1.5), intermediate (1.5–1.75), and high (> 1.75) elongation types. Leaf blast evaluation was carried out following standard evaluation system.

Phenol colour test was performed only for white gora accessions by soaking 10 grains in 0.25% aqueous phenol solution for 48 h. The accessions were classified as positive (++), or negative (–) by comparing against the standard checks : Jaya (++), IR 24 (+) and Type 3 (–).

RESULTS AND DISCUSSION

Variation in quality traits: The range, mean and coefficients of variability for different milling and cooking quality indices are presented in Table 1. The results indicated lack of variation for most of the traits under study except for alkali digestion value, head-rice recovery and water uptake. Low variability was recorded for grain shape (L : B ratio) and amylose content (Table 1).

Since the cultivar identity in gora rices is maintained mainly by their lemma–palea colour, the accessions were first grouped into three classes namely black (14 number), brown (23 number) and white (20 number). The variability pattern for quality traits was also investigated among the three groups. There was not much variation in CV among the three groups for hulling and milling recovery (Table 1) while head-rice recovery varied substantially. The overall pattern of variation in head-rice recovery in gora rices was also reflected in the black gora accessions as indicated by the closeness of CV.

Table 1. Physico-chemical and cooking quality traits in different groups of gora rices

Group	Hulling (%)	Milling (%)	Head rice (%)	Kernel length (mm)	L/B ratio	Kheth score	Amylose content (%)	Water uptake (ml)	Volume expansion	Kernel elongation
Black gora (Group I)										
Range	70.7–80.2	64.0–75.2	27.7–66.6	5.29–6.05	2.11–2.47	2.5–5.5	15.8–22.1	215.0–340.0	3.7–4.0	1.49–1.76
Mean	74.1	69.0	41.3	5.55	2.23	3.48	20.0	276.5	3.8	1.63
CV (%)	3.4	4.1	26.0	3.90	5.00	38.90	9.2	17.6	4.0	5.60
Brown gora (Group II)										
Range	72.1–80.5	67.0–75.3	31.2–68.0	4.94–6.89	2.00–3.17	2.5–5.5	17.5–23.4	175.0–345.0	3.6–4.3	1.49–1.76
Mean	76.7	71.7	53.7	5.75	2.33	3.6	21.2	253.6	3.8	1.63
CV (%)	3.3	3.7	19.5	7.50	13.20	34.8	7.6	19.1	4.0	5.60
White gora (Group III)										
Range	71.5–79.0	66.2–74.0	34.1–60.0	5.03–6.12	1.72–2.48	2.5–4.0	16.0–23.0	210.0–315.0	3.7–4.2	1.46–1.95
Mean	75.6	70.5	45.1	5.51	2.21	3.1	21.6	251.6	3.9	1.75
CV (%)	2.6	2.9	17.7	4.70	8.50	13.7	6.9	13.0	4.3	7.60
Overall										
Range	70.7–80.5	64.0–75.3	27.7–68.0	4.94–6.89	1.72–3.17	2.5–5.5	15.8–23.4	175.0–345.0	3.6–4.3	1.46–1.95
Mean	75.7	70.7	47.5	5.62	2.27	3.45	21.5	257.0	3.9	1.72
CV (%)	3.4	3.6	23.1	5.90	10.30	32.60	8.3	17.1	4.4	6.60

Grain size and shape seem to vary appreciably in the brown gora accessions as compared to black and white gora rices. Although alkali digestion value (GT) showed maximum variation in all the three groups considered together. The white gora accessions did not exhibit large variability for this trait (Table 1) and all of them (white) had either high or high–intermediate GT. The black gora accessions appeared to be more variable for amylose content than those of the rest two groups. However, the brown gora accessions had large variability for water uptake whereas, all the three groups showed similar trend of variation for volume expansion. Relatively large variability for kernel elongation was observed in the white gora accessions. All the accessions were susceptible to blast qualitatively but these could be differentiated into two groups based on distinct quantitative differences: partially resistant and completely susceptible accessions. Resistance appeared to be associated with low amylose content and high – intermediate GT as these accessions differing in their reaction to blast fell into groups separated by these two traits. For instance, HRC 309 among the white gora accessions, HRC 358 and 359 among the black gora accessions and HRC 14, 270, 274, 280, 407 and 409 among the brown gora accessions were partially resistant to blast and had low amylose content and high–intermediate GT.

The results suggest that, in general, brown gora accessions might have divergent genotypes whereas, white and black gora accessions could be genetically similar as evidenced by low CV for most of the traits under study. This, however, needs further investigation with more number of genotypes in each group for more authentic conclusions.

Characterization and identification. One of the essential prerequisites for the characters to be used in cultivar identification is that it should be genetically controlled and highly heritable with negligible influence of environmental factors. Hence, in the present investigation, only kernel size, shape, colour, GT, amylose content, appearance of milled kernel (abdominal white), kernel elongation and phenol reaction were used in the characterization of gora rices since these traits have been reported to be highly heritable [7–10]. Nevertheless, the degree of manifestation of these traits could vary a little under different agroclimatic conditions. It is, therefore, imperative that comparisons are made under identical situations. Grain size, shape and colour have been successfully used in the identification of rice cultivars [1, 2] but in the present set of materials, these traits varied little. Of the 57 accessions, 48 were short bold and only two (HRC 407, 409) were long slender (Table 2). Similarly, except for HRC 369 which had purple kernel, rest were either red (30 accessions) or white (26 accessions). Therefore, quality traits and chemical tests were employed in addition to these traits.

Group 1 (Black gora). Of the 14 accessions in the group, 13 had short bold grains and one (HRC 364) long bold grains. The accession, HRC 364, had white kernels, intermediate amylose content, high GT with clear endosperm and intermediate kernel elongation. Of the

Table 2. Physico-chemical traits of Black gora rices (Group I)

HRC No.*	Kernel colour	Grain size & shape	Amylose content	Gelatiniz-ation temp.	Abdominal white	Kernel elongation
118	Red	Short bold	Low	High	Absent	Intermediate
159	-Do-	-Do-	Intermediate	High-intermediate	-Do-	High
358	-Do-	-Do-	-Do-	-Do-	-Do-	Intermediate
359	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-
360	-Do-	-Do-	Low	High	-Do-	-Do-
361	-Do-	-Do-	Intermediate	-Do-	-Do-	-Do-
362	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-
363	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-
364	White	Long bold	Low	-Do-	-Do-	-Do-
365	Red	Short bold	-Do-	-Do-	Present	-Do-
366	-Do-	-Do-	-Do-	-Do-	Absent	-Do-
367	-Do-	-Do-	-Do-	-Do-	-Do-	Low
368	-Do-	-Do-	Intermediate	Intermediate	-Do-	Intermediate
369	Purple	-Do-	Low	-Do-	-Do-	-Do-

*Hazaribag rice collection number.

13 short bold accessions, HRC 369 had purple and the rest had red pericarp. Amylose content could further split this group of 13 accessions (Table 2). GT could also differentiate some of the accessions, though majority of them (except HRC 368 and 369) had high or high-intermediate GT. Appearance of the milled kernel and kernel elongation were of little use in distinguishing these accessions since all of them had clear endosperm with intermediate elongation. In all, five accessions (HRC 159, 364, 367, 368, 369) appeared to be distinct (Table 2).

Group 2 (Brown gora). Twenty three accessions belonging to this group fell into four classes based on kernel size and shape, viz., short bold (17 accessions), long bold (3 accessions), long slender (2 accessions) and medium slender (1 accession) (Table 3). Seventeen accessions in the short bold group were finally divided into seven distinct accessions (HRC 14, 274, 280, 371, 380, 383, 387). Three accessions in the long bold group (HRC 298, 378, 394) and two accessions in the long slender (HRC 407, 409) classes seemed to be distinct cultivars (Table 3).

Group 3 (White gora). Twenty accessions represented this group of which HRC 316 and HRC 322 exhibited medium slender and long bold grains, respectively and the remaining

Table 3. Physico-chemical traits of Brown gora rices (Group II)

HRC No.*	Kernel colour	Grain size & shape	Amylose content	Gelatiniz-ation temp.	Abdominal white	Kernel elongation
14	Red	Shortbold	Low	High	Present	High
160	-Do-	-Do-	Intermediate	-Do-	Absent	-Do-
270	-Do-	-Do-	Low	-Do-	-Do-	-Do-
274	-Do-	-Do-	-Do-	High-Intermediate	-Do-	Intermediate
280	-Do-	-Do-	Intermediate	-Do-	-Do-	High
298	-Do-	Long bold	-Do-	-Do-	-Do-	-Do-
370	-Do-	Short bold	-Do-	Intermediate	-Do-	Intermediate
371	White	-Do-	-Do-	-Do-	-Do-	-Do-
372	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-
373	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-
378	Red	Long bold	-Do-	-Do-	-Do-	-Do-
379	White	Short bold	-Do-	-Do-	-Do-	High
380	-Do-	-Do-	-Do-	-Do-	Occas. Present	Intermediate
382	Red	-Do-	-Do-	-Do-	Absent	-Do-
383	White	-Do-	-Do-	High	Occas. Present	High
386	-Do-	-Do-	-Do-	-Do-	Absent	Intermediate
387	-Do-	-Do-	-Do-	-Do-	Occas. Present	High
388	-Do-	-Do-	-Do-	-Do-	Absent	Intermediate
390	Red	-Do-	-Do-	-Do-	-Do-	-Do-
394	White	Long bold	-Do-	-Do-	-Do-	-Do-
407	Red	Long slender	-Do-	High-Intermediate	-Do-	-Do-
409	White	-Do-	Low	High	-Do-	-Do-
410	-Do-	Medium slender	Intermediate	-Do-	-Do-	-Do-

*Hazaribag rice collection number.

were short bold (Table 4). HRC 316 had white kernel, intermediate amylose content and GT, clear endosperm and intermediate kernel elongation with positive phenol reaction. HRC 322 had white kernels, intermediate amylose content, high GT, endosperm opaque, and intermediate kernel elongation. It gave negative phenol reaction (Table 4). Eighteen short bold accessions were further divided into two groups, i.e. with red kernel (7) and with white kernel (11). HRC 309 had low amylose content. The rest of the accessions in both the groups, showed intermediate amylose content (Table 4). Seven of the accessions (HRC 309, 315, 316,

Table 4. Physico-chemical traits of White gora rices (Group III)

HRC No.*	Kernel colour	Grain size & shape	Amylose content	Gelatiniz-ation temp.	Abdominal white	Kernel elongation	Phenol reaction
301	Red	Short bold	Intermediate	High	Absent	Intermediate	++
302	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-	++
303	White	-Do-	-Do-	High-Intermediate	Present	High	++
308	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-	++
309	Red	-Do-	Low	High	Absent	Low	+
310	White	-Do-	Intermediate	-Do-	-Do-	High	+
312	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-	-
313	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-	-
314	Red	-Do-	-Do-	-Do-	-Do-	-Do-	++
315	White	-Do-	-Do-	High-Intermediate	-Do-	-Do-	++
316	-Do-	Medium Slender	-Do-	Intermediate	Occas. Present	Intermediate	+
317	-Do-	Short bold	-Do-	High	Absent	High	+
318	Red	-Do-	-Do-	-Do-	-Do-	-Do-	++
319	-Do-	-Do-	-Do-	Intermediate	-Do-	Intermediate	++
320	White	-Do-	-Do-	High	-Do-	High	+
321	-Do-	-Do-	-Do-	-Do-	-Do-	-Do-	+
322	-Do-	Long bold	-Do-	-Do-	Present	Intermediate	-
323	-Do-	Short bold	-Do-	-Do-	-Do-	-Do-	-
324	Red	-Do-	-Do-	-Do-	Absent	-Do-	++
325	White	-Do-	-Do-	High-Intermediate	-Do-	-Do-	++

*Hazaribag rice collection number.

319, 322, 323, 325) appeared to be distinct cultivars and the others could not be separated by the characters studied.

In the present investigation, some of the accessions like HRC 360 and 361 (black gora) and HRC 390 (brown gora) were found to be distinct cultivars based on their flowering duration but were grouped with other accessions based on the characters under study.

Among the 57 gora accessions investigated only 28 appeared to be distinctly identifiable cultivars. The findings of the present study coupled with earlier reports [5, 11] suggested this group might not be as divergent as indicated by the number of accessions. This group

probably had only a few genetically differentiated and identifiable genotypes with minor variations induced during the process of adaptations by micro-climatic changes in different ecological niches which by and large are similar. Because these rices have very narrow distribution in the plateau region and the farmers use their own seed source, there is a possibility that a large number of duplicates could have been collected from different localities. Hence there is a further scope to eliminate the duplicates by employing some additional chemical/biochemical tests.

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