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Some Morphological Characters of the Cultivated Rice Grains Collected in India (III)

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Introduction

During the period from December in 1978 to January in 1979, the writer was sent to India for collection of the wild and cultivated rices. At this opportunity, the grains of cultivated rice distributed not only in Assam but also in West Bengal States were collected and analyzed in view of the morphological characters.

Northeastern part of India has been considered to be one of the differentiation centers of rice (*Oryza sativa* L.) in accordance with genetic and cytogenetic investigations[7]. However, an accumulation of complete data endorsed by discussions on these aspects has been unfortunately far from being perfect at the present. Sharma *et al.*[8] carried out systematic collections of current and primitive cultivars of rice in the northeastern part of India from the viewpoint of breeding program. For genetic and breeding purposes, varietal variations and the methodologies of them should be ascertained as early as possible. For these purposes, the present collection was carried out.

The origin, evolution, cultivation, dispersal and diversification of cultivated species of rice are quite interesting not only to biological scientists but also to geographers, archaeologists, anthropologists, philologists, historians and other social scientists[1].

Taking into account these backgrounds, the present experiment series was made to accomplish the works which are going to clarify the varietal variations and the phylogenetic relationships of the cultivated rice in India. In the previous papers, the records on morphological characters of the unhusked and husked grains and some mutual relations[4], and variation ranges in 6 characters[5] were reported.

In the present paper, variation ranges in 12 characters were mainly described, both in order to confirm the morphological characters of grains and to make clear the strain's specificities. Variation ranges were used in wild species of *Vigna*[3] and rice[6] and some useful informations were obtained. Although these methodologies were seen as to be under-development, those were adopted for the future new turn here. The records on the relations between the respective two characters will be reported in the separate articles.

Materials and Methods

Twenty-one strains of rice collected in India were used in the experiment. They are listed up in Table 1 of the previous paper[4]. In this table, collection number, collection date and place and detailed informations are mentioned. States included in this paper are Meghalaya, Assam and West Bengal. The rice strains distributed in the respective localities have different meanings in

view of morphological and physiological characters, and should be separately considered in view of their respective phylogenetical statuses. Accordingly, they are divided into two groups in the investigation-series, *i.e.*, Group A ··· strains collected in Meghalaya and Assam States (9 strains), Group B ··· strains collected in West Bengal State (12 strains).

The variation ranges in 12 characters (Tables 1 and 2) were illustrated by the maximum, the minimum and the pure-range values in the whole grains and the whole strains. Twelve characters used here were constituted with length, width, thickness, ratios of length to width, of length to thickness and of width to thickness in view of husked grains and comparative values (=husked/unhusked grains).

In the present paper, the following abbreviations were used, *i.e.*, L (length), W (width), T (thickness), L/W (ratio of length to width), L/T (ratio of length to thickness), W/T (ratio of width to thickness), s.d. (standard deviations), UHG (unhusked grain), HG (husked grain).

Results

1. Length in husked grains

Maximum: 1) Group A: The results are given in Table 1. In this table, the maximum, the minimum and their range are shown. The longest (6.90 mm) was obtained in No. 9, followed by No. 4 (6.45 mm) and No. 5 (6.40 mm). It was noted that the value was peculiarly large in No. 9. These combinations of strains were found to be the same as in case of the minimum of length (UHG). The shortest (5.90 mm) was noted in No. 8, followed by No. 1 (6.05 mm) and No. 3 (6.15 mm). These orders of strains were found to be the same as in case of the maximum of length (UHG). Average and its s.d. through the whole strains were found to be 6.31 ± 0.29.

2) Group B: The longest (8.25 mm) was obtained in No. 16, followed by No. 20 (8.00 mm) and No. 17 (7.75 mm). These combinations of strains were found to be the same as in case of the range of L/W (UHG). The shortest (5.20 mm) was noted in No. 12, followed by No. 15 (5.95 mm) and No. 11 (6.00 mm). It was noted that the value was peculiarly small in No. 12. Average and its s.d. through the whole strains were found to be 6.88 ± 0.93.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 6.64 ± 0.77.

Minimum: 1) Group A: The longest (6.15 mm) was obtained in No. 9, followed by No. 5 (5.75 mm) and No. 4 (5.70 mm). It was noted that the value was peculiarly large in No. 9. These combinations of strains were found to be the same as in cases of the minimum of length (UHG) and of the maximum of length (HG). The shortest (5.15 mm) was noted in Nos. 7 and 8, followed by No. 2 (5.20 mm). Average and its s.d. through the whole strains were found to be 5.49 ± 0.34.

2) Group B: The longest (6.40 mm) was obtained in No. 21, followed by No. 16 (6.30 mm) and No. 18 (6.05mm). These orders of strains were found to be the same as in case of the minimum of length (UHG). The shortest (4.60 mm) was noted in No. 12, followed by No. 19 (5.15 mm) and No. 11 (5.30 mm). It was noted that the value was peculiarly small in No. 12. These combinations of strains were found to be the same as in case of the minimum of length (UHG). Average and its s.d. through the whole strains were found to be 5.65 ± 0.49.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 5.58 ± 0.43.

Range: 1) Group A: The largest (1.25 mm) was obtained in No. 7, followed by No. 2 (1.00 mm) and No. 6 (0.90 mm). It was noted that the value was peculiarly large in No. 7. These

Table 1. Ranges of husked grains in the strain level; length (mm), width (mm), thickness (mm), raito of length to width (%), ratio of length to thickness (%) and ratio of width to thickness (%)

Strain No.	Length			Width			Thickness			Length/Width			Length/Thickness			Width/Thickness		
	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range
1	6.05	5.30	0.75	3.40	2.55	0.85	2.35	2.00	0.35	2.37	1.59	0.78	3.03	2.30	0.73	1.62	1.21	0.41
2	6.20	5.20	1.00	3.25	2.70	0.55	2.30	1.95	0.35	2.14	1.77	0.37	3.10	2.39	0.71	1.55	1.26	0.29
3	6.15	5.65	0.50	2.05	1.50	0.55	1.20	0.90	0.30	3.77	3.00	0.77	6.28	4.96	1.32	1.71	1.48	0.23
4	6.45	5.70	0.75	2.50	2.20	0.30	1.90	1.60	0.30	2.80	2.44	0.36	3.79	3.14	0.65	1.47	1.19	0.28
5	6.40	5.75	0.65	3.20	2.50	0.70	2.30	1.80	0.50	2.44	1.88	0.56	3.36	2.64	0.72	1.48	1.25	0.23
6	6.30	5.40	0.90	2.70	2.10	0.60	2.05	1.75	0.30	2.61	2.19	0.42	3.49	2.88	0.61	1.51	1.15	0.36
7	6.40	5.15	1.25	2.95	2.40	0.55	2.25	1.75	0.50	2.56	1.81	0.75	3.14	2.36	0.78	1.53	1.16	0.37
8	5.90	5.15	0.75	2.95	2.40	0.55	2.15	1.80	0.35	2.46	1.86	0.60	3.06	2.40	0.66	1.55	1.16	0.39
9	6.90	6.15	0.75	2.60	2.20	0.40	2.00	1.80	0.20	2.96	2.51	0.45	3.67	3.15	0.52	1.44	1.18	0.26
10	7.65	5.70	1.95	2.80	2.30	0.50	2.05	1.45	0.60	3.02	2.04	0.98	4.14	3.10	1.04	1.93	1.20	0.73
11	6.00	5.30	0.70	2.05	1.70	0.35	1.80	1.35	0.45	3.33	2.45	0.88	4.22	2.87	1.35	1.48	1.03	0.45
12	5.20	4.60	0.60	3.10	2.50	0.60	2.35	1.90	0.45	2.00	1.60	0.40	2.58	2.04	0.54	1.53	1.06	0.47
13	6.70	5.50	1.20	2.50	1.80	0.70	2.10	1.55	0.55	3.41	2.60	0.81	3.83	3.03	0.80	1.19	0.97	0.22
14	6.70	5.70	1.00	2.45	2.10	0.35	2.10	1.30	0.80	3.12	2.51	0.61	4.54	3.07	1.47	1.81	1.03	0.78
15	5.95	5.55	0.40	1.95	1.70	0.25	1.75	1.50	0.25	3.44	3.14	0.30	3.74	3.27	0.47	1.23	1.06	0.17
16	8.25	6.30	1.95	2.50	1.90	0.60	2.10	1.80	0.30	3.79	2.52	1.27	4.23	3.40	0.83	1.39	1.06	0.33
17	7.75	5.70	2.05	2.40	1.70	0.70	2.10	1.65	0.45	3.51	2.59	0.92	3.77	3.17	0.60	1.26	1.03	0.23
18	6.80	6.05	0.75	3.00	2.50	0.50	2.25	1.80	0.45	2.64	2.17	0.47	3.67	2.75	0.92	1.44	1.18	0.26
19	6.30	5.15	1.15	3.40	2.40	1.00	2.40	1.95	0.45	2.28	1.68	0.60	2.88	2.30	0.58	1.50	1.12	0.38
20	8.00	5.80	2.20	2.50	1.85	0.65	2.10	1.60	0.50	3.73	2.42	1.31	4.39	2.74	1.65	1.41	1.02	0.39
21	7.30	6.40	0.90	2.65	2.20	0.45	2.15	1.95	0.20	3.04	2.66	0.38	3.78	3.17	0.61	1.33	1.12	0.21

combinations of strains were found to be the same as in case of the range of length (UHG). The smallest (0.50 mm) was noted in No. 3, followed by No. 5 (0.65 mm). These combinations of strains were found to be the same as in case of the range of length (UHG). Average and its s.d. through the whole strains were found to be 0.81 ± 0.22.

2) Group B: The largest (2.20 mm) was obtained in No. 20, followed by No. 17 (2.05 mm) and Nos. 10 and 16 (1.95 mm). These orders of strains were found to be the same as in case of the range of length (UHG). The smallest (0.40 mm) was noted in No. 15, followed by No. 12 (0.60 mm) and No. 11 (0.70 mm). It was noted that the value was peculiarly small in No. 15. These combinations of strains were found to be the same as in cases of the maximum (HG) and of the range (UHG) of length. Average and its s.d. through the whole strains were found to be 1.23 ± 0.63.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 1.06 ± 0.54.

2. Width in husked grains

Maximum: 1) Group A: The widest (3.40 mm) was obtained in No. 1, followed by No. 2 (3.25 mm) and No. 5 (3.20 mm). These orders of strains were found to be the same as in cases of the maxima of width and thickness (UHG). The narrowest (2.05 mm) was noted in No. 3, followed by No. 4 (2.50 mm) and No. 9 (2.60 mm). It was noted that the value was peculiarly small in No. 3. These combinations of strains were found to be the same as in cases of the maximum and of the range of width (UHG). Average and its s.d. through the whole strains were found to be 2.84 ± 0.43.

2) Group B: The widest (3.40 mm) was obtained in No. 19, followed by No. 12 (3.10 mm) and No. 18 (3.00 mm). These orders of strains were found to be the same as in cases of the minimum of width and of the maximum of thickness (UHG). The narrowest (1.95 mm) was noted in No. 15, followed by No. 11 (2.05 mm) and No. 17 (2.40 mm). These orders of strains were found to be the same as in cases of the minimum of width (UHG) and of the maximum of thickness (UHG). Average and its s.d. through the whole strains were found to be 2.61 ± 0.42.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 2.71 ± 0.43.

Minimum: 1) Group A: The widest (2.70 mm) was obtained in No. 2, followed by No. 1 (2.55 mm) and No. 5 (2.50 mm). These combinations of strains were found to be the same as in cases of the maxima of width and thickness (UHG) and of the maximum of width (HG). The narrowest (1.50 mm) was noted in No. 3, which was the same as in cases of the maximum of width (HG) and of the range of length (HG), followed by No. 6 (2.10 mm) and Nos. 4 and 9 (2.20 mm). It was noted that the value was peculiarly small in No. 3. These combinations of strains were found to be the same as in cases of the minimum of thickness (UHG) and of the maximum of width (HG). Average and its s.d. through the whole strains were found to be 2.28 ± 0.35.

2) Group B: The widest (2.50 mm) was obtained in Nos. 12 and 18, followed by No. 19 (2.40 mm). These combinations of strains were found to be the same as in cases of the maxima of width (HG) and thickness (UHG), and of the minimum of width (UHG). The narrowest (1.70 mm) was noted in Nos. 11, 15 and 17. These combinations of strains were found to be the same as in cases of maxima of width (HG) and thickness (UHG) and of the minimum of width (UHG). Average and its s.d. through the whole strains were found to be 2.05 ± 0.32.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found

to be 2.15±0.34.

Range: 1) Group A: The largest (0.85 mm) was obtained in No. 1, which was the same as in case of the maximum of width (HG), followed by No. 5 (0.70 mm) and No. 6 (0.60 mm). These orders of strains were found to be the same as in case of the range of L/T (UHG). The smallest (0.30 mm) was noted in No. 4, followed by No. 9 (0.40 mm). Average and its s.d. through the whole strains were found to be 0.56±0.16.

2) Group B: The largest (1.00 mm) was obtained in No. 19, which was the same as in cases of the maximum of width (HG) and of the range of width (HG), followed by Nos. 13 and 17 (0.70 mm). It was noted that the value was peculiarly large in No. 19. The smallest (0.25 mm) was noted in No. 15, which was the same as in cases of the maximum of length (HG) and of the range of length (HG), followed by Nos. 11 and 14 (0.35 mm). Average and its s.d. through the whole strains were found to be 0.55±0.20.

3) Whole: Average and it s.d. through the whole strains of both of the groups were found to be 0.56±0.18.

3. Thickness in husked grains

Maximum: 1) Group A: The thickest (2.35 mm) was obtained in No. 1, which was the same as in cases of the maximum and range of width (HG), followed by Nos. 2 and 5 (2.30 mm). These combinations of strains were found to be the same as in cases of the maxima of widths (UHG and HG) and of thickness (UHG), and of the minimum of width (HG). The thinnest (1.20 mm) was noted in No. 3, followed by No. 4 (1.90 mm) and No. 9 (2.00 mm). It was noted that the value was peculiarly small in No. 3. These combinations of strains were found to be the same as in cases of the maxima of widths (UHG and HG) and thickness (UHG), and of the ranges of width, thickness, L/W and L/T (UHG). Moreover, these orders of strains were found to be the same as in case of the range of the width (HG). Average and its s.d. through the whole strains were found to be 2.06±0.36.

2) Group B: The thickest (2.40 mm) was obtained in No. 19, which was the same as in case of the maximum of width (HG), followed by No. 12 (2.35 mm) and No. 18 (2.25 mm). These combinations of strains were found to be the same as in cases of the maxima of thickness (UHG) and width (HG), and of the minima of widths (UHG and HG). Moreover, these orders of strains were found to be the same as in cases of the maxima of width (HG) and thickness (UHG), and of the minima of widths (UHG and HG). The thinnest (1.75 mm) was noted in No. 15, followed by No. 11 (1.80 mm) and No. 10 (2.05 mm). Average and its s.d. through the whole strains were found to be 2.10±0.19.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 2.08±0.27.

Minimum: 1) Group A: The thickest (2.00 mm) was obtained in No. 1, which was the same as in cases of the maxima of width (HG), thickness (HG) and of the range of length (HG), followed by No. 2 (1.95 mm). The thinnest (0.90 mm) was noted in No. 3, which was the same as in cases of the maxima of width (HG) and thickness (HG), of the minimum of width (HG) and of the range of length (HG), followed by No. 4 (1.60 mm). It was noted that the value was peculiarly small in No. 3. Average and its s.d. through the whole strains were found to be 1.71±0.32.

2) Group B: The thickest (1.95 mm) was obtained in Nos. 19 and 21, followed by No. 12 (1.90 mm). These combinations of strains were found to be the same as in case of the minimum of thickness (UHG). The thinnest (1.30 mm) was noted in No. 14, followed by No. 11 (1.35 mm)

and No. 10 (1.45 mm). Average and its s.d. through the whole strains were found to be 1.65±0.23.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 1.67±0.27.

Range: 1) Group A: The largest (0.50 mm) was obtained in Nos. 5 and 7. The smallest (0.20 mm) was noted in No. 9, followed by Nos. 3, 4 and 6 (0.30 mm). These combinations of strains were found to be the same as in cases of the maxima of widths (UHG and HG) and thickness (UHG), of the minimum of thickness (HG), and of the ranges of width, thickness, L/W and L/T (UHG). Average and its s.d. through the whole strains were found to be 0.35±0.10.

2) Group B: The largest (0.80 mm) was obtained in No. 14, followed by No. 10 (0.60 mm) and No. 13 (0.55 mm). The smallest (0.20 mm) was noted in No. 21, followed by No. 15 (0.25 mm) and No. 16 (0.30 mm). These combinations of strains were found to be the same as in case of the range of thickness (UHG). Average and its s.d. through the whole strains were found to be 0.45±0.16.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.41±0.14.

4. Ratio of length to width (L/W) in husked grains

Maximum: 1) Group A: The largest (3.77) was obtained in No. 3, followed by No. 9 (2.96) and No. 4 (2.80). It was noted that the value was peculiarly large in No. 3. These combinations of strains were found to be the same as in cases of the maximum and of the minimum of L/T (UHG). The smallest (2.14) was noted in No. 2, followed by No. 1 (2.37) and No. 5 (2.44). It was noted that the value was peculiarly small in No. 2. Average and its s.d. through the whole strains were found to be 2.68±0.47.

2) Group B: The largest (3.79) was obtained in No. 16, which was the same as in case of the maximum of length (HG), followed by No. 20 (3.73) and No. 17 (3.51). These combinations of strains were found to be the same as in cases of the range of L/W (UHG), and of the maximum of length (HG). Moreover, these orders of strains were found to be the same as in case of length (HG). The smallest (2.00) was noted in No. 12, which was the same as in cases of the maximum of length (HG) and of the minimum of length (HG), followed by No. 19 (2.28) and No. 18 (2.67). It was noted that the value was peculiarly small in No. 12. These combinations of strains were found to be the same as in cases of the maxima and of the minima of L/W and L/T (UHG). Moreover, these orders of strains were found to be the same as in cases of the maxima of L/W and L/T, and of the minimum of L/W (UHG). Average and its s.d. through the whole strains were found to be 3.11±0.56.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 2.93±0.56.

Minimum: 1) Group A: The largest (3.00) was obtained in No. 3, which was the same as in case of the maximum of L/W (HG), followed by No. 9 (2.51) and No. 4 (2.44). It was noted that the value was peculiarly large in No. 3. These combinations of strains were found to be the same as in cases of the maximum and of the minimum of L/T (UHG) and of the maximum of L/W (HG). Moreover, these orders of strains were found to be the same as in case of the maximum of L/W (HG). The smallest (1.59) was noted in No. 1, followed by No. 2 (1.77) and No. 7 (1.81). These orders of strains were found to be the same as in case of the maximum of L/T (UHG). Average and its s.d. through the whole strains were found to be 2.12±0.46.

2) Group B: The largest (3.14) was obtained in No. 15, followed by No. 21 (2.66) and No. 13 (2.60). It was noted that the value was peculiarly large in No. 15. The smallest (1.60) was noted

in No. 12, which was the same as in cases of the maxima of length and L/W (HG), and of the minimum of length (HG), followed by No. 19 (1.68) and No. 10 (2.04). Average and its s.d. through the whole strains were found to be 2.37 ± 0.43.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 2.26 ± 0.45.

Range: 1) Group A: The largest (0.78) was obtained in No. 1, which was the same as in cases of the maxima of width (HG) and thickness (HG), of the minimum of thickness (HG) and of the range of width (HG), followed by No. 3 (0.77) and No. 7 (0.75). The smallest (0.36) was noted in No. 4, which was the same as in case of the range of width (HG), followed by No. 2 (0.37) and No. 6 (0.42). Average and its s.d. through the whole strains were found to be 0.56 ± 0.17.

2) Group B: The largest (1.31) was obtained in No. 20, which was the same as in case of the range of length (HG), followed by No. 16 (1.27) and No. 10 (0.98). The smallest (0.30) was noted in No. 15, which was the same as in cases of the maxima of width and thickness (HG), and of the ranges of length and width (HG), followed by No. 21 (0.38) and No. 12 (0.40). Average and its s.d. through the whole strains were found to be 0.74 ± 0.34.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.67 ± 0.29.

5. Ratio of length to thickness (L/T) in husked grains

Maximum: 1) Group A: The largest (6.28) was obtained in No. 3, which was the same as in cases of the maximum and of the minimum of L/W (HG), followed by No. 4 (3.79) and No. 9 (3.67). It was noted that the value was peculiarly large in No. 3. These combinations of strains were found to be the same as in cases of the maxima and of the minima of L/W (HG) and L/T (UHG). Moreover, these orders of strains were found to be the same as in case of the maximum of L/T (UHG). The smallest (3.03) was noted in No. 1, which was the same as in case of L/W (HG), followed by No. 8 (3.06) and No. 2 (3.10). These combinations of strains were found to be the same as in cases of the maximum of L/W (UHG) and of the minimum of L/T (UHG). Average and its s.d. through the whole strains were found to be 3.66 ± 1.02.

2) Group B: The largest (4.54) was obtained in No. 14, which was the same as in case of the range of thickness (HG), followed by No. 20 (4.39) and No. 16 (4.23). The smallest (2.58) was noted in No. 12, which was the same as in cases of the maxima and of the minima of length (HG) and L/W (HG), followed by No. 19 (2.88) and No. 18 (3.67). It was noted that the value was peculiarly small in No. 12. These combinations of strains were found to be the same as in cases of the maxima of L/W (UHG and HG) and L/T (UHG), and of the minima of L/W (UHG) and L/T (UHG). Moreover, these orders of strains were found to be the same as in cases of the maxima of L/W (UHG and HG) and L/T (UHG), and of the minimum of L/W (UHG). Average and its s.d. through the whole strains were found to be 3.81 ± 0.58.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 3.75 ± 0.78.

Minimum: 1) Group A: The largest (4.96) was obtained in No. 3, which was the same as in cases of the maximum and of the minimum of L/W (HG) and of the maximum of L/T (HG), followed by No. 9 (3.15) and No. 4 (3.14). It was noted that the value was peculiarly large in No. 3. These combinations of strains were found to be the same as in cases of the maxima of L/W (HG) and L/T (UHG and HG), and of the minima of L/W (HG) and L/T (UHG). Moreover, these orders of strains were found to be the same as in cases of the maximum and of the minimum of

L/W (HG). The smallest (2.30) was noted in No. 1, which was the same as in cases of the maximum of L/T (HG) and of the minimum of L/W (HG), followed by No. 7 (2.36) and No. 2 (2.39). These combinations of strains were found to be the same as in cases of the maximum of L/T (UHG) and of the minimum of L/W (HG). Average and its s.d. through the whole strains were found to be 2.91 ± 0.84.

2) Group B: The largest (3.40) was obtained in No. 16, which was the same as in cases of the maxima of length and L/W (HG), followed by No. 15 (3.27) and Nos. 17 and 21 (3.17). These combinations of strains were found to be the same as in case of the minimum of L/T (UHG). The smallest (2.04) was noted in No. 12, which was the same as in cases of the maxima and of the minima of length and L/W (HG), and of the maximum of L/T (HG), followed by No. 19 (2.30) and No. 18 (2.75). It was noted that the value was peculiarly small in No. 12. These combinations of strains were found to be the same as in cases of the maxima of L/W (UHG and HG) and L/T (UHG and HG), and of the minima of L/W (UHG) and L/T (UHG). Moreover, these orders of strains were found to be the same as in cases of the maxima of L/W (UHG and HG) and L/T (UHG and HG), and of the minimum of L/W (UHG). Average and its s.d. through the whole strains were found to be 2.91 ± 0.40.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 2.91 ± 0.61.

Range: 1) Group A: The largest (1.32) was obtained in No. 3, which was the same as in cases of the maxima and of the minima of L/W and L/T (HG), followed by No. 7 (0.78) and No. 1 (0.73). It was noted that the value was peculiarly large in No. 3. The smallest (0.52) was noted in No. 9, which was the same as in case of the range of thickness (HG), followed by No. 6 (0.61) and No. 4 (0.65). These combinations of strains were found to be the same as in case of the minimum of width (UHG). Average and its s.d. through the whole strains were found to be 0.74 ± 0.23.

2) Group B: The largest (1.65) was obtained in No. 20, which was the same as in cases of the ranges of length and L/W (HG), followed by No. 14 (1.47) and No. 11 (1.35). The smallest (0.47) was noted in No. 15, which was the same as in cases of the maxima of width and thickness (HG), and of the ranges of length, width and L/W (HG), followed by No. 12 (0.54) and No. 19 (0.58). It was noted that the value was peculiarly small in No. 15. Average and its s.d. through the whole strains were found to be 0.91 ± 0.40.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.84 ± 0.34.

6. Ratio of width to thickness (W/T) in husked grains

Maximum: 1) Group A: The largest (1.71) was obtained in No. 3, which was the same as in cases of the maxima and of the minima of L/W and L/T (HG), and of the range of L/T (HG), followed by No. 1 (1.62) and Nos. 2 and 8 (1.55). These orders of strains were found to be the same as in case of the maximum of W/T (UHG). The smallest (1.44) was noted in No. 9, which was the same as in cases of the ranges of thickness and L/T (HG), followed by No. 4 (1.47) and No. 5 (1.48). These orders of strains were found to be the same as in case of the range of W/T (UHG). Average and its s.d. through the whole strains were found to be 1.54 ± 0.08.

2) Group B: The largest (1.93) was obtained in No. 10, followed by No. 14 (1.81) and No. 12 (1.53). The smallest (1.19) was noted in No. 13, followed by No. 15 (1.23) and No. 17 (1.26). These combinations of strains were found to be the same as in case of the maximum of W/T (UHG). Average and its s.d. through the whole strains were found to be 1.46 ± 0.22.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 1.49±0.18.

Minimum: 1) Group A: The largest (1.48) was obtained in No. 3, which was the same as in cases of the maxima and of the minima of L/W and L/T (HG), of the maximum of W/T (HG), and of the range of L/T (HG), followed by No. 2 (1.26) and No. 5 (1.25). It was noted that the value was peculiarly large in No. 3. These combinations of strains were found to be the same as in case of the minimum of W/T (UHG). The smallest (1.15) was noted in No. 6, followed by Nos. 7 and 8 (1.16). Average and its s.d. through the whole strains were found to be 1.23±0.10.

2) Group B: The largest (1.20) was obtained in No. 10, which was the same as in case of the maximum of W/T (HG), followed by No. 18 (1.18) and Nos. 19 and 21 (1.12). These combinations of strains were found to be the same as in case of the minimum of W/T (UHG). The smallest (0.97) was noted in No. 13, which was the same as in case of the maximum of W/T (HG), followed by No. 20 (1.02). Average and its s.d. through the whole strains were found to be 1.07±0.07.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 1.14±0.11.

Range: 1) Group A: The largest (0.41) was obtained in No. 1, which was the same as in cases of the maxima of width and thickness (HG), of the minimum of thickness (HG), and of the ranges of width and L/W (HG), followed by No. 8 (0.39) and No. 7 (0.37). These orders of strains were found to be the same as in case of the range of W/T (UHG). The smallest (0.23) was noted in Nos. 3 and 5, followed by No. 9 (0.26). Average and its s.d. through the whole strains were found to be 0.31±0.07.

2) Group B: The largest (0.78) was obtained in No. 14, which was the same as in cases of the maximum of L/T (HG) and of the range of thickness (HG), followed by No. 10 (0.73) and No. 12 (0.47). These combinations of strains were found to be the same as in case of the maximum of W/T. The smallest (0.17) was noted in No. 15, which was the same as in cases of the maxima of width and thickness (HG), and of the ranges of length, width, L/W and L/T (HG), followed by No. 21 (0.21) and No. 13 (0.22). These orders of strains were found to be the same as in case of the range of W/T (UHG). Average and its s.d. through the whole strains were found to be 0.39±0.20.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.35±0.16.

7. Quotient in length

Maximum: 1) Group A: The results are given in Table 2. In this table, the maximum, the minimum and their range are shown. The largest (0.77) was obtained in No. 7, followed by No. 1 (0.76). The smallest (0.71) was noted in No. 3, followed by No. 4 (0.72) and No. 5 (0.73). Average and its s.d. through the whole strains were found to be 0.74±0.02.

2) Group B: The largest (0.77) was obtained in Nos. 10, 16 and 19. The smallest (0.69) was noted in No. 12, followed by No. 15 (0.70). Average and its s.d. through the whole strains were found to be 0.72±0.03.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.74±0.02.

Minimum: 1) Group A: The largest (0.70) was obtained in Nos. 1, 4 and 7. The smallest (0.68) was noted in No. 3, which was the same as in case of the maximum of length. Average and its s.d. through the whole strains were found to be 0.69±0.01.

2) Group B: The largest (0.70) was obtained in No. 16, followed by No. 11 (0.69) and No. 14

Table 2. Ranges of comparative values in the strain level

Strain No.	Length			Width			Thickness			Length/Width			Length/Thickness			Width/Thickness		
	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range	Max.	Min.	Range
1	0.76	0.70	0.06	0.93	0.81	0.12	0.96	0.88	0.08	0.92	0.79	0.13	0.85	0.73	0.12	1.03	0.87	0.16
2	0.75	0.69	0.06	0.94	0.78	0.16	0.94	0.82	0.12	0.89	0.77	0.12	0.86	0.74	0.12	1.07	0.88	0.19
3	0.71	0.68	0.03	0.70	0.51	0.19	0.70	0.62	0.08	1.12	1.02	0.10	1.14	0.98	0.16	1.01	0.82	0.19
4	0.72	0.70	0.02	0.89	0.82	0.07	0.92	0.87	0.05	0.88	0.78	0.10	0.83	0.77	0.06	1.02	0.91	0.11
5	0.73	0.69	0.04	0.91	0.78	0.13	0.96	0.84	0.12	0.90	0.78	0.12	0.85	0.74	0.11	1.02	0.86	0.16
6	0.74	0.69	0.05	0.87	0.81	0.06	0.93	0.88	0.05	0.91	0.82	0.09	0.82	0.74	0.08	0.96	0.90	0.06
7	0.77	0.70	0.07	0.93	0.79	0.14	0.96	0.85	0.11	0.94	0.77	0.17	0.84	0.75	0.09	1.06	0.86	0.20
8	0.74	0.69	0.05	0.86	0.75	0.11	0.91	0.88	0.03	0.97	0.82	0.15	0.82	0.76	0.06	0.96	0.82	0.14
9	0.75	0.69	0.06	0.93	0.80	0.13	0.95	0.86	0.09	0.91	0.76	0.15	0.87	0.75	0.12	1.08	0.84	0.24
10	0.77	0.64	0.13	0.88	0.78	0.10	0.95	0.78	0.17	0.91	0.79	0.12	0.88	0.76	0.12	1.02	0.85	0.17
11	0.72	0.69	0.03	0.95	0.82	0.13	0.95	0.85	0.10	0.87	0.67	0.20	0.83	0.73	0.10	1.07	0.89	0.18
12	0.69	0.65	0.04	0.89	0.83	0.06	0.93	0.91	0.02	0.82	0.75	0.07	0.76	0.71	0.05	0.98	0.90	0.08
13	0.75	0.65	0.10	0.91	0.78	0.13	1.00	0.86	0.14	0.90	0.78	0.12	0.83	0.71	0.12	1.00	0.83	0.17
14	0.72	0.67	0.05	0.87	0.77	0.10	0.93	0.77	0.16	0.89	0.79	0.10	0.82	0.69	0.13	1.12	0.88	0.24
15	0.70	0.63	0.07	0.95	0.84	0.11	0.92	0.87	0.05	0.82	0.70	0.12	0.78	0.70	0.08	1.03	0.94	0.09
16	0.77	0.70	0.07	0.87	0.77	0.10	0.95	0.86	0.09	0.99	0.80	0.19	0.87	0.75	0.12	1.04	0.83	0.21
17	0.74	0.62	0.12	0.93	0.79	0.14	0.93	0.85	0.08	0.95	0.74	0.11	0.80	0.70	0.10	1.04	0.84	0.20
18	0.72	0.66	0.06	0.94	0.81	0.13	0.94	0.88	0.06	0.87	0.75	0.12	0.81	0.74	0.07	1.03	0.89	0.14
19	0.77	0.65	0.12	0.92	0.71	0.21	0.94	0.83	0.11	0.93	0.74	0.19	0.85	0.72	0.13	1.02	0.79	0.23
20	0.74	0.63	0.11	0.90	0.76	0.14	1.00	0.85	0.15	0.93	0.71	0.22	0.87	0.69	0.18	1.00	0.79	0.21
21	0.72	0.64	0.08	0.89	0.81	0.08	0.95	0.88	0.07	0.88	0.73	0.15	0.81	0.71	0.10	1.05	0.76	0.29

(0.67). The smallest (0.62) was noted in No. 17, followed by Nos. 15 and 20 (0.63). Average and its s.d. through the whole strains were found to be 0.65 ± 0.02.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.67 ± 0.03.

Range: 1) Group A: The largest (0.07) was obtained in No. 7, which was the same as in case of the maximum of length, followed by Nos. 1, 2 and 9 (0.06). These orders of strains were found to be the same as in case of the maximum of length. The smallest (0.02) was noted in No. 4, followed by No. 3 (0.03) and No. 5 (0.04). Average and its s.d. through the whole strains were found to be 0.05 ± 0.02.

2) Group B: The largest (0.13) was obtained in No. 10, followed by Nos. 17 and 19 (0.12). The smallest (0.03) was noted in No. 11, followed by No. 12 (0.04) and No. 14 (0.05). Average and its s.d. through the whole strains were found to be 0.08 ± 0.03.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.07 ± 0.03.

8. Quotient in width

Maximum: 1) Group A: The largest (0.94) was obtained in No. 2, followed by Nos. 1, 7 and 9 (0.93). These combinations of strains were found to be the same as in cases of the maximum and of the range of length. The smallest (0.70) was noted in No. 3, which was the same as in cases of the maximum and of the minimum of length, followed by No. 8 (0.86) and No. 6 (0.87). It was noted that the value was peculiarly small in No. 3. Average and its s.d. through the whole strains were found to be 0.88 ± 0.08.

2) Group B: The largest (0.95) was obtained in Nos. 11 and 15, followed by No. 18 (0.94). The smallest (0.87) was noted in Nos. 14 and 16, followed by No. 10 (0.88). Average and its s.d. through the whole strains were found to be 0.91 ± 0.03.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.90 ± 0.05.

Minimum: 1) Group A: The largest (0.82) was obtained in No. 4, followed by Nos. 1 and 6 (0.81). The smallest (0.51) was noted in No. 3, which was the same as in cases of the maxima of length and width, and of the minimum of length, followed by No. 8 (0.75) and No. 2 (0.78). It was noted that the value was peculiarly small in No. 3. Average and its s.d. through the whole strains were found to be 0.76 ± 0.10.

2) Group B: The largest (0.84) was obtained in No. 15, followed by No. 12 (0.83) and No. 11 (0.82). The smallest (0.71) was noted in No. 19, followed by No. 20 (0.76) and Nos. 14 and 16 (0.77). It was noted that the value was peculiarly small in No. 19. Average and its s.d. through the whole strains were found to be 0.79 ± 0.04.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.78 ± 0.07.

Range: 1) Group A: The largest (0.19) was obtained in No. 3, followed by No. 2 (0.16) and No. 7 (0.14). The smallest (0.06) was noted in No. 6, followed by No. 4 (0.07) and No. 8 (0.11). Average and its s.d. through the whole strains were found to be 0.12 ± 0.04.

(2) Group B: The largest (0.21) was obtained in No. 19, followed by Nos. 17 and 20 (0.14). It was noted that the value was peculiarly large in No. 19. The smallest (0.06) was noted in No. 12, which was the same as in case of the maximum of length, followed by No. 21 (0.08). Average and its s.d. through the whole strains were found to be 0.12 ± 0.04.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.12 ± 0.04.

9. Quotient in thickness

Maximum: 1) Group A: The largest (0.96) was obtained in Nos. 1, 5 and 7. The smallest (0.70) was noted in No. 3, which was the same as in cases of the maxima and of the minima of length and width, followed by No. 8 (0.91) and No. 4 (0.92). It was noted that the value was peculiarly small in No. 3. Average and its s.d. through the whole strains were found to be 0.91 ± 0.08.

2) Group B: The largest (1.00) was obtained in Nos. 13 and 20. The smallest (0.92) was noted in No. 15, followed by Nos. 12, 14 and 17 (0.93). Average and its s.d. through the whole strains were found to be 0.95 ± 0.03.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.93 ± 0.06.

Minimum: 1) Group A: The largest (0.88) was obtained in Nos. 1, 6 and 8. The smallest (0.62) was noted in No. 3, which was the same as in cases of the maxima and of the minima of length and width, and of the maximum of thickness, followed by No. 2 (0.82) and No. 5 (0.84). It was noted that the value was peculiarly small in No. 3. Average and its s.d. through the whole strains were found to be 0.83 ± 0.08.

2) Group B: The largest (0.91) was obtained in No. 12, followed by Nos. 18 and 21 (0.88). The smallest (0.77) was noted in No. 14, followed by No. 10 (0.78) and No. 19 (0.83). Average and its s.d. through the whole strains were found to be 0.85 ± 0.04.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.84 ± 0.06.

Range: 1) Group A: The largest (0.12) was obtained in Nos. 2 and 5, followed by No. 7 (0.11). The smallest (0.03) was noted in No. 8, followed by Nos. 4 and 6 (0.05). Average and its s.d. through the whole strains were found to be 0.08 ± 0.03.

2) Group B: The largest (0.17) was obtained in No. 10, followed by No. 14 (0.16) and No. 20 (0.15). The smallest (0.02) was noted in No. 12, which was the same as in cases of the maximum of length and of the range of width, followed by No. 15 (0.05) and No. 18 (0.06). Average and its s.d. through the whole strains were found to be 0.10 ± 0.05.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.09 ± 0.04.

10. Quotient in L/W

Maximum: 1) Group A: The largest (1.12) was obtained in No. 3, which was the same as in case of the range of width, followed by No. 8 (0.97) and No. 7 (0.94). It was noted that the value was peculiarly large in No. 3. The smallest (0.88) was noted in No. 4, which was the same as in case of the range of length, followed by No. 2 (0.89) and No. 5 (0.90). Average and its s.d. through the whole strains were found to be 0.94 ± 0.07.

2) Group B: The largest (0.99) was obtained in No. 16, which was the same as in case of the minimum of length, followed by No. 17 (0.95) and Nos. 19 and 20 (0.93). The smallest (0.82) was noted in Nos. 12 and 15, followed by Nos. 11 and 18 (0.87). These orders of strains were found to be the same as in case of the range of thickness. Average and its s.d. through the whole strains were found to be 0.90 ± 0.05.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found

to be 0.91±0.06.

Minimum: 1) Group A: The largest (1.02) was obtained in No. 3, which was the same as in cases of the range of width and of the maximum of L/W, followed by Nos. 6 and 8 (0.82). It was noted that the value was peculiarly large in No. 3. The smallest (0.76) was noted in No. 9, followed by Nos. 2 and 7 (0.77). Average and its s.d. through the whole strains were found to be 0.81±0.08.

2) Group B: The largest (0.80) was obtained in No. 16, which was the same as in cases of the minimum of length and of the maximum of L/W, followed by Nos. 10 and 14 (0.79). The smallest (0.67) was noted in No. 11, which was the same as in case of the range of length, followed by No. 15 (0.70) and No. 20 (0.71). Average and its s.d. through the whole strains were found to be 0.75±0.04.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.77±0.07.

Range: 1) Group A: The largest (0.17) was obtained in No. 7, which was the same as in cases of the maximum and of the range of length, followed by Nos. 8 and 9 (0.15). The smallest (0.09) was noted in No. 6, which was the same as in case of the range of width, followed by Nos. 3 and 4 (0.10). Average and its s.d. through the whole strains were found to be 0.13±0.03.

2) Group B: The largest (0.22) was obtained in No. 20, followed by No. 11 (0.20) and No. 16 (0.19). The smallest (0.07) was noted in No. 12, which was the same as in cases of the maximum of length, and of the ranges of width and thickness, followed by No. 14 (0.10) and No. 17 (0.11). Average and its s.d. through the whole strains were found to be 0.14±0.05.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.14±0.04.

11. Quotient in L/T

Maximum: 1) Group A: The largest (1.14) was obtained in No. 3, which was the same as in cases of the range of width, and of the maximum and of the minimum of L/W, followed by No. 9 (0.87) and No. 2 (0.86). It was noted that the value was peculiarly large in No. 3. The smallest (0.82) was noted in Nos. 6 and 8, followed by No. 4 (0.83). These combinations of strains were found to be the same as in case of the range of thickness. Average and its s.d. through the whole strains were found to be 0.88±0.10.

2) Group B: The largest (0.88) was obtained in No. 10, which was the same as in cases of the ranges of length and thickness, followed by Nos. 16 and 20 (0.87). The smallest (0.76) was noted in No. 12, which was the same as in cases of the maximum of length, and of the ranges of width, thickness and L/W, followed by No. 15 (0.78) and No. 17 (0.80). These combinations of strains were found to be the same as in case of the maximum of thickness. Average and its s.d. through the whole strains were found to be 0.83±0.04.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.85±0.07.

Minimum: 1) Group A: The largest (0.98) was obtained in No. 3, which was the same as in cases of the maxima of L/W and L/T, of the minimum of L/W, and of the range of width, followed by No. 4 (0.77) and No. 8 (0.76). It was noted that the value was peculiarly large in No. 3. The smallest (0.73) was noted in No. 1, followed by Nos. 2, 5 and 6 (0.74). Average and its s.d. through the whole strains were found to be 0.77±0.08.

2) Group B: The largest (0.76) was obtained in No. 10, which was the same as in cases of the ranges of length and thickness, followed by No. 16 (0.75) and No. 18 (0.74). The smallest (0.69) was noted in Nos. 14 and 20, followed by Nos. 15 and 17 (0.70). Average and its s.d. through the

whole strains were found to be 0.72 ± 0.02.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.74 ± 0.06.

Range: 1) Group A: The largest (0.16) was obtained in No. 3, which was the same as in cases of the range of width, and of the maxima and of the minima of L/W and L/T, followed by Nos. 1, 2 and 9 (0.12). It was noted that the value was peculiarly large in No. 3. The smallest (0.06) was noted in Nos. 4 and 8, followed by No. 6 (0.08). These combinations of strains were found to be the same as in cases of the range of thickness and of the maximum of L/T. Average and its s.d. through the whole strains were found to be 0.10 ± 0.03.

2) Group B: The largest (0.18) was obtained in No. 20, which was the same as in case of the range of L/W, followed by Nos. 14 and 19 (0.13). It was noted that the value was peculiarly large in No. 20. The smallest (0.05) was noted in No. 12, which was the same as in cases of the maxima of length and L/T, and of the ranges of width, thickness and L/W, followed by No. 18 (0.07) and No. 15 (0.08). These combinations of strains were found to be the same as in cases of the range of thickness, and of the maximum of L/W. Average and its s.d. through the whole strains were found to be 0.11 ± 0.03.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.11 ± 0.03.

12. Quotient in W/T

Maximum: 1) Group A: The largest (1.08) was obtained in No. 9, followed by No. 2 (1.07) and No. 7 (1.06). These combinations of strains were found to be the same as in case of the maximum of width. The smallest (0.96) was noted in Nos. 6 and 8, which were the same as in case of the maximum of L/T, followed by No. 3 (1.01). These combinations of strains were found to be the same as in cases of the maxima of width and thickness. Average and its s.d. through the whole strains were found to be 1.02 ± 0.04.

2) Group B: The largest (1.12) was obtained in No. 14, followed by No. 11 (1.07) and No. 21 (1.05). The smallest (0.98) was noted in No. 12, which was the same as in cases of the maxima of length and L/T, and of the ranges of width, thickness, L/W and L/T, followed by No. 20 (1.00) and Nos. 10 and 19 (1.02). Average and its s.d. through the whole strains were found to be 1.03 ± 0.04.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 1.03 ± 0.04.

Minimum: 1) Group A: The largest (0.91) was obtained in No. 4, which was the same as in case of the minimum of width, followed by No. 6 (0.90) and No. 2 (0.88). The smallest (0.82) was noted in Nos. 3 and 8, followed by No. 9 (0.84). Average and its s.d. through the whole strains were found to be 0.86 ± 0.03.

2) Group B: The largest (0.94) was obtained in No. 15, which was the same as in case of the minimum of width, followed by No. 12 (0.90) and Nos. 11 and 18 (0.89). These orders of strains were found to be the same as in case of the minimum of width. The smallest (0.76) was noted in No. 21, followed by Nos. 19 and 20 (0.79). Average and its s.d. through the whole strains were found to be 0.85 ± 0.05.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.86 ± 0.05.

Range: 1) Group A: The largest (0.24) was obtained in No. 9, which was the same as in case of the maximum of W/T, followed by No. 7 (0.20) and Nos. 2 and 3 (0.19). These combinations of

strains were found to be the same as in cases of the maxima of width and W/T. The smallest (0.06) was noted in No. 6, which was the same as in cases of the ranges of width and L/W, followed by No. 4 (0.11) and No. 8 (0.14). It was noted that the value was peculiarly small in No. 6. These combinations of strains were found to be the same as in cases of the range of thickness, and of the maximum and of the range of L/T. Average and its s.d. through the whole strains were found to be 0.16 ± 0.05.

2) Group B: The largest (0.29) was obtained in No. 21, followed by No. 14 (0.24) and No. 19 (0.23). It was noted that the value was peculiarly large in No. 21. The smallest (0.08) was noted in No. 12, which was the same as in cases of the maxima of length, L/T and W/T, and of the ranges of width, thickness, L/W and L/T, followed by No. 15 (0.09) and No. 18 (0.14). These combinations of strains were found to be the same as in cases of the maximum of L/W, and of the ranges of thickness and L/T. Moreover, these orders of strains were found to be the same as in cases of the range of thickness and of the maximum of L/W. Average and its s.d. through the whole strains were found to be 0.18 ± 0.06.

3) Whole: Average and its s.d. through the whole strains of both of the groups were found to be 0.17 ± 0.06.

Discussion

Basing on the results obtained in the present experiment, the following problems are to be discussed here.

1. Although the values were peculiarly large or small in some characters, the values were found to be the standard level in other characters in view of the same strains. For example, No. 9 showed the largest value (6.90 mm) in the maximum of length, but showed the middle value (2.00 mm) in the maximum of thickness. In other case, No. 8 showed the smallest value (5.90 mm) in the maximum of length, but showed the middle value (2.95 mm) in the maximum of width.

On the other hand, although the values were peculiarly large in some characters, the values were found to be peculiarly small in other characters in view of the same strains, and *vice versa*. For example, No. 9 showed peculiarly large value (6.90 mm) in the maximum of length, but showed nearly the smallest (2.60 mm) in the maximum of width, which was the same as in case of unhusked grains. In other case, No. 1 showed nearly the smallest value (6.05 mm) in the maximum of length, but showed the largest value (3.40 mm) in the maximum of width, which was also the same as in case of the unhusked grains. These phenomena were found in several combinations. In ratios of 3 combinations, these facts were not ascertained in the present experiment. These differences were attributable to the genetic backgrounds.

2. In comparisons of the three types of A, B and C carried out in accordance with the tripartite classifications, the following facts were ascertained. In this chapter, considerations were made using only values of the husked grains (Table 1) without making use of the comparative values (Table 2), because no clear tendency was found in the latter. Type A showed the general features as follows; 8 characters, *i.e.*, the maxima, the minima and the ranges of width and thickness, and the maximum and the range of W/T, showed the larger values than that of the average of the whole strains. The remaining 10 characters, *i.e.*, the maxima, the minima and the ranges of length, L/W and L/T and the minimum of W/T, showed the smaller values than that of the average of the whole strains. It was a remarkable fact that the maxima and the minima of length, L/W and L/T showed the lowest values through the whole strains ($=21$). These phenomena were found to be quite the

same as in case of the unhusked grains. So, it was explicable as strain's specificity. Moreover, it might be anticipated that the value of L/W was attributable to and under control of the value of length.

In type B, the values were ascertained to be flexible in accordance with the respective characters. In view of the average values through the whole strains belonging to type B, in comparison with the average values through the whole strains, 7 characters, *i.e.*, the maxima of width and the thickness, the minima of length, width, thickness and W/T, and the range of width, showed the larger values. Other 11 characters, *i.e.*, the maxima of length, L/W, L/T and W/T, the minima of L/W and L/T, and the ranges of length, thickness, L/W, L/T and W/T, showed the smaller values. These phenomena were found to be nearly the same as in case of the unhusked grains.

In type C, the values were found to be very variable in accordance with the respective characters and the respective strains. In view of the average values through type C, in comparison with the average values through the whole strains, 11 characters, *i.e.*, the maxima, the minima and the ranges of length, L/W and L/T, and the maximum and the range of W/T, showed the larger values. One character, *i.e.*, the range of thickness, showed the same value. The remaining 6 characters, *i.e.*, the maxima of width and thickness, the minima of width, thickness and W/T, and the range of width, showed the smaller values. These phenomena were found to be nearly the same as in case of the unhusked grains.

The results of type A showed nearly the reversed results of type C.

3. In comparison with Group A and Group B in view of the group-averages, the following facts were ascertained. In the husked grains, 6 characters, *i.e.*, the maxima of width and W/T, the minima of width, thickness and W/T, and the range of width, showed the larger values in Group A than those of Group B. One character, *i.e.*, the minimum of L/T, showed the same values in Groups A and B. The remaining 11 characters, *i.e.*, the maxima of length, thickness, L/W and L/T, the minima of length and L/W, and the ranges of length, thickness, L/W, L/T and W/T, showed the smaller values in Group A than those of the Group B. It is noticeable that the whole characters of width, length and L/W, showed the larger and the smaller values in Group A than those of the Group B, respectively. These phenomena may be looked upon as geographical specificities.

In comparative values, 7 characters, *i.e.*, the maxima and the minima of length, L/W and L/T, and the minimum of W/T, showed the larger values in Group A than those of Group B. One character, *i.e.*, the range of width, showed the same values in both of the Groups A and B. The remaining 10 characters, *i.e.*, the maxima of width, thickness and W/T, the minima of width and thickness, and the ranges of length, thickness, L/W, L/T and W/T, showed the smaller values in Group A than those of the Group B. It was noticeable that the whole characters of thickness showed the smaller values in Group A than those of Group B. These phenomena may also be looked upon as geographical and grain fullness[2] specificities. Moreover, it was noteworthy that Group A showed always the smaller values than that of Group B in the ranges. It was quite an interesting thing in view of strain specificity.

4. In the smaller set of width of the husked grains, the narrowest (2.05 mm) was noted in No. 3, followed by No. 4 (2.50 mm) and No. 9 (2.60 mm). In the smaller set of thickness, the thinnest (1.20 mm) was noted in No. 3, followed by No. 4 (1.90 mm) and No. 9 (2.00 mm). These orders of strains were finally illustrated in both cases as $3<4<9$, and were fixed to be the same in both of the characters. These phenomena were found in other 4 cases, *i.e.*, ① $3>9>4$···No. 3 (3.77, 3.00 and 4.96), No. 9 (2.96, 2.51 and 3.15) and No. 4 (2.80, 2.44 and 3.14) in the larger sets of the maximum and the minimum of L/W and the minimum of L/T; ② $16>20>17$···No. 16 (8.25 mm

and 3.79), No. 20 (8.00 mm and 3.73), No. 17 (7.75 mm and 3.51) in the larger sets of the maxima of length and L/W; ③ 19>12>18…No. 19 (3.40 mm and 2.40 mm), No. 12 (3.10 mm and 2.35 mm), No. 18 (3.00 mm and 2.25 mm) in the larger sets of the maxima of width and thickness; ④ 12< 19<18…No. 12 (2.00, 2.58 and 2.04), No. 19 (2.28, 2.88 and 2.30), No. 18 (2.64, 3.67 and 2.75) in the smaller sets of the maxima of L/W and L/T and the minimum of L/T. It was noticed that these synchronized orders of strains were not found in the pure-ranges. The fourth combinations (19>12>18) were found to be the same as in case of the unhusked grains. It was interesting facts that 2 sets (3<4<9 and 3>9>4, 19>12>18 and 12<19<18) were fixed to be in reversed relations.

On the other hand, some sets of strains did not show the same orders, but showed the same combinations, which meant the existence of the same strain numbers regardless of orders. Nine cases were ascertained, *i.e.*, ① 1·2·5 in the larger sets…the maximum of width (1>2>5), the minimum of width (2>1>5), the maximum of thickness (1>2=5), and the minimum of thickness (1>2>5); ② 1·3·7 in the larger sets…the ranges of L/W (1>3>7) and L/T (3>7>1); ③ 3·4·9 in the larger sets…the maximum and the minimum of L/W, and the minimum of L/T (3>9>4), maximum of L/T (3>4>9); ④ 1·2·7 in the smaller sets…the minimum of L/W (1<2<7) and the minimum of L/T (1<7<2); ⑤ 4·6·9 in the smaller sets…the range of thickness (9<4=6) and the range of L/T (9<6<4); ⑥ 10·12·14 in the larger sets…the maximum (10>14>12) and the range (14>10>12) of W/T; ⑦ 12·18·19 in the larger sets…the maxima of width and thickness (19>12> 18), and the minimum of width (12=18>19); ⑧ 11·12·15 in the smaller sets…the maximum (12< 15<11) and the range (15<12<11) of length; ⑨ 11·15·17 in the smaller sets…the maximum (15< 11<17) and the minimum (11=15=17) of width.

5. In the larger series of set of width of the comparative values, the largest (0.84) was obtained in No. 15, followed by No. 12 (0.83) and No. 11 (0.82). In the larger series of set of W/T, the largest (0.94) was obtained in No. 15, followed by No. 12 (0.90) and No. 11 (0.89). These orders of strains were finally illustrated in both cases as 15>12>11, and were fixed to be the same in both characters. Such a phenomenon as this was found in another 1 case, *i.e.*, 12<15<18…No. 12 (0.02 and 0.08), No. 15 (0.05 and 0.09), No. 18 (0.06 and 0.14) in the smaller sets of the ranges of thickness and W/T. It was noteworthy that these synchronized orders of strains were found in quite few cases in comparison with the husked and the unhusked characters.

On the other hand, some sets of strains did not show the same orders, but showed the same combinations, which meant showing the same strain numbers regardless of orders. Nine cases were ascertained, *i.e.*, ① 1·2·7·9 in the larger sets…the maximum of length (7>1>2=9), the range of length (7>1=2=9) and the maximum of width (2>1=7=9); ② 2·3·9 in the larger sets…the maximum (3>9>2) and the range (3>2=9) of L/T; ③ 2·7·9 in the larger sets…the maximum (9>2>7) and the range (9>7>2) of W/T; ④ 3·6·8 in the smaller sets…the maxima of width (3< 8<6) and W/T (6=8<3); ⑤ 4·6·8 in the smaller sets…the ranges of thickness (8<4=6) and W/T (6<4<8), and the maximum of L/T (6=8<4); ⑥ 11·15·18 in the larger sets…the maximum of width (11=15>18) and the minimum of W/T (15>11=18); ⑦ 12·15·18 in the smaller sets…the maxima of length (12<15<18) and L/W (12=15<18), and the ranges of thickness, L/T and W/T (12<15< 18); ⑧ 12·15·17 in the smaller sets…the maxima of thickness (15<12=17) and L/T (12<15<17); ⑨ 15·17·20 in the smaller sets…the minima of length (17<15=20) and L/T (20<15=17).

Summary

In order to confirm the varietal variations of cultivated rice collected in India, variation ranges

in 12 characters were investivated following the previous papers. Those were divided geographically into 2 groups, *i.e.*, Group A···northeastern India, Group B···West Bengal State. The results obtained here were summarized as follows:

1. In view of the husked grains, the maxima, the minima and the pure-ranges of length, width, thickness, L/W, L/T and W/T in Group A were ascertained as 6.31 mm, 5.49 mm, 0.81 mm; 2.84 mm, 2.28 mm, 0.56 mm; 2.06 mm, 1.71 mm, 0.35 mm; 2.68, 2.12, 0.56; 3.66, 2.91, 0.74; 1.54, 1.23, 0.31 in average values, respectively. Those of Group B were ascertained in the same order as 6.88 mm, 5.65 mm, 1.23 mm; 2.61 mm, 2.05 mm, 0.55 mm; 2.10 mm, 1.65 mm, 0.45 mm; 3.11, 2.37, 0.74; 3.81, 2.91, 0.91; 1.46, 1.07, 0.39 in average values, respectively. Those of the whole strains of both of the groups were ascertained in the same order as 6.64 mm, 5.58 mm, 1.06 mm; 2.71 mm, 2.15 mm, 0.56 mm; 2.08 mm, 1.67 mm, 0.41 mm; 2.93, 2.26, 0.67; 3.75, 2.91, 0.84; 1.49, 1.14, 0.35 in average values, respectively. Six and 11 characters showed the larger and the smaller values in Group A than those of Group B, respectively.

2. In view of the comparative values, those in Group A were ascertained in the same order as 0.74, 0.69, 0.05; 0.88, 0.76, 0.12; 0.91, 0.83, 0.08; 0.94, 0.81, 0.13; 0.88, 0.77, 0.10; 1.02, 0.86, 0.16 in average values, respectively. Those in Group B were ascertained in the same order as 0.72, 0.65, 0.08; 0.91, 0.79, 0.12; 0.95, 0.85, 0.10; 0.90, 0.75, 0.14; 0.83, 0.72, 0.11; 1.03, 0.85, 0.18 in average values, respectively. Those of the whole strains of both of the groups were ascertained in the same order as 0.74, 0.67, 0.07; 0.90, 0.78, 0.12; 0.93, 0.84, 0.09; 0.91, 0.77, 0.14; 0.85, 0.74, 0.11; 1.03, 0.86, 0.17 in average values, respectively. Seven and 10 characters showed the larger and the smaller values in Group A than those of Group B, respectively.

3. Basing on the data obtained in these characters, several patterns and strain specificities were found. Strains showing relatively large or small values in the respective characters were picked-up and grouped as "order" or "combination". These techniques were fixed to be useful ones for testing strain or geographical differentiations of rice varieties.

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