Mem. Fac. Agr. Kagoshima Univ., **17**, 1–18, 1981

Some Morphological Characters of the Cultivated Rice Grains Collected in India (1)

Tadao C. KATAYAMA
(*Laboratory of Crop Science*)
Received for Publication August 11, 1980

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 rice under the project, designated "The Distribution of Wild Rice and the Ecotypic Differentiation of Cultivated Rice in Burma and Assam", supported by a Grant from the Ministry of Education, Japan. In this opportunity, the cultivated rice distributed not only in Assam but in West Bengal State was also collected and studied.

The generally accepted indigenous centre of rice is an area embracing South Asia, Southeast Asia and China. Morinaga[6] stated that special gene-pattern of ecospecies "*japonica*" is probably to be established around southeast Himalaya. East and northeast parts of India has been considered to be one of the differentiation centres of rice in accordance with many investigations. However, accumulation of complete data endorsed by discussions on these aspects has been unfortunately far from being perfect. Sharma *et al.*[7] carried out some systematic collections of current and primitive cultivars of rice in the northeast parts of India from the viewpoint of breeding purposes. Shastry *et al.*[8] made accurate investigations of such materials. In both of them, the works were mainly done in view of breeding program. The present study was made to search the varietal variations, taking these facts into consideration.

The author is most grateful to Dr. T. Watabe and Mr. K. Tanaka, who helped and gave their kind advices to accomplish his task. The writer wishes to express his hearty thanks to Dr. K. Ueki for his guidance.

Materials and Methods

Twenty one strains of Indian rice varieties collected in India were used in this experiment. They are listed up in Table 1. In this table, collection No., collection date and place, and detailed informations are mentioned. States included in this paper are Meghalaya, Assam and West Bengal. The rice varieties 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 status. Accordingly, they are divided into two groups in this paper, *i.e.*, Group A — strains collected in Meghalaya State and Assam State. Group B — strains collected in West Bengal State.

Measurements were done for length, width and thickness of unhusked and husked grains. Thirty grains were used for the measurements. The measurements were done at the largest portion

Table 1. Locality and habitat of the cultivated rice, *Oryza sativa* L., collected in India

Collection No.	Date	Place	Detailed locality, habitat, local name and remarks
C 1	Jan. 3	Shillong	ICAR Experiment Research Station Upper Shillong Farm, Meghalaya. 150 to 160 days growing period. For upper and lower field cultivation. Local name "Khono Rolu", "US-1", "Upper Shillong-1". Called as cold tolerant.
C 2	Jan. 5	Nowgong	30 km northeast from Nowgong, Assam. *O. perennis* growing in near swamp.
C 3	Jan. 6	Jorhat	Bahana village, Assam. Shallow water paddy.
C 4	Jan. 6	Jorhat	Bahana village, a few km north from locality mentioned above, Assam. Deep water paddy.
C 5	Jan. 6	Jorhat	Same locality mentioned above. Local name "Bor Chokuwa". Semi-glutionous?
C 6	Jan. 6	Jorhat	Neamati village, Assam. Local name "Red Amona", "Bao Rice". Deep water paddy. Collected by bulk seeds.
C 7	Jan. 6	Jorhat	Neamati village, Assam. "White Amona", "Bao Rice". Deep water paddy. Collected by bulk seeds.
C 8	Jan. 6	Jorhat	Same locality and variety mentioned above. Collected by panicle.
C 9	Jan. 6	Jorhat	10 km west from Jorhat, Assam. Local name "Sola Pona", "Sali Rice" (=photoperiodically sensitive).
C 10	Dec. 20	Bhadarkh	25 km south from Bhadarkh, Orissa. Local name "Dan". *O. perennis* growing near this paddy field.
C 11	Dec. 30	Chinsurah	Chinsurah Rice Research Station, W. B. Called as good taste.
C 12	Dec. 30	Chinsurah	Chinsurah Rice Research Station, W. B. Deep water variety.
C 13	Jan. 10	Calcutta	11 km south from Diamond Harbour, W. B.
C 14	Jan. 10	Calcutta	Same locality as above.
C 15	Jan. 10	Calcutta	Same locality as above.
C 16	Jan. 10	Calcutta	24 km south from Diamond Harbour, W. B. Local name "Patni". Lowland aman.
C 17	Jan. 10	Calcutta	Same locality as above. Local name "Charmar mani". Medium lowland aman.
C 18	Jan. 11	Calcutta	17 km east from Baruipur, W. B. Local name "Halikum (Sari)".
C 19	Jan. 11	Calcutta	14 km south from Canning, W. B. Local name "Geri". Large grain.
C 20	Jan. 11	Calcutta	Same locality as above. Local name "Parnai-26".
C 21	Jan. 11	Kalimpong	Sub-Divisional Agricultural Extension Office, Kalimpong, W. B. Primitive upland variety. Local name "Kulu".

of the respective character. Calculations were done for determining the ratios of length to width, of length to thickness and of width to thickness. Correlation coefficients between the practical values of unhusked and husked grains and linear regressions between them were calculated through the whole characters measured by comparing them.

In the present paper, the following abbreviations were adopted; 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), c.c. (correlation coefficient), l.r. (linear regression) and s.d. (standard deviations).

Results

Part I. The respective characters

1. Length of unhusked grains

Group A: The results are given in Table 2. Lengths for the individual grain level ranged from 9.85 mm (No. 9) to 7.00 mm (No. 7). In the strain level, the longest (9.10 mm) was obtained in No. 9. The shortest (7.52 mm) was noted in No. 7. Average and its s.d. through the whole strains were found to be 8.21±0.49. The s.d. of each strain, *i.e.*, showing intra-population's variations, obtained were found to be 0.28±0.09.

Table 2. Some morphological characters of the unhusked grains

Strain No.	Length (mm)	Width (mm)	Thickness (mm)	L/W	L/T	W/T
1	7.75±0.30	3.43±0.20	2.36±0.12	2.27±0.19	3.29±0.24	1.46±0.11
2	8.04±0.39	3.45±0.15	2.37±0.10	2.33±0.13	3.41±0.24	1.46±0.06
3	8.35±0.14	2.90±0.08	1.62±0.06	2.88±0.06	5.18±0.13	1.81±0.08
4	8.57±0.31	2.63±0.09	1.95±0.07	3.26±0.11	4.40±0.17	1.35±0.07
5	8.50±0.19	3.40±0.16	2.32±0.10	2.51±0.14	3.67±0.20	1.47±0.03
6	8.30±0.31	2.97±0.14	2.07±0.08	2.80±0.11	4.02±0.22	1.43±0.10
7	7.52±0.40	3.09±0.14	2.17±0.11	2.44±0.19	3.48±0.22	1.43±0.11
8	7.77±0.24	3.36±0.18	2.19±0.09	2.31±0.12	3.55±0.18	1.54±0.12
9	9.10±0.28	2.80±0.08	2.11±0.06	3.26±0.11	4.31±0.11	1.32±0.04
10	9.37±0.48	3.00±0.15	2.15±0.09	3.13±0.21	4.37±0.27	1.40±0.11
11	8.04±0.20	2.19±0.05	1.91±0.10	3.67±0.10	4.23±0.27	1.15±0.07
12	7.24±0.15	3.25±0.14	2.28±0.09	2.24±0.10	3.18±0.15	1.43±0.09
13	8.85±0.45	2.40±0.17	2.02±0.13	3.70±0.24	4.41±0.31	1.19±0.06
14	9.08±0.28	2.77±0.14	2.08±0.11	3.29±0.21	4.37±0.18	1.34±0.10
15	8.65±0.19	2.05±0.07	1.79±0.05	4.24±0.17	4.84±0.19	1.15±0.04
16	10.12±0.56	2.78±0.14	2.18±0.07	3.64±0.26	4.65±0.25	1.28±0.07
17	9.23±0.42	2.43±0.26	2.03±0.11	3.83±0.34	4.56±0.21	1.20±0.09
18	9.23±0.27	3.23±0.13	2.33±0.11	2.83±0.19	3.97±0.22	1.39±0.08
19	8.13±0.33	3.56±0.15	2.56±0.16	2.29±0.12	3.19±0.22	1.39±0.08
20	10.23±0.63	2.69±0.17	2.18±0.13	3.82±0.38	4.70±0.36	1.24±0.11
21	10.11±0.44	2.83±0.11	2.22±0.08	3.58±0.19	4.57±0.24	1.28±0.06

Group B: Lengths for the individual grain level ranged from 10.80 mm (Nos. 16, 20, 21) to 6.95 mm (No. 12). In the strain level, the longest (10.23 mm) was obtained in No. 20. The shortest (7.24 mm) was noted in No. 12. It was noticeable that No. 12 showed very small value. Average and its s.d. through the whole strains were found to be 9.02±0.91. S.d. of each strain were found to be 0.37±0.15.

Whole: Average and its s.d. through the whole strains (=21) were found to be 8.68±0.85. S.d. of each strain were found to be 0.33±0.13.

2. Width of unhusked grains

Group A: Widths for the individual grain level ranged from 3.95 mm (No. 1) to 2.50 mm (No. 4). In the strain level, the widest (3.45 mm) was obtained in No. 2. The narrowest (2.63 mm) was noted in No. 4. Average and its s.d. through the whole strains were found to be 3.22 $\pm$0.41. S.d. of each strain were found to be 0.13$\pm$0.05.

Group B: Widths for the individual grain level ranged from 3.80 mm (No. 19) to 1.90 mm (No. 15). In the strain level, the widest (3.56 mm) was obtained in No. 19. The narrowest (2.05 mm) was noted in No. 15. It was noted that the value was peculiarly large in No. 19. Average and its s.d. through the whole strains were found to be 2.77$\pm$0.45. S.d. of each strain were found to be 0.14$\pm$0.05.

Whole: Average and its s.d. through the whole strains were found to be 2.92$\pm$0.43. S.d. of each strain were found to be 0.14$\pm$0.05.

3. Thickness of unhusked grains

Group A: Thicknesses for the individual grain level ranged from 2.55 mm (Nos. 1, 2) to 1.45 mm (No. 3). In the strain level, the thickest (2.37 mm) was obtained in No. 2. The thinnest (1.62 mm) was noted in No. 3. 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 2.13$\pm$0.14. S.d. of each strain were found to be 0.09$\pm$0.02.

Group B: Thicknesses for the individual grain level ranged from 2.90 mm (No. 19) to 1.55 mm (No. 11). In the strain level, the thickest (2.56 mm) was obtained in No. 19, which was the same as the width and was peculiarly large value. The thinnest (1.79 mm) was noted in No. 15, which was also the same as width. Average and its s.d. through the whole strains were found to be 2.14$\pm$0.20. S.d. of each strain were found to be 0.10$\pm$0.03.

Whole: Average and its s.d. through the whole strains were found to be 2.14$\pm$0.21. S.d. of each strain were found to be 0.10$\pm$0.03.

4. L/W of unhusked grains

Group A: L/W for the individual grain level ranged from 3.48 (No. 9) to 1.91 (No. 1). In the strain level, the largest (3.26) was obtained in Nos. 4 and 9. The smallest (2.27) was noted in No. 1. It was noted that the values were peculiarly large in Nos. 4 and 9. Average and its s.d. through the whole strains were found to be 2.67$\pm$0.39. S.d. of each strain were found to be 0.13 $\pm$0.04.

Group B: L/W for the individual grain level ranged from 4.61 (No. 15) to 2.07 (No. 12). In the strain level, the largest (4.24) was obtained in No. 15. The smallest (2.24) was noted in No. 12. It was noted that the values were peculiarly large in No. 15 and small in Nos. 12 and 19, respectively. Average and its s.d. through the whole strains were found to be 3.36$\pm$0.62. S.d. of each strain were found to be 0.21$\pm$0.09.

Whole: Average and its s.d. through the whole strains were found to be 3.06$\pm$0.63. S.d. of each strain were found to be 0.18$\pm$0.08.

5. L/T of unhusked grains

Group A: L/T for the grain level ranged from 5.52 (No. 3) to 2.80 (No. 1). In the strain level, the largest (5.18) was obtained in No. 3. The smallest (3.29) was noted in No. 1, which was the same as the L/W. It was noted that the value was peculiarly large in No. 3. Average and its

s.d. through the whole strains were found to be 3.92±0.62. S.d. of each strain were found to be 0.19±0.05.

Group B: L/T for the grain level ranged from 5.38 (No. 20) to 2.76 (No. 19). In the strain level, the largest (4.84) was obtained in No. 15, which was the same as the L/W. The smallest (3.18) was noted in No. 12, which was also the same as the L/W. It was noted that the values were peculiarly small in Nos. 12 and 19, which were the same as the L/W. Average and its s.d. through the whole strains were found to be 4.25±0.53. S.d. of each strain were found to be 0.24±0.06.

Whole: Average and its s.d. through the whole strains were found to be 4.11±0.59. S.d. of each strain were found to be 0.22±0.06.

6. W/T of unhusked grains

Group A: W/T for the grain level ranged from 2.04 (No. 3) to 1.21 (No. 7). In the strain level, the largest (1.81) was obtained in No. 3, which was the same as the L/T. The smallest (1.32) was noted in No. 9. It was noted that the value was peculiarly large in No. 3, which was the same as the L/T. Average and its s.d. through the whole strains were found to be 1.47±0.14. S.d. of each strain were found to be 0.08±0.03.

Group B: W/T for the grain level ranged from 1.89 (No. 10) to 1.06 (No. 15). In the strain level, the largest (1.43) was obtained in No. 12. The smallest (1.15) was noted in Nos. 11 and 15. Average and its s.d. through the whole strains were found to be 1.29±0.10. S.d. of each strain were found to be 0.08±0.02.

Whole: Average and its s.d. through the whole strains were found to be 1.37±0.15. S.d. of each strain were found to be 0.08±0.03.

7. Length of husked grains

Group A: The results are given in Table 3. Lengths for individual grain level ranged from 6.90 mm (No. 9) to 5.15 mm (Nos. 7, 8). In the strain level, the longest (6.49 mm) was obtained in No. 9. The shortest (5.48 mm) was noted in No. 7. It was noted that the value was peculiarly large in No. 9. Average and its s.d. through the whole strains were found to be 5.87±0.32. S.d. of each strain were found to be 0.19±0.05.

Group B: Lengths for individual grain level ranged from 8.25 mm (No. 16) to 4.60 mm (No. 12). In the strain level, the longest (7.36 mm) was obtained in No. 16. The shortest (4.89 mm) was noted in No. 12. 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 6.28±0.70. S.d. of each strain were found to be 0.28±0.14.

Whole: Average and its s.d. through the whole strains were found to be 6.10±0.60. S.d. of each strain were found to be 0.24±0.12.

8. Width of husked grains

Group A: Widths for individual grain level ranged from 3.40 mm (No. 1) to 1.50 mm (No. 3). In the strain level, the widest (2.98 mm) was obtained in No. 2. The narrowest (1.75 mm) was noted in No. 3. 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 2.57±0.39. S.d. of each strain were found to be 0.13 ±0.04.

Group B: Widths for individual grain level ranged from 3.40 mm (No. 19) to 1.70 mm (Nos. 15, 17). In the strain level, the widest (2.90 mm) was obtained in No. 19. The narrowest (1.82

Table 3. Some morphological characters of the husked grains

Strain No.	Length (mm)	Width (mm)	Thickness (mm)	L/W	L/T	W/T
1	5.65±0.22	2.97±0.18	2.17±0.10	1.91±0.16	2.62±0.18	1.37±0.09
2	5.74±0.27	2.98±0.12	2.10±0.10	1.93±0.10	2.74±0.20	1.43±0.07
3	5.83±0.11	1.75±0.11	1.08±0.06	3.37±0.16	5.46±0.29	1.62±0.05
4	6.07±0.20	2.30±0.07	1.75±0.07	2.64±0.10	3.48±0.15	1.32±0.07
5	6.03±0.15	2.88±0.14	2.10±0.11	2.10±0.12	2.88±0.17	1.38±0.07
6	5.98±0.18	2.47±0.14	1.87±0.08	2.43±0.11	3.19±0.16	1.32±0.10
7	5.48±0.26	2.67±0.15	1.98±0.10	2.06±0.18	2.78±0.17	1.35±0.09
8	5.52±0.17	2.68±0.16	1.98±0.09	2.07±0.13	2.79±0.15	1.36±0.12
9	6.49±0.19	2.39±0.08	1.88±0.07	2.72±0.11	3.45±0.11	1.27±0.06
10	6.69±0.39	2.51±0.13	1.93±0.11	2.68±0.21	3.48±0.22	1.31±0.13
11	5.66±0.16	1.95±0.08	1.72±0.09	2.89±0.18	3.31±0.23	1.14±0.08
12	4.89±0.13	2.81±0.16	2.08±0.09	1.74±0.11	2.35±0.12	1.35±0.11
13	6.18±0.32	2.04±0.16	1.83±0.12	3.04±0.18	3.39±0.21	1.12±0.06
14	6.29±0.23	2.30±0.10	1.86±0.14	2.75±0.18	3.42±0.26	1.25±0.14
15	5.76±0.08	1.82±0.04	1.62±0.04	3.17±0.08	3.56±0.10	1.13±0.05
16	7.36±0.50	2.30±0.10	1.97±0.08	3.21±0.26	3.74±0.23	1.17±0.06
17	6.30±0.39	2.04±0.18	1.82±0.10	3.11±0.23	3.47±0.15	1.12±0.06
18	6.48±0.18	2.76±0.11	2.12±0.11	2.36±0.12	3.07±0.18	1.30±0.07
19	5.74±0.28	2.90±0.19	2.26±0.13	1.99±0.15	2.54±0.17	1.29±0.09
20	7.17±0.49	2.21±0.14	1.96±0.12	3.26±0.36	3.65±0.37	1.13±0.08
21	6.88±0.22	2.41±0.09	2.03±0.08	2.86±0.12	3.40±0.13	1.19±0.05

mm) was noted in No. 15. Average and its s.d. through the whole strains were found to be 2.34 ±0.35. S.d. of each strain were found to be 0.12±0.05.

Whole: Average and its s.d. through the whole strains were found to be 2.44±0.38. S.d. of each strain were found to be 0.13±0.04.

9. Thickness of husked grains

Group A: Thicknesses for individual grain level ranged from 2.35 mm (No. 1) to 0.90 mm (No. 3). In the strain level, the thickest (2.17 mm) was obtained in No. 1. The thinnest (1.08 mm) was noted in No. 3, which was the same as the width. 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 1.88±0.33. S.d. of each strain were found to be 0.09±0.02.

Group B: Thicknesses for individual grain level ranged from 2.40 mm (No. 19) to 1.30 mm (No. 14). In the strain level, the thickest (2.26 mm) was obtained in No. 19, which was the same as the width. The thinnest (1.62 mm) was noted in No. 15, which was also the same as the width. Average and its s.d. through the whole strains were found to be 1.93±0.18. S.d. of each strain were found to be 0.10±0.03.

Whole: Average and its s.d. through the whole strains were found to be 1.91±0.25. S.d. of each strain were found to be 0.10±0.02.

10. L/W of husked grains

Group A: L/W for individual grain level ranged from 3.77 (No. 3) to 1.59 (No. 1). In the

strain level, the largest (3.37) was obtained in No. 3. The smallest (1.91) was noted in No. 1. It was noted that the value was peculiarly large in No. 3. Average and its s.d. through the whole strains were found to be 2.36±0.48. S.d. of each strain were found to be 0.13±0.03.

Group B: L/W for individual grain level ranged from 3.79 (No. 16) to 1.60 (No. 12). In the strain level, the largest (3.26) was obtained in No. 20. The smallest (1.74) was noted in No. 12. 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 2.76±0.49. S.d. of each strain were found to be 0.18±0.08.

Whole: Average and its s.d. through the whole strains were found to be 2.59±0.52. S.d. of each strain were found to be 0.16±0.07.

11. L/T of husked grains

Group A: L/T for individual grain level ranged from 6.28 (No. 3) to 2.30 (No. 1). In the strain level, the largest (5.46) was obtained in No. 3, which was the same as the L/W. The smallest (2.62) was noted in No. 1, which was also the same as the L/W. It was noted that the value was peculiarly large in No. 3. Average and its s.d. through the whole strains were found to be 3.27 ±0.88. S.d. of each strain were found to be 0.18±0.05.

Group B: L/T for individual grain level ranged from 4.54 (No. 14) to 2.04 (No. 12). In the strain level, the largest (3.74) was obtained in No. 16, which was the same as the length. The smallest (2.35) was noted in No. 12, which was the same as the length and the L/W. Average and its s.d. through the whole strains were found to be 3.26±0.41. S.d. of each strain were found to be 0.20±0.07.

Whole: Average and its s.d. through the whole strains were found to be 3.26±0.63. S.d. of each strain were found to be 0.19±0.06.

12. W/T of husked grains

Group A: W/T for individual grain level ranged from 1.71 (No. 3) to 1.15 (No. 6). In the strain level, the largest (1.62) was obtained in No. 3, which was the same as the L/W and the L/T. The smallest (1.27) was noted in No. 9. It was noted that the value was peculiarly large in No. 3. Average and its s.d. through the whole strains were found to be 1.38±0.10. S.d. of each strain were found to be 0.08±0.02.

Group B: W/T for individual grain level ranged from 1.93 (No. 10) to 0.97 (No. 13). In the strain level, the largest (1.35) was obtained in No. 12. The smallest (1.12) was noted in Nos. 13 and 17. Average and its s.d. through the whole strains were found to be 1.21±0.09. S.d. of each strain were found to be 0.08±0.03.

Whole: Average and its s.d. through the whole strains were found to be 1.28±0.13. S.d. of each strain were found to be 0.08±0.03.

PART II. Relations between the two respective characters

1. Length and width of unhusked grains

Group A: C.c. and l.r. of width on length in the same strain were calculated, and are shown in Table 4. One, 1, 1 and 6 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.7216 to the degree of freedom of 7, which is significant at 5% level. Generally speaking, the longer is the length, the narrower is the width. L.r. of length on width was calculated as follows; $Y=-0.722X-2.008$,

Table 4. Correlation coefficient and linear regression of the three components of the unhusked grains; width on length, thickness on length, thickness on width

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	−0.3727*	Y=−0.251X+5.368	−0.3129	—	0.1395	—
2	0.3073	—	−0.1754	—	0.4731**	Y=0.324X+1.248
3	0.0000	—	0.9820***	Y=0.429X−1.962	−0.1890	—
4	0.5344**	Y=0.159X+1.266	0.4050*	Y=0.088X+1.191	−0.0327	—
5	0.0174	—	−0.0985	—	0.4094*	Y=0.268X+1.411
6	0.5844***	Y=0.259X+0.821	−0.0902	—	−0.2457	—
7	−0.2976	—	0.2112	—	−0.3043	—
8	0.3519	—	−0.0564	—	−0.5251**	Y=−0.257X+3.057
9	0.3056	—	0.6461***	Y=0.134X+0.892	0.2828	—
10	0.0029	—	0.2193	—	−0.2784	—
11	0.3674*	Y=0.087X+1.488	−0.1238	—	−0.1342	—
12	0.1978	—	−0.1017	—	−0.1927	—
13	0.3728*	Y=0.142X+1.142	0.2975	—	0.7500***	Y=0.577X+0.631
14	−0.2724	—	0.6203***	Y=0.244X−0.131	−0.0967	—
15	0.0208	—	−0.2013	—	0.4398*	Y=0.318X+1.141
16	0.0566	—	0.3476	—	0.1311	—
17	0.5281**	Y=0.334X−0.652	0.5730***	Y=0.145X+0.689	0.8005***	Y=0.320X+1.247
18	−0.0965	—	0.2339	—	0.2084	—
19	0.2143	—	0.1490	—	0.5140**	Y=0.534X+0.665
20	−0.3843*	Y=−0.106X+3.776	0.2626	—	0.1305	—
21	0.2163	—	0.1369	—	0.3300	—

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=28.

where Y and X indicate length and width, respectively. This formula indicates that the length becomes 0.722 mm longer, by becoming 1 unit narrower the width (0 points, 8.75 mm in length and 2.76 mm in width, respectively).

Group B: One, 3 and 8 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.1288, showing no significance even at 5% level.

Whole: One, 2, 4 and 14 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains (=21), c.c. was +0.3926, showing no significance even at 5% level.

2. Length and thickness of unhusked grains

Group A: Two, 1 and 6 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.3506, showing no significance even at 5% level.

Group B: Two and 10 strains showed significances at 0.1% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.0325, showing no significance even at 5% level.

Whole: Four, 1 and 16 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.0627, showing no significance even at 5% level.

3. Width and thickness of unhusked grains

Group A: Two, 1 and 6 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.6167, showing no significance even at 5% level.

Group B: Two, 1, 1 and 8 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.9394 to the degree of freedom of 10, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=1.455X-1.857$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 1.455 mm wider, by becoming 1 unit thicker the thickness (0 points, 2.76 mm in width and 2.08 mm in thickness, respectively).

Whole: Two, 3, 2 and 14 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.7318 to the degree of freedom of 19, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=1.038X+0.953$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 1.038 mm wider, by becoming 1 unit thicker the thickness (0 points, 2.76 mm in width and 2.08 mm in thickness, respectively).

4. L/W and L/T of unhusked grains

Group A: C.c. and l.r. of L/T on L/W in the same strain were calculated, and are shown in Table 5. Two, 2, 2 and 3 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.5081, showing no significance even at 5% level.

Table 5. Correlation coefficient and linear regression of the three components of the unhusked grains; ratio of length to thickness (abbreviated as L/T, and so forth) on L/W, W/T on L/W, W/T on L/T

Strain No.	L/W and L/T		L/W and W/T		L/T and W/T	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.5678**	Y=0.719X+1.661	−0.5545**	Y=−0.314X+2.168	0.3613*	Y=0.162X+0.924
2	0.7880***	Y=1.486X−0.060	0.0327	—	0.6403***	Y=0.169X+0.886
3	0.9678***	Y=1.929X+1.074	−0.9920***	Y=−1.336X+5.657	0.9918***	Y=0.670X−1.662
4	0.0688	—	−0.6388***	Y=−0.384X+2.606	0.7223***	Y=0.288X+0.088
5	0.5690**	Y=0.849X+1.546	−0.4563*	Y=−0.246X+2.085	0.4703**	Y=0.170X+0.844
6	0.1865	—	−0.5590**	Y=−0.486X+2.794	0.6602***	Y=0.284X+0.292
7	0.4621*	Y=0.523X+2.204	−0.6544***	Y=−0.361X+2.314	0.3659*	Y=0.179X+0.812
8	−0.2615	—	−0.7912***	Y=−0.815X+3.423	0.7943***	Y=0.532X−0.348
9	0.4105*	Y=0.391X+3.036	−0.7091***	Y=−0.276X+2.222	0.3466	—
10	0.3780*	Y=0.494X+2.821	−0.6219***	Y=−0.338X+2.460	0.4827**	Y=0.201X+0.523
11	0.2424	—	−0.1631	—	0.9162***	Y=0.246X+0.114
12	0.0340	—	−0.6807***	Y=−0.603X+2.774	0.7061***	Y=0.430X+0.061
13	0.7439***	Y=0.972X+0.811	−0.2834	—	0.4281*	Y=0.081X+0.835
14	0.0108	—	−0.8052***	Y=−0.408X+2.680	0.5801***	Y=0.305X+0.003
15	0.6167***	Y=0.683X+1.941	−0.4437*	Y=−0.098X+1.560	0.4312*	Y=0.086X+0.731
16	0.5704***	Y=0.539X+2.689	−0.7149***	Y=−0.202X+2.011	0.1229	—
17	0.6532***	Y=0.406X+3.010	−0.8572***	Y=−0.221X+2.045	−0.1748	—
18	−0.3258	—	−0.6710***	Y=−0.292X+2.217	0.5501**	Y=0.205X+0.577
19	0.6243***	Y=1.160X+0.528	−0.1476	—	0.6788***	Y=0.230X+0.660
20	0.6558***	Y=0.631X+2.292	−0.6934***	Y=−0.196X+1.990	0.0759	—
21	0.6415***	Y=0.826X+1.610	−0.4047*	Y=−0.120X+1.706	0.4401*	Y=0.102X+0.812

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=28.

Group B: Seven, 1 and 4 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.9771 to the degree of freedom of 10, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=1.003X+1.580$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 1.003 larger, by becoming 1 unit larger the L/T (0 points, 3.25 in L/W and 4.15 in L/T, respectively).

Whole: Nine, 2, 3 and 7 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.9305 to the degree of freedom of 19, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=0.966X-1.537$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.966 larger, by becoming 1 unit larger the L/T (0 points, 3.25 in L/W and 4.15 in L/T, respectively).

5. L/W and W/T of unhusked grains

Group A: Five, 2, 1 and 1 strain showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.2667, showing no significance even at 5% level.

Group B: Seven, 2 and 3 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.6815 to the degree of freedom of 10, which is significant at 5% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; $Y=-1.571X-3.486$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 1.571 larger, by becoming 1 unit smaller the W/T (0 points, 3.25 in L/W and 1.48 in W/T, respectively).

Whole: Twelve, 2, 3 and 4 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.7511 to the degree of freedom of 19, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; $Y=-1.461X+1.365$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 1.461 larger, by becoming 1 unit smaller the W/T (0 points, 3.25 in L/W and 1.48 in W/T, respectively).

6. L/T and W/T of unhusked grains

Group A: Five, 1, 2 and 1 strain showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.4509, showing no significance even at 5% level.

Group B: Four, 2, 3 and 3 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.5009, showing no significance even at 5% level.

Whole: Nine, 3, 5 and 4 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.2976, showing no significance even at 5% level.

7. Length and width of husked grains

Group A: C.c. and l.r. of width on length in the same strain were calculated, and are shown in Table 6. Two, 3 and 4 strains showed significances at 0.1% and 5% levels and no significance

Table 6. Correlation coefficient and linear regression of the three components of the husked grains; width on length, thickness on length, thickness on width

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	−0.3616*	Y=−0.289X+4.602	−0.1819	—	0.2681	—
2	0.3825*	Y=0.171X+2.004	−0.0811	—	0.3152	—
3	0.9620***	Y=0.973X−3.923	0.6966***	Y=0.407X−1.289	0.8660***	Y=0.500X+0.208
4	0.2610	—	0.2870	—	−0.0372	—
5	−0.0932	—	0.0654	—	0.5078**	Y=0.385X+0.986
6	0.6847***	Y=0.548X−0.806	0.0065	—	−0.1437	—
7	−0.3730*	Y=−0.216X+3.851	0.1570	—	0.1222	—
8	0.2583	—	0.0497	—	−0.3297	—
9	0.1923	—	0.5255**	Y=0.186X+0.678	0.1898	—
10	−0.1852	—	0.4421*	Y=0.121X+1.117	−0.2886	—
11	−0.2480	—	−0.0421	—	0.0974	—
12	0.2417	—	−0.0982	—	−0.2815	—
13	0.5707***	Y=0.277X+0.331	0.4697**	Y=0.172X+0.762	0.6685***	Y=0.505X+0.795
14	−0.4368*	Y=−0.176X+3.401	0.6402***	Y=0.410X−0.723	−0.1247	—
15	−0.1565	—	0.1216	—	0.3076	—
16	−0.0024	—	0.4495*	Y=0.070X+1.453	0.2641	—
17	0.5522**	Y=0.261X+0.391	0.7284***	Y=0.191X+0.616	0.7908***	Y=0.437X+0.926
18	0.0619	—	0.2487	—	0.4448*	Y=0.443X+0.901
19	0.1717	—	0.2048	—	0.3910*	Y=0.261X+1.505
20	−0.1255	—	0.0914	—	0.4175*	Y=0.358X+1.171
21	0.1787	—	0.3784*	Y=0.131X+1.129	0.2602	—

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=28.

even at 5% level, respectively. In the whole strains, c.c. was −0.1704, showing no significance even at 5% level.

Group B: One, 1, 1 and 9 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.3830, showing no significance even at 5% level.

Whole: Three, 1, 4 and 13 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.2567, showing no significance even at 5% level.

8. Length and thickness of husked grains

Group A: One, 1 and 7 strains showed significances at 0.1% and 1% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.1752, showing no significance even at 5% level.

Group B: Two, 1, 3 and 6 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.0695, showing no significance even at 5% level.

Whole: Three, 2, 3 and 13 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.0579, showing no significance even at 5% level.

9. Width and thickness of husked grains

Group A: One, 1 and 7 strains showed significances at 0.1% and 1% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8342 to the degree of freedom of 7, which is significant at 1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=0.681X+1.115$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.681 mm wider, by becoming 1 unit thicker the thickness (0 points, 2.36 mm in width and 1.63 mm in thickness, respectively).

Group B: Two, 3 and 7 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8170 to the degree of freedom of 10, which is significant at 1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=1.301X-4.680$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 1.301 mm wider, by becoming 1 unit thicker the thickness (0 points, 2.36 mm in width and 1.63 mm in thickness, respectively).

Whole: Three, 1, 3 and 14 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8336 to the degree of freedom of 19, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=1.049X-4.563$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 1.049 mm wider, by becoming 1 unit thicker the thickness (0 points, 2.36 mm in width and 1.63 mm in thickness, respectively).

10. L/W and L/T of husked grains

Group A: C.c. and l.r. of L/T on L/W in the same strain were calculated, and are shown in

Table 7. Five and 4 strains showed significances at 0.1% level and no significance even at 5% level, respectively. In the whole strains. c.c. was +0.9444 to the degree of freedom of 7, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=1.004X+1.346$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 1.004 larger, by becoming 1 unit larger the L/T (0 points, 2.55 in L/W and 3.90 in L/T, respectively).

Group B: Three, 4, 1 and 4 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.9401 to the degree of freedom of 10, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=2.124X+4.726$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 2.124 larger, by becoming 1 unit larger the L/T (0 points, 2.55 in L/W and 3.90 in L/T, respectively).

Whole: Eight, 4, 1 and 8 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8152 to the degree of freedom of 19, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=1.281X+4.420$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 1.281 larger, by becoming 1 unit larger the L/T (0 points, 2.55 in L/W and 3.90 in L/T, respectively).

11. L/W and W/T of husked grains

Group A: Six, 1 and 2 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.0739, showing no significance even at 5% level.

Group B: Six, 3 and 3 strains showed significances at 0.1%, 1% and 5% levels, respectively. In the other words, whole of strains showed significances. In the whole strains, c.c. was −0.9266 to the degree of freedom of 10, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; $Y=-1.645X-6.910$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 1.645 larger, by becoming 1 unit smaller the W/T (0 points, 2.55 in L/W and 1.37 in W/T, respectively).

Whole: Twelve, 3, 4 and 2 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.4639 to the degree of freedom of 19, which is significant at 5% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; $Y=-0.586X+2.091$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.586 larger, by becoming 1 unit smaller the W/T (0 points, 2.55 in L/W and 1.37 in W/T, respectively).

12. L/T and W/T of husked grains

Group A: Four, 3 and 2 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.6053, showing no significance even at 5% level.

Group B: Four, 3, 2 and 3 strains showed significances at 0.1%, 1% and 5% levels and no significance at 5% level, respectively. In the whole strains, c.c. was −0.9912 to the degree of freedom of 10, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/T, the smaller is the W/T. L.r. of L/T on W/T was calculated as follows; $Y=-0.700X+0.625$, where

Table 7. Correlation coefficient and linear regression of the three components of the husked grains; ratio of length to thickness (abbreviated as L/T, and so forth) on L/W, W/T on L/W, W/T on L/T

Strain No.	L/W and L/T		L/W and W/T		L/T and W/T	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.6531***	Y=0.714X+1.251	−0.5967***	Y=−0.337X+2.018	0.2091	—
2	0.6782***	Y=1.376X+0.091	−0.0276	—	0.7069***	Y=0.264X+0.702
3	0.8311***	Y=1.548X+0.235	−0.1108	—	0.4607*	Y=0.079X+1.190
4	0.2385	—	−0.5842***	Y=−0.391X+2.351	0.6468***	Y=0.297X+0.282
5	0.6330***	Y=0.852X+1.096	−0.4469*	Y=−0.249X+1.900	0.4055*	Y=0.168X+0.894
6	−0.2872	—	−0.7643***	Y=−0.704X+3.029	0.8346***	Y=0.526X−0.357
7	0.6243***	Y=0.583X+1.571	−0.7003***	Y=−0.356X+2.087	0.1161	—
8	−0.1422	—	−0.7772***	Y=−0.718X+2.841	0.7309***	Y=0.575X−0.247
9	0.2780	—	−0.7278***	Y=−0.373X+2.285	0.4528*	Y=0.235X+0.461
10	0.2881	—	−0.7158***	Y=−0.450X+2.513	0.4494*	Y=0.277X+0.347
11	0.2714	—	−0.3733*	Y=−0.170X+1.633	0.7169***	Y=0.258X+0.289
12	−0.0707	—	−0.7739***	Y=−0.793X+2.735	0.6832***	Y=0.606X−0.071
13	0.5269**	Y=0.605X+1.557	−0.4768**	Y=−0.169X+1.633	0.4927**	Y=0.152X+0.605
14	−0.1306	—	−0.6709***	Y=−0.520X+2.679	0.8193***	Y=0.428X−0.207
15	0.4646**	Y=0.536X+1.863	−0.5005**	Y=−0.186X+1.715	0.5331**	Y=0.172X+0.512
16	0.7872***	Y=0.688X+1.531	−0.6573***	Y=−0.157X+1.672	−0.0629	—
17	0.6709***	Y=0.452X+2.066	−0.7963***	Y=−0.225X+1.819	−0.0894	—
18	0.5180**	Y=0.810X+1.156	−0.3670*	Y=−0.222X+1.825	0.5931***	Y=0.229X+0.602
19	0.5062**	Y=0.569X+1.411	−0.5596**	Y=−0.338X+1.957	0.4191*	Y=0.225X+0.712
20	0.8279***	Y=0.864X+0.836	−0.4540*	Y=−0.099X+1.452	0.0706	—
21	0.4091*	Y=0.441X+2.138	−0.6046***	Y=−0.260X+1.932	0.4771**	Y=0.190X+0.544

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=28.

Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes 0.700 larger, by becoming 1 unit smaller the W/T (0 points, 3.90 in L/T and 1.37 in W/T, respectively).

Whole: Eight, 3, 5 and 5 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.0629, showing no significance even at 5% level.

Discussion

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

1. According to the classification noted by Matsuo[5], the strains used here can be divided into three groups; type A — strain No. 12, type B — strain Nos. 2, 5, 18, 19 and 21, type C — the remaining 15 strains (Fig. 1). In detail, strains belonging to Group A were classified into B and C types, and were distributed relatively in the middle portions in these two classifications, *i.e.*, showing the small inter-varietal variations. On the other hand, Sikkimese strains showed many types of A grains[1] (Fig. 2). Strains collected in Nepal were classified into A, B and C types for 29%, 11% and 60%, respectively[4]. The strains collected from higher elevations of NEFA (Assam region) resemble *japonica* types in view of many characters[7]. From the several informations mentioned

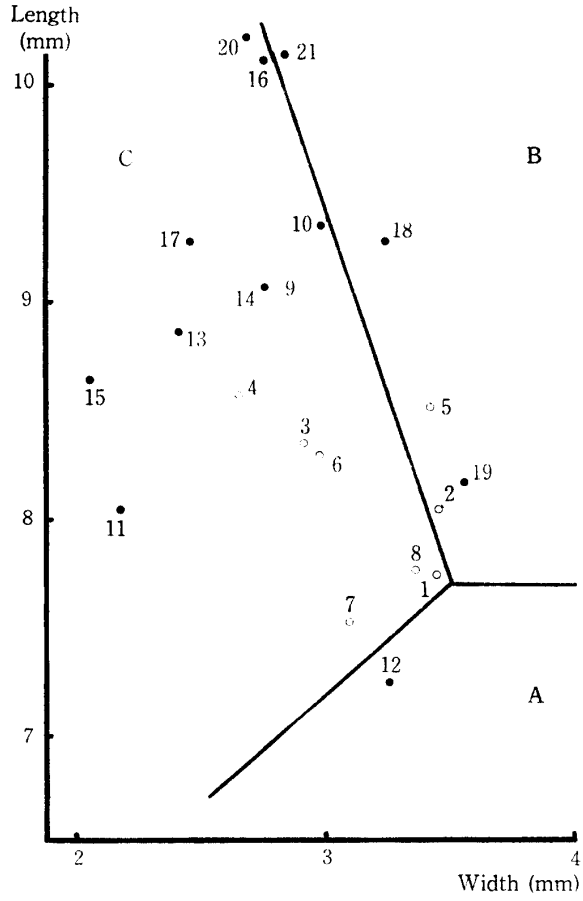

Fig. 1. Grouping of the grain types collected in India, according to tripartite classification. Open circle; Group A, filled circle; Group B.

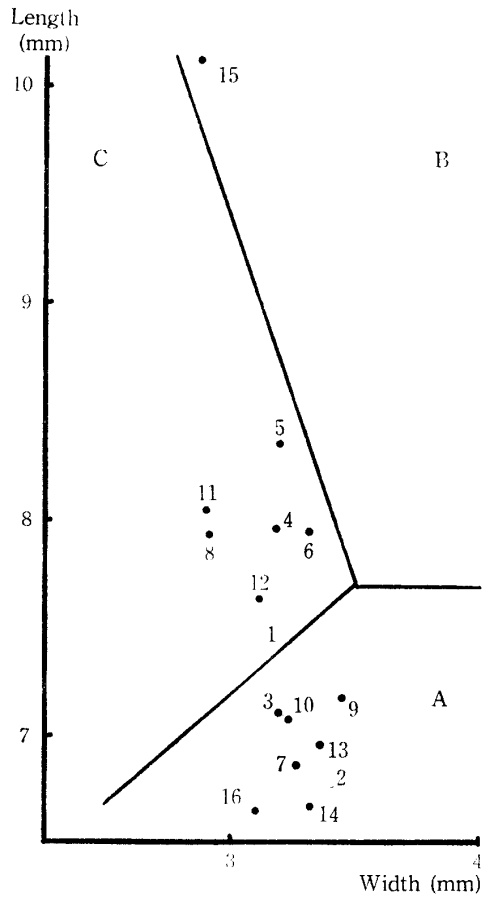

Fig. 2. Grouping of the grain types collected in Sikkim, according to tripartite classification. Open circle; testers, filled circle; Sikkimese strains.

above, it is to be concluded that the strains of Group A in the present paper might be belonging to a specific status in view of the geographical conditions.

2. Strains distributed in Calcutta Delta (strain Nos. 13–20) showed relatively large intra-group-variations in width, as well as large values in length (Fig. 1). As cultivation-conditions, *i.e.*, rainfall, flood damage, salt damage, etc., are of quite serious importance in these areas, it is presumable that varietal variations found in seed characters are adaptive for these environmental conditions[2].

3. Strain No. 21 collected in Kalimpong, northern part of West Bengal State, showed nearly the same values in seed characters as those of Champasari varieties[1], *i.e.*, length (10.11 mm and 10.16 mm in No. 21 and Champasari, respectively), width (2.83 mm and 2.89 mm in the same order). Champasari varieties were seen sporadically being cultivate in Sikkim[3]. Localities collected both strains are closely related one another. So, No. 21 may be assumed to be belonging to Champasari variety.

4. In comparison with Group A and Group B in view of group-averages, the following facts were ascertained. Averages of Group A were remarkably larger than those of Group B in W and W/T, and smaller in L and L/T, in both the unhusked and the husked grains, respectively. On the other hand, in T and L/T averages in both the groups were nearly the same. From these viewpoints, it was assumed that characters ascertained might be used as useful indices in analysing the varietal variations and variation-groups.

5. Correlation coefficients of the respective characters in the strain level were fixed to be significant in 59/108, 81/144 and 140/252 in Group A, Group B and through the whole, respectively, *i.e.*, 54.6%, 56.3% and 55.6%. In these viewpoints, no remarkable difference was noted between both the groups. In detail, however, some characteristics were found. Significant correlations in the strain level were accounted as follows:

Combination Nos.	Unhusked		Husked	
	1–3	4–6	7–9	10–12
Group A	9/27=33.3%	22/27=81.5%	9/27=33.3%	19/27=70.4%
Group B	10/36=27.8%	26/36=72.2%	16/36=44.4%	29/36=80.6%
Whole	19/63=30.2%	48/63=76.2%	25/63=39.7%	48/63=76.2%

From those data, it might be said that the combinations of 4–6 and 10–12 showed more significant strains than those of the remaining combinations. Barring those points, there was not any noticeable difference between both of the groups. Through the whole combinations (=12), 1 strain (No. 1), 2 (Nos. 3, 17), 1 (No. 5), 5 (Nos. 1, 14, 15, 19, 21), 9 (Nos. 2, 4, 6, 7, 9, 10, 11, 18, 20), 2 (Nos. 8, 16) and 1 (No. 12) showed significant correlations in 10, 9, 8, 7, 6, 5 and 4 combinations, respectively. Average value and its s.d. through the whole strains were found to be 6.62 ± 1.43.

In the whole strains through the respective groups, 2, 7 and 6 combinations showed significant relations in both the Group A, Group B and through the whole, respectively. It may be noted that Group A showed a few significant relations in comparison with Group B and the whole.

Summary

During the period from December in 1978 to January in 1979, the writer was sent to India for collecting the wild and the cultivated rices. Twenty one strains of *Oryza sativa* L. were collected during the trip. In this report, some records on morphological characters of the grains and some considerations on ecotypic differentiations have been described. Those were divided geographically into two groups, *i.e.*, Group A — Northeast India, Group B — West Bengal. The results obtained here were summarized as follows:

Lengths of the unhusked grains were ascertained to be 8.21 mm, 9.02 mm and 8.68 mm in Group A, Group B and through the whole in average values, respectively. Widths of the unhusked grains were ascertained to be 3.22 mm, 2.77 mm and 2.92 mm in the same order. Thicknesses of the unhusked grains were found to be 2.13 mm, 2.14 mm and 2.14 mm in the same order. L/W of the unhusked grains was noted to be 2.67, 3.36 and 3.06 in the same order. L/T of unhusked grains was noted to be 3.92, 4.25 and 4.11 in the same order. W/T of the unhusked grains was noted to be 1.47, 1.29 and 1.37 in the same order.

Lengths of the husked grains were noted to be 5.87 mm, 6.28 mm and 6.10 mm in the same order. Widths of the husked grains were noted to be 2.57 mm, 2.34 mm and 2.44 mm in the same order. Thicknesses of the husked grains were noted to be 1.88 mm, 1.93 mm and 1.91 mm in the same order. L/W of the husked grains were noted to be 2.36, 2.76 and 2.59 in the same order. L/T of husked grains was noted to be 3.27, 3.26 and 3.26 in the same order. W/T of husked grains was noted to be 1.38, 1.21 and 1.28 in the same order.

Concerning the correlation coefficients among the 12 character-combinations, 54.6%, 56.3% and 55.6% strains showed significant relations in Group A, Group B and through the whole, respectively.

Ecotypic differentiations were discussed basing on the values ascertained in 12 characters, 12 correlation-combinations and geographical locations.

References

1) Katayama, T. C.: Diallel cross experiment among Sikkimese varieties, indica and japonica testers of rice, *Oryza sativa* L. IV. Unhusked grains. *Mem. Fac. Agr. Kagoshima Univ.*, **12**, 1–39 (1976)
2) Katayama, T. C.: Distribution and some morphological characters of *Vigna* sp. in the Republic of Nauru. *Mem. Fac. Agr. Kagoshima Univ.*, **14**, 39–51 (1978)
3) Kihara, H. and Nakao, S.: The rice plant in Sikkim. *Seiken Zihô*, **11**, 45–54 (1960)
4) Kuroda, T. and Watabe, T.: Grain type and geographical distribution of cultivated rice collected in East Nepal (in Japanese). *Proc. Crop Sci. Soc. Japan*, **42**, Extra 1, 177–178 (1973)
5) Matsuo, T.: Genecological studies on the cultivated rice (in Japanese with English Summary). *Bull. Nat. Inst. Agr. Sci. Series D*, **3**, 1–111 (1952)
6) Morinaga, T.: Origin and geographical distribution of Japanese rice. *JARQ*, **3**(2), 1–5 (1968)
7) Sharma, S. D., Vellanki, J. M. R., Hakim, K. L. and Singh, R. K.: Primitive and current cultivars of rice in Assam — a rich source of valuable genes. *Curr. Sci.*, **40**, 126–128 (1971)
8) Shastry, S. V. S., Sharma, S. D., John, V. T. and Krishnaiah, K.: New sources of resistance to pests and diseases in the Assam rice collections. *Intn. Rice Commission Newsletter*, **29**(3), 1–16 (1971)