Mem. Fac. Agr. Kagoshima Univ., 21, 35-56, 1985

Morphological Characters of the Cultivated Rice Grains of Burma (I)

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Received for Publication August 29, 1984

Introduction

During the period from December in 1978 to February in 1979, four scientists including the author were sent to India and Burma for collection of two kinds of rice, one wild and the other cultivated, under a 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, 64 strains of cultivated rice distributed in large areas of Burma were directly collected in the field by the members of the party. The grains of these strains were used for the morphological studies.

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 northeastern parts of India have been considered to be one of the differentiation centres of rice in accordance with many investigations. Sharma *et al.*[7] carried out some systematic collections of current and primitive cultivars of rice in the northeastern parts of Inida.

Burma is located in the adjacent to regions mentioned above, and has a long history of rice cultivation. Through the cultural and agronomical exchanges between different human races, the whole rice varieties have been adopted by the respective farmers more than once. Naturally and artificially, the most adaptive and suitable strains for the respective environmental conditions, and the most desirable for the respective peoples have been selected and remained. Owing to the analyses of the native strains, the recommended strains in the respective localities are going to be made clear.

In the whole Burma, rice varieties showed very large varietal variations[8]. However, accumulation of complete data endorsed by discussions on these aspects has been unfortunately far from being perfect. At an opportunity in a thousand, the present study was made to search the varietal variations, taking these facts into considerations.

The author is most grateful to Dr. T. Takamura and Mr. K. Tanaka, who delivered him the materials to accomplish his task.

Materials and Methods

Sixty-four strains of rice cultivars, *Oryza sativa* L., collected in Burma were used in this experiment. They are listed up in Table 1. In this table, collection No., collection place, and detailed informations are mentioned.

Measurements were done for length, width and thickness of the unhusked and the husked grains.

Table 1. Locality and habitat of the cultivated rice, collected in Burma

Collection No.	Date	Place	Detailed locality, habitat, local name and remarks
1	Jan. 21	Myodwin	By bulk seeds. *Kaukkyi* var. Local name "Ngathein".
2	Jan. 21	Myodwin	Same locality as above.
3	Jan. 23	Kalagyaung	By bulk seeds. Local name "Zabani". Red grain.
4	Jan. 23	Kalagyaung	Local name "Machili" or "Makyuri".
5	Jan. 23	Kalagyaung	Local name "Shwewa".
6	Jan. 23	Kalagyaung	Local name "Manngasein".
7	Jan. 25	Maymyo	20 miles north from Maymyo. Local name "Kyundai". Good quality.
8	Jan. 25	Mandalay	3 miles east from Mandalay. Local name "Makyuri". High yielding variety.
9	Jan. 26	Tawma	Local name "Makyuri".
10	Jan. 26	Hanmyinhmo	Local name "Athey Zaba".
11	Jan. 27	Shawpin	By bulk seeds. Local name "Kaukhnyn", meaning glutinous rice.
12	Jan. 27	Shawpin	By bulk seeds. Local name "Shwepoe".
13	Jan. 27	Hlaing Tet	3 miles west from Hlaing Tet. By bulk seeds. Local name "Ngakyit Hmowe".
14	Jan. 27	Hlaing Tet	By bulk seeds. Local name "Yenet".
15	Jan. 28	Bodithat	Local name "Kunni". Glutinous rice. *Kaukkyi* variety.
16	Jan. 29	Nyaungshwe	1 mile north from Nyaungshwe. Local name "Lin Pan Chaw".
17	Jan. 29	Shwenyaung	By bulk seeds. Local name "Shan San", which is the common name for *Shannese* varieties, sticky rice.
18	Jan. 31	Yezin	Local name "Sitpwa (A)". Floating rice.
19	Jan. 31	Yezin	Local name "Sitpwa (B)". Floating rice.
20	Jan. 31	Yezin	Typical upland rice in Shan State. Local name "Khao Pa Pyu".
21	Feb. 1	Pyinmana	1 mile south from Pyinmana. Local name "Byat shwewa". High yielding variety.
22	Feb. 2	Alakyun	117 road miles from Rangoon. Local name "Seinthalei". High yielding variety.
23	Feb. 2	Barbugone	112 road miles from Rangoon. Local name "Taungpyan".
24	Feb. 3	Taukkyaunt	Local name "Kyaauknge". *Ngakyima* type variety.
25	Feb. 3	Taukkyaunt	Local name "Kalamazadauk". *Kauklat* variety. Called as good taste.
26	Feb. 3	Taukkyaunt	Local name "Ngakwephyu". *Kaukkyi* variety.
27	Feb. 3	Taukkyaunt	Local name "Kunni". Glutinous rice.
28	Feb. 3	Taukkyaunt	Local name "Shwepalin". Glutinous rice.
29	Feb. 3	Taukkyaunt	Local name "Shwetasote". *Kauklat* variety. High yielding variety.
30	Feb. 3	Taukkyaunt	Local name "Phokawgyi". *Kauklat* variety. High yielding variety.
31	Feb. 5	Kaukthalone	6 miles north from Mudon. Local name

Table 1. (Continued)

Collection No.	Date	Place	Detailed locality, habitat, local name and remarks
			unknown. By bulk seeds. *Kaukkyi* variety.
32	Feb. 7	Theindan	By bulk seeds. 6 miles north from Akyab. Local name "Sabazi". *Midon* type variety. Small grain. Shallow water rice.
33	Feb. 7	Theindan	Local name "Sabazi". *Midon* type variety. Large grain. Deep water rice.
34	Feb. 7	Theindan	Local name "Saome". *Ngasein* type variety. 150 days growing period.
35	Feb. 7	Theindan	Local name "Lonephyu". *Ngasein* type variety. 120 days growing period.
36	Feb. 7	Theindan	Local name "Mezi".
37	Feb. 7	Theindan	Local name "Kauk Nge" or "Kauk Shey". *Midon* type variety. 180 days growing period.
38	Feb. 7	Theindan	Local name "Arbaungni". By bulk seeds. *Midon* type variety. 150 days growing period.
39	Feb. 7	Kyamathauk	By bulk seeds. 6 miles north from Akyab. Local name "Ngayarpo". *Midon* type variety. 180 days growing period.
40	Feb. 7	Kyamathauk	Local name "Ngakwe". 195 days growing period.
41	Feb. 7	Kyamathauk	Local name "Tamakyi". *Midon* type variety. 180 days growing period.
42	Feb. 10	Myathintan	Local name "Yosein". 4 miles south from Bogalay. *Kaukkyi* variety. 200 days growing period. Deep water rice.
43	Feb. 10	Myathintan	Local name "Ngakywe". 180 days growing period.
44	Feb. 10	Myathintan	Local name "Migauk". *Ematha* type variety. 170 days growing period.
45	Feb. 11	Bogalay	Local name "Zayetkyi" or "Kamakyi". *Midon* type variety.
46	Feb. 11	Bogalay	Local name "Kaukkyi Hmwe".
47	Feb. 11	Bogalay	Local name "Zabar Net".
48	Feb. 11	Bogalay	Local name "Net Hla" or "Zabar Net Taungpyah".
49	Feb. 11	Bogalay	Local name "Tin Aw". *Kaukkyi* variety.
50	Feb. 11	Bogalay	Local name "Kyauk Hmwe".
51	Feb. 11	Bogalay	Local name "Taung Htake Pan".
52	Feb. 12	Myohaung	Local name "Pawsanbegya". *Kaukkyi* variety.
53	Feb. 12	Myohaung	Local name "Yathalayhnangar". Shallow water rice.
54	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Migauk". *Ematha* type variety. 170 days growing period.
55	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "C4–63", high yielding variety. 130–140 days growing period.
56	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Shwewatun", high yielding variety,

Table 1. (Continued)

Collection No.	Date	Place	Detailed locality, habitat, local name and remarks
			mutant of IR-5. 140 days growing period.
57	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Tasotepwa". *Ematha* type variety. 170 days growing period.
58	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Aung Zaya". *Ematha* type variety. 175–180 days growing period.
59	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Yagyaw Hne", high yielding variety, the same as IR-5. *Ngasein* type variety. 135–140 days growing period.
60	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name is unknown. *Ngasein* type variety. 170 days growing period.
61	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Pawsanbegya". Good quality. 200 days growing period.
62	Feb. 13	Bassein	By bulk seeds at West Bassein Rice Mill. Local name "Manuhari" or "Mashuri", high yielding variety. 135 days growing period.
63	Feb. 13	Bassein	Thayaungchaung Seed Farm. Local name "Pawsanyin". Good quality. 150 days growing period.
64	Feb. 13	Bassein	Thayaungchaung Seed Farm. Local name "Pawsanshwewar". 190–200 days growing period.

Thirty grains were used for the measurements. The measurements were done at the largest portion of the respective characters. 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 the unhusked and the 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; *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), c.c. (correlation coefficient), l.r. (linear regression), s.d. (standard deviations), UHG (unhusked grain), HG (husked grain).

Results

PART I. The respective characters

1. Lengths of UHG

The results are given in Table 2. Lengths for the individual grain level ranged from 10.80 mm (strain Nos. 17, 27 and 28) to 6.50 mm (No. 23). In the strain level, the longest (10.34 mm) was

Table 2. Some morphological characters of unhusked grains

Strain No.	Length (mm)	Width (mm)	Thickness (mm)	L/W	L/T	W/T
1	8.79±0.35	3.22±0.14	2.25±0.08	2.73±0.14	3.90±0.13	1.43±0.09
2	7.62±0.23	3.31±0.12	2.13±0.14	2.30±0.09	3.59±0.27	1.56±0.09
3	8.66±0.31	2.87±0.19	2.12±0.11	3.03±0.20	4.10±0.25	1.35±0.06
4	8.30±0.47	2.78±0.22	2.08±0.11	3.01±0.25	4.00±0.19	1.34±0.09
5	9.66±0.46	2.82±0.14	2.10±0.09	3.43±0.21	4.60±0.24	1.34±0.06
6	8.77±0.31	3.20±0.21	2.22±0.10	2.75±0.20	3.96±0.21	1.44±0.08
7	9.62±0.54	3.04±0.15	2.21±0.10	3.17±0.25	4.37±0.31	1.38±0.05
8	8.26±0.44	2.87±0.28	2.05±0.21	2.91±0.32	4.06±0.43	1.40±0.10
9	7.96±0.47	2.49±0.28	1.89±0.14	3.21±0.26	4.21±0.25	1.31±0.09
10	8.94±0.28	2.94±0.23	2.17±0.09	3.06±0.23	4.14±0.19	1.36±0.08
11	9.74±0.39	2.59±0.11	1.95±0.10	3.76±0.14	5.01±0.27	1.33±0.07
12	8.70±0.28	3.19±0.14	2.30±0.08	2.74±0.12	3.79±0.20	1.39±0.07
13	8.24±0.30	3.22±0.14	2.22±0.08	2.56±0.12	3.72±0.16	1.45±0.07
14	10.24±0.38	2.71±0.08	2.10±0.06	3.78±0.20	4.89±0.17	1.30±0.05
15	9.46±0.30	3.36±0.15	2.25±0.11	2.83±0.16	4.21±0.23	1.50±0.11
16	9.56±0.37	2.91±0.20	2.14±0.09	3.30±0.24	4.47±0.27	1.36±0.08
17	9.69±0.49	2.93±0.15	2.13±0.09	3.32±0.24	4.56±0.27	1.38±0.08
18	8.33±0.21	2.89±0.14	2.18±0.07	2.90±0.16	3.82±0.15	1.33±0.09
19	8.06±0.21	3.22±0.10	2.19±0.10	2.50±0.08	3.68±0.19	1.48±0.09
20	9.47±0.33	3.09±0.12	2.33±0.09	3.06±0.09	4.07±0.16	1.33±0.07
21	9.31±0.34	3.13±0.16	2.21±0.08	2.98±0.17	4.23±0.15	1.42±0.06
22	9.88±0.47	2.80±0.11	2.08±0.08	3.54±0.15	4.77±0.25	1.35±0.06
23	7.55±0.38	3.23±0.12	2.41±0.13	2.35±0.16	3.15±0.27	1.35±0.09
24	8.70±0.27	3.08±0.10	2.18±0.08	2.83±0.12	4.00±0.17	1.42±0.06
25	8.69±0.33	2.68±0.20	2.09±0.07	3.26±0.28	4.18±0.22	1.29±0.10
26	8.54±0.29	3.33±0.19	2.26±0.08	2.58±0.17	3.79±0.18	1.48±0.07
27	9.90±0.41	2.78±0.09	2.12±0.07	3.56±0.16	4.69±0.27	1.32±0.06
28	10.28±0.35	3.11±0.13	2.21±0.08	3.31±0.16	4.66±0.21	1.41±0.06
29	9.51±0.29	2.87±0.16	2.16±0.05	3.32±0.18	4.40±0.13	1.33±0.06
30	8.58±0.32	3.07±0.13	2.18±0.08	2.80±0.13	3.94±0.22	1.41±0.07
31	9.31±0.35	3.57±0.16	2.30±0.10	2.62±0.17	4.05±0.21	1.55±0.10
32	7.79±0.27	3.38±0.10	2.41±0.08	2.30±0.11	3.24±0.15	1.41±0.06
33	8.10±0.35	3.60±0.19	2.43±0.09	2.26±0.18	3.34±0.19	1.49±0.08
34	7.80±0.30	3.00±0.14	2.12±0.09	2.60±0.12	3.68±0.19	1.42±0.08
35	8.33±0.17	3.24±0.11	2.30±0.09	2.57±0.08	3.63±0.15	1.41±0.08
36	8.76±0.44	3.62±0.13	2.46±0.12	2.43±0.15	3.56±0.31	1.47±0.09
37	7.88±0.30	3.43±0.13	2.38±0.09	2.30±0.09	3.32±0.14	1.44±0.07
38	7.99±0.35	3.33±0.15	2.38±0.10	2.40±0.17	3.36±0.22	1.41±0.09
39	8.02±0.28	3.43±0.11	2.44±0.09	2.34±0.11	3.29±0.18	1.41±0.07
40	7.89±0.24	3.54±0.12	2.46±0.09	2.23±0.10	3.21±0.14	1.44±0.08
41	7.99±0.36	3.35±0.09	2.37±0.07	2.39±0.13	3.38±0.16	1.42±0.05
42	7.84±0.24	3.37±0.10	2.31±0.11	2.33±0.09	3.41±0.16	1.47±0.09
43	7.86±0.20	3.33±0.08	2.34±0.06	2.36±0.08	3.36±0.10	1.43±0.05
44	9.23±0.30	2.30±0.11	2.02±0.06	4.01±0.21	4.58±0.16	1.14±0.06
45	8.45±0.18	3.29±0.14	2.27±0.09	2.58±0.12	3.74±0.19	1.46±0.10

Table 2. (Continued)

Strain No.	Length (mm)	Width (mm)	Thickness (mm)	L/W	L/T	W/T
46	8.13±0.30	3.32±0.13	2.29±0.08	2.45±0.14	3.56±0.17	1.46±0.09
47	7.72±0.27	3.27±0.12	2.34±0.08	2.36±0.10	3.30±0.18	1.40±0.07
48	7.98±0.30	3.48±0.11	2.49±0.08	2.30±0.10	3.21±0.14	1.40±0.07
49	8.27±0.29	3.21±0.10	2.27±0.08	2.58±0.13	3.65±0.20	1.42±0.07
50	7.74±0.26	3.16±0.12	2.26±0.07	2.45±0.07	3.42±0.13	1.40±0.06
51	8.95±0.29	2.86±0.09	2.13±0.09	3.13±0.11	4.20±0.21	1.35±0.07
52	7.83±0.29	3.17±0.09	2.26±0.09	2.47±0.12	3.47±0.18	1.41±0.07
53	9.46±0.38	2.36±0.15	2.03±0.07	4.03±0.30	4.67±0.23	1.16±0.06
54	9.06±0.38	2.32±0.11	1.94±0.08	3.91±0.21	4.69±0.23	1.20±0.06
55	9.83±0.41	2.56±0.11	2.00±0.06	3.85±0.21	4.91±0.24	1.28±0.07
56	9.95±0.34	2.77±0.10	1.99±0.07	3.60±0.18	4.99±0.20	1.40±0.07
57	9.72±0.21	2.84±0.17	2.05±0.06	3.43±0.19	4.74±0.17	1.39±0.08
58	10.34±0.30	2.60±0.09	2.05±0.06	3.94±0.24	5.05±0.14	1.27±0.04
59	9.12±0.30	3.10±0.10	2.13±0.08	2.94±0.13	4.29±0.23	1.46±0.08
60	8.64±0.38	3.15±0.18	2.13±0.10	2.75±0.23	4.07±0.25	1.48±0.08
61	7.61±0.27	3.20±0.14	2.28±0.08	2.38±0.09	3.34±0.16	1.40±0.07
62	7.72±0.17	2.40±0.08	1.75±0.06	3.22±0.10	4.42±0.16	1.37±0.06
63	8.00±0.27	3.14±0.14	2.27±0.08	2.55±0.12	3.54±0.16	1.39±0.07
64	7.90±0.30	3.31±0.16	2.27±0.08	2.39±0.12	3.49±0.19	1.46±0.09

obtained in No. 58, followed by No. 28 (10.28 mm) and No. 14 (10.24 mm). The shortest (7.55 mm) was noted in No. 23, followed by No. 61 (7.61 mm) and No. 2 (7.62 mm). Average and its s.d. through the whole strains (=64 strains) were found to be 8.69±0.80. The s.d. of each strain, *i.e.*, showing the intra-population's variations, obtained were found to be 0.32±0.08.

2. Widths of UHG

Widths for the individual grain level ranged from 3.90 mm (Nos. 33 and 40) to 2.00 mm (No. 23). The latter was the same as in case of the L. In the strain level, the widest (3.62 mm) was obtained in No. 36, followed by No. 33 (3.60 mm) and No. 31 (3.57 mm). The narrowest (2.30 mm) was noted in No. 44, followed by No. 54 (2.32 mm) and No. 53 (2.36 mm). Average and its s.d. through the whole strains were found to be 3.06±0.33. S.d. of each strain were found to be 0.14 ±0.04.

3. Thicknesses of UHG

Thicknesses for the individual grain level ranged from 2.65 mm (Nos. 15, 36 and 40) to 1.65 mm (Nos. 2 and 62). In the strain level, thickest (2.49 mm) was obtained in No. 48, followed by Nos. 36 and 40 (2.46 mm). The thinnest (1.75 mm) was noted in No. 62, followed by No. 9 (1.89 mm) and No. 54 (1.94 mm). Average and its s.d. through the whole strains were found to be 2.20± 0.15. S.d. of each strain were found to be 0.09±0.02.

4. L/W of UHG

L/W for the individual grain level ranged from 4.46 (No. 53) to 1.91 (No. 23). The latter was the same as in cases of the L and W. In the strain level, the largest (4.03) was obtained in No. 53, followed by No. 44 (4.01) and No. 58 (3.94). The smallest (2.23) was noted in No. 40, followed by No. 33 (2.26) and Nos. 37 and 48 (2.30). Average and its s.d. through the whole strains were found to be 2.90±0.52. S.d. of each strain were found to be 0.16±0.06.

5. L/T of UHG

L/T for the individual grain level ranged from 5.65 (No. 11) to 2.75 (No. 23). The latter was the same as in cases of the L, W and L/W. In the strain level, the largest (5.05) was obtained in No. 58, which was the same as in case of the L, followed by No. 11 (5.01) and No. 56 (4.99). The smallest (3.15) was noted in No. 23, which was the same as in case of L, followed by Nos. 40 and 48 (3.21). Average and its s.d. through the whole strains were found to be 3.99±0.54. S.d. of each strain were found to be 0.20±0.06.

6. W/T of UHG

W/T for the individual grain level ranged from 1.85 (No. 2) to 1.05 (No. 44). In the strain level, the largest (1.56) was obtained in No. 2, followed by No. 31 (1.55) and No. 15 (1.50). The smallest (1.14) was noted in No. 44, which was the same as in case of the W, followed by No. 53 (1.16) and No. 54 (1.20). Average and its s.d. through the whole strains were found to be 1.39±0.08. S.d. of each strain were found to be 0.07±0.02.

7. Lengths of HG

The results are given in Table 3. Lengths for the individual grain level ranged from 7.90 mm (No. 14) to 4.55 mm (No. 23). The latter was the same as in cases of L, W, L/W and L/T of UHG.

Table 3. Some morphological characters of husked grains

Strain No.	Length (mm)	Width (mm)	Thickness (mm)	L/W	L/T	W/T
1	6.22±0.25	2.72±0.11	2.05±0.08	2.29±0.12	3.03±0.13	1.33±0.07
2	5.51±0.19	2.93±0.17	1.93±0.14	1.89±0.12	2.87±0.24	1.52±0.08
3	6.04±0.21	2.41±0.15	1.91±0.11	2.52±0.18	3.18±0.24	1.26±0.08
4	5.70±0.36	2.28±0.19	1.88±0.11	2.51±0.19	3.03±0.17	1.21±0.09
5	6.89±0.38	2.33±0.12	1.90±0.09	2.96±0.20	3.64±0.20	1.23±0.06
6	6.22±0.21	2.74±0.17	2.01±0.10	2.28±0.17	3.10±0.17	1.36±0.08
7	6.76±0.40	2.37±0.16	2.00±0.09	2.87±0.28	3.38±0.27	1.18±0.06
8	5.77±0.28	2.41±0.26	1.85±0.20	2.42±0.27	3.14±0.34	1.31±0.09
9	5.60±0.29	2.08±0.25	1.71±0.13	2.72±0.23	3.29±0.20	1.22±0.08
10	6.13±0.20	2.47±0.17	1.96±0.09	2.49±0.13	3.11±0.14	1.26±0.06
11	6.40±0.26	2.14±0.08	1.74±0.09	2.99±0.12	3.68±0.20	1.23±0.07
12	6.13±0.17	2.65±0.08	2.10±0.08	2.31±0.07	2.93±0.14	1.27±0.06
13	5.78±0.22	2.73±0.15	2.02±0.08	2.12±0.11	2.87±0.14	1.36±0.08
14	7.32±0.38	2.25±0.10	1.90±0.06	3.27±0.22	3.86±0.17	1.19±0.06
15	6.50±0.17	2.69±0.11	2.05±0.11	2.42±0.12	3.19±0.17	1.33±0.09
16	6.64±0.29	2.33±0.14	1.94±0.10	2.86±0.20	3.44±0.24	1.21±0.06
17	6.80±0.30	2.45±0.11	1.93±0.09	2.77±0.16	3.52±0.18	1.27±0.07
18	5.94±0.17	2.45±0.11	1.97±0.08	2.43±0.13	3.02±0.15	1.25±0.09
19	5.76±0.16	2.73±0.05	1.99±0.09	2.11±0.05	2.90±0.16	1.38±0.07
20	6.69±0.27	2.68±0.12	2.12±0.09	2.50±0.10	3.17±0.15	1.27±0.07

Table 3. (Continued)

Strain No.	Length (mm)	Width (mm)	Thickness (mm)	L/W	L/T	W/T
21	6.52±0.20	2.70±0.16	2.00±0.08	2.42±0.14	3.27±0.12	1.35±0.07
22	6.99±0.38	2.28±0.10	1.87±0.08	3.07±0.17	3.75±0.19	1.23±0.08
23	5.33±0.25	2.78±0.09	2.19±0.14	1.92±0.11	2.45±0.21	1.28±0.10
24	6.19±0.15	2.59±0.10	1.97±0.08	2.39±0.11	3.15±0.12	1.32±0.07
25	6.18±0.23	2.27±0.19	1.89±0.07	2.74±0.26	3.28±0.18	1.21±0.10
26	6.00±0.21	2.80±0.18	2.05±0.08	2.15±0.16	2.93±0.16	1.37±0.08
27	6.78±0.25	2.29±0.08	1.92±0.07	2.97±0.14	3.54±0.19	1.19±0.06
28	7.19±0.24	2.52±0.12	2.01±0.08	2.85±0.13	3.58±0.15	1.26±0.07
29	7.06±0.19	2.45±0.12	1.96±0.05	2.89±0.15	3.61±0.11	1.25±0.05
30	6.08±0.21	2.56±0.13	1.97±0.08	2.39±0.12	3.09±0.17	1.30±0.08
31	6.83±0.30	3.00±0.12	2.06±0.09	2.32±0.22	3.31±0.19	1.46±0.09
32	5.49±0.21	3.05±0.13	2.14±0.10	1.81±0.10	2.57±0.16	1.42±0.07
33	5.82±0.22	3.18±0.22	2.21±0.10	1.84±0.18	2.64±0.16	1.45±0.11
34	5.54±0.22	2.62±0.13	1.91±0.10	2.12±0.11	2.90±0.18	1.38±0.09
35	5.82±0.13	2.74±0.11	2.09±0.09	2.13±0.07	2.79±0.12	1.31±0.08
36	6.20±0.30	3.21±0.09	2.24±0.11	1.94±0.10	2.78±0.22	1.43±0.10
37	5.65±0.21	2.98±0.10	2.17±0.07	1.90±0.08	2.60±0.11	1.37±0.06
38	5.72±0.24	2.94±0.14	2.18±0.10	1.95±0.14	2.63±0.17	1.35±0.10
39	5.72±0.16	3.00±0.11	2.23±0.10	1.91±0.07	2.56±0.15	1.35±0.08
40	5.65±0.14	3.04±0.11	2.25±0.09	1.86±0.09	2.52±0.11	1.35±0.08
41	5.64±0.22	2.92±0.08	2.16±0.07	1.93±0.09	2.62±0.12	1.36±0.05
42	5.62±0.19	3.03±0.07	2.11±0.11	1.86±0.08	2.67±0.15	1.44±0.09
43	5.51±0.15	2.90±0.08	2.14±0.06	1.91±0.07	2.58±0.08	1.36±0.05
44	6.54±0.19	2.08±0.09	1.82±0.06	3.15±0.14	3.60±0.11	1.15±0.05
45	6.03±0.15	2.87±0.09	2.06±0.11	2.10±0.09	2.93±0.20	1.40±0.08
46	5.80±0.24	3.03±0.10	2.09±0.08	1.92±0.11	2.78±0.15	1.45±0.09
47	5.49±0.19	2.84±0.15	2.14±0.07	1.93±0.09	2.57±0.15	1.33±0.08
48	5.57±0.21	3.02±0.10	2.28±0.08	1.85±0.10	2.45±0.12	1.33±0.07
49	5.91±0.18	2.90±0.12	2.07±0.08	2.05±0.12	2.86±0.15	1.40±0.08
50	5.50±0.14	2.77±0.12	2.06±0.07	1.99±0.07	2.67±0.10	1.35±0.06
51	6.35±0.19	2.45±0.07	1.92±0.08	2.60±0.07	3.31±0.16	1.28±0.06
52	5.55±0.21	2.89±0.08	2.06±0.08	1.92±0.10	2.70±0.15	1.41±0.07
53	6.51±0.26	2.08±0.11	1.83±0.07	3.15±0.20	3.57±0.17	1.14±0.05
54	6.23±0.24	2.07±0.08	1.74±0.08	3.01±0.14	3.58±0.17	1.19±0.05
55	7.08±0.25	2.26±0.10	1.80±0.06	3.14±0.18	3.94±0.19	1.26±0.08
56	6.94±0.20	2.38±0.09	1.78±0.07	2.92±0.15	3.91±0.16	1.34±0.07
57	7.13±0.19	2.41±0.12	1.85±0.06	2.96±0.14	3.86±0.15	1.31±0.07
58	7.28±0.22	2.19±0.07	1.84±0.06	3.33±0.14	3.96±0.13	1.19±0.04
59	6.54±0.17	2.69±0.07	1.93±0.08	2.44±0.09	3.40±0.15	1.40±0.07
60	6.03±0.30	2.66±0.18	1.93±0.10	2.28±0.21	3.13±0.22	1.38±0.09
61	5.39±0.19	2.64±0.10	2.08±0.08	2.05±0.09	2.59±0.14	1.27±0.06
62	5.36±0.15	2.10±0.08	1.54±0.06	2.55±0.09	3.48±0.15	1.36±0.06
63	5.65±0.15	2.71±0.14	2.07±0.08	2.09±0.09	2.73±0.12	1.31±0.07
64	5.64±0.19	2.99±0.15	2.07±0.08	1.89±0.10	2.73±0.14	1.45±0.09

In the strain level, the longest (7.32 mm) was obtained in No. 14, followed by No. 58 (7.28 mm) and No. 28 (7.19 mm). The shortest (5.33 mm) was noted in No. 23, which was the same as in cases of L and L/T of UHG, followed by No. 62 (5.36 mm) and No. 61 (5.39 mm). Average and its s.d. through the whole strains were found to be 6.14±0.56. S.d. of each strain were found to be 0.23±0.06.

8. Widths of HG

Widths for the individual grain level ranged from 3.50 mm (No. 33) to 1.80 mm (No. 9). In the strain level, the widest (3.21 mm) was obtained in No. 36, which was the same as in case of W of UHG, followed by No. 33 (3.18 mm) and No. 32 (3.05 mm). The narrowest (2.07 mm) was noted in No. 54, followed by Nos. 9, 44 and 53 (2.08 mm). Average and its s.d. through the whole strains were found to be 2.62±0.31. S.d. of each strain were found to be 0.12±0.04.

9. Thicknesses of HG

Thicknesses for the individual grain level ranged from 2.45 mm (No. 40), which was the same as in cases of W and T of UHG, to 1.40 mm (Nos. 2 and 62), which was also the same as in case of T of UHG. In the strain level, the thickest (2.28 mm) was obtained in No. 48, which was the same as in case of T of UHG, followed by No. 40 (2.25 mm) and No. 36 (2.24 mm). The thinnest (1.54 mm) was noted in No. 62, which was the same as in case of T of UHG, followed by No. 9 (1.71 mm) and No. 54 (1.74 mm). Average and its s.d. through the whole strains were found to be 1.99±0.15. S.d. of each strain were found to be 0.09±0.02.

10. L/W of HG

L/W for the individual grain level ranged from 3.58 (No. 58) to 1.57 (No. 23). The latter was the same as in cases of L, W, L/W and L/T of UHG, and L of HG. In the strain level, the largest (3.33) was obtained in No. 58, which was the same as in cases of L and L/T of UHG, followed by No. 14 (3.27) and Nos. 44 and 53 (3.15). The smallest (1.81) was noted in No. 32, followed by No. 33 (1.84) and No. 48 (1.85). Average and its s.d. through the whole strains were found to be 2.40±0.44. S.d. of each strain were found to be 0.13±0.05.

11. L/T of HG

L/T for the individual grain level ranged from 4.47 (No. 55) to 2.08 (No. 23). The latter was the same as in cases of L, W, L/W and L/T of UHG, and L and L/W of HG. In strain level, the largest (3.96) was obtained in No. 58, which was the same as in cases of L and L/T of UHG, and L/W of HG, followed by No. 55 (3.94) and No. 56 (3.91). The smallest (2.45) was noted in Nos. 23 and 48, followed by No. 40 (2.52) and No. 39 (2.56). Average and its s.d. through the whole strains were found to be 3.11±0.43. S.d. of each strain were found to be 0.16±0.04.

12. W/T of HG

W/T for the individual grain level ranged from 1.70 (No. 33), which was the same as in cases of W of UHG and W of HG, to 1.00 (No. 38). In the strain level, the largest (1.52) was obtained in No. 2, which was the same as in case of W/T of UHG, followed by No. 31 (1.46) and Nos. 33 and 46 (1.45). The smallest (1.14) was noted in No. 53, followed by No. 44 (1.15) and No. 7 (1.18). Average and its s.d. through the whole strains were found to be 1.32±0.09. S.d. of each strain were found to be 0.07±0.02.

PART II. Relations between the two respective characters

1. Length and width of UHG

Correlation coefficient and linear regression of W on L in the same strains were calculated, and are shown in Table 4. Five, 4, 5 and 50 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 −0.4854 to the degree of freedom of 62, which is obviously significant at 0.1% level. Generally speaking, the longer is the L, the narrower is the W. L.r. of L on W was calculated as follows; Y=−0.197X+4.774, where Y and X indicate L and W, respectively. This formula indicates that the L becomes 0.197 mm longer, when the W becomes narrower by 1 degree.

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

Strain No.	Length and Width: Correlation coefficient	Length and Width: Linear regression	Length and Thickness: Correlation coefficient	Length and Thickness: Linear regression	Width and Thickness: Correlation coefficient	Width and Thickness: Linear regression
1	0.1886	—	0.5905***	Y=0.131X+1.105	−0.2321	—
2	0.3076	—	0.1578	—	0.5262**	Y=0.573X+0.233
3	0.2052	—	0.0103	—	0.6822***	Y=0.400X+0.973
4	0.2931	—	0.6111***	Y=0.139X+0.929	0.4580*	Y=0.227X+1.450
5	0.1054	—	0.2752	—	0.5856***	Y=0.384X+1.018
6	0.1157	—	0.0880	—	0.5299**	Y=0.247X+1.431
7	−0.1428	—	−0.0095	—	0.6755***	Y=0.460X+0.807
8	−0.0849	—	0.1149	—	0.7677***	Y=0.566X+0.427
9	0.6738***	Y=0.403X−0.722	0.6191***	Y=0.178X+0.476	0.8211***	Y=0.395X+0.912
10	0.2811	—	0.3724*	Y=0.125X+1.044	0.7515***	Y=0.301X+1.280
11	0.6101***	Y=0.169X+0.942	0.2933	—	0.4135*	Y=0.373X+0.981
12	0.3198	—	−0.1386	—	0.2882	—
13	0.3778*	Y=0.179X+1.749	0.2294	—	0.2465	—
14	−0.2733	—	0.4423*	Y=0.069X+1.394	0.1610	—
15	0.1031	—	0.1373	—	−0.4852**	Y=−0.354X+3.439
16	0.0953	—	−0.0451	—	0.5775***	Y=0.271X+1.354
17	−0.0457	—	0.1645	—	0.2448	—
18	−0.1012	—	0.0136	—	−0.4308*	Y=−0.220X+2.811
19	0.4110*	Y=0.186X+1.725	0.0235	—	−0.1386	—
20	0.7430***	Y=0.272X+0.514	0.5035**	Y=0.144X+0.964	0.2967	—
21	0.1595	—	0.5291**	Y=0.122X+1.067	0.5695**	Y=0.280X+1.330
22	0.5391**	Y=0.122X+1.588	0.2662	—	0.4354*	Y=0.318X+1.188
23	−0.1594	—	−0.1063	—	0.1010	—
24	0.1433	—	0.1991	—	0.2992	—
25	−0.1868	—	−0.0832	—	0.1991	—
26	0.0428	—	0.0359	—	0.4937**	Y=0.214X+1.545
27	0.2207	—	−0.1345	—	0.1950	—
28	0.2948	—	0.2271	—	0.3797*	Y=0.238X+1.471
29	0.2140	—	0.4413*	Y=0.082X+1.348	0.5145**	Y=0.173X+1.665
30	0.0936	—	−0.0497	—	0.2184	—

Table 4. (Continued)

31	−0.1987	—	0.1820	—	−0.3850*	Y=−0.231X+3.127
32	−0.0466	—	0.1312	—	0.3430	—
33	−0.2867	—	0.0713	—	0.3938*	Y=0.195X+1.722
34	0.4509*	Y=0.213X+1.338	0.2230	—	0.2766	—
35	0.5394**	Y=0.355X+0.285	0.2805	—	0.0306	—
36	0.0419	—	−0.4404*	Y=−0.123X+3.543	−0.0381	—
37	0.4656**	Y=0.197X+1.877	0.3051	—	0.0316	—
38	−0.1278	—	−0.1026	—	−0.1984	—
39	0.1114	—	−0.1830	—	−0.0195	—
40	−0.1248	—	0.1374	—	−0.1160	—
41	−0.1102	—	0.2040	—	0.0792	—
42	0.1571	—	0.2599	—	−0.3689*	Y=−0.414X+3.700
43	0.0119	—	0.3841*	Y=0.112X+1.456	−0.0474	—
44	0.1241	—	0.4043*	Y=0.084X+1.239	0.2911	—
45	0.1200	—	−0.0733	—	−0.3870*	Y=−0.267X+3.143
46	−0.1434	—	0.2282	—	−0.3790*	Y=−0.246X+3.103
47	0.3061	—	−0.2285	—	0.0255	—
48	0.2035	—	0.2913	—	−0.2049	—
49	−0.1001	—	−0.1925	—	0.0700	—
50	0.6932***	Y=0.338X+0.550	0.3170	—	0.2481	—
51	0.4149*	Y=0.124X+1.754	0.0138	—	−0.0764	—
52	−0.0343	—	0.1123	—	−0.0800	—
53	−0.2463	—	0.0583	—	0.6435***	Y=0.290X+1.348
54	0.2585	—	0.2840	—	0.4772**	Y=0.327X+1.175
55	0.1100	—	0.2157	—	0.0467	—
56	−0.0111	—	0.4889**	Y=0.098X+1.010	−0.1363	—
57	0.2444	—	0.0539	—	0.2296	—
58	0.0513	—	0.5613**	Y=0.111X+0.906	0.5461**	Y=0.371X+1.086
59	0.1125	—	−0.0795	—	−0.1503	—
60	−0.3343	—	0.0884	—	0.4615*	Y=0.267X+1.290
61	0.6270***	Y=0.334X+0.656	0.0982	—	0.2427	—
62	0.5131**	Y=0.258X+0.408	0.1408	—	0.1593	—
63	0.3628*	Y=0.197X+1.561	0.1399	—	0.2702	—
64	0.2855	—	−0.0689	—	0.0554	—

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

2. Length and thickness of UHG

Three, 4, 6 and 51 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 −0.4381 to the degree of freedom of 62, which is obviously significant at 0.1% level. Generally speaking, the longer is the L, the thinner is the T. L.r. of L on T was calculated as follows; Y=−0.082X+2.914, where Y and X indicate L and T, respectively. This formula indicates that the L becomes 0.082 mm longer, when the T becomes thinner by 1 degree.

3. Width and thickness of UHG

Eight, 8, 11 and 37 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 +0.8988 to the degree of freedom of 62, which is obviously significant at 0.1% level. Generally speaking, the wider is the W, the thicker is the T. L.r. of W on T was calculated as follows; Y=0.414X+0.934, where Y and X indicate W and T, respectively. This formula indicates that the W becomes 0.414 mm wider, when the T becomes thicker by 1 degree.

4. L/W and L/T of UHG

C.c. and l.r. of L/T on L/W in the same strains were calculated, and are shown in Table 5. Twenty-four, 12, 8 and 20 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 +0.9529 to the degree of freedom of 62, 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=0.998X+1.097, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.998 larger, when the L/T becomes larger by 1 degree.

Table 5. Correlation coefficient and linear regression of the three components of 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

	L/W and L/T		L/W and W/T		L/T and W/T	
Strain No.	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.0632	—	−0.8391***	Y=−0.501X+2.803	0.4854**	Y=0.318X+0.192
2	0.5878***	Y=0.166X−0.241	0.0266	—	0.8229***	Y=0.280X+0.554
3	0.7087***	Y=0.903X+1.361	−0.4638**	Y=−0.150X+1.810	0.2946	—
4	0.5177**	Y=0.402X+2.788	−0.8154***	Y=−0.310X+2.266	0.0603	—
5	0.7217***	Y=0.822X+1.784	−0.5622**	Y=−0.155X+1.875	0.1641	—
6	0.5968***	Y=0.652X+2.160	−0.6681***	Y=−0.284X+2.222	0.1962	—
7	0.8850***	Y=1.099X+0.882	−0.4255*	Y=−0.091X+1.666	0.0427	—
8	0.7972***	Y=1.072X+0.946	−0.3931*	Y=−0.118X+1.745	0.2384	—
9	0.5211**	Y=0.484X+2.661	−0.7072***	Y=−0.234X+2.062	0.1572	—
10	0.7093***	Y=0.578X+2.370	−0.8184***	Y=−0.270X+2.182	−0.1789	—
11	0.4119*	Y=0.799X+2.003	−0.2820	—	0.7183***	Y=0.177X+0.448
12	0.5139**	Y=0.849X+1.467	−0.3586	—	0.6147***	Y=0.204X+0.616
13	0.3843*	Y=0.543X+2.328	−0.5670**	Y=−0.345X+2.337	0.5401**	Y=0.232X+0.590
14	0.7133***	Y=0.628X+2.512	−0.7342***	Y=−0.178X+1.968	−0.0563	—
15	−0.1486	—	−0.7652***	Y=−0.530X+2.994	0.7436***	Y=0.364X−0.034
16	0.6752***	Y=0.744X+2.015	−0.6067***	Y=−0.190X+1.986	0.1726	—
17	0.6275***	Y=0.717X+2.179	−0.6057***	Y=−0.207X+2.063	0.2367	—
18	−0.0145	—	−0.7945***	Y=−0.454X+2.641	0.5864***	Y=0.353X−0.023
19	0.0832	—	−0.4568*	Y=−0.490X+2.700	0.8469***	Y=0.378X+0.084
20	−0.0598	—	−0.5975***	Y=−0.467X+2.762	0.8342***	Y=0.351X−0.097
21	0.6706***	Y=0.582X+2.489	−0.7825***	Y=−0.274X+2.238	−0.0673	—
22	0.6507***	Y=1.082X+0.939	−0.2113	—	0.6028***	Y=0.133X+0.715
23	0.6291***	Y=1.060X+0.662	−0.2820	—	0.5649**	Y=0.193X+0.738
24	0.5389**	Y=0.786X+1.784	−0.4703**	Y=−0.231X+2.072	0.4879**	Y=0.165X+0.760

Table 5. (Continued)

25	0.5719***	Y=0.449X+2.714	−0.8038***	Y=−0.278X+2.193	0.0215	—
26	0.6552***	Y=0.702X+1.984	−0.6694***	Y=−0.285X+2.212	0.1195	—
27	0.6635***	Y=1.075X+0.857	−0.2015	—	0.5952***	Y=0.125X+0.730
28	0.5054**	Y=0.648X+2.512	−0.5005**	Y=−0.195X+2.052	0.4835**	Y=0.147X+0.724
29	0.5376**	Y=0.384X+3.127	−0.8557***	Y=−0.290X+2.288	−0.0436	—
30	0.4971**	Y=0.856X+1.547	−0.3425	—	0.6428***	Y=0.215X+0.563
31	0.2152	—	−0.7601***	Y=−0.456X+2.741	0.4536*	Y=0.229X+0.622
32	0.6507***	Y=0.848X+1.298	−0.3083	—	0.4610*	Y=0.171X+0.857
33	0.7491***	Y=0.790X+1.561	−0.6833***	Y=−0.299X+2.161	−0.0318	—
34	0.3468	—	−0.4913**	Y=−0.331X+2.276	0.6455***	Y=0.268X+0.429
35	−0.1181	—	−0.6471***	Y=−0.655X+3.099	0.8310***	Y=0.432X−0.157
36	0.5982***	Y=1.271X+0.475	−0.0586	—	0.7273***	Y=0.217X+0.699
37	0.2556	—	−0.5403**	Y=−0.431X+2.436	0.6722***	Y=0.332X+0.343
38	0.4369*	Y=0.576X+1.978	−0.5630**	Y=−0.310X+2.149	0.4838**	Y=0.202X+0.726
39	0.5477**	Y=0.948X+1.075	−0.2945	—	0.6367***	Y=0.240X+0.618
40	0.3471	—	−0.6038***	Y=−0.453X+2.453	0.5356**	Y=0.291X+0.508
41	0.6975***	Y=0.844X+1.368	−0.5191**	Y=−0.211X+1.920	0.2409	—
42	−0.0393	—	−0.6361***	Y=−0.668X+3.022	0.7947***	Y=0.448X−0.060
43	0.4119*	Y=0.489X+2.210	−0.6707***	Y=−0.408X+2.391	0.3972*	Y=0.204X+0.743
44	0.4653**	Y=0.352X+3.170	−0.7641***	Y=−0.202X+1.954	0.1808	—
45	−0.1115	—	−0.6975***	Y=−0.599X+2.999	0.7858***	Y=0.420X−0.115
46	0.3264	—	−0.7159***	Y=−0.443X+2.542	0.3501	—
47	0.4734**	Y=0.827X+1.345	−0.3423	—	0.6637***	Y=0.266X+0.521
48	0.3392	—	−0.5851***	Y=−0.415X+2.354	0.5621**	Y=0.288X+0.475
49	0.6006***	Y=0.950X+1.201	−0.3522	—	0.5252**	Y=0.170X+0.794
50	0.1574	—	−0.5210**	Y=−0.462X+2.530	0.7589***	Y=0.365X+0.150
51	0.3272	—	−0.3297	—	0.7830***	Y=0.251X+0.292
52	0.5012**	Y=0.761X+1.589	−0.4295*	Y=−0.261X+2.049	0.5562**	Y=0.222X+0.636
53	0.8319***	Y=0.622X+2.155	−0.8167***	Y=−0.150X+1.765	−0.3662*	Y=−0.090X+1.580
54	0.6006***	Y=0.653X+2.140	−0.5400**	Y=−0.144X+1.763	0.3438	—
55	0.5000**	Y=0.550X+2.797	−0.6083***	Y=−0.196X+2.033	0.3810*	Y=0.112X+0.733
56	0.3788*	Y=0.428X+0.350	−0.7622***	Y=−0.322X+2.555	0.2332	—
57	0.2795	—	−0.7984***	Y=−0.334X+2.532	0.3521	—
58	0.3004	—	−0.4235*	Y=−0.066X+1.530	−0.1313	—
59	0.3766*	Y=0.692X+2.256	−0.3740*	Y=−0.230X+2.139	0.7071***	Y=0.237X+0.445
60	0.7502***	Y=0.810X+1.835	−0.6578***	Y=−0.234X+2.126	0.0000	—
61	0.3090	—	−0.4194*	Y=−0.349X+2.233	0.7311***	Y=0.324X+0.320
62	0.1161	—	−0.5754***	Y=−0.361X+2.535	0.7431***	Y=0.281X+0.128
63	0.4249*	Y=0.569X+2.085	−0.5652**	Y=−0.335X+2.239	0.4975**	Y=0.220X+0.608
64	0.4221*	Y=0.630X+1.980	−0.4912**	Y=−0.337X+2.266	0.5763***	Y=0.265X+0.535

d.f.=28

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

5. L/W and W/T of UHG

Thirty-one, 13, 7 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 −0.7726 to the degree of freedom of 62, 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=−0.118X+1.731, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.118 larger, when the W/T becomes smaller by 1 degree.

6. L/T and W/T of UHG

Twenty-four, 11, 5 and 24 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 −0.5506 to the degree of freedom of 62, 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=−0.080X+1.709, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes 0.080 larger, when the W/T becomes smaller by 1 degree.

7. Length and width of HG

C.c. and l.r. of width on length in the same strains were calculated, and are shown in Table 6. Three, 5, 11 and 45 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 −0.5073 to the degree of freedom of 62, which is obviously significant at 0.1% level. Generally speaking, the longer is the L, the narrower is the W. L.r. of L on W was calculated as follows; Y=−0.281X+4.346, where Y and X indicate

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

Strain No.	Length and Width: Correlation coefficient	Length and Width: Linear regression	Length and Thickness: Correlation coefficient	Length and Thickness: Linear regression	Width and Thickness: Correlation coefficient	Width and Thickness: Linear regression
1	0.1048	—	0.3552	—	−0.0984	—
2	0.3286	—	0.2445	—	0.7322***	Y=0.601X+0.171
3	0.0507	—	−0.2281	—	0.4821**	Y=0.358X+1.048
4	0.4588*	Y=0.236X+0.935	0.6061***	Y=0.184X+0.832	0.4405*	Y=0.261X+1.289
5	0.0867	—	0.3721*	Y=0.084X+1.315	0.4598*	Y=0.321X+1.149
6	0.0507	—	0.0754	—	0.4713**	Y=0.266X+1.286
7	−0.2103	—	−0.1837	—	0.6040***	Y=0.356X+1.162
8	0.0274	—	0.1537	—	0.7951***	Y=0.610X+0.382
9	0.5794***	Y=0.490X−0.670	0.5703***	Y=0.259X+0.255	0.8550***	Y=0.460X+0.752
10	0.6613***	Y=0.546X−0.874	0.6279***	Y=0.290X+0.186	0.6676***	Y=0.374X+1.040
11	0.5361**	Y=0.173X+1.034	0.3323	—	0.3624*	Y=0.407X+0.870
12	0.3656*	Y=0.165X+1.643	0.0194	—	0.3599	—
13	0.4012*	Y=0.264X+1.209	0.1487	—	0.2511	—
14	−0.0333	—	0.5258**	Y=0.086X+1.270	0.2017	—
15	0.0846	—	0.1988	—	−0.0833	—
16	0.0397	—	−0.0814	—	0.5512**	Y=0.377X+1.055
17	0.0948	—	0.3174	—	0.2508	—
18	−0.0656	—	0.0504	—	−0.4118*	Y=−0.291X+2.685
19	0.4954**	Y=0.160X+1.806	0.1158	—	0.0683	—
20	0.5685**	Y=0.248X+1.025	0.3287	—	0.2201	—

Table 6. (Continued)

21	0.2642	—	0.4423*	Y=0.172X+0.876	0.5436**	Y=0.264X+1.284
22	0.4309*	Y=0.115X+1.475	0.4519*	Y=0.091X+1.229	0.3717*	Y=0.282X+1.225
23	0.0300	—	−0.0264	—	0.0091	—
24	0.1371	—	0.3376	—	0.2418	—
25	−0.3097	—	−0.0373	—	0.1536	—
26	−0.0346	—	−0.0051	—	0.4568*	Y=0.209X+1.465
27	0.0886	—	−0.0876	—	−0.0876	—
28	0.4975**	Y=0.250X+0.727	0.3954*	Y=0.130X+1.080	0.2467	—
29	0.0718	—	0.3196	—	0.6230***	Y=0.286X+1.258
30	0.3775*	Y=0.225X+1.188	−0.0770	—	0.1027	—
31	−0.2156	—	0.0777	—	−0.1406	—
32	0.0214	—	−0.1790	—	0.4834**	Y=0.397X+0.933
33	−0.3779*	Y=−0.381X+5.399	−0.0809	—	0.2931	—
34	0.3337	—	0.1197	—	0.1926	—
35	0.4549*	Y=0.374X+0.560	0.3122	—	0.0458	—
36	0.2283	—	−0.3022	—	−0.0536	—
37	0.3130	—	0.2785	—	0.0673	—
38	−0.2264	—	0.0444	—	−0.3054	—
39	0.2966	—	−0.2425	—	−0.0420	—
40	−0.0890	—	0.2099	—	−0.1207	—
41	0.0663	—	0.2230	—	0.0811	—
42	−0.1899	—	0.2048	—	−0.3295	—
43	0.0555	—	0.3537	—	0.0956	—
44	0.2089	—	0.5128**	Y=0.166X+0.732	0.3325	—
45	−0.2735	—	−0.1345	—	0.1412	—
46	−0.1734	—	0.1663	—	−0.4361*	Y=−0.361X+3.179
47	0.4479*	Y=0.358X+0.869	−0.3262	—	0.0473	—
48	−0.0025	—	0.1508	—	−0.1640	—
49	−0.2314	—	−0.1566	—	0.0118	—
50	0.6033***	Y=0.526X−0.124	0.2311	—	0.3090	—
51	0.5286**	Y=0.198X+1.188	0.1834	—	0.0964	—
52	−0.1564	—	0.0911	—	−0.0959	—
53	−0.0461	—	0.3296	—	0.6680***	Y=0.461X+0.869
54	0.2593	—	0.2988	—	0.4866**	Y=0.471X+0.765
55	0.0816	—	0.1005	—	−0.1024	—
56	−0.0790	—	0.2983	—	−0.0193	—
57	0.2894	—	0.1502	—	0.1041	—
58	0.0619	—	0.4866**	Y=0.136X+0.850	0.4915**	Y=0.405X+0.954
59	0.0364	—	0.2359	—	0.0347	—
60	−0.2259	—	0.1010	—	0.4860**	Y=0.279X+1.191
61	0.3610*	Y=0.203X+1.543	−0.0610	—	0.1927	—
62	0.3623*	Y=0.182X+1.125	0.2817	—	0.2271	—
63	0.4475*	Y=0.407X+0.412	0.1723	—	0.2384	—
64	0.2626	—	0.0479	—	0.0608	—

d.f.=28

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

L and W, respectively. This formula indicates that the L becomes 0.281 mm longer, when the W becomes narrower by 1 degree.

8. Length and thickness of HG

Three, 3, 4 and 54 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 −0.3890 to the degree of freedom of 62, which is significant at 1% level. Generally speaking, the longer is the L, the thinner is the W. L.r. of L on T was calculated as follows; Y=−0.102X+2.619, where Y and X indicate L and T, respectively. This formula indicates that the L becomes 0.102 mm longer, when the T becomes thinner by 1 degree.

9. Width and thickness of HG

Seven, 8, 7 and 42 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 +0.8797 to the degree of freedom of 62, which is obviously significant at 0.1% level. Generally speaking, the wider is the W, the thicker is the T. L.r. of W on T was calculated as follows; Y=0.415X+0.977, where Y and X indicate W and T, respectively. This formula indicates that the W becomes 0.415 mm wider, when the T becomes thicker by 1 degree.

10. L/W and L/T of HG

C.c. and l.r. of L/T on L/W in the same strains were calculated, and are shown in Table 7.

Table 7. Correlation coefficient and linear regression of the three components of 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	0.3015	—	−0.7176***	Y=−0.427X+2.305	0.4437*	Y=0.250X+0.567
2	0.7796***	Y=0.157X−0.089	−0.0033	—	0.6207***	Y=0.198X+0.954
3	0.6117***	Y=0.844X+1.052	−0.3755*	Y=−0.169X+1.689	0.5014**	Y=0.164X+0.743
4	0.3214	—	−0.7753***	Y=−0.382X+2.168	0.3181	—
5	0.6836***	Y=0.684X+1.614	−0.6262***	Y=−0.197X+1.813	0.1372	—
6	0.5860***	Y=0.617X+1.690	−0.6331***	Y=−0.303X+2.052	0.2532	—
7	0.8575***	Y=0.832X+0.992	−0.5476**	Y=−0.126X+1.543	−0.0433	—
8	0.8262***	Y=0.103X+0.647	−0.3721*	Y=−0.121X+1.596	0.2063	—
9	0.7106***	Y=0.609X+1.639	−0.7447***	Y=−0.241X+1.871	−0.0727	—
10	0.3615*	Y=0.404X+2.103	−0.7249***	Y=−0.358X+2.149	0.2808	—
11	0.3308	—	−0.3477	—	0.7585***	Y=0.250X+0.316
12	0.5893***	Y=1.133X+0.310	−0.0248	—	0.7332***	Y=0.306X+0.372
13	0.3368	—	−0.6085***	Y=−0.416X+2.238	0.5399**	Y=0.288X+0.531
14	0.7175***	Y=0.562X+2.025	−0.7567***	Y=−0.193X+1.817	−0.0909	—
15	0.0807	—	−0.6455***	Y=−0.497X+2.526	0.6822***	Y=0.365X+0.164
16	0.7200***	Y=0.834X+1.059	−0.4301*	Y=−0.131X+1.582	0.3132	—
17	0.5271**	Y=0.594X+1.876	−0.5759***	Y=−0.249X+1.960	0.3785*	Y=0.145X+0.760
18	0.0450	—	−0.7260***	Y=−0.490X+2.437	0.6512***	Y=0.397X+0.050
19	0.3252	—	−0.1363	—	0.8906***	Y=0.396X+0.227
20	0.2409	—	−0.5141**	Y=−0.355X+2.157	0.6488***	Y=0.290X+0.350

Table 7. (Continued)

21	0.5380**	Y=0.471X+2.129	−0.7633***	Y=−0.360X+2.226	0.1294	—
22	0.5893***	Y=0.686X+1.638	−0.4075*	Y=−0.203X+1.856	0.3954*	Y=0.170X+0.597
23	0.4964**	Y=0.961X+0.605	−0.2442	—	0.7171***	Y=0.337X+0.453
24	0.2924	—	−0.6638***	Y=−0.413X+2.307	0.5196**	Y=0.275X+0.453
25	0.5492**	Y=0.367X+2.277	−0.8386***	Y=−0.323X+2.093	−0.0141	—
26	0.6344***	Y=0.618X+1.605	−0.6843***	Y=−0.340X+2.099	0.1251	—
27	0.5033**	Y=0.696X+1.477	−0.3997*	Y=−0.174X+1.711	0.5886***	Y=0.185X+0.537
28	0.1467	—	−0.6750***	Y=−0.368X+2.306	0.6275***	Y=0.298X+0.191
29	0.7027***	Y=0.521X+2.100	−0.8225***	Y=−0.259X+1.997	−0.1785	—
30	0.3226	—	−0.4727**	Y=−0.311X+2.041	0.6767***	Y=0.315X+0.326
31	0.4894**	Y=0.621X+1.897	−0.5710***	Y=−0.346X+2.246	0.4268*	Y=0.201X+0.790
32	0.7558***	Y=1.205X+0.390	−0.1694	—	0.5070**	Y=0.207X+0.893
33	0.6365***	Y=0.570X+1.594	−0.7569***	Y=−0.459X+2.290	0.0167	—
34	0.3449	—	−0.4511*	Y=−0.365X+2.145	0.6805***	Y=0.331X+0.409
35	−0.0857	—	−0.6557***	Y=−0.669X+2.739	0.8063***	Y=0.509X−0.108
36	0.6459***	Y=1.463X−0.055	0.0037	—	0.7386***	Y=0.318X+0.540
37	0.4004*	Y=0.577X+1.507	−0.5078**	Y=−0.418X+2.165	0.5824***	Y=0.333X+0.507
38	0.2933	—	−0.6448***	Y=−0.458X+2.246	0.5283**	Y=0.318X+0.515
39	0.3107	—	−0.3182	—	0.7912***	Y=0.438X+0.225
40	0.1380	—	−0.6861***	Y=−0.649X+2.563	0.6135***	Y=0.437X+0.254
41	0.6005***	Y=0.783X+1.102	−0.4439*	Y=−0.259X+1.860	0.3504	—
42	0.2337	—	−0.5091**	Y=−0.572X+2.501	0.7117***	Y=0.452X+0.232
43	0.4149*	Y=0.471X+1.681	−0.6593***	Y=−0.470X+2.254	0.4059*	Y=0.255X+0.701
44	0.4107*	Y=0.328X+2.568	−0.7594***	Y=−0.270X+1.997	0.2790	—
45	0.4922**	Y=1.026X+0.777	−0.2381	—	0.7266***	Y=0.296X+0.531
46	0.3595	—	−0.6292***	Y=−0.498X+2.410	0.4986**	Y=0.300X+0.619
47	0.1567	—	−0.6255***	Y=−0.554X+2.402	0.6538***	Y=0.371X+0.377
48	0.4357*	Y=0.537X+1.455	−0.5800***	Y=−0.427X+2.115	0.4774**	Y=0.285X+0.628
49	0.4631**	Y=0.589X+1.653	−0.5682**	Y=−0.376X+2.170	0.4630**	Y=0.241X+0.710
50	0.1887	—	−0.5771***	Y=−0.539X+2.416	0.6769***	Y=0.420X+0.225
51	0.2542	—	−0.3335	—	0.8249***	Y=0.326X+0.197
52	0.5087**	Y=0.787X+1.187	−0.4313*	Y=−0.323X+2.027	0.5558**	Y=0.269X+0.683
53	0.8252***	Y=0.675X+1.449	−0.7002***	Y=−0.155X+1.627	−0.1774	—
54	0.6025***	Y=0.766X+1.279	−0.3878*	Y=−0.141X+1.618	0.5020**	Y=0.144X+0.676
55	0.2836	—	−0.6666***	Y=−0.293X+2.180	0.5199**	Y=0.209X+0.438
56	0.2856	—	−0.7034***	Y=−0.358X+2.384	0.4650**	Y=0.219X+0.482
57	0.2117	—	−0.7445***	Y=−0.378X+2.424	0.4928**	Y=0.244X+0.363
58	0.6310***	Y=0.569X+2.065	−0.6608***	Y=−0.182X+1.798	0.1606	—
59	0.2429	—	−0.4665**	Y=−0.358X+2.268	0.7311***	Y=0.336X+0.255
60	0.7476***	Y=0.755X+1.405	−0.6575***	Y=−0.273X+2.000	0.0033	—
61	0.5038**	Y=0.807X+0.942	−0.3324	—	0.6331***	Y=0.288X+0.524
62	0.2686	—	−0.5338**	Y=−0.365X+2.296	0.6695***	Y=0.294X+0.340
63	0.1531	—	−0.6579***	Y=−0.520X+2.397	0.6332***	Y=0.398X+0.226
64	0.3101	—	−0.6030***	Y=−0.542X+2.473	0.5678**	Y=0.363X+0.458

d.f.=28

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

Twenty-one, 10, 5 and 28 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 +0.9566 to the degree of freedom of 62, 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; $Y=0.919X+0.907$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.919 larger, when the L/T becomes larger by 1 degree.

11. L/W and W/T of HG

Thirty-six, 8, 9 and 11 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 −0.7920 to the degree of freedom of 62, 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; $Y=-0.153X+1.680$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.153 larger, when the W/T becomes smaller by 1 degree.

12. L/T and W/T of HG

Twenty-six, 14, 5 and 19 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 −0.5873 to the degree of freedom of 62, 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; $Y=-0.118X+1.681$, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes 0.118 larger, when the W/T becomes smaller by 1 degree.

Discussion

Basing on the results obtained in the present experiments, 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 two groups; type B ··· 13 strains (20.3% of the whole strains) and type C ··· 51 strains (79.7% of the whole strains) (Fig. 1). Strains collected by the field survey in India[2] were classified into type A (0% in Group A, 8% in Group B and 5% in the whole), type B (22% in Group A, 25% in Group B and 24% in the whole) and type C (78% in Group A, 67% in Group B and 71% in the whole). Sikkimese strains showed a large number of types of A grains[1]. Strains collected in Nepal were classified into A, B and C types, with the ratio of 29%, 11% and 60%, respectively[4]. Strains collected in the higher elevations of NEFA (Assam region) resembled *japonica* types (=A type) in view of many characters[7]. Strains delivered from Chinsurah, West Bengal, India, were classified into type A (0% in Group A, 2% in Group B and 1% in the whole), type B (2% in Group A, 54% in Group B and 28% in the whole) and type C (98% in Group A, 44% in Group B and 71% in the whole)[3].

From the several informations mentioned above and others, it might be concluded that the constitutions of strains used in the present experiments were fixed to be resembling the strains distributed in the northeastern India, especially Assam and Sikkim regions. In other words, tight relationships between northeastern India and Burma were recognized and endorsed not only in agronomical, botanical but also in ethnological evidences. Further analyses in ethno-agronomical field should be done.

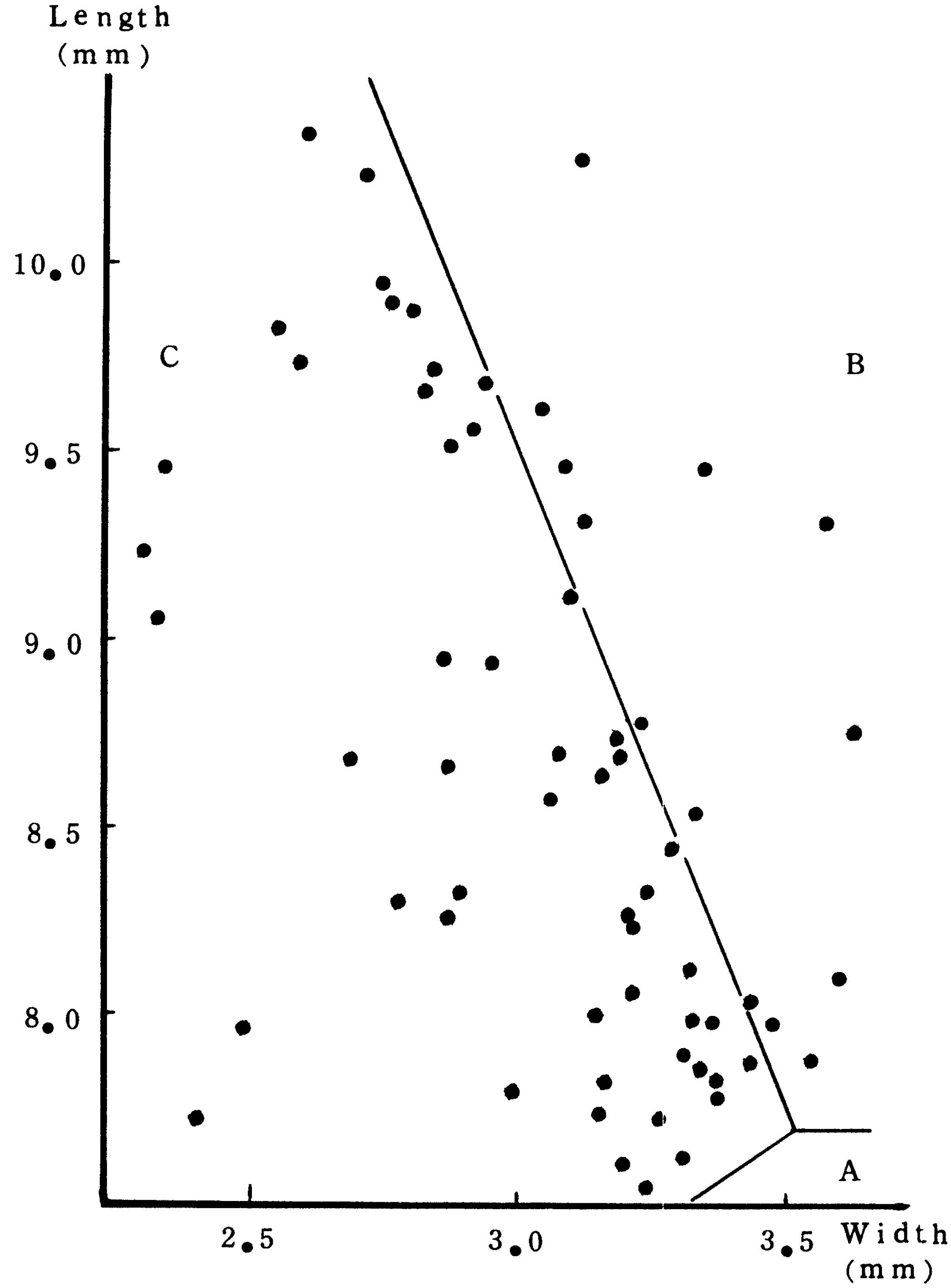

Fig. 1. Relation between length and width of unhusked grains in mm in accordance with tripartite classification. Vertical axis; length of grain, abscissa; width of grain.

2. The variations found in the whole strains (=64) in view of the strain level were recognized quite large, though they were comparatively smaller than those of the strains obtained in the field survey in the northeastern India[2] in the whole characters of UHG, except L and W/T, *i.e.*, L (10.34 mm~7.55 mm, 2.79 mm in the difference in the present experiment; 10.23 mm~7.24 mm, 2.99 mm in the field survey), W (3.62 mm~2.30 mm, 1.32 mm; 3.56 mm~2.05 mm, 1.51 mm in the same order), T (2.49 mm~1.75 mm, 0.74 mm; 2.56 mm~1.91 mm, 0.65 mm), L/W (4.03~2.23, 1.80; 4.24~2.24, 2.00), L/T (5.05~3.15, 1.90; 5.18~3.18, 2.00), W/T (1.56~1.14, 0.42; 1.43~1.15, 0.28). It was a particular phenomenon that the values of T and W/T of the present experiment were larger than those of the northeastern India. It may be assumed that the character of T is of large flexible and is quite affectable by environmental conditions in comparison with other characters.

3. Owing to the comparative studies carried out in type A, type B and type C in accordance with the tripartite classification[5], the following facts were ascertained. In type A, no strain showed anything. In type B, 13 strains, *i.e.*, strain Nos. 1, 7, 15, 20, 21, 26, 28, 31, 33, 36, 39, 40 and 48, showed the general features as follows; the values in L, W, T and W/T of UHG and HG were found to be larger than the average of the whole materials; the values of L/W and L/T of UHG and HG were found to be smaller than the average of the whole strains.

In type C, the remaining 51 strains showed the reversed results with that of the type B.

4. A lot of attempts were made for classifying the cultivated rice strains in accordance with the data obtained in grain morphology. Especially, tripartite classification has been adopted in many investigations. However, it was only for the UHG that it was applied. For the HG, there is no standard method for the classification. So, it was attempted for the first time in the present experiment (Fig. 2). Clear tendency was not ascertained here at the present time. As analysis and conclusion have left several points in question, further analyses are to be performed sincerely.

5. In the previous paper[3], 7 sets of strains in the larger and the smaller values were fixed to be in the same orders of strain numbers. They were found in the very cases of UHG itself, in HG itself and in comparison of UHG and HG. However, these phenomena were not found in comparison of UHG and HG in the present experiment. This fact might reasonably be regarded as a group specificity in Burmese rice varieties. In the smaller sets of values, the smallests of T (1.75 mm in UHG and 1.54 mm in HG) were noted in No. 62, followed by No. 9 (1.89 mm in UHG and 1.71 mm in HG) and No. 54 (1.94 mm in UHG and 1.74 mm in HG). These orders of strains were finally illustrated as $62<9<54$. These orders of strains were fixed to be the same as both in T of UHG and HG. These phenomena were found in other 2 cases, *i.e.*, ② $29<14=44=55=57=58=62$ in UHG and HG in view of s.d. in T···No. 29 (0.05 in UHG and HG), Nos. 14, 44, 55, 57, 58 and 62 (0.06 in UHG and HG) in the smaller sets; ③ $58<41=43$ in UHG and HG in view of s.d. of W/T··· No. 58 (0.04 in UHG and HG), Nos. 41 and 43 (0.05 in UHG and HG) in the smaller sets.

On the other hand, some sets of strains did not show the same orders, but showed the same combinations, which meant the same strain numbers regardless of its orders. For example, in W (UHG), the narrowest (2.30 mm) was noted in No. 44, followed by No. 54 (2.32 mm) and No. 53 (2.36 mm). These combinations of strains were finally illustrated as $44<54<53$. In W/T (UHG), the smallest (1.14) was noted in No. 44, followed by No. 53 (1.16) and No. 54 (1.20). These combinations of strains were finally illustrated as $44<53<54$. These combinations of strains were fixed to be the same as both in W and W/T of UHG, and illustrated as 44·53·54. The combinations of strains were after all constituted in 3 characters, *i.e.*, 44·53·54 in the smaller sets ··· W in UHG ($44<54<53$), W/T in UHG ($44<53<54$) and W in HG ($54<44=53$). These phenomena were found in other 5 cases, *i.e.*, ② 14·28·58 in the larger sets of L in UHG ($58>28>14$) and in HG ($14>58>28$); ③ 36·40·48 in the larger sets of T in UHG ($48>36=40$) and in HG ($48>40>36$); ④ 23·40·48 in the smaller sets of L/W in UHG ($23<40=48$) and in HG ($23=40<48$); ⑤ 19·35·43·50 in the smaller sets of L/W in view of s.d. in UHG ($50<19=35=43$) and in HG ($19<35=43=50$); ⑥ 28·43·50 in the smaller sets of L/T in view of s.d. in UHG ($43<28=50$) and in HG ($43<50<28$).

6. Correlation coefficients of the respective characters in the strain level were fixed to be significant in 374/768 cases, *i.e.*, 48.7%, through the whole strains. In detail, these were ascertained

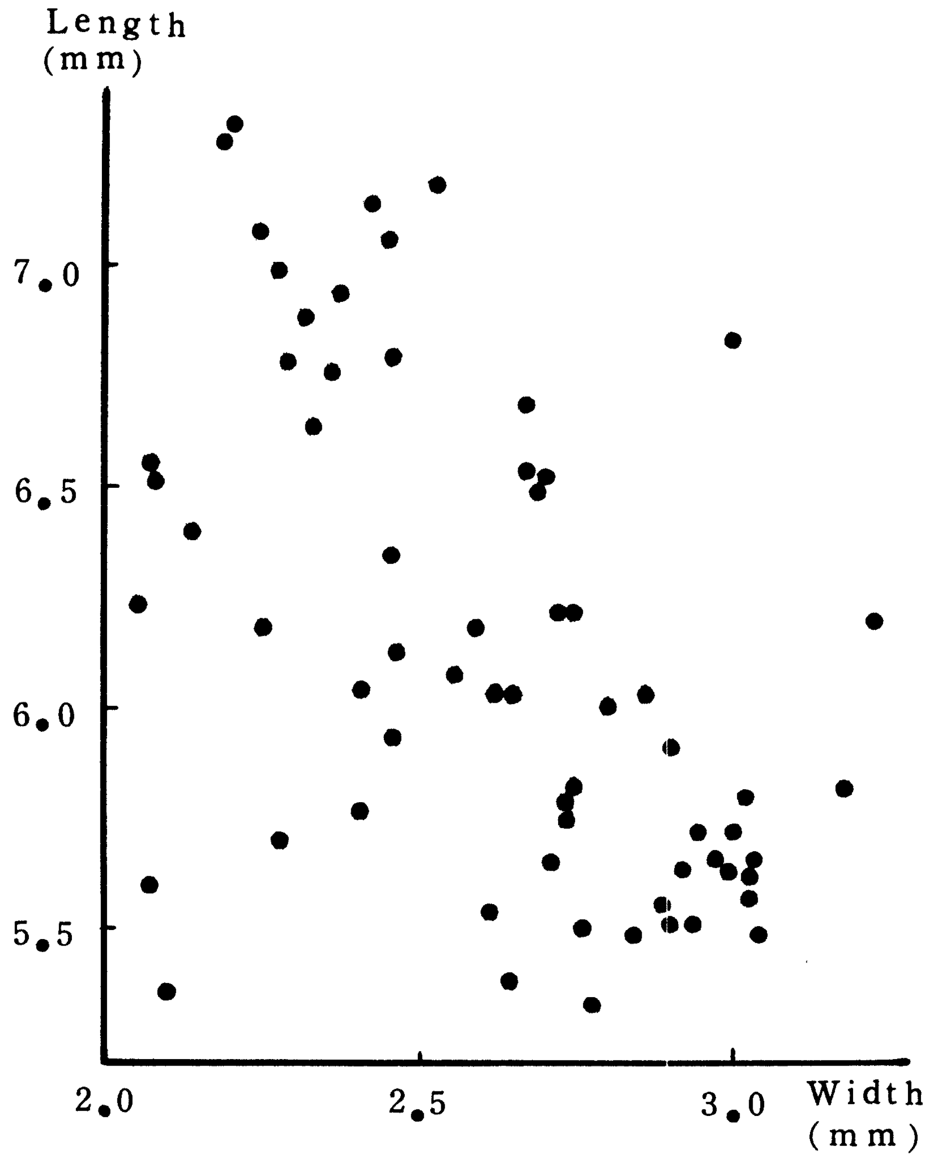

Fig. 2. Relation between length and width of husked grains in mm. Vertical axis; length of grain, abscissa; width of grain.

in the respective combination-groups as follows; group 1 (L and W, L and T, W and T in UHG) ··· 54/192=28.1%, group 2 (L/W and L/T, L/W and W/T, L/T and W/T in UHG) ··· 135/192=70.3%, group 3 (L and W, L and T, W and T in HG) ··· 51/192=26.6%, group 4 (L/W and L/T, L/W and W/T, L/T and W/T in HG) ··· 134/192=69.8%. From those data, it might be said that the combinations in the groups 2 and 4 showed more significant strains than those in the groups 1 and 3. Barring these points, there were not any noticeable differences between the present experiment and the northeastern India[2]. Although the whole combinations (=12), 2, 1, 3, 11, 18, 22, 5 and 2 strains showed significant correlations in 10, 9, 8, 7, 6, 5, 4 and 3 combinations, respectively. Average values and its s.d. through the whole strains were found to be 5.84±1.38.

Summary

During the collection trip in Burma from January to February in 1979 by the members of the party, 64 strains of the cultivated rice, *Oryza sativa* L., were collected in the field survey. They were

used for grain morphology. The results obtained here were summarized as follows:

Length, width, thickness, L/W, L/T and W/T of UHG were measured as 8.69 mm, 3.06 mm, 2.20 mm, 2.90, 3.99 and 1.39 in strain averages, respectively. Those of HG were measured as 6.14 mm, 2.62 mm, 1.99 mm, 2.40, 3.11 and 1.32 in strain averages, respectively.

Concerning the correlation coefficients among the 12 character-combinations, 374/768, 48.7% cases showed significant relations.

Basing on the data obtained in these characters, several patterns were found as strain specificities. In comparison with the data obtained in the present and the previous papers, ecotypic and varietal differentiations were discussed on the basis of the values ascertained in geographical localities.

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