

Distribution and Some Morphological Characters of the Wild Rice in the Northeastern India (III)

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Introduction

During the period from December in 1978 to January in 1979, the writer was sent to India for collection of the wild and cultivated rice. In this opportunity, 17 strains of wild rice were collected in the northeastern India, which was denoted here as follows; Assam, Meghalaya and most northern part of West Bengal. Geographical distribution of wild rice found was briefly illustrated in Figure 1 of the previous paper²⁾.

Gustchin¹⁾ reported that rice might have been originated on the slopes of Himalaya, both on the Indian and Chinese sides. Those areas have been considered to be one of the most important world centers for the origin and dispersal of the cultivated rice strains, *Oryza sativa* L.

It seems to be very important to keep in mind that morphological characteristics of the respective strains should be made clarified. In the previous papers, the habitat and the record of some morphological characters of unhusked and husked grains of the wild rice collected in the northeastern India²⁾ and variation ranges in 12 characters and some mutual relations³⁾ were reported. In the present paper, comparison of the unhusked and the husked grains for 12 characters and variation ranges in 12 characters were mainly described, in order to confirm the morphological characters of grains as well as to make clear the species specificities and the ecotypic differentiations of those grains. In the present state of affairs, it is not clear whether variation ranges could be used in analyzing strain differentiations or not. These characters were used in peanut⁵⁾. These were firstly used in rice³⁾. Following the previous paper, these characters were adopted in this paper for ascertaining variabilities and valuations. This methodology was undertaken as a new trial.

Strains showing relatively large or small values in the respective characters were, moreover, picked-up and grouped into "order" or "combination". These new techniques were also attempted to clear varietal variations.

Lastly, some comparisons with the data obtained in central India were extensively discussed for analyzing geographical specificities.

The records on the relations between the respective two characters and some considerations of wild rice in the whole India and in the world are going to be reported in the separate articles.

Materials and Methods

Seventeen strains of wild rice were collected in this trip, and they were used for morphological investigations. Their collection number, collection date, district and habitat were mentioned in Table 1 of the previous paper³⁾. Thirty grains were used for the measurement of each strain.

Comparative values for 6 characters (Table 1) were illustrated by the ratios of value in husked to value in unhusked grains in the respective characters. The following 6 characters of unhusked and husked grains (Table 2) were illustrated by the areas (= length \times width) and volumes (= length \times width \times thickness) for unhusked and husked grains, the area and volume quotients (= ratio of value of husked to value of unhusked grains). The whole data referring to the 12 characters were illustrated by the average value in the whole grains.

The variation ranges in 12 characters (Tables 3 and 4) were illustrated by the maximum, the minimum and the pure-range values in the whole grains.

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

Results

PART I. The repective characters

1. Quotient in length

The results are given in Table 1. The values for the individual grain level ranged from 0.78 (strain No. 10) to 0.63 (No. 15). In the strain level, the largest (0.74) was obtained in No. 16, followed by Nos. 7 and 10 (0.73). The smallest (0.69) was noted in No. 1, followed by Nos. 2 and 11 (0.70). Average and its s.d. through the whole strains were found to be 0.72 ± 0.01 . The s.d. of each strain, *i.e.*, showing intra-population's variations, obtained were found to be 0.02 ± 0.01 .

2. Quotient in width

The values for the individual grain level ranged from 0.95 (No. 5) to 0.74 (Nos. 1 and 6). In the strain level, the largest (0.90) was obtained in No. 5, followed by No. 15 (0.88) and No. 2 (0.87). The smallest (0.79) was noted in No. 6, followed by Nos. 12 and 13 (0.80). Average and its s.d. through the whole strains were found to be 0.84 ± 0.03 . S.d. of each strain were found to be 0.03 ± 0.01 .

3. Quotient in thickness

The values for the individual grain level ranged from 0.94 (No. 17) to 0.74 (No. 14). In the strain level, the largest (0.90) was obtained in Nos. 7, 10 and 17. The smallest (0.80) was noted in No. 13, followed by Nos. 8 and 14 (0.81). Average and its s.d. through the whole strains were found to be 0.85 ± 0.03 . S.d. of each strain were found to be 0.03 ± 0.01 .

4. Quotient in L/W

The values for the individual grain level ranged from 0.98 (Nos. 6 and 12) to 0.73 (No. 15). In the strain level, the largest (0.92) was obtained in No. 12, followed by No. 6 (0.91) and No. 13 (0.90). The smallest (0.80) was noted in No. 5, followed by Nos. 2 and 15 (0.81). Average and its s.d. through the whole strains were found to be 0.86 ± 0.04 . S.d. of each strain were found to be 0.03 ± 0.01 .

5. Quotient in L/T

The values for the individual grain level ranged from 1.04 (No. 12) to 0.74 (Nos. 15 and 17). In the strain level, the largest (0.90) was obtained in No. 13, followed by No. 8 (0.89) and No. 6

Table 1. Comparative table on some morphological characters of unhusked and husked grains of the wild species; illustrating by the ratios of value in husked to value in unhusked grains in the respective characters

| Strain No. | Length | Width | Thickness | L/W | L/T | W/T |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | 0.69±0.01 | 0.79±0.03 | 0.83±0.03 | 0.88±0.04 | 0.84±0.03 | 0.95±0.04 |
| 2 | 0.70±0.02 | 0.87±0.03 | 0.87±0.01 | 0.81±0.01 | 0.81±0.03 | 1.01±0.04 |
| 3 | 0.72±0.02 | 0.85±0.03 | 0.85±0.04 | 0.84±0.04 | 0.85±0.05 | 1.01±0.04 |
| 4 | 0.72±0.02 | 0.86±0.01 | 0.83±0.03 | 0.84±0.02 | 0.87±0.04 | 1.03±0.04 |
| 5 | 0.72±0.03 | 0.90±0.02 | 0.85±0.03 | 0.80±0.03 | 0.85±0.05 | 1.07±0.04 |
| 6 | 0.72±0.01 | 0.79±0.03 | 0.82±0.02 | 0.91±0.04 | 0.88±0.03 | 0.96±0.05 |
| 7 | 0.73±0.02 | 0.85±0.02 | 0.90±0.01 | 0.86±0.03 | 0.81±0.03 | 0.95±0.03 |
| 8 | 0.72±0.02 | 0.84±0.03 | 0.81±0.02 | 0.85±0.04 | 0.89±0.04 | 1.04±0.04 |
| 9 | 0.72±0.01 | 0.85±0.02 | 0.83±0.03 | 0.84±0.02 | 0.86±0.02 | 1.03±0.03 |
| 10 | 0.73±0.02 | 0.86±0.03 | 0.90±0.02 | 0.85±0.04 | 0.81±0.03 | 0.96±0.03 |
| 11 | 0.70±0.01 | 0.86±0.06 | 0.83±0.02 | 0.83±0.06 | 0.85±0.03 | 1.02±0.10 |
| 12 | 0.72±0.02 | 0.80±0.02 | 0.83±0.05 | 0.92±0.03 | 0.87±0.06 | 0.96±0.07 |
| 13 | 0.72±0.02 | 0.80±0.02 | 0.80±0.03 | 0.90±0.02 | 0.90±0.04 | 1.00±0.04 |
| 14 | 0.71±0.01 | 0.81±0.03 | 0.81±0.02 | 0.88±0.03 | 0.87±0.04 | 0.99±0.05 |
| 15 | 0.71±0.03 | 0.88±0.03 | 0.84±0.04 | 0.81±0.04 | 0.85±0.05 | 1.05±0.06 |
| 16 | 0.74±0.02 | 0.86±0.02 | 0.88±0.02 | 0.86±0.02 | 0.84±0.03 | 0.97±0.04 |
| 17 | 0.72±0.01 | 0.83±0.02 | 0.90±0.02 | 0.88±0.03 | 0.81±0.03 | 0.93±0.04 |

(0.88). The smallest (0.81) was obtained in Nos. 2, 7 and 17. Average and its s.d. through the whole strains were found to be 0.85 ± 0.03 . S.d. of each strain were found to be 0.04 ± 0.01 .

6. Quotient in W/T

The values for the individual grain level ranged from 1.15 (No. 11) to 0.86 (Nos. 12 and 17). In the strain level, the largest (1.07) was obtained in No. 5, which was the same as in case of the width, followed by No. 15 (1.05) and No. 8 (1.04). These strain-order (=No. 5 and No. 15) was the same as in case of the width. The smallest (0.93) was noted in No. 17, followed by Nos. 1 and 7 (0.95). Average and its s.d. through the whole strains were found to be 1.00 ± 0.04 . S.d. of each strain were found to be 0.05 ± 0.02 .

7. Area in unhusked grains

The results are given in Table 2. The practical values for the individual grain level ranged from 26.32 mm² (No. 17) to 12.50 mm² (No. 14). In the strain level, the widest (24.14 mm²) was obtained in No. 17, followed by No. 10 (21.14 mm²) and No. 7 (20.76 mm²). These combinations of strains were found to be the same as in case of the thickness. The narrowest (14.89 mm²) was noted in No. 14, followed by No. 15 (14.97 mm²) and No. 9 (15.14 mm²). Average and its s.d. through the whole strains were found to be 16.97 ± 2.70 .

The largest (2.21) of s.d. was obtained in No. 1, followed by No. 10 (2.18) and No. 12 (1.72). It was noted that the values were peculiarly large in Nos. 1 and 10. The smallest (0.72) was noted in No. 2, followed by No. 4 (0.82) and No. 6 (1.05). S.d. of each strain were found to be 1.32 ± 0.42 .

8. Volume in unhusked grains

The practical values for the individual grain level ranged from 58.66 mm³ (No. 10) to 18.53 mm³

Table 2. Six characters of unhusked and husked grains; illustrating by the area (= length \times width), the volume (= length \times width \times thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains)

| Strain No. | Unhusked | | Husked | | Quotient | |
|------------|-------------------------|---------------------------|-------------------------|---------------------------|-----------------|-----------------|
| | Area (mm ²) | Volume (mm ³) | Area (mm ²) | Volume (mm ³) | Area | Volume |
| 1 | 17.05 \pm 2.21 | 27.47 \pm 4.96 | 9.32 \pm 1.26 | 12.53 \pm 2.83 | 0.55 \pm 0.02 | 0.46 \pm 0.03 |
| 2 | 16.21 \pm 0.72 | 25.45 \pm 2.32 | 9.92 \pm 0.54 | 13.49 \pm 1.55 | 0.61 \pm 0.04 | 0.53 \pm 0.03 |
| 3 | 15.27 \pm 1.22 | 24.27 \pm 2.85 | 9.27 \pm 0.78 | 12.56 \pm 1.99 | 0.61 \pm 0.02 | 0.52 \pm 0.03 |
| 4 | 15.55 \pm 0.82 | 24.38 \pm 2.44 | 9.59 \pm 0.59 | 12.50 \pm 1.05 | 0.62 \pm 0.02 | 0.51 \pm 0.03 |
| 5 | 15.29 \pm 1.24 | 25.30 \pm 2.58 | 9.86 \pm 0.82 | 13.79 \pm 1.50 | 0.65 \pm 0.03 | 0.55 \pm 0.03 |
| 6 | 15.73 \pm 1.05 | 25.41 \pm 1.88 | 8.91 \pm 0.77 | 11.88 \pm 1.18 | 0.57 \pm 0.02 | 0.47 \pm 0.03 |
| 7 | 20.76 \pm 1.74 | 42.63 \pm 4.99 | 12.85 \pm 1.08 | 23.63 \pm 2.94 | 0.62 \pm 0.02 | 0.56 \pm 0.02 |
| 8 | 15.89 \pm 1.38 | 26.25 \pm 2.16 | 9.55 \pm 0.64 | 12.79 \pm 0.98 | 0.60 \pm 0.02 | 0.49 \pm 0.03 |
| 9 | 15.14 \pm 1.13 | 24.97 \pm 2.71 | 9.42 \pm 0.56 | 12.70 \pm 1.45 | 0.61 \pm 0.02 | 0.51 \pm 0.03 |
| 10 | 21.14 \pm 2.18 | 44.68 \pm 6.87 | 13.19 \pm 1.19 | 24.90 \pm 3.29 | 0.63 \pm 0.03 | 0.56 \pm 0.03 |
| 11 | 15.70 \pm 1.11 | 25.25 \pm 2.42 | 9.51 \pm 1.01 | 12.68 \pm 1.60 | 0.63 \pm 0.10 | 0.52 \pm 0.04 |
| 12 | 15.63 \pm 1.72 | 25.02 \pm 3.20 | 8.93 \pm 0.66 | 11.90 \pm 1.61 | 0.57 \pm 0.03 | 0.48 \pm 0.04 |
| 13 | 15.70 \pm 1.14 | 25.81 \pm 2.02 | 9.08 \pm 0.82 | 11.97 \pm 1.29 | 0.58 \pm 0.02 | 0.46 \pm 0.02 |
| 14 | 14.89 \pm 1.22 | 25.20 \pm 2.70 | 8.43 \pm 0.83 | 11.60 \pm 1.46 | 0.57 \pm 0.02 | 0.46 \pm 0.02 |
| 15 | 14.97 \pm 1.08 | 24.70 \pm 2.00 | 9.24 \pm 0.58 | 12.77 \pm 0.96 | 0.62 \pm 0.03 | 0.52 \pm 0.04 |
| 16 | 19.40 \pm 1.08 | 35.05 \pm 2.79 | 11.94 \pm 0.27 | 19.35 \pm 1.64 | 0.63 \pm 0.03 | 0.55 \pm 0.02 |
| 17 | 24.14 \pm 1.32 | 42.97 \pm 4.62 | 14.38 \pm 0.86 | 22.85 \pm 2.46 | 0.60 \pm 0.02 | 0.53 \pm 0.02 |

(No. 12). In the strain level, the largest (44.68 mm³) was obtained in No. 10, followed by No. 17 (42.97 mm³) and No. 7 (42.63 mm³). These combinations of strains were found to be the same as in cases of the thickness and the area of UHG. It was noted that the values were peculiarly large in Nos. 7, 10 and 17. The smallest (24.27 mm³) was noted in No. 3, followed by No. 4 (24.38 mm³) and No. 15 (24.70 mm³). Average and its s.d. through the whole strains were found to be 29.11 \pm 7.27.

The largest (6.87) of s.d. was obtained in No. 10, followed by No. 7 (4.99) and No. 1 (4.96). It was noted that the value was peculiarly large in No. 10. The smallest (1.88) was noted in No. 6, followed by No. 15 (2.00) and No. 13 (2.02). S.d. of each strain were found to be 3.15 \pm 1.38.

9. Area in husked grains

The practical values for the individual grain level ranged from 15.87 mm² (No. 17) to 7.25 mm² (No. 11). In the strain level, the widest (14.38 mm²) was obtained in No. 17, followed by No. 10 (13.19 mm²) and No. 7 (12.85 mm²). The combinations of strains were found to be the same as in cases of the thickness, area and volume of UHG. Moreover, these orders of strains were found to be the same as in case of the area of UHG. The narrowest (8.43 mm²) was noted in No. 14, which was the same as in case of the area of UHG, followed by No. 6 (8.91 mm²) and No. 12 (8.93 mm²). Average and its s.d. through the whole strains were found to be 10.20 \pm 1.75.

The largest (1.26) of s.d. was obtained in No. 1, which was the same as in case of the area of UHG, followed by No. 10 (1.19) and No. 7 (1.08). These combinations of strains were found to be the same as in case of the volume of UHG. The smallest (0.27) was noted in No. 16, followed by No. 2 (0.54) and No. 9 (0.56). It was noted that value was peculiarly small in No. 16. S.d. of each strain were found to be 0.78 \pm 0.25.

10. Volume in husked grains

The practical values for the individual grain level ranged from 31.55 mm³ (No. 10) to 7.84 mm³ (No. 12). In the strain level, the largest (24.90 mm³) was obtained in No. 10, followed by No. 7 (23.63 mm³) and No. 17 (22.85 mm³). These combinations of strains were found to be the same as in cases of the thickness, the area and volume of UHG, and the area of HG. In other words, these combinations were quite the same as in 4 cases, *i.e.*, the areas and volumes of UHG and HG. It was noted that the values were peculiarly large in Nos. 7, 10 and 17. The smallest (11.60 mm³) was noted in No. 14, followed by No. 6 (11.88 mm³) and No. 12 (11.90 mm³). These orders of strains were found to be the same as in case of the area of HG. Average and its s.d. through the whole strains were found to be 14.94 ± 4.58 .

The largest (3.29) of s.d. was obtained in No. 10, followed by No. 7 (2.94) and No. 1 (2.83). These orders and combinations of strains were found to be the same as in cases of the volume of UHG and of area of HG, respectively. It was noted that the value was peculiarly large in No. 10, which was also the same as in cases of the area and volume of UHG. The smallest (0.96) was noted in No. 15, followed by No. 8 (0.98) and No. 4 (1.05). S.d. of each strain were found to be 1.75 ± 0.71 .

11. Quotient in areas

The values for the individual grain level ranged from 0.72 (No. 5) to 0.53 (Nos. 1 and 12). In the strain level, the largest (0.65) was obtained in No. 5, which was the same as in cases of the width and W/T, followed by Nos. 10, 11 and 16 (0.63). The smallest (0.55) was noted in No. 1, which was the same as in case of the length, followed by Nos. 6, 12 and 14 (0.57). Average and its s.d. through the whole strains were found to be 0.60 ± 0.03 . S.d. of each strain were found to be 0.03 ± 0.02 .

12. Quotient in volumes

The values for the individual grain level ranged from 0.61 (Nos. 5 and 10) to 0.39 (No. 12). In the strain level, the largest (0.56) was obtained in Nos. 7 and 10, followed by Nos. 5 and 16 (0.55). The smallest (0.46) was noted in Nos. 1, 13 and 14. Average and its s.d. through the whole strains were found to be 0.51 ± 0.04 . S.d. of each strain were found to be 0.03 ± 0.01 .

PART II. Ranges among the respective characters

1. Quotient in length

Maximum: The results are given in Table 3. In this table, the maximum, the minimum and their range are shown. The largest (0.78) was obtained in No. 10, followed by No. 12 (0.77) and Nos. 5, 7 and 16 (0.76). The smallest (0.71) was noted in No. 1, followed by No. 14 (0.72) and No. 2 (0.73). Average and its s.d. through the whole strains were found to be 0.74 ± 0.02 .

Minimum: The largest (0.71) was obtained in No. 16, followed by Nos. 6 and 9 (0.70). The smallest (0.63) was noted in No. 15, followed by No. 2 (0.66) and No. 1 (0.67). It was noted that the value was peculiarly small in No. 15. Average and its s.d. through the whole strains were found to be 0.68 ± 0.02 .

Range: The largest (0.11) was obtained in No. 15, followed by Nos. 10 and 12 (0.09). The smallest (0.03) was noted in No. 14, followed by Nos. 1 and 6 (0.04). Average and its s.d. through the whole strains were found to be 0.06 ± 0.02 .

Table 3. Ranges of comparative values in the strain level

| Strain No. | Length | | | Width | | | Thickness | | | Length/Width | | | Length/Thickness | | | Width/Thickness | | |
|------------|--------|------|-------|-------|------|-------|-----------|------|-------|--------------|------|-------|------------------|------|-------|-----------------|------|-------|
| | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range |
| 1 | 0.71 | 0.67 | 0.04 | 0.84 | 0.74 | 0.10 | 0.89 | 0.80 | 0.09 | 0.96 | 0.81 | 0.15 | 0.87 | 0.78 | 0.09 | 1.04 | 0.88 | 0.16 |
| 2 | 0.73 | 0.66 | 0.07 | 0.90 | 0.82 | 0.08 | 0.88 | 0.83 | 0.05 | 0.83 | 0.79 | 0.04 | 0.88 | 0.76 | 0.12 | 1.08 | 0.95 | 0.13 |
| 3 | 0.74 | 0.68 | 0.06 | 0.89 | 0.80 | 0.09 | 0.88 | 0.76 | 0.12 | 0.92 | 0.79 | 0.13 | 0.94 | 0.78 | 0.16 | 1.11 | 0.96 | 0.15 |
| 4 | 0.74 | 0.68 | 0.06 | 0.87 | 0.85 | 0.02 | 0.87 | 0.78 | 0.09 | 0.86 | 0.80 | 0.06 | 0.95 | 0.83 | 0.12 | 1.11 | 0.98 | 0.13 |
| 5 | 0.76 | 0.68 | 0.08 | 0.95 | 0.87 | 0.08 | 0.89 | 0.79 | 0.10 | 0.86 | 0.75 | 0.11 | 0.96 | 0.78 | 0.18 | 1.12 | 1.01 | 0.11 |
| 6 | 0.74 | 0.70 | 0.04 | 0.82 | 0.74 | 0.08 | 0.85 | 0.79 | 0.06 | 0.98 | 0.86 | 0.12 | 0.91 | 0.84 | 0.07 | 1.02 | 0.88 | 0.14 |
| 7 | 0.76 | 0.69 | 0.07 | 0.89 | 0.82 | 0.07 | 0.91 | 0.87 | 0.04 | 0.92 | 0.80 | 0.12 | 0.86 | 0.76 | 0.10 | 1.02 | 0.91 | 0.13 |
| 8 | 0.74 | 0.69 | 0.05 | 0.90 | 0.80 | 0.10 | 0.85 | 0.77 | 0.08 | 0.91 | 0.78 | 0.13 | 0.95 | 0.86 | 0.09 | 1.10 | 0.99 | 0.11 |
| 9 | 0.75 | 0.70 | 0.05 | 0.90 | 0.83 | 0.07 | 0.87 | 0.79 | 0.08 | 0.88 | 0.79 | 0.09 | 0.90 | 0.82 | 0.08 | 1.08 | 0.99 | 0.09 |
| 10 | 0.78 | 0.69 | 0.09 | 0.89 | 0.77 | 0.12 | 0.93 | 0.86 | 0.07 | 0.94 | 0.80 | 0.14 | 0.90 | 0.75 | 0.15 | 1.00 | 0.87 | 0.13 |
| 11 | 0.73 | 0.68 | 0.05 | 0.91 | 0.77 | 0.14 | 0.87 | 0.79 | 0.08 | 0.91 | 0.75 | 0.16 | 0.90 | 0.80 | 0.10 | 1.15 | 0.94 | 0.21 |
| 12 | 0.77 | 0.68 | 0.09 | 0.83 | 0.77 | 0.06 | 0.86 | 0.69 | 0.17 | 0.98 | 0.88 | 0.10 | 1.04 | 0.80 | 0.24 | 1.13 | 0.86 | 0.27 |
| 13 | 0.74 | 0.69 | 0.05 | 0.83 | 0.78 | 0.05 | 0.84 | 0.77 | 0.07 | 0.92 | 0.84 | 0.08 | 0.95 | 0.84 | 0.11 | 1.06 | 0.94 | 0.12 |
| 14 | 0.72 | 0.69 | 0.03 | 0.83 | 0.78 | 0.05 | 0.83 | 0.74 | 0.09 | 0.91 | 0.82 | 0.09 | 0.97 | 0.83 | 0.14 | 1.09 | 0.94 | 0.15 |
| 15 | 0.74 | 0.63 | 0.11 | 0.90 | 0.83 | 0.07 | 0.91 | 0.79 | 0.12 | 0.88 | 0.73 | 0.15 | 0.91 | 0.74 | 0.17 | 1.13 | 0.92 | 0.21 |
| 16 | 0.76 | 0.71 | 0.05 | 0.89 | 0.81 | 0.08 | 0.90 | 0.85 | 0.05 | 0.90 | 0.82 | 0.08 | 0.88 | 0.80 | 0.08 | 1.03 | 0.91 | 0.12 |
| 17 | 0.74 | 0.68 | 0.06 | 0.85 | 0.78 | 0.07 | 0.94 | 0.84 | 0.10 | 0.92 | 0.81 | 0.11 | 0.87 | 0.74 | 0.13 | 1.01 | 0.86 | 0.15 |

2. Quotient in width

Maximum: The largest (0.95) was obtained in No. 5, followed by No. 11 (0.91). It was noted that the value was peculiarly large in No. 5. The smallest (0.82) was noted in No. 6, followed by Nos. 12, 13 and 14 (0.83). Average and its s.d. through the whole strains were found to be 0.88 ± 0.04 .

Minimum: The largest (0.87) was obtained in No. 5, which was the same as in case of the maximum, followed by No. 4 (0.85) and Nos. 9 and 15 (0.83). The smallest (0.74) was noted in Nos. 1 and 6. Average and its s.d. through the whole strains were found to be 0.80 ± 0.04 .

Range: The largest (0.14) was obtained in No. 11, followed by No. 10 (0.12) and Nos. 1 and 8 (0.10). The smallest (0.02) was noted in No. 4, followed by Nos. 13 and 14 (0.05). It was noted that the value was peculiarly small in No. 4. Average and its s.d. through the whole strains were found to be 0.08 ± 0.03 .

3. Quotient in thickness

Maximum: The largest (0.94) was obtained in No. 17, followed by Nos. 7 and 15 (0.91). The smallest (0.83) was noted in No. 14, which was the same as in case of the range of the length, followed by No. 13 (0.84) and Nos. 6 and 8 (0.85). Average and its s.d. through the whole strains were found to be 0.88 ± 0.03 .

Minimum: The largest (0.87) was obtained in No. 7, followed by No. 10 (0.86) and No. 16 (0.85). The smallest (0.74) was noted in No. 14, which was the same as in cases of the range of the length, and the maximum of thickness, followed by No. 3 (0.76) and Nos. 8 and 13 (0.77). Average and its s.d. through the whole strains were found to be 0.80 ± 0.05 .

Range: The largest (0.17) was obtained in No. 12, followed by Nos. 3 and 15 (0.12). It was noted that the value was peculiarly large in No. 12. The smallest (0.04) was noted in No. 7, followed by Nos. 2 and 16 (0.05). Average and its s.d. through the whole strains were found to be 0.09 ± 0.03 .

4. Quotient in L/W

Maximum: The largest (0.98) was obtained Nos. 6 and 12, followed by No. 1 (0.96). The smallest (0.83) was noted in No. 2, followed by Nos. 4 and 5 (0.86). Average and its s.d. through the whole strains were found to be 0.91 ± 0.04 .

Minimum: The largest (0.88) was obtained in No. 12, which was the same as in case of the range of thickness, followed by No. 6 (0.86) and No. 13 (0.84). The smallest (0.73) was noted in No. 15, which was the same as in case of the minimum of length, followed by Nos. 5 and 11 (0.75). Average and its s.d. through the whole strains were found to be 0.80 ± 0.04 .

Range: The largest (0.16) was obtained in No. 11, which was the same as in case of the range of the width, followed by Nos. 1 and 15 (0.15). The smallest (0.04) was noted in No. 2, which was the same as in case of the maximum of L/W, followed by No. 4 (0.06) and Nos. 13 and 16 (0.08). Average and its s.d. through the whole strains were found to be 0.11 ± 0.03 .

5. Quotient in L/T

Maximum: The largest (1.04) was obtained in No. 12, which was the same as in cases of the range of the thickness, the maximum and the minimum of L/W, followed by No. 14 (0.97) and No. 5 (0.96). It was noted that the value was peculiarly large in No. 12. The smallest (0.86) was noted in No. 7, which was the same as in case of the range of the thickness, followed by Nos. 1 and 17 (0.87). Average and its s.d. through the whole strains were found to be 0.92 ± 0.05 .

Table 4. Ranges of area, volume and quotient in the strain level

| Strain No. | Unhusked | | | | | | Husked | | | | | | Quotient | | | | | |
|------------|----------|-------|-------|--------|-------|-------|--------|-------|-------|--------|-------|-------|----------|------|-------|--------|------|-------|
| | Area | | | Volume | | | Area | | | Volume | | | Area | | | Volume | | |
| | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range | Max. | Min. | Range |
| 1 | 21.68 | 15.40 | 6.28 | 39.02 | 23.30 | 15.72 | 12.40 | 8.50 | 3.90 | 19.84 | 10.20 | 9.64 | 0.58 | 0.52 | 0.06 | 0.51 | 0.43 | 0.08 |
| 2 | 17.38 | 15.12 | 2.26 | 30.64 | 22.45 | 8.19 | 11.02 | 9.25 | 1.77 | 15.41 | 11.88 | 3.53 | 0.66 | 0.54 | 0.12 | 0.56 | 0.48 | 0.08 |
| 3 | 17.38 | 13.41 | 3.97 | 27.97 | 21.00 | 6.97 | 10.26 | 8.00 | 2.26 | 15.26 | 8.80 | 6.46 | 0.63 | 0.57 | 0.06 | 0.55 | 0.45 | 0.10 |
| 4 | 16.91 | 14.30 | 2.61 | 29.48 | 22.17 | 7.31 | 10.50 | 8.93 | 1.57 | 13.96 | 11.26 | 2.70 | 0.65 | 0.58 | 0.07 | 0.55 | 0.46 | 0.09 |
| 5 | 18.04 | 13.69 | 4.35 | 29.64 | 21.36 | 8.28 | 11.20 | 8.33 | 2.87 | 15.84 | 11.25 | 4.59 | 0.72 | 0.60 | 0.12 | 0.61 | 0.52 | 0.09 |
| 6 | 16.94 | 13.59 | 3.35 | 27.67 | 21.74 | 5.93 | 9.90 | 7.54 | 2.36 | 13.37 | 9.80 | 3.57 | 0.60 | 0.53 | 0.07 | 0.51 | 0.43 | 0.08 |
| 7 | 24.00 | 17.25 | 6.75 | 51.60 | 32.78 | 18.82 | 14.79 | 10.50 | 4.29 | 28.84 | 17.85 | 10.99 | 0.67 | 0.58 | 0.09 | 0.59 | 0.52 | 0.07 |
| 8 | 17.33 | 13.68 | 3.65 | 29.45 | 21.89 | 7.56 | 10.36 | 8.48 | 1.88 | 14.89 | 11.05 | 3.84 | 0.63 | 0.57 | 0.06 | 0.53 | 0.44 | 0.09 |
| 9 | 17.28 | 13.65 | 3.63 | 28.44 | 20.48 | 7.96 | 10.30 | 8.64 | 1.66 | 14.85 | 10.37 | 4.48 | 0.65 | 0.60 | 0.05 | 0.56 | 0.48 | 0.08 |
| 10 | 26.00 | 16.33 | 9.67 | 58.66 | 32.66 | 26.00 | 15.39 | 10.40 | 4.99 | 31.55 | 18.72 | 12.83 | 0.68 | 0.56 | 0.12 | 0.61 | 0.48 | 0.13 |
| 11 | 17.02 | 13.32 | 3.70 | 28.26 | 19.31 | 8.95 | 10.71 | 7.25 | 3.46 | 14.10 | 8.70 | 5.40 | 0.65 | 0.54 | 0.11 | 0.55 | 0.43 | 0.12 |
| 12 | 18.60 | 12.78 | 5.82 | 29.76 | 18.53 | 11.23 | 9.81 | 7.84 | 1.97 | 13.62 | 7.84 | 5.78 | 0.64 | 0.52 | 0.12 | 0.53 | 0.39 | 0.14 |
| 13 | 17.74 | 13.86 | 3.88 | 29.11 | 22.63 | 6.48 | 10.17 | 7.70 | 2.47 | 14.31 | 10.01 | 4.30 | 0.61 | 0.55 | 0.06 | 0.50 | 0.44 | 0.06 |
| 14 | 16.45 | 12.50 | 3.95 | 28.73 | 21.17 | 7.56 | 9.45 | 7.28 | 2.17 | 13.77 | 9.46 | 4.31 | 0.61 | 0.53 | 0.08 | 0.50 | 0.43 | 0.07 |
| 15 | 17.25 | 12.96 | 4.29 | 28.46 | 21.38 | 7.08 | 10.26 | 8.19 | 2.07 | 13.83 | 11.06 | 2.77 | 0.66 | 0.54 | 0.12 | 0.60 | 0.45 | 0.15 |
| 16 | 20.76 | 17.71 | 3.05 | 39.44 | 30.86 | 8.58 | 12.90 | 11.50 | 1.40 | 21.12 | 16.10 | 5.02 | 0.67 | 0.62 | 0.05 | 0.58 | 0.52 | 0.06 |
| 17 | 26.32 | 21.44 | 4.88 | 50.01 | 32.16 | 17.85 | 15.87 | 12.90 | 2.97 | 26.59 | 18.06 | 8.53 | 0.62 | 0.57 | 0.05 | 0.57 | 0.50 | 0.07 |

Minimum: The largest (0.86) was obtained in No. 8, followed by Nos. 6 and 13 (0.84). The smallest (0.74) was noted in Nos. 15 and 17, followed by No. 10 (0.75). Average and its s.d. through the whole strains were found to be 0.80 ± 0.04 .

Range: The largest (0.24) was obtained in No. 12, which was the same as in cases of the range of the thickness, the minimum of L/W, and the maximum of L/T, followed by No. 5 (0.18) and No. 15 (0.17). It was noted that the value was peculiarly large in No. 12. The smallest (0.07) was noted in No. 6, which was the same as in case of the maximum of the width, followed by Nos. 9 and 16 (0.08). Average and its s.d. through the whole strains were found to be 0.13 ± 0.04 .

6. Quotient in W/T

Maximum: The largest (1.15) was obtained in No. 11, which was the same as in cases of the ranges of the width and L/W, followed by Nos. 12 and 15 (1.13). The smallest (1.00) was noted in No. 10, followed by No. 17 (1.01) and Nos. 6 and 7 (1.02). Average and its s.d. through the whole strains were found to be 1.08 ± 0.05 .

Minimum: The largest (1.01) was obtained in No. 5, which was the same as in cases of the maximum and the minimum of the width, followed by Nos. 8 and 9 (0.99). The smallest (0.86) was noted in Nos. 12 and 17, followed by No. 10 (0.87). Average and its s.d. through the whole strains were found to be 0.93 ± 0.05 .

Range: The largest (0.27) was obtained in No. 12, which was the same as in cases of the range of the thickness, the minimum of L/W, the maximum and the range of L/T, followed by Nos. 11 and 15 (0.21). These combinations of strains were found to be the same as in case of the maximum of W/T. It was noted that the value was peculiarly large in No. 12. The smallest (0.09) was noted in No. 9, followed by Nos. 5 and 8 (0.11). Average and its s.d. through the whole strains were found to be 0.15 ± 0.05 .

7. Area in unhusked grains

Maximum: The results are given in Table 4. In this table, the maximum, the minimum and their range are shown. The widest (26.32 mm^2) was obtained in No. 17, which was the same as in case of the maximum of the thickness, followed by No. 10 (26.00 mm^2) and No. 7 (24.00 mm^2). The narrowest (16.45 mm^2) was noted in No. 14, which was the same as in cases of the minimum of the length, the maximum and the minimum of the thickness, followed by No. 4 (16.91 mm^2) and No. 6 (16.94 mm^2). Average and its s.d. through the whole strains were found to be 19.24 ± 3.29 .

Minimum: The widest (21.44 mm^2) was obtained in No. 17, which was the same as in cases of the maximum of the thickness, and the maximum of the area of UHG, followed by No. 16 (17.71 mm^2) and No. 7 (17.25 mm^2). The narrowest (12.50 mm^2) was noted in No. 14, which was the same as in cases of the range of the length, the maximum and the minimum of the thickness, and the maximum of the area of UHG, followed by No. 12 (12.78 mm^2) and No. 15 (12.96 mm^2). Average and its s.d. through the whole strains were found to be 14.76 ± 2.30 .

Range: The largest (9.67 mm^2) was obtained in No. 10, which was the same as in case of the maximum of the length, followed by No. 7 (6.75 mm^2) and No. 1 (6.28 mm^2). It was noted that the value was peculiarly large in No. 10. The smallest (2.26 mm^2) was noted in No. 2, which was the same as in cases of the maximum and the range of L/W, followed by No. 4 (2.61 mm^2) and No. 16 (3.05 mm^2). Average and its s.d. through the whole strains were found to be 4.48 ± 1.80 .

8. Volume in unhusked grains

Maximum: The largest (58.66 mm³) was obtained in No. 10, which was the same as in cases of the maximum of the length, and the range of the area of UHG, followed by No. 7 (51.60 mm³) and No. 17 (50.01 mm³). These combinations of strains were found to be the same as in case of the maximum of area of UHG. It was noted that the value was peculiarly large in No. 10. The smallest (27.67 mm³) was noted in No. 6, which was the same as in cases of the maximum of width and the range of L/T, followed by No. 3 (27.97 mm³) and No. 11 (28.26 mm³). Average and its s.d. through the whole strains were found to be 34.49 ± 9.80 .

Minimum: The largest (32.78 mm³) was obtained in No. 7, which was the same as in case of the minimum of the thickness, followed by No. 10 (32.66 mm³) and No. 17 (32.16 mm³). These combinations of strains were found to be the same as in cases of the maxima of area and volume of UHG. The smallest (18.53 mm³) was noted in No. 12, followed by No. 11 (19.31 mm³) and No. 9 (20.48 mm³). Average and its s.d. through the whole strains were found to be 23.88 ± 4.86 .

Range: The largest (26.00 mm³) was obtained in No. 10, which was the same as in cases of the maximum of the length, the range of area of UHG, and the maximum of volume of UHG, followed by No. 7 (18.82 mm³) and No. 17 (17.85 mm³). These combinations of strains were found to be the same as in cases of the maxima of area and volume of UHG, and the minimum of volume of UHG. Moreover, these orders of strains were found to be the same as in case of the maximum of volume of UHG. It was noted that the value was peculiarly large in No. 10. The smallest (5.93 mm³) was noted in No. 6, which was the same as in cases of the maxima of the width and volume of UHG, and the range of L/T, followed by No. 13 (6.48 mm³) and No. 3 (6.97 mm³). Average and its s.d. through the whole strains were found to be 10.62 ± 5.60 .

9. Area in husked grains

Maximum: The widest (15.87 mm²) was obtained in No. 17, which was the same as in cases of the maxima of thickness and the area of UHG, and the minimum of area of UHG, followed by No. 10 (15.39 mm²) and No. 7 (14.79 mm²). These combinations of strains were found to be the same as in cases of the maxima of area and volume of UHG, the minimum and the range of volume of the UHG. Moreover, these orders of strains were found to be the same as in case of the maximum of area of UHG. The narrowest (9.45 mm²) was noted in No. 14, which was the same as in cases of the range of the length, the maxima and the minima of the thickness and area of UHG, followed by No. 12 (9.81 mm²) and No. 6 (9.90 mm²). Average and its s.d. through the whole strains were found to be 11.49 ± 2.05 .

Minimum: The widest (12.90 mm²) was obtained in No. 17, which was the same as in cases of the maxima of the thickness, areas of UHG and HG, and the minimum of area of UHG, followed by No. 16 (11.50 mm²) and No. 7 (10.50 mm²). These orders of strains were found to be the same as in case of the minimum of area of UHG. The narrowest (7.25 mm²) was noted in No. 11, followed by No. 14 (7.28 mm²) and No. 6 (7.54 mm²). Average and its s.d. through the whole strains were found to be 8.90 ± 1.57 .

Range: The largest (4.99 mm²) was obtained in No. 10, which was the same as in cases of the maxima of the length and volume of UHG, and the ranges of area and volume of UHG, followed by No. 7 (4.29 mm²) and No. 1 (3.90 mm²). These orders of strains were found to be the same as in case of the range of area of UHG. It was noted that the value was peculiarly large in No. 10. The smallest (1.40 mm²) was noted in No. 16, followed by No. 4 (1.57 mm²) and No. 9 (1.66 mm²). Average and its s.d. through the whole strains were found to be 2.59 ± 1.03 .

10. Volume in husked grains

Maximum: The largest (31.55 mm³) was obtained in No. 10, which was the same as in cases of the maxima of the length, volumes of UHG and HG, and the ranges of areas of UHG and HG and of volume of UHG, followed by No. 7 (28.84 mm³) and No. 17 (26.59 mm³). These combinations of strains were found to be the same as in cases of the maxima of areas of UHG and HG and of volume of UHG, the minimum of volume of UHG, and the range of volume of UHG. Moreover, these orders of strains were found to be the same as in cases of the maximum and the range of volume of UHG. It was noted that the value was peculiarly large in No. 10. The smallest (13.37 mm³) was noted in No. 6, which was the same as in cases of the maxima of the width and of volume of UHG, and the ranges of L/T and volume of UHG, followed by No. 12 (13.62 mm³) and No. 14 (13.77 mm³). These combinations of strains were found to be the same as in case of the maximum of area of HG. These phenomena were ascertained for the first time in the smaller columns. Average and its s.d. through the whole strains were found to be 17.72 ± 5.84 .

Minimum: The largest (18.72 mm³) was obtained in No. 10, which was the same as in cases of the maxima of the length and volumes of UHG and HG, the ranges of areas of UHG and HG, and of volume of UHG, followed by No. 17 (18.06 mm³) and No. 7 (17.85 mm³). These combinations of strains were found to be the same as in 6 cases, *i.e.*, the maxima of areas and volumes of UHG and HG, the maximum and the range of volume of UHG. The smallest (7.84 mm³) was noted in No. 12, which was the same as in case of the minimum of volume of UHG, followed by No. 11 (8.70 mm³) and No. 3 (8.80 mm³). Average and its s.d. through the whole strains were found to be 11.91 ± 3.49 .

Range: The largest (12.83 mm³) was obtained in No. 10, which was the same as in cases of the maxima of the length and of volumes of UHG and HG, the minimum of volume of HG, the ranges of areas of UHG and HG, and the range of volume of UHG, followed by No. 7 (10.99 mm³) and No. 1 (9.64 mm³). These orders of strains were found to be the same as in cases of the ranges of areas of UHG and HG. It was noted that the value was peculiarly large in No. 10. The smallest (2.70 mm³) was noted in No. 4, which was the same as in case of range of the width, followed by No. 15 (2.77 mm³) and No. 2 (3.53 mm³). It was noted that the values were peculiarly small in Nos. 4 and 15. Average and its s.d. through the whole strains were found to be 5.81 ± 2.96 .

11. Quotient in areas

Maximum: The largest (0.72) was obtained in No. 5, which was the same as in cases of maximum of width, and the minima of width and W/T, followed by No. 10 (0.68) and No. 16 (0.67). The smallest (0.60) was noted in No. 6, which was the same as in cases of the maxima of the width and volumes of UHG and HG, and the ranges of L/T and volume of UHG, followed by Nos. 13 and 14 (0.61). These combinations of strains were found to be the same as in case of the minimum of width. Average and its s.d. through the whole strains were found to be 0.64 ± 0.03 .

Minimum: The largest (0.62) was obtained in No. 16, which was the same as in case of the minimum of the length, followed by Nos. 5 and 9 (0.60). The smallest (0.52) was noted in Nos. 1 and 12, followed by Nos. 6 and 14 (0.53). Average and its s.d. through the whole strains were found to be 0.56 ± 0.03 .

Range: The largest (0.12) was obtained in Nos. 2, 5, 10 and 15. The smallest (0.05) was noted in Nos. 9, 16 and 17. Average and its s.d. through the whole strains were found to be 0.08 ± 0.03 .

12. Quotient in volumes

Maximum: The largest (0.61) was obtained in Nos. 5 and 10, followed by No. 15 (0.60). The smallest (0.50) was noted in Nos. 13 and 14, followed by Nos. 1 and 6 (0.51). Average and its s.d. through the whole strains were found to be 0.55 ± 0.04 .

Minimum: The largest (0.52) was obtained in Nos. 5, 7 and 16. The smallest (0.39) was noted in No. 12, which was the same as in cases of the minima of the volumes of UHG and HG, followed by Nos. 1, 6, 11 and 14 (0.43). Average and its s.d. through the whole strains were found to be 0.46 ± 0.04 .

Range: The largest (0.15) was obtained in No. 15, which was the same as in case of the range of the length, followed by No. 12 (0.14) and No. 10 (0.13). The smallest (0.06) was noted in Nos. 13 and 16, followed by Nos. 7, 14 and 17 (0.07). Average and its s.d. through the whole strains were found to be 0.09 ± 0.03 .

Discussion

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

Comparative values

1. In L/W, the largest (0.92) was obtained in No. 12. This value was attributable to the nearly smallest value (0.80) in width. On the other hand, the smallest (0.80) was noted in No. 5. This value was attributable to the largest value (0.90) in width. In L/T, the largest (0.90) was obtained in No. 13. This value was attributable to the smallest value (0.80) in thickness. On the other hand, the smallest (0.81) was noted in No. 7. This value was attributable to the largest value (0.90) in thickness. In W/T, the largest (1.07) was obtained in No. 5. This value was attributable to the largest value (0.90) in width. On the other hand, the smallest (0.93) was noted in No. 17. This value was attributable to the largest value (0.90) in thickness. As mentioned above the largest or the smallest values were attributable to the one character through the whole characters. On the other hand, these values were attributable to 2 characters concerned in the cultivated species⁴. These differences were looked upon as one of the species specificities.

In quotients of areas and volumes, any tendency was not found, so far as the present data were considered.

2. Though the values were peculiarly large or small in some characters, the values were found to be the standard level in other cases in view of the same strains. For example, No. 16 showed the peculiarly large value (0.74) in length, but showed nearly the middle value (0.86) in width. In other case, No. 11 showed nearly the smallest value (0.70) in length, but showed nearly the middle value (0.86) in width.

On the other hand, though the values were peculiarly large in some characters, the values were found to be very small in other characters in view of the same strains, and *vice versa*. For example, No. 15 showed nearly the largest value (0.88) in width, but showed relatively small value (0.71) in length.

In view of area and volume characters, the following facts were ascertained. In general, the larger is the value of one character, the larger is the value of another character.

3. In view of s.d., the following facts were ascertained to some extent. As values of s.d. of comparative columns were very small, the consideration was done here only in area and

volume columns. The larger is, in general, s.d. in some character, the larger is s.d. in another character. For example, No. 1 showed the largest s.d. (2.21) in area (UHG), and showed nearly the largest s.d. (4.96) in volume (UHG). Moreover, in general, the larger is the practical value, the larger is its s.d. For example, No. 10 showed the largest practical value (44.68 mm³) and the largest s.d. (6.87) in volume (UHG). However, some disorders were found. No. 2 showed 16.21 mm² and 0.72 in the practical value and its s.d., respectively, in area (UHG). The former and the latter were located in the middle and the smallest portions, respectively. These phenomena may partly be due to the evolutionary processes. These topics were, however, unexplainable at the present, and were put under examination.

4. In view of the species specificities, the following facts were ascertained. In general, the extremely large values in area and volume characters were found only in *O. sativa* var. *spontanea*, but the extremely small values were found only in *O. perennis*. These findings proposed an interesting problem concerning species differentiations. In comparative characters, any clear tendency was not found.

5. In the larger set of areas, the widest (24.14 mm² in UHG and 14.38 mm² in HG) were obtained in No. 17, followed by No. 10 (21.14 mm² and 13.19 mm² in the same order, and so forth) and No. 7 (20.76 mm² and 12.85 mm²). These orders of strains were finally illustrated as 17 > 10 > 7. These orders were fixed to be the same as both in UHG and HG. These phenomena were found in other 2 cases, i.e., ① 14 < 6 < 12 ... No. 14 (8.43 mm² and 11.60 mm³), No. 6 (8.91 mm² and 11.88 mm³) and No. 12 (8.93 mm² and 11.90 mm³) in the smaller sets of area (HG) and volume (HG); ② 10 > 7 > 1 ... No. 10 (6.87 and 3.29), No. 7 (4.99 and 2.94) and No. 1 (4.96 and 2.83) in the larger sets of s.d. of volume (UHG and HG). It may be noticeable that these synchronized orders of strains were found only in area and volume columns, but not found in other columns.

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 the volume (UHG), the largest (44.68 mm³) was obtained in No. 10, followed by No. 17 (42.97 mm³) and No. 7 (42.63 mm³). These combinations were finally illustrated as 10 > 17 > 7. In volume (HG), the largest (24.90 mm³) was obtained in No. 10, followed by No. 7 (23.63 mm³) and No. 17 (22.85 mm³). These combinations were finally illustrated as 10 > 7 > 17. These combinations were after all constituted in 5 characters, i.e., 7 · 10 · 17 in the larger sets ... area in UHG (17 > 10 > 7), volume in UHG (10 > 17 > 7), area in HG (17 > 10 > 7), volume in HG (10 > 7 > 17), and thickness (7 = 10 = 17). These phenomena were found in another 1 case, i.e., 1 · 7 · 10 in the larger sets ... s.d. of volume in UHG (10 > 7 > 1), area in HG (1 > 10 > 7), and volume in HG (10 > 7 > 1).

Ranges

1. Though the values were peculiarly large or small in some characters, the values were found to be the standard level in other characters in view of the same strains. For example, No. 5 showed the peculiarly large value (0.95) in the maximum of width, but showed nearly the middle value (0.89) in the maximum of thickness. In other case, No. 15 showed the peculiarly small value (0.63) in the minimum of length, but showed nearly the middle value (0.79) in the minimum of thickness.

On the other hand, though the values were peculiarly large in some characters, the values were found to be peculiarly small in other characters in view of the same strains, and *vice versa*. For example, No. 6 showed the peculiarly large value (0.70) in the minimum of length, but showed

the peculiarly small value (0.74) in the minimum of width. These phenomena were found in the several combinations.

In view of area and volume characters, the following facts were ascertained. In general, the larger is the value of the maximum, the larger is the values of the minimum and the ranges. This tendency was looked upon as the same as one in case of comparative values. However, some disorders were found. For example, No. 16 showed the largest or nearly the largest values (17.71 mm², 30.86 mm³, 11.50 mm², 16.10 mm³, 0.62 and 0.52) in the minima of area (UHG), volume (UHG), area (HG), volume (HG), quotient of areas and quotient of volumes, respectively, but showed the smallest or nearly the smallest values (3.05 mm², 8.58 mm³, 1.40 mm², 5.02 mm³, 0.05 and 0.06) in the ranges in the same orders, respectively. This tendency was looked upon as strain specificity in case of strain No. 16, collected in swamp near Bagdogra.

2. In view of species specificities, the following facts may appreciably be drawn from the data obtained in this experiment. In general, the extremely large values in the area and volume columns were found in *O. sativa* var. *spontanea* (= annual plants), but the extremely small values in these columns were found in *O. perennis* (= perennial plants). It was noticeable that No. 10 showed extremely the large values and Nos. 6 and 14 showed the extremely small values in these columns, respectively. These findings proposed quite an interesting problem concerning the species differentiations. Species-geographical relations were, however, not ascertained in these strains, so far as the data obtained in the previous paper³⁾ and it is the reason why they were taken into account, here.

3. In the maximum of areas, the widest (26.32 mm² in UHG and 15.87 mm² in HG) were obtained in No. 17, followed by No. 10 (26.00 mm² and 15.39 mm² in the same order, and so forth) and No. 7 (24.00 mm² and 14.79 mm²). These orders of strains were finally illustrated as 17 > 10 > 7. These orders of strains were fixed to be the same as both in UHG and HG. These phenomena were found in the other 3 cases, i.e., ① 10 > 7 > 17 ... No. 10 (58.66 mm³ and 31.55 mm³), No. 7 (51.60 mm³ and 28.84 mm³) and No. 17 (50.01 mm³ and 26.59 mm³) in the maxima of volumes; ② 17 > 16 > 7 ... No. 17 (21.44 mm² and 12.90 mm²), No. 16 (17.71 mm² and 11.50 mm²) and No. 7 (17.25 mm² and 10.50 mm²) in the minima of areas; ③ 10 > 7 > 1 ... No. 10 (9.67 mm² and 4.99 mm²), No. 7 (6.75 mm² and 4.29 mm²) and No. 1 (6.28 mm² and 3.90 mm²) in the ranges of areas. It may be noticeable that these synchronized orders of strains were clearly found only in area and volume columns, but not found in other columns. Then, it may be concluded that these strains were almost of the stable status in view of the genetic backgrounds, so far as these characters were concerned. In other words, *O. sativa* var. *spontanea* (strain Nos. 7, 10 and 17) was genetically more advanced than that of *O. perennis* in evolutionary viewpoints.

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 the maximum of W/T, the largest (1.15) was obtained in No. 11, followed by Nos. 12 and 15 (1.13). Finally, these combinations were illustrated as 11 > 12 = 15. In the range of W/T, the largest (0.27) was obtained in No. 12, followed by Nos. 11 and 15 (0.21). Finally, they were shown as 12 > 11 = 15. These phenomena were found in other 3 cases, i.e., ① 2 · 4 · 16 ... the smaller set of the range of L/W (2 < 4 < 16) and the smaller set of the range of area (UHG) (2 < 4 < 16); ② 6 · 13 · 14 ... the smaller set of the maximum of width (6 < 13 = 14) and the smaller set of the maximum of quotient of areas (6 < 13 = 14); ③ 7 · 10 · 17 ... the larger set of the maximum (17 > 10 > 7) of area (UHG), the larger sets of the maximum (10 > 7 > 17), the min-

imum ($7 > 10 > 17$) and the range ($10 > 7 > 17$) of volume (UHG), the larger set of the maximum ($17 > 10 > 7$) of area (HG), the larger sets of the maximum ($10 > 7 > 17$) and the minimum ($10 > 17 > 7$) of volume (HG), and the smaller set of the maximum ($10 > 17 = 7$) of W/T.

In these senses, it was worthy of attention that any same order or combination was not found in the characters of comparative columns. Genetically, these characters were assumed to have expressed themselves, independently from each other. However, as the analyses and conclusions have left several points in question in the stricter sense, further analyses had better be performed sincerely.

Summary

In order to confirm the morphological characters of wild rice collected in the northeastern India, comparison of the unhusked and husked grains for 12 characters and variation ranges also the same 12 characters were investigated following the previous papers. The main results obtained during this study were summarized as follows:

Comparative values of length, width, thickness, L/W, L/T and W/T were measured as 0.72, 0.84, 0.85, 0.86, 0.85 and 1.00 in average values, respectively. Area (UHG), volume (UHG), area (HG), volume (HG), quotient of areas and quotient of volumes were measured as 16.97 mm², 29.11 mm³, 10.20 mm², 14.94 mm³, 0.60 and 0.51 in average values, respectively. The maximum, the minimum and the range of the respective characters in the same orders mentioned above were ascertained as 0.74, 0.68, 0.06; 0.88, 0.80, 0.08; 0.88, 0.80, 0.09; 0.91, 0.80, 0.11; 0.92, 0.80, 0.13; 1.08, 0.93, 0.15; 19.24 mm², 14.76 mm², 4.48 mm²; 34.49 mm³, 23.88 mm³, 10.62 mm³; 11.49 mm², 8.90 mm², 2.59 mm²; 17.72 mm³, 11.91 mm³, 5.81 mm³; 0.64, 0.56, 0.08; 0.55, 0.46, 0.09 in average values, respectively.

Basing on the data obtained in these characters, several patterns were found as strain- or species-specificities.

In area and volume characters, the peculiarly large values were found only in *O. sativa* var. *spontanea* (= annual plant). Strains showing relatively large or small values in the respective characters were tentatively picked-up and grouped into "order" or "combination". These new techniques were fixed to be very useful for testing strain- or species-differentiations.

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