

Grain Morphology of Wild Rice in African Countries (IV)

Tadao C. KATAYAMA

(Laboratory of Crop Science)

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Introduction

During the periods from October to November in 1984, from August to November in 1985 and from May to August in 1988, the writer was sent to 8 countries of Africa, *i.e.*, Madagascar, Tanzania, Kenya, Nigeria, Ivory Coast, Liberia, Senegal and Gambia, for the collection of wild and cultivated rices under the project, "Studies on the Distribution and Ecotypic Differentiation of Wild and Cultivated Rice Species in Africa", supported by a Grant from the Ministry of Education, Science and Culture, of the Japanese Government. Making use of these occasions, wild rices distributed in African countries were studied, too.

On the distribution of wild rice in Africa, some scientific reports have already been published^{3-7,25,27,28)}. Although Africa has been considered to be one of the most important distribution areas of the wild rice in the world, accumulation of complete data on these aspects is far from being perfect. Taking these facts into account, the present study-series were made to ascertain exactly the distribution, and the geographical, seasonal and ecotypic differentiations of wild rice in African areas.

Recently wild *Oryza* species have frequently been studied from several agronomic viewpoints. For example, Sitch *et al.* (1989)²⁶⁾ studied 'prefertilization incompatibility barriers' in the selected interspecific and intergeneric crosses involving 7 species of 2 genera, *Oryza* and *Rhynchoryza*. Manuel *et al.* (1990)²⁴⁾ examined the F₁s from 8 japonica/indica, 6 japonica/japonica-indica, and 2 interspecific crosses including *Oryza sativa* var. *spontanea*, in the view of hybrid sterility. Biaoqi *et al.* (1991)²⁾ crossed cultivars with a shorter duration plant selected from the F₂ of *Oryza longistaminata*/*Oryza sativa* var. *spontanea*, in view of breeding the short duration growth. Ahmed *et al.* (1991)¹⁾ tested 33 wild rice accessions from IRRI for reactions to blight. Velusamy (1991)²⁹⁾ evaluated 195 breeding lines derived from *Oryza officinalis* for the resistance to brown planthopper. These wild rices mentioned above may be used in the wider ranges of agronomy, *i.e.*, growing period, resistance for several pests and insects²³⁾, genetic research³⁰⁾. These are the reasons why wild rice should be studied in global viewpoints.

In the previous papers, the preliminary and advanced data have been published as the results of the first and the second survey trips made in 1984 and 1985⁹⁻¹⁵⁾, respectively. In the following papers, the results obtained in the third survey trip made in 1988 were reported¹⁷⁻¹⁹⁾. Further, in the previous papers else than these, habitat and the records of the morphological characters of the unhusked grains²⁰⁾, the husked grains²¹⁾ and the comparative data (=husked/unhusked)²²⁾ of the wild rices collected in 1984, 1985 and 1988 were described.

In the present paper, grain areas and volumes characters of wild rice were mainly described, in order to confirm the morphological characters of grains, which were to make the strain's specificities clearer.

Materials and Methods

190 strains of *Oryza longistaminata* CHEV. et ROEHR., 49 strains of *Oryza breviligulata* CHEV. et ROEHR., 44 strains of *Oryza punctata* KOTSCHY, and 1 strain of *Oryza brachyantha* CHEV. et ROEHR., were used for morphological investigations.

Thirty grains were used for the measurements of each strain. The following 6 characters of the unhusked and the husked grains were illustrated by the area (=length x width) and volume (=length x width x thickness) for the unhusked and the husked grains, and area and volume quotients (=ratio of value of husked to value of unhusked grains). The whole data referring to the 6 characters were illustrated by the average value through the whole grains.

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

Results and Discussion

The results were given in Tables 1 to 10, *i.e.*, *O. longistaminata*: Table 1 — Madagascar, Accession Nos. 301-313 collected in 1985 and Nos. 2001-2047 collected in 1988, Table 2 — Tanzania, No. 314 in 1984 and Nos. 2048-2083 in 1988, Table 3 — Kenya, Nos. 315-324 in 1985, Table 4 — Nigeria, Nos. 325-336 in 1984 and Nos. 337-382 in 1985, Table 5 — Ivory Coast, Nos. 384-390 in 1984, Table 6 — Senegal including Gambia, Nos. 391-441 in Casamance region and Nos. 444-455 in northern region, *O. breviligulata*: Table 7 — Nigeria, Nos. 328-334 in 1984 and Nos. 344-380 in 1985, Table 8 — Ivory Coast, No. 383 in 1984, Table 9 — Senegal including Gambia, Nos. 398-442 in Casamance region and Nos. 443-456 in northern region, *O. punctata*: Table 10 — Tanzania, Nos. 457-459 in 1984 and Nos. 2084-2109 in 1988, Table 11 — Kenya, Nos. 460-464 in 1984 and Nos. 465-474 in 1985, *O. brachyantha*: Table 12 — Senegal, No. 475 in 1985.

For summing-up the data, the results mentioned above were used, and were given in Table 11 for the practical value, and in Table 12 for the standard deviations, but not given for the individual grain level. In these tables, 6 morphological characters of the grains were illustrated by the average values of the respective groups; *i.e.*, *O. longistaminata* in the first column --- **1**: Madagascar (**MD** mark in the tables) collected in 1985 (13 strains); **2**: the same, collected in 1988 (47 strains); **3**: the same, collected in the both years (60 strains); **4**: Tanzania (**TA**) collected in 1984 (1 strain); **5**: the same, collected in 1988 (36 strains); **6**: the same, collected in the both years (37 strains); **7**: Kenya (**KE**) collected in 1985 (10 strains); **8**: Nigeria (**NI**) collected in 1984 (5 strains); **9**: the same, collected in 1985 (29 strains); **10**: the same, collected in the both years (34 strains); **11**: Ivory Coast (**IV**) collected in 1984 (7 strains); **12**: Senegal (**SE**) collected in 1985 in Casamance region (35 strains); **13**: the same, collected in northern region (7 strains); **14**: the same, of both the regions (42 strains); **15**: the summed up data of strains (**SUM**) collected in 1984 and 1985 in the whole countries (107 strains); **16**: the summed up data of strains collected in 1984, 1985 and 1988 in the whole countries (190 strains); *O. breviligulata* in the second column --- **17**: Nigeria (**NI**) collected in 1984 (7 strains); **18**: the same, collected in 1985 (17 strains); **19**: the same, collected in the both years (24 strains); **20**: Ivory Coast (**IV**) collected in 1984 (1 strain); **21**: Senegal (**SE**) collected in 1985 in Casamance region (17 strains); **22**: the same, collected in northern region (7 strains); **23**: the same, of both the regions (24 strains); **24**: the summed up data of strains (**SUM**) collected in 1984 and 1985 in the three countries (49 strains); *O. punctata* in the third column --- **25**: Tanzania

(**TA**) collected in 1984 (3 strains); **26**: the same, collected in 1988 (26 strains); **27**: the same, collected in both the years (29 strains); **28**: Kenya (**KE**) collected in 1984 (5 strains); **29**: the same, collected in 1985 (10 strains); **30**: the same, collected in both the years (15 strains); **31**: the summed up data of strains (**SUM**) collected in 1984 and 1985 in the two countries (18 strains); **32**: the summed up data of strains collected in 1984, 1985 and 1988 in the two countries (44 strains); *O. brachyantha* in the fourth column --- **33**: Senegal (**SE**) collected in 1985 (1 strain).

Some strains have different meanings in view of physiological, meteorological and phylogenetical characters, and should be separately considered in morphological studies as well. Accordingly, they are divided into two groups, and thereafter summed-up in the respective countries and groups, in view of the future analyses. **34**: East Africa of *O. longistaminata*; 107 strains in the total, *i.e.*, Madagascar (**1** [13 strains] and **2** [47 strains]), Tanzania (**4** [1 strain] and **5** [36 strains]) and Kenya (**7** [10 strains]), **35**: West Africa of *O. longistaminata*, 83 strains in the total, *i.e.*, Nigeria (**8** [5 strains] and **9** [29 strains]), Ivory Coast (**11** [7 strains]), Senegal (**12** [35 strains] and **13** [7 strains]).

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1. Areas in UHG

The values of areas in UHG for the individual grain level ranged from 40.59 mm² (strain No.2051, collected in Tanzania in 1988) to 7.28 mm² (strain No.2027, collected in Madagascar in 1988). In the strain level, the widest (32.12 mm²) was obtained in No.336, followed by No.449 (32.07 mm²) and No.335 (30.02 mm²), in which the former two were the same as in case of L in HG. These combinations of strains (335, 336 and 449) were found to be the same as in cases of L and W in UHG, and W in HG. The narrowest (13.40 mm²) was noted in No.303, which was the same as in cases of L in UHG and HG, followed by No.2009 (13.69 mm²) and No.2011 (14.24 mm²). These orders of strains (303 < 2009 < 2011) were found to be the same as in case of L in UHG.

In the group level (Table 11), the widest (23.92 mm²) was obtained in the strains collected in northern region of Senegal in 1985 [illustrated as mark **13** in Tables 11 and 12], followed by group **4** [Tanzania in 1984] (23.40 mm²) and group **8** [Nigeria in 1984] (22.75 mm²). These orders of groups (**13** > **4** > **8**) were found to be the same as in cases of L in UHG and HG. Moreover, these combinations of groups (**4**, **8** and **13**) were found to be the same as in cases of W in UHG and HG, and T in UHG. The narrowest (18.00 mm²) was noted in group **2** [Madagascar in 1988], followed by group **3** [Madagascar in 1985 and 1988] (18.46 mm²) and group **11** [Ivory Coast in 1984] (18.80 mm²). These orders of groups (**2** < **3** < **11**) were found to be the same as in cases of L and W in UHG, and L and T in HG, and these combinations of groups (**2**, **3** and **11**) were found to be the same as in case of W in HG. Averages and those standard deviations (s.d.) through the whole strains belonging to the group **34** (summed-up of groups **1**, **2**, **4**, **5** and **7**, *i.e.*, East Africa) and to the group **35** (summed-up of groups **8**, **9**, **11**, **12** and **13**, *i.e.*, West Africa) were found to be 19.34 ± 2.73 and 21.11 ± 2.87, respectively.

In the s.d. of each strain, *i.e.*, in those showing intra-population's variations, the largest (5.84) was obtained in No.2051, followed by No.335 (3.22) and No.2057 (3.05). The smallest (0.09) was noted in No.306, followed by No.313 (0.13) and No.304 (0.40). In the group level, the largest (7.35) was obtained in group **8**, followed by the group **13** (3.79) and group **10** (3.22), in which groups **8** and **13** were the same as in cases of L in UHG and HG. Moreover, these orders of groups (**8** > **13** > **10**) were found to be the same as in cases of L and W in HG. It was noticed

Table 1. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Madagascar, *O. longistaminata*, 301-313 in 1985 and 2001-2047 in 1988

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W1	301	22.29±0.74	36.42±1.66	12.86±0.38	17.58±0.65	0.58±0.01	0.48±0.01
W2	302	15.33±1.49	22.03±2.64	8.96±0.81	10.55±1.27	0.59±0.05	0.48±0.05
W3	303	13.40±1.23	18.86±2.47	7.72±0.70	8.68±0.96	0.58±0.07	0.47±0.07
W4	304	22.30±0.40	37.11±0.46	12.90±0.37	17.93±0.72	0.57±0.01	0.48±0.02
W5	305	23.15±0.98	36.60±2.40	13.13±1.00	17.22±1.60	0.57±0.02	0.47±0.02
W6	306	23.41±0.09	37.66±2.28	13.88±0.51	18.45±1.03	0.59±0.01	0.49±0.01
W7	307	22.09±1.30	40.91±3.35	13.70±0.95	22.70±2.16	0.62±0.02	0.55±0.02
W8	308	21.97±0.75	36.19±1.65	10.57±0.63	14.60±0.69	0.48±0.04	0.40±0.01
W9	309	19.91±1.32	31.43±1.83	10.88±0.56	14.24±0.76	0.55±0.01	0.45±0.02
W10	310	19.61±0.59	31.05±1.18	11.34±0.62	15.13±0.91	0.58±0.02	0.49±0.03
W11	311	21.46±1.38	33.89±2.21	11.63±1.06	14.89±1.48	0.54±0.02	0.44±0.03
W12	312	18.55±1.58	28.39±3.23	9.11±1.63	10.67±2.55	0.49±0.10	0.38±0.10
W13	313	17.94±0.13	27.21±0.98	10.20±0.25	12.93±0.95	0.57±0.01	0.48±0.02
Whole	Average	20.11±2.96	32.14±6.25	11.30±1.88	15.04±3.67	0.54±0.08	0.47±0.04
W1	2001	15.92±1.86	24.16±3.56	9.50±1.11	12.01±1.98	0.60±0.06	0.50±0.06
W2	2002	15.45±1.59	22.52±3.05	9.19±1.06	10.87±1.32	0.60±0.06	0.49±0.07
W3	2003	16.89±1.98	25.73±3.70	9.89±1.23	12.24±1.58	0.59±0.05	0.48±0.06
W4	2004	16.36±1.94	24.73±3.26	9.07±1.02	10.70±1.40	0.56±0.08	0.44±0.07
W5	2005	14.29±1.81	20.62±3.58	8.34±1.08	9.60±1.55	0.59±0.07	0.47±0.08
W6	2006	15.60±1.51	22.37±3.52	8.78±0.96	10.12±1.56	0.57±0.08	0.46±0.08
W7	2007	17.37±1.78	25.94±4.77	10.14±0.99	12.42±1.65	0.59±0.05	0.49±0.06
W8	2008	14.40±1.19	20.50±1.89	8.72±1.09	9.90±1.36	0.61±0.06	0.49±0.07
W9	2009	13.69±1.39	19.58±2.39	8.65±0.94	9.67±1.62	0.50±0.08	0.66±0.08
W10	2010	14.58±1.26	20.54±2.30	8.47±1.07	9.39±1.45	0.58±0.09	0.46±0.08
W11	2011	14.24±1.77	20.40±2.83	8.63±1.02	9.80±1.54	0.61±0.08	0.49±0.08
W12	2012	17.71±2.16	26.89±3.35	9.63±1.14	11.51±1.54	0.55±0.07	0.43±0.07
W13	2013	18.04±1.56	28.20±3.52	10.18±0.90	12.42±1.79	0.57±0.05	0.44±0.06
W14	2014	17.98±1.52	27.19±3.43	9.98±1.37	12.31±2.59	0.45±0.07	0.67±0.06
W15	2015	17.35±1.36	24.54±2.78	9.42±1.24	11.17±1.88	0.54±0.07	0.46±0.06
W16	2016	22.51±1.59	36.97±3.86	12.98±1.09	17.53±2.25	0.58±0.06	0.48±0.07
W17	2017	22.36±2.38	36.44±4.40	13.06±1.58	17.47±2.78	0.59±0.05	0.48±0.06
W18	2018	18.96±1.94	30.47±3.31	11.11±1.00	15.05±1.68	0.59±0.06	0.50±0.05
W19	2019	18.97±1.73	31.38±3.78	11.63±1.04	15.90±2.02	0.62±0.06	0.51±0.06
W20	2020	17.53±2.73	25.19±4.25	9.69±1.08	11.45±1.79	0.56±0.05	0.46±0.05
W21	2021	18.44±2.28	26.20±3.80	10.24±1.37	12.26±2.05	0.56±0.08	0.47±0.08
W22	2022	23.29±2.01	36.35±4.31	13.15±3.03	17.37±3.03	0.48±0.06	0.75±0.03
W23	2023	23.76±1.77	36.95±3.51	12.51±0.97	16.07±2.02	0.53±0.06	0.44±0.06
W24	2024	16.68±1.42	23.29±2.60	9.05±1.13	10.37±1.39	0.54±0.05	0.77±0.05
W25	2025	16.54±1.50	23.42±2.76	9.93±1.03	11.41±1.59	0.60±0.07	0.49±0.07
W26	2026	15.89±1.78	21.59±2.93	9.39±0.87	10.88±1.23	0.59±0.05	0.51±0.04

(Continued)

Table 1. (Continued)

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W27	2027	14.49±2.03	19.86±3.11	8.59±0.96	9.89±1.44	0.60±0.08	0.50±0.07
W28	2028	17.28±1.27	26.72±2.87	9.34±0.74	11.56±0.98	0.54±0.07	0.44±0.06
W29	2029	18.24±2.20	26.12±3.90	9.45±1.17	11.09±1.88	0.52±0.05	0.43±0.06
W30	2030	17.98±2.24	27.31±3.77	9.82±1.09	12.07±1.89	0.55±0.07	0.45±0.07
W31	2031	16.92±1.92	24.07±3.60	9.07±1.23	10.51±1.73	0.54±0.07	0.44±0.06
W32	2032	15.87±2.00	23.33±3.84	9.10±0.93	11.31±1.35	0.58±0.06	0.49±0.06
W33	2033	15.87±1.88	22.52±2.88	8.76±1.25	10.17±1.80	0.55±0.07	0.45±0.06
W34	2034	18.93±1.51	29.53±3.99	10.51±1.18	12.99±1.80	0.56±0.07	0.45±0.08
W35	2035	17.68±2.00	26.76±3.77	9.59±0.72	11.68±1.52	0.55±0.06	0.44±0.06
W36	2036	19.16±1.76	29.78±4.32	10.57±1.20	13.42±1.58	0.55±0.07	0.46±0.06
W37	2037	19.81±2.12	30.09±3.68	10.34±1.09	12.90±1.67	0.53±0.06	0.43±0.06
W38	2038	19.23±1.30	30.06±3.25	10.81±1.30	13.75±2.04	0.56±0.06	0.46±0.06
W39	2039	18.07±1.42	28.22±3.40	10.70±0.91	13.86±1.97	0.59±0.05	0.49±0.06
W40	2040	20.59±1.67	33.34±3.63	12.04±1.24	15.74±2.09	0.59±0.05	0.47±0.06
W41	2041	17.12±1.64	27.05±3.56	10.46±1.37	13.90±2.25	0.61±0.07	0.52±0.07
W42	2042	18.42±1.40	28.57±3.51	10.42±1.30	13.31±1.84	0.57±0.07	0.63±0.08
W43	2043	20.15±2.79	31.90±7.67	11.52±1.60	15.28±3.57	0.58±0.07	0.48±0.07
W44	2044	21.25±1.78	35.80±5.02	12.34±1.54	16.96±2.42	0.58±0.06	0.48±0.05
W45	2045	22.80±3.03	41.91±7.81	12.36±1.41	17.87±2.62	0.55±0.08	0.44±0.07
W46	2046	21.67±1.84	39.35±3.89	12.08±1.51	17.41±3.27	0.56±0.09	0.44±0.08
W47	2047	19.81±1.99	29.54±3.99	10.83±1.07	13.42±1.61	0.55±0.08	0.46±0.08
Whole	Average	18.00±2.51	27.53±5.45	10.21±1.33	12.74±2.47	0.57±0.03	0.49±0.08
Average of both groups		18.46±2.76	28.53±5.94	10.45±1.53	13.24±2.93	0.56±0.03	0.49±0.07

Table 2. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Tanzania, *O. longistaminata*, 314 in 1984 and 2048-2083 in 1988

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W14	314	23.40±1.65	41.91±4.18	13.56±1.05	20.83±2.65	0.58±0.01	0.50±0.02
W48	2048	20.54±1.86	34.56±4.28	12.69±1.25	18.00±2.35	0.62±0.07	0.53±0.07
W49	2049	17.68±2.37	26.24±4.09	11.28±1.68	13.78±2.45	0.64±0.10	0.53±0.10
W50	2050	19.37±1.59	32.04±3.91	11.76±1.21	16.51±2.09	0.61±0.07	0.52±0.08
W51	2051	26.07±5.84	48.64±14.87	14.79±3.07	22.12±7.53	0.57±0.07	0.46±0.06
W52	2052	20.69±2.38	35.09±5.04	12.48±1.65	17.96±3.33	0.61±0.06	0.51±0.07
W53	2053	20.06±2.35	34.60±5.84	12.12±1.04	16.80±2.04	0.61±0.07	0.49±0.06
W54	2054	20.55±2.34	32.29±4.97	12.01±1.06	15.19±1.73	0.59±0.06	0.48±0.06
W55	2055	18.60±2.61	28.98±3.65	10.92±1.33	14.10±1.45	0.59±0.06	0.49±0.05
W56	2056	20.14±2.77	32.23±6.18	9.46±2.45	12.01±3.72	0.47±0.10	0.37±0.08
W57	2057	23.49±3.05	40.58±6.76	12.77±2.20	18.28±3.92	0.54±0.06	0.45±0.06
W58	2058	22.37±2.38	36.72±5.46	12.29±1.05	16.48±1.77	0.55±0.07	0.45±0.06

(Continued)

Table 2. (Continued)

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W59	2059	23.10±2.47	39.12±6.33	12.76±1.68	17.74±3.41	0.56±0.07	0.46±0.07
W60	2060	22.15±2.44	38.16±5.63	11.33±1.20	15.38±2.36	0.52±0.07	0.41±0.07
W61	2061	21.92±2.03	36.28±5.38	12.21±1.30	16.01±2.16	0.56±0.08	0.45±0.08
W62	2062	20.59±1.85	33.22±4.71	11.49±1.50	14.76±2.33	0.56±0.08	0.45±0.08
W63	2063	20.18±1.54	32.13±3.94	11.77±1.17	15.58±2.53	0.59±0.07	0.49±0.08
W64	2064	19.16±1.98	30.41±3.35	10.98±1.23	14.33±1.91	0.58±0.08	0.48±0.07
W65	2065	18.65±1.71	29.17±4.30	10.86±0.97	14.23±2.05	0.58±0.05	0.49±0.04
W66	2066	17.99±1.54	28.30±3.43	9.55±0.93	12.14±1.82	0.53±0.05	0.43±0.07
W67	2067	19.61±1.66	32.40±4.26	12.35±0.97	17.12±1.91	0.63±0.06	0.53±0.05
W68	2068	17.29±1.76	27.26±4.00	10.24±0.95	13.22±1.96	0.60±0.07	0.49±0.07
W69	2069	25.16±2.62	42.54±6.18	12.31±1.70	15.56±3.47	0.49±0.08	0.37±0.09
W70	2070	19.28±1.16	31.47±3.72	11.59±1.07	15.43±2.34	0.60±0.05	0.49±0.06
W71	2071	17.76±2.02	27.34±4.16	10.32±1.28	12.62±2.29	0.59±0.08	0.47±0.07
W72	2072	20.33±1.59	33.70±3.35	11.56±1.40	15.53±2.38	0.57±0.07	0.46±0.07
W73	2073	23.15±2.76	37.09±5.30	11.82±1.90	14.55±3.52	0.51±0.06	0.39±0.08
W74	2074	19.26±2.82	31.78±6.30	11.02±1.28	14.57±2.20	0.58±0.08	0.47±0.07
W75	2075	18.95±2.30	30.78±4.76	11.10±1.47	14.60±2.51	0.59±0.09	0.48±0.07
W76	2076	19.07±1.45	31.10±3.67	11.31±1.45	15.16±2.40	0.59±0.07	0.49±0.06
W77	2077	23.22±2.45	39.96±5.20	12.73±1.32	18.02±2.48	0.55±0.06	0.45±0.06
W78	2078	19.99±2.03	33.98±4.78	11.63±1.17	16.38±2.45	0.58±0.05	0.48±0.05
W79	2079	21.43±1.62	37.41±3.75	12.27±1.33	17.23±2.61	0.58±0.07	0.46±0.07
W80	2080	18.83±1.33	30.05±2.77	11.46±0.68	15.04±1.21	0.61±0.06	0.50±0.06
W81	2081	19.13±1.89	30.41±3.45	11.04±1.27	14.23±2.23	0.58±0.08	0.47±0.08
W82	2082	18.43±1.60	27.72±3.31	10.25±1.49	12.48±2.23	0.56±0.07	0.45±0.06
W83	2083	17.62±1.80	26.78±3.98	10.47±1.08	12.78±1.38	0.60±0.05	0.48±0.06
Whole	Average	20.33±2.10	33.35±4.83	11.58±1.01	15.44±2.05	0.57±0.04	0.47±0.04
Average of both groups		20.41±2.13	33.58±4.96	11.64±1.05	15.59±2.21	0.57±0.04	0.47±0.04

that the value of group **8** was particularly large. The smallest (1.28) was noted in group **11**, followed by group **4** (1.65) and group **12** (1.88), in which the first one was the same as in case of W/T in HG.

The s.d. of the respective characters illustrated by average values of the respective groups were shown in Table 12. The largest (2.17 mm²) was obtained in group **5**, followed by group **6** (2.15 mm²) and group **11** (2.14 mm²). These orders of groups (**5**>**6**>**11**) were found to be the same as in cases of L in UHG and quotient of L. Moreover, these combinations of groups (**5**, **6** and **11**) were found to be the same as in cases of L, T, L/W and L/T in UHG, and W in HG. The smallest (0.92 mm²) was noted in group **1**, followed by group **9** (1.11 mm²) and group **12** (1.14 mm²). Averages and those s.d. in the whole strains belonging to the groups **34** and **35** were found to be 1.78±0.70 and 1.29±0.59, respectively.

2. Volumes in UHG

The values of volumes in UHG for the individual grain level ranged from 100.52 mm³ (No. 336), which was the same as in cases of L and W in UHG, to 7.35 mm³ (No.2027), in which the last one was the same as in cases of areas in UHG and W in HG. In the strain level, the largest

Table 3. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Kenya in 1985, *O. longistaminata*, 315-324

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W15	315	19.06 ± 1.54	28.82 ± 3.30	11.13 ± 1.02	13.79 ± 1.85	0.59 ± 0.06	0.48 ± 0.05
W16	316	16.91 ± 1.82	25.15 ± 3.40	9.15 ± 1.09	11.00 ± 1.73	0.55 ± 0.09	0.44 ± 0.08
W17	317	16.67 ± 1.79	23.91 ± 2.90	8.48 ± 0.96	9.92 ± 1.67	0.52 ± 0.09	0.42 ± 0.07
W18	318	23.11 ± 2.10	39.59 ± 4.43	12.28 ± 1.05	17.09 ± 1.89	0.53 ± 0.05	0.43 ± 0.04
W19	319	18.34 ± 1.76	28.53 ± 3.40	9.98 ± 0.80	12.40 ± 1.22	0.55 ± 0.06	0.44 ± 0.07
W20	320	21.02 ± 0.75	34.66 ± 0.83	11.83 ± 0.34	15.62 ± 0.58	0.56 ± 0.01	0.45 ± 0.01
W21	321	23.77 ± 0.64	39.46 ± 1.63	13.18 ± 1.05	17.93 ± 1.59	0.55 ± 0.03	0.45 ± 0.03
W22	322	22.48 ± 0.92	38.65 ± 1.43	12.61 ± 0.75	17.26 ± 0.89	0.56 ± 0.02	0.45 ± 0.02
W23	323	23.47 ± 0.83	40.62 ± 2.21	12.91 ± 0.72	18.22 ± 1.50	0.55 ± 0.03	0.45 ± 0.03
W24	324	21.35 ± 0.61	34.52 ± 1.39	12.23 ± 0.25	16.52 ± 0.38	0.57 ± 0.01	0.48 ± 0.02
Whole	Average	20.62 ± 2.56	33.39 ± 6.00	11.38 ± 1.56	14.98 ± 2.85	0.55 ± 0.02	0.45 ± 0.02

(62.70 mm³) was obtained in No.336, followed by No.335 (56.31 mm³) and No.449 (56.01 mm³). These orders of strains (336 > 335 > 449) were found to be the same as in case of W in UHG. Moreover, these combinations of strains (335, 336 and 449) were found to be the same as in cases of L and areas in UHG, and W in HG. The smallest (18.86 mm³) was noted in No.303, followed by No.2009 (19.58 mm³) and No.2011 (20.40 mm³). These orders of strains (303 < 2009 < 2011) were found to be the same as in cases of L and areas in UHG.

In the group level (Table 11), the largest (41.91 mm³) was obtained in group 4, followed by group 13 (40.59 mm³) and group 8 (37.95 mm³). These combinations of groups (4, 8 and 13) were found to be the same as in cases of L, W, T and areas in UHG, and W in HG. The smallest (27.53 mm³) was noted in group 2, followed by group 3 (28.53 mm³) and group 11 (30.69 mm³). These orders of groups (2 < 3 < 11) were found to be the same as in cases of L, W and areas in UHG. Averages and those s.d. through the whole strains belonging to the groups 34 and 35 were found to be 30.73 ± 6.16 and 34.84 ± 6.52, respectively.

In the s.d. of each strain, the largest (14.87) was obtained in No.2051, followed by No.336 (10.36) and No.335 (8.66), in which the first and the third strains were the same as in cases of L/W and areas in UHG. It was noticed that the value of No.2051 was particularly large. The smallest (0.26) was noted in No.369, followed by No.304 (0.46) and No.320 (0.83). In the group level, the largest (9.97) was obtained in group 8, followed by group 13 (8.09) and group 10 (7.40). These orders of groups (8 > 13 > 10) were found to be the same as in cases of W and areas in UHG, and L and W in HG. It was noticed that the value of group 8 was particularly large. The smallest (4.18) was noted in group 4, followed by group 12 (4.32) and group 9 (4.55). These combinations of groups (4, 9 and 12) were found to be the same as in cases of W and areas in UHG.

In the s.d. of each group (Table 12), the largest (5.68 mm³) was obtained in group 8, followed by group 5 (4.86 mm³) and group 6 (4.84 mm³). These combinations of groups (5, 6 and 8) were found to be the same as in case of T in UHG. The smallest (2.03 mm³) was noted in group 1, which was the same as in case of areas in UHG, followed by group 9 (2.31 mm³) and group 14 (2.54 mm³). These combinations of groups (1 and 9) were found to be the same as in case of T in

Table 4. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Nigeria, *O. longistaminata*, 325-336 in 1984 and 337-382 in 1985

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W25	325	17.42 ± 1.71	26.69 ± 3.83	9.93 ± 0.77	12.38 ± 1.66	0.57 ± 0.07	0.47 ± 0.07
W26	326	21.78 ± 1.10	38.49 ± 3.20	11.96 ± 0.71	17.60 ± 1.50	0.55 ± 0.03	0.46 ± 0.03
W27	327	21.40 ± 1.27	36.56 ± 2.35	12.13 ± 1.16	17.09 ± 1.95	0.57 ± 0.06	0.47 ± 0.05
W35	335	30.02 ± 3.22	56.31 ± 8.66	17.41 ± 1.90	28.37 ± 4.60	0.58 ± 0.03	0.51 ± 0.04
W36	336	32.12 ± 2.98	62.70 ± 10.36	18.77 ± 1.73	31.65 ± 4.29	0.59 ± 0.03	0.51 ± 0.04
Whole	Average	22.75 ± 7.35	37.95 ± 9.97	14.04 ± 3.42	21.42 ± 7.32	0.57 ± 0.01	0.48 ± 0.02
W37	337	24.58 ± 0.83	43.74 ± 1.45	13.55 ± 0.42	19.09 ± 0.36	0.55 ± 0.01	0.44 ± 0.01
W38	338	19.23 ± 1.36	30.12 ± 3.95	10.23 ± 1.05	13.18 ± 2.20	0.53 ± 0.03	0.44 ± 0.03
W39	339	23.58 ± 1.43	39.17 ± 3.10	10.91 ± 0.50	13.43 ± 0.80	0.47 ± 0.05	0.35 ± 0.05
W40	340	18.11 ± 0.47	31.13 ± 0.89	10.43 ± 0.20	15.12 ± 0.69	0.58 ± 0.01	0.49 ± 0.02
W41	341	21.31 ± 1.73	34.12 ± 3.39	12.04 ± 1.29	15.76 ± 1.57	0.56 ± 0.03	0.46 ± 0.02
W42	342	19.59 ± 1.18	34.27 ± 2.22	11.22 ± 0.52	16.25 ± 0.55	0.57 ± 0.01	0.48 ± 0.02
W43	343	19.02 ± 0.66	32.85 ± 1.69	11.05 ± 0.66	16.19 ± 0.75	0.58 ± 0.02	0.49 ± 0.03
W45	345	20.71 ± 1.22	36.50 ± 3.17	12.17 ± 1.21	17.53 ± 1.76	0.59 ± 0.04	0.48 ± 0.03
W46	346	19.09 ± 2.03	29.29 ± 4.32	9.92 ± 1.07	12.03 ± 1.61	0.52 ± 0.07	0.42 ± 0.07
W48	348	23.89 ± 1.28	42.10 ± 3.60	13.56 ± 1.38	19.71 ± 2.55	0.57 ± 0.03	0.47 ± 0.03
W49	349	19.16 ± 0.93	33.49 ± 1.00	10.69 ± 0.45	15.61 ± 0.85	0.56 ± 0.03	0.47 ± 0.02
W52	352	17.67 ± 1.80	26.68 ± 3.48	9.75 ± 0.97	11.93 ± 1.72	0.56 ± 0.06	0.45 ± 0.07
W54	354	17.27 ± 1.32	26.95 ± 2.84	10.11 ± 1.01	13.10 ± 1.82	0.59 ± 0.07	0.49 ± 0.07
W55	355	20.76 ± 1.61	35.98 ± 3.75	11.62 ± 0.77	16.97 ± 1.48	0.56 ± 0.04	0.47 ± 0.03
W57	357	21.87 ± 0.60	38.27 ± 1.51	12.18 ± 0.60	17.69 ± 1.38	0.56 ± 0.02	0.46 ± 0.02
W58	358	19.20 ± 0.82	33.81 ± 2.10	11.16 ± 0.53	16.76 ± 1.02	0.58 ± 0.02	0.50 ± 0.02
W60	360	19.73 ± 1.18	33.95 ± 2.49	11.37 ± 0.53	16.38 ± 0.94	0.58 ± 0.02	0.48 ± 0.03
W62	362	19.91 ± 1.07	32.22 ± 1.59	12.09 ± 1.54	16.34 ± 2.28	0.61 ± 0.06	0.51 ± 0.06
W64	364	19.04 ± 1.22	31.76 ± 1.68	11.05 ± 1.04	15.49 ± 0.74	0.58 ± 0.03	0.49 ± 0.02
W65	365	22.78 ± 0.79	39.17 ± 0.86	12.64 ± 1.02	17.94 ± 1.51	0.55 ± 0.04	0.46 ± 0.04
W69	369	24.42 ± 0.42	41.05 ± 0.26	13.22 ± 0.54	17.72 ± 0.84	0.54 ± 0.02	0.43 ± 0.02
W71	371	17.27 ± 1.96	26.70 ± 2.97	9.93 ± 0.90	12.57 ± 1.25	0.58 ± 0.07	0.47 ± 0.05
W73	373	19.76 ± 0.82	31.42 ± 1.51	10.83 ± 0.47	13.99 ± 1.19	0.55 ± 0.03	0.45 ± 0.04
W75	375	23.89 ± 1.51	39.96 ± 3.76	12.90 ± 0.56	17.05 ± 1.38	0.54 ± 0.02	0.43 ± 0.03
W77	377	20.89 ± 0.87	33.88 ± 2.44	12.02 ± 0.57	16.49 ± 1.20	0.58 ± 0.02	0.49 ± 0.02
W78	378	22.06 ± 0.93	35.76 ± 2.14	12.16 ± 0.47	16.21 ± 1.82	0.55 ± 0.02	0.45 ± 0.03
W79	379	22.94 ± 0.71	40.60 ± 1.51	12.96 ± 0.59	18.80 ± 1.08	0.57 ± 0.01	0.46 ± 0.01
W81	381	22.83 ± 0.98	38.61 ± 2.40	12.95 ± 0.35	18.27 ± 0.72	0.57 ± 0.02	0.47 ± 0.02
W82	382	20.28 ± 0.44	33.86 ± 0.87	12.13 ± 0.37	17.58 ± 0.46	0.60 ± 0.02	0.52 ± 0.02
Whole	Average	20.72 ± 2.14	34.74 ± 4.55	11.62 ± 1.11	16.11 ± 2.11	0.56 ± 0.03	0.47 ± 0.03
Average of both groups		21.28 ± 3.22	36.13 ± 7.40	11.97 ± 1.88	16.89 ± 3.90	0.56 ± 0.03	0.47 ± 0.03

Table 5. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Ivory Coast in 1984, *O. longistaminata* (384-390) and *O. breviligulata* (383)

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W84	384	16.69±2.30	25.51±4.67	9.14±1.46	11.20±2.53	0.55±0.05	0.44±0.05
W85	385	17.94±1.68	29.17±3.19	9.79±1.12	12.91±2.14	0.55±0.07	0.44±0.06
W86	386	17.71±2.77	28.50±5.41	9.80±0.75	12.58±1.54	0.56±0.08	0.45±0.08
W87	387	19.99±1.90	32.04±4.11	12.01±1.30	16.05±2.08	0.51±0.07	0.68±0.03
W88	388	19.07±2.63	31.69±5.07	10.77±1.13	14.34±2.30	0.57±0.08	0.46±0.09
W89	389	19.75±1.73	33.12±3.93	11.71±1.44	16.07±2.47	0.59±0.06	0.49±0.06
W90	390	20.46±1.98	34.79±4.39	11.54±1.14	16.01±2.20	0.46±0.06	0.68±0.03
Whole	Average	18.80±1.28	30.69±2.92	10.39±1.44	14.17±1.83	0.53±0.04	0.52±0.10
W83	383	27.82±1.30	45.99±2.94	17.74±0.66	25.83±1.70	0.64±0.02	0.56±0.02

Table 6. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Senegal in 1985, *O. longistaminata*, 391-441 in Casamance region and 444-455 in northern region

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W91	391	21.59±1.70	35.13±4.56	11.80±0.90	15.71±1.45	0.55±0.03	0.45±0.03
W92	392	22.24±0.61	37.60±2.37	12.15±0.22	17.24±0.58	0.55±0.02	0.46±0.02
W93	393	20.27±0.98	34.19±1.10	11.55±0.26	16.17±1.13	0.57±0.02	0.47±0.02
W94	394	19.44±1.26	31.50±2.10	10.98±0.61	14.46±0.40	0.57±0.04	0.46±0.04
W95	395	20.49±0.82	30.93±2.03	11.62±0.34	14.51±0.81	0.57±0.01	0.47±0.01
W96	396	20.92±0.89	31.58±1.10	11.92±0.74	15.03±1.25	0.57±0.03	0.48±0.03
W97	397	19.05±0.88	29.94±2.04	10.70±0.44	13.71±0.98	0.56±0.02	0.46±0.03
W99	399	18.00±1.69	27.61±3.70	10.17±1.38	12.48±2.31	0.57±0.08	0.45±0.07
W100	400	22.09±0.97	36.70±2.40	12.62±0.48	17.29±0.92	0.57±0.01	0.47±0.02
W101	401	20.96±2.43	34.89±6.26	11.65±1.34	15.42±2.24	0.56±0.06	0.45±0.06
W102	402	20.64±0.63	34.24±1.36	12.28±0.40	16.44±0.51	0.60±0.01	0.48±0.01
W106	406	20.89±1.53	35.07±2.52	11.70±0.57	15.91±0.91	0.56±0.03	0.46±0.03
W107	407	22.24±1.06	36.26±2.31	12.89±0.57	17.03±1.16	0.58±0.02	0.47±0.01
W108	408	20.46±1.62	32.21±3.71	11.62±1.08	15.02±1.73	0.57±0.02	0.47±0.13
W109	409	22.30±1.16	36.12±2.10	12.68±0.76	17.36±1.01	0.57±0.01	0.48±0.01
W111	411	21.01±1.06	33.86±5.32	12.32±0.64	16.78±1.61	0.59±0.03	0.50±0.03
W112	412	18.93±0.75	28.97±1.34	11.14±0.49	14.69±0.51	0.59±0.03	0.51±0.03
W114	414	24.60±0.59	42.33±1.80	13.75±0.43	19.24±0.60	0.60±0.01	0.46±0.02
W116	416	21.25±1.10	26.68±2.43	9.21±0.80	7.55±0.73	0.44±0.04	0.29±0.03
W119	419	21.01±1.08	33.61±2.16	12.19±0.60	15.88±1.61	0.58±0.03	0.47±0.03
W120	420	20.07±0.55	30.91±1.27	11.37±0.78	15.01±1.23	0.57±0.03	0.49±0.03
W123	423	21.05±0.71	35.19±2.52	11.94±0.59	16.62±1.45	0.57±0.01	0.47±0.01

(Continued)

Table 6. (Continued)

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W124	424	21.52±0.64	35.55±3.49	12.36±0.29	16.68±1.02	0.58±0.01	0.47±0.02
W126	426	17.70±2.03	24.57±1.80	8.10±0.76	7.96±2.41	0.47±0.10	0.33±0.12
W127	427	26.22±1.64	43.67±3.20	16.00±0.82	23.72±1.54	0.61±0.01	0.54±0.02
W129	429	26.23±1.29	45.05±2.23	16.14±0.55	24.91±1.02	0.62±0.02	0.55±0.02
W131	431	20.63±1.10	34.03±2.70	12.55±0.82	17.34±1.80	0.61±0.02	0.51±0.02
W133	433	20.94±1.63	32.21±2.46	11.31±0.41	14.49±1.08	0.54±0.05	0.45±0.05
W134	434	19.70±0.77	31.73±2.13	11.76±0.53	15.77±1.07	0.60±0.03	0.50±0.02
W135	435	19.24±1.67	30.36±2.35	10.57±0.98	13.70±1.02	0.55±0.02	0.45±0.01
W136	436	19.44±1.59	29.43±3.41	11.01±1.06	13.89±1.48	0.57±0.03	0.47±0.03
W137	437	19.46±0.80	31.42±3.66	10.80±0.55	13.65±1.45	0.56±0.01	0.44±0.02
W139	439	20.51±1.19	30.92±1.55	11.14±0.82	13.93±1.39	0.54±0.02	0.45±0.03
W140	440	18.52±0.73	29.96±1.68	10.56±0.67	14.09±0.93	0.57±0.02	0.47±0.02
W141	441	19.95±0.79	30.12±1.34	10.53±0.79	12.95±1.02	0.53±0.03	0.43±0.03
Whole	Average	20.85±1.88	33.27±4.32	11.75±1.49	15.50±3.16	0.57±0.03	0.46±0.05
W144	444	22.54±1.41	36.31±2.77	13.00±0.70	17.19±1.77	0.58±0.01	0.47±0.02
W147	447	19.85±1.04	30.18±1.67	10.63±0.67	13.10±1.18	0.54±0.04	0.44±0.05
W149	449	32.07±2.10	56.01±3.90	20.01±1.14	31.28±3.21	0.63±0.03	0.56±0.04
W151	451	20.22±1.94	32.55±3.12	11.55±0.95	15.60±1.38	0.57±0.02	0.48±0.02
W152	452	25.28±0.63	45.76±1.56	14.35±0.19	20.81±0.44	0.57±0.01	0.46±0.02
W154	454	23.43±1.57	42.00±3.88	13.53±0.75	19.08±1.26	0.58±0.01	0.46±0.02
W155	455	24.05±0.91	41.31±1.34	13.27±0.69	18.94±0.87	0.55±0.02	0.46±0.01
Whole	Average	23.92±3.79	40.59±8.09	13.76±2.80	19.43±5.38	0.57±0.03	0.48±0.04
Average of both groups		21.36±2.58	34.49±5.82	12.08±1.93	16.16±3.91	0.57±0.03	0.47±0.05

HG. Averages and those s.d. in the whole strains belonging to the groups **34** and **35** were found to be 3.77 ± 1.71 and 2.81 ± 1.59 , respectively.

3. Areas in HG

The values of areas in HG for the individual grain level ranged from 22.48 mm^2 (No.336), which was the same as in cases of L, W, T and volumes in UHG, and T in HG, to 6.00 mm^2 (No.2033). In the strain level, the widest (20.01 mm^2) was obtained in No.449, followed by No.336 (18.77 mm^2) and No.335 (17.41 mm^2). These orders of strains ($449 > 336 > 335$) were found to be the same as in case of L in UHG. Moreover, these combinations of strains (335, 336 and 449) were found to be the same as in cases of W, areas and volumes in UHG. The narrowest (7.72 mm^2) was noted in No.303, which was the same as in cases of L, areas and volumes in UHG, followed by No.426 (8.10 mm^2) and No.2005 (8.34 mm^2).

In the group level (Table 11), the widest (14.04 mm^2) was obtained in group **8**, followed by group **13** (13.76 mm^2) and group **4** (13.56 mm^2). These combinations of groups (**4**, **8** and **13**) were found to be the same as in cases of L, W/T, areas and volumes in UHG, and L in HG. The narrowest (10.21 mm^2) was noted in group **2**, followed by group **11** (10.39 mm^2) and group **3** (10.45 mm^2). These combinations of groups (**2**, **3** and **11**) were also found to be the same as in cases of L, W, areas and volumes in UHG, and L in HG. Averages and those s.d. through the whole strains belonging to the groups **34** and **35** were found to be 10.95 ± 1.50 and 11.92 ± 1.89 , respec-

Table 7. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Nigeria, *O. breviligulata*, 328-334 in 1984 and 344-380 in 1985

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W28	328	30.46 ± 2.98	68.86 ± 7.75	19.22 ± 1.80	38.29 ± 4.01	0.63 ± 0.02	0.56 ± 0.02
W29	329	27.76 ± 2.88	56.78 ± 5.93	17.40 ± 1.91	31.54 ± 3.73	0.63 ± 0.02	0.56 ± 0.03
W30	330	28.87 ± 1.54	61.62 ± 4.48	17.79 ± 0.92	33.57 ± 2.14	0.62 ± 0.01	0.55 ± 0.01
W31	331	29.01 ± 2.30	59.38 ± 5.39	17.33 ± 1.27	31.79 ± 2.67	0.60 ± 0.02	0.54 ± 0.02
W32	332	32.88 ± 1.56	62.48 ± 4.42	19.37 ± 0.98	31.99 ± 2.86	0.59 ± 0.03	0.51 ± 0.03
W33	333	35.75 ± 1.70	72.37 ± 3.50	21.72 ± 1.08	39.70 ± 1.85	0.61 ± 0.01	0.55 ± 0.02
W34	334	31.86 ± 1.60	57.78 ± 2.57	18.58 ± 0.91	30.13 ± 1.54	0.58 ± 0.02	0.52 ± 0.02
Whole	Average	30.94 ± 2.57	62.75 ± 5.38	18.77 ± 1.43	33.85 ± 3.40	0.61 ± 0.02	0.54 ± 0.02
W44	344	32.74 ± 1.12	65.55 ± 2.71	19.76 ± 0.90	33.63 ± 2.62	0.60 ± 0.03	0.51 ± 0.04
W47	347	27.66 ± 1.36	53.69 ± 3.87	16.95 ± 0.90	29.07 ± 1.97	0.61 ± 0.02	0.54 ± 0.02
W50	350	28.51 ± 1.26	51.85 ± 2.97	18.31 ± 0.77	29.83 ± 1.90	0.64 ± 0.01	0.58 ± 0.02
W51	351	25.73 ± 1.21	45.52 ± 4.01	15.52 ± 0.85	23.71 ± 2.48	0.60 ± 0.03	0.52 ± 0.03
W53	353	27.09 ± 2.47	53.24 ± 5.18	16.69 ± 1.34	28.55 ± 2.29	0.62 ± 0.02	0.54 ± 0.02
W56	356	31.82 ± 1.95	63.10 ± 4.96	19.33 ± 0.95	32.50 ± 2.08	0.61 ± 0.02	0.52 ± 0.03
W59	359	29.04 ± 1.97	53.79 ± 3.81	18.16 ± 1.08	29.88 ± 1.94	0.63 ± 0.02	0.56 ± 0.02
W61	361	31.43 ± 1.71	63.41 ± 4.31	19.21 ± 0.94	33.01 ± 2.74	0.61 ± 0.03	0.52 ± 0.03
W63	363	32.48 ± 1.49	60.58 ± 4.30	19.67 ± 1.02	31.81 ± 3.22	0.61 ± 0.03	0.53 ± 0.03
W66	366	34.35 ± 1.42	66.23 ± 3.74	21.11 ± 0.85	35.44 ± 2.59	0.62 ± 0.03	0.54 ± 0.04
W67	367	23.17 ± 2.08	36.03 ± 4.90	14.48 ± 1.35	20.21 ± 3.00	0.63 ± 0.02	0.56 ± 0.03
W68	368	25.07 ± 1.98	39.57 ± 3.79	15.36 ± 1.09	21.37 ± 1.97	0.61 ± 0.03	0.54 ± 0.02
W70	370	27.13 ± 1.31	47.14 ± 2.36	16.74 ± 0.75	26.33 ± 1.38	0.62 ± 0.02	0.56 ± 0.02
W72	372	25.91 ± 1.23	46.17 ± 3.44	15.77 ± 0.88	25.46 ± 2.07	0.61 ± 0.01	0.55 ± 0.02
W74	374	30.07 ± 2.41	59.24 ± 4.62	18.48 ± 1.27	31.87 ± 2.82	0.62 ± 0.02	0.54 ± 0.03
W76	376	30.39 ± 1.83	60.71 ± 3.92	17.80 ± 1.17	30.76 ± 2.56	0.59 ± 0.02	0.51 ± 0.03
W80	380	31.97 ± 1.62	66.95 ± 5.13	19.48 ± 1.14	36.18 ± 3.45	0.61 ± 0.03	0.54 ± 0.04
Whole	Average	29.09 ± 3.06	54.99 ± 9.12	17.81 ± 1.81	29.39 ± 4.50	0.61 ± 0.01	0.54 ± 0.02
Average of both groups		29.63 ± 3.04	57.25 ± 8.94	18.09 ± 1.76	30.69 ± 4.67	0.61 ± 0.01	0.54 ± 0.02

tively.

In the s.d. of each strain, the largest (3.07) was obtained in No.2051, which was the same as in cases of areas and volumes in UHG, followed by No.2022 (3.03) and No.2056 (2.45). The smallest (0.19) was noted by No.452, followed by No.340 (0.20) and No.392 (0.22). In the group level, the largest (3.42) was obtained in group 8, which was the same as in cases of areas and volumes in UHG, followed by group 13 (2.80) and group 14 (1.93). It was noticed that the value of group 8 was particularly large. The smallest (1.01) was noted in group 5, followed by groups 4 and 6 (1.05).

In the s.d. of each group (Table 12), the largest (1.38 mm²) was obtained in group 5, followed by group 6 (1.37 mm²) and group 8 (1.25 mm²). These combinations of groups (5, 6 and 8) were found to be the same as in cases of T and volumes in UHG. The smallest (0.67 mm²) was noted in group 12, followed by group 14 (0.68 mm²), and groups 1 and 13 (0.73 mm²). Averages and

Table 8. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Senegal in 1985, *O. breviligulata*, 398-442 in Casamance region and 443-456 in northern region; *O. brachyantha*, 475

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W98	398	25.83±1.03	48.32±2.88	15.21±0.28	24.78±1.04	0.59±0.02	0.51±0.02
W103	403	23.96±1.55	45.64±3.54	15.02±0.90	25.27±2.00	0.63±0.02	0.55±0.02
W104	404	28.28±1.35	51.62±3.18	17.71±0.67	28.35±2.00	0.63±0.02	0.55±0.02
W105	405	23.69±1.75	43.41±3.51	14.62±1.02	23.66±2.06	0.62±0.02	0.55±0.02
W110	410	29.40±1.21	50.26±2.60	17.79±0.79	26.17±1.86	0.61±0.01	0.52±0.01
W113	413	28.68±1.26	54.47±2.32	18.22±1.06	30.61±1.79	0.64±0.02	0.56±0.02
W115	415	29.06±1.21	53.69±2.80	17.84±0.71	29.55±1.44	0.61±0.02	0.55±0.02
W117	417	25.34±0.31	49.92±1.23	16.41±0.34	28.38±1.27	0.65±0.01	0.57±0.01
W118	418	27.96±1.51	47.81±2.76	17.66±1.04	28.00±2.23	0.63±0.02	0.59±0.03
W121	421	25.86±1.28	49.87±3.30	16.21±1.12	27.64±2.73	0.63±0.03	0.55±0.03
W122	422	26.26±0.46	45.42±1.07	15.67±0.44	23.65±0.62	0.60±0.02	0.52±0.01
W125	425	29.32±1.46	51.39±3.27	18.47±0.85	28.38±2.12	0.63±0.03	0.55±0.03
W128	428	19.64±1.63	25.42±1.79	9.71±1.07	8.74±1.98	0.50±0.06	0.35±0.08
W130	430	24.05±1.71	42.01±4.02	14.88±0.85	23.25±1.90	0.62±0.02	0.56±0.03
W132	432	25.78±1.60	44.99±3.10	15.83±1.11	24.74±2.35	0.61±0.02	0.55±0.03
W138	438	27.15±1.00	46.18±2.32	15.66±0.41	23.02±0.48	0.58±0.03	0.50±0.03
W142	442	25.19±1.56	40.82±3.55	15.03±1.15	20.58±2.54	0.60±0.04	0.50±0.04
Whole	Average	26.20±2.47	46.54±6.50	16.00±2.02	24.99±4.84	0.61±0.03	0.53±0.05
W143	443	25.91±0.95	49.73±2.14	16.23±0.76	27.65±1.93	0.63±0.03	0.56±0.03
W145	445	26.33±1.40	50.37±3.19	16.64±0.79	28.03±1.51	0.63±0.02	0.56±0.02
W146	446	27.66±1.39	55.75±3.67	16.60±0.76	29.60±2.10	0.60±0.02	0.53±0.03
W148	448	24.65±1.45	48.07±3.58	15.31±0.81	26.84±2.04	0.62±0.02	0.56±0.03
W150	450	31.94±1.94	59.69±3.43	19.46±1.20	32.46±1.71	0.61±0.02	0.54±0.02
W153	453	26.61±1.22	50.18±2.98	16.08±0.70	26.38±1.56	0.60±0.01	0.53±0.02
W156	456	26.27±1.67	48.91±4.13	15.64±1.07	25.38±3.02	0.60±0.03	0.52±0.04
Whole	Average	27.05±2.16	51.81±3.95	16.57±1.26	28.05±2.18	0.61±0.01	0.54±0.02
Average of both groups		26.45±2.42	48.08±6.34	16.16±1.85	25.88±4.46	0.61±0.03	0.54±0.04
W175	475	16.40±0.96	22.93±2.44	11.04±0.84	13.96±2.13	0.67±0.04	0.61±0.06

those s.d. in the whole strains belonging to the groups **34** and **35** were found to be 1.16 ± 0.44 and 0.78 ± 0.36 , respectively.

4. Volumes in HG

The values of volumes in HG for the individual grain level ranged from 40.77 mm^3 (No.2051), which was the same as in case of areas in UHG, to 5.88 mm^3 (No.312). In the strain level, the largest (31.65 mm^3) was obtained in No.336, followed by No.449 (31.28 mm^3) and No.335 (28.37 mm^3). These orders of strains ($336 > 449 > 335$) were found to be the same as in case of areas in UHG. Moreover, these combinations of strains (335, 336 and 449) were found to be the same as in cases of L, W and volumes in UHG, W and areas in HG. The smallest (7.55 mm^3) was noted in No.416, followed by No.426 (7.96 mm^3) and No.303 (8.68 mm^3). These combinations of

Table 9. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Tanzania, *O. punctata*, 457-459 in 1984 and 2084-2109 in 1988

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W157	457	16.58±1.79	25.72±3.35	9.84±0.52	13.43±1.22	0.60±0.04	0.53±0.05
W158	458	15.62±0.77	24.67±2.53	9.28±0.58	12.55±1.10	0.59±0.04	0.51±0.06
W159	459	15.76±0.74	24.57±2.10	9.74±0.40	12.82±0.80	0.62±0.03	0.52±0.04
Whole	Average	15.99±0.42	25.32±0.46	9.62±0.24	12.93±0.37	0.60±0.01	0.52±0.01
W84	2084	13.43±0.78	19.81±1.61	8.23±1.17	9.91±1.53	0.61±0.10	0.50±0.08
W85	2085	14.93±1.28	24.08±2.39	9.87±0.80	13.09±1.50	0.66±0.15	0.54±0.05
W86	2086	13.42±1.18	20.23±2.05	7.89±1.17	9.48±1.92	0.59±0.10	0.47±0.10
W87	2087	14.43±1.41	22.90±2.34	9.00±0.91	12.00±1.57	0.63±0.06	0.53±0.06
W88	2088	14.22±1.63	22.58±3.24	9.35±1.07	12.34±1.87	0.66±0.08	0.54±0.07
W89	2089	12.07±1.14	17.57±2.20	7.14±1.30	8.61±1.70	0.59±0.08	0.49±0.07
W90	2090	11.67±1.25	16.71±2.30	7.22±0.85	8.60±1.24	0.62±0.07	0.52±0.07
W91	2091	14.00±1.62	21.05±2.91	8.42±1.12	10.27±1.54	0.61±0.12	0.50±0.10
W92	2092	13.89±1.43	20.81±2.26	8.02±0.97	9.39±1.41	0.58±0.08	0.45±0.07
W93	2093	14.09±1.49	21.17±3.15	8.49±0.93	10.09±1.16	0.61±0.07	0.48±0.07
W94	2094	14.26±1.61	21.03±2.87	8.22±1.04	9.71±1.54	0.58±0.08	0.46±0.06
W95	2095	13.18±1.38	20.91±2.41	8.62±0.76	11.25±1.53	0.66±0.06	0.54±0.06
W96	2096	13.05±1.62	19.94±3.00	8.30±1.00	10.56±1.43	0.64±0.07	0.53±0.06
W97	2097	12.76±1.14	18.83±1.75	7.44±0.64	8.97±0.76	0.48±0.06	0.60±0.06
W98	2098	15.55±1.00	25.08±2.10	8.75±1.07	11.74±1.63	0.56±0.06	0.47±0.06
W99	2099	13.28±1.26	20.50±1.96	8.07±0.92	10.53±1.51	0.61±0.05	0.51±0.05
W100	2100	13.35±1.06	20.18±1.54	8.24±0.89	10.26±1.13	0.62±0.08	0.51±0.06
W101	2101	14.28±1.36	21.36±2.04	8.73±0.83	10.86±1.31	0.62±0.08	0.51±0.08
W102	2102	15.93±1.37	22.94±2.79	8.99±1.01	10.49±1.57	0.57±0.06	0.46±0.07
W103	2103	14.18±1.51	20.76±2.67	8.60±0.94	10.47±1.43	0.61±0.07	0.51±0.07
W104	2104	14.02±1.30	20.50±2.00	8.42±0.67	10.16±0.98	0.61±0.07	0.50±0.06
W105	2105	12.23±1.07	17.51±1.79	7.42±0.81	8.74±1.07	0.61±0.08	0.50±0.08
W106	2106	12.78±1.34	19.42±2.84	7.89±0.84	9.83±1.35	0.62±0.08	0.51±0.07
W107	2107	13.43±1.50	21.11±2.62	8.27±0.96	10.87±1.56	0.62±0.07	0.52±0.06
W108	2108	13.34±1.20	20.17±2.42	7.70±0.80	9.11±1.00	0.58±0.07	0.46±0.06
W109	2109	13.53±1.24	19.96±2.27	8.09±1.03	9.75±1.33	0.60±0.06	0.49±0.07
Whole	Average	13.67±0.96	20.67±1.86	8.28±0.62	10.27±1.12	0.61±0.04	0.50±0.03
Average of both groups		13.91±1.16	21.12±2.21	8.42±0.72	10.55±1.34	0.61±0.03	0.51±0.03

strains (416 and 426) were found to be the same as in case of T in HG.

In the group level (Table 11), the largest (21.42 mm³) was obtained in group **8**, followed by group **4** (20.83 mm³) and group **13** (19.43 mm³). These combinations of groups (**4**, **8** and **13**) were found to be the same as in cases of L, W, T, areas and volumes in UHG, and L, W and areas in HG. The smallest (12.74 mm³) was noted in group **2**, followed by group **3** (13.24 mm³) and group **11** (14.17 mm³). These orders of groups (**2**<**3**<**11**) were found to be the same as in cases of L, W, areas and volumes in UHG, and W in HG, and these combinations of groups (**2**, **3** and **11**) were

Table 10. Six morphological characters of the unhusked and the husked grains illustrated by the area (= length x width), the volume (= length x width x thickness), the area and volume quotients (= ratio of value of husked to value of unhusked grains); collected in Kenya, *O. punctata*, 460-464 in 1984 and 465-474 in 1985

Collection No.	Accession No.	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
W160	460	14.66±2.01	22.48±4.46	8.38±0.57	10.15±1.48	0.58±0.06	0.46±0.08
W161	461	14.30±0.88	21.22±3.89	8.29±0.45	9.14±1.04	0.58±0.04	0.44±0.08
W162	462	16.02±1.43	24.70±4.34	9.26±0.66	11.24±1.42	0.58±0.04	0.46±0.05
W163	463	17.41±1.75	27.45±3.80	10.24±0.68	14.00±1.35	0.59±0.05	0.52±0.08
W164	464	16.35±1.36	24.45±2.54	9.50±0.71	12.79±1.60	0.58±0.03	0.52±0.03
Whole	Average	15.75±1.14	24.06±2.13	9.13±0.73	11.46±1.75	0.58±0.00	0.48±0.03
W165	465	16.26±1.98	25.42±3.16	8.78±0.87	10.85±1.43	0.54±0.05	0.43±0.05
W166	466	14.94±1.36	23.70±1.96	8.98±0.66	11.74±1.09	0.60±0.03	0.50±0.04
W167	467	14.84±1.30	22.23±3.43	8.96±0.58	10.12±1.24	0.61±0.04	0.46±0.05
W168	468	12.32±1.05	18.17±2.40	7.97±0.88	9.16±1.52	0.65±0.04	0.51±0.06
W169	469	13.72±1.13	19.36±3.41	7.60±0.65	8.03±1.03	0.56±0.05	0.42±0.07
W170	470	14.13±1.52	22.09±3.47	7.98±0.78	10.62±1.09	0.57±0.04	0.49±0.07
W171	471	13.89±1.56	21.52±3.08	8.32±0.85	11.02±1.30	0.60±0.04	0.52±0.06
W172	472	14.05±1.14	21.06±2.68	8.44±0.66	9.91±1.15	0.60±0.04	0.47±0.05
W173	473	17.95±0.99	28.30±1.91	10.34±0.70	12.38±1.02	0.58±0.03	0.44±0.03
W174	474	17.26±1.81	26.62±1.80	9.64±0.48	11.92±0.43	0.56±0.06	0.45±0.03
Whole	Average	14.94±1.65	22.85±3.02	8.70±0.79	10.58±1.26	0.59±0.03	0.47±0.03
Average of both groups		15.21±1.54	23.25±2.81	8.85±0.80	10.87±1.50	0.59±0.03	0.47±0.03

found to be the same as in case of areas in HG. Averages and those s.d. through the whole strains belonging to the groups **34** and **35** were found to be 14.22 ± 2.92 and 16.14 ± 4.05 , respectively.

In the s.d. of each strain, the largest (7.53) was obtained in No.2051, followed by No.335 (4.60) and No.336 (4.29). It was noticed that No.2051 showed very large value. These combinations of strains (335, 336 and 2051) were found to be the same as in case of volumes in UHG. The smallest (0.36) was noted in No.337, followed by No.324 (0.38) and No.394 (0.40). In the group level, the largest (7.32) was obtained in group **8**, which was particularly large, followed by group **13** (5.38) and group **14** (3.91). These orders of groups (**8**>**13**>**14**) were found to be the same as in cases of W and areas in HG. The smallest (1.83) was noted in group **11**, which was the same as in case of areas in UHG, followed by group **5** (2.05) and group **9** (2.11). These combinations of groups (**5**, **9** and **11**) were found to be the same as in case of T in UHG.

In the s.d. of each group (Table 12), the largest (2.80 mm³) was obtained in group **8**, which was the same as in case of volumes in UHG, followed by group **4** (2.65 mm³) and group **6** (2.52 mm³). The smallest (1.21 mm³) was noted in groups **1** and **12**, followed by group **14** (1.25 mm³), in which groups **1** and **12** were found to be the same as in cases of volumes in UHG. Averages and those s.d. in the whole strains belonging to the groups **34** and **35** were found to be 1.96 ± 0.88 and 1.43 ± 0.76 , respectively.

5. Quotients in areas

The values of quotient in areas for the individual grain level ranged from 0.81 (No.2046) to 0.31 (Nos.312 and 2056), in which No.312 was the same as in case of volumes in HG. In the strain

Table 11. Six morphological characters of unhusked and husked grains illustrated by area, volume and quotients of the respective groups. Group marks were noted in the text.

Country	Group mark	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
MD	1	20.11±2.96	32.14±6.25	11.30±1.88	15.04±3.67	0.54±0.08	0.47±0.04
	2	18.00±2.51	27.53±5.45	10.21±1.33	12.74±2.47	0.57±0.03	0.49±0.08
	3	18.46±2.76	28.53±5.94	10.45±1.53	13.24±2.93	0.56±0.03	0.49±0.07
TA	4	23.40±1.65	41.91±4.18	13.56±1.05	20.83±2.65	0.58±0.01	0.50±0.02
	5	20.33±2.10	33.35±4.83	11.58±1.01	15.44±2.05	0.57±0.04	0.47±0.04
	6	20.41±2.13	33.58±4.96	11.64±1.05	15.59±2.21	0.57±0.04	0.47±0.04
KE	7	20.62±2.56	33.39±6.00	11.38±1.56	14.98±2.85	0.55±0.02	0.45±0.02
NI	8	22.75±7.35	37.95±9.97	14.04±3.42	21.42±7.32	0.57±0.01	0.48±0.02
	9	20.72±2.14	34.74±4.55	11.62±1.11	16.11±2.11	0.56±0.03	0.47±0.03
	10	21.28±3.22	36.13±7.40	11.97±1.88	16.89±3.90	0.56±0.03	0.47±0.03
IV	11	18.80±1.28	30.69±2.92	10.39±1.44	14.17±1.83	0.53±0.04	0.52±0.10
SE	12	20.85±1.88	33.27±4.32	11.75±1.49	15.50±3.16	0.57±0.03	0.46±0.05
	13	23.92±3.79	40.59±8.09	13.76±2.80	19.43±5.38	0.57±0.03	0.48±0.04
	14	21.36±2.58	34.49±5.82	12.08±1.93	16.16±3.91	0.57±0.03	0.47±0.05
SUM	15	20.96±2.87	34.44±6.52	11.81±1.87	16.03±3.79	0.56±0.03	0.47±0.05
	16	20.11±2.92	32.52±6.64	11.37±1.75	15.11±3.50	0.57±0.03	0.48±0.06
NI	17	30.94±2.57	62.75±5.38	18.77±1.43	33.85±3.40	0.61±0.02	0.54±0.02
	18	29.09±3.06	54.99±9.12	17.81±1.81	29.39±4.50	0.61±0.01	0.54±0.02
	19	29.63±3.04	57.25±8.94	18.09±1.76	30.69±4.67	0.61±0.01	0.54±0.02
IV	20	27.82±1.30	45.99±2.94	17.74±0.66	25.83±1.70	0.64±0.02	0.56±0.02
SE	21	26.20±2.47	46.54±6.50	16.00±2.02	24.99±4.84	0.61±0.03	0.53±0.05
	22	27.05±2.16	51.81±3.95	16.57±1.26	28.05±2.18	0.61±0.01	0.54±0.02
	23	26.45±2.42	48.08±6.34	16.16±1.85	25.88±4.46	0.61±0.03	0.54±0.04
SUM	24	27.57±4.77	52.49±8.98	17.10±2.03	28.23±5.12	0.61±0.02	0.54±0.03
TA	25	15.99±0.42	25.32±0.46	9.62±0.24	12.93±0.37	0.60±0.01	0.52±0.01
	26	13.67±0.96	20.67±1.86	8.28±0.62	10.27±1.12	0.61±0.04	0.50±0.03
	27	13.91±1.16	21.12±2.21	8.42±0.72	10.55±1.34	0.61±0.03	0.51±0.03
KE	28	15.75±1.14	24.06±2.13	9.13±0.73	11.46±1.75	0.58±0.00	0.48±0.03
	29	14.94±1.65	22.85±3.02	8.70±0.79	10.58±1.26	0.59±0.03	0.47±0.03
	30	15.21±1.54	23.25±2.81	8.85±0.80	10.87±1.50	0.59±0.03	0.47±0.03
SUM	31	15.34±1.45	23.54±2.66	8.97±0.79	11.22±1.58	0.59±0.02	0.48±0.04
	32	14.35±1.44	21.84±2.63	8.57±0.77	10.66±1.41	0.60±0.03	0.50±0.04
SE	33	16.40±0.96	22.93±2.44	11.04±0.84	13.96±2.13	0.67±0.04	0.61±0.06

level, the largest (0.64) was obtained in No.2049, followed by Nos.449 and 2067(0.63), in which No.449 was the same as in cases of areas and volumes in UHG and HG. The smallest (0.44) was noted in No.416, which was the same as in cases of T in UHG, T, W/T and volumes in HG, followed by No.2014(0.45) and No.390(0.46).

In the group level (Table 11), the largest (0.58) was obtained in group 4, which was the same as in cases of T and volumes in UHG, followed by 7 groups. The smallest (0.53) was noted in group 11, which was the same as in case of W/T in UHG, followed by group 1(0.54) and group 7(0.55). Averages and those s.d. through the whole strains belonging to the groups 34 and 35 were

Table 12. Standard deviations of areas, volumes and quotients of the respective groups. Group marks were noted in the text.

Country	Group mark	Unhusked		Husked		Quotient	
		Area (mm ²)	Volume (mm ³)	Area (mm ²)	Volume (mm ³)	Area	Volume
MD	1	0.92±0.49	2.03±0.81	0.73±0.35	1.21±0.57	0.03±0.03	0.03±0.03
	2	1.82±0.40	3.66±1.06	1.16±0.38	1.87±0.52	0.07±0.01	0.07±0.01
	3	1.63±0.56	3.30±1.22	1.06±0.41	1.73±0.60	0.06±0.02	0.06±0.02
TA	4	1.65±0.00	4.18±0.00	1.05±0.00	2.65±0.00	0.01±0.00	0.02±0.00
	5	2.17±0.78	4.86±1.97	1.38±0.45	2.51±1.05	0.07±0.02	0.07±0.01
	6	2.15±0.77	4.84±1.95	1.37±0.45	2.52±1.04	0.07±0.02	0.07±0.01
KE	7	1.28±0.55	2.49±1.10	0.80±0.29	1.33±0.51	0.05±0.03	0.04±0.02
NI	8	2.06±0.88	5.68±3.21	1.25±0.49	2.80±1.35	0.04±0.02	0.05±0.01
	9	1.11±0.44	2.31±1.07	0.74±0.34	1.26±0.55	0.03±0.02	0.03±0.02
IV	10	1.25±0.62	2.80±1.98	0.82±0.41	1.49±0.91	0.03±0.02	0.03±0.02
	11	2.14±0.40	4.40±0.69	1.19±0.22	2.18±0.30	0.07±0.01	0.06±0.02
SE	12	1.14±0.45	2.60±1.02	0.67±0.27	1.21±0.49	0.03±0.02	0.03±0.03
	13	1.37±0.50	2.53±1.15	0.73±0.27	1.44±0.82	0.02±0.01	0.03±0.01
	14	1.18±0.47	2.54±1.13	0.68±0.27	1.25±0.56	0.03±0.02	0.03±0.03
SUM	15	1.25±0.59	2.69±1.50	0.78±0.35	1.40±0.73	0.03±0.02	0.04±0.02
	16	1.56±0.70	3.34±1.73	0.99±0.45	1.73±0.87	0.05±0.03	0.05±0.03
NI	17	2.08±0.59	4.86±1.57	1.27±0.39	2.69±0.86	0.02±0.01	0.02±0.01
	18	1.67±0.41	4.00±0.80	1.02±0.18	2.42±0.52	0.02±0.01	0.03±0.01
	19	1.79±0.51	4.25±1.15	1.09±0.29	2.50±0.65	0.02±0.01	0.03±0.01
IV	20	1.30±0.00	2.94±0.00	0.66±0.00	1.70±0.00	0.02±0.00	0.02±0.00
SE	21	1.29±0.39	2.78±0.80	0.81±0.28	1.79±0.61	0.02±0.01	0.03±0.02
	22	1.43±0.29	3.30±0.58	0.87±0.17	1.98±0.47	0.02±0.01	0.03±0.01
	23	1.33±0.37	2.93±0.78	0.83±0.26	1.85±0.58	0.02±0.01	0.03±0.01
SUM	24	1.56±0.50	3.58±1.18	0.95±0.30	2.16±0.69	0.02±0.01	0.03±0.01
TA	25	1.10±0.49	2.66±0.52	0.50±0.08	1.04±0.18	0.04±0.01	0.05±0.01
	26	1.31±0.21	2.37±0.46	0.94±0.15	1.41±0.27	0.07±0.02	0.07±0.01
	27	1.29±0.26	2.40±0.48	0.90±0.20	1.37±0.28	0.07±0.02	0.07±0.01
KE	28	1.49±0.38	3.81±0.68	0.61±0.09	1.38±0.19	0.04±0.01	0.06±0.02
	29	1.39±0.32	2.73±0.64	0.71±0.13	1.13±0.28	0.04±0.01	0.05±0.01
	30	1.42±0.34	3.09±0.83	0.68±0.13	1.21±0.28	0.04±0.01	0.06±0.02
SUM	31	1.37±0.39	3.02±0.80	0.65±0.14	1.18±0.27	0.04±0.01	0.05±0.02
	32	1.34±0.30	2.63±0.70	0.82±0.21	1.32±0.29	0.06±0.02	0.06±0.02
SE	33	0.96±0.00	2.44±0.00	0.84±0.00	2.13±0.00	0.04±0.00	0.06±0.00

found to be 0.57 ± 0.04 and 0.56 ± 0.03 , respectively.

In the s.d. of each strain, the largest (0.10) was obtained in Nos.312, 426, 2049 and 2056. The smallest (0.01) was noted in 24 strains (No.301 and others). In the group level, the largest (0.08) was obtained in group 1. The smallest (0.01) was noted in groups 4 and 8, followed by group 7 (0.02), in which group 4 was the same as in case of volumes in UHG.

In the s.d. of each group (Table 12), the largest (0.07) was obtained in groups 2, 5, 6 and 11. These combinations of groups (2, 5 and 6) were found to be the same as in cases of L and W/T in UHG, L/T and W/T in HG. The smallest (0.01) was noted in group 4, followed by group

13(0.02). These combinations of groups (**4** and **13**) were found to be the same as in cases of **W** and **L/W** in **HG**. Averages and those s.d. in the whole strains belonging to the groups **34** and **35** were found to be 0.06 ± 0.02 and 0.03 ± 0.02 , respectively.

6. Quotients in volumes

The values of quotient in volumes for the individual grain level ranged from 0.69 (No.2048) to 0.19 (No.312), in which the latter was the same as in cases of volumes in **HG** and quotient in areas. In the strain level, the largest (0.77) was obtained in No.2024, followed by No.2022 (0.75), and Nos.387 and 390 (0.68). The smallest (0.29) was noted in No.416, which was the same as in cases of **T** in **UHG**, **T** and volumes in **HG**, and quotient in areas, followed by No.426 (0.33) and No.339 (0.35).

In the group level (Table 11), the largest (0.52) was obtained in group **11**, followed by group **4** (0.50), and groups **2** and **3** (0.49). The smallest (0.45) was noted in group **7**, followed by group **12** (0.46). Averages and those s.d. through the whole strains belonging to the groups **34** and **35** were found to be 0.48 ± 0.06 and 0.47 ± 0.05 , respectively.

In the s.d. of each strain, the largest (0.13) was obtained in No.408, followed by No.426 (0.12), and Nos.312 and 2049 (0.10), in which the latter 3 strains were the same as in case of quotient in areas. The smallest (0.01) was noted in 13 strains (No.301 and others). In the group level, the largest (0.10) was obtained in group **11**, followed by group **2** (0.08) and group **3** (0.07). The smallest (0.02) was noted in groups **4**, **7** and **8**. These combinations of groups (**4**, **7** and **8**) were found to be the same as in case of quotient in areas.

In the s.d. of each group (Table 12), the largest (0.07) was obtained in groups **2**, **5** and **6**. These combinations of groups (**2**, **5** and **6**) were found to be the same as in cases of **T** and **W/T** in **UHG**, **L/T** and **W/T** in **HG**, and quotient in areas. The smallest (0.02) was noted in group **4**, which was also the same as in case of quotient in areas. Averages and those s.d. in the whole strains belonging to the groups **34** and **35** were found to be 0.06 ± 0.02 and 0.03 ± 0.02 , respectively.

7. Further strain and group comparisons

Strains: The comparison was made in the respective strains. The following aspects were ascertained. For the individual grain level, the strain No.336, collected at the pond in Dikwa, Nigeria in 1984, showed the largest or nearly the largest values through 4 characters of areas and volumes. No.449, collected at the upland rice field, Matam, Senegal in 1985, and No.2051, collected at the small stream, Ifakara, Tanzania in 1988, showed nearly the same tendency. On the contrary, the strain No.303, collected at the paddy field, Marovoay, Madagascar in 1985, No.312, collected at the swamp, Antanifuttsy, Madagascar in 1985, and No.2027, collected at the paddy field, Ambondramamy, Madagascar in 1988, showed the smallest or nearly the smallest values through 4 characters.

For the strain level, the strain Nos.335 and 336, collected at the pond, Dikwa, Nigeria in 1984, and Nos. 449 and 2051 showed the largest or nearly the largest values through 4 characters. On the contrary, strain Nos.303 and 426, collected at the paddy field, Kolda, Senegal in 1985, No.2009 collected at the terraced paddy field, Marovoay, and No.2111, collected at the pond, Mampikony, Madagascar in 1988, showed the largest or nearly the largest values through 4 characters. In view of quotient characters, it was an interesting aspect that no strain was found showing the largest values in 2 characters. On the contrary, No.416, collected at the swamp, Saresara, Senegal in 1985, and No.426 showed the smallest values in 2 characters. The strain No.429, collected at the paddy field, Kolda, Senegal in 1985, Nos.449 and 2049, collected at the paddy field, Ifakara, Tanzania in

1988 and No.2067, collected at a waste land, Uvinza, Tanzania in 1988, showed the largest or nearly the largest values of quotient in volumes. On the contrary, Nos.387 and 390, collected at the paddy field, Korhogo, Ivory Coast in 1984, showed quite the reversed results.

Table 13. Comparison of values shown in the respective characters; 1 = the largest, 6 = the smallest, country and group marks were the same as those in Table 11. Upper column; practical values shown in Table 11, lower column; standard deviations shown in Table 12.

Country	Group mark	Practical value				Standard deviations			
		Unhusked		Husked		Unhusked		Husked	
		Area	Volume	Area	Volume	Area	Volume	Area	Volume
MD	3	6	6	5	6	2	3	4	3
TA	6	4	3	3	3	5	5	6	5
KE	7	3	4	4	4	4	2	3	4
NI	10	2	1	2	1	1	1	2	2
IV	11	5	5	6	5	6	6	5	6
SE	14	1	2	1	2	3	4	1	1
MD	3	3	3	3	3	3	3	2	3
TA	6	1	1	1	1	1	2	1	1
KE	7	4	6	5	5	4	5	4	5
NI	10	5	4	4	4	2	1	2	2
IV	11	2	2	2	2	6	6	6	6
SE	14	6	5	6	6	5	4	5	4

Quotients of areas and volumes were omitted owing to their negligibilities.

In view of s.d., Nos.335, 336, 449 and 2051 showed the largest or nearly the largest values through 4 characters. On the contrary, No.304, collected at the paddy field, Mahajanga, Madagascar in 1985, No.306, collected at the swampy area, Marovoay, Madagascar in 1985, No.313, collected at a small river, Antanifutsy, Madagascar in 1985, showed the smallest or nearly the smallest values through 4 characters. It was noticed that the smallest value in s.d. (0.01) was noted in 24 and 13 strains in quotients in areas and volumes, respectively, and found only in the strains collected in 1984 and 1985, but not those in 1988. It seemed to be one of the locality specificities.

Groups: To obtain the locality specificity, a comparison was made by the representatives of Madagascar (group 3 in Tables 11 and 12), Tanzania (6), Kenya (7), Nigeria (10), Ivory Coast (11) and Senegal (14), and was shown in Table 13. The data of quotients in areas and volumes were omitted in the comparison, because those data were fixed to be very small in quantity. From the data shown in Tables 11, 12 and 13, the following locality specificities were ascertained to some extent. The strains of Nigeria (10) and Senegal (14) showed the largest or nearly the largest values through the 4 characters of practical values, and strains of Nigeria (10) showed the largest or nearly the largest values in s.d., too (Table 11 and the upper column of Table 13). On the contrary, strains of Madagascar (3) and Ivory Coast (11) showed the smallest or nearly the smallest values in practical values. Strains of Tanzania (6) and Ivory Coast (11) showed the smallest or nearly the smallest values in s.d.

In view of s.d. (Table 12 and the lower column of Table 13), strains of Tanzania (6) showed the largest values through 8 characters. Strains of Ivory Coast (11) and Nigeria (10) showed the largest or nearly the largest values in practical values and s.d., respectively. On the contrary, strains of Kenya (7) and Senegal (14) showed the smallest or nearly the smallest values through

the 8 characters. Strains of Ivory Coast (**11**) showed the smallest values in s.d. The strains of West Africa (**35**) showed the larger values in areas and volumes in UHG and HG in comparison with those of East Africa (**34**). In the s.d., the strains of East Africa showed clearly larger values through the whole characters in comparison with those of West Africa. It was the same as in case of ratios²²⁾.

In case of the strain collected in Fogera Plain, Ethiopia ($12^{\circ}12'N$, $37^{\circ}30'E$)¹⁶⁾, average values and those s.d. were found to be 24.30 ± 3.49 , 42.78 ± 8.23 , 13.20 ± 2.43 , 18.43 ± 4.43 , 0.55 ± 0.08 and 0.43 ± 0.08 in L, W, T, L/W, L/T and W/T, respectively. In comparison with the present data (Tables 11, 12 and 13), the strain of Ethiopia showed the following specificities. Average values of 2 and other 2 characters, *i.e.*, areas and volumes in UHG, and areas and volumes in HG, showed the largest ones and nearly the largest ones through the whole groups of Africa, respectively. On the contrary, the values of quotient in areas and those of volumes showed the smallest and nearly the smallest ones through the whole groups of Africa. The strain of Ethiopia should be located in the position relatively higher in size and shape but relatively lower in grain fullness⁸⁾ in the *Oryza longistaminata* and its relatives distributed in the whole Africa. This state of affairs was fixed to be explained in the larger values in UHG²⁰⁾ and in the smaller values in HG²¹⁾ characters.

It is well known that the grain fullness value of grain length is of the most stable character, and that of the grain thickness is, on the contrary, of the most unstable character. So, this character seems to be very important in view of plant evolution and in that of artificial selection, in the future.

II. *O. breviligulata* CHEV. et ROEHR.

1. Areas in UHG

The values of areas in UHG for the individual grain level ranged from 40.63 mm^2 (strain No.333, collected in Nigeria in 1984), which was the same as in case of L in HG, to 17.60 mm^2 (No.428, collected in Senegal in 1985), which was the same as in case of W in UHG. In the strain level, the widest (35.75 mm^2) was obtained in No.333, followed by No.366 (34.35 mm^2) and No.332 (32.88 mm^2). The narrowest (19.64 mm^2) was noted in No.428, which was the same as in cases of W and T in UHG and HG, followed by No.367 (23.17 mm^2) and No.405 (23.69 mm^2), in which No.405 was the same as in cases of L in UHG and HG.

In the group level (Table 11), the widest (30.94 mm^2) was obtained in the strains collected in Nigeria in 1984 [illustrated as mark **17** in Tables 11 and 12], followed by group **19** [Nigeria in 1984 and 1985] (29.63 mm^2) and group **18** [Nigeria in 1985] (29.09 mm^2), in which groups **17** and **19** were found to be the same as in cases of L and T in UHG and HG, and T in HG. The narrowest (26.20 mm^2) was noted in group **21** [Casamance region of Senegal in 1985], followed by group **23** [both regions of Senegal in 1985] (26.45 mm^2) and group **22** [northern region of Senegal in 1985] (27.05 mm^2). These combinations of groups (**21**, **22** and **23**) were found to be the same as in cases of L in UHG and HG, and W in HG.

In the s.d. of each strain, *i.e.*, in those showing intra-population's variations, the largest (2.98) was obtained in No.328, followed by No.329 (2.88) and No.353 (2.47). The smallest (0.31) was noted in No.417, followed by No.422 (0.46) and No.443 (0.95). It was noticed that the values of Nos.417 and 422 were particularly small. In the group level, the largest (4.77) was obtained in group **24**, followed by group **18** (3.06) and group **19** (3.04). It was noticed that the value of group **24** was particularly large. These combinations of groups (**18**, **19** and **24**) were found to be the same

as in case of W in UHG. The smallest (1.30) was noted in group **20**, which was the same as in case of W in UHG, followed by group **22**(2.16) and group **23**(2.42).

The s.d. of the respective characters illustrated by average values of the respective groups were shown in Table 12. The largest (2.08 mm²) was obtained in group **17**, followed by group **19** (1.79 mm²) and group **18**(1.67 mm²). These orders of groups (**17**>**19**>**18**) were found to be the same as in case of L in HG. Moreover, these combinations of groups (**17**, **18** and **19**) were found to be the same as in cases of L, W, T, L/W and L/T in HG. The smallest (1.29 mm²) was noted in group **21**, followed by group **20**(1.30 mm²) and group **23**(1.33 mm²), in which groups **21** and **23** were the same as in cases of L in UHG and HG. Moreover, these combinations of groups (**20**, **21** and **23**) were found to be the same as in case of W in UHG.

2. Volumes in UHG

The values of volumes in UHG for the individual grain level ranged from 83.10 mm³ (No.328) to 22.55 mm³ (No.428). The former and the latter strains were found to be the same as in cases of W in HG, and of W and areas in UHG, respectively. These combinations of strains (No.328 and No.428) were fixed to be the reversed result of W/T in UHG. In the strain level, the largest (72.27 mm³) was obtained in No.333, followed by No.328(68.86 mm³) and No.380(66.95 mm³). The smallest (25.42 mm³) was noted in No.428, which was the same as in cases of W and T in UHG, W in HG, and quotient in L, followed by No.367(36.03 mm³) and No.405(43.41 mm³). It was noticed that the value of No.428 was particularly small.

In the group level (Table 11), the largest (62.75 mm³) was obtained in group **17**, followed by group **19**(57.25 mm³) and group **18**(54.99 mm³). These orders of groups (**17**>**19**>**18**) were found to be the same as in case of areas in UHG. The smallest (45.99 mm³) was noted in group **20**, followed by group **21**(46.54 mm³) and group **23**(48.08 mm³). These orders of groups (**20**<**21**<**23**) were found to be the same as in cases of W and T in UHG and HG.

In the s.d. of each strain, the largest (7.75) was obtained in No.328, which was the same as in cases of W, T and areas in UHG, and W in HG, followed by No.329(5.93) and No.331(5.39). The smallest (1.07) was noted in No.422, followed by No.417(1.23) and No.443(2.14). In the group level, the largest (9.12) was obtained in group **18**, followed by group **24**(8.98) and group **19**(8.94). These combinations of groups (**18**, **19** and **24**) were found to be the same as in cases of W and areas in UHG. The smallest (2.94) was noted in group **20**, followed by group **22**(3.95) and group **17**(5.38). It was noticed that group **20** showed particularly small value. These orders of groups (**20**<**22**<**17**) were found to be the same as in cases of W in UHG and HG, and T in HG. Moreover, these combinations of groups (**17**, **20** and **22**) were found to be the same as in case of T in UHG.

In the s.d. of each group (Table 12), the largest (4.86 mm³) was obtained in group **17**, followed by group **19**(4.25 mm³) and group **18**(4.00 mm³). These orders of groups (**17**>**19**>**18**) were found to be the same as in cases of areas in UHG, and L in HG. The smallest (2.78 mm³) was noted in group **21**, followed by group **23**(2.93 mm³) and group **20**(2.94 mm³). These combinations of groups (**20**, **21** and **23**) were found to be the same as in cases of W and areas in UHG, and L, W, T, L/W and L/T in HG.

3. Areas in HG

The values of areas in HG for the individual grain level ranged from 23.94 mm² (No.333) to 7.93 mm² (No.428), which were the same as in cases of areas and volumes in UHG. In the strain level, the widest (21.72 mm²) was obtained in No.333, followed by No.366(21.11 mm²) and No.344(19.76 mm²), in which No.333 and No.336 were found to be the same as in cases of areas

and volumes in UHG, and areas in UHG, respectively. The narrowest (9.71 mm^2) was noted in No.428, followed by No.367 (14.48 mm^2) and No.405 (14.62 mm^2). These orders of strains ($428 < 367 < 405$) were found to be the same as in cases of areas and volumes in UHG. It was noticed that the value of No.428 was particularly small.

In the group level (Table 11), the widest (18.77 mm^2) was obtained in group **17**, followed by group **19** (18.09 mm^2) and group **18** (17.81 mm^2). These orders of groups ($17 > 19 > 18$) were found to be the same as in cases of areas and volumes in UHG. The narrowest (16.00 mm^2) was noted in group **21**, followed by group **23** (16.16 mm^2) and group **22** (16.57 mm^2). These orders of groups ($21 < 23 < 22$) were found to be the same as in case of areas in UHG. Moreover, these combinations of groups (**21**, **22** and **23**) were found to be the same as in case of L in UHG.

In the s.d. of each strain, the largest (1.91) was obtained in No.329, followed by No.328 (1.80) and No.367 (1.35), in which the former two strains were the same as in cases of L, areas and volumes in UHG, and showed particularly large values. The smallest (0.28) was noted in No.398, which was the same as in cases of W in UHG and HG, followed by No.417 (0.34) and No.438 (0.41), in which No.417 was the same as in cases of W, areas and volumes in UHG. In the group level, the largest (2.03) was obtained in group **24**, which was the same as in cases of areas and volumes in UHG, followed by group **21** (2.02) and group **23** (1.85). The smallest (0.66) was noted in group **20**, followed by group **22** (1.26) and group **17** (1.43). These orders of groups ($20 < 22 < 17$) were found to be the same as in cases of W and volumes in UHG, and W in HG. Moreover, these combinations of groups (**17**, **20** and **22**) were found to be the same as in cases of W and T in UHG, and T in HG.

In the s.d. of each group (Table 12), the largest (1.27 mm^2) was obtained in group **17**, followed by group **19** (1.09 mm^2) and group **18** (1.02 mm^2). These orders of groups ($17 > 19 > 18$) were found to be the same as in cases of areas and volumes in UHG, and L in HG. It was noticed that the value of group **17** was particularly large. The smallest (0.66 mm^2) was noted in group **20**, followed by group **21** (0.81 mm^2) and group **23** (0.83 mm^2). These orders of groups ($20 < 21 < 23$) were found to be the same as in case of W in HG. Moreover, these combinations of groups (**20**, **21** and **23**) were found to be the same as in cases of L, W, T, L/W, L/T, areas and volumes in UHG.

4. Volumes in HG

The values of volumes in HG for the individual grain level ranged from 45.67 mm^3 (No.328) to 6.34 mm^3 (No.428), in which the former and the latter were the same as in cases of W, T and volumes in UHG, and W and T in HG, and areas in UHG, areas and volumes in UHG, respectively. In the strain level, the largest (39.70 mm^3) was obtained in No.333, followed by No.328 (38.29 mm^3) and No.380 (36.18 mm^3). These orders of strains ($333 > 328 > 380$) were found to be the same as in case of volumes in UHG. The smallest (8.74 mm^3) was noted in No.428, followed by No.367 (20.21 mm^3) and No.442 (20.58 mm^3), in which the former two were the same as in cases of T, areas and volumes in UHG, and areas in HG. These combinations of strains (367, 428 and 442) were found to be the same as in cases of W in UHG, and W and T in HG.

In the group level (Table 11), the largest (33.85 mm^3) was obtained in group **17**, followed by group **19** (30.69 mm^3) and group **18** (29.39 mm^3). These orders of groups ($17 > 19 > 18$) were found to be the same as in cases of areas in UHG and HG, and volumes in UHG. The smallest (24.99 mm^3) was noted in group **21**, followed by group **20** (25.83 mm^3) and group **23** (25.88 mm^3). These combinations of groups (**20**, **21** and **23**) were found to be the same as in cases of W, T and areas in UHG, and W and T in HG.

In the s.d. of each strain, the largest (4.01) was obtained in No.328, followed by No.329 (3.73) and No.380(3.45), in which the former two were the same as in cases of L and areas in UHG, and areas and volumes in HG. The smallest (0.48) was noted in No.438, followed by No.422(0.62) and No.398(1.04). In the group level, the largest (5.12) was obtained in group **24**, followed by group **19**(4.67) and group **18**(4.50). These combinations of groups (**18**, **19** and **24**) were found to be the same as in cases of W, areas and volumes in UHG. The smallest (1.70) was noted in group **20**, followed by group **22**(2.18) and group **17**(3.40). These orders of groups (**20**<**22**<**17**) were found to be the same as in cases of W and volumes in UHG, and W and areas in HG. Moreover, these combinations of groups (**17**, **20** and **22**) were found to be the same as in case of T in UHG.

In the s.d. of each group (Table 12), the largest (2.69 mm³) was obtained in group **17**, followed by group **19**(2.50 mm³) and group **18**(2.42 mm³). These orders of groups (**17**>**19**>**18**) were found to be the same as in cases of areas and volumes in UHG, L and areas in HG. The smallest (1.70 mm³) was noted in group **20**, followed by group **21**(1.79 mm³) and group **23**(1.85 mm³). These orders of groups (**20**<**21**<**23**) were found to be the same as in cases of W in UHG, and W and areas in HG, and these combinations of groups (**20**, **21** and **23**) were found to be the same as in cases of areas and volumes in UHG, and T, L/W and L/T in HG.

5. Quotients in areas

The values of quotient in areas for the individual grain level ranged from 0.72(No.380) to 0.42(No.428), in which the latter was the same as the former 4 characters, and W and T in UHG. In the strain level, the largest (0.65) was obtained in No.417, followed by Nos.350, 383 and 413(0.64). The smallest (0.50) was noted in No.428, which was the same as in cases of T in UHG, and areas and volumes in UHG and HG, followed by Nos.334 and 438(0.58).

In the group level (Table 11), the largest (0.64) was obtained in group **20**, which was the same as in cases of L, L/W and L/T in UHG, and L, L/W, L/T and W/T in HG. The smallest (0.61) was noted in the other 7 groups.

In the s.d. of each strain, the largest (0.06) was obtained in No.428, followed by No.442 (0.04). The smallest (0.01) was noted in 7 strains. In the group level, the largest (0.03) was obtained in group **21**, which was the same as in cases of W, T, L/W and L/T in HG. The smallest (0.01) was noted in groups **18**, **19** and **22**. It was noticed that the variations of s.d. were fixed to be very small as in case of the practical values.

In the s.d. of each group (Table 12), the whole values were 0.02, and showed no variation.

6. Quotients in volumes

The values of quotient in volumes for the individual grain level ranged from 0.65(No.380) to 0.25(No.428), in which the former and the latter characters were the same as the 1 and 4 characters in the former, respectively. In the strain level, the largest (0.59) was obtained in No.418, followed by No.350(0.58) and No.417(0.57), in which the latter two were the same as in case of quotient in areas. The smallest (0.35) was noted in No.428, which was the same as in cases of the former 5 characters, followed by Nos.438 and 442(0.50).

In the group level (Table 11), the largest (0.56) was obtained in group **20**, which was the same as in cases of L, L/W and L/T in UHG and HG, W/T in HG, and quotient in areas. The smallest (0.53) was noted in group **21**, which was the same as in cases of areas in UHG and HG, and volumes in HG.

In the s.d. of each strain, the largest (0.08) was obtained in No.428, which was the reversed results of the practical values of 6 characters, followed by Nos.344, 366, 380 and 442(0.04). The

smallest (0.01) was noted in Nos.330, 410, 417 and 442. In the group level, the largest (0.05) was obtained in group **21**, which was the same as in cases of W, T, L/W, L/T and W/T in HG, and quotient in areas. The smallest (0.02) was noted in 5 groups.

In the s.d. of each group (Table 12), the values ranged from 0.03 to 0.02, showing very small variation.

7. Further strain and group comparisons

Strains: The comparison was made in the respective strains, and the following aspects were ascertained. In the individual grain level, strain No.333, collected at the paddy field, Maiduguri, Nigeria in 1984, showed the largest or nearly the largest values through the 4 characters, *i.e.*, areas and volumes in UHG and HG. The strain No.380, collected at the swamp, Jengle, Nigeria in 1985, showed the largest and nearly the largest values of areas in UHG, volumes in UHG and HG, and quotients in areas and volumes, respectively. On the other hand, No.367, collected at the dried-up waste land, Goronyo, Nigeria in 1985, showed nearly the smallest values through areas and volumes in UHG and HG. Moreover, No.428, collected at the paddy field, Kolda, Senegal in 1985, showed the smallest values through the 6 characters. The tendency was fixed to be the same as in case of quotients in UHG and HG²²¹.

In the strain level, strain No.333 showed the largest values through areas and volumes in UHG and HG, which was the same as in case of grain level. The strain No.366, collected at the paddy field, Wurno, Nigeria in 1985, showed the same tendency. On the contrary, No.428 showed the smallest values through the 6 characters in UHG and HG, which was also the same as in case of grain level. The strain No.367 showed the smallest values through 4 characters of areas and volumes in UHG and HG. In view of the s.d., Nos.328 and 329, collected at the paddy fields of *O. glaberrima*, Zaria, Nigeria in 1984, showed the largest or nearly the largest s.d. through areas and volumes in UHG and HG. No.417, collected at the paddy field of *O. glaberrima*, Tiapa, Senegal in 1985, and No.422, collected at the paddy field, Biaobe, Senegal in 1985, showed the smallest or nearly the smallest s.d. in 4 characters, including quotient in volumes.

Groups: The strains collected in Nigeria in 1984 (group **17** in Tables 11 and 12), in 1985 (**18**), and in 1984 and 1985 (**19**), showed the largest or nearly the largest values through areas and volumes in UHG and HG, and showed the smallest or nearly the smallest values in quotients in areas and volumes. On the contrary, strains collected in Casamance region (**21**) and in both the regions (**23**) of Senegal showed the smallest or nearly the smallest values in 5 and 4 characters, respectively.

In s.d. of each group (Table 12), group **24** showed the largest or nearly the largest values through 4 characters of areas and volumes. On the contrary, group **20** showed the smallest values through the same characters.

The strain collected in Ivory Coast showed nearly the middle values through areas and volumes in UHG and HG. On the contrary, it showed the largest values in quotients in areas and volumes.

Data shown by the comparative studies using group average did not completely feature in varietal variations, because the strain numbers are different in the respective areas. However, these group comparisons are to be looked upon as useful to some extent.

III. *O. punctata* KOTSCHY

1. Areas in UHG

The values of areas in UHG for the individual grain level ranged from 21.42 mm² (No.465) to 9.80 mm² (No.2090). In the strain level, the widest (17.95 mm²) was obtained in No.473,

followed by No.463 (17.41 mm²) and No.474 (17.26 mm²). These combinations of strains (463, 473 and 474) were found to be the same as in cases of L and L/T in UHG and HG. The narrowest (11.67 mm²) was noted in No.2090, followed by No.2089 (12.07 mm²) and No.2105 (12.23 mm²). These combinations of strains (2089, 2090 and 2105) were found to be the same as in cases of W in UHG and HG.

In the group level (Table 11), the widest (15.99 mm²) was obtained in the strains collected in Tanzania in 1984 [illustrated as mark **25** in Tables 11 and 12], followed by the strains collected in Kenya in 1984 [illustrated as mark **28**] (15.75 mm²) and the strains summed-up in 1984 and 1985 in Tanzania and Kenya [illustrated as mark **31**] (15.34 mm²). These orders of groups (**25** > **28** > **31**) were found to be the same as in cases of L and W in UHG, and L in HG. The narrowest (13.67 mm²) was noted in group **26** [Tanzania in 1988], followed by group **27** [Tanzania in 1984 and 1988] (13.91 mm²) and group **32** [summed-up of strains in 1984, 1985 and 1988 in Tanzania and Kenya] (14.35 mm²). These orders of groups (**26** < **27** < **32**) were also found to be the same as in cases of L, W and W/T in UHG, and L in HG. Average and its standard deviations through the whole strains belonging to the species (group **32** --- summed-up of the groups **25**, **26**, **28** and **29**) were found to be 14.35 ± 1.44.

In the s.d. of each strain, *i.e.*, those showing intra-population's variations, the largest (2.01) was obtained in No.460, followed by No.465 (1.98) and No.474 (1.81). The smallest (0.74) was noted in No.459, followed by No.458 (0.77) and No.2084 (0.78). In the group level, the largest (1.65) was obtained in group **29**, followed by group **30** (1.54) and group **31** (1.45). These orders of groups (**29** > **30** > **31**) were found to be the same as in cases of L, L/W and L/T in UHG and HG. The smallest (0.42) was noted in group **25**, followed by group **26** (0.96) and group **28** (1.14). These combinations of groups (**25**, **26** and **28**) were found to be the same as in cases of L/T in UHG and HG. It was noticed that the value of group **25** was particularly small.

The s.d. of the respective characters illustrated by average values of the respective groups were shown in Table 12. The largest (1.49 mm²) was obtained in group **28**, followed by group **30** (1.42 mm²) and group **31** (1.37 mm²). These orders of groups (**28** > **30** > **31**) were found to be the same as in case of L in UHG. The smallest (1.10 mm²) was noted in group **25**, followed by group **27** (1.29 mm²) and group **26** (1.31 mm²). These orders of groups (**25** < **27** < **26**) were found to be the same as in case of L in UHG.

2. Volumes in UHG

The values of volumes in UHG for the individual grain level ranged from 35.78 mm³ (No.460) to 13.11 mm³ (No.2089), in which the latter was the same as in case of areas in UHG. In the strain level, the largest (28.30 mm³) was obtained in No.473, followed by No.463 (27.45 mm³) and No.474 (26.62 mm³). These orders of strains (473 > 463 > 474) were found to be the same as in case of areas in UHG. Moreover, these combinations of strains (463, 473 and 474) were found to be the same as in cases of L and L/T in UHG, and L in HG. The smallest (16.71 mm³) was noted in No.2090, followed by No.2105 (17.51 mm³) and No.2089 (17.57 mm³). These combinations of strains (2089, 2090 and 2105) were found to be the same as in cases of W and areas in UHG, and W in HG.

In the group level (Table 11), the largest (25.32 mm³) was obtained in group **25**, followed by group **28** (24.06 mm³) and group **31** (23.54 mm³). These orders of groups (**25** > **28** > **31**) were found to be the same as in cases of L and W in UHG and HG, and areas in UHG. Moreover, these combinations of groups (**25**, **28** and **31**) were found to be the same as in cases of W/T in UHG, and W and T in HG. The smallest (20.67 mm³) was noted in group **26**, followed by group **27**

(21.12 mm³) and group **32** (21.84 mm³). These orders of groups (**26** < **27** < **32**) were also found to be the same as in cases of L, W, T, L/T, W/T and areas in UHG, and L in HG.

In the s.d. of each strain, the largest (4.46) was obtained in No.460, which was the same as in case of areas in UHG, followed by No.462 (4.34) and No.461 (3.89). The smallest (1.54) was noted in No.2100, which was the same as in case of T in HG, followed by No.2084 (1.61) and No.2097 (1.75). In the group level, the largest (3.02) was obtained in group **29**, followed by group **30** (2.81) and group **31** (2.66). These orders of groups (**29** > **30** > **31**) were found to be the same as in cases of L, L/W, L/T, W/T and areas in UHG, and L and L/W in HG. The smallest (0.46) was noted in group **25**, followed by group **26** (1.86) and group **28** (2.13). It was noticed that the value of group **25** was particularly small. These orders of groups (**25** < **26** < **28**) were found to be the same as in case of areas in UHG.

In the s.d. of each group (Table 12), the largest (3.81 mm³) was obtained in group **28**, followed by group **30** (3.09 mm³) and group **31** (3.02 mm³). These orders of groups (**28** > **30** > **31**) were found to be the same as in cases of L and areas in UHG. It was noticed that the value of group **28** was particularly large. The smallest (2.37 mm³) was noted in group **26**, followed by group **27** (2.40 mm³) and group **32** (2.63 mm³). These combinations of groups (**26**, **27** and **32**) were found to be the same as in cases of T and L/T in UHG, and T in HG.

3. Areas in HG

The values of areas in HG for the individual grain level ranged from 11.64 mm² (No.2085) to 4.86 mm² (No.2089), in which the latter was the same as in cases of areas and volumes in UHG. In the strain level, the widest (10.34 mm²) was obtained in No.473, followed by No.463 (10.24 mm²) and No.2085 (9.87 mm²), in which the former two were the same as in cases of L, areas and volumes in UHG. The narrowest (7.14 mm²) was noted in No.2089, followed by No.2090 (7.22 mm²) and No.2105 (7.42 mm²). These orders of strains (2089 < 2090 < 2105) were found to be the same as in cases of W in UHG and HG. Moreover, these combinations of strains (2089, 2090 and 2105) were found to be the same as in cases of areas and volumes in UHG.

In the group level (Table 11), the widest (9.62 mm²) was obtained in group **25**, followed by group **28** (9.13 mm²) and group **31** (8.97 mm²). These orders of groups (**25** > **28** > **31**) were found to be the same as in cases of L and W in UHG, and L in HG. The narrowest (8.28 mm²) was noted in group **26**, followed by group **27** (8.42 mm²) and group **32** (8.57 mm²). These orders of groups (**26** < **27** < **32**) were found to be the same as in cases of L, W, L/T and W/T in UHG, and L and T in HG.

In the s.d. of each strain, the largest (1.30) was obtained in No.2089, followed by Nos.2084 and 2086 (1.17). The smallest (0.40) was noted in No.459, which was the same as in cases of L and areas in UHG, followed by No.461 (0.45) and No.474 (0.48). In the group level, the largest (0.80) was obtained in group **30**, followed by groups **29** and **31** (0.79). These combinations of groups (**29**, **30** and **31**) were found to be the same as in cases of L, L/W, areas and volumes in UHG, and L, L/W and L/T in HG. The smallest (0.24) was noted in group **25**, followed by group **26** (0.62) and group **27** (0.72), in which the former two were found to be the same as in cases of L, areas and volumes in UHG. These orders of groups (**25** < **26** < **27**) were found to be the same as in cases of T, L/W and W/T in HG.

In the s.d. of each group (Table 12), the larger (0.94 mm²) was obtained in group **26**, followed by group **27** (0.90 mm²) and group **32** (0.82 mm²). These orders of groups (**26** > **27** > **32**) were found to be the same as in cases of L/W in UHG, and L, W, T and L/W in HG. The smallest (0.50 mm²) was noted in group **25**, followed by group **28** (0.61 mm²) and group **31** (0.65 mm²).

These combinations of groups (**25**, **28** and **31**) were found to be the same as in cases of W, L/W, L/T and W/T in HG.

4. Volumes in HG

The values of volumes in HG for the individual grain level ranged from 16.59 mm³ (No.464) to 5.35 mm³ (No.2089), in which the latter was the same as in cases of areas and volumes in UHG, and areas in HG. In the strain level, the largest (14.00 mm³) was obtained in No.463, followed by No.457 (13.43 mm³) and No.2085 (13.09 mm³), in which the first and the third ones were the same as in case of areas in HG. The smallest (8.03 mm³) was noted in No.469, followed by No.2090 (8.60 mm³) and No.2089 (8.61 mm³), in which the latter two were the same as in cases of areas and volumes in UHG, and areas in HG.

In the group level (Table 11), the largest (12.93 mm³) was obtained in group **25**, followed by group **28** (11.46 mm³) and group **31** (11.22 mm³). These orders of groups (**25** > **28** > **31**) were found to be the same as in cases of L, W, areas and volumes in UHG, and L and areas in HG. The smallest (10.27 mm³) was noted in group **26**, followed by group **27** (10.55 mm³) and group **29** (10.58 mm³), in which the former two were the same as in cases of T, L/T, W/T, areas and volumes in UHG, and areas in HG.

In the s.d. of each strain, the largest (1.92) was obtained in No.2086, followed by No.2088 (1.87) and No.2089 (1.70). The smallest (0.43) was noted in No.474, followed by No.2097 (0.76) and No.459 (0.80). It was noticed that the value of No.474 was particularly small. In the group level, the largest (1.75) was obtained in group **28**, followed by group **31** (1.58) and group **30** (1.50). These combinations of groups (**28**, **30** and **31**) were found to be the same as in cases of T and W/T in HG. The smallest (0.37) was noted in group **25**, followed by group **26** (1.12) and group **29** (1.26), in which the former two were the same as in cases of L, L/W and L/T in UHG. It was noticed that the value of group **25** was particularly small.

In the s.d. of each group (Table 12), the largest (1.41 mm³) was obtained in group **26**, followed by group **28** (1.38 mm³) and group **27** (1.37 mm³), in which the former two were the same as in case of areas in HG. The smallest (1.04 mm³) was noted in group **25**, which was the same as in cases of L/W and areas in UHG, and areas in HG, followed by group **29** (1.13 mm³) and group **31** (1.18 mm³).

5. Quotients in areas

The values of quotient in areas for the individual grain level ranged from 0.85 (No.2086) to 0.40 (No.2094). In the strain level, the largest (0.66) was obtained in Nos.2085, 2088 and 2095. The smallest (0.48) was noted in No.2097, followed by No.465 (0.54), and Nos.469, 474 and 2098 (0.56).

In the group level (Table 11), the largest (0.61) was obtained in groups **26** and **27**. The smallest (0.58) was noted in group **28**.

In the s.d. of each strain, the largest (0.12) was obtained in No.2091, followed by Nos.2084 and 2086 (0.10), in which the latter two were the same as in case of areas in HG. The smallest (0.03) was noted in Nos.459, 464, 466 and 473, in which the first one was the same as in cases of areas in UHG, and areas and volumes in HG. In the group level, the largest (0.04) was obtained in group **26**. The smallest (0.00) was noted in group **28**.

In the s.d. of each group (Table 12), the largest (0.07) was obtained in groups **26** and **27**, followed by group **32** (0.06). These combinations of groups (**26**, **27** and **32**) were found to be the same as in cases of L, W, T, W/T and areas in HG. The smallest (0.04) was noted in groups **25**, **28**, **29**, **30** and **31**, in which the combinations of groups (1) **25**, **28** and **31** and groups (2) **25**, **29** and

31, were found to be the same as in cases of ① L in UHG, and ② L/W in UHG, and L, areas and volumes in HG, respectively.

6. Quotients in volumes

The values of quotient in volumes for the individual grain level ranged from 0.71 (No.2091) to 0.30 (No.469). In the strain level, the largest (0.60) was obtained in No.2097, followed by Nos.2085, 2088 and 2095 (0.54), in which the latter three were found to be the same as in case of quotient in areas. The smallest (0.42) was noted in No.469, which was the same as in cases of T and volumes in HG, followed by No.465 (0.43) and No.473 (0.44).

In the group level (Table 11), the largest (0.51) was obtained in group **27**, followed by groups **26** and **32** (0.50), in which the former two were the same as in case of quotient in areas. The smallest (0.47) was noted in groups **29** and **30**.

In the s.d. of each strain, the largest (0.10) was obtained in Nos.2086 and 2091, followed by Nos.460, 461, 463, 2084, 2101 and 2105 (0.08), in which the combinations of Nos.2084, 2086 and 2091 were the same as in case of quotient in areas. The smallest (0.03) was noted in Nos.464, 473 and 474, in which Nos.464 and 473 were the same as in case of quotient in areas. In the group level, the largest (0.04) was obtained in groups **31** and **32**. The smallest (0.01) was noted in group **25**, which was the same as in cases of L, W, L/W, L/T, W/T, areas and volumes in UHG, and areas and volumes in HG.

In the s.d. of each group (Table 12), the largest (0.07) was obtained in groups **26** and **27**, which were the same as in cases of L/W in UHG, W and L/T in HG, and quotient in areas. The smallest (0.05) was noted in groups **25**, **29** and **31**, in which the combinations of groups **25**, **29** and **31** were found to be the same as in cases of L/W in UHG, volumes in HG, and quotient in areas.

7. Further strain and group comparisons

Strains: The comparison was made in the respective strains, and the following aspects were ascertained. In the individual grain level, the strain No.463, collected at the drip-up waste land, Mariakani, Kenya in 1984, showed nearly the largest values through the 4 characters of areas and volumes. On the contrary, Nos.2089 and 2090, collected at the waste land, Uvinza, and at the swampy area, Mwanza, Tanzania in 1988, respectively, showed the smallest or nearly the smallest values through the 4 characters of areas and volumes. In view of quotients of areas and volumes, No.2091 and No.2105, collected at the upland rice field, Mwanza, and at the waste land, Ole, Tanzania in 1988, respectively, showed the largest or nearly the largest values through 2 characters. On the contrary, No.2094, collected at the waste land, Mwanza, Tanzania in 1988, showed the smallest or nearly the smallest values through 2 characters.

For the strain level, No.463 and No.473, collected at the waste land, Mariakani, Kenya in 1985, showed the largest or nearly the largest values through 4 characters of areas and volumes. On the contrary, Nos.2089 and 2090 showed the smallest or nearly the smallest values through 4 characters. In view of quotients in areas and volumes, Nos.2085 and 2088, collected at the paddy field, Dodoma, and at the irrigation canal, Singida, Tanzania in 1988, respectively, showed the largest or nearly the largest values through 2 characters. On the contrary, Nos.465 and 469 showed the smallest or nearly the smallest values through 2 characters. It was noticeable that No.2097, collected at the paddy field, Upenja, Tanzania in 1988, showed the smallest and the largest values in quotient of areas and quotient of volumes, respectively.

In view of s.d., No.2086, collected at the small river, Manyoni, Tanzania in 1988, showed the largest or nearly the largest values through 4 characters. On the contrary, No.459, collected at the swampy area, Dakawa, Tanzania in 1984, and No.474, collected at the waste land adjacent to a

seasonal river, Mariakani, Kenya in 1985, showed the smallest or nearly the smallest values through 4 and 3 characters, respectively. It was noticeable that No.2084, collected at Mbarari, Tanzania in 1988, showed nearly the largest values and nearly the smallest values through 3 and 2 characters, respectively.

Groups: To obtain the locality specificity, a comparison was made with the representatives of Tanzania (group 27 in the Tables 11 and 12) and Kenya (group 30). The following aspects were ascertained to some extent. In the practical values and those s.d., the values of areas and volumes in UHG and HG of group 27 were fixed to be smaller than those of group 30. On the contrary, the values of quotients in areas and volumes of group 27 were fixed to be larger than those of group 30.

In the s.d. (Table 12), the values of areas and volumes in UHG of group 27 were fixed to be smaller than those of group 30. On the contrary, the values of the remaining 4 characters of group 27 were fixed to be larger than those of group 30.

From the results of group comparison in case of *Oryza punctata*, it appears to be important to compare the respective conditions, because they varied very much in every cases. This should be discussed in the following paper.

IV. *O. brachyanta* CHEV. et ROEHR.

The values of areas in UHG for the individual grain level ranged from 18.24 mm² to 13.92 mm². Average and its standard deviations (s.d.) in the whole grains were found to be 16.40 ± 0.96. The volumes in UHG for the individual grain level ranged from 26.65 mm³ to 18.05 mm³. Average and its s.d. in the whole grains were found to be 22.93 ± 2.44. The areas in HG for the individual grain level ranged from 12.87 mm² to 9.45 mm². Average and its s.d. in the whole grains were found to be 11.04 ± 0.84. The volumes in HG for the individual grain level ranged from 17.38 mm³ to 10.05 mm³. Average and its s.d. in the whole grains were found to be 13.96 ± 2.13.

The values of quotient in areas for individual grain level ranged from 0.76 to 0.57. Average and its s.d. in the whole grains were found to be 0.67 ± 0.04. The values of quotient in volumes for the individual grain level ranged from 0.70 to 0.48. Average and its s.d. in the whole grains were found to be 0.61 ± 0.06.

Summary

During the periods from October to November in 1984, from August to November in 1985 and from May to August in 1988, the writer was dispatched to 8 countries of Africa, *i.e.*, Madagascar, Tanzania, Kenya, Nigeria, Ivory Coast, Liberia, Senegal and Gambia, for collecting the wild and cultivated rices. During the trips, 284 strains of wild rice, *i.e.*, 190 strains of *Oryza longistaminata* CHEV. et ROEHR., 49 of *Oryza breviligulata* CHEV. et ROEHR., 44 of *Oryza punctata* KOTSCHY, and 1 of *Oryza brachyantha* CHEV. et ROEHR., were collected and many populations of those were observed. Some characters of their areas and volumes of the unhusked and husked grains, and quotients in the areas and volumes were reported in the present paper.

Average values and the standard deviations in the whole strains were found to be 20.11 mm² ± 2.92, 32.52 mm³ ± 6.64, 11.37 mm² ± 1.75, 15.11 mm³ ± 3.50, 0.57 ± 0.03 and 0.48 ± 0.06 in area (unhusked), volume (unhusked), area (husked), volume (husked), quotient in areas and quotient in volumes, respectively, in case of *O. longistaminata*. In general, the strains of Nigeria

and Senegal showed the largest or nearly the largest values through 4 characters of areas and volumes in the practical values, and strains of Nigeria showed the largest values in standard deviations, too. The strains of Madagascar and Ivory Coast showed the smallest values in practical values. Strains of Tanzania and Ivory Coast showed the smallest values in standard deviations. The strains of West Africa (Nigeria, Ivory Coast and Senegal) showed larger values in areas and volumes in the unhusked and husked grains, in comparison with those of East Africa (Madagascar, Tanzania and Kenya).

In case of *O. breviligulata*, average values and the standard deviations in the whole strains were found to be $27.57 \text{ mm}^2 \pm 4.77$, $52.49 \text{ mm}^3 \pm 8.98$, $17.10 \text{ mm}^2 \pm 2.03$, $28.23 \text{ mm}^3 \pm 5.12$, 0.61 ± 0.02 and 0.54 ± 0.03 in the same order, respectively. The strains collected in Nigeria showed the largest values through areas and volumes in the unhusked and husked grains, and showed the smallest values in quotients in areas and volumes. On the contrary, the strains collected in Senegal showed nearly the reversed results.

In case of *O. punctata*, average values and the standard deviations in the whole strains were found to be $14.35 \text{ mm}^2 \pm 1.44$, $21.84 \text{ mm}^3 \pm 2.63$, $8.57 \text{ mm}^2 \pm 0.77$, $10.66 \text{ mm}^3 \pm 1.41$, 0.60 ± 0.03 and 0.50 ± 0.04 in the same order, respectively. The strains of Tanzania showed larger values in areas and volumes in the unhusked and husked grains, and smaller values in quotients in areas and volumes than those of Kenya.

In case of *O. brachyantha*, average values were 16.40 mm^2 , 22.93 mm^3 , 11.04 mm^2 , 13.96 mm^3 , 0.67 and 0.61 in the same order, respectively.

Several character-specificities ascertained from some morphological viewpoints and in mutual connections were fixed out. However, basing on the analyses of the data obtained in the field survey, morphological, genetical and ecological characters, geographical, ecotypic and varietal differentiations should further be discussed and fixed in the future.

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