

On Distribution and Morphology of Cultivated Rice in Liberia

Akinori NAKAGAMA, Akio SUMI* and Tadao C. KATAYAMA

(Received for Publication October 19, 1987)

Introduction

During the period of October in 1985, the writers were sent to Liberia for collecting the 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. In this opportunity, cultivated rices distributed in Liberia were studied.

On the distribution of cultivated rice in Liberia, some reports have already been published^{1,3)}. In this trip, various types of cultivated rice, distributed and under the cultivation, were collected in Liberia. In this report, only the habitat and record of morphological characters of unhusked grains of the cultivated rice collected in Liberia were described. Based on the analyses of the data obtained in the further morphological characters, varietal variations are going to be informed in the following papers.

The writers are most grateful to the government officials in Liberia. Thanks are also due to the following persons; Mr. S. Gblorzuo TOWEH, Dr. Sadi COULIBALY, Dr. J. E. JOHNSTONE, Dr. A. O. ABIFARIN, Dr. J. O. OLUFOWOTE, Mr. H. MIYAISHI.

Abstract of distribution and habitat of cultivated rice

Geographical distributions and habitats of cultivated rice collected in Liberia were briefly illustrated in Fig. 1, in which the routes of trip and the collection-sites of seed samples are given, too.

I. *Oryza sativa* L.

Seed samples of the species were collected from the following districts; Kpatawee, Gayea, Baila, Gbalatuai, Palala and Gbedin. Those were found in irrigated paddy fields, shifting fields and swampy low lands.

II. *Oryza glaberrima* STEUD.

Seed samples of the species were collected from the following districts; Gayea, Blefuanai, Gbalatuai, Palala, Ble, Sanniquillie and Gboi-Darvoryee. Those were found in shifting fields, upland fields and swampy low lands.

Distributions of cultivated rices collected were listed up in Table 1. In this table, the strain number, the species name, the date of collection, the local name, the locality and some informations of the habitat were described.

*Laboratory of Tropical Crop Science

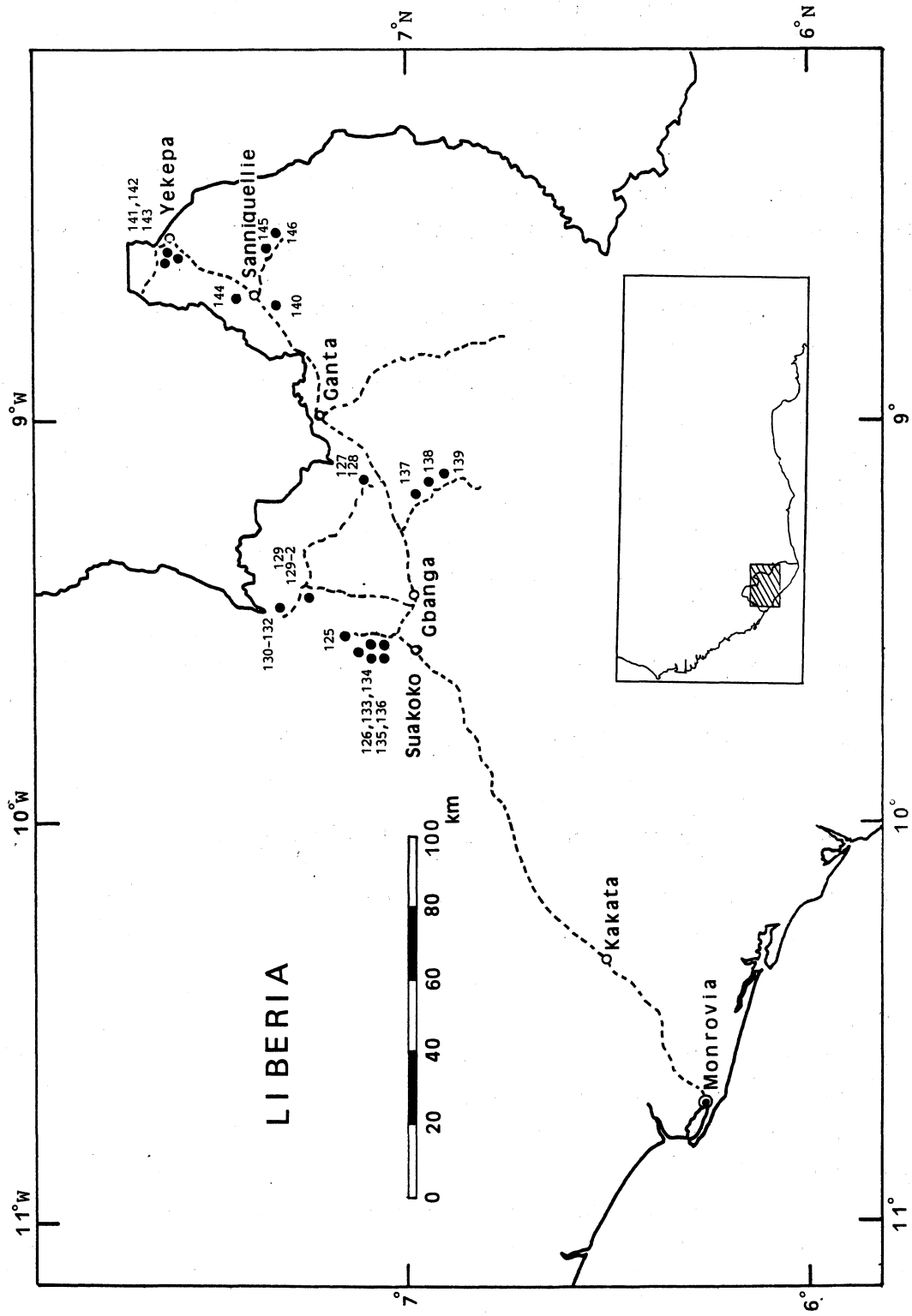


Fig. 1. Map showing several localities where the cultivated rices were collected in Liberia. Dotted lines; routes of observations, filled circles; collection sites, open circles; main towns. Code-numbers used in the figure are corresponding to the strain number used in the tables.

Table 1. Distribution and habitat of cultivated rice collected in Liberia, 1985. Abbreviations; **S**; *Oryza sativa* L., **G**; *Oryza glaberrima* STEUD., respectively

Strain No.	Species	Collecting date	Local name	Place, habitat and remarks
125	S	Oct. 17	Lac-23	Kpatawee, Bong County. Irrigated paddy field in Chinese farm.
126	G	Oct. 17	Siawound	Gayea, Bong County. Shifting field.
127	S	Oct. 18	Ta-a-boah	Baila, Bong County. Shifting field on hill slope.
128	S	Oct. 18	Yo polu	The same habitat as No. 127.
129	G	Oct. 18	—	Blefuanai, Bong County. Upland field in farmer's garden.
129-2	G	Oct. 18	—	Separated from No. 129 in 1986.
130	G	Oct. 18	—	Gbalatuai, Bong County. Swampy low land in valley.
131	S	Oct. 18	—	The same habitat as No. 130.
132	G	Oct. 18	—	The same habitat as Nos. 130 and 131.
133	G	Oct. 19	—	Gayea, Bong County. Edge of upland field. Growing wild status.
134	S	Oct. 19	Jao	Gayea, Bong County. Shifting field.
135	S	Oct. 19	Pantio	Gayea, Bong County. Shifting field.
136	S	Oct. 19	Qua Qua	Gayea, Bong County. Shifting field.
137	G	Oct. 19	Siawound	Palala, Bong County. Shifting field on hill slope.
138	S	Oct. 19	Vilikolin	Palala, Bong County. Shifting field on hill slope.
139	S	Oct. 19	Yopo	Palala, Bong County. Shifting field on hill slope.
140	S	Oct. 22	—	Gbedin, Nimba County. Swampy area.
141	S	Oct. 23	Zor	Ble, Nimba County. Irrigated paddy field.
142	G	Oct. 23	Gata	Ble, Nimba County. Swampy valley surrounded by shifting field on hill slope.
143	G	Oct. 23	Bee	Ble, Nimba County. Shifting field on hill slope. A few plants growing as weed in <i>O. sativa</i> field.
144	G	Oct. 24	Gata	Sanniquillie, Nimba County. Shifting field on hill slope. Growing as weed in <i>O. sativa</i> field.
145	G	Oct. 24	Ma	Gboi-Darvoryee, Nimba County. Shifting field on hill slope. Growing as weed in <i>O. sativa</i> field.
146	G	Oct. 24	Ma	Gboi-Darvoryee, Nimba County. Shifting field on hill slope. Growing as weed in <i>O. sativa</i> field.

Table 2. Some morphological characters of unhusked grains of *O. sativa* collected in Liberia

Strain No.	Length (L) (mm)	Width (W) (mm)	Thickness (T) (mm)	L/W	L/T	W/T
125	9.41±0.26 ¹⁾	3.42±0.07	2.29±0.04	2.75±0.11	4.11±0.13	1.50±0.05
127	9.86±0.29	3.53±0.06	2.39±0.06	2.80±0.10	4.13±0.14	1.48±0.05
128	9.42±0.30	3.39±0.08	2.39±0.04	2.78±0.11	3.95±0.12	1.42±0.05
131	9.80±0.29	3.76±0.07	2.40±0.05	2.61±0.08	4.09±0.12	1.57±0.05
134	9.35±0.34	3.40±0.08	2.30±0.05	2.75±0.12	4.07±0.17	1.48±0.05
135	9.45±0.24	3.45±0.09	2.27±0.05	2.74±0.10	4.17±0.09	1.52±0.06
136	9.77±0.25	3.46±0.07	2.35±0.07	2.83±0.08	4.16±0.12	1.47±0.06
138	9.27±0.22	3.41±0.07	2.17±0.09	2.72±0.06	4.27±0.23	1.57±0.08
139	8.01±0.24	3.30±0.10	2.11±0.04	2.43±0.08	3.81±0.10	1.51±0.04
140	9.75±0.33	3.39±0.08	2.33±0.07	2.88±0.13	4.19±0.14	1.46±0.06
141	8.29±0.16	3.19±0.09	2.09±0.06	2.60±0.08	3.97±0.14	1.53±0.07
Grand ²⁾ mean	9.31±0.58	3.43±0.14	2.28±0.11	2.72±0.12	4.08±0.12	1.51±0.05

1) Mean of 20 grains and standard deviation.

2) Mean of means in the respective strains (n=11) and standard deviation.

Eleven strains of *O. glaberrima* were collected in this trip. However, strain No. 129-2 was separated from No. 129 in cultivation for seed propagation in 1986.

Some morphological characters of unhusked grains

Eleven strains of *O. sativa* and 12 strains of *O. glaberrima* were collected in this trip and those were used for morphological investigations of unhusked grains.

Investigations were done for length, width and thickness of unhusked grains, using 20 grains of each strain. Measurements were done at the largest position of the respective characters. Moreover, of the unhusked grains, calculations were done on the ratios of the following components, namely, 'length to width', 'length to thickness', and 'width to thickness', using average values of the respective characters.

I. *O. sativa*

The results are given in Table 2. Lengths of grains were observed to be between 8.01 mm and 9.86 mm. The shortest grain was obtained in strain No. 139. The longest grain was obtained in No. 127. Average value was found to be 9.31 mm. The standard deviations of each strain, *i. e.*, showing intra-strain variation, were noted to be between 0.16 and 0.34.

Widths of grains were observed to be between 3.19 mm and 3.76 mm. The narrowest grain was obtained in No. 141. The widest grain was obtained in No. 131. Average value was found to be 3.43 mm. The standard deviations of each strain were noted to be between 0.06 and 0.10.

Thicknesses of grains were observed to be between 2.09 mm and 2.40 mm. The thinnest

grain was obtained in No.141. The thickest grain was obtained in No.131. Average value was found to be 2.28 mm. The standard deviations of each strain were noted to be between 0.04 and 0.09.

To make clear the relationships of the three components, *i. e.*, length and width, length and thickness, and width and thickness of unhusked grains, correlation coefficients were calculated. The correlation coefficient between length and width of unhusked grains was ascertained to be 0.72 showing significant correlation among them at 0.1 % level. The correlation coefficient between length and thickness of unhusked grains was ascertained to be 0.90 showing significant correlation among them at 0.1 % level. The correlation coefficient between width and thickness of unhusked grains was ascertained to be 0.73, showing significant correlation among them at 0.1 % level.

Ratios of grain-length to grain-width of unhusked grains were observed to be between 2.43 and 2.88. The smallest value was obtained in No.139. The largest value was obtained in No.140. Average value was found to be 2.72. The standard deviation of the whole strains, *i. e.*, showing inter-strain variation, was 0.12.

Ratios of grain-length to grain-thickness of unhusked grains were observed to be between 3.81 and 4.27. The smallest value was obtained in No.139. The largest value was obtained in No.138. Average value was found to be 4.08. The standard deviation of the whole strains was 0.12.

Ratios of grain-width to grain-thickness of unhusked grains were observed to be between 1.42 and 1.57. The smallest value was obtained in No.128. The largest values were obtained in Nos.131 and 138. Average value was found to be 1.51. Standard deviation of the whole strains was 0.05.

As shown in Fig. 2, based on the data obtained concerning the grain-length and grain-width of unhusked grains, the whole strains of *O. sativa* used were classified into two grain types, *i. e.*, B (large type) and C (slender type), according to the tripartite classification by Matsuo²⁾. In this figure, code-numbers used are corresponding to the strain number used in Table 1. Nine strains of those belonged to the B type and 2 strains to the C type, respectively. As shown in Table 3, average values of grain-length were found to be 9.56 mm in 9 strains belonging to the B type and 8.15 mm in 2 strains to the C type, respectively. Average values of grain-width were found to be 3.47 mm in the B type and 3.25 mm in the C type, respectively. Strains belonging to the C type were remarkably long in view of grain-length. In grain-length, standard deviations of the whole strains belonging to the B and C types, *i. e.*, showing inter-strain variations, were 0.21 in the B type and 0.14 in the C type, respectively. In grain-width, standard deviations of the whole strains belonging to the B and the C types were 0.11 and 0.06, respectively.

II. *Oryza glaberrima*

The results are given in Table 4. Lengths of grains were observed to be between 7.99 mm and 9.77 mm. The shortest grain was obtained in No.129-2. The longest grain was obtained in No.129. Average value was found to be 8.76 mm. The standard deviations

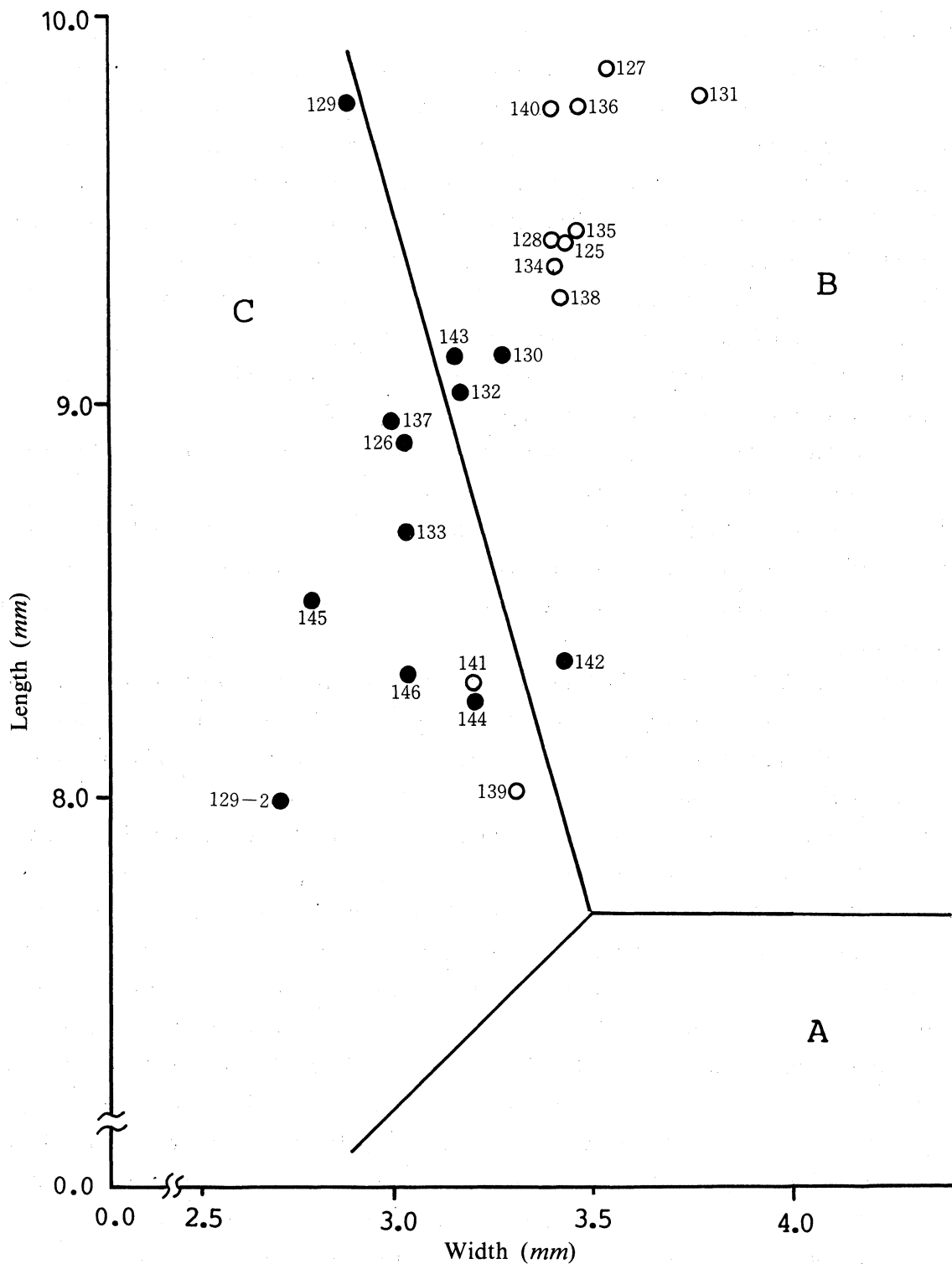


Fig. 2. Classification of grain type of unhusked grains in cultivated rice collected in Liberia according to the tripartite classification by Matsuo²⁾. Vertical axis; length of grain, abscissa; width of grain, open circle; *Oryza sativa* L., filled circle; *O. glaberrima* STEUD., respectively. Code-numbers used in the figure are corresponding to the strain number used in Tables 2 and 4.

Table 3. Number of strains and average values of length and width of unhusked grains of *O. sativa* belonging to the respective grain types

Grain ¹⁾ type	No. of strains	Length (mm)	Width (mm)
B	9	9.56±0.21	3.47±0.11
C	2	8.15±0.14	3.25±0.06

1) For explanation, refer to Fig. 2.

Table 4. Some morphological characters of unhusked grains of *O. glaberrima* collected in Liberia

Strain No.	Length (L) (mm)	Width (W) (mm)	Thickness (T) (mm)	L/W	L/T	W/T
126	8.89±0.20 ¹⁾	3.01±0.09	1.96±0.05	2.95±0.08	4.54±0.12	1.54±0.06
129	9.77±0.33	2.87±0.11	1.75±0.05	3.40±0.13	5.59±0.24	1.64±0.08
129-2	7.99±0.18	2.70±0.10	1.60±0.09	2.96±0.14	5.02±0.26	1.70±0.10
130	9.12±0.22	3.27±0.08	1.96±0.07	2.79±0.07	4.65±0.15	1.67±0.07
132	9.03±0.28	3.15±0.08	1.96±0.05	2.87±0.11	4.61±0.16	1.61±0.06
133	8.72±0.10	3.04±0.06	1.97±0.05	2.87±0.05	4.44±0.10	1.55±0.03
137	8.96±0.25	2.98±0.06	2.00±0.04	3.01±0.08	4.49±0.10	1.49±0.04
142	8.36±0.17	3.41±0.08	2.09±0.07	2.45±0.05	4.01±0.13	1.63±0.06
143	9.14±0.17	3.14±0.08	2.03±0.06	2.91±0.09	4.51±0.17	1.55±0.06
144	8.25±0.12	3.20±0.08	1.99±0.05	2.58±0.08	4.16±0.10	1.61±0.05
145	8.50±0.16	2.78±0.07	1.72±0.05	3.06±0.09	4.95±0.14	1.62±0.07
146	8.35±0.18	3.03±0.06	1.95±0.05	2.76±0.07	4.28±0.14	1.55±0.06
Grand ²⁾ mean	8.76±0.47	3.05±0.19	1.92±0.14	2.88±0.23	4.60±0.41	1.60±0.06

1) Mean of 20 grains and standard deviation.

2) Mean of means in the respective strains (n=12) and standard deviation.

of each strain, *i. e.*, showing intra-strain variation, were noted to be between 0.10 and 0.33.

Widths of grains were observed to be between 2.70 mm and 3.41 mm. The narrowest grain was obtained in No. 129-2. The widest grain was obtained in No. 142. Average value was found to be 3.05 mm. The standard deviations of each strain were noted to be between 0.06 and 0.11.

Thicknesses of grains were observed to be between 1.60 mm and 2.09 mm. The thinnest grain was obtained in No. 129-2. The thickest grain was obtained in No. 142. Average value was found to be 1.92 mm. The standard deviations of each strain were noted to be between 0.04 and 0.09.

To make clear the relationships of the three components, *i. e.*, length and width, length

Table 5. Number of strains and average values of length and width of unhusked grains in *O. glaberrima* belonging to the respective grain types

Grain ¹⁾ type	No. of strains	Length (mm)	Width (mm)
B	4	8.91±0.32	3.24±0.11
C	8	8.68±0.51	2.95±0.15

1) For explanation, refer to Fig. 2.

and thickness, and width and thickness of unhusked grains, correlation coefficients were calculated. The correlation coefficient between length and width of unhusked grains was ascertained to be 0.08 showing no significant correlation even at 5 % level. The correlation coefficient between length and thickness of unhusked grains was ascertained to be 0.13 showing no significant correlation even at 5 % level. The correlation coefficient between width and thickness of unhusked grains was ascertained to be 0.87 showing significant correlation among them at 0.1 % level. This relation indicated that the wider was the grain-width, the thicker was the grain-thickness.

Ratios of grain-length to grain-width were observed to be between 2.45 and 3.40. The smallest value was obtained in No. 142. The largest value was obtained in No. 129. Average value was found to be 2.88. The standard deviation of the whole strains, *i. e.*, showing inter-strain variation, was 0.23.

Ratios of grain-length to grain-thickness were observed to be between 4.01 and 5.59. The smallest value was obtained in No. 142. The largest value was obtained in No. 129. Average value was found to be 4.60. The standard deviation of the whole strains was 0.41.

Ratios of grain-width to grain-thickness were observed to be between 1.49 and 1.70. The smallest value was obtained in No. 137. The largest value was obtained in No. 129-2. Average value was found to be 1.60. The standard deviation of the whole strains was 0.06.

As shown in Fig. 2, based on the data obtained concerning the grain-length and grain-width of unhusked grains, the whole strains of *O. glaberrima* used were classified into two grain types, *i. e.*, B and C types. Four strains of those belonged to the B type and 8 strains to the C type, respectively. As shown in Table 5, average values of grain-length were found to be 8.91 mm in 4 strains belonging to the B type and 8.68 mm in 8 strains belonging to the C type, respectively. Average values of grain-width were found to be 3.24 mm in the B type and 2.95 mm in the C type, respectively. In grain-length, standard deviations of the whole strains belonging to the B and the C types, *i. e.*, showing inter-strain variation, were 0.32 and 0.51, respectively. In grain-width, standard deviations of the whole strains of the B and the C types were 0.11 and 0.15, respectively.

Summary

During the trip of October in 1985 in Liberia, 23 strains of cultivated rice, *i. e.*, 11 strains of *O. sativa* and 12 strains of *O. glaberrima*, were collected. Their localities and habitats were reported (Table 1). Locality names are as follows; Kpatawee, Gayea, Baila, Blefuanai, Gbalatuai, Palala, Gbedin, Ble, Sanniquillie and Gboi-Darvoryee.

In the whole strains of *O. sativa* collected, average values of length, width and thickness of unhusked grains were 9.31 mm, 3.43 mm and 2.28 mm, respectively. Of unhusked grains, correlation coefficients between length and width, length and thickness, and width and thickness were 0.72, 0.90 and 0.73, respectively. Of unhusked grains, ratios of length to width, of length to thickness and of width to thickness were 2.72, 4.08 and 1.51, in average values, respectively.

Using grain-length and grain-width, the whole strains of *O. sativa* used were classified into two grain types. Nine strains belonged to the B type and 2 strains to the C type, respectively.

In *O. glaberrima*, length, width and thickness of unhusked grains were 8.76 mm, 3.05 mm and 1.92 mm, in average values, respectively. Of unhusked grains, correlation coefficients between length and width, length and thickness, and width and thickness were 0.08, 0.13 and 0.87, respectively. Of unhusked grains, ratios of length to width, of length to thickness and of width to thickness were 2.88, 4.60 and 1.60, in average values, respectively.

Using grain-length and grain-width, the whole strains of *O. glaberrima* used were classified into two grain types. Four strains belonged to the B type and 8 strains to the C type, respectively.

References

- 1) Katayama, T.C. 1987. General remarks on cultivated rice in Africa concerned. Kagoshima Univ. Res. Center S. Pac. Occ. Papers 10: 91-102.
- 2) Matsuo, T. 1952. Genecological studies on cultivated rice (in Japanese with English summary). Bull. Natl. Inst. Agr. Sci. Ser. D3: 1-111.
- 3) Perez, A. T. 1977. Plant exploration in Liberia (Sep. 24-Oct. 20, 1977). Genetic Resouces Unit Exploration 77, IITA: 27-68.

摘 要

リベリアにおける栽培稲の分布と形態

中釜明紀・角 明夫*・片山忠夫

1985年10月にリベリアにおいて栽培稲の分布と生態について調査を行ない、*Oryza sativa* 11系

統, *Oryza glaberrima* 12 系統を採集した。それらの分布と生息地の生態条件は Table 1 に示したとおりである。

粳の形態調査の結果, 粳の長さ, 幅, および厚さの系統間平均は, *O. sativa* では 9.31, 3.43, 2.28 mm であり, *O. glaberrima* では 8.76, 3.05, 1.92 mm であった。これらの形質間の相関には *O. sativa* では粳の長さ、幅、長さ、厚さおよび幅と厚さのいずれにも高い正の相関が認められた。一方, *O. glaberrima* では, 粳幅と粳厚に高い相関係数が得られ, 粳幅の広い系統ほど厚くなる傾向が認められた。長幅比, 長厚比, 幅厚比の系統間平均は, *O. sativa* で 2.72, 4.08, 1.51 であり, *O. glaberrima* では, 2.88, 4.60, 1.60 であった。粳型の分類により, *O. sativa* では 9 系統が B 型, 2 系統が C 型に, *O. glaberrima* では 4 系統が B 型, 8 系統が C 型に分類された。

今後, さらに多くの形態的特性の分析をもとにリベリアを含むアフリカ地域における栽培稲の品種分化を検討する。

(* 熱帯作物学研究室)