

## On Distribution and Morphology of Cultivated Rice in Madagascar

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### Introduction

During the period from August to September in 1985, writers took a trip in Madagascar 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.

On the distribution of cultivated rice in Madagascar, some reports have already been published<sup>1,2)</sup>. In this trip, various types of cultivated rice, distributed and under cultivation, were collected in Madagascar. In this report, only the habitat and record of some morphological characters of unhusked grains of the cultivated rice collected in Madagascar 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.

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### Abstract of distribution and habitat of cultivated rice

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

Seed samples were collected in the following districts; Maevatanana, Ambolajanakomby, Marovoay, Andranovelona, Mohitsy, Antsapanimahozo and Anororo.

Distribution of cultivated rice collected was given in Table 1. In this table, the strain number, the date of collection, the local name, the locality and some informations for the habitat were described.

Sixteen strains of seed samples were collected during the trip. At that time, cultivated rice had been harvested from most of the field. Twelve strains of 16 seed samples were gathered from farmer's stores, as well as from threshing floor and unthreshed panicles

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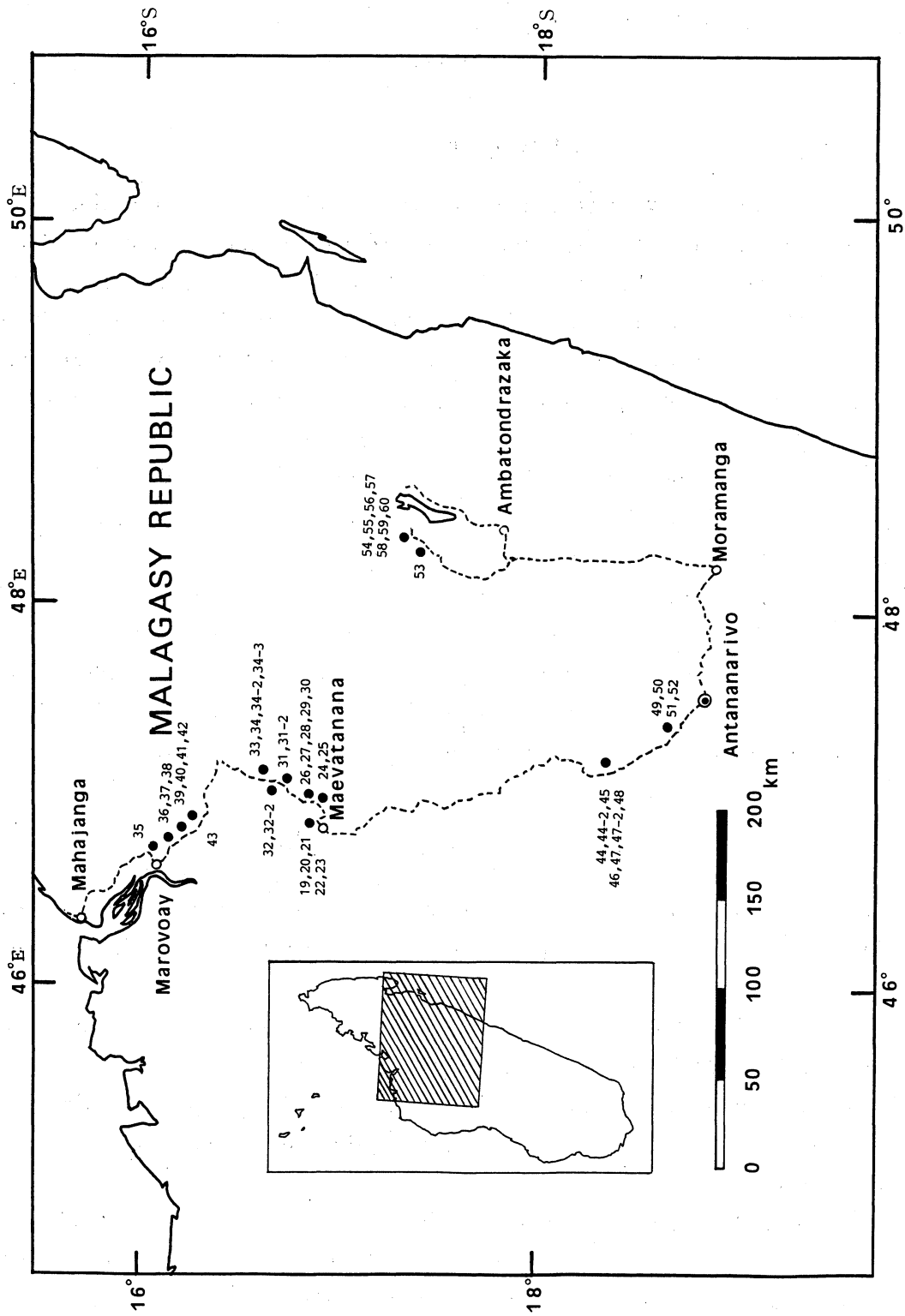


Fig. 1. Map showing several localities where the cultivated rices were collected in Madagascar. Dotted lines; routes of observations, filled circles; collection areas, open circles; main towns. Code-numbers used in the figure are corresponding to the strain number used in the tables.

Table 1. Distribution and habitat of cultivated rice collected in Madagascar in 1985

Strain No.	Collecting date	Local name	Place, habitat and remarks
19	Aug. 28	Bekimondro	Maevatanana. Collected from farmer's store. Mixed variety.
20, 21, 22, 23	Aug. 28	—	Samples of Nos. 20~23 were separated from No. 19 in 1985.
24	Aug. 28	Rokorintsane	Maevatanana. Collected from farmer's store. Mixed variety.
25	Aug. 28	—	Separated from No. 24 in 1985.
26	Aug. 29	Bekimondro	Maevatanana. Collected from farmer's store. Mixed variety.
27, 28, 29, 30	Aug. 29	—	Samples of Nos. 27~30 were separated from No. 26 in 1985.
31	Aug. 29	Tsipala	Ambolajanakomby. Irrigated paddy field at the fringe of pond.
31-2	Aug. 29	—	Separated from No. 31 in 1986.
32	Aug. 29	Hozolahy	The same habitat as No. 31. Collected from a rice heap adjacent to rice field.
32-2	Aug. 29	—	Separated from No. 32 in 1986.
33	Aug. 29	Japone	The same habitat as Nos. 31 and 32. Collected from farmer's store. Mixed variety.
34	Aug. 29	—	Separated from No. 33 in 1985.
34-2, 34-3	Aug. 29	—	Samples of Nos. 34-2 and 34-3 were separated from No. 34 in 1986.
35	Aug. 30	1329 Boina	Tsararano Village, Marovoay. Irrigated paddy field of FIFABE.
36	Aug. 31	Ali-combo	Murarano Village, Marovoay. Collected from farmer's store.
37	Aug. 31	Tsipala	The same place as No. 36. Collected from farmer's store.
38	Aug. 31	1329 Boina	The same place as Nos. 36 and 37. Collected from farmer's store.
39	Aug. 31	Andramonta	Mbalano Village, Marovoay. Collected from farmer's store. Mixed variety.
40, 41, 42	Aug. 31	—	Samples of Nos. 40~42 were separated from No. 39 in 1985.
43	Aug. 31	Menakely	Mbalano Village, Marovoay. Irrigated paddy field.
44	Sep. 3	Rojofotsy	Andranovelona. Collected from farmer's store. Mixed variety.
44-2	Sep. 3	—	Separated from No. 44 in 1986.
45, 46, 47, 48	Sep. 3	—	Samples of Nos. 45~48 were separated from No. 44 in 1985.
47-2	Sep. 3	—	Separated from No. 47 in 1986.
49	Sep. 3	Botry	Samples of Nos. 50~52 were separated from No. 49 in farmer's store. Mixed variety.
50, 51, 52	Sep. 3	—	Samples of Nos. 50~52 were separated from No. 49 in 1985.
53	Sep. 5	Makalioka	Antsapanimahozo. Collected from farmer's store.
54	Sep. 5	Vary malady	Anororo. Collected from threshing floor in paddy field. Mixed variety.
55, 56, 57, 58, 59, 60	Sep. 5	—	Samples of Nos. 55~60 were separated from No. 54 in 1985.

piled to dry. Almost of those were ascertained to be mixed varieties. The other seed samples were collected from the paddy fields of the dry season cropping found in an irrigated paddy field in Marovoay and in a swampy low land adjacent to a pond in Ambolajanakomby.

Identifications of individual strains in the mixed varieties were carried out twice for grain morphology, *i. e.*, shape and size of grain, colors of hull and pericarp, in 1985, and for morphological and physiological characters, *i. e.*, earliness of heading and presence of awn and hair, in 1986. Consequently, those were identified to be 48 strains in the total.

### Some morphological characters of unhusked grains

Forty-eight strains were collected in this trip and those were used for morphological investigations of unhusked grains. Eight strains were removed from investigation, because their grains were wholly immature or quite few.

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.

The results are given in Table 2. Lengths of grains were observed to be between 7.22 *mm* and 12.40 *mm*. The shortest grain was obtained in strain No. 33. The longest grain was obtained in No. 36. Average value was found to be 9.30 *mm*. The standard deviations of each strain, *i. e.*, showing intra-strain variation, were noted to be between 0.13 and 0.65.

Widths of grains were observed to be between 2.49 *mm* and 3.89 *mm*. The narrowest grains were obtained in No. 31-2 and No. 55. The widest grain was obtained in No. 51. Average value was found to be 3.05 *mm*. The standard deviations of each strain were noted to be between 0.06 and 0.17.

Thicknesses of grains were observed to be between 1.89 *mm* and 2.29 *mm*. The thinnest grain was obtained in No. 24. The thickest grain was obtained in No. 38. Average value was found to be 2.07 *mm*. The standard deviations of each strain were noted to be between 0.03 and 0.10.

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 -0.32 showing negative correlation among them at 5% level. The correlation coefficient between length and thickness of unhusked grains was ascertained to be 0.21 showing no significant correlation even at 5% level. The correlation coefficient between width and thickness was ascertained to be 0.53 showing significant correlation among them at 0.1% level.

Ratios of grain-length to grain-width were observed to be between 2.02 and 4.09.

Table 2. Some morphological characters of unhusked grains collected in Madagascar

Strain No.	Length (L) (mm)	Width (W) (mm)	Thickness (T) (mm)	L/W	L/T	W/T
19	9.57±0.37 <sup>1)</sup>	2.78±0.09	2.06±0.06	3.44±0.14	4.64±0.20	1.35±0.05
21	8.87±0.33	2.80±0.07	1.94±0.06	3.17±0.12	4.57±0.17	1.44±0.06
22	8.35±0.26	3.30±0.12	2.21±0.05	2.54±0.10	3.78±0.15	1.49±0.05
23	9.18±0.35	3.04±0.14	2.09±0.08	3.03±0.08	4.39±0.14	1.45±0.06
24	8.26±0.21	2.72±0.08	1.89±0.08	3.04±0.08	4.39±0.15	1.44±0.05
26	9.54±0.41	2.75±0.09	2.06±0.06	3.47±0.16	4.64±0.19	1.34±0.05
27	7.95±0.26	3.12±0.09	1.99±0.07	2.55±0.08	4.01±0.11	1.57±0.06
28	9.16±0.40	3.25±0.14	2.25±0.08	2.74±0.43	4.05±0.37	1.52±0.31
31	10.44±0.32	2.68±0.13	2.06±0.05	3.90±0.19	5.06±0.18	1.30±0.05
31-2	10.15±0.33	2.49±0.14	1.95±0.07	4.09±0.23	5.21±0.20	1.28±0.09
32	9.82±0.29	2.79±0.12	2.04±0.08	3.52±0.15	4.82±0.18	1.37±0.08
32-2	9.87±0.31	2.55±0.11	1.97±0.06	3.88±0.21	5.02±0.20	1.30±0.08
33	7.22±0.22	3.58±0.12	2.22±0.07	2.02±0.10	3.25±0.14	1.61±0.07
34	7.45±0.26	2.98±0.10	1.97±0.08	2.50±0.10	3.78±0.14	1.51±0.09
34-2	7.32±0.33	3.02±0.08	1.94±0.07	2.42±0.10	3.78±0.20	1.56±0.08
34-3	7.49±0.32	3.14±0.08	2.00±0.04	2.39±0.10	3.74±0.17	1.57±0.05
35	10.48±0.23	3.19±0.08	2.26±0.03	3.29±0.10	4.64±0.11	1.41±0.04
36	12.40±0.41	3.09±0.11	2.21±0.06	4.02±0.20	5.61±0.18	1.40±0.05
37	10.08±0.44	2.75±0.11	2.09±0.06	3.68±0.22	4.83±0.27	1.32±0.04
38	11.71±0.65	3.02±0.10	2.29±0.04	3.89±0.19	5.12±0.29	1.32±0.05
39	10.19±0.37	3.01±0.08	2.16±0.05	3.39±0.12	4.73±0.17	1.40±0.04
40	9.94±0.35	2.90±0.15	1.97±0.07	3.44±0.24	5.05±0.29	1.47±0.11
41	9.51±0.38	3.07±0.06	2.01±0.10	3.10±0.15	4.76±0.37	1.53±0.07
42	9.79±0.33	2.99±0.10	1.91±0.07	3.27±0.15	5.15±0.30	1.58±0.10
43	9.59±0.33	2.94±0.09	1.98±0.07	3.27±0.11	4.84±0.21	1.48±0.07
44	9.05±0.13	3.03±0.08	1.91±0.06	2.99±0.09	4.74±0.17	1.59±0.06
44-2	9.45±0.32	3.33±0.10	2.18±0.07	2.84±0.08	4.33±0.21	1.53±0.08
45	9.57±0.22	3.15±0.09	2.10±0.08	3.05±0.12	4.58±0.21	1.50±0.08
46	9.55±0.24	3.36±0.06	2.12±0.05	2.84±0.10	4.51±0.16	1.59±0.06
47	9.37±0.23	3.35±0.11	2.16±0.07	2.80±0.10	4.35±0.15	1.56±0.07
47-2	9.28±0.24	3.24±0.11	2.06±0.08	2.86±0.10	4.51±0.21	1.58±0.10
49	7.73±0.45	3.65±0.12	2.24±0.08	2.12±0.11	3.45±0.19	1.63±0.07
50	9.39±0.18	3.37±0.13	1.93±0.06	2.79±0.11	4.88±0.14	1.75±0.10
51	8.24±0.29	3.89±0.10	2.09±0.06	2.12±0.09	3.94±0.14	1.86±0.08
52	10.20±0.29	3.56±0.17	2.11±0.07	2.87±0.17	4.85±0.21	1.69±0.09
53	9.79±0.33	2.55±0.10	2.02±0.06	3.85±0.20	4.85±0.19	1.26±0.07
54	8.50±0.23	3.24±0.07	2.19±0.05	2.63±0.10	3.88±0.13	1.48±0.06
55	9.79±0.41	2.49±0.09	1.97±0.05	3.93±0.17	4.98±0.18	1.27±0.05
56	9.24±0.28	2.58±0.09	1.95±0.05	3.58±0.14	4.73±0.22	1.32±0.07
60	8.73±0.28	3.11±0.08	2.10±0.06	2.81±0.10	4.17±0.16	1.49±0.07
Grand <sup>2)</sup> mean	9.30±1.08	3.05±0.33	2.07±0.11	3.10±0.55	4.52±0.52	1.48±0.14

1) Mean of 20 grains and standard deviation.

2) Mean of means in the respective strains (n=40) and standard deviation.

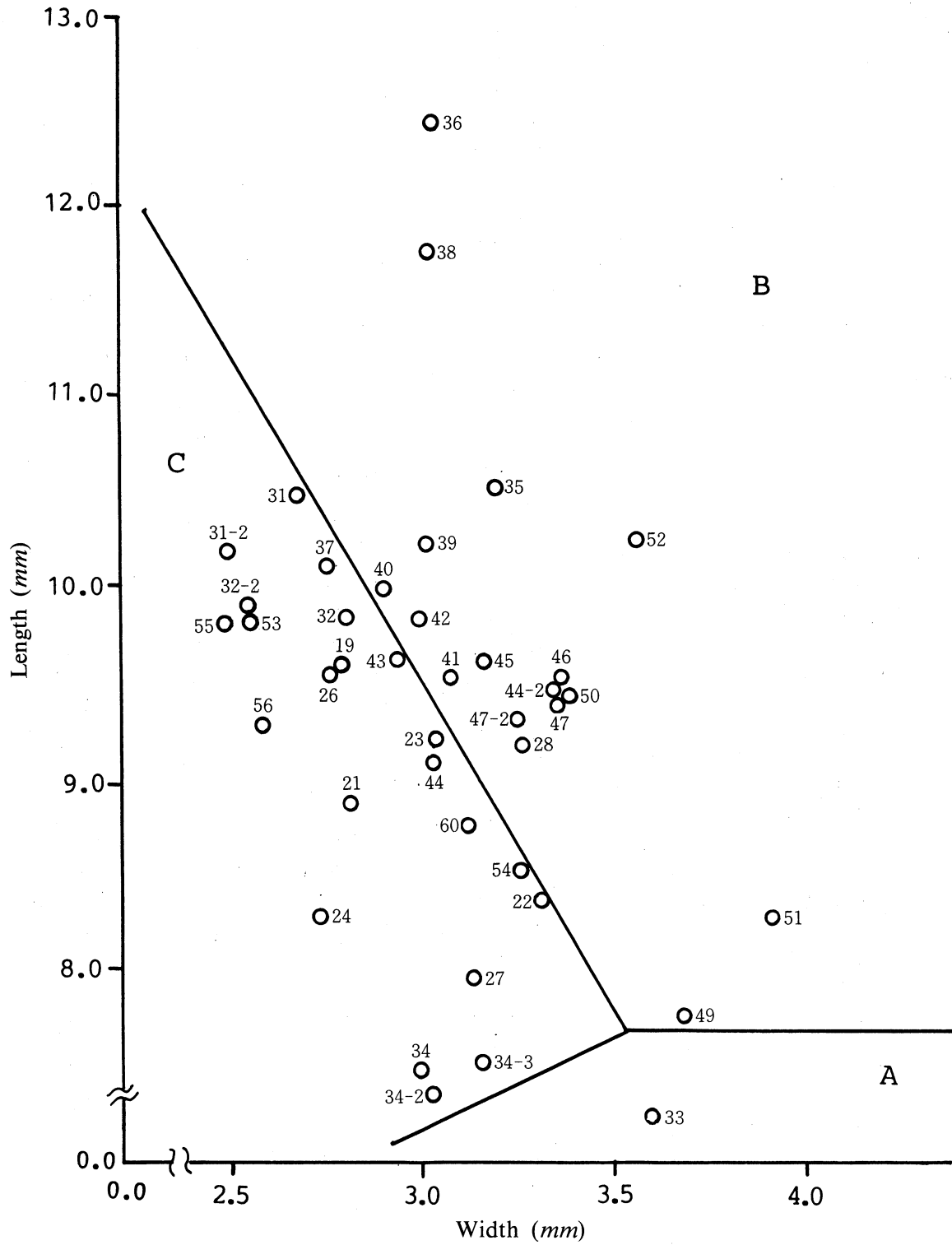


Fig. 2. Classification of grain types of unhusked grains in cultivated rice collected in Madagascar according to the tripartite classification by Matsuo<sup>3)</sup>. Vertical axis; length of grain, abscissa; width of grain, open circle; *Oryza sativa* L., respectively. Code-numbers used in the figure are corresponding to the strain number used in Table 2.

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

Grain <sup>1)</sup> types	No. of strains	Length (mm)	Width (mm)
A	1	7.22±0.00	3.58±0.00
B	17	9.76±1.07	3.26±0.25
C	22	9.05±0.91	2.86±0.24

1) For explanation, refer to Fig. 2.

The smallest value was obtained in No. 33. The largest value was obtained in No. 31-2. Average value was found to be 3.10. The standard deviation of the whole strains, *i. e.*, showing inter-strain variation, was 0.55.

Ratios of grain-length to grain-thickness of unhusked grains were observed to be between 3.25 and 5.61. The smallest value was obtained in No. 33. The largest value was obtained in No. 36. Average value was found to be 4.52. The standard deviation of the whole strains was 0.52.

Ratios of grain-width to grain-thickness of unhusked grains were observed to be between 1.26 and 1.86. The smallest value was obtained in No. 53. The largest value was obtained in No. 51. Average value was found to be 1.48. The standard deviation of the whole strains was 0.14.

As shown in Fig. 2, based on the data obtained concerning the grain-length and grain-width of unhusked grains, the cultivated rice strains used were classified into three grain types, *i. e.*, A (short type), B (large type) and C (slender type), according to the tripartite classification by Matsuo<sup>3)</sup>. One strain of those belonged to the A type, 17 strains to the B type and 22 strains to the C type, respectively.

As shown in Table 3, average values of grain-length were found to be 7.22 mm in 1 strain belonging to the A type, 9.76 mm in 17 strains belonging to the B type and 9.05 mm in 22 strains belonging to the C type, respectively. Average values of grain-width were found to be 3.58 mm in A type, 3.26 mm in B type and 2.86 mm in C type, respectively. Strain belonging to the A type was remarkably short in view of grain-length and strains belonging to the C type were remarkably narrow in view of grain-width. In grain-length, standard deviations of the whole strains belonging to the B and the C types, *i. e.*, showing inter-strain variations, were 1.07 in B type and 0.91 in C type, respectively. In grain-width, standard deviations of the whole strains belonging to the B and the C types were 0.25 and 0.24, respectively.

### Summary

During the trip from August to September in 1985, in Madagascar, 16 strains of seed

sample including 12 mixed varieties of cultivated rice, *i. e.*, *Oryza sativa* L., were collected. Those were identified into 48 strains in the total, according to the morphological and physiological observations in 1985 and 1986. Their localities and habitats were reported (Table 1). Locality names are as follows; Maevatanana, Ambolajanakomby, Marovoay, Andranovelona, Mohitsy, Antsapanimahozo and Anororo.

Of 48 strains forty were used for morphological investigations of unhusked grains. In average values, length, width and thickness of unhusked grains were 9.30 mm, 3.05 mm and 2.07 mm, respectively. Of unhusked grains, correlation coefficients between length and width, length and thickness, and width and thickness were -0.32, 0.21 and 0.53, respectively. Of unhusked grains, ratios of the following components, namely, 'length to width', 'length to thickness' and 'width to thickness', were 3.10, 4.52 and 1.48 in average values, respectively.

Using grain-length and grain-width, cultivated rice strains used were classified into three grain types. One strain belonged to the A type, 17 strains to the B type and 22 strains to the C type, respectively.

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#### 摘 要

#### マダガスカルにおける栽培稲の分布と形態

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1985年8月から9月に、マダガスカルにおいて栽培稲の分布と生態について、調査を行ない、12系統の混種を含む16系統の種子標本を採集した。それらは、1985、1986年の形態的、生理的観察により、全体として48系統に分類された。それらの分布と生態条件はTable 1に示したとおりである。

48系統のうち40系統を供試して籾の形態的特性を調査した。籾の長さ、幅、厚さは、系統間平均でそれぞれ9.30、3.05、2.07 mmであった。これらの形質間には、長さとおよび幅と厚さにそれぞれ-0.32、0.21、0.53の相関係数が得られ、籾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、幅厚比は、系統間平均でそれぞれ3.10、4.52、1.48であった。籾型の分類により1系統がA型、17系統がB型、22系統がC型にそれぞれ分類された。



今後、さらに多くの形態的特性の分析をもとにマダガスカルを含むアフリカ地域における栽培稲の品種分化について検討する。

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