Morphological Characters of the Cultivated Rice Grains of Madura, Indonesia (V)

Tadao C. KATAYAMA

(Experimental Farm)

Received for Publication August 22, 1990

Introduction

During the period from June to July in 1981, the writer was sent to Indonesia for making research on agricultural practices under the project, designated as "Ecological Biology and the Promotion of Tropical Primary Industry", supported by a Grant from the Ministry of Education, Science and Culture, Japan. Rice cultivation in East Java, Indonesia, was studied from several viewpoints. Observations were also made in Middle Java and Bali Islands for the extensive comparisons, and the results obtained in East Java were briefly reported in the previous papers.

On the grain morphology of rice grains distributed in islands of Indonesia, some reports have been published[2]. However, no distinct record has been reported on the grain morphology of cultivated rice varieties in Madura Island, East Java, Indonesia. In these districts, several cultivated rice, *Oryza sativa* L., are used in lowland and upland fields. Most of them are introduced from Java proper, Bali, India, the Philippines and others. It is said that improved varieties of the *indica* type of rice are being cultivated and that primitive types of *indica* and *javanica* are not used in these areas at the present. However, it is not ascertained whether the same can be said as to Madura Island.

To obtain sources of RTV (resistance to tungro virus) for the breeding programs in Indonesia, field screening IRRI lines was done in Lanrang sub-station during the wet monsoon season in 1986[11]. On the other hand, scientists evaluated some herbicides to control weeds in hybrid rice Shen Zhan 97A/Sadang in wet season during 1985-1986[12]. In Vietnam, tolerant varieties for low temperature were evaluated[1]. As shown, recent and hybrid rice varieties are adopted. However, primitive varieties are being kept consciously, everywhere. Recently, a local upland rice variety in Indonesia was used for selection of dwarf and semi-dwarf mutant[8].

Since 1969, high yielding varieties have been recommended by the governments of a lot of countries in south and southeast Asia. In India, for example, breeding works have been pushed forward in viewpoints of aromatic[10], short-duration[9] varieties, etc. Sarma *et al.* (1990)[10] reported that 43 traditional varieties in Assam showed grain length as 5.66-9.94mm, breath as 1.80-2.96mm, L/B ratio as 2.44-4.33. Paramasivan *et al.* (1990)[9] reported the TM6012 variety in Tamil Nadu showed 'long slender' as grain shape.

Accumulations of complete data endorsed by discussions on their aspects have been unfortunately far from being perfect. The present experimental series has been carried out to search the varietal variations, taking these facts into considerations.

In the previous paper[3], the records of morphological characters of the unhusked and the husked grains, comparisons of the unhusked and the husked grains of 12 characters and variation ranges in 24 characters[4], correlation coefficients between the practical values of the unhusked and

the husked grains and linear regression between them[6], the remaining 15 mutual relations among 24 characters in views of practical values[7], were reported, in order to confirm the morphological characters of grains which were to make the strain's specificities clear.   In the present paper, mutual relations in the views of practical values, standard deviations and variation ranges were mainly described as the final report of the present experimental series, in order to confirm the morphological characters of grains as well as to make clear the geographical and ecotypic differentiations of the grains.

Materials and Methods

Twenty-nine strains of rice cultivars, *Oryza sativa* L., collected in East Java during the trip, especially on Madura Island, were used in this experimental series.   They were listed up in Table 1 of the previous paper[3].   In that table, collection number, collection data, collection place, and detailed informations were mentioned.

Thirty grains were used for the measurement of the respective strains.   To make clear the relationships between practical values, standard deviations and variation ranges in the strain level, 6 relations were calculated, *i.e.*, practical value and other practical values, standard deviations and other standard deviations, variation range and other variation ranges (Table 1), practical value and its standard deviations, practical value and its variation range, standard deviations and its variation range (Table 2).   Finally, comparisons of 8 relation-groups were made, using mainly the data shown in Table 1 (Table 3) and those in Table 2 (Table 4).

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), c.c. (correlation coefficient), l.r. (linear regression), d.f. (degree of freedom).

Results

1. Relations between the practical values of the two respective characters

Correlation coefficient (abbreviated as c.c.) and linear regression (abbreviated as l.r.) of the practical value on another practical value among 27 character-combinations were calculated, and are shown in the left column of Table 1.   Nineteen, 1 and 7 character-combinations showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively.   For example, c.c. of length (UHG) on width (UHG) through the whole strains (=29) was -0.4488 to the degree of freedom of 27, which is negatively significant at 5% level.   Generally speaking, the longer is the length (UHG), the narrower is the width (UHG).   L.r. of length on width was calculated as follows; $Y = -0.195X + 4.662$, where Y and X indicate length and width, respectively. This formula indicates that the length (UHG) becomes 0.195mm longer, when the width (UHG) becomes narrower by 1 degree.

2. Relations between the standard deviations of the two respective characters

C.c. and l.r. of s.d. on another s.d. among 27 character-combinations were calculated, and are shown in the central column of Table 1.   Thirteen, 3, 1 and 10 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.   For example, c.c. of s.d. of L/T (UHG) on s.d. of W/T (UHG) through the whole strains was $+0.7112$ to the degree of freedom of 27, which is obviously significant at 0.1% level.   Generally speaking, the

Table 1.　Correlation coefficient and linear regression of the former character (Y) on the latter character (X) for 27 combinations; practical values (left), s.d. (center) and ranges (right)

Combination	Practical value		S.d.		Range	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1·2	−0.4488*	Y=−0.195X+4.662	0.2697	—	0.3651	—
1·3	−0.0186	—	−0.0710	—	−0.1265	—
2·3	0.6468***	Y=0.353X+1.041	−0.1421	—	0.0202	—
4·5	0.8270***	Y=0.917X+1.516	0.1674	—	0.0975	—
4·6	−0.6397***	Y=−0.165X+1.930	−0.1933	—	−0.1269	—
5·6	−0.0104	—	0.7112***	Y=0.260X+0.024	0.5093**	Y=0.174X+0.149
11·12	−0.2132	—	0.1382	—	0.3057	—
11·13	0.3474	—	0.2775	—	0.2976	—
12·13	0.7374***	Y=0.532X+0.547	0.1960	—	0.0294	—
14·15	0.8164***	Y=0.845X+1.270	0.4724**	Y=0.778X+0.067	0.3777*	Y=0.548X+0.352
14·16	−0.6228***	Y=−0.192X+1.847	0.4180*	Y=0.347X+0.032	0.4421*	Y=0.285X+0.139
15·16	−0.0701	—	0.7214***	Y=0.364X+0.017	0.5513**	Y=0.245X+0.131
21·22	0.6333***	Y=1.000X+0.120	0.3553	—	0.2028	—
21·23	0.7658***	Y=0.993X+0.177	0.5578**	Y=0.761X+0.008	0.4766**	Y=0.627X+0.036
22·23	0.6573***	Y=0.539X+0.437	0.1958	—	0.1744	—
24·25	0.3087	—	0.6626***	Y=0.557X+0.007	0.1778	—
24·26	−0.6173***	Y=−0.734X+1.573	0.7288***	Y=0.884X+0.008	0.5262**	Y=0.609X+0.066
25·26	0.2794	—	0.5869***	Y=0.848X+0.015	−0.0433	—
1·11	0.9170***	Y=0.699X+0.146	0.8339***	Y=0.709X+0.006	0.7060***	Y=0.554X+0.187
2·12	0.9266***	Y=0.790X+0.132	0.4758**	Y=0.556X+0.036	0.6175***	Y=0.666X+0.083
3·13	0.9864***	Y=1.111X−0.459	0.9193***	Y=1.078X−0.004	0.8049***	Y=0.698X+0.072
4·14	0.9787***	Y=0.799X+0.176	0.6450***	Y=0.721X+0.034	0.6476***	Y=0.746X+0.107
5·15	0.9819***	Y=0.749X+0.249	0.8521***	Y=0.850X+0.004	0.6197***	Y=0.626X+0.174
6·16	0.9349***	Y=0.914X+0.040	0.8824***	Y=1.213X−0.012	0.7965***	Y=1.049X−0.005
31·33	0.8620***	Y=0.608X−10.259	0.7305***	Y=0.428X+0.239	0.6685***	Y=0.402X+0.990
32·34	0.9475***	Y=0.609X−4.056	0.7966***	Y=0.446X+0.384	0.7171***	Y=0.453X+1.335
35·36	0.9699***	Y=1.150X−0.157	0.7729***	Y=0.675X+0.008	0.6990***	Y=0.423X+0.050

Character numbers; 1, 11, 21-length, 2, 12, 22-width, 3, 13, 23-thickness, 4, 14, 24-L/W, 5, 15, 25-L/T, 6, 16, 26-W/T, 1~6-unhusked grains, 11~16-husked grains, 21~26-comparative values (=husked/unhusked), 31-area (UHG), 32-volume (UHG), 33-area (HG), 34-volume (HG), 35-quotient of areas (=33/31), 36-quotient of volumes (=34/32)
***, **, *; significant at 0.1%, 1% and 5% levels, respectively
d.f.=27

larger is the s.d. of L/T (UHG), the larger is the s.d. of W/T (UHG). L.r. of the s.d. of L/T on the s.d. of W/T was calculated as follows; Y=0.260X+0.024, where Y and X indicate s.d. of L/T and s.d. of W/T, respectively. This formula indicates that the s.d. of L/T (UHG) becomes 0.260 larger, when the s.d. of W/T (UHG) becomes larger by 1 degree.

3. Relations between the variation ranges of the two respective characters

C.c. and l.r. of variation range on another variation range among 27 character-combinations were calculated, and are shown in the right column of Table 1. Nine, 4, 2 and 12 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of the variation range of L/T (UHG) on variation range of W/T (UHG) through the whole strains was $+0.5093$ to the degree of freedom of 27, which is significant at 1% level. Generally speaking, the larger is the variation range of L/T (UHG), the larger is the variation range of W/T (UHG). L.r. of variation range of L/T (UHG) on variation range of W/T (UHG) was calculated as follows; $Y=0.174X+0.149$, where Y and X indicate the variation range of L/T (UHG) and the variation range of W/T (UHG), respectively. This formula indicates that the variation range of L/T (UHG) becomes 0.174 larger, when the variation range of W/T (UHG) becomes larger by 1 degree.

4. Relations between the practical values and its standard deviations

C.c. and l.r. of practical value on its s.d. among 24 characters were calculated, and are shown in the left column of Table 2. Four, 4, 4 and 12 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of practical value of L/W (UHG) on s.d. of L/W (UHG) through the whole strains $(=29)$ was $+0.7231$ to the degree of freedom of 27, which is obviously significant at 0.1% level. Generally speaking, the larger is the practical value of L/W (UHG), the larger is the s.d. of L/W (UHG). L.r. of practical value of L/W (UHG) on s.d. of L/W (UHG) was calculated as follows; $Y=0.067X-0.059$, where Y and X indicate practical value and s.d. of L/W (UHG), respectively. This formula indicates that the practical value of L/W (UHG) becomes 0.067 larger, when the s.d. of L/W (UHG) becomes larger by 1 degree.

5. Relations between the practical values and its variation ranges

C.c. and l.r. of practical value on its variation range among 24 characters were calculated, and are shown in the central column of Table 2. Three, 5, 3 and 13 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of practical value of L/W (UHG) on variation range of L/W (UHG) through the whole strains was $+0.5781$ to the degree of freedom of 27, which is significant at 1% level. Generally speaking, the larger is the practical value of L/W (UHG), the larger is the variation range of L/W (UHG). L.r. of practical value of L/W (UHG) on variation range of L/W (UHG) was calculated as follows; $Y=0.193X-0.058$, where Y and X indicate the practical value and variation range of L/W (UHG), respectively. This formula indicates that the practical value of L/W (UHG) becomes 0.193 larger, when the variation range of L/W (UHG) becomes larger by 1 degree.

6. Relations between the standard deviations and its variation ranges

C.c. and l.r. of s.d. on its variation range among 24 characters were calculated, and are shown in the right column of Table 2. The whole characters $(=24)$ showed significances at 0.1% level. For example, c.c. of s.d. of length (UHG) on variation range of length (UHG) through the whole strains was $+0.8632$ to the degree of freedom of 27, which is obviously significant at 0.1% level. Generally speaking, the larger is the s.d. of length (UHG), the larger is the variation range of length (UHG). L.r. of s.d. of length (UHG) on variation range of length (UHG) was calculated as follows; $Y=2.962X+0.182$, where Y and X indicate s.d. and variation range of length (UHG), respectively. This formula indicates that the s.d. of length (UHG) becomes 2.962 larger, when the variation range (UHG) becomes larger by 1 degree.

Table 2. Correlation coefficient and linear regression of the former character (Y) on latter character (X) for 24 characters; practical value on its s.d. (left), practical value on its range (center), and s.d. on its range (right)

Char-acter	Practical value on S.d.		Practical value on Range		S.d. on Range	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.3202	—	0.3510	—	0.8632***	Y=2.962X+0.182
2	0.3116	—	0.3263	—	0.8383***	Y=3.327X+0.023
3	−0.2184	—	−0.1034	—	0.9458***	Y=3.242X+0.022
4	0.7231***	Y=0.067X−0.059	0.5781**	Y=0.193X−0.058	0.9109***	Y=3.295X+0.051
5	0.3261	—	0.2773	—	0.8891***	Y=2.883X+0.147
6	0.7789***	Y=0.188X−0.188	0.5991***	Y=0.436X−0.339	0.8690***	Y=2.622X+0.074
11	0.2082	—	0.1202	—	0.9305***	Y=2.946X+0.131
12	0.4719**	Y=0.059X−0.046	0.3606	—	0.8720***	Y=3.195X+0.031
13	−0.3955*	Y=−0.071X+0.204	−0.1743	—	0.8696***	Y=2.203X+0.086
14	0.2989	—	0.3101	—	0.8772***	Y=3.268X+0.048
15	0.5674**	Y=0.114X−0.225	0.4829**	Y=0.318X−0.492	0.8527***	Y=2.800X+0.136
16	0.8183***	Y=0.278X−0.288	0.7413***	Y=0.727X−0.682	0.9317***	Y=2.692X+0.066
21	−0.5221**	Y=−0.174X+0.138	−0.5562**	Y=−0.628X+0.501	0.8695***	Y=2.941X+0.012
22	−0.1810	—	0.1410	—	0.7942***	Y=3.281X+0.011
23	−0.8170***	Y=−0.287X+0.274	−0.7724***	Y=−0.886X+0.854	0.8559***	Y=2.793X+0.014
24	0.3380	—	0.2564	—	0.8795***	Y=3.233X+0.008
25	0.3515	—	−0.0713	—	0.6151***	Y=1.974X+0.045
26	0.3164	—	0.3716*	Y=0.633X−0.464	0.8849***	Y=3.102X+0.022
31	0.4314*	Y=0.068X−0.383	0.5107**	Y=0.338X−3.497	0.8897***	Y=3.598X+0.303
32	0.4755**	Y=0.065X+0.056	0.4782**	Y=0.224X+1.448	0.8723***	Y=2.987X+0.289
33	0.3674*	Y=0.049X+0.066	0.4314*	Y=0.240X−0.624	0.8943***	Y=3.707X+0.026
34	0.3088	—	0.4184*	Y=0.193X+1.916	0.9023***	Y=3.486X+0.584
35	−0.2974	—	−0.0306	—	0.8248***	Y=2.738X+0.020
36	−0.4303*	Y=−0.063X+0.057	−0.0518	—	0.6704***	Y=1.541X+0.048

Character numbers; 1, 11, 21-length, 2, 12, 22-width, 3, 13, 23-thickness, 4, 14, 24-L/W, 5, 15, 25-L/T, 6, 16, 26-W/T, 1~6-unhusked grains, 11~16-husked grains, 21~26-comparative values (=husked/unhusked), 31-area (UHG), 32-volume (UHG), 33-area (HG), 34-volume (HG), 35-quotient of areas (=33/31), 36-quotient of volumes (=34/32)

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

d.f.=27

7. The four relation-groups under comparison

From the data obtained in the Table 1 of the present experiment, relations between the two respective characters were compared, and are shown in Table 3. In this table, 3 relation-groups, i.e., relation between the two respective practical values (A column in Table 3), relation between the two respective s.ds. (B column in Table 3) and relation between the two respective variation ranges (C column in Table 3), were analyzed. In addition to these, summed-up data from columns A, B and C were regulated, and are shown in D column of Table 3, under the condition that the calculation was to be made by means of the significances in disregard of significant levels.

Significant combinations were counted as 20/27 cases (=74.1%), 17/27 cases (=63.0%), 15/27 cases (=55.6%) and 52/81 cases (=64.2%) in columns A, B, C and D, respectively. In column A, 19, 1 and 7 character-combinations showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In column B, 13, 3, 1 and 10 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In column C, 9, 4, 2 and 12 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In column D, 41, 7, 4 and 29 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. Average and its s.d. through the whole character-combinations were found to be 1.74 ± 1.39. Moreover, 13, 2, 9 and 3 character-combinations showed significances at 3, 2, 1 and 0 columns, respectively.

Through the whole columns, 27 character-combinations might be divided into 2 categories, i.e., the one with higher frequency and the other with lower frequency. Thirteen character-combinations, i.e., Nos.14·15, 14·16, 21·23, 24·26, 1·11, 2·12, 3·13, 4·14, 5·15, 6·16, 31·33, 32·34, 35·36, belonged to the former one. The remaining 14 character-combinations, i.e., Nos.1·2, 1·3, 2·3, 4·5, 4·6, 5·6, 11·12, 11·13, 12·13, 15·16, 21·22, 22·23, 24·25, 25·26, belonged to the latter one. It was noticed that the whole characters of unhusked grains and one third of the husked and

Table 3. Comparisons of 4 relation-groups; relations between the respective character-combinations in view of practical values (A), standard deviations (B), variation ranges (C) and summing-up of A, B and C packs (D). Figures used in columns of D showed the number of significant relations in the respective combinations in disregard of the grade of significances.

Combination	A	B	C	D	Combination	A	B	C	D
1·2	*			1	21·22	***			1
1·3				0	21·23	***	**	**	3
2·3	***			1	22·23	***			1
4·5	***			1	24·25		***		1
4·6	***			1	24·26	***	***	**	3
5·6		***	**	2	25·26		***		1
11·12				0	1·11	***	***	***	3
11·13				0	2·12	***	***	***	3
12·13	***			1	3·13	***	***	***	3
14·15	***	**	*	3	4·14	***	***	***	3
14·16	***	*	*	3	5·15	***	***	***	3
15·16		***	**	2	6·16	***	***	***	3
					31·33	***	***	***	3
					32·34	***	***	***	3
					35·36	***	***	***	3

Character numbers; 1, 11, 21-length, 2, 12, 22-width, 3, 13, 23-thickness, 4, 14, 24-L/W, 5, 15, 25-L/T, 6, 16, 26-W/T, 1~6-unhusked grains, 11~16-husked grains, 21~26-comparative values (=husked/unhusked), 31-area (UHG), 32-volume (UHG), 33-area (HG), 34-volume (HG), 35-quotient of areas (=33/31), 36-quotient of volumes (=34/32)
***, **, *; significant at 0.1%, 1% and 5% levels, respectively
d.f.=27

the comparison belonged to the latter one.

8. The other four relation-groups under comparison

From the data obtained in Table 2 of the present experiment, relations between the two respective characters were compared, and are shown in Table 4. In this table, 3 relation-groups, *i.e.*, relation between practical values and their s.d. (E column in Table 4), relation between practical values and their variation ranges (F column in Table 4), and relation between s.d. and their variation ranges (G column in Table 4), were analyzed. In addition to these, summed-up data from columns E, F and G were regulated, and are shown in H column of Table 4, under the condition that the calculation was made by means of the significances in disregard of significant levels.

Table 4. Comparisons of 4 relation-groups; relations between practical values and its standard deviations (E), practical values and its variations ranges (F), standard deviations and its variation ranges (G) and summing-up of E, F and G packs (H). Figures used in columns of H showed the number of significant relations in the respective characters in disregard of the grade of significances.

Character	E	F	G	H	Character	E	F	G	H
1			***	1	21	**	**	***	3
2			***	1	22			***	1
3			***	1	23	***	***	***	3
4	***	**	***	3	24			***	1
5			***	1	25			***	1
6	***	***	***	3	26		*	***	2
11			***	1	31	*	**	***	3
12	**		***	2	32	**	**	***	3
13	*		***	2	33	*	*	***	3
14			***	1	34		*	***	2
15	**	**	***	3	35			***	1
16	***	***	***	3	36	*		***	2

Character numbers; 1, 11, 21-length, 2, 12, 22-width, 3, 13, 23-thickness, 4, 14, 24-L/W, 5, 15, 25-L/T, 6, 16, 26-W/T, 1~6-unhusked grains, 11~16-husked grains, 21~26-comparative values (=husked/unhusked), 31-area (UHG), 32-volume (UHG), 33-area (HG), 34-volume (HG), 35-quotient of areas (=33/31), 36-quotient of volumes (=34/32)
***, **, *; significant at 0.1%, 1% and 5% levels, respectively
d.f.=27

Significant characters were counted as 12/24 cases (=50.0%), 11/24 cases (=45.8%), 24/24 cases (=100.0%) and 47/72 cases (=65.3%) in columns E, F, G and H, respectively. In the column E, 4, 4, 4 and 12 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the column F, 3, 5, 3 and 13 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the column G, the whole characters (=24) showed significances at 0.1% level. In the column H, 31, 9, 7 and 25 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. Average and its s.d. through the whole characters were found to be 1.64 ± 1.34. Moreover, 9, 5 and 10 characters showed significances at 3, 2 and 1 columns, respectively. In other words, the whole of characters showed significances. Average and its s.d. through the whole cases were found to be

1.96 ± 0.89.

Through the whole columns, 24 characters may tentatively be divided into 2 categories, *i.e.*, the one with higher frequency and the other with lower frequency. Nine characters, *i.e.*, character Nos.4, 6, 15, 16, 21, 23, 31, 32, 33, belonged to the former one. The remaining 15 characters, *i.e.*, character Nos.1, 2, 3, 5, 11, 12, 13, 14, 22, 24, 25, 26, 34, 35, 36, belonged to the latter one. It was said that about two thirds cases belonged to the latter one.

Discussion

Basing on the results obtained in the previous and the present experiments, the following problematic items are to be discussed here.

1. C.c. of the practical value on another practical values (the left column of Table 1 and column A of Table 3) were decided to be significant in 20/27 cases (=74.1%). Nineteen character-combinations, *i.e.*, 3 of UHG, 3 of HG, 4 of comparative values, 6 of comparison, 3 of area and volume, showed significances at 0.1% level. One character-combination, *i.e.*, 1 of UHG, showed significance at 5% level. Seven character-combinations, *i.e.*, 2 of UHG, 3 of HG, 2 of comparative values, showed no significance even at 5% level. Comparisons, and area and volume columns showed high significances. Average significant level and its s.d. through the whole character-combinations were found to be 2.15 ± 1.33.

C.c. of the intra-strain's variation (=s.d.) on another variation (=s.d.) (the central column of Table 1 and column B of Table 3) were decided to be positively significant in 17/27 cases (=63.0%). Thirteen character-combinations, *i.e.*, 1 of UHG, 1 of HG, 3 of comparative values, 5 of comparison, 3 of area and volume, showed significances at 0.1%. Three character-combinations, *i.e.*, each 1 of HG, comparative values and comparison, showed significances at 1% level. One character-combination, *i.e.*, 1 of HG, showed significance at 5% level. Ten character-combinations, *i.e.*, 5 of UHG, 3 of HG, 2 of comparative values, showed no significance even at 5% level. In general, UHG and HG showed a few significances. Average significant level and its s.d. through the whole character-combinations were found to be 1.70 ± 1.38.

C.c. of the range on another range (the right column of Table 1 and column C of Table 3) were decided to be positively significant in 15/27 cases (=55.6%). Nine character-combinations, *i.e.*, 6 of comparison, 3 of area and volume, showed significances at 0.1% level. Four character-combinations, *i.e.*, 1 of UHG, 1 of HG, 2 of comparative values, showed significances at 1% level. Two character-combinations, *i.e.*, 2 of HG, showed significances at 5% level. Twelve character-combinations, *i.e.*, 5 of UHG, 3 of HG, 4 of comparative values, showed no significance even at 5% level. In general, UHG, HG and comparative values showed a few significances. Average significant level and its s.d. through the whole character-combinations were found to be 1.37 ± 1.34.

C.c. of the three columns mentioned above (column D of Table 3) were decided to be significant in 52/81 cases (=64.2%). Thirteen character-combinations, *i.e.*, 2 of HG, 2 of comparative values, 6 of comparison, 3 of area and volume, showed significances at 3 columns. Two character-combinations, *i.e.*, each 1 of UHG and HG, showed significances at 2 columns. Nine character-combinations, *i.e.*, 4 of UHG, 1 of HG, 4 of comparative values, showed significances at 1 column. Three character-combinations, *i.e.*, 1 of UHG, 2 of HG, showed no significance at all. In general, UHG and comparative values showed a few significances. Average and its s.d. through the whole character-combinations were found to be 1.74 ± 1.39. In view of significant chance, those were found to be 1.93 ± 1.12.

2.　C.c. of the practical value on their s.d. of the respective characters (the left column of Table 2 and column E of Table 4) were decided to be significant in 12/24 cases (=50.0%). Four characters, *i.e.*, 2 of UHG, 1 of HG, 1 of comparative values, showed significances at 0.1% level. Four characters, *i.e.*, 2 of HG, 1 of comparative values, 1 of area and volume, showed significances at 1% level. Other 4 characters, *i.e.*, 1 of HG, 3 of area and volume, showed significances at 5% level. Twelve characters, *i.e.*, 4 of UHG, 2 of HG, 4 of comparative values, 2 of area and volume, showed no significance even at 5% level. In general, UHG and comparative values showed a few significances. Average significant level and its s.d. through the whole characters were found to be 1.00±1.16.

C.c. of practical value on their variation ranges of the respective characters (the central column of Table 2 and column F of Table 4) were decided to be significant in 11/24 cases (=45.8%). Three characters, *i.e.*, each 1 of UHG, HG and comparative values, showed significances at 0.1% level. Five characters, *i.e.*, each 1 of UHG, HG and comparative values, 2 of area and volume, showed significances at 1% level. Three characters, *i.e.*, 1 of comparative values and 2 of area and volume, showed significances at 5% level. Thirteen characters, *i.e.*, 4 of UHG, 4 of HG, 3 of comparative values, 2 of area and volume, showed no significance even at 5% level. Average significant level and its s.d. through the whole characters were found to be 0.92±1.12.

C.c. of s.d. on their variation ranges of the respective characters (the right column of Table 2 and column G of Table 4) were decided to be positively significant in 24/24 cases (=100.0%). Moreover, the whole of them showed significances at 0.1%. So, average significant level and its s.d. through the whole characters were found to be 3.00±0.00.

C.c. of the three columns mentioned above (column H of Table 4) were decided significant in 47/72 cases (=65.3%). Nine characters, *i.e.*, each 2 of UHG, HG, comparative values, 3 of area and volume, showed significances at 3 columns. Five characters, *i.e.*, 2 of HG, 1 of comparative values, 2 of area and volume, showed significances at 2 columns. Ten characters, *i.e.*, 4 of UHG, 2 of HG, 3 of comparative values, 1 of area and volume, showed significances at 1 column. The whole characters, in the other words, showed significances at least in one column. In general, UHG showed low significant level. Average and its s.d. through the whole characters were found to be 1.64±1.34. In view of significant level, those were found to 1.93±1.12.

3.　Four, 0, and 0 negative correlations at the significant levels were found in the relations of the practical value on another practical value (column A), of s.d. on another s.d. (column B) and of variation range on another variation range (column C), respectively. It was noticeable that the character-combinations of comparison and area and volume showed no negative correlation at all. Moreover, character-combinations of UHG showed relatively many negative correlations.

Four, 2 and 0 negative correlations at the significant levels were found in the relations between the practical value and its s.d. (column E), between the practical value and its variation range (column F) and between s.d. and its variation range (column G), respectively. It was noticed that the characters of comparative values showed many negative correlations. Moreover, character No.21 (L) and No.23 (T) showed negative correlations in 2 columns.

Basing on the data obtained in the columns A to H, it was concluded that those phenomena meant the character-specificities in those characters. In other words, those characters might genetically be fixed as those in possession of a flexibility and affectability to any of the several environmental conditions.

4.　In summing-up, significant relations were found as 74.1%, 63.0%, 55.6%, 64.2%, 50.0%, 45.8%, 100.0% and 65.3% in the order of columns A to H, respectively. Average and its s.d.

through the whole columns were found to be 64.75 ± 15.79. It might be concluded that column G (=relation between s.d. and its variation range) was of the most stable character, and was intimately correlated with each other through the whole strains in disregard of the geographical conditions. This tendency was also found in the strains of Burma[5]. However, some characters showed quite low correlation or no significant correlation at all even at 5% level.

Twenty-four characters and 27 mutual combinations were used for analysing the variety- and strain-differentiations in the present experimental series. Some of them are yet of developing status. However, it might be affirmed that those characters of character-combinations are to be used for analysing the grain morphological constitution in the future.

5. It might be noticeable that significant relations were found as 99/153 cases (=64.7%) in the summed-up data. Moreover, in view of significant level, 72/99 cases (=72.7%), 16/99 cases (=16.2%) and 11/99 cases (=11.1%) showed significances at 0.1%, 1% and 5% levels, respectively. In view of significant level through columns A, B and C, 41/52 cases (=78.9%), 7/52 cases (=13.5%) and 4/52 cases (=7.7%) showed significant relations at 0.1%, 1% and 5% levels, respectively. In those three columns E, F and G, 31/47 cases (=66.0%), 9/47 cases (=19.2%) and 7/47 cases (=14.9%) showed significant relations at 0.1%, 1% and 5% levels, respectively. No clear difference was found between those 2 groups.

In addition to these facts, 72/153 cases (=47.1%), 16/153 cases (=10.5%), 11/153 cases (=7.2%) and 54/153 cases (=35.3%) showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Hence, the assumption that this might mean some biological functions, extremely called "all or nothing", *i.e.*, a phenomenon going from one extreme to another. In a stricter sense, those characters were looked upon as being in possession of a stable state, to be exhibited independent of other characters.

Summary

Succeeding to the previous papers, some morphological studies on grain characters and considerations on ecotypic differentiations of 29 strains of cultivated rice species, *Oryza sativa* L., collected in Madura, Indonesia, were reported. The results obtained here were summarized as follows:

1. In the data obtained by summing-up informations from the 3 relation-groups, *i.e.*, practical value on the other practical values, s.d. on the other s.ds., and variation range on other variation ranges, 20/27 character-combinations (=74.1%), 17/27 character-combinations (=63.0%) and 15/27 character-combinations (=55.6%) showed significant relations, respectively. Average significant levels and their s.ds. through the whole character-combinations were found to be 2.15 ± 1.33, 1.70 ± 1.38 and 1.37 ± 1.34, respectively, in the same order. Through the 3 columns, 52/81 cases (=64.2%) showed significances.

2. Concerning correlations among the 3 components in the same characters, *i.e.*, between practical value and its s.d., practical value and its variation range, and s.d. and its variation range, 12/24 characters (=50.0%), 11/24 characters (=45.8%) and 24/24 characters (=100.0%) showed significant relations, respectively. Average significant levels and their s.ds. through the whole characters were found to be 1.00 ± 1.16, 0.92 ± 1.12 and 3.00 ± 0.00, respectively, in the same order. Through the 3 columns, 47/72 cases (=65.3%) showed significances.

3. Varietal and ecotypic differentiations were extensively discussed, basing on the data from

the previous and the present experiments. Characters and character-combinations confirmed in the experiments were to be looked upon as something useful, having some universal validities and working indices in the examinations of variety- and strain-differentiations. Moreover, comparisons of data obtained here and other neighbouring regions were carried out to some extents, and several interesting informations were shown in view of the locality-specificities.

Several problems were left unascertained, then, further experiments might be requested.

References

1) Duc, D.: Low temperature tolerance of traditional Vietnamese varieties. *Intern. Rice Res. Newsletter,* **12**(4), 21 (1987)

2) Katayama, T.C.: Grain morphology of cultivated rice, "Pelita", in Ambon, Indonesia. *Mem. Fac. Agr. Kagoshima Univ.,* **12**, 41-45 (1976)

3) Katayama, T.C.: Morphological characters of cultivated rice grains of Madura, Indonesia (I). *Mem. Kagoshima Univ. Res. Center S. Pac.,* **8**(1), 58-68 (1987)

4) Katayama, T.C.: Morphological characters of cultivated rice grains of Madura, Indonesia (II). *Mem. Fac. Agr. Kagoshima Univ.,* **24**, 37-65 (1988)

5) Katayama, T.C.: Morphological characters of the cultivated rice grains of Burma (V). *Mem. Fac. Agr. Kagoshima Univ.,* **25**, 19-29 (1989)

6) Katayama, T.C.: Morphological characters of cultivated rice grains of Madura, Indonesia (III). *Mem. Fac. Agr. Kagoshima Univ.,* **25**, 31-38 (1989)

7) Katayama, T.C.: Morphological characters of cultivated rice grains of Madura, Indonesia (IV). *Mem. Fac. Agr. Kagoshima Univ.,* **26**, 29-42 (1990)

8) Mugiono, P.S. and Soemanggono, A.M.R.: Rice dwarf mutant of Seratus Malam variety. *Intern. Rice Res. Newsletter,* **13**(1), 5 (1988)

9) Paramasivan, K.S., Thyagarajan, A., Nilakantapillai, K. and Ranganatha, T.B.: TM6012, a short-duration rainfed rice. *Intern. Rice Res. Newsletter,* **15**(2), 21 (1990)

10) Sarma, K.K., Ahmed, T. and Baruak, D.K.: Grain characteristics of some aromatic rice varieties of Assam. *Intern. Rice Res. Newsletter,* **15**(1), 13 (1990)

11) Sudjak, S.M., Muis, A., Sama, S. and Wakman, W.: Field screening IRRI lines against tungro (RTV) disease in Lanrang. *Intern. Rice Res. Newsletter,* **12**(4), 13 (1987)

12) Yasin, M.: Weed control in hybrid rice. *Intern. Rice Res. Newsletter,* **12**(4), 48 (1987)