Mem. Fac. Agr. Kagoshima Univ., **25**, 19−29, 1989

Morphological Characters of the Cultivated Rice Grains of Burma (V)

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Received for Publication August 19, 1988

Introduction

During the period from December in 1978 to February in 1979, four scientists including the present author were sent to India and Burma for collection of the wild and cultivated rices under the project, designated "The Distribution of Wild Rice and the Ecotypic Differentiation of Cultivated Rice in Burma and Assam", supported by a Grant from the Ministry of Education, Science and Culture of Japanese Government. In this opportunity, 64 strains of cultivated rice distributed in large areas of Burma, for example, Myodwin, Kalagyaung, Yezin, were collected by the members of the party. The grains of these strains were used for the morphological studies.

The generally accepted indigenous center of rice is an area embracing south Asia, southeast Asia and China. Morinaga[8] stated that spacial gene-pattern of ecospecies "*japonica*" is probably to be established around southeast Himalaya. East and northeast parts of India have been considered to be one of the differentiation centres of rice in accordance with many investigations. Sharma *et al.*[9] carried out some systematic collections of current and primitive cultivars of rice in the north-eastern part of India.

Burma is located in the region adjacent to the one mentioned above, and has long history of rice cultivations. All over the land of Burma, rice varieties showed very large varietal variation[10]. Recent situations of rice cultivation in Burma were reported, in view of socio-economy and natural conditions[6] and production system and marketing, storage structures[7]. However, accumulation of complete data endorsed by discussions on these aspects has been unfortunately far from being perfect. The present experimental series were made to search the varietal variations, taking these facts into account.

In the previous papers, the records of morphological characters of the unhusked and the husked grains, some mutual relations[2], comparative data of the unhusked and husked grains and their variation ranges[3] and other variation ranges[4], and 15 mutual relations[5], were reported.

In the present paper, mutual relations in 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 those grains.

Materials and Methods

Sixty-four strains of rice cultivars, *Oryza sativa* L., collected in Burma were used in this experiment. They are listed up in Table 1 of the previous paper[2]. In this table, collection number,

collection date, collection place, and detailed informations are mentioned.

To make clear the relationships between practical value, standard deviations and variation ranges in the strain level, 6 relations were calculated, *i.e.*, practical value and other practical value, standard deviations and other standard deviations, variation range and other variation range (Table 1), practical value and its standard deviations, practical value and its variation range, standard

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	−0.4854***	Y=−0.197X+4.774	0.3332**	Y=0.183X+0.079	0.4833***	Y=0.357X+0.145
1 · 3	−0.4381***	Y=−0.082X+2.914	0.3058*	Y=0.092X+0.058	0.4045***	Y=0.125X+0.212
2 · 3	0.8988***	Y=0.414X+0.934	0.5258***	Y=0.287X+0.048	0.5551***	Y=0.231X+0.232
4 · 5	0.9529***	Y=0.998X+1.097	0.5499***	Y=0.511X+0.119	0.4227***	Y=0.398X+0.567
4 · 6	−0.7726***	Y=−0.118X+1.731	0.0617	−	0.1296	−
5 · 6	−0.5506***	Y=−0.080X+1.709	0.2870*	Y=0.077X+0.059	0.2758*	Y=0.110X+0.219
11 · 12	−0.5073***	Y=−0.281X+4.346	0.2611*	Y=0.177X+0.082	0.3803**	Y=0.268X+0.270
11 · 13	−0.3890**	Y=−0.102X+2.619	0.1846	−	0.2011	−
12 · 13	0.8797***	Y=0.415X+0.907	0.5116***	Y=0.280X+0.054	0.4019***	Y=0.220X+0.253
14 · 15	0.9566***	Y=0.919X+0.907	0.6319***	Y=0.518X+0.095	0.5509***	Y=0.545X+0.396
14 · 16	−0.7920***	Y=−0.153X+1.680	0.1341	−	0.1444	−
15 · 16	−0.5873***	Y=−0.118X+1.681	0.3444**	Y=0.124X+0.054	0.2342	−
21 · 22	0.3093*	Y=0.745X+0.330	0.0918	−	0.1065	−
21 · 23	0.1645	−	−0.0057	−	0.1041	−
22 · 23	−0.0290	−	0.1440	−	0.2907*	Y=0.191X+0.034
24 · 25	0.2686*	Y=0.140X+0.665	0.2625*	Y=0.199X+0.014	0.4302***	Y=0.372X+0.041
24 · 26	−0.8438***	Y=−0.981X+1.759	0.6691***	Y=0.771X+0.005	0.5455***	Y=0.602X+0.039
25 · 26	0.2439	−	0.3024*	Y=0.461X+0.014	0.2530*	Y=0.324X+0.073
1 · 11	0.9780***	Y=0.684X+0.198	0.8733***	Y=0.687X+0.004	0.8067***	Y=0.639X+0.068
2 · 12	0.9605***	Y=0.915X−0.177	0.8546***	Y=0.830X+0.007	0.4837***	Y=0.365X+0.287
3 · 13	0.9974***	Y=0.972X−0.145	0.9610***	Y=0.936X+0.005	0.9397***	Y=0.932X+0.017
4 · 14	0.9810***	Y=0.840X−0.036	0.8736***	Y=0.777X+0.010	0.8070***	Y=0.708X+0.082
5 · 15	0.9891***	Y=0.777X+0.012	0.9114***	Y=0.716X+0.021	0.7814***	Y=0.720X+0.097
6 · 16	0.8652***	Y=0.938X+0.010	0.7208***	Y=0.756X+0.018	0.7562***	Y=0.688X+0.094
31 · 33	0.9119***	Y=0.568X+0.988	0.8633***	Y=0.553X+0.084	0.7865***	Y=0.507X+0.666
32 · 34	0.9576***	Y=0.569X−1.177	0.9128***	Y=0.503X+0.308	0.8464***	Y=0.478X+1.855
35 · 36	0.9655***	Y=0.905X+0.001	0.6993***	Y=0.750X+0.005	0.7898***	Y=0.930X+0.006

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 area (=33／31), 36 − quotient of volume (=34／32)

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

d. f. =62

deviations and its variation range (Table 2). Finally, comparisons of 4 relation-groups were made, mainly using 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), c.c. (correlation coefficient), l.r. (linear regression), s.d. (standard deviations), d.f. (degree of freedom), UHG (unhusked grain), HG (husked grain).

Table 2. Correlation coefficient and linear regression of the former character (Y) on the 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)

Character	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	0.4398***	Y=0.044X−0.062	0.2663*	Y=0.116X+0.287	0.8720***	Y=3.762X+0.080
2	−0.0724	−	0.0998	−	0.6370***	Y=3.709X+0.095
3	0.0527	−	0.0856	−	0.8711***	Y=3.868X+0.033
4	0.6137***	Y=0.071X−0.045	0.5240***	Y=0.243X−0.055	0.9089***	Y=3.663X+0.066
5	0.3067*	Y=0 031X+0.076	0.2607*	Y=0.109X+0.389	0.6355***	Y=2.598X+0.305
6	0.4360***	Y=0.082X−0.040	0.4420***	Y=0.507X−0.395	0.8452***	Y=5.132X−0.070
11	0.4332***	Y=0.049X−0.076	0.3141*	Y=0.155X−0.055	0.8743***	Y=3.801X+0.040
12	−0.0275	−	−0.0809	−	0.8556***	Y=3.868X+0.039
13	0.0937	−	0.1341	−	0.8519***	Y=3.855X+0.028
14	0.5407***	Y=0.065X−0.021	0.4686***	Y=0.223X+0.007	0.9146***	Y=3.639X+0.054
15	0.2306	−	0.1599	−	0.8349***	Y=4.005X+0.033
16	0.4688***	Y=0.086X−0.039	0.4016**	Y=0.386X−0.200	0.8312***	Y=4.376X−0.017
21	−0.0825	−	−0.0684	−	0.7555***	Y=2.921X+0.018
22	−0.1905	−	−0.2671*	Y=−0.567X+0.567	0.8555***	Y=3.501X+0.009
23	−0.3546**	Y=−0.251X+0.239	−0.1769	−	0.6006***	Y=2.438X+0.021
24	0.0940	−	0.0782	−	0.8350***	Y=3.453X+0.015
25	−0.0842	−	−0.0854	−	0.7720***	Y=3.644X+0.007
26	−0.2901*	Y=−0.082X+0.101	−0.2246	−	0.8268***	Y=3.279X+0.023
31	0.0234	−	−0.0410	−	0.9082***	Y=3.692X+0.663
32	−0.0192	−	−0.0896	−	0.8769***	Y=3.789X+1.496
33	−0.0788	−	−0.1497	−	0.9145***	Y=3.841X+0.270
34	−0.0277	−	−0.0808	−	0.8803***	Y=3.897X+0.669
35	−0.0120	−	−0.1920	−	0.7787***	Y=3.076X+0.018
36	−0.0225	−	−0.1090	−	0.8004***	Y=3.472X+0.010

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 area (=33／31), 36 − quotient of volume (=34／32)

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

d. f. =62

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 disregarding of the grade of significances.

Combination	A	B	C	D	Combination	A	B	C	D
1 · 2	***	**	***	3	21 · 22	*			1
1 · 3	***	*	***	3	21 · 23				0
2 · 3	***	***	***	3	22 · 23			*	1
4 · 5	***	***	***	3	24 · 25	*	*	***	3
4 · 6	***			1	24 · 26	***	***	***	3
5 · 6	***	*	*	3	25 · 26		*	*	2
11 · 12	***	*	**	3	1 · 11	***	***	***	3
11 · 13	**			1	2 · 12	***	***	***	3
12 · 13	***	***	***	3	3 · 13	***	***	***	3
14 · 15	***	***	***	3	4 · 14	***	***	***	3
14 · 16	***			1	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 area (=33／31), 36 – quotient of volume (=34／32)

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

d. f. =62

Results

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

C.c. (=correlation coefficient) and l.r. (=linear regression) of the practical value on another practical value among 27 combinations were calculated, and are shown in the left column of Table 1. Twenty-one, 1, 2 and 3 character-combinations showed significances at 0.1%, 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 (=64) was −0.4854 to the degree of freedom of 62, which is significant at 0.1% 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; $Y=-0.197X+4.774$, where Y and X indicate length and width, respectively. This formula indicates that the length (UHG) becomes 0.197 mm longer, when the width (UHG) becomes narrower by 1 degree.

2. Relations between the s.d. 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. Fourteen, 2, 5 and 6 character-combinations showed

Table 4. Comparisons of 4 relation-groups; relations between practical values and its standard deviations (E), practical values and its variation 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 disregarding of grade of significances.

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

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 area (=33/31), 36 – quotient of volume (=34/32)

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

d. f. = 62

significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of s.d. of length (UHG) on s.d. of width (UHG) thrcugh the whole strains was + 0.3332 to the degree of freedom of 62, which is significant at 1% level. Generally speaking, the larger is the s.d. of length (UHG), the larger is the s.d. of width (UHG). L.r. of s.d. of length on s.d. of width was calculated as follows; $Y=0.183X+0.079$, where Y and X indicate s.d. of length and s.d. of width, respectively. This formula indicates that the s.d. of length (UHG) becomes 0.183 larger, when the s.d. of width (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. Seventeen, 1, 3 and 6 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of variation range of length (UHG) on variation range of width (UHG) through the whole strains was +0.4833 to the degree of freedom of 62, which is significant at 0.1% level. Generally speaking, the larger is the variation range of length (UHG), the larger is the variation range of width (UHG). L.r. of variation range of length (UHG) on variation range of width (UHG) was calculated as follows; $Y=0.357X+0.145$, where Y and X indicate the variation range of length (UHG) and variation range of width (UHG), respectively. This formula indicates that the variation range of length (UHG) becomes 0.357 larger, when the variation range of width (UHG) becomes larger by 1 degree.

4. Relations between the practical values and its s.d.

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. Six, 1, 2 and 15 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 length (UHG) on s.d. of length (UHG) through the whole strains (=64) was +0.4398 to the degree of freedom of 62, which is significant at 0.1% level. Generally speaking, the longer is the practical value of length (UHG), the larger is the s.d. of length (UHG). L.r. of practical value of length (UHG) on s.d. of length (UHG) was calculated as follows; $Y=0.044X-0.062$, where Y and X indicate practical value and s.d. of length (UHG), respectively. This formula indicates that the practical value of length (UHG) becomes 0.044 mm longer, when the s.d. of length (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, 1, 4 and 16 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 length (UHG) on variation range of length (UHG) through the whole strains was +0.2663 to the degree of freedom of 62, which is significant at 5% level. Generally speaking, the longer is the practical value of length (UHG), the larger is the variation range of length (UHG). L.r. of practical value of length (UHG) on variation range of length (UHG) was calculated as follows; $Y=0.116X+0.287$, where Y and X indicate the practical value and variation range of length (UHG), respectively. This formula indicates that the practical value of length (UHG) becomes 0.116 mm longer, when the variation range of length (UHG) becomes larger by 1 degree.

6. Relations between the s.d. 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 +0.8720 to the degree of freedom of 62, 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; $Y=3.762X+0.080$, where Y and X indicate s.d. and variation range of length (UHG), respectively. This formula indicates that the s.d. of length becomes 3.762 larger, when the variation range of length (UHG) becomes larger by 1 degree.

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 colum in Table 3), relation between the two respective s.d. (B column in Table 3) and relation between the two respective variation ranges (C column in Table 3), were analysed. 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 24/27 cases (=88.9%), 21/27 cases (=77.8%), 21/27 cases (=77.8%) and 66/81 cases (=81.5%) in columns A, B, C and D, respectively. In

column A, 21, 1, 2 and 3 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In column B, 14, 2, 5 and 6 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In column C, 17, 1, 3 and 6 character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In coulum D, 19, 2, 5 and 1 character-combinations showed significances at 3, 2, 1 and 0 chances, respectively. Average and its s.d. through the whole character-combinations were found to be 2.44 ± 0.92.

Through the whole columns, 27 character-combinations might be divided into 2 categories, *i.e.*, the one with high frequency and the other with low frequency. Nineteen character-combinations, *i.e.*, character-combination Nos. 1·2, 1·3, 2·3, 4·5, 5·6, 11·12, 12·13, 14·15, 24·25, 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 8 character-combinations, *i.e.*, 4·6, 11·13, 14·16, 15·16, 21·22, 21·23, 22·23, 25·26, 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 of Table 4), practical values and their variation ranges (F column of Table 4) and s.d. and their variation ranges (G column of Table 4), were analysed. 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 to be made by means of the significances in disregard of significant levels.

Significant characters were counted as 9/24 cases (=37.5%), 8/24 cases (=33.3%), 24/24 cases (=100.0%) and 41/72 cases (=56.9%) in columns E, F, G and H, respectively. In column E, 6, 1, 2 and 15 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In column F, 3, 1, 4 and 16 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In column G, the whole characters (=24) showed significances at 0.1% level. In column H, 7, 3 and 14 characters showed significances at 3, 2 and 1 chances, respectively. In other words, the whole of the characters showed significances. Average and its s.d. through the whole characters were found to be 1.71 ± 0.89.

Through the whole columns, 24 characters may tentatively be divided into 2 categories, *i.e.*, the one with higher frequency and other with lower frequency. Seven characters, *i.e.*, character Nos. 1, 4, 5, 6, 11, 14, 16, belonged to the former one. The remaining 17 characters, *i.e.*, character Nos. 2, 3, 12, 13, 15, 21～26, 31～36, belonged to the latter one.

Discussion

Basing on the results obtained in the previous[2,5] and the present experiments, the following problems 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 at 24/27 cases (=88.9%). Twenty-one character-combinations, *i.e.*, 6 combinations of UHG, 5 combinations of HG, 1 combination of comparative value, 6 combinations of comparison, 3 combinations of area and volume columns, showed significances at 0.1% level. One character-combination, *i.e.*, 1 combination of HG, showed significance at 1% level. Two character-combinations, *i.e.*, 2 combinations of comparative values, showed significances at

5% level. Three character-combinations, *i.e.*, 3 combinations of comparative values, showed no significance even at 5% level. Comparative values showed, in general, a few significances. Average significant level and its s.d. through the whole character-combinations were found to be 2.48±1.03.

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 21/27 cases (=77.8%). Fourteen character-combinations, *i.e.*, 2 combinations of UHG, 2 combinations of HG, 1 combination of comparative values, 6 combinations of comparison, 3 characters of area and volume columns, showed significances at 0.1% level. Two character-combinations, *i.e.*, 1 combination of UHG, 1 combination of HG, showed significances at 1% level. Five character-combinations, *i.e.*, 2 combinations of UHG, 1 combination of HG, 2 combinations of comparative values, showed significances at 5% level. Six character-combinations, *i.e.*, 1 combination of UHG, 2 combinations of HG, 3 combinations of comparative values, showed no significance even at 5% level.

In general, comparative values showed a few significances. Average significant level and its s.d. through the whole character-combinations were found to be 1.89±1.26.

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 21/27 cases (=77.8%). Seventeen character-combinations, *i.e.*, 4 combinations of UHG, 2 combinations of HG, 2 combinations of comparative values, 6 combinations of comparison, 3 combinations of area and volume columns, showed significances at 0.1% level. One character-combination, *i.e.*, 1 combination of HG, showed significance at 1% level. Three character-combinations, *i.e.*, 1 combination of UHG, 2 combinations of comparative values, showed significances at 5% level. Six character-combinations, *i.e.*, 1 combination of UHG, 3 combinations of HG, 2 combinations of comparative values, showed no significance even at 5% level. In general, comparative values showed a few significances. Average significant level and its s.d. through the whole character-combinations were found to be 2.07±1.27.

C.c. of the three columns mentioned above (column D of Table 3) were decided to be significant in 66/81 cases (=81.5%). Nineteen character-combinations, *i.e.*, 5 combinations of UHG, 3 combinations of HG, 2 combinations of comparative values, 6 combinations of comparison, 3 combinations of area and volume columns, showed significances at 3 chances. Two character-combinations, *i.e.*, 1 combination of HG, 1 combination of comparative values, showed significances at 2 chances. Five character-combinations, *i.e.*, 1 combination of UHG, 2 combinations of HG, 2 combinations of comparative values, showed significances at 1 chance. One character-combination, *i.e.*, 1 combination of comparative values, showed no significance at all. In general, comparative values showed a few significances. Average significant level and its s.d. through the whole character-combinations were found to be 2.44±0.92.

One character-combination, *i.e.*, Nos. 21·23 (=comparative values of L and T), showed no significance through 3 columns (A, B and C). One character-combination, *i.e.*, Nos. 22·23 (comparative values of W and T), showed no significance in columns A and B. Four character-combinations, *i.e.*, Nos. 4·6 (L/W and W/T of UHG), 11·13 (L and T of HG), 14·16 (L/W and W/T of HG), 21·22 (comparative values of L and W), showed no significance in columns B and C. One character-combination, *i.e.*, Nos. 25·26 (comparative values of L/T and W/T), showed no significance in column A. One character-combination, *i.e.*, Nos. 15·16 (L/T and W/T of HG), showed no significance in column C.

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 9/24 cases (=37.5%). Six characters, *i.e.*, 3 characters of UHG, 3 characters of HG, showed significances at 0.1% level. One character,

i.e., 1 character of comparative values, showed significance at 1% level. Two characters, *i.e.*, 1 character of UHG, 1 character of comparative values, showed significances at 5% level. Fifteen characters, *i.e.*, 2 characters of UHG, 3 characters of HG, 4 characters of comparative values, 6 characters of area and volume columns, showed no significance even at 5% level. In general, comparative values, and area and volume columns showed a few significances. Average significant level and its s.d. through the whole characters were found to be 0.92 ± 1.29.

C.c. of the 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 8/24 cases (=33.3%). Three characters, *i.e.*, 2 characters of UHG, 1 character of HG, showed significances at 0.1% level. One character, *i.e.*, 1 character of HG, showed significance at 1% level. Four characters, *i.e.*, 2 characters of UHG, 1 character of HG, 1 character of comparative values, showed significances at 5% level. Sixteen characters, *i.e.*, 2 characters of UHG, 3 characters of HG, 5 characters of comparative values, 6 characters of area and volume columns, showed no significance even at 5% level. In general, comparative values, and area and volume columns showed a few significances. Average significant level and its s.d. through the whole characters were found to be 0.63 ± 1.03.

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 significant in 24/24 cases (=100.0%). Moreover, the whole of them showed significances at 0.1% level. 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 to be significant in 41/72 cases (=56.9%). Seven characters, *i.e.*, 4 characters of UHG and 3 characters of HG, showed significances at 3 columns. Three characters of comparative values showed significances at 2 columns. Fourteen characters, *i.e.*, 2 characters of UHG, 3 characters of HG, 3 characters of comparative values, whole characters (=6) of comparison, showed significances at 1 column. In general, comparative values and comparison, especially comparison, showed a few significances. Average significant level and its s.d. through the whole characters were found to be 1.71 ± 0.89.

Fourteen characters, *i.e.*, character Nos. 2 (W of UHG), 3 (T of UHG), 12 (W of HG), 13 (T of HG), 15 (L/T of HG), 21 (comparative value of L), 24 (comparative value of L/W), 25 (comparative value of L/T), 31~36 (characters of area and volume columns), showed no significance in columns E and F. One character, *i.e.*, character No. 22 (comparative value of W), showed no significance in column F. Two characters, *i.e.*, character Nos. 23 and 26 (comparative values of T and W/T), showed no significance in column E. The whole characters showed significances in column G.

3. Nine, 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 the s.d. on another s.d. (column B), and of the variation range on another variation range (column C), respectively. It was noticed that character-combinations of UHG and HG showed many negative correlations. Morever, character-combinations L/W and W/T (4·6, 14·16, 24·26) showed negative correlations through 3 cases.

Two, 1 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.

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, these characters might genetically be fixed as those in possesion of a flexibility and affectability to any by a few environmental conditions.

4. In summing-up, significant relations were found to be 88.9%, 77.8%, 77.8%, 81.5%, 37.5%,

33.3%, 100.0% and 56.9% in the order of columns A to H, respectively. Average and its s.d. through the whole columns were found to be 69.21±22.59. It might be concluded that column G (= 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. However, some characters showed quite low correlations or no significant correlations 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. Although it might be affirmed that those characters or character-combinations are to be used for analysing the grain morphological constitutions in the future. Moreover, it might be confirmed that such indices of ideas may be used as a sort of handy index in the experiments.

5. It might be noticeable that significant relations were found as 107/153 cases (=69.9%) in summed-up data. Moreover, in view of significant level, these were found in 85/107 cases (=79.4%), 6/107 cases (=5.6%) and 16/107 cases (=15.0%) at 0.1%, 1% and 5% levels, respectively. In view of significant level through columns A, B and C, 52/66 cases (=78.8%), 4/66 cases (=6.1%) and 10/66 cases (=15.2%) showed significant relations at 0.1%, 1% and 5% levels, respectively. In those through three columns of E, F and G, 33/41 cases (=80.5%), 2/41 cases (=4.9%) and 6/41 cases (=14.6%) showed significant relations at 0.1%, 1% and 5% levels, respectively. No clear difference was found between these 2 groups.

In addition to those facts, 85/153 cases (=55.6%), 6/153 cases (=3.9%), 16/153 cases (=10.5%) and 46/153 cases (=30.1%) showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

It might have meant those biological actions, which were extremely called "all or nothing", *i.e.*, going from one extreme to another. In a stricter sense, those characters were looked upon as being in possesion of a stable state, and they were exhibited independent of the other characters.

Summary

Succeeding to the previous papers, some morphological studies on grain characters and considerations on ecotypic differentiations of 64 strains of cultivated rice species, *Oryza sativa* L., collected in Burma, were reported in the present paper. The results obtained here were summarized as follows:

1. In the data obtained by summing-up the three relation-groups, *i.e.*, practical value on the other practical values, s.d. on the other s.d., and variation range on the other variation ranges, 24/27 character-combinations (=88.9%), 21/27 character-combinations (=77.8%) and 21/27 character-combinations (=77.8%) showed significant relations, respectively. Average significant level and its s.d. through the whole character-combinations were found to be 2.48±1.03, 1.89±1.26 and 2.07±1.27, respectively, in the same order. Through the 3 columns, 66/81 cases (=81.5%) 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, 9/24 characters (=37.5%), 8/24 characters (=33.3%) and 24/24 characters (=100.0%) showed significant relations, respectively. Average significant level and its s.d. through the whole characters were found to be 0.92±1.29, 0.63±1.03 and 3.00±0.00, respectively, in the same order. Through the 3 columns, 41/72 cases (=56.9%) 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 as working indices in the examinations of variety- and strain-differentiations. Morever, comparisons of data obtained here and other neighbouring countries were carried out to some extents, and several interesting informations were shown in view of the locality-specificities.

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