Mem. Fac. Agr. Kagoshima Univ., **20**, 19–35, 1984

Distribution and Some Morphological Characters of the Wild Rice in the Northeastern India (IV)

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Received for Publication August 18, 1983

Introduction

During the period from December in 1978 to January in 1979, the writer was sent to India for the collection of the wild and cultivated rices. At this opportunity, 17 strains of wild rice were collected in the northeastern India, which was denoted here as follows; Assam, Meghalaya and most northern part of West Bengal. Geographical distribution of the wild rice found here was briefly illustrated in Fig. 1 in the previous paper[3].

Gustchin[1] reported that rice might have been originated on the slopes of Himalaya, both on the Indian and Chinese sides. Those areas have been considered to be one of the most important world centers for the origin and dispersal of the cultivated rice strains, *Oryza sativa* L.

It has been recognized that wild relatives of the cultivated rice are of great potentialities in helping both to solve problems of disease and pest resistance and to improve yields and adaptation to extreme environment[8]. Many examples concerning the usefulness of the wild rice species will no doubt be found as screening and breeding proceeds[7]. Accordingly, it becomes to be an urgent problem to make clear the relationships between the wild and cultivated species of the genus *Oryza* and the varietal variations of the wild species.

It seems to be very important to keep in mind that morphological characteristics of the respective strains have been made cleared-up. In the previous papers, the habitat and the record of some morphological characters of the unhusked and the husked grains of the wild rice collected in the northeastern India[3], comparisons of the unhusked and the husked grains in 12 characters[5], variation ranges in 24 characters[5,6], and some mutual relationships[5] were reported. In the present paper, the remaining mutual relations among 24 characters in views of practical value, standard deviations and variation ranges were mainly described, in order to confirm the morphological characters of grains as well as to make clear the species specificities and the ecotypic differentiations of those grains. The records on the comparisons of wild rice distributed in the other areas and the considerations of wild rice in the whole world will be reported in the separate articles.

Materials and Methods

Seventeen strains of wild rice were collected in this trip, and they were used for morphological investigations. Their collection-number, -date, district and habitat were mentioned in Table 1 of the previous paper[5]. Thirty grains were used for the measurement of each strain.

To make clear the relations between the respective 2 characters of the unhusked and the husked grains in the grain level, correlation coefficient and linear regression between them were calculated

through the whole characters, *i.e.*, comparative values (Tables 1 and 2), comparison of the unhusked with the husked grains (Tables 3 and 4), area and volume columns (Table 5).

To make clear the relationships between practical value, standard deviations and range in the strain level, 6 relations were calculated, *i.e.*, practical value and other practical value, standard deviations and other standard deviations, range and other range (Table 6), practical value and its standard deviations, practical value and its range, standard deviations and its range (Table 7). At last, comparisons of 4 relationships were made, mainly using the data shown in Table 6 (Tables 8 and 9).

In this paper, the following abbreviations were used, *i.e.*, 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 1. Correlation coefficient and linear regression of the three components; comparative values of width (Y) on length (X), comparative values of thickness (Y) on length (X), and comparative values of thickness (Y) on width (X)

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	−0.4088*	Y=−0.902X+1.415	0.4820**	Y=1.222X−0.011	0.2644	—
2	0.8572***	Y=1.026X+0.150	−0.3777*	Y=−0.216X+1.018	−0.3957*	Y=−0.189X+1.030
3	−0.3031	—	−0.3021	—	0.6360***	Y=0.962X+0.031
4	0.2987	—	0.4320*	Y=0.653X+0.364	−0.0687	—
5	0.2014	—	−0.4540*	Y=−0.500X+1.205	0.2618	—
6	0.0489	—	−0.0838	—	0.0904	—
7	−0.0668	—	−0.1078	—	−0.3371	—
8	−0.5804***	Y=−1.200X+1.700	−0.0080	—	0.4069*	Y=0.307X+0.551
9	−0.1748	—	0.3519	—	0.5681**	Y=0.868X+0.089
10	0.1172	—	−0.2807	—	0.0998	—
11	−0.1756	—	0.0686	—	0.1716	—
12	0.5380**	Y=0.447X+0.475	−0.0772	—	0.2654	—
13	0.1698	—	−0.3043	—	−0.1570	—
14	0.3901*	Y=1.111X+0.022	−0.4525*	Y=−1.222X+1.673	0.0000	—
15	0.0008	—	0.2716	—	−0.0737	—
16	0.0608	—	0.5112**	Y=0.868X+0.188	0.0140	—
17	−0.0534	—	−0.1055	—	−0.3405	—

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=28.

Results

PART I. Grain level

1. Comparative values of length and width

Correlation coefficient (abbreviated as c.c., and so forth) and linear regression (abbreviated as l.r., and so forth) of width on length in the same strains were calculated, and are shown in the left column of Table 1. Two, 1, 2 and 12 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.1823, showing no significance even at 5% level.

2. Comparative values of length and thickness

C.c. and l.r. of thickness on length in the same strains were calculated, and are shown in the central column of Table 1. Two, 4 and 11 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.3919, showing no

Table 2. Correlation coefficient and linear regression of the three components; comparative values of ratio of length to thickness (Y) on ratio of length to width (X), comparative values of ratio of width to thickness (Y) on ratio of length to width (X), and comparative values of ratio of width to thickness (Y) on ratio of length to thickness (X)

Strain No.	L/W and L/T		L/W and W/T		L/T and W/T	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.4913**	Y=0.345X+0.533	−0.6994***	Y=−0.693X−1.561	0.2537	—
2	0.2604	—	−0.1643	—	0.8953***	Y=0.999X+0.195
3	0.7921***	Y=1.100X−0.082	0.0759	—	0.6648***	Y=0.486X+0.595
4	0.2616	—	−0.3657*	Y=−0.704X+1.621	0.7908***	Y=0.977X+0.185
5	0.8249***	Y=1.361X−0.231	0.3646*	Y=0.441X+0.716	0.7980***	Y=0.585X+0.568
6	0.2200	—	−0.7095***	Y=−0.805X+1.690	0.5165**	Y=0.903X+0.168
7	0.5960***	Y=0.534X+0.358	−0.5224**	Y=−0.515X+1.392	0.1870	—
8	0.6060***	Y=0.481X+0.477	−0.6823***	Y=−0.591X+1.540	0.1171	—
9	0.6108***	Y=0.629X+0.335	−0.3464	—	0.5083**	Y=0.583X+0.528
10	0.5578**	Y=0.483X+0.402	−0.6512***	Y=−0.565X+1.436	0.2950	—
11	0.4895**	Y=0.248X+0.646	−0.7264***	Y=−1.305X+2.093	−0.2694	—
12	0.2188	—	0.0470	—	0.8908***	Y=0.937X+0.138
13	0.3523	—	−0.3089	—	0.7659***	Y=0.771X+0.309
14	0.0979	—	−0.5242**	Y=−0.806X+1.697	0.7889***	Y=1.000X+0.123
15	0.4351*	Y=0.495X+0.445	−0.4533*	Y=−0.626X+1.554	0.5798***	Y=0.704X+0.452
16	−0.2571	—	−0.6773***	Y=−0.105X+1.823	0.7384***	Y=0.965X+0.134
17	0.2208	—	−0.3532	—	0.6079***	Y=0.886X−0.211

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=28.

significance even at 5% level.

3. Comparative values of width and thickness

C.c. and l.r. of thickness on width in the same strains were calculated, and are shown in the right column of Table 1. One, 1, 2 and 13 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.4294, showing no significance even at 5% level.

4. Comparative values of L/W and L/T

C.c. and l.r. of L/T on L/W in the same strains were calculated, and are shown in the left column of Table 2. Five, 3, 1 and 8 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.3483, showing no significance even at 5% level.

5. Comparative values of L/W and W/T

C.c. and l.r. of W/T on L/W in the same strains were calculated, and are shown in the central column of Table 2. Six, 2, 3 and 6 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.7171 to the degree of freedom of 15, which is significant at 1% level. Generally speaking, the larger is the comparative value of L/W, the smaller is the comparative value of W/T. L.r. of L/W on W/T was calculated as follows; $Y=-0.840X+1.718$, where Y and X indicate comparative values of L/W and W/T, respectively. This formula indicates that comparative value of L/W becomes 0.840 larger, by becoming 1 unit smaller the comparative value of W/T.

6. Comparative values of L/T and W/T

C.c. and l.r. of W/T on L/T in the same strains were calculated, and are shown in the right column of Table 2. Ten, 2 and 5 strains showed significances at 0.1% and 1% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.3841, showing no significance even at 5% level.

7. Lengths of unhusked and husked grains

C.c. and l.r. of length of husked grains (abbreviated as HG, and so forth) on length of unhusked grains (abbreviated as UHG, and so forth) in the same strains were calculated, and are shown in the left column of Table 3. Sixteen and 1 strain showed significances at 0.1% and 1% levels, respectively. In other words, the whole strains (=17) showed significant relations. In the whole strains, c.c. was +0.9732 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the longer is the length of UHG, the longer is the length of HG. L.r. of length of UHG on length of HG was calculated as follows; $Y=0.769X-0.472$, where Y and X indicate length of UHG and length of HG, respectively. This formula indicates that the length of UHG becomes 0.769 longer, by becoming 1 unit longer the length of HG.

8. Widths of unhusked and husked grains

C.c. and l.r. of width of HG on width of UHG in the same strains were calculated, and are shown in the central column of Table 3. The whole strains (=17) showed significances at 0.1% level. In the whole strains, c.c. was +0.9572 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the wider is the width of UHG, the wider is the width of HG. L.r. of width of UHG on width of HG was calculated as follows; $Y=0.868X-0.061$, where Y and X indicate width of UHG and width of HG, respectively. This formula indicates that the width of UHG becomes 0.868 wider, by becoming 1 unit wider the width of HG.

9. Thicknesses of unhusked and husked grains

C.c. and l.r. of thickness of HG on thickness of UHG in the same strains were calculated, and

Table 3. Correlation coefficient and linear regression of three characters of unhusked (Y) on husked (X) grains; length, width and thickness

Strain No.	Length		Width		Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.9690***	Y=0.700X−0.064	0.8436***	Y=0.698X+0.199	0.9645***	Y=1.265X−0.695
2	0.6330***	Y=0.544X+1.220	0.5582***	Y=0.516X+0.749	0.9858***	Y=0.826X+0.060
3	0.8546***	Y=0.404X+2.265	0.9095***	Y=0.901X−0.106	0.9606***	Y=1.199X−0.553
4	0.8221***	Y=0.221X+3.673	0.9999***	Y=1.000X−0.300	0.8524***	Y=0.676X+0.245
5	0.7942***	Y=0.413X+2.247	0.9368***	Y=0.856X+0.089	0.9298***	Y=0.938X−0.151
6	0.9783***	Y=0.552X+1.261	0.9683***	Y=1.240X−0.928	0.8262***	Y=0.742X+0.134
7	0.8979***	Y=0.704X+0.180	0.8982***	Y=0.663X+0.516	0.9656***	Y=1.021X−0.257
8	0.7941***	Y=0.579X+1.041	0.9268***	Y=0.467X+0.779	0.8963***	Y=0.972X−0.266
9	0.9381***	Y=0.548X+1.247	0.9674***	Y=0.823X+0.065	0.9162***	Y=0.783X+0.076
10	0.8617***	Y=0.623X+0.794	0.9018***	Y=0.656X+0.564	0.8359***	Y=1.048X−0.303
11	0.9178***	Y=0.632X+0.534	0.9228***	Y=1.317X−0.952	0.9240***	Y=0.832X−0.005
12	0.6094***	Y=0.267X+3.401	0.9745***	Y=0.674X+0.253	0.9134***	Y=1.250X−0.671
13	0.8201***	Y=0.312X+3.042	0.9873***	Y=0.912X−0.227	0.9628***	Y=1.198X−0.650
14	0.8560***	Y=0.469X+1.759	0.9399***	Y=0.950X−0.289	0.8914***	Y=0.840X−0.046
15	0.5634**	Y=0.646X+0.455	0.8936***	Y=0.557X+0.637	0.6598***	Y=0.889X−0.083
16	0.8847***	Y=0.411X+2.748	0.8376***	Y=0.556X+0.649	0.9360***	Y=1.046X−0.290
17	0.7785***	Y=0.568X+1.141	0.9154***	Y=0.976X−0.402	0.9513***	Y=0.748X+0.255

***, **; significant at 0.1% and 1% levels, respectively. d.f.=28.

are shown in the right column of Table 3. The whole strains (=17) showed significances at 0.1% level. In the whole strains, c.c. was +0.9813 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the thicker is the thickness of UHG, the thicker is the thickness of HG. L.r. of thickness of UHG on thickness of HG was calculated as follows; Y=1.116X−0.457, where Y and X indicate thickness of UHG and thickness of HG, respectively. This formula indicates that the thickness of UHG becomes 1.116 thicker, by becoming 1 unit thicker the thickness of HG.

10. L/W of unhusked and husked grains

C.c. and l.r. of L/W of HG on L/W of UHG in the same strains were calculated, and are shown in the left column of Table 4. Sixteen and 1 strain showed significances at 0.1% and 1% levels, respectively. In the other words, the whole strains (=17) showed significant relations. In the whole strains, c.c. was +0.9027 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the larger is the L/W of UHG, the larger is the L/W of HG. L.r. of L/W of UHG on L/W of HG was calculated as follows; Y=0.874X−0.066, where Y and X indicate the L/W of UHG and the L/W of HG, respectively. This formula indicates that the L/W of UHG

becomes 0.874 larger, by becoming 1 unit larger the L/W of HG.

11. L/T of unhusked and husked grains

C.c. and l.r. of L/T of HG on L/T of UHG in the same strains were calculated, and are shown in the central column of Table 4. The whole strains (=17) showed significances at 0.1% level. In the whole strains, c.c. was +0.9421 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the larger is the L/T of UHG, the larger is the L/T of HG. L.r. of L/T of UHG on L/T of HG was calculated as follows; $Y=0.875X-0.115$, where Y and X indicate the L/T of UHG and the L/T of HG, respectively. This formula indicates that the L/T of UHG becomes 0.875 larger, by becoming 1 unit larger the L/T of HG.

12. W/T of unhusked and husked grains

C.c. and l.r. of W/T of HG on W/T of UHG in the same strains were calculated, and are shown in the right column of Table 4. The whole strains (=17) showed significances at 0.1% level. In the whole strains, c.c. was +0.6423 to the degree of freedom of 15, which is significant at 1% level. Generally speaking, the larger is the W/T of UHG, the larger is the W/T of HG. L.r. of W/T of

Table 4. Correlation coefficient and linear regression of three characters of unhusked (Y) on husked (X) grains; ratio of length to width, ratio of length to thickness, and ratio of width to thickness

Strain No.	Length/Width		Length/Thickness		Width/Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.6908***	Y=0.587X+1.036	0.9446***	Y=1.017X−0.881	0.7363***	Y=0.815X+0.188
2	0.5194**	Y=0.967X−0.494	0.8895***	Y=0.660X+0.745	0.9291***	Y=0.871X+0.182
3	0.7470***	Y=0.557X+0.997	0.7820***	Y=1.021X−0.813	0.9605***	Y=1.234X−0.304
4	0.9449***	Y=0.709X+0.456	0.7822***	Y=0.757X+0.507	0.9369***	Y=1.129X−0.132
5	0.9112***	Y=0.602X+0.697	0.6934***	Y=0.541X+1.381	0.9703***	Y=1.208X−0.178
6	0.9404***	Y=1.228X−1.169	0.8634***	Y=0.677X+0.911	0.8985***	Y=1.112X−0.198
7	0.8820***	Y=0.734X+0.337	0.6516***	Y=0.577X+0.871	0.8588***	Y=0.760X+0.255
8	0.6839***	Y=0.318X+1.929	0.8744***	Y=0.944X−0.274	0.9261***	Y=0.916X+0.153
9	0.9676***	Y=0.813X+0.095	0.9402***	Y=0.903X−0.179	0.9763***	Y=0.885X+0.186
10	0.8855***	Y=0.753X+0.259	0.8654***	Y=0.911X−0.350	0.8920***	Y=0.935X+0.029
11	0.9234***	Y=1.153X−1.185	0.8527***	Y=0.720X+0.600	0.6919***	Y=0.688X+0.436
12	0.9396***	Y=0.864X+0.193	0.6918***	Y=0.806X+0.383	0.7405***	Y=0.717X+0.311
13	0.9691***	Y=0.891X+0.018	0.8548***	Y=1.199X−1.363	0.9667***	Y=1.182X−0.227
14	0.9509***	Y=0.983X−0.404	0.8539***	Y=0.834X+0.146	0.9097***	Y=1.132X−0.167
15	0.7749***	Y=0.644X+0.609	0.7706***	Y=1.036X−0.850	0.7939***	Y=0.977X+0.085
16	0.8109***	Y=0.630X+0.912	0.8831***	Y=0.840X−0.082	0.8547***	Y=0.821X+0.149
17	0.8685***	Y=1.083X−0.701	0.8910***	Y=0.618X+0.983	0.7915***	Y=0.675X+0.375

***, **; significant at 0.1% and 1% levels, respectively. d.f.=28.

UHG on W/T of HG was calculated as follows; $Y=0.565X+0.563$, where Y and X indicate the W/T of UHG and the W/T of HG, respectively. This formula indicates that the W/T of UHG becomes 0.565 larger, by becoming 1 unit larger the W/T of HG.

13. Areas of unhusked and husked grains

C.c. and l.r. of area of HG on area of UHG in the same strains were calculated, and are shown in the left column of Table 5. Sixteen and 1 strain showed significances at 0.1% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.9701 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the wider is the area of UHG, the wider is the area of HG. L.r. of area of UHG on area of HG was calculated as follows; $Y=0.627X-0.437$, where Y and X indicate the area of UHG and the area of HG, respectively. This formula indicates that the area of UHG becomes 0.627 wider, by becoming 1 unit wider the area of HG.

14. Volumes of unhusked and husked grains

C.c. and l.r. of volume of HG on volume of UHG in the same strains were calculated, and are

Table 5. Correlation coefficient and linear regression of three characters; area of husked grain (Y) on area of unhusked grain (X), volume of husked grain (Y) on volume of unhusked grain (X), and quotient of volume (Y) on quotient of area (X)

Strain No.	Area		Volume		Quotient	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.9645***	Y=0.549X−0.033	0.9153***	Y=0.544X−2.405	0.8459***	Y=1.565X−0.401
2	0.2165	—	0.7008***	Y=0.274X+6.754	0.9628***	Y=0.812X+0.035
3	0.9376***	Y=0.596X+0.171	0.9532***	Y=0.665X−3.578	0.6619***	Y=1.196X−0.211
4	0.8392***	Y=0.601X+0.246	0.8030***	Y=0.346X+4.057	0.7696***	Y=1.157X−0.199
5	0.8340***	Y=0.547X+1.495	0.8851***	Y=0.514X+0.800	0.7708***	Y=0.666X+1.154
6	0.8960***	Y=0.659X−1.481	0.8696***	Y=0.545X−1.973	0.8445***	Y=0.959X−0.075
7	0.9229***	Y=0.572X+0.977	0.9663***	Y=0.570X−0.650	0.9189***	Y=0.807X+0.055
8	0.9544***	Y=0.445X+2.476	0.8155***	Y=0.368X+3.129	0.8023***	Y=1.138X−0.196
9	0.9254***	Y=0.510X+1.566	0.8904***	Y=0.474X+0.861	0.8967***	Y=1.451X−0.379
10	0.8922***	Y=0.485X+2.932	0.9422***	Y=0.451X+4.765	0.9077***	Y=0.857X+0.023
11	0.8439***	Y=0.766X−2.525	0.8121***	Y=0.537X−0.874	0.9221***	Y=0.909X−0.047
12	0.9241***	Y=0.335X+3.667	0.8756***	Y=0.440X+0.896	0.7175***	Y=0.878X−0.027
13	0.9434***	Y=0.675X−1.522	0.9399***	Y=0.597X−3.427	0.6103***	Y=0.662X+0.081
14	0.9037***	Y=0.616X−0.743	0.9217***	Y=0.497X−0.927	0.7670***	Y=0.754X+0.034
15	0.7174***	Y=0.388X+3.442	0.5433**	Y=0.260X+6.360	0.8080***	Y=0.990X−0.092
16	0.8640***	Y=0.361X+5.032	0.8608***	Y=0.411X+4.185	0.8636***	Y=0.888X−0.004
17	0.8876***	Y=0.580X+0.374	0.9572***	Y=0.505X+1.130	0.6362***	Y=0.614X+0.166

***, **; significant at 0.1% and 1% levels, respectively. d.f.=28.

shown in the central column of Table 5. Sixteen and 1 strain showed significances at 0.1% and 1% levels, respectively. In other words, the whole strains (=17) showed significant relations. In the whole strains, c.c. was +0.9867 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the larger is the volume of UHG, the larger is the volume of HG. L.r. of volume of UHG on volume of HG was calculated as follows; $Y=0.625X-3.280$, where Y and X indicate the volume of UHG and the volume of HG, respectively. This formula indicates that the volume of UHG becomes 0.625 larger, by becoming 1 unit larger the volume of HG.

15. Quotients of area and volume

C.c. and l.r. of quotient of volume on quotient of area in the same strains were calculated, and are shown in the right column of Table 5. The whole strains (=17) showed significances at 0.1% level. In the whole strains, c.c. was +0.8816 to the degree of freedom of 15, which is clearly significant at 0.1% level. Generally speaking, the larger is the quotient of area, the larger is the quotient of volume. L.r. of quotient of area on quotient of volume was calculated as follows; $Y=1.129X-1.713$, where Y and X indicate the quotient of area and quotient of volume, respectively. This formula indicates that the quotient of area becomes 1.129 larger, by becoming 1 unit larger the quotient of volume.

PART II. Strain level

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

C.c. and l.r. of the practical value on another practical value among 27 combinations were calculated, and are shown in the left column of Table 6. Twelve, 2, 1 and 12 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of width (UHG) on thickness (UHG) through the whole strains was +0.8961 to the degree of freedom of 15, which is obviously significant at 0.1% level. Generally speaking, the wider is the width (UHG), the thicker is the thickness (UHG). L.r. of width on thickness was calculated as follows; $Y=0.540X+0.501$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.540 mm wider, by becoming 1 degree thicker the thickness.

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 combinations were calculated, and are shown in the central column of Table 6. Five, 2, 5 and 15 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/W (UHG) on s.d. of W/T (UHG) through the whole strains was +0.6733 to the degree of freedom of 15, which is obviously significant at 0.1% level. Generally speaking, the larger is the s.d. of L/W (UHG), the larger is the s.d. of W/T (UHG). L.r. of s.d. of L/W on s.d. of W/T was calculated as follows; $Y=0.315X+0.035$, where Y and X indicate s.d. of L/W and s.d. of W/T, respectively. This formula indicates that the s.d. of L/W becomes 0.315 larger, by becoming 1 degree larger the s.d. of W/T.

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

C.c. and l.r. of variation range on another range among 27 combinations were calculated, and are shown in the right column of Table 6. Five, 3, 2 and 17 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 range of length (HG) through the whole strains was +0.8611 to the degree of freedom of 15, which is obviously significant at 0.1% level. Generally speaking,

Table 6. 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	0.4780*	Y=0.286X+0.021	0.3004	—	0.3581	—
1·3	0.2262	—	0.1693	—	0.3782	—
2·3	0.8961***	Y=0.540X+0.501	−0.0871	—	0.3720	—
4·5	0.7906***	Y=0.999X+1.057	0.0380	—	−0.0404	—
4·6	−0.3749	—	0.6733***	Y=0.315X+0.035	0.1763	—
5·6	0.2628	—	0.2578	—	0.0646	—
11·12	0.4816	—	0.0917	—	0.3685	—
11·13	0.4329	—	0.1350	—	0.2982	—
12·13	0.9386***	Y=0.709X+0.116	−0.0398	—	0.3652	—
14·15	0.8701***	Y=1.055X+0.712	0.1562	—	0.1548	—
14·16	−0.2688	—	0.5376*	Y=0.256X+0.071	0.3055	—
15·16	0.2351	—	0.2404	—	0.0160	—
21·22	0.1823	—	−0.3037	—	0.0185	—
21·23	0.3919	—	0.2965	—	0.4001	—
22·23	0.4294	—	−0.1928	—	−0.1598	—
24·25	0.3483	—	0.0948	—	0.0404	—
24·26	−0.7177**	Y=−0.840X+1.718	0.5950*	Y=0.856X+0.019	0.3483	—
25·26	0.3841	—	0.2734	—	0.6036*	Y=0.608X+0.071
1·11	0.9732***	Y=0.769X−0.472	0.6658**	Y=0.622X−0.002	0.8611***	Y=0.753X−0.181
2·12	0.9572***	Y=0.868X−0.061	0.5639*	Y=0.623X+0.036	0.7426***	Y=0.585X+0.132
3·13	0.9813***	Y=1.116X−0.457	0.5512*	Y=0.565X+0.048	0.6515**	Y=0.604X+0.133
4·14	0.9027***	Y=0.874X−0.066	0.8074***	Y=0.880X−0.003	0.6633**	Y=0.874X+0.031
5·15	0.9421***	Y=0.875X−0.115	0.6136**	Y=0.669X+0.095	0.5994*	Y=0.918X+0.081
6·16	0.6423**	Y=0.565X+0.563	0.9141***	Y=1.014X+0.009	0.8500***	Y=0.946X+0.061
31·33	0.9701***	Y=0.627X−0.437	0.7289***	Y=0.441X+0.199	0.8336***	Y=0.423X+0.775
32·34	0.9867***	Y=0.625X−3.280	0.9526***	Y=0.491X+0.208	0.9416***	Y=0.497X+0.529
35·36	0.8816***	Y=1.129X−1.713	0.4997*	Y=0.180X+0.024	0.6889**	Y=0.652X+0.038

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.=15.

the larger is the range of length (UHG), the larger is the range of length (HG). L.r. of range of length (UHG) on range of length (HG) was calculated as follows; $Y=0.753X-0.181$, where Y and X indicate the range of length (UHG) and range of length (HG), respectively. This formula indicates that the range of length (UHG) becomes 0.753 larger, by becoming 1 degree larger the range of length (HG).

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 7. Three, 1 and 20 characters showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of practical value of L/T (UHG) on s.d. of L/T (UHG) through the whole strains was +0.7656 to the degree of freedom of 15, which is obviously significant at 0.1% level. Generally speaking, the larger is the practical value of L/T (UHG), the larger is the s.d. of L/T (UHG). L.r. of practical value of L/T (UHG) on s.d. of L/T (UHG) was calculated as follows; $Y=0.143X-0.354$, where Y and X indicate practical value and s.d. of L/T, respectively. This formula indicates that the practical value of L/T becomes 0.143 larger, by becoming 1 degree larger the s.d. of L/T.

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 7. Two, 4 and 18 characters showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of practical value of volume (UHG) on variation range of volume (UHG) through the whole strains was +0.8646 to the degree of freedom of 15, which is obviously significant at 0.1% level. Generally speaking, the larger is the practical value of volume (UHG), the larger is the variation range of volume (UHG). L.r. of practical value of volume (UHG) on variation range of volume (UHG) was calculated as follows; $Y=0.667X-8.788$, where Y and X indicate the practical value and variation range of volume (UHG), respectively. This formula indicates that the practical value of volume becomes 0.667 larger, by becoming 1 degree larger the variation range of volume.

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 7. Twenty-three and 1 character showed significances at 0.1% level and no significance even at 5% level, respectively. For example, c.c. of s.d. of length (UHG) on variation range of length (UHG) through the whole strains was +0.7174 to the degree of freedom of 15, 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; $Y=4.187X-0.246$, where Y and X indicate s.d. and variation range of length (UHG), respectively. This formula indicates that the s.d. of length becomes 4.187 larger, by becoming 1 degree larger the variation range of length.

7. Comparisons of the four relation-groups

From the data obtained in the Table 6 of the present experiment, relations between the two respective characters were compared, and are shown in Tables 8 and 9. In this table, at first, 3 relation-groups, *i.e.*, relations between the two respective practical values (A group in Table 8), relations between the two respective s.d. (B group in Table 8) and relations between the two respective variation ranges (C group in Table 9), were analyzed. In addition to these, summing-up-data from groups A, B and C were regulated, and are shown in D group of Table 9, under the condition that the calculation was to be made only by means of the significances in disregard of significant levels.

Table 7. Correlation coefficient and linear regression of the former characters (Y) on the latter characters (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 its range		s.d. on its range	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	−0.2079	—	−0.0014	—	0.7174***	Y=4.187X−0.246
2	0.2302	—	0.4495	—	0.9077***	Y=4.171X−0.119
3	0.0607	—	0.2937	—	0.8374***	Y=3.568X−0.019
4	0.3600	—	0.1434	—	0.8349***	Y=2.406X+0.249
5	0.7656***	Y=0.143X−0.354	0.5490*	Y=0.315X−0.398	0.8604***	Y=2.648X+0.253
6	−0.0832	—	0.2621	—	0.8181***	Y=2.698X+0.062
11	−0.1193	—	0.0788	—	0.8648***	Y=3.697X−0.085
12	−0.0468	—	0.2922	—	0.8525***	Y=2.795X+0.061
13	0.0348	—	0.1640	—	0.8713***	Y=3.356X−0.013
14	0.4496	—	0.2447	—	0.9242***	Y=3.221X+0.061
15	0.5565*	Y=0.122X−0.179	0.3184	—	0.8725***	Y=3.775X−0.071
16	0.3503	—	0.5042*	Y=1.125X−1.041	0.8782***	Y=2.907X+0.046
21	0.2967	—	0.1690	—	0.7490***	Y=2.367X+0.020
22	0.3078	—	0.1610	—	0.7894***	Y=2.066X+0.024
23	−0.3919	—	−0.0272	—	0.8803***	Y=2.601X+0.019
24	0.0009	—	−0.0234	—	0.9226***	Y=2.589X+0.027
25	0.3638	—	−0.0473	—	0.8306***	Y=3.517X−0.005
26	0.1331	—	−0.1766	—	0.7696***	Y=1.982X+0.057
31	0.4087	—	0.5197*	Y=0.347X−1.409	0.9113***	Y=3.922X−0.682
32	0.8132***	Y=0.155X−1.350	0.8646***	Y=0.667X−8.788	0.9788***	Y=3.972X−1.885
33	0.2177	—	0.4939*	Y=0.290X−0.370	0.9172***	Y=3.710X−0.302
34	0.7525***	Y=0.117X+0.001	0.7637***	Y=0.494X−1.564	0.9803***	Y=4.081X−1.340
35	0.3520	—	0.3312	—	0.2842	—
36	−0.0481	—	0.1352	—	0.8616***	Y=3.394X−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% and 5% levels, respectively. d.f.=15.

Table 8. Comparisons of 2 relation-groups; relations between the 2 respective characters in view of practical values (A) and standard deviations (B)

Group	Character	Character																
		2	3	5	6	11	12	13	14	15	16	22	23	25	26	33	34	36
A	1	*	—			***												
	2		***				***											
	3							***										
	4			***	—				***									
	5				—					***								
	6										**							
	11						—	—										
	12							***										
	14									***	—							
	15										—							
	21											—	—					
	22												—					
	24													—	**			
	25														—			
	31															***		
	32																***	
	35																	***
B	1	—	—			**												
	2		—				*											
	3							*										
	4			—	***				***									
	5				—					**								
	6										***							
	11						—	—										
	12							—										
	14									—	*							
	15										—							
	21											—	—					
	22												—					
	24													—	*			
	25														—			
	31															***		
	32																***	
	35																	*

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.=15.

Table 9. Comparisons of the 2 relation-groups; relations between the 2 respective characters in view of variation ranges (C) and summing-up of A, B and C groups (D). Figure used in column D shows the number of significant relations in the respective combinations in disregarding of the grade of significances.

Group	Character	Character																
		2	3	5	6	11	12	13	14	15	16	22	23	25	26	33	34	36
C	1	—	—			***												
	2		—				***											
	3							**										
	4			—	—				**									
	5				—					*								
	6										***							
	11						—	—										
	12							—										
	14									—	—							
	15										—							
	21											--	—					
	22												—					
	24													—	—			
	25														*			
	31															***		
	32																***	
	35																	**
D	1	1	—			3												
	2		1				3											
	3							3										
	4			1	1				3									
	5				—					3								
	6										3							
	11						—	—										
	12							1										
	14									1	1							
	15										—							
	21											--	—					
	22												—					
	24													—	2			
	25														1			
	31															3		
	32																3	
	35																	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.=15.

Significant combinations were counted as 15, 12, 10 and 37 in A, B, C and D groups, respectively. Groups of A, B, C and D showed their frequencies as 55.6% (=15/27), 44.7% (=12/27), 37.0% (=10/27) and 45.7% (=37/81), respectively. In D group, 9, 1, 8 and 9 combinations showed significances at 3, 2, 1 and 0 chance, respectively. Twenty-seven combinations may be divided into 2 categories, *i.e.*, the one with higher frequency and the other with lower frequency. Nine combinations, *i.e.*, 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 18 combinations belonged to the latter one.

Discussion

Basing on the results obtained in the previous[5,6] and the present experiments, the following problems are to be discussed here.

1. C.c. of the respective character-combinations in the strain level were fixed to be significant in 311/459 cases, *i.e.*, 67.8% of the whole cases. But those in the whole strains were fixed to be significant in 16/27 cases, *i.e.*, 59.3% of the whole cases. In detail, some characteristics were found. Significant correlations in the strain level were accounted as follows in the order of the combination numbers from 1 to 27; 7, 7, 5; 6, 16, 12; 9, 8, 6; 9, 14, 13; 5, 6, 4; 9, 11, 12; 17, 17, 17; 17, 17, 17; 16, 17 and 17 strains, respectively. It may be noticed that the values were peculiarly large in the combinations with No. 5 and Nos. 19~27. Average value and its s.d. through the whole combinations were found to be 11.52 ± 4.69.

The whole combinations were divided into 2 groups, *i.e.*, group I (combination Nos. 1~18) and group II (Nos. 19~27). Significant correlations were accounted as 51.96% (=159/306) and 99.35% (=152/153) in groups I and II, respectively. Those averages and s.d. through the whole combinations within the groups were found to be 8.83 ± 3.37 and 16.89 ± 0.31 in groups I and II, respectively. From those data, it might be said that the group II showed combinations by for more significant than those in group I. Moreover, group I were re-divided into 6 sub-groups as follows; sub–1 (combination Nos. 1~3), sub–2 (Nos. 4~6), sub–3 (Nos. 7~9), sub–4 (Nos. 10~12), sub–5 (Nos. 13~15) and sub–6 (Nos. 16~18). Significant correlations were accounted as follows in the order from sub–1 to sub–6; 37.26% (19/51), 66.67% (34/51), 45.10% (23/51), 70.59% (36/51), 29.41% (15/51) and 62.75% (32/51), respectively. It was ascertained that subs–2, –4 and –6, *i.e.*, ratio-columns, showed the higher significances in comparison with those of subs–1, –3 and –5. It may duely be attributed to gene actions.

2. The respective strains showed significant combinations as follows in the order from strain No. 1 to No. 17; 22, 18, 19, 21, 20, 14, 19, 19, 18, 18, 17, 19, 16, 17, 16, 17 and 21, respectively. It may be noted that strain No. 1 showed significances in 22/27 combinations, *i.e.*, 81.48% of the whole, and strain No. 6 showed significances only in 14/27 combinations, *i.e.*, 51.85% of the whole, respectively. Average value and its s.d. through the whole strains were found to be 18.29 ± 1.99.

3. Significant correlations were analyzed in the positive or negative status and degree of their status. Significant correlations were accounted as follows in the order of 0.1% levels (positive, negative and the whole), 1% levels (positive, negative and the whole) and 5% levels (positive, negative and the whole); 197 combinations (63.3%), 34 (10.9%), 231 (74.3%); 29 (9.3%), 15 (4.8%), 44 (14.2%); 23 (7.4%), 13 (4.2%), 36 (11.6%). It may be a noticeable phenomenon that about three fourths of them showed significant combinations at 0.1% level. 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 possession of a stable state, and the

exhibition of them was made independent of the other characters. The total positive and negative correlations were accounted as 249 combinations (80.1%) and 62 combinations (19.9%), respectively.

Negative correlations were found in the strain level in some combinations, though positive correlations were found in the most strains in the same combinations, and *vice versa*. Four cases were found, *i.e.*, strain No. 2···combinations 2·3 and 22·23, strain No. 5···combination 24·26, strain No. 12···combination 11·13. These unnatural facts and discrepancies are not to be unfortunately fully explained at the present time. It was, however, an interesting phenomenon concerning the strain differentiations. It may be attributable to the actions of the respective genes concerned in the all events.

4. The three strains showed the relatively large values were picked up in the respective combinations (=27). The respective strains showed the following numbers in the order from strain Nos. 1 to 17; 11, 5, 5, 4, 7, 3, 8, 4, 7, 3, 3, 4, 8, 1, 0, 3 and 5, respectively. Average and its s.d. through the whole strains were found to be 4.77 ± 2.67. The same order or the same combination was not found at all.

The three strains showing the relatively small values were picked up in the respective combinations (=27). The respective strains showed the following numbers in the order from strain Nos. 1 to 17; 6, 10, 3, 3, 2, 7, 4, 4, 2, 2, 4, 7, 1, 7, 11, 6 and 2, respectively. Average and its s.d. through the whole strains were found to be 4.77 ± 2.84. In the smaller set of combination with length (UHG) and thickness (UHG), the smallest (+0.0163) was noted in No. 15, followed by No. 16 (−0.0289) and No. 6 (+0.1083). In the smaller set of combination with length (comparison) and width (comparison), the smallest (+0.0008) was noted in No. 15, followed by No. 6 (+0.0489) and No. 16 (+0.0608). Those combinations of strains were finally illustrated in both of the cases as 6·15·16.

The strains showing the relatively large and small values were summed-up in the respective combinations. The respective strains showed the following numbers in the order from strain Nos. 1 to 17; 17, 15, 8, 7, 9, 10, 12, 8, 9, 5, 7, 11, 9, 8, 11, 9 and 7, respectively. Average and its s.d. through the whole strains were found to be 9.53 ± 2.91.

5. C.c. of the practical value on another practical value were decided to be significant in 15/27 cases, *i.e.*, 55.6% of the whole combinations. One character (width of UHG), 8 characters (length of UHG, width of HG, thicknesses of UHG and HG, L/W and L/T of UHG and HG), 11 characters (length of HG, W/T of UHG and HG, L/W and W/T of comparison, 6 characters of area and volume) and 4 characters (length, width, thickness and L/T of comparison) showed significant correlations in 3, 2, 1 and 0 combination, respectively. Comparison-characters showed, in general, a few significances. Average and its s.d. through the whole characters were found to be 1.25 ± 0.78.

C.c. of the intra-strain's variation (=s.d.) on another variation were decided to be positively significant in 12/27 cases, *i.e.*, 44.4% of the whole combinations. It was noticeable that only 3 combinations showed significances within UHG, HG and comparison, *i.e.*, the respective L/W and W/T combinations. Four characters (L/W and W/T of UHG and HG), 16 characters (lengths, widths, thicknesses and L/T of UHG and HG, L/W and W/T of comparison, 6 characters of area and volume) and 4 characters (length, width, thickness and L/T of comparison) showed significant correlations in 2, 1 and 0 combination, respectively. Comparison-characters showed a few significances, which was the same as in case of the previous column. Average and its s.d. through the whole characters were found to be 1.00 ± 0.58.

C.c. of the range on another range were decided to be positively significant in only 10/27 cases, *i.e.*, 37.0% of the whole combinations. It was noticeable that only 1 combination showed sig-

nificance within UHG, HG and comparison, *i.e.*, L/T and W/T of comparison. Twenty characters, excluding length, width, thickness and L/W of comparison, showed significant correlations in 1 combination. Average and its s.d. through the whole characters were found to be 0.83 ± 0.37.

C.c. of the three columns mentioned just above were decided to be significant in 37/81 cases, *i.e.*, 45.7% of the whole combinations. Three characters (width of UHG, L/W of UHG and HG), 8 characters (length of UHG, width of HG, thicknesses, L/T and W/T of UHG and HG), 8 characters (length of HG, W/T of comparison, 6 characters of area and volume), 1 character (L/W of comparison), 1 character (L/T of comparison) and 3 characters (length, width and thickness of comparison) showed significances in 5, 4, 3, 2, 1 and 0 combination, respectively. It was noticeable that 3 characters, *i.e.*, length, width and thickness of comparison, showed no significance through the whole columns. Average and its s.d. through the whole characters and through the whole columns were found to be 3.08 ± 1.47.

6. C.c. of the practical value on its s.d. of the respective characters were decided to be positively significant in only 4/24 cases, *i.e.*, 16.7% of the whole characters. C.c. of the practical value on its range of the respective characters were decided to be significant only in 6/24, *i.e.*, 25.0%. These two results were found to be the same ones as those in the previous paper[2], at the same time, when compared with those in the other previous paper[4], these were wholly reversed ones. These discrepancies might be attributable to the differences of materials used.

C.c. of s.d. on its variation range of the respective characters were expectedly decided to be significant with one exception, *i.e.*, quotient of area. Moreover, they were shown to have some high levelled relationships in 0.1% level. These phenomena meant that the character-s.d. was reasonably found to be connected with the character-range. Generally speaking, the larger is the s.d., the larger is the variation range. Concerning the three relation-groups, it may be concluded that these two components were of the most stable characters, and were intimately correlated each other through the whole rice in disregard of the species-status, *i.e.*, *O. sativa* var. *spontanea* or *O. perennis*.

7. Many characters were used for analysing the species or strain differentiations. Some of them are yet developing status. So, it might be affirmed that those characters of these combinations are to be used in analysing strain differentiations in the future. Moreover, it was confirmed that such indices or ideas as these may be used as useful index in the experiments.

It may be expected that these methods used here may have a universal validity for explaining species- and locality-specificities of the rice species.

Summary

Succeeding to the previous papers, some morphological studies on grain characters and considerations on ecotypic differentiations of 17 strains of the wild rice, belonging to 2 species of the genus *Oryza*, collected in northeastern India, were reported in the present paper. The results obtained here were summarized as follows:

1. Concerning correlation coefficients among 15 character-combinations, 199/255 cases, *i.e.*, 78.04% of combinations, showed significant relations through the whole cases. From the previous and the present experiments, concerning correlation coefficients among 27 character-combinations, 311/459 cases, *i.e.*, 67.8% combinations, showed significant relations through the whole cases. The whole combinations were divided into 2 groups in view of the correlation-occurrence frequencies, *i.e.*, group I (combination Nos. 1～18) and group II (Nos. 19～27). Significant correlations were

accounted as 51.96% (159/306) and 99.35% (152/153) in groups I and II, respectively. Those averages and s.d. through the whole combinations within the groups were found to be 8.83 ± 3.37 and 16.89 ± 0.31 in groups I and II, respectively.

2. In the data obtained by summing-up from 3 relation-groups, *i.e.*, practical value on other practical value, s.d. on other s.d., range on other range, 9, 1, 8 and 9 combinations showed significances in 3, 2, 1 and 0 group, respectively. Concerning correlation among the 3 components in the same characters, *i.e.*, between practical value and its s.d., practical value and its range, and s.d. and its range, 3, 4, 16 and 1 character showed significances in 3, 2, 1 and 0 case, respectively.

3. Varietal and ecotypic differentiations were extensively discussed basing on the data from the previous and the present experiments. Characters and character-combinations ascertained here were assumed to be great value, on account of their having universal validities as indices in the examination of species and strain differentiations.

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