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

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Introduction

During the period from December in 1978 to January in 1979, the writer was sent to India for the collection of strains of the wild and cultivated rices. At this opportunity, 11 strains of wild rice were collected in the central India, which was denoted here as follows; southern part of West Bengal, southern part of Bihar, Orissa, Andhra Pradesh and Madhya Pradesh. Geographical distribution of the wild rice found here was briefly illustrated in Fig. 1 in the previous paper[2]. Although these areas have been considered to be a region of the secondary centers for origin of rice[9,10], accumulation of complete data obtained from these aspects is far from being perfect. Nair *et al.*[7] advanced some phytogeographical evidence in support of considering the peninsular part in India as the center of the origin of rice, basing on the occurrence which was as often as the one in case of the fine wild taxa, the presence of the high varietal diversity, and also the wide occurrence of several dominant genes in local rice varieties. It is important to keep in mind that natural habitats of wild rice are disappearing due to the man-made environments year by year, and that the wild rices may play a part as some sorts of reservoirs of germplasm for cultivated rice, and moreover as one of the emergency crops in many countries of southern and southeastern Asia.

In view of the importance of the relations of rice in the wild, a biosystematic study was carried out on *Oryza* series *Sativae*. It was aimed at a better understanding of the germplasm and clarification of the taxonomy of the species[8].

Taking these facts into account, the present series was carried out in order to accomplish the works which are going to clarify the distribution and ecotypic differentiation of wild rice in the central India. In the previous papers, the habitat and the record of morphological characters of the unhusked and the husked grains of the wild rice collected in the central India[2], comparisons of the unhusked and the husked grains in 12 characters[4], variation ranges in 24 characters[4,5], and some mutual relations[4] were reported. In the present paper, the remaining mutual relations among 24 characters in the 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 record on the comparisons of the wild rice distributed in other areas and the considerations of wild rice in the whole world will be reported in the separate articles.

Materials and Methods

Eleven strains of wild rice were collected in these areas, and those were used for morphological

investigations. Their collection-number, -date, district and habitat were mentioned in Table 1 of the previous paper[4]. 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), and 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 relation-groups 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).

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

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	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.1757	−0.1431	—	−0.1647	—
2	0.1133	0.2757	—	0.2047	—
3	0.0180	0.0067	—	0.5560**	Y=1.507X−0.226
4	0.1188	0.5542**	Y=0.917X+0.214	0.4458*	Y=0.568X+0.398
5	0.0649	0.2549	—	−0.1397	—
6	0.2805	−0.2848	—	−0.3802*	Y=−0.658X+1.393
7	−0.1589	0.1839	—	−0.0776	—
8	0.1469	−0.2767	—	−0.0757	—
9	0.2081	−0.0988	—	0.2549	—
10	−0.0432	0.0783	—	0.3943*	Y=0.622X+0.361
11	−0.2514	−0.1643	—	0.0862	—

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

column of Table 1. The all strains (=11) showed no significance even at 5% level. In the whole strains, c.c. was +0.3913, 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. One and 10 strains showed significance at 1% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.2512, showing no 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, 3 and 7 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.6706 to the degree of freedom of 9, which is significant at 5% level. Generally speaking, the larger is the comparative value of width, the larger is the comparative value of thickness. L.r. of width on thickness was calculated as follows; $Y=0.317X+0.615$, where Y and X indicate comparative values of width and thickness, respectively. This formula indicates that the comparative value of width becomes 0.317 larger, by becoming 1 unit larger the comparative value of thickness.

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. Three, 1, 1 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 +0.4821, showing no significance even at 5% level.

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	0.1981	—	−0.6367***	Y=−0.753X+1.601	0.4965**	Y=0.729X+0.408
2	0.4616*	Y=0.526X+0.346	−0.4126*	Y=−0.445X+1.316	0.4246*	Y=0.402X+0.630
3	0.6750***	Y=0.987X−0.138	0.2159	—	0.8553***	Y=0.686X+0.272
4	0.3075	—	−0.4158*	Y=−0.383X+1.285	0.4489*	Y=0.560X+0.492
5	0.5792***	Y=0.549X+0.312	−0.4340*	Y=−0.461X+1.308	0.4659**	Y=0.523X+0.535
6	0.0574	—	−0.4514*	Y=−0.899X+1.704	0.8549***	Y=1.117X+0.025
7	−0.1046	—	−0.5736***	Y=−1.623X+2.352	0.7123***	Y=1.003X+0.184
8	0.1851	—	−0.2770	—	0.3098	—
9	0.5244**	Y=0.721X+0.158	−0.1592	—	0.7381***	Y=0.717X+0.319
10	0.7183***	Y=0.728X+0.191	−0.0946	—	0.4587*	Y=0.373X+0.644
11	0.1517	—	−0.2582	—	0.0509	—

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

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. Two, 4 and 5 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.8459 to the degree of freedom of 9, 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; $Y=-0.827X+1.651$, where Y and X indicate comparative values of L/W and W/T, respectively. This formula indicates that the comparative value of L/W becomes 0.827 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. Four, 2, 3 and 2 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 +0.0453, showing no significance even at 5% level.

7. Lengths of unhusked and husked grains

C.c. and l.r. of length of HG on length of UHG in the same strains were calculated, and are shown in the left column of Table 3. Nine, 1 and 1 strain showed significances at 0.1% and 1% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.9525 to the degree of freedom of 9, which is obviously 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; $Y=0.571X+1.049$, where Y and X indicate length of UHG and length of HG, respectively. This formula indicates that the length of UHG becomes 0.571 longer, by becoming 1 unit longer the length of HG.

Table 3. Correlation coefficient and linear regression of the 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	0.1891	—	0.6890***	Y=0.723X+0.389	0.9663***	Y=1.022X−0.247
2	0.8662***	Y=0.447X+2.001	0.7749***	Y=0.638X+0.538	0.7811***	Y=0.913X−0.024
3	0.9546***	Y=0.758X−0.527	0.9903***	Y=0.951X−0.673	0.9803***	Y=1.230X−0.611
4	0.9410***	Y=0.831X−0.906	0.9816***	Y=0.923X−0.212	0.9869***	Y=1.087X−0.348
5	0.6535***	Y=0.487X+1.682	0.9712***	Y=1.071X−0.728	0.8678***	Y=0.777X+0.202
6	0.8045***	Y=0.808X−0.935	0.6741***	Y=0.411X+0.911	0.8476***	Y=1.037X−0.286
7	0.8997***	Y=0.648X+0.450	0.9679***	Y=0.913X−0.097	0.9699***	Y=1.332X−0.786
8	0.8981***	Y=0.626X+0.662	0.8431***	Y=1.051X−0.627	0.8948***	Y=0.730X+0.285
9	0.7844***	Y=0.523X+1.530	0.8917***	Y=0.801X−0.050	0.9690***	Y=0.957X−0.138
10	0.7772***	Y=0.877X−1.291	0.9561***	Y=0.970X−0.328	0.9260***	Y=0.978X−0.180
11	0.5503**	Y=0.301X+3.314	0.6086***	Y=0.525X+0.796	0.8463***	Y=0.692X+0.351

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

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 (=11) showed significances at 0.1% level. In the whole strains, c.c. was +0.8310 to the degree of freedom of 9, which is significant at 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; $Y=0.668X+0.374$, where Y and X indicate width of UHG and width of HG, respectively. This formula indicates that the width of UHG becomes 0.668 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 are shown in the right column of Table 3. The whole strains (=11) showed significances at 0.1% level. In the whole strains, c.c. was +0.9960 to the degree of freedom of 9, which is obviously 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; $Y=1.104X-0.398$, where Y and X indicate thickness of UHG and thickness of HG, respectively. This formula indicates that the thickness of UHG becomes 1.104 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. Ten and 1 strain showed significances at 0.1% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.7588 to the degree of freedom of 9, which is significant at 1% level. Generally speaking, the larger is the L/W of UHG, the larger

Table 4. Correlation coefficient and linear regression of the 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	0.7365***	Y=0.661X+0.456	0.7416***	Y=0.761X+0.164	0.0039	—
2	0.7859***	Y=0.631X+0.609	0.8510***	Y=0.626X+0.651	0.8366***	Y=1.003X−0.077
3	0.9672***	Y=1.393X−1.166	0.9567***	Y=1.221X−1.936	0.9500***	Y=1.216X−0.648
4	0.8977***	Y=0.698X+0.603	0.9436***	Y=0.856X−0.157	0.8837***	Y=0.935X+0.022
5	0.8345***	Y=0.860X−0.141	0.7304***	Y=0.593X+0.816	0.9263***	Y=1.069X−0.224
6	0.7717***	Y=0.560X+1.087	0.7873***	Y=1.185X−1.860	0.6889***	Y=0.846X+0.100
7	0.9262***	Y=0.866X−0.175	0.9361***	Y=1.124X−1.292	0.9685***	Y=1.627X−0.809
8	0.7950***	Y=1.024X−0.449	0.6172***	Y=0.521X+1.193	0.8212***	Y=1.004X−0.122
9	0.8653***	Y=0.845X+0.155	0.9362***	Y=0.828X−0.122	0.9714***	Y=0.984X−0.145
10	0.8150***	Y=0.825X+0.124	0.8056***	Y=0.831X−0.062	0.9181***	Y=0.877X+0.098
11	0.2745	—	0.6934***	Y=0.331X+2.100	0.6940***	Y=0.686X+0.354

***; significant at 0.1% level. d.f.=28.

is the L/W of HG. L.r. of L/W of UHG on L/W of HG was calculated as follows; Y=0.669X+0.613, 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 0.669 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 (=11) showed significances at 0.1% level. In the whole strains, c.c. was +0.9447 to the degree of freedom of 9, which is obviously 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=0.872X−0.297, where Y and X indicate the L/T of UHG and L/T of HG, respectively. This formula indicates that the L/T of UHG becomes 0.872 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. Ten and 1 strain showed significances at 0.1% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8521 to the degree of freedom of 9, which is obviously significant at 0.1% 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 UHG on W/T of HG was calculated as follows; Y=0.561X+0.554, 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 0.561 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

Table 5. Correlation coefficient and linear regression of the three characters; area of unhusked 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	0.6450***	Y=0.340X+5.441	0.8141***	Y=0.411X+5.012	0.9493***	Y=0.860X+0.016
2	0.8590***	Y=0.375X+4.402	0.7481***	Y=0.325X+7.932	0.8720***	Y=1.110X−0.126
3	0.9868***	Y=0.591X−2.239	0.9844***	Y=0.552X−4.731	0.8129***	Y=1.552X−0.347
4	0.9913***	Y=0.729X−2.336	0.9951***	Y=0.665X−4.002	0.9321***	Y=1.410X−0.318
5	0.8602***	Y=0.598X−1.147	0.8554***	Y=0.453X+2.018	0.8467***	Y=0.992X−0.059
6	0.7962***	Y=0.520X+0.644	0.9140***	Y=0.502X−0.719	0.5879***	Y=0.599X+0.149
7	0.9577***	Y=0.574X+0.675	0.8953***	Y=0.609X−2.371	0.6443***	Y=1.509X−0.406
8	0.8669***	Y=0.605X−0.570	0.8771***	Y=0.493X+0.654	0.9260***	Y=0.850X+0.021
9	0.8471***	Y=0.495X+1.320	0.9176***	Y=0.492X−0.407	0.7309***	Y=0.912X−0.020
10	0.9241***	Y=0.754X−3.037	0.9408***	Y=0.661X−4.723	0.8633***	Y=1.036X−0.094
11	0.7533***	Y=0.407X+3.834	0.8036***	Y=0.371X+5.746	0.9006***	Y=0.842X+0.024

***; significant at 0.1% level. d.f.=28.

in the left column of Table 5. The whole strains (=11) showed significances at 0.1% level. In the whole strains, c.c. was +0.9046 to the degree of freedom of 9, which is obviously 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; $Y=0.479X+1.896$, where Y and X indicate the area of UHG and area of HG, respectively. This formula indicates that the area of UHG becomes 0.479 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 shown in the central column of Table 5. The whole strains (=11) showed significances at 0.1% level. In the whole strains, c.c. was +0.9391 to the degree of freedom of 9, which is obviously 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; $Y=0.515X-0.468$, where Y and X indicate the volume of UHG and volume of HG, respectively. This formula indicates that the volume of UHG becomes 0.515 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 (=11) showed significances at 0.1% level. In the whole strains, c.c. was +0.9677 to the degree of freedom of 9, which is obviously 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; $Y=0.990X-0.068$, where Y and X indicate the quotient of area and quotient of volume, respectively. This formula indicates that the quotient of area becomes 0.990 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. Seven, 4, 5 and 11 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 was +0.7321 to the degree of freedom of 9, which is significant at 5% level. Generally speaking, the longer is the length (UHG), the wider is the width (UHG). L.r. of length on width was calculated as follows; $Y=0.414X-0.771$, where Y and X indicate the length and width, respectively. This formula indicates that the length becomes 0.414 mm longer, by becoming 1 unit wider the width.

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. Six, 3, 5 and 13 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 width (UHG) on thickness (UHG) through the whole strains was +0.7204 to the degree of freedom of 9, which is significant at 5% level. Generally speaking, the larger is the s.d. of width (UHG), the larger is the s.d. of thickness (UHG). L.r. of s.d. of width on s.d. of thickness was calculated as follows; $Y=0.797X+0.005$, where Y and X indicate the s.d. of width and the s.d. of thickness, respectively. This formula indicates that the s.d. of width becomes 0.797 larger, by becoming 1 degree larger the s.d. of thickness.

Table 6. Correlation coefficient and linear regression of the former characters (Y) on the latter characters (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	0.7321*	Y=0.414X−0.771	0.2454	—	0.2814	—
1·3	0.3460	—	0.2091	—	0.0198	—
2·3	0.4656	—	0.7204*	Y=0.797X+0.005	0.2926	—
4·5	0.2455	—	0.5276	—	0.1829	—
4·6	−0.5893	—	0.3982	—	0.3650	—
5·6	0.6378*	Y=0.255X+0.289	0.8337**	Y=0.302X+0.015	0.8642***	Y=0.277X+0.099
11·12	0.7218*	Y=0.547X−1.003	0.7080*	Y=0.536X−0.008	0.6515*	Y=0.526X+0.045
11·13	0.4713	—	0.6419*	Y=0.619X−0.029	0.7471**	Y=0.484X−0.021
12·13	0.7767**	Y=0.535X+0.403	0.4950	—	0.4135	—
14·15	0.6762*	Y=1.043X+0.913	0.6621*	Y=1.756X−0.015	0.6130*	Y=2.029X−0.200
14·16	−0.2396	—	0.5904	—	0.6666*	Y=0.819X−0.053
15·16	0.5510	—	0.7758**	Y=0.415X+0.012	0.7695**	Y=0.286X+1.648
21·22	0.3913	—	0.1029	—	0.1673	—
21·23	0.2512	—	−0.5197	—	−0.3318	—
22·23	0.6706*	Y=0.317X+0.615	−0.4063	—	−0.4077	—
24·25	0.4821	—	−0.0447	—	−0.2081	—
24·26	−0.8459**	Y=−0.827X+1.651	0.0372	—	−0.0231	—
25·26	0.0453	—	0.7609**	Y=1.522X−0.014	0.6254*	Y=0.737X+0.046
1·11	0.9525***	Y=0.571X+1.049	0.4576	—	0.3160	—
2·12	0.8310**	Y=0.668X+0.374	0.8979***	Y=1.162X−0.025	0.9199***	Y=0.994X−0.006
3·13	0.9960***	Y=1.104X−0.398	0.9153***	Y=1.364X−0.026	0.7944***	Y=1.188X−0.065
4·14	0.7588**	Y=0.669X+0.613	0.6511*	Y=0.584X+0.061	0.4855	—
5·15	0.9447***	Y=0.872X−0.297	0.9047***	Y=0.924X+0.005	0.8592***	Y=1.336X−0.287
6·16	0.8521***	Y=0.561X+0.554	0.9050***	Y=1.366X−0.014	0.9035***	Y=1.624X−0.153
31·33	0.9046***	Y=0.479X+1.896	0.8604***	Y=0.679X−0.083	0.8423***	Y=0.588X+0.257
32·34	0.9391***	Y=0.515X−0.468	0.8991***	Y=0.621X−0.225	0.9367***	Y=0.504X+0.569
35·36	0.9677***	Y=0.990X−0.068	0.1226	—	0.2175	—

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.=9.

3. Relations between the variation ragnes 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. Seven, 2, 4 and 14 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 L/T (UHG) on range of W/T (UHG) through the whole strains was +0.8642 to the degree of freedom of 9, which is obviously significant at 0.1% level. Generally speaking, the larger is the range of L/T (UHG), the larger is the range of W/T (UHG). L.r. of range of L/T on range of W/T was calculated as follows; $Y=0.277X+0.099$, where Y and X indicate variation range of L/T and range of W/T, respectively. This formula indicates that the range of L/T becomes 0.277 larger, by becoming 1 degree larger the range of W/T.

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. One, 7 and 16 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 thickness (UHG) on s.d. of thickness (UHG) through the whole strains was −0.6820 to the degree of freedom of 9, which is significant at 5% level. Generally speaking, the thicker is the practical value of thickness (UHG), the smaller is the s.d. of thickness (UHG). L.r. of practical value of thickness on s.d. of thickness was calculated as follows; $Y=-0.154X+0.360$, where Y and X indicate practical value of thickness and s.d. of thickness, respectively. This formula indicates that the practical value of thickness becomes 0.154 thicker, by becoming 1 degree smaller the s.d. of thickness.

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. One, 6 and 17 characters showed significances at 1% and 5% levels and no significance even at 5% level, respectively. For example, c.c. of practical value of thickness (UHG) on variation range of thickness (UHG) through the whole strains was −0.6913 to the degree of freedom of 9, which is significant at 5% level. Generally speaking, the thicker is the practical value of thickness (UHG), the smaller is the variation range of thickness (UHG). L.r. of practical value of thickness on variation range of thickness was calculated as follows; $Y=-0.516X+1.261$, where Y and X indicate practical value of thickness and variation range of thickness, respectively. This formula indicates that the practical value of thickness becomes 0.516 thicker, by becoming 1 degree smaller the variation range of thickness.

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. Nineteen and 5 characters showed significances at 0.1% and 1% levels, respectively. In other words, the whole characters showed significant relations. For example, c.c. of s.d. of length (UHG) on variation range of length (UHG) through the whole strains was +0.8501 to the degree of freedom of 9, 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 on variation range of length was calculated as follows; $Y=3.879X-0.010$, where Y and X indicate s.d. of length and variation range of length, respectively. This formula indicates that the s.d. of length becomes 3.879 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

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	−0.3841	—	−0.2086	—	0.8501***	Y=3.879X−0.010
2	0.2547	—	0.4952	—	0.8873***	Y=5.601X−0.145
3	−0.6820*	Y=−0.154X+0.360	−0.6913*	Y=−0.516X+1.261	0.9231***	Y=3.055X+0.082
4	0.7029*	Y=1.244X−0.231	0.7264*	Y=0.569X−1.123	0.8693***	Y=3.847X+0.532
5	0.6917*	Y=1.935X−0.626	0.4446	—	0.8913***	Y=3.458X+0.131
6	0.4777	—	0.4857	—	0.9730***	Y=3.344X+0.072
11	−0.1269	—	−0.2647	—	0.7812**	Y=3.864X−0.001
12	0.3183	—	0.4448	—	0.9530***	Y=5.022X−0.057
13	−0.7145*	Y=−0.217X+0.429	−0.7564**	Y=−0.762X+1.564	0.9671***	Y=3.212X+0.046
14	0.2118	—	0.6493*	Y=0.006X+0.658	0.9346***	Y=4.425X−0.019
15	0.8484***	Y=0.263X−0.730	0.6476*	Y=1.184X−3.296	0.9064***	Y=5.353X−0.227
16	0.6290*	Y=0.365X−0.385	0.6811*	Y=1.617X−1.741	0.9752***	Y=3.991X+0.018
21	0.1604	—	−0.0555	—	0.7418**	Y=2.500X+0.020
22	0.0682	—	0.1390	—	0.8710***	Y=3.815X+0.003
23	−0.1526	—	−0.7142*	Y=−1.040X+1.010	0.8261**	Y=2.312X+0.045
24	−0.0850	—	−0.0425	—	0.8856***	Y=4.163X+0.000
25	0.6045*	Y=0.160X−0.097	0.5207	—	0.7737**	Y=5.217X−0.034
26	0.6235*	Y=0.158X−0.113	0.5210	—	0.9122***	Y=3.625X+0.019
31	0.3545	—	0.2740	—	0.9122***	Y=4.667X−0.678
32	0.3655	—	0.4099	—	0.9668***	Y=5.080X−3.111
33	0.2964	—	0.3916	—	0.9030***	Y=4.093X+0.155
34	−0.0451	—	0.0582	—	0.9678***	Y=3.966X+0.222
35	0.2625	—	−0.0219	—	0.7619**	Y=3.594X+0.010
36	0.2142	—	0.0784	—	0.9199***	Y=3.385X+0.014

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.=9.

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.=9.

Table 9. Comparisons of 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	—			1												
	2		1				3											
	3							3										
	4			—	—				2									
	5				3					3								
	6										3							
	11						3	2										
	12							1										
	14									3	1							
	15										2							
	21											—	—					
	22												1					
	24													—	1			
	25														2			
	31															3		
	32																3	
	35																	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.=9.

respective characters were compared, and are shown in Tables 8 and 9. In these tables, 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 in Table 9, under the condition that the calculation was to be made only by means of the significances in disregard of significant levels.

Significant combinations were counted as 16, 14, 13 and 43 in A, B, C and D groups, respectively. Groups of A, B, C and D showed their frequencies as 59.3% (=16/27), 51.9% (=14/27), 48.2% (=13/27) and 53.1% (=43/81), respectively. In D group, 9, 4, 8 and 6 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 other with lower frequency. Nine combinations, *i.e.*, 2·12, 3·13, 5·6, 5·15, 6·16, 11·12, 14·15, 31·33, 32·34, belonged to the former one. The remaining 18 combinations belonged to the latter one.

Discussion

Basing on the results obtained in the previous[4,5] 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 191/297 cases, *i.e.*, 64.3% 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; 4, 6, 3; 4, 8, 11; 4, 3, 3; 5, 8, 11; 0, 1, 4; 5, 6, 9; 10, 11, 11; 10, 11, 10; 11, 11 and 11 strains, respectively. It may be noticed that the values were peculiarly large in the combination numbers of 6, 12, 20, 21, 23, 25, 26 and 27. Average value and its s.d. through the whole combinations were found to be 7.07 ± 3.55.

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 47.98% (95/198) and 96.97% (96/99) in groups I and II, respectively. Those averages and s.d. through the combinations within the groups were found to be 5.28 ± 3.02 and 10.67 ± 0.47 in groups I and II, respectively. From the 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 fixed from sub–1 to sub–6; 39.39% (13/33), 69.70% (23/33), 30.30% (10/33), 72.73% (24/33), 15.15% (5/33) and 60.61% (20/33), 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.

2. The respective strains showed significant combinations as follows in the order fixed from strain No. 1 to No. 11; 15, 17, 21, 23, 17, 17, 16, 15, 18, 19 and 13, respectively. It may be noted that strain No. 4 showed significances in 23/27 combinations, *i.e.*, 85.19% of the whole, and strains Nos. 1 and 8 showed significances only in 15/27 combinations, *i.e.*, 55.56% of the whole, respectively. Average value and its s.d. through the whole strains were found to be 17.36 ± 2.71.

3. Significant correlations were analyzed in the positive or negative status and in the 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); 131 combinations (68.6%), 12 (6.3%), 143 (74.9%); 16 (8.4%), 5 (2.6%), 21 (11.0%); 18 (9.4%), 9 (4.7%), 27 (14.1%). It may be a noticeable phenomenon that about three fourths 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 they were exhibited independently of the other characters. The positive and negative combinations in the total were accounted as 165 combinations (86.4%) and 26 combinations (13.6%), 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. 6···combination 22·23, strain No. 9···combinations 2·3, 12·13 and 14·15. Unfortunately those unnatural facts and discrepancies are not to be fully explained at the present time. It was, however, an interesting phenomenon concerning strain differentiations, especially in case of strain No. 9, which was collected in road-side ditch at Calcutta. These phenomena may be attributed in the actions of the respective genes concerned in all the events.

4. The three strains showing the relatively large values were picked-up in the respective combinations (=27). The respecitve strains showed the following numbers of the larger values in the order from strain Nos. 1 to 11; 6, 2, 18, 18, 4, 8, 8, 4, 8, 4 and 1, respectively. Average and its s.d. through the whole strains were found to be 7.36 ± 5.50. In the larger set of combinations of width (UHG) and thickness (UHG), the largest (+0.8624) was found in No. 4, followed by No. 3 (+0.7234) and No. 9 (−0.4125). In the larger set of combinations of width (HG) and thickness (HG), the largest (+0.9157) was found in No. 4, followed by No. 3 (+0.7375) and No. 9 (−0.3765). These orders of strains were finally illustrated in both cases as 4>3>9, and were fixed to be the same as both character-combinations. These phenomena were found in the other 2 cases, *i.e.*, 9>7>3···No. 9 (+0.9305 and +0.9714), No. 7 (+0.8202 and +0.9685) and No. 3 (+0.7622 and +0.9500) in the larger sets of combinations of L/T (UHG) and W/T (UHG), and of W/T (UHG) and W/T (HG); 4>3>7···No. 4 (+0.9869 and +0.9913), No. 3 (+0.9803 and +0.9868) and No. 7 (+0.9699 and +0.9577) in the larger sets of combinations of thickness (UHG) and thickness (HG), and of area (UHG) and area (HG).

On the other hand, some sets of strains did not show the same orders, but showed the same combinations, which meant the strain numbers regardless of the orders. Four cases were ascertained, *i.e.*, ① 3·4·9···the combination of width (UHG) and thickness (UHG) (4>3>9), the combination of width (HG) and thickness (HG) (4>3>9) and the combination of L/T (UHG) and L/T (HG) (3>4>9); ② 2·3·4···the combination of L/W (UHG) and L/T (UHG) (4>2>3) and the combination of L/W (HG) and L/T (HG) (3>4>2); ③ 3·4·10···the combination of width (comparison) and thickness (comparison) (3>4>10) and the combination of volume (UHG) and volume (HG) (4>3>10); ④ 3·4·7···the combination of length (UHG) and length (HG) (3>4>7), the combination of thickness (UHG) and thickness (HG) (4>3>7), the combination of L/W (UHG) and L/W (HG) (3>7>4) and area (UHG) and area (HG) (4>3>7).

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 11; 11, 8, 5, 3, 10, 10, 6, 6, 3, 6 and 13, respectively. Average and its s.d. through the whole strains were found to be 7.36 ± 3.14. In the smaller set of combination of length (HG) and thickness (HG), the smallest (+0.0068) was noted in No. 2, followed by No. 11 (+0.1371) and No. 6 (+0.1537). In the smaller set of combination of thickness (UHG) and thickness (HG), the

smallest (+0.7811) was noted in No. 2, followed by No. 11 (+0.8463) and No. 6 (+0.8476). These combinations of strains were finally illustrated in both of the cases as 2<11<6.

On the other hand, some sets of strains did not show the same strain orders, but showed the same combinations, which meant the strain numbers regardless of orders. Two cases were ascertained, *i.e.*, ① 3·9·10…the combination of length (comparison) and thickness (comparison) (3<10<9) and the combination of L/W (comparison) and W/T (comparison) (10<9<3); ② 1·6·11…the combination of width (UHG) and width (HG) (11<6<1), the combination of L/W (UHG) and L/W (HG) (11<1<6), the combination of W/T (UHG) and W/T (HG) (1<6<11) and the combination of area (UHG) and area (HG) (1<11<6).

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 11; 17, 10, 23, 21, 14, 18, 14, 10, 11, 10 and 14, respectively. Average and its s.d. through the whole strains were found to be 14.73±4.33.

5. C.c. of the practical value on another practical value were decided to be significant in 16/27 cases, *i.e.*, 59.3% of the whole combinations. One character (width of HG), 8 characters (lengths of UHG and HG, width of UHG, thickness and L/W of UHG, L/T of UHG and HG, W/T of UHG), 13 characters (thickness and L/W of UHG, W/T of HG, width, thickness, L/W and W/T of comparison, 6 characters of area and volume) and 2 characters (length 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 1.33±0.69.

C.c. of the intra-strain's variations (=s.d.) on other variations were decided to be positively significant in 14/27 cases, *i.e.*, 51.9% of the whole combinations. One character (L/T of HG), 9 characters (length of HG, widths, thicknesses and W/T of UHG and HG, L/W of HG, L/T of UHG), 7 characters (L/W of UHG, L/T and W/T of comparison, areas and volumes of UHG and HG) and 7 characters (length of UHG, length, width, thickness and L/W of comparison, quotients of area and volume) showed significant correlations in 3, 2, 1 and 0 combination, respectively. Comparison-characters showed a few significances, which were the same as in case of the previous column. Average and its s.d. through the whole characters were found to be 1.17±0.90.

C.c. of the range on another range were decided to be positively significant in only 13/27 cases, *i.e.*, 48.2% of the whole combinations. It was noticeable that only the respective one combination showed significance within UHG and comparison, *i.e.*, combination of L/T and W/T. Two characters (L/T and W/T of HG), 6 characters (length, width, thickness and L/W of HG, L/T and W/T of UHG), 8 characters (width and thickness of UHG, L/T and W/T of comparison, areas and volumes of UHG and HG) and 8 characters (length and L/W of UHG, length, width, thickness and L/W of comparison, quotients of area and volume) showed significant correlations in 3, 2, 1 and 0 combination, respectively. Those patterns were found to be nearly the same as in case of the previous column. Average and its s.d. through the whole characters were found to be 1.08±0.96.

C.c. of the three columns mentioned above were decided to be significant in 43/81 cases, *i.e.*, 53.1% of the whole combinations. One character (L/T of HG), 1 character (width of HG), 6 characters (length, thickness, L/W and W/T of HG, L/T and W/T of UHG), 1 character (width of UHG), 1 character (thickness of UHG), 5 characters (W/T of comparison, areas and volumes of UHG), 3 characters (length and L/W of UHG, L/T of comparison), 5 characters (width, thickness and L/W of comparison, quotients of area and volume) and 1 character (length of comparison) showed significant correlations in 8, 7, 6, 5, 4, 3, 2, 1 and 0 combination, respectively. It was notice-

able that 1 character, *i.e.*, length 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 3.58 ± 2.27.

6. C.c. of the practical value on its s.d. of the respective characters were decided to be significant in 8/24 cases, *i.e.*, 33.3% of the whole characters. C.c. of the practical value on its range of the respective characters were decided to be significant in 7/24 cases, *i.e.*, 29.2% of the whole characters. These two results were found to be the same as those in the previous papers[1,6], at the same time, were wholly reversed ones, when compared with those in the other previous papers[3,4]. These discords might be due to the differences of the materials used.

Two and 3 negative correlations were found in relations between the practical value and its s.d. and between the practical value and its range, respectively. Moreover, thicknesses of UHG and HG, and thicknesses of UHG, HG and comparison showed those correlations in the former and in the latter relations, respectively. It was concluded that those phenomena meant character specificities in thickness. In other words, character of thickness may genetically be fixed as the one in possession of a flexibility and affectability to and by a few environmental conditions.

C.c. of s.d. on its range of the respective characters were expectedly decided to be significant throughout the whole characters. Moreover, they were noted to have some high levelled relationships in 0.1% and 1% levels. Those phenomena meant that the character-s.d. was reasonably assumed 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 those 2 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*, *O. sativa* var. *spontanea* or *O. perennis*. However, some characters showed quite low correlations or no significant correlations at all even at 5% level.

7. Twenty-four characters and 27 mutual combinations were used for analyzing the species and strain differentiations. Some of them are yet of developing status. Although, it may be affirmed that those characters or combinations are to be used for analyzing grain morphological investigations in the future. Moreover, it was confirmed that such indices or ideas may be used as a sort of handy index in the experiments.

8. Comparisons of morphological characters found in materials, which had been collected in northeastern and central India, are looked upon as having quite important meanings in view of the origin and diversity of the wild rice species. These considerations were carried out, aiming at getting better understandings of the phylogenetic status and of mutual relationships between them. Although several comparative data were mentioned in the present paper, an accumulation of complete comparison data endorsed by discussions on these aspects has been far from being perfect, and further studies are to be performed sincerely. Universal theory on ancestral species and original place of the cultivated rice species (*Oryza sativa* L.) will be accomplished only after consummation of these schemes.

Summary

Succeeding to the previous papers, some morphological studies on grain characters and considerations on ecotypic differentiations of 11 strains, belonging to 2 species of the genus *Oryza*, collected in central India, were reported in the present paper. The results obtained here were summarized as follows:

1. Concerning correlation coefficients among the 15 character-combinations, 121/165 cases, *i.e.*, 73.33% of the whole combinations, showed significant relations through the whole cases. From the previous and the present experiments, concerning correlation coefficients among 27 character-combinations, 191/297 cases, *i.e.*, 64.3% 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 47.98% (95/198) and 96.97% (96/99) in groups I and II, respectively. These averages and s.d. through the whole combinations within the groups were found to be 5.28 ± 3.02 and 10.67 ± 0.47 in groups I and II, respectively.

2. In the data obtained summing-up from 3 relation-groups, *i.e.*, practical value on other practical value, s.d. on other s.d., and range on other range, 9, 4, 8 and 6 combinations showed significances in 3, 2, 1 and 0 group, respectively. Concerning correlations 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, 5, 5 and 14 characters showed significances in 3, 2 cases and 1 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 confirmed in the experiments were to be looked upon as something useful, having some universal validities as indices in the examinations of species and strain differentiations. Moreover, comparisons of data obtained in northeastern and central India were carried out to some extents, and several interesting informations were shown in view of the locality-specificities.

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