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Morphological Characters of the Cultivated Rice Grains Delivered from Rice Research Station, Chinsurah, West Bengal, India (V)

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Introduction

During the period from December in 1978 to January in 1979, the writer was sent to India for collection of the wild and cultivated rices under the project, designated "The Distribution of Wild Rice and the Ecotypic Differentiation of Cultivated Rice in Burma and Assam", supported by the Grant from the Ministry of Education, Science and Culture of the Japanese Government. In this opportunity, 100 strains of cultivated rice stocked in Rice Research Station, Chinsurah, West Bengal, India, were delivered to the present author through the kindness of Dr. S. Biswas of the station. The grains of these strains were used for the morphological studies.

In the station, many strains of cultivated rice, *Oryza sativa* L., were collected and studied in view of the breeding program. While they were not used for morphological characters. For genetic and breeding purposes, however, varietal variations and methodology of these should be ascertained as promptly as possible.

Since 1969, high yielding varieties have been recommended by the governments of a lot of countries in south and southeast Asia. In India, breeding works are pushed forward in viewpoints of aromatic[3], early-maturing[10] and medium-duration[11] varieties. On the other hand, it is said that local and domestic varieties have disappeared in these processes[1,2]. However, because of the several problems in modern agronomical practices using the high yielding varieties, local varieties have been consciously kept in the respective localities. Recently, analyses of the primitive varieties have been being put into limelight in these scientific fields.

Taking these factors into account, the author tried to accomplish the work, whose aim was a classification of the varietal variation and a confirmation of the phylogenetic relationships of cultivated-rice-strains (= cultivars), using the relatively primitive and un-advanced ones in India in the previous experimental series. The present experimental series was made to search the varietal variations, using the relatively advanced cultivars in India, taking these facts into considerations.

In the previous papers, the records of morphological characters of the unhusked and husked grains[6], comparative values, area and volume columns and 6 characters of ranges[7], 12 variation ranges[8], and other 6 variation ranges and their summed-up data[9], were reported.

In the present paper, 12 mutual relations among 24 characters in the views of practical value were mainly described, in order to confirm the morphological characters of grains as well as to make clear the ecotypic differentiation of these grains.

Materials and Methods

One hundred strains of rice cultivars were used in this experiment. They are listed up in the Table 1 of the previous paper[6]. In this table, collection number, local name, original place are mentioned. They have different meanings in view of physiological characters, *i.e.*, *aman* and *aus*, and should be considered separately also in morphological status. Accordingly, they are divided into two groups in the present experiment, *i.e.*, Group A --- *aman* varieties (= strain Nos.1-50), Group B --- *aus* varieties (= strain Nos.51-100).

Correlation coefficients between the practical values of the unhusked and husked grains and linear regressions between them were calculated through the whole characters measured by comparing them.

In the present paper, the following abbreviations were used, *i.e.*, L (length), W (width), T (thickness), L/W (ratio of length to width), L/T (ratio of length to thickness), W/T (ratio of width to thickness), c.c. (correlation coefficient), l.r. (linear regression), UHG (unhusked grain), HG (husked grain).

Results

1. Length and width of unhusked grains

Group A : Correlation coefficient (c.c.) and linear regression (l.r.) of width on length in the same strains were calculated, and are shown in the left column of Table 1. One, 1, 5 and 43 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 +0.0154 to the degree of freedom of 48, showing no significance even at 5% level.

Group B : One, 7, 11 and 31 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 +0.0101 to the degree of freedom of 48, showing no significance even at 5% level.

Whole : Two, 8, 16 and 74 strains showed significances at 0.1%, 1% and 5% levels, and no significance even at 5% level, respectively. In the whole strains of both of the groups (=100), c.c. was −0.1963 to the degree of freedom of 98, showing no significance even at 5% level.

2. Length and thickness of unhusked grains

Group A : 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, 10 and 34 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 + 0.2416 to the degree of freedom of 48, showing no significance even at 5% level.

Group B : Two, 3, 4 and 41 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 +0.1985 to the degree of freedom of 48, showing no significance even at 5% level.

Whole : Four, 7, 14 and 75 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.0166 to the degree of freedom of 98, showing no significance even at 5% level.

3. Width and thickness of unhusked grains

Group A : 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. Three, 3 and 44 strains showed significances at 1% and 5% levels and

Table 1. Correlation coefficient and linear regression of the three components of unhusked grains; width on length, thickness on length, thickness on width

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	0.1118	—	0.0246	—	−0.1148	—
2	0.3163	—	0.3178	—	0.0160	—
3	0.1976	—	−0.0091	—	−0.1751	—
4	−0.1778	—	0.6174***	Y=0.194X+0.221	−0.4739**	Y=−0.262X+2.688
5	0.0551	—	0.3700*	Y=0.095X+1.096	0.1931	—
6	0.2512	—	0.2180	—	−0.3006	—
7	0.1121	—	0.2597	—	0.0181	—
8	−0.2435	—	0.5699**	Y=0.143X+0.592	−0.5521**	Y=−0.515X+3.412
9	−0.0645	—	0.2496	—	0.0313	—
10	0.1969	—	0.1687	—	−0.1715	—
11	−0.1970	—	0.1886	—	0.1385	—
12	0.3674*	Y=0.120X+1.549	0.1106	—	−0.0623	—
13	−0.0276	—	0.5831***	Y=0.096X+1.151	0.0942	—
14	0.1647	—	0.0517	—	−0.0834	—
15	0.0277	—	0.4253*	Y=0.149X+0.653	−0.5692**	Y=−0.456X+3.140
16	0.0822	—	0.4400*	Y=0.077X+1.270	0.0216	—
17	0.4166*	Y=0.162X+0.885	0.2007	—	0.2168	—
18	0.1781	—	0.4534*	Y=0.152X+0.821	−0.1940	—
19	0.4437*	Y=0.155X+1.496	0.2972	—	−0.0835	—
20	0.2299	—	0.5101**	Y=0.132X+0.918	−0.1765	—
21	0.1232	—	0.0351	—	−0.4578*	Y=−0.189X+2.873
22	−0.1224	—	0.4205*	Y=0.152X+0.934	−0.0882	—
23	0.0261	—	−0.0916	—	0.0636	—
24	−0.0448	—	0.3762*	Y=0.092X+1.311	−0.3698*	Y=−0.360X+3.163
25	0.0579	—	0.2253	—	−0.0559	—
26	0.2267	—	−0.0198	—	−0.2765	—
27	0.1237	—	0.3431	—	−0.1832	—
28	0.2962	—	−0.1862	—	0.1035	—
29	0.2526	—	−0.0741	—	0.3747*	Y=0.232X+1.322
30	0.0794	—	0.2179	—	0.0203	—
31	0.2164	—	0.1841	—	0.2810	—
32	−0.3154	—	0.4747**	Y=0.129X+0.899	−0.3539	—
33	−0.0630	—	0.3846*	Y=0.073X+1.350	−0.1271	—
34	0.6396***	Y=0.170X+0.926	0.5285**	Y=0.093X+1.237	0.2235	—
35	−0.0421	—	0.4306*	Y=0.094X+0.981	−0.2971	—
36	−0.2283	—	0.2595	—	−0.1713	—
37	0.0930	—	0.2450	—	−0.1592	—
38	0.1013	—	0.4195*	Y=0.139X+0.716	−0.0757	—
39	−0.1548	—	0.3038	—	0.1381	—
40	0.3116	—	0.3346	—	0.1966	—
41	0.3703*	Y=0.185X+0.950	0.3770*	Y=0.097X+1.195	0.1907	—

(Continued)

Table 1. (Continued)

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
42	−0.1345	−	0.1751	−	0.2155	−
43	0.0673	−	0.1821	−	−0.0508	−
44	0.1927	−	0.3603	−	−0.1376	−
45	0.1145	−	−0.0412	−	0.3354	−
46	0.5306**	Y=0.210X+0.484	0.0288	−	0.0474	−
47	−0.0024	−	0.2738	−	−0.0480	−
48	0.0373	−	−0.1767	−	−0.1126	−
49	−0.3275	−	0.3492	−	−0.0064	−
50	0.4403*	Y=0.171X+1.333	0.3017	−	−0.2435	−
51	−0.0053	−	−0.1832	−	−0.3291	−
52	0.2797	−	0.2414	−	0.2658	−
53	0.4461*	Y=0.128X+2.089	0.1797	−	0.1465	−
54	0.4817**	Y=0.128X+2.070	0.1358	−	0.1057	−
55	0.3684*	Y=0.291X+1.047	−0.0538	−	−0.3887*	Y=−0.174X+3.128
56	0.5090**	Y=0.254X+1.523	0.2078	−	0.0528	−
57	0.3734*	Y=0.139X+1.897	−0.0252	−	−0.0291	−
58	−0.0672	−	0.4173*	Y=0.120X+1.392	−0.2804	−
59	0.3251	−	−0.1486	−	−0.3383	−
60	0.4296*	Y=0.230X+1.435	−0.2864	−	−0.1927	−
61	0.2058	−	0.2029	−	−0.0859	−
62	0.3388	−	−0.0664	−	0.3300	−
63	0.0889	−	0.1463	−	−0.2033	−
64	0.2716	−	−0.0690	−	−0.1733	−
65	−0.0558	−	0.2198	−	−0.1450	−
66	0.0942	−	0.5487**	Y=0.098X+1.137	−0.0865	−
67	0.5009**	Y=0.234X+1.774	0.0975	−	0.2890	−
68	0.1866	−	−0.1255	−	−0.2450	−
69	0.3959*	Y=0.222X+1.828	0.5856***	Y=0.291X−0.192	0.2036	−
70	−0.3171	−	−0.0275	−	0.2026	−
71	0.3808*	Y=0.155X+1.385	0.0744	−	−0.1824	−
72	0.3095	−	0.3587	−	−0.1216	−
73	0.0082	−	0.6349***	Y=0.144X+0.935	−0.0211	−
74	0.4143*	Y=0.363X+0.743	0.2106	−	0.0794	−
75	−0.1494	−	0.1804	−	−0.4110*	Y=−0.403X+3.324
76	0.3281	−	−0.1656	−	0.2164	−
77	0.3052	−	−0.0581	−	−0.1315	−
78	−0.0106	−	0.3477	−	−0.4991**	Y=−0.433X+3.371
79	0.4794**	Y=0.280X+1.305	0.0818	−	0.0444	−
80	0.0146	−	0.3391	−	−0.0319	−
81	−0.2070	−	0.1328	−	0.0519	−
82	0.0454	−	0.4383*	Y=0.087X+1.388	0.2069	−
83	−0.0032	−	0.1572	−	−0.2267	−

(Continued)

Table 1. (Continued)

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
84	−0.2374	−	0.2302	−	−0.1914	−
85	0.1893	−	0.2835	−	0.4377*	Y=0.164X+1.696
86	0.5373**	Y=0.230X+0.938	0.3258	−	−0.1056	−
87	0.4060*	Y=0.162X+1.898	−0.1316	−	−0.0492	−
88	0.3152	−	0.1218	−	−0.2987	−
89	0.4865**	Y=0.157X+1.282	0.1353	−	0.0034	−
90	0.2123	−	0.1118	−	−0.0387	−
91	0.4440*	Y=0.159X+2.245	0.4847**	Y=0.123X+1.348	0.1496	−
92	0.4359*	Y=0.154X+1.835	0.1074	−	0.0427	−
93	0.7634***	Y=0.350X−0.285	0.3848*	Y=0.107X+1.092	0.5546**	Y=0.337X+1.090
94	0.0625	−	0.3828*	Y=0.070X+1.587	0.1335	−
95	0.1534	−	0.1986	−	−0.1382	−
96	0.2620	−	0.5658**	Y=0.170X+0.688	0.0885	−
97	−0.0082	−	0.1630	−	−0.4407*	Y=−0.308X+2.871
98	0.0309	−	0.3439	−	0.0982	−
99	0.4032*	Y=0.135X+2.409	0.3491	−	0.3073	−
100	0.5649**	Y=0.218X+1.199	0.1785	−	0.0527	−

d. f. =28

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

no significance even at 5% level, respectively. In the whole strains, c.c. was +0.7490 to the degree of freedom of 48, which was obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; Y=0.245X +1.395, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.245mm wider, when the thickness becomes larger by 1 degree.

Group B : Two, 4 and 44 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8947 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; Y=0.378X+0.985, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.378mm wider, when the thickness becomes larger by 1 degree.

Whole : Five, 7 and 88 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was +0.9005 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; Y= 0.299X+1.245, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.299mm wider, when the thickness becomes larger by 1 degree.

4. L/W and L/T of unhusked grains

Group A : 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, 8, 3 and 36 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 +0.8407 to the

Table 2. Correlation coefficient and linear regression of the three components of unhusked grains; ratio of length to thickness (abbreviated as L/T, and so forth) on L/W, W/T on L/W, W/T on L/T

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	0.2500	–	−0.7631***	Y=−0.273X+2.172	0.4219*	Y=0.176X+0.499
2	0.1008	–	−0.6410***	Y=−0.330X+2.378	0.5990***	Y=0.251X+0.287
3	0.2084	–	−0.6469***	Y=−0.311X+2.394	0.6085***	Y=0.233X+0.257
4	−0.3279	–	−0.9279***	Y=−0.387X+2.670	0.6475***	Y=0.469X−0.864
5	0.3516	–	−0.7883***	Y=−0.253X+2.147	0.2958	–
6	−0.3332	–	−0.7623***	Y=−0.377X+2.913	0.8625***	Y=0.302X−0.418
7	0.1987	–	−0.6794***	Y=−0.299X+2.367	0.5635**	Y=0.250X+0.219
8	−0.1166	–	−0.8191***	Y=−0.415X+2.891	0.6492***	Y=0.338X−0.335
9	0.1760	–	−0.7847***	Y=−0.294X+2.327	0.4680**	Y=0.202X+0.338
10	0.4765**	Y=0.671X+2.437	−0.4876**	Y=−0.194X+2.048	0.5336**	Y=0.151X+0.596
11	0.4005*	Y=0.570X+2.705	−0.5360**	Y=−0.244X+2.201	0.5304**	Y=0.170X+0.603
12	0.2302	–	−0.5726***	Y=−0.274X+2.270	0.6644***	Y=0.224X+0.294
13	0.5098**	Y=0.363X+3.390	−0.8240***	Y=−0.264X+2.257	0.0538	–
14	0.4752**	Y=0.617X+2.353	−0.5487**	Y=−0.217X+2.046	0.4666**	Y=0.142X+0.714
15	−0.4202*	Y=−0.459X+6.020	−0.8654***	Y=−0.525X+3.103	0.8105***	Y=0.451X−0.685
16	0.5381**	Y=0.530X+2.488	−0.5652**	Y=−0.149X+1.749	0.3809*	Y=0.102X+0.709
17	0.2625	–	−0.5366**	Y=−0.220X+2.034	0.6702***	Y=0.200X+0.275
18	−0.0115	–	−0.7122***	Y=−0.493X+2.828	0.7087***	Y=0.346X−0.020
19	0.0676	–	−0.6396***	Y=−0.402X+2.586	0.7208***	Y=0.299X+0.100
20	0.0851	–	−0.7166***	Y=−0.489X+2.808	0.6326***	Y=0.332X+0.150
21	0.0463	–	−0.7835***	Y=−0.530X+2.900	0.5808***	Y=0.345X+0.119
22	0.1831	–	−0.7677***	Y=−0.522X+2.769	0.4851**	Y=0.305X+0.381
23	0.5712***	Y=0.975X+1.333	−0.3660*	Y=−0.187X+1.976	0.5507**	Y=0.165X+0.756
24	0.2837	–	−0.6047***	Y=−0.265X+2.173	0.5692**	Y=0.236X+0.285
25	0.3235	–	−0.6117***	Y=−0.207X+2.038	0.5491**	Y=0.161X+0.435
26	−0.1028	–	−0.4199*	Y=−0.546X+2.972	0.9440***	Y=0.351X−0.063
27	−0.0641	–	−0.7275***	Y=−0.470X+2.717	0.7263***	Y=0.375X−0.105
28	0.5414**	Y=0.926X+0.934	−0.1215	–	0.7662***	Y=0.149X+0.406
29	0.6724***	Y=0.756X+1.089	−0.3641*	Y=−0.100X+1.416	0.4397*	Y=0.107X+0.726
30	0.3141	–	−0.6540***	Y=−0.286X+2.230	0.5055**	Y=0.190X+0.459
31	0.2395	–	−0.7546***	Y=−0.281X+2.235	0.4244*	Y=0.168X+0.598
32	0.1254	–	−0.8341***	Y=−0.396X+2.616	0.3761*	Y=0.247X+0.308
33	0.3358	–	−0.8328***	Y=−0.257X+2.148	0.2340	–
34	0.2083	–	−0.5953***	Y=−0.253X+2.056	0.6600***	Y=0.227X+0.225
35	0.0728	–	−0.8037***	Y=−0.342X+2.682	0.5029**	Y=0.227X+0.176
36	0.3048	–	−0.8739***	Y=−0.281X+2.346	0.1482	–
37	0.0138	–	−0.7521***	Y=−0.386X+2.558	0.6459***	Y=0.304X+0.008
38	0.0199	–	−0.7188***	Y=−0.331X+2.501	0.6793***	Y=0.266X−0.003
39	0.5464**	Y=0.391X+2.990	−0.7823***	Y=−0.224X+2.033	0.0818	–
40	0.2855	–	−0.6179***	Y=−0.203X+1.933	0.5734***	Y=0.176X+0.357

(Continued)

Table 2. (Continued)

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
41	0.1642	—	−0.7710***	Y=−0.323X+2.389	0.4993**	Y=0.227X+0.274
42	0.6476***	Y=0.683X+2.090	−0.5470**	Y=−0.139X+1.763	0.2640	—
43	0.1981	—	−0.6706***	Y=−0.366X+2.422	0.5895***	Y=0.276X+0.254
44	−0.0425	—	−0.7667***	Y=−0.450X+2.690	0.6706***	Y=0.343X−0.055
45	0.5457**	Y=0.482X+2.706	−0.6891***	Y=−0.183X+1.889	0.2231	—
46	0.1407	—	−0.6999***	Y=−0.299X+2.321	0.5610**	Y=0.207X+0.252
47	0.2965	—	−0.7174***	Y=−0.237X+2.083	0.4514*	Y=0.157X+0.477
48	0.3629*	Y=0.561X+2.478	−0.5265**	Y=−0.304X+2.295	0.5714***	Y=0.213X+0.523
49	0.4833**	Y=0.365X+3.176	−0.8013***	Y=−0.240X+2.116	0.1165	—
50	0.0994	—	−0.5651**	Y=−0.293X+2.164	0.6972***	Y=0.348X−0.012
51	0.4181*	Y=0.650X+2.017	−0.4678**	Y=−0.334X+2.301	0.5569**	Y=0.256X+0.595
52	0.6037***	Y=0.983X+1.221	−0.3658*	Y=−0.203X+1.981	0.5197**	Y=0.177X+0.834
53	0.4862**	Y=0.909X+1.505	−0.2662	—	0.6985***	Y=0.255X+0.432
54	0.5976***	Y=1.060X+1.078	−0.2715	—	0.6067***	Y=0.182X+0.715
55	−0.2030	—	−0.8076***	Y=−0.696X+3.175	0.7396***	Y=0.481X−0.262
56	0.1442	—	−0.4665**	Y=−0.517X+2.621	0.8068***	Y=0.409X+0.153
57	0.3857*	Y=0.615X+2.323	−0.4868**	Y=−0.285X+2.246	0.6165***	Y=0.226X+0.503
58	0.2388	—	−0.7089***	Y=−0.487X+2.653	0.5133**	Y=0.294X+0.440
59	0.1273	—	−0.5833***	Y=−0.495X+2.791	0.7298***	Y=0.349X+0.159
60	0.1865	—	−0.5418**	Y=−0.400X+2.519	0.6221***	Y=0.213X+0.674
61	0.0572	—	−0.6963***	Y=−0.438X+2.682	0.6702***	Y=0.326X+0.074
62	0.5445**	Y=1.032X+1.123	−0.2432	—	0.6789***	Y=0.200X+0.614
63	0.0955	—	−0.6266***	Y=−0.430X+2.604	0.5704***	Y=0.299X+0.288
64	0.2311	—	−0.6181***	Y=−0.509X+2.840	0.6145***	Y=0.302X+0.408
65	0.3839*	Y=0.388X+2.794	−0.4614*	Y=−0.194X+1.946	0.4387*	Y=0.182X+0.703
66	0.3568	—	−0.7843***	Y=−0.325X+2.391	0.2977	—
67	0.4785**	Y=1.003X+1.361	−0.3003	—	0.6924***	Y=0.287X+0.585
68	0.2171	—	−0.5694**	Y=−0.390X+2.480	0.6767***	Y=0.300X+0.256
69	−0.0332	—	−0.6554***	Y=−0.715X+3.263	0.7746***	Y=0.444X−0.056
70	0.6385***	Y=0.961X+1.318	−0.3805*	Y=−0.173X+1.919	0.4674**	Y=0.141X+0.880
71	−0.1299	—	−0.6204***	Y=−0.395X+2.611	0.7526***	Y=0.291X+0.093
72	0.0246	—	−0.7176***	Y=−0.480X+2.810	0.6759***	Y=0.333X+0.074
73	0.3016	—	−0.8434***	Y=−0.443X+2.696	0.2524	—
74	0.0122	—	−0.5942***	Y=−0.698X+3.115	0.7949***	Y=0.444X+0.043
75	0.0843	—	−0.6504***	Y=−0.362X+2.396	0.6483***	Y=0.225X+0.423
76	0.4456*	Y=0.610X+2.315	−0.5584**	Y=−0.306X+2.296	0.4919**	Y=0.197X+0.681
77	0.1350	—	−0.6277***	Y=−0.404X+2.608	0.6854***	Y=0.296X+0.175
78	−0.2076	—	−0.7760***	Y=−0.685X+3.390	0.7534***	Y=0.437X−0.326
79	0.1649	—	−0.4236*	Y=−0.497X+2.658	0.8220***	Y=0.397X+0.171
80	0.4566*	Y=0.674X+2.168	−0.5581**	Y=−0.361X+2.446	0.4609*	Y=0.211X+0.770
81	0.4285*	Y=0.579X+2.147	−0.5788***	Y=−0.383X+2.397	0.4704**	Y=0.230X+0.753
82	0.5853***	Y=0.629X+2.383	−0.6937***	Y=−0.324X+2.390	0.1716	—

(Continued)

Table 2. (Continued)

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
83	0.1508	–	−0.6916***	Y=−0.517X+2.848	0.6079***	Y=0.325X+0.263
84	0.2208	–	−0.7473***	Y=−0.535X+2.719	0.4795**	Y=0.312X+0.466
85	0.6038***	Y=0.618X+2.404	−0.6780***	Y=−0.294X+2.305	0.1660	–
86	−0.0872	–	−0.7118***	Y=−0.535X+2.921	0.7594***	Y=0.380X−0.113
87	0.4224*	Y=0.809X+1.627	−0.2849	–	0.6849***	Y=0.268X+0.542
88	0.4777**	Y=0.773X+1.998	−0.4926**	Y=−0.298X+2.320	0.5266**	Y=0.197X+0.740
89	0.3405	–	−0.5590**	Y=−0.246X+2.144	0.5841***	Y=0.192X+0.442
90	0.2247	–	−0.4682**	Y=−0.494X+2.728	0.7495***	Y=0.358X+0.300
91	0.3346	–	−0.5847***	Y=−0.449X+2.526	0.5565**	Y=0.285X+0.541
92	0.4079*	Y=0.653X+2.249	−0.4775**	Y=−0.279X+2.238	0.6030***	Y=0.220X+0.517
93	0.3445	–	−0.4096*	Y=−0.243X+2.168	0.7138***	Y=0.230X+0.390
94	0.6026***	Y=0.602X+2.059	−0.7130***	Y=−0.343X+2.285	0.1263	–
95	0.2739	–	−0.6547***	Y=−0.321X+2.330	0.5446**	Y=0.221X+0.432
96	0.0372	–	−0.8306***	Y=−0.438X+2.635	0.5006**	Y=0.314X+0.156
97	0.1967	–	−0.6649***	Y=−0.329X+2.486	0.5952***	Y=0.239X+0.271
98	0.3201	–	−0.6160***	Y=−0.400X+2.552	0.4553*	Y=0.211X+0.758
99	0.5244**	Y=0.845X+1.653	−0.4408*	Y=−0.264X+2.166	0.5311**	Y=0.197X+0.765
100	0.1042	–	−0.4593*	Y=−0.418X+2.738	0.8259***	Y=0.312X+0.133

d. f. = 28

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

degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; Y=0.753X+1.808, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.753 larger, when the L/T becomes larger by 1 degree.

Group B : Six, 5, 8 and 31 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 +0.9273 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; Y=0.901X+1.490, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.901 larger, when the L/T becomes larger by 1 degree.

Whole : Nine, 13, 11 and 67 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was +0.9144 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; Y=0.727X+1.927, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.727 larger, when the L/T becomes larger by 1 degree.

5. L/W and W/T of unhusked grains

Group A : 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. Thirty-eight, 8, 3 and 1 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

−0.7411 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; Y=−0.162X+1.848, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.162 larger, when the W/T becomes smaller by 1 degree.

Group B : Twenty-seven, 11, 7 and 5 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 −0.8303 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; Y=−0.199X+2.002, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.199 larger, when the W/T becomes smaller by 1 degree.

Whole : Sixty-five, 19, 10 and 6 strains showed significances at 0.1%, 1% and 5% levels and no significances even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.8929 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; Y=−0.205X+2.007, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.205 larger, when the W/T becomes smaller by 1 degree.

6. L/T and W/T of unhusked grains

Group A : 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. Twenty-three, 13, 6 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 −0.2669 to the degree of freedom of 48, showing no significance even at 5% level.

Group B : Thirty, 12, 3 and 5 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 −0.5683 to the degree of freedom of 48, which is significant at 1% level. Generally speaking, the larger is the L/T, the smaller is the W/T. L.r. of L/T on W/T was calculated as follows; Y=−0.140X+2.017, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/W becomes 0.140 larger, when W/T becomes smaller by 1 degree.

Whole : Fifty-three, 25, 9 and 13 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.6458 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/T, the smaller is the W/T. L.r. of L/T on W/T was calculated as follows; Y=−0.186X+2.154, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes 0.186 larger, when W/T becomes smaller by 1 degree.

7. Length and width of husked grains

Group A : C.c. and l.r. of width on length in the same strains were calculated, and are shown in the left column of Table 3. Three, 5 and 42 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.0810 to the degree of freedom of 48, showing no significance even at 5% level.

Group B : One, 2, 7 and 40 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c.c was −0.1190 to the degree of freedom of 48, showing no significance even at 5% level.

Whole : One, 5, 12 and 82 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.3054 to the degree of freedom of 98, which is significant at 1% level. Generally speaking, the longer is the length, the narrower is the width. L.r. of length on width was calculated as follows; Y

Table 3. Correlation coefficient and linear regression of the three components of husked grains; width on length, thickness on length, thickness on width

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
1	−0.0881	−	0.0090	−	0.2099	−
2	0.1251	−	0.2678	−	0.1499	−
3	−0.2723	−	0.2925	−	−0.4626*	Y=−0.296X+2.607
4	0.0745	−	0.6237***	Y=0.316X−0.302	−0.1568	−
5	0.2539	−	0.2761	−	0.0689	−
6	0.2968	−	0.4930**	Y=0.253X−0.202	−0.0482	−
7	0.0764	−	0.2448	−	−0.0345	−
8	−0.3205	−	0.6515***	Y=0.256X+0.022	−0.4901**	Y=−0.619X+2.273
9	0.0670	−	0.3699*	Y=0.207X+0.506	−0.0765	−
10	−0.2467	−	0.3104	−	−0.2007	−
11	−0.0592	−	0.2916	−	−0.3475	−
12	0.2567	−	0.3314	−	−0.0668	−
13	−0.1158	−	0.4814**	Y=0.134X+0.939	−0.2360	−
14	0.3906*	Y=0.235X+0.843	−0.0947	−	0.0850	−
15	0.4684**	Y=0.409X−0.277	0.4225*	Y=0.345X−0.379	−0.1109	−
16	0.0102	−	0.0114	−	−0.2041	−
17	0.1632	−	0.0826	−	0.3004	−
18	−0.0084	−	0.1962	−	0.0970	−
19	0.5087**	Y=0.297X+0.607	0.1633	−	−0.0308	−
20	0.2260	−	0.0721	−	0.3160	−
21	0.3053	−	−0.0295	−	−0.2660	−
22	−0.2969	−	0.4723**	Y=0.219X+0.681	0.1454	−
23	0.4131*	Y=0.259X+0.913	0.1687	−	0.3729*	Y=0.315X+1.068
24	−0.1734	−	0.5848***	Y=0.165X+0.918	−0.2099	−
25	0.1987	−	0.5397**	Y=0.147X+0.844	0.1282	−
26	0.3343	−	0.1651	−	−0.2449	−
27	0.0145	−	0.4840**	Y=0.269X+0.369	−0.2669	−
28	0.1221	−	0.0301	−	−0.0547	−
29	0.2256	−	0.1449	−	0.0726	−
30	0.1751	−	0.1232	−	−0.0649	−
31	0.0871	−	0.1052	−	0.1884	−
32	−0.3849*	Y=−0.153X+3.216	0.4083*	Y=0.130X+1.016	−0.5288**	Y=−0.425X+2.777
33	0.1877	−	0.0959	−	−0.1477	−
34	−0.1365	−	0.3442	−	0.1841	−
35	0.1228	−	0.5128**	Y=0.200X+0.325	−0.0876	−
36	0.3953*	Y=0.197X+0.830	0.2324	−	−0.0072	−
37	−0.0142	−	0.3192	−	−0.0516	−
38	−0.0856	−	0.4515*	Y=0.165X+0.693	−0.2759	−
39	−0.0673	−	0.3112	−	0.1320	−
40	0.2370	−	0.4749**	Y=0.160X+0.768	0.1883	−
41	0.1898	−	0.4359*	Y=0.129X+1.036	0.1227	−

(Continued)

Table 3. (Continued)

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
42	−0.1509	−	0.4792**	Y=0.120X+1.042	0.1389	−
43	0.1393	−	0.2120	−	−0.1387	−
44	0.4971**	Y=0.255X+0.829	0.3608	−	0.2688	−
45	−0.1109	−	0.2017	−	0.2418	−
46	0.4063*	Y=0.131X+1.208	0.1789	−	0.1040	−
47	0.2020	−	0.1935	−	−0.0518	−
48	−0.0135	−	−0.1034	−	−0.2442	−
49	−0.3508	−	0.5230**	Y=0.253X+0.162	−0.2339	−
50	0.3031	−	0.3315	−	−0.1949	−
51	−0.3612*	Y=−0.203X+4.285	−0.0145	−	−0.0061	−
52	0.0245	−	−0.0497	−	0.0257	−
53	0.2476	−	0.2817	−	0.3009	−
54	0.2799	−	−0.1732	−	0.1387	−
55	0.2054	−	−0.1799	−	−0.3992*	Y=−0.275X+3.099
56	0.3229	−	0.2042	−	0.1884	−
57	0.3554	−	−0.0368	−	−0.0455	−
58	−0.2962	−	0.5927***	Y=0.256X+0.647	−0.0124	−
59	0.0261	−	−0.0090	−	0.1495	−
60	0.2411	−	0.0797	−	−0.2554	−
61	0.3734*	Y=0.291X+0.671	0.1684	−	0.0233	−
62	0.2505	−	0.0809	−	0.3310	−
63	0.0949	−	0.2698	−	−0.1918	−
64	0.3793*	Y=0.226X+1.586	0.1667	−	−0.1556	−
65	−0.2085	−	0.3748*	Y=0.110X+1.368	0.1038	−
66	0.0485	−	0.4540*	Y=0.120X+1.061	−0.0220	−
67	0.3045	−	−0.0138	−	−0.0069	−
68	0.2615	−	−0.0683	−	−0.3297	−
69	0.3415	−	0.5253**	Y=0.317X+0.214	0.2555	−
70	−0.2675	−	−0.0328	−	0.1962	−
71	0.1206	−	0.0454	−	−0.1369	−
72	0.2433	−	0.3927*	Y=0.254X+0.348	−0.0452	−
73	−0.1060	−	0.4982**	Y=0.202X+0.775	−0.1231	−
74	0.2259	−	0.1862	−	0.2183	−
75	−0.3871*	Y=−0.272X+4.130	0.2687	−	−0.5573**	Y=−0.294X+2.715
76	0.1551	−	0.0129	−	0.2401	−
77	0.2328	−	0.1306	−	−0.1282	−
78	−0.0505	−	0.5631**	Y=0.261X+0.291	−0.0826	−
79	0.4689**	Y=0.505X−0.038	0.0069	−	0.2072	−
80	0.0555	−	0.3624*	Y=0.135X+1.192	0.1179	−
81	−0.0910	−	0.1887	−	−0.0490	−
82	−0.2958	−	0.5067**	Y=0.227X+0.529	−0.0160	−
83	0.0888	−	0.2307	−	−0.3360	−

(Continued)

Table 3. (Continued)

Strain No.	Length and Width		Length and Thickness		Width and Thickness	
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression
84	−0.2736	−	0.3537	−	−0.0805	−
85	0.4556*	Y=0.272X+0.992	0.2252	−	0.2872	−
86	0.4439*	Y=0.207X+1.132	0.4254*	Y=0.182X+0.750	0.1168	−
87	0.3592	−	−0.0174	−	−0.2845	−
88	0.2729	−	0.0370	−	−0.2686	−
89	0.2617	−	−0.0007	−	−0.1923	−
90	−0.2138	−	−0.1257	−	0.2302	−
91	0.3454	−	0.2108	−	−0.0112	−
92	0.5825***	Y=0.295X+0.761	0.0665	−	0.2264	−
93	0.5685**	Y=0.528X−0.906	0.1521	−	0.4982**	Y=0.262X+1.241
94	0.0107	−	0.3037	−	0.1135	−
95	−0.1267	−	0.3863*	Y=0.141X+0.978	0.0274	−
96	0.2013	−	0.4295*	Y=0.214X+0.619	−0.1607	−
97	0.2844	−	0.2189	−	0.0408	−
98	0.1048	−	0.1201	−	−0.0712	−
99	0.3097	−	0.2744	−	0.1643	−
100	0.4338*	Y=0.248X+1.037	0.0275	−	−0.0143	−

d. f. =28

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

$=-0.186X+3.641$, where Y and X indicate length and width, respectively. This formula indicates that the length becomes 0.186 mm longer, when the width becomes narrower by 1 degree.

8. Length and thickness of husked grains

Group A : C.c. and l.r. of thickness on length in the same strains were calculated, and are shown in the central column of Table 3. Three, 9, 5 and 33 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 +0.1725 to the degree of freedom of 48, showing no significance even at 5% level.

Group B: One, 4, 7 and 38 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 +0.0669 to the degree of freedom of 48, showing no significance even at 5% level.

Whole : Four, 13, 12 and 71 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.1080 to the degree of freedom of 98, showing no significance even at 5% level.

9. Width and thickness of husked grains

Group A : C.c. and l.r. of thickness on width in the same strains were calculated, and are shown in the right column of Table 3. Two, 2 and 46 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.7277 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=0.310X+1.152$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.310 mm wider, when the thickness becomes thicker by 1 degree.

Group B : Two, 1 and 47 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.8945 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=0.424X+0.838$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.424 mm wider, when the thickness becomes thicker by 1 degree.

Whole : Four, 3 and 93 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was +0.8876 to the degree of freedom of 98, which was obviously significant at 0.1% level. Generally speaking, the wider is the width, the thicker is the thickness. L.r. of width on thickness was calculated as follows; $Y=0.339X+1.078$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.339 mm wider, when the thickness becomes thicker by 1 degree.

10. L/W and L/T of husked grains

Group A : 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 4. Two, 5, 8 and 35 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 +0.8971 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=0.817X+1.124$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.817 larger, when the L/T becomes larger by 1 degree.

Group B : Three, 6, 7 and 34 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 +0.9441 to the degree of freedom of 48, which was obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=0.901X+1.023$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.901 larger, when the L/T becomes larger by 1 degree.

Whole : Five, 11, 15 and 69 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was +0.9375 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; $Y=0.763X+1.305$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.763 larger, when the L/T becomes larger by 1 degree.

11. L/W and W/T of husked grains

Group A : 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 4. Forty-two, 1, 5 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 −0.7036 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; $Y=-0.145X+1.633$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.145 larger, when the W/T becomes smaller by 1 degree.

Group B : Thirty-five, 9, 3 and 3 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 −0.8096 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; $Y=-0.193X+1.798$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes

Table 4. Correlation coefficient and linear regression of the three components of husked grains; ratio of length to thickness (abbreviated as L/T, and so forth) on L/W, W/T on L/W, W/T on L/T

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	0.5295**	Y=0.374X+2.284	−0.7907***	Y=−0.260X+1.918	0.0954	−
2	0.3616*	Y=0.361X+2.261	−0.6521***	Y=−0.321X+2.067	0.4664**	Y=0.230X+0.499
3	0.0577	−	−0.8111***	Y=−0.401X+2.427	0.5293**	Y=0.317X+0.084
4	−0.2906	−	−0.8879***	Y=−0.450X+2.589	0.6945***	Y=0.457X−0.481
5	0.1086	−	−0.7800***	Y=−0.349X+2.224	0.5356**	Y=0.279X+0.168
6	−0.2698	−	−0.6324***	Y=−0.493X+3.044	0.9144***	Y=0.313X−0.210
7	0.0742	−	−0.7961***	Y=−0.404X+2.411	0.5377**	Y=0.321X+0.146
8	−0.2245	−	−0.8121***	Y=−0.500X+2.798	0.7386***	Y=0.466X−0.525
9	−0.0415	−	−0.7709***	Y=−0.411X+2.408	0.6631***	Y=0.354X−0.032
10	0.2925	−	−0.6718***	Y=−0.314X+2.229	0.5094**	Y=0.215X+0.442
11	−0.0913	−	−0.6600***	Y=−0.479X+2.608	0.8058***	Y=0.379X−0.071
12	0.1022	−	−0.6944***	Y=−0.392X+2.343	0.6420***	Y=0.314X+0.148
13	0.1275	−	−0.8817***	Y=−0.388X+2.421	0.3511	−
14	0.2401	−	−0.6252***	Y=−0.326X+2.126	0.6033***	Y=0.272X+0.320
15	−0.3610*	Y=−0.587X+5.148	−0.7598***	Y=−0.645X+3.063	0.8772***	Y=0.458X−0.328
16	0.4521*	Y=0.579X+1.783	−0.4532*	Y=−0.192X+1.751	0.5887***	Y=0.194X+0.447
17	0.5056**	Y=0.901X+0.788	−0.1873	−	0.7509***	Y=0.214X+0.378
18	0.3548	−	−0.4093*	Y=−0.278X+1.982	0.7061***	Y=0.293X+0.367
19	−0.0208	−	−0.6407***	Y=−0.521X+2.567	0.7790***	Y=0.396X+0.002
20	0.4951**	Y=0.883X+1.106	−0.3242	−	0.6598***	Y=0.256X+0.585
21	−0.0967	−	−0.6775***	Y=−0.629X+2.742	0.7957***	Y=0.487X−0.128
22	0.4403*	Y=0.438X+1.992	−0.7481***	Y=−0.479X+2.398	0.2620	−
23	0.4194*	Y=0.695X+1.551	−0.3971*	Y=−0.273X+1.998	0.6636***	Y=0.275X+0.444
24	0.3150	−	−0.8388***	Y=−0.371X+2.210	0.2501	−
25	0.3057	−	−0.6838***	Y=−0.245X+1.956	0.4831**	Y=0.187X+0.417
26	−0.2661	−	−0.5792***	Y=−0.851X+3.386	0.9390***	Y=0.465X−0.191
27	−0.2040	−	−0.8024***	Y=−0.646X+2.795	0.7448***	Y=0.517X−0.255
28	0.2562	−	−0.4844**	Y=−0.198X+1.820	0.7091***	Y=0.237X+0.160
29	0.5465**	Y=0.667X+1.061	−0.3920*	Y=−0.179X+1.540	0.5531**	Y=0.207X+0.549
30	0.1475	−	−0.6474***	Y=−0.338X+2.168	0.6078***	Y=0.292X+0.190
31	0.3914*	Y=0.371X+2.433	−0.6805***	Y=−0.285X+2.041	0.4050*	Y=0.179X+0.620
32	−0.0519	−	−0.7451***	Y=−0.310X+2.082	0.3363	−
33	0.4416*	Y=0.445X+2.072	−0.5837***	Y=−0.216X+1.785	0.4682**	Y=0.172X+0.508
34	0.6569***	Y=0.580X+1.579	−0.6515***	Y=−0.199X+1.702	0.0828	−
35	−0.0543	−	−0.7446***	Y=−0.376X+2.476	0.5124**	Y=0.218X+0.373
36	0.0287	−	−0.6876***	Y=−0.355X+2.329	0.7311***	Y=0.302X+0.048
37	0.0978	−	−0.6940***	Y=−0.389X+2.292	0.6447***	Y=0.313X+0.153
38	0.0056	−	−0.7889***	Y=−0.369X+2.381	0.6062***	Y=0.305X+0.030
39	0.4116*	Y=0.333X+2.446	−0.7319***	Y=−0.262X+1.938	0.3163	−
40	0.2135	−	−0.7899***	Y=−0.302X+2.052	0.4275*	Y=0.219X+0.337

(Continued)

Table 4. (Continued)

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
41	0.3098	—	−0.6900***	Y=−0.287X+2.027	0.4682**	Y=0.216X+0.413
42	0.5464**	Y=0.431X+2.344	−0.7232***	Y=−0.215X+1.853	0.1784	—
43	−0.0136	—	−0.7467***	Y=−0.490X+2.446	0.6715***	Y=0.405X+0.007
44	0.2502	—	−0.6444***	Y=−0.375X+2.178	0.5755***	Y=0.284X+0.340
45	0.6196***	Y=0.574X+1.772	−0.6197***	Y=−0.182X+1.713	0.2297	—
46	0.3229	—	−0.3780*	Y=−0.156X+1.627	0.6916***	Y=0.215X+0.351
47	0.2485	—	−0.6084***	Y=−0.277X+1.993	0.5906***	Y=0.236X+0.317
48	0.0484	—	−0.6892***	Y=−0.558X+2.682	0.6871***	Y=0.412X+0.019
49	0.0397	—	−0.7768***	Y=−0.342X+2.226	0.5760***	Y=0.307X+0.051
50	−0.0981	—	−0.7089***	Y=−0.539X+2.507	0.7383***	Y=0.465X−0.114
51	0.5645**	Y=0.722X+1.366	−0.5766***	Y=−0.390X+2.187	0.3427	—
52	0.3839*	Y=0.456X+1.930	−0.6501***	Y=−0.449X+2.321	0.4488*	Y=0.261X+0.646
53	0.4764**	Y=0.607X+1.705	−0.5693**	Y=−0.342X+2.137	0.4486*	Y=0.212X+0.705
54	0.5141**	Y=0.613X+1.680	−0.5639**	Y=−0.302X+2.039	0.4128*	Y=0.186X+0.761
55	0.1492	—	−0.5752***	Y=−0.591X+2.575	0.7166***	Y=0.440X+0.177
56	0.5218**	Y=0.799X+1.101	−0.4217*	Y=−0.329X+2.005	0.5508**	Y=0.281X+0.686
57	0.2899	—	−0.4974**	Y=−0.344X+2.150	0.6813***	Y=0.307X+0.347
58	0.3444	—	−0.9218***	Y=−0.607X+2.595	0.0317	—
59	0.3661*	Y=0.428X+2.125	−0.6572***	Y=−0.438X+2.362	0.4572*	Y=0.260X+0.630
60	−0.1467	—	−0.8240***	Y=−0.662X+2.798	0.6645***	Y=0.576X−0.295
61	0.0491	—	−0.7995***	Y=−0.495X+2.564	0.5579**	Y=0.377X+0.055
62	0.4028*	Y=0.460X+2.046	−0.6412***	Y=−0.390X+2.250	0.4414*	Y=0.236X+0.614
63	−0.0943	—	−0.8178***	Y=−0.644X+2.785	0.6484***	Y=0.505X−0.165
64	0.0393	—	−0.6164***	Y=−0.670X+2.821	0.7565***	Y=0.474X+0.051
65	0.5817***	Y=0.449X+1.972	−0.7800***	Y=−0.338X+2.088	0.0531	—
66	0.4599*	Y=0.471X+2.137	−0.6653***	Y=−0.300X+2.072	0.3541	—
67	0.5126**	Y=1.377X+0.155	−0.2396	—	0.5639**	Y=0.227X+0.805
68	−0.0603	—	−0.7221***	Y=−0.629X+2.747	0.7313***	Y=0.455X−0.053
69	0.1249	—	−0.5785***	Y=−0.626X+2.681	0.7346***	Y=0.467X−0.147
70	0.7043***	Y=1.122X+0.486	−0.2120	—	0.5431**	Y=0.170X+0.809
71	0.1479	—	−0.4146*	Y=−0.314X+2.140	0.6753***	Y=0.285X+0.331
72	−0.0912	—	−0.6566***	Y=−0.637X+2.864	0.8091***	Y=0.443X−0.070
73	0.1800	—	−0.7831***	Y=−0.540X+2.588	0.4669**	Y=0.346X+0.335
74	0.3420	—	−0.6982***	Y=−0.506X+2.380	0.4324*	Y=0.282X+0.624
75	0.0836	—	−0.8478***	Y=−0.503X+2.469	0.4540*	Y=0.362X+0.180
76	0.4372*	Y=0.470X+2.025	−0.6829***	Y=−0.395X+2.262	0.3543	—
77	0.1083	—	−0.5509**	Y=−0.412X+2.350	0.7536***	Y=0.372X+0.101
78	0.0512	—	−0.7328***	Y=−0.604X+2.800	0.6391***	Y=0.408X+0.103
79	0.2014	—	−0.5429**	Y=−0.516X+2.394	0.7108***	Y=0.417X+0.222
80	0.2655	—	−0.8228***	Y=−0.443X+2.336	0.3222	—
81	0.2315	—	−0.7563***	Y=−0.593X+2.560	0.4590*	Y=0.346X+0.441
82	0.2756	—	−0.8721***	Y=−0.474X+2.486	0.2183	—

(Continued)

Table 4. (Continued)

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
83	−0.3945*	Y=−0.802X+4.733	−0.7349***	Y=−0.790X+3.123	0.8463***	Y=0.448X+0.103
84	0.1732	−	−0.8259***	Y=−0.577X+2.519	0.3594	−
85	0.3326	−	−0.6788***	Y=−0.411X+2.336	0.4636**	Y=0.245X+0.578
86	0.0873	−	−0.6102***	Y=−0.477X+2.459	0.7330***	Y=0.376X+0.107
87	−0.0827	−	−0.6067***	Y=−0.659X+2.673	0.8246***	Y=0.546X−0.123
88	0.0818	−	−0.5926***	Y=−0.449X+2.384	0.5334**	Y=0.262X+0.579
89	0.3233	−	−0.5513**	Y=−0.257X+1.965	0.6089***	Y=0.230X+0.369
90	0.4780**	Y=0.738X+1.497	−0.4830**	Y=−0.386X+2.261	0.5341**	Y=0.276X+0.698
91	0.4391*	Y=0.837X+1.138	−0.3439	−	0.6909***	Y=0.358X+0.481
92	0.3430	−	−0.4624*	Y=−0.319X+2.117	0.6724***	Y=0.290X+0.385
93	0.2226	−	−0.6593***	Y=−0.356X+2.231	0.4651**	Y=0.200X+0.627
94	0.6135***	Y=0.453X+1.827	−0.6002***	Y=−0.284X+1.944	0.1279	−
95	0.3560	−	−0.7257***	Y=−0.335X+2.141	0.3798*	Y=0.194X+0.636
96	−0.1518	−	−0.8056***	Y=−0.590X+2.723	0.6996***	Y=0.504X−0.275
97	0.3225	−	−0.4863**	Y=−0.271X+2.078	0.6674***	Y=0.246X+0.370
98	0.1926	−	−0.6011***	Y=−0.571X+2.601	0.6661***	Y=0.403X+0.281
99	0.3591	−	−0.6434***	Y=−0.449X+2.319	0.4750**	Y=0.269X+0.626
100	0.1414	−	−0.5132**	Y=−0.458X+2.522	0.7747***	Y=0.356X+0.160

d. f. =28

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

0.193 larger, when the W/T becomes smaller by 1 degree.

Whole : Seventy-seven, 10, 8 and 5 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.8724 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/W, the smaller is the W/T. L.r. of L/W on W/T was calculated as follows; Y=−0.199X+1.800, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.199 larger, when the W/T becomes smaller by 1 degree.

12. L/T and W/T of husked grains

Group A : 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 4. Twenty-nine, 10, 2 and 9 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 −0.3251 to the degree of freedom of 48, which was significant at 5% level. Generally speaking, the larger is the L/T, the smaller is the W/T. L.r. of L/T on W/T was calculated as follows; Y=−0.073X+1.473, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes 0.073 larger, when the W/T becomes smaller by 1 degree.

Group B : Twenty-two, 10, 9 and 9 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 −0.5765 to the degree of freedom of 48, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/T, the smaller is the W/T. L.r. of L/T on W/T was calculated as follows; Y=−0.144X+1.803, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes

0.144 larger, when the W/T becomes smaller by 1 degree.

Whole : Fifty-one, 20, 11 and 18 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains of both of the groups, c.c. was −0.6576 to the degree of freedom of 98, which is obviously significant at 0.1% level. Generally speaking, the larger is the L/T, the smaller is the W/T. L.r. of L/T on W/T was calculated as follows; $Y=-0.184X+1.892$, where Y and X indicate L/T and W/T, respectively. This formula indicates that the L/T becomes 0.184 larger, when the W/T becomes smaller by 1 degree.

Discussion

Basing on the results obtained in the present experiment, the following problems are to be discussed here.

1. Correlation coefficients of the respective characters in the strain level were fixed to be significant in 267/600, 272/600 and 539/1,200 in Group A, Group B and through the whole, respectively, *i.e.*, 44.5%, 45.3% and 44.9%. In these viewpoints, no remarkable differences were noted between both of the groups. This tendency was also found to be quite the same as that of the cultivated strains collected during the field survey in India[5]. In detail, however, some characteristics were found. Significant correlations in the strain level were accounted as follows:

Combination Nos.	Unhusked		Husked	
	1 ~ 3	4 ~ 6	7 ~ 9	10~12
Group A	29/150=19.3%	105/150=70.2%	29/150=19.8%	104/150=69.3%
Group B	34/150=22.8%	109/150=73.1%	25/150=16.8%	104/150=69.3%
Whole	63/300=21.0%	214/300=71.3%	54/300=18.0%	208/300=69.3%

From those data, it might be said that the combinations of 4~6 and 10~12 showed more significant strains than those of the remaining combinations. Barring those points, there was not any noticeable difference between both of the groups. Through the whole combinations (=12), in Group A, 1 (No. 15), 2 (Nos. 8, 23), 5 (Nos. 4, 16, 29, 32, 41), 8, 88 and 12 strains showed significant correlations in 10, 8, 7, 6, 5 and 4 combinations, respectively. Average and its s.d. through the whole strains (=50) were found to be 5.34 ± 1.24. In Group B, 1 (No. 93), 5 (Nos. 55, 69, 75, 86, 92), 14, 25, 4 (Nos. 63, 68, 77, 98) and 1 (No. 84) strains showed significant correlations in 9, 6, 5, 4 and 3 combinations, respectively. Average and its s.d. through the whole strains (=50) were found to be 5.44 ± 0.98. In the whole, 1, 1, 2, 10, 22, 47, 16 and 1 strains showed significant correlations in 10, 9, 8, 7, 6, 5, 4 and 3 combinations, respectively. Average and its s.d. through the whole strains (=100) were found to be 5.39 ± 1.12. It may be noted that these tendencies were nearly the same in Groups A and B.

2. According to the tripartite classification, correlation coefficients of the respective characters in the strain level were fixed to be significant in 6/12, 153/336 and 380/852 cases in type A, type B and type C, respectively, *i.e.*, 50.0%, 45.5% and 44.6%. In these view points, no remarkable difference was noted between these types.

Summary

In order to confirm the varietal variations of the cultivated rice delivered from Rice Research Station, Chinsurah, West Bengal, India, 12 mutual relations among 24 characters in view of the practical values were investigated in this report, following the previous papers. Those were divided into 2 groups, *i.e.*, Group A --- *aman* varieties, Group B --- *aus* varieties. The results obtained here were summarized as follows:

Concerning correlation coefficients among 12 character-combinations, 267/600 cases (= 44.5%) in Group A, 272/600 cases (=45.3%) in Group B and 539/1,200 cases (=44.9%) in the whole, respectively, showed significant relations through the whole cases.

Some character-specificities were found.

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