Mem. Fac. Agr. Kagoshima Univ., **25**, 31−38, 1989

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

Tadao C. KATAYAMA
(*Experimental Farm*)
Received for Publication August 19, 1988

Introduction

During the period from June to July in 1981, the writer was sent to Indonesia for research on agricultural practices under the project, designated as "Ecological Biology and the Promotion on Tropical Primary Industry", supported by a Grant from the Ministry of Education, Science and Culture, Japanese Government.

Rice cultivation in East Java, Indonesia, was studied from several viewpoints. Observations were also made in Middle Java and Bali Islands for the extensive comparisons, and the results obtained in East Java are briefly reported in the previous papers.

On the grain morphology of rice grains distributed in islands of Indonesia, some reports have been already published[2]. However, no distinct record has been reported on the grain morphology of cultivated rice varieties in Madura Island, East Java, Indonesia. In these districts, several cultivated rice, *Oryza sativa* L., are used in lowland and upland fields. Most of them are introduced from Java proper, Bali, India, the Philippines and others. It is said that improved varieties of the *indica* type of rice are being cultivated and that primitive types of *indica* and *javanica* are not used in these areas at the present. However, it is not ascertained whether the same can be said for Madura. To obtain sources of RTV (resistance to tungro virus) for the breeding programs in Indonesia, field screening IRRI lines was done in Lanrang sub-station during the 1986 wet monsoon season[9]. On the other hand, scientists evaluated some herbicides to control weeds in hybrid rice Shen Zhan 97A/Sadang in 1985-1986 wet season[10]. In Vietnam, tolerant varieties for low temperature was evaluated[1]. As shown, recent and hybrid rice varieties are adopted. However, primitive varieties are consciously keeping everywhere.

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

In the previous paper[5], the records on morphological characters of the unhusked and the husked grains, comparison of the unhusked and the husked grains of 12 characters and variation ranged in 24 characters[6], were reported, in order to confirm the morphological characters of grains which were to make the strain's specificities clear. In the present paper, correlation coefficients between the practical values of the unhusked and the husked grains and linear regressions between them were mainly described.

Materials and Methods

Twenty-nine strains of rice cultivars, *Oryza sativa* L., collected in East Java during the trip, especially on Madura Island, were used in this experimental series. They are listed up in the Table 1 of the previous paper[5]. In this table, collection number, collection date, collection place, and detailed informations are mentioned.

Thirty grains were used for measurement of the respective strains. 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.*, the unhusked grains (Tables 1 and 2) and the husked grains (Tables 3 and 4).

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

Results

1. Length and width of UHG

Correlation coefficient (abbreviated as c.c.) and linear regression (abbreviated as l.r.) of width (W) on length (L) in the same strains were calculated, and are shown in the left column of Table 1. Two and 27 strains showed significances at 5% level and no significance even at 5% level, respectively. In the whole strains (=29), c.c. was −0.4488 to the degree of freedom of 27, which is significant at 5% level. Generally speaking, the longer is the L, the narrower is the W. L.r. of L on W was calculated as follows; $Y=-0.195X+4.664$, where Y and X indicate L and W, respectively. This formula indicates that the L becomes 0.195 mm longer, when the W becomes narrower by 1 degree.

2. Length and thickness of UHG

C.c. and l.r. of T on L in the same strains were calculated, and are shown in the central column of Table 1. One, 2 and 26 strains showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.0186 to the degree of freedom of 27, showing no significance even at 5% level.

3. Width and thickness of UHG

C.c. and l.r. of T on W in the same strains were calculated, and are shown in the right column of Table 1. Three and 26 strains showed significances at 1% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.6468 to the degree of freedom of 27, which is obviously significant at 0.1% level. Generally speaking, the wider is the W, the thicker is the T. L.r. of W on T was calculated as follows; $Y=0.353X+1.041$, where Y and X indicate W and T, respectively. This formula indicates that the W becomes 0.353 mm wider, when the T becomes thicker by 1 degree.

4. L/W and L/T of UHG

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. Two, 3,4 and 20 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 +0.8270 to the degree of freedom of 27, which is obviously significant at 0.1% level. Generally speaking, the larger is the

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	−0.5164*	Y=−0.195X+4.386	−0.3396	−	0.0375	−
2	0.2499	−	0.0602	−	−0.1225	−
3	−0.1637	−	−0.2784	−	−0.3446	−
4	−0.0891	−	−0.0657	−	0.2688	−
5	0.3237	−	−0.3888	−	−0.5615**	Y=−0.424X+3.443
6	0.1352	−	0.1226	−	0.1222	−
7	−0.3330	−	−0.0191	−	−0.0946	−
8	0.1779	−	0.1012	−	0.3515	−
9	0.4409	−	0.3505	−	0.0785	−
10	0.0893	−	0.0666	−	−0.3351	−
11	−0.4057		0.1714	−	−0.0682	−
12	0.5018*	Y=0.104X+1.735	0.3718	−	0.2533	−
13	−0.0949	−	0.3312	−	−0.4094	−
14	0.3635	−	0.3131	−	−0.1480	−
15	0.1602	−	0.1215	−	0.0477	−
16	0.2341	−	0.2623	−	0.2015	−
17	0.2811	−	0.1219	−	0.4178	−
18	0.0800	−	0.3306	−	−0.6455**	Y=−0.500X+2.870
19	0.0681	−	0.2818	−	0.2462	−
20	0.1875	−	0.4994*	Y=0.123X+1.001	0.3678	−
21	−0.0125	−	0.4264	−	−0.4064	−
22	−0.0148	−	0.0295	−	0.0996	−
23	0.2536	−	0.0512	−	−0.2537	−
24	0.3849	−	0.1973	−	0.1469	−
25	0.3602	−	0.4587*	Y=0.064X+1.468	0.0517	−
26	0.1826	−	0.0787	−	−0.1429	−
27	0.0974	−	0.2778	−	0.5707**	Y=0.339X+1.135
28	0.2559	−	−0.0196	−	0.2932	−
29	0.1133	−	0.6889***	Y=0.156X+0.644	−0.1900	−

d. f. = 18

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

L/W, the larger is the L/T. L.r. of L/W on L/T was calculated as follows; Y=0.917X+1.516, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.917 larger, when the L/T becomes larger by 1 degree.

5. L/W and W/T of UHG

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. Nine, 6,7 and 7 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 −0.6397 to the degree of freedom of 27, 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=−0.165X+1.930,

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, and 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	0.3246	—	−0.0745	—	0.9185***	Y=0.333X+0.203
2	0.0906	—	−0.7783***	Y=−0.318X+2.500	0.5521*	Y=0.228X+0.243
3	0.4941*	Y=0.652X+2.546	−0.5151*	Y=−0.189X+2.043	0.4804*	Y=0.133X+0.694
4	0.5592*	Y=0.646X+2.361	−0.4060	—	0.1719	—
5	0.0607	—	−0.4345	—	0.8148***	Y=0.325X+0.162
6	0.4400	—	−0.6689**	Y=−0.250X+2.217	0.3714	—
7	0.5521*	Y=0.719X+2.190	−0.4872*	Y=−0.172X+1.954	0.4215	—
8	0.1165	—	−0.7853***	Y=−0.297X+2.378	0.4524*	Y=0.187X+0.396
9	0.1340	—	−0.8098***	Y=−0.515X+2.862	0.4659*	Y=0.287X+0.320
10	0.3469	—	−0.5616**	Y=−0.223X+2.105	0.5327*	Y=0.166X+0.544
11	0.3937	—	−0.7137***	Y=−0.322X+2.302	0.2800	—
12	0.6845***	Y=0.964X+1.204	−0.3440	—	0.2168	—
13	0.2563	—	−0.7477***	Y=−0.504X+2.674	0.4466*	Y=0.303X+0.423
14	0.1501	—	−0.5347*	Y=−0.456X+2.677	0.7543***	Y=0.347X+0.143
15	0.2665	—	−0.5325*	Y=−0.366X+2.434	0.6700**	Y=0.310X+0.318
16	0.2239	—	−0.4340	—	0.7797***	Y=0.314X+0.231
17	0.1990	—	−0.4520*	Y=−0.001X+1.238	0.2942	—
18	−0.6043**	Y=−0.969X+1.004	−0.8970***	Y=−0.618X+4.038	0.8899***	Y=0.391X−0.882
19	0.3497	—	−0.0083	—	0.4465*	Y=0.190X+0.591
20	0.3198	—	−0.5854**	Y=−0.331X+2.377	0.5879**	Y=0.240X+0.450
21	0.0293	—	−0.7590***	Y=−0.606X+3.186	0.6189**	Y=0.369X+0.061
22	0.6452**	Y=0.763X+1.972	−0.5625**	Y=−0.191X+1.993	0.2668	—
23	−0.1084	—	−0.7886***	Y=−0.458X+2.907	0.6953***	Y=0.339X−0.169
24	0.2495	—	−0.4910*	Y=−0.341X+2.420	0.7236***	Y=0.278X+0.253
25	0.5784**	Y=0.659X+2.060	−0.5407*	Y=−0.164X+1.822	0.3713	—
26	0.5206*	Y=0.598X+2.322	−0.5679**	Y=−0.214X+2.012	0.3487	—
27	0.7729***	Y=0.831X+1.628	−0.5655**	Y=−0.125X+1.737	0.0855	—
28	0.2791	—	−0.2644	—	0.5108*	Y=0.122X+0.942
29	0.0269	—	−0.8543***	Y=−0.457X+2.817	0.4956*	Y=0.310X+0.064

d. f. = 18

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

where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.165 larger, when the W/T becomes smaller by 1 degree.

6. L/T and W/T of UHG

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. Seven, 3,9 and 10 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 −0.0104, showing no significance even at 5% level.

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	−0.2647	−	0.5929**	Y=0.431X−0.880	−0.2309	−
2	0.1319	−	0.0949	−	−0.4736*	Y=−0.298X+2.388
3	−0.1035	−	−0.0589	−	−0.2791	−
4	−0.3119	−	−0.0704	−	0.2048	−
5	0.1868	−	0.1152	−	−0.0288	−
6	0.1658	−	−0.0445	−	−0.1569	−
7	0.0944	−	0.1263	−	0.2643	−
8	0.0983	−	0.1205	−	−0.3285	−
9	0.4016	−	0.0734	−	−0.3906	−
10	−0.3209	−	−0.0028	−	−0.1411	−
11	0.0361	−	0.3767	−	−0.0738	−
12	0.1722	−	0.4789*	Y=0.091X+1.204	−0.1485	−
13	−0.1379	−	0.1271	−	−0.4515*	Y=−0.286X+2.893
14	0.2608	−	0.3890	−	−0.0449	−
15	0.0567	−	0.1169	−	−0.0693	−
16	0.2265	−	0.2922	−	0.1971	−
17	−0.1065	−	0.0986	−	0.3473	−
18	0.5116*	Y=0.055X+1.536	0.0135	−	−0.0330	−
19	−0.1819	−	0.3480	−	−0.1756	−
20	0.1372	−	0.4711*	Y=0.138X+0.977	0.1492	−
21	−0.1849	−	0.4580*	Y=0.155X+0.935	−0.4769*	Y=−0.319X+2.905
22	−0.1124	−	0.0618	−	−0.1301	−
23	−0.0625	−	0.3292	−	−0.2234	−
24	0.3719	−	0.3213	−	0.0284	−
25	0.1704	−	0.1984	−	0.1080	−
26	0.1054	−	−0.0681	−	−0.2819	−
27	0.2613	−	0.4458*	Y=0.074X+1.324	0.4934*	Y=0.377X+1.001
28	0.0908	−	−0.2301	−	−0.2905	−
29	0.3348	−	0.6524**	Y=0.214X+0.452	0.1579	−

d. f. = 18

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

7. Length and width of HG

C.c. and l.r. of W on L in the same strains were calculated, and are shown in the left column of Table 3. One and 28 strains showed significance and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.2132, showing no significance even at 5% level.

8. Length and thickness of HG

C.c. and l.r. of T on L in the same strains were calculated, and are shown in the central column of Table 3. Two, 4 and 23 strains showed significances at 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.3474, showing no significance even at 5% level.

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	−0.2481	−	−0.3940	−	0.8896***	Y=0.502X−0.244
2	−0.1379	−	−0.7825***	Y=−0.457X+2.711	0.7224***	Y=0.355X−0.129
3	0.2344	−	−0.6210**	Y=−0.313X+2.254	0.6133**	Y=0.250X+0.303
4	0.5664**	Y=0.554X+2.028	−0.5977**	Y=−0.207X+1.852	0.2923	−
5	−0.0632	−	−0.9369***	Y=−0.342X+2.190	0.8235***	Y=0.392X+0.111
6	0.0546	−	−0.5074*	Y=−0.381X+2.402	0.8296***	Y=0.321X+0.053
7	0.6582**	Y=0.692X+1.694	−0.5659**	Y=−0.181X+1.803	0.2450	−
8	0.9000***	Y=0.794X+1.267	−0.8213***	Y=−0.165X+1.718	−0.4951*	Y=−0.133X+1.647
9	0.2033	−	−0.7505***	Y=−0.474X+2.441	0.4894*	Y=0.321X+0.376
10	0.3197	−	−0.5290*	Y=−0.195X+1.819	0.4994*	Y=0.136X+0.712
11	0.8207***	Y=0.717X+1.361	−0.7571***	Y=−0.248X+1.883	−0.2680	−
12	0.2029	−	−0.7616***	Y=−0.378X+2.365	0.4780*	Y=0.244X+0.386
13	0.1506	−	−0.7622***	Y=−0.587X+2.598	0.5211*	Y=0.401X+0.241
14	0.2065	−	−0.6524**	Y=−0.478X+2.447	0.6022**	Y=0.332X+0.338
15	0.8544***	Y=0.447X+2.036	−0.9323***	Y=−0.314X+2.076	−0.6154**	Y=−0.396X+2.546
16	0.4487*	Y=0.761X+1.453	−0.3818	−	0.6398**	Y=0.271X+0.496
17	0.5877**	Y=1.016X+0.633	−0.2114	−	0.6637**	Y=0.162X+0.612
18	0.4832*	Y=1.546X−0.463	0.0599	−	0.9025***	Y=0.226X+0.332
19	0.4374	−	−0.6194**	Y=−0.321X+2.166	0.4296	−
20	0.4934*	Y=0.540X+2.001	−0.6639**	Y=−0.319X+2.140	0.3190	−
21	0.0645	−	−0.9216***	Y=−0.560X+2.775	0.3171	−
22	0.4873*	Y=0.438X+2.367	−0.7167***	Y=−0.299X+2.126	0.2548	−
23	0.0876	−	−0.8305***	Y=−0.365X+2.321	0.4728*	Y=0.294X+0.174
24	0.5857**	Y=0.400X+2.556	−0.8292***	Y=−0.327X+2.243	−0.0391	−
25	0.7888***	Y=0.970X+0.728	−0.3295	−	0.3181	−
26	0.4450*	Y=0.462X+2.197	−0.6363**	Y=−0.267X+1.996	0.4030	−
27	0.7659***	Y=0.801X+1.185	−0.5358*	Y=−0.127X+1.578	0.1323	−
28	0.2282	−	−0.6304**	Y=−0.630X+2.193	0.3276	−
29	0.4504*	Y=0.771X+1.584	−0.5029*	Y=−0.245X+2.017	0.4223	−

d. f. = 18

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

9. Width and thickness of HG

C.c. and l.r. of T on W in the same strains were calculated, and are shown in the right column of Table 3. Four and 25 strains showed significances at 5% level and no significance even at 5% level, respectively. In the whole strains, c.c. was +0.7374 to the degree of freedom of 27, which is obviously significant at 0.1% level. Generally speaking, the wider is the W, the thicker is the T. L.r. of W on T was calculated as follows; Y=0.532X+0.547, where Y and X indicate W and T, respectively. This formula indicates that the W becomes 0.532 mm wider, when the T becomes thicker by 1 degree.

10. L/W and L/T of HG

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. Five, 4, 6 and 14 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 +0.8164 to the degree of freedom of 27, 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; $Y=0.845X+1.270$, where Y and X indicate L/W and L/T, respectively. This formula indicates that the L/W becomes 0.845 larger, when the L/T becomes larger by 1 degree.

11. L/W and W/T of HG

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. Twelve, 8, 4 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 −0.6228 to the degree of freedom of 27, 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; $Y=-0.192X+1.847$, where Y and X indicate L/W and W/T, respectively. This formula indicates that the L/W becomes 0.192 larger, when the W/T becomes smaller by 1 degree.

12. L/T and W/T of HG

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. Five, 5,6 and 13 strains showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively. In the whole strains, c.c. was −0.0701, showing no significance even at 5% level.

Discussion

Basing on the results 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 124/348 cases, 35.6% through the whole strains. In detail, these were ascertained in the respective combination-groups as follows; group 1 (L and W, L and T, W and T in UHG) --- 8/87=9.2%, group 2 (L/W and L/T, L/W and W/T, L/T and W/T in UHG) --- 50/87=57.5%, group 3 (L and W, L and T, W and T in HG) --- 11/87=12.6%, group 4 (L/W and L/T, L/W and W/T, L/T and W/T in HG) --- 55/87=63.2%. From those data, it might be said that the combinations in groups 2 and 4 showed more significant strains than those in groups 1 and 3. Barring these points, there were not any noticeable differences between the present experiment and the northeastern India[3], India proper[7] and Burma[4].

Although the whole combinations (=12), 2, 2, 7, 11, 5 and 2 strains showed significant correlations in 7, 6, 5, 4, 3 and 2 combinations, respectively. Average values and their standard deviations through the whole strains were found to be 4.28 ± 1.23. It was noticed that strain Nos.18 and 27, and 19 and 28 showed significant correlations in 7/12 cases, *i.e.*, 58.3%, and in only 2/12 cases, *i.e.*, 16.7%, respectively.

2. According to the tripartite classification[8], correlation coefficients in the respective character-combinations in strain level were fixed to be significant in 16/48 (=33.3%) and 108/300 (=36.0%) in type B and type C, respectively. In these viewpoints, no remarkable difference was noticed between these two types.

In detail, these were ascertained in the respective combination-groups as follows in the case of

type B; group 1 --- 0/12=0.0%, group 2 --- 7/12=58.3%, group 3 --- 2/12=16.7%, group 4 --- 7/12=58.3%, type C; group 1 --- 8/75=10.7%, group 2 --- 43/75=57.3%, group 3 --- 9/75=12.0%, group 4 --- 48/75=64.0%. From those data, it might be said that the combinations of groups 2 and 4 showed more significant strains than those of the remaining combination-groups, even in type B and type C as likewise as in case of the whole strains.

Through the whole combinations (=12), in type B, 1, 2 and 1 strains showed significant correlations in 5, 4 and 3 combinations, respectively. In type C, 2, 2, 6, 9, 4 and 2 strains showed significant correlations in 7, 6, 5, 4, 3 and 2 combinations, respectively. Average values and its standard deviations through the whole strains were found to be 4.00 ± 0.71 and 4.32 ± 1.29 in type B and type C, respectively.

Summary

In order to confirm the varietal variations of the cultivated rice strains, *Oryza sativa* L., in Madura Island, East Java, Indonesia, 12 mutual relations among 24 characters in view of the practical values were investigated in this report, following the previous papers. The main results obtained were summarized as follows:

Concerning correlation coefficients among 12 character-combinations, 16/48 cases (=33.3%), 108/300 cases (=36.0%) and 124/348 cases (=35.6%) in type B, type C and in the whole strains of both of the types, respectively, showed significant relations through the whole cases. In the whole combinations (=12), average values and these standard deviations through the whole strains were found to be 4.00 ± 0.71, 4.32 ± 1.29 and 4.28 ± 1.23 in type B, type C and in the whole strains of both of the types, respectively.

Some character-specificities were found.

References

1) Duc, D.: Low temperature tolerance of traditional Vietnamese varieties. *Intern. Rice Res. Newsletter*, **12**(4), 21 (1987)
2) Katayama, T.C.: Grain morphology of cultivated rice, "Pelita", in Ambon, Indonesia. *Mem. Fac. Agr. Kagoshima Univ.*, **12**, 41-45 (1976)
3) Katayama, T.C.: Some morphological characters of the cultivated rice grains collected in India (I). *Mem. Fac. Agr. Kagoshima Univ.*, **17**, 1-18 (1981)
4) Katayama, T.C.: Morphological characters of the cultivated rice grains of Burma (I). *Mem. Fac. Agr. Kagoshima Univ.*, **21**, 35-56 (1985)
5) Katayama, T.C.: Morphological characters of cultivated rice grains of Madura, Indonesia (I). *Mem. Kagoshima Univ. Res. Center S. Pac.*, **8**, 58-68 (1987)
6) Katayama, T.C.: Morphological characters of cultivated rice grains of Madura, Indonesia (II). *Mem. Fac. Agr. Kagoshima Univ.*, **24**, 37-65 (1988)
7) Katayama, T.C.: Morphological characters of the cultivated rice grains delivered from Rice Research Station, Chinsurah, West Bengal, India (V). *Mem. Fac. Agr. Kagoshima Univ.*, **25**, 1-18 (1989)
8) Matsuo, T.: Genecological studies on the cultivated rice. *Bull. Nat. Inst. Agr. Sci. Series D*, **3**, 1-111 (1952) (in Japanese with English Summary)
9) Sudjak, S.M., Muis, A., Sama, S. and Wakman, W.: Field screening IRRI lines against tungro (RTV) disease in Lanrang. *Intern. Rice Res. Newsletter*, **12**(4), 13 (1987)
10) Yasin, M.: Weed control in hybrid rice. *Intern. Rice Res. Newsletter*, **12**(4), 48 (1987)