Distributions and Some Morphological Characters of the Wild Rice in the Ganga Plains (PART IV)

Tadao C. KATAYAMA
(Laboratory of Crop Science)
Received for Publication August 5, 1977

Introduction

From October in 1971 to January in 1972, the writer was dispatched to stay in India and Ceylon (Sri Lanka) for collecting the wild and cultivated rice under the project, "The Origin and the Alteration of Cultivated Rice in Tropical Asia", supported by a Grant from the Ministry of Education, Japan. During this trip, many wild, cultivated and natural hybrid strains of rice were collected.

On the distribution of wild rice in India, some reports have been already published[1,5,6]. In the previous papers[3,4], abstracts of natural habitats and morphological characters of grains collected during the trip were reported. Some considerations on the distribution of wild rice in the Ganga Plains were described[2], too. In the present report, comparisons of morphological characters obtained in unhusked and husked grains of the wild species have mainly been described.

Materials and Methods

Forty two strains of wild rice were used in this experiment. They are listed up in Table 1 of the previous paper[3]. Twenty grains were used for the measurement of each strain. The measurements were done at the largest position concerning the respective character. Calculations, moreover, were done to fix the ratios of length to width, of length to thickness and of width to thickness. To make clear the relations between unhusked and husked grains, the correlation coefficient and linear regression of the respective character were calculated. Basing on the data obtained by the calculation, t-test was made from analysis of variance for the whole strains.

Results

I. Ratios of length to width, of length to thickness and of width to thickness

Correlation coefficient of ratio of length to width of unhusked grains on husked grains in the whole strains was shown in Table 1. The value was +0.8541 to the degree of freedom of 40, which was obviously significant at 0.1% level. It means that the larger is the ratio of unhusked grains, the larger is the ratio of husked grains. Linear regression of ratio of husked grains on unhusked grains was calculated as follows; $Y=0.722X-2.346$, where Y and X indicate ratios of unhusked and husked grains, respectively. This formula indicates that the former becomes 0.722 larger, by becoming 1.000 degree

Table 1. Correlation coefficients and linear regressions of the three characters of unhusked grain (Y) on husked grain (X); ratios of length to width (I), of length to thickness (II) and of width to thickness (III). O points; Y···2.85 (I), 3.95 (II) and 1.55 (III), X···3.25 (I), 5.10 (II) and 1.60 (III), respectively

Character	Correlation coefficient	d.f.	Linear regression
Length/Width	0.8541***	40	Y=0.722X−2.346
Length/Thickness	0.7837***	40	Y=1.223X+4.050
Width/Thickness	0.5062***	40	Y=0.583X−0.365

***; significant at 0.1% level.

larger the latter (O points, 2.85 in the former and 3.25 in the latter, respectively).

Correlation coefficient of ratio of length to thickness of unhusked grains on husked grains in the whole strains was shown in Table 1. The value was +0.7837 to the degree of freedom of 40, which was obviously significant at 0.1% level. It means that the larger is the ratio of unhusked grains, the larger is the ratio of husked grains. Linear regression of ratio of husked grains on unhusked grains was calculated as follows; Y=1.223X +4.050, where Y and X indicate ratios of unhusked and husked grains, respectively. This formula indicates that the former becomes 1.223 larger, by becoming 1.000 degree larger the latter (O points, 3.95 in the former and 5.10 in the latter, respectively).

Correlation coefficient of ratio of width to thickness of unhusked grains on husked grains in the whole strains was shown in Table 1. The value was +0.5062 to the degree of freedom of 40, which was obviously significant at 0.1% level. It means that the larger is the ratio of unhusked grains, the larger is the ratio of husked grains. Linear regression of ratio of husked grains on unhusked grains was calculated as follows; Y=0.583X −0.365, where Y and X indicate ratios of unhusked and husked grains, respectively. This formula indicates that the former becomes 0.583 larger, by becoming 1.000 degree larger the latter (O points, 1.55 in the former and 1.60 in the latter, respectively).

II. Relation between the practical value and its standard deviations

Unhusked grains; Correlation coefficient of length on its standard deviations in the whole strains was shown in Table 2. The value was +0.2667 to the degree of freedom of 40, and showed no significant correlation among them even at 5% level. Correlation coefficient of width on its standard deviations in the whole strains was shown in Table 2. The value was −0.2761 to the degree of freedom of 40, and showed also no significant correlation among them even at 5% level.

Correlation coefficient of thickness on its standard deviations in the whole strains was shown in Table 2. The value was −0.4526 to the degree of freedom of 40, which was obviously significant at 1% level. It means that the thicker is the thickness of unhusked grains, the smaller is the standard deviations. Linear regression of thickness on its standard deviations was calculated as follows; Y=−0.354X−7.752, where Y and X indicate the standard deviations and thickness, respectively. This formula indicates that the former becomes 0.354 smaller, by becoming 1.000 degree thicker the latter (O points, 0.20 in the former and 1.65 *mm* in the latter, respectively).

Husked grains; Correlation coefficient of length on its standard deviations in

Table 2. Correlation coefficients and linear regressions of the practical values (X) on their standard deviations (Y). O points; 8.60 *mm*, 2.65 *mm*, 1.65 *mm*, 6.00 *mm*, 2.20 *mm* and 1.45 *mm* in the practical values of length (unhusked), width (unhusked), thickness (unhusked), length (husked), width (husked) and thickness (husked); 0.39, 0.18, 0.20, 0.38, 0.21 and 0.16 in their standard deviations in the same order, respectively

Character		Correlation coefficient	d.f.	Linear regression
Unhusked	Length	0.2667	40	–
	Width	–0.2761	40	–
	Thickness	–0.4526**	40	Y=−0.354X−7.752
Husked	Length	–0.3005*	40	Y=−0.737X−5.253
	Width	–0.1900	40	–
	Thickness	–0.3589*	40	Y=−0.433X−1.849

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

the whole strains was shown in Table 2. The value was −0.3005 to the degree of freedom of 40, which was significant at 5% level. It means that the longer is the length of husked grains, the smaller is the standard deviations. Linear regression of length on its standard deviations was calculated as follows; Y=−0.737X−5.253, where Y and X indicate the standard deviations and length, respectively. This formula indicates that the former becomes 0.737 smaller, by becoming 1.000 degree longer the latter (O points, 0.38 in the former and 6.00 *mm* in the latter, respectively).

Correlation coefficient of width on its standard deviations in the whole strains was shown in Table 2. The value was −0.1900 to the degree of freedom of 40, and showed no significant correlation among them even at 5% level.

Correlation coefficient of thickness on its standard deviations in the whole strains was shown in Table 2. The value was −0.3589 to the degree of freedom of 40, which was significant at 5% level. It means that the thicker is the thickness of husked grains, the smaller is the standard deviations. Linear regression of thickness on its standard deviations was calculated as follows; Y=−0.433X−1.849, where Y and X indicate the standard deviations and thickness, respectively. This formula indicates that the former becomes 0.433 smaller, by becoming 1.000 degree thicker the latter (O points, 0.16 in the former and 1.45 *mm* in the latter, respectively).

III. Relation between unhusked and husked grains in view of the standard deviations

Correlation coefficient of standard deviations found in length of unhusked grains on its husked grains in the whole strains was shown in Table 3. The value was −0.1012 to the degree of freedom of 40, and showed no significant correlation among them even at 5% level. Correlation coefficient of standard deviations found in width of unhusked grains on its husked grains in the whole strains was shown in Table 3. The value was −0.0028 to the degree of freedom of 40, and showed no significant correlation among them even at 5% level.

Correlation coefficient of standard deviations found in thickness of unhusked grains

Table 3. Correlation coefficients and linear regressions of standard deviations of husked (Y) on unhusked (X) grains. O points; 0.20 and 0.16 in unhusked and husked grains, respectively, in view of grain thickness

Character	Correlation coefficient	d.f.	Linear regression
Length	–0.1012	40	–
Width	–0.0028	40	–
Thickness	–0.4251**	40	$Y=-0.344X-5.758$

**; significant at 1% level.

on its husked grains in the whole strains was shown in Table 3. The value was -0.4251 to the degree of freedom of 40, which was obviously significant at 1% level. It means that the larger is the standard deviations of unhusked grains, the smaller is the standard deviations of husked grains. Linear regression of standard deviations of unhusked grains on it of husked grains was calculated as follows; $Y=-0.344X-5.758$, where Y and X indicate the standard deviations of husked and unhusked grains, respectively. This formula indicates that the former becomes 0.344 smaller, by becoming 1.000 degree larger the latter (O points, 0.16 in the former and 0.20 in the latter, respectively).

Discussion

As mentioned already in the previous paper[3], 42 strains of wild rice, *Oryza sativa* var. *spontanea* ROSCHEV. and *O. perennis* MOENCH, were collected in this trip and used for the morphological investigations in the unhusked and husked grains. Comparative studies of data reported in the previous paper were looked upon as one of the most important characters for ecotypic differentiation of them in the view of evolution of wild rice in the Ganga Plains or the Hindustan Plain. So in this paper, succeeding to the previous paper[4], the comparison of these has been mainly described.

1) Correlation coefficients between length, width and thickness of unhusked on husked grains showed very high correlations among them at 0.1% level[2]. So, it seemed to be reasonable that correlation coefficients of ratios of length to width, of length to thickness and of width to thickness, of unhusked on husked grains showed also very high correlation among them at 0.1% level, as mentioned in the present paper. These relations are going to be clarified by the detailed analyses.

2) It was clearly ascertained that some strains were always observed to have been deranged from the standard pattern to put themselves into exceptional regions for several characters; for example, No.6, collected in road-side pond near Darbhanga (4.99 in unhusked grain and 4.82 in husked grain for L/T values, respectively; 1.68 in unhusked grain and 1.83 in husked grain for W/T values, respectively), No.26, collected in road-side swamp near Faizabad (3.76 in unhusked grain and 3.39 in husked grain for L/W values, respectively). Whole strains mentioned above belong to *O. perennis*.

In view of the variety specificity in *O. perennis*, the following facts were ascertained. In the whole correlations mentioned in this paper, 3 strains, No.6, 7 and 18, were distributed nearly in the same regions and the remaining 10 strains formed another group. The former group showed a pattern shown commonly by *O. sativa* var. *spontanea*. Gen-

erally, the latter group showed a pattern different from the one shown by *O. sativa* var. *spontanea*. The strains of the former group were distributed relatively in northern part of the Plains. These findings propose a quite interesting problem concerning the species or variety differentiations, in addition to the geographical relationships. However, as the analyses and conclusion have left several points unascertained, further analysis is to be carried out in earnest.

3) From the view of the origin of the cultivated rice, grain morphology and ecotypic differentiation occupy an important portion[2]. Ecotypic differentiation of the wild species should be, of course, discussed on the several characters of the whole part of plants, *i.e.*, grain, panicle, culm, leaf, root and rhizome. Unfortunately, however, only grain morphology only is available up to this time. So, this item is going to be discussed on the intra-strain's variation, *i.e.*, standard deviations.

So far as data obtained by using grains of the wild species were concerned, intra-strain's variations found in the whole characters seemed to be relatively small among the whole strains collected. As shown in Table 2, almost all the correlation coefficient were noted to be negative, and moreover half of them were statistically significant at 1% or 5% levels. It means that the larger is the practical values, the smaller is its standard deviations, *i.e.*, intra-strain's variation. In other words, the larger is the grain, the more stable is the character, too. Those tendencies were clearer in husked grains than in unhusked grains. On this hypothesis, some conclusive considerations are going to be published in the future papers after analyses were carried out, using the materials collected during the present trip and in other countries.

Summary

During the trip from October to December, 1971, in the Ganga Plains, 42 strains of wild rice species, *Oryza sativa* var. *sponianea* ROSCHEV. and *O. perennis* MOENCH, were collected. Succeeding to the previous papers, some comparisons of the data obtained in unhusked and husked grains were mainly described. The results obtained here were summarized as follows:

1) Correlation coefficients of three characters, .*e.*, ratios of length to width, of length to thickness and of width to thickness, of unhusked on husked grains were +0.8541, +0.7837 and +0.5062, respectively, and the whole of these showed very high correlations among them at 0.1% level.

2) Correlation coefficients of three characters, *i.e.*, length, width and thickness of unhusked grains, and those of the practical values on their standard deviations were +0.2667, −0.2761 and −0.4526, respectively. The last one showed significant correlation among them at 1% level. Those in husked grains were −0.3005, −0.1900 and −0.3589 in the same order, respectively. The first and the last ones showed significant correlations among them at 5% level.

3) Correlation coefficients of three characters, *i.e.*, standard deviations of length, width and thickness of unhusked on their husked grains were −0.1012, −0.0028 and −0.4251, respectively. The last one showed significant correlation among them at 1% level.

4) Species and ecotypic differentiations were extensively discussed in view of the intra-strain's variations and geographical relations.

References

1) Chang, T. T.: Exploitation of useful gene pools in rice through conservation and evaluation. *SABRAO Journal*, **8**, 11–16 (1975)
2) Katayama, T. C.: Distributions and some morphological characters of the wild rice in the Ganga Plains (PART III). *Mem. Fac. Agr. Kagoshima Univ.*, **18**, 1–27 (1973)
3) Katayama, T. C., Watabe, T. and Kuroda, T.: Distributions and some morphological characters of the wild rice in the Ganga Plains (PART I). *Pre. Rep. Tottori Univ. Sci. Survey, 1971*, **1**, 1–47 (1972)
4) Katayama, T. C. and Kuroda, T.: Distributions and some morphological characters of the wild rice in the Ganga Plains (PART II). *Pre. Rep. Tottori Univ. Sci. Survey, 1971*, **2**, 19–70 (1974)
5) Ramiah, K. and Ghose, R. L. M.: Origin and distribution of cultivated plants of south Asia – Rice. *Indian J. Genet. Plant Breed.*, **11**, 7–13 (1951)
6) Sampath, S. and Govindaswami, S.: Wild rice of Orissa – their relationship to cultivated varieties. *Rice News Teller*, **6**(3), 17–20 (1958)