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COMPARISON OF DNA CONTENT PER NUCLEUS BETWEEN JAPANESE AND U.S. VARIETIES OF COMMON WHEAT

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Synopsis. The microspectrophotometrical study was carried out on the relative amount of nuclear DNA of ten Japanese and 15 U. S. varieties of common wheat. The result showed no difference in DNA content per nucleus among all varieties tested, indicating that changes in the amount of nuclear DNA might, if any, have had a minor significance in the improvement of common wheat.

Recent improvement in techniques and equipments for microspectrophotometry has permitted a detailed comparative study of nuclear DNA content among related plant species. BHASKARAN and SWAMINATHAN (1960) were first to report the DNA content per nucleus in di-, tetra- and hexaploid *Triticum* species. PAI *et al.* (1961) found that considerable DNA diminution had taken place in the evolution of polyploid wheat. Contrary to it, REES (1963) and REES and WALTERS (1965), who carried out the same work as PAI *et al.*, have arrived at a quite different conclusion, namely that no diminution of nuclear DNA had taken place. They found an additive relationship of nuclear DNA content between the analysers and their amphidiploids, using di-, tetra- and hexaploid wheat and the analysers, *Aegilops speltoides* and *Ae. squarrosa*. UPADHYA and SWAMINATHAN (1963), however, found again a diminution of DNA in polyploid wheat, though at a lesser extent than found by PAI *et al.* The present authors measured the relative amount of DNA per nucleus in artificially synthesized 6 x wheats and their parental species. Our result is in good agreement with that of REES (NISHIKAWA and FURUTA, unpublished). In the present paper, the result of our further comparative study is reported on the relative amount of nuclear DNA of Japan and U. S. varieties of common wheat.

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Materials and Method

Ten Japanese and 15 U. S. varieties of common wheat listed in Table 1 were provided by Dr. K. TSUNEWAKI, Kyoto University.

After soaking the seed in water for four hours at room temperature, the embryos were excised,fixed in Farmer's solution,embedded in paraffin and sectioned longitudinally at twelve micron thickness. On each slide paraffin ribbons of four varieties were placed side by side along with that of Chinese Spring as control. For Feulgen staining the procedure elaborated by SIBATANI and NAORA (1952) was adopted. Microspectrophotometrical measurements of DNA were made at the wave length of 550 mμ by Naora's method (NAORA, 1955) using Olympus MSP A-IV. The experiment was carried out in three replications. Ten spherical nuclei of nearly the same size were selected for measurement per variety per replication. Measurement obtained were adjusted to the value of Chinese Spring on each slide.

Results and Consideration

Mean DNA content per nucleus of 25 varieties are given in Table 1. The results of analysis of variance are summarized in Table 2. It should be noted that variance between replicates is significant at the 5% level. This may be due to variation in color intensity among separately treated slides, which is also the main source of error. Color development in Feulgen staining is known to be affected very sensitively by the duration and/or temperature of HCl hydrolysis, and especially by

the pH of Schiff's reagent (ISHIDA, 1959). Accordingly, all materials should be treated together for comparison, if possible, to minimize this kind of error. On the other hand, variance between varieties is by no means significant. This shows that all varieties tested had the same amount of nuclear DNA. It should be emphasized that U.S. varieties tested include not only old but also recently improved ones, while Japanese varieties are old local ones. All these facts suggest that improvement, no matter whether obtained by modern breeding technique or unconscious selection, might have been accomplished in terms of molecular changes of DNA or mutations and their recombination but not by those in the amount of nuclear DNA which might, if any, have had a minor significance in the improvement of common wheat.

Table 1. Mean DNA content (arbitrary unit) per nucleus in Japanese and U.S. varieties of common wheat.

N.I.G. No.	Japanese variety	DNA cont.	C.I. No.	U.S. variety	DNA cont.
1501	Abura-komugi	1.374	1744	Genesee Giant	1.363
1502	Aka	1.369	3326	Currell	1.362
1503	Akabôro No. 1	1.365	3365	Pried Genesee	1.363
1504	Akabôshi	1.365	3384	Democrat	1.364
1505	Akabôzu	1.367	3436	Gipsy	1.370
1506	Akabôzu No. 1	1.354	6223	Chinese Spring*	1.353
1507	Akabôzu Taka No. 34	1.345	6990	Michikof	1.362
1508	Akabungo	1.350	6999	Fulhio	1.370
1509	Akatake No. 1	1.418	7359	Oregon Zimmerman	1.347
1510	Akadaruma	1.358	7364	Regal	1.348
			7370	Reliance	1.354
			13634	(unknown)	1.351
			13667	Improved Triumph	1.350
			13669	Super Triumph	1.360
			13701	Knox 62	1.362

* see Sears (1954)

Table 2. Analysis of variance of DNA content per nucleus in Japanese and U.S. varieties of common wheat.

Source	Sum of square	d.f.	Mean square	F-value	P
Between varieties	0.145	24	0.006	1.50	>0.05
Between replicates	0.207	50	0.004	2.00	0.01～0.05
Error	1.351	675	0.002		

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日米パンコムギ品種間における核当りDNA量の比較

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摘　要

日本のコムギ在来品種10品種および米国の新旧15品種 (C.I. No. 1744～13701) について，顕微分光測光法により核当りDNA量を測定し比較した。その結果，核当りDNA量について，供試25品種の間に有意な差は認められなかつた。このことから核当りDNAの量的変化は，少くともパンコムギの品種改良に対して，ほとんど重要性をもつていなかつたと推論される。

STUDIES ON THE BREEDING OF RICE VARIETIES RESISTANT TO STRIPE DISEASE

II. Genetic Study on Resistance to Stripe Disease in Japanese Upland Rice

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Synopsis. Data on the seedling reaction of four hybrids between resistant Japanese upland rice and susceptible paddy varieties showed that stripe disease resistance in Japanese upland varieties is controlled by two pairs of complementary dominant genes, St_1 and St_2. This result suggests that in a backcross breeding program for incorporating stripe disease resistance to paddy rice varieties the selection of resistant seedlings in B_1F_1 generation will effective.

Introduction

Rice stripe disease is one of the most serious diseases affecting rice production in southwestern Japan. At present, there is no effective practical control method against this disease. The breeding and planting of resistant varieties appear to be the principal and the most economical means of controlling stripe disease.

An extensive screening test done by SAKURAI and EZUKA (1964) and YAMAGUCHI *et al.* (1965) revealed that some Japanese upland rice varieties and also several foreign varieties were highly resistant to stripe disease. On the contrary, no varieties among Japanese paddy rice were found to be resistant to the malady. In part I of this series (WASHIO *et al.* 1967), it was stated that the resistance in the Japanese upland varieties is stronger and more stable than the resistance in the introduced varieties. Furthermore, the former has more resemblance to the Japanese paddy rice varieties in morphological and genealogical properties. It is for these differences that the Japanese upland varieties are considered better than the foreign ones for use as source of resistance in a hybridization program.

In the breeding program in which the distantly related varieties are to be used, adequate information of the genetic behavior of the resistance gene or genes are highly useful. The present report deals with the mode of inheritance of resistance to stripe disease in Japanese upland rice varieties.

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Materials and Methods

Upland rice varieties used as resistant parents were Kuroka, Kanto Mochi No. 70, Norin No. 11 and Hatanishiki. Kuroka is one of the native varieties in Japan. Kanto Mochi No. 70 is a promising strain from a hybrid with paddy rice. Norin No. 11 and Hatanishiki are improved varieties from cross between the native upland varieties. Paddy varieties, Kibiyoshi and Yuukara, were used as susceptible parents.

Seedling reaction to stripe disease was determined by following the seedling test devised by SAKURAI *et al.* (1963). The outline of this method was given and described in part I of this series. The results obtained by using this method were found to be more or less influenced by number and age of insect for inoculation and also by the ratio of the viruliferous individuals involved in the test. The testing of parents, F_1s and the segregating generations, except for cross No. 4, were therefore conducted in one season in order to have similar environmental and other factors that might influence the experiment.

The history and the number of plants tested for parents and hybrids of each cross are presented in Table 1.

It was earlier reported by the authors that the symptom types of the affected seedlings with this method corresponded with the degree of resistance to the disease. Accordingly, in this paper, the seedlings were clas-