WHEAT INFORMATION SERVICE

Fig. 1

Fig. 2

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Laboratory of Genetics
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I. Research Notes

Mode of production and properties of a *Triticale*-strain with 70 chromosomes

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For several years the present writer has been working with strains of *Triticale* ($2n=56$), representing a summation of the chromosome complements of *Triticum vulgare* ($2n=42$) and *Secale cereale* ($2n=14$). The best ones of these *Triticale*-strains have a rather satisfactory yield and other favourable properties though none of them is yet sufficiently good to be in practical use. As tetraploid strains of rye have been found to be quite vigorous and productive and two of them have already been released to the farmers, it seemed desirable to produce *Triticale*-types with 70 chromosomes, representing a combination of wheat and tetraploid rye ($42+28=70$).

At first, however, this work was quite unsuccessful, owing to the fact that the primary cross, wheat × tetraploid rye, in spite of repeated attempts, gave a completely negative result. This may be caused by a lower rate of growth of the pollen tubes of tetraploid rye as compared with the pollen tubes of diploid rye.

However, the desired result was obtained by crossing different strains of *Triticale* ($2n=56$) with diploid rye. In spite of the large difference in chromosome number this cross succeeds fairly easily and gives viable seeds. It is also possible to cross *Triticale* and tetraploid rye. After colchicine treatment of plants representing the first-mentioned hybrid combination a strain with 70 chromosomes was obtained. This strain really represents a combination of ordinary *vulgare*-wheat and tetraploid rye, but of the two rye genomes in the primary hybrid one came through the female parent, the other one through the pollen.

From a practical point of view the 70-chromosome *Triticale*-strain is a complete failure, vigour and especially fertility being quite poor. Moreover, the cytological stability is very unsatisfactory, and the strain shows a marked tendency to revert to lower chromosome numbers. Thus, meiosis must be highly irregular. If further strains, representing the same genomatic combination, behave in a similar way, this indicates that four rye genomes cannot co-operate successfully with the genomes of hexaploid wheat. *Triticale*-types with 42 chromosomes (tetraploid wheat + diploid rye), at least under Swedish conditions, also have much poorer fertility than 56-chromosome *Triticale*-strains with 6 wheat and 2 rye genomes. These facts seem to indicate that the ratio of wheat to rye genomes may be important for the fertility of the *Triticale*-types. If the wheat genomes are numerous in relation to the rye genomes, the *Triticale*-types are fairly fertile, but if the relative proportion of rye genomes is increased this will on an average have deleterious consequences.

A genetic analysis of self-sterility in rye, *Secale cereale* L.

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Within 15 S_1-progenies of diploid Steel-rye, a well-known Swedish commercial variety, genetics of self-incompatibility has been studied by means of selfings, intercrosses, and reciprocal backcrosses to the corresponding parent plant, forced through repeated cloning to a second-year flowering. In all, 170 plants have been studied in 276 crossing combinations. Degree of seed setting on selfing shows a strong positive correlation between parent plants and corresponding S_1-progeny groups ($r=+0.77$). The percentage of compatible crosses in the different crossing combinations tried are summarized in the table.

Crossing combination				Percentage
Intercross	BC+	×	S_1	82
Backcross	S_1	×	P	77
Intercross	S_1	×	BC−	74
〃	S_1	×	S_1	59
〃	S_1	×	BC+	54
〃	BC−	×	S_1	11
Backcross	P	×	S_1	0

(BC+ = female compatible with the parent plant;
BC− = 〃 incompatible 〃 〃 〃 〃)

The results obtained indicate that self-incompatibility in Steel-rye is controlled by two multiallelic incompatibility loci, identity at both loci being necessary for full incompatibility. The fact that self-incompatibility in rye is practically unimpaired after chromosomal doubling, may be considered to indicate a sporophytic control of incompatibility. The analysis has been carried on, however, especially in backcross progeny groups (from S_1-plants compatible as mother with their corresponding parent plant) and the number of inter-compatible groups within such a progeny has in all cases indicated that the reaction of the pollen in question (from the parent plant) has not been uniform. In four out of five cases analysed, the number of inter-compatible, intra-incompatible groups has been three, exactly the number expected if the parent plant is assumed to be heterozygous in two incompatibility loci with gametophytic control of incompatibility, and the corresponding S_1-plant homozygous in one or both of them. The remaining case has given only two inter-compatible groups.

In the case of sporophytic control of incompatibility, the pollen reaction being uniform, 4 and 6 inter-compatible groups could be expected in the progeny, if the pollinated S_1-plant is assumed to be homozygous in both or only one, respectively, of the incompatibility loci. Therefore, the hypothesis seems probable that self-incompatibility in Steel-rye is *gametophytically* controlled by two multiallelic self-incompatibility loci. In such case, the haploid pollen, already, will have had an opportunity of becoming adapted to carry more than one allele without disturbing allelic interaction, and this will obviously be enough to account for the self-incompatibility being unimpaired after chromosomal doubling in rye.

Results of crossing experiments between *Triticum* and *Secale*

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	♀ \ ♂	*S. cereale*	*S. Vavilovii*	*S. montanum*	*S. africanum*
Dinkel	*T. vulgare*	++++[1] amph.	++++	+++	+++
	T. compactum	+++ amph.	++++ amph.	++	++ amph.
	T. sphaerococcum	++	+++	+++ amph.	++ amph.
	T. Macha	++ amph.	++	++ amph.	++ amph.
	T. Spelta	+	+		+ amph.
Emmer	*T. durum*	+	−	+++ amph.	++ amph.
	T. turgidum	+ amph.	−	++ amph.	++ amph.
	T. persicum	+ amph.	−	++ amph.	+++ amph.
	T. pyramidale	+ amph.	−	+	+ amph.
	T. dicoccum var. *atratum*	+	+	++	+ amph.
	T. polonicum	−	−	++	+ amph.
	T. orientale	−	−		
	T. dicoccoides	+	−		
Timopheevi	*T. Timopheevi*	+	−	+	+++
Einkorn	*T. aegilopoides*	−	−		−

1) Crossability is denoted by the number of + symbols which indicate the proportion of surviving F_1 plants to pollinated flowers in %: ++++, more than 20%; +++, (10∼19)%; ++, (1∼9)%; +, less than 1%; −, zero. amph.=amphidiploid has been obtained.

Source of materials:

T. dicoccum var. *atratum* and *T. vulgare* from Gumma Agricultural Experiment Station.

T. compactum, *T. Spelta*, *T. durum*, *T. turgidum*, *T. polonicum*, *T. Timopheevi*, *T. aegilopoides* and *S. cereale* from Utsunomiya Agricultural College.

T. sphaerococcum, *T. Macha*, *T. dicoccoides*, *T. pyramidale*, *T. orientale* and *T. persicum* from Kyoto University (Faculty of Agriculture).

S. africanum and *S. montanum* from Dr. A. MÜNTZING (Lund University).

S. Vavilovii from Montreal Botanical Garden of Canada (through kindness of Mr. T. KAWATANI).

Inheritance of leaf rust reaction among the eight differential varieties of wheat

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All eight of the leaf rust differential varieties have 21 pairs of chromosomes and intercross readily. Malakof, Democrat, Hussar and Mediterranean have a winter habit of growth and Carina, Loros, Webster and Brevit have a spring habit of growth. All possible crosses have been made among the eight varieties and to Pawnee and Wichita winter wheats. The study is divided into three phases; 1) conventional genetic procedure studying the response of the F_1, F_2 and F_3 generations, 2) monosomic analysis, and 3) transferring the rust resistant factors of the eight differential varieties into a common genetic background by backcrossing to Wichita, a variety susceptible to all races of leaf rust for which it has been tested.

Studies made to date on seedling reaction indicate that one or two factors generally explain the difference in reaction between any two varieties. Generally when the reaction of the resistant parent is of a high type (0; zero fleck) and susceptible parent a 4-type the F_1 reaction is intermediate but of a resistant reaction (2 or 2+ response). The only case of complete dominance observed so far has been in the cross Webster × Mediterranean. Webster is highly resistant to race 5 and the F_1 reacts like Webster and in the F_3 segregating lines the ratio is 3 highly resistant to one susceptible. Mediterranean and Democrat have similar response to all races and in the progeny from this cross no segregation was observed in F_3 lines for the races used, indicating that those two varieties have the same factors for resistance. Brevit and Carina have similar responses but for reaction to race 9 they appear to have different alleles. Brevit and Hussar have a similar reaction to race 9 probably due to two factors closely linked. In tests involving Pawnee winter wheat the same factor governs resistance to races 9, 10, 11, 13, 19, 20, 31 and 93. It has been shown by monosomic analysis that the factor for resistance to race 9 of Pawnee is located on chromosome X.

The F_1 generation of Carina and Webster crossed with the 21 Chinese monosomics indicated that resistance of both varieties to race 15 was dominant and no monosomic analysis of rust reaction was possible in the F_1 generation. The F_2 generation of Carina × Webster gave no segregation for reaction to race 5. This is as far as the monosomic analysis for leaf rust inheritance has progressed.

First and second backcrosses are now being made to Wichita. Several more backcrosses to Wichita will be made before detailed studies of leaf rust reaction will be attempted. The response of Carina, Brevit and Hussar to some races is variable, probably due to environment. It will be of particular interest to study the response of the Wichita backcross material when the factors of these three varieties have been transferred to a common genetic background.

Reaction of *Aegilops* and *Triticum* to *Puccinia graminis* PERS. and *Puccinia glumarum* ERIKS. et HENN.

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Species or variety	Reaction[1]	
	Puccinia graminis f. sp. *Tritici* 11	*Puccinia glumarum* f. sp. *Tritici* 31
Aegilops biuncialis	S	S
Ae. umbellulata	MR-S	MR-S
Ae. ovata-1	S	MR
Ae. ovata-2	R-MR	R-MR
Ae. triaristata-1	S	R
Ae. triaristata-4	MR-S	S
Ae. triuncialis-1	S	R
Ae. triuncialis-3	R-MR	R
Ae. triuncialis-5	R	R
Ae. variabilis-1	S	MR
Ae. Kotschyi-1	S	MR-S
Ae. Kotschyi-3	S	MR-S
Ae. columnaris-1	R	MR
Ae. caudata-1	S	S
Ae. cylindrica-1	MR	S
Ae. cylindrica-2	S	S
Ae. comosa	S	

1) R: resistant; MR: moderately resistant; S: susceptible.

— Continued —

Ae. uniaristata–1	S	R
Ae. uniaristata–2	MR–S	R
Ae. speltoides–2	R	R
Ae. bicornis	S	MR–S
Ae. bicornis 4*x*	S	
Ae. longissima–1	S	MR–S
Ae. sharonensis	R–MR	
Ae. squarrosa–1	S	MR–S
Ae. squarrosa–2	S	MR–S
Ae. squarrosa–2 4*x*	S	MR–S
Ae. crassa 4*x*	S	S
Ae. crassa 6*x*	S	S
Ae. ventricosa	S	S
Ae. caudata × *Ae. umbellulata* (KONDO–26)	R–MR	MR–S
Ae. sharonensis × *Ae. umbellulata*–2	S	S
Triticum monococcum var. *vulgare*	S	S
T. monococcum (early)	R	MR–S
T. monococcum (Himeji)	S	S
T. monococcum C. I. 2433 (Einkorn)	S	S
T. aegilopoides var. *boeoticum*	S	S
T. dicoccoides var. *spontaneonigrum*	S	
T. dicoccoides var. *Straussianum*	S	S
T. dicoccoides var. *Kotschyanum*	S	
T. dicoccum var. *liguliforme*	S	S
T. dicoccum (Khapli)	R	MR
T. dicoccum (Vernal)	R	R
T. durum var. *coerulescens*	S	S
T. durum var. *Reichenbachii*	S	S
T. durum (Arnautka)	S	S
T. durum (Mindum)	S	S
T. durum (Acme)	S	S
T. turgidum var. *nigrobarbatum*	S	S
T. polonicum var. *vestitum*	MR–S	S
T. persicum var. *stramineum*	MR–S	S
T. pyramidale var. *recognitum*	MR–S	S
T. orientale	S	S
T. Timopheevi–1	R	S
T. Timopheevi–2	R	S
T. Timopheevi–3	MR	S
T. Spelta (Sahara)	S	S

— Continued —

T. Spelta (Kopenhagen)	S	S
T. vulgare (Antaguro)	S	S
T. vulgare var. *graecum*	R	S
T. vulgare var. *ferrugineum*	MR–S	S
T. vulgare var. *erythroleucon*–1	S	S
T. vulgare var. *erythroleucon*–2	S	S
T. vulgare var. *erythrospermum*	MR–S	S
T. vulgare (Hohenheim)	S	MR–S
T. vulgare (Marquis)	S	S
T. vulgare (Reliance)	S	S
T. vulgare (Kota)	S	MR–S
T. vulgare (Timstein)	R	S
T. compactum	S	
T. sphaerococcum var. *rotundatum*	S	MR–S
T. sphaerococcum var. *rubiginosum*	S	S
T. Macha	MR–S	S
(Illinois × Chinese) × *T. Timopheevi*	R	
T. dicoccoides var. *spontaneonigrum* × *Ae. squarrosa*–2	S	
(*T. dicoccoides* var. *spontaneonigrum* × *Ae. squarrosa*–2) × *T. Spelta*	S	
T. durum var. *coerulescens* × *Ae. squarrosa* (1 × 2)	S	
T. persicum var. *fuliginosum* × *Ae. squarrosa*–2	S	
(Mindum × *Agropyron trichophorum*) × Red Chief	R	

Chromosome pairing in hybrids between *Aegilops sharonensis* and some species of *Aegilops* and *Triticum*

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Chromosome pairing and fertility of the hybrids are listed in Table 1.

In *Ae. sharonensis* × *Ae. longissima* and the reciprocal hybrid, the chromosome pairing was the regular of the investigated combinations. However, one tetravalent was found in every PMC, and rarely one univalent. The pollen- and seed-fertility were practically normal: 81.3–87.1% and 81.8–86.0%, respectively. The outer glumes of *Ae. sharonensis* are awned but those of *Ae. longissima* are not. The hybrids are awnless. The F_2 segregated in awnless : awned in the proportion of 38:12. In the backcrosses the segregation was 29:0 in F_1 × *Ae. longissima*, and 12:9 in F_1 × *Ae. sharonensis*.

Table 1. Chromosome pairing and fertility in F_1 hybrids of *Aegilops sharonensis* with some species of *Aegilops* and *Triticum*

Combinations	Bivalents	Univalents	Complexes	Fertility Pollen in %	Fertility Seed in %
Ae. sharonensis × *Ae. longissima*	5	0—1	1_{IV} or 1_{III}	81.3	81.0
Rec.	5	0—1	1_{IV} or 1_{III}	87.1	81.8
Ae. sharonensis × *Ae. bicornis*	6—7	0—2	0	73.3	61.9
Ae. sharonensis × *Ae. Aucheri*	4—7	0—6	0	3.6	0.0
Rec.	3—7	0—8	0	3.5	0.0
Ae. sharonensis × *Ae. caudata*	2—5	2—10	2_{III}	0.0	0.0
Ae. sharonensis × *T. turgidum*	0—4	0—21	—	0.0	0.0
Ae. sharonensis × *T. monococcum*	1—4	6—12	0	0.0	0.0

In the hybrid *Ae. sharonensis* × *Ae. bicornis* the chromosome pairing was fairly regular but a few univalents were found. Pollen- and seed-fertility were high. But the plants were dwarf-like and weak.

In the hybrid *Ae. Aucheri* × *Ae. sharonensis* and its reciprocal more univalents were found than in the hybrid between the latter and other species of S-group. Pollen fertility was very low (3.5%) and no seed, even from open pollination, was obtained. The plants were semi-dwarfs. These results suggest that the genome of *Ae. sharonensis* is homologous to that of *Ae. longissima* (S^1-genome), except for one translocation. Accordingly, from the view point of genome analysis, *Ae. sharonensis* may be considered to be a variety of *Ae. longissima*.

According to Eig (1929), *Ae. sharonensis* is closely related to *Triticum*. Unpublished data of the present writer and Matsubayashi indicate that *Ae. longissima* and *Ae. sharonensis* have, some morphological characteristics of the B-genome of Emmer- and Dinkel-wheats. However, the chromosome pairing in the hybrids of *Ae. sharonensis* with *T. monococcum* and *T. turgidum* is so incomplete that S^1-genome cannot be homologous to B-genome.

A new amphidiploid from the hybrid *Ae. sharonensis* × *Ae. umbellulata*

By Masatake Tanaka
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According to Kihara, the genome formula of *Ae. variabilis* and *Ae. Kotschyi* is $C^uC^uS^vS^v$.

The present writer has produced an amphidiploid from the cross *Ae. umbellulata* (C^uC^u) × *Ae. sharonensis* (S^1S^1). In 1950, very young seedlings of the F_1 hybrid *Ae.*

sharonensis × *Ae. umbellulata* were subjected to colchicine treatment. In 1951, 12 out of 20 treated plants showed chromosome doubling. The chromosome pairing and the percentage of pollen- and seed-fertility of the F_1 hybrid are given in Table 1.

Table 1. Chromosome pairing and fertility of the F_1 hybrid

Combination	Bivalents	Univalents	Complexes	Fertility Pollen in %	Fertility Seed in %
Ae. sharonensis × *Ae. umbellulata*	1—5 (3)	5—11	-1_{III}, 1_{IV} or $1_{IV}+1_{III}$	3.0	0.0

The fertility of the amphidiploids is given in Table 2.

Table 2. Fertility of the amphidiploids

Culture No. (1951)	Fertility Pollen in %	Fertility Seed (No. of seeds) in %
64—1	—	46.2 (11)
—2	—	56.5 (77)
—3	—	6.5 (3)
—4	—	60.7 (34)
—5	85.1	36.0 (17)
—6	86.7	44.6 (33)
Average (Total)	85.9	41.8 (175)

Table 3. Chromosome pairing and fertility of the amphidiploids

Year	Bivalents	Univalents	Complexes	Fertility Pollen in %	Fertility Seed in %
1952	13—14 (14)	0—2 (0)	0	82.1	77.1
1953	12—14 (14)	0—2 (0)	1_{IV} (rarely)	88.3	70.2
1954	14	0	0	94.0	62.0

Data on chromosome pairing and fertility of seed and pollen in the amphidiploids from 1952 to 1954 are summarized in Table 3.

Reciprocal crosses between the amphidiploid ($S^1S^1C^uC^u$) and *Ae. variabilis* were made for testing the chromosome homology (Table 4). The chromosome pairing of these hybrids was almost normal; 9–14 (mode at 13) bivalents were observed. Complexes were found in all individuals. Pollen-fertility was 65–75% and seed-fertility also was relatively high. A cross between $S^1S^1C^uC^u$ and *Ae. ovata* ($C^uC^uM^oM^o$) produced only sterile dwarfs. From these results it became clear that the genomes of *Ae.*

Table 4. Chromosome pairing and fertility of $S^1S^1C^uC^u \times$ *Ae. variabilis* and its reciprocal

Combinations	Bivalents	Univalents	Complexes	Fertility Pollen in %	Fertility Seed in %
$S^1S^1C^uC^u \times$ *Ae. variabilis*	9–14 (13)	0–4 (2)	(0–2) III,IV	71.5	50.0
Rec.	9–14 (13)	1–4 (2)	(0–2) III,IV	72.7	44.5

variabilis are homologous to those of the amphidiploid.

Ae. variabilis and *Ae. Kotschyi* must have arisen as an amphidiploid between *Ae. umbellulata* with C^u-genome and *Ae. sharonensis* with S^1-genome in the course of evolution.

According to EIG (1929), *Ae. umbellulata* and *Ae. sharonensis* are separately distributed. There are, however, three modifications of the S-genome (S, S^1, S^b) in the S-group. Some of them (f. inst. S-genome in *Ae. speltoides* and *Ae. Aucheri*) occur together with *Ae. umbellulata* in Asia Minor and Syria. One of them may have been the genome of one of the parents.

From the taxonomic view point, the amphidiploid ($S^1S^1C^uC^u$) resembles *Ae. Kotschyi* in main morphological characters. But, in some characteristics, the synthesized $S^1S^1C^uC^u$ is different from *Ae. Kotschyi* and *Ae. variabilis*, for example, regarding the number of spikelets in the ear, shape of the awn, etc.

Right- and left-handedness in *Triticum* and *Aegilops*. I.

By H. SUEMOTO and K. KOJIMA
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1. Description of the right- and left-handedness as a quantitative character:

Right-handed and left-handed leaves are defined according to the way of folding, namely when the overlapping edge of a leaf, seen from outside, is on the right hand of the observer, it is called right-handed, and if on the left hand, left-handed. Correspondingly, the right- or left-handedness of a spikelet is determined by the position of the first floret in the spikelet. Namely, a spikelet seen from its dorsal side is right-handed, when the first floret is on the right, and left-handed when it is on his left hand (KIHARA et al. 1951). The right-handed and left-handed leaves are regularly arranged in alternative sequence from the base up to the flag leaf and the same regularity is found in the spikes. The regularity is not always complete, deviations occur often in the upper part of spikes and in the lower positions of leaves (such as the 1st, 2nd and 3rd leaves). The regularly arranged leaves or spikelets are called "concordant" and the deviating "discordant".

2. Measurement of the right- and left- handedness...... Concordance proportion (C) and mean concordance proportion ($\bar{C}$):

A. Concordance proportion...... If a variate X_i is assumed to have the value 1 in case of a concordant leaf or spikelet and 0 in that of a discordant one, the concordance proportion of the kth position of leaf or spikelet (C_k) is $\overset{n}{\underset{i=1}{S}}(X_i/n)$ where n is the number of shoots investigated.

The expected standard error of C_k is $\sigma_{ok}=\sqrt{C_k(1-C_k)/n}$

This value represents the degree of the regularity or the intensity of the polarity at the given position on the stem (SUEOKA and MUKAI 1955).

B. Mean concordance proportion...... The use of the concordance proportion was frequently found to be inconvenient as a measure of species differences with regard to the right- and left-handedness and troublesome in its genetic analysis. KOJIMA (1953), therefore, proposed a more convenient value, i.e. mean concordance proportion ($\bar{C}$). The value is expressed by $\bar{C}=\sum_{k=1}^{m} C_k/m$

where C_k is the value of concordance proportion at the kth spikelet position and m is the number of spikelets. The sampling variance can be obtained as follows:

$$V_{\bar{c}}=\frac{1}{m^2}\overset{m}{\underset{k=1}{S}} C_k^2-\frac{1}{n}\bar{C}^2$$

3. Change of the degree of regularity throughout the developmental stages:

We have considered that the regularity of the R/L character might be interpreted as an expression of polarity existing throughout the whole development of a grass. An exact observation on the R/L handedness of the leaves and spikelets from the first foliage leaf to the 20th spikelet was made for *T. monococcum flavescens* (Table 1).

Table 1. Concordance proportion for each leaf and spikelet position of main shoots in *T. monococcum flavescens*

Leaf position	I	II	III	IV	V		XIII
$\bar{C}$	48.6	40.5	75.7	97.3	100.0		100.0
Spikelet position	1	2	3	4	5	6	7
$\bar{C}$	93.3	100.0	97.0	98.0	94.0	93.0	93.0
Spikelet position	8	9	10	11	12	13	14
$\bar{C}$	94.0	85.0	92.0	83.0	74.0	77.0	76.0
Spikelet position	15	16	17	18	19	20	
$\bar{C}$	65.0	65.0	62.0	61.0	67.0	55.0	

The results indicate that the regularity appears at the 3rd or 4th leaf's position, is maintained to the 10th spikelet or its vicinity and disappears around 20th spikelet.

Right- and left-handedness in *Triticum* and *Aegilops*. II. $\bar{C}$ values among species of *Triticum* and *Aegilops*

By H. SUEMOTO and K. KOJIMA
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Each species of *Triticum* and *Aegilops* has its own specific value of $\bar{C}$. A certain relation between the $\bar{C}$ value and the genome constitution was found (Table 1).

Genome set AA shows the highest value of $\bar{C}$ (80% or more), DD has about 65%, whereas CC, MM, C^uC^u and S^1S^1 give no indication of regularity, at least in the spike. BB and GG have no polarity, and, also, seem to suppress the effect of AA. Although the values are not highly reliable, because of the small number of samples, the hybrid (AD) between *T. aegilopoides* and *Ae. squarrosa* gives ca. 68% which is similar rather to DD than to AA. These results suggest that the polarity of the right- and left-handedness of the spikes is found only in the A- and D- genomes throughout the examined *Triticum* and *Aegilops* species and that BB and GG suppress the effect of AA.

Table 1. $\bar{C}$ values of the examined species of *Triticum* and *Aegilops*

Species	Genome	Number of spikes observed	Year	$\bar{C}$
Triticum				
(Einkorn)				
T. aegilopoides v. *boeoticum*	AA	108	1952	87.54 ± 0.97
T. monococcum v. *vulgare*	AA	29	1951	94.48 ± 1.23
v. *flavescens*	AA	100	〃	81.11 ± 1.14
v. *vulgare* "early"	AA	20	〃	80.16 ± 3.97
(Emmer)				
T. dicoccum "Emmer"	AABB	25	1954	57.80 ± 2.82
T. dicoccum "French"	AABB	20	〃	55.00 ± 4.26
T. durum v. *Reichenbachii*	AABB	25	〃	53.20 ± 5.58
T. turgidum v. *nigrobarbatum*	AABB	20	〃	53.50 ± 1.49
T. pyramidale v. *recognitum*	AABB	20	〃	54.00 ± 1.23
(Timopheevi)				
T. Timopheevi	AAGG	61	1949	51.10 ± 1.51
(Dinkel)				
T. Spelta v. *Duhamelianum*	AABBDD	35	1954	55.00 ± 2.46
v. *Arduini*	AABBDD	20	〃	58.30 ± 1.20
T. vulgare "Hohenheim"	AABBDD	50	〃	66.20 ± 3.94

— Continued —

T. compactum v. *icterinum*	AABBDD	50	〃	61.40 ± 0.51
T. persicum v. *rubiginosum*	AABBDD	20	〃	59.50 ± 4.49
Aegilops				
(Polyeides)				
Ae. umbellulata	C^uC^u	45	1954	44.10 ± 3.05
Ae. ovata-1	$C^uC^uM^oM^o$	40	〃	50.00 ± 2.33
Ae. triaristata (6x−1)	$C^uC^uM^tM^t$??	35	〃	51.00 ± 1.24
Ae. biuncialis	$C^uC^uM^bM^b$	40	〃	50.50 ± 4.63
Ae. variabilis-1	$C^uC^uS^vS^v$	35	〃	55.10 ± 4.51
Ae. Kotschyi-1	$C^uC^uS^vS^v$	10	〃	77.00 ±10.00
〃 -2	$C^uC^uS^vS^v$	30	〃	50.50 ± 5.49
Ae. triuncialis	CCC^uC^u	40	1954	55.00 ± 4.96
(Cylindropyrum)				
Ae. cylindrica	CCDD	35	〃	56.70 ± 1.21
(Comopyrum)				
Ae. comosa	MM	30	〃	44.80 ± 2.94
Ae. Heldreichi	MM	20	〃	58.00 ± 3.74
(Sitopsis)				
Ae. longissima	S^lS^l	25	〃	56.40 ± 4.26
(Vertebrata)				
Ae. squarrosa	DD	70	1949	67.30 ± 1.57
〃	DD	35	1954	64.30 ± 2.50
Ae. ventricosa	DDM^vM^v	35	〃	69.70 ± 2.31
(Hybrid)				
T. aegil. boeot.	AD F_1	12		68.10
×*Ae. squarrosa*	A′D′ F_2	1		88.20

Gene mutation in Einkorn wheat induced by X-rays

By S. Matsumura and T. Fujii

National Institute of Genetics, Misima

In order to study the relation between the frequency of gene mutations and the dose or wave length of X-rays, dormant seeds of *Triticum monococcum* were exposed to X-rays at 180 KVP, 3 mA, without a filter. The doses ranged from 5,400 to 13,500 *r* units. The data are shown in Table 1. The frequency of head progenies with induced mutations in the X_2-generation increases with X-ray dosage in a linear relation. There was some difference in the sensitivity to X-rays between two varieties, *flavescens* and *vulgare*.

Table 1. Relation between dosage or wave length of X-rays and frequency of induced mutations in *T. monococcum flavescens* and *vulgare*

Voltage (KVP)	Dosage (r)	% of head progenies in X_2 with mutants in var. *flavescens*		var. *vulgare*	
Control	—	0/18	0.00	0/14	0.00
180	5,400	4/60	6.67	5/44	11.36
180	8,100	7/55	12.73	5/26	19.23
180	13,500	10/27	37.04	6/15	40.00
130	8,100	2/55	3.64	4/43	9.31
80	8,100	3/54	5.56	4/46	8.69

At the same dosage (8,100 r) and target distance, but with varying kilovoltage (80-180 KVP) and time of exposure, the mutation frequency was increasing with the decrease of wave length, but not in a linear relation (Tab. 1). As to the difference in sensitivity between the two varieties, the results above mentioned have been confirmed. The relation of mutation rate to X-ray quality was generally in good accord with the results of previous experiments concerned with the frequency of chromosome aberrations (MATSUMURA 1951). These facts can be explained on the basis of the difference in the distribution of ionization within the nuclei and the chromosomes. At irradiation by hard X-rays, the majority of the resulting ionization is more scattered than when soft X-rays are used.

About 70% of the mutants were chlorophyll abnormalities, about half of which were albina and the other half chlorina, virido-albina, basi-viridis, striata (white striped) and so on. The remaining mutants were: early, irregular ear, slender (narrow leaf), dwarf, shrunk, etc. These mutants behaved like simple Mendelian recessives. The virescent mutants with partly green leaves, virido-albina and basi-viridis, mostly died out during the winter in the field, but not in the greenhouse. Moreover, these mutants could recover completely and produce green leaves under the light of a fluorescent lamp.

As to the nature of the mutants, the same types were often observed in both varieties, *flavescens* and *vulgare*, showing a pronounced parallelism. But var. *flavescens* showed always a higher tolerance to X-rays than var. *vulgare*.

Chromosome aberrations in Einkorn wheat induced by X-rays

By Seiji MATSUMURA
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With regard to the relation between the frequency of chromosome aberrations in the PMC's of *Triticum monococcum* and the dose or wave length of X-rays, the same materials reported by MATSUMURA and FUJII in the foregoing paper were used, and the results of previous experiments at 30–90 KVP (MATSUMURA 1951) have been confirmed. The data are shown in Table 1. The frequency of ears with chromosome aberrations (mostly reciprocal translocations) increases with X-ray dose. It is also fairly certain that the shorter the wave length of X-rays, the higher the frequency of chromosome aberrations. These facts can be again explained on the basis of the difference in the distribution of ionization within the nuclei and the chromosomes. The chromosome breaks induced by hard rays are widely scattered on the same chromosome or on different chromosomes, so that a union of broken ends of different origin, or interchange, takes place more easily than in the case with soft-ray irradiation, which produces more closely adjacent breaks, and is liable to give a high proportion of restitution.

Table 1. Relation between dosage or wave length of X-rays and frequency of chromosome aberrations in *T. monococcum flavescens* and *vulgare*

Voltage (KVP)	Dosage (r)	% of chromosome aberration in X_1			
		var. *flavescens*		var. *vulgare*	
Control	—	0/12	0.00	0/7	0.00
180	5,400	3/52	5.77	4/68	5.88
180	8,100	6/48	12.50	8/53	15.09
180	13,500	11/38	28.95	21/55	38.08
130	8,100	5/40	12.50	10/69	14.49
80	8,100	3/40	7.50	3/76	3.95

In all cases of different dosages the frequency of chromosome aberrations was higher in var. *vulgare* than in var. *flavescens*. Thus, var. *flavescens* showed always higher tolerance to X-rays than var. *vulgare*. These results are generally in good accord with those of experiments concerned with the rate of gene mutations described in the foregoing report.

Nucleolus organizing chromosome in Einkorn wheats

By K. YAMASHITA and M. KOYAMA
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The senior author has established a series of six types of reciprocal translocation (RT) in Einkorn wheats, *Triticum aegilopoides* and *T. monococcum*, involving all the seven chromosomes, namely a–b, b–c, c–d, d–e, e–f and f–g. Subsequently, the authors attempted to identify the nucleolus organizing chromosome by using the RT–hetero-zygotes.

Table 1. Relation of ring complex to nucleolus in RT-heterozygotes

RT-complex	Attachment*
a—b	–
b—c	–
c—d	Not yet studied
d—e	+
e—f	–
f—g	–

* +: attached, –: not attached.

Anthers fixed with FARMER's fluid (absolute alcohol: acetic acid= 3:1) were placed in 2% iron-alum solution for the first 24 hours and in 45% aceto-carmine for succeeding 24 hours, before the PMC's were smeared on a slide-glass for cytological observation. Early diakinesis was found to be the proper stage for the analyses.

The results are summarized in Table 1.

The ring complex of four chromosomes in the d—e heterozygote is attached to the nucleolus which is free from the remaining five bivalents, while in each of the other types, a—b, b—c, e—f and f—g, the ring complex is free from the nucleolus, which appears attached to one of the remaining bivalents.

From these observations, it has been concluded that the d-chromosome on which the genes for the mutant characters, old rose, early and lethal-1 are located is the nucleolus organizer.

Chlorophyll analyses in X-ray induced mutants in *Triticum monococcum*

By Kosuke YAMASHITA
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A considerable number of chlorophyll mutants have been reported by SMITH (1939 and elsewhere), KIHARA and YAMASHITA (1947 and elsewhere), YAMASHITA (1953 and elsewhere) and FUJII (1955). These induced mutants have been proved to be Mendelian recessives due to single gene differences.

Leaves taken from mature plants of some of these mutants were macerated in aceton with a small quantity of silicate powder and the extracts were submitted to paperchromatographic analyses of chlorophyll a and b. As the solvent, the upper layer of the mixture of petroleum ether, aceton and water in a ratio of 4:1:1 was used.

As summarized in Table 1, chlorophyll b, is missing in *yg* mutant.

Table 1. Chlorophylls in *T. monococcum*

Material	Chlorophyll a	Chlorophyll b
normal	+	+
tiger-band (*tig*)	+	+
old rose (*old*)	+	+
light-green (*lg*)	+	+
yellow-green (*yg*)*	+	–

* Induced by SMITH (1939).

In order to determine the ratio of chlorophyll a and b in these materials, a method of absorption spectra was adopted for the normals and the yellow-green. The chlorophyll extracts were obtained by grinding leaf cuts in chloroform with a small quantity of silicate powder. It is already known that chlorophyll a shows the maximum peak at 432 mμ and 663 mμ, while chlorophyll b at 456 mμ and 644 mμ.

In advance, model absorption spectra of the mixture of chlorophyll a and b in certain ratios were prepared for comparison. The normals showed a similar curve to that of the model in which chlorophyll a and b were mixed in a ratio of 1:1. In the yellow-green, no peak for chlorophyll b was found and a minor peak appeared at 480 mμ and 630 mμ. Further studies are now in progress.

A karyomorphological study on the genus *Eremopyrum*

By Priyabrata SARKAR

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At present most classifications of the *Gramineae* divide the family into tribes, genera, and species on the basis of the structure and arrangement of the spikelets. However, it appears that morphological studies alone cannot provide all the data necessary for the ideal natural classification aimed at in scientific taxonomy. On the basis of the studies on the morphology of chromosomes and their basic numbers, AVDULOV (1931) attempted to subdivide the grasses from a phylogenetic point of view. Cytological methods were found to be helpful as a tool, but have been put to little use except in the genera *Aegilops* (SENJANINOVA-KORCZAGINA 1932) and *Triticum* (KAGAWA 1929; BHATIA 1938; LEVITSKY et al. 1939; PATHAK 1940; CAMARA 1943; SCHRIMPF 1951 and others). The evolutionary development of *Triticum* can now be partially traced using the method of genome analysis (McFADDEN and SEARS 1946). However, the origin of the B-genome is still unknown and the search for it indicates a need for a better understanding of the wheatgrasses which are in taxonomical disorder. In the present study only one group of species of wheatgrasses will be discussed.

As early as 1829 LEDEBOUR placed *Agropyron cristatum* and *A. triticeum* in a new section *Eremopyrum*. Later JAUBERT and SPACH (1850–53) gave *Eremopyrum* a generic status and included in it the annual species *orientale* and *squarrosum*. The recognition of *Eremopyrum* as a separate genus was helpful in making it possible for others to put the annual wheatgrasses in one separate group.

In recent years the Russian taxonomist NEVSKI (1936) has attempted to clarify the position of the wheatgrasses and their relatives. According to his classification, the content of the genus *Agropyron* in its wider sense has been separated under three more genera, viz., *Roegneria*, *Elytrigia*, and *Eremopyrum*. He places the genus *Eremopyrum* in the subtribe *Aegilopinae* along with *Triticum*, *Secale*, *Aegilops*, *Haynaldia*, and other annuals.

Morphologically the species under the genus *Eremopyrum* (*E. triticeum*, *E. hirsutum*, *E. Bounapartis*, *E. orientale*, and *E. distans*) seem to form a homogeneous group. To find a correlation at the cytological level, the karyotype analyses of the available species of this group have been undertaken. The results are summarized below.

The karyotype of *Eremopyrum triticeum* ($2n=14$) has been found to be very different from all other groups of *Triticeae* that have so far been investigated. All of its chromosomes show subterminal centromeres with one of the arms reduced to a knob-like head (Fig. 1 on the cover). This is in contradistinction to the median or submedian centromeres of the chromosomes of all other groups studied in the wheatgrasses.

Eremopyrum hirsutum ($2n=14$) is remarkably similar in floral morphology to *E. triticeum*, and particularly to *E. Bounapartis*, the only distinguishing character from the latter species being the hairiness of its spikelets. The external morphological similarity finds corroboration in the morphology of the chromosomes. The karyotype of *E. hirsutum* differs from that of *E. triticeum* in that two pairs of its chromosomes have relatively longer distal arms instead of knob-like heads (Fig. 2 on the cover).

From the point of view of chromosome morphology *Eremopyrum orientale* ($2n=28$) shows a mixture of two groups of chromosomes. Fourteen of its chromosomes are similar to those of *E. triticeum*, while the other fourteen have median or submedian centromeres. This might be indicative of its being an amphidiploid between two diploid species which contribute the two different groups of chromosomes.

The present study is in conformity with the observations of AVDULOV (1931), who, although he recognized the diversity in the karyotypical pattern within *Agropyron*, did not think it necessary to separate *triticeum* and its relatives into a new group. The present writer, however, is of the opinion that the peculiar chromosome morphology together with the genetical data of sterility barrier between *Eremopyrum triticeum* and other members of *Triticeae*, definitely strengthens the validity of the new genus *Eremopyrum*.

Karyotypes of diploid *Agropyron* species

By S. MATSUMURA and S. SAKAMOTO
National Institute of Genetics, Misima

On the strength of his previous crossing experiments, the senior author (MATSUMURA 1949) arrived at the conclusion that the genome which *Agropyron glaucum* ($2n=42$) and *A. elongatum* ($2n=72$) have in common with tetra- and hexaploid wheats is the B-genome. This view is contradictory to the hypothesis of McFADDEN and SEARS (1946) who assume that *A. triticeum* is the carrier of the B-genome.

It is well known that all chromosomes of B-genome have median or submedian constrictions. Our karyomorphological investigation of diploid *A. elongatum* and *A. triticeum* shows that the former has mostly median and submedian chromosomes, while all 7 chromosomes of the latter have subterminal centromeres. Our finding strongly supports the senior author's view and places McFADDEN's and SEARS' assumption in a very doubtful light.

A hydrid between autotetraploid *Triticum aegilopoides* and *Agropyron intermedium*

By Mikio MURAMATSU
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The cross between *Triticum aegilopoides* and *Agropyron intermedium* was successful when autotetraploid *T. aegilopoides* var. *boeoticum* was the mother. The F_1-plants grew very slowly, and only one attained maturity and developed ears in the second year. Certain characteristics of the hybrid were intermediate but most of the others resembled one of the parents.

The somatic chromosome number, examined in root tip cells, was $2n=35$ as expected. At MI, 1–3 trivalents, 6–14 bivalents and many univalents were found. Seven of the bivalents must have originated from the pairing between the two A-genomes of autotetraploid *T. aegilopoides* and the remaining 0–7 bivalents are considered to be due to scattered homologies between and within the three genomes of *Agropyron intermedium*, E, F and J.

Pollen fertility varied considerably; from three examined anthers one contained only shrivelled pollen grains and the mean number of good grains in the other two amounted to 8.4%.

The hybrid was completely sterile but a few seeds were obtained from pollination with pollen of diploid *T. aegilopoides* and the *Agropyron* parent.

II. Genetic Stocks

List of *Secale* species at Biological Laboratory, Faculty of Technology, Gumma University, Kiryû

Species or variety	Chromosome number (*n*)	Source
S. Vavilovii GROSS.	7	Montreal Botanical Garden, Canada (1951)
S. africanum STAPH.	7	MÜNTZING (1950), Sweden
S. montanum GUSS.	7	〃 〃
S. montanum GUSS. var. *dalmaticum* VIS.		Botanischer Garten, Berlin-Dahlem, Germany (1954)
S. montanum GUSS. var. *anatolicum* BOISS.		〃 〃
S. fragile M. B.	7	Kiss ARPAD (1954), Hungary
S. Kukrijanovi GROSS.	7	MAKKINK (1952), Netherland

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IV. News

International Genetics Symposia, Japan

The agenda programme and other items of the International Genetics Symposia, Japan, 1956 have been modified and these along with the modifications are reproduced in the following paragraphs:

1. AGENDA

Section I. *IUBS International Symposium on the Physical and Chemical Approaches to Problems in Chromosomes*

A. Chromosome Structure and Mitosis
B. Chemistry of Chromosomes
C. Cytological Aspects of Cancer

Section II. *JSC International Symposium on Applied Genetics*

A. Induced Mutation
B. Polyploidy
C. Heterosis
D. Resistance[1)]
E. Polygenic Inheritance (including Breeding Systems)
F. Microorganisms and Viruses
G. Blood Groups

Informal Meeting on Standardization of Nomenclature and Symbols of Genes

On this occasion of the presence of geneticists from many countries, we have thought it an opportune chance to provide a gathering among those interested in the above subject for the purpose of exchanging opinions and views in conjunction with the work of the International Committee on Symbols and Nomenclature of the Permanent International Committee for Genetics Congresses.

2. OFFICIAL LANGUAGE

The official language at the sessions will be English.

3. PARTICIPATION IN THE SYMPOSIA

The membership at has been established at a sum equivalent to US $6.00 to cover the cost and postage (by surface mail) of the Proceedings. Persons who are not attending the Symposia but who are interested in receiving further information and the Proceedings are requested to pay the same amount.

Further copies of the Second Circular will be sent upon request to the Secretary of the Organizing Committee.

The Third Circular will be sent only to those who answer this Second Circular.

1) Item II D should include such subjects as Drug Resistance and Phage Resistance of microorganisms and insects.

4. PROGRAMME

Date	Morning		Noon	Evening and Night
September 6 (Thu.)	10:00–12:00 Session Opening	Reception Luncheon	Section I Section II	Night in Tôkyô
September 7 (Fri.)	9:00–12:00 Special Lectures		Section I Section II	Reception Dinner; Night in Tôkyô
September 8 (Sat.)	9:00–12:00 Joint Session		Exhibits related to: Silkworms, Poultry, Classic Documents	Invitation to classical Japanese Theatre for those visiting Nikkô on Sunday; Night in Tôkyô
September 9 (Sun.)	Excursions: 1. In and around town 2. Visit to Nikkô resort			Invitation to classical Japanese Theatre for those staying in town; Night in Tôkyô
September 10 (Mon.)	9:00–12:00 Joint Session	Reception Luncheon	Leave on Trip to Kyôto—visit en route Kihara Inst. for Biol. Res. (New premises in Yokohama) and Hiratuka Branch, National Inst. of Agric. Sciences (Exhibits of Rice)	Night in Hakone
September 11 (Tue.)	Leave Hakone for Kyôto—visit en route the National Inst. of Genetics, Misima (Exhibits of Pharbitis)	Lunch at Misima	Afternoon on Train to Kyôto	Night in Kyôto
September 12 (Wed.)	Exhibits related to; Wheat, Radish, Goldfish	Reception Luncheon	Closing Session	Reception Dinner; Night in Kyôto

Informal meeting on Nomenclature and Symbols during Symposia.
After the adjournment of the Symposia, several excursions shall be arranged for visiting various institutions of interest to geneticists, as well as for sightseeing.

International Genetics Symposia 1956, Science Council of Japan,
Ueno Park, Taito-ku, Tokyo, Japan
Cable Address: Sciencouncil Tokyo

Miscellaneous

Dr. Hitoshi KIHARA, the leader, and Dr. Kosuke YAMASHITA returned early in September from their tour of the Kyoto University Scientific Expedition to the Karakoram and Hindukush. Twelve members, specialists in various branches of science, took part. One of the important tasks of the expedition is to collect *Aegilops* species possessing the D-genome. The search was carried on successfully along the entire route, which stretched from Quetta (Pakistan) through Afghanistan to Azerbaijan (Iran), a distance over 5,000 kms.

Kihara Institute for Biological Research is moving from Kyoto to Yokohama. Experimental work at the new place will begin soon.

Preparations are being made for the English translation of Dr. KIHARA's Wheat Monograph.

Copies of WIS No. 1 are available. They will be sent free on application.

V. Announcement for Issue No. 3

WIS No. 3 will be ready for publication in March, 1956. It is open to all contributions dealing with informations on methods, materials and stocks, ideas and research notes related to wheat genetics and cytology, including *Triticum*, *Aegilops*, *Agropyron*, *Secale* and *Haynaldia*.

Contributions should be typewritten in English. The authors are cordially requested to present not later than January 31, 1956, their manuscripts which do not exceed two printed pages. List of stock are not required to conform to this page limit No illustrations can be accepted for publication.

Manuscripts and communications regarding editorial matters should be addressed to Dr. K. YAMASHITA. The address of the Editorial and Business Office of the WIS is as follows: Laboratory of Genetics, Biological Institute.
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VI. Acknowledgement

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Nitto Flour Milling Co. Ltd., Tokyo, Japan
The Iyenohikari Association, Tokyo, Japan
The Central Co-operative Bank for Agriculture and Forestry, Tokyo, Japan
The Kyoei Mutual Fire and Marine Insurance Company, Tokyo, Japan
National Federation of Agricultural Co-operative Marketing Associations, Tokyo, Japan
The National Purchasing Federation of Agricultural Co-operative Association. Tokyo, Japan

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Explanation of the figures on the cover

Fig. 1. Somatic metaphase of *Eremopyrum triticeum*. ×2235
Fig. 2. Somatic metaphase of *Eremopyrum hirsutum*. ×2235
(P. SARKAR)

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