WHEAT INFORMATION SERVICE

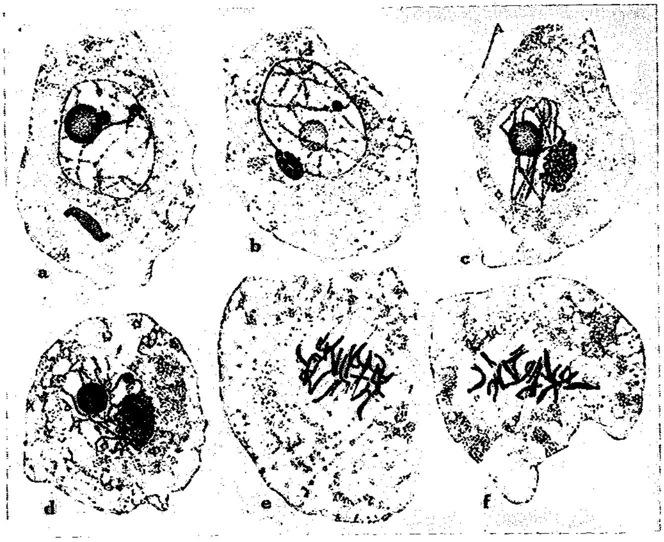
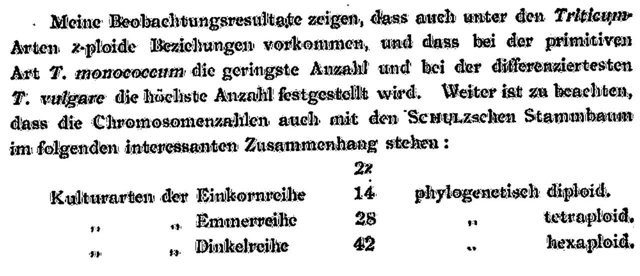


Fig. 1



Meine Beobachtungsresultate zeigen, dass auch unter den *Triticum*-Arten *x*-ploide Beziehungen vorkommen, und dass bei der primitiven Art *T. monococcum* die geringste Anzahl und bei der differenziertesten *T. vulgare* die höchste Anzahl festgestellt wird. Weiter ist zu beachten, dass die Chromosomenzahlen auch mit den SCHULZschen Stammbaum im folgenden interessanten Zusammenhang stehen:

		$2x$		
Kulturarten	der Einkornreihe	14	phylogenetisch	diploid.
,,	,, Emmerreihe	28	,,	tetraploid.
,,	,, Dinkelreihe	42	,,	hexaploid.

Fig. 2

No. 7 June, 1958

Wheat Information Service
Biological Laboratory, Kyoto University
Kyoto, Japan

CONTENTS

III. **Genetic Stocks:**

No. 7

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I. Editorial

40 years after the discovery of right chromosome numbers of the genus *Triticum*

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It is already 40 years since the right chromosome numbers of wheat were found by two botanists. Their discoveries were made independently and confirmed each other. In Japan, in 1918, Sakamura reported in a short paper[1] that the chromosome numbers of *Triticum* species show a polyploid relationship with 7 as the basic number, namely:

Species	n	$2n$
T. monococcum		14
T. dicoccum		28
T. turgidum		28
T. durum		28
T. polonicum		28
T. spelta		42
T. compactum		42
T. vulgare	21	42

In U.S.A. Sax observed 28 chromosomes in the first nuclear division of the fertilized egg in *T. durum*. His paper was published also in 1918, whereupon he found polyploidy in this genus and went further into investigations of sterility and chromosome behavior in wheat hybrids[2] (cf. the figures on the cover i and explanations on the cover iii).

Until 1918, it was generally accepted that all wheat species have the same chromosome number, namely 8 haploid and 16 diploid chromosomes. It was therefore a great surprise to many cytologists and geneticists of the world, when these findings were reported. Particularly attention was drawn to the fact that Schulz's classification of wheat

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[1] Sakamura, T. (1918): Kurze Mitteilung über die Chromosomenzahlen und die Verwandtschaftsverhältnisse der *Triticum*-Arten. Bot. Mag. Tokyo, 32.

[2] Sax, K. (1918): The behavior of the chromosomes in fertilization. Genetics 3.
——— (1921): Sterility in wheat hybrids I. Ibid. 6.
——— (1922): Idem II, III. Ibid. 7.

into three groups (1913) based upon morphological characters is in perfect agreement with their chromosome numbers, einkorn having 7, emmer 14 and dinkel 21 in haploid phase. That the *Triticum* species fell naturally into three groups has been concluded independently by 3 authors already in 1914, namely by Vavilov as a result of studying their resistance to the attacks of fungi, by Zade from serum reactions and by Tschermak from the degree of sterility they show when crossed.

Wheat genetics entered a fresh phase with the discovery of the polyploid relationship in this genus. Since then partially sterile hybrids between two parents with different chromosome numbers, such as pentaploid combinations, have been studied extensively by many workers both genetically and cytologically. The present writer has begun in those days his studies on wheat (1919–1924) when he was given the material (seeds of $5x$-hybrids and parental species) by Dr. Sakamura, who went abroad shortly after his discovery mentioned above to study plant physiology.

In the course of these investigations, the present writer came to the conclusion that the polyploid series in wheat species might have originated from hybridization followed by doubling of the chromosome numbers of the hybrids. The genome types for the 3 groups were determined to be AA (einkorn), AABB (emmer) and AABBDD (dinkel). As the third genome of $6x$-wheats is the specific one to the dinkel group, it was designated by D.

D was soon found by Sax (1928) as a constituent genome of *Aegilops cylindrica*, a tetraploid species whose another genome was identified with that of *Ae. caudata* (C). This finding gave a new key to the solution on the origin of common wheat. However, the finding of a diploid species with D genome had to wait until 1944, when *T. spelta* was synthesized from colchicine treatment of the hybrid, *T. dicoccoides* × *Ae. squarrosa*, by 2 American authors, McFadden and Sears. Similar results were obtained by Kihara and Lilienfeld. This time the chromosome doubling was obtained by the union of unreduced gametes in F_1.

We don't need to describe details of the recent advances in wheat genetics. But we can not fail to mention a unique accomplishment, namely the establishment of 21 nullisomics. This work was accomplished by Sears, while Matsumura found 7 nullisomics of the D genome.

There are still many new discoveries which might be compared with that of polyploidy in 1918. However, we might be justified to commemorate the epoch-making discoveries and pay our sincere homage to Dr. Sakamura, Emeritus Professor of Hokkaido University, Japan, and Dr. Sax, Director of Arnold Arboretum, U.S.A., for their pioneering contributions in the field of wheat genetics. Indeed it was the milestone in the first half of this century.

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II. Research Notes

X-ray induced mutations in Einkorn wheats II. Pigment analysis

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Various mutations induced by X-ray irradiation in *Triticum monococcum* have been reported by the senior author, including those regarding pigmentation such as chlorina, carotina, albino and many others, which were proved to be Mendelian recessive. In the seedling stage, a primary leaf of the chlorina is whitish at the base and green at the top with gradation in the middle portion. In the carotina an entire leaf is orange-yellow with carotinoid. The lower portion of a leaf in the albino shows an anthocyanin color.

In the present paper the results of the cytological and microchemical observations on the above mentioned three mutants are reported. The carotina is the name given to the "orange" mutant in the Yamashita's former papers.

A cross section of a leaf blade was observed under the microscope mounted by distilled water, with or without treatment by one per cent silver nitrate solution for more than a half hour. When treated, the chloroplast was clearly demonstrated as a result of reduction of silver nitrate by active chlorophyll.

For the observation of chloroplast in guard cells, lower epidermis was dipped in one percent silver nitrate solution for more than a half hour or mounted by saturated sodium hydroxide, so that the chloroplast was colored black by the former and yellow-brown by the latter treatments.

1) Chloroplasts in the mesophyll of a leaf blade:

In a normal leaf chloroplasts were distributed in the mesophyll uniformly along an entire leaf blade, while no chloroplasts were observed in the carotina and albino mutants. In the chlorina the upper part of a leaf blade contained chloroplasts embedded in the thin layer of cytoplasma as in the normal. In the chlorina mutants the number of chloroplasts per one cell was less and their size was smaller than in the normal as shown in the following table. In the middle portion, both the number of chloroplast per one cell and the number of the cells having chloroplasts decreased gradually from the top to the base, where only a few or no chloroplasts were observed. The same was the fact when treated with silver nitrate. In some cases, a few chloroplasts were distributed to the lower portion, e.g. No. 953. In these cases, the cells having chloroplasts were localized mainly around the bundle sheath or in the mesophyll just under the epidermis. Leucoplasts were observed in the cells of the whitish lower portion of the chlorina.

Chloroplasts in the mesophyll of a leaf blade

Strain No.	Mean number			Mean size (μ) upper portion
	Upper portion	middle portion	Lower portion	
Normal	–	40.1±1.1	–	8.1±1.3
946	33.2±1.3	13.3±1.5	0	–
949	30.5±1.2	15.5±1.6	0	6.4±1.4
951	31.3±1.4	13.0±1.7	0	6.3±1.5
952	32.4±1.3	15.3±1.5	0	–
953	34.8±1.5	25.1±1.3	13.2±1.1	6.4±1.3

2) Chloroplasts in the guard cells:

The chloroplasts with the reduced silver nitrate by active chlorophyll were observed in the guard cells irrespective of the leaf portions in the normal and in the chlorina strains as well. The stomatal guard cells contained chloroplasts in the whitish portion of the chlorina, while no chloroplasts were observed in the guard cells of the carotina strain.

3) Corotinoids in the mesophyll of the carotina:

Chromoplasts having carotinoids was distributed in the cytoplasm surrounding the vacuole in all cells of the mesophyll of the corotina.

4) Anthocyanin in the albino:

Anthocyanin was observed in the cells of the outermost layer of the mesophyll in the albino. Carotinoids was identified by the Molisch's "Kalimethode" and the color reaction by concentrate sulphuric acid (1).

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Photosynthetic capacity in green and white leaf portions of an X-ray induced mutant "*japonica* stripe[1]" in *Triticum monococcum*

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Leaf blades of "*japonica* stripe (*j*)" in *T. monococcum* has a white (sometimes yellowish) stripe. The authors have studied the difference of photosynthetic capacity between the green and white portions of the striped leaves. After the dark treatment for the starvation of carbohydrates, the leaf blades taken from the maturing plants were exposed to 1% carbon dioxide labelled with radioactive C^{14} for an hour, at 25°C and under 4000 lux. Each leaf blade was then divided into the green and white portions, and the $C^{14}O_2$ fixation was determined by cpm/g dry wt., as given in the following table.

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[1] Induced by late Dr. L. Smith, who was the Professor of Agronomy, State College of Washington, Pullman, Washington, U.S.A.

Carbon dioxide fixation in the green and white portions of leaf blades of "*j*" mutant

Exp. No.	Portion {Fraction}	Dry wt. (g)	$C^{14}O_2$ fixed (cpm)	cpm/g dry wt.	Ratio
1	green	0.0206	470	22.8($\times 10^3$)	100
	white	0.0114	178	15.6	68
2	green	0.0310	1,190	38.3	100
	white	0.0088	222	25.2	66
3	green	0.0819			100
	alc. sol.		66,295	809.5	
	residue		2,660	32.5	
	total		68,955	841.9	
	white	0.347			49
	alc. sol.		13,925	401.3	
	residue		580	16.7	
	total		14,405	415.1	

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Effects of temperature and irradiation time upon mutations induced by radiations

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Dormant seeds of *Triticum monococcum flavescens* were exposed to X- and γ-rays at the dosage 10 and 20 *kr*. The growth of seedlings, the single-spike fertility and chromosome aberrations of treated plants (X_1) and the chlorophyll mutations in X_2 were compared for acute and chronic irradiation. At acute irradiation with X- and γ-rays treatment was given either immediately before sowing or the irradiated seeds were kept for 30 days in storage at room temperature (about 20°C) or at 5°C. At chronic γ-irradiation with ^{60}Co the treatment lasted 54 days. Also, the effect of β-radiation by ^{32}P was examined for comparison.

The data are shown in the table. The relation between the inhibition of seedling growth and dosage, temperature in storage and irradiation time coincides roughly with the relation between the percentage of induced sterility and all those conditions. X- and γ-irradiations were far more effective at 20 *kr* than at 10 *kr*. In the case of 30 day storage, γ-rays inhibited the growth of seedlings and reduced the fertility more than X-rays, while irradiation applied just before sowing showed the reverse relation. It was found further, especially with γ-rays, that low temperature had the strongest inhibiting effect. At 10 *kr* acute γ-irradiation was more effective than the chronic one, while at 20 *kr* the reverse relation was observed.

The frequency of ears with chromosome aberrations in X_1-plants was strikingly higher at 20 *kr* than at 10 *kr*. In most of the cases of induced chromosome aberrations ④$+5_{II}$, often $6_{II}+2_{I}$, ⑥$+4_{II}$, ④+④$+3_{II}$ or ④$+4_{II}+2_{I}$ and seldom $1_{III}+5_{II}+1_{I}$ or asynap-

Genetic effects of ionizing radiation in *Triticum monococcum*

	Dosage (*kr*)	Length of seedlings* (cm)	Fertility of spikes in X_1 (%)	Chromosome aberrations in X_1 (%)	Chlorophyll mutations in X_1 (%)
Control		17.69 (11.08)	74.62	0.00	0.0
30 day storage at room temperature	X-10	14.99	81.82	0.00	0.0
	X-20	13.53	11.59	19.05	33.3
	γ-10	8.96	60.32	14.29	2.9
	γ-20	6.79	32.78	25.00	0.0**
30 day storage at 5°C	X-10	13.81	61.95	0.00	2.3
	X-20	11.63	33.53	54.17	14.3
	γ-10	9.73	60.58	4.08	7.6
	γ-20	3.45	8.34	40.00	33.3
Acute irradiation just before sowing	X-10	10.71	62.32	7.50	6.1
	X-20	4.29	34.65	20.00	13.3
	γ-10	12.00	64.38	10.00	2.6
	γ-20	6.75	40.10	38.46	5.6
Chronic irradiation	γ-10	14.69	66.45	4.08	3.5
	γ-20	5.37	15.47	28.57	0.0**
^{32}P	β-10	(12.66)	68.60	0.00	1.9
	β-20	(14.14)	79.28	2.50	4.1

* X- and γ-irradiated seeds were sown October 25 and the seedlings were measured 27 days after sowing. ( ) Sown October 27 and measured 25 days after sowing.

** Due to the small number of observed head progenies with very few surviving seedlings.

tic 14_I have been observed. The effect of γ-rays was generally stronger than that of X-rays. Also, irradiation just before sowing and 30 day storage at low temperature produced more chromosome aberrations than storage at room temperature after irradiation. On the other hand, the effect of chronic γ-irradiation, because of two-hit aberrations, such as translocation, are limited in time.

The frequency of head progenies with chlorophyll mutations in the X_2-generation increased with the increase of radiation dosage. Because of the small number of observed head progenies, due to a lower survival rate, the results with 20 *kr* irradiation were insufficient. But they were roughly in accord with the observations of chromosome aberrations.

The effects of β-irradiation were unexpectedly slight. It was found from another experiment with seed absorption of ^{32}P-solution that the actual dosage of β-rays was very low.

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Effect of AET upon radio-sensitivity of wheat seeds

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To examine the protection effect of AET (Amino-ethyl-isothiruonium) upon radio-sensitivity, seeds of *Triticum monococcum flavescens* were treated with 0.0001 and 0.001% AET-solution for 24 hrs just before X- and γ-irradiations at 5 and 9 *kr*.

Seeds treated with 0.001% solution showed no higher germination rates and no better growth of seedlings than the water-soaked ones, while when treated with 0.0001% solution rather better germination and growth of seedlings were observed. X-rays were more effective than γ-rays. At X-irradiation, especially when 0.001% treatment was used, AET unexpectedly increased the inhibiting effect of radiation. In γ-rays the protection effect of AET was generally not found at 9 *kr*, while only the treatment with 0.0001% AET at 5 *kr* slightly promoted germination and growth. This promotion might be due to the effect of 0.0001% AET, mentioned above. The protection effect of AET upon radiation could not, therefore, be easily determined.

(Received April 24, 1958)

Genome analysis of *Triticum georgicum*

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Many authors have taken an interest in the classification of *Triticum georgicum*. When it was classified as a subspecies of *T. Macha*, Dekaprelevich and Menabde (1932) have reported that it has 28 somatic chromosomes. At present, it is assigned as a subspecies to *T. dicoccum* by Flaksberger (1939).

Morphologically, it is markedly different from other Emmer wheats, namely, it has dense ear and the tops of the awns are not at the same level, and on the other hand it resembles *T. Macha* and *T. Timopheevi*.

In order to make clear those relationships the authors have crossed *T. georgicum* with the Emmer group and others, and cytologically analysed the F_1 hybrids. Particular attention was given to the chromosome pairing in the meiosis of PMC. 1) *T. georgicum* × *T. monococcum*: The F_1 plants were obtained rather easily. The percentage of cells having $6_{II}+9_{I}$ was 49%, and that of the secondary $5_{II}+11_{I}$ was 27%. Pollen- and seed-fertility was very low. 2) *T. georgicum* × *T. turgidum*, *T. durum* × *T. georgicum*: Of all crosses, the percentage of seed formation was the highest in these 2 combinations. The chromosome pairing was very regular, the percentage of cells having

14_{II} was 98% in the former case and 82% in the latter. The pollen- and seed-fertility was as high as that of the parents. 3) *T. georgicum* × *T. vulgare*: The hybrids were not easily obtained. As to chromosome conjugation, polyvalents were rarely found, and the configuration $14_{II}+7_{I}$ occurred in 82% PMC. 4) *T. georgicum* × *T. Timopheevi*: The F_1 hybrids were easily obtained, but the hybrids were very poor, indicating an abnormal chlorophyll situation, and completely sterile. Various configuration of chromosomes were found, namely cells with one trivalent or 3 more amounted to 86%, and the configuration $12_{II}+4_{I}$ occurred in 41% PMC. This finding is the same as KIHARA (1934). It seems that the chromosomes of *T. georgicum* are not homologous to the chromosomes of *T. Timopheevi*.

It is concluded from the above results that *T. georgicum* belongs to the Emmer group. Its genome formula is AABB.

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Genetic effect of ionizing radiation in Einkorn wheat

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Dormant seeds of *Triticum monococcum* var. *flavescens* were exposed to X-rays, γ-rays and fast neutrons.

X-rays of different wave lengths at the same dosage (10 *kr*) and intensity (82 *r*/min) were used with different filters; also the effect of γ-radiation by Co^{60} was examined for comparison. The thickness of the filter was adjusted inverse proportion to the wave length; that is, at 100 KVP a filter of 2 mm Al, and at 180 KVP one of 0.8 mm Cu+1.5 mm Al was inserted into MATSUDA's Type KXC-17 apparatus. At 50 KVP and 20 KVP, irradiation was applied by two other types, Modified Type KR-75 and Type TX-20 (Grenz-rays) without filter, respectively. The data are shown in the following table.

There was no striking difference between hard and soft X-radiation, in so far as the germination of seeds is concerned, but the growth of seedlings showed a slight delay with the decrease of wave length. The higher the dosage of γ-rays or neutrons, the lower was the germination rate of irradiated seeds, and the more delayed were the germination of seeds and growth of seedlings. It was shown, in terms of growth inhibition of the seedlings, that neutrons with a high specific ionization more uniformly affect the irradiated seeds than X- and γ-radiations with a low specific ionization.

The mean single-spike fertility of X-rayed plants generally decreased with the decrease of wave length. This relation is in good accord with that between the growth of seedlings and wave length. Also, the relation between the rate of induced sterility and wave length coincides roughly with the relation between the frequency of chromo-

Relation between wave length of X- or γ-rays and frequency of chromosome aberrations in *Triticum monococcum*

Dosage (*Kr*)	Voltage (KVP)	Germination rate (%)	Length of seedlings* (cm)	Fertility of spike in X_1 (%)	Chromosome aberration in X_1 (%)	Chlorophyll mutation in X_2 (%)	Head progenies without germination (%)
Control		92.00	17.44 (14.54)	60.45	0.00	0.0	0.0
10 (82*r*/min)	20	82.00	15.85	44.20	12.50	6.3	3.0
〃 (82 〃)	50	88.00	14.23	40.73	4.88	6.8	4.8
〃 (81.4 〃)	100 (with filter 2 Al)	60.00	10.20	32.33	10.81	8.3	7.7
〃 (81.2 〃)	180 (with filter 0.8 Cu+1.5 Al)	90.00	11.11	36.50	21.82	10.3	8.1
5 (8.3 〃)	γ-ray	92.00	13.93	62.95	1.67	4.8	1.2
10 (16.6 〃)	〃	38.00	12.73	38.72	5.56	2.2	0.0
15 (25 〃)	〃	50.00	8.96	32.18	6.25	0.0	5.1
10 Ah	Neutron (4–7 MeV) (10^9 neutron/A. sec)	98.00	(14.25)	54.20	1.33	1.2	2.4
15 Ah	〃	88.00	(14.53)	37.01	4.17	3.7	1.2
20 Ah	〃	79.59	(13.84)	27.66	4.55	2.7	6.3

* X- and γ-irradiated seeds were sown November 9 and the seedlings were measured 26 days after sowing. ( ) Sown December 12 and measured 26 days after sowing.

some aberrations or chlorophyll mutations and wave length. But at 20 KVP the aberration frequency was unexpectedly high, while at 50 KVP it was too low.

It was also ascertained, as expected, that mean fertility decreased with decreasing germination rate accompanied by weaker growth of seedlings, and the chromosome aberrations increased in proportion to the dosage of γ-rays and neutrons. Concerning the frequency of gene mutations in X_2, the head progenies which did not germinate at all, must be added to the chlorophyll mutations.

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Effect of X- and γ-radiations upon wheat seedlings and their modification due to temperature or polyploidy

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Dormant seeds of *Triticum monococcum* were subjected to X- and γ-ray treatments at the dosage 10 and 20 *kr*. The germination rate of treated seeds and the growth of seedlings were compared for acute and chronic irradiation was applied either immediately before sowing or the irradiated seeds were kept for 30 days in storage and in the latter γ-irradiation lasted 54 days. In one experiment with acute irradiation one part of the treated seeds were kept at room temperature (about 20°C) and the remainder at low temperature (5°C) for 30 days.

There was no marked difference in germination rate between untreated and treated seeds at 10 *kr*, while the germination rate was reduced to 1/2~2/3 at 20 *kr*. In the case of 30 day storage, γ-rays inhibited the growth of seedlings more than X-rays, while the irradiation applied just before sowing showed the reverse relation. It was found further especially with γ-rays that low temperature was more effective in inhibiting growth than room temperature. At 10 *kr*, the acute γ-irradiation was more effective in this respect than the chronic one. On the other hand, the reverse relation between acute and chronic γ-irradiation was observed.

To examine the relation between the sensitivity to ionizing radiation and polyploidy, dormant seeds of *Triticum monococcum* ($2x$), *T. durum* ($4x$) and *T. vulgare* ($6x$) were exposed to X- and γ- rays at the dosage 10~40 *kr*. In general, γ-irradiation had a markedly stronger inhibiting effect upon seed germination and seedling growth than X-irradiation. $2x$ was most sensitive to X- and γ-rays and $6x$ was most resistant. There was unexpectedly no significant difference between $4x$ and $6x$.

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Crosses between various X-ray induced recessive mutants in wheat

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Several mutant strains of *Triticum monococcum flavescens*, namely chlorina, basi-viridis II, virido-albina, slender and irregular-ear were crossed with each other. All of these mutations were in crosses with normals simple recessives. In F_2 dihybrid segregation was observed and double recessive segregants were obtained.

Chlorophyll content of double recessive plants from the cross virido-albina × chlorina was slightly decreased in the seedling stage, compared with virido-albina itself. When they were placed in the phytotron (20°C, 80% relative humidity), their leaves gradually turned to light green and increased the chlorophyll content, until its amount was restored to the chlorina level, but a further increase was never observed. Seedlings obtained from the double recessive plants from the cross virido-albina × basi-viridis II had no chlorophyll just like albina and died out a half month after germination, even in the phytotron. Double recessive plants in a cross virido-albina slender or irregular-ear were in the seedling stage similar as to chlorophyll to virido-albina itself. When both were placed in the phytotron, their chlorophyll content gradually became restored and about a month later was as that of the normals.

From these experiments it follows that the chlorophyll content of virido-albina could be recovered in the cross combinations with slender and irregular-ear which have a normal chlorophyll content. But the virido-albina gene was hypostatic to the chlorina gene and the same behavior was shown by the double recessive plants between basi-viridis and chlorina (WIS No. 6). Albina-like plants obtained from the cross between virido-albina and basi-viridis II must have been genetically different from albina mutants but they behaved like the latter.

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Radio-sensitivity in *Triticum* and *Aegilops*

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Differences of sensitivity between di-, tetra- and hexaploid plants were compared in several species and varieties of *Triticum* and *Aegilops*. Dry dormant seeds were used for this examination which were irradiated from 20 to 70 *kr* by γ-ray. Radiosensitivity was determined by the decrease of germination rate and the average length of the seedlings. Genus *Aegilops* showed more tolerance to radiation than genus *Triticum*. In tetraploid species of *Aegilops* the germination rate remained even at 40 *kr*, compared with that of the control, while that of the tetraploid *Triticum dicoccum* showed a marked decrease at 30 *kr*. A part of the results is shown in the table. Diploid species of *Triticum* and *Aegilops* were most sensitive to radiation, and the hexaploid *Triticum* species were not more resistant than the tetraploid ones. Differences of sensitivity were also observed in different varieties (or species) of a species (or group). These facts show that radio-sensitivity depends not only on the kind and number of genomes but also on the kind of alleles present.

Germination rate in *Triticum* and *Aegilops*

Material	2n	Genome	Control	20 *kr*	30 *kr*	40 *kr*	70 *kr*
T. aegilopoides	14	AA	30.0	6.3	0.0	0.0	0.0
T. monococcum	〃	〃	61.3	47.5	38.0	12.5	21.3
T. dicoccum	28	AABB	62.5	73.4	33.8	21.3	0.0
T. durum	〃	〃	50.0	66.3	55.0	42.5	15.0
T. spelta	42	AABBDD	71.3	72.2	76.3	50.0	10.0
T. vulgare	〃	〃	75.0	62.5	50.0	42.5	15.0
Ae. cylindrica	28	CCDD	86.3	82.5	78.8	56.3	0.0
Ae. uniaristata	14	M^uM^u	58.2	71.3	81.3	12.5	0.0
Ae. squarrosa	14	DD	72.5	66.3	65.0	32.5	0.0
Ae. ventricosa	28	DDM^vM^v	61.3	77.2	63.8	70.0	0.0

Albino mutation in common wheat

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The occurrence of a recessive albino mutation in *Triticum vulgare* was reported in the Australian Plant Breeding and Genetics Newsletter 1956 (No. 9, p. 5). The mutant was first detected in 1953 in the F_4 of the cross, Federation × Normandie.

Two further mutations at apparently the same locus were observed last year.

One F_6 plant of the above crossbred produced two leaves each with a narrow white stripe extending the length of the leaves. This plant was subsequently shown to be heterozgous for albinism so that the striping appeared to be the result of a somatic mutation of the normal allel (in the broad sense).

The second mutation appeared in an F_8 of quite unrelated material—a backcross derivative (Iumillo × *Aegilops squarrosa*) × Javelin 6. The original amphiploid was supplied to the writer by Dr. E. P. Baker of Sydney University who in turn had received it from Dr. Sears of U.S.A. The material was being studied during an investigation of mildew resistance. The population segregated 7 green and 3 albino—the albino plants being similar to those observed previously and dying in the seedling stage. Genetic tests involving a cross between two plants each heterozygous for albinism segregated albino seedlings, indicating that the same locus was involved on each occasion in 1953 and 1957.

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Effect of gibberellic acid on a compactoid wheat

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The restoration of normal growth by gibberellic acid in many types of genetic dwarfing and virus stunting in plants has been reported. It stimulates growth of wheat and rye, and accelerates internode growth (Lona, 1956); in rye, no acceleration of flower formation has been found (Lang, 1957).

In a tetrasome compactoid line of wheat, described in a recent communication to "Nature", the application of gibberellic acid has produced a response in the early growth of upper internodes, earlier flowering, variable effects on fertility and possibly a slight reduction in ear density. The results are not conclusive, as too few plants were available, but they suggest a need for further work with earlier applications and higher concentrations.

Four plants in the glasshouse at the shot-blade stage (Feekes' scale, 8~9) were treated on September 11, 1957, with 5 or 10 μgm of gibberellic acid per plant, applied by microloop to the first four tillers on each plant. There was no wilting after 22 hours, but after a further 24 hours the upper leaves of all tillers had wilted, wilting being more severe at the higher concentration. On September 18 the application was repeated on one plant at each dose (Feekes' scale 10.1). Five days later there were 18 ears emerging (through the side of the leaf sheath) in the treated plants, from 36 tillers, and only two of the 19 tillers on the two control plants had ears emerging. The commencement of flowering on each plant as expressed by the number of days after September 26 is shown in the table; also given are the average numbers of grains per spikelet, referring to the total production of grain in well-developed spikelets on each plant, and internode length, defined as the average length in mm of the top 14 internodes in the least dense of the later ears.

Response to gibberellic acid

Treatment	Start of flowering	Grains per spikelet	Internode length
Control	4	0.48	1.13
〃	6	0.60	1.07
5 μgm	4	0.66	1.07
〃 twice	2	0.32	1.21
10 μgm	0	0.95	1.36
〃 twice	0	0.23	1.29

The correlation coefficient for initial dose and start of flowering was −0.92, and the correlation was lower for the later flowers; for the fifth flower it was −0.69. The production of grains in the glumes (Wright, in press) was not affected, but the effect on the total fertility of the plants was marked. Although the numbers of well-developed spikelets on the plants were similar, ranging from 109 to 131, the plants treated once were more fertile, and those treated twice were much less fertile than the controls (see the table).

No response in plant height or stem internode lengths, or in the density of the base of the ear, was established. It is probable that the treatment was too late to affect the rachis development of the early ears, but it is possible that the density of some of the later ears was affected, as shown in the table. The corresponding internode lengths for "average" ears of *T. compactum* and *T. vulgare* were 1.36 and 4.14 mm, and although the response to gibberellic acid in the compactoid wheat is doubtful, it does not, even if it is real, represent any substantial change towards normality.

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Frequency and types of mutations induced in bread wheat by some physical and chemical mutagens

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Seeds of C-591, a cultivated bread wheat variety, were irradiated in 1956 with X-rays, fast neutrons and beta particles from radioactive phosphorus (P^{32}) and sulphur (S^{35}) with a view to compare the frequency and types of mutations observed in the M_2 progenies derived from the different treatments. Following the observation made in our Laboratory that vegetable oils such as those derived from groundnut (*Arachis hypogaea*) caster (*Ricinus communis*) and mustard (*Brassica campestris* var. *toria* and *B. juncea*) are capable of inducing chromosome breakage in species of *Triticum* (Swaminathan and Natarajan, Curr. Sci. 25: 382–84; 1956), dry seeds of C-591 were soaked in these oils for 24 hours and then sown in the field. The M_2 progenies (the term M_2 is being used to designate second generation progenies of all treated material irrespective of the mutagen involved) from these treatments were also screened for mutations. The variety C-591 is highly stable and homogeneous and is characterised by a fully bearded earhead, white and pubescent glumes, amber coloured grains and medium maturity. No spontaneous mutation has been observed in the large control material of this variety grown each year. The frequency and types of mutations observed in the different M_2 progenies are given in the following tables (Tabs. 1, 2).

From the data it is seen that (1) a high frequency of viable mutations is induced in bread wheat by radio-isotope and groundnut oil treatments; (2) 16,000 r of X-rays yields a higher percentage of mutations than either 11,000 or 22,000 r; (3) besides *albina* mutation which was found only in Fast Neutron treatment and a fine and thin straw

Table 1. Mutation rate

Mutagens	Dosage	Plant progenies examined	Total mutations observed in M_2	Mutation rate per plant progeny (%)
(1) P^{32}	5 μc per seed	92	39	42.4
(2) S^{35}	〃	100	94	94.0
X-rays	11,000 r	60	29	48.3
	16,000 r	43	23	53.5
	22,000 r	27	6	22.2
(3) Fast Neutrons	10^9/cm²/sec. for 3 hrs.	107	23	21.5
(4) Groundnut oil	Soaking for 24 hrs.	29	44	155.5
Castor oil	〃	54	33	61.0
Mustard oil	〃	55	2	3.6

Table 2. Types of mutations in M_2 progenies

Mutation	Number of mutants and % of total mutations					
	P^{32}	S^{35}	Fast Neutrons	X-rays (11,000 r)	Groundnut oil	Castor oil
albina mutation	0	0	9 (39.51)	0	0	0
Short and stiff straw	1 (2.51)	1 (1.06)	0	4 (13.8)	9 (20.45)	0
Fine straw	0	0	0	8 (27.60)	0	0
Speltoid	15 (38.65)	41 (43.62)	3 (13.17)	8 (27.60)	24 (54.54)	22 (66.6)
Dense ear	5 (12.82)	17 (18.09)	3 (13.17)	4 (13.8)	1 (2.27)	0
Lax ear	1 (2.51)	3 (3.18)	0	2 (6.90)	0	2 (6.06)
Awn characters	9 (23.07)	21 (22.33)	6 (26.34)	1 (3.45)	2 (4.54)	3 (9.09)
Others*	8 (20.08)	11 (11.70)	2 (8.78)	2 (6.90)	8 (18.18)	6 (18.18)

* Include grass clumps, early and late types, colour and hairiness of glumes and grain colur.

mutation which was found only in X-ray treatment, the same types of mutations occur in all the treatments and (4) a large proportion of the viable mutations in all treatments consists of speltoids. An interesting feature of the material from radioisotope treatments was the occurrence of several chimeras and haploid plants ($2n=21$). A common chimeral change was the appearance of brown glume colour and long tipped condition in some tillers of a plant in which other tillers have the normal white glumes and fully bearded earheads.

The *albina* mutation found by us in fast neutron irradiated material is the first record of its type in an induced mutation experiment in bread wheat. Another mutation of genetic interest is a completely beardless type obtained in material treated with groundnut oil; associated with this change there was a heavy reduction in tillering. Crosses have been made between the control and several of the mutants and the material is also being studied cytologically. It is particularly interesting that while chemical mutagens like nitrogen mustard have not been useful for inducing viable mutations in bread wheat, agents like groundnut oil are very effective (cf. MacKey, J. Acta Agric. Scand. 4: 419–29, 1954). The restricted group of morphological mutations observed by us lends support to MacKey's (Hereditas 40: 65–180, 1954) conclusion that the "diploid sector" of the germ plasm of bread wheat is limited and that polyploidy while imposing a restriction on the morphological frame permits a more varied and subtle differentiation within this frame.

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Spring wheat production in Taiwan

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A large number of wheat varieties have been collected in the last 10 years from the mainland of China, Japan, U. S. A., Canada, Australia and India. Results of test-*t* on these have shown that only early varieties of spring habit are adapted to the rotation system in Taiwan. Wheat is grown from November to the middle of February as a catch crop after harvesting the second of two crops of rice per annum. The average yield of wheat was 1,732 kg. per hectare, equivalent to 25 bushels per acre, in 1956. This wheat has high gluten content and good baking quality. The plant is free from all smuts, probably because seed-born spores of smut cannot live through the long, hot and moist summer. There has been litte stripe rust to cause loss in yield. Orange leaf rust and black stem rust appear every season and become a determining yield factor.

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Establishment of a monosomic series of Yogo winter wheat

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Transference of the monosomic condition from an aneuploid series of Chinese spring wheat to Yogo winter wheat was initiated during the winter of 1956–57, when the first crosses were made in the greenhouse. F_1 hybrids, grown in the winter of 1957–58, were examined cytologically, and those presumed to be monosomic were backcrossed to Yogo. It is planned to continue the backcrossing program until a series of Yogo, monosomic for each of the 21 chromosomes, has been obtained. This aneuploid Yogo series will then be used in a chromosome-substitution program with certain other winter wheat varieties in an effort to determine which chromosomes carry factors affecting milling and baking qualities, as well as agronomic characters. The problem will then be to combine the desirable chromosomes into a winter wheat variety suitable to our climatic conditions.

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The number of the chloroplasts in the stomatal guard cells of *Triticum* and *Aegilops*

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The number of plastids or chloroplasts were counted in the stomatal guard cells of fourteen species of *Triticum*, nine species of *Aegilops* and several hybrids (Tab. 1).

Table 1. PNS and the size of stomata of *Triticum* and *Aegilops*

Species	Genome	PNS	Size of stomata
T. aegilopoides	AA	18.29 ± 0.086	49.8 μ
T. monococcum var. *vulgare*	〃	17.00 ± 0.208	44.5
T. monococcum var. *flavescens*	〃	16.94 ± 0.244	49.4
T. dicoccoides	AABB	17.25 ± 0.365	42.7
T. durum	〃	14.82 ± 0.230	59.7
T. turgidum	〃	14.10 ± 0.245	65.5
T. orientale	〃	12.13 ± 0.271	58.6
T. polonicum	〃	14.80 ± 0.252	68.3
T. persicum	〃	14.58 ± 0.226	67.2
T. spelta	AABBDD	20.32 ± 0.308	75.1
T. vulgare	〃	21.85 ± 0.348	72.9
T. compactum	〃	19.84 ± 0.332	60.7
T. sphaerococcum	〃	19.00 ± 0.326	61.4
T. Timopheevi	AAGG	17.32 ± 0.275	57.0
T. monococcum fl. × *T. turgidum*	AAB	18.25 ± 0.288	66.9
T. monococcum vulg. × *T. Timopheevi*	AAG	19.71 ± 0.329	59.1
Rec.		18.93 ± 0.232	53.9
T. durum × *T. vulgare*	AABBD	18.17 ± 0.385	60.8
T. compactum × *T. durum*	〃	17.67 ± 0.333	64.1
Ae. umbellulata	C^uC^u	12.58 ± 0.329	47.1
Ae. caudata	CC	13.95 ± 0.324	43.5
Ae. comosa	M^uM^u	13.81 ± 0.368	42.0
Ae. uniaristata	〃	12.60 ± 0.292	42.6
Ae. speltoides	SS	14.02 ± 0.307	41.5
Ae. sharonensis	S^sS^s	17.33 ± 0.354	52.6
Ae. longissima	S^lS^l	14.40 ± 0.353	55.0
Ae. bicornis	S^bS^b	27.11 ± 0.512	47.7
Ae. squarrosa	DD	18.53 ± 0.322	40.8

The middle portion of the flag leaf of main culm has been taken and about fifty stomata were observed with the aid of the Molisch reaction.

The number of the plastids in the stomatal guard cells (abbrev. PNS) seems to be specific to the respective species. PNS is increased with autoploidy but not always with alloploidy (Tab. 2). It is smaller in Emmer group than in the other groups of wheat. It is interesting that the PNS of *T. dicoccoides* var. *spontaneonigrum* and *Ae. bicornis* is quite different from that of the other species in the same group or section. The hybrids show the intermediate number between or higher than the parents, and the reciprocal cross combinations do not show any difference.

Tab. 3 shows the relation between the PNS and combinations of three genomes, A, B and D. This suggests that the PNS of the unknown BB speceies may be smallest.

Table 2. PNS and the size of stomata of 2*x* and 4*x*

Species	Genome	PNS 2*x*	PNS 4*x*	Size of stomata (μ) 2*x*	Size of stomata (μ) 4*x*
T. aegilopoides	A	18.45	32.56	49.8	76.4
Ae. umbellulata	C	12.58	21.38	47.1	67.5
Ae. uniaristata	M	12.60	22.24	42.6	73.4
Ae. speltoides	S	14.02	17.14	41.5	43.1
Ae. sharonensis	S	17.33	31.62	52.6	73.8
Ae. bicornis	S	27.11	44.43	47.7	69.0
Ae. squarrosa	D	18.53	27.09	40.8	55.8

Table 3. The combinations of genome, A, B and D, and PNS

Genome	Species	PNS
AABBDD	*T. spelta*	20.32
AADD[1]		28.14
AAAA	*T. aegilopoides* 4*x*	32.56
AABB	*T. durum* (Stewart)	14.82
DDDD	*Ae. squarrosa* 4*x*	27.09
DD	〃	18.53
AA	*Ae. aegilopoides*	18.29
AB[2]		10.54

[1] Amphiploid of *T. aegilopoides* × *Ae. squarrosa*

[2] A haploid of *T. durum* (Stewart)

Chromosome conjugation in the hybrids between Emmer wheat and induced autotetraploid *Aegilops squarrosa* or *Ae. bicornis*

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The partial homology between A and B genomes involved in Emmer wheats was analyzed in their hybrids with colchicine induced 4*x* *Aegilops squarrosa* (DDDD) or *Ae. bicornis* ($S^bS^bS^bS^b$) by Kondo (1941).

The Emmer parents were *Triticum dicoccum* var. *liguliforme*; *T. pyramidale* var. *recognitum*; *T. persicum* var. *fuliginosum*, var. *fuliginosum* (Black Persian) and var. *stramineum*; *T. polonicum* var. *vestitum* and var. *gracile*; *T. durum* var. *coerulescens*, var. *hordeiforme*, var. *Reichenbachii* and var. *africanum* No. 2; *T. turgidum* var. *nigrobarbatum*; *T. orientale*; *T. dicoccoides* var. *spontaneo-nigrum* and var. *Strausianum*.

The following table shows the chromosome configurations at MI in those hybrids, which have the genome constitution ABDD or ABS^bS^b. The number of bivalents observed varied from 3 to 9 (mode at 7). It is expected that 7 pairs of chromosomes might be attributed to the conjugations between D and D or S^b and S^b genomes derived from the pollen parents and additional 0~2 pairs to conjugations due to a partial homology between A and B genomes derived from Emmer wheats, which fairly accords with that Kihara (1936) found 0~3 conjugations in haploid *T. durum* (AB). However, the conjugations were found to be 3 or 4 in the hybrids.

This indicates that 7 pairs observed could possibly involve certain number of conjugations between A and B genomes of Emmer wheats, according to the varying number of the D-D or S^b-S^b pairings.

Trivalents occurred rarely in the hybrid combinations of 4*x* *Ae. squarrosa*, while trivalents and tetravalents were observed in the hybrids of 4*x* *Ae. bicornis*, especially with *T. dicoccoides* var. *spontaneo-nigrum* indicating that the affinity between A or B and S^b genomes is higher than that between A or B and D genomes.

If B genome were homologous to S^b genome as suggested by Sarker and Stebbins (1956) and Sears (1956), the hybrids between Emmer and 4*x* *Ae. bicornis* would have genome constitution related to ABBB. However, the maximum number of trivalents in the hybrids was 2, while that was 5 in the hybrids between *Ae. cylindrica* and 4*x* *Ae. squarrosa* (Kondo 1950) having the similar genome constitution, namely CDDD. On this basis, the present authors can hardly agree with the opinions of Sarkar and Stebbins, and Sears, regarding the homology between B and S^b.

Chromosome conjugations in the hybrids

Hybrid combinations		Items examined	Univalents	Bivalents			Trivalents	Tetravalents	Number of PMC's observed
♀	♂			open	closed	total			
Ae. squarrosa 4x	*T. dicoccum liguliforme*	Range	12–16	0–3	4–7	6–8			100
		Mode	14	1	6	7			
		Average	13.46	1.10	6.23	7.27			
	T. pyramidale recognitum	Range	10–18	0–6	1–7	5–9	0–1		100
		Mode	14	2	5	7	0		
		Average	13.37	1.62	4.67	6.73	0.01		
	T. persicum fuliginosum	Range	10–16	0–3	4–7	6–9			100
		Mode	14	1	6	7			
		Average	13.21	1.96	6.09	7.39			
	T. persicum fuliginosum (Black Persian)	Range	12–16	0–4	2–7	6–8			100
		Mode	14	2	5	7			
		Average	14.48	1.47	5.28	7.75			
	T. persicum stramineum	Range	12–18	0–3	4–7	5–8	0–1		100
		Mode	14	1	7	7	0		
		Average	14.44	0.61	6.18	6.78	0.01		
	T. polonicum vestitum	Range	10–16	0–3	5–7	6–9			50
		Mode	14	0	7	7			
		Average	12.40	0.59	6.80	7.27			
	T. polonicum gracile	Range	12–16	0–3	4–7	6–8			100
		Mode	14	0	7	7			
		Average	14.04	0.59	6.38	6.97			
	T. durum coerulescens	Range	12–18	0–4	3–7	5–8			100
		Mode	14	1	7	7			
		Average	14.16	1.20	5.66	6.86			
	T. durum hordeiforme	Range	10–20	0–4	3–7	4–9			100
		Mode	14	1	6	7			
		Average	13.92	1.15	5.19	6.34			
	T. durum Reichenbachii	Range	12–22	0–5	0–6	3–8			100
		Mode	16	2	5	6			
		Average	16.72	2.28	3.33	5.64			
	T. durum africanum No. 2	Range	12–18	0–4	2–7	5–8	0–1		100
		Mode	14	1	6	7	0		
		Average	14.62	1.45	5.38	6.83	0.01		
	T. turgidum nigrobarbatum	Range	10–16	0–3	4–7	6–9	0–1		100
		Mode	14	1	6	7	0		
		Average	13.53	0.99	6.22	7.21	0.01		
	T. orientale	Range	10–18	0–5	2–7	5–9			50
		Mode	14	2	5	7			
		Average	10.16	2.00	4.80	6.98			
	T. dicoccoides spontaneo-nigrum	Range	12–16	0–2	3–7	6–8			100
		Mode	14	1	6	7			
		Average	14.28	0.96	4.90	6.86			
Ae. bicornis 4x	*T. dicoccoides spontaneo-nigrum*	Range	10–22	0–5	0–6	3–9	0–2	0–1	100
		Mode	14,16	2	5	6,7	0	0	
		Average	14.52	1.87	4.11	6.07	0.34	0.04	
	T. dicoccoides Strausianum	Range	10–16	0–4	3–7	6–9	0–2	0–1	100
		Mode	14	1	6	7	0	0	
		Average	13.52	10.94	5.30	7.24	0.29	0.02	

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Fertility restoration of cytoplasmic male-sterile Emmer wheats

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As already reported (Fukasawa, 1955), F_1 hybrids between male-sterile *durum* and *T. dicoccoides* var. *Kotschyanum* produced about 86% good pollen grains. The hybrid plants were somewhat weak and late maturing. Since some of them died before heading sufficient investigation have not been carried out. Thus, male-sterile *dicoccum* (Khapli) plants which have earlier maturing were used in the crossing experiment with *dicoccoides* var. *Kotschyanum*. The resulting F_1 plants showed vigorous growth habit and high pollen fertility (97%) as expected.

From the selfing or backcrossing with normal *dicoccum* (Khapli) plants, many offsprings, sterile, semifertile and fertile plants, were obtained. They were divided into five classes according to the degree of their pollen fertilities as shown in the following table.

Five classes of F_2- and backcross-plants from the cross of male-sterile *dicoccum* × *dicoccoides* var. *Kot.*

Lines	a 0%	b 1～25%	c 26～50%	d 51～75%	e 76～100%	Total
F_2 from male-sterile *dicoccum* × *dicoccoides*	10	7	3	10	44	74
%	13.5	9.4	4.1	13.5	59.5	100
(Male-sterile *dicoccum* × *dicoccoides*) × *dicoccum*	15	2	5	6	11	39
%	38.5	5.1	12.8	15.4	28.2	100

The pollen fertility of semi-fertile plants seems to be influenced considerably by environmental conditions. From the data obtained, however, it could be suggested that pollen restoring factor derived from *dicoccoides* is not one simple gene, but two more genes are involved.

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Morphological characters of nine diploid

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Species	Genome	Ear-shape	Type of disarticulation	Shape of lateral spikelet	Keel: presence + none –	Upper margin of the empty glume in the lateral spikelet
caudata	C	spikelets linearly arranged	umbrella	flat & lanceolate	–	bidentate, one of the teeth forming a narrow own
umbellulata	C^u	short, narrow-conical	〃	ovovate with abrupt inflation	–	broadly-horizontal, with long awns
comosa	M	lanceolate, elongated-ovate	〃	ovate-lanceolate	–	bidentate, teeth divergent, one of them broader
uniaristata	M^u	elongated-ovate or lanceolate	〃	ovate & inflated	–	a broad and strong awn and a broad triangular tooth
squarrosa	D	cylindrical	barrel	square	–	truncate without awns and teeth
mutica	Mt	spikelets linearly arranged	wedge	trapezoid square	–	bidentate, teeth short and broad at the base, showing between them a not acute notch
speltoides	S	linear & flat	wedge or umbrella	trapezoid	+(weak)	horizontal, with round tooth in one corner, showing a slightly curved transition to the lateral side
longissima	S^l	linear & flat	wedge	convex & lanceolate	+(〃)	unequally bidentate, the teeth fang-form, showing not an acute notch between them
bicornis	S^b	linear & flat	〃	〃	+(〃)	bidentate, the teeth never pointed beaks, showing not an acute notch between them

analysers of the genus *Aegilops*

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Number of awns of 1st floret				Position of empty glume and flowering glume	Hulled or naked	Number of the sterile top spikelets	Number of the sterile base spikelets
Empty glume		Outer glume					
apical spikelet	lateral spikelet	apical spikelet	lateral spikelet				
1	0~1	–	–	outer glume slightly exceeded	hulled	0	3
4~5	4~5	2	2~3	〃	naked	1~3	3
2~3	–	0~1	0	〃	hulled	0	1 (occasionally 1)
2~3	1~2	1	0	〃	〃	0	3 (occasionally 2)
0	–	1	1	〃	〃	1~2	0
0	0	0	0	outer flowering glume considerably exceeded	〃	0	0
0	0	1	0~1	〃	〃	0	0
0	–	1	0~1	〃	〃	0	0
–	–	1	1	〃	〃	0	0

Results of genome exchange among *Aegilops* and *Triticum* species through the successive backcrosses

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Female parents		Pollen providers		Resulting plants	
Species name	Cytoplasm & genome	Species	Genome	Cytoplasm & genome	Fertility
Ae. ovata	α^o $C^uC^uM^oM^o$	*T. durum* (*R*)	AABB	α^o AABB	Male sterile
Ms *durum* (*R*)	〃 AABB	〃 (*h*)	〃	〃 〃	〃
〃	〃 〃	*T. dicoccum* (E)	〃	〃 〃	〃
〃	〃 〃	〃 (Kh)	〃	〃 〃	〃
〃	〃 〃	*T. dicoccoides* (*K*)	〃	〃 〃	Fertile
〃	〃 〃	〃 (*sp*)	〃	〃 〃	Male sterile
〃	〃 〃	〃 (*St*)	〃	〃 〃	〃
〃	〃 〃	*T. vulgare* (*e*)	AABBDD	〃 AABBDD	〃
〃	〃 〃	*T. compactum*	〃	〃 〃	〃
〃	〃 〃	Norin No. 26	〃	〃 〃	〃
		Ae. ovata	$C^uC^uM^oM^o$	$C^uC^uM^oM^o$	Fertile
ovata with *durum* cytoplasm	β^d $C^uC^uM^oM^o$	*T. durum* (*R*)	AABB	β^d AABB	〃
T. durum (*R*)	〃 AABB	*Ae. ovata*	$C^uC^uM^oM^o$	〃 $C^uC^uM^oM^o$	〃
Ae. ovata	α^o $C^uC^uM^oM^o$	*Ae. variabilis*	$C^uC^uS^vS^v$	α^o $C^uC^uS^vS^v$	〃
Ae. ventricosa	α^v DDM^vM^v	*T. vulgare* (*e*)	AABBDD	α^v AABBDD	〃
Ae. caudata	α^c CC	〃 (〃)	〃	α^c 〃	Male sterile1)
T. dicoccoides (*sp*)	β^{di} AABB	〃 (〃)	〃	β^{di} 〃	Fertile

1) after Kihara (1951)

Errata of WIS No. 6

Page 5, lines 3∼2 from bottom, for "a certain number of days, read "an hour".
Page 13, line 11 from top, for "5 strains", read "6 strains".
Page 13, line 12 from top, for "16 strains", read "15 strains".

III. Genetic Stocks

Autopolyploids and amphipolyploids in *Triticinae* produced at the University of Manitoba from April 1957 to March 1958

M. Rommel and B. C. Jenkins
Division of Plant Science, University of Manitoba Winnipeg, Manitoba, Canada

Accession number	Variety or cross	Growth habit
	Autopolyploids	
4 D 11	*Secale cereale* (Prolific)	S
4 B 472	*Triticum monococcum* (Einkorn)	S
8 B 481	*T. durum* (Golden Ball)	S
8 B 482	〃 〃 (Stewart)	S
8 B 483	*T. turgidum* var. *ramoso-megalopolitanum*	S
	Amphipolyploides	
8 A 94	*T. aestivum* (Prelude) × *S. cereale* (Prolific)	S
8 A 95	〃 〃 (Rescue) × 〃 〃 〃	S
8 A 96	〃 〃 (Selkirk) × 〃 〃 〃	S
6 A 149	*T. timopheevi* var. *typicum* × *A. elongatum* ($2n=14$)	S
8 A 150	*T. sphaerococcum* × *S. cereale* (Prolific)	S
8 A 158	*T. aestivum* (Kharkov) × *S. fragile*	W
6 A 187	*T. turgidum* var. *ramoso-megalopolitanum* × *A. elongatum* ($2n=14$)	S

(*Received May 20, 1958*)

Differential Varieties of *Triticum* and *Avena* Species Wanted

N. Hiratsuka
Faculty of Agric., Tokyo Univ. of Education, Tokyo, Japan

We would appreciate receiving the Following seeds:

(1) Differential varieties of *Triticum* spp. used for identifying physiological races of *Puccinia graminis* var. *tritici*:

T. compactum: Little Club, C. I. 4066.
T. vulgare: Marquis, C. I. 3641, Reliance, C. I. 7370, Kota, C. I. 5878
T. monococcum: Einkorn, C. I. 2433
T. durum: Arnautka, C. I. 1493, Mindum, C. I. 5296, Spelmar, C. I. 6236, Kubanka, D. I. 2094, Acme, C. I. 5284
T. dicoccum: Vernal, C. I. 3686, Khapli, C. I. 4013
Lee, C. I. 12488. (Supplemental differential)

(2) Differential varieties of *Triticum* spp. used for indentifying physiological races of *Puccinia triticina*:

Malakoff, C. I. 4898, Webster, C. I. 3780, Loros, C. I. 3779
Mediterranean, C. I. 3332, Democrat, C. I. 2384, Thew

---

(3) Differential varieties of *Avena* spp. used for identifying physiological races of *Puccinia coronata*:

Anthony (101), Victoria (102), Appler (103), Bond (104), Landhafer (105), Santa Fe (106), Ukraine (107), Trispernia (108), Bondvic (109), Saia (110)

(*Received May 20, 1958*)

IV. Informations of the International Meetings

The First International Wheat Genetics Symposium, Winnipeg, Canada, August 11～15, 1958

E. H. Lange
Publicity Chairman

B. C. Jenkins
Symposium Secretary-Organizer

Wide Representation Assured

We know now that scientists from 23 countries will attend the Symposium and reservations are still arriving. The following are definitely planning to come:
Dr. Vallega of Argentina, Drs. Finlay and Pugsley of Australia, Dr. da Silva of Brazil, Thirty-four representatives from Canada, Drs. Gibler and Roming from Colombia, Drs. Li and Shen from Formosa, Dr. de Vilmorin from France, Dr. Gaul from Germany, Dr. Chennaveeraiab will represent India, Drs. Arnon and Pinthus from Israel, Dr. Harrington from Italy, Drs. Kihara, Matsumura, Yamashita and others from Japan, Dr. Thorpe from Kenya, Dr. Borlaug of Mexico, Dr. Hair of New Zealand, Drs. Camara and Noronha-Wagner of Portugal, Dr. Laubscher of South Africa, Dr. Sanchez-Monge of Spain, Drs. MacKey and Müntzing of Sweden, Dr. Riley from the United Kingdom, Thirty-five representatives from the U. S. A., Drs. Zhukovsky, Zhebrak and Tsitsin of the U.S.S.R., Dr. Borojevic of Yugoslavia.

Living Herbarium

A living herbarium of wheat varieties and related species has been specially planted for the Wheat Genetics Symposium.

1. Thirty-two countries have so far contributed a total of over 400 varieties to the

wheat nursery. These wheats have been planted in a manner to facilitate close comparison. Included among them are almost all Canadian varieties used since wheat was first grown in this country.

2. There will be a display of monosomics in eight varieties-168 lines, and four substitution series-84 lines.
3. Over sixty artificially produced species will be available for inspection.
4. Over fifty *Triticum* species will be on display.
5. The herbarium contains also several special displays of backcross-derived varieties and genetic dwarfs.

The International Spring Wheat Rust Nursery, grown by the Cereal Breeding Laboratory of the Canada Department of Agriculture, has been planted adjacent to the wheat genetics herbarium.

Just a Request

To assist the Accommodation Committee will you please *let us have your reservation as soon as possible.* After June 15 we must ask you to make your own reservations. We will be pleased to provide information at any time.

An interesting program has been arranged for the ladies. Please indicate whether your wife will be with you.

You will enjoy it in
Winnipeg - Manitoba - Canada !
Make your seservations now.

The Xth International Congress of Genetics, Montreal, Canada, August 20∼27, 1958

A list of exhibits of wheat and its relatives from Japan

1. Classification of wheats (4 charts, 6 pictures, 17 specimens):
   a. Schulz's (1913) classification
   b. Classification based on genome analysis
   c. Morphological characters of 4 groups
   d. Schema showing the principle of Kihara's genome analysis
2. Pentaploid hybrids (2 charts, 9 pictures):
   a. Fertile and sterile chromosome combinations in the following generations of pentaploid hybrid
   b. Increasing and decreasing groups in $F_2 \sim F_5$ generations
3. Classification of *Aegilops* (5 charts, 26 specimens):
   a. Classification based on genome analysis

   b. Geographical distributions of the diploid species
   c. Possible and successful combinations of species hybrids
   d. Genome relations between $2x$ and $4x$ species
   e. Diagram showing inter- and intra-group relationships for 3 groups

4. Autopolyploids and amphidiploids in *Triticum* and *Aegilops* (4 charts, 1 picture, 24 specimens):
   a. Induced polyploids of *Triticum* and synthesized amphidiploids from *Triticum* × *Aegilops*
   b. Possible and successful amphidiploid combinations among 11 diploid species in *Aegilops*
   c. Synthesized amphidiploids in *Aegilops*
   d. Induced polyploids in *Aegilops*
5. Synthesis and origin of $6x$ wheats (4 charts, 4 pictures, 8 specimens):
   a. Genealogical relations in *Triticum* and *Aegilops*
   b. Characteristics of DD species expected from the morphological analysis
   c. Geographical distributions of *T. dicoccoides* and *Ae. squarrosa*
   d. Synthesized $6x$ wheats
6. Collection of the Kyoto University Scientific Expedition to the Karakoram and Hindukush in 1955 (3 charts, 21 wheat specimens 48 *Aegilops* specimens):
   a. Map of localities of *Aegilops* species collected
   b. Number of strains and localities of *Triticum* collected
   c. Number of strains and localities of *Aegilops* collected
7. Himalayan wheats (1 chart, 19 specimens):
   Variety of wheat in Nepal and their frequencies
8. Japanese wheat varieties (3 charts, 18 specimens):
   a. Breeding in general
   b. Leaf rust resistant variety from the pentaploid hybrid—Norin No. 3
   c. Pedigrees of the Nōrin varieties
9. X-ray induced mutations in Einkorn wheats (5 charts, 2 pictures, 10 specimens):
   a. Seven linkage groups
   b. 16 reciprocal translocations induced by X-ray treatment
   c. A plan of combining RT-sets of chromosomes by successive crosses.
   d. Induced and synthesized meiotic configurations
   e. Variation in pollen fertility
10. Right- and left-handedness (4 charts, 8 pictures, 5 specimens):
   a. Illustrations of the right- and left- handedness of leaf and spikelet
   b. Change of the intensity in the R/L regularity at various positions
   c. The intensity $(\overline{C})$ of the R/L-handedness of the species in *Triticum* and *Aegilops*
   d. Polygenic analysis of $\overline{C}$

11. Nuclear substitution (7 charts, 12 pictures, 10 specimens):
    a. A figure of nuclear substitution
    b. Comparison of phenotypes
    c. A diagram of nuclear substitution and restoration
    d. Relation between the number of *caudata* sat-chromosomes and pollen fertility
    e. A diagram showing the interrelationships between nucleus and cytoplasm in pollen production
    f. Fertility curves
12. *Agropyron* in Japan (2 charts, 7 specimens):
    a. *Agropyron* species
    b. Distribution

Exhibited by H. Kihara and K. Yamashita

V. Circulation List of WIS

(Addition May 20, 1958)

BAKSHI, J. S.: Agronomy Department, Oklahoma State University, Stillwater, Oklahoma, U. S. A.
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(New Addresses May 20, 1958)

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VI. NEWS

40th Anniversary for the discovery of right chromosome number of wheat

"It is already 40 years since the right chromosome numbers of wheat were found by Dr. K. Sax and Dr. T. Sakamura in 1918." Dr. Kihara writes an article for the present number (page 1–2) in regared to this matter, and we shall be happy if any one would write for the next number of WIS about the surprise which was occasioned by their epochmaking discoveries.

We are very glad to know that both Dr. Sax and Dr. Sakamura are keeping good health, and we expect to hear something from them in the next number. *(K. Y.)*

Wheat Newsletter Vol. IV

Annual wheat Newsletter Vol. IV, 1957, edited by Dr. E. G. Heyne, Kansas State College, U.S.A. and Dr. D. R. Knott, University of Saskatchewan, Canada, appeared in April, 1958.

Robigo No. 5

"Robigo No. 5, cereal rusts news from everybody to everybody" appeared in February, 1958 (pp. 23). All correspondence concerning this publication may be addressed to: Ing. Agr. José Vallega, Instituto de Fitotecnia, Castelar, Argentina (cf. information in WIS No. 4, p. 28).

Back Numbers of WIS

Back numbers of WIS, 1, 2, 3, 4, 5, and 6, are available. They will be sent free on application.

VII. Announcement for the Next Issue, No. 8

WIS No. 8 will be ready for publication in December, 1958. The number is expected to include some reports about the Ist International Wheat Genetics Symposium held in Winnipeg, Canada, August 11~15, 1958.

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 by typewritten in English. The authors are cordially requested to present—*not later than October 31, 1958*— their manuscripts which should not exceed two printed pages. Lists of stocks 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. Kosuke Yamashita
Wheat Information Service
Biological Laboratory
Kyoto University, Kyoto, Japan

(*K.Y.*)

VIII. Acknowledgement

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Showa Sangyo Co., Ltd., Tokyo, Japan
Nitto Flour Milling Co., Ltd., Tokyo, Japan

We should like to express our sincere gratitude for favorable comments regarding WIS Nos. 1~6 and the valuable contributions for the present number. Increased support for further issues would be appreciated.

The Managing Editor

Explanation of the Figures on the Cover

(H. Kihara, s. Page 1)

Fig. 1. Photograph of the figures in the plate 2 of Sax (1918): a. (orig. Fig. 13) Male nucleus in the egg cell. b. (orig. Fig. 14) Male nucleus in contact with the egg nucleus. c, d. (orig. Figs. 15, 16) Male nucleus within the egg nucleus. e. (orig. Fig. 17) Metaphase of the first division of the fertilized egg. "There are approximately twenty-eight chromosomes to be seen in this section." f. (orig. Fig. 18) Late metaphase of the first division of the zygote.

Fig. 2. Photograph of a paragraph, Page 152: lines 20–29, of Sakamura (1918): Meine Beobachtungsresultate zeigen, dass auch unter den *Triticum*-Arten *x*-ploide Beziehungen vorkommen, und dass bei der primitiven Art *T. monococcum* die geringste Anzahl und bei der differenziertesten *T. vulgare* die höchste Anzahl festgestellt wird. Weiter ist zu beachten, dass die Chromosomenzahlen auch mit den Schulzschen Stammbaum im folgenden interessanten Zusammenhang stehen:

	$2x$		
Kulturarten der Einkornreihe	14	phylogenetisch	diploid.
„ „ Emmerreihe	28	„	tetraploid.
„ „ Dinkelreihe	42	„	hexaploid.

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