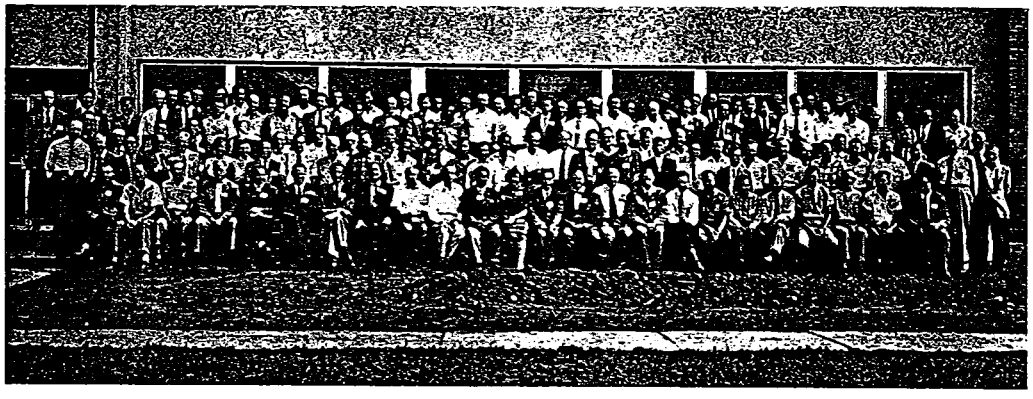
WHEAT INFORMATION SERVICE



Participants of the
FIRST INTERNATIONAL WHEAT GENETICS SYMPOSIUM
University of Manitoba Winnipeg, Manitoba, Canada
August 11-15, 1958

Nos. 9-10 **December, 1959**

Wheat Information Service
Biological Laboratory, Kyoto University
Kyoto, Japan

Participants of the

FIRST INTERNATIONAL WHEAT GENETICS SYMPOSIUM

University of Manitoba Winnipeg, Manitoba, Canada

August 11–15, 1958

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Nos. 9–10

December, 1959

I. Research Notes

On the findings of *Triticum Spelta* L. in Iran and on the arising of *Triticum aestivum*-types through crossing of different *Spelta*-types

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The author during his assignment as F.A.O. expert for cereal-breeding in Iran in 1952–1954 found in the Baktiari country a well confined region with culture of *Triticum Spelta* L. This region extends from Shahr-Kord, the capital of the Baktiari country, located on a plateau of 2000–2300 m altitude, southwards 120 km to Shansebad and Buldaji. Massiv mountains, difficult to cross, cover the area near the lowlands of Khuzistan. Spelta culture extends about 150 km northwards from Shahr-Kord up to Golpaigan. The region lies between 50/51th longitude and 31/32th latitude. Besides *T. Spelta*, also *T. aestivum* is cultivated to a larger and increasing extent. In the same area, also *T. dicoccum* can be found under cultivation but rather rarely.

The Iranian *Spelta*-types exhibit the main characteristics of the species, *T. Spelta* L.: spikelets with firmly sticked glumes, shouldered and keeled shape of the glumes and brittle rachis. Comparative anatomical studies of the author's coworker Mrs. Dr. G. Pohlendt with different *Spelta*-forms from Iran and Europe and furthermore with *T. Macha* and *T. aestivum* (bred variety Heine VII) revealed that the anatomical basis in some Iranian samples is completely the same as in *T. Spelta* of Swiss origin, and that other samples are distinguished only by a feebler formation of the parenchymatic cave in the links of the rachis below the spikelets. Hereby the disarticulation is likely to be made more difficult. With the Iranian *Spelta*-type no spontaneous articulation of the upper part of the rachis was observed under cultivation in Germany as it happens with the European. Among the Iranian *Spelta*-types winter, summer and intermediate (" Wechselweizen ") types were found. The winterhardiness particularly of the intermediate types is very low when cultivated in Germany. The morphological variability is rather limited. The exceptional finding of fragile but freethreshing types is very

striking and interesting from a phylogenetical point of view.

Generally in crosses of *T. Spelta* from Iran with *T. Spelta* from Europe no segregations were observed in characteristics of *T. Spelta*. Only in a few progenies some freethreshing plants appeared which corresponded to the *compactum*-, *subcompactum*- and squarehead-types. The same types but in a much larger extent were observed in F_2 and F_3 of a cross between *T. Spelta* from Asturia with a distinct line of *T. Macha*. The segregated freeshreshing types proved to be rather constant. Now their cytogenetical analysis is under investigation.

It can be concluded from the studies carried hitherto that the genetical basis of *Spelta*-characteristics is the same with *T. Macha*, *T. Spelta* Europe and *T. Spelta* Iran. However the occurence of small structural chromosomal differences must be assumed to cause disturbances in the meiosis of hybrids between different *Spelta*-types and to lead to the formation of the observed chromatin bridges. Therefore chromosomal rearrangements could result in the origin of freethreshing types. Probably the chromosome IX is favoured to undergo rearrangements, as in this the Q-factor, the suppressor of *Spelta*-characteristics, and the B-factor, the suppressor of awns, are located. Although *T. Spelta* Asturia and *T. Macha* are awned some of their hybrids proved to be awnless resp. short-awned, and only in the progenies of these awnless hybrids the segregation of *compactum* and other freethreshing types were observed.

From the findings of *T. Spelta* in Iran and their cytogenetical behaviour the conclusion can be drawn that the culture of *T. Spelta* in Iran does not trace back to imports from Europe; but both *Spelta*-types could derive from a common origin. However *T. Spelta* should be regarded as the original form of the cultivated hexaploid wheats, not as one of the derived form of hexaploid naked wheats (*T. aestivum*). There are several possibilities for the origin of freethreshing wheat from *Spelta* wheat. For example, a genetically possible mechanism revealed in the experiments of the author is the crossing of different hexaploid *Spelta*-forms, from which a large number of naked types with tough rachis arose.

Some studies concerning the metabolic basis for the speltoid-compactoid series in *Triticum vulgare**

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It is well known that aneuploids of *Triticum vulgare*, concerning Chromosome IX (the "speltoid chromosome"), give rise to plants that when mature are of various heights and head types, depending on their chromosome constitution. Thus plants

* These investigations were carried out at the University of Alberta, Edmonton, Alberta, Canada. They formed part of an M. Sc. thesis which was supported by a bursary from the National Research Council of Canada.

monosomic for Chromosome IX are taller than the normal disomic and have speltoid heads, while plants that are trisomic and tetrasomic are increasingly shorter than the disomic, and have, what may be described as, semi-compactoid and compactoid heads respectively. Heights of field grown plants disomic trisomic, and tetrasomic for Chromosome IX, measured by averaging the heights of the three tallest tillers of each plant, are shown in Table 1.

Table 1. Mature heights of *T. vulgare*, variety Chinese Spring, and some of its aneuploids for Chromosome IV

	Number of plants	Mean ht.	Standard error
Disomic	9	111 cm	1.3
Trisomic	18	74 cm	1.24
Tetrasomic	21	52 cm	0.91

A number of investigations are being conducted in an attempt to determine the metabolic basis for these height differences. Broadly speaking there are two approaches for such investigations. One approach is through the study of differences between the plant types in their respiratory systems and the concomitant production of high energy metabolites; the other is through the study of the better known growth promoting substances. These two approaches differ essentially in that the former tends to seek general information, while the latter seeks specific information. Each approach has its own disadvantages. Thus respiratory studies may provide information that is rather vague, and growth substance studies may result only in negative information. A start has been made on the latter approach.

Plant extracts were obtained from disomic and tetrasomic seedlings by the following method. After harvesting, the seedlings were weighed and immediately frozen at −14°C. The tissues were then ground to a pulp with a pestle and mortar at 0°C. To this pulp was added iced distilled water at the rate of 100 ml per 1 g fresh seedling weight, and the mixture was centrifuged. Following centrifugation the supernatant was dialysed against distilled water. The dialysates were tested for indoleacetic acid (IAA) oxidase activity; the destruction of IAA by the dialysates was measured colorimetrically. A control of boiled dialysate showed no IAA destruction. Table 2 summarises these results.

These experiments demonstrated that on a fresh weight basis there is no significant difference in IAA destruction by extracts of disomic and tetrasomic seedlings. Further evidence of this point was obtained by using wheat coleoptiles, both disomic and tetrasomic, in place of *Avena* coleoptiles in the standard *Avena* coleoptile test. Known amounts of IAA in agar blocks placed on the prepared wheat coleoptiles gave no significant differences between the resulting curvatures of the disomic and tetrasomic coleoptiles.

Table 2. IAA destroyed in 60 minutes by dialysates from wheat seedlings, variety Chinese Spring (Sets of figures are grouped for each experiment.)

Seedling age	Seedling type	μg IAA destroyed per ml dialysate
16 days	Disomic	13.12
	Tetrasomic	12.75
19 days	Disomic	14.75
	Tetrasomic	13.87
21 days	Disomic	14.00
	Tetrasomic	13.85

Disomic and tetrasomic seedlings were grown in solutions of gibberellic acid (GA),

Table 3. The effect of various treatments on the growth of wheat seedlings, variety Chinese Spring, disomic and tetrasomic for Chromosome IX (Sets of figures are grouped for each experiment.)

Treatment	No. of seedlings	Average ht. of seedlings			Increase in ht. during period of measurement
		0 hr	96 hr	120 hr	
Disomic	12	5 mm	105 mm		100 mm
Tetrasomic } Light	12	2	53		51
Disomic	12	16	138		122
Tetrasomic } Dark	12	10	79		69
Disomic	15	8	133		125
Tetrasomic } GA, 50 mg/liter	15	5	76		71
Disomic	15	7		59 mm	52
Tetrasomic } Kinetin, 5 mg/l	15	4		54	50
Disomic	15	7		117	110
Tetrasomic } Water	15	3		78	75
Disomic	35	19		104	85
Tetrasomic } Kinetin, 5 mg/l	35	14		98	84
Disomic	35	22		94	72
Tetrasomic } Kinetin, 0.5 mg/l	35	18		88	70

kinetin, and water. The seedlings clearly showed a response to GA; however disomic and tetrasomic seedlings seemed to respond by nearly equal amounts. Seedlings grown in kinetin has reduced growth compared with those grown in water, and it appeared that disomic and tetrasomic seedlings had nearly equal growth rates. It may well be that the kinetin solution gave rise to overall limiting factors, quite divorced from the factors causing the dwarfness under study, but such as to prevent the typical development of both disomic and tetrasomic phenotypes. Seedlings were also grown in water under light and dark conditions; no differential responses were observed. These results are summarised in Table 3.

The breeding of *Triticum durum* by means of interspecies crosses

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In Italy research is now being carried out on a large scale on breeding of *Triticum durum*, because, also in typical areas, the species is going to be substituted by *T. vulgare*, which has a markedly superior productivity capacity.

As is well-known, Italians are traditionally large consumers of soup-paste, and must, therefore, rely on imports of macaroni wheat for their needs, while in Italy over production of soft grain is deplored.

It is particularly interesting, therefore, to review the results, which for the present have been obtained by means of interspecific hybridization at the "Stazione Fitotecnica" of St. Angelo Lodigiano, Milano.

From the cross *T. turgidum* var. *pseudocervinum* × *T. durum* with the method of a repeated backcrosses using *T. durum* as the recurrent parent, is obtained a definite increase in number of kernels per spike (above 100 kernels in comparison to 40–60 of the best *durum* spikes) through an increase in number of florets per spikelet and number of spikelets. Moreover the plant height is lowered as far as 35 cm less than the standard variety of *T. durum* "Cappelli". The main obstacle encountered in the selection consists of the difficulty in separating those lines which can at least be equal in quality to "Cappelli".

From *T. dicoccoides* crossed to *T. durum* and backcrosses, are obtained types which present, in comparison with *T. durum*, a higher winter hardiness, a better tillering, a more intense color of the leaves and larger seeds.

From *T. durum* × *T. orientale* lines have been obtained which are especially interesting for large dimensions of grains.

The cross between *T. durum* and *T. Timopheevi* gave types resistant to cold and rust.

From *T. persicum* × *T. durum* and relative backcrosses, more satisfying results have been obtained. The most evident result is represented by a very much higher increase in floret fertility and a great improvement in the grain which is perfectly hard.

It is to be noted that *T. durum* in all varieties in the growing conditions of North Italy has many soft grains.

From *T. durum* × *T. vulgare* have been obtained interesting types for winter hardiness, humidity resistance, low stem height and more fertile spike.

At the "Stazione Fitotecnica" *T. durum* has been submitted to a long series of crosses and backcrosses, also with species of *Aegilops* and *Agropyron*. These data will be given on another occasion.

Radiation experiments on *Triticum durum* and *Triticum vulgare*

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Polygenic systems controlling quantitative characters have been shown to undergo spontaneous as well as X-ray induced mutation.

In view of the significance of such findings for problems of evolution, as well as for plant and animal breeding, an experiment has been started for obtaining more data on the induction of mutations in polygenic systems by treatments applied to seed, using *T. durum* (one variety: Cappelli) and *T. vulgare* (two varieties: Damiano and Mara).

At present, data on the effect of X-ray treatment at a dose of 10,000 r applied to seed and observed on R_1 plants are available.

Treatments (230 Kv, 12 mA, 4 mm Al filter) were given to part of the seed of several heads; the remaining seed being used as control. Each head had been considered as the parent of lines for which treated and untreated progenies were available.

On the seedlings the length of the coleoptile and of the main root at 3 and 5 days of age have been found to be reduced by the treatment. Interactions Head × Treatment were found to be significant for these traits. Such finding shows a different response of different heads to the same treatment.

On the mature plant the number of internodes was reduced and the internodes were shorter, so that the plant height was found to be reduced in the series when compared with the control. Interactions Head × Treatments were found to be significant for such traits.

On the ears a reduction of the internode length was observed in *T. vulgare* and a reduction of the number of spikelets and of the number of seed set was found in *T. durum* and *T. vulgare*. This work will be continued in order to obtain data on variability for different polygenic traits in the treated as well as in the untreated series.

Chromosome pairing in the F_1 of monosomic IX (Chinese Spring) × *T. boeoticum* Boiss.

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On the basis of the fact that the model number of bivalents in the F_1 of β-speltoid × *T. boeoticum* Boiss. (*T. aegilopoides* Bal.) was the same as that observed by Hosono (1935) in the F_1 of *T. persicum rubiginosum* (21_{II}) × *T. boeoticum* Boiss., Matsumura (1951) concluded that the chromosome missing in the β speltoid was in the B genome[1].

In four different 27-chromosome F_1 plants of the cross mono-IX Chinese and *T. boeoticum* Boiss., chromosome pairing was as follows: (3 and 4 were calculated as $1_{II}+1_I$ and 2_{II}, respectively)

Plant No.	Date sampled	Ears	Spikelets	Anthers	Total cells observed	Frequency of bivalents 0	1	2	3	4	5	6	7	8
9.208.1-1	April 2	1	1	1	100	0	0	5	19	29	30	16	1	0
〃	〃	2	1	1	100	1	0	4	11	30	38	16	0	0
〃	〃	2	2	1	100	1	0	4	13	25	40	15	2	0
〃	〃	2	3	1	100	0	0	5	11	43	30	11	0	0
9.208.1-2	April 13	3	1	1	100	39	34	20	6	1	0	0	0	0
〃	〃	3	2	1	100	34	31	26	8	1	0	0	0	0
〃	May 12	4	1	1	100	0	1	10	25	45	15	4	0	0
〃	〃	4	1	2	100	1	0	5	13	38	41	2	0	0
9.208.7-1	April 16	5	1	1	186	15	24	44	61	32	8	2	0	0
〃	April 21	6	1	1	100	0	2	13	27	28	25	5	0	0
9.208.7-2	May 12	7	1	1	100	1	4	10	26	42	17	0	0	0
〃	〃	7	1	2	100	0	0	2	13	45	35	5	0	0

The data suggest that:

(1) The model number of bivalents tends to be the same or not very widely different in samples taken on the same day from the same plant or even from different plants.

(2) The mode varies according to the day on which the sample is taken.

1) Editor's note: Yamashita (1937) stated that "Es laege nahe, zu vermuten, dass der Speltoid-Weizen mit 40 Chromosomen, bei dem die Halme sehr dickwandig sind, ein Paar Dinkel-Chromosomen mit dem Faktor fuer hohl verloren habe."

$^{14}CO_2$ assimilation in germinating wheat

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Physiological change in the process of germination from heterotrophic to autotrophic furnishes very interesting problems. Consequently, we have performed an experiment in which carborn dioxyde labelled with ^{14}C was used for the inverstigation on photosynthetic assimilation of two kinds of the germinating wheat.

Experiment 1. Material: Japanese wheat variety, Norin No. 26.

1) According to the difference in dry weight, three stages were found in the germination, namely, the stages (1) of decreasing dry weight by respiration, (2) of constant dry weight and (3) of increasing dry weight by photosynthesis.

2) Assimilation of $^{14}CO_2$ increased considerably after 6 days from sowing, and the photosynthetic products have been mostly proved to be sucrose. It is therefore suggested that sugar translocated from endosperm to leaves is monosaccharide.

3) Starch contained in leaves at the early period of germination relies on endosperm, but that found in leaves after 6 days is a new product of photosynthesis.

Experiment 2. Material: X-ray induced mutant, "carotina" and "normal" of Einkorn wheat.

1) The change in dry weight was the same in "normal" and "carotina" before the consumption of endosperm nutrients.

2) "Carotina" contains a little chlorophyll, and the same carotinoids as found in "normal" although the amount is small.

3) The amount of $^{14}CO_2$ fixed per plant at each stage of germination by "carotina" was about 15% of that of "normal".

4) After five days from sowing, photosynthetic products in 1, 10 and 60 min were investigated, and it has been found that the products in "carotina" are qualitatively the same as in "normal", but incorporation of ^{14}C into sucrose and starch in "carotina" was lower than in "normal".

Genetic effects of thermal neutrons on wheat

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The thermal neutron irradiations were conducted in the thermal colum of the Japan Atomic Energy Research Institute's Nuclear Reactor, JRR-1. Hole No. 7 (North 6″ϕ Thermal Column Access Port) was selected to keep gamma contamination in the thermal

column as small as possible. The thermal neutron flux was calculated to be 2.6×10^8 n/cm²·sec when the reactor was operated at 25 kilowatts.

In a preliminary experiment dormant seeds of *Triticum monococcum flavescens* were kept in this hole for 1–5 weeks (actually 131.5–1068.7 kWh: $4.9–40.0\times10^{12}$ n/cm²). The data are shown in Table 1. The higher was the dosage of the thermal neutrons, the more delayed were germination and growth of seedlings. The seeds were almost uniformly injured. There was no germination at 4–5 week treatment ($31.4–40.0\times10^{12}$ n/cm², IV–V) and the seedlings did not grow and died in early stage. In the root tips just after germination the frequency of chromosome aberrations increased with the increase of dosage and in IV and V more than 95% of dividing cells had chromosome aberrations. In PMC's a ring of 4 chromosomes was observed. In X_2 chlorophyll mutations, such as *albina*, *xantha*, *viridis* etc. were found. The frequency of chromosome aberrations and chlorophyll mutations increased in proportion to the dosage.

Table 1. Genetic effects of thermal neutrons on Einkorn wheat

	Kilowatt hours	Thermal neutron flux ($\times10^{12}$ n/cm²)	Germination rate (%)	Length of seedlings* (cm) (Index)	Abnormal cells in root tips (%)	Chromosome aberrations in PMC (%)	Chlorophyll mutations in X_2 (%)
Control	—	—	65.0	9.41 (100)	0.24	0.00	0.00
I	131.5	4.9	65.0	7.76 (82.47)	22.04	3.13	3.77
II	363.2	13.6	79.0	7.08 (75.24)	28.30	18.52	10.53
III	491.5	18.4	87.5	4.86 (51.65)	43.67	15.79	8.00
IV	838.0	31.4	20.0	0.50 (5.31)	96.43	—	—
V	1068.7	40.0	40.0	0.47 (4.99)	96.61	—	—

* The seedlings were measured 14 days after sowing.

In the next experiment the reactor was operated at 40 kW and the seeds of *T. monococcum* (2*x*), *T. durum* (4*x*) and *T. vulgare* (6*x*) were subjected to thermal neutrons at 5 different distances in the reactor hole No. 7 for 2 weeks (actually 990.8 kWh). The thermal neutron flux ranged from $0.49–4.2\times10^8$ n/cm²·sec (total flux: $4.4–37.5\times10^{12}$ n/cm²). At 37.5×10^2 n/cm² *T. monococcum* did not germinate, while the seeds of *T. durum* and *T. vulgare* germinated but the seedlings died in on early stage without further growth. At 20.6×10^{12} n/cm² about 2/3 of seeds germinated in *T. monococcum* but the seedlings soon died, while in *T. durum* and *T. vulgare* slow growth of seedlings was observed. Therefore, *T. monococcum* was most sensitive to thermal neutrons and *T. durum* was unexpectedly most resistant. There was no significant difference between *T. durum* and *T. vulgare*.

Genetic effects of β- and γ-radiations on Einkorn wheat

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To compare the genetic effects of β-radiation with those of γ-radiation, seeds of *Triticum monococcum flavescens* were soaked in ^{32}P and ^{131}I solutions for 2 days just before sowing. Radioactive solutions of pH 6 to 7 contained 0.05–0.4 mc/gm of ^{32}P and 0.2–0.8 mc/gm of ^{131}I. Also γ-irradiation with ^{60}Co was applied at the dosages 2.5, 5, 10 and 20 kr immediately after soaking seeds in water for 2 days. The growth of seedlings, single-spike fertility and chromosome aberrations of treated plants (X_1) and the chlorophyll mutations in X_2 were compared for β- and γ-irradiations. The data are shown in Table 1. The seedlings were measured 18 days after sowing. The relation between the inhibition of seedling growth and dosage of β- and γ-radiations coincides roughly with that between the decrease of fertility and dosage. γ-rays at 2.5 kr slightly inhibited the growth of seedlings and reduced the fertility, those effects correspond roughly to those of β-radiation from 0.2 mc/gm ^{32}P solution and 0.8 mc/gm ^{131}I solution. γ-irradiation at 10 kr was markedly effective. There was no germination at 20 kr with γ-irradiation.

Table 1. Genetic effects of β- and γ-radiations in Einkorn wheat

Dosage		Germination rate (%)	Length of seedlings* (cm)	Fertility in X_1 (%)	Chromosome aberrations in PMC (%)	Chlorophyll mutations in X_2 (%)
γ-ray	Control	38.0	13.46	92.09	0.00	0.00
	2.5 kr	42.0	10.12	83.17	2.44	14.00
	5.0 kr	56.0	9.10	64.63	24.53	17.46
	10.0 kr	16.0	2.71	47.36	90.91	28.57
	20.0 kr	0.0	—	—	—	—
^{32}P	0.05 mc/gm	52.0	14.33	92.25	6.89	5.19
	0.1 mc/gm	54.0	13.13	89.02	1.35	5.33
	0.2 mc/gm	76.0	12.70	82.25	7.69	11.11
	0.4 mc/gm	48.0	7.97	71.18	7.94	18.87
	0.8 mc/gm	0.0	—	—	—	—
^{131}I	0.2 mc/gm	68.0	12.46	95.0	2.13	0.00
	0.8 mc/gm	44.0	11.63	88.38	0.00	6.45

* The seedlings were measured 18 days after sowing.

In the treated plants (X_1) white and yellow stripes were often found, especially in ^{32}P. The frequency of ears with chromosome aberrations in X_1-plants was strikingly high with γ-irradiation. The majority of induced chromosome aberrations were: ④+5_{II}, often ④+④+3_{II} or ⑥+4_{II} and seldom ⑧+3_{II} or asynaptic 14_I.

The frequency of head progenies with chlorophyll mutations in the X_2-generation increased with the increase of radiation dosage. The effects of β-radiation from 0.4 mc/gm ^{32}P solution correspond roughly to those of 5.0 kr γ-radiation. The majority of chlorophyll mutations with β-irradiation were *albina*, *xantha* and *viridis*, while with γ-irradiation *albo-viridis*, *virido-albina* and *basi-viridis* were also often observed.

In conclusion the effects of β-radiation from 0.2 mc/gm ^{32}P solution and 0.8 mc/gm ^{131}I solution correspond to those of 2.5 kr γ-radiation. If we assume that the effects of β-radiation are confined only to embryo, from calculation we find that the 0.2 mc/gm ^{32}P solution equals about 2.4 krad. This will account for the present data.

Crossing experiments between *basi-viridis* II and other mutant strains of T. *monococcum*

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Crosses between *basi-viridis* II and *basi-viridis* I or other mutant strains were carried out in 1957–'58, and double recessive segregants were obtained from each cross. *Basi-viridis* II and *brsi-viridis* I recovered the chlorophyll content up to normal when they were placed in the phytotron, but in seedling stage it was only about 50% in comparison with the chlorophyll content of the normals. The chlorophyll content of the double recessive derived from the cross *basi-viridis* I×II was further decreased and the plants had the appearance of *virido-albina* mutants. When they were placed in the phytotron, their leaves gradually recovered normal green color as did both parents. On the other hand, early, slender and irregular-ear mutants were crossed to *basi-viridis* II and double recessive plants were also obtained from these crosses. As to chlorophyll, all double recessive segregants in the seedling stage were similar to the *basi-viridis* II parent.

From those results and similar symptoms exhibited by double recessive plants obtained from crosses between *virido-albina* and other chlorophyll mutants, it seems that the chlorophyll content of the double recessive shows in seedling stage a further decrease as compared with that of the parents. On the contrary, the chlorophyll content and recovery in double recessive plants obtained from crosses between chlorophyll mutants and mutants of other kind were quite similar to those of the parental chlorophyll mutant, and they resembled morphologically the other parental mutant. This may be due to the fact that in the crosses between chlorophyll mutants the involved genes have an additive action causing a decrease of chlorophyll content, while the genes for morphological traits have no effect on chlorophyll formation.

Double recessive plants between *chlorina* and *striata* of *T. monococcum*

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All F_1 plants from a cross between *chlorina* and *striata* were of normal green color and showed at meiosis the chromosome conjugation $1_{IV}+5_{II}$ while in both parents seven normal bivalents were formed. Normal, *chlorina*, *striata* and double recessive plants segregated in the F_2 generation. The segregation ratio was also observed in F_3 generation, but the linkage relationship was not clear because the germination rate of *chlorina* was low, and that of *striata* was still worse. In F_3 *striata* (or *chlorina-striata*) plants were segregated only from the F_2 plants with a tetravalent (Table 1). Moreover, F_1 plants from the crosses between *striata* and the mutants *basi-virids* I or II, slender and early also showed the conjugation $1_{IV}+5_{II}$. From these facts, the *striata* gene must be located on one of the chromosomes involved in the reciprocal translocation.

Table 1. Segregation of *chlorina* and *striata* in F_3 generation

Phenotype in F_3	Chromosome conjugation in F_3	Number of strains in F_3	Segregation in F_3			
			Normal	*chorina*	*striata*	Double recessives
Normal	7_{II}	2	98			
〃	〃	4	141	46		
chlorina	〃	4		147		
normal	$1_{IV}+5_{II}$	5	207		34	
〃	〃	5	176	67	21	8
chlorina	〃	6		201		35

Relation of ploidy to radiation effect

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The effect of radiation is influenced by various factors, Polyploidy is one of them. The author has examined in this connection meiotic irregularities and seed fertility in three groups—di-, tetra- and hexaploid—of wheats. As material 6 species were used, namely, *Triticum aegilopoides*, *T. monococcum*, *T. dicoccum*, *T. durum*, *T. Spelta*, and *T. vulgare*. Dormant seeds were exposed to γ-rays of 20, 30, or 40 kr for 18 hours.

The percentage of PMC's with meiotic irregularities, mostly reciprocal translocations, increased with increasing ploidy. In $4x$ species the great majority (83.4%) of PMC's showed aberrations at 30 kr and in $6x$ species 88.7% cells showed similar irregularities

at 20 kr., while in $2x$ species only 38.3% had aberrations at 20 kr. At higher dosages (30–40 kr) all cells were abnormal. A similar increase of multivalents (⑥, ⑧, ⑩) was observed, especially in $6x$ species (Table 1). As to other abnormalities, asynapsis and deficiency were observed, and rarely heteroploidy. The number of breaks per cell increased almost linearly with the dosage within each group. Comparison between the three groups—$2x$, $4x$ and $6x$—showed an increase in breakages in a ratio of 1:2:4. Seed fertility decreased with increasing dosage. The $2x$ species were most susceptible in this respect, next to them the $6x$, followed by the $4x$. The fertility of the $6x$ species decreased suddenly at dosages between 20 and 30 kr. The higher the ploidy, the more aberrations arose. The highest number of multivalents was found in the $6x$ plants.

Table 1. Frequency of chromosome aberrations at MI in PMC's induced by γ-rays in wheats

Material	Dosage (kr)	Total No. of cells observed	Fragments	Univalents	④	⑥	⑧	⑩	Average No of breaks per cell
T. aegilopoides	Control	4							0.00
	20	4			2	1			1.75
T. monococcum	Control	6							0.00
	20	30			10				0.66
T. dicoccum	Control	7	1						0.14
	20	19	7	1	12	3			2.15
	30	9		4	14				3.55
T. durum	Control	7							0.00
	20	27		2	12	1			1.07
	30	27		3	22	2			1.96
	40	27		2	30	2			2.51
T. Spelta	Control	17							0.00
	20	26	2	6	27	3			2.73
	30	18	1	6	28	8		2	5.38
	40	9		6	11	3	5	1	6.88
T. vulgare	Control	6		2	1				0.66
	20	27	1	2	24	5	1	1	2.77
	30	16		11	17	6	2		4.43
	40	14		3	15	4	4	2	5.07

Susceptibility of chlorophyll mutants of Einkorn wheat to stem and leaf rusts, *Puccinia graminis* and *P. triticina*

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In order to examine the susceptibility of chlorophyll mutants of *Triticum monococcum flavescens* to stem and leaf rusts, the mutants *chlorina*, *basi-viridis* II, *virido-albina* and *albina* were tested in the phytotron (20°C in daytime, 15°C at night) at the first leaf stage with *Puccinia graminis* f. sp. *tritici* 17 and *P. triticina* 21 B. Both filter paper and brushing inoculation methods were used. Rust readings were made 7 to 16 days after inoculation. The degree of susceptibility was determined by the types of lesions formed on the leaves. These tests were repeated 2 or 3 times.

Susceptibility of chlorophyll mutants to stem and leaf rusts is shown in Table 1. The mutant strain "*chlorina*" whose chlorophyll content amounted to about 50% of that of the normal plants was not much different from the normal plants in susceptibility to both rusts. However it showed a tendency to earlier formation of uredosori. The

Table 1. Susceptibility of seedlings of chlorophyll mutants to stem and leaf rust

Plants inoculated		Type of infection*	
		P. graminis f. sp. *tritici* 17	*P. triticina* 21 B
normal		S	R–MR
chlorina		S	R–MR
basi-viridis II	green parts	S	
	light green parts	S	
virido-albina	green parts	S	MR–S
	white parts	S	MR–S
albina		R	R

* R: Resistant, MR: Moderately Resistant, S: Susceptible.

mutant strain "*albina*", exhibiting resistance, differed from the normal plants in susceptibility to both rusts. No uredosori were found, since *albina* dies from 7 to 12 days after inoculation. Both kinds of rusts formed uredosori on the white parts, having no chlorophyll, and also on the green parts of the leaves of *virido-albina*, having chlorophyll. The susceptibility of this mutant to leaf rust was higher than that of normal plants. The mutant strain "*basi-viridis* II" was susceptible to stem rust.

Triticum ispahanicum: a new species of cultivated wheat from Iran

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Among several samples of wheat brought back from Iran in 1957 by Prof. Viennot-Bourgin, one appeared to me as representing probably a new species. Chromosome counts in root tips gave $2n=28$.

Later, Dr. Ataï, Professor of the Agricultural University of Karadj, Iran, kindly sent me, on request, seeds of a related form.

The type sent by Dr. Ataï is in fact closely related morphologically to the first type, and the two forms are to be considered as two varieties belonging to the same species. Both have $2n=28$ chromosomes.

In 1958, the two forms have been cultivated in Paris. Simultaneously I sent seeds of the first type to Prof. Zhukovsky, Director of the Leningrad Institute of Plant Industry, and to his collalorator, Dr. Jakubziner. This wheat was then cultivated in the experiment station of Taschkent (Central Asia).

Following a close study, Prof, Zhukovsky and Dr. Jakubziner reached a conclusion strictly identical to mine: we were dealing with a new species. Meanwhile Dr. Ataï sent me the following precisions on his sample: " This wheat is cultivated on a limited surface in a few villages of the Vazrak Canton (Faridan district, Ispahan Province), at an altitude of 2,000-2,500 meters."

To the new species, I have given the name *Triticum ispahanicum* sp. nov. The Latin diagnosis has been published recently*.

In cooperation with Dr. M. Simonet, *T. ispahanicum* has been crossed with *T. durum* and *T. Timopheevi* and the F_1 hybrids are being analyzed cytologically. It appears that *T. ispahamicum* has the genomic constitution AABB. The full results will be published later on.

Seeds of the new species may be made available upon request.

(Editor's note: This species seems to be the one reported by H. Kihara and others in WIS No. 4, p. 3, 1956.)

* C. R. Acad. Sciences, **247** (1958), 2477-2479.

Ethyl methane sulfonate: a powerfull mutagenic agent for cultivated plants

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Among several chemicals recently synthesized and tried on barley, ethyl methane sulfonate leads to extremely high mutation frequencies.

The mutation rate being measured by the percentage of spikes segregating for chlorophyll mutants, we found the following results:

Control	:	0.05%
γ-Rays (25,000 roentgens)	:	5%
Ethyl methane sulfonate (various treatments)	:	up to 50%

The details of treatment conditions and results have been published in full elsewhere**.

Part of the offspring of the treated plants has been cultivated this year up to the adult stage and the number of morphological mutants has been found to be also very high.

Although no treatment of wheat has been made by me with ethyl methane sulfonate, I think advisable to inform wheat geneticists of the remarkable activity of this compound.

In unpublished experiments, Dr. Dommergnes has obtained, with this same substance, very high mutation rates on lettuce. This suggests that the mutagenic activity of ethyl methane sulfonate may be a general property, and it is certainly worth while to test it on a series of cultivated plants, including wheat.

Wheat breeding in Kenya

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The breeding efforts of the past, and progress and plans for the future, are set against the story of continuing changes of rust races. Black stem rust, brown leaf rust, and yellow rust all afflict Kenya wheat, but stem rust is the most important, with yellow rust a serious factor only at the higher altitudes. Stem rust resistance is therefore the main topic of this paper.

Breeding began in 1910, following the failure of the first imported varieties to stand up to stem rust and yellow rust. The early work was based on the Italian variety

** C. R. Acad. Sciences, 248 (1959), 729–732.

Rieti, an Egyptian wheat and a series of Australian wheats. This was interupted by the first world war and staff difficulties and progress was only sporadic. Nevertheless the foundation for Kenya wheats was laid at that time. Real progress dated from the starting of a special station in 1928, but even then the emphasis was on the exploitation of the range of material already available from earlier years. As new physiologic races of stem rust arose, so new parents were brought into the programme to combat them on the basis of additive resistances. The range of additional parents was small and again the strong Australian component is stressed. From this breeding a very successful range of Kenya wheats was built up during the 1930–1950 period, wheats which are in fact now known internationally.

Unfortunately the release of a large number of these varieties just after the second world war was marked by their very rapid eclipse by a new series of stem rust races. Clearly the wheats, though the best yet achieved from the agronomic viewpoint, were too closely related and therein lay their weakness. Bad rust attacks have occurred over the last decade and during this time much loss of confidence has resulted; the range of varieties available has been much reduced and general suitability has fallen. In particular the varieties in current use are causing marked concern to the millers. However certain foreign varieties have been helpful, most notably the quick variety H462 from Wisconsin.

Current lines of wheat work of the recently expanded Plant Breeding Service are discussed under three headings. However the accent is on maximum diversity rather than quantity, though with the great expansion both of staff and facilities during the last three years, the quantity and intensity of the work on hand has very greatly increased. Work on the International and F.A.O. Nurseries dates from 1953 and 1954, and this now forms a very important function in the provision of new material. The range covered since 1953 has been very large, and during this time many varieties have been extracted both for direct multiplication and for breeding.

The names of ten varieties are quoted which are under multiplication for direct release at the 50 ton stage. These came into the Nurseries from the U.S.A., Brazil, Portugal, South Africa and particularly Mexico. They show useful ranges of seedling resistance to stem rust, five being fully resistant to all 9 stock races, and they should be very useful as a group of stop-gap varieties. The derivation of two of them from inter-generic hybridisation is specially noted.

In 1955 a number of chosen varieties from the Nurseries was used to give new breadth to the crossing work; 11 such parents are listed. However in 1957 special new collections were formed, based on both local data and international results, containing the widest possible range of varieties for resistance to stem rust and yellow rust. These, numbering 188 and 153 respectively, are too big to quote, but the breadth of genetic base is the important point involved. Crossing the stem rust resistant collection to five locally valued varieties has yielded 940 crosses which are now being rapidly taken through

back-crosses. There will thus be a wealth of material in which to select, and the accent will be on maximum genetic diversity so that the narrowness of earlier years is never repeated. Selection for breadth of resistance is the aim, rather than the discarding of individual susceptibilities.

Two other breeding approaches are mentioned. The possibility of building up mechanical resistances has recently been re-advocated by Dr. Stakman and may prove useful. Secondly, the search for higher levels of resistance in inter-specific and inter-generic derivatives is considered important. A number of such lines so far examined is listed, the main interest being centred on derivatives of *Triticum Timopheevi*.

Attention is being given to work on Kenya wheats in other countries. A considerable body of information is now available in the literature and this is being summarised, both for race resistances and for genes. The frequency of temperature effects is notable, but special value is being obtained from the realisation that certain Kenya wheats once discarded on local, limited susceptibilities nevertheless have marked general levels of resistance when viewed internationally and therefore merit renewed interest in Kenya. Much the same remarks apply to the data available on specific genes for rust resistance, and the value of Kenya Farmer is specially noted in this respect. Such research must proceed continually, but is essential to the best furtherance of the practical programme.

For the future, two matters receive special attention. Speed of working can be increased in the multiplication stages by the use of an area near Mount Kenya where two crops can be grown each year. Irrigation can also be used. But on the breeding side, speed is more difficult to obtain successfully. Out-of-season crops upset selection for rust resistance and can cause unusual behaviour; they therefore need careful planning if they are to be effective. The use of growth chambers and other artificial devices carries similar reservations, but an investigation has been in progress to see to what extent supplemental lighting can be useful. Results have been disappointing and point to greater value being obtainable from extra generations out-of-doors. The risk of insufficient testing is also stressed where speed is the aim, for a fair balance must be struck between haste and caution if the new products are to have lasting value.

The other line of thought for the future is the "composite variety" idea. This scheme, by relying on a number of components differing in their rust resistance, aims at offering greater breadth of resistance to infection and greater insurance against loss than pure-line varieties. There is clearly considerable value in this concept, though the practical implications are still being studied. The large backcrossing programme of 1958 is however suited to providing material for use in composites in due course.

The final point to be made is that throughout the foregoing the need for genetic breadth has been stressed as the lesson of previous years. International co-operation in the Nurseries is shown as of the greatest importance in achieving this aim, and has already had a profound influence on wheat breeding progress in Kenya.

Competition between diploid, tetraploid and aneuploid rye in "tetra-rye" populations in practical farming

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A number of problems arise when a new autotetraploid population is released for use in practical farming. Three of them are dealt with in a recent paper on tetraploid rye by Hagberg and Ellerström (in press), *e.g.* a) the frequency of aneuploids and their effect on the yield of the population, b) the effect of vicinism between diploid and tetraploid populations grown close to each other, c) the effect of diploid admixtures in tetraploid populations.

From nine lots of the same variety of tetraploid rye grown in different parts of southern and central Sweden, samples were taken to check the frequency of diploids, triploids and aneuploids. By sieving, the samples were divided into four grain size fractions. No diploids or triploids were found. Thus, their frequency in the populations must be less than 0.1%. Hypotetraploids were found mainly among the small seeds while hypertetraploids were more evenly distributed among the fractions as can be seen from Table 1. It is possible, by sieving and rejecting the small seeded fraction, to

Table 1. Distribution of euploids, hypotetraploids and hypertetraploids in grain size fractions of tetraploid rye

Grain size fraction I = a seed thickness less than 2.00 mm
" II = " 2.25 "
" III = " 2.50 "
" IV = " greater " 2.50 "

Grain size fraction	Percentage of seeds	Frequency of		
		hypoploids	euploids	hyperploids
I	9.9	17.8%	70.1%	12.1%
II	1.2	15.4	66.3	18.3
III	12.0	7.3	82.7	10.0
IV	76.9	0.9	94.8	4.3

decrease the frequency of hypotetraploids to some extent. The nine lots investigated had an average frequency of aneuploids of 14.7% while the same material 10 generations earlier had 22.7%. However, there was a considerable variation between the samples from the nine lots, the extreme values being 6.8 and 20.4%.

When $4x$ and $2x$ rye are crossed, triploid embryos are formed but most of them (about 97%) abort. Thus, there is an effective sterility barrier between the two levels of ploidy. By growing $2x$ and $4x$ rye close to each other there is a risk of sterility arising and causing decreased yield in both crops. Table 2 summarizes the data ob-

Table 2. Five plots of tetraploid rye at different distances from the diploid field, representing three year trials each with the five plots in the four cardinal points (The size of each plot=200 m²)

Distance in metre from the diploid field	10	50	100	200	300
Seed set at the front	49.7	58.2	57.2	60.3	60.4
Seed set within the plot	59.5	64.2	64.5	65.5	65.2
Grain yield dt/ha	22.8	24.4	26.0	25.2	25.1

tained from experiments during the years 1952–1955, growing plots of $4x$ rye at different distances from a large field of $2x$ rye. As is evident from these results, 100 metre is a "safe" distance, since there is no decrease in yield. The fertility might be slightly decreased but it is compensated by a larger seed size.

In practical farming it will be impossible to avoid admixtures of $2x$ into $4x$ rye populations. In the "seed certification regulations" there has to be a maximum limit for the frequency of diploid admixtures that can be tolerated by a tetraploid population. To be able to give the information required for these regulations, large plots of mixtures between $2x$ and $4x$ rye have been investigated during the years 1952–1956. The main results are summarized in Table 3. It is evident from these data that the tetraploid rye is self cleaning even if the population contains a rather high frequency of diploids. There is an equilibrium at about 40%. Above this frequency the diploids will dominate and tetraploids will disappear, whereas below this "threshold value" the diploids will disappear gradually and the tetraploid population is self cleaning. The "threshold value" is somewhat influenced by environmental factors.

Table 3. Frequency of diploids in the first and second generations of mixed populations of diploid and tetraploid rye (The size of each plot=400 m², separated from each other and other rye crops by distances of over 70 to 100 m)

Diploids in original seed:	0	0.5	1	2	4	8	16	32	40	50 %
Diploids in the progeny, average from 4 years:	0	0	0	0	0.1	0.6	4.3	28.5	35.6	56.3%
The second generation was examined in one of the experiments:										
Diploids in original seed 1952:					0	1	4	8	16	32 %
Diploids in first generation progeny 1953:					0	0	0	0.6	2.3	19.2%
Diploids in the second generation progeny 1954:					0	0	0	0	0.6	17.1%

This "threshold value" varies widely in different crops. Red clover, for instance, has a "threshold value" of about 3% and it is very difficult to keep the admixtures of diploids in a tetraploid population below this value. Due to the high "threshold value" in rye this problem is not severe in this crop. As soon as a tetraploid population of rye is established by the plant breeder, there is practically no risk that this population reverts to diploidy if the population is large enough.

Effect of aneuploids on the yield of tetraploid rye

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In a recent paper by Hagberg and Ellerström (Hereditas 45, 1959), among other things, the frequency of aneuploids and their effect on the yield of tetraploid rye was discussed. It was concluded that it is very difficult to obtain a good estimation of the relation of the aneuploids in the population to yield. This is due to the fact that the aneuploid plants can not be distinguished phenotypically but have to be identified by determining their chromosome number. Using cytological methods for distinguishing euploids and aneuploids in a rye field, however, means a removal of organs from the plants, which most probably will disturb the equilibrium of the population. Thus a direct estimation of the effect of aneuploids on the yield of tetraploid rye seems practically impossible.

However, an indirect approach to the problem may yield results of some interest. Considering the fact that a correlation exists between seed size and frequency of aneuploid, especially hypotetraploid seeds, it was possible, by sieving, to put together three seed lots with the following percentages of aneuploid seeds: 30, 19 and 5%. The original seed lot of tetraploid Steel-rye, which was divided in the three fractions, contained 9% aneuploids.

The three seed size fractions together with the original seed lot were tested in field trials during two years. The following table gives the data for the seed yield in 1958 and 1959 of the three seed size fractions (I containing 30, II 19 and III 5% aneuploids) relative to the original seed lot (35):

	35	I	II	III
1958:	100	86	95	98
1959:	100	93	96	106

A statistical analysis of these data shows that there is an indication of a significant difference in seed yield between the fraction with the highest aneuploid frequency and the one with the lowest ($t=6.05$, $0.05>P>0.01$).

The three seed size fractions differ, however, not only in frequency of aneuploids, but also in seed size, which may have an effect on seed yield too. To obtain an estimation of the effect of seed size on seed yield a seed lot of the variety Steel-rye, the diploid progenitor to the tetraploid variety used, was divided into three seed size fractions with the same relative seed size differences as between the tetraploid fraction. These diploid fractions (I, II and III corresponding to the $4x$ fractions) were tested in a field trial together with the original seed lot (13). The relative figures for seed yield

are given below:

	13	I	II	III
1959:	100	103	105	103

There are no significant differences between the seed size fractions. Moreover, the mean square for the error in this trial is of the same magnitude as in the tetraploid trials, which strenghtens the indication of significance in the latter case. Thus, it may be concluded that, at least in the material investigated, aneuploid plants have an effect on the seed yield of the tetraploid rye population.

As a complement to the results briefly reported here, an investigation, based on a thorough examination of single plants from the different tetraploid seed fraction populations in under way.

Information on the crossability of tetraploid rye with *T. vulgare* and *Triticale*

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In the program of species hybridization in *Triticinae*, crosses between tetraploid rye with *T. vulgare* and *Triticale* have been included.

It was believed that the crosses between *vulgare* wheat and tetraploid rye could show better crossability than between *vulgare* wheat and diploid rye and possibly furnish better material than present *Triticale* strains which are rather poor under our condition. Different varieties of *vulgare* wheat were crossed with tetraploid rye (Steel rye and Petkuser). Direct and reciprocal crosses were made for two years. All these crosses, however, were completely unsuccessful, giving no seeds.

As for the crosses between *Triticale* and tetraploid rye, one combination (*Triticale* A×Petkuser) where extensive crosses were made, gave viable seeds. The F_1 plants were very vigorous having beautiful long heads, intermediate in appearance. Since the doubling of the chromosomes was not undertaken, the F_1 plants were completely sterile. Meiosis showed good pairing of seven rye chromosomes and the rest were as univalents showing the tendency of almost equal distribution (in numbers) to the poles.

Next year many new crosses between *Triticale* and tetraploid rye were made with the purpose to apply colchicine treatment. Unfortunately the crosses did not succeed, probably due to some mistakes made in time or other circumstances during the crossing period. Obtained informations support Müntzing's assumption that the ratio of wheat to rye genomes seems to be important for the fertility of the *Triticale* types.

Amphiploids in *Triticinae* produced at the University of Manitoba from March 1958 to December 1959

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Accession number[1]	Cross	Growth habit[2]
6A190	*T. durum* (Stewart) × *S. cereale* (Prolific)	S
6A191	〃 〃 × *S. montanum*	S & W
6A208	〃 〃 × *S. montanum* var. *dalmaticum*	S & W
8A206	*T. aestivum* (Chinese Spring) × *A. elongatum* (2*n*=14)	S & W
8A209	〃 (Kharkov MC22) × *S. cereale* (Prolific)	S & W
8A210	〃 〃 × 〃 (Kings)	W
8A211	〃 〃 × 〃 (Izumrudnaya)	W
8A212	〃 〃 × *S. anatolicum*	W
8A213	〃 〃 × *S. cereale* (Population with purple grains)	W

1) The first number indicates the ploidy: 6=hexaploid and 8=octaploid.
2) S=Summer type, W=Winter type, S & W=Summer and Winter type.

Frequency of bivalents in meiosis of intergeneric F_1 hybrids between Dinkel wheat and two species of *Secale, ancestrale* and *Kukrijanovi*

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Hybrid combination	2n	Number of PMC's with bivalents								Total	Mode	Mean±S. D.	Coefficient of variation
		0	1	2	3	4	5	6	7				
T. vulgare × *S. ancestrale*	28	3492 (69.84)	1063 (21.26)	370 (7.40)	65 (1.30)	10 (0.20)				5000	0_{II} (69.8)	0.408±0.701	1.72
T. compactum × *S. ancestrale*	28	3966 (79.32)	807 (16.1)	197 (3.94)	30 (0.60)					5000	0_{II} (79.3)	0.258±0.553	2.14
T. sphaerococcum × *S. ancestrale*	28	1162 (15.49)	1686 (22.48)	2160 (28.80)	1656 (22.00)	632 (8.43)	164 (2.10)	40 (0.58)		7500	2_{II} (28.8)	1.942±1.532	0.79
T. Spelta × *S. ancestrale*	28	622 (66.20)	262 (26.20)	68 (6.80)	7 (0.70)	7 (0.10)	1			1000	0_{II} (66.2)	0.423±0.659	1.56
T. Macha × *S. ancestrale*	28	1613 (32.26)	1950 (39.00)	1002 (20.04)	340 (6.80)	88 (1.76)	7 (0.14)			5000	1_{II} (39.0)	1.072±0.989	0.92
T. vulgare × *S. Kukrijanovi*	28	1228 (24.56)	1067 (21.34)	1342 (26.84)	971 (19.42)	333 (6.66)	57 (1.14)	2 (0.04)		5000	2_{II} (26.8)	1.659±1.284	0.77
T. compactum × *S. Kukrijanovi*	28	622 (41.74)	319 (21.37)	296 (19.73)	178 (11.37)	71 (4.73)	12 (0.80)	2 (0.13)		1500	0_{II} (41.7)	1.201±1.279	1.07
T. sphaerococcum × *S. Kukrijanovi*	28	559 (23.36)	482 (19.28)	640 (25.60)	479 (19.15)	243 (9.72)	73 (2.92)	19 (0.76)	5 (0.20)	2500	2_{II} (65.6)	1.874±1.445	0.77
T. Macha × *S. Kukrijanovi*	28	998 (28.51)	1137 (32.49)	808 (23.09)	356 (10.17)	177 (5.06)	24 (0.69)			3500	1_{II} (32.5)	1.328±1.169	0.88

Note: Figure in parenthesis refers to percentage.

Results of crossings between *Triticum* and *Agropyron*

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Since 1956 the crossing experiments between *Triticum* and *Agropyron* have been carried out, and the following results have been obtained.

Cross combination	No. of florets pollinated	No. of seed set (%)	No. of seed sown	No. of seed germinated (%)	No. of F_1's matured	Crossability (%)	Year
T. durum (2n=28) × *Ag. elongatum* (2n=70)	323	75 (23.22)	75	16 (21.33)	14	4.33	1956
T. durum (2n=28) × *Ag. elongatum* (2n=56)	362	24 (6.63)	24	3 (12.50)	3	0.83	1956
T. durum (2n=28) × *Ag. junceum* (2n=70)	70	41 (58.57)	30	24 (80.00)	18	35.14	1957
T. durum (2n=28) × *Ag. intermedium* (2n=42)	253	214 (84·59)	30	29 (96.67)	27	76.13	1957
T. durum (2n=28) × *Ag. obtusuiculum* (2n=42)	80	56 (70.00)	20	10 (50.00)	9	31.50	1957
T. turgidum (2n=28) × *Ag. elongatum* (2n=70)	106	5 (4.72)	5	4 (80.00)	3	2.83	1957
T. turgidum (2n=28) × *Ag. elongatum* (2n=56)	63	13 (20.63)	13	6 (46.15)	4	6.35	1957
T. turgidum (2n=28) × *Ag. intermedium* (2n=42)	197	152 (77.16)	30	28 (93.33)	26	67.00	1957
T. dicoccum (2n=28) × *Ag. junceum* (2n=56)	116	19 (16.38)	19	14 (73.69)	12	10.34	1958
T. dicoccum (2n=28) × *Ag. intermedium* (2n=42)	50	30 (60.00)	30	12 (40.00)	9	18.00	1957
T. dicoccum (2n=28) × *Ag. obtusuiculum* (2n=42)	28	20 (71.43)	20	10 (50.00)	8	28.57	1957
T. polonicum (2n=28) × *Ag. intermedium* (2n=42)	348	71 (20.40)	30	28 (93.33)	28	19.04	1957
T. persicum (2n=28) × *Ag. intermedium* (2n=42)	178	74 (41.57)	30	27 (90.00)	24	33.26	1957
T. pyramidale (2n=28) × *Ag. intermedium* (2n=42)	63	30 (47.60)	20	14 (70.00)	12	28.56	1958
T. orientale (2n=28) × *Ag. intermedium* (2n=42)	42	24 (57.14)	24	7 (29.17)	7	16.67	1956
T. dicoccoides (2n=28) × *Ag. intermedium* (2n=42)	60	6 (10.00)	6	0 (0.00)	—	—	1957
T. Timopheevi (2n=28) × *Ag. intermedium* (2n=42)	25	9 (36.00)	9	8 (88.89)	6	24.00	1957
T. vulgare—Norin 29 (2n=42) × *Ag. intermedium* (2n=42)	62	42 (67.74)	42	22 (52.38)	16	25.81	1957
T. vulgare—Alton (2n=42) × *Ag. intermedium* (2n=42)	164	40 (25.00)	40	30 (75.00)	22	14.38	1957
T. vulgare—Alton (2n=42) × *Ag. elongatum* (2n=56)	40	0 (0.00)	—	— —	—	—	1957

(continued)

Cross Combination	No. of florets pollinated	No. of seed set (%)	No. of seed sown	No. of seed germinated (%)	No. of F_1's matured	Cross-ability (%)	Year
T. Macha (2n=42) × *Ag. intermedium* (2n=42)	146	17 (11.64)	17	12 (70.59)	8	5.48	1958
T. compactum (2n=42) × *Ag. intermedium* (2n=42)	86	30 (34.88)	30	2 (6.67)	1	1.16	1958
T. Spelta (2n=42) × *Ag. elongatum* (2n=56)	100	1 (1.00)	1	1(100.00)	1	1.00	1956
T. Spelta (2n=42) × *Ag. intermedium* (2n=42)	90	0 (0.00)	—	— —	—	—	1958
×	95	4 (4.26)	4	1 (25.00)	1	1.05	1959

Further information on an x-ray induced translocation of *Agropyron* stem rust resistance to common wheat

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Recently the author reported the translocation of stem rust resistance from an *Agropyron elongatum*—common wheat derivative (SH 198-4, 2n=56) to a stable hexaploid wheat referred to as a translocation stock (*J. Hered.* 48: 77-81, 1957). During the past year critical information relative to the rust reactions of the translocation stock, the resistant octaploid parent, and Kenya Farmer has been obtained by the Cooperative Rust Laboratory, University of Minnesota, St. Paul. A summary of this information has been generously made available for inclusion in the WIS Bulletin and is appended to this report.

A slight difference in reaction to Race 15 (Culture No. 58-URN-94) is evident between the translocation stock and the octaploid parent on one hand and Kenya Farmer, although this is not considered significant. When the single-pustule isolate of the 17-29 group was used, however, (Section III, footnote 3) there was a difference between the reactions of Kenya Farmer and the other two selections. Thus, the stem rust resistance of the translocation stock and Kenya Farmer are not identical genetically. Though differing by 14 chromosomes the parallel reactions exhibited by the translocation stock and its parent to the biotypes involved indicate that a major component of resistance was transferred to the hexaploid. This line is quite unique in that the rust reaction of the resistant parent is combined with other characters not found in either parent such as red glumes and red seed coat color. During the past year Swaminathan

and Natarajan (*J. Hered.* 50: 177–187, 1959) have reported the induction of some very interesting and similar mutants by vegetable oils. From the variety C. 591 with white glumes and amber colored grains they obtained a wide array of mutants including those with red seeds and others with red glumes.

An attempt will be made to relate the glume and grain color of the translocation stock to other natural and induced types of a similar nature.

Seedling reactions in the greenhouse (D. M. Stewart)

Race	Culture No.	Translocation Stock $2n=42$	SH 198-4 $2n=56$	Kenya Farmer
I. (Inoculations Jan. 30; notes Feb. 12)				
15	58-URN-94	0; to 1– and pronounced tip burn	1=	2±
48A	58-36-11	0; blotch and some tip burn	0; 1=	0; 1
17-29 gr.	58-21S-9	0; blotch and slight tip burn	1=	0; 1
II. (Inoculations March 20; notes April 6)				
40	58-70-1	0; 1	1 to 2=	2–
186	58-30-24	1– to 1	1– to 2=	0; 1
III. (Inoculations May 6; notes May 18)				
17-29	[3]58-21S-9	[1]0;	0; to 1	2– to 3+
		[2]Necrotic blotch, with tip necrosis	0; to 1=	2 to 3+

1) Greenhouse, uncontrolled environment.

2) Controlled-environment room (12 hrs. at 65°F in dark, alternating with 12 hrs. at 75°F in artificial light).

3) Inoculum in this case was a single-pustule isolation, the first one that we had obtained that could infect seedlings of Kenya Farmer.

Adult plant reactions in the rust nursery at St. Paul (James D. Miller)

Border rows were inoculated with 38 races and subraces of stem rust	Severity and response		
	Trans. stock	SH 198-4	Kenya Farmer[4]
	5%, S	Trace, S	30%, S-MS

4) Although the three entries were grown in the Rust Nursery, the first two were side by side, whereas Kenya Farmer was not adjacent.

Meiotic chromosome behaviours and cross-abilities of some species in the genus *Agropyron*

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Meiotic chromosome behaviours of seven species in the genus *Agropyron* and their cross-abilities inter se as well as these with common wheat varieties were studied. Name of seven species used and $2n$ chromosome numbers determined are given in Table 1 together with their sources.

Chromosome configurations and their frequencies at MI of PMC's are given in Table 2, and the data on the meiotic chromosome behaviours are computed in Table 3 somewhat in detail.

Table 1. Materials, $2n$ chromosome numbers and sources

Species name	$2n$	Years	Sources
Agropyron elongatum–I	14	1956	Canada (Dr. B. C. Jenkins), as seeds
" *junceum*–I	28	1954	Sweden (Dr. G. Östergren), as stocks
" *glaucum*	42	1951	Japan (Dr. S. Matsumura), "
" *junceum*–II	42	1956	Spain (Dr. M. Hyčka), as seeds
" *trichophorum*	42	"	" "
" *campestre*	56	"	" "
" *elongatum*–II	70	"	" "

A. elongatum–II and *A. campestre*, especially the former, showed conspicuous association of multivalent chromosomes because of their high polyploidy, and accordingly variable meiotic configurations were encountered. In the other five species including the basic species, *A. elongatum*–I, every species except *A. junceum*–II showed rather variable configurations. Above all, in both *A. glaucum* and *A. trichophorum*, the formation of a considerable amount of multivalent and univalent chromosomes were observed. It is interesting to observe some irregularities in the basic species, *A. elongatum*–I. From the facts described above, it may be said that each genome constituting these species is not wholly different but has more or less homology with each other, and in some cases there must be present semi-homology between some chromosomes of one genome.

The cross-abilities of species inter se and these with common wheat varieties were examined about six species except *A. junceum*–I. In the cross-abilities of species inter se, it was found that three species, *A. glaucum*, *A. junceum*–II and *A. trichophorum* were fertile with each other in both directions. On the other hand, their cross-abilities

with common wheat varieties were classified into three groups: High (*A. elongatum*-II, *A. junceum*-II and *A. trichophorum*), Low (*A. glaucum* and *A. campestre*) and None (*A. elongatum*-I).

Table 2. Meiotic chromosome configurations in seven species

A. elongatum-I		*A. junceum*-I		*A. junceum*-II	
Configuration	Frequency	Configuration	Frequency	Configuration	Frequency
7_{II}	40	14_{II}	42	21_{II}	47
$6_{II}+2_{I}$	9	$13_{II}+2_{I}$	6	$20_{II}+2_{I}$	3
$1_{IV}+4_{II}+2_{I}$	1	$1_{IV}+12_{II}$	2		
Total	50	Total	50	Total	50

A. glaucum		*A. trichophorum*	
Configuration	Frequency	Configuration	Frequency
21_{II}	28	21_{II}	24
$20_{II}+2_{I}$	11	$20_{II}+2_{I}$	11
$19_{II}+4_{I}$	2	$19_{II}+4_{I}$	5
$1_{III}+19_{II}+1_{I}$	1	$18_{II}+6_{I}$	1
$1_{III}+18_{II}+3_{I}$	1	$1_{III}+19_{II}+1_{I}$	6
$1_{IV}+18_{II}+2_{I}$	3	$1_{III}+18_{II}+3_{I}$	1
$1_{IV}+19_{II}$	4	$1_{IV}+17_{II}+4_{I}$	2
Total	50	Total	50

A. campestre		*A. elongatum*-II	
Configuration	Frequency	Configuration	Frequency
$27_{II}+2_{I}$	11	$1_{X}+1_{VI}+1_{V}+3_{IV}+18_{II}+1_{I}$	1
28_{II}	10	$1_{X}+2_{VI}+2_{IV}+20_{II}$	1
$26_{II}+4_{I}$	8	$1_{IX}+1_{VII}+3_{IV}+3_{III}+15_{II}+3_{I}$	1
$25_{II}+6_{I}$	1	$1_{VIII}+1_{VI}+2_{IV}+23_{II}+2_{I}$	1
$24_{II}+8_{I}$	1	$1_{VIII}+1_{VII}+2_{VI}+1_{IV}+19_{II}+1_{I}$	1
$1_{III}+26_{II}+1_{I}$	8	$2_{VI}+1_{III}+27_{II}+1_{I}$	2
$1_{III}+25_{II}+3_{I}$	1	$1_{IV}+2_{III}+30_{II}$	1
$2_{III}+25_{II}$	1	$1_{IV}+1_{III}+29_{II}+5_{I}$	1
$1_{IV}+26_{II}$	2	others	41
$1_{IV}+25_{II}+2_{I}$	2		
$1_{IV}+1_{III}+24_{II}+1_{I}$	3		
$1_{IV}+1_{III}+23_{II}+3_{I}$	1		
$2_{IV}+23_{II}+2_{I}$	1		
Total	50	Total	50

Table 3. Meiotic chromosome behaviours in seven species

Species	2n	Association / Variation	I	II			III	IV	V	VI	VII	VIII	IX	X	Total number of bivalents calculated	No. of cells observed
				open	closed	Total										
A. elongatum-I	14	Range	0~2	0~5	2~7	4~7		0~1							6~7	50
		Mode	0	0	7	7		0							7	
		Average	0.20	0.92	5.84	6.76		0.02							6.80	
A. junceum-I	28	Range	0~2	0~3	10~14	12~14		0~1							13~14	50
		Mode	0	0	13: 14	14		0							14	
		Average	0.12	1.24	12.56	13.80		0.04							13.88	
A. junceum-II	42	Range	0~2	2~12	9~19	20~21									20~21	50
		Mode	0	7	14	21									21	
		Average	0.12	5.98	13.68	20.94									20.94	
A. glaucum	42	Range	0~4	10~20	1~11	18~21	0~1	0~1							19~21	50
		Mode	0	15	3	21	0	0							21	
		Average	0.76	15.88	3.68	20.28	0.04	0.14							20.58	
A. trichophorum	42	Range	0~6	0~6	14~21	17~21	0~1	0~1							18~21	50
		Mode	0	1	18	21	0	0							21	
		Average	1.30	1.32	18.70	20.02	0.14	0.04							20.24	
A. campestre	56	Range	0~8	1~9	17~26	22~28	0~2	0~3							22~28	50
		Mode	0; 2	3	22	26	0	0							27	
		Average	1.80	3.84	22.36	26.20	0.28	0.24							26.58	
A. elongatum	70	Range	0~5	0~14	9~28	15~30	0~4	0~5	0~2	0~3	0~1	0~1	0~1	0~1	31~35	50
		Mode	0	2	20	25	0	0	0	0	0	0	0	0	34	
		Average	1.32	5.04	18.02	24.54	0.72	1.98	0.44	0.74	0.12	0.18	0.02	0.04	33.60	

Progress in the transfer of resistance to bunt (*Tilletia Caries*, and *T. foetida*) from *Agropyron* to wheat*

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The transfer of a chromosome responsible for bunt resistance from *A. elongatum* $2n=70$ to *T. compactum* variety Elgin, $2n=42$, was completed by F. C. Elliott. This was accomplished through a number of backcrosses of the resistant hybrid to the variety Elgin. Numerous lines resistant to bunt have been selected by the present workers. Cytological examination has revealed that all resistant lines carry 44 chromosomes. Certain resistant lines, however, appeared to have 42 normal chromosomes, and a pair that are about half the size of normal chromosomes. These may be isochromosomes of the segment carrying the bunt resistance, and should greatly facilitate transfer of the desired genetic element to the standard variety. All lines carrying 42 chromosomes, when tested in the field, proved to be susceptible, indicating that no substitution lines, as yet have been observed.

The Elgin backcross lines that contain the 42 + 2 isochromosomes appear to be superior to the 44 chromosome lines as far as visible agronomic merit is concerned. We may thus logically assume that the isochromosomes are identical with one of the arms of the *Agropyron* chromosomes in the 44 chromosome lines, but the possible inferiority of the 44 lines stems from the fact that the other arm contains genes responsible for undesirable characters.

The isochromosomes can be readily identified both in mitotic and meiotic cells. Certain lines show some cytological instability, and as a consequence, instability in their bunt resistance. However, other lines appear to be quite stable both in chromosome behavior and bunt resistance.

At present we are attempting to induce, by x-rays, a transfer of a segment carrying the resistance to a normal chromosome of Elgin. This can best be accomplished by using lines promising the 42+2 complement.

(* Journal note, Washington Agricultural Experiment Stations. Work was conducted project 966, in cooperation with the Washington State Department of Agriculture.)

Seed dormancy associated with red grain colour

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During the past ten years the resistance of the amphiploid Iumillo × *Aegilops squarrosa*

to *Erysiphe graminis tritici* has been transferred to the Australian bread wheat Javelin. Five backcrosses were carried forward and at the same time one resistant selection was made having red grain colour in contrast to the white grain of the recurrent parent Javelin.

In 1959 near-isogenic lines of white and red grain colour were compared in order to determine if seed dormancy was associated with grain colour differences. Seed harvested at the late dough stage was set out to germinate immediately and after holding in the laboratory for eight days. The following results clearly indicate that dormancy was associated with red grain colour:

	White grain selection	Red grain selection
Tested immediately after harvest	66% germination in 10 days 100% germination in 13 days	0% germination in 10 days 77% germination in 13 days
Tested after eight days storage	60% germination in 5 days 100% germination in 7 days	0% germination in 5 days 15% germination in 7 days

Homology of chromosomes of *Aegilops caudata* with common wheat

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In a study of some of Kihara's derivatives of crosses between *Aegilops caudata* and *Triticum aestivum*, it was desired to learn to what extent the chromosomes of *Ae. caudata* are homologous with those of *T. aestivum*. Since Okamoto (1957), Riley and Chapman (1958), and Riley, Chapman and Kimber (1959) have shown that pairing of homoeologous chromosomes is greater in the absence of chromosome V of *T. aestivum*, hybrids of *Ae. caudata* were made to monosomic V (variety Chinese Spring) as well as to monotelo XVII Chinese. An F_1 plant deficient for chromosome V (27 chromosomes) was compared with another carrying telo XVII (28 chromosomes). The plant lacking chromosome V showed much more chromosome conjugation (Table 1).

Table 1. Chromosome pairing in hybrids of *Ae. caudata* with monosomic V and monotelo XVII

	$2n$	No. of cells	Average number of						Most frequent conjugation	Range of conjugated chromosomes
			Is	bivalents		IIIs	IVs	Vs		
				closed	opened					
Mono V × *Ae. caudata*	27	70	9	0.89	4.33	2.21	0.21	0.01	$3_{III}+6_{II}+6_{I}$	6—23
Monotelo XVII × *Ae. caudata*	28	70	22.16	0.04	2.47	0.27	—	—	$2_{II}+24_{I}$	0—13

Since *Ae. caudata* has three acrocentric (i-type) chromosomes, it is possible to identify the bivalent which include them. It is also possible, with somewhat greater difficulty, to identify the bivalents which include the J-type chromosomes of *Ae. caudata*. These five chromosomes apparently pair with fairly high frequency.

Chromosome XVII has been identified as corresponding to the satellited *caudata* chromosome which was introduced into common wheat by Kihara. In the F_1 hybrid between a strain of monotelo XVII and *Ae. caudata*, it is frequently possible to identify the telo XVII. 63 cells were checked, and 19 of them were considered to have a heteromorphic bivalent involving telo XVII.

These results show that at least six of the *caudata* chromosome have considerable homology with wheat chromosomes. The amount of pairing is comparable to that which has been observed in diploid hybrids involving the genomes concerned. In *T. aegilopoides* × *Ae. caudata* up to seven bivalents have been found, and in *Ae. caudata* × *Ae. squarrosa* up to 13 of the 14 chromosomes can be included in pairing (Sears 1941). Thus the reduced pairing in the normal *aestivum-caudata* hybrid must be due wholly or in large part to the effect of chromosome V.

Riley and Chapman found up to 19 chromosomes conjugated in a nullihaploid of Holdfast. Indications are that the chromosomes of *Ae. caudata* have virtually as much homology with these genomes A, B, and D as the *T. aestivum* chromosomes have among themselves.

Aneuploids found in synthesized wheats, ABD Nos. 4 and 5

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The writer found several aneuploids in synthesized 6x-wheats, ABD No. 4 and 5. Aneuploids with $2n=41$ showed mostly the pairings $20_{II}+1_I$, $19_{II}+3_I$ and $18_{II}+5_I$ at MI in PMC. Five individuals of ABD No. 4 with $2n=41$ were backcrossed to *T. persicm stramineum* and *T. persicum fuliginosum*, respectively. The somatic chromosome numbers in the BF_1 hybrids from the above crossings were 35, 34 and 33. Among them plants with $2n=35$ showed mostly $14_{II}+7_I$ and rarely $13_{II}+9_I$ at MI, while plants with $2n=34$ revealed $13_{II}+18_I$ and $12_{II}+10_I$, and plants with $2n=33$, $13_{II}+7_I$ and $12_{II}+9_I$. Consequently, it has been assumed that those $2n=41$ plants have lost one chromosome from A or B genome.

Susceptibility of various strains or varieties of *Aegilops squarrosa* to yellow rust (*Puccinia striiformis*), brown rust (*P. recondita* f. sp. *tritici*) and black rust (*P. graminis* f. sp. *tritici*)

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Seedlings of 136 strains or varieties of *Aegilops squarrosa* L., which were collected by the Kyoto University Scientific Expedition to the Karakoram and Hindukush (KIHARA and YAMASHITA, 1956), were tested with uredospores of yellow rust, *Puccinia striiformis* WESTENDORF (*P. glumarum* ERIKSSON et HENNING), brown rust, *P. recondita* ROBERGE et DESM. f. sp. *tritici* (*P. triticina* ERIKSSON) and black rust, *P. graminis* PERSOON f. sp. *tritici*.

The experimental results are summarized as the following table.

Table 1. Susceptibility of various strains or varieties of *Aegilops squarrosa* to yellow rust (*Puccinia striiformis*), brown rust (*P. recondita* f. sp. *tritici*) and black rust (*P. graminis* f. sp. *tritici*)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group**
var. *typica*	No. 2001 (Quetta, Pakistan)	S* (4)	S (3)	S (3–4)	A
	No. 2002 (Quetta, Pakistan)	S (3–4)	S (3)	S (4)	A
	No. 2014 (Quetta, Pakistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2026 (Kandahar-Jaldak, Afghanistan)	S (4)	S (3–4)	S (3)	A

* S=Susceptible (3 or 4), MR=Moderately resistant (2), R=Resistant (0 or 1).

** Group A=Yellow rus t(S)–brown rust (S)–black rust (S); Yellow rust (S)–brown rust (S)–black rust (MR–S).

Group B=Yellow rust (S)–brown rust (R)–black rust (S); Yellow rust (S)–brown rust (R–(MR)–black rust (S); Yellow rust (MR–S)–brown rust (R)–black rust (S).

Group C=Yellow rust (S)–brown rust (S)–black rust (MR); Yellow rust (S)–brown rust (S)–black rust (R–MR); Yellow rust (S)–brown rust (MR–S)–black rust (R); Yellow rust (S)–brown rust (MR–S)–black rust (R–MR); Yellow rust (S)–brown rust (MR–S)–black rust (MR).

Group D=Yellow rust (S)–brown rust (R)–black rust (R); Yellow rust (S)–brown rust (R)–black rust (R–MR); Yellow rust (S)–brown rust (R–MR)–black rust (R–MR); Yellow rust (S)–brown rust (MR)–black rust (R).

Group E=Yellow rust (MR–S)–brown rust (S)–black rust (S).

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
	No. 2027 (Kabul, Afghanistan)	S (3–4)	S (3)	S (3–4)	A
	No. 2029 (Kabul, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2030 (Kabul, Afghanistan)	S (3–4)	S (3)	S (3)	A
	No. 2031 (Kabul, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2033 (Jaldak, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2035 (Jaldak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2037 (Jaldak-Ghazni, Afghanistan)	S (3–4)	S (3)	S (3)	A
	No. 2038 (Jaldak-Ghazni, Afghanistan)	S (3–4)	S (3)	S (3–4)	A
	No. 2040 (Ghazni, Afghanistan)	S (4)	S (3–4)	S (3)	A
var. *typica*	No. 2041 (Kabul, Afghahistan)	S (4)	S (3)	S (3–4)	A
	No. 2042 (Kabul, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2043 (Kabul, Afghanistan)	S (3–4)	S (3)	S (3–4)	A
	No. 2045 (Kabul, Afghanistan)	S (3)	S (3–4)	S (3–4)	A
	No. 2046 (Kabul, Afghanistan)	S (3)	S (3–4)	S (3)	A
	No. 2047 (Kabul, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2048 (Kabul, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2049 (unknown)	S (4)	S (3)	S (3–4)	A
	No. 2050 (unknown)	S (4)	S (3)	S (3–4)	A
	No. 2051 (Kabul-Pulikhumri, Afghanistan)	S (4)	S (3–4)	S (3)	A

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
	No. 2052 (Pulikhumri, Afghanistan)	S (4)	S (4)	S (3)	A
	No. 2053 (Pulikhumri-Haibak, Afghanistan)	S (3–4)	S (3)	S (3–4)	A
	No. 2054 (Pulikhumri-Haibak, Afghanistan)	S (3)	S (3)	S (3–4)	A
	No. 2056 (Pulikhumri, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2059 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2063 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2065 (Pulikhumri, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2066 (Pulikhumri-Haibak, Afghanistan)	S (3–4)	S (3)	S (3–4)	A
	No. 2067 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
var. *typica*	No. 2068 (Pulikhumri, Afghanistan)	S (3)	S (3–4)	S (3–4)	A
	No. 2069 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2071 (Pulikhumri, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2072 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2073 (Pulikhumri, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2074 (Pulikhumri-Haibak, Afghanistan)	S (3–4)	S (3–4)	S (3–4)	A
	No. 2079 (Pulikhumri, Afghanistan)	MR–S (2–3)	S (3–4)	S (3–4)	E
	No. 2081 (unknown)	S (4)	S (3–4)	S (3)	A
	No. 2082 (Andkhui-Maimana, Afghanistan)	S (3–4)	S (3–4)	S (3–4)	A
	No. 2083 (Andkhui-Maimana, Afghanistan)	S (4)	S (3)	S (3–4)	A

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
	No. 2084 (Andkhui-Maimana, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2085 (Andkhui-Maimana, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2086 (Andkhui-Maimana, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2087 (Maimana, Afghanistan)	S (3–4)	S (3–4)	S (3–4)	A
	No. 2089 (Maimana-Laman, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2090 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2091 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2092 (Maimana-Laman, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2096 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3)	A
var. *typica*	No. 2097 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2099 (Maimana-Laman, Afghanistan)	S (4)	S (4)	S (3–4)	A
	No. 2101 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2102 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2103 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2104 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	N. 2105 (Ghazin, Iran)	S (3–4)	S (3)	S (3–4)	A
	No. 2106 (Karaj, Suburbs of Tehran, Iran)	S (4)	S (3–4)	S (4)	A
	No. 2107 (Karaj, Suburbs of Tehran, Iran)	S (3–4)	S (3–4)	S (4)	A
	No. 2108 (Karaj, Suburbs of Tehran, Iran)	S (4)	S (3–4)	S (3)	A

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
	No. 2109 (Karaj, Suburbs of Tehran, Iran)	S (4)	S (3–4)	S (4)	A
	No. 2126 (Gorgan-Khoshyailagh, Iran)	S (4)	R (0)	S (3–4)	B
	No. 2128 (Gorgan-Khoshyailagh, Iran)	S (3)	R (0)	S (3)	B
	No. 2129 (Khoshyailagh, Iran)	S (3–4)	S (4)	S (3)	A
	No. 2131 (Firuzkuh, Iran)	S (3–4)	S (3)	R–MR (1–2)	C
	No. 2132 (Firuzkuh, Iran)	S (3)	S (3–4)	S (3)	A
	No. 2141 (Babulsar-Chalus, Iran)	S (4)	S (3–4)	MR (2)	C
	No. 2142 (Ramsar, Iran)	S (4)	S (3)	R–MR (0–2)	C
	No. 2143 (Pahlavi, Iran)	S (4)	R (0–1)	S (4)	B
var. *typica*	No. 2146 (Ramsar-Rasht, Iran)	S (3–4)	S (3–4)	R–MR (0–2)	C
	No. 2147 (Ramsar-Rasht, Iran)	S (3–4)	S (3–4)	R–MR (0–2)	C
	No. 2148 (Rasht, Iran)	S (4)	S (3–4)	R–MR (0–2)	C
	No. 2150 (Pahlavi, Iran)	S (4)	S (3–4)	S (3)	A
	No. 2151 (Pahlavi, Iran)	S (4)	S (4)	S (3–4)	A
	No. 2152 (Pahlavi, Iran)	S (4)	S (3–4)	S (4)	A
	No. 2153 (Pahlavi, Iran)	S (4)	S (4)	S (3–4)	A
	No. 2154 (Pahlavi-Astara, Iran)	S (4)	R–MR (0–2)	S (3)	B
	No. 2159 (Astara, Iran)	S (4)	MR (2)	R (1)	D
	No. 2160 (Pahlavi, Iran)	S (4)	MR–S (2–3)	R (1)	C

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
var. *typica*	No. 2167 (Mahabad, Iran)	S (4)	S (4)	S (3)	A
	No. 2168 (Mahabad, Iran)	S (4)	S (4)	S (4)	A
	No. 2169 (Mahabad-Rezaiye, Iran)	S (3)	S (3–4)	S (3–4)	A
	No. 2170 (Razaiyeh-Khoy, Iran)	S (4)	S (3–4)	S (3–4)	A
	No. 2174 (Khoy-Tabriz, Iran)	S (4)	S (3–4)	S (3–4)	A
	No. 2175 (Tabriz, Iran) (Mixed in chicken feed)	MR–S (2–3)	R (0–1)	S (3)	B
	No. 2176 (Tabriz, Iran) (Mixed in chicken feed)	S (4)	S (4)	S (4)	A
var. *anathera*	No. 2003 (Quetta, Pakistan)	S (3–4)	S (3–4)	S (3)	A
	No. 2005 (Quetta, Pakistan)	S (4)	S (3)	S (3)	A
	No. 2008 (Quetta, Pakistan)	S (4)	S (3)	S (4)	A
	No. 2015 (Quetta-Chaman, Pakistan)	S (4)	S (3–4)	S (4)	A
	No. 2017 (Chaman, Pakistan)	S (3–4)	S (3)	S (4)	A
	No. 2055 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3)	S (4)	A
	No. 2057 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2064 (Pulikhumri, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2075 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2094 (Maimana, Afghanistan)	S (4)	S (3)	S (3)	A
	No. 2127 (Gorgan, Iran)	S (4)	R (0)	S (3–4)	B
var. *strangulata*	No. 2111 (Sari-Behshahr, Iran)	S (3–4)	R (0)	R–MR (0–2)	D

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
var. *strangulata*	No. 2112 (Sari-Behshahr, Iran)	S (3)	R (0–1)	S (3)	B
	No. 2115 (Behshahr-Gorgan, Iran)	S (3–4)	R–MR (0–2)	R–MR (0–2)	D
	No. 2116 (Gorgan, Iran)	S (3–4)	S (3)	S (3)	A
	No. 2118 (Behshahr-Gorgan, Iran)	S (4)	R–MR (0–2)	S (3–4)	B
	No. 2119 (Gorgan-Khoshyailagh, Iran)	S (4)	S (3)	MR (2)	C
	No. 2120 (Gorgan-Khoshyailagh, Iran)	S (3–4)	S (3–4)	MR (2)	C
	No. 2122 (Gorgan-Khoshyailagh, Iran)	S (4)	S (4)	S (3–4)	A
	No. 2123 (Gorgan-Khoshyailagh, Iran)	S (4)	S (3)	R–MR (0–2)	C
	No. 2133 (Sari-Beshahr, Iran)	S (3–4)	MR–S (2–3)	R–MR (0–2)	C
	No. 2134 (Sari-Beshahr, Iran)	S (3–4)	S (3)	R–MR (0–2)	C
	No. 2135 (Beshahr, Iran)	S (4)	S (3–4)	MR (2)	C
	No. 2136 (Beshahr, Iran)	S (4)	S (3–4)	MR–S (2–3)	A
	No. 2137 (Babulsar-Sari, Iran)	S (4)	MR–S (2–3)	R–MR (0–2)	C
	No. 2138 (Babulsar-Sari, Iran)	S (4)	S (3–4)	R–MR (0–2)	C
	No. 2140 (Babulsar-Sari, Iran)	S (4)	MR–S (2–3)	MR (2)	C
var. *meyeri*	No. 2144 (Ramsar, Iran)	S (4)	R (0–1)	R (0–1)	D
	No. 2145 (Ramsar, Iran)	S (3–4)	S (3–4)	R–MR (0–2)	C
	No. 2155 (Pahlavi-Astara, Iran)	S (4)	S (4)	R–MR (0–2)	C
	No. 2157 (Astara, Iran)	S (4)	R (0)	R–MR (0–2)	D

Table 1. (continued)

Varieties of *Aegilops squarrosa*	Material No. (Source)	*Puccinia striiformis* (*P. glumarum*)	*Puccinia recondita* f. sp. *tritici* 21B	*Puccinia graminis* f. sp. *tritici* 21	Group
Intermediate between var. *typica* and var. *anathera*	No. 2016 (Chaman, Pakistan)	S (3–4)	S (3–4)	S (3)	A
	No. 2024 (Kandahar-Jaldak, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2032 (Jaldak, Afghanistan)	S (4)	S (3–4)	S (3)	A
	No. 2036 (Jaldak, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2058 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2060 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3)	S (3–4)	A
	No. 2076 (Pulikhumri-Haibak, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2088 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2093 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2095 (Maimana-Laman, Afghanistan)	S (4)	S (3–4)	S (3–4)	A
	No. 2130 (Khoshyailagh, Iran)	S (3–4)	S (3–4)	S (3)	A
	No. 2162 (Ardabil, Iran)	S (4)	S (4)	R–MR (0–2)	C
	No. 2163 (Ardabil-Surab, Iran)	S (4)	S (4)	R–MR (0–2)	C
	No. 2171 (Rezaiye-Khoy, Iran)	S (4)	S (3–4)	S (3–4)	A
	No. 2173 (Khoy-Tabriz, Iran)	S (3–4)	S (3–4)	S (3–4)	A
Intermediate between var. *typica* and var. *strangulata*	No. 2139a (Gorgan, Iran)	S (4)	S (3)	MR (2)	C
	No. 2139b (Gorgan, Iran)	S (4)	MR (2)	R–MR (0–2)	D
	No. 2139c (Gorgan, Iran)	S (4)	S (3–4)	MR (2)	C

Chromosomes of *Heteranthelium piliferum* Hochst

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This monotypic taxon occupying an isolated position in the tribe *Hordeeae* is an annual, and grows on rocky and dry slopes of foothills in semi-arid zones of Caucasus and Central Asia. The general distribution is from the Eastern Mediterranean, Armenia-Kurdistan to Iran. In the manner of disarticulation of spikelets *Heteranthelium* remotely resembles the genus *Eremopyrum*; in the structure of awns it resembles *Aegilops*; and in the structure of glumes, the genus *Hordeum*. Seeds and spikelets of it for our study were obtained from "Hortus Botanicus," Taschkent, U.S.S.R.

The somatic chromosome number counted from the root tips is 14. Its karyotype has all chromosomes with median or submedian centromeres and one pair with satellites. The chromosomes have been measured: the lengths of long and short arms of each pair in microns, relative length of each pair (expressed as a percentage of the total sum of the lengths of all chromosomes in a plate), and the index (ratio of short arm to long arm) are given in the following table.

Chromosome pair	Long arm in microns	Short arm in microns	Total length in microns	Relative length	Index
I	5.0	4.2	9.2	15.8	0.84
II	4.8	3.9	8.7	14.9	0.81
III	4.3	4.3	8.6	14.8	1.00
IV	5.0	3.3	8.3	14.3	0.66
V	4.2	2.5			0.60
VI		1.2 (SAT)	7.9	13.6	0.29 (SAT)
	4.3	3.5	7.8	13.4	0.81
VII	4.2	3.5	7.7	13.2	0.83

In view of the recent interest in the transfer of various characters to wheat from related wild species, by using monosomic and nullisomic lines, this little known species should be more intensively studied and its relation with the other species of *Hordeeae* clarified.

II. A preliminary report of the Botanical Mission of the University of Kyoto (B.M.U.K.) to the Eastern Mediterranean Countries, April-July, 1959

K. YAMASHITA
Biological Laboratory, Kyoto University, Kyoto, Japan

With a Rockefeller research grant, the Kyoto University, Kyoto, Japan, organized the Botanical Mission to the Eastern Mediterranean Countries, including Egypt (U.A.R.), Lebanon, Syria (U.A.R.), Jordan, Turkey, Greece and Italy, for the collection of mainly wheat and *Aegilops* materials for the studies on the origin of wheats.

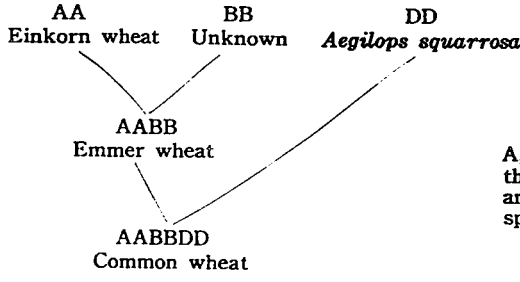
Members

Dr. Kosuke Yamashita, Professor of Biology, Kyoto University (Leader)
Mr. Masatake Tanaka, Assistant Professor of Genetics, Kyoto University
Dr. Osamu Suzuka, Lecturer of Cytogenetics, Kyoto University
Mr. Seiji Nakamura, a cameraman of the Nichiei Co. Ltd., Tokyo

Proposed Project

A proposed project is referred to WIS No. 8, as follows:

" According to the cytological and genetical studies of Dr. H. Kihara, the former Professor of Genetics, Kyoto University, Japan, it is known that the genealogical relationship of wheats and their relatives is as follows:



Annotation:
A, B or D represents the symbol of the genome which is the cytological and genetical unit of making up each species.

DD-species has already been found to be *Aegilops squarrosa*, a wild growing species from Pakistan to Iran through Afghanistan, and it is thought that our common wheat, AABBDD, occurred by the hybridization between Emmer wheat and *Aegilops squarrosa* in those regions.

Similarly, it is presumed that Emmer wheat was originated by the crossing between Einkorn wheat, an existing diploid wheat species, and a certain unknown species with BB constitution. By recent studies, however, it is thought that BB-species can be the species of the Section *Sitopsis* of the genus *Aegilops*. It is also known that the species of *Aegilops* are distributed in the Eastern Mediterranean Countries.

In this connection, K. Yamashita, and his colleagues are especially interested in the botanical exploration in the Eastern Mediterranean Countries. They are also interested in other wild growing plant species as well as cultivated plants."

Itinerary

The members left Tokyo for Cairo in the middle of April and returned home in the middle of July from Istanbul, as stated as follows.

The writer wishes to express his appreciation to the officials and people in those countries mentioned above who kindly afforded the Mission with their facilities.

Abbreviations—*Y*: K. Yamashita, *S*: O, Suzuka, *T*: M. Tanaka, *N*: S. Nakamura; (a): by air, (j): by jeep, (c): by car, (t): by train, (b): by bus, and (s): by ship

		YTSN	
April:	13 (M)	Tokyo (Japan) —(a)—	
	15 (W)	→Cairo (U.A.R.)	
		YT	*SN*
	19 (Su)		Cairo—(a)→Luxor
	21 (Tu)	Cairo—(j)→Alexandria	
	22 (W)	Alexandria—(j)→Matruh	
	23 (Th)	Matruh	Luxor
		(j) → Cairo ← (t)	
		YTS	*N*
	25 (Sa)	Cairo—(j)→Suez	Cairo
	26 (Su)	Suez—(j)→Ismailia—(j)→Cairo	⋮
		YTSN	
	28 (Tu)	Cairo—(j)→Alexandria	
	29 (W)	Alexandria—(s)—	
	30 (Th)	→Beirut (Lebanon)	
May:	1 (F)	Excursion to Saida and Biblos (j)	
		YTS	*N*
	3 (Su)	Beirut—(j)→Baalbek	Beirut
	4 (M)	Baalbek—(j)→Beirut	Excursion to Biblos (c)
		YTSN	
	6 (W)	Beirut—(j)→Damascus (U.A.R.)	
	7 (Th)	Excursion to Mt. Hermon (j)	
	8 (F)	Excursion to Soueida (j)	
	10 (Su)	Damascus—(j)→Amman (Jordan)	
	11 (M)	Damascus—(j)→Dead Sea	
	12 (Tu)	Dead Sea —(j)→Jerusalem	

13 (W) Excursion to Bethlehem and Hebron (j),
Jerusalem—(j)→Dead Sea

14 (Th) Excursion to the north of Jerico (j), Dead Sea—(j)→Amman

15 (F) Amman—(j)→Damascus (U.A.R.)

Y *TSN*

16 (Sa) Damascus—(a)→Kemshly

17 (Su) Kemshly (a)→ Aleppo ←(j) Damascus

YTSN

18 (M) Aleppo—(j)→Adana (Turkey)

19 (Tu) Adana—(j)→Ankara

YTS *N*

24 (Su) Ankara—(a)→Rome (Italy) Ankara—(t)—
25 (M) →Istanbul
26 (Tu) Rome—(c)→Naples ⋮
27 (W) Excursion to Pompei (c),
Naples—(c)→Rome
28 (Th) Rome—(a)→Palermo Istanbul—(a)→Athens
29 (F) Palermo—(t)→Agrigento ⋮
30 (Sa) Agrigento—(t)→Catania
31 (Su) Catania—(a)→Rome,

Y *TS*

Rome—(a)→Milano Rome

June: 1 (M) Milano—(b)→Pavia ⋮
2 (Tu) Excursion to St. Angelo (c),
Pavia—(b)→Milano,
Milano—(a)→Rome

YTS

3 (W) Rome—(a)→Athens (Greece)

Y

5 (F) Athens—(a)→Istanbul
(Turkey)

T *S*

6 (Sa) Istanbul—(a)→Ankara Athens—(t)→Olympia Athens—(a)→Chania
7 (Su) Excursion to Excursion around Chania—(b)→Iraklion,
Ankara Baraij (j) Olympia Excursion to Erini,
8 (M) Wheat and Barley Bree- Olympia—(b)→Tripolis Excursion to Knosos,
ders' Meeting (F.A.O.) Iraklion—(a)→Athens

		Y	T	S
	9 (Tu)	Visit Ankara Univ.	Excursion around Trioplis	Athens
	10 (W)	Excursion to the south of Ankara (j)	Trioplis–(b)→Athens	Athens—(t)→Larissa
	11 (Th)	Excursion to Beypazan (j)	Athens–(a)→Ankara	Excursion to Volos and Portaria
		YT		
	12 (F)			Larissa—(t)→Thessaloniki, Excursion to Vasilika
	13 (Sa)	Excursion to Ayas (j)		
	14 (Su)			Excursion to Lachanas
	15 (M)	Ankara—(j)→Bursa		Tessaloniki—(t)→Sarrai
	16 (Tu)	Bursa—(j)→Bandirma		Sarrai—(t)→Istanbul (Turkey)
	17 (W)	Excursion to Gönen (j), Bandirma—(s)→Istanbul		Hyderpasa—(t)—
	18 (Th)	Istanbul—(j)→Bolu		→Ankara
	19 (F)	Bolu—(j)→Ankara		Ankara—(t)→Kayseri
	20 (Sa)	Excursion around Ankara (j)		Excursion to Mt. Ali
	21 (Su)	Ankara—(j)→Corum		〃 to Erkilet
	22 (M)	Corum—(j)→Samsun		〃 to Upper Talas
		(Nakamura returned to Ankara.)		
	23 (Tu)	Samsun—(j)→Amasya		〃 to Urgüp and Göreme
	24 (W)	Amasya—(j)→Yozgat		Kayseri—(t)→Konya
	25 (Th)	Yozgat—(j)→Ankara		Konya—(b)→Akseki
		YTN		
	26	Ankara—(a)→Agri		Akseki—(b)→Antalya
	27 (Sa)	Excursion to Dogbayazit (c)		Antalya—(b)→Afyon
	28 (Su)	Agri—(b)→Erzurum		Excursion around Afyon, Afyon—(t)→Denizli
	29 (M)	Erzurum—(a)→Ankara		Excursion to Pamukkale and Denizli
	30 (Tu)			Denizli—(b)→Izmir, Excursion to Bergama
July:	1 (W)			Excursion to Ephesos
	2 (Tu)	Excursion to Ayas (j)		
	3 (F)	Excursion to Ayas (j)		Izmir—(t)→Ankara
	4 (Sa)	Excursion to the south of Ankara (j)		

YTSN

5 (Su) Excursion to the north east of Ankara (j)
6 (M) Ankara—(j)→Adapazari
7 (Tu) Adapazari—(j)→Istanbul
9 (W) Visit Agr. Exp. Station in Yesilköy (j)

Y *TSN*

12 (Su) Istanbul—(a)—
13 (M) →Teheran (Iran)
14 (Tu) Teheran—(a)→Kabul (Afghanistan)

Istanbul
(a)
Tokyo (Japan)

16 (Th) Excursion to Sorobi (c)
17 (F) Kabul—(a)→New Delhi (India)
18 (Sa) New Delhi
(a)
19 (Su) Tokyo (Japan)

Collections

Table 1. Number of strains of wheats and their relatives collected

Country	*Triticum*	*Aegilops*	*Haynaldia*	*Agropyron*	*Secale*	*Hordeum*	*Avena*
Egypt	38	56	—	—	—	7	7
Jardan	16	140	—	—	—	3	4
Lebanon	5	32	—	—	1	2	2
Syria	29	90	—	—	2	6	3
Turkey	201	620	—	12	37	10	13
Greece	19	216	5	—	5	1	7
Italy	9	29	6	—	2	—	8
Total	317	1,183	11	12	47	29	44

F.N. Total: 1643 strains from 390 habitats.

Table 2. Number of strains of *Secale* and *Hordeum* collected

	Wild type	Cultivated type	Total
Secale	14	33	47(31)
Hordeum	12	17	29(24)

F.N.: Number of habitats is given in ( ).

Table 3. Number of strains and habitats of *Triticum* collected

Country	Einkorn		Emmer		Dinkel
	Wild type	Cultivated type	Wild type	Cultivated type	Cultivated type
Egypt	—	—	—	8(3)	30(11)
Jordan	—	—	1(1)	15(5)	—
Lebanon	—	—	—	4(3)	1(1)
Syria	1(1)	—	2(2)	12(9)	14(5)
Turkey	47(23)	9(6)	—	54(49)	91(35)
Greece	7(1)	—	—	3(2)	9(2)
Italy	—	—	—	6(3)	3(1)
Total	55(25)	9(6)	3(3)	102(74)	148(55)

F.N.: Number of habitats is given in ( ). Total number of strains is 317.

Table 4. Number of strains and habitats of *Aegilops* collected

Species \ Country	Egypt	Jordan	Lebanon	Syria	Turkey	Greece	Italy	Total
Ae. umbellulata	—	1(1)	—	2(1)	72(44)	—	—	75(46)
ovata	—	9(8)	7(4)	19(13)	51(30)	8(4)	22(12)	116(71)
triaristata	—	—	—	—	69(44)	52(9)	6(4)	127(57)
biuncialis	—	—	6(2)	7(4)	97(44)	1(1)	—	111(51)
columnaris	—	—	—	—	6(3)	—	—	6(3)
variabilis (includ. *Ae. Kotschyi*)	28(15)	119(30)	7(6)	12(8)	8(4)	41(9)	1(1)	216(73)
triuncialis	—	—	9(5)	10(9)	166(100)	54(11)	—	239(125)
caudata	—	—	—	3(1)	30(26)	39(9)	—	72(36)
cylindrica	—	—	—	1(1)	28(22)	—	—	29(23)
Heldreichii	—	—	—	—	6(2)	20(7)	—	26(9)
uniaristata	—	—	—	—	—	1(1)	—	1(1)
mutica	—	—	—	—	65(20)	—	—	65(20)
speltoides	—	—	—	13(7)	7(4)	—	—	20(11)
Aucheri	—	—	—	15(8)	12(6)	—	—	27(14)
longissima	—	9(7)	2(2)	7(5)	—	—	—	18(14)
bicornis	27(6)	—	—	—	—	—	—	27(6)
crassa	—	2(2)	1(1)	1(1)	—	—	—	4(4)
ventricosa	1(1)	—	—	—	—	—	—	1(1)
Natural hybrids	—	—	—	—	3(3)	—	—	3(3)
Total	56	140	32	90	620	216	29	1,183(313)

F.N.: Number of habitats is given ( ).

III. Review

Proceedings of the First International Wheat Genetics Symposium

A. B. BURDICK
Biological Laboratory, Kyoto University, Kyoto, Japan

The proceedings of the First International Wheat Genetics Symposium have been published, distributed to the 147 participants (from 29 different countries), and offered for sale to the rest of us. I bought a copy because it appears to me to be a good buy for five dollars.

The symposium was held at the University of Manitoba in Winnipeg, Canada in August of 1958, just prior to the International Genetics Congress in Montreal. It's organization was brought about by Dr. B. C. Jenkins, who also compiled and edited the symposium volume, under a committee headed by Dr. H. Kihara. The symposium had been contemplated as long ago as Bellagio (1953) and had been finally planned at the Genetics Symposium in Japan in 1956. Now that the first internationale has been accomplished, wheat geneticists can look forward to future meetings as more-or-less permanent adjuncts of international genetics congresses, the next one being planned now in connection with the forthcoming congress in Germany.

The 270 page proceedings of the First International Wheat Genetics Symposium contains 20 full-length research papers taken from the four Sessions of the symposium, Genetics and Plant Breeding (7 papers), Mutation (3 papers), Genetic Stocks (3 papers), and Polyploidy and Aneuploidy (7 papers), as well as a special research lecture on the Hindukush Expedition of 1955 by Dr. Kihara. This volume accomplishes an important purpose if it serves to draw attention to the broad scope and sophistication of wheat genetics research, research which, although only 40 years old, can display (as it did at the symposium) 60 artificial species, can take pride in the most advanced work in ploidy, in evolution, and in the application genetics to plant breeding. The informal discussions which followed most of the symposium papers are recorded in verbatim style which makes them particularly valuable and interesting.

(Editor's note: A picture and the names of the participants are given on cover pages i and ii.)

IV. News and Editorial Remarks

Errata of WIS No. 8

(pp. 25–27)

Y. Tanaka

All + symbols in p. 25 and p. 27 should be in italic.

All numerals composing a part of gene symbols should be in italic.

p. 27 (Examples) for "*bvg*" read "*b vg*".

p. 27 5th line from bottom, for "*T* translocation" read "*T* for translocation".

"Robigo"

"ROBIGO has had a little stop on the road, but now with the sending of the issues 7 and 8 we hope that it will be possible to regain the lost time, so here he is again, shaking friend's hands and as always ready to fight the rusts. *The Editors*"

General Table of Contents

We are very glad that WIS Nos. 1–10 have been completed. The general table of contents, including an index of authors' names, is given in the following pages.

Announcement for the Next Issue, No. 11

WIS No. 11 will be ready for publication in August, 1960.

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 July 31, 1960**—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
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(*K. Y.*)