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I. Research Notes

Polyploids and aneuploids of *Triticum dicoccum* var. Khapli produced by N_2O-treatment

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Ostergren reported in 1954 that N_2O treatment is effective for the production of polyploids in *Crepis*. NYGREN (1955) and OSTERGREN (1957) obtained by the same treatment good results in *Melandrium* and *Phalaris*, respectively.

The present authors (1960) applied Ostergren's method to an Emmer wheat, *T. dicoccum* var. Khapli and obtained polyploids and aneuploids from almost all florets treated under the optimum condition.

In this note, performance as to fertility and other characters of the first generation of N_2O-treated Khapli and the chromosomal constitution of the offspring are reported.

Table 1. Performance of aneuploids and polyploids of *T. dicoccum* var. Khapli produced by N_2O-treatment

Group	Somatic chromosome number	Number of plants observed	Average plant height (cm)	Average number of tillers	Average seed fertility (%)	Average number of seeds produced
1	28	11	55.5	5	96.8	70.1
2	27	2	41.9	4	27.5	9.5
3	27+t*	1	29.8	4	50.0	13.0
4	27, 29**	1	35.2	5	25.0	4.0
5	29	1	38.2	6	100.0	43.0
6	31	1	20.0	1	0.0	0.0
7	57	1	34.1	2	0.0	0.0
8	54	2	38.4	2	17.5	2.5
9	55	4	43.6	4	10.0	2.3
10	56	25	38.7	3	14.8	5.3

* a telocentric chromosome ** mosaic roots with 27 and 29 chromosomes

First generation Plants in the first generation after N_2O - treatment were checked as to their chromosome number in root-tip mitoses and were cultivated in the greenhouse. Their performance as to plant height, seed fertility and some other characters was recorded, as summarized in Table 1, in which the plants are grouped in respect to their chromosome number.

The monosomic plants were more slender and shorter than the disomics, and their seed-fertility was extremely low in comparison with that of the latter. A plant having a telocentric chromosome and one with mixed chromosome numbers (2n=27 and 29) showed also very low seed-fertility. A trisomic plant showed a weaker vigor than the disomics but its seed-fertility was normal and it produced many seeds. Two plants having extremely aberrant chromosome numbers (2n=31 and 2n=47) were very weak and did not bear any seed. All autotetraploids (2n=56) and hypotetraploids (2n=55 and 2n=54) had stiffer and thicker straw than the disomics and showed low fertility.

Offspring The chromosome number of the offspring was cytologically investigated in root-tip cells. The results of the investigation are summarized in Table 2.

Table 2. Progenies of aneuploid and polyploid Khapli produced by N_2O-treatment

Group	Parent's chromosome number	Number of offspring observed	Number of offspring having chromosomes (2n)													Average chromosome number
			27	28	29	51	52	53	54	55	56	57	58	59	61	
1	28	48		48												28.0
2	27	13		12	1											28.1
3	27+t*	12		12												28.0
4	27, 28**	4		1	3											27.8
5	29	17		15	2											28.1
8	54	9				1	2	1	2	3						53.4
9	55	10						1	2	3	4					55.0
10	56	44							5	8	22	4	2	2	1	56.0

* a telocentric chromosome ** mosaic roots with 27 and 29 chromosomes

In the control (Group 1) no aberrant offspring were found. Progenies of two monosomics consisted of 12 disomics and one trisomic but no monosomics were recovered. The trisomic seemed to be produced from an aberrant meiosis in the monosomic parent as is known in monosomics of common wheat. A plant, whose roots were a mosaic of mono- and trisomic cells, gave in its offspring four plants, one of which was monosomic. Since the seed-fertility of those monosomics including the mosaic plant was about 25%, the very low transmission rate of the monosomic condition in this Emmer variety was seemingly due to strong selection against chromosome-deficient gametes and/or zygotes.

The trisomic plant produced 17 descendants among which two trisomics were recovered. The transmission rate of the trisomic condition is also significantly lower than that known in common wheat.

These facts suggest that it will be very difficult to establish an aneuploid series in Emmer wheat and that both monosomic and trisomic analyses will mean hard work.

All tetra- and hypotetraploids produced offspring which were also tetra- or hypotetraploids (2n=51~61). In these groups, there was on the average a strict correlation between the chromosome number of the parents and that of the offspring. The 56-chromosome Khapli, being fairly stable in respect to the chromosomal constitution of the offspring, can be used for further genetic investigations.

The effect of chromosome 5B at prophase

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The genetical control of the diploid-like meiosis of the polyploid wheats has been shown to be located on the long arm of chromosome 5B (V). (See publications of Riley *et. al.*). The effect of 5B is to limit the pairing in the polyploid wheats to strictly homologous chromosomes and thus regimenting as bivalents chromosomes that would form multivalents in its absence. This control of pairing is recognised by its effects at first meiotic metaphase, that is after both pairing and chiasma formation have taken place. Consequently it is impossible to decide whether the mechanism acts through the control of either or both of these agencies. To make this distinction it is necessary to examine the prophase of certain derivatives of *T. aestivum*.

Prophase studies in *T. aestivum* are complicated by the difficulty of making good squash preparations because of the large number of chromosomes present. The analysis is further complicated since all of the centromeres are essentially submedian in position, and consequently it is not possible to recognise individual chromosomes by this feature. Also as two chromosomes (1B and 6B) are satellited the usefulness of this diagnostic character is limited. However, certain general conclusions concerning the group action of the chromosomes can be gleaned from an examination of prophase preparations.

The prophase of euploid *T. aestivum* exhibits clearly all of the stages that are recognized as typical of a normal meiotic prophase. No anomalous chromosome behaviour was observed. The prophase of 21-chromosome euhaploids of *T. aestivum* was quite distinct from that of 42-chromosome euploids. There was some, but very little, chromosome pairing in the euhaploids and a certain degree of desynapsis took place so that the metaphase pairing gave a minimal estimate of the potential pairing ability.

The prophase of haploids nullisomic for chromosome 5B presents an entirely different picture. In the majority of the cells examined much more pairing was observed and configurations of great complexity were seen quite frequently. Often three and occasionally more chromosomes were seen to be involved in one figure giving a preview of the multivalent configurations seen at meta-anaphase. In addtion to this increased complexity the chromosomes lay closer together than in euhaploids and the prophases of nullisomic-5B haploids were comparable to those observed in euploids in this respect. With the restriction that each chromosome has a homologous partner in nullisomics, the prophase pairing of nullisomic 5B was remarkably similar, in its general appearance, to that of nullisomic-5B haploids. There was apparently no change in the forces initiating homologous pairing in nullisomic 5B but superimposed on the normal and regular pattern was a freedom of presumably homoeologous chromosomes to pair with each other. The complex multivalents that were visible at metaphase in nullisomic 5B are a reflection of this intergenomic synapsis at prophase.

The complexity of the metaphases of nullisomic-5B haploids could be caused in two ways, first an increase in the chiasma frequency of cells that already have a high degree of synapsis or secondly, an increase in synapsis and either as a result of this or by a separate and simultaneous action an increase in the chiasma frequency.

If the absence of chromosome 5B simply allowed an increase in chiasma frequency then in nullisomics of 5B, where there is already total homologous synapsis, a change in the chiasma frequency would be directly detectable. Table 1 gives the chromosome pairing and the chiasma frequency per paired chromosome in examples of 42-chromosome euploid, 21-chromosome euhaploid, 40-chromosome nullisomic 5B and 20-chromosome nullisomic-5B haploid plants. The number of chiasmata per paired chromosome in the nullisomic is not significantly different from that of euploid and therefore the increased pairing in the nullisomic-5B haploid is not a result of an increase in chiasma frequency in cells that already have a high degree of synapsis. Also there cannot be a separate and simultaneous increase in chiasma frequency for this too should lead to a detectable increase in the chiasma frequency in the nullisomic.

Therefore, the most plausable hypothesis describing the action of chromosome 5B at prophase is that it prohibits synapsis between homoeologous chromosomes in both euploid and euhaploid so that only bivalents are formed in the 42 chromosome plants and mainly univalents in the euhaploids where no homologous chromosomes are present. The removal of 5B in nullisomic-5B haploids allows synapsis to occur between presumably homoeologous chromosomes and there is consequently a rise in the chiasma frequency. Whilst the absence of chromosome 5B in nullisomic 5B plants cannot increase the already total synapsis it can, and does, allow the attraction and synapsis of homoeologous chromosomes so that the highly characteristic metaphase picture is produced.

Table 1. Meiotic analyses, as means per cell, and chiasma counts for euploid, nullisomic 5B, euhaploid and nullisomic-5B haploid.

Material	Number of cells	Univalents	Rod bivalents	Ring bivalents	Total bivalents	Trivalents	Quadrivalents	Total chiasmata	Chiasmata per cell	Chiasmata per paired chromosome
Euploid	50	0.08	1.44	19.52	20.96	-	-	2424	48.48	1.16
Nullisomic 5B	20	2.60	2.30	13.05	15.35	0.90	1.00	776	38.80	1.04
Euhaploid	50	18.74	1.10	-	1.10	0.02	-	58	1.16	0.51
Nullisomic-5B haploid	50	8.12	4.46	0.78	5.24	0.44	0.02	418	8.36	0.71

Meiotic irregularities in intervarietal hybrids of common wheat

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Meiosis in PMC's of the F_1 hybrids between spring and winter types was studied in comparison with that of spring × spring or winter × winter hybrids. As spring wheat varieties, NŌRIN No. 3, Sapporo - Haru - komugi No. 1, Saitama No. 27, Kōnosu No. 25, and as winter wheat varieties, Aoba-Komugi, Nanbu-Komugi, Fultz No. 1, Kanred were used respectively. As is clearly seen from this table, the univalent frequency of F_1's is very high compared with that of the parents, and there seems to be no definite relation between the univalent occurrence and the growth habits of parental varieties concerned in the crossing, unlike the results of HOWARD et JOSHI (1951), as shown in oats.

Anyway, one can see that the irregularities of meiosis, above all, the univalent formation, are promoted by hybridization, whether it may be made between spring and spring or winter and winter or not. Especially in the cross combinations in which Kōnosu No. 25 or Aoba-Komugi were concerned, the univalent were formed in abnormally high frequency of 30%, rarely over 70%. The number of univalents observed is usually two, often 4 to 6 being encountered. Multivalent chromosomes such as trivalent or tetravalent were also observed. However, Sapporo - Harukomugi No. 1, though this variety itself shows low value in both the univalent frequency and the percentage of irregularity, resulted in an excessive number of multivalent chromosomes in the hybrids with which it was concerned. In such hybrids, the mode of chromosome configurations is in $1_{VI}+19_{II}$, and 1_{VI} was often observed, 1_x being rarely met with.

Table 1 The percentage of irregularity and of univalent occurrence in intervarietal hybrids in comparison with their parents

♀ \ ♂		*Spring Varieties*				*Winter Varieties*			
		Nōrin Nr. 3	Sapporo-Harukomugi No. 1	Saitama No. 27	Kōnosu No. 25	Aoba-Komugi	Nanbu-Komugi	Fultz No. 1	Kanred
Spring Varieties	Nōrin No. 3	11.25 / 11.41	25.03 / 72.19	13.00 / 13.00	38.00 / 38.67	40.80 / 41.60	32.80 / 33.60	16.65 / 16.65	21.56 / 21.56
	Sapporo-Harukomugi No. 1		5.60 / 8.00	38.40 / 82.80	33.20 / 66.00	52.00 / 76.00	24.23 / 84.58	11.11 / 94.02	4.40 / 95.60
	Saitama No. 27			4.80 / 4.80	36.91 / 36.91	46.80 / 46.80	15.60 / 15.60	16.00 / 21.00	28.40 / 29.20
	Kōnosu No. 25				2.80 / 2.80	50.00 / 52.00	72.80 / 74.00	32.67 / 40.67	37.20 / 42.0
Winter Varieties	Aoba-Komugi					4.80 / 4.80	34.40 / 36.40	34.67 / 36.67	40.40 / 40.40
	Nanbu-Komugi		22.00 / 77.20	18.96 / 18.96			2.00 / 2.00	21.30 / 21.70	20.80 / 20.80
	Fultz No. 1		28.40 / 92.80	18.00 / 20.00				3.60 / 3.60	21.50 / 21.50
	Kanred								0.80 / 0.80

(Note) The percentage of irregularity was noted in denominator, that of univalent occurrence in numerator

This is because it contains at least a translocation in the homozygous condition.

The failure of chromosome pairing or the formation of multivalent chromosomes has been often observed so far even in the pure varieties of common wheat. This is because there exists semi-homology between chromosomes of three different genomes constituting *T. vulgare Vill.*. And the degree of semi-homology is perhaps different in different varieties, in spite of their possessing the identical genome formula. Moreover, there are chromosomes which are structurally differentiated. Therefore, when two gametes, male and female, different in the degree of chromosome differentiation, were united with each other through fertilization, the F_1 plant thus produced would come to reveal its intrinsic disharmony by taking the form of meiotic instability. By examining the amount of such irregularities in F_1 hybrids, the relative affinities among their parental varieties may be determined.

Directed change in seed dormancy period of Moskovka Spring Wheat

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The Moskovka spring wheat variety (*T. aestivum* var. *graecum*) has been so far standardised for production in 18 regions and autonomous republics of the non-chernozem zone, i.e. in an area stretching from the Baltic to the Ural Mountains.

The Moskovka wheat is high-yielding, smut-resisting, of very high baking quality, and resists lodging. However, together with good qualities, Moskovka has shown an undesirable characteristic - short post-harvest dormancy. Given a rainy and warm autumn the variety will start germinating in the field condition.

In working to change the heredity of Moskovka variety the period of grain forming form milky through gold to complete ripeness was used.

In one case grain after-ripening in sheaves was subjected to low temperature (about 0° Centigrade) and, in another case, physiologically ripe seed was heated by immersion in hot water (55° Centigrade) for 30 minutes. In that time the seed swelled, absorbing over 25 per cent water to its weight, and the caryopsis began coming out of dormancy in conditions unusual for a germinating seed. The result in both cases was the same, viz. a shift in the heredity of the processed seed toward a longer post-harvest dormancy. However, on examination, the grain that was subjected to low temperature showed a tendency to developing a pale-pink colouring.

200 of such grains were selected and sown in vegetation pots. Cropping was done individually, plant by plant. Out of the 176 plants 72 yielded the typical white grain of var. *graecum*, while 102 plants yielded red grain, *e. i.* they were of var. *erythrospermum*

Germination of grain gave the following results: after twelve days 80 per cent of the whitec-oloured grain germinated and only 4 per cent of the red-coloured variety.

Anatomical examination of red-coloured grain revealed that as distinct from the parent Moskovka seed it has a wellpronounced layer of inner integument of golden-yellow colour. This golden layer can be clearly seen between the colourless layer of inner integument and the inner epidermis of the nucellus. The absence of such a pigment layer in grain skin is a distinctive feature of the white-grain Moskovka.

This emergence of a solid pigment layer is seen as the main cause of a longer dormancy period in the red-grain variety. So long as atmosphere oxygen cannot penetrate this layer seed germination is retarded.

To achieve a quantity transformation of white-grain Moskovka into a new, red-grain, variety the technique of "prewinter sowing" was used. This technique envolves sowing seed a few days prior to ground freezing, which for Moscow region falls on the first ten days of December. Seed is required in this case just to start germinating, which process is then stopped by the complete freezing of the ground. This technique is a usual practice at Soviet breeding stations to combat smut (*Ustilago tritici* Jensen).

Subsequently the red-grain plants thus obtained were used as the foundation stock to establish a new variety, Krasnozernaya (Red-grain). The following table gives the data on the retarded germination of the new variety obtained in the course of five years.

Seed germination within two weeks after wax-state harvest in percentages

Variety	1954	1955	1956	1957	1958	Average
Krasnozernaya	4.7	19.4	3.2	14.0	2.3	8.7
Moskovka	41.9	74.2	19.6	64.5	62.0	52.4

It should be noted that the new variety has retained the high baking quality of the parent variety and in a number of non-chernozem regions has considerably surpassed it in yields.

Morphologically the new variety, Krasnozernaya has no difference.

This transformation of a white-grain variety into a red-grain variety is seen as a process of mutation caused by temperature shock.

Chemical induction of mutation in common wheat

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In the search for more efficient mutagens and means to direct the mutation process, the Swedish mutation research has turned more and more over to the study of chemical mutagenesis. Seeds, mainly of barley and peas, have consistently been used in these experiments, and up to now a series of alkylating compounds (mustard gas, nitrogen mustards, diethyl sulfate, ethylene oxide, glycidol, ethyleneimine, epichlorohydrine, methyl, ethyl and propyl methanesulfonate, diepoxybutane, triethylenemelamine, myleran), oxidizing or substituting agents (oxygen, p-dioxan, chlorine, iodine), and purine derivatives (8-ethoxycaffeine, nebularine) have been investigated as to their effect on survival, fertility, mutation frequency and spectrum. The results have been very encouraging. Thus, treatments with ethyleneimine and alkanesulfonic esters gave the same or even higher mutaion rates in M_2 than X-irradiation. In addition, the mutation spectrum was changed, and entirely new mutant types could be found (*cf.* EHRENBERG *et al.*, 1961. Hereditas 47 : 243-281).

In general, chemical mutagenesis also proved less associated with sterility in the first M-generation, which must be taken as an indication of a relative prevalence of point over chromosome mutations. This interpretation has also been supported otherwise, *e. g.* by cytological analyses of primary effects. This shift in mutation mechanism inherent of many chemicals studied can, however, be expected to alter the evaluation in connection with polyploids. The visible mutation spectrum is here generally representing more drastic events than a gene or point mutation which easily will be phenotypically suppressed by the reduplicated genic system typical for this category of plants. In order to study this aspect, a series of experiments in 6x *vulgare* wheat was performed in 1957-60.

Besides X-rays and fast neutrons, five different alkylating agents were tried. Ethylene oxide, ethyleneimine and ethyl methanesulfonate are easily soluble in water and were used in a series of successively increasing concentrations. Originally dry seeds were soaked in the solutions at room temperature and due to the different penetrating ability of the three substances for 5, 6, and 24 hours, respectively. Diethyl sulfate and especially myleran are less soluble in water, and therefore time of treatment in a saturated solution was here used as varying factor. Since ethyleneimine, ethyl methanesulfonate and diethyl sulfate are unstable at low pH values, a Tris buffer was added to keep pH at 7.6-7.7. and, in addition, the continuous shaking occurred in open flasks to accomplish a certain aeration.

The seeds were sown in the field immediately after treatment. Unfortunately, the spring of 1959 and 1960 was too dry to give a satisfactory germination, which condition was especially critical for the X-ray series. This even failed completely in the 1959 year experiment. From comprehensive earlier studies, it can, however, be stated that the relation between X-rays and fast neutrons is representative in the 1957 year experiment.

In order to condense the results as much as possible and to present only data supported by a complete progeny test, Table 1 is concentrated to the mutational events in

Table 1. Maximum mutagenic effect on chromosome 5A of Rival *vulgare* wheat obtained by seed treatment with X-rays, fast neutrons and five alkylating compounds.

Treatment and dose	Survival in M_1, %	Mean plant fertility in M_1	Rel. frequency (%) of M_1 plant progenies segregating:				
			compactoid mut.	spelt-toid mut.	bearded normal mut.	winter habit mut.	mut. in chrom. 5A
1957 year experiment:							
Control	83.0	83.2±0.45	-	0.8	-	-	0.8
X-rays, 52,000 r	19.3	77.6±1.66	2.9	27.9	2.3	1.2	34.3
Neutrons, 600 reps	56.1	49.3±2.88	10.7	28.1	-	-	38.8
Myleran, 1 hour soaking	58.9	82.8±0.91	2.0	14.0	1.0	-	17.0
Ethylene oxide, 0.20%	15.8	89.8±6.47	1.0	5.3	-	-	6.3
1959 year experiment:							
Control	64.0	86.2±0.55	0.3	-	-	-	0.3
Neutrons, 770 reps	55.0	66.0±1.60	12.0	40.0	3.0	4.0	59.0
Ethyleneimine 0.04%	51.6	88.5±0.84	1.0	5.0	-	-	6.0
Diethyl sulfate, ½ hour soaking	55.0	88.1±0.72	0.5	2.0	-	-	2.5
1960 year experiment:							
Control	70.4	88.0±0.39	-	1.2	-	-	1.2
X-rays, 5,000 r	30.6	78.4±2.02	2.9	7.6	-	-	10.5
Neutrons, 670 reps	60.7	65.6±1.80	4.5	20.0	-	-	24.5
Myleran, 8 hours soaking	77.9	89.1±0.65	-	4.0	1.0	-	5.0
Ethyleneimine, 0.02%	56.1	84.7±1.05	-	2.2	-	-	2.2
Ethyl methanesulfonate, 0.33%	44.7	77.7±1.08	0.5	4.0	4.0	-	8.5

chromosome 5A (IX) and those doses which gave the highest mutation rates in the various years and treatment series. The wheat variety used (Svaloef Rival Spring Wheat) carries three markers on the long arm of chromosome 5A. The inactivation of a proximal factor S_K results in a shift from spring to winter wheat, a mutation involving B_1 will cause awning and the loss of the distal factor Q will give a speltoid. A terminal deficiency longer than 30 centimorgans will result in a bearded spring speltoid or, when the loss includes S_K as well, a bearded winter speltoid. A simple segregation test will further reveal, whether a part or whole the chromosome is lost, and the duplication of Q will phenotypically be distinguished as a compactoid. The system obviously allows for a rough grouping from point mutations to aneuploidy, a width in scorable mutation mechanisms, which is not available in a diploid and well suited for studies on mutagenic specificity.

As evident from Table 1, none of the chemical mutagens proved as efficient as X-rays and neutrons in producing mutational events in chromosome 5A of 6x *vulgare* wheat. As in other chromosomes of this polyploid, most of the events scored must involve more than a simple gene alteration, which is evident from comparing the relative prevalence of compactoids and speltoids against bearded normals and winter types. The two last categories includes only gene mutations or interstitual deficiencies, since here only B_1 or S_K, respectively, is mutated or lost. The compactoid and speltoid groups include, however, not only mutations merely related to Q but also to B_1 alone or together with S_K. The high correlation between induced sterility in M_1 and mutation rate in M_2 further favours the idea that visible mutations in common wheat are mostly associated with changes above the simple gene level.

The lower efficiency of the studied chemicals to produce visible mutations in a polyploid than in a diploid organism if compared with X-rays and neutrons thus strongly supports the idea of a different mutagenic specificity. Since chromosome mutations are more likely to be deleterious, a lower efficiency of chemical mutagenesis in polyploids will not necessarily imply a lower yield of practically interesting mutations. Repeated treatments over successive generations may also overcome the phenotypic buffering against minor genetic events.

The effect of temperature on coleoptile elongation of three groups of wheat varieties [1/]

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Poor stands often result from early seeding (late August, early September) of winter wheat in eastern Washington even when moisture is adequate. Late-sown (October) wheat generally produces suitable stands. Work at Pullman, Washington, has shown that selections which possess long coleoptiles generally emerge more rapidly than selections with short coleoptiles. Furthermore, selections which emerge rapidly generally produce better stands than selections that emerge slowly and erratically. High soil temperatures often occur during August and September in eastern Washington; readings as high as 90°F have been recorded at soil depths of 3 inches during August at Pullman.

This study was initiated to determine the effect of high temperature on coleoptile elongation of wheat selections in 3 groups. Fourteen standard height, 25 common-type semidwarf and 16 club-type semidwarf selections were grown at temperatures of 50 and 90°F in a totally darkened plant growth chamber. The selections were sown in shallow sand flats with each selection replicated 4 times.

Analysis of variance indicated that the high temperature (90°F) significantly reduced the coleoptile lengths of wheat selections in all 3 groups as compared with measurements taken at low temperature (50°F). Furthermore, highly significant variety by temperature interactions occurred within the standard-height and club-type semidwarf group which showed that within these 2 groups selections differed in their sensitivity to high temperature. No significant difference in sensitivity occurred among the 25 common semidwarf selections.

Table 1 shows the average coleoptile measurements obtained at both temperatures and the percentage reduction in length caused by high temperature. The rankings of the various selections for all measurements are also shown.

Among the standard-height selections Spinkcota, a rapid emerging variety, was reduced the least; whereas Brevor, a poor emerging variety, was reduced the most. The semidwarf clubs showed the greatest varietal variability in reduction due to high temperature. Selection 216, which has a short coleoptile even at low temperatures, showed the least reduction (25%); whereas selection 229 was reduced 54%. Although reduction varied from 38% to 55% in the common-type semidwarf group, no significant differences among selections were apparent.

Results of the present study showed that high temperature (90°F) inhibited coleoptile

[1/] Cooperative investigations of Crops Research Division, ARS, USDA and Washington Agricultural Experiment Stations.

Table 1. Coleoptile-length measurements of wheat selections in three groups at two temperatures and percent reduction due to high temperature

Standard-height selections					Club-type-semidwarf selections					Common-type-semidwarf selections				
Name	50°F(mm)	90°F(mm)	Percent reduced		Row No.	50°F(mm)	90°F(mm)	Percent reduced		Wash. No.	50°F(mm)	90°F(mm)	Percent reduced	
Baart	120 (1)*	69 (1)	42	(5)	231	84 (1)	43 (2)	49	(2)	3723	66 (1)	35 (2)	47	(6)
Pentad	107 (2)	62 (3)	42	(5)	238	74 (2)	44 (1)	41	(8)	3758	64 (2)	36 (1)	44	(9)
Dickson 114	103 (3)	61 (4)	41	(6)	211	73 (3)	40 (4)	45	(6)	3753	63 (3)	30 (7)	52	(2)
Spinkcota	95 (4)	63 (2)	34	(10)	234	71 (4)	36 (7)	49	(2)	3743	61 (4)	35 (2)	43	(10)
T. orientale	90 (5)	58 (5)	36	(9)	226	66 (5)	35 (8)	47	(4)	3736	61 (4)	32 (5)	48	(5)
Golden	89 (6)	51 (7)	43	(4)	224	66 (5)	38 (5)	42	(7)	3752	61 (4)	33 (4)	46	(7)
Nigger	89 (6)	52 (6)	42	(5)	218	66 (5)	36 (7)	45	(6)	3756	61 (4)	34 (3)	44	(9)
Royal	80 (7)	45 (8)	44	(3)	233	65 (6)	35 (8)	46	(5)	3726	60 (5)	27 (10)	55	(1)
Brevor	79 (8)	38 (11)	52	(1)	203	65 (6)	41 (3)	37	(9)	3749	60 (5)	30 (7)	50	(3)
Wyoming 618	76 (9)	45 (8)	41	(6)	222	64 (7)	37 (6)	42	(7)	3741	60 (5)	30 (7)	50	(3)
Wyoming 89	75 (10)	38 (11)	49	(2)	232	64 (7)	34 (9)	47	(4)	3733	58 (6)	36 (1)	38	(14)
Wyoming 349	71 (11)	45 (8)	37	(8)	227	61 (8)	32 (11)	48	(3)	3725	58 (6)	29 (8)	50	(3)
Itana	71 (11)	43 (9)	39	(7)	229	57 (9)	26 (12)	54	(1)	3757	57 (7)	32 (5)	44	(9)
Burt	68 (12)	40 (10)	41	(6)	219	56 (10)	33 (10)	41	(8)	3738	56 (8)	34 (3)	39	(13)
					221	55 (11)	36 (7)	35	(10)	3750	56 (8)	31 (6)	45	(8)
					216	53 (12)	40 (4)	25	(11)	3759	55 (9)	34 (3)	38	(14)
										3747	55 (9)	32 (5)	42	(11)
										3745	53 (10)	32 (5)	40	(12)
										3751	53 (10)	31 (6)	42	(11)
										3755	52 (11)	30 (7)	42	(11)
										3748	51 (12)	26 (11)	49	(4)
										3746	50 (13)	26 (11)	48	(5)
										3734	50 (13)	24 (12)	52	(2)
										3694	48 (14)	26 (11)	46	(7)
										3744	47 (15)	28 (9)	40	(12)

* Figures in parenthesis give the rank.

elongation. This observation may partially explain why early seedings during the warm months of August and September generally emerge poorer than late seedings in October, when cool weather prevails.

Further tests are underway with selections of diverse origin in a search for germ plasm stocks that are less sensitive to reduction in coleoptile lenght at high temperatures than our own indigenous lines. Field trials are being made to measure more accurately the association that appears to exist between amount of coleoptile reduction at high temperature and rate of seedling emergence.

Effect of X-ray on some wheat characters

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Seed of two *vulgare* wheats namely Tosson and Giza 144 and one *durum* wheat namely Baladi Bahtim and Einkorn wheat were exposed to different X-ray treatments. Exposure was done at the Natural Research Centre with the help of D. A. MAHROUS. Total exposure amounted to 12000, 18000 or 24000 r. Exposed seed were dry or

Table 1. Average percentage of seedling emergence

Wheat variety	Average percentage of seedling emergence when seed was exposed to:-			
	0	12000 r	18000 r	24000 r
Dry treatment:				
Tosson	97.5 %	98.4 %	98.5 %	98.5 %
Giza 144	100	98.5	95.5	98.4
Baladi Bahtim	91.0	99.0	100	98.0
Soaked treatment:				
Tosson	100	94.00	93.9	90.9
Giza 144	99.0	93.4	92.6	94.4
Baladi Bahtim	98.0	72.0	89.0	86.9
Einkorn	90.8	76.0	56.6	81.8

soaked for 24 hours in water prior to X-ray treatment. Treated and untreated seed were planted in the greenhouses in steamed soil and replicated 4 times, using fifty or twenty-five seed in each replicate.

Period for seedling emergence was delayed one day when the seed was dry at the time of X-ray exposure and delayed 2~3 days when the seed was soaked for 24 hours prior to X-ray treatment.

Percentage of seedling emergence decreased when seed was exposed to X-ray as shown in Table 1. Differences in the percentage of seedling emergence were highly significant in the case of the soaked seed when results were analyzed statistically.

Length of seedlings was measured and average length was calculated for each replicate and results were analyzed statistically (Table 2). Differences were highly significant in the case of soaked seed, and the least significant differences were 0.85 cm, 0.74 cm at 5% level and 1.22 cm and 1.00 cm, respectively. In the case of the dry seed differences were highly significant only for the X-ray treatments and the least significant differences were 1.21 cm at 5 % and 1.66 cm at 1 % level.

Table 2. Average length of seedlings from X-ray treated and untreated seeds

Wheat variety	Average length of seedlings when seeds were exposed to:			
	0	12000 r	18000 r	24000 r
Dry treatment:				
Tosson	24.9 cm	27.2 cm	24.5 cm	20.2 cm
Giza 144	24.2	28.6	21.1	20.7
Baladi Bahtim	24.7	23.9	23.5	20.1
Soaked treatment:				
Tosson	28.8	0.6	0.5	0.6
Giza 144	32.3	0.8	0.6	0.7
Baladi Bahtim	30.9	0.9	0.7	0.8
Einkorn	23.8	0.3	0.4	0.3

Newly induced mutants of *Triticum vulgare* by X-ray-treatments

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The following types of mutants were newly found in X_2 and X_3 generation besides formerly reported speltoid, compactoid, lax-eared, dense-eared, short-strawed and bearded (Uchikawa, 1960). Treatments (75 kV, 20 mA, 315 r/m, dose 5-25 kr) were given to dormant seeds of *T. vulgara* containing 18.8% of water at 18° C.

(a) Dwarf-compactoids. These mutants include two cytogenetic types. All of these mutants are highly sterile and have remarkably short culms, broad and compact ears. The first type heterozygote had 41 chromosomes including three IX chromosomes, and the homozygote possessed 42 chromosomes involving four IX chromosomes; while the second type heterozygote had 40 chromosomes including one iso-IX chromosome, and the homozygote possessed 40 chromosomes involving two iso-IX chromosomes. From these findings it is assumed that the compactoid characters may be brought about by the duplication of one long arm or one whole IX chromosome which involves the gene Q locus, and that the dwarfness is caused by the lacking of other one or two chromosomes.

(b) Dense-eared (Type II). This type differs from compactoids in the form of spikes and the arrangement of spikelets, and is also different from hitherto reported Type I dense-eared mutants in their chromosome constitution and appearance. This type plants are half sterile and have short culms and dense ears. The hetero- and homozygotes of this type had 42 chromosomes similarly, and at MI of PMC's the chromosome arrangement $19_{II} + 1_{III} + 1_{I}$ was observed in the heterozygote and $19_{II}+1_{IV}$ in the homozygote. These facts show that the mutants of this type may be brought about by the duplication of a whole chromosome which bears the dense ear promoting gene, owing to chromosome substitution.

(c) Disorder-eared. This type differs from so-called irregular eared. This type mutants are highly sterile and have disorderly ear forms caused by the prevention of shooting-out of ears due to hard embracing of top-leaf-sheaths. The heterozygote had 41 chromosomes including one fragment and the homozygote possessed 40 chromosomes. These facts show that this type mutants may be produced by the partial or whole deficiency of one chromosome bearing normal leaf-sheath embracing gene.

(d) Spiral-leafed. This type mutants uniformly have twisted leaf-sheaths, spirally coiled leaf-blades and slightly twisted spikes. These are classified into three types by their ear forms. The first type having normal ears had 42 chromosomes, and usually chowed $19_{II} + 1_{IV}$ association at MI of PMC's. The second type having lax ears possessed 41 chromosomes in the heterozygote and 40 chromosomes in the homozygote. Both zygotes usually formed tetrapartite chromosomes at MI of PMC's. The third type poss-

essing compactoid ear form commonly showed $19_{II} + 1_{IV}$ including one IX-iso-IX pair at MI of PMC's in the heterozygote. The homozygote usually showed $19_{II} + 1_{IV}$ including one iso - IX pair in PMC's. From these facts the author assumes that the spiral-leafed mutation is caused by the reciprocal translocation of two chromosomes, and that the ear forms are controlled by the aberration of other chromosomes.

(e) Narrow-leafed and Broad-leafed. The former has narrow long dark-green leaves, thin and slightly short culms, while the latter possesses remarkably broad hard light-green leaves, thick and tough culms. The former had 42 chromosomes including one partially deficient chromosome in the heterozygote, and 42 chromosomes including two partially deficient chromosomes in the homozygote; while the latter had 43 chromosomes including one fragment in the heterozygote and 44 chromosomes including two fragments in the homozygote. From these facts it is assumed that the former type mutants arise from the partial deficiency of one chromosome bearing broad leaf promoting gene, and that the latter type are produced by the partial duplication of the same chromosome.

(f) Trough-leafed. This type has short straws and hard dark-green trough-like leaves, the right and left margins of which are bent toward the reverse sides forming crescent-shaped troughs. This type mutants had 41 chromosome in the heterozygote, and the homozygote possessed 42 chromosomes including two partially duplicated chromosomes. These facts show that this type mutants are brought about by the partial duplication of one chromosome bearing trough leaf gene.

(g) Short-strawed with normal ear (Type II). This newly found type differs from formerly reported short-strawed mutants. This type plants have thick and remarkably short straws and normal ears. The heterozygote had 42 chromosomes including one chromosome with duplicated long arm, while the homozygote possessed 42 chromosomes including two chromosomes with duplicated long arms. From these findings it is assumed that this type mutants may be caused by the duplication of one long arm of a chromosome which bears the short-straw promoting gene.

(h) Other dwarf mutants. Three cytogenetic types of dwarfs are included here. All of them are highly sterile and have the culms shorter by one third than those of normal plants similarly. The first type has normal ear, and was observed to have 41 chromosomes in the heterozygote and 40 chromosomes in the homozygote. This type, therefore, is produced by the deficiency of one chromosome which bears normal straw promoting gene.

The second type is very highly sterile and has lax ear. The heterozygote of this type had 40 chromosomes including one partially deficient chromosome, and the homozygote possessed 40 chromosomes including two partially deficient chromosomes. These findings show that the lax ear form of this type is caused by the partial deficiency of one chromosome and dwarfness is originated from the deficiency of one pair of other chromosomes.

The third type of dwarf mutants has dense ear. The heterozygote of this type had 40 chromosomes including one partially duplicated chromosome, while the homozygote possessed 40 chromosomes including two partially duplicated chromosomes. These facts show that the dwarfness of this type is caused by the deficiency of one pair chromosome and the dense ear is brought about by the partial duplication of another chromosome.

(i) Macurescens. This mutant appears very rarely and yellow spots become visible toward the laster part of March. The heterozygote and the homozygote had both 42 chromosomes and the chromosome behaviors in meiosis of PMC's were very regular. From these facts this mutant is assumed to be caused by minute delation of one chromosome or point mutation.

Segregation ratio and viability of several chlorophyll mutants in *T. monococcum*

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The segregation ratio often showed a wide range of variation in the X_2-generation. The mutant homozygotes appeared very often in too small numbers, for instance 14:2 in *albina*-5002, 12:2 in *albina*-5005 and 19:4 in *xantha*-5041. Occurrence of more than 25 per cent of recessive homozygotes, as 1:5 in *chlorina*-5040, was very rare. But the usual 3:1 ratio could be found in the successive generations of 35 of 45 chlorophyll mutant strains. Among the remaining 10 strains, such as *albina*-5008, -5012, *striata*-5057, *basi-viridis*-5059, the segregation did not fit the 3:1 ratio. Low germination ability of the mutant homozygotes in some strains (*striata*-5057, *basi-viridis*-5059) is partly responsible for their deficient numbers. In all investigated cases the mutation from dominant to recessive concerned single genes. But in some strains, such as *basi-viridis*-5077, *viridi-albina*-5072, *virdo-xantha*-5100 etc., *albina* and *striata* plants were segregated from the heterozygotes. A peculiar phenomenon was observed in *virido-xantha*-5100, namely the occurrence of 76 *virido-xantha*s, 9 *albina*s and 6 *striata*s besides 59 normal plants. These strains will be further investigated.

Viability was examined in 65 strains of several chlorophyll mutants, such as *albina chlorina, basi-viridis*, etc. Ability recover the chlorophyll content was mostly observed in bi-colored mutants, to such as *basi-viridis* and *virido-albina* and did not occur in uniformly colored ones, such as *chlorina, xantha* and *albina*. Neither could the *striata* mutant recover the chlorophyll content. The recovery occurred only when they were grown in the greenhouse or in the phytotron and was restricted in the field to the warm season. In most of the mutants, except *chlorina* and *striata*, occurred a more pronounced dilution of green color in the field during the winter months than at seedling stage and they all died out. But the time rate of chlorophyll content recovery was different

by the strain. Also differences within the same mutant type were observed, for instance in the recovery speed and viability. May be different steps in the genetic make-up of chlorophyll production are blocked in the various strains.

Chromosome pairing in F_1 hybrid plants between synthesized 6x-wheat and rye

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It is of interest to know whether or not there is any difference between F_1 hybrid plants (2n=28, ABDR) of conmon wheat × rye and of synthesized 6x-wheat × rye in regard to their meiotic behavior.

The F_1 hybrid plants used in this experiment were obtained from crosses between each of the five strains of synthesized 6x-wheat, ABD 1b, 2, 4, 5 (WIS No.1) and Sears', and the rye variety Petkuser. In comparison to the aforementioned hybrid plants, the F_1 hybrid plants between common wheat (*T. aestivum* var. *Sanshu-kochiku*) and rye were observed, too. One to three plants for each of the cross combinations were selected for observations, and three heads per plant were collected on different dates. Microsporocytes were studied at MI in order to record the chromosome configurations and their frequencies until observations of 100 MI cells had been recorded. The results obtained are presented in the following table.

The number of conjugated chromosomes at MI varies from 0 to 2 with mode of 0 for cross No. 1 and 2, from 0 to 3 with mode of 0 for cross No. 3 and 5, from 0 to 5 with mode of 1 for cross No. 4, and from 0 to 4 or 5 with mode of 0 for cross No. 6 (control).

According to their metaphase configurations the F_1 bybrid plants are classified into two groups : of those which consist of cross No. 1, 2 and 5, and of those which consist of cross No. 3, 4 and 6 (control), and there is statistically a significant difference between those two chromosome configuration types since no significant variation among heads of each plant and among plants of each cross number is observed with respect to the number of conjugated chromosomes and their frequency. However, it may well be said that there is no significant difference between the chromosome configuration types of the F_1 hybrid plants of synthesized 6x-wheat × rye and those of common wheat × rye because according to my previous studies on wheat-rye hybrids, there are many varieties of common wheat which show the some chromosome configuration type in the F_1 hybrid plants with rye as that in the F_1 hybrid plants of cross No. 1, 2 and 5.

In some microsporocytes of cross No. 3 and 6 (control), it is noticed that there is a tripartite or tetrapartite besides usual conjugated chromosomes. This kind of obser-

vations has been previousely mentioned in the reports on wheat-rye F_1 hybrids by many investigators. It is also of interest that a ring-shaped bivalent is found besides zero or one conjugated chromosome in some microsporocytes of cross No. 3, 4 and 6 (control). No certain relationships are found between the chromosome configuration types in the F_1 hybrid plants of the synthesized 6x-wheats with rye and the crossability between their parents.

In conclusion, it might be said that there are no significant differences between synthesized 6x-wheat and common wheat regarding chromosome pairing at MI of F_1 hybrid plants with rye.

Conjugated chromosome number at MI in PMC of the F_1 hybrid plants between synthesized 6x-wheat and rye

Cross No.	Combination	Plant No.	Head No.	Number of cells observed	Number of conjugated chromosomes						Average conj. chrom. per. cell	1 tripartite	1 tetrapartite
					0	1	2	3	4	5			
1	ABD1b × R	275-1	1	100	83	14	3	-	-	-	.20	-	-
			2	100	85	15	-	-	-	-	.15	-	-
			3	100	84	12	4	-	-	-	.20	-	-
			Sum	300	252	41	7	-	-	-	.18	-	-
			%		84.0	13.7	2.3	-	-	-	-	-	-
2	ABD 2 × R	272-1	1	100	87	12	1	-	-	-	.14	-	-
			2	100	82	16	2	-	-	-	.20	-	-
			3	100	76	22	2	-	-	-	.26	-	-
		272-2	1	100	94	5	1	-	-	-	.07	-	-
			2	100	92	6	2	-	-	-	.10	-	-
			3	100	91	9	-	-	-	-	.09	-	-
			Sum	600	522	70	8	-	-	-	.14	-	-
			%		87.0	11.7	1.3	-	-	-	-	-	-

3	ABD 4 × R	273-2	1	100	50	39	10*	1	-	-	.62	1	-
			2	100	45	39	13*	3	-	-	.74	3	1
			3	100	46	40*(5)**	11(1)	3	-	-	.71	2	-
			Sum	300	141	118*(5)	34*(1)	7	-	-	.69	6	1
			%		47.0	39.3	11.3	2.3	-	-		2.0	0.3
4	ABD 5 × R	270-1	1	100	34	32	21	10	1	-	1.80	-	-
			2	100	31	45	20	3	1	1	1.03	-	-
			3	100	32	34(5)	23(5)	7	2	1	1.14	-	-
			Sum	300	97	111(5)	64(5)	20	4	2	1.08	-	-
			%		32.3	39.0	21.3	6.7	1.3	0.7		-	-
5	ABD Sears' × R	269-1	1	100	73	19	5	3	-	-	.28	-	-
			2	100	89	9	2	-	-	-	.13	-	-
			3	100	91	8	1	-	-	-	.10	-	-
			Sum	300	253	36	8	3	-	-	.17	-	-
			%		84.3	12.0	2.7	1.0	-	-		-	-
6	*Sanshu-Kochiku* × R (control)	226-1	1	100	49	27	18	4	2	-	.83	-	-
			2	100	48	32	15(2)	3	1	1	.80	-	-
			3	100	47	35	14*	4	-	-	.75	1	-
		226-5	1	100	45	28	19	7	1	-	.91	-	-
			2	100	45	34*(1)	17*	3	-	1	.82	2	-
			3	100	50	31	17(2)	2	-	-	.71	-	-
		226-7	1	100	44	32	17	5	2	-	.89	-	-
			2	100	57	28	11	3	1	-	.63	-	-
			3	100	59	29(1)	7	5	-	-	.58	-	-
			Sum	900	444	276*(2)	135*(4)	36	7	2	.77	3	-
			%		49.3	36.2	15.0	4.0	0.8	0.2		1.0	-

* Counted a tripartite as one conjugated chromosome, a tetrapartite as two conjugated chromosomes, respectively.

** Numeral in parentheses shows number of cells in which a ring-shaped bivalent was observed.

Analysis of chromosome pairing in interspecific F_1 hybrids involving *Aegilops Juvenalis*

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A large number of interspecific and intergeneric hybrids involving *Aegilops* species were produced and cytologically investigated while the authors were on staff at the Cereal Breeding Laboratory, Winnipeg. The major objective was to determine the genome constitution of the hexaploid species. In 1958, Kihara, Yamashita and Tanaka published the results of their work in which the genomes of the three hexaploid species were designated.

The main purpose of this report is to present cytological data on several interspecific crosses with *Ae. juvenalis* which had not been studied previously. In all, 13 F_1 hybrids involving *Ae. juvenalis* were studied, of which 12 were new combinations. These hybrid plants were established through the use of an embryo culture technique.

The results of the study are presented in Table 1. These results support the earlier work of McGinnis (1956) who concluded that *Ae. juvenalis* has the C^u and D genomes. The data were inconclusive with respect to the third genome which Kihara *et al.* have designated as the M^t.

The cross between *Ae. juvenalis* and *Ae. Aucheri* bears speical mention. Multivalents were extremely prevalent, and associations of up to eleven were observed. Similarly the cross with *Ae. crassa* produced a high frequency of multivalents with associations of up to nine chromosomes. These crosses should be studied more intensively to determine the reason for the high multivalent formation.

Table 1. Mean pairing of chromosomes in hybrids involving *Aegilops juvenalis*

Ae. juvenalis ×	Uni-valents	Closed bivalents	Open bivalents	Total pairs	Tri-valents	Quadri-valents	Higher multiv.(max)	Total biv. assoc. per cell	No. of cells exam.
Ae. caudata (C)	14.70	.08	4.88	4.96	.99	.11	.00 (C^{IV})	6.16	200
„ *umbellulata* (C^u)	6.39	4.46	3.59	8.05	1.42	.28	.03 (C^{VI})	10.09	200
„ *squarrosa* (D)	11.73	2.13	4.42	6.55	0.92	.10	.00 -	7.67	200
„ *uniaristata* (M^u)	18.50	.02	2.80	2.82	1.15	.08	.02 (C^V)	4.17	200
„ *mutica* (M^t)	14.21	.08	4.66	4.74	1.08	.25	.02 (C^V)	6.34	200
„ *Aucheri* (S)	8.32	.20	3.38	3.58	1.89	.84	.62 (C^{XI})	8.71	200
„ *speltoides* (S)	10.24	.92	4.60	5.52	1.57	.40	.08 (C^V)	8.04	200
„ *longissima* (S^l)	15.86	.08	3.23	3.31	1.28	.36	.01 (C^V)	5.30	200
„ *sharonensis* (S^l)	13.14	.42	4.17	4.59	1.40	.35	.03 (C^{VI})	6.75	200
„ *cylindrica* (CD)	14.35	1.09	5.97	7.06	1.53	.39	.11 (C^{VII})	9.53	200
„ *columnaris* (C^uM^c)	12.95	3.57	4.24	7.81	1.79	.22	.04 (C^{VI})	10.12	200
„ *triuncialis* (CC^a)	12.94	2.27	5.37	7.64	1.70	.34	.02 (C^{VII})	10.18	130
„ *crassa* (DDM^{cr})	14.05	5.38	3.52	8.90	2.01	.59	.28 (C^{IX})	12.82	200

Analysis of chromosome pairing in interspecific and intergeneric F_1 hybrids involving hexaploid *Aegilops crassa*

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In 1957 when both authors were on staff of the Cereal Breeding Laboratory, Winnipeg, a program was conducted to attempt to determine the genome constitution of *Aegilops crassa* (6x). A total of 10 interspecific and 3 intergeneric F_1 hybrids were produced with the aid of an embryo culture technique. Most of these were new combinations and it is primarily for this reason that the present results are being reported.

The F_1 hybrids were examined cytologically to determine chromosome pairing. The pairing frequencies are presented in Table 1.

In 1958, KIHARA *et al.* concluded that the three genomes of *Ae. crassa* are DDM^{CR}. Thus is any hybrid with this species, approximately 7 bivalents should be formed by pairing of the chromosomes of the two D genomes. In 12 of the above 13 crosses, sufficient pairing was observed to conclude that *Ae. crassa* is partly autoploid. However in the crosses with *Ae. squarrosa* and *T. aestivum*, where a third D genome is present in the hybrid, a high numder of trivalents would be expected. This was not observed in the present study indicating that the genome constitution may be somewhat more complex than previously suggested.

The pairing in the hybrid with *T. durum* was remarkably low, only 1.05 bivalents per cell. Perhaps in *T. durum* there is a much more effective diploidizing gene than in the other species used in the study, which prevented the expression of the true degree of homology.

Table 1. Frequencies of bivalents and higher associations of chromosomes in hybrids involving *Aegilops crassa*

Ae. crasse ×	Univalents	Closed bivalents	Open bivalents	Total pairs	Trivalents	Quadrivalents	Higher multiv.(max)	Total biv. assoc. per cell	No. of cells exam.
Ae. caudata (C)	13.28	2.02	4.05	6.07	.76	.05	.01 (C^{V})	6.96	166
„ *squarrosa* (CD)	10.21	4.42	2.61	7.03	1.03	.24	.03 (C^{VI})	8.37	100
„ *cylindrica* (CD)	13.12	3.73	4.39	8.12	1.42	.32	.02 (C^{V})	10.22	100
„ *umbellulata* (C^{u})	13.94	1.46	4.06	5.52	.81	.09	.03 (C^{VI})	6.84	200
„ *variabilis* ($C^{u}S^{v}$)	19.67	1.50	4.29	5.79	.98	.17	.03 (C^{VI})	7.12	200
„ *ventricosa* (DM^{v})	16.56	2.74	4.26	7.00	1.60	.14	.02 (C^{V})	8.92	200
„ *sharonensis* (S^{l})	10.88	2.34	4.44	6.78	.94	.15	.04 (C^{V})	8.08	200
„ *Aucheri* (S)	10.57	3.32	2.54	5.86	1.11	.36	.18 (C^{VII})	8.10	200
„ *speltoides* (S)	8.00	3.42	3.05	6.47	1.42	.38	.08 (C^{V})	8.81	24
„ *mutica* (M^{b})	11.14	2.28	3.58	5.86	1.30	.60	.04 (C^{V})	7.74	50
T. aestivum (ABD)	24.53	2.24	4.22	6.45	1.31	.12	.02 (C^{VI})	8.03	200
T. durum (AB)	32.91	0.00	1.05	1.05	0.00	.00	.00	1.05	200
H. villosa (V)	14.20	1.86	3.86	5.72	.73	.01	.00	7.46	200

Correlation between the frequency of trisomics and seed weight in rye trisomics

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In barley trisomics the transmission rates of the extra chromosome were higher in the smaller seeds than in the larger ones (RAMAGE 1955). TSUCHIYA (1960) also obtained the same result in barley trisomics. According to EINSET (1943) there is a correlation between the chromosome length and the transmisson rate in maize trisomics. The trisomic possessing larger chromosome showed a higher frequency of trisomics in their progenies than in shorter chromosome. In *Datura* there is, however, no relation between the transmission rate and the chromosome length (BLAKESLEE and AVERY 1938). In *Matthiola* trisomics (FROST 1919) it is probable that the higher frequency of transmission of the extra chromosome is associated with the higher percentage of seed germination.

In rye trisomics chromosome length and germination percentage seem not to be correlated with the transmission rate of the extra chromosome. Each trisomic has the different extra chromosome in length.

In order to check the correlation between the transmission rate of the extra chromosome and seed weight, the seed of four types out of seven primary trisomics, that is *Feeble*, *Pseudonormal*, *Semi-stout* and *Dwarf* were classified into two groups by their weight. In both groups of each type, twenty seeds were utilized and sown individually. The germinated plants were examined by chromosome counting.

In *Feeble* the average weight of lighter seeds is 8.7 m gr. and 14.2 m gr. for heavier grains. Those of the other three types are like as *Feeble*. From the data presented in table it is apparent that there is significant correlation between the transmission rate and seed weight. The frequency of the trisomics from lighter grains was conspicuously higher than from heavier seeds. In *Dwarf* the lighter seeds produced 90 percent of trisomics, whereas no trisomic plant was found from heavier seeds at all. The results from lighter seeds showed a variation from 46.7 percent in *Pseudonormal* to 90 percent in *Dwarf*, while 0 percent in *Dwarf* to 10.5 percent in both *Feeble* and *Pseudonormal* from heavier grains.

From a random sample the frequencies of trisomics were 13.9 percent in *Feeble*, 29.3 in *Pseudonormal*, 13.6 in *Semi-stout* and 20.7 in *Dwarf*, respectively.

This tendency of an increased frequency of trisomics from lighter seeds enable the selection of a higher percentage of trisomics than from random sample.

The frequency of the trisomics from the different group

Types	*Feeble*		*Pseudonormal*		*Semi-stout*		*Dwarf*	
Seed weight	lighter	heavier	lighter	lighter	lighter	heavier	lighter	heavier
	5.0-11.0 (8.7)* (m gr)	11.5-16.5 (14.2)	9.0-16.8 (13. 3)	17.0-26.0 (21.3)	12.0-27.5 (20.4)	28.5-45.0 (36.7)	11.5-18.5 (15.5)	24.8-33.0 (28.3)
No. of plants examined	15 (75.0)	19 (95.0)	15 (75.0)	19 (95.0)	19 (95.0)	20 (100.0)	20 (100.0)	20 (100.0)
Trisomics	10 (66.7)	2 (10.5)	7 (46.7)	2 (10.5)	9 (47.4)	1 (5.0)	18 (90.0)	0
14 + f**	1 (6.7)	1 (5.3)	0	1 (5.3)	0	0	0	0

* average

** fragment chromosome

Chromosome pairing in the F_1 hybrid plants between *Triticale* No. 17 (8x) and *Agrapyron glaucum* (6x)

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From the cross of *Triticale* No. 17 (2n=56, AABBDDRR) with *Agropyron glaucum* ROEM. et SCHULT. (2n=42, BBEEFF?[1]), two hybrid plants (2n=49) were obtained. It seems likely that no F_1 hybrid plants with ABDRBEF genomes have been cytologically investigated before though there have been many reports of cytological observations on F_1 hybrid plants between *Ag. glaucnm* and a species of *Triticinae*. Thus, meiotic behavior of the plants was studied. The chromosome configurations and their frequency at MI in PMC's of the F_1 were summarized in the following table.

Chromosome configerations and their frequency at MI in PMC's of the F plant between *Tc.* No. 17 and *Ag. glaucnm*

Chromosome configuration	Frequency	
$0_{II}+\ 49_I$	1	
$1_{II}+\ 47_I$	-	
$2_{II}+\ 45_I$	2	
$3_{II}+\ 43_I$	2	
$4_{II}+\ 41_I$	9	
$5_{II}+\ 39_I$	19*	22
$1_{III}+\ 4_{II}+\ 38_I$	3	
$6_{II}+\ 37_I$	15	
$7_{II}+\ 35_I$	11	12
$1_{III}+\ 6_{II}+\ 34_I$	1	
$8_{II}+\ 33_I$	5	
No. of cells observed	68	

* 1 cell had two ring-shaped bivalents.

The number of conjugated chromosomes varies from 0 to 8 with mode of 5, and few cells of PMC's examined had a trivalent. Out of 68 cells, only one cell of the class with $5_{II}+3_{9I}$ had two ring-shaped bivalents besides rod-shaped bivalents and univalents, and all the rest cells had rod-shaped bivalents and univalents.

According to the previous workers, it is suggested that wheat within Dinkel group and *Ag. glaucum* have at least one genome, probably B genome, in common. However, from only the aforementioned result, it is impossible to know definitely whether those conjugated chromosomes were of B genome or not.

The hybrid plants were perennial, completely sterile and seemed to be less valuable as the breeding material for fodder plants. But, it is quite interest that the perennial, character of *Ag. glaucum* is epistatic to the annual of both wheat (ABD) and rye (R) even when they are together in a plant.

1/ Suggested by Matsumura (1949)

Male sterility interaction of the *Triticum aestivum* nucleus and *Triticum timopheevi cytoplasm* [1]

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Cytoplasmic male sterility in backcross derivatives of common wheat having *Aegilops caudata* L. and *Aegilops ovata* L. cytoplasm has stimulated interest in other species of Hordeae. Work has been done along this line involving various species. Kihara[3] indicated that substituting *Triticum dicoccum* Schrank. nucleus into *T. timopheevi* Zhukov. cytoplasm resulted in male and female fertility.

We used *T. timopheevi* as the female parent in greenhouse crosses to *T. aestivum* L., 'Bison', C. I. 12518. Bison was used recurrently as the male parent in subsequent backcrosses.

Slight pollen fertility was expressed in the F_1, *T. timopheevi* × Bison, and BC_1, *T. timopheevi* × Bison[2]. Of five BC_1 plants, one showing partial pollen fertility was used as the female in the second backcross. All 10 BC_2 plants, *T. timopheevi* × Bison[3] were pollen sterile. One of the pollen sterile BC_2 plants looked quite like the recurrent parent, Bison. Six of the 10 BC_2 plants were backcrossed again to Bison. From these backcrosses, six BC_3 families, *T. timopheevi* × Bison[4], consisting of 20 plants were grown out. All 20 plants were male sterile.

At least two families in the BC_3 were meiotically unstable. Chromosome observations on a family that appeared Bison-like indicated that they were stable meiotically and at the hexaploid chromosome number level.

In the BC_4, *T. timopheevi* × Bison[5], 17 of 19 plants in five families again were pollen sterile. The two plants shedding pollen came from the family of greatest meiotic instability in the BC_3 but doubtfully were segregates carrying pollen-restoring genes from *T. timopheevi*. More likely they were rogues coming from a mechanical mixture.

Male sterility in the hexaploid lines was characterized by shriveled and curved anthers with aborted pollen. The appearance of the antenrs was very similar to those observed in male-sterile varieties with *Ae. ovata* cytoplasm. Seed was obtained easily on these lines during backcrossing.

1 Contribution No. 168, Ft. Hays Branch Station.

2 Now Wheat Research leader, Dekalb Agricultural Association; lubbock, Texas.

3 Kihara, H. Fertility and morphological variation in the substitution and restoration backcrosses of the hybrids, *Triticun vulgare* × *Aegilops caudata*. *In* Proc. 10th Int. Cong. Gen. 1958. University of Toronto Press. Toronto, Canada. p. 166. 1959.

An X-ray induced awned mutant in Thatcher wheat[1]

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A fully awned plant was found in the second cycle of a recurrently X-irradiated population of awnless Thatcher wheat (*Triticm vulgare*). This mutant differs phenotypically from its progenitor in that it is fully awned (approximately 50-70 mm in length) from the apex to the base of the spike, and the beaks of all outer glumes have an awned extension approximately 15-25 mm in length.

Seed from the mutant was increased in Mexico during the winter of 1960-61. Preliminary tests of the agronomic characters of the mutant and parental types were made in rod-row trials at St. Paul, Minn. in 1961 (Table 1). In addition, milling and baking quality tests were conducted by the Department of Agricultural Biochemistry of the University of Minnesota (Table 2).

Table 1. Agronomic characteristics of Thatcher wheat and the derived awned mutant

Variety	Heading date	Mature date	Height inches	Lodging class*	Leaf rust%	Bu. wt. Lbs.	Yield Bu./A.
Thatcher (Awnless)	6/28	7/28	33	1.0	80	59.9	20.9
Thatcher (Awned)	6/28	7/28	34	1.0	80	59.0	20.3

*1.0 - erect

From these data it is clear that, for all the characters examined except awning and mixing time, the lines are indistinguishable. Whether one mutational event determines both these traits is not known; however, in all agronomic characters, except awning, the lines appear to be identical and, therefore, may be isogenic. Because awning in *T. vulgare* is known to be governed by two allelic series and several suppressor and modifying genes, studies will be set up with a nullisomic series to determine if the induced mutant is at the same locus as a naturally occurring gene for awn development.

A small quantity of seeds of the mutant, and the Thatcher selection from which it was derived, are available for distribution to breeders and geneticists.

Table 2. Milling and baking quality characteristics of Thatcher wheat and the derived awned mutant

Variety	Pearling Index	Flour Yield %	Milling Char.	Wheat Protein %	Flour Protein %	Flour Absorp. %	Mixing Time sec.	Dough Qual.	Loaf Vol. cc.	Loaf Type Score*	Crumb Tex.	Score* Grain	Color	Bread Cal. Score	Gen Bread Rating
Thatcher (Awnless)	26.4	70	Fair	14.0	13.5	64	135	Good	862	7.9	8.0	7.7	8.0	98	Very Good
Thatcher (Awned)	26.6	70	Fair	14.7	14.2	65	210	Good	885	8.0	8.5	8.1	8.0	101	Very Good

*Score : 1-10 ; 10 very good

[1] Cooperative investigations, the University of Minnesota Agricultural Experiment Station, Crop Research Division, ARS, USDA, and the University of Idaho. This work was conducted under Contract No. AT(11-1)-332 between the University of Minnesota and the U. S. Atomic Energy Commission.

II. Editorial Remarks

2nd International Wheat Genetics Symposium

The 2nd International Wheat Genetics Symposium is now under arrangement in hands of Dr. J. Mac Key and the members of the organizing committee. It has been tentatively set that the symposium will be held in Lund-Svaloef in August 19-24, 1963. Thus there will be one week between the symposium and the genetics congress in Hague-Scheveningen in September 2 - 12, 1963.

Announcement for further issues

WIS Nos. 15 and 16 will be published during the fiscal year from April 1962 to March 1963. Manuscripts for those issues are accepted any time, and they will go to press in sequence as soon as they cover the planned pages of each number. WIS is open to all contributions regarding methods, materials and stocks, ideas and research results related to genetics and cytology of *Triticum, Aegilops, Agropyron, Secale* and *Haynaldia.*

The manuscripts should not exceed 3 printed pages. List of stocks is exempted from this page limit. No illustrations are accepted for this publication.

Communications regarding editorial matters should be addressed to:

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The Managing Editor

THE 2ND INTERNATIONAL WHEAT GENETICS SYMPOSIUM
in Lund-Svalöf, Sweden.
August 19-24. 1963.

Organizing Committee: B. C. Jenkins, Canada (Chairman), A. T. Pugsley, Australia, R. Riley, Great Britain, E. R. Sears, U. S. A., K. Yamashita, Japan, and J. Mac Key, Sweden (Secretary).

Participation: 150-200 participants are expected to attend the symposium.

Language: The language of the symposium will be English.

Demonstrations: A field display of living material will unfortunately not be possible to arrange due to the late time in the season of the symposium. This incident is dependent on the desirability to have the symposium close to the congress of genetics and the decision to hold the latter as late in the season as September 2-12. To some extent a display of material brought together by different specialists could compensate for living material. Everybody interested is thus asked to send material in due time in 1963 for a minor exhibition. Participation in this way should as soon as possible be announced to the secretary. Already this summer may be valuable for the collection of display material!

Tentative program.

August 19, Monday.

Morning Opening remarks and address of welcome.
SESSION I. **Wheat quality.**
F. J. R. Hird (Australia): Wheat quality in relation to chemical bonds.
O. Hall (Sweden): Electrophoretic parameters on wheat quality.
J. C. Grosskreutz (USA): Microphysical structure of wheat protein.

Afternoon Conducted tour of agricultural areas and historical sites near Lund and a visit to Weibullsholm Plant Breeding Institute, Landskrona.

Evening Dinner at Strandpaviljongen, Landskrona. Address by Dr. F. Fajersson (Sweden): Methods and achievements in Swedish wheat breeding.

August 20, Tuesday.

Morning SESSION II. **Plant breeding methods.**
A. Vincent (France): Quantitative inheritance and selection for yield.
S. Borojevic (Yugoslavia): Combining ability in wheat crosses.

C. F. Konzak (USA): Physical and chemical mutagenesis in wheat breeding.
R. E. Scossiroli (Italy): Wheat mutagenesis in quantitative traits.

Afternoon SESSION III. **Disease resistance in wheat.**
P. Zhukovsky (USSR): Natural sources of disease resistance in wheat.
A. T. Pugsley (Australia): The genetics and exploitation of resistance to mildew and take-all.
E. E. Sebesta (USA): Wheat viruses and their genetic control.
W. Q. Loegering (USA): The relationship between host and pathogen in wheat rust.

Evening SESSION III (continued).
R. C. F. Macer (Great Britain): The formal and aneuploid genetic analysis of stripe rust resistance.
R. G. Anderson (Canada): The inheritance of leaf rust resistance in wheat.
D. R. Knott (Canada): The inheritance of stem rust resistance in wheat.

August 21, Wednesday.

Morning SESSION IV. **Wheat taxonomy and phylogeny.**
D. Zohary (Israel): The evolution of genomes in ***Aegilops*** and ***Triticum.***
Y. Cauderon (France): The genome constitution of ***Agropyron.***
M. M. Jakubziner (USSR): Modern Russian aspects on the systematics of wheat.
J. Mac Key (Sweden): Species relationship in ***Triticum.***

Afternoon Tour of the Swedish Seed Association, Svalöf.

Evening Dinner at Svalöf Hotel, Svalöf. Address by Dr. K. Yamashita (Japan): Collections of wheat and wheat relatives in the near East.

August 22, Thursday.

Morning SESSION V. **Amphiploids and addition to wheat of characters from related genera.**
V. Pissarev (USSR): ***Triticale*** amphidiploids.
B. C. Jenkins (USA): Rye substitutions and additions.
H. Kihara (Japan): Chromosome and nuclear substitutions involving wheat and ***Aegilops.***
A. Wienhues-Ohlendorf (Germany): ***Agropyron*** additions to wheat

Afternoon SESSION VI. **Aneuploidy in wheat genetics.**
R. I. Larson (Canada): Monosomic analysis of quantitative characters.
J. Kuspira (Canada): Reciprocal intervarietal chromosome substitution lines.
E. R. Sears and M. Okamoto (USA and Japan): Telocentrics in common and durum wheats.
M. Norohna-Wagner (Portugal): Aneuploids in durum wheat.

Evening Free.

August 23, Friday.

Morning SESSION VII. **Cytogenetic structure of wheat.**
R. Riley (Great Britain): The regulation of chromosome behaviour and the cytogenetic structure of wheat and its relatives,
M. Okamoto (Japan): Studies on the chromosome 5B effect.
M. S. Swaminathan (India): Mutational analysis of the hexaploid wheat complex.
J. G. T. Hermsen (Holland): Genetics of complementary necrosis.

Afternoon SESSION VIII. **Presentation of short papers of various topics.**
The program of this session will be settled first in the beginning of 1963. About ten lectures with a duration of 10 - 15 minutes each can be included.

Evening Closing banquet at Akademiska Föreningen, Lund. Address by Dr. S. G. Stephens (USA): Evolution in polyploid crop plants.

August 24, Saturday.

Morning BUSINESS SESSION.
This session will include a short report from the Stock Preservation Committee by E. C. Heyne (USA).

The symposium ends at noon time.