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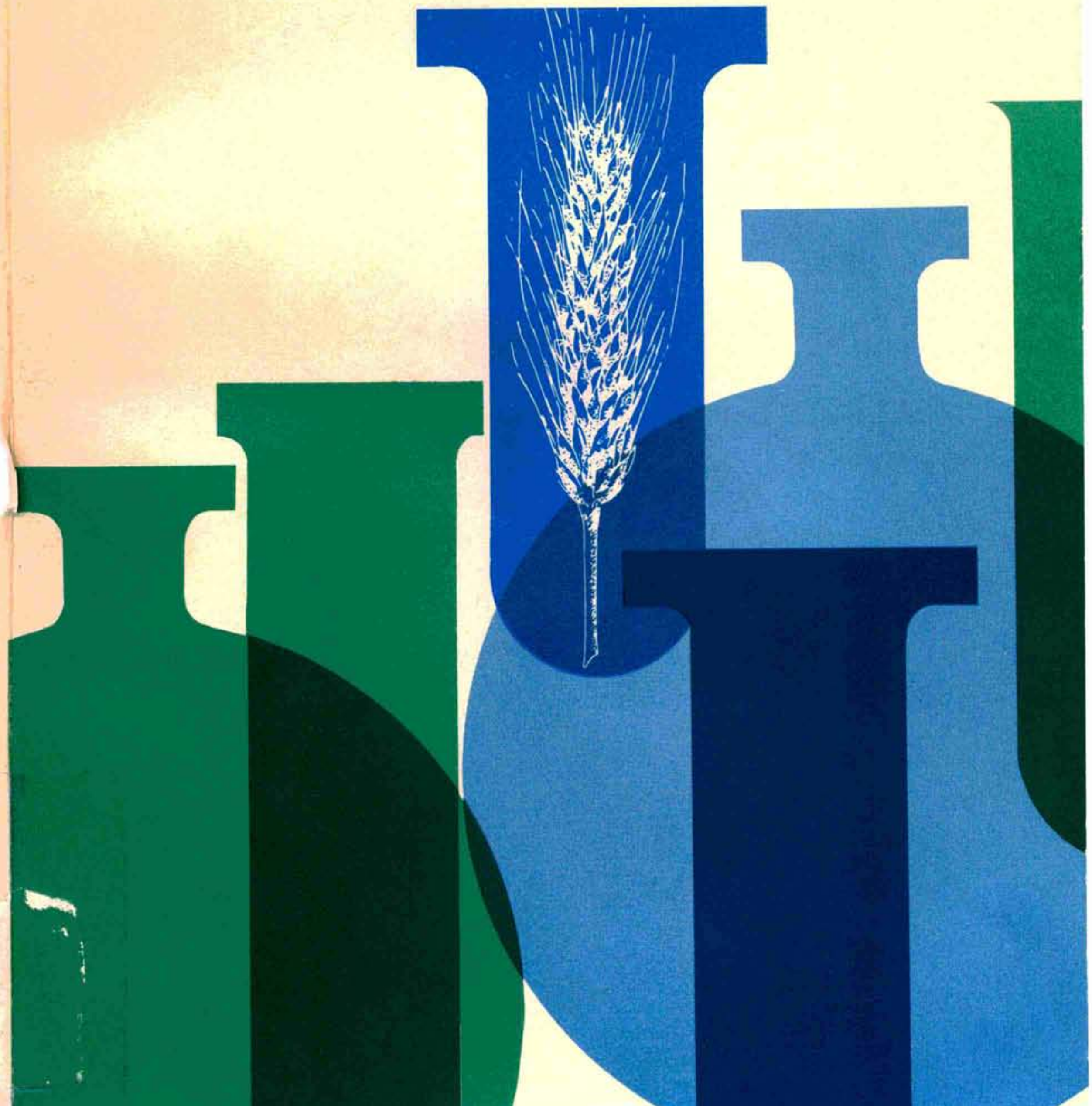
Editors: Reginald MacIntyre/Marilyn Campbell



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This symposium was co-sponsored by the Centro Internacional de Mejoramiento de Maiz y Trigo, the University of Manitoba, and the International Development Research Centre.

*The views expressed in this publication are those of the individual author(s) and do not necessarily represent the views of the International Development Research Centre.

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Contents

Use of Chromosome Analysis to Detect Favourable Combinations from Octoploid × Hexaploid Crosses

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DE SOSA, M. H. 1974. Use of chromosome analysis to detect favourable combinations from octoploid × hexaploid crosses, p. 173–180. *In* Triticale: proceedings of an international symposium, El Batan, Mexico, 1–3 October 1973. Int. Develop. Res. Centre Monogr. IDRC–024e.

Abstract In 1973, an octoploid triticale line (FW 121 × Prolific rye) from the University of Manitoba was crossed with a hexaploid triticale (Cinnamon) from CIMMYT and a chromosome analysis was made on both parents as well as their offspring from F_1 to F_4. Results showed that the octoploid line had one of the lowest percentages of aneuploidy so far reported; that in spite of a high frequency of univalents, the hexaploid triticale showed a high fertility; and that the high yield in F_1 plants, the rapid decrease of the univalents number in F_2 to F_4 generations as well as the clear tendency toward the hexaploid level, could have been the result of the continuous search for plants with phenotypes resembling those of hexaploid lines.

Résumé Un triticale octoploïde (FW 121 × seigle Prolific), de l'Université du Manitoba, a été croisé en 1973 avec un triticale hexaploïde (Cinnamon) du CIMMYT, et l'on a procédé ensuite à une analyse chromosomique des deux parents et des générations F_1 à F_4. Les résultats ont démontré: que la lignée octoploïde avait l'un des pourcentages d'aneuploïdée les plus faibles que l'on ait signalé jusqu'ici; qu'en dépit d'une fréquence élevée en monovalents, les triticales hexaploïdes faisaient preuve d'une grande fertilité; que le rendement élevé des plants F_1, la diminution rapide du nombre de monovalents dans les générations F_2 à F_4 et la tendance très nette vers l'hexaploïdie, pourraient bien être le résultat de la quête permanente de plants dotés de phénotypes ressemblant à ceux des lignées hexaploïdes.

ALMOST 10 years ago, the University of Manitoba and CIMMYT established a cooperative program in triticale. During the summer of 1972, cytological studies in some triticale lines were started in CIMMYT laboratories. Besides the routine work, such as the identification of the chromosome complement and determination of the frequency of aneuploids in some octoploid and hexaploid lines, in February of 1973 we decided to make a chromosome analysis in offspring derived from crosses between octoploid and hexaploid triticale, in the hope that cytological studies will help plant breeders in the selection of lines with a high chromosomic stability.

An octoploid triticale line (FW 121 × Prolific rye) from the University of Manitoba was crossed with a hexaploid triticale

(Cinnamon) from CIMMYT and both parents as well as their offspring from F_1 to F_4 were analyzed.

Mitosis

The results of mitotic analysis are shown in Table 1. Plants derived from the octoploid triticale line showed 84.8% euploidy, 13.6% hipoploidy, and 1.51% hyperploidy. The frequency on euploid plants from this octoploid parent was higher than the frequency given to other lines by different authors.

The hexaploid line (Cinnamon) produced 90% euploid plants, 6% hipoploid plants, and 4% hyperploid plants. The chromosome number in F_1 plants ranged from 45 to 50. However, 66.7% of the population showed 49 chromosomes. As seen in Table 1, plants belonging to F_2, F_3, and F_4 generations showed a clear tendency to the hexaploid level.

Meiosis

Meiotic observations were made in randomly sampled plants. The octoploid parent generally showed 28_{II} during diakinesis (Fig. 1). However, the frequency of univalents per cell in metaphase-I ranged from 1 to 4 with a mean value of 1.5.

The hexaploid parent showed an acceptable chromosome pairing during metaphase-I (M-I) (Fig. 2) as well as a normal chromosome separation during anaphase-I (A-I) (Fig. 3). The mean frequency of univalents per cell was not higher than 1.1 (Table 2). At first glance, and even without statistical analysis, it is clear from the results shown in Table 2 that there is considerable difference among the mean univalent values in F_1 to F_4.

In F_1 plants, some meiotic disturbances, such as the formation of a higher number of univalents than expected, were found (Fig. 4 and 5). Laggards (Fig. 6) and micronuclei were not uncommon. In F_2, the chromosome

FIG. 1. Diakinesis in 8x line showing 28_{II}. 800×.

TABLE 1. Variation in somatic chromosome number in octoploid and hexaploid triticale and in their F_1, F_2, F_3, and F_4 offspring.

Material	Germination ability (%)	No. analyzed plants	Frequency (%) of plants with the following no. chromosomes: 40	41	42	43	44	45	46	47	48	49	50	51	54	55	56	57
8x from U of M	85	66											1.52	3.03	6.06	3.03	84.84	1.52
6x Cinnamon	92	50		6.0	90.0	4.0												
F_1 plants	80	78						2.56	5.13	6.41	16.67	66.67	2.56					
F_2 plants	82	49	6.12	6.12	49.00	10.20	10.20	4.08	6.12	4.08			4.08					
F_3 plants	74	72	1.39	20.83	68.05	2.78	4.17	1.39	1.39									
F_4 plants	70	47		8.51	80.85	6.38	2.13	2.13										

TABLE 2. Univalents at metaphase-I in octoploid and hexaploid triticale and in their F_1, F_2, F_3, and F_4 offspring.

Material	No. analyzed plants	No. PMC	Univalents: 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	18	$\bar{x}$
8x Tcl. (from U of M)	2	167		108	46		13												1.5
6x Tcl. (Cinnamon)	2	118	64		41		13												1.1
F_1 plants	6	360				1	55	64	57	91	23	44	11	8	1	4	2	1	7.1
F_2 plants	2	478			108		110		108		102		50						5.4
F_3 plants	2	244	175		51		18		1										0.71
F_4 plants	2	280	251		22	2	7												0.25

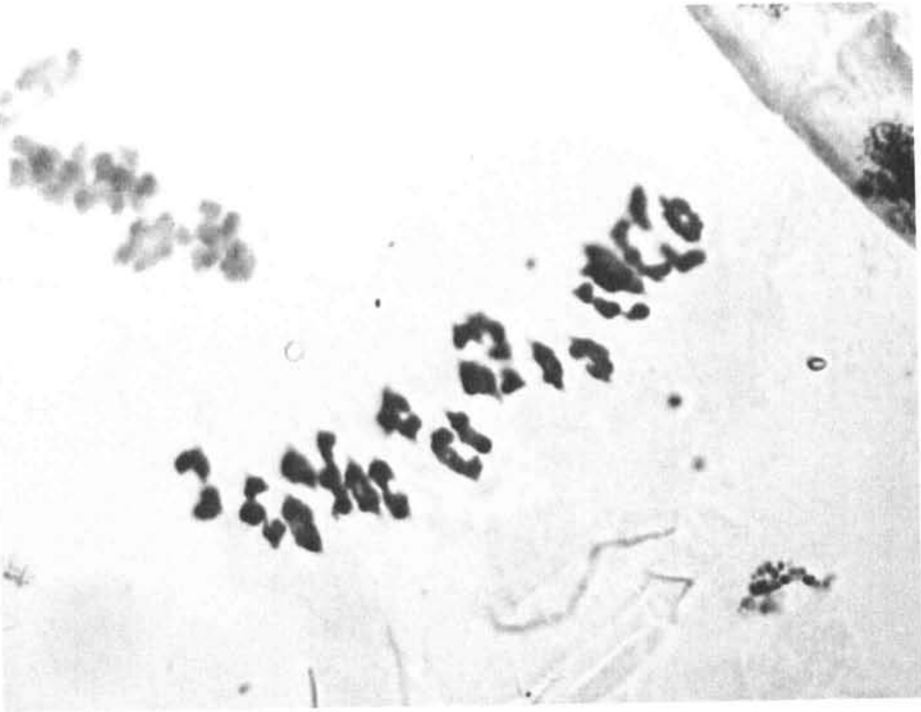

FIG. 2. Metaphase-I in 6x parent showing 21_{II}. 500×.

FIG. 3. Anaphase-I in 6x parent showing 21 chromosomes in each pole. 800×.

complement was not the same for the two analyzed plants. The first one was shown to have a chromosome complement of 45. However, the chromosome formula in the next two PMC were not the same, even though they belonged to the same author (Fig. 7 and 8). The second plant had 42 chromosomes with a normal separation during A-I (Fig. 9). Generally speaking, the chromosome behaviour in F_3 and in F_4 plants was normal.

Fertility

Fertility was measured by the number of seeds per spikelet (Table 3). The F_1 values for the number of seeds per spikelet and the number of spikelets per spike was less than between parents' values. In further generations, that is to say from F_2 to F_4, the values for these two characters did not show any consistent tendency to an increase or decrease. However, it was really unusual to have found a 2.25 seed per spikelet value in F_1 plants.

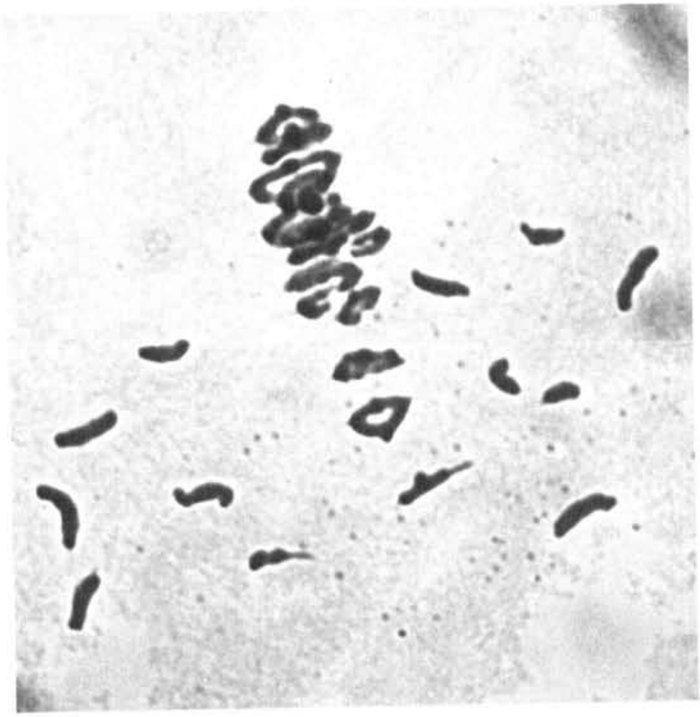

FIG. 4. Metaphase-I in F_1 plant showing at least 13_I. 800×.

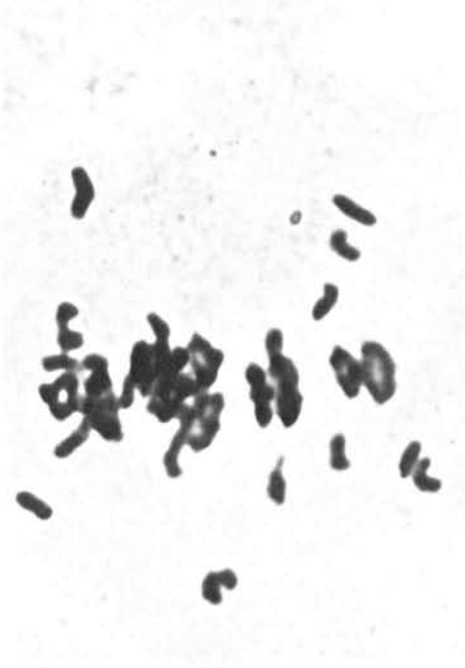

FIG. 5. Metaphase-I in F_1 plant showing 10 univalents out of the plate. 500×.

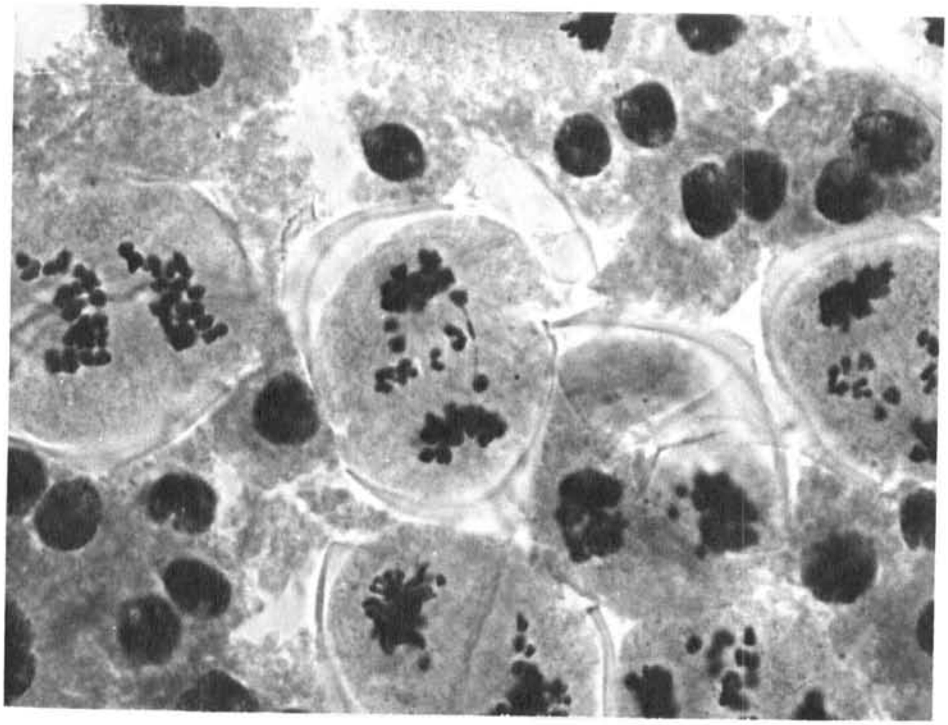

FIG. 6. Telophase-I in F_1 plant showing some laggards. 500×.

FIG. 7. Metaphase-I in F_2 plant showing $22_{II} + 1_I$. 800×.

FIG. 8. Metaphase-I in the same F_2 plant showing $21_{II} + 3_I$. 800×.

FIG. 9. F_2 plant with $2n=42$ showed an Anaphase-I with 21 chromosomes in each pole. 800×.

TABLE 3. Fertility and number of spikelets in octoploid and hexaploid triticale and in their F_1, F_2, F_3, and F_4 offspring.

Material	8x Tcl. (from U of M)	6x Tcl. (Cinnamon)	Plants			
			F_1	F_2	F_3	F_4
Spikelets/spike	22.7	17.8	18.9	21.7	20.0	20.0
Seeds/spikelet	1.88	2.78	2.25	1.81	2.25	2.50

Conclusions

The following points should be stressed:

(1) The octoploid line from the University of Manitoba showed one of the lowest percentages (15) of aneuploidy so far reported. The frequency of univalents in M-1 was in accordance with the value given to other octoploid lines.

(2) In spite of a high frequency of univalents, our hexaploid triticale showed a high fertility.

(3) The high yield in F_1 plants, the rapid decrease of the univalents' number in F_2 to F_4 generations, as well as the clear tendency toward the hexaploid level, could have been the result of the continuous search for plants with phenotypes resembling those of hexaploid lines.