14. KERR, M. and M. RASHAD. Chromosome studies on spontaneous abortions. *Am. J. Obstet. Gynecol.* 94:322–339. 1966.
15. LUTHARDT, F.W., C.G. PALMER, and P
and univalent frequencies in aging female mice
Genet. 12:68–79. 1973.
16. MAGENIS, R.E., F. HECHT, and S. MILI
(D_1) syndrome: studies on parental age, sex ra
J. Pediat. 73:222–228. 1968.
17. MCFEELY, R.A. Chromosome abnormalities in early embryos of the pig. *J. Reprod. Fert.* 13:579–581. 1967.
18. PARSONS, P.A. Parental age and the offspring. *Quart. Rev. Biol.* 39:258–275. 1964.
19. SMITH, J.H. and T.J. MARLOWE. A chromosomal analysis of 25-day-old pig embryos. *Cytogenetics* 10:385–391. 1971.
B. Effect of maternal age on reproductive
bstet. *Gynecol.* 102:451–477. 1968.
.L. KROHN. Effect of maternal age on the
und on the ability of the uterus to support
ec. 151:424. 1965.
M. and J. LEV, Statistical Inference. Henry Holt and Co., New York. p. 424. 1953.
23. YAMOMOTO, M., A. ENDO, and G. WATANABE. Maternal age dependence of chromosome anomalies. *Nature New Biol.* 241:141–142. 1973.

Genetic sectoring in F_3 progeny of a *Triticum* pentaploid

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NORMAL nuclear divisions in exceptional cases may spontaneously or by induction generate cells with double the somatic number. Thus, somatic polyploidy provides for chromosome reduplication and autonomous chromatid separation at late prophase with the remaining mitotic events eliminated. Geitler[7] termed the phenomena endomitosis; related terminology includes DNA endoreduplication, nuclear restitution, and polyteny[10]. Polyteny, however, involves chromosome reduplication without the additional sister chromatid separation, and creates cell types that maintain the basic somatic chromosome number but possess multistranded chromosomes. Multistranded chromosomes have been observed in the Gramineae where, in subsequent cell divisions, centromere splitting occurred more precociously in *Hordeum* and *Triticum* species than in *Secale* species[2].

Mixoploidy, a result of cell populations carrying a varied somatic chromosome number, may progress in tissues to yield mosaics or chimaeras. We report such chromosome sectoring in a *Triticum* species progeny derived from its pentaploid series ($2n = 4x = 28 \times 2n = 6x = 42$). This spontaneous occurrence may explain the induction of F_1 fertility in intergeneric hybrids developed by post-fertilization paternal DNA insertion, and subsequent elimination[4,5].

Materials and Methods

Natural outcrossing between a self-sterile *Triticum durum* ($2n = 4x = 28$, AABB) and *Triticum aestivum* ($2n = 6x = 42$, AABBDD) produced the pentaploid *Triticum* series ($2n = 5x = 35$, AABBD). Subsequent generation advance formed the F_3 seed utilized in this analysis. The variations in chromsosome numbers were from $2n = 4x = 28$ to $2n = 6x = 42$. One derived F_3 progeny yielded four plants with somatic counts of 40,40,41, and 40/80 sectored. The sectored 40/80 chromosome plant is reported here. The mitotic schedule of Mujeeb et al. (unpublished) was followed for somatic studies. Meiotic squashes were prepared from three spikelets sampled individually from each of the four tillers produced. Spikelets were fixed in acetic acid-alcohol (1:3) and stained by 2 percent propionic-orcein. Chromosome pairing was scored in pollen mother cells at diakinesis and first metaphase of meiosis.

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Results and Discussion

Gametic segregation and chromosome stabilization[9,11] over subsequent generations directed the *Triticum* pentaploid progeny toward 1) $2n = 4x = 28 + (0 \text{ to } 7)$, or 2) $2n = 6x = 42 - (0 \text{ to } 7)$ chromosome plants. Our sectored plant had a majority of 40 chromosome cells compared to 80 chromosome cells. Figure 1 characterizes the cellular and chromosome information. The large late-prophase cell size (Figure 1*B*) depicts the endopolyploid nature constituted of 80 monochromosomes with a possible diplochromosome derivation. D'Amato[6] reported such derivations in differentiating tissues. The first centromere splitting and loss of relational coiling appears synchronous by mid/late prophase. Cells in extremely early prophase were not observed; hence, the presence of diplochromosomes could not be ascertained. Eight satellited chromosomes (IB and VIB in four doses) were present. Meiotic analysis of each of the four tillers gave a $19_{II}\ 2_I$ relationship in all cells scored. The 14_{II} were derived from the A and B genomes, while D genome chromosomes completed the observed meiotic configuration. The 80 chromosome cells were lost either through cellular competition via somatic reduction, or by failure to be carried sectorially into the tiller primordia.

Somatic doubling and genetic sectoring, although not common phenomena in intraspecific hybrids, appear to occur more readily in interspecific and intergeneric hybrids. Various abnormal phenomena occur more frequently with crosses between increasingly divergent germ plasm[8]. Chromosome anomalies are reported regularly for intergeneric hybrids[1]. We have reported anomalous chromosome behavior[3] and have suggested somatic doubling is a routine event in our intergeneric

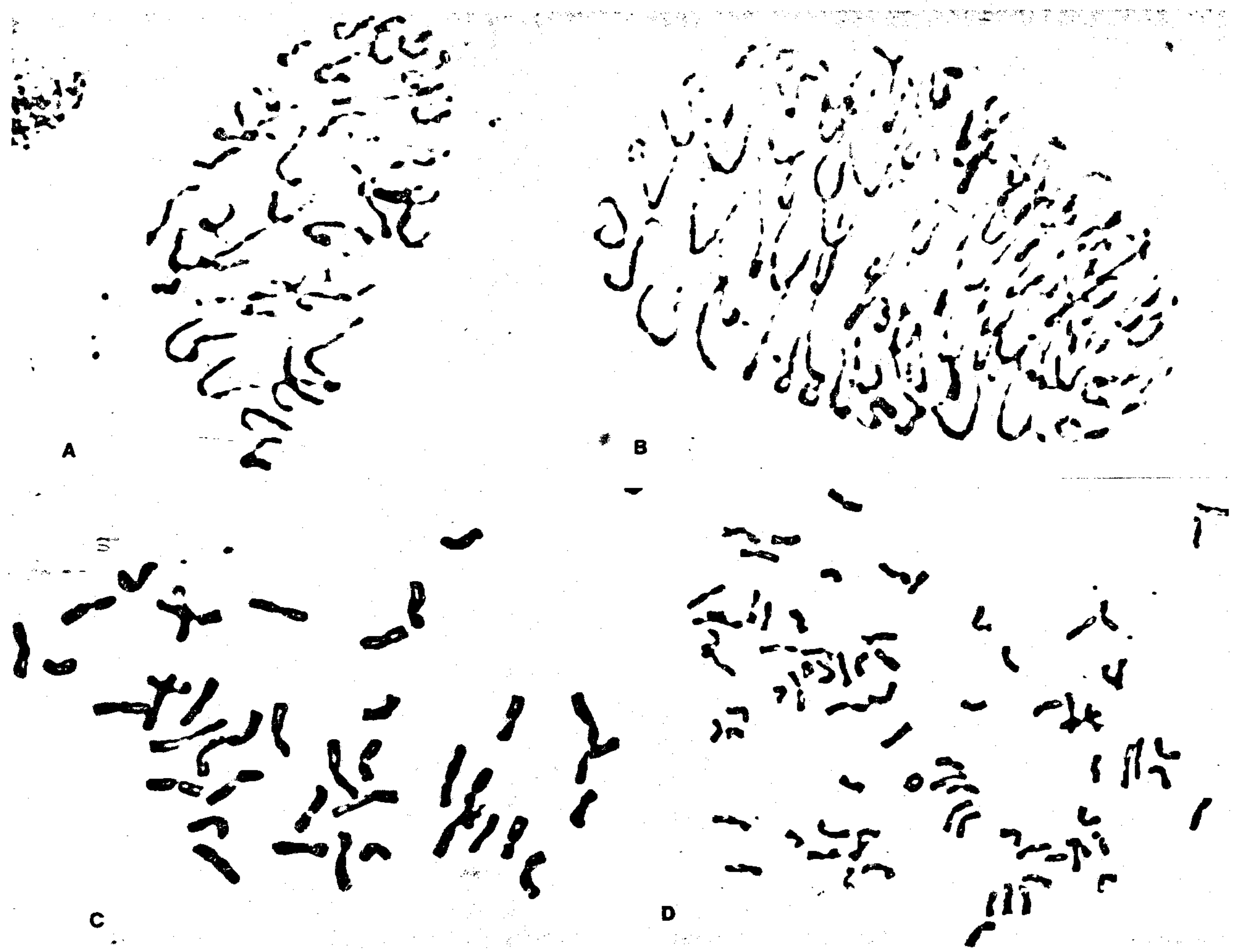

FIGURE 1—*Triticum* pentaploid progeny. *A* shows a mid-prophase cell with 40 chromosomes. *B*—a mid-prophase endopolyploid cell with 80 monochromosomes. *C*—mitotic metaphase with 40 chromosomes. *D*—mitotic metaphase showing endopolyploidy; 80 monochromosomes.

cereal crosses associated with chromosome elimination[4,5] and F_1 fertility.

Summary

A chance occurrence of genetic sectoring in F_3 progeny of pentaploid *Triticum* was observed in root tip cells. Cells with 40 chromosomes were meiotically arranged as 19_{II} 2_I in all tillers of the plant. The less dominant 80 chromosome cells did not transgress to the gametic tissue. This spontaneous chromosome sectoring encourages associating the phenomenon with post-zygotic somatic doubling in our intergeneric cereal hybrids.

Literature Cited

1. Ahokas, H. Some artificial intergeneric hybrids in the Triticeae. *Ann. Bot. Fennici* 7:182–192. 1970.

2. Avanzi, M.B. Richerche sulla poliploidia somatica nei tessuti differenziati della radice di alcune Graminaceae. *Caryologia* 3:351–369. 1951.

3. Bates, L.S., A.V. Campos, R.R. Rodriguez, and R.G. Anderson. Progress toward novel cereal grains. *Cereal Science Today* 19:283–285. 1974.

4. ———, K.A. Mujeeb, R.R. Rodriguez, and R.F. Waters. Rye dwarf gene introgression into barley. *Barley Genet. Newsltr.* 6:7–8. 1976.

5. ———, R.R. Rodriguez, R.F. Waters, and K.A. Mujeeb. Wide hybridization: Gene transfer from barley and rye. *Wheat Newsltr.* 22:84–85. 1976.

6. D'Amato, F. Endopolyploidy in differentiated plant tissues. *Caryologia* 4:115–117. 1951.

7. Geitler, L. Endomitose und endomitotische polyploidisierung. Protoplasmatologia VI/C. Springer, Wien. 1953.

8. Harlan, J.R. and J.M.J. Dewet. Toward a rational classification of cultivated plants. *Taxon* 20:509–517, 1971.

9. Kihara, H. and S. Matsumura. Weitere untersuchungen uber die pentaploides Triticum. *Jap. J. Botany* 11:27–39. 1940.

10. Nagl, W. DNA eudoreduplication and polyteny understood as evolutionary strategies. *Nature* 261:614–615. 1976.

11. Sears, E.R. The cytology and genetics of wheats and their relatives. *Adv. Genet.* 2:239–270. 1948.