

containing sperm has occurred on the c sh wx gl<sub>15</sub> ears. The data from crosses 3, 4, and 5, where F<sub>1</sub>'s involving the c sh wx gl<sub>15</sub> stock are used as female parents, show that the factor responsible for suppression of preferential fertilization acts as a recessive.

The findings with the c sh wx gl<sub>15</sub> stock indicate that the ovary of the plants may be structurally or chemically different from that found in most plants. The possibility that the effect is due to abortion of specific seed types has been ruled out by ovule counts. Sectioning of the ears may reveal a difference in the ovary and at the same time give a clue to the exact mechanism of preferential fertilization.

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### 3. Concerning the mechanism of preferential fertilization.

Roman described preferential fertilization of the egg by B chromosome-containing sperm in 1948. He considered two possible explanations for preferential fertilization. One was that the presence of B chromosomes in a sperm cell increases the ability of the sperm to fertilize the egg. The other explanation assumes that preferential fertilization by a certain sperm cell occurs even in the absence of B chromosomes, but, when B chromosomes are present, they enter the sperm cell which has the advantage in fertilizing the egg. The latter idea is favored by Catcheside.

The explanations for preferential fertilization can be distinguished from each other by observing the nondisjunction of two B chromosomes in the same pollen grain. For example, if B chromosomes must enter a specific sperm cell in order to effect preferential fertilization, then two B chromosomes, undergoing nondisjunction simultaneously, should both migrate to the same pole. On the other hand, if preferential fertilization depends on some advantage conferred on sperm cells by the presence of B chromosomes, one expects two B chromosomes to migrate at random with respect to each other at the second pollen mitosis.

The nondisjunction of two B chromosomes, and their distribution with respect to each other, was followed genetically by combining two of Roman's A-B translocations, TB-9b and TB-4a. Cases of simultaneous nondisjunction of the B<sup>4</sup> Su and the B<sup>9</sup> C Yg chromosomes were examined. Crosses of the following type were made: c yg/+ +, su/+ ♂ X 9C Yg 9B 9C Yg, 4Su 4B B<sup>4</sup> Su B<sup>4</sup> Su ♂. Among the progeny, Su kernels were not used, since nondisjunction of the B<sup>4</sup> Su chromosome was not assured in this case. The su kernels were classified for C vs. c in the endosperm, and for Yg vs. yg in the embryo. The Yg c su and yg C su individuals that were found represent cases of simultaneous nondisjunction of the B<sup>4</sup> and B<sup>9</sup> chromosomes. The nondisjunction, in the case of the Yg c su individuals, was followed by inclusion of the B<sup>4</sup> and B<sup>9</sup> chromosomes in the same sperm cell. In the case of the yg C su individuals, nondisjunction was followed by inclusion of the B<sup>4</sup> and B<sup>9</sup> chromosomes in different sperm cells. The yg C su class should occur rarely if B chromosomes are preferentially included in a specific sperm cell. The results were: Yg c su = 461    yg C su = 310. The yg C su class is certainly not rare. The data are consistent with the idea that preferential fertilization

results from a competitive advantage that is conferred on the sperm cell by the B chromosome. However, the possibility that inclusion of B chromosomes in a specific sperm cell is the cause of preferential fertilization has not been entirely ruled out. Until now, this theory has been interpreted to mean that B chromosomes are almost always included in a specific sperm cell which has a certain advantage in fertilizing the egg. The "mistakes" in preferential fertilization (fertilization of the polar nuclei by the B-containing sperm) would be "mistakes" of the specific sperm cell. One can imagine, however, a situation in which a specific sperm cell fertilizes the egg 100% of the time, and "mistakes" are caused by migration of the B chromosome to the "wrong" pole at the second pollen mitosis. This theory would allow for a considerable number of yg C su individuals in the data, while still depending on the inclusion of B chromosomes in a specific sperm cell for preferential fertilization.

For this reason, preferential fertilization by B<sup>9</sup>-containing sperm was tested in the presence and absence of extra B chromosomes. If inclusion of the B<sup>9</sup> in a specific sperm cell is all that is required for preferential fertilization, the presence of extra B chromosomes at the second pollen mitosis should have no effect upon it. However, if preferential fertilization depends on a selective advantage conferred on the sperm cell by the B<sup>9</sup> chromosome, extra B's should eliminate the advantage by their presence in both sperm cells. Black Mexican plants, with and without B chromosomes, were crossed as male parents to TB-9b plants. Among the progeny, five TB-9b plants, lacking extra B chromosomes, were selected and crossed as male parents onto a yg sh bz wx stock. Five other TB-9b plants, with 6-8 extra B chromosomes, were also crossed as male parents onto a yg sh bz wx stock. The ratio of bz kernels to yg seedlings was calculated for each cross as a measure of preferential fertilization. It was found that preferential fertilization does not occur in the presence of extra B chromosomes. The data are given below:

Female parent	Male parent (TB-9b with no extra B chromosomes)*	Progeny Data		
		bz	yg	% bz
yg sh bz wx	1028-5	351	170	67.5%
yg sh bz wx	1029-1	516	310	62.5%
yg sh bz wx	1030-3	283	126	69.1%
yg sh bz wx	1156-2	337	190	64.2%
yg sh bz wx	1157-2	505	253	66.6%
		1992	1049	65.5%

Female parent	Male parent (TB-9b with 6-8 extra B chromosomes)*	Progeny Data		
		bz	yg	% bz
yg sh bz wx	886-2	207	212	49.4%
yg sh bz wx	886-4	223	220	50.2%
yg sh bz wx	887-2	257	251	50.8%
yg sh bz wx	887-5	344	296	53.7%
yg sh bz wx	1031-3	231	240	49.0%
		1262	1219	51.0%

\*The male parent in each cross was heterozygous for TB-9b:  $\frac{9^{Bz}}{B^{9Bz}} \frac{Yg}{Yg} 9^B$

The data support the hypothesis that preferential fertilization of the egg depends on a selective advantage conferred on sperm cells by the B chromosome. The data also point out that preferential fertilization is a self-limiting mechanism for B chromosome accumulation. This is probably an important factor in determining B chromosome numbers in a natural population.

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#### 4. Male and female transmission of $B^4$ in the presence of chromosome 4.

The chromosome  $B^4$  carrying the dominant Su has been followed for a number of generations in su<sub>1</sub> backgrounds (see MNL 1966, 1967). Reciprocal crosses of such hyperploid genotypes were made to detect the amount of transmission of the hyperploid type through the pollen and through the egg. Self pollinations of hyperploids of the same genotype were also made, and the results are given in Table 1.

In reciprocal crosses a maximum theoretical transmission would be 50% (no loss of  $B^4$ ). However, the recovery of 28.7% Su kernels when the hyperploid was the egg parent indicates the rate of loss (42.6%) which has presumably taken place during meiosis. A considerably smaller percentage of Su kernels is recovered when the hyperploid was used as the pollen parent. This indicates that the second major factor responsible for the loss of the hyperploid type is gametophyte competition: the hyperploid type is unable in some cases to successfully compete with the normal type for fertilization. Secondary factors affecting the recovery of the  $B^4$  may be loss of the  $B^4$  during embryo sac development or during microspore divisions.

When the hyperploid is used as the male parent, an additional 25.4% of loss is found. This establishes that even through the male most of the loss takes place during meiosis. Previous cytological observations of