

The crossover values for male flowers are higher than those for female flowers, except for the Bt_1-Pr region of K10k10 plants lacking B chromosomes. K10 increases crossing over in both the A_2-Bt_1 and Bt_1-Pr regions. A similar effect for the A_2-Bt_1 region has also been found by Robertson (this MNL, p. 89). This increase is greater in the females than in the males, resulting in smaller differences in crossing over between the sexes, particularly in the longer Bt_1-Pr region.

Hanson (MNL 35:61, MNL 36:34 and Ph.D. thesis) has reported that B chromosomes increase crossing over in chromosomes 3 and 9. From the present study, although the numbers of plants in classes without B chromosomes were small and tests of significance were not done, it would seem that B chromosomes may cause an increase in crossing over in chromosome 5 and that the effect, in contrast to that of K10, is greater in males than in females.

Further work, which should make definite conclusions possible as to the effects of B chromosomes, will be done during the coming summer.

Paul Nel

2. The influence of the female parent on preferential fertilization by B^9 -containing sperm.

The B chromosome of maize possesses an accumulation mechanism, whereby non-disjunction of the B chromosome at the second pollen mitosis, followed by preferential fertilization of the egg by the B-containing sperm, results in an increase in B chromosome number (Roman). Preferential fertilization of the egg has been found to occur at approximately the same rate in different genetic backgrounds (Catcheside) and is a constant feature of B chromosome inheritance.

In 1966, plants carrying one of Roman's A-B translocations, TB-9b, were crossed as male parents onto two different inbred lines, a $c\ sh\ wx$ tester and a $c\ sh\ wx\ gl_{15}$ tester. The constitution of the TB-9b plants was $9c\ sh\ wx\ 9^B\ wx\ B^9\ C\ Sh\ B^9\ C\ Sh$. The Wx locus is very close to the translocation breakpoint of TB-9b, and crossing-over of the Wx allele onto the normal chromosome 9 occurs less than 0.5% of the time (Robertson). It may be assumed, therefore, that when Wx kernels are selected from the progeny of a $c\ sh\ wx\ X\ 9c\ sh\ wx\ 9^B\ wx\ B^9\ C\ Sh\ B^9\ C\ Sh$ cross, the vast majority of the individuals each contain the $9^B\ wx$ chromosome. It is also known, from the work of Robertson, that crossing-over of the $c\ sh$ markers from the normal chromosome 9 onto the B^9 chromosome is a very rare event (0.26%). As a result, classification of C and Sh is an accurate method for determining the presence or absence of the B^9 chromosome in the endosperm. In the crosses that were made onto the $c\ sh\ wx$ tester and the $c\ sh\ wx\ gl_{15}$ tester, the Wx seeds were selected and classified for C and Sh . The results are given below:

$c\ sh\ wx\ X\ 678-5\ (TB-9b)$
$c\ sh\ Wx = 422\ (62.5\%)$
$C\ Sh\ Wx = 252$
$C\ sh\ Wx = 1$

$c\ sh\ wx\ X\ 808-1\ (TB-9b)$
$c\ sh\ Wx = 238\ (58.4\%)$
$C\ Sh\ Wx = 170$

$c\ sh\ wx\ gl_{15}\ X\ 678-5$
$c\ sh\ Wx = 224\ (38.5\%)$
$C\ Sh\ Wx = 356$
$c\ Sh\ Wx = 1$

$c\ sh\ wx\ gl_{15}\ X\ 808-1$
$c\ sh\ Wx = 131\ (43.5\%)$
$C\ Sh\ Wx = 170$

According to Roman's method of classification, the c sh Wx seeds represent cases of nondisjunction of the B^9 chromosome, in which the embryo received two B^9 chromosomes. The C Sh Wx seeds represent either cases of nondisjunction of the B^9 in which the endosperm received two B^9 's, or cases of proper division of the B^9 in which the endosperm and embryo each received one B^9 chromosome. Growing the plants from the C Sh Wx seeds and backcrossing to a c sh wx tester classifies the plants for the presence (C Sh) or absence (c sh) of the B^9 chromosome.

In the data given above, a difference exists between the percentage of c sh Wx seeds found in crosses with the c sh wx tester and that found in crosses with the c sh wx gl₁₅ tester. The genetic background of the female parents apparently had an effect on the behavior of the B^9 chromosome. The difference in c sh Wx seeds could be accounted for by a change in the rate of nondisjunction of the B^9 chromosome, or a change in the degree of preferential fertilization of the egg by the B^9 -containing sperm. It is difficult to see how the genetic background of the female parent could influence the rate of nondisjunction of the B^9 chromosome, but it is possible that pollen grains in which nondisjunction has occurred are selected for or selected against during fertilization. For this reason, an estimate of the total rate of nondisjunction of the B^9 chromosome was made for each cross.

In order to calculate the rate of nondisjunction of the B^9 chromosome, the C Sh Wx class must first be divided into cases of nondisjunction and cases of proper division of the B^9 . C Sh Wx seeds were planted and the progeny classified for the presence or absence of the B^9 chromosome, by backcrossing to a c sh wx tester. The absence of the B^9 chromosome in the embryo (backcross seeds all c sh) indicates that nondisjunction has occurred. Among 93 C Sh Wx individuals from the cross c sh wx X 678-5, 88 had resulted from nondisjunction of the B^9 . In the c sh wx gl₁₅ X 678-5 cross, the figure was 86/91. From this data, the overall rate of nondisjunction in the c sh wx X 678-5 cross was found to be 93%, and the rate in the c sh wx gl₁₅ X 678-5 cross 96%. Obviously there was no difference in the rate of nondisjunction between the two crosses. A similar result was found in the crosses of plant 808-1. Among 92 C Sh Wx individuals from the cross c sh wx X 808-1, 57 had resulted from nondisjunction. The rate of nondisjunction in this cross was calculated to be 84%. In the cross c sh wx gl₁₅ X 808-1, nondisjunction was found in 51/75 of the C Sh Wx individuals tested. The rate of nondisjunction for this cross was 82%. Again, no difference in the rate of nondisjunction between the two crosses was found.

Preferential fertilization in the crosses of 678-5 and 808-1 was determined by the per cent of the total amount of nondisjunction that was contributed by c sh Wx seeds. The results for preferential fertilization are given below:

<u>c sh wx</u> X 678-5	Pref. Fert. = 64% (422/660)
<u>c sh wx gl₁₅</u> X 678-5	Pref. Fert. = 40% (224/561)
<u>c sh wx</u> X 808-1	Pref. Fert. = 69% (238/343)
<u>c sh wx gl₁₅</u> X 808-1	Pref. Fert. = 53% (131/247)

From these results it was suspected that the c sh wx gl₁₅ stock was capable of preventing preferential fertilization of the egg by the sperm containing the B⁹ chromosome.

This conclusion was supported by results found in 1967. TB-9b plants were again crossed as male parents onto the c sh wx gl₁₅ stock and onto several other tester lines. In each cross a single pollen shedding from a TB-9b plant was used for pollination of the c sh wx gl₁₅ stock and one other tester line. While the progeny have not been grown up for exact calculation of preferential fertilization, it is obvious from the kernel phenotypes that preferential fertilization has been greatly decreased in crosses involving the c sh wx gl₁₅ stock. Classification of the Wx seeds in these crosses is shown below:

Female parent	TB-9b Male parent	Percentage of <u>c sh Wx</u> or <u>bz sh Wx</u> seeds
1. c sh wx	1122-2	65.4% 237/362
c sh wx gl ₁₅	1122-2	27.5% 332/1204
2. c sh wx	1119-1	66.7% 239/358
c sh wx gl ₁₅	1119-1	49.9% 124/249
3. c sh wx/c sh wx gl ₁₅	1016-1	58.0% 351/603
c sh wx gl ₁₅	1016-1	43.0% 142/332
4. c sh wx/c sh wx gl ₁₅	1013-4	64.0% 369/577
c sh wx gl ₁₅	1013-4	46.6% 194/415
5. c sh wx/c sh wx gl ₁₅	1015-2	59.0% 252/428
c sh wx gl ₁₅	1015-2	32.2% 142/441
6. yg sh bz wx	1018-2	57.5% 260/452
c sh wx gl ₁₅	1018-2	40.0% 182/456
7. yg sh bz wx	1020-2	51.0% 211/417
c sh wx gl ₁₅	1020-2	38.0% 159/418
8. yg sh bz wx	1019-1	60.5% 374/619
c sh wx gl ₁₅	1019-1	42.6% 125/300
9. sh bz wx B Pl	1017-3	66.7% 614/925
c sh wx gl ₁₅	1017-3	43.0% 260/660

The above results are consistent with the idea that preferential fertilization never occurs when the c sh wx gl₁₅ stock is used as female parent. However, an exact calculation of preferential fertilization is required to show this. In two of the crosses listed above (1 and 5) the differences in progeny data between the two female parents are so great that it is suspected that preferential fertilization of the polar nuclei by the B⁹

containing sperm has occurred on the c sh wx gl₁₅ ears. The data from crosses 3, 4, and 5, where F₁'s involving the c sh wx gl₁₅ 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 gl₁₅ 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.

Wayne Carlson

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 B⁴ Su and the B⁹ C Yg chromosomes were examined. Crosses of the following type were made: c yg/+ +, su/+ ♂ X 9C Yg 9B 9C Yg, 4Su 4B B⁴ Su B⁴ Su ♂. Among the progeny, Su kernels were not used, since nondisjunction of the B⁴ 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 B⁴ and B⁹ chromosomes. The nondisjunction, in the case of the Yg c su individuals, was followed by inclusion of the B⁴ and B⁹ chromosomes in the same sperm cell. In the case of the yg C su individuals, nondisjunction was followed by inclusion of the B⁴ and B⁹ 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