THE CORRELATION OF CYTOLOGICAL AND GENETICAL CROSSING-OVER IN ZEA MAYS. A CORROBORATION

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There has recently been some skepticism expressed (Brink and Cooper, 1935)[1] as to the value of the studies on the correlation of cytological and genetical crossing-over in maize published by Creighton and McClintock (1931)[6] because of the fewness of the data. Since the paper by Stern (1931)[9] dealing with *Drosophila* and having much more extensive data appeared at practically the same time and yielded the same conclusions, the authors felt it unnecessary to add to the ever-increasing amount of published work merely to record more evidence of the same nature without supplying anything essentially new or advancing. Therefore, confirmatory data which have accumulated since the time the joint paper mentioned above was published have not been considered for a separate publication. However, we now feel forced to add more data merely to counteract any suspicion that the evidence previously presented constituted insufficient proof. This will be done in as brief a form as possible, since a discussion of the method has been given in the paper mentioned above.

Chromosome 9 in maize is characterized by its relative size in the chromosome complement and by the 1:2 ratio in lengths of its two arms. The end of the short arm in some strains possesses a large knob while other strains have a very small knob or no knob. Evidence that the knob or knobless condition of a particular chromosome 9 is inherited with the same precision as a gene has been given in the previous paper and has been confirmed in many additional crosses. The knob, therefore, could be used as one cytological marker for this chromosome. The presence of an interchange between chromosomes 8 and 9 (Burnham, 1930,[2] 1934[3]; McClintock, 1930[7]) which broke chromosome 9 at a position on the long arm a short distance away from the spindle fibre attachment region provided the second cytological marker. That the genes *yg*, *c*, *sh*, *wx* * lie in the interchanged chromosome which possesses the short arm of chromosome 9 has been shown by McClintock, 1931,[8] Creighton, 1934,[5] and Burnham 1934.[3,4] With reference to the knob and the interchange point, the order of the genes is knob-*yg*-*c*-*sh*-*wx*-interchange with *yg* very close to the knob (Creighton, 1934)[5] and *wx* close to the spindle fibre attachment region (Burnham, 1934[4] and unpublished). The standard crossover values for these genes alone are *yg*-*c* 21%, *c*-*sh* 3.3%, *sh*-*wx* 21%. The crossover value of *wx* to the interchange is 13.7% (Burnham, 1934[3]). That there is very little crossing-over between the knob and *yg* can be seen from the data given below.

A plant with the constitution knob-*Yg-C-Sh-Wx*-interchange was crossed to a plant with the constitution knobless-*yg-c-sh-wx*-normal. The F_1 was backcrossed to knobless-*yg-c-sh-wx*-normal. Two hundred and sixty-one individuals resulting from this backcross were examined cytologically to determine the presence or absence of the knob (knob or knobless in table below) and the presence or absence of the interchange (interchange or normal in table below) in the chromosome carrying these genes contributed by the F_1 parent. Since there are five regions in which a crossover can be detected, the results have been tabulated according to crossovers which occurred in each of these regions. The tabulated results do not represent the total backcross progeny. A higher percentage of *Yg-C-Sh-Wx* and *yg-c-sh-wx* plants were examined cytologically in an effort to obtain crossovers between the knob and *yg*. Likewise, more *Yg* plants were examined cytologically than *yg*, since plants homozygous for *yg* are reduced in vigor and often do not afford sufficient material for cytological examination.

TABLE 1

$\frac{\text{KNOB-}Yg\text{-}C\text{-}Sh\text{-}Wx\text{-INTERCHANGE}}{\text{KNOBLESS-}yg\text{-}c\text{-}sh\text{-}wx\text{-NORMAL}}$ × KNOBLESS-*yg-c-sh-wx*-NORMAL

	NUMBER OF INDIVIDUALS
Non-crossovers	
1. Knob-*Yg-C-Sh-Wx*-interchange	84
2. Knobless-*yg-c-sh-wx*-normal	45
Crossovers in region 1	
3. Knob-*yg-c-sh-wx*-normal	3
4. Knobless-*Yg-C-Sh-Wx*-interchange	1
Crossovers in region 2	
5. Knob-*Yg-c-sh-wx*-normal	13
6. Knobless-*yg-C-Sh-Wx*-interchange	11
Crossovers in region 3	
7. Knob-*Yg-C-sh-wx*-normal	3
8. Knobless-*yg-c-Sh-Wx*-interchange	3
Crossovers in region 4	
9. Knob-*Yg-C-Sh-wx*-normal	53
10. Knobless-*yg-c-sh-Wx*-interchange	18
Crossovers in region 5	
11. Knob-*Yg-C-Sh-Wx*-normal	16
12. Knobless-*yg-c-sh-wx*-interchange	3
Double crossover involving regions 2 and 4	
13. Knobless-*yg-C-Sh-wx*-normal	1
Double crossovers involving regions 4 and 5	
14. Knob-*Yg-C-Sh-wx*-interchange	5
15. Knobless-*yg-c-sh-Wx*-normal	2

It is obvious from the data given above that a genetic crossing-over between the genes *Yg-C-Sh-Wx* involves a cytological crossover between the knob and the interchange point. These data, therefore, supplement those given in our previous publication and indicate the soundness of the conclusions drawn.

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* The genes referred to in this paper by symbols are: *yg*, yellow-green plants; *c*, colored aleurone; *sh*, shrunken endosperm; *wx*, waxy endosperm.

[1] Brink, R. A., and Cooper, D. C., *Genetics*, **20**, 22–35 (1935).

[2] Burnham, C. R., these PROCEEDINGS, **16**, 269–277 (1930).

[3] Burnham, C. R., *Genetics*, **19**, 430–447 (1934).

[4] Burnham, C. R., *Am. Nat.*, **68**, 81–82 (1934).

[5] Creighton, H. B., these PROCEEDINGS, **20**, 111–115 (1934).

[6] Creighton, H. B., and McClintock, B., *Ibid.*, **17**, 492–497 (1931).

[7] McClintock, B., *Ibid.*, **16**, 791–796 (1930).

[8] McClintock, B., *Ibid.*, **17**, 485–491 (1931).

[9] Stern, C., *Biol. Zbl.*, **51**, 547–587 (1931).