

8. Observations on chiasma frequency in primitive and evolved varieties of maize and their hybrids.

Observations have been recorded on chiasma formation in 155 plants of maize belonging to 6 primitive varieties, 3 evolved types and 18 hybrids obtained by crossing the primitive and evolved types. The number of chiasmata were counted at metaphase I in a minimum of 10 pollen mother cells (Table 1).

It will be seen from Table 1 that the primitive varieties, as a group, show a significantly higher chiasma frequency than the evolved varieties. This observation can have several explanations. It is clear that these varieties have been grown for a very long time under primitive conditions of management. In other words, these varieties have been subjected to conditions of natural selection to a greater extent than the present day commercial varieties like KT 41, which have been relatively free from pressures of natural selection. In view of these differential selection pressures in the two groups of materials, it is obvious that a greater potential for genetic recombination would be of greater value in the case of primitive varieties. This would be particularly so, if the primitive varieties showed some amount of self-pollination, as has been suggested on the basis of occurrences of inflorescences having both male and female flowers such as those found in SP 1. The observations on chiasma frequency, thus, support the suggestion that the primitive varieties, especially varieties like SP 2, are quite distinct from the present day varieties of commerce. The two would appear to have been separated from each other over a much longer period than the concept of a wholly post-Columbian introduction of maize in Asia would suggest.

Secondly, the present studies have also provided evidence of a heterotic response for chiasma formation in the crosses between the primitive and the evolved types. The heterosis is significant in one of the crosses, that is, Palomero Toluqueno X Kanpur type 41, where the hybrid forms a significantly higher number of chiasmata than either of the parents as will be seen below.

Table 1

Mean chiasmata per cell per plant in the primitive and evolved varieties and their hybrids

S.No.	Variety or cross	Plants analyzed	Mean chiasmata ± S.E.
A. <u>Primitive varieties</u>			
1.	SP 1	9	30.54 ± 0.86
2.	SP 2	8	33.79 ± 0.91
3.	Chapalote	4	29.96 ± 1.30
4.	Chapalote Sinaloa	4	31.36 ± 1.29
5.	Nal-Tel (Yucatan 7)	6	31.63 ± 1.05
6.	Palomero Toluqueno	8	30.91 ± 0.91
	Mean over primitives	-	31.36 ± 0.41
B. <u>Evolved varieties</u>			
7.	Kanpur type 41	7	29.83 ± 0.98
8.	Basi	7	28.40 ± 0.98
9.	Mexican June	7	30.43 ± 0.98
	Mean over evolved varieties	-	29.55 ± 0.56
C. <u>Hybrids</u>			
10.	SP 1 X KT 41	5	31.88 ± 1.15
11.	SP 1 X Basi	6	33.05 ± 1.05
12.	SP 1 X Mexican June	6	31.59 ± 1.05
13.	SP 2 X KT 41	8	33.50 ± 0.91
14.	SP 2 X Basi	2	33.65 ± 1.82
15.	SP 2 X Mexican June	6	33.75 ± 1.05
16.	Chapalote X KT 41	5	33.28 ± 1.15
17.	Chapalote X Basi	4	30.85 ± 1.29
18.	Chapalote X Mexican June	5	32.12 ± 1.15
19.	Chapalote Sinaloa X KT 41	6	31.47 ± 1.05
20.	Chapalote Sinaloa X Basi	5	31.98 ± 1.15
21.	Chapalote Sinaloa X Mexican June	6	31.84 ± 1.05
22.	Nal-Tel (Yucatan 7) X KT 41	6	33.51 ± 1.05
23.	Nal-Tel (Yucatan 7) X Basi	5	33.62 ± 1.15
24.	Nal-Tel (Yucatan 7) X Mexican June	6	32.40 ± 1.05
25.	Palomero Toluqueno X KT 41	5	35.66 ± 1.15
26.	Palomero Toluqueno X Basi	6	31.23 ± 1.05
27.	Palomero Toluqueno X Mexican June	3	31.23 ± 1.49
	Mean over hybrids	-	32.59 ± 0.26
Total plants analyzed		155	
Overall mean			31.98

	Hybrid (Pal. Tol. X KT 41)	Palomero Toluqueno	KT 41
Mean chiasmata per cell	35.66	30.91	29.83

It is known that chiasma frequency is genetically determined. Rees has also found evidence for the occurrence of heterosis for this character in rye when completely different inbred lines were crossed (Rees, 1955). Thus, we find that the primitive and the evolved races of maize show genetic differentiation in respect of chiasma formation.

Reference

Rees, H. (1955) Heterosis in chromosome behaviour. Proc. Roy. Soc. London, B, 144:150-159.

H. K. Jain
D. Gupta

9. Effect of knobs on chiasma number in a cell.

We have observed that the varieties and hybrids of maize having greater knob volume (measured in arbitrary scores) form more chiasmata at metaphase I. A highly significant correlation has been obtained ($r = 0.628^{**}$) with the regression equation, $Y = 27.66 + 0.257 X$, where $Y =$ chiasma number in a cell, and $X =$ units of knob volume in the cell. When a consideration is made of the knob number and chiasma frequency together, a highly significant negative correlation is obtained ($r = -0.704^{**}$) with the regression equation, $Y = 37.83 - 0.609 X$, where $Y =$ chiasma number in a cell, and $X =$ number of knobs in the cell. These results demonstrate that a higher number of knobs is associated with fewer chiasmata per cell, whereas the greater knob volume increases the chiasma frequency in a cell.

Thus, the knobs, which are supposed to be made up of heterochromatin, appear to have a regulatory function with regard to crossing over. It may be explained that the heterochromatic B-chromosomes have also been found to have a similar regulatory function with regard to crossing over (MNL 42:63, 79; 43:54).

D. Gupta
H. K. Jain