2. Crossing over and preferential segregation in chromosome 10 induced by abnormal chromosome 10.

Inasmuch as abnormal chromosome 10 has been shown to enhance recombination in the proximal segments of chromosomes 3 and 5, it appeared desirable to see if an increase would be found when similarly placed regions in chromosome 10 were tested. Earlier crossover data for the G-R region in K10 k10 plants (Rhoades 1952) indicated an essentially normal recombination frequency for this centrally placed region, but nothing was known about possible enhancement in a more proximal segment in chromosome 10.

In the summer of 1967, backcross progenies were grown from sib plants all heterozygous for the Du, G, and R alleles and differing in that some had one abnormal 10 and the others only normal chromosomes 10. The waxy gene was homozygous so accurate classification of the du phenotype was possible. The following data were obtained from test-crossing Du G R k10/ du g r k10 plants as the female parent:

(0)	(0)	(1)	(1)	(2)	(2)	(1-2)	(1-2)	
Du	du	Du	du	Du	du	Du	du	
G	g	g	G	G	g	g	G	
R	r	r	R	r	R	R	r	
658	527	260	188	131	108	13	13	Σ = 1898

Region (1) Du-G = 25.0%

Region (2) G-R = 14.0%

% Du = 55.9 % G = 52.2 % R = 50.9

(The lower field germination of du kernels accounts for the excess over 50% of Du).

Calculated tetrad ranks:

nons = 27.6%
(1) = 44.5%
(2) = 22.4%
(1-2) = 5.5%

Data from sister plants of Du G R K10/ du g r k10 constitution gave the following:

(0)	(0)	(1)	(1)	(2)	(2)	(1-2)	(1-2)	
Du	du	Du	du	Du	du	Du	du	
G	g	g	G	G	g	g	G	
R	r	r	R	r	R	R	r	
600	253	240	485	42	110	31	27	Σ = 1788

Region (1) Du-G = 43.8%

Region (2) G-R = 11.9%

% Du = 51.1 % G = 64.5 % R = 68.6

Calculated tetrad ranks:

nons = 1.9%
(1) = 74.6%
(2) = 10.5%
(1-2) = 13.0%

The calculations of tetrad ranks reveal that in K10 k10 female parents, compared to k10 k10, there were markedly fewer noncrossover tetrads, more with single exchanges in (1), only half as many singles in (2), and 2½ times as many double exchange tetrads. The G-R recombination value in K10 k10 plants is somewhat less than in k10 k10 individuals. Indeed, Gavazzi and Avila (MNL, 1969) reported an even greater reduction for the G-R region in K10 k10 compared to k10 k10 bivalents (10.7% vs 19.5%). The observations indicate that K10 causes a decrease rather than an increase in the G-R region. The increase in the more proximal Du-G region could be attributed to the influence of K10 on proximal segments.

However, it could be argued that the higher value for the Du-G interval was a compensatory increase due to the virtual elimination of crossing over in the distal R-sr_2 region in K 10/ N 10 heterozygotes (Kikudome 1959). If the distal region of structural dissimilarity does not include the adjacent G-R segment, a compensating increase in G-R recombination might be expected. Since no increase was observed, one could conclude that a portion of the G-R region shows no (or reduced) recombination while the remainder shows an increase, the net result in our data approaching a normal frequency for G-R recombination. According to this argument, the recombination differences in K10 k10 and k10 k10 plants stem from the fact that K10 plants have a reduction in distal exchanges and a compensatory increase in proximal crossing over. However, the data can also be interpreted to indicate that K10 increases crossing over in the proximal segment of chromosome 10 as it does for the other tested chromosomes. The situation in chromosome 10 is more complicated because the proximal increase can be ascribed to two causes. The present data afford no unequivocal decision between these two alternatives, but a definitive answer should be obtained from recombination values in homozygous K10 bivalents.

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