

APPLICATION OF THE INTERCROSS METHOD TO PISUM

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Crosses made between lines of interchanges that involve the same two chromosomes but with different break locations could be used for the detection of the points at which chromosome pairing is initiated and for the mapping of T-points and genes (K. J. Kasha and C. R. Burnham, *Can. J. Genet. Cytol.* 7:620-632, 1965). I have studied a cross of this kind, viz. between Hilsson's N I, L-114, T(4-6)a, and Lamprecht's 'Graues Posthkirnchen', L-58, T(4-6)b.

F1 hybrids between these lines and the normal karyotype as represented by Lamprecht's L-110, 'Roi des gourmands', show the normal behavior of semi-sterile plants with respect to chromosome pairing at meiosis and gametic fertility. Thus the ring of four chromosomes observed at M I of meiosis is quite simple without chiasmata in the interstitial segments between the centromeres and the T-point. Pairing behavior and the percentage of sterile pollen grains are given in Table 1.

Table 1. Chromosome pairing and fertility in hybrids between four structural types viz. L-110=N-type, L-114=T(4-6)a, L-58=T(4-6)b and L-488=fTf2-31a+Tf4-71a1.

Cross no.	Parental lines x	Maximum biva- lents	Config. at M I		Pollen grains Nos. n	sterile %
			Rings of four	six		
1	114 x 110	5	1	0	636	49
2	58 x 110	5	1	0	764	50
3	114 x 58	5	1	0	1185	70
4	488 x 110	3	2	0	2167	75
5	114 x 488	2	1	1	741	78
6	58 x 488	2	1	1	634	79

In the intercross between L-114 and L-58, a ring of four chromosomes has been observed in 60 of our 70 M I plates, the rest having seven bivalents. The gametic sterility is, however, considerably higher than in the hybrids previously mentioned (cf. Table 1). S. Blixt (*Agri Hort. Genet.* 17:47-75, 1959) has shown that the T-points of L-58 are situated in the short arms of the chromosomes involved. The location of the T-points in L-114 are probably not too far from the centromeres of the long arms. For a satisfactory interpretation of the pairing configurations at M I of the intercross hybrids, new cytological investigations with the aid of the Giemsa C-banding technique are desirable and would probably be quite informative.

L-114 and L-58 have been crossed with Klein's T-488, which is homozygous for two reciprocal translocations, viz. T(2-3)a and T(4-7)a (cf. R. Lamm, PNL 10:31-32, 1978). The observed maximum configurations at M I of meiosis given in Table 1 are in agreement with those expected. Whereas the maximum configuration of one ring of six chromosomes + one ring of four + two bivalents is very common in the F1 of cross No. 5 of Table 1, it is rare in cross No. 6 where it may easily be overlooked. In this F1 hybrid, configurations with two rings of four and three bivalents dominate. From this point of view, L-114 is superior to L-58 as a member of a translocation tester set. On the other hand, the linkage relations between the T-points of L-58 and marker genes in the chromosomes involved are, so far, better known in this line than in L-114. The gametic sterility is equal for the two F1 hybrids of the crosses Nos. 5 and 6, both with respect to the male and female gametes, which is remarkable considering the differential pairing behavior.

In H. Lamprecht's "Monographic der Gattung Pisum" (Graz, 1974) linkage values between the T-points of L-58 and the genes Le, N, Wlo, P, and Lt are given on p. 492. Especially the two genes first mentioned show strong linkage with the T-point. These genes are certainly situated in the short arm of chromosome No. 4. In the investigations of R. Lamm and R. J. Miravalle (Hereditas 45:417-440, 1959), there was no significant linkage between the T-points of L-114 and the genes Le and PI. These data have been completed by the results given in Table 2, which indicate linkage relations to the genes Le and Fa of chromosome No. 4 and P and Wlo of chromosome No. 6. The backcross data of Table 2 originate from investigations made by Ernst Nilsson (unpub.). The probable linkage between the T-points and the gene N of chromosome No. 4 will be tested by investigations in progress.

Table 2. Segregation and linkage data from crosses between L-114=T(4-6)a and lines of N-type=normal type.

Type of progeny	F ₂		BC	
Parental lines	114 x 116	114 x 1120	(114 x 124) x 124	
Chromosome no.	4	4	6	6
Linkage	T- <u>Le</u>	T- <u>Fa</u>	T- <u>P</u>	T- <u>Wlo</u>
Nos. of plants				
Fertile	+ 120	45	10	13
"	- 50	18	26	23
Semisterile	+ 134	69	22	23
"	- 31	18	15	14
Total number	335	150	73	73
χ^2 fertility	0.075	3.840	0.014	0.014
χ^2 gene	0.120	0.080	1.110	0.014
χ^2 linkage	5.016	1.280	7.247	4.945
% Cr 0 \pm S.E.	26.7 \pm 4.83	(30.1)	34.3 \pm 5.56	37.0 \pm 5.65

As regards the intercross method, future work on this subject would be greatly facilitated by trying to find translocation lines involving the same two chromosomes but with the T-points situated in the same arm of one of the chromosomes but in different arms of the other chromosome. This is especially desirable for the mapping work of chromosomes 4 and 7 since, in my experience, translocation heterozygotes involving these chromosomes seldom, if ever, give rise to interchange trisomies in their progenies. Such trisomies are otherwise one of the best tools for the mapping of the chromosomes.