

IS Td LOCATED ON CHROMOSOME 3 OR 4?

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Lamprecht (1) reported linkage among N-Z-Fa and Td, a linkage group that he later assigned to chromosome 4 (2). Recently, in connection with another study, I confirmed the linkage and order among N-Z-Was (3). Still more recently I had occasion to test the relationship among Was, Z, and Td in the course of developing a multi-marker line for chromosome 4. Because was and Td are scoreable in the seedling stage, part of the available seed from Fj plants was planted in greenhouse flats containing builders' sand (63 plants/flat). The population of 504 plants segregated also for A-a, D*-D°, and B-b and each of these allelic pairs was scored along with Was-was and Td-td, the B-b difference being determined on the basis of axil color (in A/- plants). The 121 a/a segregants were excluded from the analysis. Later, 50 additional seeds from the same cross were planted in pots and the resulting plants were grown to maturity, so that flower color (B-b.) and seed phenotype (Z-z) could be observed. The additional 50 plants were grown to establish with certainty that the pale axil color was a function of a pleiotropic effect of b and that was was associated with to assure that chromosome 4 markers were involved.

The Td line (A886-193) used as the parent of the present cross ultimately traced to a line designated Pisum abyssinicum acquired in 1966 from Dr. K. Dodds. A886-193 expresses the classic Td phenotype, with the leaves (stipules and leaflets) becoming dentate at node 6 or 7 and in all succeeding leaves; in crosses the F1 exhibits incomplete dominance and heterozygous F2 segregants can often be distinguished from Td/Td segregants. A886-193 is a, Pl. Relevant genes in the male parent [A486-170-(1)] are A, was, z, and b.

Unexpectedly, there was no evidence of linkage between Was and Td (Table 1A). Instead, there was clear evidence of linkage between Td and b. The population that was grown to maturity displayed normal fertility with good pod and seed set. Although there were relatively few plants in that population and the effective size was reduced further by 10 a plants, clearly the pale axil color in the larger population was attributable to b, and clearly Was and Z were linked in coupling (Table 1B). Moreover, neither Td nor B showed evidence of linkage with Was or Z. The present data strongly suggest that Td belongs to chromosome 3, not 4. However, Lamprecht's data (1), shown in Table 2, are equally convincing. Fa, Z, and N all showed linkage with Td in his experiments. Yet, it should be noted that loose linkage between Td and B is also suggested by Lamprecht's data (Table 2, line 5). Additional evidence is needed to resolve this issue.

1. Lamprecht, H. 1945. Hereditas 31:347-382.
2. Lamprecht, H. 1948. Agri Hort. Genet. 6:10-48.
3. Marx, G. A. 1986. PNL 18:70.

Table 1. F2 analysis of a multi-point cross: a Td Was Z B x A td was z b.

A. Analysis of three of the five genes segregating in the cross
(a/a segregants excluded)

Was	Td	B	No.				Chi-square	Recomb.		
				Gene Pair	X	Y	Linkage	fract.	S.E.	
	+	+	179							
+	+	-	21	Was-Td	0.95	0.73	1.08	-	-	
+	-	+	29	Was-B	0.95	0.20	1.22	-	-	
+	-	-	50	Td-B	0.73	0.20	132.18**	17.1	2.1	
-	+	+	76							
-	+	-	4							
-	-	+	7							
-	-	-	17							
Total			383							

(Pop. C286-534-542)

B. Analysis of 50 additional plants from the same cross as above grown to maturity

Gene Pair	XY	Xy	xY	xy	Tot.	Chi-square			Recomb.	S.E.
						X	Y	Linkage	fract.	
Was-Z	32	1	1	6	40	1.20	1.20	17.78**	5.9	3.9
Td-B	29	3	2	6	40	0.53	0.13	12.84**	14.2	6.0
Was-B	25	8	6	1	40	1.20	0.13	0.18	-	-
Was-Td	32	8	9	1	50	0.67	1.31	0.22	-	-
Z-B	25	8	6	1	40	1.20	0.13	0.18	-	-
Td-Z	26	6	7	1	40	0.53	1.20	0.04	-	-

(Pop. C286-754)

Table 2. Segregation data from Lamprecht's (1945) crosses 258 and 539 relating to the location of Td. See reference 2.

Gene Pair	XY	Xy	xY	xy	Tot.	Chi-square			Recomb.	S.E.
						X	Y	Linkage	fract.	
Ea-ld	238	121	109	11	479	0.007	1.67	28.90**	28.4	4.1
Ea-Z	233	126	111	5	479	0.007	1.41	45.93**	19.1	4.4
Z-Td	271	77	76	55	479	1.41	1.67	21.86**	37.3	2.4
Z-B	254	94	92	39	479	1.41	1.95	0.51	-	-
E-Td	240	106	107	26	479	1.95	1.67	6.32*	41.6	3.7
Fa.-B	263	96	83	37	479	0.007	1.95	0.81	-	-
N-Td	234	101	88	13	436	0.78	0.30	11.89	35.2	4.1

Lamprecht's raw data (above) were analyzed using the computer program developed at Geneva by Dr. John Barnard.