Proceedings of the Iowa Academy of Science

Volume 38 | Annual Issue Article 13

1931

Linear Order of Four Genes on the First Chromosome of the Tomato

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LINEAR ORDER OF FOUR GENES ON THE FIRST CHROMOSOME OF THE TOMATO [1]

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Genetic tests for linkage have shown that four pairs of hereditary factors belong on the first chromosome of the tomato. They are:

1. Tall — dwarf growth habit. Genes *Dd.*
2. Smooth — peach (pubescent) fruit. Genes *Pp.*
3. Oblate (or round) — ovate fruit shape. Major genes *Oo.*
4. Simple — compound flower cluster. Genes *Ss.*

The linkage interrelations of these four genes are known to some extent, but their linear order on the chromosome has never been determined.

A quadruple-recessive strain, *dd pp oo ss* (dwarf, peach, ovate, compound) has finally been synthesized. This was hybridized with a quadruple-dominant, standard variety, Marglobe, and the F_1 plants backcrossed reciprocally to the quadruple-recessive type. The experimental data from this reciprocal backcross have been arranged in Table I where a total of 139 plants is shown.

Table I — Backcross Data from F_1 (DPOS . dpos) x dd pp oo ss and Reciprocal

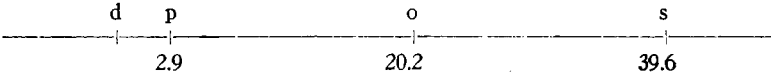
Combinations		F_1 x dpos ♂	dpos x F_1 ♂	Total	Per Cent
Parental —	DPOS	25	24	88	63.31
	dpos	20	19		
Single c.o. —	DPOs	8	3	23	16.55
	dpoS	4	8		
Single c.o. —	DPos	3	7	20	14.39
	dpOS	8	2		
Single c.o. —	Dpos	1	1	4	2.88
	dPOS	2	0		
Double c.o. —	DPoS	2	2	4	2.88
	dpOs	0	0		
Total		73	66	139	100.01
Percent c.o.		38.4	34.8		

These data prove conclusively that the linear order of the genes is D-P-O-S. Single crossovers occurred in all three possible re-

[1] Paper No. 39 — Department of Genetics, Iowa State College.

gions, but double crossing-over was only found between the longer P-O and O-S regions, presumably because the D-P region was too short (2.9 per cent). One triple crossover plant was discovered (genotype *dPoS*) but it has not been included in the table because it was abnormal in fruit development, being almost sterile. Evidently some chromosomal disturbance had occurred in this case.

From the data in Table I, a tentative chromosome map of this linkage group may be constructed as follows:



The amount of interference between crossing-over in adjacent regions of the chromosome may be determined from the percentage of double crossovers, which in this experiment was 2.88 per cent where 3.36 per cent is to be expected with no interference. This gives a value for coincidence of 0.86 which indicates very little interference in this analyzed section of the first chromosome.

As the backcross shown in Table I was made reciprocally, it becomes possible to determine whether crossing-over occurs with equal frequency in male and female gametogenesis. The calculated, total crossing-over percentage in microsporogenesis was 38.4 ± 3.8, and for megasporogenesis 34.8 ± 3.9, showing a difference of 3.6 per cent which indicates that crossing-over occurs slightly more frequently in pollen than in ovule formation, although this difference is not statistically significant.

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