THE EFFECT OF TEMPERATURE ON THE FREQUENCY OF SOMATIC CROSSING-OVER IN DROSOPHILA MELANOGASTER

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The frequency of crossing-over between chromosomes during gametogenesis is known to be subject to temperature influences. It seemed desirable to investigate a possible effect of temperature on *somatic* crossing-over.

Methods.—The occurrence of somatic crossovers in *Drosophila melanogaster* heterozygous for suitable factors results in the appearance of mosaic spots.[1] The number of spots is a measure of the frequency of somatic crossing-over. Females with the zygotic constitution Minute-*n*/yellow white singed[3] were inspected. They appear normal except for the presence of the short Minute-*n* bristles. Somatic crossing-over to the right of *Mn* leads to cells of the constitution *y w sn*^{3}/*y w sn*^{3} which appear as patches of yellow singed[3] setae or of white eye-facets according to the body region. Other types of crossovers result in different spots. Out of a total of 120 spots found during the course of this study 118 were derived from crossing-over to the right of *M-n*, 1 from crossing-over between *y* and *sn*^{3} and 1 from a double crossover on both sides of *sn*^{3}. The distribution of spots over different individuals was as follows: 109 flies with 1 spot each, 4 with 2 spots, 1 with 3 spots. The search for spots was restricted to an inspection of the macrochaetae and the eye only. All experiments were carried out by the junior author.

The flies were raised at three different temperatures—17° ± 0.5°C., 25° ± 0.1°C. and 29.5° ± 0.1°C. 2–3 *Mn*/+ females and 3–5 *y w sn*^{3} males were mated together in each culture bottle.

Results.—In order to compare the frequency of somatic crossing-over at 25° and 17° four sets of cultures were raised. They were started at different times from parental stocks which had not been highly inbred. Accordingly it is not surprising that the percentages of mosaic spots varied considerably (table 1). However, there was a high degree of correlation between the frequencies at the two temperatures for the different sets. In no case is the difference in percentage of crossing-over significant. This is borne out by the total of these experiments. At 25° a frequency of 12.7 ± 1.7 per cent was observed as compared to 11.4 ± 1.6 per cent at 17°. The difference between the two values is smaller than its standard error.

A significant difference was found in comparing somatic crossing-over at 25° and 30°. In both sets of experiments of this group a rather low percentage of mosaic spots at 25° was encountered, namely, 7.2 and 8.5 per

cent. The values at 30° were still lower, namely, 2.0 and 2.2 per cent. The total frequencies were 7.8 ± 1.6 at 25° and 2.1 ± 0.9 at 30°. The difference between these values is about 3.2 times its standard error.

A corroboration of this result is seen in an unpublished experiment performed in our laboratory by Mr. William James. His work was done in an

TABLE 1

NUMBER OF MOSAIC SPOTS IN MINUTE-*n* FLIES REARED AT DIFFERENT TEMPERATURES

SET	T°	NUMBER OF CULTURES	TOTAL M-N FLIES	TOTAL MOSAICS	% MOSAICS
1	25°	3	132	19	14.4
	17°	4	84	9	10.7
2	25°	3	129	11	8.5
	17°	4	135	11	8.1
3	25°	2	49	6	12.2
	17°	3	73	9	12.3
4	25°	5	85	14	16.5
	17°	5	84	14	16.7
Total 1–4	*25°*	*13*	*395*	*50*	*12.7 ± 1.7*
	17°	*16*	*376*	*43*	*11.4 ± 1.6*
5	25°	6	139	10	7.2
	30°	6	150	3	2.0
6	25°	3	142	12	8.5
	30°	3	92	2	2.2
Total 5–6	*25°*	*9*	*281*	*22*	*7.8 ± 1.6*
	30°	*9*	*242*	*5*	*2.1 ± 0.9*
W. J.	25.5°	19	345	16	4.6 ± 1.1
	29.5°	16	103	1	1.0 ± 1.0

earlier year at somewhat different temperatures and with different stocks (constitution of flies: Blond-Minute white/*y sn*^{3}). At 25.5° he obtained 4.6 ± 1.1 per cent of somatic crossing-over and at 29.5° 1.0 ± 1.0 per cent. Taken by themselves these values yield a difference which is not fully significant.

Discussion.—The result of these tests is that the frequency of somatic crossing-over in the X-chromosomes is low at 30° and high at both 25° and 17°. This is in contrast to most findings on the influence of temperature

on germinal crossing-over in *Drosophila melanogaster*, where the high temperature increases the frequency of crossovers as compared with the standard condition of 25°. But it should be remembered that an increase of temperature in the interval 13° to 25° can lead to a decrease of germinal crossing-over.[2]

It is interesting to compare the frequencies of mosaics known to be due to somatic crossing-over with those of mosaics due to "unstable" or "eversporting" genic loci. Gowen and Gay's data[3] with an eversporting eye color in *Drosophila melanogaster* "indicate that the incidence of eversporting varies inversely with temperature." Surrarer[4] in a striking series of observations on another unstable eye color obtained a corresponding result. Demerec[5] observed no difference in the rate of change of the unstable miniature-3 gamma gene of *Drosophila virilis* between 25° and 20°, but the value at 30° was slightly though significantly lower. Demerec interprets the lower number of mosaics at 30° as due to an observational error rather than to the effect of temperature. He points out that the wings of miniature flies reared at 30° are often wrinkled and only about half as large as those raised at 25°, so that minute mosaic spots are easily missed. In view of the results cited above it would be of interest to test the miniature-3 gamma case again and to determine if the low frequency at 30° is not due to an intrinsic cause.

The frequency of "normal" gene mutations varies directly with temperature. It is perhaps significant that the frequency of changes in "unstable" loci agrees with that of somatic crossing-over in that it varies inversely with temperature.

Summary.—The rate of somatic crossing-over between the X-chromosomes of *Drosophila melanogaster* was found not to be different at 17° and 25°, but lower at 30°. The results are compared with data from other authors on the influence of temperature on "unstable" genic loci.

[1] Stern, C., *Genetics*, **21** (1936). In press.

[2] Plough, H. H., *Jour. Exp. Zoöl.*, **24**, 147–209 (1917).

[3] Gowen, J. W., and Gay, E. H., *Science*, **77**, 312 (1933); *Genetics*, **19**, 189–208 (1934).

[4] Surrarer, T. C., *Genetics*, **20**, 357–362 (1935).

[5] Demerec, M., *Proc. Nat. Acad. Sci.*, **18**, 430–434 (1932).