Some Parameters of Mitotic Recombination
in Drosophila melanogaster

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Summary. 1. Somatic mosaicism in the tergites has been studied in both irradiated and control individuals. Several cell marker mutants, corresponding to eleven different loci scattered along the five major chromosome arms, have been characterized for their penetrance in marking spots.

2. Several of these mutants belonging to the same chromosome arms in cis and trans configuration yield comparable values of mosaicism, thus indicating their origin by mitotic recombination. Moreover, spots corresponding to double crossing-over events have been detected.

3. Recombination frequencies for mutants located in different chromosome arms have been studied in multiple heterozygous individuals. Their recombination frequencies are characteristic of the distances between their loci and their corresponding centromeres.

4. From the data on mitotic recombination for different loci of the same chromosome arm and of different chromosomes a mitotic recombination map was constructed. The map deriving from spontaneous recombination data differs in several respects from the data gained from irradiation experiments. The location of the different markers in irradiation experiments corresponds well with their cytogenetic location in the mitotic chromosomes.

5. Structural, physiological and developmental restrictions of mitotic recombination are discussed.

Introduction

Genetic mosaicism results from multiple insemination, somatic mutation or the uncovering of recessive alleles during development. The uncovering of recessive alleles may take place by a variety of mechanisms such as chromosome loss or inactivation, gene deletion, and especially by mitotic recombination (see Stern, 1968).

Mitotic recombination in Drosophila was first demonstrated by Stern (1936) to occur spontaneously between homologous chromatids in the 4 strand stage of the cell cycle. Genetic factors apparently control or modify the occurrence of genetic events related to spontaneous crossing-over (Bridges, 1925; Stern, 1936; Weaver, 1960; Ronen, 1964). Similarly, temperature (Stern and Rentschler, 1936; Kaplan, 1953; Brosseau, 1957) and ionizing radiations (Patterson, 1929; Friesen, 1935; Shapiro, 1941; Lefevre, 1948; Becker, 1957, and many others) induce the occurrence of somatic spots possibly due to mitotic recombination. In spite of important work devoted to elucidate the conditions of the mitotic recombination, it remains very much of a mystery. And yet the increasing interest in somatic cell genetics and clonal analysis of development requires a more thorough knowledge of the mitotic recombination parameters.
The present work is aimed to study the occurrence of mitotic recombination in different chromosome arms and within different regions of the same chromosome. Attention will be paid to both, induced and spontaneous recombination, in order to compare both processes.

We will study mitotic recombination in the histoblasts giving rise to the adult tergites, as previous authors did (Stern, 1936; Brosseau, 1957; Abbadessa and Burdick, 1963; Walen, 1964, and others) especially since the developmental parameters of such organs have been previously worked out (García-Bellido and Merriam, 1971).

**Material and Methods**

The cell marker mutants used in the present work can be classified in three groups: A) a trichome marker, *mwh* which changes in the abdomen the density of cell processes; B) colour mutants, *y* and *stw* which make yellow and pale chaetes, respectively; and C) shape mutants of the chaetes, *sn*, *f$, *je*, *Ki* and *Sb*, which characteristically change the structures of the trichogen element of the chaetes (Fig. 1). The genetic and cytogenetic location of these mutants is presented in Table 10 and in Lindsley and Grell (1968). *Ki* appears to be located in the right arm of the third chromosome, in view of its behavior in mitotic recombination (Merriam and García-Bellido, 1969).

Somatic mosaicism was induced by X-rays (Philips MG 151 Be; 150 r/min, 100 kV, 15 mA and 2 mm Al filter) at a total dose of 500 r and in some experiments, indicated in text, of 1000 r, doubling the exposure time. Larvae of all ages of the different crosses were irradiated and collected as pupae, every 24 hrs. This method permits to calculate the age of the larvae at the moment of irradiation since these doses of X-rays do not retard larval development (García-Bellido and Merriam, 1971). Non-irradiated sib flies of the same experiments were used as controls.

The following genotypes were studied in order to detect somatic mosaicism. In the following description the first genotype of each chromosome derives from the maternal stock, the second one from the paternal stock:

1. $y^{F60}/++$
2. $y/++$
3. $y^{sn^{3}}/++$

![Diagram](image)

**Fig. 1.** Meiotic loci and phenotype of the different mutants used