

## Spontaneous recombination in males of *Drosophila bipectinata*

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**Abstract.** Spontaneous recombination in males of *Drosophila bipectinata* was tested in five wild type laboratory stocks of different geographic origins by using sepia eye and black body colour double recessive mutant stock. The results indicate that *Drosophila bipectinata* exhibits spontaneous male recombination. Further, recombination occurs at low rate and there is interstrain variation with respect to the rate of male crossing-over. This is the first report of spontaneous recombination in males of *Drosophila bipectinata*.

**Keywords.** Spontaneous recombination; males; *Drosophila bipectinata*.

### 1. Introduction

Since the discovery of absence of male recombination in *Drosophila melanogaster* (Morgan 1912), this phenomenon has been investigated in several species resulting in reports of spontaneous male recombination in *D. melanogaster* (Patterson and Suche 1934), *D. ananassae* (Kikkawa 1938; Moriwaki 1940; Kale 1969; Hinton 1970; Singh and Singh 1988), *D. simulans* (Woodruff and Bortolozzi 1976), *D. virilis* (Kikkawa 1935), *D. littoralis* (Coyne 1988) and *D. willistoni* (Franca *et al* 1968). However, it occurs at a very low rate in all of these species with the exception of *D. ananassae* which exhibits an appreciable level of spontaneous male recombination.

*D. ananassae* is unique in the whole of genus *Drosophila* due to the presence of spontaneous male recombination in appreciable frequency (Singh 1985). In certain strains, the total recombination frequency in males was found to approach the recombination frequency observed in females (Hinton 1970). Spontaneous male recombination in *D. ananassae* is meiotic in origin (Kale 1969) and is influenced by various genetic factors such as enhancers, suppressors, polygenes and heterozygous inversions (see Singh and Singh 1988). Matsuda *et al* (1983) showed the presence of chiasmata at a frequency capable of accounting for the observed recombination values in *D. ananassae* males.

*D. bipectinata* is a member of the *bipectinata* species complex of the *ananassae* subgroup of the *melanogaster* species group (Bock and Wheeler 1972). It is of common occurrence in India (Gupta and Panigrahy 1990). Chromosome inversions and spontaneous mutations have been detected in Indian populations of *D. bipectinata* (Gupta and Panigrahy 1990; Hegde and Krishna 1995; Singh *et al* 1995a, b; Banerjee and Singh 1996). *D. ananassae* and *D. bipectinata* are the members of the *ananassae* subgroup of the *melanogaster* species group. *D. ananassae* shows considerable level of spontaneous male recombination but it has not been studied in *D. bipectinata*. In view

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of this, we tested whether spontaneous male recombination occurs in *D. bipectinata* by employing a double recessive mutant stock and five wild stocks of different geographic origins and the results are reported in this communication.

## 2. Materials and methods

For this study a double recessive mutant stock (*se b*) was prepared by crossing stocks fixed for the autosomal recessive mutations *se* (sepia) and *b* (black body) respectively. Both these markers are located in the second chromosome and map distance between *se* and *b* is 33.75 map units (B N Singh and Rakhee Banerjee, unpublished results). Male recombination was studied in five wild type mass culture laboratory stocks of *D. bipectinata* which were raised from flies collected from different geographic localities: (i) BHU (Varanasi, UP—1987), (ii) SG (Siliguri, West Bengal—1993), (iii) MY (Mysore, Karnataka—1995), (iv) PG (Panagarh, West Bengal—1995) and (v) TD (Trivandrum, Kerala—1996).

All these stocks were established from several flies collected from different geographic localities. Since they were established at different times, they have spent varying number of generations in the laboratory. All these stocks are being maintained in the laboratory on simple culture medium under standard laboratory conditions (temperature approximately 24° C).

### 2.1 Common plan of the experiment

All the wild type and *se b* mutant stocks were cultured in food bottles and virgin females and males were collected. In all the crosses 2–3 day old flies were used. For parental cross wild type virgin females were mated with *se b* mutant males in food bottles. Newly eclosed heterozygous males were collected from among the F<sub>1</sub> progeny and aged for 2 days in food vials. Ten F<sub>1</sub> males were then test crossed with ten *se b* virgin females in food bottles. For each wild type stock test cross was made in five bottles and each set was transferred to fresh food bottles after three days. The parental flies were discarded after the third transfer. Thus, for each stock there were twenty culture bottles. F<sub>2</sub> progeny were scored for each stock and each bottle separately and numbers of phenotypically distinct flies were noted irrespective of sex.

## 3. Results and discussion

Phenotypic analysis of the F<sub>2</sub> progeny showed the presence of recombinants in four out of the five stocks tested (table 1). The rate of recombination in males in different wild stocks varied from 0.00 to 0.17 %. When the results of all the stocks were combined the average rate of male recombination was 0.08%.

It is evident from the present results that *D. bipectinata* exhibits spontaneous male recombination although some populations may not show recombination in males.

In comparison to other species of *Drosophila* in which male recombination has been studied, *D. bipectinata* shows considerably high degree of male recombination; in most species (except *D. ananassae*), spontaneous male recombination is very rare. Patterson and Suche (1934) found only one recombinant among 8329 third chromosomes marked

**Table 1.** Results of a test cross between *se b* females and heterozygous males (+ + / *se b*) of *D. bipectinata*.

| Wild stocks | No. of parental types |             | No. of recombinant types |            | Total no. of progeny examined | Crossing-over: (%) |
|-------------|-----------------------|-------------|--------------------------|------------|-------------------------------|--------------------|
|             | + +                   | <i>se b</i> | <i>se</i> +              | + <i>b</i> |                               |                    |
| BHU         | 730                   | 443         | 0                        | 2          | 1175                          | 0·17               |
| SG          | 1755                  | 1511        | 3                        | 2          | 3271                          | 0·15               |
| MY          | 1817                  | 1417        | 2                        | 1          | 3237                          | 0·09               |
| PG          | 1360                  | 1274        | 0                        | 0          | 2634                          | 0·00               |
| TD          | 1954                  | 1508        | 1                        | 1          | 3464                          | 0·05               |
| Total       | 7616                  | 6153        | 6                        | 6          | 13781                         | 0·08               |

with eight recessive genes in *D. melanogaster*. The possibility of male recombination at very low rate was suggested in certain populations of *D. simulans* by Woodruff and Bortolozzi (1976). Kikkawa (1935) found three recombinants in males of *D. virilis* out of 38598 progeny examined. Coyne (1988) found crossing-over in only one strain (at frequency 0·0017) out of three strains tested in males of *D. littoralis*. On the other hand, we found male recombination in four out of five strains tested in *D. bipectinata*. Thus the results of present study suggest that *D. bipectinata* shows high frequency of recombination in males as compared to *D. melanogaster*, *D. simulans*, *D. virilis* and *D. littoralis*. However, it shows very low frequency of male recombination when compared with *D. ananassae* which is characterized by appreciable level of male recombination. Thus both these species differ in the level of spontaneous male recombination although they belong to the same species subgroup and have similarities in their chromosomal constitution such as same number of chromosomes and identical pattern of chromosome arms in polytene chromosomes (Singh and Gupta 1979; Panigrahy 1984).

The low rate of spontaneous male recombination in *D. melanogaster* has been explained by suggesting that it is mitotic in origin. This suggestion is based on the clustered appearance of crossovers (Whittinghill 1947). Further mitotic crossing-over is unaffected by heterozygous inversions (Ramel 1962). Sinclair and Grigliatti (1985) also presented evidence for the premeiotic origin of recombination in *D. melanogaster* males associated with hybrid dysgenesis. These observations clearly suggest the premeiotic origin of crossovers in *D. melanogaster* males. Gethmann (1988) suggested that mitotic crossing-over occurs at a low frequency in all diptera.

*D. ananassae* shows spontaneous male recombination in considerable frequency (Kikkawa 1938; Moriwaki 1940; Kale 1969; Singh and Singh 1988). Based on equality of complementary crossovers, Kale (1969) suggested that spontaneous male recombination in *D. ananassae* is meiotic in origin. This has been confirmed by genetic data of Hintotr (1970) and Moriwaki *et al* (1970). The observation of chiasmata in males of *D. ananassae* (Matsuda *et al* 1983) and effects of heterozygous inversions on spontaneous male recombination (Singh and Singh 1988) lend further support to the previous suggestion that spontaneous male recombination in *D. ananassae* is meiotic in origin. Kale (1969) studied male recombination in four wild strains of *D. ananassae* and found significant variation among the strains. He suggested that it results from difference in the genetic constitution of the strains which extends

evidence for genotypic control of this phenomenon. Positive response to selection for high and low spontaneous male recombination in *D. ananassae* extends evidence for polygenic control of this phenomenon (Mukherjee 1961; Kale 1968; Mohanty and Singh 1992).

It is evident from the present results that *D. bipectinata* shows spontaneous male recombination and the rate of male recombination varies among different strains which is likely to be due to genetic heterogeneity among the strains as they were derived from different geographic localities.

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