



Mating activity of *yellow* and *sepia* *Drosophila willistoni* mutants

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Received 16 June 2005; accepted 16 June 2005

Abstract

By analyzing the mating activity of newly isolated *yellow* and *sepia* mutants of *Drosophila willistoni* no difference in behavior between *sepia* and wild-type flies were observed, whereas *yellow* males were less successful than wild-type males when competing for females. These results are in agreement with those reported for other *Drosophila* species. *D. willistoni* was different in the ‘females-competing’ crosses because wild-type males mated more frequently with wild-type females whereas *yellow* males mated successfully with both phenotypes. These results indicate the complexity of the courtship behavior in *D. willistoni* and provide data for comparative and evolutionary research into the genus.

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Keywords: *Drosophila willistoni*; Mating success; *sepia*; Sexual behavior; *yellow*

1. Introduction

Mating in *Drosophila* depends on complex interactions between the sexes consisting of the interchange of visual, acoustic, and chemical stimuli (Ehrman, 1978; Spieth and Ringo, 1983; Cobb and Ferveur, 1996; Yamamoto et al., 1997). In *Drosophila*, male competition for mates depends on the male rate of orientation, ability to maintain orientation on rapidly moving females, persistence and courtship vigor, while females can present differences in the level of their receptivity

(Spieth and Ringo, 1983). Mating speed or copulation latency (the time elapsed between the first encounter of a courting pair of flies and their copulation) is, therefore, both a measure of female receptivity and male courtship efficiency and intensity (Casares et al., 1992).

One of the major problems in behavior genetic studies is pleiotropy, or the production of multiple phenotypic effects originating from one genotypic effect (Hall, 1994; Cobb and Ferveur, 1996; Sokolowski, 2001). A wide variety of genes influence *Drosophila* courtship patterns and many different kinds of pleiotropic mutations lead to defective courtship (Hall, 1994; Yamamoto et al., 1997). Any mutation that promotes a deleterious effect on the well-being

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of the organism will reduce mating success if the fly cannot produce the required level of reproductive activity (Hall, 1994; Cobb and Ferveur, 1996; Sokolowski, 2001). Nowadays, behavior geneticists are having to come to terms with the fact that genes have pleiotropic effects, that multiple splicing can produce more than one gene product, that genes may be active in different tissues at different moments in development, with different consequences, and finally that the delicately balanced homeostatic system that constitutes any organism can easily be disrupted by a cascade of interacting effects (Cobb and Ferveur, 1996).

Sturtevant (1915) showed that *yellow* (*y*) *Drosophila melanogaster* males are usually unsuccessful in competition with wild-type males for females, and low mating success of *yellow* males has also been observed by Rendel (1944) in *Drosophila subobscura*. The *yellow* locus controls the melanotic pigment pattern of the cuticle of the adult fly and the pigmented mouth parts and denticle belts of the larval cuticle (Lindsley and Zimm, 1992). Recently, Drapeau (2001) reported the presence of 12 Yellow-like proteins in *D. melanogaster*. However, little is still known about the biochemical function of Yellow in general.

D. melanogaster yellow males have been observed to court abnormally (Bastock, 1956; Burnet and Connolly, 1974; Wilson et al., 1976), which may be because such pigment defects go hand-in-hand with neurochemical anomalies (Hall, 1994). Burnet and Connolly (1974) have suggested that the *yellow* gene affects the pathways leading to the synthesis of both the pigment melanin and the catecholamines involved in neural transmission, and because of impaired catecholamine production, the behavioral effects of the *yellow* gene may have a neurochemical basis. Null mutants of *y* disrupt wing extension, a specific male courtship behavior (Bastock, 1956; Burnet et al., 1973; Drapeau et al., 2003). Radovic et al. (2002) demonstrated that Yellow protein is associated with male-specific fruitless protein in a subset of neuroblasts in third-instar larval male brains. The recent work of Drapeau et al. (2003) suggests that Yellow is important for the normal development of *D. melanogaster* male wing extension, and *y* expression in the developing central nervous system is downstream of the *fruitless* gene that is hypothesized to regulate a genetic hierarchy specifying the development of adult male courtship behavior (Baker et al., 2001; Sokolowski, 2001).

The *sepia* phenotype has brown eye color at eclosion, which darkens to sepia and becomes black with age. The *sepia* gene responsible for this change is thought to be the structural gene for the enzyme PDA synthetase catalyzing the conversion of 6-pyruvoyltetrahydropterin to 2-amino-4-oxo-6-acetyl-7,8-dihydro-3H,9H-pyrimido [4,5,6]-[1,4] diazepine (PDA), which is a precursor of the red drospterin pigments (Lindsley and Zimm, 1992). Anxolabehere (1980) observed that *sepia* males had lower mating success when competing with wild-type *D. melanogaster* males and suggested that the *sepia* locus itself or closely linked genes played a role in mating success. However, other studies with *D. melanogaster* (Markow, 1978) and *Drosophila ananassae* (Singh and Chatterjee, 1989) found that both wild-type males and *sepia* males were equally successful in mating when present in the same ratio.

Despite the wealth of studies on the genetics of *Drosophila* courtship behavior, we have no clear answers to many problems concerning the genetic bases and the evolution of various elements of courtship (Cobb and Ferveur, 1996). The study of *Drosophila* courtship behavior was mainly performed on the species of the *D. melanogaster* subgroup, however for comparative and evolutionary behavioral research other species have to be studied. In the present work we present the results of mating activity analysis of *yellow* and *sepia* mutant phenotypes of the Neotropical species *Drosophila willistoni* (subgenus *Sophophora*) with the aim of contributing to the knowledge on the behavioral consequences of the appearance of new genetic variants.

2. Materials and methods

The *yellow* and *sepia* mutant phenotype lines of *D. willistoni* arose spontaneously in two different laboratory-reared isofemale lines. Three males with a *yellow*-like phenotype arising in the Dois Lajeados line (28°98'S/51°83'W, south Brazil) and five males with a *sepia*-like phenotype in the line collected at Santana Hill (30°04'S/51°31'W, south Brazil). It is important to note that mutant flies were isolated from just one highly inbred isofemale line. Moreover, to lessen the difference in the genetic background between mutant and wild-type lines the mutant males were crossed with virgin wild-type sisters, and one

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