Van den Haute, J.P. and A. Elens.
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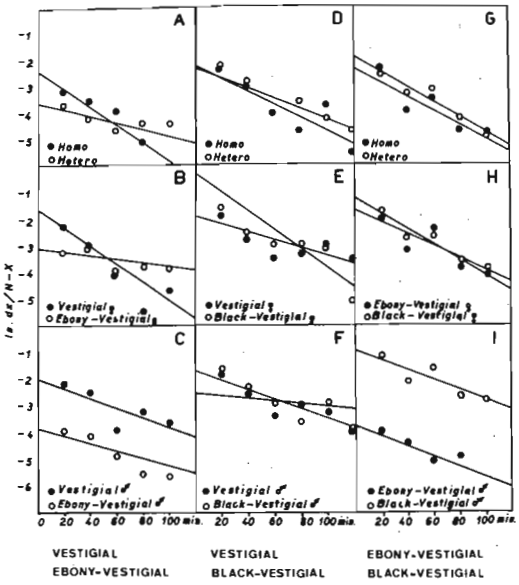
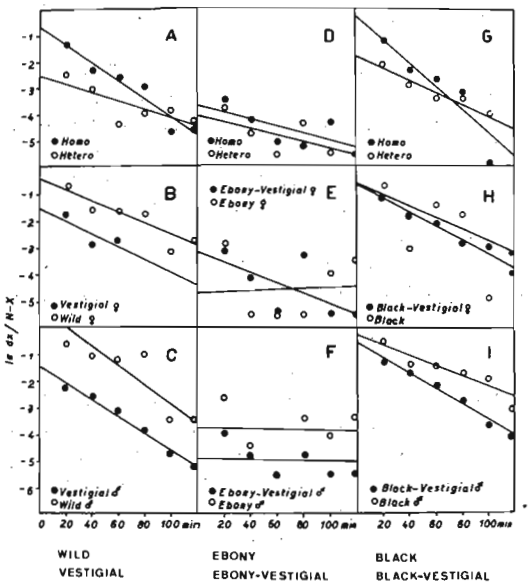
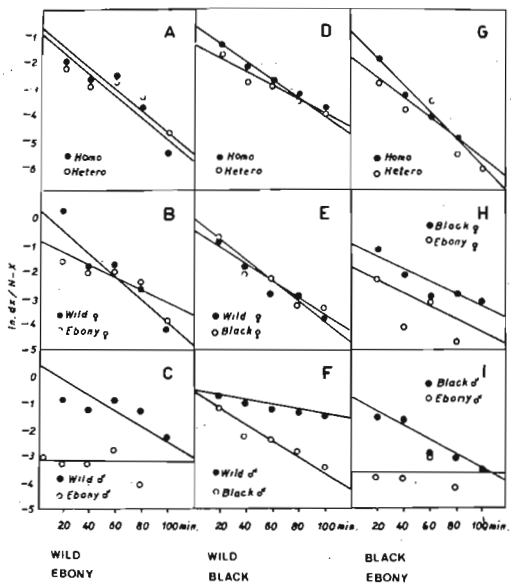
Sexual selection is a complex phenomenon. Various factors, some of which control the choice of a partner, and others control sexual activity as such, are at work at the same time. According to Faugères et al. (1971), in the beginning of the experiments of sexual selection ethological factors are primordial, but when the most receptive females are inseminated, only the males vigorous enough to court a long time have some chance to succeed with the less receptive females; the metabolic factors, controlling the sexual activity, are predominant.



To reach a deeper understanding of the phenomenon of sexual selection, it is therefore necessary to use a method enabling us to distinguish between both types of factors and to follow their action in the course of time. It seems that a method described in 1964 by Wattiaux can help in this way; the purpose of the present paper is to show its application to some cases of sexual competition between various strains of D. melanogaster.

In the multiple choice direct observation method fully described elsewhere (1958, 1964) and which has been successfully used by many authors, the graphic expression of the mating successes are curves beginning exponentially but ending as sigmoids approaching plateaux, the levels of which differ. The results of the comparisons between the various genotypes in competition can be biased by the time at which the observation is ended. Consequently it seems better to turn into straight lines the curves of mating successes, by logarithmic transformation; the value of the measure becomes independent from time.





In the formula of Wattiaux

$$\frac{dx_A}{(n_A - x_A)dt} = bk\, e^{-kt}$$

n_A is the total number of individuals of one sex and genotype, dx_A the number of these flies mating in the interval of time dt, and x_A the number of these flies having mated. After logarithmic transformation

$$\ln \frac{dx_A}{(n_A - x_A)dt} = \ln bk - kt = a - kt \qquad \text{if} \qquad b = \frac{e^a}{k}$$

The two constants a and k can easily be estimated from the regression line

$$\hat{Y} = A - k(X - \bar{X}) \quad \text{where} \quad a = A + k\bar{X}.$$

The superiority of such an expression of the sexual activity or sexual isolation on other indices or coefficients generally used is grounded on the biological signification of the constants A and k . They give information not only on the level of sexual activity but on its variations with time as well. A steep slope of the regression line means that the sexual vigor falls rapidly after the first minutes initiating the competition. In this case the ethological factors are predominant. On the other hand, if the slope is not marked, the sexual vigor remains constant and the metabolic factors prevail.

The figures here presented concern 9 pairs of strains in competition. They give the regression lines allowing a comparison between homogamic and heterogamic matings, between the copulations of the females of both strains in competition, and also between copulations of the males. Table 1 shows the results of a covariance analysis.

Table 1. Probability of no significant differences.

Strain A	Strain B	Homogamic versus Heterogamic Matings		Males A versus Males B Activity		Females A versus Females B Activity	
		Difference		Difference		Difference	
		Slope	Elev.	Slope	Elev.	Slope	Elev.
vestigial	x ebony vestigial	-	-	-	c	-	-
vestigial	x black-vestigial	-	-	-	-	-	-
black-vestigial	x ebony-vestigial	-	-	-	b	-	-
wild	x vestigial	-	-	-	c	-	-
ebony	x ebony-vestigial	-	-	-	a	-	-
black	x black-vestigial	-	-	-	c	-	-
wild	x ebony	-	-	b	-	-	-
wild	x black	-	-	-	c	-	-
black	x ebony	-	-	a	b	-	b

- = non-significant a = $P < 0.100$ b = $P < 0.025$ c = $P < 0.005$

This indicates that a significant isolation is never found, for any of the pairs of strains in competition. Of course, the "isolation estimates" calculated according to Merrel (1950), should give the appearance of an isolation between wild and vestigial ($I = 0.45$; $X^2 = 28.57$) or black and black-vestigial ($I = 0.56$; $X^2 = 16.13$). Yet, the "isolation indices" calculated according to Petit and Ehrman (1968) for the same pairs of strains are not high enough (respectively 2.02 ± 0.15 and 1.72 ± 0.10) to confirm this opinion. But the comparison of the regression lines gives more information: the figures presented visualize quite well how the ratio of heterogamic on homogamic copulations increases with time: similar fluctuations are not uncommon (see also the case of vestigial with ebony-vestigial) and have yet been previously described (1970).

If one excepts the case of black and ebony, the females genotypes have not influence. But the most striking differences appear in comparing the male sexual activities (see Table 1)

Particularly demonstrative is the behaviour of the males ebony: the elevation of the regression line is always relatively low, but the slope is never a steep one, and such characteristics appear when in competition with wild, black, or ebony-vestigial. The sexual activity of the males ebony, although never high, remains however remarkably constant with time (a confirmation of which is easily obtained by extending the duration of observation to 4 or 6 hours); such a constance of the vigor may help (with other factors as e.g. heterosis) in protecting ebony from elimination when in competition with his wild type allele. On the other hand, the steeper slope of their regression line shows that the sexual activity of the wild males, high in the beginning of the experiment, falls rapidly; the black males behave similarly, but with a lower level of activity. For both the vigor factors seem less important than the ethological ones. The presence of the vestigial gene is in every case responsible for a lowered male sexual activity, but is does not change otherwise the behavioural characteristics of the wild, ebony or black males, since the slopes of the regression lines are nearly the same.

Generally speaking, the results of the covariance analysis are, for the male activities,

in good agreement with the calculated values of the Petit and Ehrman indices and even of the Merrel coefficients; but the comparison of the regression lines seems more interesting, in enabling us to make obvious the part played by the vigor factors.

References: Elens, A. 1958, Experientia 15:274; Elens, A. and J.M. Wattiaux 1964, DIS 39:118; Faugères, A., C. Petit and E. Thibout 1971, Evolution 25:265; Merrel, D.J. 1950, Evolution 4:326; Petit, C. and L. Ehrman 1968, Bull. Biol. 102:433; Wattiaux, J.M. 1964, Z. Vererbungsl. 95:10; Wattiaux, J.M. and A. Elens 1964, DIS 30:118.

Mahajani, S. and V.L. Chopra, Indian Agricultural Research Institute, New Delhi, India. Nitrosoguanidine mutagenesis in Drosophila melanogaster.

Nitrosoguanidine (NG) is extensively used as a mutagen in a wide variety of organisms. In Drosophila melanogaster, NG has been shown to be effective in inducing mutations in mature sperm (Khan, 1968 DIS 43:162) by feeding adult males with solution of NG in glucose, and in all stages of spermatogenesis (Browning, 1969 Mutat. Res. 8:157) following injection of saturated solution of NG into adult males. We have been studying NG mutagenesis in D. melanogaster with a view to reinvestigating the finding that the time of action of NG, at least in part, corresponds to the time of meiotic DNA synthesis in the testis. The results of some of our experiments are briefly outlined below.

Both the adult feeding method (0.05% NG in 5% glucose) and injection of NG (0.01%, in distilled water) were used. Treated males were mated to a succession of Muller-5 virgins so as to determine the mutagenic effectiveness of NG for different germ cell stages. Mature sperm were found to give the highest response to the mutagenic action of NG (SLRL frequency in the first brood was 9.1% and 6.5% for feeding and injection methods respectively). Further the two methods were found to give very similar results at concentrations which produced comparable sterility. However, premiotic germ cell stages of the treated adults remained, largely refractory to NG action. The percentage mutation (SLRL) frequencies in a representative experiment for 6 three-day broods were: 8.98, 5.61, 2.42, 0.48, 0.58 and 1.13. The considerable mutagenic effect observed for the earlier broods thus disappears by the 4th brood onwards (i.e. 10 days after treatment) when our brooding technique will sample treated spermatocytes and spermatogonia.

Treatments to larvae were next undertaken to ensure effective treatment of the premeiotic germ cell stages. Two treatment methods were used: (1) larvae were reared on basal medium containing 0.06% NG and (2) larvae were fed on 0.03% solution of NG in distilled water for 12 hours and then allowed to complete development on basal medium. Smaller, but significant, frequencies of SLRL (3.3% and 3.6% respectively) were induced in 24 hour larvae (egg laying time) by both these methods.

Table 1

Age of treated larvae (hours)	% SLRL in broods (3 days, 2♀♀/♂) 1	2	3
24	3.85	3.31	2.67
36	2.73	3.22	1.33
48	2.16	1.76	0.00
60	3.16	0.00	0.00
72	2.05	2.43	0.20
84	1.07	0.00	0.00

(frequencies based on a minimum of about 500 tested chromosomes from 50-60, treated males)

When feeding of 0.05% NG in medium was extended to larvae of different ages and SLRL frequencies were determined in successive broods from emerging males, the results shown in Table 1 were obtained. The following conclusions emerge from the data in Table 1.

(1) For a particular age of treated larvae, the mutation frequencies decline in successive broods. This is true even for successive batches of treated spermatogonia which will be sampled, for example, in treatments of 24 and 36 hr larvae.

(2) Where analysis of successive broods permits comparison between sensitivities of spermatogonia and spermatocytes (e.g. 48 hr and older), the latter give higher mutation frequencies.

(3) The conclusion in (2) above, however, has to be viewed in the context of age of the treated larvae and the mutation frequencies obtained therefrom. For, as is obvious, the older the treated larvae, the smaller is the mutagenic effect of NG treatment.