INFLUENCE OF SELECTION ON THE VIABILITY OF IRRADIATED EXPERIMENTAL POPULATIONS OF *DROSOPHILA MELANOGASTER*¹

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Received June 26, 1967

SANKARANARAYANAN (1964, 1965a, b, 1966) has reported the results of studies on radiation-induced genetic loads and the egg-to-adult viability in experimental populations of *Drosophila melanogaster*. These populations were maintained under conditions designed to minimize larval competition and crowding (for details, see the references cited above). Populations in which the males were irradiated generation after generation showed a decline of the viability for the first four or five generations, after which equilibria were attained, the levels of which depended on the amount and the history of the radiation exposure. Subpopulations derived from such "chronically irradiated" populations after 1, 5, 10, 15, 20, etc., generations of irradiation and propagated without further irradiation recovered rapidly; most of them reached 90 to 95% of the viability of the control population in three to seven generations, while others recovered less fully. In the latter category were the three subpopulations designated as VI-ER-20, IV-ER-30 and II-EGR-60 whose viability records were followed more closely. Each of them had received a total dose of 120,000r of X-irradiation. However, this dose of irradiation had been delivered over 20 generations in VI-ER-20 (6000r/generation), 30 generations in IV-ER-30 (4000r/generation) and 60 generations in II-EGR-60 (2000r/generation) as acute exposures to the males in every generation. Following the cessation of the irradiation, there was an increase in the viability for the first four or five generations, after which near-plateau levels of between 69 and 77% were reached (compared to the control level of about 90%). VI-ER-20 has remained at the equilibrium level for 54 generations, IV-ER-30 for 44 generations, and II-EGR-60 for 31 generations.

It was considered of interest to examine whether this situation was due to the relaxed natural selection conditions under which these populations were maintained. To test this hypothesis, the populations were transferred and propagated in population cages, and thereby were exposed to stringent competitive conditions. The present communication summarizes the results of studies on egg-to-adult viability in these cage populations.

MATERIALS AND METHODS

A description of the populations studied is given in Table 1. 250 pairs of parents were introduced into lucite cages (32 × 27 × 10 cm) having room for 15 food cups. The cages were main-

¹ The work reported here was carried out under Contract No. AT-(30-1)-3096, U.S. Atomic Energy Commission.

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TABLE 1
Description of the populations

Cage	Derived from parent population	At generation*	Started
A (control)	C-1	65	January 13, 1965
B	II-EGR-60	18	January 13, 1965
C	IV-ER-30	31	January 13, 1965
D	VI-ER-20	41	January 13, 1965

* Contemporaneous generations in the parent populations.

tained by the insertion of a new food cup twice a week. The populations were allowed to expand under cage conditions. Periodic egg samples were taken by inserting into the cages several paper spoons (with cornmeal-molasses-agar medium darkened with charcoal and yeasted with a thick suspension) for about 2 to 3 hours. For each population a sample of 900 eggs was counted and transferred to 15 half-pint culture bottles with standard *Drosophila* medium (60 eggs/bottle) and allowed to develop into adults under near-optimal conditions. The first egg-samples were obtained after 30 days from the initiation of the cages and subsequent ones at 25-day intervals, approximately corresponding to a generation under the cage conditions (BARKER 1962). Complete counts of the flies emerging in each bottle were made.

RESULTS AND DISCUSSION

Table 2 presents the data on the egg-to-adult viabilities in the experimental population. In the control, there had been no change in viability. However, a rather striking and rapid improvement is noticed in all the populations with radiation histories. In about two to three generations from the start, the viability levels increased to more than 90% of that of the control and in subsequent generations, the viability records of these populations become almost indistinguishable from that of the control. These observations are thus in striking contrast to those recorded for the populations maintained under relaxed selection conditions. In the latter populations, the viabilities remained at a near-plateau level between

TABLE 2
Egg-to-adult viability in the experimental populations

Days	Populations			
	A	B	C	D
0*	88.5	71.7	70.7	73.0
30	88.8	77.7	75.0	82.7
55	88.1	78.9	77.9	82.4
80	88.5	82.6	80.4	84.3
105	89.8	84.4	82.8	85.0
130	88.6	84.7	83.6	86.9
155	90.0	85.3	84.4	86.7
180	89.0	87.0	86.8	87.5

* Viability in the parent populations at the time of starting of the cages.

69 and 77% for the different populations for the comparable period. This is far below the control level (SANKARANARAYANAN 1966).

It is tempting to postulate that the causal mechanisms that underlie the steep increase in viability in the cage populations are presumably the opposite of those operating in populations VI-ER-20, IV-ER-30 and II-EGR-60 where a consistent lowering of viability was observed. The magnitude of concealed genetic loads as measured by the frequencies of lethal and semilethal second chromosomes perhaps offers little clue to the situation, since it was found that populations VI-ER-20, IV-ER-30 and II-EGR-60 are widely different in this respect despite the similarity in their egg-to-adult viability records (SANKARANARAYANAN 1966). This finding, coupled with the evidence obtained for the existence of some heterotic lethals at least in one population—VI-ER-20, points to the possibility that the qualitative nature of the genetic loads in these populations might be different.

The observed rapid increases in viability in the cage populations over the first two or three generations can be accounted for if it is assumed that during this period, natural selection has efficiently eliminated those genetic variants that were deleterious under the cage conditions. Likewise, the dynamics of the remaining components of the genetic loads will be dictated entirely by their effects on population fitness under the new conditions. Mutants that may not have been beneficial to their carriers on the genetic background and under conditions in which they arose and were retained may form new combinations and may be adaptively incorporated into the gene pools of the populations. Essentially a similar phenomenon was recorded by AYALA (1966) in his radiation experiments with populations of *D. birchii* and *D. serrata* where the parameters chosen were population size and productivity.

A genetic analysis of our cage populations carried out by SALCEDA (1967) reveals that in these populations, the frequencies of lethals and allelism rates are quite high (in addition to their high egg-to-adult viability) suggesting that many of these lethals that were present in these populations were still retained, and at least some of them were multiplied by natural selection, even under the stringent conditions obtained in the cage environments.

It is a pleasure to thank PROFESSOR TH. DOBZHANSKY for his encouragement and critical reading of the manuscript and PROFESSOR F. H. SOBELS for his hospitality.

SUMMARY

Cage populations were made from three populations with past radiation histories and a control population, which were maintained under conditions designed to minimize larval crowding. The egg-to-adult viability remained at plateau levels of between 69 and 77% (far below that of the control) for periods ranging from 31 to 54 generations in the different parent populations. Under the cage conditions, the viability in all the populations increased to more than 90 to 95% of the control value in about two generations, and later on these were almost indistinguishable from the control level. It is suggested that the rapid rise in viability is a consequence of intense selection prevailing under cage conditions. Presum-

ably mutants that were unfavorable in the new environment were eliminated rapidly and those that were favorable were retained and multiplied.

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