SHORT COMMUNICATION

THE EFFECT OF INBREEDING ON VIABILITY IN *DROSOPHILA SIMULANS*

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The effect of inbreeding on the egg to adult survival values was examined for *D. simulans* over a wide range of inbreeding levels ($0 < F < 0.886$). Viability was found to be a curvilinear function of the inbreeding coefficient, indicating synergistic interaction among loci.

For the estimation of the amount of deleterious mutations which are concealed in populations, two ingenious methods have been developed, one by Morton, Crow and Muller (1956) and the other by Greenberg and Crow (1960). In the latter method, the amount of genetic load can be directly measured by homozygous viability depression at $F=1$, after having made certain chromosomes completely homozygous by a series of crosses using genetic markers and complicated inversions available in few species of *Drosophila*. In the former method, on the other hand, one can be calculated by regressing viability on the inbreeding coefficient, F . With these two different techniques, a great deal of study have been carried out to estimate the magnitude of genetic variability in various species of *Drosophila* and other organisms.

It has been shown that the values evaluated by these two independent methods do not coincide for a given population (Dobzhansky *et al.* 1963; Malogolowkin-Cohen *et al.* 1964). That is, the homozygous load estimated by the Greenberg and Crow method is larger than the one calculated using the Morton, Crow and Muller method. The discrepancy might be partly explained by the difference in viability measurements of these two methods and partly by the synergistic interaction at higher degrees of inbreeding. Considerable evidence for synergistic interaction among deleterious alleles at different loci in *Drosophila* was accumulated (Spassky *et al.* 1965; Temin *et al.* 1969; Mukai 1969; Kosuda 1971).

Kosuda (1972) clearly demonstrated synergistic effect in *D. virilis* applying the Morton, Crow and Muller method at considerably higher degrees of inbreeding ($0 < F < 0.734$). The purpose of the present study is to examine the effect of inbreeding on egg to adult survival values in *D. simulans*, and to show a further evidence for synergistic interaction at higher levels of inbreeding. *D. simulans* is one member of

Table 1. Egg to adult viability in outbred and inbred progenies

F	n	Viability	$-\log_e(\text{Viability})$
0	239	.7649 $\pm$.0105	.2680
.250	221	.7584 $\pm$.0101	.2765
.375	220	.6167 $\pm$.0115	.4834
.500	208	.5339 $\pm$.0157	.6275
.594	200	.5488 $\pm$.0163	.6000
.672	202	.5230 $\pm$.0185	.6482
.734	163	.4119 $\pm$.0213	.8870
.886	175	.2320 $\pm$.0150	1.4610

Table 2. Analysis of variance for regression

Source	df	S.S.	M.S.	F
Regression	2			
Linear	1	.7838	.7838	52.25**
Quadratic	1	.1707	.1707	11.38**
Residual	5	.0752	.0150	
Total	7	1.0297		

chromosomally monomorphic species as well as *D. virilis*. The experimental method is essentially the same as Kosuda (1972). Many isofemale lines were established from a natural population in Ogasawara island, Japan and maintained by full sib-pair matings every generation. The survival rate of inbred progenies from each isofemale line were successively measured every generation with four to eight replicate cultures. Fifty eggs were placed in each culture vial. The temperature was maintained at $25\pm 1^\circ\text{C}$. The average survival rates expressed as the proportions of eggs yielding adults, at the eight levels of inbreeding are given in Table 1. With an increase in the value of F, some inbred lines were lost in the course of experiment.

The viability of outbred progeny is considerably low in comparison with other reports. The fact seems to suggest that culture conditions were not good for *D. simulans* in the present study. Table 1 indicates definitely that survival rate is a decreasing function of the level of inbreeding, as expected. In the Morton, Crow and Muller method, it is assumed that the contributions of different loci to overall fitness are independent, that is, the linear regression equation of $\text{Viability}=1-aF$ is assumed.

If the separate contributions of various loci are not independent, however, viability is no longer a linear function of F. The analysis of variance disclosed that the deviation from linearity was highly significant (Table 2). The estimated equation of standardized viability is $V=1-0.0787F-0.7597F^2$ (Fig. 1.)

Inbreeding coefficient, F, could be overestimated since selection could not be avoided in the process of continued inbreeding, leading to underestimates of synergism. With all the data available including the present report, it can be regarded that synergism

Fig. 1. Relationship between viability and inbreeding.

at high levels of F is well established. The magnitude of genetic load was evaluated from the given data in Table 1. The inbred load at $F=1$ and the outbred load at $F=0$ were estimated to be 1.707 and 0.304, respectively, after having obtained a curvilinear regression equation of $-\ln(\text{Viability})$ on F . Therefore, the ratio is calculated to be 5.62. It is natural that the ratio should become much larger unless synergistic interaction is assumed. Taken at face value, this ratio seems to argue for the greater importance of mutational load than balanced load, although various assumptions and shortcomings are included in the Morton, Crow and Muller method (Kosuda 1972).

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