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AUTOSOMAL LETHALS IN POPULATIONS OF *DROSOPHILA MELANOGASTER* WITH IRRADIATION HISTORIES*

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RESUMEN

Posteriormente a la irradiación, y bajo condiciones de extrema competencia y aglomeración larvaria, fueron obtenidas las frecuencias de letales y semiletales en el II cromosoma, mostrando que estas frecuencias han alcanzado un equilibrio. Fue hecha una prueba de alelismo para 50 letales por población y fueron calculadas las frecuencias de alelos.

Comparando con la distribución de Poisson las frecuencias observadas de cromosomas con más de un letal, obtenidas por medio de la prueba de alelismo, nos indican que dicha distribución de letales es excesiva.

SUMMARY

Follow up irradiation and under conditions of extreme larval competition and crowding the frequencies of lethals and semilethals in the II chromosome were obtained, showing that these frequencies have reached and equilibrium. An allelism test for 50 lethals per population was done and the frequencies of alleles were calculated.

A comparison with a Piosson distribution shows that the observed frequencies of chromosomes with more than one lethal, as obtained by test for allelism are excesive.

INTRODUCCION

Sankaranarayanan (1964) established four experimental populations of *D. melanogaster* to determine the genetic load induced by irradiation, on the viability of Drosophila populations.

For that purpose he exposed three experimental populations to X-rays irradiation, doing the irradiation every generation and using three different dosages of radiation (namely 2,000r, 4,000r and 6,000r), until each population had accumulated a total of 120,000r. This ocurred obviously in generations 60, 30 and 20 respectively.

He then measured the viability of the flies in each population at different stages of their development, and also studied the magnitude of the concealed genetic load after the irradiation had been completed.

The frequencies of the lethals and semilethals for the second chromosome in each of the four populations (one a control) were obtained, these values are as follow:

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A = Control	17.8%
B = II EG R (2,000r)	57.0%
C = IV ER (4,000r)	90.3%
D = VI ER (6,000r)	87.9%

These populations were kept in sets of fifteen ½ pint bottles each with a number of eggs per bottle which resulted in approximately 40-60 adults per bottle. The population size in each case varied from 600-750 adults. This procedure was followed to eliminate as much as possible any selection effects due to larval competition.

The populations were tested a second and third time for the frequencies of lethal and semilethal II chromosomes at the generations 19th and 45th after the completion of irradiation (when possible).

Population B was checked only at generation 19th. We should note here that the ages in generation time in these populations are not identical but were measured from the time of the completion of the irradiation.

The data gathered at these two times are as follow:

A = 11.6%	45th. generation
B = 40.9%	19th. generation
C = 46 %	45th. generation
D = 40.1%	45th. generation

MATERIAL AND METHODS

Following the 45th generation after the irradiation, the populations were placed in four population cages and then the flies were allowed to breed freely. In population cages the crowding of the larvae produces a severe competition and a more rigorous selection. After a period of about 10 months in the cages, that is about 15 generations, started the analysis in more detail of the dynamics of changes in frequencies of lethals and semilethals for the second chromosome. Everyday, during the sampling period ten chromosomes per population were extracted in order to test them for lethals and semilethals. The Cy L technique for lethal analysis was utilized.

To obtain sufficient number of individuals for each chromosome tested; flies were allowed to oviposit in three bottles in succession. in each for two days.

Counts of the emerging progeny from these replicates were made every other day and the number of counts were four. All this was done in ½ pint bottles with regular medium and at 25° centigrades.

At the end of the sampling period the counts were added up and the percent of lethals and semilethals was determined using as a minimum of 80 flies to take in count the culture in the analysis.

The criteria used for the determination of lethals and semilethals was as follow:

0% wild type	= lethal (at least 80 flies)
between 0% and 15% wild type	= semilethal
more than 15% wild type	= normal

All the lethals obtained this way were kept as balanced stocks.

RESULTS

Three times during the sampling period the data were summarized and the frequencies of lethals and semilethals in the four populations were calculated, these three sets of values were very similar. At the end of the sampling period the final frequencies of lethals and semilethals were calculated and are as follow:

Population	Number of tested chromosomes	semilethal % lethal and
A	451	13.29
B	373	29.75
C	310	48.06
D	327	45.55

If we compare these data with those obtained by Sankaranarayanan before the populations were placed in cages we see that populations A, C., and D have nearly the same frequencies of lethals and semilethals. There is only an increase of two to five percent in the frequencies of lethals and semilethals. Population B, however, shows a decrease in the lethal and semilethal frequency of about ten percent. We should note again that this population was tested only at the 19th generation after the irradiation was completed and not at the 45th generation as were populations A, C and D.

ALLELISM TEST

A plot of the frequencies of lethals against time after completion of irradiation seems to show that for this particular test the four populations have reached and equilibrium. The mechanism underlaying such an equilibrium is the problem with which we are presently concerned.

As a first step in the anlysis of this mechanism a test for allelism was done among randomly chosen lethals for each of the four populations.

Fifty such lethals were taken from each irradiated population and forty-five from the control population. Crosses were made in all possible combination taking two lethals at a time, and the results were as follow:

Population	Number of crosses	% of alleles
A	990	13.73
B	1,225	5.28
C	1,225	8.71
D	1,225	11.07

Thus among the irradiated populations the frequencies of alleles were increased with the increase of the intensity of irradiation; however, the highest frequency of alleles was observed in the control population, which is puzzling.

Using the allele frequencies it is possible to calculate a Poisson distribution for the expected number of lethals per second chromosome.

$$u = \log.\ e\ \left(\frac{1}{P_0}\right)$$

$$P_1 = \frac{e^{-u}\ u^1}{1!};\ \text{etc.}$$

Were:

u = mean number of lethals per chromosome
P_0 = frequency of non-lethal chomosome
P_1 = frequency of chromosomes with one lethal
P_2 = with 2; P_3 = with 3; etc.

A comparison was made between the observed number of lethals per chromosome in each population and the expected values according to the Poisson distribution. The comparison (as is seen in Tab. 1) shows that the lethals are not randomly distributed among the chromosomes. But rather that the numbers of chromosomes with several lethal loci are larger than expected.

Accurate of experimental frequencies for chromosomes with two, three or more lethals have not been obtained due to the complexity of the results.

It is also interesting to note that the control population contains the largest number of chromosomes with several loci, one le-

% Normal	N° Crosses	% Allelism	% Lethal & semilethal	u	PO	Poisson Values	
			Population A				
86.69	990	13.73	13.29	0.14275	0.8669	P1	0.12375
						P2	0.00883
						P3	0.00042
						P4	0.0001
							0.1311
			Population B				
70.24	1225	5.28	29.75	0.35348	0.7024	P1	0.2484
						P2	0.0439
						P3	0.0052
						P4	0.0001
							0.2976
			Population C				
51.93	1225	8.71	48.06	0.65545	0.5193	P1	0.3404
						P2	0.1116
						P3	0.0244
						P4	0.0043
							0.4807
			Population D				
59.43	1225	11.07	45.55	0.60817	0.5443	P1	0.3310
						P2	0.1007
						P3	0.0204
						P4	0.0086
							0.4357

TABLE I. Poisson values for chromosomes with one, two or more lethals.

thal was found to be present 17 times in chromosomes taken at random from this population.

Using these lethals which are most frequent in a given populations an allelism test between populations has been plane for the future. This may help to elucidate the cause of these complex groups of linked lethals.

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