Sperlich, D. University of Tübingen, F.R.Germany. Useful population cage experiments for demonstrating directional and balancing selection.

In a basic course in population genetics we are using successfully for years a simple cage experiment to demonstrate the effect of natural selection in populations carrying a recessive lethal. Depending on the population system the lethal is either going to be balanced or eliminated (Sperlich & Karlich 1970). Strains used for the experiment are: a wild type strain of D.melanogaster (D.pseudoobscura can be also used; see Sved & Ayala 1970) and a LCy/Pm strain with good expression of the markers (occasional selection of the strain for good manifestation of Cy is recommended). Using the ordinary marker strain technique pairs of lines are established (see Figure 1) carrying the same wild chromosome II in homozygous condition ($+^A/+^A$) or in combination with LCy ($LCy/+^A$). At least ten such pairs of lines (A/A - LCy/A, B/B - LCy/B ..., J/J - LCy/J) must be available for the experiment. Lines with homozygotes A/A being lethal (about 30 percent!) must be discarded. "Monochromosomal" populations are then started each by founder flies from one pair of the lines only; e.g., line C/C and line LCy/C. Wild flies are taken from the C/C line and LCy-phenotypes from the LCy/C line (there are wild type flies in this line too which must be either discarded or counted as "wild" type C/C). The ratio between C/C and LCy/C genotypes in the founder population is chosen 2:1. "Polychromosomal" population are founded in the same way but wild type flies are now taken equally from all different pairs of lines (A/A, B/B, ..., J/J) and LCy flies from the corresponding LCy-line (LCy/A, LCy/B, ..., LCy/J). The ratio wild: LCy is again 2:1. Any population cage system can be used to keep the populations for three to four months. The temperature should be 25°C which ensures good manifestation of Cy and a generation time of about 15 days.

Egg samples should be taken every second generation (this means monthly) by inserting 4-6 fresh vials into the cage for 24 hours. The flies hatching from these samples are then counted. The relative frequency of the LCy chromosomes in the cage populations is easily calculated. Three to four

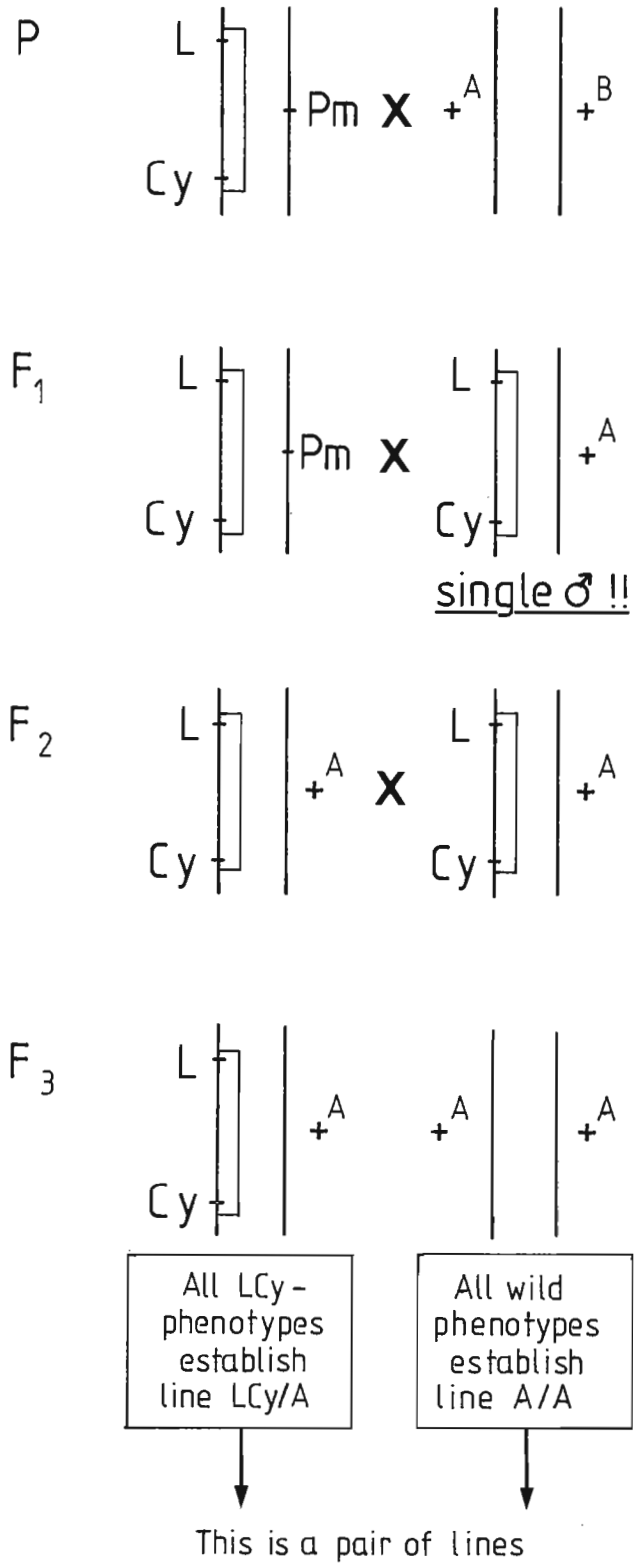

Fig. 1. Crossing procedure for the construction of "monocrhomosomal" and "polychromosomal" populations.

samples are usually enough to demonstrate that LCy is almost completely eliminated in this short period from the gene pool of the polychromosomal populations but appears balanced in the monochromosomal populations (Sperlich & Karlich 1970; Sved 1971). Starting with a LCy frequency of q=.167 (=1/6) it becomes nearly zero in the polychromosomal and around q=0.25 to almost q=0.50 in the monochromosomal populations.

The population system is very simple since LCy/LCy phenotypes are completely lethal. Putting the relative fitness of the heterozygotes (e.g., LCy/A) 1 only the fitness of the wild type "homozygotes" (e.g., A/A in mono. and A/B...D/D in poly.) remains unknown. Starting with q=.167 and the following fitness distribution calculations can be easily made with any pocket calculator by the students:

	A/A	LCy/A	LCy/LCy	
fitness	W	1	0	population fitness = $\bar{W}$
frequency	p^2	2pq	q^2	$= W \cdot p^2 + 2pq$

$$q_1 = \frac{p_o q_o}{W p_o^2 + 2 p_o q_o} = \frac{q_o}{W p_o + 2 q_o}$$ (q_o=.1667; W=1.4, 1.2, 1.0, 0.8, 0.6, 0.4, 0.2, 0.0)

By iteration of this formula and by using different W values students can easily gain basic understanding for selection processes maximizing population fitness. Additional discussions arise automatically about genetic load, balancing selection and computer simulations of populations systems (Sperlich et al. 1982).

References: Sperlich, D. & A. Karlik 1970, Genetica 41:265-304; Sved, J. 1971, Genet. Res. 18:97-105; Sved, J. & F.J. Ayala 1970, Genetics 66:97-113; Sperlich, D., A. Karlik & P. Pfriem 1981, BiolZbl. 101:395-411.

SPECIAL NOTE

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A checklist of maps of polytene chromosomes of Drosophilids.

Published maps (not always complete karyotypes) of Drosophila polytene chromosomes. (*) indicates a photomap. If a species is not on this list check close relatives (e.g., those of same species group). We have tried to use only Wheeler approved names (Wheeler, M. 1981, Chapter 1 of "The Genetics and Biology of Drosophila" volume 3a). Please send any corrections or additions to M. Ashburner.

acanthoptera	(*) Ward & Heed 1970 J Hered 61:248.
adiastola	(*) Carson & Stalker 1968 Univ Texas Pubs 6818:367.
affinis	L E Stone 1968, Thesis, Nebraska (see also athabasca)
albomicans	(*) Lambert 1976 J Hered 67:92; Lin et al 1974 DIS 51:42.
algonquin	Miller 1939 Genetics 24:699.
ambigua	Frumento 1954 Scientia Genetica (Turino) 4:205; Mainx et al 1953 Z indukt Abstamm -u Verebungsl 85:354.
americana	Hughes 1939 Genetics 24:811
a.texana	Hughes 1939 Genetics 24:811
ananassae	Dutta Gupta et al 1973 The Nucleus (Calcutta) 16:130; Hinton & Downs 1975 J Hered 66:353; Kikkawa 1938 Genetica 20:458; Kikkawa 1939 Cytologia 9:452; Futch 1966 Univ Texas Pubs 6615:79; (*) Moriwaki & Ito 1969 Jap J Genet 44:129; Seecof In: Stone et al 1957 Univ Texas Pubs 5721:260; (*) Sreerama Reddy & Krishnamurthy 1973 DIS 50:142.
andamanensis	Sing & Gupta 1979 Genetica 51:55.
athabasca	Miller & Voelker 1968 J Hered 59:86; ____ 1969 J Hered 60:230; ____ 1969 J Hered 60:306; ____ 1972 J Hered 63:2; Miller & Sanger 1968 J Hered 59:322; Miller 1979 J Hered 68:105.
auraria	(*) Oguma et al 1982 DIS 58:118.