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# LARVAL INTERACTIONS BETWEEN A COLONIZING POPULATION OF *Drosophila subobscura* AND THREE ESTABLISHED SPECIES OF *Drosophila* IN CHILE

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## ABSTRACT

The egg-to-adult viability and the developmental time of *Drosophila subobscura is* strongly modified by the accumulation of larval biotic residues of *D. pavani*, *D. immigrans*, and *D. melanogaster*. This effect could be an important regulatory factor for this species in nature.

## INTRODUCTION

Ten years ago, *Drosophila subobscura,* a paleartic species, was detected for the first time in a locality in the southern part of Chile. Since then, the expansion of this species has been very fast and now it is found over a distance of 3000 km north-south (Brncic and Budnik, 1980; Prevosti *et al.*, 1988).

Monthly collections of Drosophilidae near Santiago (Central Chile), made during a three year period, revealed that *D. subobscura* is seasonally isolated from *D. simulans* but not from *D. immigrans*, *D. pavani*, and *D. melanogaster*, which are the commonest species in the area (Brncic *et al.*, 1985).

Some years ago we demonstrated that *D. simulans* interfered in the growth of larvae of *D. subobscura* (Budnik and Brncic, 1983). The waste metabolic products of growing larvae of the former species appear have a negative impact both on the egg-to-adult viability and the rate of development of *D. subobscura*. For this reason we decided to investigate any possible interference in the *D. subobscura* larvae development when bred together with the other species mentioned above and with which this species do not suffer any seasonal isolation.

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The experiments referred to here were performed in order to investigate whether the accumulation of biotic residues of larvae of *D. immigrans*, *D. pavani* and *D. melanogaster* would modify the survival rate and the developmental time of *D. subobscura* larvae. This factor could be part of an important regulatory mechanism of the populations in nature (Budnik and Brncic, 1976).

## MATERIAL AND METHODS

The following stocks of *Drosophila* were used in the experiments: *D. subobscura*, *D. pavani*, *D. immigrans*, and *D. melanogaster*, originating from flies collected in the central zone of Chile (Quilicura, near Santiago).

The method used to investigate the effects of waste metabolic products of larvae both on egg-to-adult viability and developmental time (in days), was similar to the one reported by Weisbrot (1966) and Budnik *et al.* (1983).

In each of a series of vials containing 10 cc of basic food media for *Drosophila*, 50 fertilized eggs of either *D. pavani*, *D. immigrans* or *D. melanogaster* were transferred and left at 22°C in a constant temperature chamber. Larvae were allowed to develop for three to five days according to the species and then were killed by exposing the vials to -30°C for 6 hours. After this time, the vials were left at 22°C for 24 hours in order to thaw the food media. Each one of the vials treated with larvae of *D. pavani*, *D. immigrans* or *D. melanogaster*, was sown with 20 fertilized eggs of *D. subobscura*. The total number of eggs transferred in each group was 1000. A control series of 50 vials for each experimental group, containing fresh untreated culture medium and shown with 20 fertilized eggs of *D. subobscura*, was set up concurrently.

Vials were placed at 18°C in a constant temperature chamber. The emerging adults were counted and recorded daily.

## RESULTS

Table I shows the egg-to-adult viability expressed as mean values of emergences per vial and the corresponding standard errors. It is interesting to note that preadult *D. subobscura* bred in food media containing metabolic wastes from *D. pavani*, *D. immigrans* or *D. melanogaster* showed a lower viability. The differences in viability with respect to the controls grown in untreated media are statistically significant. Thus, *D. subobscura* seem to be strongly subjected to interference under the above conditions.

The results shown in Table II indicate that the egg-to-adult development period is significantly lengthened when *D. subobscura* preadults are grown in media treated with *D. immigrans* and *D. melanogaster*, but it is shortened when grown in vials treated with *D. pavani* preadults. Interestingly this shortening is statistically

Table I - Differences in egg-to-adult viability of *D. subobscura* bred at 18°C in food media untreated or treated with 50 *D. pavani*, *D. immigrans* or *D. melanogaster*. Twenty eggs of *D. subobscura* were sown in each vial and each group consisted of 50 vials.

| Groups | $\bar{X}$ viability per vial and S.E. | T-test |
|---|---|---|
| *D. subobscura* (untreated) | 15.10 ± 0.407 | |
| *D. subobscura* (treated with *D. pavani*) | 9.74 ± 0.642 | 7.046** |
| *D. subobscura* (untreated) | 16.30 ± 0.362 | |
| *D. subobscura* (treated with *D. immigrans*) | 14.76 ± 0.360 | 3.019** |
| *D. subobscura* (untreated) | 16.26 ± 0.309 | |
| *D. subobscura* (treated with *D. melanogaster*) | 15.50 ± 0.253 | 1.905* |

*$P < 0.05$ (49 d.f.); **$P < 0.001$ (49 d.f.).

significant only in females. In conclusion, both preadult viability and developmental time of *D. subobscura* are modified by waste metabolic products of *D. pavani*, *D. immigrans* and *D. melanogaster* in the absence of competition for food.

## DISCUSSION

In previous experiments, Budnik *et al.* (1982, 1983) have demonstrated that the preadult viability of *D. subobscura* is diminished when sharing resource in short supply with either *D. pavani*, *D. immigrans*, *D. melanogaster* or *D. simulans*.

In addition to the scramble for common limiting resources, other kinds of interactions between competing species have been described. In certain species of *Drosophila*, both the egg-to-adult development rate and viability are modified when preadults are bred in culture media previously used for the development of larvae of the same or different species (Budnik and Brncic, 1976, 1983; Barker, 1983).

It is not known how these effects are produced, but it has been suggested that chemical substances secreted or excreted by larvae to the culture media would interfere with the growth of nutrient yeast necessary for metamorphosis (Weisbrot, 1966). Budnik and Gajardo (1981) have suggested that this kind of interference due to larval biotic residues may be compensated by a mechanical facilitation caused by the tunnelling of the medium by larvae during feeding. The chemical composition of the biotic residues is unknown. In this respect, Botella *et al.* (1985) have demonstrated that urea and uric acid produce a delay in the developmental time, reduce viability and, at higher doses, they also produce larval stop in *D. melanogaster*.

Table II - Sex differences in the egg-to-adult development period (days) of *D. subobscura* bred at 18°C in food media untreated or treated with 50 *D. pavani*, *D. immigrans* or *D. melanogaster*. Twenty eggs of *D. subobscura* were sown in each of 50 vials for each group.

| Groups | Females | | Males | | Total | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ period of develop. and S.E. (days) | T-test | $\bar{X}$ period of develop. and S.E. (days) | T-test | $\bar{X}$ period of develop. and S.E. (days) | T-test |
| *D. subobscura* (untreated) | 27.48 ± 0.079 | | 26.97 ± 0.080 | | 27.26 ± 0.057 | |
| *D. subobscura* (treated with *D. pavani*) | 26.87 ± 0.163 | 3.38** | 26.80 ± 0.178 | 0.87 | 26.83 ± 0.120 | 3.203** |
| *D. subobscura* (untreated) | 27.03 ± 0.115 | | 26.92 ± 0.096 | | 26.98 ± 0.075 | |
| *D. subobscura* (treated with *D. immigrans*) | 28.43 ± 0.099 | 9.22** | 28.37 ± 0.099 | 10.40** | 28.39 ± 0.070 | 13.82** |
| *D. subobscura* (untreated) | 27.19 ± 0.096 | | 27.01 ± 0.088 | | 27.10 ± 0.065 | |
| *D. subobscura* (treated with *D. melanogaster*) | 28.45 ± 0.115 | 8.51** | 27.82 ± 0.102 | 6.01** | 28.14 ± 0.076 | 10.31** |

*P < 0.05; **P < 0.001.

In the present experiments, food and space were not in short supply because the number of eggs sown in each vial was only 20, near the optimal density for larvae development in *D. subobscura* (Ricci and Budnik, 1984). So the lowering in viability and the lengthening of the development time could be attributed mainly to the accumulations of wastes. With regard to the last mentioned parameter, females were more affected than males. The different responses of females and males when confronted with situations of stress, are difficult to explain but they could be of high importance for the population dynamics (Parsons, 1973; Price, 1975). Bos *et al.* (1977) described a distorted sex ratio in preadult viability of *D. simulans* when grown in culture medium containing a pure sterol mutant strain of the baker's yeast *Saccharomyces cerevisiae* (erg-2).

The kinds of interactions described in this paper, their effects and the competition for food and space, could be of importance for the regulation of population size and the relative frequency of species in nature. But, we cannot oversimplify on the sole basis of experimental observations. Recently, Brncic (1987) found that the number of *D. subobscura* adults emerging from some rotten fruit collected from the ground and brought to laboratory, was lower when they did emerged together with *D. melanogaster*, or *D. simulans* or *D. immigrans* than when *D. subobscura* was the only emerging species. These observations on natural breeding sites are in accordance with our experimental results.

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## RESUMO

A viabilidade ovo-adulto e o tempo de desenvolvimento em *Drosophila subobscura* é bastante modificada pela acumulação de resíduos bióticos de larvas de *D. pavani*, *D. immigrans* e *D. melanogaster*. Este efeito poderia ser um fator regulador importante para estas espécies na natureza.

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