Oviposition site preferences in natural populations of *Drosophila melanogaster.*

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Introduction

Habitat selection is postulated to contribute to the maintenance of genetic variation within and among populations. This occurs if genetically different individuals differ in their ability to use different resources in a heterogeneous environment (Jaenike, 1986; Barker and Starmer, 1999; Fanara *et al.*, 1999; Fanara and Hasson, 2001; Gorur *et al.*, 2007; Soto *et al.*, 2008). In addition, it has been proposed that ecological divergence and the establishment of habitat preferences may trigger speciation (R' Kha *et al.*, 1991).

In insects, oviposition site preference is one of the components of habitat selection (Fox, 1993, and references therein). In consequence, evolutionary changes in oviposition site preferences may result in selection for increased performance in a new host and may lead as a by-product to host race formation and speciation (Takamura, 1980; Jaenike and Grimaldi, 1983; Sezer and Butlin, 1998; Craig *et al.*, 2001).

Oviposition site preference is a measure of the tendency of females to lay eggs on a particular host or substrate when they are given the choice. In fruit flies of the genus *Drosophila* this decision determines the chances of survival of the offspring, since chances of larvae of changing or finding a suitable host are minimal (Jaenike, 1986; Sezer and Butlin, 1998; Sheeba *et al.*, 1998). *Drosophila* flies are saprophytophagous insects that use decaying plant materials, including fruits, vegetables, and flowers as breeding and feeding sites (Jaenike and Grimaldi, 1983; R'Kha *et al.*, 1991; Reaume and Sokolowski, 2006). *D. melanogaster* is an excellent model to investigate oviposition site preference, because there is a deep knowledge of its genetics but very little is known about its natural breeding sites.

The aim of the present work is to investigate oviposition behavior in *D. melanogaster* by studying inter- and intrapopulation variation of oviposition site preference.

Materials and Methods

Oviposition behavior was studied in flies derived from collections in three different localities: Güemes (24º 38' N 65º 03' W), Neuquén (38º 58' N 68º 08' W), and Lavalle (32º 50 N 68º 28' W). From each population five isofemale lines (lines hereafter) were tested for oviposition site preferences.

To measure oviposition site preferences, twenty mating couples were released in egg-collecting cages with two types of plates, containing a mix of agar and either smashed grapes (*Vitis vinifera*) or smashed orange (*Citrus aurantium*). Females were allowed to oviposit for 48 hs. All plates were photographed using a digital camera connected to a microscope (10×) and the number of eggs in each plate was scored (Soto *et al.*, 2008, in preparation). Data were analyzed by means of two types of ANOVA's. The first type aimed to investigate the effect of Resource (two levels) and Population (three levels) on the number of eggs oviposited. A second set of ANOVAs was performed for each population separately to investigate the among-line component of variance in oviposition behavior. In these ANOVAs the main sources of variation were Resource and Line.

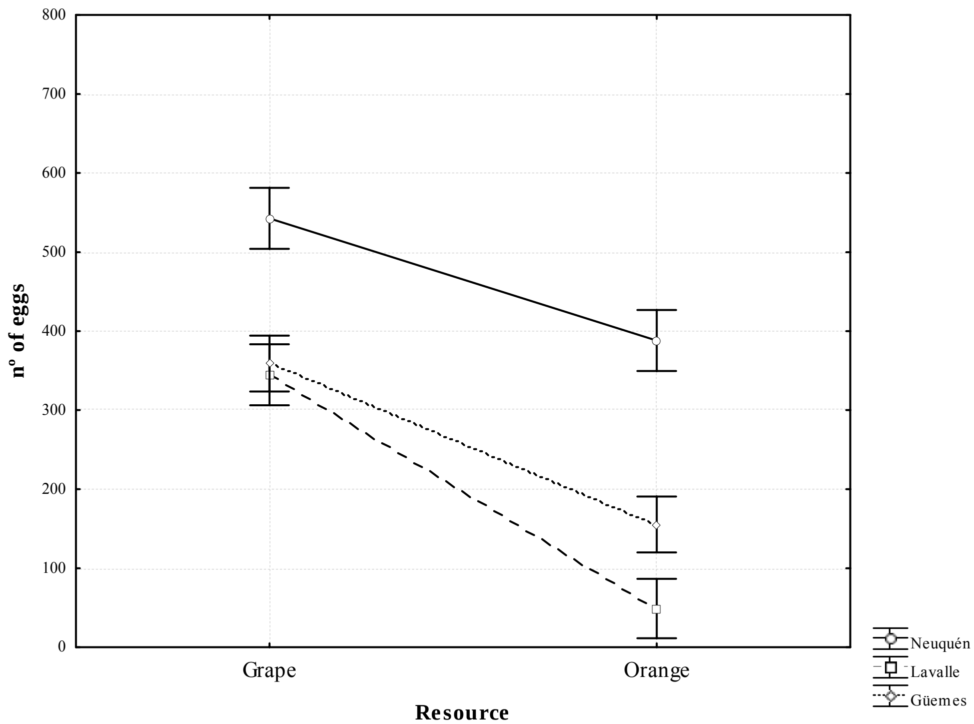


Figure 1. Plot of the number of eggs oviposited on each type of resource for the three populations analyzed.

Table 1. ANOVAs performed for the populations separately. *p<0.0001.

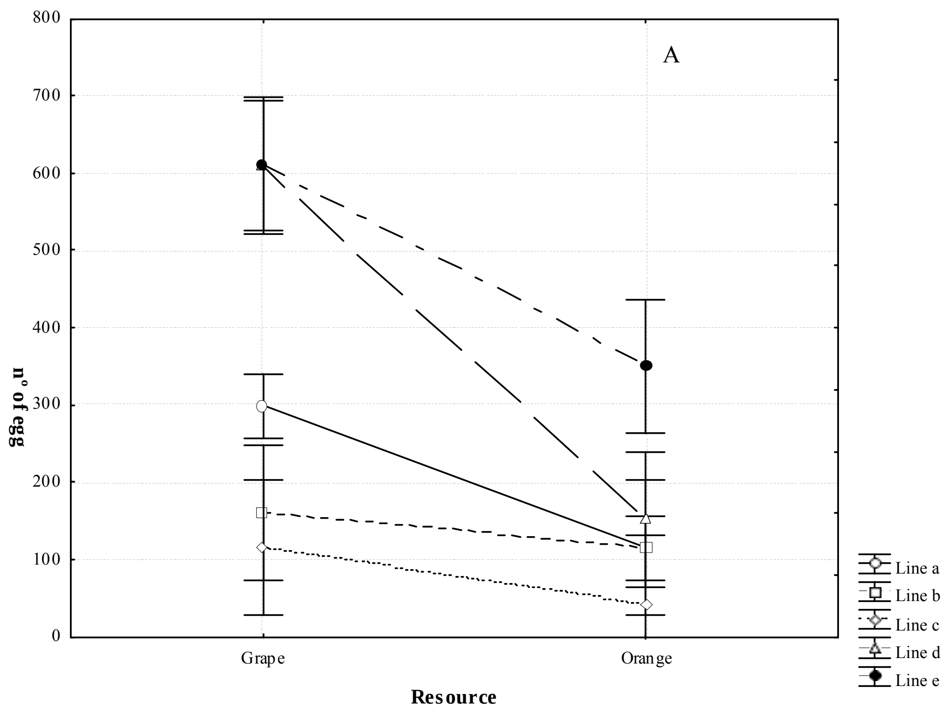
	Population								
	Güemes			Lavalle			Neuquén		
	d.f.	*MS*	*F*	*d.f.*	*MS*	*F*	*d.f.*	*MS*	*F*
L	4	591613	4.30	4	27901	0.98	4	105697	0.30
R	1	1225833	10.24*	1	2239742	78.68*	1	597065	1.80
L x R	4	139048	7.18*	4	28501	3.16*	4	332012	11.33*
Error	160	19369		93	9026		90	29312	

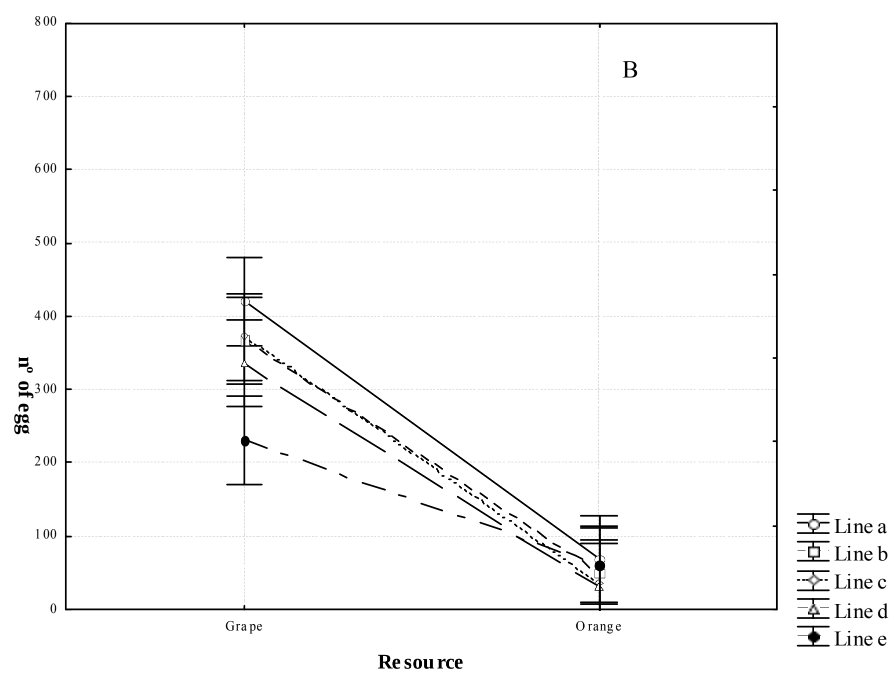
Results

In the first ANOVA performed for the interpopulation analysis, the factors Population (P, $F_{2,367} = 70.94$, $p = 0.000$) and Resource (R, $F_{1,367} = 127.52$, $p = 0.000$) and the Interaction (P × R, $F_{2,367} = 4.06$, $p = 0.021$) were significant. Tukey *post hoc* comparisons showed that differences between resources were significant in all populations (Tukey's test $p < 0.000$ for all comparisons). In Figure 1 we show the number of eggs oviposited in both resources in the three populations analyzed.

Even though the preferred oviposition resource was grape in all populations, we detected differences among them.

The results of the ANOVAs testing for differences among lines (L) within populations are shown in Table 1. In all cases the interaction L × R was significant. In Figure 2 we plot the numbers of eggs oviposited in each resource by females of each line. In our model differences among lines can be considered as an estimate of genetic variance for oviposition preferences, since each line may be considered as different genotypes sampled from the same population.





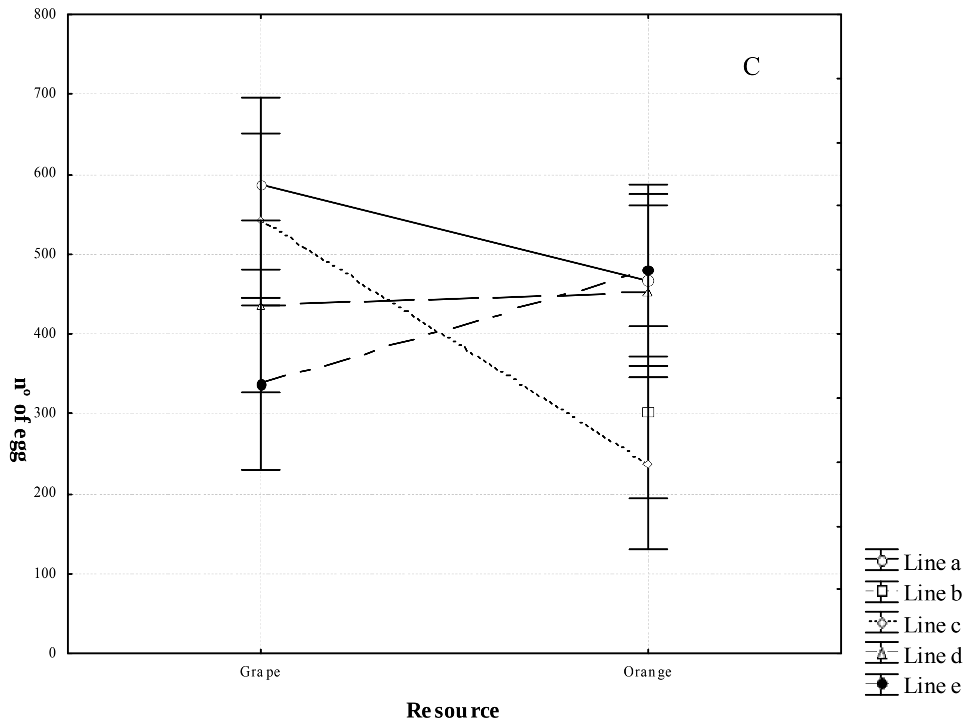


Figure 2. Plot of number of eggs oviposited by each line in each resource for Güemes (A), Lavalle (B), and Neuquén (C).

Discussion

Our results indicate that, in general, grape (*V. vinifera*) was the preferred oviposition substrate regardless of the population of origin of females. In addition, the ANOVAs revealed a significant L × R interaction which under our experimental design may be interpreted as a genotype by environment interaction. Moreover, we can conclude that there is substantial genetic variation for oviposition site preferences in all populations.

There are two questions that derive from our study and should be considered and tested in future experiments. First, given the preference for grape, we may ask whether flies developed in this resource are more viable than in the other resource tested, since a correlation between preference and larval fitness is a prediction of the optimal oviposition behavior hypothesis (Jaenike, 1990), which is an issue of debate in speciation models (Fox, 1993, and references therein). Second, it would be interesting to analyze the genetic architecture underlying oviposition site preferences, *i.e.* number of genes involved and the nature of the effects of alleles.

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The frequencies and activity of locus *β-est* alleles in laboratory populations of *Drosophila melanogaster*, originating from wild flies of the Chernobyl Exclusion Zone.

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Summary

We determined the expression of *β*-specific carboxylesterase and the frequencies of related alleles and genotypes in some lines of *Drosophila melanogaster* originating from various regions of the Chernobyl exclusion zone. The enzymes' activities were studied by alkaline polyacrylamide gel electrophoresis and computer densitometry. We also compared activities of *S*- and *F*-allozymes of *β*-esterase from different populations. As the populations were heterogeneous in locus of *β*-esterase, frequencies of alleles and genotypes in studied populations have been determined. The data characterize the Chernobyl population (natural) and *Odessa* population (wild type laboratory strain).

Key words: *β-esterases, allozyme expression, frequencies of the alleles and genotypes, populations of* Drosophila melanogaster.

Introduction

The effect of environmental factors on population genetics brings about changes in various biochemical parameters. These changes therefore can be used to monitor systems of populations in harsh environmental conditions [1]. One of the most effective and widely used techniques to study molecular polymorphism is alkaline polyacrylamide gel electrophoresis (PAGE) [2, 3]. Our object was to determine the frequencies and expressions of S- and F-allozymes of *β*-esterase in *Drosophila* imagoes and to study genetic structure of locus *β-est* in populations of flies derivating from various regions of the Chernobyl exclusion zone.