Genet. Res., Camb. (1979), **34**, *pp.* 317–319
With 1 *text-figure*
Printed in Great Britain

SHORT PAPER

Seasonal variation in the frequencies of the alcohol dehydrogenase isoalleles of *Drosophila*: correlation with environmental factors

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(*Received* 6 *February* 1979)

SUMMARY

Drosophila melanogaster adults were collected throughout the summers of 1976 and 1977 in Hartford, Connecticut. The frequencies of the *Adh* isoalleles were determined and seasonal variation demonstrated. Correlation coefficients were calculated between *Adh* frequencies and the seasonal variations in temperature, precipitation, relative humidity and barometric pressure. Although five correlations were significant it was concluded that these were due to chance.

1. INTRODUCTION

The maintenance of allelic isozymic variation in natural populations is in question. Both selective and non-selective mechanisms have been proposed. Support for the selective mechanism would come from the demonstration of seasonal variation in isoallelic frequencies and its correlation with certain environmental forces. Dobzhansky & Ayala (1973) reported significant seasonal variation for isozymes of *Drosophila pseudoobscura* and *D. persimilis* but did not attempt to correlate the variation with any specific environmental factor. In a previous paper Gionfriddo & Vigue (1978) reported considerable seasonal variation during 1976 for the alcohol dehydrogenase (*Adh*) isoalleles of *D. melanogaster* but were unable to correlate the variation with environmental temperature. In this paper we extend the previous work by attempting to correlate the 1976 variation with other environmental factors and by repeating the experiment for 1977.

2. MATERIALS AND METHODS

Drosophila melanogaster collection and electrophoresis methods have been published previously (Gionfriddo & Vigue, 1978). At least 50 single fly extracts were electrophoresed for each determination. Weather data is from the National Oceanic and Atmospheric Administration Environmental Data Service statistics for Hartford, Connecticut, which is approximately four miles from the collection site. Correlation coefficients were calculated assuming no delay, a 1-week delay, a 2-week delay, a 3-week delay and a 4-week delay of the effect of the environmental forces on the frequency of $Adh^{4(Fast)}$.

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0016-7623/79/2828-7690 $01.00

3. RESULTS AND DISCUSSION

We have addressed the question of whether isozymic variation in natural populations is maintained by selective or non-selective mechanisms by studying the seasonal variation of *Adh* isoallelic frequencies and attempting to correlate the frequencies with various environmental forces.

As indicated in Fig. 1, the frequency of the $Adh^{4(Fast)}$ allele fluctuated throughout the periods of study. The patterns for 1976 and 1977 although not identical are similar, indicating that the variation is stable over a 2-year period.

Table 1. *Correlation coefficients between the frequency of* $Adh^{4(Fast)}$ *and temperature, humidity, barometric pressure and precipitation*

Delay (weeks) ...	0	1	2	3	4
		1976			
Temperature	0·0	−0·061	−0·282	0·362	0·194
Humidity	0·116	0·324	−0·077	0·543*	0·320
Pressure	−0·196	−0·109	−0·257	0·387	0·229
Precipitation	0·062	0·085	−0·266	−0·122	−0·123
		1977			
Temperature	0·615*	0·367	0·484	0·651**	0·057
Humidity	−0·341	−0·485	−0·460	−0·532*	−0·710**
Pressure	0·147	−0·269	−0·219	−0·471	−0·268
Precipitation	−0·264	−0·076	−0·403	−0·422	−0·142

* Significant to 0·05. ** Significant to 0·01.

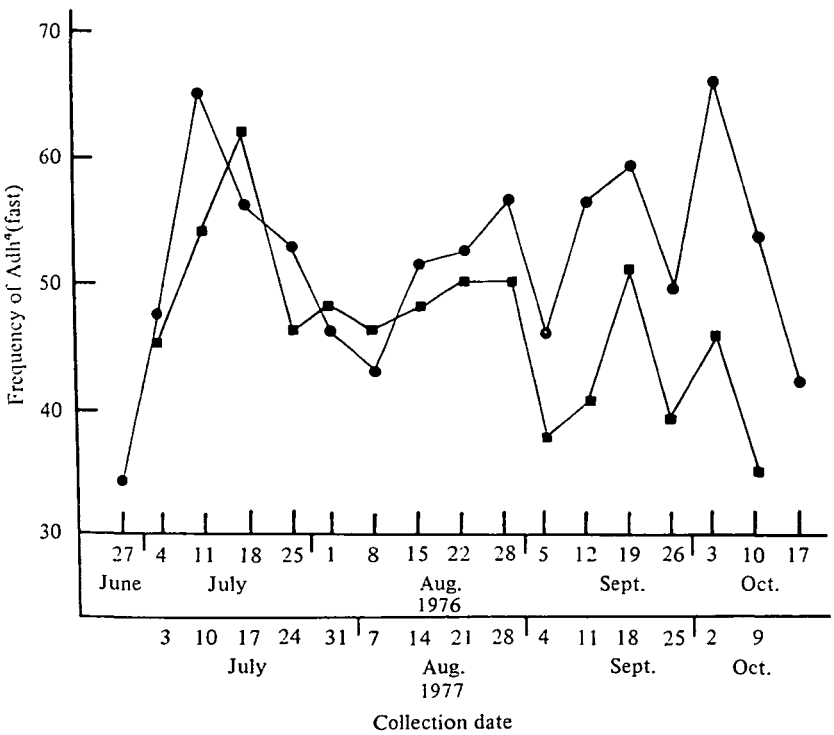

Fig. 1. A comparison of the seasonal variation in the frequencies of $Adh^{4(Fast)}$ during 1976 and 1977. ●, 1976; ■, 1977.

https://doi.org/10.1017/S0016672300019546 Published online by Cambridge University Press

Correlation coefficients between the frequencies of $Adh^{4(Fast)}$ and the environmental forces assuming various delays of the effect of the forces on the frequency of $dAh^{4(Fast)}$ are presented in Table 1. Although five are significant with 40 correlations one may expect five significant ones by chance. A pattern, however, does exist since the correlation coefficients for relative humidity assuming a 3-week delay are significant for both 1976 and 1977. Whether or not this pattern is real or artifactual is unknown. Recent experiments by Vigue (manuscript in preparation) in which no effect of humidity was demonstrated argue in favour of the pattern being a chance artifact.

Although the seasonal variation reported here is consistent with the selection theory, the cause of the variation remains obscure. Since ethanol seems to be a selective agent of the *Adh* isoalleles (Gibson, 1970; Ward & Hebert, 1972; Vigue & Johnson, 1973; Clarke, 1975; Briscoe, Robertson & Malpica, 1975; Vigue, manuscript in preparation) a viable hypothesis is that ethanol is a selective agent with its effects being modified by various environmental factors.

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