

GENETIC RESPONSE TO THE SEQUENCE OF TWO ENVIRONMENTS

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STUDIES on chromosomal polymorphism in *Drosophila pseudoobscura* have shown that the relative fitness of the different gene sequences varies under different temperature conditions. At 25° C., populations composed of the gene sequences Arrowhead (AR) and Chiricahua (CH) establish a stable polymorphic system with characteristic equilibrium frequencies of 25-30 per cent. CH and correspondingly 75-70 per cent. AR (Dobzhansky, 1948; Levine, 1955; Beardmore, Dobzhansky and Pavlovsky, 1960; Mourad, 1962; Strickberger, 1963). At slightly lower temperatures, there appears a partly non-determinate situation. In one set of experiments at 22° C., CH appeared to have established itself at the characteristic 25-30 per cent. level. In a second set of experiments at 22° C., and in experiments at 17-27° C. fluctuating temperatures, CH tended toward elimination (Van Valen, Levine and Beardmore, 1962). In the populations in which CH tended toward elimination, the direction of the selection process became evident when the populations were one year old. At that time, subsamples of four populations were taken and placed in population cages at 25° C. In three of the four derived populations, CH continued to tend toward elimination (Van Valen, Levine and Beardmore, 1962). The inability of these three derived populations to establish and maintain the chromosomal polymorphism so characteristic at 25° C. has led us to study the effects of reversing the sequence of temperatures.

An experimental population, #173, containing AR and CH, has been maintained at 25° C. for some seven years (Beardmore, Dobzhansky and Pavlovsky, 1960; M. Druger, personal communication). This population was started in January, 1957, in a wooden cage, with initial frequencies of 80 per cent. CH and 20 per cent. AR. In a little more than a year and a half, the population reached the expected frequency of 25-30 per cent. CH. In August, 1961, a subsample was taken from this population and placed in a lucite population cage. The methods used have been described elsewhere (Van Valen, Levine and Beardmore, 1962). The population cage containing the subsample was placed in a 22° C. incubator. Eggs from both populations were sampled at varying intervals, 300 chromosomes being examined at each sample. The data are presented in table 1. It can be seen that the frequency of CH dropped initially in both populations. In population #173, CH decreased to 19 per cent., a frequency which was maintained for one year. The most recent sample shows that CH has returned to its characteristic level. In contrast to the parental population,

population #173-22° C. appears to be in the process of slowly eliminating CH.

Based on earlier findings, these results were unexpected. In previous studies it was found that populations maintained at 22° C. or 17-27° C. fluctuating temperatures for only one year (about 11 generations) tended to lose their ability to respond to a 25° C. environment. Reversing the sequence of temperatures gives different results. A population maintained

TABLE 1
Percentage CH in population #173 and its derivative

| #173 | | Dates | #173-22° C. | |
|---|---------------|-----------|-------------------|---------------|
| Month | Percentage CH | | Month | Percentage CH |
| 0 | 80.0 | Jan. 1957 | | |
| Data for this period reported by Beardmore <i>et al.</i> , 1960 | | | | |
| 26 | 25.3 | Mar. 1959 | | |
| 34 | 28.0 | Nov. 1959 | | |
| 46 | 25.3 | Nov. 1960 | | |
| 53 | 25.9 | June 1961 | | |
| 55 | — | Aug. 1961 | started from #173 | |
| — | — | Jan. 1962 | 5 | 22.7 |
| 62 | 19.0 | Mar. 1962 | — | — |
| — | — | May 1962 | 9 | 10.7 |
| — | — | Aug. 1962 | 12 | 7.7 |
| — | — | Jan. 1963 | 17 | 9.3 |
| 74 | 19.0 | Mar. 1963 | — | — |
| — | — | June 1963 | 22 | 5.0 |
| — | — | Aug. 1963 | 24 | 6.3 |
| 81 | 26.3 | Oct. 1963 | 26 | 7.0 |
| — | — | Jan. 1964 | 29 | 4.3 |

at 25° C. for 4½ years (over 50 generations) can still respond to a 22° C. environment as seen in the elimination or near elimination of CH. This finding indicates that the effects on a population of a series of environments may depend on the order in which the environments are experienced. These results also support our earlier findings (Van Valen, Levine and Beardmore, 1962) that 22° C. represents an environment in which chromosomal polymorphism may be eliminated.

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INTERRELATIONSHIP OF CHIASMA FREQUENCY IN
BIVALENTS IN *DACTYLIS GLOMERATA* subsp. *LUSITANICA*

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THE chiasma frequency in one bivalent is in many cases not independent of chiasma frequency in other bivalents and often the bivalents compete with each other (Darlington, 1933; Mather and Lamm, 1935; Morgan *et al.*, 1933; Jain and Maherchandani, 1961). Mather (1936) examined this relation in 27 species and hybrids in both plants and animals belonging to diverse groups and he observed that while a positive correlation of chiasma frequency in various bivalents occurs in some cases, a negative correlation occurs more often. He generalises from the data that after a certain level of chiasma formation bivalents must compete and this will result in a negative correlation.

Some plants with supernumeraries were obtained in *Dactylis glomerata* subsp. *lusitanica*. These supernumeraries are heteropycnotic and they pair among themselves (Shah, 1963). The normal complement in this subspecies consist of 14 chromosomes. The seven pairs of homologues have no obvious size differences at meiosis. A study of "competition" in plants having supernumeraries could give information with respect to the effect of the presence of heterochromatin in the cell on competition. Also such material allows one to study the effect of the chiasma frequency in the supernumeraries on the chiasma frequency in the normal set. The author has not come across any similar studies in the literature, though extensive work has been done on supernumeraries both in plants and animals (see reviews by Müntzing, 1958 and by White, 1954). In the present paper data are presented on the interrelationships of chiasma frequency in the bivalents of the normal set in plants with 2 supernumeraries. Data for the same