Budnik, M. and D. Brncic. University of Chile, Santiago, Chile. The ability to survive under crowding conditions as an expression of heterosis in inversion heterozygotes in Drosophila pavani.

D. pavani, which is endemic in the central part of Chile, constitutes a good example of a chromosomally polymorphic species, in which the inversion heterozygotes (heterokaryotypes) are at an advantage in most of the environments mastered by the species. Both in the natural populations and laboratory stocks, heterokaryotypes for the fourth chromosome are always in frequencies of about 50%. In searching for physiological properties responsible for the adaptive superiority of these heterokaryotypes, it was found that inversion heterozygotes are superior in longevity (Brncic and del Solar, 1961) exhibit a greater mating activity (Brncic and Koref-Santibañez, 1964) and have a faster rate of development (Brncic, Koref-Santibañez, Budnik and Lamborot, 1969).

A series of experiments was designed to determine whether the inversion heterozygotes in D. pavani in the preadult stages were superior in viability under crowding conditions with respect to the corresponding homokaryotypes. The ability to survive and reproduce under high density conditions represents an adaptive character, and it is well-known that the viability of certain genotypes depends on the density (rev. in Ayala, 1970).

In one series of experiments, eggs from a genetically heterogeneous stock of D. pavani were placed at various densities in small vials with a limited amount of basic cornmeal-agar medium. In a number of these vials the relationship between density and survival from egg to adult was estimated. In the remaining vials, the salivary gland polytene chromosomes of third instar larvae were analyzed in order to investigate the frequency of the different genetic arrangements in the fourth chromosome. In all the experiments there were found a significant increase of the heterokaryotypes in the more crowded vials and, also, a correlation between density and number of adults that emerged (Table 1).

Table 1. Frequencies of heterokaryotypes at various densities in the first series of experiments.

No. eggs x vial	No. of larvae examined	Chromosome IV-R Het.		Chromosome IV-L Het.	
		No.	%	No.	%
10	400	190	47.50	199	49.75
50	400	201	50.25	206	51-50
100	400	231	57.75	248	62.00
TOTAL	1200	622	51.83	653	54.42
Chi-square		9.02		14.15	
P (df 2)		0.01-0.02		<0.001	

In a second series of experiments, eggs of D. pavani at different densities were put together in small vials with an equal number of eggs of the mutant "yellow" of the "sibling" species D. gaucha. In order to determine the chromosomal structure of the D. pavani adults which emerged, each adult was crossed individually with flies which were homozygous for gene arrangements in all of their chromosomes, then the chromosomal arrangements of the F_1 progeny were examined cytologically. It was again found that among the flies that develop in the more crowded vials, the frequency of structural heterozygotes was significantly higher (Table 2). D. pavani and D. gaucha larvae do not compete at low densities, but D. pavani seems to be superior at high densities.

The general conclusion of the experiments reported is that heterokaryotypes in D. pavani

Table 2. Frequencies of heterokaryotypes at various densities in the second series of experiments.

No. eggs x vial	No. of adults examined	Chromosome IV-R Het.		Chromosome IV-L Het.	
		No.	%	No.	%
10	150	62	41.33	70	46.66
50	118	57	48.30	71	60.16
100	167	89	53.29	91	54.49
200	72	48	66.66	52	72.22
TOTAL	507	256	50.50	284	56.01
Chi-square		13.32		13.98	
P (df 3)		0.01-0.001		0.01-0.001	

have a greater survival under crowding conditions than the homokaryotypes. This property, along with their known superiority in longevity, mating, and rate of development, could contribute to the explanation of the high frequency of these heterokaryotypes in all the natural populations of D. pavani investigated.

References: Ayala, F.J., 1970 In: Essays in Evolution and Genetics in Honor of Th. Dobzhansky, M.K. Hecht and W.C. Steere, Eds. (Appleton Century-Crofts, New York): 121-158; Brncic, D. and E. del Solar, 1961 Amer. Nat. 95: 211-216; Brncic, D. and S. Koref-Santibañez 1964 Genetics 49: 585-591; Brncic, D., S. Koref-Santibañez, M. Budnik and M. Lamborot, 1969 Genetics 61: 471-478.

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Miller, D.D. and A.J. Kleager. University of Nebraska, Lincoln, Nebraska. Some additional data and a summary on interspecific mating in the D. affinis subgroup.

The following table has been put together from some very old unpublished data (circa 1940, D. D.M., designated by "M") on interspecific inseminations between D. affinis subgroup species in 10-day, "no-choice" combinations and some recent similarly derived data on combinations with D. narragansett (by A.J.K., designated by "K"; from Master's thesis, University of Nebraska, 1970). The older work involved various mutant strains, now defunct, the recent work a variety of wild and mutant strains. Frequencies are presented as raw insemination fractions. The data are supplemented by published insemination frequencies with D. tolteca (Ensign, 1960) and by reference to known cases of interspecific hybrids (including one newly reported here, from narragansett ♀ x affinis ♂). Despite the smallness of some of the numbers and the unequal attention to the different combinations, it is believed the table may be worthwhile to persons interested in this species group since it illustrates how at least some insemination has been encountered in 20 out of the 30 possible interspecific combinations of the six major American D. affinis subgroup species, eight combinations of which yield hybrids, of which three kinds manifest some fertility.

D. affinis ♀♀ x algonquin ♂♂: 0/56 "M"; x athabasca ♂♂: 158/431 "M", very few sterile HYBRIDS (Miller, Amer. Nat. 84: 81-93, 1950); x azteca ♂♂: 0/57 "M"; x narragansett ♂♂: 0/50 "M" and 0/87 "K"; x tolteca ♂♂: 31/107 (Ensign, Evolution 14: 378-385, 1960).

D. algonquin ♀♀ x affinis ♂♂: 0/52 "M"; x athabasca ♂♂: 3/144 "M", few fertile ♀♀ and sterile ♂♂ HYBRIDS (Miller, 1950); x azteca ♂♂: 0/52 "M"; x narragansett ♂♂: 10/225 "M" (some cultures gave few matroclinous offspring; nonvirginity?) and 2/62 "K"; x tolteca ♂♂: 1/104 (Ensign, 1960).

D. athabasca ♀♀ x affinis ♂♂: 14/281 "M"; x algonquin ♂♂: 0/159 "M"; x azteca ♂♂: 9/53 "M", sterile HYBRIDS including dwarf ♂♂ (Sturtevant and Dobzhansky, Amer. Nat. 70: 574-584, 1936); x narragansett ♂♂: 0/56 "M" and 3/87 ("western" ath), 2/61 ("eastern" ath.) "K"; x tolteca ♂♂: 19/118, 8/66, 21/59, sterile HYBRIDS (Ensign, 1960).

D. azteca ♀♀ x affinis ♂♂: 0/52 "M"; x algonquin ♂♂: 0/61 "M"; x athabasca ♂♂: 44/59 "M", sterile HYBRIDS including large-winged ♂♂ (Sturtevant and Dobzhansky, 1936); x narragansett ♂♂: 0/54 "M" and 1/55 "K"; x tolteca ♂♂: 35/115 (Ensign, 1960), sterile HYBRIDS (Patterson, Univ. Texas Publ. 5422: 46, 1954), fertile ♀ but sterile ♂ HYBRIDS (Miller and Sanger, Amer. Midl. Nat. 82: 618-621, 1969).

D. narragansett ♀♀ x affinis ♂♂: 0/55 "M" and 2/92 "K" with single sterile, poorly viable ♂ HYBRID; x athabasca ♂♂: 0/57 "M" and 0/68 ("western" ath.), 11/101 ("eastern" ath.) "K"; x azteca ♂♂: 0/52 "M" and 1/68 "K"; x tolteca ♂♂: 2/64 (Ensign, 1960), 0/56 "K".

D. tolteca ♀♀ x affinis ♂♂: 25/105 (Ensign, 1960); x algonquin ♂♂: 12/104 (Ensign, 1960); x athabasca ♂♂: 60/102, 17/60, 34/53 (Ensign, 1960); x azteca ♂♂: 58/109 (Ensign, 1960), fertile HYBRIDS of both sexes (Patterson, 1954); x narragansett ♂♂: 13/98 (Ensign, 1960), 1/66 "K".