An inversion within the subterminal inversion in *Drosophila ananassae*

B.N. Singh[1]

Genetics Laboratory, Department of Zoology, Banaras Hindu University, Varanasi-221005 (India), January 20, 1982

Summary. An inversion within the subterminal inversion in 2L of *Drosophila ananassae* has been detected in a laboratory strain originating from Kuala Lumpur, Malaysia. The break points of inversion have been located in the reference map of salivary chromosomes. The data on the frequencies of different karyotypes indicate that inversion heterozygotes exhibit heterosis.

Drosophila ananassae, although a cosmopolitan and domestic species, presents a high degree of chromosomal polymorphism[2–8]. Freire Maia[6] reported a number of peculiar chromosome rearrangements in Brazilian natural populations of this species. Most of the inversions have localized distribution but the 3 paracentric inversions, namely subterminal (alpha), terminal (delta) and basal (eta) are coextensive within the species[7,9,10]. The present communication reports in a laboratory strain a new inversion which has occurred within the inverted segment of a chromosome with alpha gene arrangement.

The KL 1-4 strain of *D. ananassae* which forms the material of the present study was obtained from Tokyo Metropolitan University, Japan in December 1980. This strain was established from a single female captured at Kuala Lumpur in 1972 (Tobari, personal communication). The chromosomal analysis of the strain was made by squashing a large number of larvae taken directly from culture bottles, using the usual acetocarmine method.

The cytological analysis of the KL 1-4 stock has uncovered the presence of a new inversion which has occurred within the subterminal inversion (alpha) of 2L. In the reference map of salivary chromosomes constructed by Ray-Chaudhuri and Jha[8], the alpha inversion extends from 1C to 13C. The new inversion detected during the present study has occurred within the inverted segment of a chromosome with alpha gene order. One break point has occurred very close to the proximal break point of the alpha inversion (or on the same point) and the other near 7C. The location of both the inversions in 2L is shown in figure d. The KL 1-4 stock contains 2 types of 2nd chromosomes, one having the standard gene order and the other having alpha arrangement with the new inversion in it. Thus the heterozygote (ST/AL^{in}) shows 2 loops within the alpha segment (fig. a). The KL 1-4 stock was crossed with a stock homozygous for the alpha inversion. The examination of F_1 larvae revealed the presence of 2 types of heterokaryotypes viz., ST/AL showing a subterminal loop (fig. c) and AL^{in}/AL showing a small median loop (fig. b).

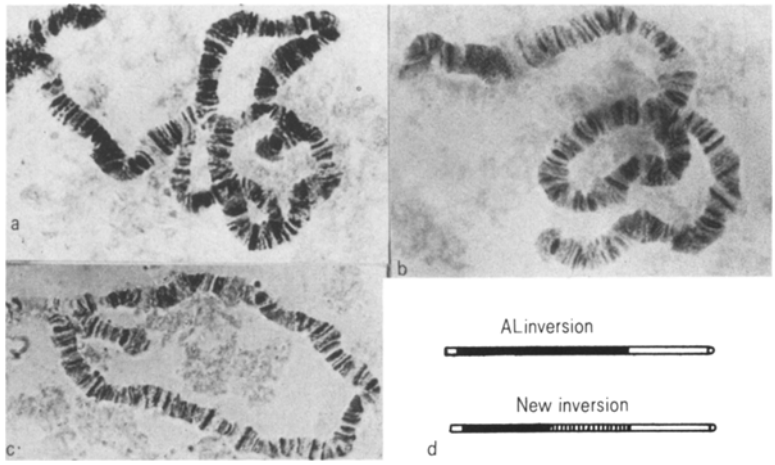
In a random sample of 120 larvae analyzed from the KL 1-4 stock, 3 karyotypes, ST/ST, ST/AL^{in} and AL^{in}/AL^{in} were distinguished. The observed and expected numbers of 3 karyotypes and the frequencies (in percent) of 2 chromosomes are shown in the table.

From the frequencies of chromosomes (ST and AL^{in}), the expected frequencies of 3 karyotypes have been calculated by following the Hardy-Weinberg formula. It is evident from the data that there is an excess of heterozygotes and a deficiency of homozygotes. The χ^2-value of 9.55 with 1 degree of freedom clearly indicates that the deviation from Hardy-Weinberg equilibrium is highly significant ($p < 0.01$). Thus the inversion heterozygotes exhibit heterosis with respect to viability. Earlier studies[11–17] have indicated that heterosis is associated with the subterminal inversion. The persistence of chromosomal polymorphism due to this subterminal inversion with its new inversion in a

Observed and expected numbers of 3 karyotypes, and frequencies (in percent) of 2 chromosomes in the KL 1-4 stock of *D. ananassae*

Total No. of larvae analyzed		Karyotypes ST/ST	ST/AL^{in}	AL^{in}/AL^{in}	Chromosomes ST	AL^{in}
120	Observed	32	75	13	57.9	42.1
	Expected	40.26	58.49	21.25		
	$\chi^2 = 9.55$ df = 1 $p < 0.01$					

ST, Standard gene arrangement; AL^{in}, alpha gene arrangement with the new inversion.



Photomicrographs of the left arm of 2nd chromosome from larvae heterozygous for inversions and diagram of 2L showing location of inversions. *a* Pairing between ST and AL^{in} chromosomes. *b* Pairing between AL^{in} and AL chromosomes. *c* Pairing between ST and AL chromosomes. *d* Diagram of 2L showing the location of inversions. The circle indicates the basal end of 2L.

strain maintained under uniform conditions in the laboratory and the significant excess of heterozygotes observed during the present investigation extend evidence that the heterotic property of subterminal inversion is maintained even after the alteration of gene arrangements within the inverted segment caused by the new inversion. Thus the property of a chromosome depends on its gene content rather than on the gene arrangement itself.

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Genetic variability in mating activity of *Drosophila melanogaster* males

K. Kosuda

Biological Laboratory, Faculty of Science, Josai University, Sakado, Saitama 350-2 (Japan), April 19, 1982

Summary. Male mating activity was measured for 29 lines of *D. melanogaster*, made homozygous for the second chromosome. Genetic differences between lines were found to be highly significant. Mating activity of homozygous males was much lower than that of heterozygous ones.

Drosophila melanogaster females are generally refractory to mating for a certain period after they have mated once[1]. On the other hand, males generally mate with several females within a limited period[2-4]. Male multiple mating is a very important phenomenon from the population-biological standpoint, since it implies that a proportion of males may be eliminated from a reproductive population. This would make the effective size of a population much smaller than its logistic potential, and would constitute an important component of sexual selection.

To study the genetic variability in male mating activity in natural populations, 2nd chromosomes of *D. melanogaster* were extracted from a natural population in Katsunuma, Japan, and made homozygous by means of the complete marked inversion technique. 29 homozygous lines having no lethal or sterility genes were finally established. The genetic background of these 2nd chromosome homozygote lines is the same as that of the natural population, since the genetic background of the *Cy/Pm* balancer strain used was previously substituted with that of Katsunuma population. Chromosomes, except for the 2nd one, were not under control. The tendency was found that chromosomes with low viability in the homozygous condition often show low fertility or even sterility (Kosuda, unpublished observation). Male mating activity was measured by the number of females inseminated by single males within 24 h under conditions of permanent artificial light at 25 °C. 10 out of 12 females of a standard line (designated 2SG) were placed together with 1 male in a 3×8 cm culture vial and were examined as to whether or not they had sperms in their ventral receptacles or spermathecaes. The 2 remaining females were kept as a provision against technical failure. The age of the 2SG females was 3 or 4 days and 3-day-old males were always utilized. 12 replicates each were made for 29 homozygous lines for the measurement of male mating activity.

The frequency distribution of mating activity for all 348 males is given in figure 1. 25 out of 348 males (7.2%) did not mate and 8 males (2.3%) mated more than 10 times

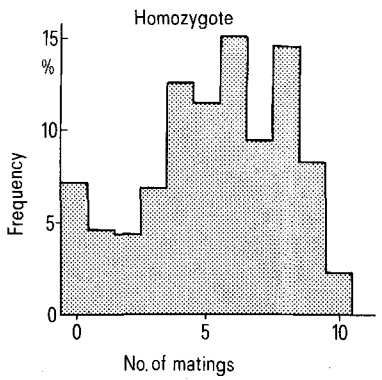

Fig. 1 Frequency distribution of mating activity in homozygous males.

Analysis of variance for mating activity among 29 homozygous second chromosome lines

Source	d.f.	S.S.	M.S.	F
Line	28	838.01	29.93	5.95**
Error	319	1604.92	5.03	
Total	347	2442.93		

** Significant at 1% level.