

## A New Chromosome Configuration in *Drosophila simulans*

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*Drosophila simulans* was described by A.H. Sturtevant (1919); when a researcher in his laboratory at Columbia University obtained confusing results with field-collected *Drosophila* from Alabama. Males of the Alabama strain mated to mutant *D. melanogaster* females produced only sterile female progeny. The Alabama strain ultimately was identified as *D. simulans*. Until that time, *D. simulans* was not distinguished from *D. melanogaster*, which it very closely resembles. The most reliable differentiating character is the difference in the posterior process of the male genital tergite. The process is clamshell-like in *D. simulans* and is hook-like in *D. melanogaster*.

The *D. melanogaster*-*D. simulans* cross was the first interspecific hybrid discovered in *Drosophila*. Sturtevant, capitalizing on this discovery and the well-known genetic background of *D. melanogaster*, through a series of experiments determined that any hybrids produced carried a *D. simulans*-X chromosome. That is, in the reciprocal cross between *D. simulans* females and *D. melanogaster* males only males were produced. However some regular females were realized infrequently in this cross. With an attached-X *D. melanogaster* female and a *D. simulans* male patroclinous sons were produced.

Since *D. simulans* was described by A.H. Sturtevant, there have been only two larvae which possessed heterozygous banding sequences of their polytene salivary chromosomes (Dobzhansky 1939, Sturtevant 1931). A female *D. simulans* collected on a Niles, Michigan tomato farm in September 1979 has given rise to a strain which has a salivary chromosome configuration different from that of a *D. simulans* strain from a national stock center. The X and third chromosome banding patterns of the Niles strain *D. simulans* are most distinctive from the laboratory strain *D. simulans*, and from Oregon-R strain *D. melanogaster*.

## MATERIALS AND METHODS

All strains were kept on standard cornmeal-molasses-yeast medium at 25°C by mass dump transfer. (The medium at SIU-C was cornmeal-karyo syrup-yeast). Larvae of experimental crosses for cytological study were kept on the same medium at 18°C.

Reciprocal crosses were made between the NILES strain (NILES) and laboratory strain *D. simulans* (LAB). Reciprocal crosses were also made between *D. melanogaster* (ORE-R) and each of the *D. simulans* strains.

Polytene chromosome squashes were made by dissecting the larvae in 45% acetic acid, and immediately transferring the salivary glands to a drop of 1% lacto-acetic orcein stain on a silicon-treated coverslip for 2 minutes. A clean slide was then placed on the coverslip, inverted, and heavy thumb pressure applied.

Chromosomes were examined at 320x with a Zeiss WL phase contrast microscope. The best preparations were recorded on Kodak Panatomic-X, 35mm black and white film.

## RESULTS AND DISCUSSION

Crosses between the *D. simulans* strains produced both male and female progeny regardless of the female parents' origin (Table 1), while the crosses between ORE-R and the *D. simulans* strains resulted in characteristic unisexual broods of the *D. melanogaster* - *D. simulans* interspecific cross (Table 2). The males that were produced in the third ORE-R × NILES cross of 1981 were assumed to be XO males, due to non-disjunctional events in the development of the eggs (Sturtevant 1920). The female produced in the only successful LAB × ORE-R cross was one of the last flies produced, and had degenerate ovaries. It was probably due to non-disjunction in the egg and subsequent fertilization of the XX egg by a Y-carrying sperm. At least 45 preparations were made of female salivary gland chromosomes of each strain and experimental cross; at least 6 preparations from each strain and cross were photographed. The quality of the preparations from larvae with *D. melanogaster* female parent was consistently superior to those preparations with *D. simulans* strain female parent, irrespective of the acetic acid batch, lacto-acetic orcein batch, or variation in staining time.

The X-chromosome of the NILES *D. simulans* exhibits a radically different banding pattern than both the LAB *D. simulans* and *D. melanogaster*. There appears to be a band or two missing at the end of the NILES X-chromosome, and possibly a deletion between bands 3A and 3C (Fig. 1). The *D. simulans* NILES strain and LAB X-chromosomes are synapsed only from 3C to 4E in Fig 1b. This is the only cell in which I found this asynaptic/desynaptic state.

The NILES *D. simulans* has an inversion in 3R, encompassing the region between 84B and 92C, with respect to *D. melanogaster* (Fig. 2). This inversion is known to be present in *D. simulans* salivary gland chromosomes with respect to *D. melanogaster* (Patau 1935). The break-points of this inversion have been variously given as 84B3 and 92C3 (Horton 1939), 84E and 93F (Dubinin et al. 1937; *vide* Lecomunier and Ashburner 1976), and 93F6-7 (Ashburner 1969). I am unable to further delineate this inversion due to the generally poor quality of the preparations. This inversion is not seen in hybrids between the two *D. simulans* strains (Fig. 1).

An inversion is present also in 3L of the NILES *D. simulans* with respect to both *D. melanogaster* and the LAB *D. simulans*. It appears to encompass the

chromosome arm from 74A to a region distad of 66A (Fig. 2). This inversion has not been found in the *D. melanogaster* species subgroup (Lemeunier and Ashburner 1976). Again, the quality of the preparations prevented further delineation of the breakpoints. Examination of the male genitalia (unpublished data) indicate NILES is *D. simulans*. In addition, in reciprocal crosses with the LAB *D. simulans*, fertile  $F_1$  were realized (Table 3). I have no explanation for any significant differences from a 1:1 sex ratio. Observation of the mating behavior also indicates NILES is *D. simulans*. The actions of both NILES males and females are consistent with the description of *D. simulans* mating behavior reported by Spieth (1952).

An interesting extension of this discovery would be to compare the niche width of the NILES strain *D. simulans* with strains already in various laboratories, and with strains from more southern climes. Parsons (1975) has pointed out that *D. simulans* is generally found to outnumber *D. melanogaster* in the southern United States, while *D. melanogaster* is more prevalent in the northern states. *D. simulans* is more restricted in its tolerance to temperature fluctuation than *D. melanogaster* (Hosgood and Parsons 1966). Perhaps the chromosome configuration is related to the occurrence of this strain in the northern section of the *D. simulans* range.

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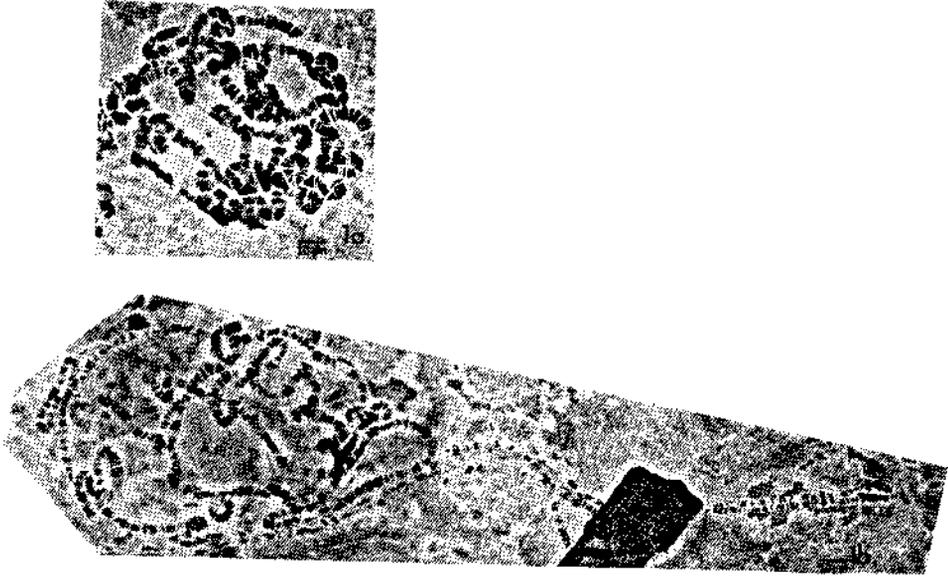


Fig. 1. *Drosophila simulans* hybrid chromosomes.

a)  $F_1$  female larva of NILES female  $\times$  LAB male cross. Arrow indicates shortened X-chromosome of NILES in synapsis with LAB X-chromosome.

b)  $F_1$  female larva of different NILES female  $\times$  LAB male cross than (a) demonstrating different banding patterns of the X-chromosomes of each strain. Roman numerals indicate chromosome arm (R: right; L: left) Arabic numbers indicate bands.

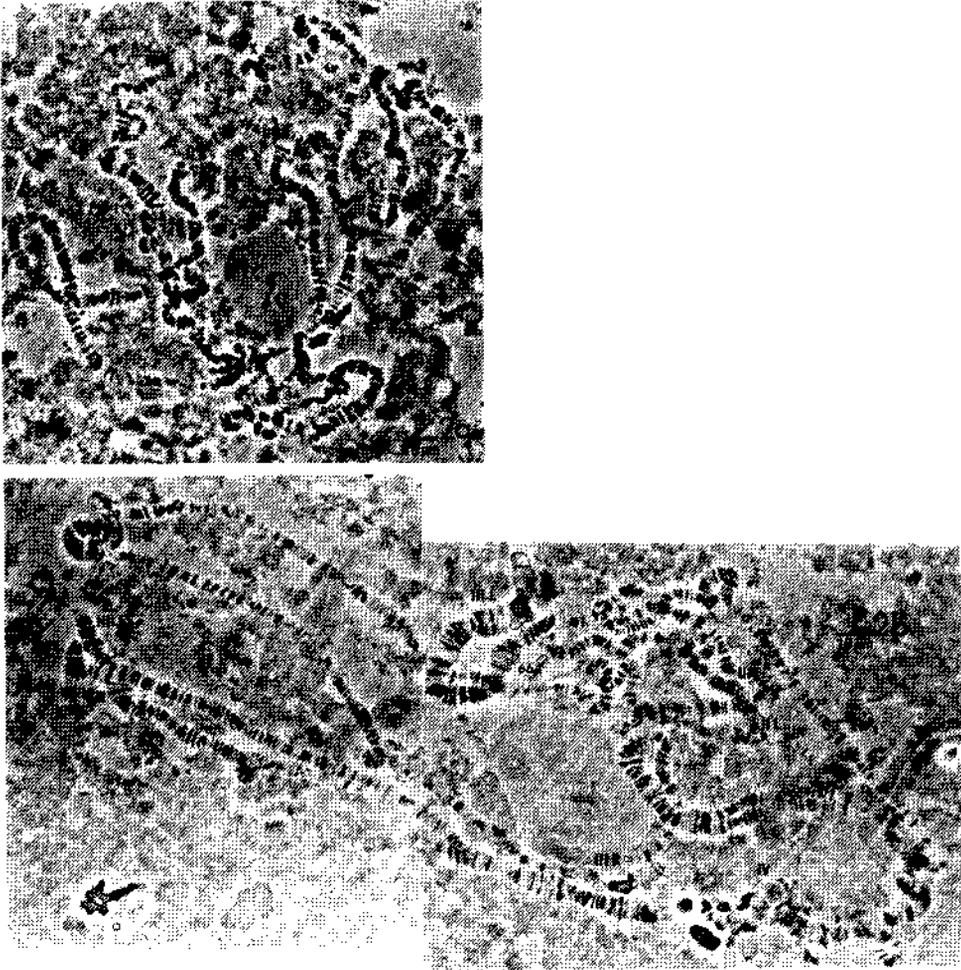


Fig. 2. *Drosophila melanogaster-Drosophila simulans* hybrid chromosomes.  
 a)  $F_1$  female larva of ORE-R female  $\times$  NILES male cross demonstrating breakpoints of III R inversion.  
 b)  $F_1$  female larva of different ORE-R female  $\times$  NILES male cross demonstrating asynapsis in tip of X-chromosomes beyond band 3.  
 Breakpoint of III I. inversion (66a) indicated.  
 Designations as in Fig. 1.

Table 1. Results of interstrain crosses between *Drosophila simulans* strains from Niles, Michigan (NILES) and laboratory (LAB). Six matings attempted each year, only productive matings listed; Female P<sub>1</sub> listed first. 1981 Medium: Cornmeal-Molasses-Yeast. 1982 Medium: Cornmeal-Karyo Syrup-Yeast.

Cross	Year	Progeny	1	2	3	4	5
LAB × NILES	1981	♀♀	34	27	232	2	
		♂♂	32	27	243	2	
		$\chi^2$	0.06	0	0.25	0	
	1982	♀♀	36	57	26	40	16
		♂♂	29	39	29	33	13
		$\chi^2$	0.75	3.38	0.75	0.67	0.31
NILES × LAB	1981	♀♀	138	145	115	204	133
		♂♂	38	131	80	102	92
		$\chi^2$	0	0.71	6.26*	34.0*	7.47*
	1982	♀♀	95	95	92	94	147
		♂♂	97	95	95	104	117
		$\chi^2$	0.09	0	0.05	0.51	3.41

\*p < 0.05 ( $\chi^2 > 3.84$ )

Table 2. Results of interspecific crosses between *Drosophila melanogaster* (OREGON-R Strain: ORE-R) and two strains of *Drosophila simulans* (LAB or NILES). Six matings attempted each year (12 in 1980), only productive matings listed. Female P<sub>1</sub> listed first. 1979-1981 Medium: Cornmeal-Molasses-Yeast. 1982 Medium: Cornmeal-Karyo Syrup-Yeast.

Cross	Year	Progeny	1	2	3	4	5	6	7	8	9
ORE-R × NILES	1979	♀♀	153								
		♂♂	0								
	1980	♀♀	243	455	61	37	2	101	221	70	159
		♂♂	0	0	0	0	0	0	0	0	0
1981	♀♀	57	67	55							
	♂♂	0	0	2							
1982	♀♀	53	98	116	62						
	♂♂	0	0	0	0						
NILES × ORE-R	1981	♀♀	0								
		♂♂	28								
	1982		None Successful								
ORE-R × LAB	1981		None Successful								
1982	♀♀	88	94								
	♂♂	0	0								
LAB × ORE-R	1981	♀♀	1								
		♂♂	111								
	1982		None Successful								

Table 3. Results of interse matings of progeny from 1981 Cross No. 1 and 2 of intrastain matings (See Table 1).

Parental Cross		F <sub>2</sub>		$\chi^2$
		♀♀	♂♂	
LAB X NILES	No. 1	212	189	1.32
	No. 2	173	164	0.24
NILES X LAB	No. 1	43	37	0.45
	No. 2	208	136	15.07*

\*P < 0.05 ( $\chi^2 > 3.84$ )