

POPULATION GENETICS OF *DROSOPHILA NASUTA NASUTA*,
DROSOPHILA NASUTA ALBOMICANA AND THEIR HYBRIDS.
I. KARYOTYPIC MOSAICISM IN THE HYBRID POPULATIONS

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ABSTRACT

D. n. nasuta and *D. n. albomicana* constitute a pair of chromosomal races with $2n=8$ and $2n=6$, respectively. The F_1 of these has $2n=7$ and it is fertile. There exists a state of karyotypic mosaicism as evidenced by the presence of 26 types of chromosome combinations in F_2 , F_3 and F_{10} populations. In the midst of this karyotypic noise, the karyotype similar to that of F_1 reached 51% of the population. Implications of these findings are discussed.

THE *nasuta* subgroup of the *immigrans* species group of *Drosophila* is a fertile group for the study of many facets of population genetics. It is an assemblage of morphologically almost identical forms with various degrees of reproductive isolation. Of these, *D. nasuta nasuta* ($2n=8$) and *D. nasuta albomicana* ($2n=6$) are allopatric and have mutually open genetic systems; hence, they are treated as chromosomal races (NIRMALA and KRISHNAMURTHY 1972; RANGANATH, RAJASEKARASETTY and KRISHNAMURTHY 1974). The present project has been undertaken to study some aspects of population genetics of these chromosomal races and their hybrids. This paper deals with the extent of karyotypic mosaicism in hybrid populations of *D. n. nasuta* and *D. n. albomicana*.

MATERIALS AND METHODS

A chromosomally monomorphic strain of *D. n. nasuta* extracted from Coorg stock (Mysore, India) and *D. n. albomicana* from Okinawa (University of Texas Stock No. 3045.11) were employed for the present experiment. Larval brain squashes were made to check the karyotypes of the parents and the hybrids. The cultures of the hybrid populations were maintained by randomly selecting 100 males and 100 females in each generation, and they were bred to obtain the next generation. From these hybrid populations, 100 larvae at random were chosen for screening the frequencies of various karyotypes in the F_2 , F_3 and F_{10} generations. Brains from second-instar larvae were removed in physiological saline, pretreated with a hypotonic solution (1% sodium citrate) for five min before being stained in 2% lacto-aceto orcein for thirty min. The squashes were made in 45% acetic acid.

RESULTS AND DISCUSSION

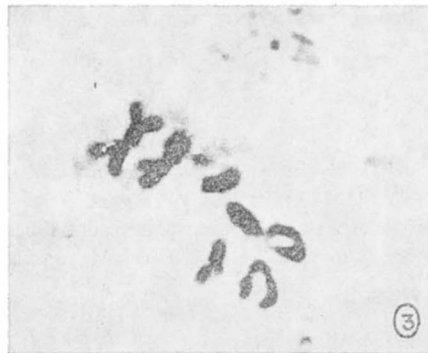
D. n. nasuta ($2n=8$) has a pair of V-shaped metacentric chromosomes, (chromosome 2), two pairs of rod-shaped acrocentric chromosomes (one of these is the X chromosome and the other is chromosome 3) and a pair of small dots (chromosome 4) (Figure 1). *D. n. albomicana* ($2n=6$) has two pairs of metacentrics, of which one pair represents chromosome 2, while in the other, one arm is the sex chromosome (X/Y) and the other is chromosome 3; and a pair of elongated dots (Figure 2). The F_1 hybrid of these has $2n=7$, with three metacentrics, two acrocentrics, a small dot and a long dot (Figure 3). The evolution of the karyotype of *D. n. albomicana* occurred through the fusion of two pairs of acrocentrics of *D. n. nasuta*, *i.e.*, chromosome 3 and the sex chromosomes



$2n=8$ (2V 4R ●●)



$2n=6$ (4V II)



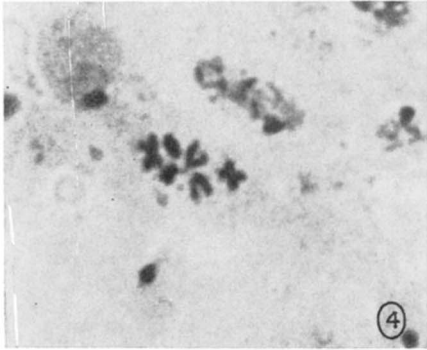
$2n=7$ (3V 2R I●)

- FIGURE 1.—Karyotype of *D. nasuta nasuta*.
 FIGURE 2.—Karyotype of *D. nasuta albomicana*.
 FIGURE 3.—Karyotype of F_1 hybrid.

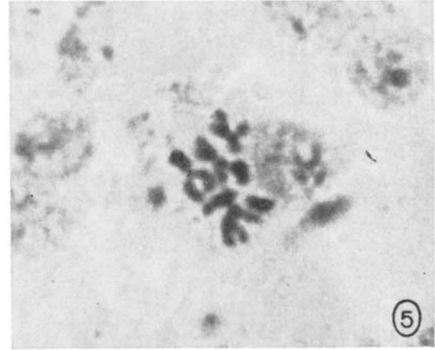
(WILSON *et al.* 1969; WAKAHAMA, KITAGAWA and YAMAGUCHI 1971; NIRMALA and KRISHNAMURTHY 1972).

On inbreeding F_1 individuals with the above karyotypic constitution, one can theoretically expect 144 different chromosome combinations in the F_2 . Further, in succeeding generations, the extent of this recombination should increase. But the chromosome analysis of the F_2 population has exposed only 26 variants. Analysis of chromosome combinations in the F_3 and F_{10} generations of inbreeding showed that only these 26 types were present; no other combinations appeared. This amounts to saying that, except for these 26 combinations, other combinations are inviable.

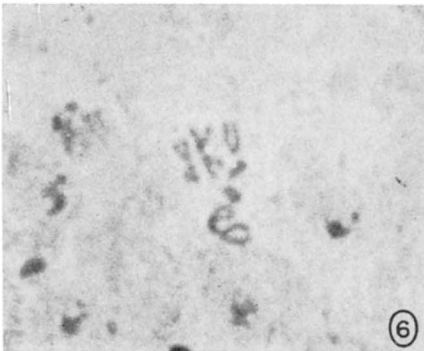
By considering the permutations and combinations of the macrochromosomes (V's and rods), the 26 types can be categorized into 11 groups. Of these 11, three represent the chromosome complement of the two parents and the F_1 hybrid. The remaining eight are new. These new combinations are either duplications or deficiencies for the X chromosomes and chromosome 3. Some of these new karyotypic combinations are shown in Figures 4 to 7. The frequencies (in



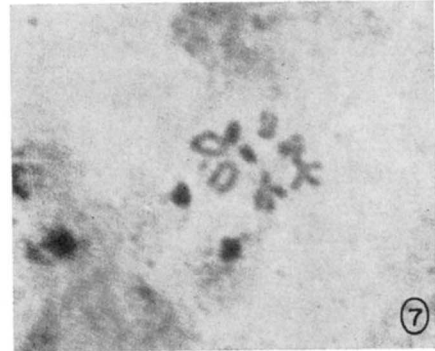
$2n=6$ (2V 2R II)



$2n=7$ (4V IR II)



$2n=6$ (3V IR II)



$2n=8$ (3V 3R I•)

FIGURES 4-7.—Four different types of chromosomal combinations encountered in F_2 , F_3 and F_{10} hybrid populations of *D. nasuta nasuta* \times *D. nasuta albomicana*.

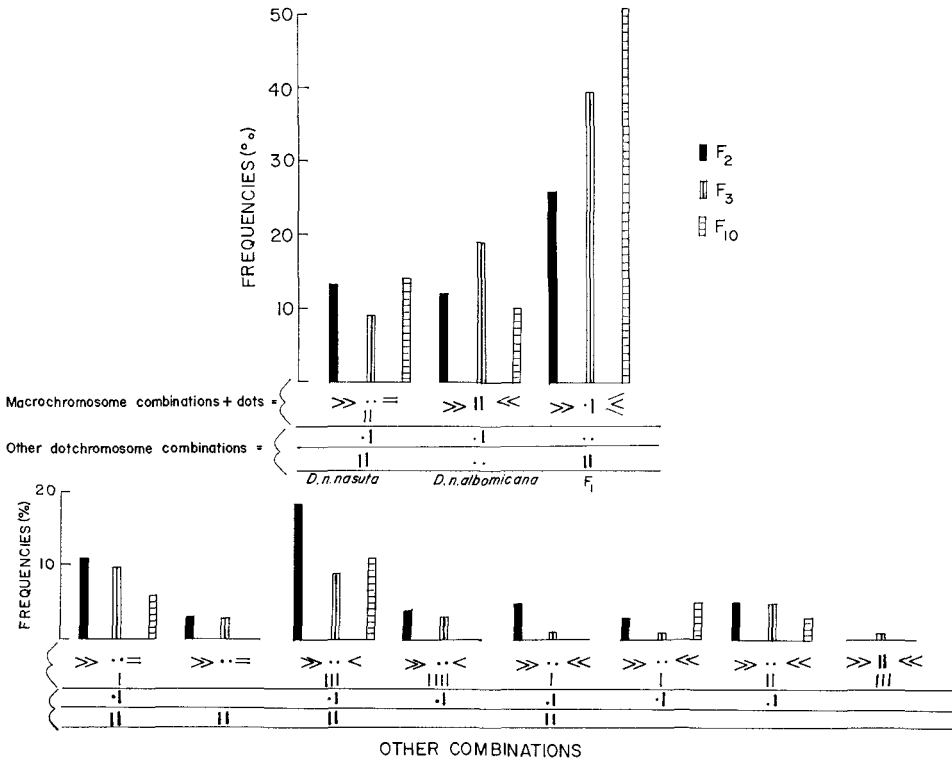


FIGURE 8.—Frequencies (in percent) of the 11 classes of karyotypes recorded in the F_2 , F_3 and F_{10} hybrid populations of *D. nasuta nasuta* \times *D. nasuta albomicana*.

percent) of these 11 classes of chromosome combinations in F_2 , F_3 and F_{10} hybrid populations are presented in Figure 8. It is interesting to note that in these three populations the incidence of the parental and F_1 hybrid karyotypic combinations amounts to 80%, while the new abnormal karyotypes have a combined frequency of 20%. The crux of the problem is to account for the viability of these abnormal karyotypes. The present paper deals with the chromosome variation of the hybrid population as an unit and is not concerned with the fitness of the individuals. These eight new karyotypic combinations, whether they are viable or not, are perpetually produced in these hybrid populations because of the dominance of the karyotypic combination of the F_1 hybrid. The permutations and combinations of the F_1 karyotype produces these new types. If these eight new abnormal karyotypes were as viable as the parental combinations, they should have increased in their frequencies. But it is not so.

It is premature to conclude anything at this stage as to the fitness of these new aberrant individuals. Further studies are in progress, by backcrossing individuals of the hybrid populations to their parents, in an attempt to learn which of the hybrid individuals are fertile and hence their karyotype. "Population genetics has always begun with and centered around the characterization of

genetic variation in populations" (LEWONTIN 1970). The purpose of this report is to unravel the extent of karyotypic variation in the hybrid populations of *D. n. nasuta* and *D. n. albomicana*.

The significant observation in the hybrid populations under study is the persistent coexistence of a variety of combinations of karyotypes leading to karyotypic mosaicism. Further, in the midst of this karyotypic noise, by the F_{10} generation, a karyotype similar to the karyotypic combination of F_1 hybrid (3 V's, 2 rods and 2 dots) has reached 51% of the population. Thus, it has exceeded the frequencies of the parents, namely *D. n. nasuta* and *D. n. albomicana*. This is in agreement with the findings of RAJASEKARASETTY *et al.* (1979a,b). They reported that there is overdominant heterosis in the F_1 hybrids of *D. n. nasuta* and *D. n. albomicana* for most of the fitness characters leading to a competitive superiority of hybrid populations over their parents. On the basis of these findings, the authors feel that there exist two levels of genetic stabilization in the gene pool of the hybrid populations under discussion: (a) representatives of the 11 chromosomal combinations with variable frequencies are produced leading to the karyotypic mosaicism, and (b) of these 11 classes, maintenance of an adaptively superior karyotype in a high frequency of more than 50%. Thus, in the genetic system of the hybrid population under study there exist different chromosomal combinations, one of which has evinced the highest fitness, and it enshrines the adaptive integrity of the populations.

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