Population Genetics on Three Races of *Drosophila auraria* Peng.

II. Sexual Isolation among Strains within a Race C.

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Introduction

Although the sequence of sexual isolation could be sometimes modified by changing certain experimental conditions, namely, age of flies used, time of mating duration, and temperature (Levene, 1949; Patterson and Stone, 1952; Barker, 1962), sexual isolation *per se* acts, like other isolating mechanisms, as a barrier for interbreeding between individuals belonging to different populations, and then, it should be an important biological function leading to sustain the gene pool as a population (Dobzhansky, 1947; Patterson and Stone, 1952).

The three races, A, B and C of *Drosophila auraria*, show interracially considerable degree of sexual isolation with one another. In intraracial sexual isolation, however, the degree is not significant in either cases of race A and B (Kurokawa, 1959; 1960). On the other hand, it became eventually clear that, the individuals belonging to race C are more variable within a race than those belonging to races of A and B in some morphological and ecological characteristics (Kurokawa, 1956 a, b; 1962). The question often comes to my mind whether or not such a variability found in a race C is comparable to that in magnitudes of the intraracial sexual isolation. Thus, the various crosses using different strains were carried out in order to test the validity of this problem.

Materials and Methods

Seven wild strains belonging to race C collected at separated localities, except for two (Oyakawa-'53 and Oyakawa-'55) which were from the same locality, but at different times at an interval of two years, were used in this experiment. These strains are symbolized as follows:

C 2.....Morioka, Iwate Pref.

C 3.....Usuitoge, Nagano Pref.

C 4.....Suzaki, Kochi Pref.

C 5.....Meguro-Shizenen, Tokyo

C 6.....Oyakawa-'53, Tokyo

C 8.....Oyakawa-'55' Tokyo

C 9.....Korea

Out of these seven strains, three, C 3 (Usuitoge), C 4 (Suzaki) and C 5 (Meguro-Shizenen), were used repeatedly for testing the degree of sexual isolation among them in this experiment.

For the examination of mating preference, a usual male multiple choice technique (Merrell, 1950) was adopted. To measure the degree of randomness of the mating, Levene's "Coefficient of isolation= K " was used (Levene, 1949). The experimental procedure differs from the previous experiments (Kurokawa, 1959; 1960) in putting vials containing males and females in an incubator for 8-12 hours, since there is evident fact that, in the present species, this shortening of the time of mating duration has no serious effect upon the isolation degree (Fukatami, unpub.). The other procedure and examination of the data were the same as in the previous reports. The experiment was done throughout at 25 °C.

Results and Discussion

The results of the experiment are summarized in Table 1. Out of these, the nine crosses, C 2—C 3, C 2—C 5, C 2—C 6, C 2—C 8, C 3—C 4, C 3—C 5, C 3—C 8, C 6—C 9, and C 8—C 9, similarly resulted in no particular deviation from randomness of mating to show relatively low coefficients. Coefficient ($K_{2,1}$) measures 0.131, at most, in the case of C 2, C 8 (♀)×C 8 (♂). The C 2 strain, above all, seems not to be discrete from the others concerning mating preference.

On the other hand, it becomes clear that the coefficients of joint isolation obtained in these intraracial crosses indicated more considerable variability from cross to cross than those found in either of the races, A and B, though the values were less than those in interracial crossings (Kurokawa, 1959; 1960). It was clearly found that, the crosses which showed relatively high coefficients, reaching first place of decimals, were much more frequent than in the case of race A (see Kurokawa, 1959).

The cross, C 3×C 6 shows certain sexual isolation between them ($K_{1 \text{ and } 2}=0.214$). Similarly, the C 6 strain seems to have a preference for conspecific mating, that is, relatively high coefficients have been shown in the crosses using this strain as a partner, as in C 3 and C 6, C 5 and C 6, and C 6 and C 8, respectively. The males of C 4 strain tend to mate more frequently with alien females than with its own females. Consequently, in the crosses, C 2 and C 4, C 4 and C 8, and C 4 and C 9, the negative isolation has appeared in every case, K 's being measured as -0.429, -0.485, and -0.278, respectively.

The C 9 strain is always found to be discrete from any of the other strains, C 2, C 3, C 4, C 5, C 6, and C 8. The coefficients ($K_{2,1}$) have been estimated as 0.299, 0.374,

Table 1. Summarized data of sexual isolation: percentages of females found inseminated (%) in several crosses involving geographical strains of race C of *D. auraria*

Crosses (♀), (♀) (♂)		Homogamic % (+)	Heterogamic % (+)	$K_{1,2}$ and $K_{2,1}$	$K_{1 \text{ and } 2}$ (Joint-K)
C 2, C 3	× C 2	55.4	65.0	-0.130	-0.051
" "	× C 3	50.5	48.6	0.027	
C 2, C 4	× C 2	26.4	35.1	-0.170	-0.299
" "	× C 4	17.6	38.4	-0.429	
C 2, C 5	× C 2	72.4	65.9	0.089	0.065
" "	× C 5	80.0	77.2	0.042	
C 2, C 6	× C 2	61.0	60.5	0.006	-0.038
" "	× C 6	47.0	52.8	-0.084	
C 2, C 8	× C 2	33.4	43.9	-0.174	-0.021
" "	× C 8	27.4	21.8	0.131	
C 2, C 9	× C 2	38.2	53.3	-0.225	0.037
" "	× C 9	57.6	37.0	0.299	
C 3, C 4	× C 3	66.4	71.2	-0.066	0.011
" "	× C 4	52.4	46.6	0.089	
C 3, C 5	× C 3	55.5	48.6	0.097	0.092
" "	× C 5	66.4	60.0	0.086	
C 3, C 6	× C 3	80.0	62.3	0.245	0.214
" "	× C 6	66.4	52.9	0.183	
C 3, C 8	× C 3	80.5	78.5	0.030	-0.091
" "	× C 8	33.7	47.0	-0.214	
C 3, C 9	× C 3	72.8	85.3	-0.191	0.091
" "	× C 9	86.8	60.2	0.374	
C 4, C 5	× C 4	50.0	45.6	0.065	0.155
" "	× C 5	65.7	51.5	0.245	
C 4, C 6	× C 4	66.7	38.3	0.389	0.192
" "	× C 6	61.6	65.7	-0.006	
C 4, C 8	× C 4	27.8	63.9	-0.485	-0.159
" "	× C 8	44.8	34.5	0.168	
C 4, C 9	× C 4	18.3	30.1	-0.278	0.075
" "	× C 9	63.1	32.9	0.428	
C 5, C 6	× C 5	57.6	73.9	-0.220	-0.014
" "	× C 6	58.6	45.0	0.192	
C 5, C 8	× C 5	60.8	46.7	0.184	0.153
" "	× C 8	57.8	49.2	0.121	
C 5, C 9	× C 5	67.3	87.7	-0.258	0.022
" "	× C 9	68.7	46.4	0.301	
C 6, C 8	× C 6	55.7	40.7	0.219	0.123
" "	× C 8	45.6	43.9	0.026	
C 6, C 9	× C 6	63.2	69.1	-0.079	0.024
" "	× C 9	65.2	59.3	0.126	
C 8, C 9	× C 8	42.4	53.2	-0.149	-0.015
" "	× C 9	61.5	52.8	0.120	

$K_{1,2}$ = coefficient of isolation when strain 1 ♂'s are placed with strain 1 ♀'s and strain 2 ♀'s.

$K_{2,1}$ = coefficient of isolation using strain 2 ♂'s.

$K_{1 \text{ and } 2}$ (Joint-K) = coefficient of joint isolation of strains 1 and 2.

0.428, 0.301, 0.126, and 0.120, respectively. The considerably high degree of sexual isolation found in these cases were beyond expectation. Beside this uniqueness in the mating preference from the other strains, the females of Korea strain which are placed with alien males are found to be acceptable to them. This may be attributed to their high sexual activity in either of the sexes. Moreover, it is concluded that the fact found in the experiments concerning sexual isolation using this strain suggests some degree of genetic differentiation as well as some influences brought about by its special circumstance.

The geographical distribution of the race C strains has a casual relationship with the degree of sexual isolation found among them, except for the case of C 9 (Korea) strain. On the other hand, the relationship between variation in the number of sixth sternite bristles of male flies (Kurokawa, 1962) and the degree of sexual isolation among strains can somewhat be detected. The two, C 3 and C 6 strains, which significantly differ in the number of the bristles from each other (Kurokawa, 1962), are mutually discrete, by showing high degree of the sexual isolation. The similar relationship can be found between C 5 and C 6, and C 6 and C 8 strains.

Finally, in the cross between C 4 and C 5 strains, especially, C 4, C 5 (♀) $\times$ C 5 (♂), out of the three crosses which were repeatedly tested in this experiment, the coefficient significantly risen up to the present (from 0.02 to 0.24 in $K_{2,1}$). It has sometimes been found that the degree of sexual isolation in the strains kept as laboratory stocks tends to increase with the time, though the cause of this rise remains unexplained.

Summary

The variability of the race C of *Drosophila auraria* has been discussed with regard to intraracial sexual isolation.

Occurrence of intraracial sexual isolation between strains was detectable in many cases.

The relationship between variability in the degree of sexual isolation and that in the sixth sternite bristles of male flies was found to be parallel in some cases.

The geographical distribution of the strains is thought, however, usually to stand in a casual relationship with the degree of sexual isolation.

Certain intensification in the degree of sexual isolation with time during which the flies have been kept in the laboratory stocks was recognized.

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