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SEX DIMORPHISM ON THE 2nd M_g (2nd Media 2 Cell) AREA. OF THE WING of .CERATITIS. CAPITA TA (Diptera).

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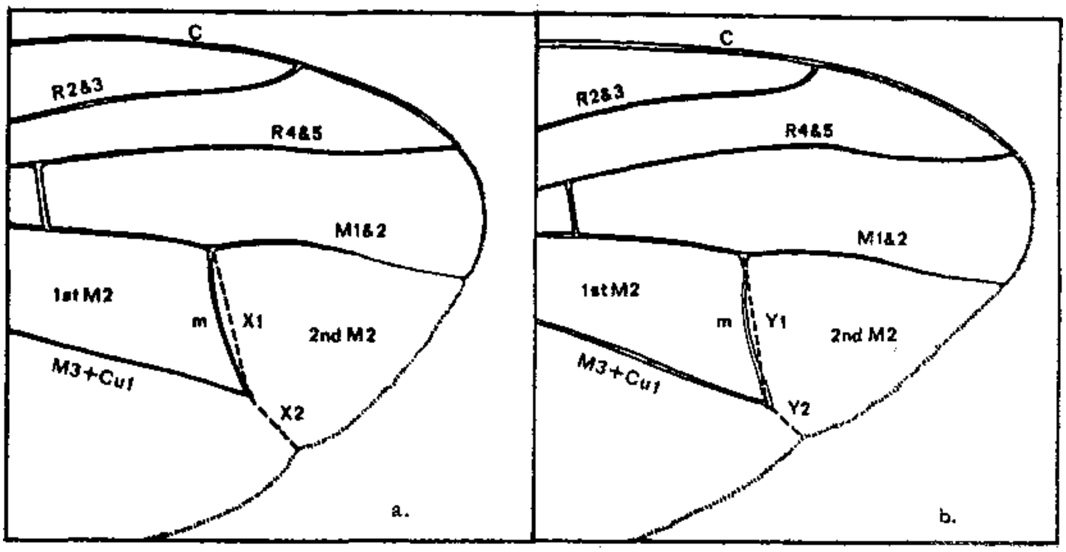
ABSTRACT

Sex dimorphism is established in the wing of Ceratitis capitata which is statisticaly analyzed.

This dimorphism is expressed by the ratio $x_1 : x_2$ and $y_1 : y_2$ (Fig.)different for the two sexes and equal approximately 2 for the male and 3 for the female flies.

Material and Methods

Observations made on the wings' veins m and $M_3 + Cu_1$ (Borror and Delong 1964, Efflatoun 1924) of Ceratitis capitata, have shown that these veins exhibit a sex dimorphism in the cell 2nd M_g (Fig.) ; this dimorphism is statistically analyzed below.



Distal part of wing of Ceratitis capitata Wied. a: male; b: female

The observations were made under the light microscope, on mounts of the wings, imbedded in Canada balsam. Measurements have been taken on 111 female and 107 male wing preparations from 218 photomicrographs (92X) in centimeter units. The wings were measured as follows: m is taken as straight line from its point of intersection with vein $M_3 + Cu_1$, therefore we consider m = X_1 or Y_1 (Fig.).

The extention of vein $M_3 + Cu_1$, from this point to the edge of the wing, in the area 2nd M_2, is designated X_2 or Y_2 and considered as a complete vein (Fig.).

As origin of each measurement was the intersection of the axes for each vein. The sample for the measurements was taken at random from a population and not from individual pairs and without any selection as regards the left or the right wing. All individuals were raised under identical conditions and were of the same age. Table I shows the distribution of X_1, X_2 and Y_1, Y_2 correspondingly for the male and female wings.

Statistical Analysis of the Data

It was found that the ration $X_1:X_2$ and $Y_1:Y_2$ (Fig.) was different for male and female flies and was estimated to be approximately 2 for the male and 3 for the female.

It is of interest to see whether there is a significant difference in these ratios for the two sexes.

The null hypothesis is that the ratio is the same for both cases. Therefore $\bar{X}_2:\bar{X}_1$ and $\bar{Y}_2:\bar{Y}_1$ should not differ significantly, where $\bar{X}_1$, $\bar{X}_2$ are the means of X_{1i}, X_{2i} measurements for the males and Y_1, Y_2 the means of X_{1i}, X_{2i} measurements for the males and $\bar{\bar{Y}}_1$, $\bar{\bar{Y}}_2$ the means of Y_{1i}, Y_{2i} measurements for the females.

To test this hypothesis we followed the method in Olkin, Kraft and van Eeden (1969), and to our knowledge, this is the first application of this method on an entomological sample. The test is as follows:

$$-2 \log \lambda = N \log \left[1 + 1/2 \left(N_1 \bar{X} S^{-1} \bar{X}' + N_2 \bar{Y} S^{-1} \bar{Y}' - \sqrt{G}\right)\right] \quad (1)$$

$$\text{where } G = (N_1 \bar{X} S^{-1} \bar{X}' - N_2 Y S^{-1} \bar{Y}')^2 + 4 N_1 N_2 (\bar{X} S^{-1} \bar{Y}')^2 \quad (2)$$

and is asymptotically distributed as X_1^2

In the above formulae $N = N_1 + N_2$, where N_1 = number of the measurements for males, N_2 = number of the measurements for females, and $S = S_X + S_Y$ where:

$$S_X = \begin{pmatrix} \sum_{i=1}^{N_1} (X_{1i} - \bar{X}_1)^2 & \sum_{i=1}^{N_1} (X_{1i} - \bar{X}_1)(X_{2i} - \bar{X}_2) \\ \sum_{i=1}^{N_1} (X_{1i} - \bar{X}_1)(X_{2i} - \bar{X}_2) & \sum_{i=1}^{N_1} (X_{2i} - \bar{X}_2)^2 \end{pmatrix} \qquad (3)$$

$$\text{and } S_Y = \begin{pmatrix} \sum_{i=1}^{N_2} (Y_{1i} - \bar{Y}_1)^2 & \sum_{i=1}^{N_2} (Y_{1i} - \bar{Y}_1)(Y_{2i} - \bar{Y}_2) \\ \sum_{i=1}^{N_2} (Y_{1i} - \bar{Y}_1)(Y_{2i} - \bar{Y}_2) & \sum_{i=1}^{N_2} (Y_{2i} - \bar{Y}_2)^2 \end{pmatrix} \qquad (4)$$

After the calculations it is found that:

$S_X = \begin{pmatrix} 0,5691 & 0,5735 \\ 0,5735 & 1,6948 \end{pmatrix}$ and $S_Y = \begin{pmatrix} 0,5006 & 0,6571 \\ 0,6571 & 2,8480 \end{pmatrix}$

Thus: $S = S_X + S_Y = \begin{pmatrix} 1,0697 & 1,2306 \\ 1,2306 & 4,5428 \end{pmatrix}$ and its inverse S^{-1} is:

$$S^{-1} = \frac{1}{3,3450} \begin{pmatrix} 4,5428 & -1,2306 \\ -1,2306 & 1,0697 \end{pmatrix}$$

Also $\bar{\bar{X}} S^{-1} \bar{\bar{X}}' = 1,5751$, where $\bar{\bar{X}} = \begin{pmatrix} \bar{\bar{X}}_1 \\ \bar{\bar{X}}_2 \end{pmatrix} = \begin{pmatrix} 1,1588 \\ 2,3331 \end{pmatrix}$

Likewise $\bar{\bar{Y}} S^{-1} \bar{\bar{Y}}' = 1,3297$ ($\bar{\bar{Y}}_1 = 0,7936$, $\bar{\bar{Y}}_2 = 2,4351$), and $\bar{\bar{X}} S^{-1} \bar{\bar{Y}}' = 1,3464$.

Substituting these values in equation (2):

$G = 86560,9441$ and $\sqrt{G} = 294,2124$.

Similarly after the substitution in equation (I) it is found that $-2 \log \lambda = 540,64$. The upper 99% point of the x_1^2 is 6,635. Hence the result is highly significant. This suggests the existance of a difference between the two ratios.

As stated above from the measurements on the wings, the ratios $X_2:X_1$ was estimated to be 2 for the males, and the ration $Y_2:Y_1$ 3 for the females. To test whether these ratios differ significantly from the above values we used a t-test. Applying this method to the present problem, every measurement X_{1i} is doubled for the male and every Y_{1i} is tripled for the female and the differences X_{1i} is tripled for the female and the differences $X_{2i} - 2X_{1i}$, $Y_{2i} - 3Y_i$ are given.

Under the null hypothesis, the means of these differences are zero. We found that t ♂ = 0,3297 and t ♀ = 1,2732. Because of the large size of the sample the distribution of t is considered normal N(0,1). Because t is found to be within $\pm$ 1,96 the test does not show any significant departure at the 5% level.

This means that by observing the wing under the microscope, it is possible to determine whether the wing comes from a male or a female fly, just by estimating the ration $X_1 : X_2$, $Y_1 : Y_2$, regardless of the size of the whole wing, by restricting the observation only in the above described 2ndM_2 area of the wing.

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TABLE 1

The distribution of X_1, X_2 for the males (above) and Y_1, Y_2 for the females (below)

	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70
1.35		X_1/X_2								1					
1.30									1				1		
1.25							1	2	8		3	1			
1.20					2	3	3	7	11	4	1	2			
1.15					1	3	5	3	1	3	4				
1.10		3	2	1	4	5	3	3	2				1		
1.05	1				3		1	1		1					
1.00		1	1			1	1								
0.95			1								1		1		
0.90		Y_1/Y_2				1			1		1	2	5		2
0.85							1	1	5		1	3	3	2	2
0.80					1	1	3	7	6	5	5	3	8	2	1
0.75				2	2	1	2		5		1	1		1	
0.70	1		2		3	1	3	1		5	1	1	1		
0.65	1			1		1									