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A GENETIC STUDY OF TWO SEX-LINKED RECESSIVE MUTANTS, MARGINAL CELL LESS (MCL) WING AND CUT (CT) WING OF *DROSOPHILA ANANASSAE*.

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Abstract

The present study was made in order to carry out further genetic investigations of two mutants *ct* wing and *mcl* wing isolated by Bogahawatta in 1982. These two mutants were observed to be recessive and sex-linked, but were also seen not to strictly obey Mendelian rules. In the absence of the wild allele the mutants allele behaves in a peculiar manner. Each mutant allele is capable of producing all the types of mutants such as *ct* wing *mcl* wing, and *ct-mcl* wing along with the wild types. The most probable explanation for this peculiar behaviour is that these two allele are unstable.

Introduction

Drosophila ananassae is the most abundant drosophilid species in Asia and Sri Lanka. Genetic studies on this species have been in progress since 1930, particularly in Japan. In Sri Lanka Genetic studies of *D.ananassae* were started in 1981 by Ratnayake and Bogahawatta with the initiation of a survey of mutant alleles in the wild population and the estimation of their mutant load. (Bogahawatta, 1984).

The present study is a part of this programme. The objective was to carry out further genetic investigations on two visible sex-linked mutations namely, cut (*ct*) wing and marginal cell less (*mcl*) wing isolated by Bogahawatta in 1982.

Even though there were no previous records of cut (*ct*) wing mutants of *Drosophila* in Sri Lanka, there were five other instances recorded in other parts of the world. (Kikkawa, 1933, 1937; Moriwaki, 1936, 1971) In all the above instances the cut (*ct*) wing has been recorded as a recessive sex-linked mutant. The marginal cell less (*mcl*) mutant has not been recorded anywhere in the world before.

In the present study, these two mutants did not strictly obey the Mendelian rules, but it could be inferred that they behave as sex-linked recessve mutants.

Materials and Methods

The cut (*ct*) wing mutant is clearly distinguishable from the other wing mutants by the appearance of the wing tip which looks as if cut by a pair of scissors. But there are three patterns of this mutant (see Fig. 1) in

the present stock. These three types also differ from each other in the extent of the area of the cut. However, all three types were considered as cut (*ct*) wing mutants in the present study.

Marginal cell—less (*mcl*) mutant showed the absence of the marginal cell of the wing. Here too there were variations. (See Fig. 2) Sometimes instead of the entire marginal cell, only a portion of the marginal cell or even the marginal vein was found to be snipped off. In this case, too, all these aberrant types were considered as the *mcl.* mutant.

Perhaps these variants of the two mutants may be due to variabilities in their expressivity.

In order to study the pattern of inheritance of these mutants, the following crosses were made. In each case pair matings were carried out.

Cross 1. – wild type male × *ct* wing female

2. – *ct* wing male × wild type female

3. – The wild flies obtained from the cross 2 were intercrossed

4. – wild type male × *mcl* wing female

5. – *mcl* wing male × wild type female

6. – The wild type flies obtained from the cross 5 were intercrossed

7. – *ct* wing male × *ct* wing female

8. – *mcl* wing male × *mcl* wing female

9. – The wild type flies obtained from cross 7 were intercrossed

10. - The wild type flies obtained from cross 8 were intercrossed

11. – wild type male × wild type female (from *ct* Stock)

12. – wild type male × wild type female (from *mcl* stock)
(wild type male flies, were obtained from the wild population But wild type female flies in cross 11 and 12 were obtained from *ct* wing and *mcl* wing mutant stocks respectively.

13. – *ct* wing male × *mcl* wing female

14. – *mcl* male × *ct* wing female.

The standard culture medium for *Drosophila* was used and all experimental crosses were carried out at room temperature which ranged from 26°C – 31°C.

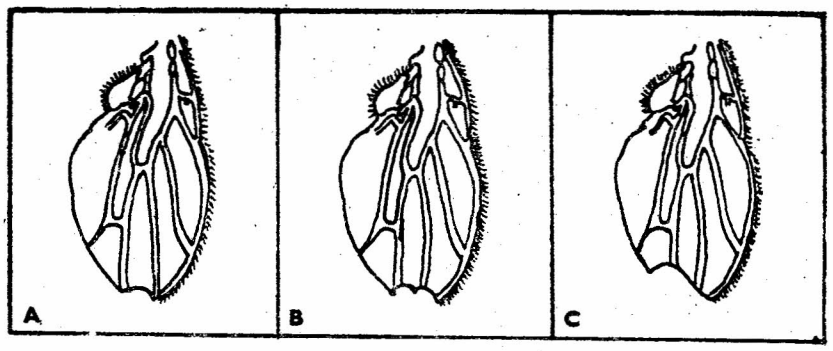

Figure 1 : A, B, C, Patterns of *et* wing mutant

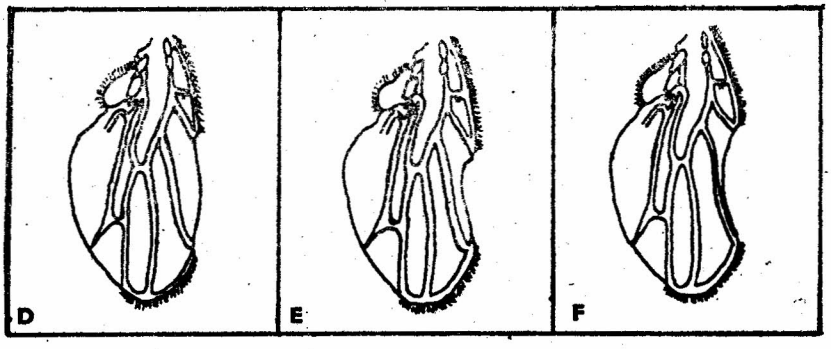

Figure 2 : D, E, F, Patterns of *mcl* wing mutant

Results

The results obtained from the crosses (1 – 14) are presented in the following Table.

TABLE 1—PHENOTYPES OF THE F_1 AND F_2 PROGENY

		Cross	Expected								Unexpected							
			wild type		ct wing		mcl wing		ct-mcl wing		wild type		ct-wing		mcl wing		ct-mcl wing	
			♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
	01.	Wild type ♂ x *ct* wing ♀		384	198						57				38		116	
	02.	*ct* wing ♂ x wild type ♀	297	343														
a	03.	F_1 wild type ♂ x F_1 wild type ♀	525	890	136										29		143	
	04.	wild type ♂ x *mcl* wing ♀		357			184				76		30				48	
	05.	*mcl* wing ♂ x wild type ♀	276	287														
b	06.	F_1 wild type ♂ x F_1 wild type ♀	519	699			61						70				79	
	07.	*ct* wing ♂ x *ct* wing ♀			114	94					15	26			02	05	87	89
	08.	*mcl* wing ♂ x *mcl* wing ♀					120	149			47	36	03	05			09	05
c	09.	F_1 wild type ♂ x F_1 wild type ♀	36	51									95	96	19	18	20	13
d	10.	F_1 wild type ♂ x F_1 wild type ♀	65	104									08	02	58	62	28	10
e	11.	wild type ♂ x wild type ♀ (from *ct* wing stock)	50	268									116		15		76	
f	12.	wild type ♂ x wild type ♀ (from *mcl* wing stock)	43	168									12		85		25	
	13.	*ct* wing ♂ x *mcl* wing ♀		53			40				38		54	25		24	29	43
	14.	*mcl* wing ♂ x *ct* wing ♀		98		82					66			26	27	19	32	28

a, b, c, d, The wild flies obtained from the crosses 02,05,07,08 were intercrossed respectively.
e.,f, wild type male flies were obtained from the wild population. But wild type female flies in cross.
11 and 12 were obtained from *ct* wing and *mcl* wing mutant stock respectively. Results of all crosses carried out in this study.

As *ct* is a sex-linked recessive mutant, from the cross 1 (wild type male x *ct* wing female) only *ct* males and wild females are expected in the F_1 generation. But the results show that apart from *ct* males, *mcl*, *ct-mcl* and wild type males too have appeared. However, the percentage of the females is as expected. In the reciprocal cross (*ct* male x wild female), only wild type males and females were obtained as expected. In cross 3 all F_2 female progeny are wild type, whereas the males are of all types with wild type males predominating. *ct* wing and *ct-mcl* wing mutants show more or less the same percentages.

These results also appear very similar to obtained with the *mcl* wing mutant. (cross 4-6)

It can be concluded from these data that both mutants *ct* wing and *mcl* wing behave more or less similarly in their inheritance patterns. The phenotypic expression of the two mutants are completely suppressed in the presence of the wild allele. When the wild allele is not present, the phenotypic expression varies. The phenotypes can be *ct* wing, *ct-mcl* wing, *mcl* wing or even wild type.

Cross 7 and 8 clearly show that the F_1 progeny of the *ct* wing and *mcl* wing colonies comprised the various mutant forms: *ct*. *ct-mcl*, and *mcl*. Further in both these colonies wild type flies too appear in the F_1 generation. However, the ratios of the 4 phenotypes appearing in the F_1 generation differ in the two mutant types.

In the *ct* wing colony, the percentage occurence of *ct* wing and *ct-mcl* wing phenotypes in the F_1 generation, is comparatively higher than that in *mcl* colony, whereas in the *mcl* colony *mcl* wing and wild type phenotypes occur at a higher percentage.

The remarkable feature of the results of crosses 7 and 8 is the appearance of wild flies in the F_1 generation. In crosses 9-12, the data clearly show that these wild flies are not true breeders for the wild character. They are indeed homozygotes for the respective mutant characters but not fully expressing them phenotypically.

Discussion

ct wing and *mcl* wing are two visible mutants of *Drosophila ananassae* isolated in Sri Lanka by Bogahawatta in 1982. The *ct* wing mutant is clearly distinguishable from the other wing mutants by the appearance of the wing tip which looks as if cut by a pair of scissors. The *mcl* wing mutant character is where the marginal cell of the wing is entirely or in part missing.

The results of the present study clearly indicate that the two mutants *ct* wing and *mcl* wing are recessive and sex-linked. The phenotypic expression of these mutants are clearly marked by the presence of alternative wild alleles.

In the absence of respective wild alleles the phenotypic expressions of the mutant types were variable. Both *ct* wing and *mcl* wing alleles in the absence of the wild counterparts produced all types of mutants *ct* wing, *ct-mcl* wing, *mcl* wing. They also produced wild types.

Table 11 — Percentage of F_1 phenotypes of crosses 7 & 8

Cross	Percentage							
	ct wing		*mcl* wing		wild type		*ct-mcl* wing	
	♂	♀	♂	♀	♂	♀	♂	♀
7 – *ct* wing ♂ × *ct* wing ♀	26.4	21.7	0.5	1.2	3.5	6.0	20.2	20.6
8 – *mcl* wing ♂ × *mcl* wing ♀	0.8	1.3	32.1	39.8	12.5	9.6	2.4	1.3

The mutant allele at the *ct* locus in the absence of the wild allele gave rise to more *c t* wing and *c t-mcl* wing flies, whereas the allele at *m cl* locus gave rise to more *mcl* wing and wild flies. In both these cases the wild offspring produced can be considered as pseudo – wild phenotypes, because when intercrossed, they themselves behaved as homozygotes of the respective mutant types. The *c t-mcl* double mutant too acts as *ct* wing and *mcl* wing mutants but with slight changes in the percentage occurence of the same phenotypes (*ct* wing and *c t-mcl* wing).

Therefore, it is possible to consider these two mutants as being due to a single mutant gene whose phenotypic appearance is seen to differ.

The most probable mechanism that can explain the peculiar mode of inheritance of this single mutant is Gerasimova's (1983) description which was given to explain the mutation at the *ct* locus of *D. melanogaster*. According to him the induced *ct μmR2* mutant allele of *D. melanogaster* can change into ct^+ (wild type) with time. Therefore, according to these revertants 3 groups were recognized by him as stable, unstable, and superunstable mutants.

He further reported that new *ct* alleles could not be obtained from stable groups, but could be obtained from the other two groups in a few generations of inbreeding.

In the present case too, it became evident that this single mutant behaves as an unstable mutant expressing itself as *ct. mcl*, *ct-mcl* or even as wild type.

The fact that such unstable genes are present have been recently demonstrated at the molecular level with regard to the white-eye mutant in *D.melanogaster*. (Bingham *et. al.* 1982).

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