

**ELIMINATION OF MUTANT TYPES IN SELECTION
EXPERIMENT BETWEEN WILD TYPE
AND MUTANT EYE COLOUR IN
*DROSOPHILA ANANASSAE***

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Abstract

Equal number of males and females of wild type and ruby eye colour mutant flies of *Drosophila ananassae* were cultured and the progeny derived from such cross were transferred to successive generations until the numbers of mutant flies completely disappear from the population. Comparison of gene frequencies between wild males and mutant males were made and it was found that ruby eyed flies of both sexes completely disappeared in F₉.

Keywords: *Drosophila*, wild type and mutant flies, natural selection.

Introduction

Organisms with phenotypes that are better suited to the environment have a better probability of surviving the struggle and will leave more offspring. Presumably, the better an organism can see, the better chance it has of locating food, defending itself, finding mates and so on and the greater will be its chance of survival and reproduction. Darwin called the process of differential survival and reproduction of different types as natural selection by analogy with the artificial selection carried out by animal and plant breeders, when they deliberately select some individuals of a preferred type. The relative probability of survival and rate of reproduction of a phenotype or genotype is now called its Darwinian fitness. In fact the concept of fitness really applies to the average survival and reproduction of individuals in a phenotypic or genotypic class. The concept of natural selection provides a frame work for explaining how allele frequencies are maintained in the populations; it also explains how species become adapted to the environments in which they live. One can observe several species in their native environments, and in some cases, it seems obvious how certain characteristics provide an organism with a survival advantage.

Genetic variations occur in all the organisms. Natural selection is a creative force in the process of evolution since it favours and encourages efficient genes and gene combinations. The phenomenon of natural selection has been demonstrated in artificial population containing chromosomal or genetic variants. Selection operates in only one direction, towards the elimination of deleterious alleles and fixation of favourable alleles (Strickberger, 1976). However, when the heterozygotes have higher Darwinian fitness to the corresponding homozygotes, an equilibrium is established due to selection and both the alleles will remain in the population.

Besides morphological variations, a number of chromosomal features for example chromosomal polymorphism have been taken into consideration to study natural selection in different species of *Drosophila*. In *Drosophila* it has been demonstrated that chromosomal polymorphism is adaptive and balanced due to adaptive superiority of heterozygotes (Dobzhansky, 1970). *Drosophila melanogaster* has extensively been used to study the effect of natural selection on different mutant genes located on sex chromosome or autosomes. It has been observed that the frequency of various sex-linked genes and autosomal mutant genes decline rapidly (Heritier and Teissier 1937, Merrell, 1953; Reed and Reed, 1950). Reed and Reed (1950) performed selection experiments using wild type and white eyed *D. melanogaster* and they reported that white eye gene was eliminated from population in 25 generations. This was caused due to an inefficiency of white eye males in mating. Chatterjee and Singh (1986) also conducted similar experiments in *D. ananassae* and found that white eyed flies do not appear after sixth generation. They suggested that various components of fitness such as sexual activity, fecundity and viability acting in combination might have caused very quick elimination of mutant gene from the laboratory populations.

Singh, Chatterjee and Roy (1985) studied mating behaviour of white eyed and wild type *D. ananassae* and their results indicated that white eyed males were less successful in mating as compared to wild type males. In the present experiment normal eyed and mutant type (ruby eye colour) flies of *D. ananassae* were cultured in the same food bottles and were reared for some generations to see whether the eye colour mutation show a deleterious effect on the survival of these types.

Materials and Methods

In our laboratory different strains of wild type *Drosophila ananassae* and mutant stocks are being cultured. In this study one of the wild type stocks derived from the mass culture of Varanasi and a mutant stock having ruby eye colour were employed. The gene causing ruby eye colour is situated on the X-chromosome and shows sex linked pattern of inheritance. Virgin females and males from both the stocks were collected and aged for five days. Equal number of males and females of both the stocks (5 wild females and 5 wild males; 5 ruby females and 5 ruby males) were cultured in individual food bottles. In each generation when all the flies hatched in the bottle, they were sorted out into different phenotypes in respect to their sex and counted. All the flies were then mixed and transferred to fresh culture bottles. This was continued for several generations and the

experiment was considered to be over when the mutant flies of both the sexes did not appear in two successive generations.

Results

In this experiment two stocks were utilized, one mutant stock which is being reared in our laboratory for several years and the other wild type stock which was established from the flies collected from Varanasi. Virgin females and males from both the stocks were collected and put in the separate vials for five days. On sixth day equal numbers of males and females of both the stocks (wild 5 females + wild 5 males + ruby 5 females + 5 ruby males) were kept in food bottles. This experiment was done in replicate and the data were pooled to calculate the gene frequency. Since this experiment was initiated by culturing equal number of wild type and mutant flies, the frequency of both the alleles at beginning was equal i.e. 50 percent each. In subsequent generations the the gene frequency was estimated on the basis of data by following the method suggested by Strickberger (1976).

Table 1 shows the number of wild type (red eyed) and mutant type (ruby eyed) flies in different generations of *Drosophila ananassae*. Male and female flies with red and ruby eye colour were recorded for ten generations. It was found that all four types of flies appeared up to eight generations. The mutant females and males completely disappeared in the ninth generation. When flies scored in ninth generation were cultured for one more generation, it was found that none of the mutant type of either sex appeared in the next generation.

Table1
Number of wild type (red eyed) and mutant type (ruby eyed) flies in different generations of *Drosophila ananassae*.

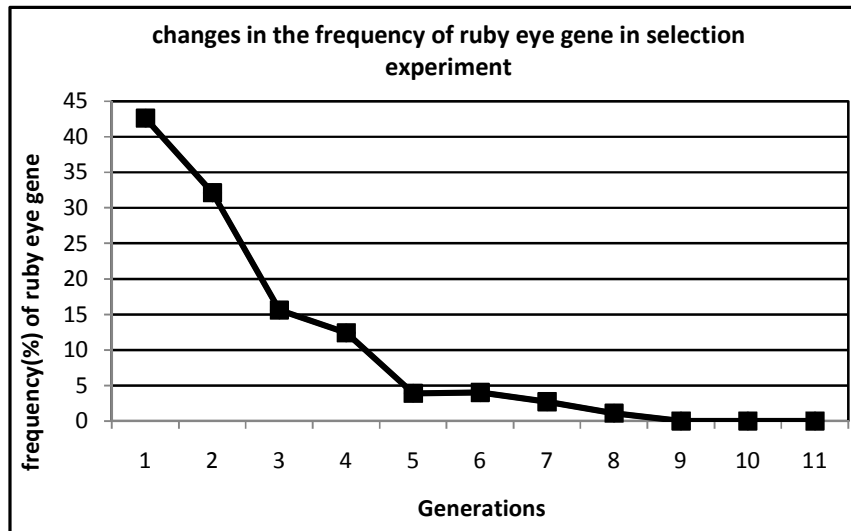
Generation	Red eyed female	Ruby eyed female	Red eyed male	Ruby eyed male	Total
I	511	397	478	358	1744
II	495	143	465	220	1323
III	402	138	689	127	1356
IV	644	96	984	139	1863
V	613	44	696	28	1381
VI	393	22	764	32	1211
VII	512	38	432	12	994
VIII	446	06	623	07	1082
IX	426	00	642	00	1068
X	618	00	509	00	1127

Table 2
Number of mutant males and the frequency of ruby eye gene in ten generations in competition experiment in *Drosophila ananassae*

Generation	Total male flies	Ruby allele (<i>rb</i>) frequency
I	836	42.6
II	685	32.1
III	816	15.6
IV	1123	12.4
V	724	3.9
VI	796	4.02
VII	444	2.7
VIII	630	1.1
IX	642	0.0
X	509	0.0

Table 2 shows number of mutant males and the frequency of ruby eye gene in ten generations in competition experiment in *Drosophila ananassae*. In this table only males of two different phenotypes are being compared because genotype of only male individuals could be ascertained. Red eyed females cannot be compared with their respective types as they could also be carrier for the *rb* allele. It is clearly seen that the frequency of *rb* allele declines in subsequent generations (except in sixth generation when a slight increase was recorded), and the frequency of mutant type becomes nil in the ninth generation.

Figure 1
Frequency of ruby eye allele in different generations of selection experiments in *D. ananassae*.



The change in the frequency of ruby gene is depicted in Fig.1. There is steady decrease in the frequency of rb allele in further generation and complete elimination of this mutant allele is witnessed in ninth generation.

Discussion

Natural selection results from the cumulative action of all forces tending to ensure that individuals possessing one genetic constitution shall leave larger numbers of offspring than will individuals possessing some other genetic constitution. Thus if a mutation contributes in any way to the leaving of larger numbers of offspring it will be perpetuated in increased proportion in the next generation since it will be carried by those "larger number of offspring". In case if the mutation interferes in any way with the leaving of larger number of offspring it will be perpetuated in decreased proportion in the next generation since it will be carried by but a decreased number of individuals in that generation.

Natural selection experiments have been performed in different species of *Drosophila* including *Drosophila melanogaster* by taking genetically determined traits. For this purpose various autosomal and sex-linked genes have been utilised. The results obtained indicate that the frequencies of mutant types declined rapidly in subsequent generations (Hertier and Teissier 1934, Merrell 1953, Reed and Reed 1950). Experiments in several species of *Drosophila* have also indicated that wild type males are more successful in mating than mutant types. Therefore mutant genes have been found to diminish mating activity in males of *Drosophila* (Reed and Reed 1950, Merrell 1953, Petit 1951, Bastock 1956, Elens 1957). Reed and Reed (1950) performed experiment involving wild type and white eye mutants in *Drosophila melanogaster* and observed quick decline of mutant flies from subsequent generations. They suggested that the elimination of white eye gene in about twenty five generations was caused due to inefficiency of white males in mating. They also observed that for every 100 mating of red males only 75 white males succeeded in *D. melanogaster*.

Singh, Chatterjee and Roy (1985) analyzed mating behaviour of white eyed and wild type *D. ananassae* and their results indicated that white eyed males are less successful in mating as compared to wild type males. Effect of light and dark on mating behavior of red eye and white eye *Drosophila ananassae* was studied by Chatterjee and Singh(1988) and their results suggest that white eye males are not successful in mating whereas red eye males readily mate with both the types of females i.e. red eyed females and white eyed females. They could also know that white eye males are more successful in mating in dark than in light conditions and a significant decrease in mating success of red eye males in dark was also found which is likely to be due to their lowered locomotor activity indicating the importance of visual clues during courtship behavior in this species.

Chatterjee and Singh (1986) conducted competition experiments to study the effect of selection on white eye gene in *D. ananassae* and found that white eye gene was eliminated from the laboratory population in F7. Their experiments on mating propensity

and selection clearly indicated that the rapid elimination of white eye gene in *D. ananassae* is due to reduced sexual activity of white eye males combined with other components of fitness such as fecundity and viability.

This experiment was conducted to see the persistence of mutant gene which causes ruby eye colour along with wild type flies. Although ruby eye colour mutants provide good culture and show normal fecundity when only mutants are being cultured but their presence with wild type flies do affect their chances of mating and survival. The present results of competition experiments in *Drosophila ananassae* show that the ruby gene was completely eliminated from the population in ninth generation. In ninth and tenth generation only wild type flies of both sexes were present in the population. Thus selection favours wild type gene. It confers adaptive values to those which bear such gene. Singh, Chatterjee and Roy studied mating behaviour between white eye and wild type flies of *D. ananassae* and have shown that white eye gene diminishes the sexual activity of males. The wild males were nearly two times more successful than white males in mating, when females were exposed to males for six hours. Ruby eye mutants in *D. ananassae* have not been involved for their effect on mating behaviour but the results of this study give a clear hint that male individuals possessing ruby allele show lesser mating success than their normal eye counterparts and that is the prime reason that their number dwindles very fast in subsequent generations.

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