The study on genetic patterns of eye color and wing presence in *Drosophila melanogaster*

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Introduction

Fruit fly, *Drosophila melanogaster*, is commonly used as a model organism because it has significant properties such as short life cycle, abundance in genetic variations, relative inexpensiveness, small body size, etc. In consideration of inheritance patterns (Klug et al. 2010 Spencer and Kristian 2013) and the supply of various strains in Drosophila melanogaster (Carolina 2018), the objective of the study was to investigate the classical, genetic patterns of gene segregation and interaction in two traits, eye color and wing presence, using the commercial strains.

Materials and Methods

The mutant strains, apterous (wingless, aa on chromosome 2), brown eyes (bb, on chromosome 2) and scarlet eyes (ss, on chromosome 3) were purchased from Carolina Biological Supply Company in 2018.

For the gene segregation in the first dihybrid cross, brown eye, winged strain (bbAA) was mated by red eye, wingless strain. The expected ratio in F_2 was 9 red eye and winged (B_A_) : 3 red eye and wingless(B_aa) : 3 brown eye and winged (bbA_) : 1 brown eye and wingless (bbaa).

For the gene interaction in the second dihybrid cross, brown eye strain (bbSS) was crossed by scarlet eye strain (BBss). It was uncertain for the expected ratio in F_2, red eye (B_S_) : scarlet eye (B_ss) : brown eye (bbS_) : white (bbss).

The χ^2 statistical test was chosen to detect the fitness of the segregation ratios (Klug et al. 2010). In monohybrids all the scoring datum were generated by adding the number of flies with one trait regardless of another traits in dihybrids. For example, the number of red eye flies (412) in the monohybrid was obtained from the addition of the numbers of red eye, winged and red eye, wingless flies (290 and 122) in the dihybrid.

Results

The phenotypes of fruit flies from different generations in two dihybrids were shown in the following figure.

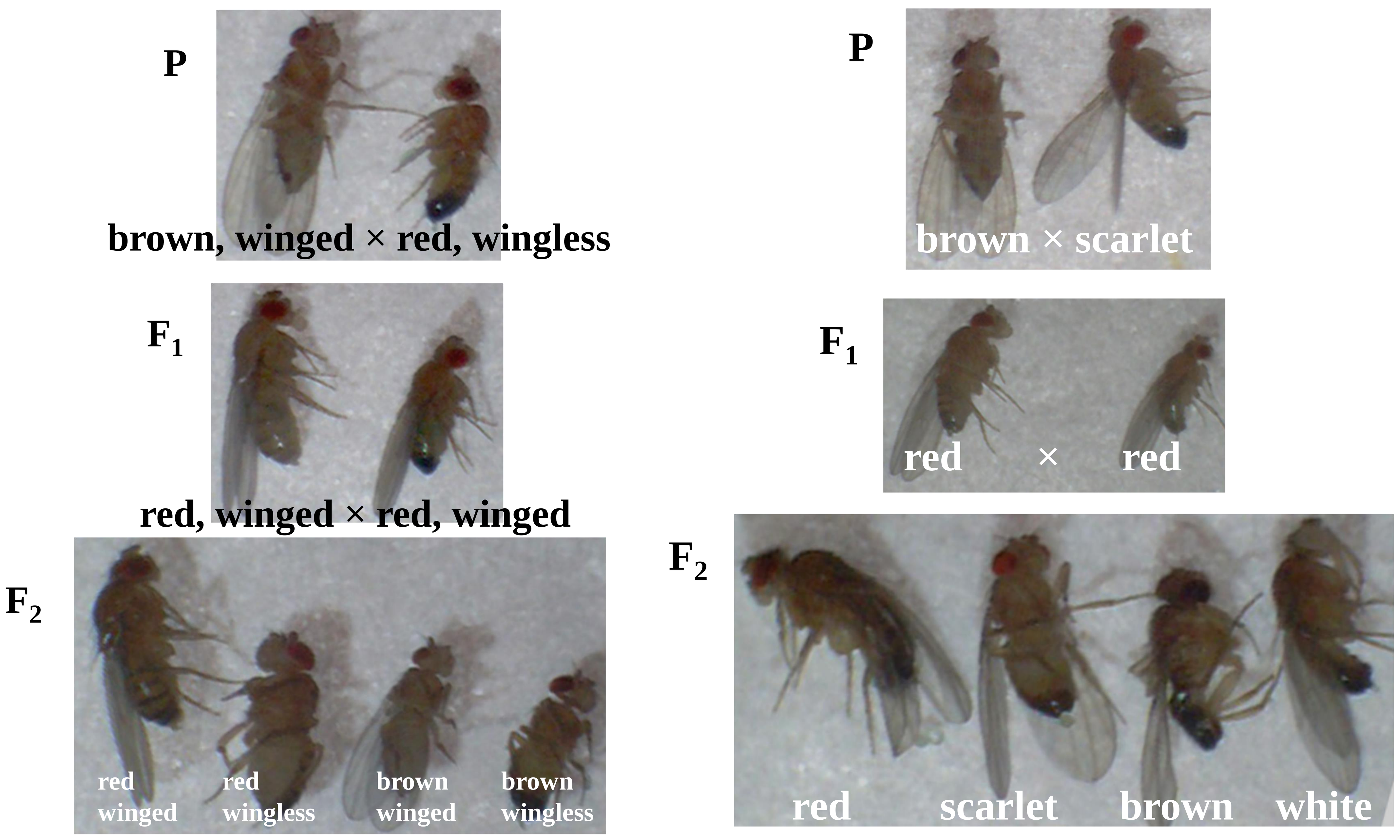

Figure A display of the phenotypes from different generations in two dihybrids.

Table 1 Dihybrid (brown × apterous) χ^2 tests for 9:3:3:1 ratio in fruit flies

Sex	Male			Female			Male + Female		
Phenotype	Obs	Exp	χ^2	Obs	Exp	χ^2	Obs	Exp	χ^2
Red eye, winged (B_A_)	290	311.1	4.03	469	427.5	4.03	759	738.6	0.57
Red eye, wingless (B_aa)	122	103.7	0.21	148	142.5	0.21	270	246.2	2.30
Brown, winged (bbA_)	139	103.7	0.02	141	142.5	0.02	280	246.2	4.64
Brown, wingless (bbaa)	2	34.6	43.58	2	47.5	43.58	4	82.1	74.26
Total	553	553	47.84	760	760	47.84	1313	1313	81.77

As showed in Table 1, in the dihybrid to observe two-gene segregation, All χ^2 test results indicated that probabilities were smaller than 5% because all χ^2 values were greater than $\chi^2_{0.05,3}$ = 7.82. It meant that the segregations of the genes controlling eye color and presence of wing didn't obey the second Mendelian genetic law. The number of brown and wingless flies was too far from expected number.

Table 2 Dihybrid (brown × scarlet) χ^2 tests for 9:3:3:1 ratio in fruit flies

Sex	Male			Female			Male + Female		
Phenotype	Obs	Exp	χ^2	Obs	Exp	χ^2	Obs	Exp	χ^2
Red eye (B_S_)	480	421.4	8.17	531	455.6	12.47	1011	876.9	20.49
Scarlet eye (B_ss)	143	140.4	0.05	169	151.9	1.93	312	292.3	1.33
Brown (bbS_)	111	140.4	6.17	96	151.9	20.56	207	292.3	24.90
White (bbss)	15	46.8	21.62	14	50.6	26.50	29	97.5	48.07
Total	749	749	36.01	810	810	61.45	1559	1559	94.79

In Table 2, the dihybrid was made to observe two-gene interaction. All χ^2 test results indicated that probabilities were smaller than 5% because all χ^2 values were greater than $\chi^2_{0.05,3}$ = 7.82. It meant that the segregations of the genes controlling eye colors didn't conform to the second Mendelian genetic law. The number of three phenotypes was too far from expected numbers. The classical gene interaction was not observed in the cross.

Discussion and Conclusion

In many organisms, genetic factors, called Meiotic Drive Elements (MDs), have found ways to break Mendel's laws of heredity (Grognet et al. 2014). They may play a critical role in population behavior, leading to sex ratio distortion. Additionally, fitness can also be altered by MD factors if they are genetically linked to alleles that confer deleterious traits (Saupe 2012).

In the dihybrids of the eye color and wing presence, the segregations of male, female and overall results didn't fit 9:3:3:1 ratio. The same situations occurred in another dihybrid of four different eye colors.

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