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Lab Report 4: Genetic Crosses

Abstract: The purpose of this lab was to examine patterns of inheritance by completing monohybrid crosses using real fruit flies, *Drosophila melanogaster*, over the course of four weeks. These flies were used as a simulation to Mendel's experiment with pea plants, as they are easier to reproduce and have a smaller genome. The sex of the flies and the unique characteristics present in mutant and wild-type varieties were observed and recorded. Based on the experiment, this proved both Mendel's Law of Segregation in which each pair of alleles from the parent would separate and be passed on to the offspring, and the concept of sex-linked inheritance.

Introduction: The pattern of inheritance was first introduced by Gregor Mendel in the mid-1800s. He proposed three laws, Law of Dominance, Law of Segregation, and Law of Independent Assortment, that would explain and predict which phenotypes would appear in offspring and the ratios of phenotypes shown in the offspring. To understand this, Mendel used pea plants as his experiment. Pea plants were used due to its small size and its advantage to grow easily. In addition, each pea plant had male and female structures, which allowed for different plants to cross fertilize. For this experiment, *Drosophila* melanogaster, were used to set up F_1 crosses and produce F_2 generation. Furthermore, Punnett squares were used to predict the outcome of simple genetic crosses between these mutant and wild-type flies.

Methods: In the first week, students in pair were given anesthetized flies and petri dishes. The rest of the class also repeated the same group of flies, in addition to White Eyes x Wild-Type. Each group were instructed to use a brush and carefully transfer the anesthetized flies into the petri dish for observations. A table was given to fill out with the distinct characteristics found from the flies. When finished, the anesthetized flies were transferred into a vial of alcohol. In the second week, students were instructed on how to set up their own culture vials. Each student obtained a vial, added one cup of the Instant *Drosophila* Medium and mixed it with 15 mL of water. When the solution solidified, 4-7 grains of yeast was added into the culture media. The culture media was colored blue. The next setup was to obtain 6 males/females' pairs of anesthetized flies and add it into the culture vial that was prepped. Two groups received Sepia x Wildtypes, while the other two groups received White Eyes x Wildtypes. The vial was labeled according to the type of flies received. In addition, "F_1 Cross" was written to help identify this crossing as parental. The culture vials were put away for the following week, to allow the flies to mate. In the third week, F_1 parental flies were removed from the culture vial, and transferred into the vial of alcohol. The larvae were left in the culture vial for growth. In the fourth week, the larvae have grown into flies and were labeled as the F_2 Generation. A FlyNap were given to each group to anesthetize the F_2 flies and transfer them into petri dishes for analysis. A magnifying glass was used to observe the flies and record the data.

Results

Week One- Table I. Phenotypes of Wild-Type and Mutant Parental Strains

Phenotype	**Phenotype**
Vestigial	Short wings; red eyes; stripe pupa
White Eyes	Long wings; white eyes; stripe pupa
Sepia Eyes	Long wings; brown eyes; stripe pupa
Wild Type	Long wings; red eyes; stripe pupa

Week Four- Table II. Sex and Phenotypic data for F_2 Offspring

$\underline{X^S X^{WT}}$ x $\underline{X^S Y}$

Female Parent (P gen) Male Parent (P gen)

Phenotype (and sex)	**Total**
Sepia (F)	3
Wild-Type (F)	13
Sepia (M)	10
Wild Type (M)	15

Total scored <u>41</u>

Week Four- Table III. F_2 Sex and Phenotypic data for the entire class

$\underline{X^S X^{WT}}$ x $\underline{X^S Y}$

Female Parent (P gen) Male Parent (P gen)

Phenotype (and sex)	**Total**
Sepia (M + F)	26
Wild-Type (M + F)	43

Total scored <u>69</u>

$\underline{X^{WT}X^W}$ x $\underline{X^W Y}$

Female Parent (P gen) Male Parent (P gen)

Phenotype (and sex)	**Total**
White Eyes (M + F)	51
Wild-Type (M + F)	62

Total scored <u>113</u>

Week Four- Table IV. Punnett Square for F_2 Offspring

	X^s	**X^{WT}**
X^s	$X^s X^s$	$X^s X^{WT}$
Y	$X^s Y$	$X^{WT} Y$

Discussion: As a result, there were a total 69 of Sepia and Wild-Type flies including both male and females. There was a total of 26 Sepia flies and 43 Wild-Type flies. Based on the Punnett square, the phenotypic ratio for the F_2 generation is 3:1. This monohybrid cross confirms that the pattern of inheritance on these flies is sex-linked inheritance. Only the male flies were shown to be Wild-Type with red eyes. Meanwhile, the female flies were shown to be Sepia with brown eyes (normal eye color). This concludes that red eye is a recessive allele in a X-linked gene. However, there might have been possible contamination when transferring either the F_1 vials or F_2 gen vials. This possible contamination may have led to inaccurate genotypic and phenotypic ratio of the flies, especially for the crossover between White Eyes x Wild- Type. The ratio for this crossover based on the experiment was 1:1. The crossover should've been $X^{WT}Y$ x $X^W X^W$. This would have led to all female flies to be Wild-Type or have red eyes, and all male flies would have white eyes. No female flies would have white eyes since they receive one of the X-chromosomes. According to Brooker, this experiment confirms that X-linked recessive phenotypes are more common in males, while females tend to be carrier of the recessive allele without any expression (2016).

References

Brooker, R. J. (2016). *Concepts of genetics*. New York, NY: McGraw Hill Education.