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An Assessment of Inheritance Patterns in Two Mutant Eye-color Traits of Drosophila melanogaster

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II. INTRODUCTION

Fruit flies make excellent species for genetic tests. They possess a small genome and a quick life cycle, around 2 weeks per generation. Also, characteristics such as eye color and wing length are easily assessed under a microscope while the flies are reared. This project utilized the former trait to build a basic Punnett square and test the hypothesis with Chi-square statistical analysis. Historically several breakthrough discoveries and Nobel Prizes in science have been awarded due to work with fruit flies. Thomas Hunt Morgan founded this practice and earned a Nobel Prize. His student Hermann Joseph Muller also earned a Nobel for irradiating specimens to produce mutations. Both Nettie Stevens and Edmund Beecher Wilson simultaneously discovered the presence of sex-linked traits. All of them used fruit flies.

H. Materials and Methods

Purdue University’s inbreeding populations were utilized as the parental generations. The wild-type (WT) fruit flies were paired with the opposite sex of two different true-breeding recessive (-/-) eye colors: sepia and white. This yielded four colony conditions:

- Condition 1: Wild-type females with white-eyed males
- Condition 2: Wild-type females with sepia-eyed males
- Condition 3: Wild-type males with white-eyed females
- Condition 4: Wild-type males with sepia-eyed females

The colonies consisted of labeled plastic cylinders (10 cm long and 3.5 cm diameter) with 1.1 liter volumes of water to Ward’s Drosophila Medium Blue dye food flake [see figure 3]. After the mixture settled into a gel in an upright container, the containers were laid on their side and 6-8 females and 8-8 males were placed in the tubes in the conditions previously described. These flies were anesthetized using an anesthetic gas supplied shown in figure 4. They were then correctly sexed by the morphological features shown in figure 2.

The flies were then allowed to breed for a period lasting one week (Sept. 30 to Oct 7). The parental generation was then anesthetized and discarded, and the pupal offspring allowed to colonize the containers. After maturing for another 9 days (Oct 8), these offspring were then sexed by phenotype and sex and counted. 6-8 individuals from each available phenotype and sex were selected (this point only two options) for each condition group and put into fresh, labeled colonies.

This whole process was allowed to repeat to obtain the F2 generation and their counts on the 8th to 9th of November with a discard of the F1 parents taking place October 30, 2018.

III. RESULTS

The Chi-squared equation was used to assess expected percentage values of the total population corresponding to established inheritance patterns against observed values from the actual counts performed on October 18th and November 9th and 9th. Because these values included 4 possible phenotypes we counted those as degrees of freedom to give us the critical value of 7.81.

None of our measurement exceeded this value so we accept the hypothesis that sepia eyes are autosomal recessive and white eyes are X chromosome sex-linked recessive.

V. CONCLUSION

As our Punnett squares and data show we accept the null hypothesis that white eyes are X chromosome sex-linked recessive and sepia eyes are autosomal recessive. Sex-linked means that only one recessive X chromosome is necessary to be phenotypically present in males but two are needed to be present in females. Red eyes are completely dominant if the allele is present, in white-eyed males it is not. This held up as our no white-eyed females were present in the F1 generation of Conditions 1 and 3 but there were only white-eyed males in Condition 1. The Y chromosome which transmits male characteristics can only be inherited from a male father. This also means in males their X chromosome must come from their mother. Because the white-eyed allele is linked to the X chromosome the only group that can make white-eyed males in the next generation are white-eyed or heterozygous females. Males can only contribute their white-eyed allele to the next generation's females.

Sex-linked is a simple autosomal recessive genetic condition. The F1 generation came out being all red-eyed, however the Punnett squares show that the F1 generation were all heterozygous regardless of gender. This occurs because the later deletion of a pigment protein PDA synthase refer to figure 5. This flow chart of eye pigment possibilities also shows that the white eyes occur because the entirety of the pathway and the onchrome pathway are shut off. The GTP second messenger system and tyrosinase conversion that initiates them respectively are disabled leaving no pigment production.