

Population genetics of albinism in zea mays essay sample

[Science](#), [Genetics](#)



Introduction

Zea mays or maize was chosen as the study system for this experiment for many reasons. The phenotype being studied is observable to the naked eye, green or yellow plants. It is an important agricultural system used in crop and is an ideal genetic model. Zea mays also has a quick turnaround time from generation to generation and crossing Zea mays was feasible in the facility. Lethal alleles are those that fail to successfully code for the proper production of a functional protein that is vital for life. Recessive lethal alleles are mutations that are only lethal to homozygotic individuals with two copies of the mutated allele (Castle, 1910). In humans cystic fibrosis and sickle cell anemia are two examples of recessive lethal alleles.

A dominant lethal allele is a mutation that is lethal to any individual that has one or two copies of the allele. Huntington's disease is an example of a dominant lethal allele, it is maintained in the population because of the late onset of death. Sub lethal alleles are those that cause death in only some carriers of the gene, an example of this is hemophilia where the male who has an affected X chromosome, will only die if he is affected by trauma to the body, otherwise he will stay healthy.

Zea mays has a lethal recessive allele for albinism; which in homozygotes causes a plant to grow with zero chlorophyll and to undergo death very fast. Heterozygotes are the carriers for this trait since the recessive homozygotes are killed. The heterozygotes for the "L" allele are green since they produce chlorophyll. The aim of the Zea mays investigation was to distinguish lethal alleles by reviewing observing frequencies in growth. In order to do this,

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dominant and recessive alleles had to be observed. In Zea mays deleterious alleles cause a loss of function through the deletion of a vital part of the gene that codes for chlorophyll. Deleterious alleles have a normal phenotype in heterozygotes.

Deleterious alleles can have a disease fighting effect where it is more beneficial for an individual to have the heterozygote form; this is the case in sickle cell disease and cystic fibrosis. In sickle cell disease the heterozygous individual is protected against malaria, and an individual with the CF trait is protected from Typhoid. This is known as heterozygote advantage (McCune, 2004). Slightly deleterious alleles remain in the population for much longer than purely deleterious alleles; these alleles are maintained through drift and in small populations (Sunyaev, 2000) . Thus the frequency of deleterious alleles falls drastically with each generation, compared to the slightly deleterious allele.

Background

The purpose of this experiment was to observe the phenotypic frequencies of the Zea mays, in order to do that we had to plant and observe 3 generations of the species. We were looking for a ratio of albino plants that died very quickly after growth, to decrease proportionally. The expected proportions were 3: 1 green: albino for F2; 35: 1 for F6; and 64: 1 for F8.

The process for planting was that outlined in the lab manual with the following changes. We planted 32 F2, F6, and F8 plants in week 2. We used a 50: 50 mix of vermiculite and peat lite. We first filled the units $\frac{3}{4}$ full with soil

then added 1L water. next we planted our seeds, 4 per cell. Next we added the soil to cover to the top of the cells. Finally another 1. 5 L of water was added to the trays via the bottoms.

cell

UNIT

Fig. 1 This figure illustrates the planting scheme used.

Predictions and Hypotheses

Before the counts were performed it was predicted that the Albino allele q or genotype $P2$ would decreasingly become less pronounced in the population. It was also predicted that the population would maintain its numbers of the heterozygotes or green corn plants that possessed the p allele or $P1$ genotype. The null hypothesis was that the albino plants would maintain allele frequencies consistent to those at Hardy-Weinberg Equilibrium. The hypothesis being tested was whether the allele frequencies of a double heterozygous cross between two Lw/Lw individuals changed over time, focusing on the q or albino allele; determining whether it was conforming to the Hardy-Weinberg Equilibrium Model and not steadily declining in the population as a lethal allele.

Predictions and Hypotheses After F2

After harvesting. F2 generation it was many predictions were viable. The first prediction is that the albino allele will continue in the population at a

decreasing rate due to maintenance by those who germinate with it before its death. It is also predicted that the albino allele will become fixated near or at zero.

Discussion and Conclusion

Overall the data are inconclusive, Figure 2 illustrates the expected frequency distribution overtime and how the albino allele will become fixated within the population. The fixation of this allele approaches zero. Tables 1-3 illustrates the scoring of the class data for the Zea mays. Table 4 is the calculations used in finding the chi square goodness of fit test to determine whether the albino allele was conforming to the Hardy-Weinberg Equilibrium Model and not steadily declining in the population as a lethal allele.

Because our Chi square calculated $>$ Chi square critical value, there is a statistical difference between the observed number of individuals and expected number of individuals surviving with the albino allele, under HW equilibrium conditions, That is you reject the null hypothesis and conclude the population is not under HW equilibrium in the Lw/lw locus of the Zea mays population. Table 6 summarizes these results.

Two main future directions for this experiment include expanding the experiment into further generations and using different varieties of maize to utilize the aspects of hybrid vigor (Salerno, 2007). Expanding the experiment further will allow the scientist to see whether the allele is fixated or lost all together. Using multiple subspecies of maize will allow the scientist

to learn if there is overdominance or single locus heterosis going on as well as many other characteristics at the population level (Salerno, 2007).

Works Cited

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