CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

S1706

Project Title

Deciphering the Genotypes of Zea Mays: An Analysis of the Chi-Square Test and Genetic Make-Up

Abstract

Objectives/Goals

"Deciphering Zea mays" tests the viability of the Chi-Square Test in determining the genotypes and respective alleles of organisms whose phenotypes are known but genotypes are not. The sample will include three variations of Zea mays (American corn) with phenotypes representing kernel color (yellow and purple) and kernel shape (smooth, dimpled, and wrinkled). Because the chi-square test analyzes statistical significance and error between predicted and actual outcomes, the experiment requires initial theoretical genotypes based upon observations, samplings of kernel color/shape, and finally the application of the Chi-Square.

Methods/Materials

Materials include 15 specimens of corn, 5 ears in 3 sub-species; rubber bands to segment each ear into quarters; and, masking tape to label each quadrant. Procedures: 1) Visually analyze each ear of corn to find phenotypic patterns, such as dominance in color/shape. 2) Using Mendelian laws and observed phenotypes, hypothesize a genotype for the ear and its parents. 3) Wrap two rubber bands along the ear#s lateral equators and label each quadrant with masking tape. 3) Record each type of kernel per row. 5) Use the Chi-Square Test to test the accuracy of the predicted genotypes with the actual result. 6) Repeat for each ear of corn.

Results

After counting each ear of corn and comparing the predicted genotypes with the actual phenotypes, Type 1 and Type 2 were found to have accurate readings when tested with at least one of the predicted genotypes. Given that the chi-square test was testing statistical significance to the 7th degree, each test was proven to have more than 60% accuracy and significance, with one sample being over 95% accurate. However, no correct predictions could be made about Type 3 corn because its complex phenotypic appearance could not yield a predicted genotype.

Conclusions/Discussion

Given successful tests of Type 1 and 2 corn, the experiment suggests that geneticists can use an organism#s phenotypes to determine its genotype. However, as the overall results imply, sufficient knowledge of the organism#s genotype must be known to provide an accurate prediction. Thus, the experiment reveals how statistical testing can essentially eliminate the trial-and-error process in predicting results. Furthermore, provided a case in which an organism#s genotype must be known, such as to determine carriers of disease, a mathematical approach can be taken.

Summary Statement

Given samples of Zea mays, or American corn, and knowledge of Mendelian laws of inheritance, the experiment explores the capacity of the chi-square test in determining the genotypes of an organism, whose genotypic properties are established

Help Received

I would like to thank Mrs. Robin Pearce for providing me the sample corn, purchased from Carolina Biological Supply Company