BIOL 1301-01 Introduction to Biology

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**Introduction**

Gregor Mendel's experiments, which elucidated the laws of genetics, laid the foundations of modern genetics. In particular, his law of independent assortment explains how different genetic traits are inherited independently. In this study, we replicate Mendel's dihybrid cross to ascertain how applicable his laws are today. Through a dihybrid cross using pea plants, we observe how the traits of plant height and pod shape (inflated or constricted) are inherited and whether they segregate independently.

This experiment is central to understanding Mendel's genetic laws and involves a detailed analysis of how traits are transmitted based on a specific mating plan and observation. Here, we outline the design, implementation, and method of analysis of the experiment, verifying that Mendel's hypotheses remain valid with modern scientific techniques. This process reaffirms basic genetic concepts and highlights the importance of scientific methodology.

**Experimental Methods**

The cross is performed by transferring pollen from dwarf plants to the stigmas of tall plants. It is crucial to remove the pollen from tall plants before this operation to prevent self-pollination. This technique ensures that the genetically distinct traits are combined. The F1 generation is expected to be uniformly tall with inflated pods, but the segregation of traits based on Mendel's laws is anticipated in the F2 generation.

Special precautions in the experiment include:

* Environmental Management: Maintaining constant environmental conditions such as temperature, humidity, and light exposure ensures optimal growth conditions for the plants.
* Data Recording: Accurate trait recording for each plant secures data integrity for later analysis.
* Genetic Diversity Assurance: Using a large number of plants with the same genetic background enhances statistical reliability.

Thorough implementation of these procedures increases the reliability of the experiment and clarifies data interpretation. Additionally, self-crossing from the F1 to the F2 generation is a critical step to verify whether the traits segregate independently as observed.

**Analysis of Experimental Results**

The observational results for the F2 generation of pea plants are as follows:

* Tall plants with inflated pods: 2706
* Tall plants with constricted pods: 930
* Dwarf plants with inflated pods: 888
* Dwarf plants with constricted pods: 300

Calculating the ratio of each phenotype from this data is crucial. The calculated phenotype ratios are then compared to the expected 9:3:3:1 ratio based on Mendel's laws. The ratios compute to 9.02:3.10:2.96:1.00.

**Conclusion**

The phenotype ratios for the F2 generation of pea plants were calculated to be 9.02:3.10:2.96:1.00, closely aligning with the theoretically expected 9:3:3:1 ratio according to Mendel's law of independent assortment. Notably, the proportion of tall plants with inflated pods was slightly higher, which could be attributed to experimental errors or minor environmental influences.

These results strongly support the validity of Mendel's law of independent assortment under modern conditions. The principle that each trait is inherited independently was reaffirmed through this experiment. The slight deviations in the ratios could be due to biological variability or errors in experimental operations, which are within the expected range for genetic studies.

If the number of plants used in the experiment had been significantly lower, random variations could have had a greater impact on the results. As alleles are randomly distributed into gametes, significant deviations from the expected ratios could be more pronounced in a small sample size. Therefore, securing a sufficient number of samples is crucial for ensuring scientific accuracy in genetic analysis.

External factors such as unexpected pollen dispersion due to strong winds could also affect the results. Controlling these environmental variables is challenging, and genetic studies must consider these factors.

This experiment confirmed the applicability of Mendel's genetic laws in the modern era, deepening our fundamental understanding of genetics. It also highlighted the importance of experimental design and the necessity of ensuring adequate sample sizes in genetic research. Considering more variables in future studies could provide more detailed data.

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References

1. Openstax. (2024). *Biology*. https://openstax.org/books/biology/pages/preface