

Diet Coke and Peas: An Experiment



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Introduction and Background

- Diet Coke linked to severe health problems in observational studies (Veldhuizen, 2017).
- Consumption has been steadily decreasing in recent years (Nielsen 2017).



Research Questions

This led us to ask the following **Research Questions** about the short term effects of Diet Coke on plant life (*since we couldn't get a human-based experiment past the IRB*):

1. How does Diet Coke affect the ability of a plant to grow?
2. Does Diet Coke interact with plant food to affect plant growth?
3. Does pure Diet Coke differ from Diet Coke dilution in how it affects pea plant growth?



Factors of Interest

Two factors of interest were studied:

Watering Type

- Diet Coke
- Diet Coke dilution (22 percent DC)
- Tap Water

Plant Food

- Treated with plant food at planting
- Not treated (Control)



All About Peas

We chose to use **Alaska peas**, which were purchased in March from Wal Mart in seed packets.



Experimental Design

Our experiment was a **randomized complete block** design in which all 6 treatment combinations were blocked by row (to account for differences in sunlight).



Methods of Analysis

The Model:

$$Y_{ijkl} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + Row_k + Cup_l + \epsilon_{ijkl}$$

We assume the following:

$$\epsilon_{ijkl} \sim N(0, \sigma^2)$$

$$Row_k \sim N(0, \sigma_{rb}^2)$$

$$Cup_l \sim N(0, \sigma_{cup}^2)$$



The Experiment

Pea plants were grown for fifteen days between March 21 and April 5th. The first 24 hours after planting, peas received only water in order to induce germination prior to treatments being imposed.

Plant food: administered once during the initial stage (per directions).



Experiment: Early Growth



Experiment: After a week

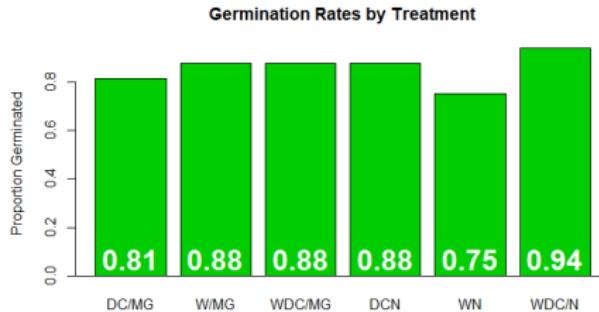


Experiment: After a week



Germination Rates

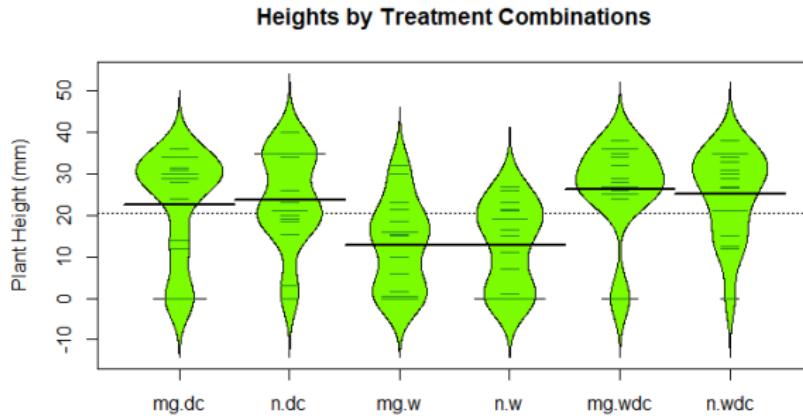
Unfortunately, not all of the pea plants germinated. Prior to doing any analysis, we had to check to see if **germination rates differed by treatment**.



A χ^2 test for independence between the treatment groups and germination rate yielded a p-value of 0.7498, indicating little evidence that germination rates depended on treatment.



Exploratory Analysis



ANOVA Results

We used an ANOVA with Type II Sums of Squares (since attrition led to unequal sample sizes):

	Chisq	Df	Pr(>Chisq)
Water Type	16.61	2	0.0002
Plant Food	0.00	1	0.9847
WT:PF Interaction	0.15	2	0.9298

The only factor that appears to be affecting plant height is the **watering type**, as evidenced by the small *p*-value.



Tukey Comparisons

Effects Plot and Compact Letter Display:

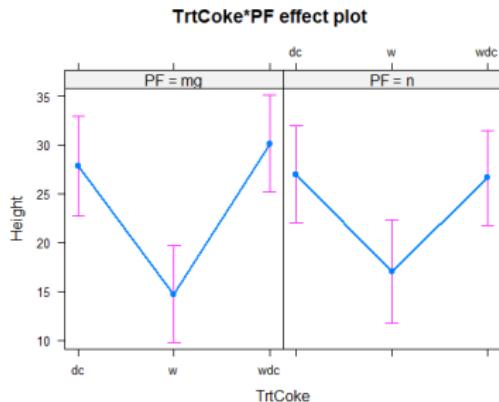


Figure:

	Diet Coke	Diluted Diet Coke	Water
Ranking	A	A	B



Scope of Inference

Pea plants were **randomly selected** from a population of Wal-Mart's Ferry Morse Alaska pea plants. Likely, these seeds are modified and differ genetically from other brands of Alaska pea plants. Treatments were then **randomly assigned** to cups.

Under the assumption that Ferry Morse seeds are randomly distributed to Wal Marts across the country, we infer the **causal relationship** that Diet Coke *caused* these pea plants to grow taller.



Any Questions?

Thank you!



Additional Slides: Future Work

Future work could include:

- Different Response Variables: Plant dry mass (in decigrams or milligrams).
- Repeated Measures: It would be interesting to look at growth rates over time (daily measurements).
- Different types of pea plants or altogether different vegetables.
Does the effect remain the same?



Key Insights

Interestingly, it appears that pea plants actually preferred Diet Coke-based mixtures to pure tap water. This could be for several reasons:

- Alaska Peas are hardier than most plants.
- Diet Coke contained other nutrients necessary for pea growth.

