The Effects of Different Fertilizers on Plants

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Grade 9
Problem

- Chemical fertilizers:
  - Harm the environment
  - Used widely

- Plant fertilizers
  - "ingredients“ - enhance plant growth
  - Competition

- This experiment:
  - Two all-purpose fertilizers - which product works the best
  - Looking for noticeable effect

Is there a better fertilizer that people can use that is less harmful to the environment or is no fertilizer the best fertilizer?
What fertilizer works best (seedlings):

- Chemical
- Organic
- No fertilizer

Effects of fertilizer on seedlings
**Miracle-Gro Liquid All Purpose Plant Food Fertilizer**

- Light, odorless, transparent green (concentrated)
- Easy and pleasant
- “All purpose plant food”
- “Feeds all types of plants instantly”
- Application: *seven to fourteen days*
- Mix with water
- Nitrogen, phosphorus, and potassium
  - “The *three most important nutrients the plants need*” - Miracle-Gro
Unpleasant odor and coloration

Benefits:

- “Won’t burn” plants
- “Great for all indoor and outdoor plants”

Fish fertilizer - used for centuries

Nitrogen, phosphate, and potash
Squash

*Cucurbita pepo variety*

North America

Came from *Mexico*

*Food, decoration, and recreation*

Weigh 6 to 75 lbs.
Scientific Name: Cucurbita

Native to Americas
- Europe - discovered
- Place of Origin - Andes and Mesoamerica

Five (common) species - squash

Fruit and seeds (edible)

Utensils, storage containers, decoration, etc.

Contains: vitamin A, vitamin C, dietary fiber, niacin, folic acid, and iron; free of cholesterol.
Cucumber

- Gourd family
- Grow on vines
- Three main varieties: slicing, pickling, and burpless
- From Southern Asia
  - Widespread today
  - Found on most continents
- Desired and sold on global markets
Liquid fertilizer:
- Gives *greatest release of nutrients*
- Releases *nutrients fastest*
- Result: grow *most quickly and healthy*
- Powdered and solid fertilizers - slower
- Easiest to apply because:
  - *Mixed with water*
  - Applied - *top of the soil*
**Hypotheses**

**Null Hypothesis**
- Fertilizer will not increase plant growth.

**Alternative Hypothesis**
- Fertilizer will improve the growth of the tested plants.
Materials

- Miracle-Gro All Purpose Plant Food
- Alaska Fish Fertilizer
- pumpkin seeds
- squash seeds
- cucumber seeds
- okra seeds (back up group)
- peat planting cups
- styrofoam cups
- Jiffy Natural and Organic Seed Starting
- plastic food wrap
- various colored tape rolls
- plant sticks and clips
- camera (optional)
- 5-foot tall adjustable lighting stand
- 4-foot grow lights
- Hydrofoam 4-foot fluorescent grow light fixture
- 2-in-1 soil moisture / light tester
- thermometer / humidity gauge
- Ohaus Pioneer Scale (measures down to .0001 grams)
- plastic weigh boats (6)
- 60 mL syringe
- Sharpie pen
- scissors
- journal / notebook and pen
- de-chlorinated water
- glass terrarium
- ruler / tape measure
- plastic folding table
- 5 or more 2-gallon buckets
- printer paper
- large plastic sheet
1. Assembled light and light fixture, table, aquarium, and positioned light fixture (light should be one inch above the top of aquarium)

2. Filled all peat planting cups (36) with Jiffy Natural and Organic Seed Starting Mix

3. Made small indentation for seeds in the top soil in the peat cups for the seeds (1/2 to 1/4 inch deep [2x the width of the seed])

4. Cut off tops of 36 Styrofoam cups (1 inch from bottom) (keep bottoms only), labeled each (1 to 36), paired with a peat pot, organized each according to the chart (see Diagram 1)

5. Inserted respective seed, watered plants (10 mL each) [repeated every 2 days]

6. Placed plastic wrap on top of aquarium to retain moisture (removed when lighting switched to 12-hour intervals)
Diagram 1

Diagram 2

P = Pumpkin
S = Squash
C = Cucumber
O = Okra (Back up in case a seed group did not sprout)

- Control
- Low M-Grow
- High M-Grow
- Low O. Fert
- High O. Fert

Low
1/4 tsp. per gallon

Low
1 tsp. per gallon

High
1/2 tsp. per gallon

High
2 tsp. per gallon
7. Monitored *temperature and humidity* to keep it consistent throughout the experiment.

8. Day 14 - *began fertilization* - mixed with *one gallon of water*, applied to plants (10 mL) every *two weeks*.


10. Powered on *Ohaus Pioneer Scale*, blanked scale, *cut* plants at *dirt level*, *removed soil* from both sections of plant, *took 2 measurements* (wet and dry), and quantified data.
Effect of Fertilizer on Dry Biomass

Pumpkin Dry Biomass

P-Values:
Dry, Above = 0.444311
Dry, Below = 0.493237
Dry, Total = 0.653131
Effect of Fertilizer on Dry Biomass

Squash Dry Biomass

P-Values:
- Dry, Above = 0.444311
- Dry, Below = 0.493237
- Dry, Total = 0.653131

<table>
<thead>
<tr>
<th>PART OF PLANT</th>
<th>Control</th>
<th>M-G Low</th>
<th>M-G High</th>
<th>O.F. Low</th>
<th>O.F. High</th>
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<tbody>
<tr>
<td>Above</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
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<tr>
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<td>1.0</td>
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<tr>
<td>Total</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
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Effect of Fertilizer on Dry Biomass

Cucumber Dry Biomass

P-Values:
- Dry, Above = 0.444311
- Dry, Below = 0.493237
- Dry, Total = 0.653131

MASS

PART OF PLANT

Above

Below

Total

Control  M-G Low  M-G High  O.F. Low  O.F. High
P-Value: 0.331212

Pumpkin Dry Biomass

Fertilizer: Control, M-G Low, M-G High, O.F. Low, O.F. High

Ratio (Above-Below Ground Mass)
Effect of Fertilizer on Plant Resource Management

P-Value: 0.331212

Squash Dry Biomass

<table>
<thead>
<tr>
<th>FERTILIZER</th>
<th>Control</th>
<th>M-G Low</th>
<th>M-G High</th>
<th>O.F. Low</th>
<th>O.F. High</th>
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<tr>
<td>RATIO</td>
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Effect of Fertilizer on Plant Resource Management

Cucumber Dry Biomass

P-Value: 0.331212
Based on this experiment:

- *Fertilizer did not* have a direct effect on seedlings and their early development
- Neither *organic or Miracle-Gro fertilizer* appeared to have a *significant benefit*
- *P-Value* was far *above the 0.05 standard*
  - The *null hypothesis* is *accepted*

**Observations**

- *Fertilizer caused the seedlings to grow quickly and spindly*
- Leaves showed slight traces of yellow - *too many nutrients*
Limitations

- Too short of a growing cycle for the plants to properly mature.
- Not a “natural” germination / growing period
- Too small of a seed sample and too few replications
- Difficulty in removing soil from the plants’ roots in biomass measurement

Extensions

- Experiment is only preliminary
- Add more seed variety, replicates, and time
- Add light and distance from light source - new variable
Sources & References


http://en.m.wikipedia.org/wiki/Fertilizer.

“Is Plant Food the Same as Fertilizer?” eHow. 14 Dec. 2014


### Dry Biomass Chart

<table>
<thead>
<tr>
<th></th>
<th>16</th>
<th>15</th>
<th>28</th>
<th>6</th>
<th>18</th>
<th>30</th>
<th>8</th>
<th>20</th>
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<td>1.998</td>
<td>0.455</td>
<td>0.632</td>
<td>1.749</td>
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### Wet Biomass Chart

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<td>Above</td>
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Pumpkin Wet Biomass

P-Values:

Control: 0.718329
O.F. Low: 0.58935
Total: 0.882937
Bar Graphs (Continued)

Squash Wet Biomass

P-Values:

- Above: 0.718329
- Below: 0.58935
- Total: 0.882937

PART OF PLANT

- Control
- M-G Low
- M-G High
- O.F. Low
- O.F. High
Cucumber Wet Biomass

P-Values:
- Above: 0.718329
- Below: 0.58935
- Total: 0.882937

Graph showing biomass data for different parts of the plant (Above, Below, Total) across different conditions (Control, M-G Low, M-G High, O.F. Low, O.F. High).
P-Value: 0.665292

Pumpkin Wet Biomass

Fertilizer: Control, M-G Low, M-G High, O.F. Low, O.F. High

Ratio (Below-Above Ground Mass)
P-Value: 0.665292

Squash Wet Biomass

RATIO

FERTILIZER

Control  M-G Low  M-G High  O.F. Low  O.F. High
Cucumber Wet Biomass

P-Value: 0.665292