GROW UP!

The Rate of Soybean Growth With Different Food Sources

Abstract

In 2016 there were several natural disasters in the United States. These disasters include hurricanes, blizzards, and floods. The **United States Blizzard** (January 2016) dumped heavy snow from the Mid-Atlantic to the Southern New England states. In June 2016, the **West Virginia flood** destroyed many homes and left people feeling hopeless. In August 2016, extended rainfall in the state of **Louisiana** resulted in **tragic flooding** that destroyed many cities. **Hurricane Matthew** (October 2016) was an extremely destructive cyclone. Natural disasters like these have the ability to destroy agriculture. The loss of resources impacts the area's economic and agriculture growth. We (Colin and Kyle) wanted to know how areas of devastation recover. This question led us to our science experiment. What is the effect of different food sources (Coca Cola Classic®, tap water, and Miracle Grow®) on soybean plant growth?

We placed soybean seeds into Jiffy soil pods and rehydrated the soil with one of three food sources; Coca Cola Classic®, tap water, or Miracle Grow® fertilized water. Coca-Cola® (our first food source) was discovered by a pharmacist named Dr. John S. Pemberton. Dr. Pemberton created a flavored syrup and took it to his neighborhood pharmacy and mixed it with carbonated water. It was believed to be an excellent syrup by those who sampled the drink. We chose Coca Cola® because it is a very popular

beverage. Coca Cola® is extremely acidic, and we wanted to know how it would affect the growth of soybeans.

The pods were kept in Jiffy® starter greenhouses. The pods were fed with 5 milliliters of food every 3 days (Tuesday, Thursday, and Sunday). The sprouting plants were measured every Sunday and on any days of substantial growth. Findings were recorded in a science notebook (Colin) and using Google Forms (Kyle). This procedure concluded after 30 days. The experiment was conducted independently at each of our homes to ensure reliable and valid results.

The procedure provided three outcomes. The primary outcome was that the pods that were fed with fertilized water sprouted soybean plants before the Coca Cola Classic® and fertilized water. The second outcome was that the pods fed with tap water had a faster rate of growth and a better root system. The third outcome was that seeds that were fed Coca Cola Classic® had minimal growth throughout the month.

History of Soybeans & Background Information

Soybeans emerged in Asia and were first introduced by Chinese farmers in 1100 B.C. Later, around 1904, George Washington Carver discovered soybeans were a precious source of protein and oil. He also discovered the benefits of soybeans for preserving good quality soil. He introduced rotating crops, every 3 years, which helped enrich the soil to produce healthier and hardier crops.

Henry Ford was known for his production and involvement with the car industry. Did you know he used parts of soybean plants to make parts for cars? He brought a

bag of soybeans to his research facility where his scientists conducted experiments using the plants. The scientists used their discoveries and parts of the soybean plant to make plastic stronger for gearshift knobs, horn buttons, window frames, accelerator pedals, light-switches and the outside structure of the cars.

Around 1940, soybean farming became popular in the United States. America produced the needed soybean crops during WWII when production was halted in China. During the second war, the U.S. experienced increased success with soybean production. It was determined that soybean plants were an affordable and preferred way to feed animals. To this day, it is still an essential source of food for animals.

Uses of Soybeans

Soybeans are almost in 80% of the foods that are consumed in the United States. A popular food that soybeans are used in is chocolate. Soybeans are used as an emulsifier in the production process. Emulsifiers allow the fat in a chocolate bar to not separate so a bar of chocolate remains solid. Soybeans are also an ingredient in shortening, margarine, cooking oil, and salad dressings. Soy flour and grits (made from grinding whole soybeans) are used in the commercial baking industry to aid in making different doughs. This is because soybeans have excellent moisture-holding qualities that help slow down staling in bakery products. Pharmaceutical companies use soybeans to coat tablets and capsules. The coating helps extend the expiration of medications. Soybeans and their plants are used in so many ways that they have proven to be an important resource to our world.

There are many professional organizations that support soybeans. The **American Soybean Association** looks out for the best interest for American soybean growers. Anyone that believes that this is a worthy cause can join this organization. The **United Soybean World** is an organization where farmers invest a portion of their profit to fund continuing research on soybeans. Finally, The United Soybean Board created by the Farm Bill of 1990 to manage and direct the National Soybean Checkoff, is dedicated to spreading knowledge and understanding of the soybean.

Purpose/Question

Which type of food source (Classic Coca Cola®, Tap Water, or Fertilized Water) would be most beneficial to grow sustainable soybean plants?

Variables

The **Dependent Variable** is the change that occurs because of the independent variable. In our project, the dependant variable was the height measurements taken of each plant.

The **Independent Variable** is the variable that changes in an experiment. The independent variables were the liquid food sources used in the experiment (tap water, Coca-Cola Classic, and fertilized water).

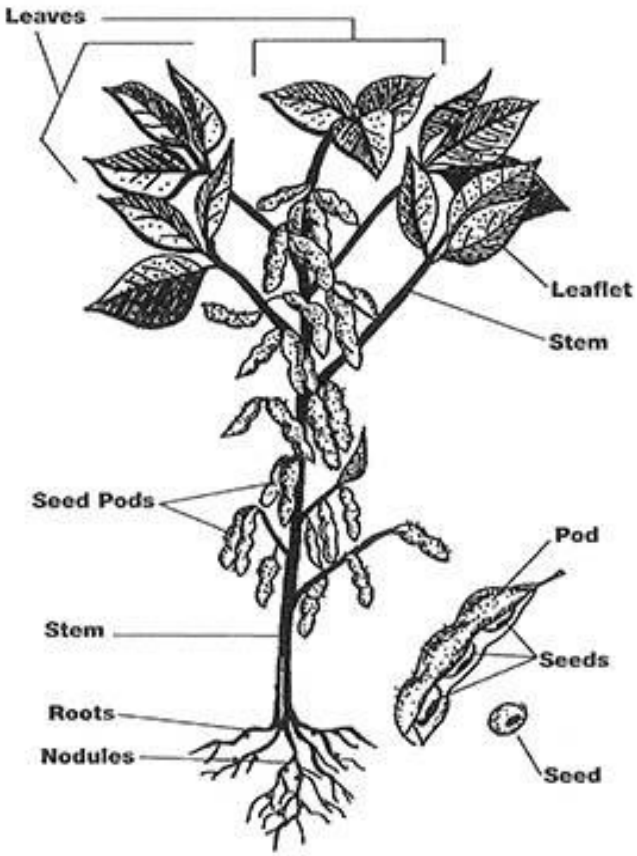
The **Controlled Variables** are the variables that stay constant and do not change. In this experiment, the soybean seeds, amount of liquid provided, soil type, greenhouse, pots, and wavelength of grow light were the controlled variables.

Hypothesis

Kyle's Hypothesis: The Classic Coca Cola® would be most beneficial due to the energy it gives humans, then fertilized water, and lastly tap water.

Colin's Hypothesis: The fertilized water would be most beneficial due to the elements in it's make up, then tap water, and lastly Classic Coca Cola®

Soy Plant Anatomy:



Key Terms

- **Leaves** are usually part of the plant that come off the stem and are key structures for photosynthesis.
- **Seedpod** is a vessel that holds seeds of a plant
- **Stem** is the structure that supports a plant
- **Seeds** are the fertilized/mature part of a flowering plant
- **Leaflets** are young leaf blades of a plant
- **Roots** are the underground structure of a plant used for absorbing nutrients
    - **Taproot** is the main root that helps anchor a plant in soil
    - **Rootlets** are small roots that stem from the taproot and help anchor and absorb nutrients
- **Fertilizer** is a substance that is used to make soil more fertile for plant growth
- **Nodules** occur on the roots of the plant that associate with Nitrogen bacteria

Material List:

- 6 in. Clay Pots (6)
- Classic Coca Cola®
- Tap Water
- All Purpose Plant Food By Miracle-Gro® (Fertilized Water)
- Jiffy 5 By 5 Greenhouse (2)
- Aptoyu® 7 Watt LED Grow Light (2)
- Coffee Filter (6)
- Scissors
- Syringes (2)
- Nature's Care Potting Soil By Miracle-Gro®
- Metric Ruler
- Pen and Pencil
- Notebook/computer
- P-Touch® labeling machine
- Soybean Plant Seeds
- Soil Pods

Experimental Procedure:

Step 1: Put each soil pod into the greenhouse & fill 6-inch pots with potting soil that has a coffee filter at the bottom for future use.

Step 2: Rehydrate each soil pod with tap water.

Step 3: Push finger gently into each soil pod and place a soybean seed in the hole. Then cover seed with pod soil.

Step 4: Remove extra protective netting on the outside of soil pod.

Step 5: Label each section of the greenhouse according to the food source that will be given, as well as the pots.

Step 6: Feed them according to the labels 5 mLs each. Feed the plants that need Classic Coca Cola® and Tap Water every Sunday, Tuesday, and Thursday. Feed the plants that need Fertilized Water every Sunday, following Miracle Grow® fertilizer instructions.

Step 7: Every Sunday, Tuesday, and Thursday measure each plant using a ruler and record results.

Step 8: Expose greenhouse to natural light when possible. Use grow light 3 hours everyday.

Step 9: When soybean plant grew taller than greenhouse, transplant to the clay pots that are correctly labeled.

Step 10: Repeat steps 6-8 throughout the thirty day experiment.

Step 11: After 30 days, remove plants from pots and greenhouse and make observations about their root structure. Compare and contrast.

Data Analysis and Discussion

Colin Doss	Classic Red Coca Cola®	Tap Water	Fertilized Water	Kyle Bender	Classic Coca Cola®	Tap Water	Fertilized Water
11/1/16	0 cm	1.05 cm	1.15 cm	11/1/16	0 cm	1 cm	1.2 cm
11/6/16	0.4 cm	1.78 cm	3.5 cm	11/6/16	0 cm	3.5 cm	3 cm
11/7/16	1 cm	2 cm	4 cm	11/7/16	0 cm	3.6 cm	3.2 cm
11/8/16	1.875 cm	13 cm	10.6 cm	11/8/16	0 cm	3.6 cm	3.2 cm
11/13/16	2.375 cm	21.33 cm	14.8 cm	11/13/16	0 cm	5.35 cm	4.3 cm
11/16/16	2.625 cm	26.42 cm	15.3 cm	11/16/16	0 cm	7.6 cm	7.46 cm
11/21/16	2.5 cm	36.5 cm	25.33 cm	11/21/16	1.5 cm	9.1 cm	8 cm
11/24/16	3 cm	34.9 cm	24.33 cm	11/24/16	2 cm	10 cm	8.3 cm
11/26/16	4 cm	34.2 cm	24.83 cm	11/26/16	2.5cm	10.5 cm	8.77 cm

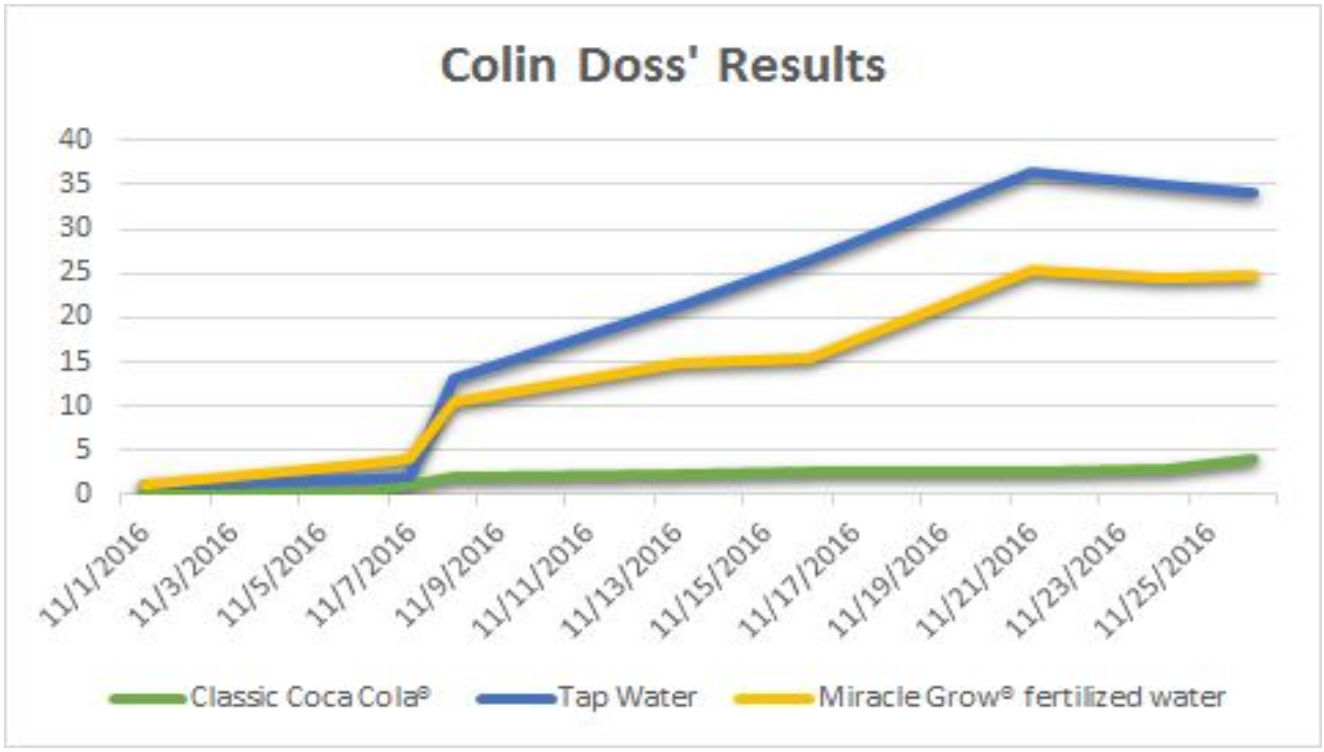
Colin

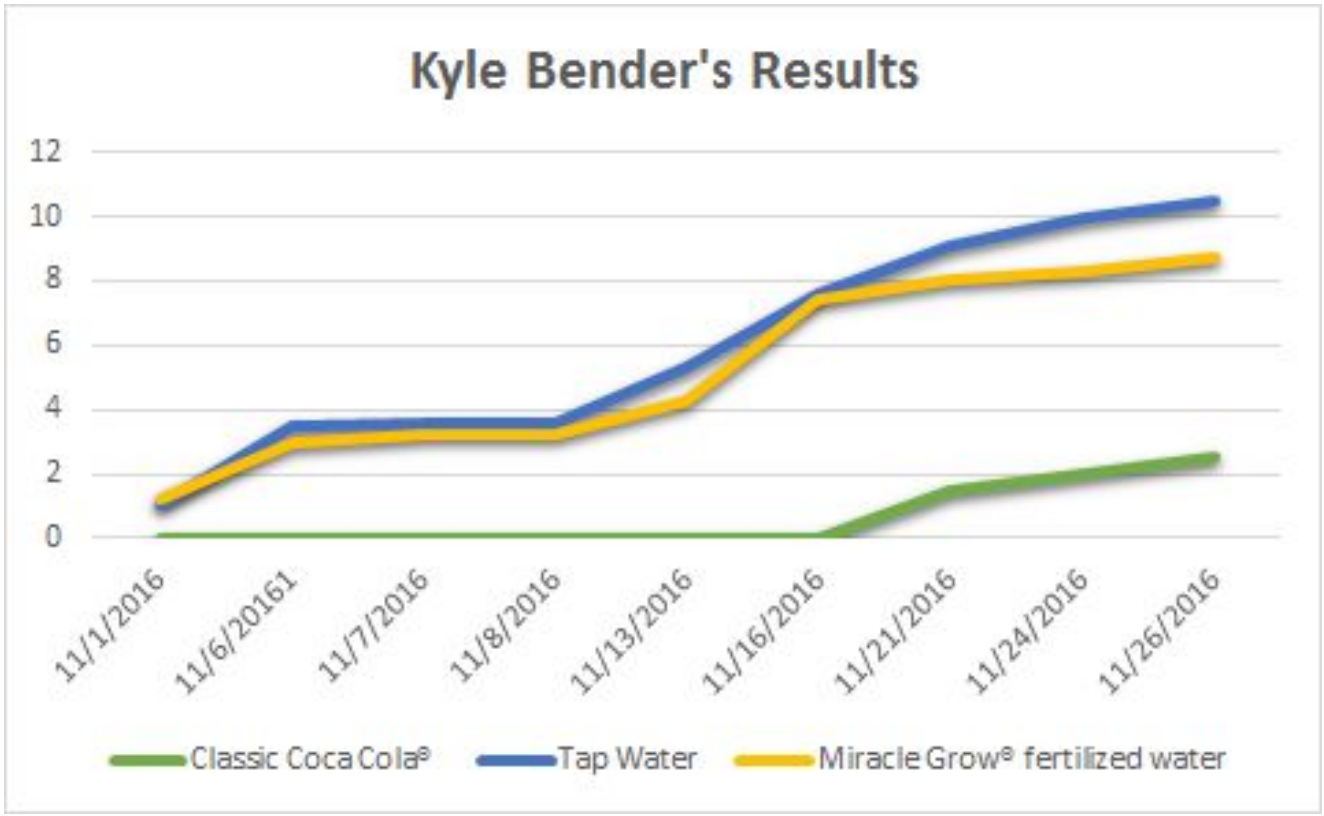
Coca Cola	6/10
Tap Water	5/5
Fertilized Water	6/10

Kyle

Coca Cola	2/10
Tap Water	4/5
Fertilized water	4/10

*The information above states the success rates of possible growth. The chart is the averages of plant growth per group


Colin Doss' Results
40
35
30
25
20
15
10
5
0
11/1/2016
11/3/2016
11/5/2016
11/7/2016
11/9/2016
11/11/2016
11/13/2016
11/15/2016
11/17/2016
11/19/2016
11/21/2016
11/23/2016
11/25/2016
Classic Coca Cola®
Tap Water
Miracle Grow® fertilized water


Kyle Bender's Results
12
10
8
6
4
2
0
11/1/2016
11/6/20161
11/7/2016
11/8/2016
11/13/2016
11/16/2016
11/21/2016
11/24/2016
11/26/2016
Classic Coca Cola®
Tap Water
Miracle Grow® fertilized water

Conclusions:

There were three conclusions that we discovered. Each of the conclusions found true between both of our experiments that were conducted from each of our homes. The first conclusion, seeds that were fed with fertilized water were the first to sprout, followed by tap water, then Classic Coca Cola®. The second conclusion, plants that were fed tap water grew faster and had a better root structure than the other two. The third conclusion, seeds and plants that were fed Classic Coca Cola® had the least growth and root development. Furthermore, seeds and plants that were fed Classic Coca Cola® had mold grow on the plants and in the soil. The mold may have been a contributor to this finding. Taking these three conclusions into account, it is possible that after a natural disaster, crops should first be fertilized to promote initial growth and then use tap water to promote health growth.

Ideas For Future Research:

This project focused on which plant food supports soybean plants growth. In the future, we could focus on how different colored light sources affect plant growth, because each color has a different wavelength. Another idea for future research is to try to grow the soybeans again during a different season. Different amounts of daylight, temperature and allowing the plants to sit outside could produce different results. This would also allow the opportunity to plant a few outside in soil and keep some inside mimicking the greenhouse effect. It would be interesting to compare these results to our initial experiment.

Acknowledgments

Colin Doss

I would like to thank my partner, Kyle for his support during this long and interesting project. It took a lot of hard work and passion to be able to support 25 soybeans for a full month, and I am very fortunate to have him as my partner. I would also like to thank our volunteer Science Club teacher for giving us the idea to use soybeans. Some other people that took part in this project are Mr. and Mrs. Bender, Mr. Doss, the gentleman at The Home Depot® for helpful advice about soybean growth, and our science teacher at school for teaching us about plants.

Kyle Bender

I would like to thank my partner Colin Doss, for putting in the time to help us do this science project. His friendship and teamwork is invaluable to me. Together, as a team, we rock! I would like to thank Mr. Doss and my parents because they arranged their schedules to help us with this project and pronounce words that were difficult and offered suggestions for ideas. I also would like to thank our volunteer Science Club teacher for the idea of soybeans.

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