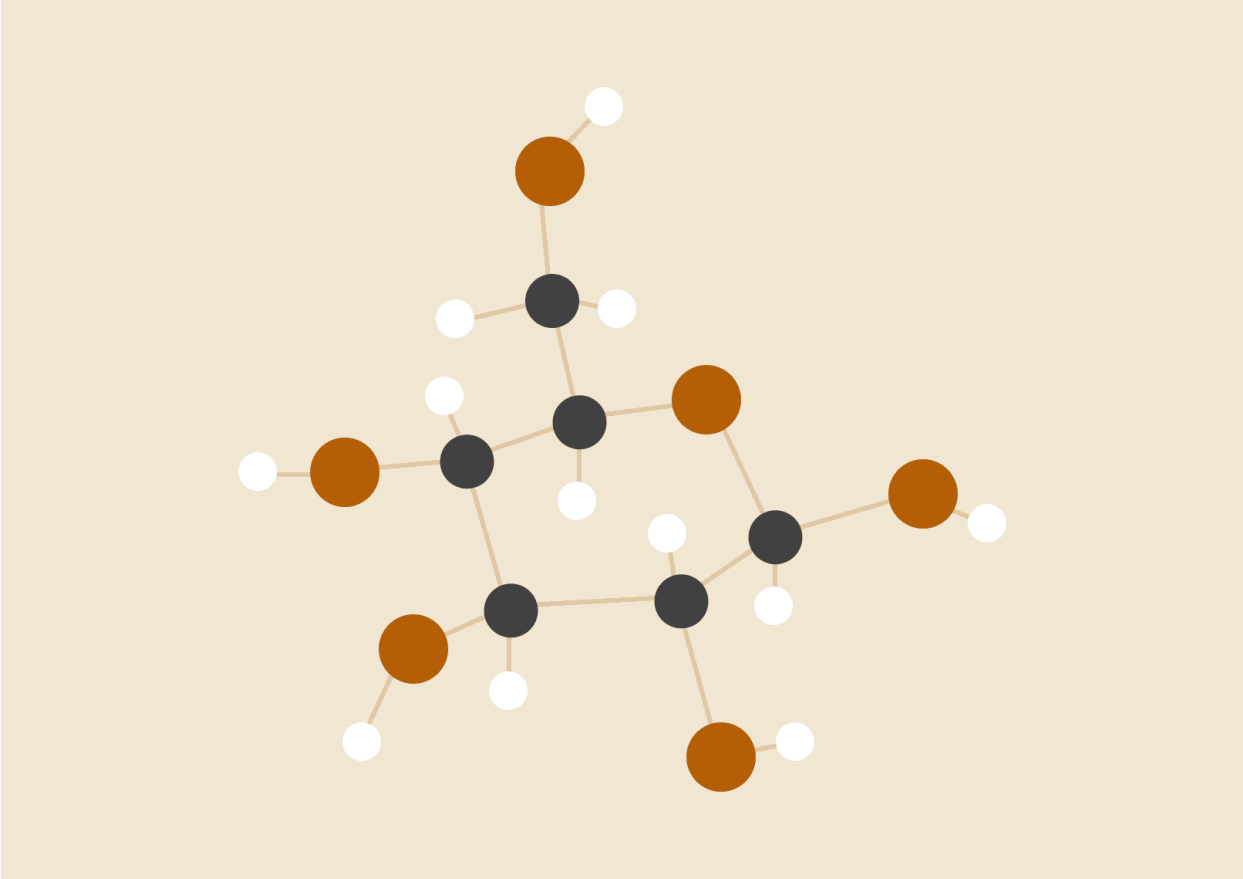
SCIENCE FAIR

Fast Fashion Fertilizer

(A Continuation)



Kaitlyn & Karmen

2023-24
7th Grade

CYSF Platform

EXPERIMENT #2

INTRODUCTION

Using the ash from the clothing that was environmentally friendly, can we grow plants?

We plan to use the ash combined with fertilizer to grow bean plants.

SCIENTIFIC QUESTION

Does the ash from clothing affect the growth of the plant, beans?

BACKGROUND RESEARCH

1. Conditions that beans need to grow
2. Research the effects of ash on plant growth
3. How clothing is made from beans
4. How much ash we will need so that it affects the plants

1. How the non environmentally friendly pieces of clothing can be upcycled
2. Brainstorm our own ideas on how to re use fabrics
3. What other people have done to upcycle clothing

INSERT URLS HERE - BEANS
• Bean | Definition, Description, Nutrition, & Examples | Britannica - January 27, 2024 • Common Bean (Phaseolus vulgaris) | Safety Assessment of Foods and Feeds Derived from Transgenic Crops, Volume 3 - January 27, 2024 • How to Grow and Care for Common Beans - January 27, 2024 • Common bean (Phaseolus vulgaris) | Feedipedia - January 27, 2024 • Phaseolus vulgaris - an overview | ScienceDirect Topics - January 27, 2024 • Common Bean: A Legume Model on the Rise for Unraveling Responses and

Adaptations to Iron, Zinc, and Phosphate Deficiencies - January 27, 2024

- Dry beans (Phaseolus vulgaris L.) as a vital component of sustainable agriculture and food security—A review - January 27, 2024
- Environmental Assets - Meatless Monday - January 27, 2024

BEANS

The plant we used in our experiment is called the common bean or Phaseolus vulgaris. Legumes such as beans have a long shelf life and are nutrient packed, which results in a lower carbon footprint for the world. They are popular because beans are high in iron, thiamin, and riboflavin, which provides quality inexpensive protein. Each pod contains four to twelve seeds packed with nutrients. They are used for treatment for diabetes and kidney problems, being very helpful to the human body.

One of the reasons why beans are commonly used is because of its sustainable nature. The common bean absorbs nitrogen in the air and fixes about 60 million metric tons into the soil with the symbiosis of a nitrogen-fixing bacteria called rhizobia. Due to the fact that this fertilizer is high in nitrogen, adding more will overdose the chemicals in the plant. This natural fertilizer saves approximately 40 billion US dollars that would've gone to farming fertilizers.

In addition to natural fertilizer, the process of harvesting beans is also environmentally friendly. Beans have a stable moisture content so no drying is necessary. In turn, less fossil fuels and harmful gasses are emitted from not using drying machines. Phaseolus vulgaris can survive drought with its own stable moisture, making them easy to access for most of the planet.

SCIENCE FAIR 2024 Webber Academy, Research Paper

CLOTHING
A BIG PROBLEM

—

By: Kaitlyn Joy & Karmen Dhillon

The Problem

You undoubtedly believe that when you donate clothes, they are being utilized in someone's home. In reality, the majority of your clothing, that is between 40% and 80%, is truly exported to underdeveloped nations abroad. Only ten to twenty percent is resold or down cycled into rags and insulation. Seventy percent ends up all around Africa's shores and is left for the local population to deal with. "We dump our waste into their (developing countries) landfills''. (Paul Jay, 2018) Apart from this, the way the clothing arrives there is even more shocking. Hence, we experimented with different textiles to find an environmentally safe way to dispose of unwanted, used clothing. Now, we are using the clothing's ash to test how it works as fertilizer. Will it negatively affect plants' growth or enhance it? We are researching characteristics of our manipulated variables and the main problem with donating unwanted clothes.

Ghana, an African nation with a population of 30 million, gets 15 million items of unwanted, worn clothing per week on its coasts. The country recycles 100 million items in four months as a result of having to figure out how to dispose of this waste. Due to a lack of available space, households of this community are turning into landfills. "Mountains of unusable, lower quality textile waste ," quote, "ending up in landfills. (Paul Jay, 2018). This quantity of clothing is sent to Africa primarily because the North continent's nations don't want to manage their own waste. Another reason is the continuous misconception that there is a grave shortage of clothing in the Global South. The primary resources are the United States of America, United Kingdom, and Canada.

In Kantamanto 30,000 people toil for 6 hours a week to sell, repair, and upcycle waste. Just some of these workers are Kayayei. Kayayei means she who carries burden. Their job is to travel neck breaking distances to deliver heavy bales of clothes, weighing 65 kg. In addition, "We see the spine of a 60 year old in a teenager's body"(Dr. Naa Asheley, 2021) despite the fact that they aren't even aware of their age. Kayayei are mostly mothers who also carry their children on their back. Although the legal working age in Ghana is 16, children work with their mothers. There have been unfortunate incidents where bales have fallen and crushed children's skulls, due to the unsafe environment where they cling to their mother's back.``Labor is physically backbreaking and spiritually dehumanizing." (Liz Rickets, 2021). The result of all their hard work is 30 cents to $1 a trip.

About 10 million tonnes of clothing are discarded each year in Accra, Ghana with 3,000 tonnes entering the country every day. Disposal charges are $45 per tonne. The amount of mechanical and chemical recycling is increasing air pollution, energy demand, water use, and carbon

footprints. Floods frequently happen because gutter systems are so clogged with garments. Even more microplastics are transported to the ocean by the flow of water. Toxic chemicals may be poured into streams during the sorting and dyeing of garments, further damaging water systems.

Characteristics Of Clothing

Some fabrics, mainly made of natural fibers like wool and cotton can naturally decay and don't have as environmentally negative impact as polyesters or nylon. Clothing is made by the threading of various fibers and that is normally identified on a clothing tag. You will see blends such as 50% cotton/polyester. Various blends of fibers offer different types and quality of fabric desired by articles of clothing for various activities. It is these same types of blends that pose certain problems at the end of the clothing use or life cycle related to reuse, recycling or elimination.

Cotton and silk are natural materials primarily made from cellulose. It grows naturally in warm climates and is a sustainable resource. Cotton is absorbent, soft and comfortable to wear. Cotton is easy to color or print and does not conduct electricity so it does not get staticy. Cotton is slow to dry and can be damaged by mildew or long term light exposure. This fabric heavily relies on the use of nitrogen for sufficient plant growth. Similar to wool, if garments are made from 100% cotton fibers they are recyclable as well as biodegradable.

Wool is the most reusable and recyclable fiber on the planet. This animal grown natural fiber varies slightly from type of animal or place of harvest but it all shares some of the most environmentally and sustainable characteristics. Wool garments do not feel damp or clammy because of the fibers natural ability to either repeal or retain water. It absorbs moisture from the air to reach an equilibrium allowing the wearer to feel comfortable and not wet or cold. Natural fibers such as wool are much more biodegradable because fungi and bacteria through the process of decomposition allow for wool to become part of the natural carbon and nutrient cycle. Moths and carpet beetles eat wool. Clothing made of 100% wool can make recycling much easier because the material can be broken down and remade into a new item through a less complex process versus a blend of fibers. Wool is flame retardant and does not melt.

Textile Incineration

Disposal of textiles is a growing problem because the production of these clothes has become less expensive over time. Waiting for 40 or more years for synthetic clothing to decompose may not be a viable option of disposal because landfills are filling up at a rate faster than

decomposition and many municipalities are running out of room. Shipping these textiles to under developed nations is simply making someone else deal with our problem.

The incineration of textile waste is a common method of disposal much quicker than decomposition. However, there are drawbacks, including exposure to the air pollution from burning which could result in severe health issues. Burning clothing could impact climate change by emitting hazardous gasses. One benefit is that all the chemicals in clothes can be converted into fuel and energy for cogeneration, which can be heating or electricity.

The carbon neutrality of wool and other natural fibers means that they can take in as much gas as they create, if not more.

The Experiment

The experiment is to test wool, denim, silk, and cotton after incineration for how the textiles can potentially aid plants in growth. Polyester and nylon were excluded from this test because they are mainly synthetic fibers and, proven by our previous experiment, they would not be a helpful fertilizer for plants.

The plant we used in our experiment is called the common bean or Phaseolus vulgaris. Legumes such as beans have a long shelf life and are nutrient packed, which results in a lower carbon footprint for the world. They are popular because beans are high in iron, thiamin, and riboflavin, which provides quality inexpensive protein. Each pod contains four to twelve seeds packed with nutrients. They are used for treatment for diabetes and kidney problems, being very helpful to the human body.

One of the reasons why beans are commonly used is because of its sustainable nature. The common bean absorbs nitrogen in the air and fixes about 60 million metric tons into the soil with the symbiosis of a nitrogen-fixing bacteria called rhizobia. Due to the fact that this fertilizer is high in nitrogen, adding more will overdose the chemicals in the plant. This natural fertilizer saves approximately 40 billion US dollars that would’ve gone to farming fertilizers.

In addition to natural fertilizer, the process of harvesting beans is also environmentally friendly. Beans have a stable moisture content so no drying is necessary. In turn, less fossil fuels and harmful gasses are emitted from not using drying machines. Phaseolus vulgaris can survive drought with its own stable moisture, making them easy to access for most of the planet.

Other Solutions

Following the plastic recycling model, a similar process could be applied to textiles where first items of clothing in good condition that are resellable could be identified and shipped to secondary markets. Those deemed to be non-desirable can then be sorted based on their fiber blends. Clothing made from 100% natural fibers like wool or cotton could be broken down and remade into new garments or potentially naturally decomposed through the use of fungi, bacteria or moths. Alternatively these materials can be thrown away in a landfill here in Canada rather than shipped across the globe.

“The bottom line is that we need to produce and consume less”(Liz Ricketts, cofounder of the OR Foundation, 2021) Influencing the government to impose taxes on lower-quality or synthetic fiber apparel is an alternate method to decrease consumption. Taxation and legislation has been used for many years to change the behaviors of the public. For instance, if garments are made with the use of polyester or nylon fibers and are taxed at a higher rate than cotton or wool, more individuals will opt to purchase eco-friendly fabrics. If there is less demand for clothing made of synthetic fibers the production of these items would decrease resulting in less waste. Additionally if items made from these fabrics were more expensive perhaps people wouldn’t be so quick to throw them away following changing fashion trends.

Conclusion

A prosperous country like Canada shouldn't dump its trash into an underdeveloped nation like Africa. It isn't helping those areas because the garbage accumulates on the beaches and in its waterways and ocean, damaging the life and creatures that live there. North America and other countries have the financial resources to construct their own material recycling or incineration facilities for the disposal of unwanted textiles. In conclusion, educating ourselves on what happens to our unwanted clothes will hopefully change future behaviors and make us more accountable for what we buy, how we use it and most importantly how we dispose of it.

VARIABLES

Manipulated

the type of ash in the soil (wool, cotton, denim, silk)

Responding

Qualitative- how healthy the plant looks at

Quantitative- how big the plant is (cm and using measuring tape)

Controlled

- Type of original soil
- Type of plant
- Amount of water
- Amount of sunlight
- Time of watering
- Time of measurement
- Type of pot
- Time of planting
- Location in house
- Distance from windows or other openings

HYPOTHESIS

If clothing ash affects the plant growth, then the plants with the clothing ash will be taller and healthier then the controlled plant. More specifically, wool will be the tallest and denim will be the shortest. This is because burned clothing can be filled with rich nutrients to help the plant grow. Additionally, wool is a natural animal fabric and is the least processed, leading us to believe that it will help the plants grow taller and healthier.

MATERIALS

1. Bean plants
2. Pots
3. Soil
4. Wool ash
5. Denim ash

6. Silk ash
7. Cotton ash

PROCEDURE

THIS EXPERIMENT WILL TAKE APROXIMATELY 1-2 MONTHS

1. Thoroughly mix the clothing ash with the soil (1 and a half cups ash, one half cup soil)
2. Fill the bottom of the pot with and inch of soil
3. Place two bean seeds in the pot about 2-3 inches apart (this insures one will sprout)
4. Fill the rest of the pot up with soil
5. Proceed to do this with the rest of the pots (two pots per type of ash and two control plants)
6. Every day, give each plant a cup of water (medicine cup- 40mL), make observations and count the number of leaves (note how healthy the plant looks/ its color)

DATA

DAY #1 January 18th

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	O cm	No growth this far
Cotton Blue	O cm	No growth this far
Denim	O cm	No growth this far
Denim Blue	O cm	No growth this far
Wool	O cm	No growth this far
Wool Blue	O cm	No growth this far
Silk	O cm	No growth this far
Silk Blue	O cm	No growth this far

DAY #10 January 27

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	0cm	No growth this far
Cotton Blue	0cm	No growth this far
Denim	0cm	No growth this far
Denim Blue	Not measurable, just visible	Sprouted, visible growth
Wool	0cm	No growth this far
Wool Blue	0cm	No growth this far
Silk	Not measurable, just visible	Sprouted, visible growth
Silk Blue	0cm	No growth this far

DAY #13 January 24th

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	0cm	No growth this far
Cotton Blue	0cm	No growth this far
Denim	0cm	No growth this far
Denim Blue	4cm	Sprouted, visible growth
Wool	0cm	No growth this far
Wool Blue	0cm	No growth this far
Silk	Not measurable, just visible	Sprouted, visible growth
Silk Blue	0cm	No growth this far
Control	0cm	No growth this far
Control Blue	Not measurable, just visible	Sprouted, visible growth

DAY #16 January 27th

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	Not measurable, just sprouting	Growing!
Cotton Blue	2cm	No observations
Denim	Not measurable, just sprouting	Growing!
Denim Blue	14cm	2 leaves, very tall
Wool	Not measurable, just sprouting	Growing!
Wool Blue	Ocm	No growth so far
Silk	Not measurable, just sprouting	Growing!
Silk Blue	Not measurable, just sprouting	Growing!
Control	Not measurable, just sprouting	Growing!
Control Blue	0cm	No growth so far

DAY #19 January 30th

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	3cm	0 leaves but is a healthy green color
Cotton Blue	16cm	2 medium leaves, healthy growth
Denim	7cm	2 small leaves, nice green color
Denim Blue	20cm	2 very large leaves, largest plant so far
Wool	5cm	0 leaves, healthy start to growth
Wool Blue	0cm	No growth so far
Silk	8cm	1 leaf, healthy start to growth
Silk Blue	4cm	1 leaf, good growth so far
Control	7cm	2 leaves, healthy green color
Control Blue	0cm	No growth so far

DAY #22 February 2nd

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	11cm	0 leaves
Cotton Blue	21cm	2 big leaves
Denim	19cm	2 leaves
Denim Blue	23cm	2 big leaves
Wool	19cm	2 leaves
Wool Blue	Just peeking through	No observations
Silk	16 cm	2 leaves
Silk Blue	17cm	2 leaves
Control	19m	2 leaves
Control	Ocm	No observations

DAY #25 February 5th

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	13cm	0 leaves
Cotton Blue	23cm	Many holes in the 2 leaves
Denim	25cm	2 big leaves
Denim Blue	25cm	2 big sized leaves
Wool	23cm	One medium sized leaf
Wool Blue	Ocm	No observations
Silk	15cm	One medium sized leaf
Silk Blue	19cm	One medium sized leaf
Control	22cm	Very tall and healthy
Control Blue	21cm	Very tall and healthy

DAY #28 February 8th

TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	14cm	0 leaves
Cotton Blue	19 cm	Prominent holes in the 2 leaves
Denim	25cm	2 big leaves
Denim Blue	27cm	2 big leaves
Wool	2 cm	No observations
Wool Blue	23cm	2 medium sized leaves
Silk	18cm	2 medium sized leaves
Silk Blue	19cm	2 medium sized leaves
Control	27 cm	2 small leaves
Control Blue	21cm	2 big sized leaves

DAY #31 February 11th

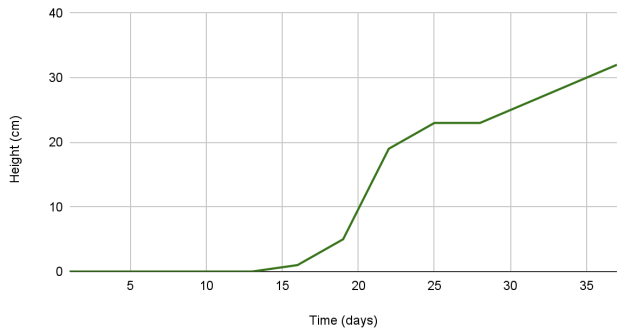
TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	15cm	0 leaves
Cotton Blue	23 cm	Prominent holes in the 2 leaves (small)
Denim	26cm	2 big leaves
Denim Blue	30cm	4 big leaves
Wool	3cm	No observations
Wool Blue	26cm	2 medium sized leaves 2 small sized leaves
Silk	22cm	2 medium sized leaves
Silk Blue	20cm	2 big sized leaves 2 small leaves
Control	28 cm	2 small leaves
Control Blue	26cm	2 big sized leaves

DAY #37 February 17th

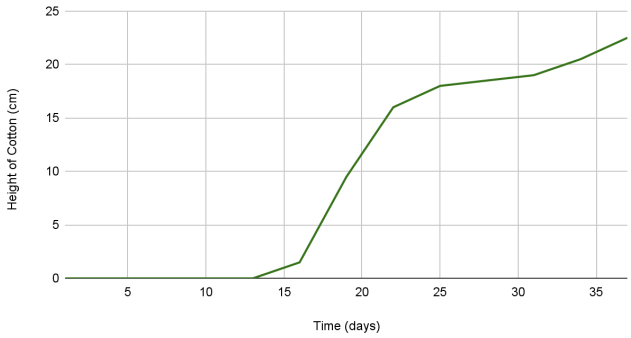
TYPE OF ASH	HEIGHT OF PLANT	OBSERVATIONS AND PHOTO
Cotton	16cm	2 leaves
Cotton Blue	29 cm	Prominent holes in the 2 leaves
Denim	30cm	2 big leaves 3 small leaves
Denim Blue	39cm	2 big leaves 3 small leaves
Wool	2 cm	No observations (NOT USING DATA)
Wool Blue	32cm	5 medium sized leaves
Silk	30cm	5 medium sized leaves
Silk Blue	20cm	2 medium sized leaves
Control	30 cm	4 medium sized leaves
Control Blue	29cm	2 big sized leaves

GRAPHS

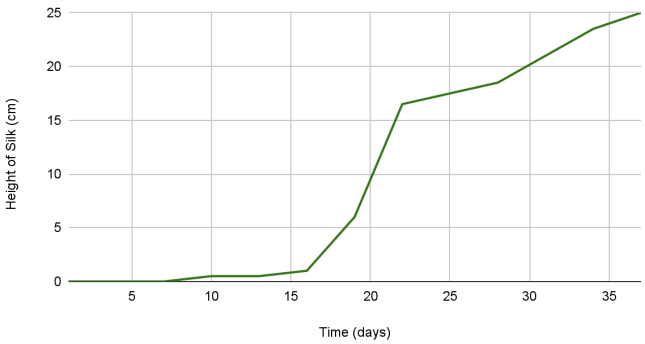
Average Growth Of Wool



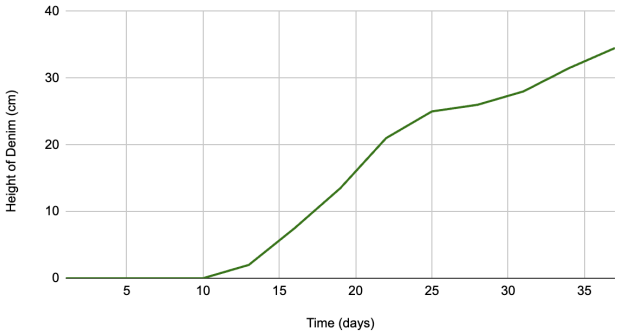
Average Growth of Cotton



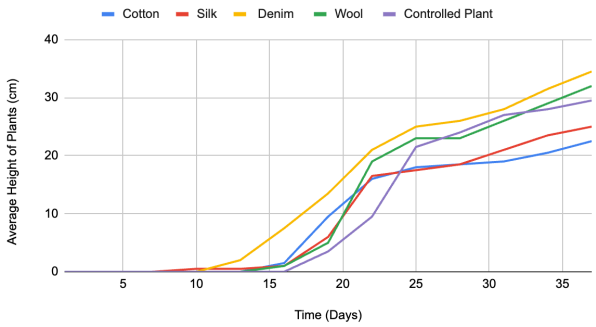
Average Growth of Silk



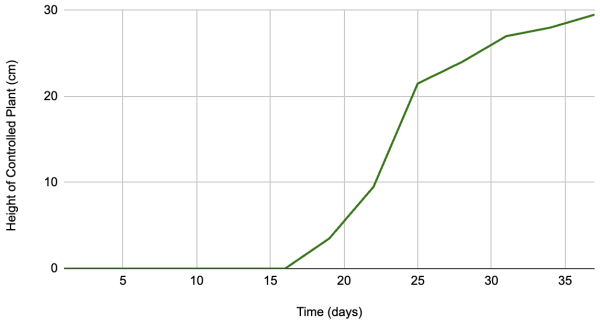
Average Growth of Denim



Ash Fertilizer Plants & Controlled Plant Comparison



Average Growth of Controlled Plant



RESULTS ANALYSIS

Denim reached an average height of 34.5 centimeters, it was the first bean plant to sprout after 11 days and was the tallest plant. Silk reached an average of 25 cm and wool grew to a total height of 32 cm. When cotton was growing, we noticed that the leaves had some holes and white spots which faded over time and the average height of these plants were 22.5 cm. All plants started to grow approximately 10-15 days after planting. Based on these results, we can confirm the ash doesn't negatively affect the starting growth time of the plants or the overall quality or size of the bean plants. The controlled plant which was plain potting soil was the last to sprout.

Other than cotton, all the other plants grew healthily and green. The control plant and wool had the thickest stems while cotton had the thinnest and weakest stem.

The control plant and silk had the most leaves but denim had the largest leaves.

CONCLUSION

The hypothesis was that the plants with the clothing ash will result in healthier growth than the plants without the ash because the incinerated clothing will provide nutrients for the plant.

One prediction was that the plant with the wool's ash will grow the healthiest and tallest because it is the least processed and comes from an animal and is more nutrient rich. Meanwhile the plant with denim's ash will grow the shortest in length because it is the most processed.

The tallest plant was denim and the shortest was cotton which was a very interesting finding because both fabrics are cotton. It's likely that the processing of denim versus cotton has some effect once turned to ash. Denim provided a richer fertilizer than cotton potentially due to the chemical process of making cotton into denim or because it is a heavier woven fabric and was denser fertilizer.

Considering this data, we can conclude that the only clothing ash that potentially

affected the plant was cotton because the plant grew short and the leaves had holes. In saying this, we now know that wool, silk, and denim ash can be effectively applied to soil on farms and in gardens. This occurred because the plants that grew the tallest were combined with ash that wasn't very processed. By burning these fabrics, we are going to see a huge decrease in the amount of physical clothing waste in Africa because over 60% of fashion garbage can now be successfully incinerated and used as fertilizer.

APPLICATIONS

We experimented with different textiles to find an environmentally safe way to dispose of unwanted clothing. We have habitually and yet still dumped our pollution in developing nations. This is harmful to the environment because textile waste, microplastics, and toxic chemicals, made by dyeing garments, gather in waterways and the ocean. This damages all nature and life. Clogged gutter systems can also cause floods frequently. Given that municipal landfills are running out of space and that textile waste takes a long time to decompose, it is not the greatest solution. In reality, the North continent's nations send their clothing to Africa primarily because they don't want to manage their own waste. Additionally, citizens believe that there is a shortage of clothing in the South. Very little percent of the population is aware of the reality. They constantly donate clothes thinking that they would end up in good use. We seek a fast and effective method of disposing of our old clothing. Our study will raise awareness of the issue with recycling and identify more environmentally friendly fabrics and disposal methods.

IMPROVEMENTS

During this project, we believe our only source of error was only using one trial for the wool plant. This plant started growing quite late and only grew a total height of 5cm. We decided that the best decision was to not use this information as the other wool plant was over 30cm tall. For the average we are just using the height of the tall plant. If this plant had grown, it would have made our results more reliable. Additionally, we would like to start our experiment earlier next year because growing plants takes a long time.

PRESENTATION

Intro > problem > bad solutions > another solution (incineration > experiment (about beans) > hypothesis > results graphs > improvements > conclusion > ending

Our project is about the reality behind where donated clothes go and how we can fix it.

Many people believe that when you donate clothes, they find a new life in someone else's wardrobe. Additionally, citizens believe that there is a shortage of clothing in the developing nations. They constantly donate clothes thinking that they would end up in good use. Very little percent of the population is aware of the reality. Majority of your clothing, that is between 40% and 80%, is truly exported to underdeveloped nations abroad. Only less than twenty percent is resold or down cycled into rags and insulation. Seventy percent ends up all around Africa and developing nation's shores and is left for the local population to deal with. This is harmful to the environment because textile waste, microplastics, and toxic chemicals, made by dyeing garments, gather in waterways and oceans.

Disposal of textiles is a growing problem because the production of clothing has become less expensive over time. Waiting for 40 or more years for synthetic clothing to decompose may not be a viable option of disposal because landfills are filling up at a faster rate than decomposition and many municipalities are running out of room. Shipping these textiles to under developed nations is simply making someone else deal with our problem. Other methods of disposal such as mechanical and chemical recycling have the potential to raise air pollution, energy demand, water use, and carbon footprints, making them a less desirable solution.

We seek a fast and effective method of disposing of our old clothing that manages our waste without causing harm to our environment. Our study will raise awareness of the issue with recycling and identify more environmentally friendly fabrics and disposal methods.

The incineration of textile waste is a common method of disposal much quicker than decomposition. However, there are drawbacks, including exposure to the air

pollution from burning which could result in severe health issues. Burning clothing could impact climate change by emitting hazardous gasses. One benefit is that all the chemicals in clothes can be converted into fuel and energy for heating or electricity. The carbon neutrality of wool and other natural fibers means that they can take in as much gas as they create, if not more.

Last year, we burned different types of clothing including wool, denim, silk, cotton, nylon and polyester. The two fabrics that we named "bad for the environment" or not safe to burn were polyester and nylon. These two fabrics released high amounts of harmful gasses into the air and burned into small pieces of plastic.

This experiment is to test wool, denim, silk, and cotton after incineration for how the textiles can potentially aid plants in growth. Polyester and nylon were excluded from this test because they are mainly synthetic fibers and, proven by our previous experiment, they would not be a helpful fertilizer for plants.

The hypothesis is, if clothing ash affects the plant growth, then the plants with the clothing ash will be taller and healthier then the controlled plant. More specifically, wool will be the tallest and denim will be the shortest. This is because burned clothing can be filled with rich nutrients to help the plant grow. Additionally, wool is a natural animal fabric and is the least processed, leading us to believe that it will help the plants grow taller and healthier.

The plant we used in our experiment is called the common bean. Legumes such as beans have a long shelf life and are nutrient packed with quality inexpensive protein, which results in a lower carbon footprint for the world. They are used for treatment for diabetes and kidney problems, and are very helpful to the human body.

One of the reasons why beans are commonly used is because of its sustainable nature. The common bean absorbs nitrogen in the air and fixes about 60 million metric tons into the soil with the symbiosis of a nitrogen-fixing bacteria called rhizobia. Due to the fact that this plant is high in nitrogen, adding more will overdose the chemicals in the plant. This natural fertilizer saves approximately 40 billion US dollars that would've gone to farming fertilizers.

In addition to natural fertilizer, the process of harvesting beans is also environmentally friendly. Beans have a stable moisture content so no drying is necessary. In turn, less fossil fuels and harmful gasses are emitted from not using drying machines. The common bean can survive drought with its own moisture, making them low maintenance and easy to access for most of the planet.

We started germinating the beans in January, and the plants grew for one month and a half. After conducting the experiment with one part soil and two parts ash, results showed that denim reached an average height of 34.5 centimeters, it was the first bean plant to sprout after 11 days and was the tallest plant. Silk reached an average of 25 cm and wool grew to a total height of 32 cm. When cotton was growing, we noticed that the leaves had some holes and white spots which faded over time and the average height of these plants were 22.5 cm. All plants started to grow approximately 10-15 days after planting. Based on these results, we can confirm the ash doesn't negatively affect the starting growth time of the plants or the overall quality or size of the bean plants. The controlled plant which was plain potting soil was the last to sprout.

Other than cotton, all the other plants grew healthily and green. The control plant and wool had the thickest stems while cotton had the thinnest and weakest stem. The control plant and silk had the most leaves but denim had the largest leaves.

During this project, we believe our only source of error was only using one trial for the wool plant. One of the trials for this plant started growing quite late and only grew a total height of 5cm. We decided that the best decision was to not use this information as the other wool plant was over 30cm tall. For the average we are just using the height of the tall plant. If this plant had grown, it would have made our results more reliable. Additionally, we would like to start our experiment earlier next year because growing plants takes a long time.

The hypothesis was that the plants with the clothing ash will result in healthier growth than the plants without the ash because the incinerated clothing will provide nutrients for the plant.

One prediction specifically was that the plant with the wool's ash will grow the healthiest and tallest because it is a naturally sustainable textile. Meanwhile the plant with denim's ash will grow the shortest in length because it is the most processed.

The tallest plant was denim and the shortest was cotton which was a very interesting find because both fabrics are originally made with cotton. It's likely that the processing of denim versus cotton has some effect once turned to ash. Denim provided a richer fertilizer than cotton potentially due to the chemical process of making cotton into denim or because it is a heavier woven fabric and was denser fertilizer.

Considering the data, we can conclude that the only clothing ash that potentially affected the plant was cotton because the plant grew short and the leaves had holes. In saying this, we now know that wool, silk, and denim ash can be effectively applied to soil on farms and in gardens. This occurred because the plants that grew the tallest were combined with ash that wasn't very processed.

In conclusion, your clothing donations aren't being put to good use. The unwanted items are shipped to developing nations. Since majority of the clothing finds itself in landfills and waterways, we thought to create a solution to this problem. We discovered that by burning the fabric and using the ash as fertilizer we can successfully eliminate the "garbage" and use it for something beneficial. In our experiment, we looked at which materials could be effectively used as fertilizer. However if gasses are released when burning clothing, adding this ash could encourage the growth of more plants, which would help the environment absorb carbon dioxide.

Ultimately, third world places shouldn't end up being North America's dumping sites. It is important that we clean up our own mess instead of forcing it upon developing countries. This experiment proves that we can take action and solve this growing problem. Not only can we reduce the amount of garbage, we can create a more nutrient rich soil in a country that suffers from food scarcity.

Bibliography

"A Simple Guide To Eco-Friendly Fabrics And Where To Shop Them." *VETTA*, https://www.vettacapsule.com/blogs/blog/your-guide-to-eco-friendly-fabrics. Accessed 4 January 2023.]

Batista, Candice. "The Lowdown on Nylon: Is it an Eco-Friendly, Sustainable Fabric?" *The Eco Hub*, 30 June 2022, https://theecohub.com/nylon-eco-friendly-sustainable-fabric/. Accessed 4 January 2023.

Castro-Guerrero, Norma A., Mariel C. Isidra-Arellano, David G. Mendoza-Cozatl, and Oswaldo Valdés-López. "Common Bean: A Legume Model on the Rise for Unraveling Responses and Adaptations to Iron, Zinc, and Phosphate Deficiencies." *Frontiers*, April 18, 2016. Accessed January 27, 2024. https://www.frontiersin.org/journals/plant-science/articles/10.3389/fpls.2016.00600/full

"Common Bean (Phaseolus Vulgaris)." *Common Bean (Phaseolus vulgaris) | Safety Assessment of Foods and Feeds Derived from Transgenic Crops, Volume 3 : Common bean, Rice, Cowpea and Apple Compositional Considerations | OECD iLibrary*. Accessed January 27, 2024. https://www.oecd-ilibrary.org/sites/544d03d6-en/index.html

Dang, Christina. "Spandex is Elastic but the Environment is Not." *AndHerShop*, 10 August 2022, https://www.andher.us/blogs/news/spandex. Accessed 4 January 2023.

Dowding, Jessica. "What Are the Best Eco-Friendly Fabrics? A Complete Guide." *Wild Minimalist*, 9 September 2021, https://wildminimalist.com/blogs/news/what-are-the-best-eco-friendly-fabrics-your-co

mplete-guide-to-16-common-materials. Accessed 4 January 2023.

Durfee, Nell, et al. “The troubled second life of donated clothes.” *Scienceline*, 6 June 2018, https://scienceline.org/2018/06/the-troubled-second-life-of-donated-clothes/. Accessed 4 January 2023.

“Environmental Research about Meatless Monday.” The Monday Campaigns, March 10, 2022. Accessed January 27, 2024. https://www.mondaycampaigns.org/meatless-monday/research/environment.

Hertantyo, Stella. “The Truth About What Happens to Donated Clothes.” *Conscious Life and Style*, 27 October 2021, https://www.consciouslifeandstyle.com/what-happens-to-donated-clothes/. Accessed 4 January 2023.

Heuzé V., Tran G., Nozière PLebas F. “*Common bean (Phaseolus vulgaris).*” *Feedipedia. INRAE, CIRAD, AFZ and FAO. October 20, 2015. Accessed January 27, 2024.* https://www.feedipedia.org/node/266.

“How to Recycle Clothes That Can't Be Repaired, Donated or Resold.” *ClosettCandyy*, https://www.closettcandyy.ca/post/how-to-recycle-clothes-that-can-t-be-repaired-donated-or-resold. Accessed 31 January 2023.

Iannotti, Marie. “Common Beans: Plant Care & Growing Guide.” *The Spruce*, June 29, 2024. Accessed January 27, 2023.

Jay, Paul. “Here's where your donated clothing really ends up.” *CBC*, 29 May 2018, https://www.cbc.ca/news/canada/ottawa/donated-clothing-where-it-ends-up-1.466202

3. Accessed 4 January 2023.

Uebersax Mark A., Karen A. Chichy, Franscisco E. Gomez, Timothy G. Porch, et al. “Dry Beans (Phaseolus Vulgaris L.) as a Vital Component of Sustainable …” *Wiley*, June 9, 2022. Accessed January 27, 2024 https://onlinelibrary.wiley.com/doi/full/10.1002/leg3.155.

Marshall, Shonagh. “A conversation with Liz Ricketts — Denier.” *Denier*, 30 July 2020, https://www.fashiondenier.com/conversations/a-conversation-with-liz-ricketts. Accessed 4 January 2023.

Mendes, Pedro. “How jeans became one of the most polluting garments in the world.” *CBC*, 13 September 2019, https://www.cbc.ca/radio/ideas/how-jeans-became-one-of-the-most-polluting-garments-in-the-world-1.5280773. Accessed 4 January 2023.

Osmanski, Stephanie. “How Fabric Gets Recycled.” *Green Matters*, 29 April 2020, https://www.greenmatters.com/p/how-fabric-gets-recycled. Accessed 4 January 2023.

Petruzzello, Melissa. “Bean.” *Encyclopædia Britannica*, February 15, 2024. Accessed January 27, 2024. https://www.britannica.com/plant/bean.

“Phaseolus Vulgaris.” Phaseolus vulgaris - an overview | ScienceDirect Topics. Accessed February 19, 2024. https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/phaseolus-vulgaris.

Porter, Beth. “What Really Happens to Unwanted Clothes?” *Green America*, https://www.greenamerica.org/unraveling-fashion-industry/what-really-happens-unwa

nted-clothes. Accessed 4 January 2023.

RICKETTS, LIZ, and Branson Skinner. “Introduction.” *Dead White Man's Clothes*, https://deadwhitemansclothes.org/intro. Accessed 4 January 2023.

RICKETTS, LIZ. “Carrying Capacity.” *Atmos*, 11 July 2020, https://atmos.earth/kantamanto-market-ghana-clothing-waste-women. Accessed 4 January 2023.

RICKETTS, LIZ. “This Is Not Your Goldmine. This Is Our Mess.” *Atmos*, 30 January 2021, https://atmos.earth/fashion-clothing-waste-letter-ghana/. Accessed 4 January 2023.

“SMART Textile Recycling.” *CT.gov*, https://portal.ct.gov/-/media/DEEP/waste_management_and_disposal/Solid_Waste_Management_Plan/June2013/SMARTTextileRecyclingGroipenSWACJune2013pdf.pdf. Accessed 4 January 2023.

Weber, Sabine. “Opportunities for Textile Recycling - Waste & Recycling.” *Solid Waste & Recycling*, 6 July 2017, https://www.wasterecyclingmag.ca/feature/opportunities-for-textile-recycling/. Accessed 4 January 2023.

“Why wool is the best choice for the environment.” *British Wool*, https://www.britishwool.org.uk/why-wool-is-the-best-choice-for-the-environment. Accessed 4 January 2023.

TO DO

- ☑ ~~Scientific Question~~
- ☑ ~~Hypothesis~~
- ☑ ~~Background Research Notes~~
- ☑ ~~Bean bullet notes~~
- ☑ ~~Complete Variables~~
- ☑ ~~Create Procedure~~
- ☑ ~~Collect Materials~~
- ☑ ~~Start Experiment~~
- ☑ ~~Data Table *4~~
- ☑ ~~Graphs~~
- ☑ ~~Results~~
- ☑ ~~Conclusion~~
- ☑ ~~Real Life Applications~~
- ☑ ~~Improvements~~
- ☑ ~~Bibliography~~
- ☑ ~~Trifold~~
- ☑ ~~Presentation~~
- ☑ ~~Finish Logbook~~