Hydroponics: Garbage to Garden

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Table of Contents

Abstract

In today's World, the irresponsible practices of humans poses an enormous threat to earth's ecosystem and ultimately, life for all creatures. Because of human's voracious expansion further out to the earth, farmers are running out of suitable land for growing food. Not only this, but pollution caused by household waste also causes a major problem for the environment. My problem statement is as follows; families are uneducated about the ways they can reuse their old items in a manner that is helpful to them and the environment. As a solution I engineered a hydroponics system using only recycled household materials. The system created was by testing many different types of household materials from sponges to milk cartons. Different materials were tested during growth cycles of plants in which soybeans were grown in each different environment. At the end of each growth cycle, I took measurements of each plants height and made observations about the root structure. At the end of the project, I found that a simple, versatile, and inexpensive hydroponics systems can be created using common household items. This project can help reduce waste created by humans and educate families about effective ways to recycle and grow plants.

Garbage to Garden

Hydroponics is an innovative and efficient way to grow plants without using any soil. Plants grown in a hydroponics system do not feed off of soil but instead, the roots are submerged in a nutrient rich water that can help the plants grow up to 25% faster. While the roots of the plant are submerged in water the rest of the plants are in the air so they still get the light and oxygen they need. Hydroponics systems can vary in size, chemical composition, and plant type. However, one thing many systems have in common is that they are easy to control. You can manipulate the water type, chemical solution, and bedding type. Although any plant can be grown in a hydroponics system the most common type of plants are lettuce, tomatoes, and spinach. Because suitable growing land is decreasing it is imperative that we have new ways to grow food. Because the plants are grown in a tank, hydroponic systems can be placed virtually anywhere. This makes hydroponics very valuable to our world. For my project, I will be creating a hydroponic system entirely out of recycled materials. I hope to find a way to educate families about reusable waste in their homes and to find a practical way to lessen waste pollution and teach families about growing food in a sustainable way.

Background

Hydroponics is a way to grow plants without using a lot of space or any soil. The plant's roots in a hydroponic system are submerged in nutrient rich water, while the rest of the plant is exposed to air. Usually a system will consist of a reservoir, nutrient pump, timer, air pump and stone, and a grow bed. The most common type of plants grown in a hydroponics system are leafy plants such as lettuce or spinach. While humans push forward into the world, cut down forests and construct new buildings, land suitable for growing plants is diminishing. Hydroponics is the next way to grow food without using land, also you can place a hydroponics system anywhere. There are many advantages to hydroponics, here they are. 1. You can grow anywhere, 2. Uses 20 times less water than soil based gardening. 3. Your environment is sterile, which means no pesticides, 4.you'll use 20% less space for growing. 5. The system water can be reused, allowing you to conserve water, 6. Harvesting is easier, and 7.you can grow year round if indoors. Even though there are many advantages to a hydroponics system, there are also disadvantages. 1. Putting together a hydroponic system isn't cheap, 2. Constant monitoring is required, 3. Hydroponic systems are vulnerable to power outages, 4. In the event of a power outage that outlasts your generators you will be manually watering your garden, 5. Micro-organisms that are water-based can creep in rather easily, 6. Growing a hydroponic garden demands technical expertise, 7. Production is limited compared to field conditions, 8. If a disease appears, all plants in the system will be affected, 9. Without soil to serve as a buffer if the system fails plant death will occur rapidly. When growing plants in a hydroponic systems bedding is key to how the plants thrive. Bedding holds the plants up and allows the roots to grow in the water. Some growth mediums include Rockwool, grow rock, coco fiber, perlite, vermiculite, oasis cubes, and floral foam, and grow stone, river rock, pine shavings, and composted materials. Nutrient pumps pump

a chemical solution into the water that helps the plant grow. The chemicals in the solution are usually used to clean out the tank or to give the plant nitrate. Nitrate is usually found in soil or droppings from animals.

Types of Hydroponics Systems

1. Deepwater Culture (DWC), also known as the reservoir method, is by far the easiest method for growing plants with hydroponics. In a Deepwater Culture hydroponic system, the roots are suspended in a nutrient solution. An aquarium air pump oxygenates the nutrient solution, this keeps the roots of the plants from drowning. Remember to prevent light from penetrating your system, as this can cause algae to grow.

2. Nutrient Film Technique, or NFT, is a type of hydroponic system where a flow of nutrient solution runs over the plants roots. This type of system is on a slight tilt so that the nutrient solution will flow with the force of gravity.

3. Wicking is one of the easiest and lowest costing methods of hydroponics. When using the wicking method a material, such as cotton, that is surrounded bedding with one end of the wick material placed in the nutrient solution. The solution is then sucked up to the roots of the plant.

4. An ebb & flow hydroponics system, also known as a flood and drain system, is a great system for growing plants with hydroponics. This type of system functions by flooding the growing area with the nutrient solution at specific intervals. The nutrient solution then slowly drains back into the reservoir

5. A hydroponic drip system is rather simple. A drip system works by providing a slow feed of nutrient solution to the hydroponics medium, this waters the plants.

-Recycled Growth Media

Last year for my experiment I created a recycled growth media that yielded more plants than two other store bought medias. This new media was created with used paper towels, paper, pencil shavings, cardboard, and tissues. This media will be used in this year's experiment.

-Household Waste

The average American wastes just under five pounds of trash each day while a family creates seven pounds each day.

Materials and Methods

The materials for this project are as follows; empty juice container, empty yogurt or soda cans, standard tubing for aquarium pumps, standard air pump, duct tape, soybeans, paper towels, cardboard, pencil shavings, paper, and nitrate based liquid fertilizer.

To make a recycled hydroponics system attention to detail is very important, but before the cproject can be started there are a few things needed to be done. One of these things is to create a growth media. To make the growth media there are a few simple steps. To begin, collect the recycled paper, paper towels, cardboard, tissue boxes, and pencil shavings. Then, shred all of these materials into thin strips. Using 3 parts paper, 2 parts paper towels, 1 part shredded cardboard and tissue boxes, and 1 part pencil shavings. Mix these items together to create a completely recycled growth media.

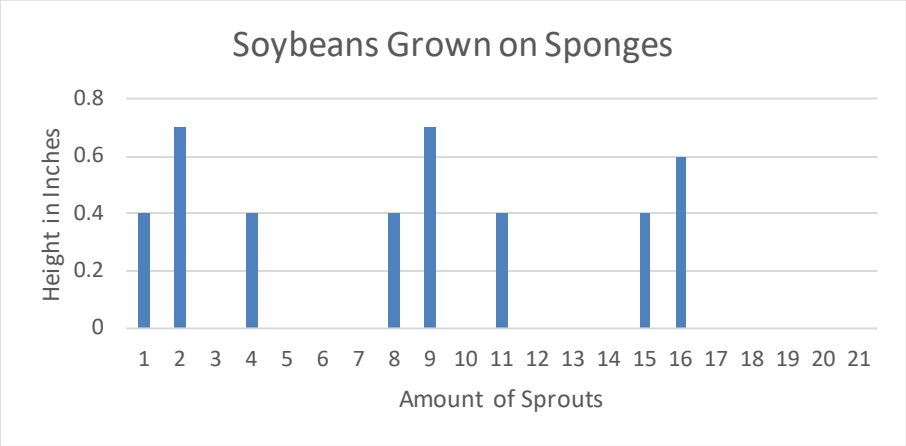
To begin creating the hydroponics system itself, trace the shape of your empty yogurt cup or soda can on the side of the side of the empty juice container. If you do not have a juice container, you can use an empty tupperware container and complete this step on the lid. Next, cut the shape drawn out of the plastic. If this task is hard, use a screw driver or knife to begin the cut then use scissors to finish. After, cut a small hole near the previous cuts, this hole only needs to be a half inch in diameter because the tubing for the air pump will be placed through it. Seal the bottle and lid together with duct tape. Make small holes all around the bottom of the yogurt cups. The holes should be large enough for water to flow through, but small enough to keep the growth media inside. Using the holes you created in the previous steps fill the juice container up as much as possible without overflow. Then, add one teaspoon per gallon of the nitrate solution to the water. Put the tubing and yogurt cups in their cut-out holes and fill them with growth media. Then, plant five beans in each yogurt container. Make observations each day about the beans and keep a detailed log. After seven days, remove the bean sprouts and measure them. The measurements should be recorded in a spreadsheet.

Different stages in this experiment took place, one was growing the bean sprouts on used sponges rather than with a yogurt cup and growth media. To complete this stage, use the same system designed in the previous step but use sponges in place of the yogurt cups. The second was to grow plants in yogurt cups following the same directions but by cutting slits in the cup instead of holes. And Lastly following the original yogurt cup method and removing the air pump.

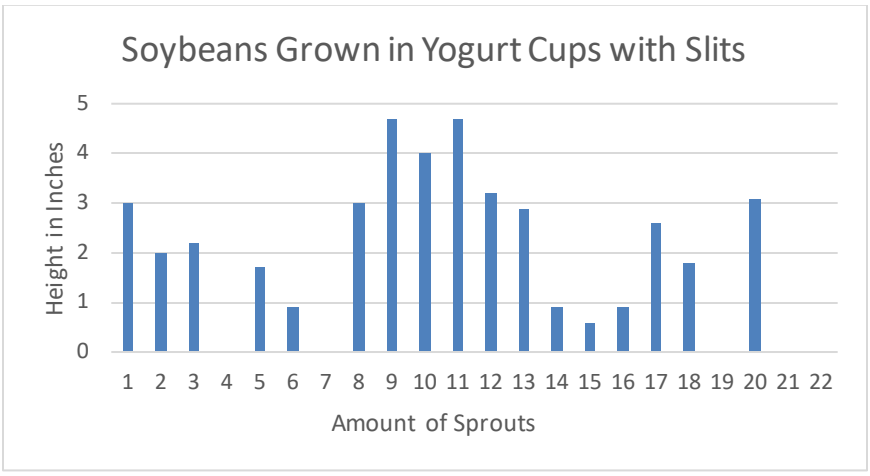
Results

During the first round of testing plants where grown in sponges, this method yielded very poor results. 12 out of the 21 plants grown fell off the sponge while the ones that remained on the

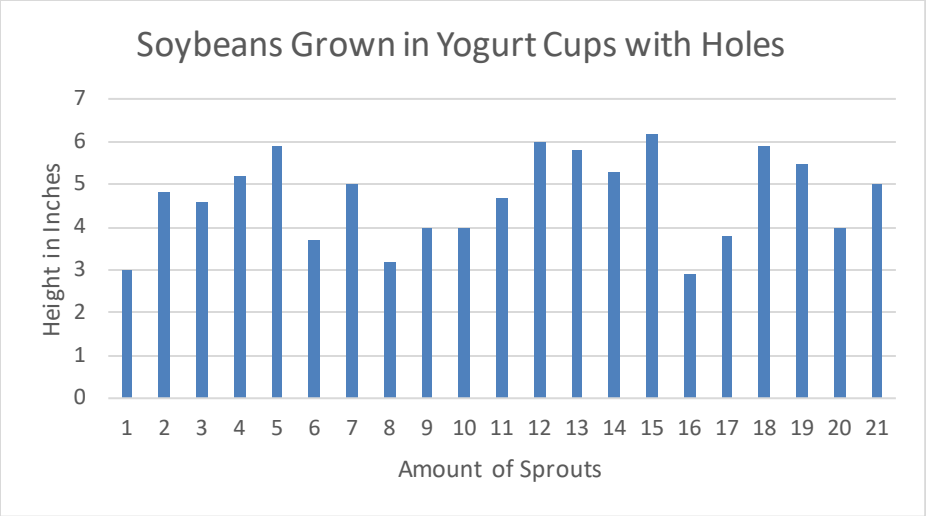
sponge did not sprout roots. That means that only 42% of the plants in this cycle sprouted. Because the plants were unable to sprout roots they did not grow successfully. The average



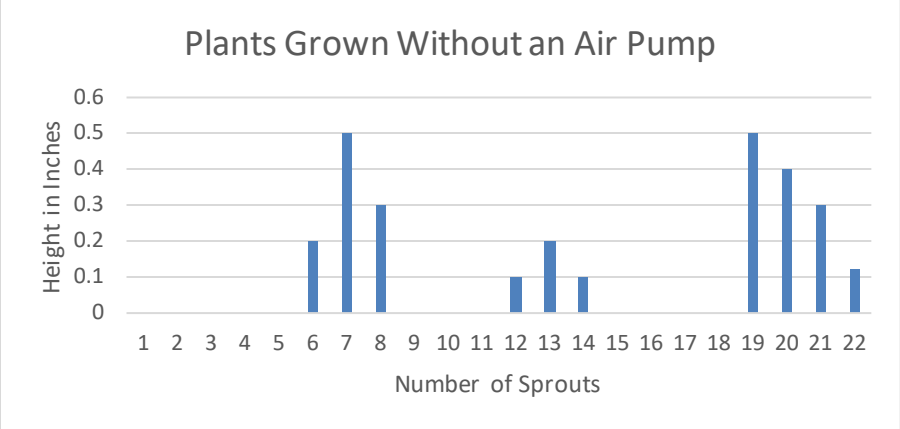
height for the plants grown was only .36 inches, not one plant grew above an inch. Because the plants fell off the sponge, didn't grow root systems, and only grew slightly I consider this method a failure. In the second round of testing, the soybeans were grown in used yogurt cups with slits cut in the bottom and sides of the container. Inside the container I used the growth media made from recycled materials. The plants in this round grew significantly taller and healthier. 100% of the soybeans planted sprouted and the average height of the plants was 2.2 inches which is an improvement from the last round of testing.



For the third round of testing plants were grown in yogurt cups with holes rather than slits cut into them. 100% of the plants planted sprouted with an average height of 4.6 inches.



For the last growth cycle in this project the plants were grown in a yogurt cup with holes and recycled media, but an air pump was not used. Only 42 percent of the plants sprouted with an average of 1.2 inches in height.



Discussion and Conclusions

During this project, I found that a hydroponics system can be made from common household items easily. During last year's experiment, the beansprouts grown in a store-bought system grew at an average of 6.28 inches in 10 days, this year, I found that plants grown in my recycled system grew an average of 4.6 inches in 7 days. Considering that the plants grown in a store-bought system had three extra days to grow I would conclude that my project was a

success. The recycled system I made only cost 20 dollars, this money bought and air pump and nitrate solution. Because the hydroponics system is so versatile, smaller air pumps and different nitrate solutions could be used for this project which would lower the cost significantly. During the first test of growing plants with sponges, I believe the plants did not thrive because they could not grow root systems in the dense sponge material. In the second trial I used growth media instead of a sponge which allowed the plant's roots to grow develop. In the third trial the plants grew taller than the second trial because water was able to circulate through the yogurt cups more freely, this was because I cut holes rather than slits in the yogurt cups. Lastly, I believe the plants in the fourth trial failed because the water could not circulate without the air pump. Proven by the trails listed above, for a recycled hydroponic system to be successful, plants need proper water circulation and less dense growing conditions so the root system can develop.

Because the system was placed under a window sunlight could be an uncontrolled factor that affected my results, that is why I performed multiple rounds of testing. If I were to do this project again, I would try to grow the plants in a more controlled area so sunlight would not be as large of a factor. This project has inspired two new experiments that could be conducted; one is to create a solar powered pump so the system could be self-sufficient and another is to create a nitrate solution out of compost.

To conclude, I believe this experiment was a success because I solved my problem statement which was that families are uneducated about the ways they can reuse their old items in a manner that is helpful to them and the environment. The results of my experiment show that a hydroponics system can be created using household materials, with this information families can be taught about inventive ways to reduce waste and grow fresh produce in their homes. I am very excited about the ways my findings can be applied, some applications are as follows;

schools could reuse their waste by making a hydroponics system which would be educational to teachers and students and by collecting waste from American households, more hydroponics systems can be created and sent to countries with poor agricultural techniques.

Acknowledgment

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