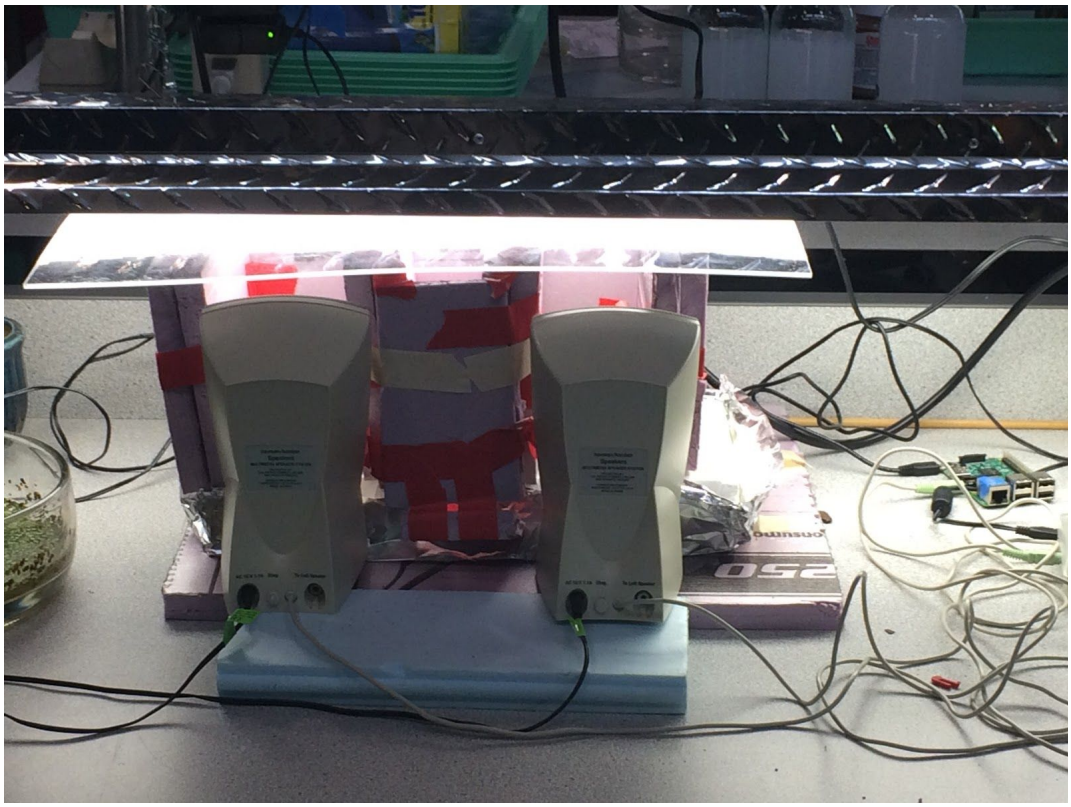
The Effect of Different Sound Frequencies on Plant Growth



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INTRODUCTION

In this experiment, the effects of different frequencies on plant growth were studied. Finding the ideal frequencies of growth for Wisconsin Fast plants can have an effect on how they are grown and can provide a way to grow larger Wisconsin Fast plants. There have also been very few experiments done on the effects of sound frequencies on a plant. An experiment has been done on the effects of sound frequencies on bean plant growth and it suggested that higher frequencies were beneficial to bean plants, but there had not been an experiment like this done on Wisconsin Fast Plants previously (Collins). We used the Wisconsin Fast Plant Website, other websites studying the effects of music, and journal articles on the effects of tone to come up with this experiment.

HYPOTHESIS

Alternate

Higher pitched sound tones will have a positive effect on the growth of Wisconsin Fast plants.

Null

There will be no significant difference in the growth of Wisconsin Fast Plants that are exposed to different pitches of sound.

MATERIALS

1. Masking Tape	Available
2. Styrofoam	Available
3. Scissors	Available
4. Potting Soil	Available
5. Styrofoam Grid	Available
6. 36 Wisconsin Fast Plant Seeds	Available

7.	2 External Computer Speakers	Available
8.	2 Pi Power Adapters	Available (one provided by Gustav)
9.	2 Speaker Power Adapters	Available
10.	Tin Foil Bed	Available
11.	Hanging Light	Available
12.	2 Raspberry Pi Computers	Available (one provided by Gustav)

Timeline

On September 26, 2016, this project was started. The group got together and started to brainstorm ideas. On October 7, 2016, the group had decided that the experiment was going to be about the effect of sound frequencies on plants. On October 20, 2016, the group had gathered all of the materials necessary and built the foam structure for the plants and finished setting up the raspberry pi to play the sounds. On October 24, 2016, the soil was put in and the seeds were planted. The plants were checked and watered almost everyday until November 17, 2016, when the data for height of plants and number of leaves was collected and recorded. Finally, on November 22, 2016, the full analysis of the data was complete.

Experimental Design Diagram

Title: The Effect of Different Levels of Sound Tones on Wisconsin Fast Plant Growth *(Brassica rapa)*

Hypotheses:

Alternate
Higher pitched sound tones will have a positive effect on the growth of Wisconsin Fast plants.

Null
There will be no significant difference in the growth of Wisconsin Fast Plants that are exposed to different pitches of sound.

Independent variable: Sound Tone Level *(hz)*

Levels:	No Sound	500 hz	15,000 hz
# trials:	12	12	12
Control?	control		

Dependent variable:

Growth of Wisconsin Fast Plants (average height of plants and average number of leaves at conclusion of study period)

Operational definition of dependent variable:

Average Height at conclusion of study = (height of each plant added)/12
Average Leaves at conclusion of study period = (leaved of each plant added)/12

Height measured in millimeters.

Constants:

Plants receive same type and amount of lighting

Plants given same amount of water per day (5 mL)

Plants grown in same amount and type of soil

Styrofoam enclosures are the same for each plant group

Each pot receives the same amount of seeds and similar dispersion

Plants are given the same length of time to grow (2 weeks)
Type of pot is the same for each plant.

Same speaker is used for each plant (if speaker is necessary).

Experiment Setup:

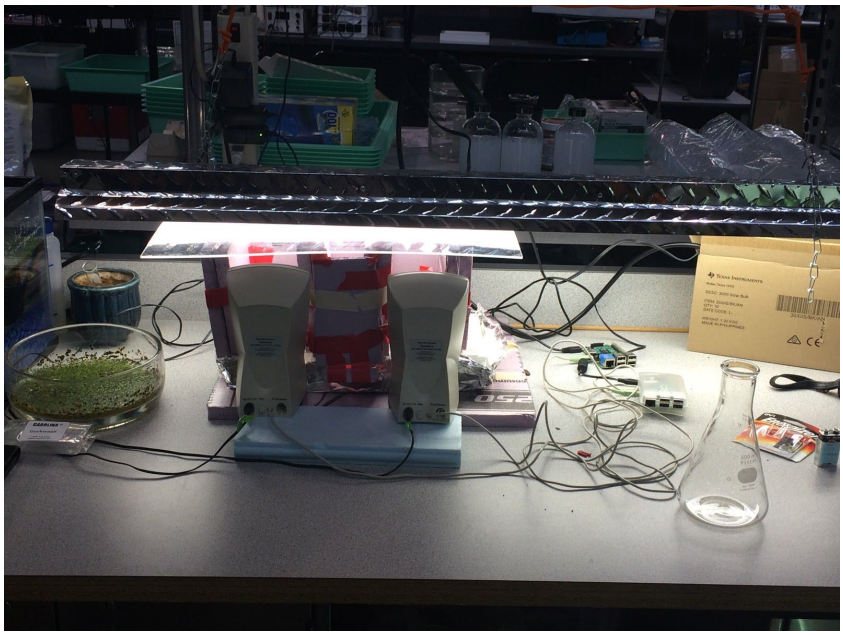

FIGURE 1: Experiment Setup
We built a styrofoam cover to go around where we would grow our plants. We included a clear plexiglass sheet on top so that light could get throw and we had two openings for the speaker. We placed an aluminum tray underneath the apparatus for watering because the bottom of our styrofoam container had holes where the plants could absorb the water from.

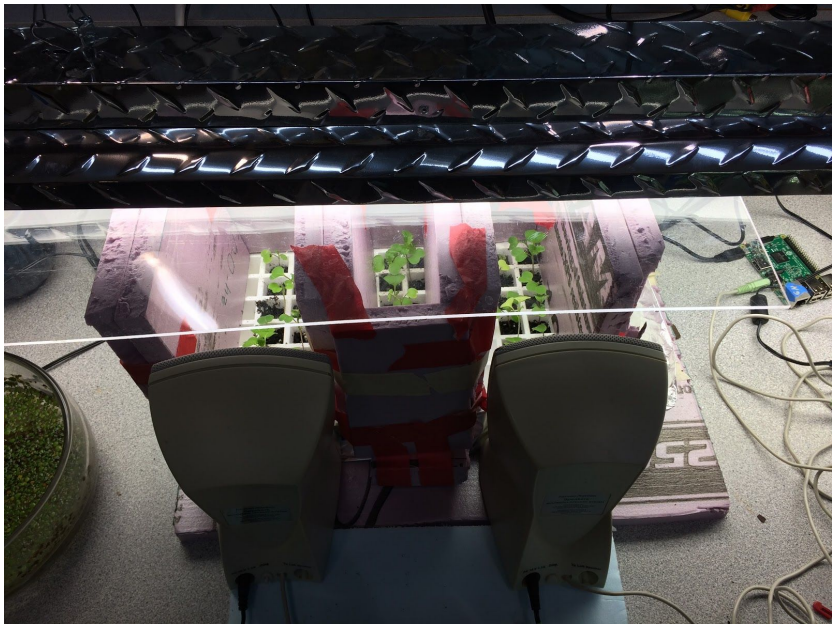

FIGURE 2: Plants about 2 weeks into experiment (Left is 500 Hz, Middle is Control, and Right is 7600 Hz)

PROCEDURE

1. Create a sound reduction chamber out of styrofoam with three growth sections. Use the scissors to cut the styrofoam to the appropriate size for three 2 by 6 growing sections and masking tape to seal openings in the styrofoam walls. The outer sections should be lacking a wall on one side while the middle should have four walls surrounding it.
2. Affix the sound reduction chamber to a styrofoam pots grid, using masking tape to seal gaps and leaving three 2 by 6 sections of pots between the walls.
3. Fill the 36 pots with potting soil until they are left with about a millimeter of styrofoam visible on the side of each pot.
4. Press a Wisconsin Fast plant seed into each pot and lightly cover it with soil.
5. Place the transparent plastic plate over the enclosure to enclose the plants completely with only the two missing walls still open.
6. Program two Raspberry Pi computers to constantly broadcast 500 hertz and 7600 hertz sound tones respectively at equal volume via external speakers. Run the program continuously.
7. Attach an external computer speaker to both Raspberry Pi computers and use power adapters to plug both computers and the speakers into wall power

sockets.

8. Place the speakers in the missing wall sections of the soundproof enclosure. From left to right, the sections should be receiving constant sound tones of 500 hz, no sound, and 7600 hz respectively. Use volume meter to calibrate volume.
9. Place the completed enclosure on a tin foil bed that will allow water to seep from its edges under all plants to provide constant water.
10. Move the tinfoil bed and its contents under a grow light. Plug the grow light into a wall power socket and turn it on.
11. Refill the tinfoil bed with water every 1-3 days to give plants continuous water.
12. Photograph plants and enclosure regularly throughout the growth cycle.
13. Repeat steps 11-12 until the plants have completed their growth cycle.
14. Measure the plants' above ground height and count each plant's number of leaves. Record this quantitative data.
15. Analyse the data for trends related to the change in the hertz level of the constant sound tones.

DATA

TABLE 1: Wisconsin Fast Plant Height (cm)

Control	500 Hz	7600 Hz
5.1	12.4	9.5
15.8	5.1	9.6
2.0	10.5	9.2
0	13.1	14.7
16.1	6.0	15.0

8.1	8.0	8.7
0	12.2	8.0
16.9	8.0	12.7
0	4.5	12.8
13.9	11.4	0
11.1	0	7.8
6.5	8.1	2.0

TABLE 2: Wisconsin Fast Plant Leaf Count

Control	500 Hz	7600 Hz
4	3	4
4	4	6
3	3	3
0	4	4
4	5	6
6	4	4
0	4	4
3	3	4

0	7	3
4	3	0
3	0	7
4	3	5

Table 3: Summative Data Table for Wisconsin Fast Plant Height (cm)

	Control	500 Hz	7600 Hz
Mean	7.96	8.28	9.17
Standard Deviation	6.67	3.91	4.57
Variance	44.43	15.33	20.86
Number of Trials	12	12	12

TABLE 4: Summative Data Table for Wisconsin Fast Plant Leaf Count

	Control	500 Hz	7600 Hz
Mean	2.97	3.58	4.17
Standard Deviation	1.93	1.62	1.80
Variance	3.72	2.63	3.24
Number of Trials	12	12	12

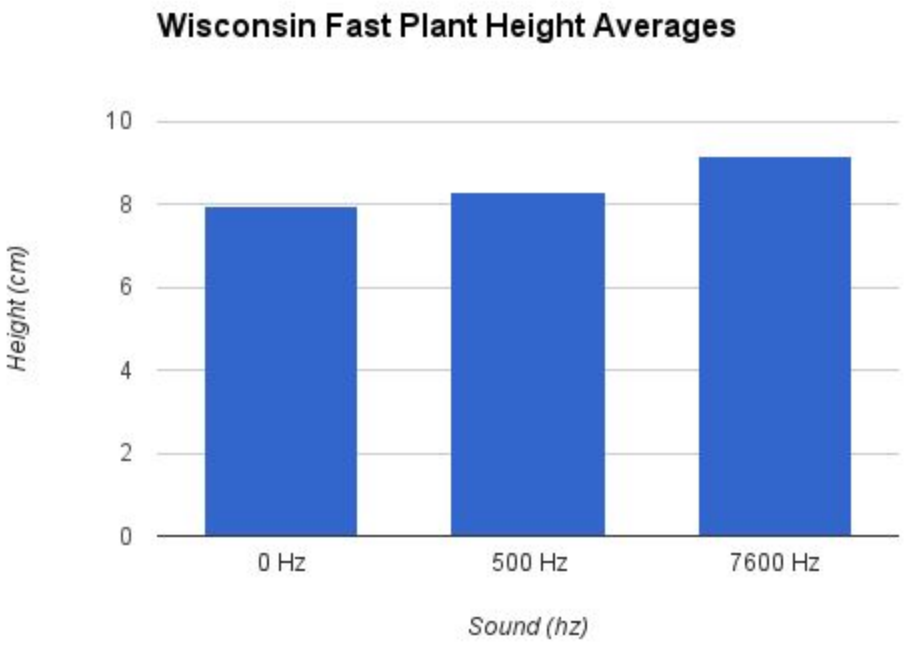

FIGURE 3: Graph of average height of Wisconsin Fast Plants.

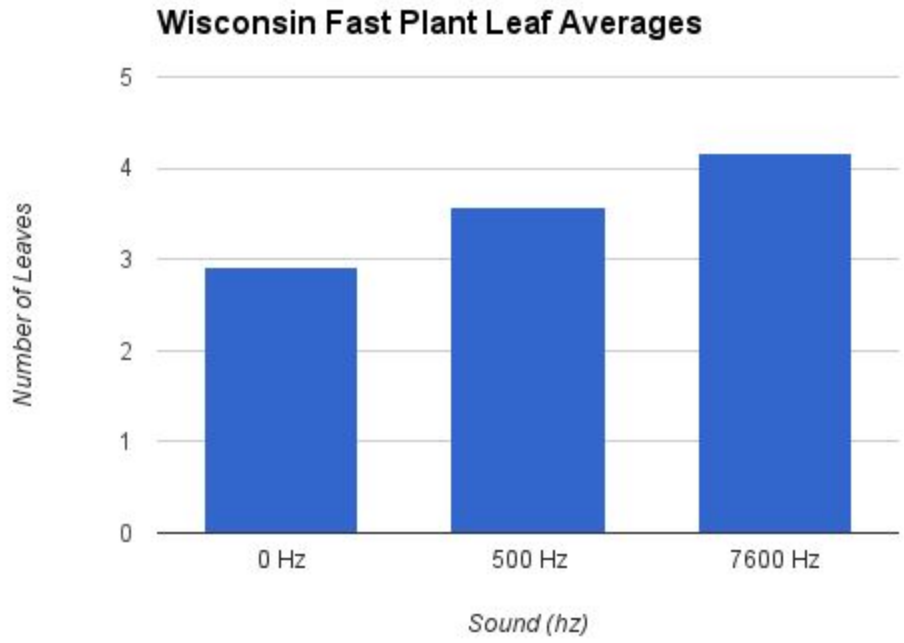

FIGURE 4: Graph of average number of leaves on Wisconsin Fast Plants.

All of the Data collected is quantitative data. The independent variable is the sound frequency each plant is receiving, and the dependent variable is the height of plants and number of leaves each plant has.

REFERENCES

Collins, Margaret E, and John E.K. Foreman. "The Effect of Sound on The Growth of Plants." *Canadian Acoustics*, vol. 29, no. 2, 2001, pp. 3–8. jcaa.caa-aca.ca/index.php/jcaa/article/download/1358/1100.
This is a research article on the effect of sound tones on the growth of bean plants.

"Wisconsin Fast Plants® Program." *Wisconsin Fast Plants® Program*, www.fastplants.org/.
This website contains information pertaining to Wisconsin Fast Plants and how to grow them.

"Effect of Music on Plant Growth." *HubPages Inc*, 29 August, 2016, https://dengarden.com/gardening/the-effect-of-music-on-plant-growth.
This article explains how different types of sound can cause different reactions in plants.

Hassanien, Reda He et al. "Advances in Effects of Sound Waves on Plants." *Journal of Integrative Agriculture*, vol. 13, no. 2, 2014, pp. 335–348, http://www.sciencedirect.com/science/article/pii/S209531191360492X.
This journal article explains the effect of tones on crops and concludes that they have had a significant effect on plant growth.

Vanol, Devendra and Vaidya, Rajiv. "Effect of types of sound (music and noise) and varying frequency on growth of guar or cluster bean (cyamopsis tetragonoloba) seed germination and growth of plants." *Quest*, vol. 2, no. 3, July 2014, http://aribas.edu.in/Quest/2014/Issue3/3.pdf.
This journal is an example of an experiment done by ARIBAS giving some data and explaining the effect of rock, classical, and traffic sounds on plants.