

Bubbly Soil: The Effect of Carbonated Water on Plant Development



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Introduction

Plants undergo the processes of photosynthesis and respiration throughout the entire plant. Leaves produce oxygen, which is utilized by mitochondrial cells for respiration. Respiration occurs in all parts of the plant, including the roots- which have a limited supply of oxygen. **Under natural conditions in soils, the oxygen supply to the roots is controlled by the oxygen diffusion through the soil (Geisler, p.1).** Oxygen concentration in soil is vital for the plant growth, and allows the root cells to respire, which creates the energy that the cells need to function. **Oxygen supply affects the division and elongation of the cells (Hitoshi Kojima, last page).** For the plant to grow, oxygen must be present in the soil.

How much does the presence of oxygen alter the plant's physical appearance? We know that waterlogged soil will drown the roots and kill the plants, but there is evidence that the plants will change according to this environmental pressure. **Many aquatic and bog plants are able to grow in waterlogged habitats even though the availability of oxygen in such habitats is low (Greenwood, p.1).** They do this by altering their root physiology. In this experiment, we deoxygenated the soil by watering the plant with carbonated water to observe the effect on the plant.

Research Question: How does adding excess carbon dioxide affect the plant's growth.

Hypothesis: if plants are grown in soil with increased carbon dioxide, then the plants will have less overall growth.

Methods

1. Two liters of carbonated or uncarbonated water were applied to their respective groups of radishes and grasses every two days.
2. Plants were allowed to germinate and grow for two weeks before treatment began.
3. Plants were placed in a room under a lamp for the entire experiment.
4. The water was poured into the tray of each group to allow water to be absorbed through the bottom of the pots in order to minimize the amount of carbon dioxide lost from the water to the air.
5. The stem height and the leaf count of each plant were recorded every week.
6. At the end of experiment, plants were uprooted and root length and biomass were recorded.

Figure 1: Week 3 of Effect of Bubbly Soil on Plant Height of Radish vs. Grass

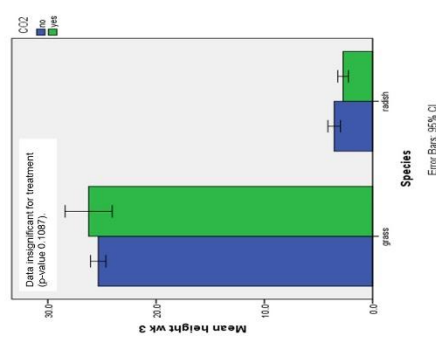
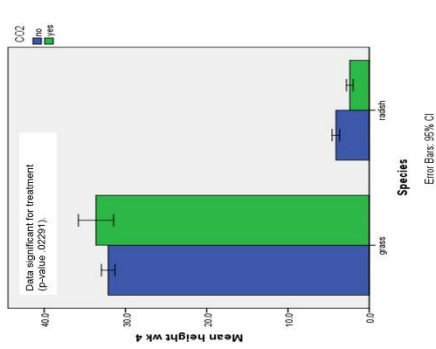


Figure 2: Week 4 of Effect of Bubbly Soil on Plant Height of Radish vs. Grass



Results

- Biomass average:
 - o Carbonated Radish- 17.72167 Carbonated Grass- 6.880444
 - o Uncarbonated radish- 15.61627 Uncarbonated Grass- 5.8755
 - o P-value- 0.06268 (Significant)
- Plant Height at Week 3:
 - o Carbonated Radish- 2.686667 Carbonated Grass- 26.27278
 - o Uncarbonated radish- 3.553333 Uncarbonated Grass- 25.35
 - o P-value- 1.087 (Insignificant)
- Plant Height at Week 4:
 - o Carbonated Radish- 2.394444 Carbonated Grass- 33.62222
 - o Uncarbonated radish- 4.106667 Uncarbonated Grass- 32.12222
 - o P-value- 0.2291 (Significant)
- Root Length average:
 - o Carbonated Radish- 27.57778 Carbonated Grass- 23.54444
 - o Uncarbonated radish- 26.64667 Uncarbonated Grass- 26.56667
 - o P-value- 5.006 (Insignificant)

Discussion and Conclusion

None of the results supported the hypothesis that carbonated water hinders plant growth; in fact, our results suggested that carbonated water promotes plant growth, especially in overall biomass and plant height. During week three of our experiment and after one week of treatment, no significant data was collected that would suggest carbonated water affected the height of the plant. This can possibly be dismissed by the fact that one week of treatment did not produce measurable differences in vertical growth of the radish or grass. During week four, after two weeks of treatment, correlation between treatment and plant height produced significant data suggesting that the presence of carbonated water did promote plant growth in both the radish and grass. During the experiment, radish height unexpectedly decreased. This was most likely caused by subsoil plant growth which may have created a "sinking" phenomena. Because both groups would have experienced the same phenomena, the week 4 radish height data should not be disregarded. After two weeks of treatment, root length and plant biomass were also measured. The correlation between root length and treatment was insignificant in nature. It is important to note that during the process of data collection many roots were damaged and may have affected the accuracy of both the radish and the grass.

We propose two possible explanations as to why carbonated water may have promoted plant growth. First is that carbonated water produced air pockets in the soil; thus, gaseous exchange within subsoil portions of the plant was enhanced. Increased levels of respiration would result in promoted plant growth. Second, a factor not taken into consideration during the design of the experiment was that added carbonation would notably decrease the pH of water (from 7 to about 5-6). Ideal pH for radish growth is slightly acidic; therefore, it is possible that carbonation provided a more ideal environment in which the carbonated group grew. In conclusion, it is evident that in order to determine the underlying reason(s) carbonation promoted overall plant size, more experiments are necessary.



Figure 4: Effect of Bubbly Soil on Rootlength of Radish vs. Grass

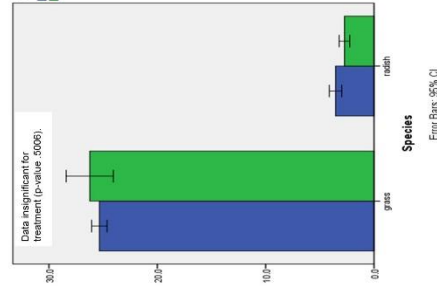
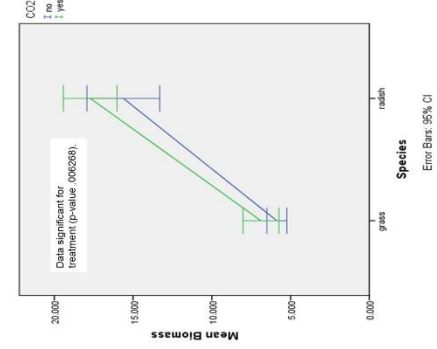


Figure 1: Effect of Bubbly Soil on Biomass of Radish vs. Grass



References

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