The Effects of Acid Rain on the Fast Plant Brassica Rapa

Author(s) Redacted

Introduction

This experiment was designed to discover whether or not acid rain stunts the growth of the fast plant brassica rappa. When pollution from various sources combines with moisture in the atmosphere, it falls back to earth as acid rain. Acid rain pollutes lakes, damages trees and wildlife, and washes nutrients out of the soil. Data collected from the early 1960's from New Hampshire's Hubbard Brook Experimental Forest showed that nearly half of the soil nutrients normally responsible for neutralizing acid had been leached from the soil, rendering vegetative growth nearly impossible. Acid rain is blamed for the death of more than half of the mature red spruce trees in the Adirondack and Green mountains, and is also fingered in the destruction of more than 80% of some sugar maple strands in Pennsylvania. Our experiment was designed to see if acid rain would have the same deadly effects on brassica rappa. To do this we squirted the soil with an acidic solution that would mimic that of acid rain once a week, and then documented plant height, number of leaves, and finally number of seed pods.

Methods and Materials

Four control groups, and four treatment groups of brassica rappa were planted in a Styrofoam planter which was divided into 32 even squares. Each group consisted of four plants planted in their own square. Each square was planted with fertilizer and a wick, in an alternating pattern to even out the effects of environmental factors. The planter was then set on top of a tupperware container, which had a slit in the side, through which an absorbent pad was placed. The pad ran from inside the container, which was filled with water, up along the cover of the container, and it was this pad that the planter sat on, so water traveled up the pad, through the wicks and into the soil of each plant. Of the four treatment groups, two were treated with a solution of HCL and water with a pH of 2, and two were treated with a solution of HCL and water with a pH of 5. These pHs covered the range that acid rain can fall in. Once a week a set amount of each solution, approximately 5 mLs was squirted with a dropper into the soil of the respective treatment groups. Once a week, starting one week after planting, for four weeks the height of the plants was measured in centimeters using a six inch ruler. Also once a week the number of leaves on each plant was counted, and on the last week the number of seed pods which had developed on each plant were also counted.

Results

Number of plants that died

ControlpH5pH2012

This chart shows how many plants from each experimental group died. The pH2 treatment group had the highest mortality, and the control group had the lowest

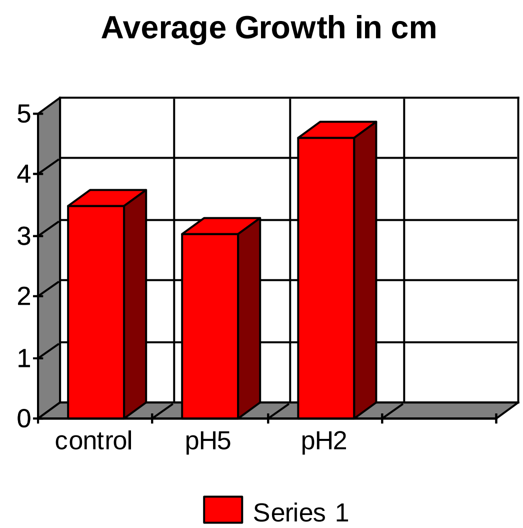
Table 1

Average number of seed pods that developed

ControlpH5pH2321

This chart shows the average number of seed pods which developed on the plants in each group. The control groups showed the highest quantity of seed pods, while the pH2 treatment group showed the lowest.

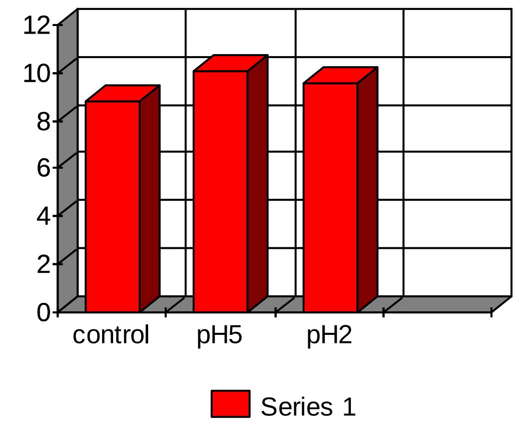
Table 2



This chart shows the average growth in centimeters that occurred between week 2 (we planted week one) and week 3. The group being treated with a pH2 solution had the highest average growth, while the pH5 treatment group had the lowest.

Figure 3

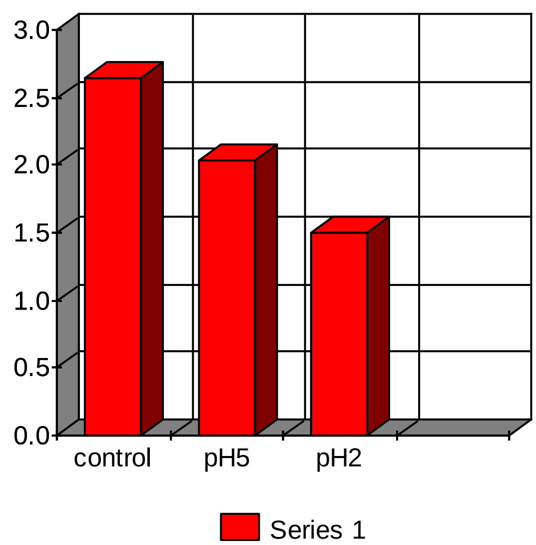
Average Growth in cm



This graph shows the average growth that occurred between week three and week four. The pH5 treatment group had the highest average growth and the control group had the lowest. The plants had the highest average growth between these two weeks. There was a big jump from the last week, and then a big dive the next week.

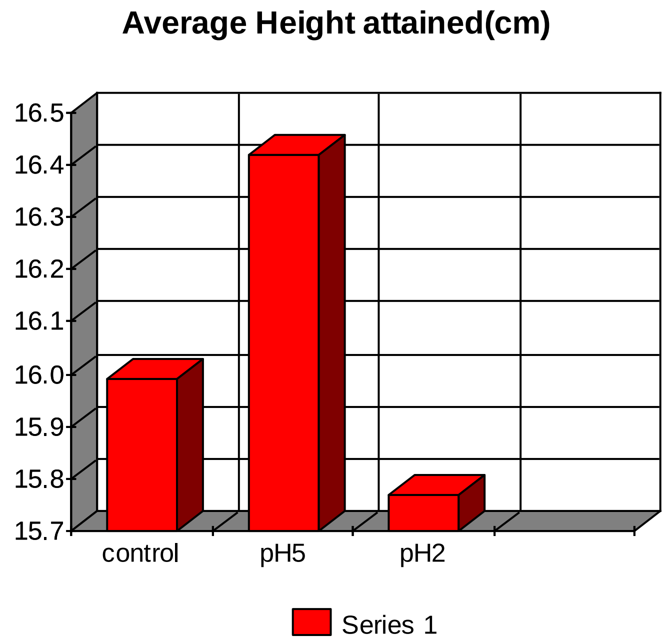
Figure 4

Average growth in cm



This graph shows the average growth that occurred between week four and week 5. During this week the control had the highest average growth, and the pH2 had the lowest. This was also the week during which the least amount of growth occurred.

Figure 5



This graph shows the final average height attained by the plants in each group. The pH5 treatment group had a 0.43 edge over the control group, and the pH2 treatment group showed the lowest average height.
Figure 6

Discussion

Our results were somewhat inconsistent. It seems that the acidic solution did negatively effect mortality rate (Table one), and seed development (table two). The control group showed a lower mortality rate and a higher quantity of seed pods. The pH2 treatment group showed the highest mortality rate, and the lowest seed development. This data is consistent with our hypothesis, that adding an acidic solution to the soil would impair development and growth.

However average growth rates were all over the place, each experimental group took a turn having the highest and the lowest amount of growth (figures 3, 4 and 5), and final plant heights (figure 6) are not consistent with our hypothesis, the pH5 treatment group showed the highest average height. The pH2 treatment group did attain the lowest average height which is consistent, but why did the pH 5 treatment group grow taller on average then our control group? It's possible that a pH of 5 was not acidic enough to do damage to the plants, and the extra water each week was actually beneficial to the plants. That could mean that the higher mortality rate in the pH5 group was caused by another factor, however many pains were taken to avoid the effects of outside factors such as extra light, or cold drafts, also the groups were staggered in the planter, so any outside factor would have affected all of them equally. Also there were only 2 pH5 groups and there were 4 control groups. With more plants it was more probable that the control group would have had a higher mortality rate if the acidic solution was not affecting the plants. So if the acidic solution was to blame for the higher mortality rate, perhaps this suggests that the acidic solution hinders germination, or early development, but if the plant can make it through early development, then the pH of 5 will have little effect on it.

However, almost all of our plants developed yellow spots on their leaves. Because this occurred equally among the control groups and treatment groups, it was probably due to a nutrient deficiency of some sort. It's possible that the acid, which damages plants by leaching nutrients out of the soil, made the deficiency worse, in the acidic plants, not enough to effect growth, but enough to prevent early development if the plant couldn't pull enough nutrients from the soil early on. Another thing that has to be considered is that all the plants' water systems were interconnected through their wicks, and the absorbent pad the planter sat on. The acid would have been inclined to diffuse down the wicks and onto the pad, where there was a lower concentration of HCL. Once the acid was on the pad, it had full access to all the other plants. This would mean that all the plants in the experiment were getting acid, which was leaching the nutrients out of their soil.

That would explain why all the plants showed signs of nutrient deficiency. Which would explain why the growth averages were not consistent with our hypothesis. Perhaps because the control groups had a much higher concentration of acid in their soil, they were more affected, and that is why they showed higher mortality rates, and lower seed development. Since the average height of the plants differed by only a small amount, it's possible that the acid had little effect on the plants height. Perhaps there were fewer seed pods in the acidic plants because they had fewer nutrients, and had use what they had towards growing taller, which enabled them to get more light.

So our experiment showed that acid does have a negative effect on plant development, but did not corroborate the drastic effects that have been found in other studies. That could be because most studies done on acid rain are done over a long period of time, and the overall effects of acid rain are not seen immediately. This would suggest that one plant may be able to survive the effects of acid rain, but a population will slowly fall victim to the long term effects of acid rain, especially if as our study showed, it effects seed development. I chose not to use the data concerning the number of leaves that developed on each plant because when looking back through my data I discovered that different members of the group had different opinions on what counted as leaves, and so our data is not correct.

Conclusion

To conclude the effects of acid rain were not as drastic in our experiment as we had predicted, however the signs of long term damage to a population were seen. Our experiment did not show significant effects on the growth of our plants. The average height of all three groups was very close, with the pH5 treated group coming out on top. This would indicate that acid does not have a significant effect on one plants' ability to survive. However the plants treated with acid did show increasing mortality rates, and decreasing seed development as the pH of the acid increased. This would be very damaging for a population in the long run, with fewer seeds and higher mortality rates, it is easy to see how a population would quickly die out, especially as over time, acid would up in the soil making the effects more and more drastic.

Works cited

Anonymous. August-September 2001. Hard Rain Keeps Falling (effects on environment of acid rain). National Wildlife (177 words)

Kevin Krajick. April 13, 2001. Long-term data Show Lingering Effects from Acid Rain. Science. 292:195