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| ***� Why Acid Rain Makes Plants Go Brrr�*** ��� Procedure |

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|  | * First, we obtained enough radish seeds (*Raphanus sativus L*.) to produce control and test groups of sufficient size.� We chose to use three groups consisting of fifty plants each to provide a sample size large enough to work with statistically.� Radish, a �winter-vegetable�, was chosen for its natural ability to survive and thrive in cold temperatures.� Seeds were purchased at Home Depot in Pleasanton, CA for less than two dollars. * The seeds were planted in clear, plastic cups filled with Scotts� Perlite, which is also available from Home Depot.� The perlite was only slightly compacted and the seeds were placed roughly one half inch deep, as per the seeding instructions found on the radish seed packages.� * We gave all plants the exact same treatment (water, sunlight, fertilizer, etc.) for exactly three weeks.� The plants were then mature and hardy enough to be tested, but still young enough that the roots were still growing.� Root growth was important during the testing period because soluble aluminum enters plants through the growing root system.� * The duration and intensity of sunlight was dictated by nature for our experiment.� The plants were all placed near the same window and dispersed evenly so an equal distribution of light was achieved throughout the experiment.� * The plants were watered at the same time on a daily basis to maintain a moisture level of six according to the combination moisture, light, and pH meter used throughout the experiment.� All watering took place beneath the plant�s leaves to avoid any confounding variables dealing with damage to the leaves or their waxy coating called the cuticle. * The plants were fertilized with Miracle Gro brand All Purpose Plant Food.� As per the instructions, the plants were watered every two weeks with 1 teaspoon of fertilizer mixed with a gallon of water.� This was necessary because the perlite used for potting is chemically inert and could not provide an adequate nutrient supply for the plants to thrive.� It was also desirable because it allowed us to control the amount of nutrients each plant received to assure it was equal.� * Once three weeks had passed, the 150 plants were separated randomly into three groups of 50 plants each.� This was done using a random number generator on a TI-83 calculator.� With three groups of identically treated plants, testing could now commence. * During the following two weeks, the control (blue) group experienced no change in its treatment.� The first test (red) group, however, was watered with a solution of pH 4.0 simulated acid rain.� This simulated acid rain was made by mixing one part 100 uM nitric acid (4.0 pH) and three parts 50 uM sulfuric acid (4.0 pH) with distilled water until the desired pH was reached.� This was the only change made in the treatment of the red group.� The second test (green) group was watered with the same solution of simulated acid rain as the red group as well as an additional solution of lime (CaCO3), obtained from UC Berkeley�s chemistry department with the assistance of Loi Do, in an attempt to buffer acidity of the perlite.� The lime was added in quantities equivalent to 80lbs/1000 square feet.� This was the rate indicated to raise a sand-like soil of pH 4.5 to pH 6.5, well within the safe range for plants (Pursell).� We determined each cup of perlite represented about a half of a square foot.� This meant that .04 lbs (roughly 18 grams) of lime had to be used for each plant.� This was the only change made to the treatment regimen of the green group.� Also, the volume of liquid with which each plant was watered remained equal throughout the experiment, with the exception of the additional lime solution used for the green group.� This is because any buffer solutions added to combat aluminum toxicity would be added in addition to natural precipitation.� * After two weeks of these new treatments, the plants were deemed ready to be tested.� The plants were placed for a half hour in a well-lit refrigerator and two hours in a well-lit freezer.� The temperatures in each were 40 degrees Fahrenheit and 20 degrees Fahrenheit, respectively.� The plants were placed in a cooler environment before being introduced to the freezing environment because temperatures do not drop 40 degrees Fahrenheit in a matter of seconds.� The change is much more gradual, so we endeavored to replicate this natural condition.� This gave the guard cells about as much time to close as they might have under natural conditions.� * After being removed from the freezer, the plants were monitored for a 48- hour period before being declared either dead or alive.� Immediately after these 48 hours, the root length of each plant was also recorded. * The last step was to analyze the data statistically in order to draw quantitative conclusions in addition to any obvious qualitative conclusions. |  |
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