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Craig D� Souza

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AP-Biology P3

Research Project

Introduction:

�������� Why did I choose to do an experiment measuring the effects of a magnetic field on plants� ability to photosynthesize ATP? Originally I did not intend to do this experiment; I planned to do a similar experiment to determine if high frequency radio waves, like the ones transmitted into space to deliver television shows across the world, had any effect on plants ability to produce ATP by photosynthesis. The reason I did not carryout this experiment was that I would need a license to broadcast a signal that would be powerful enough to have any effect on the plants that I would be testing. In addition, I was not able to obtain a transmitter that would be powerful enough to produce a radio wave that I would be able to use in my experiment. Also, I was not able to secure a location that would be far away from other peoples radio communications equipment, so my signal would not interfere with their communication, and that would be free from outside parties tampering with my experiment. So, after careful consideration I decided to scrap the radio wave experiment in favor of the experiment to grow plants in a magnetic field to see if there were any effects. There have been many studies on the effects of EMF�s on people as well as on animals yet there have been few on plats. In 1999 a group of scientists; **Lise I. Loberg, James R. Gauger, James L. Buthod, William R. Engdahl and David L. McCormick they examined the possible** relationship between exposure to power frequency **magnetic** fields (EMF) and breast cancer. I believe that there would be some sort of an affect of growing a plant in a magnetic field because plants make most of their ATP by the electron transport chain where oxygen is the final electron acceptor. Also, a magnetic field would affect ligand-gated ion channels by pulling or pushing charged ions across the plants� cell walls. Plants carry out photosynthesis in their leaves and in some cases their stems, so a good way to measure any difference in the ability of plants to produce ATP would be to measure the lengths of a plants stems, leaves, their color, and the number of leaves the plant has.

Hypothesis:

�������� I believe that a magnetic field will have some effect on the ability of Radishes to produce ATP by photosynthesis.

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�������� If a magnetic field has an effect on Radishes ability to produce ATP by photosynthesis then there will be some measurable difference in the plants stalk length, color, the length of, and the number of its leaves.

Experiment:

�������� Materials for electro magnet

1.     At least 500 ft of magnet wire (very thin copper wire that is made for the construction of electro magnets sold at radio shack the more wire the stronger the magnet will be)

2.    2 inch long solid soft iron rod (to be used as the core of the electro magnet there are other metals that are better than iron for magnets but they are harder to obtain)

3.    DC power supply ( an AC power supply will not generate a magnetic field)

4.    Wire cutters.

Procedure for making the electro magnet

1.     Use wire cutters and expose one end of the wire.

2.    Wrap the wire tightly around the soft iron core with the exposed end of the wire sticking out a little bit.

3.    Continue wrapping the wire over the core and cover it with many layers of wire.

4.    When you run out of wire tie off the loose end and use the wire cutters to expose the end of that wire.

5.    You should now have an iron core with multiple layers of copper wire around it and two ends of the wire exposed.

6.    Hook one end of the wire to the positive port of the power supply and the other end of the wire to the negative port.

7.    Start out with a low voltage and then increase to test the power of the electro magnet. Be careful not to put to much voltage and damage the electro magnet.

Materials for the experiment:

1.     A powerful magnet or electromagnet.

2.    Radish seeds.

3.    DC power supply (if using electro magnet)

4.    Potting soil that is thoroughly mixed.

5.    5ml eyedropper.

6.    30 pots

7.    camera

8.    ruler

Procedure:

1.     Mix the soil thoroughly and place some in each pot.

2.    In each pot place 3 Radish seeds.

3.    Place some more soil on top of the seeds

4.    Arrange the pots in a circular patter around the magnet in a well-lit place.

5.    First Place 6 pots equally spaced from each other around the magnet then 12 pots around the original 6 and then finally 12 pots around them.

6.    You should now have a circle of pots with the magnet as the center with a radius of 3 pots. The outer ring is the control and should just be out side the magnet's magnetic field, while the inner right should be well enveloped in the magnet's field. The middle ring should be halfway from the inner ring to the outer ring.

7.    Using the 5ml-eyedropper place 5ml of water in each pot daily.

8.    Use the camera to take a picture of the pots every 2 days.

9.    Repeat steps 7 and 8 until 23 days has passed.

10. Record each plats color stem length, leaf length, number of leaves and in which group it is in. The control, the intermediates, or the ones emerged it the field.

Conclusion:

�������� There is a measurable difference between the number of leaves in the control and the intermediate group. I preformed a double-sided z test to check if they�re where any differences between stem length, leaf length, and number or leaves. For the stem length I calculated a p-value of 0.617268, not significant at 1% significance level, which means if there was no difference between the control and the intermediate group we would expect to see results like we obtained in 61.72% of the samples we take if we sampled repeatedly. I took an SRS of 6 pots from each circle so that it would be random. For the number of leaves however I calculated a very small p-value of 1.17502E-9, which is very strong evidence at the 1-% significance level that there is a difference between the number of leaves in the intermediate and in the control. Finally for the length of the leaves I calculated a p-value of .005958 which is also significant at the 1-% level and is strong evidence of a difference between the control and the intermediate group.

�������� For the group that was the least distance from the magnet I calculated a p-value of .481455 which is strong evidence against a difference between the stem lengths of the control and the alpha group. However for the number of leaves I calculated a p-value of .000422 which is very strong evidence of a difference between the number of leaves in the control and in the alpha group. This shows that if there were no difference we would get the results we obtained in less than 1% of all samples if we sampled rapidly. This is very strong evidence showing that there is a difference.

When I compared the proportion of seeds that did not germinate in the control group to the intermediate group they were the same. However, when I compare the control group to the alpha group�s seeds that did not germinate I calculated a p-value of 0.023342, which is significant at the 5% significance level. This shows strong evidence that there is a difference between the two groups.

All tests were used with a sample size of 10 or greater and the data was gathered through a SRS of 6 pots in each level. I concluded that the magnetic field caused by the magnet did have effects on the lengths of leaves, and the number of leaves that the plant had. If I were to repeat my experiment I would use an electro magnet since it would be much more powerful than a regular magnet and I would be able to regulate the intensity of the magnetic field that it puts out.

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