Effects of Electric Fields on Plant Life

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Objective

To determine how electric fields affect the growth and yield of radishes.

Background

Some people believe that electric fields from power lines are increasing rates of cancer in those that live near them. It is hard to determine if power lines cause cancer in humans do to all the compounding factors involved (living near roads, living at different altitudes, etcetera). Some research involving animals has been done. These animals spent their whole lives in large electric fields with no negative consequences. However, almost no research has been done on how electric fields affect plant life.

Theory

The plants are set up along a 2.54m length. The wires are 22.86m long, so we can make a very good approximation for the electric field at each seed by assuming that the wire is actually an infinite line of charge.

$$E = \frac{\lambda}{2\pi r \varepsilon_0}$$

Electric fields diminish rapidly over long distance and grow quickly over short distances. Thus, keeping one group of plants near a wire with a current running through it will provide a sufficiently powerful electric field.

Hypothesis

If electric fields do not cause cancer or other health anomalies, and an electric field is generated near growing radishes, than there should be no significant difference in the yield rate between those radishes and radishes that lived with almost no electric field.

Materials

- 50W light bulbs (4)
- 16 gauge wire (22.86m)
- Water
- Radish seeds (100)
- Soil
- Pots

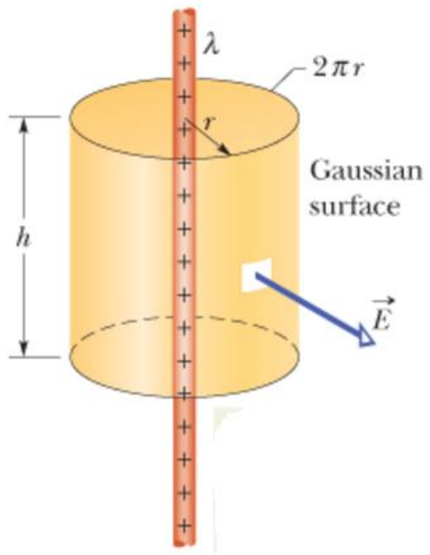
Procedure

1. 50 radishes are placed 1.27cm deep in soil, 5.08cm apart in rows in one set of containers.
2. The 16 gauge wire is laid out in a line parallel to the row of radishes, approximately 12.7cm away from the seeds. These wires connect to two 50W light bulbs suspended 91cm above the radishes.
3. A separate set of 50 radishes are grown in an identical setup without the wires near them. This functions as the control group.
4. 3 cups of water are evenly distributed to each row of radishes every day.
5. The 50W lights are shined for 10 hours a day for two weeks.
6. The yield of each group of radishes is compared.

Results

The control group yielded 37 out of 50 radishes. The group exposed to the electric field yielded 34 out of 50 radishes.

$$\left|\frac{37-34}{37}\right| = 8.1\%$$



$$\lambda = \frac{q}{m} = \frac{8.33C}{22.86m} = 0.365C/m$$

$$r = 0.05m$$

$$E = \frac{0.365C/m}{2\pi(0.05m)(8.855 * 10^{-12})}$$

$$E = 1.31 * 10^{11} V/C$$

Analysis and Observations

- The radishes with the wires seemed to dry out more quickly and took longer to grow (these radishes emerged from days 9-10, while the other radishes emerged from days 6-8)
- The radishes grew to similar heights and had a less than 10% difference in yield.

Sources of Error

- This experiment could only determine weather more radishes died as a result of the electric field. More subtle interactions between the radishes and the electric field as well as the overall health of the radishes could not be measured.
- Ambient light and heat from the environment could have affected the growth rates of the radishes.
- This experiment was limited to environments where a total electric flux of zero could not be achieved due to wiring in the walls.
- With the wires so close to the seeds, heat radiating off of the wires might have affected the results of the experiment.
- Given that only 74% of the control group survived, it is safe to assume that growing conditions were not perfect to begin with.

Conclusion

The electric field had no significant affect on the radishes that were grown near it. However, this experiment could only measure extreme interactions between the field and the radishes. Other information about general health of the radishes could not be determined from a glance. Still, there is no reliable evidence that the radishes were harmed in any way. For future experimentation, one can use more intense electric fields and grow more radishes to see if the effect is in any way more pronounced. Or, one can compare the effects of different magnitudes of electric fields.