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|  |  | In 1748, a French scientist by the name of L’Abbe Nollet discovered that plants placed under charged electrodes grew faster than those not exposed. Later, in 1775, Father Giam Battista Baccaria wrote "It appears manifest that nature makes extensive use of atmospheric electricity for promoting vegetation...and we have also observed that artificial electricity has the same effect" [3].  In 1979, John W. Baum determined the possible mutagenic effects of stationary fields ranging in strength from 20 to 37000 gauss (G) on the plant *Tradescantia*. These fields could influence the development of germ cells and could produce alterations, leading ultimately to carcinogenesis. After exposing *Tradescantia* to 8 hours of 200-G magnetic field, a mutation increase of 8.0 x 10-5 % was estimated.  Later, in 1989, Dr. Krizag et al. of Yugoslavia tested the effect of 50 Hz magnetic fields of different field strengths on the plant *Lepidium sativum*. The magnetic field was measured with a magnetic induction coil probe. Tests were run for a period of four days by growing plants in an agar solution, after which the roots and shoots were measured. Overall, the roots were most affected by the magnetic field. He concluded that since auxins regulate shoot and root growth, the field might have changed the concentrations of the enzyme, thus altering growth. However, this experiment did not take into consideration the thermal effects of the heat created by the current in the wire.  ***Table 2: Results of Krizag et al.***   |  |  |  |  | | --- | --- | --- | --- | | Temperature (� C) | Magnetic Field (mT) | Root Length (% Control) | Shoot Length (% Control) | | + 2 | 6 | 86.5 � 1.4 | 96.2 � 1.2 | | + 4.5 | 12 | 87.0 � 0.8 | 106.5 � 0.7 | | + 12 | 18 | 58.2 � 0.3 | 89.9 � 0.5 |   Stephen Smith has conducted numerous experiments on the effects of ELF EMFs on plants. In 1984, he experimented with root cuttings from four different plant species—*Impatiens sultani*, *Begonia*, *Forsythia*, and *Ilex japonica nana*—using magnetic fields similar to those used in bone healing. Except for root stimulating powder, no fertilizers or chemicals were used. Two-40 watt bulbs providing a light intensity of 1700-lux were set for a 12-hour on-off cycle. Magnetic field of approximately 2 G of magnetic flux, peaking at approximately 20-G was created by a series of coils.  The field produced marginally significant alterations in number of roots formed in two of the four species. *Forsythia* and *Begonia* cuttings developed about twice as many roots in the experimental compared to the control. *Ilex japonica nana* showed a 28% suppression of root formation, while *Impatiens sultani* seemed unaffected. Every species demonstrated decreased root elongation in the field. The average decrease was 21.2% with a high of 39.8% in *Forsythia* and a low of 14.9% for *Impatiens sultani*.  Smith’s findings showed that magnetic fields had a minor effect on root initiation. To explain the increase of root numbers and the decrease of root length, the most obvious suggestion would be that root initiation and root length are controlled by entirely separate systems. This can be corroborated because elongation depends on cell enlargement as well as cell proliferation (or reproduction) while initiation depends on differentiation.  Later, in 1991, Smith expanded his investigation by experimenting this time with the effect of a 60-Hz ELF magnetic field on *Raphanus sativus*, the common garden radish. His main intent in using this plant was to make his experiment "reproducible by anyone" [4]. The magnetic field was allowed to run 24 hours a day for 21 days. Two separate controls were used, one in which the earth’s static DC magnetic field was canceled and another in which the field was allowed to come into play. Two experimental setups, both with AC induced magnetic fields, were also used: one with a calcium-tuned field and the other with a potassium-tuned field. On Day 10, water was replaced by a fertilizer solution, which may have had an influence on the results because another variable was added. Also, Smith’s small sample size of 5 per test run may have caused too much variation.  The experiment tested the premise that the interaction of weak AC in static electric fields can couple to physiologically significant ions, such as potassium and calcium. This is called the physical process of ion cyclotron resonance. Smith hypothesized that: "The ion is assisted in its passage through the membrane channel when the energetic conditions are appropriately configured to make the envelope of ion travel fit the channel dimensions exactly" [4]. Smith found that plants subjected to calcium tuned radiation were slower to generate, but grew more rapidly and were finally larger than the controls. Plants subjected to potassium tuned radiation sprouted earlier, but eventually were inhibited in growth.  Recently, in 1996, a researcher by the name of Mark Davies from the United Kingdom, in an attempt to verify Smith’s findings, tested the effect of 50-Hz ELF electromagnetic radiation on barley (*Hordeum vulgare*), radish (*Raphanus sativus)*, and mustard plants (*Sinapsis alba*). Unlike Smith, however, Davies did not use fertilizer at any time in the experiment, thus ensuring more stability. Possible errors in his experiments lay in his lack of sham setups for certain controls, as only the radishes had shams. Another oversight is that mustards were exposed to ELF EMFs for only nine days, whereas the setups for barley and radish ran for 21 days.  In radishes and barley EMF plants, wet root weight, dry leaf weight, dry whole weight, and stem diameters were significantly greater than control setups. As Davies notes, the mustard plants "failed to respond to EMFs" [5]. Possibly, nine days were too short of an experimental period to find physical differences caused by EMFs.  Davies concluded that his experiments did not significantly justify Smith’s conclusions, commenting that "It is rare that a bioelectromagnetic phenomenon is successfully redemonstrated…Whatever the effects [of ELF EMFs on plants,] the underlying mechanism remains obscure" [5]. Furthermore, he noted a major difficulty encountered when conducting the experiment: although plants did provide a cheap and manageable source of experimentation, their experimental period was far too long to merit repeatability. As he mentions,  A 9 to 21 day experimental period limited the number of experiments that could be performed to make up this study, and careful choices had to be made to determine which experiments to perform and which not to perform. A long experimental period also introduces additional factors of seasonality and temperature into the experiments resulting in great interexperiment variability. [5] |