ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 6, Issue 4, pp: (59-64), Month: October - December 2018, Available at: www.researchpublish.com

The Effect of Various Electrical Fields on Seed Germination and Growth Rate of *Vigna radiate*

[1]Urvi Gupta, [2]Dharamsinh Ninama, [3]Abhishek Pandya

[1]Assistant professor (Botany), Indian Institute of Teacher Education, Gandhinagar, Gujarat, India
[2,3]M.SC. Student, Indian Institute of Teacher Education, Gandhinagar, Gujarat, India

***Abstract*: The electroculture has emerged as one of the important tool to increase plant growth without using any chemical. Present study was also carried out to evaluate the impact of electric current of different volts (i.e. 1V, 2V, 3V and 4V) on germination and growth of *Vigna radiata.* Enhanced germination rate, biomass and chlorophyll concentration was recorded among the treated plants in comparison of controlled one. Out of all given treatments, plants treated with 3V and 4V showed the best results.**

***Keywords:* Electroculture, *Vigna radiate,* Chlorophyll, Biomass, Voltage.**

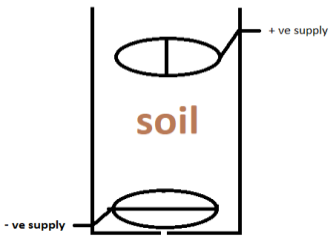
I. INTRODUCTION

Electroculture refers to a group of electricity and magnetism involving techniques used to improve plant quality. Several experiments proved it as an important tool to enhance plant growth, quality and production. It is not harmful for human being as chemical fertilizer and pesticides do. The concept initiated in 1746 when Dr. Maimbray treated myrtle plant with the output of an electrostatic generator and noticed enhanced growth and early flowering [1]. Smigel and coworkers [2] observed that electric fields with high voltage have significant effects on potato before cultivation. Costanzo [3] stated that the electrical and magnetic fields can be used in scientific agriculture as a non-chemical method. Present experiment was performed to determine the effect of electric fields on germination and growth of *Vigna radiata* L. As treatment, DC current with different voltage viz 1V, 2V, 3V and 4V were used to treat seeds and plant with a set of controlled condition i.e. without any current.

II. METHODOLOGY

For the experiment, certified seeds of *Vigna radiata* L. (Mung bean) were sown in plastic container designed to provide electric current in soil and seeds prepared with 2 copper wire loops to connect positive and negative supply (Figure 1). In same manner 15 plastic containers have been prepared and set of 3-3 container was connected through parallel connection to make one field (Figure 2). Total 5 fields each consists of 3 containers have been prepared. One field was kept as controlled i.e. without any treatment and others were treated with different voltage viz. 3V (field 1), 6V (Field 2), 9V (Filed 3) and 12V (Filed 4). Treatments were started after seed sowing in each container. As the field comprised of 3 containers, each container of 3V field received 1V, 6V field received 2V, 9V field received 3V and 12v field received 4V. 4 seeds were sown in each container and DC current supply of different voltage was given for 5 minutes twice a day at the interval of 4 hour by using digital DC converter (Figure 3). All fields have been placed and designed in such a way that all plant can get optimum sunlight, air and appropriate amount of water. Various parameters i.e. Seed germination percentage, number of leaves, fresh weight, dry weight and chlorophyll content were estimated to evaluate the impact of electric current on the growth of plant. Chlorophyll a, b and total chlorophyll have been quantified by using the protocol given by Arnon [4].

ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 6, Issue 4, pp: (59-64), Month: October - December 2018, Available at: www.researchpublish.com



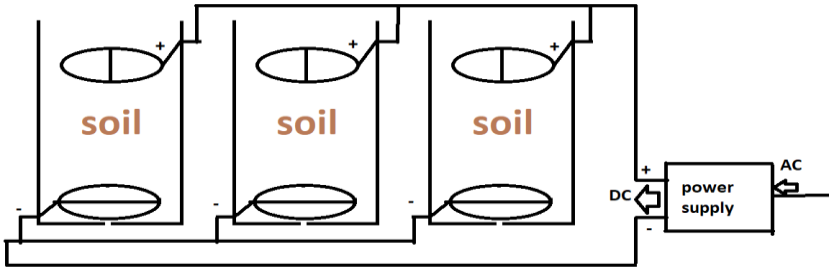


Figure 1: Copper wire loop arrangement in a plastic container **Figure 2: parallel circuit in plastic container**

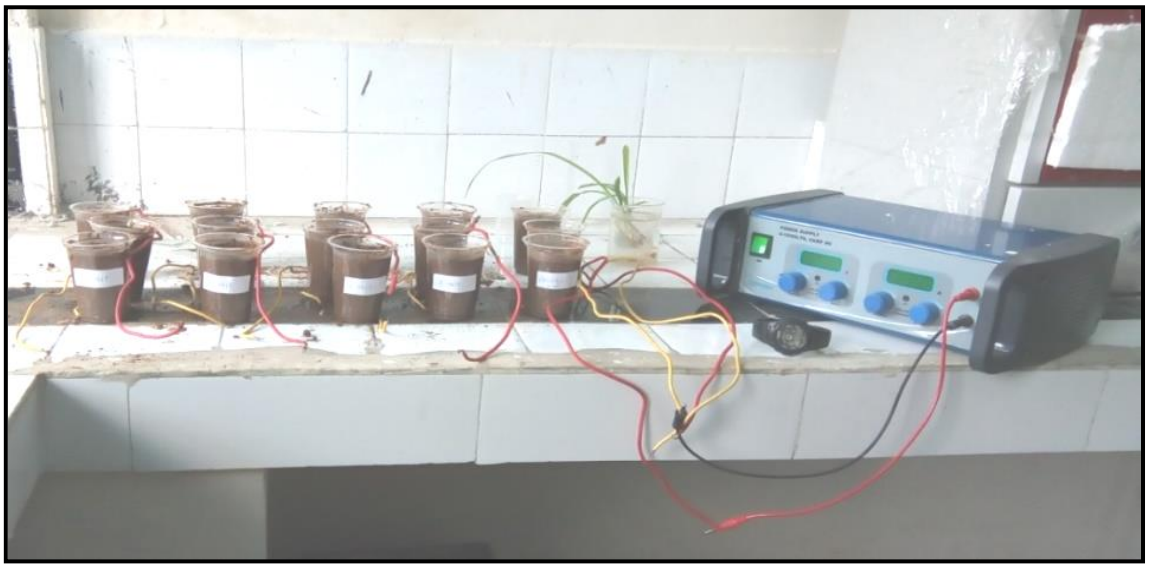
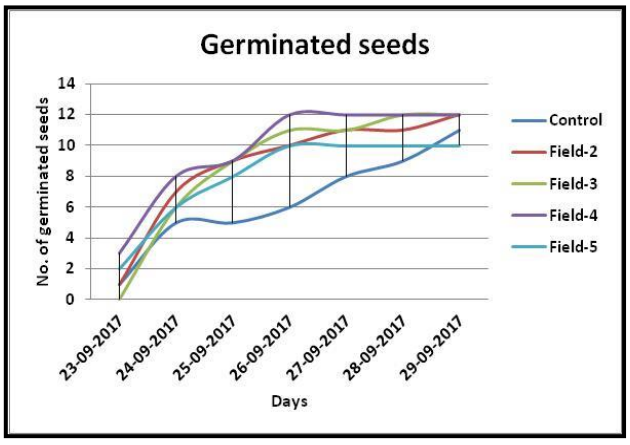


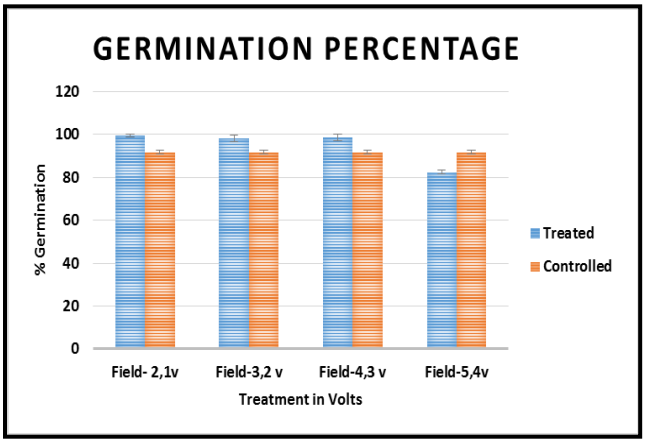
Figure 3: various field with DC converter

III. RESULTS

A. Seed germination rate and percentage:

Experiment set up comprised 12 seeds in each field i.e. total 60 seeds in whole set up. Among all fields, seeds from 4th field were reported with early germination i.e. within 6 days all seeds were germinated. Seeds sown in controlled field took 9 days to germinate. All treated plants were germinated early in comparison to controlled plants.



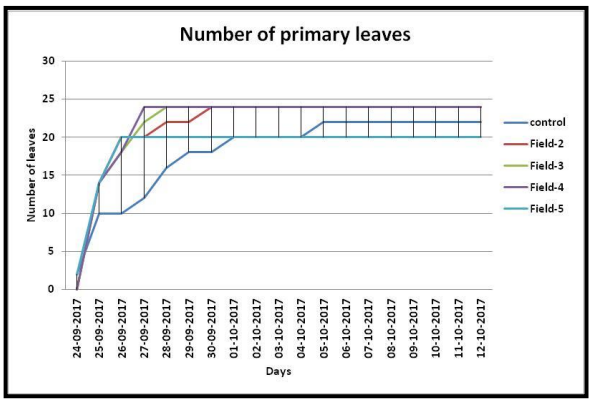


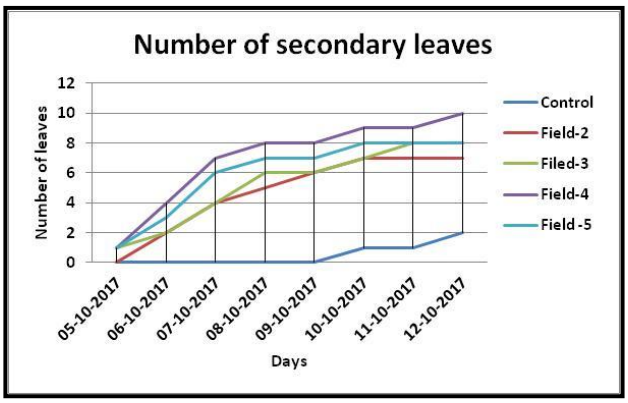
Graph 1: Germination of Seeds **Graph 2: Percent seed germination**

ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 6, Issue 4, pp: (59-64), Month: October - December 2018, Available at: www.researchpublish.com

Fields treated with 1V, 2V and 3V (i.e. 2nd, 3rd and 4th field) showed 99.33%, 98.32% and 98.66% seed germination respectively. 91.66% seeds were germinated in controlled field. Least germination was observed in 5th field i.e. 82.44%. Although it was less than the controlled field but the germination duration was shorter than controlled field.

B. Number of leaves and their development rate:





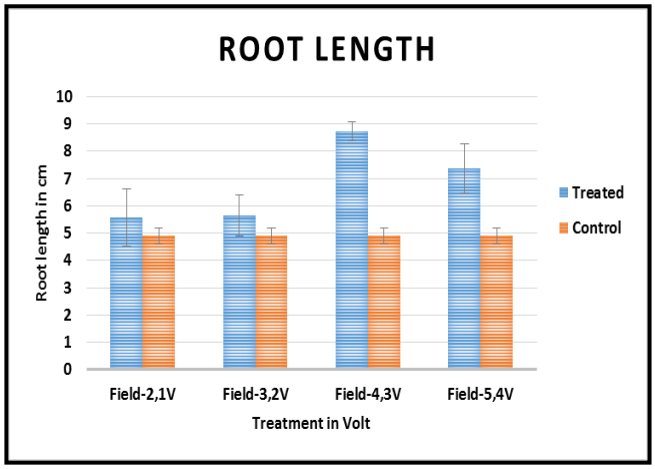
Graph 3: Number of Primary Leaves **Graph 4: Number of Secondary Leaves**

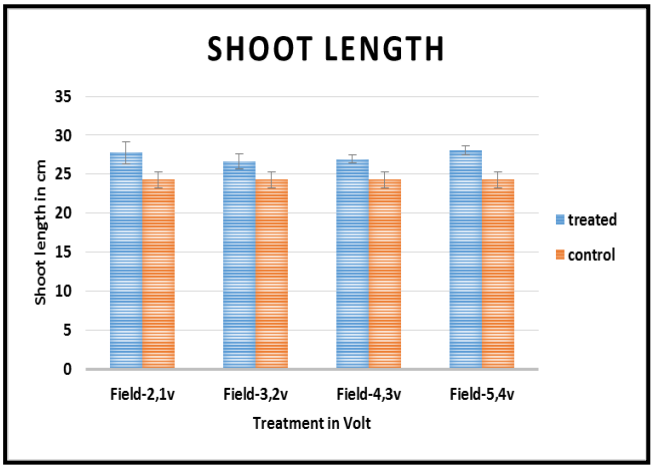
Primary leaves in 4th field i.e. treated with 3V developed within 6days whereas controlled plants took 15 days to develop primary leaves. Other treated plants, developed primary leaves in 9 days. This shows the positive impact of electricity on the plant growth.

Plants of controlled field showed poor development and less number of secondary leaves in comparison of treated one i.e. only 2 plants have been reported with secondary leaves. Among treated plants, 10 plants, 8 plants and 7 plants were observed with secondary leaves in 4th, 5th and 3rd, 2nd field respectively. Present result indicated that 3V was the best treatment for the development of secondary leaves.

C. Root Length and shoot length:

Maximum root length was observed in plants of 4th field (treated with 3V) i.e. 8.73cm. 5th field, treated with 4V also observed plants with root length of 7.36cm. Minimum root length was observed in controlled field i.e. 4.9 cm. 2nd and 3rd fields reported to have plants with 5.56 cm and 5.63 cm root length respectively. Average root length found to be increased with the amount of volt till the 3 volt after that decreased.





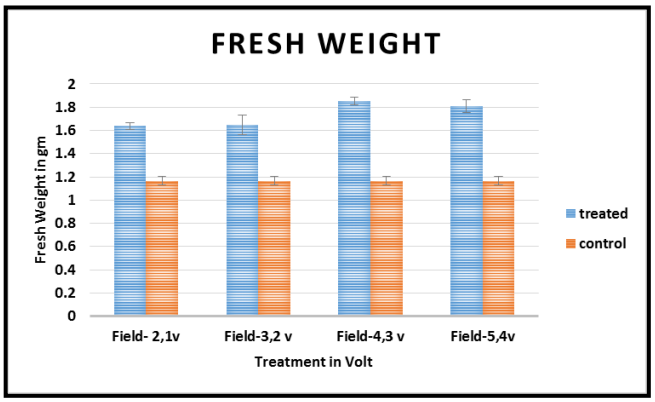
Graph – 5: Average Root length **Graph 6: Average shoot length**

Plants treated with 4V (5th Field) were reported to have maximum shoot length i.e. 28.1 cm. 2nd, 3rd and 4th field plants shared almost similar shoot lengths i.e. 27.76 cm, 26.60 cm, 26.93 cm respectively. Plants from controlled field showed 24.33 cm shoot length which was less than the treated field.

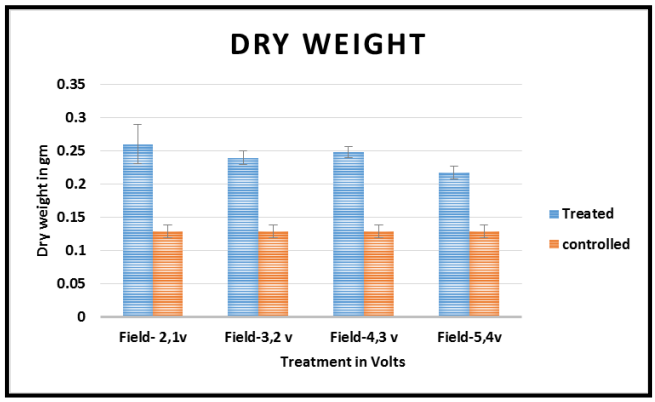
ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 6, Issue 4, pp: (59-64), Month: October - December 2018, Available at: www.researchpublish.com

D. Fresh weight and Dry weight:

Results indicated that all treated plants have higher fresh weight than the controlled plants. 1.85gm was the highest reported fresh weight from 4th field (3V). 1.81gm fresh weight was reported from 5th field (4V) whereas plants from 2nd and 3rd field were observed with 1.636gm and 1.646 gm respectively. The plants kept under controlled condition were reported to have least fresh weight i.e. 1.16 gm. Fresh weight is dependent on the water content in plant tissue, so it can be said that plants treated with 3-4V absorbed more water than the other treated and controlled plants.



Graph 7: Fresh weight

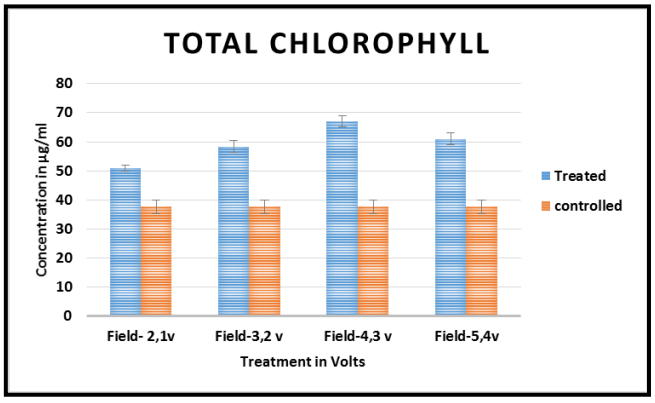


Graph 8: Dry weight

Dry weight of plants is almost same in every treated fields [2nd, 3rd, 4th, 5th] around 0.2 gm, but in 2nd field it was maximum 0.26gm, which was 2 times higher than the controlled field. Dry weight of controlled field was 0.12gm. It may possible treatment of electricity enhanced the fixation of carbohydrates and absorption of nutrients.

E. Chlorophyll estimation

(i) Total Chlorophyll



Graph 9: Total Chlorophyll

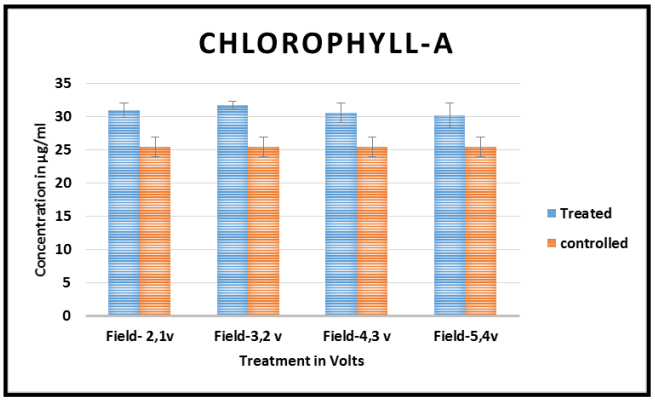
Total amount of chlorophyll was maximum found in 4th field's plants i.e. 67.08 ug/ml, which were treated with 3 volt and controlled has very less amount chlorophyll only 37.569 ug/ml. Total chlorophyll in 2nd, 3rd and 4th was 50.839 ug/ml, 58.279ug/ml and 60.971 ug/ml respectively.

(ii) Chlorophyll –a and Chlorophyll – b

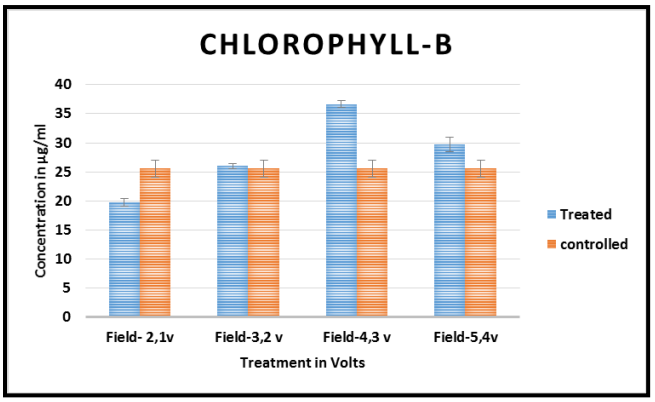
The concentration of chlorophyll a in controlled plants was 25.482 ug/ml, which was much lower than the treated plants. All treated plants showed high chlorophyll content i.e. near about 30 ug/ml. Maximum reported content was 31.787 ug/ml in 3rd field. Plants from 2nd, 4th and 5th field were recorded with 30.96 ug/ml, 30.59 ug/ml and 30.19 ug/ml respectively.

Chlorophyll- b is increased with the amount of voltage till the 4th field after that it's decreased in 5th field. Concentration of chlorophyll b in 2nd to 5th field is 19.762 ug/ml, 25.976 ug/ml, 36.621 ug/ml and 29.728 ug/ml respectively. In controlled plant, the chlorophyll b concentration was 25.552 ug/ml and field 2 was reported with minimum chlorophyll b concentration.

ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 6, Issue 4, pp: (59-64), Month: October - December 2018, Available at: www.researchpublish.com



Graph 10: Chlorophyll – a



Graph 11: Chlorophyll -b

IV. DISCUSSION

In present experiment, rapid seed germination of treated plants than the controlled one indicated that electricity may play important role in speedy enzyme secretion and increased rate of food mobilization. It may also involve in breaking down the seed dormancy as treated seeds were recorded with high germination rate. Several other researches are also supporting this finding by pointing towards the role of electricity in seed germination. Lynikiene and co-workers [5] studied the electricity impact on seed germination of carrot, garden radish, beet, and barely and reported higher rate of germination in treated seeds. Similar observations were made by Pozeliene [6] and Podlesny [7] on cotton and cucumber seeds respectively. This may be the outcome of the influence of the electric field on plant metabolism by effecting on the electron transport chain and the dark and light reactions of photosynthesis in leaves [8] [9].

Present results also showed the impact of electrical field on plant biomass as treated plants was reported with early growth and higher number of primary and secondary leaves; increased root and shoot length, fresh and dried weight. Overall treated plants were found with higher biomass which is supported by findings of Luben *et al.* [10], who noticed increased biomass of oak seedlings due to the electric treatment. Ozel [11] studied the effects of high voltage electric field on the yield and yield components of different cultivars of bread wheat. Mustafayeve [12] proved the effect of high voltage electric field on the precocity of cotton cultivars.

Higher content of total chlorophyll, chlorophyll a and b among treated plants have also been found in present study. Higher chlorophyll content helps in increased carbohydrate production and that can result in the higher biomass of the plants.

A number of researches have been performed to understand the influence mechanism of electricity on plants. Results indicated that the electricity is influencing the ion mobility in soil as well as in plants. It also affects the permeability of plasma membrane results into increased ion transport. These increased and easy transports of ions affect many physiological and biochemical functioning of plant including food mobility, proteins and enzyme synthesis which ultimately leads to increased seed vigour and biomass [13] [14] [15] [16] [9] [3] [17].

V. CONCLUSION

From the study it has been concluded that the 3-4 voltage is the best suitable amount of DC for the growth of vigna radiata plant. All treated plants showed better results than the controlled one so it can also be concluded that electric treatment is increasing the plant growth. Although it is possible only for the plants grown in greenhouse, so the open field treatment is still questionable.

REFERENCES

[1] E. Solly, “The influence of electricity on vegetation”, J. Horticultural Soc, vol. 1, pp. 81-109, 1845.

[2] V. N. Smigel, A. F. Kovalenko, and G. S. Babitsin, “Shocking of potato before planting with high voltage electrical current”, Journal of Mechanization and Electrification Research Institute of Celyabinsk, vol. 31, pp. 76-82, 1968.

[3] E. Costanzo, “The influence of an electric field on the growth of soy seedlings”, Electrostatics, vol. 66, pp. 417–420, 2008.

[4] D. Arnon, "Copper enzymes isolated chloroplasts, polyphenoloxidase in *Beta vulgaris",* Plant Physiology, vol. 24, pp. 1-15, 1949.

[5] S. Lynikiene, A. Pozeliene and G. Rutkauskas, "Influence of corona discharge field on seed viability and dynamics ofGermination", Institute of Agricultural Engineering, Lithuanian Agricultural University, Raudondvaris, Kaunor.L.T.54132, Lithuania, 2006.

[6] A. Pozeliene, "Influence of electric field on the quality of flax seed", Agricultural of Engineering International: The CIGR Journal of Scientific Research and Development, pp. 1-6, 2000.

[7] J. Podlesny, W. Lenartowicz, and M. Sowinski, "The effect of pre-sowing treatment of seeds magnetic biostimulation on Morphological feature formation and white lupine yielding (in polish)", Zecz.Probl.Post. NaukRoln, vol. 495, pp. 399-406, 2003.

[8] C. H. Bachman and M. Reichmanis, "Some effects of high electrical fields on barley growth", Intern. J. Biometeorology, vol. 17, pp. 253-262, 1973.

[9] C. Celestino, M. L. Picazo, M. Toribio, "Influence of chronic exposure to an electromagnetic field to germination and early growth of Quercussuber seeds: preliminary study", Electro-Magnetobiol, vol. 19, pp. 115-120, 2000.

[10] R. A. Luben, C. D. Cain, MC-Y. Chen, D. M. Rosen, Adey, "Effects of electromagnetic stimuli on bone and bone cells In vitro: Inhibition of responses to parathyroid hormone by low-energy low-frequency fields", ProcNatlAcadSci, USA, vol. 79, pp. 4180—4184, 2000.

[11] B. Ozel, "High voltage electrical current on the yield and yield components of different bread wheat cultivars". M.Sc. Thesis, University of Kahramanmaras Sutcu Imam, Institute of Natural and Applied Sciences, Department of Field Crops, Turkey, 2003.

[12] S. A. Mustafayev, "Using of high voltage electrical current on obtaining early maturing cotton cultivars", Proceedings of the Conference of USSR on Science and Social Sciences, (CSSS'74), Baku, Azerbaijan, pp. 150-153, 1974.

[13] Y. Jia-Ming, "Effects of high-voltage electrostatic field on growth in plants". Proceedings of International Conference On Modern Electrostatics, Beijing, China, pp. 140-143, 1988.

[14] M. M. Labes, "A possible explanation forthe effect of magnetic fields on biological systems", Nature, pp. 211: 969, 1993.

[15] A. F. Putincev and N. A. Platonova, "Treatment of seed in electromagnetic field (in Russian)", Agriculture, vol. 4, pp. 45, 1997.

[16] R. Morar, R. Munteanu, E. Simion and I. Munteanu, "Electrostatic treatment of bean seeds", IEEE-IA, vol. 35, no. 1, pp. 208-212, 1999.

[17] L. Stefa and A. Pozeliene (2003): Effect of Electrical Field on Barley Seed Germination Stimulation. Agricultural Engineering International 2: 3-7.