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EFFECT OF DC AND AC ELECTRIC FIELDS, GENERATED BY THE SPECIAL ARRAY OF EMBEDDED ELECTRODES, ON GERMINATION OF SOIL IMPLANTED BARLEY SEEDS

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Effect of low voltage DC and AC electric fields on germination of soil implanted Barley seeds has been presented for the first time. The placement of Barely seeds was in between the special array of two electrodes that consisted of a circular base plate, and a firmly held hanging loop electrode (horizontally-parallel, placed about 2 cm vartical-distance from the base plate electrode). The loop shaped electrode was used to minimize the hindrance to the upward movement of the germinating stems. A parallel experiment with no electric field was also carried out. An almost quenched germination in DC, and considerably reduced germination in AC electric field were found to occur, in comparision to no elecrtric field. The quenched germination, in DC field, might be due to unidirectional ion-migration. Less germination in AC electric field might be due to oscillation of ions which makes ions or nutrient less accessible to the seed. The present findings are entirely different from the influence of high intensity external electric field as reported earlier, and may setup a mile stone in the field of study.

Keywords : DC and AC Electric-field effect; Germination; Soil implanted Barley seeds; Special array of electrode.

Introduction

There have been upsurge of investigations concerning effect of magnetic and electrical fields on biological systems and human beings[1-6]. Electric and magnetic treatments are assumed to enhance seed vigour by inducing the biochemical processes that involve free radical and by stimulating the activity of proteins and enzymes[7-9]. There has been considerable research involving effect of high intensity electric fields on plant growth, but most of those works involve the influence of external electric fields[10-12]. Survey of literature revealed that there was no report that involves effect of electric fields due to embedded electrodes on soil implanted seeds. In this communication, effect of low voltage DC and AC (50 Hz) electric fields on soil implanted Barley seeds has been reported. For the study, special array of electrode was used, and the electric field intensity (voltage) has been kept very low in contrast to previously reported studies.

Experimental

Special array of electrodes - During the present investigation a special array of electrodes was designed in such a way that hindrance to the upward movement of germinating stems get minimized. The special array of electrodes consisted of one circular base plate electrode and a horizontally placed, firmly held, loop shaped electrode. The circular base electrode was of iron and the loop electrode was made up of about 2 mm thick aluminium wire.

Material

100 seeds were randomly selected from a bulk of Barley seeds.

Experimental setup -The low voltage AC (50Hz) and DC electric fields were generated from the same power supply source, using a 12V step down transformer. The DC voltage was produced from the AC voltage using a bridge rectifier and shunt capacitor (1000μF) filter circuit. The 12V AC (50Hz) and its corresponding DC voltages were applied to the respective special array of electrodes (as per the procedure). A schematic representation of the setup is given in Fig. 1.

Procedure :- 45 Barely seeds with apparently same appearance were randomly selected from 100 seeds. For conditioning, the garden soil was kept, moistened and properly aerated for 5 days. The two circular plate electrodes (one for AC and DC each) were connected with the electric supply source (switched off) and placed at the bottom of two circular plastic boxes. Some amount of soil was added to cover the electrodes up to about 1 cm height.

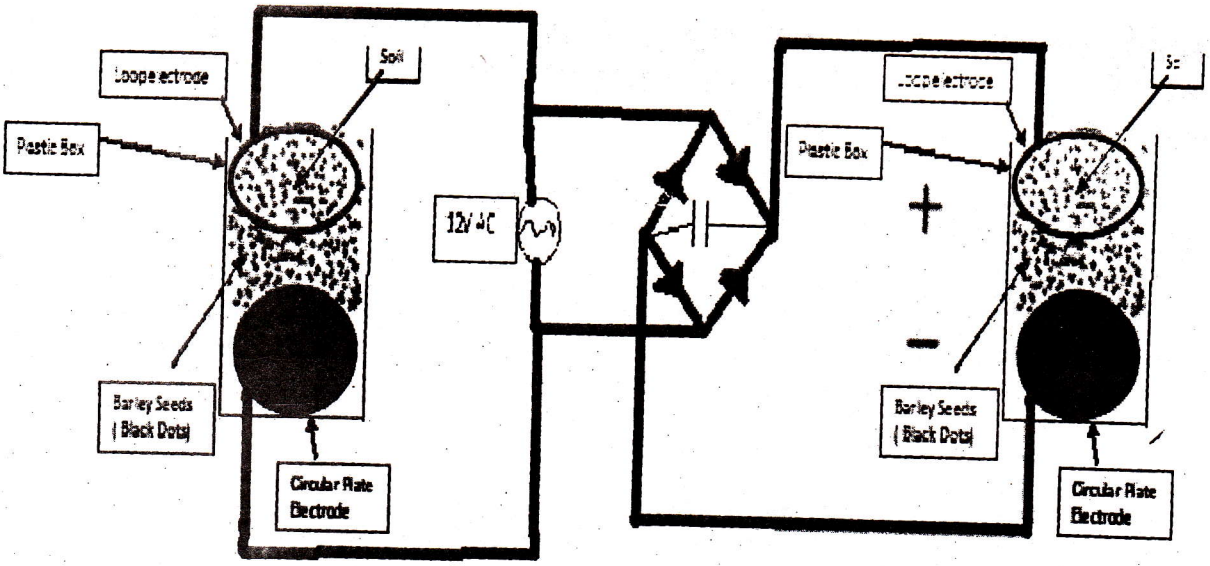

Fig.1. Schematic representation of the actual experimental setup to generate DC and AC electric field.

Table 1. Number of germinations observed, in DC, AC, and no electric fields.

Field	Day						
	1st	2nd	3rd	4th	5th	6th	7th
DC	Nil	Nil	Nil	Nil	Nil	Nil	Nil
AC	Nil	Nil	Nil	Nil	04	04	04
No Electric Field	Nil	Nil	Nil	09	15	15	15

Then 15 Barely seeds were placed on the soil surface, and about 1 cm thickness of soil was further added. Now, the loop aluminium electrodes (one for AC and DC each) were placed in each box, and further, soil sufficient enough to cover the loop electrode was added. The soil of the boxes was moistened by adding appropriate amount of water. The power source was switched on, and visible protrusions of radicles from soil (germinations, hereafter) were observed. To compensate water losses from the soil 2 ml water was added, intermittenly,. A schematic representation of the procedure is given in Fig.2.A parallel germination of 15 seeds was also carried out in the absence of any electric field.

The experiments were carried out in ambient conditions (April-May months) at Bharatpur (27.20 Latitude and 77.46 Longitude).

Results and Discussion

The results of the experiments are presented in the Table 1. Repeated experimentation yielded almost the same results. A comparative chart of the number of seed germination in DC, AC, and no electric fields is presented in Fig.3.

There was no germination for the first three days, in any of the three setups (DC, AC and no field (Table 1). On the fourth day, there were 09 germinations in the absence of any electric field, while, AC and DC electric fields induced no germination. On fifth day, all the 15 Barely seeds got germinated in no field setup, AC and DC electric fields indicated 04 and nil germinations, respectively. On the sixth day, number of germinations remained the same in AC and DC fields *viz.* 04 and nil, respectively. No further germinations were noticed, on seventh day of the experiment. It is apparent that in DC electric field, generated by the special array of electrodes, there is almost quenched germination of the soil implanted Barley seeds, while, AC field has considerably reduced

Barley Seeds Selection | **Soil conditioning** | **Electrode preparation**

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Implantation of circular plate electrodes at the base (In circular plastic boxes)

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Partial soil filling in the plastic boxes

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Placement of Barley seeds

↓

Further soil filling in the plastic boxes

↓

Loop electrode placement

↓

Covering of loop electrode with soil

↓

Moistening of the plastic box soil

↓

Application of DC and AC electric fields to the respective setup

↓

Protrusion of radicles through soil observed

Fig.2. Flow Chart of Procedure.

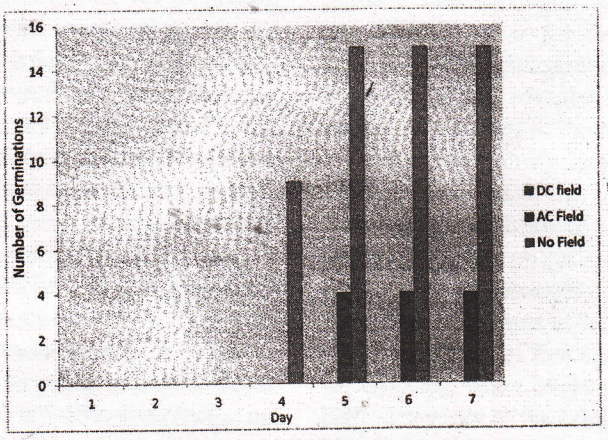

Fig.3. Number of germinations, comparative chart DC, AC and no electric field.

the germinations. These findings differ significantly from the effect of external high voltage electric fields, on non soil implanted seeds, where increased in germination growth is seen.

The present study is related to an important process in plant sience, the seed germination, in the presence of electric fields. It apparently reveals an important aspect of the process of germination. The germination seems to be greatly influenced by the ion-migration. In DC electric field, the migration of ions is unidirectional which, is perhaps leading to quenched germination. Probably, there is leaching of essential nutrients from the seed to the soil. In contrast, in AC electric field there would be oscillatory movement of ions or nutrients in the vicinity of the seeds and they become less accessible, this might be leading to less number of

seed germinations.

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