Impact of electromagnetic treatment on seed germination and growth of Cucurbita pepo and Cucumis melo

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Priyanka Singh, and Manisha Agrawal

Impact of Electromagnetic Treatment on Seed Germination and Growth of cucurbita pepo and cucumis melo

Priyanka Singh[a] and Manisha Agrawal[b]

Department of Applied Chemistry, Rungta College of Engineering & Technology, Kohka Kurud Road, Bhilai(C.G), India

Corresponding author: [a]paripri.singh@gmail.com
[b]dr.manisha.agrawal@rungta.ac.in

Abstract. In order to develop a chemical-free and sustainable agricultural practice to trigger the germination and growth in plants, pre-sowing electromagnetic treatment was exposed on seeds of pumpkin (Cucurbita pepo) and melon (Cucumis Melo) were investigated. Genetically uniform seeds were exposed to the magnetic fields 0.3, 0.6, 0.9 and 1.0 kilogauss (kG) for 15 minutes, respectively by an electromagnet (rectified sinusoidal no uniform). The treated and control (non-treated) seeds were sown in separate trays in same laboratory conditions. Germination percentage (GP), relative germination percentage (RGP), relative root growth (RRG), relative shoot growth (RSG), Germination Index (GI), Vigor index (VI) and biochemical parameters were measured by standard methods. There were significant statistical and visual differences noticed among all sets of experiments. Data analyzed that electromagnetically treated seeds give better results than non-treated seeds. The suitable range of electromagnetic treatment for melon seed was 0.9 kG and for pumpkin seed, it was 0.6 kG for 15 minutes each. Results suggest that the pre-sowing electromagnetic treatment could possibly be used to improve the productivity of plants by enhancing germination and seedling growth with a chemical free, damage-free and sustainable method at cultivator level.

INTRODUCTION

Pumpkin (Cucurbita pepo) and melon (Cucumis Melo) belong to the family of Cucurbitaceae. These plants are useful as food, seed oil and in medicine, for the treatment of deficiency of vitamins in the body. Due to the important features pumpkin and melons are cultivated as an annual crop in various parts of the world in bulk [1]. For Cucurbita pepo and Cucumis Melo seeds germination may take long as two weeks. These seeds have a hard seed coat, which causes problems in germination of seeds because of physical dormancy. Antagonistic effects and temperature are also responsible for uneven and low germination rates and poor crop production [2-6]. Literature shows that methods available for breaking dormancy of seeds are of a chemical, thermal, abrasion and imbibition's method [7-9]. Each method has certain limitations. Chemical method is costly and gives adverse effects to the environment, thermal and abrasion methods cause damage of seeds in bulk and imbibed seeds were not possible to store for a long time [10]. So it is a topic of interest of researchers to find out some non-hazardous, chemical free and eco-friendly method for germination and growth of plants. In order to find out such options very limited work has been reported that germination qualities of the maize and soyabean and bitter guard seeds get enhanced by exposure of the magnetic field [11-12].

MATERIAL AND METHODS

The seed was collected from government authorized shop, Healthy and uniform 50 seeds lot were selected and stored in the dry and sterile container.

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Electromagnetic Exposure Treatment

Seeds were exposed to magnetic field 0.3kG, 0.6kG, 0.9kG, 0.1kG for 15min, respectively through electromagnetic field stimulator. The schematic diagram of magnetic field stimulator is shown in Fig.1.

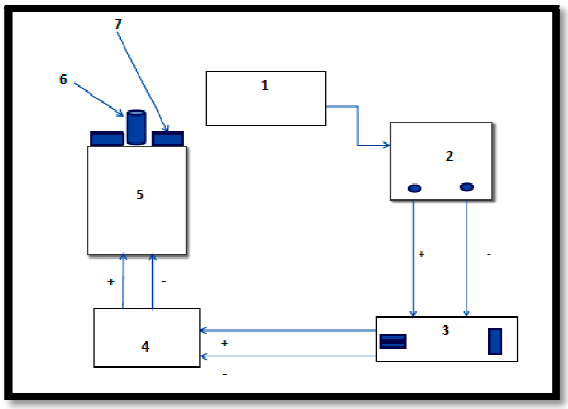

FIGURE 1. Block diagram of the magnetic stimulator.

Detailed description of main parts of magnetic stimulator is given below:
1. Current Supply: 230 volt single phase AC current is used.
2. Dimmer sate:It is used to control the current flow.
3. Converter:It is used to convert AC current to DC current.
4. Ammeter:It is used to measure the current supply in the circuit.
5. Magnetic Field Stimulator: Mug Tech association with variable magnetic strength (1 kG to 10 kG).
6. Sample holder
7. Magnet Bar

Seed Propagationand Culture Practices

The experiments were carried out in laboratory condition. The experimental soil pot size taken was 30 cm long, 20 cm width and 8 cm in depth. Pots were filled with garden soil up to 5 inches. Row to row and seed to seed distance was 1to 1.5 inches. Used for germination purpose, seed were seeded in pit 1.5-2.5 cm depth and Irrigated twice in a day.

Germination Measurement

According to, International Seed Testing Association (ISTA) was implemented the germination percentage of pumpkin and melon seed was measured following the reported method:

Germination percentage: Germination percentage is an estimation of the viability of the seed. The equation to calculate germination percentage is

$$G\% = \frac{\text{No. of germinated seed}}{\text{Total No. of seed}}$$

Percentage of Relative Seed Growth (RSG %):

$$RSG\% = \frac{\text{NO.of treated seed germinated in soil}}{\text{No.of seed germinated in control}} x\ 100$$

TABLE 1. Germination percentage and Relative Seed Growth of seed After 24, 48, 72, 96 hrs.

S. No.	Electromagnetic Treated Seed Sample in KiloGauss(kG)	Germination Percentage							
		Cucurbita pepo				Cucumis melo			
		After 24 hrs	After 48 hrs	After 72 hrs	After 96 hrs	After 24 hrs	After 48 hrs	After 72 hrs	After 96 hrs
1	Control	00	76	86	86	00	68	72	72
2	0.3	00	82	90	90	00	94	100	100
3	0.6	00	86	94	94	00	70	76	76
4	0.9	00	98	100	100	00	90	94	94
5	0.1	00	90	92	92	00	60	70	70
		Relative Seed Growth							
6	Control	-	-	-	-	-	-	-	-
7	0.3	00	107.89	104.65	104.65	00	140.62	138.88	138.88
8	0.6	00	113.15	109.30	109.30	00	106.25	105.55	105.55
9	0.9	00	128.94	116.27	116.27	00	134.37	130.55	130.55
10	1.0	00	118.42	106.97	106.97	00	103.125	97.22	97.22

Percentage of Relative Root Growth (RRG%): It measures the growth efficiency of the plant

$$\text{RRG\%} = \frac{\text{mean root length in soil}}{\text{mean root length in control}} x\ 100$$

Germination Index (GI): GI is a synthetic measure designed to reflect the synthesized germination ability including germination rate and germination of seed.

$$\text{GI \%} = \frac{RSG \text{ x } RRG}{100}$$

Vigor Index (VI): To assess the vigor, the length of the root and shoot of each individual seedling was measured. The VI was calculating using the formula.

VI = Total seedling length (Root + Shoot) **x** percentage of germination

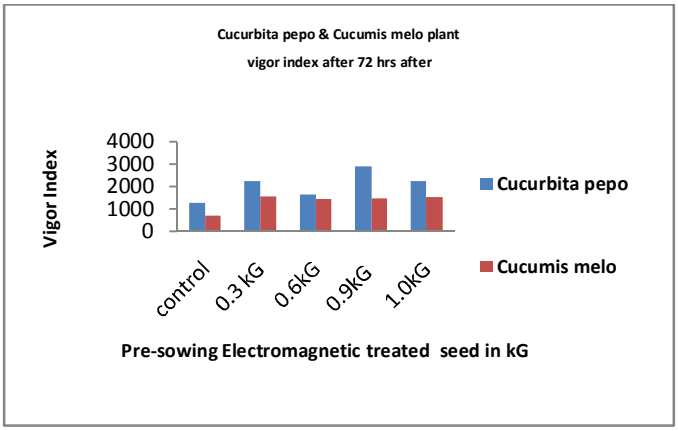

FIGURE 2. Cucurbita pepo & Cucumis melo plant vigor index after 72 hrs after.

RESULT AND DISCUSSION

Electromagnet actuated physiological and biochemical changes in biological entities. Water assimilation and intensified photosynthesis collectively enhance the seed germination and development (Podleoeny, I., Pietruszewski, s., Podleoena, A.,2004).For the first time, in the field of seed science and in order to break seed dormancy, application of the magnetic field is proposed.

Determination of the protein Content

The colorimetric process of Lowry et al. (1951) was followed to determine the estimation of total protein. From the finely sliced pooled samples 150 gm seed sample was weight and homogenized in cold, double distilled water using mortar and pestle and the homogenate was used for the test. The concentration of protein in seed material after treatment and control are shown in Fig. 3.

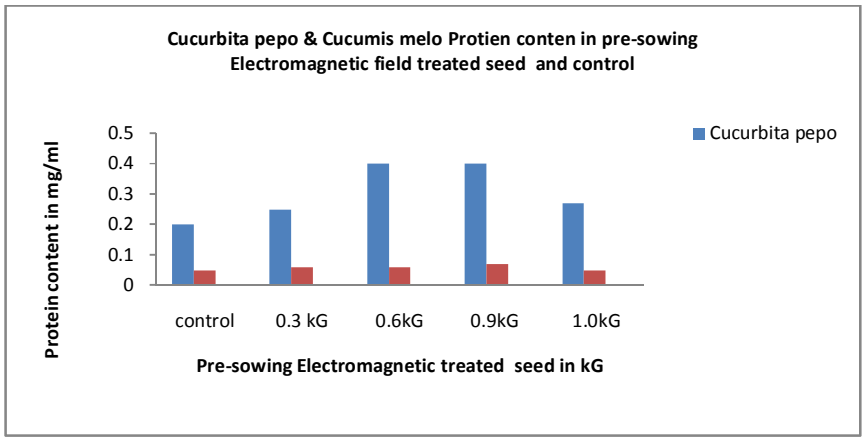

FIGURE 3. Cucurbita pepo & Cucumis melo Protein content in pre-sowing Electromagnetic field treated seed and control.

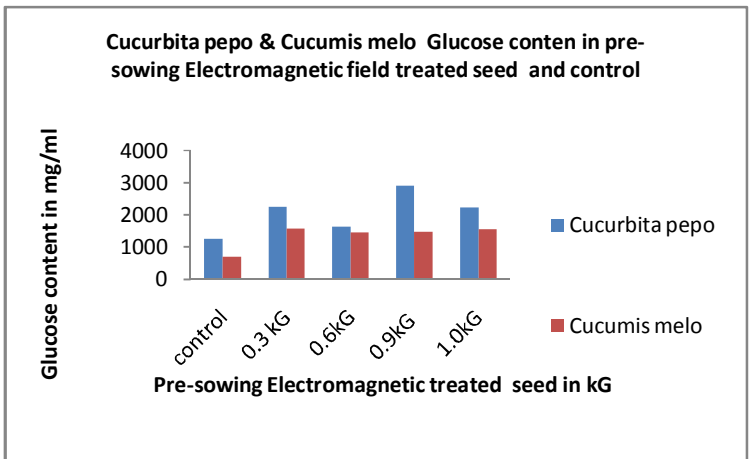

FIGURE 4. Cucurbita pepo & Cucumis melo Glucose content in pre-sowing Electromagnetic field treated seed and control

TABLE 2. Physical and Biological parameter of *Cucurbita pepo and* Cucumis melo.

		Cucurbita pepo					**Cucumis melo**				
			15 min treated seed					15 min treated seed			
Parameters	Unit	Control	0.3kG	0.6kG	0.9kG	1.0kG	Control	0.3kG	0.6kG	0.9kG	1.0kG
Average Shoot Length	cm/plant	5.75	8.0	5.0	09.75	7.5	4.5	0.6	8.75	7.0	6.5
Average Root Length	cm/plant	12.4	17.00	15.5	19.4	16.00	5.5	9.7	10.3	08.7	9.0
Total length plant (cm/plant)	cm/plant	18.15	25.00	20.5	29.14	20.1	10.00	15.7	19.05	15.7	12.4
The dry weight of seed	mg	187.6	173.5	182.5	180.2	175.3	46.56	46.34	48.44	47.88	45.7
The weight of water soaked seed	mg	252	252.6	257.4	265.5	254.4	64.4	64.52	80.72	68.34	65.3
Protein	mg/ml	0.2	0.25	0.40	0.40	0.27	0.05	0.06	0.06	0.07	0.05
Glucose	mg/ml	0.3	0.4	0.5	0.4	0.3	0.2	0.3	0.4	0.5	0.4
Vigor index	Percentage	1270.5	2250	1640	2914	2240	700	1570	1447.8	1475.8	1550

continued

TABLE 2. Physical and Biological parameter of *Cucurbita pepo and* Cucumis melo.

		Cucurbita pepo					**Cucumis melo**				
		Control	15 min treated seed				Control	15 min treated seed			
			0.3kG	0.6kG	0.9kG	1.0kG		0.3kG	0.6kG	0.9kG	1.0kG
Germination Index	Percentage	-	99.25	115.72	146.36	110.73	-	143.51	149.02	165.31	113.20
Relative root	Percentage	-	94.94	105.88	125.88	103.52	-	103.34	141.19	126.63	116.44

Plant Height

Low strength of electromagnetic exposure on pre-sowing seed gives a promising effect on plant height and root growth. Fig. 4 and 5 shows the remarkable difference between control seeds and treated seeds.

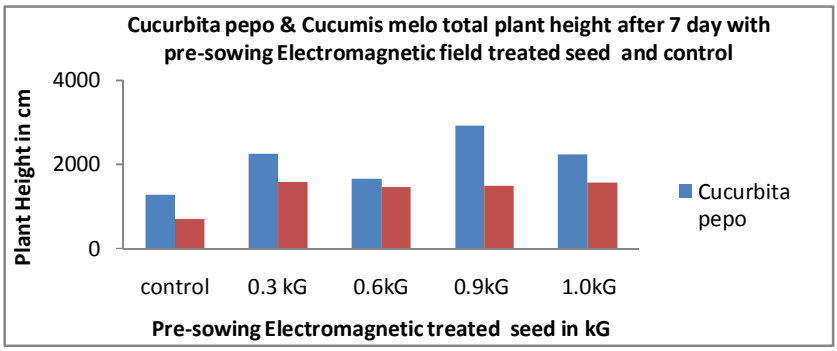

FIGURE 5. Cucurbita pepo & Cucumis melo total plant height after 7 days with pre-sowing Electromagnetic field treated seed and control.

FIGURE 6. Effect of electromagnetic treatment on growth of plants applied various field (1) 0.0 kG Control (2) 0.3 kG electromagnetic field (3) 0.6 kG electromagnetic field (4) 0.9 kG electromagnetic field.

CONCLUSION

Exposure of electromagnetic field in seed triggers the germination and growth stimulating hormones. It influences several nodding pathways and inherent factor in plant cells outcome of the treatment shows that seeds give an effective result on 0.9 kG whereas 0.6 kG electromagnetic exposure have better agreement for on the basis of above investigation it may be concluded that electromagnetic exposure activates biochemical reaction inside the seeds without any damage of seeds. It may be concluded that electromagnetic field exposure technology in seeds may have the potential to give have the potential to give a significant improvement in agriculture technology to improve crop germination and productivity in the future.

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