Effect of Magnetic Pretreatment on seed Growth

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ABSTRACT

The effects of magnetic pretreatment of seeds on growth were studied. Chickpea seeds were used in this work and pretreated with magnetic field (magnetic flux density) B of 2000 gauss for 1, 2 and 3 hours treatment time. After ten days of growth, the average length measured and show clear difference between treated and untreated one. The average length difference between 1, 2 and 3 hours treatment and untreated one are 13.88 cm, 14.67 cm, and 15.721 cm respectively.

Introduction

Over many years, the effect of magnetic fields on plant life has been the subject of several studies. It has been reported that external magnetic fields influence both the activation of ions and polarization of dipoles in living cells. As early as 1930 Savostin reported 100% increase in the rate of elongation of seedlings under the influence of magnetic condition [1]. Later Murphy [2] reported changes in seed germination Also, It was reported a strong magneto tropic affection on root development [3]. Smith found that using different field combination one could separately alter the root mass, Leaf size and stems thickness. In general, the enhancement of growth under magnetic conditions appears to have been confirmed by many scientists [4]. Magnetic field was used widely as pretreatment for seeds to increase seed vigor, seedling growth and yield [5]. However, it is physiological and mechanism is still
poorly understood. In this study, we used Chickpea, which is an edible legume of the family Fabaceae, subfamily Faboideae.and we subject magnetic field to chickpea seed in constant intensity and different time.

MATERIALS & METHODS

In this work we use chickpea seeds for there availability and easy to germinates. The criteria of choosing such seeds depends on uniform shape, size, light yellow color and free of faults. The selected seeds divided to four groups with ten seeds for each group. The first group (control) with out pretreatments and the other three groups (1hr,2hr and 3hr) exposure to magnetic pretreatment for one ,two and three hour respectively. Permanent magnets used for this purpose with magnetic flux density (B) 2000 gauss (figure 1). The seeds sowed in pots (60 mm diameter, 30 mm height). The samples irrigated and measured their length daily. The natural light cycle was 14hr light /10hr darkness and temperature 33±3C.

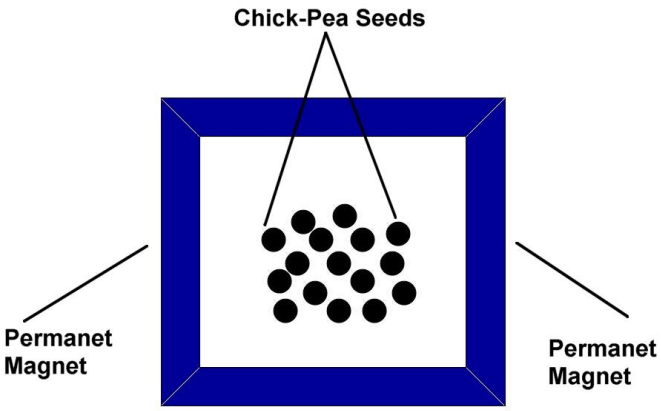

Figure 1 Schematic of Magnetic pretreatment setup.

Results & Discussion:

The seeds showed up the soil surface after four days. Average length recorded daily for the four groups (control, 1hr, 2hr and 3hr) and for ten seeds to each group. Some seeds died out and therefore they neglected from our counting. The recorded average length for all the groups is tabled in Table (1). It is obvious the difference in average length between control group and the other three pretreated groups there is a difference between the pretreated groups. Figure (1) shows the average length for four groups vs. time in days, according to the figure the divergence increase as the time increase. The four groups show semi linear behavior and if we fit the curves then the slop of every curve could be easily obtained. Figure 2 shows the curve fitting and the equation of all lines mentioned. The slope-intercept equation is:

$$y = mx + b$$

m represents the slope and the slope represents the growth rate and *b* represents the intersection with y-axis. Growth rate (slope) plotted vs. treatment time (figure 3), here, it is clear that growth rate increase sharply when the seeds are pretreated.

The mechanisms are not well known yet, but several theories have been proposed, including biochemical changes or altered enzyme activities by Phirke et al. (1996). Garcia and Arza [6] carried out an experiment study on water absorption by lettuce seeds previously treated in a stationary magnetic field of 1000 to 10000 gauss. They reported an increase in water uptake rate due to the applied magnetic field, which may be the explanation for the increase in the germination seed of treated lettuce seeds. It seems changes in intracellular levels of ca^{2+} and in other ionic current density across cellular membrane cause alteration in osmotic pressure and changes in capacity of cellular tissues to absorb water [6]. By analyzing the changes in ca^{2+} distribution and contents in cells of pea flax, lentil, onion and radish seedlings exposed to weak magnetic field, it was concluded that such a stress has resulted in serious disturbances at the cellular level. Magnetic fields cause effects related to interference with cytoplasm ion currents or ion distribution [7]. Therefore potential sensing

component could be ca^{2+} ions. The increase of ca^{2+} level is fully consistent with assumption of the parametrical resonance model. It is believed that primary link in the chain of events triggered by weak magnetic field action in a biological system is the ca^{2+} ions connected with ca^{2+} - binding site of the proteins [8,9]. It also observed seedlings growth from treated plunged seeds in the water that showed unarranged and less growth than control. On the other hand, seedlings grown from pretreated seeds without water in the same condition showed more growth by increasing the exposure time. Considering that these plants have ferritin cells, and each ferritin cell has 4500 Fe atoms, it is obvious that they have an outstanding role in the plants growth. As the last spin magnetic moment of the Fe atom posed to an external magnetic field, the composition of them creates an oscillator in the system. Then we have a moment of force on ferritin cells. This oscillator exerts its energy, then damps and finally locates in the field direction. The relaxed energy increased the internal temperature; as a result, it is situated in a proper temperature for growing. This phenomenon occurs in the initial minutes of applying the magnetic field. So it depends on the number of times of locating the plant in magnetic field . Different growth rate in different growth condition (such as immersed seeds in water) suggested that response to magnetic treatment would be different. Therefore, the response depends not only on the magnetic induction and its gradient, but also on the physiological state of experimental organism. [10]. As a result, we need to concentrate on defining the environmental conditions accompanying the response to magnetism. Anatomical structure observation showed that stele and xylem vessels develop and grow more than control. This may be attributed to peroxidase enzyme augmentation which causes more lignifying and it speeds up making secondary structure. Parenchyma cells are larger than control in both root and shoot (including stem and leaf). Belyauskays in 2004 reported that magnetic field effect on G2 Phase of cell cycle in lentil and flax. In fact magnetic fields causes G2 phase to become longer and cells division decrease. Air pores and sub-stomata chamber in leaf are more and larger than control. It suggests that gas exchange would be easier and more accelerated than control. Spongy parenchyma cells are the most effective cells under stress and different environmental factors, because their cell walls are thinner than others are.

In conclusion, the magnetic field pre-treatment enhanced seed germination rate and seedling emergence percentage. In addition, it has positive effect on chickpea seedlings, such as stimulating seedling growth and development.

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Table 1 Shows the Average Length of growth seeds through Ten days.

TIME(DAYS)	AVERAGE LENGTH OF SAMPLES			
	control	1hr	2hr	3hr
0	0	0	0	0
1	0.65	1.74	1.112	1.57
2	1.26	2.99	2.94	3.5
3	2.51	8.24	8.321	8.33
4	3.15	10.11	10.55	12.1
5	6.69	12.73	13.07	13.75
6	7.043	14.1	15.72	18.15
7	8.8	17.5421	18.15	19.89
8	9.837	19.44	22.12	24.63
9	10.8	22.93	24.63	28
10	13.02	26.9	27.69	28.741
slop	1.406352	2.701129	2.942285	3.183691

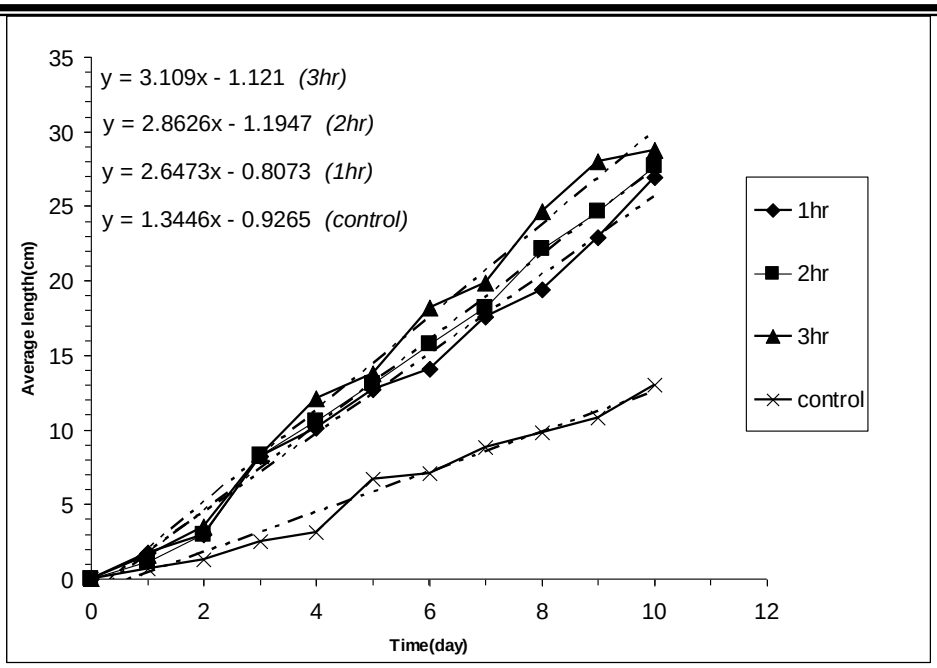

Figure 2 Increasing of plants length with time that illustrates the effect of magnetic pretreatment.

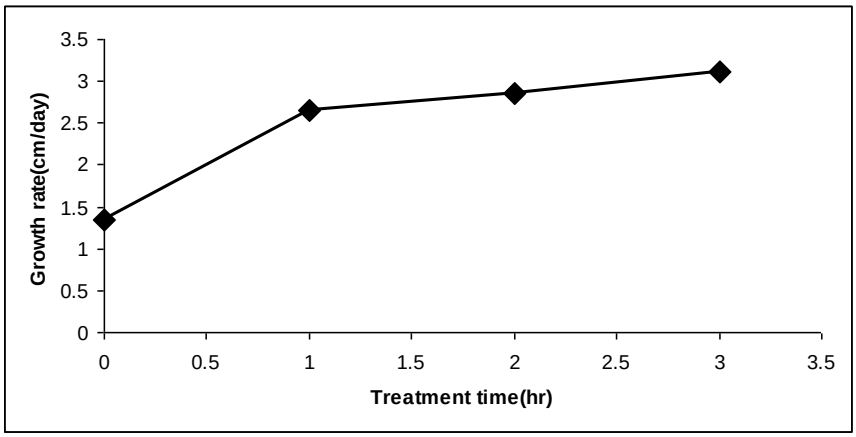

Figure 3 Illustrate the growth rate (slop) as a function to treatment time.

Figure 4 The influence of Magnetic Pretreatment on seeds germination.

Figure 5 Comparison of the length and shape of the root for: a (control), b (1 hr), c (2 hr) and d (3 hr).

الخلاصة

تم في هذا البحث دراسة تاثير معاملة البذور بالمجال المغناطيسي. بذور الحمص تعرضت لمجال مغناطيسي بشدة 2000 B كاوس لأزمان مختلفة (ساعة ،ساعتان وثلاثة ساعات). بعد عشرة ايام من النمو قيست اطوال النباتات واخذ المعدل لكل حالة وبدا الفرق واضح بين الأزمان المختلفة وبين العينات الغير معاملة بالمجال المغناطيسي وهي تباعا 13.88 سم ،14.67سم و 15.721سم.