Saudi Journal of Biological Sciences 14 (1) 103-107, June 2007
ISSN 1319-562 X
The Official Journal of the Saudi Biological Society
htt:www.saudibiosoc.com

The Effect of Static Magnetic Forces on Water Contents and Photosynthetic Pigments in Sweet Basil *Ocimum basilicum* L. (Lamiaceae)

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Abstract

Three different magnetic regimes; aerial, surface and buried; each with three different forces, have been used to investigate their effects on the water contents and photosynthetic pigments of sweet basil plants (*Ocimum basilicum* L.). Two groups of sweet basil seeds, *Ocimum basilicum* L. have been cultivated, one under normal conditions and the second has been subdivided into three portion (aerial, surface and buried) to examine the effect of different magnetic forces coming from the three directions on the resulted plants. At all directions of magnets, water contents have been significantly affected by the magnetic forces. Chlorophyll A and carotene contents have been affected, as well, according to the three magnetic forces coming from soil surface regime only. Chlorophyll B did not significantly affected by differences magnetic forces in the three regimes, but it is affected by magnetism wherever its direction or force. But all the photosynthetic pigments contents (Chlorophyll A, B and Carotenes) decreased significantly than the control in the three magnetic regimes., but without any effect according to differences in the magnetic force in the aerial and burried regimes of magnetism. It was concluded that magnetism affects both water absorption and retention , the most influenced regime was the aerial magnets followed by the surface and buried ones. This result can be interpreted by the ionization of water which makes water ions respond to magnetic forces. Photosynthetic pigments have been decreased significantly by the exposure to magnetic fields, irrespective to its direction or force and this may be due to the effect of magnetic fields on the reduction in plastids inside the cells.

Key words: Magnetism – Photosynthetic pigments- Water absorption.

Introduction

Till 1980 a little were known about how the magnetic field can stimulate plant growth or even prevent it. Wojcik (1995) reported that in the beginning of 1980s Japanese called Fujio Shimazaki working in Shimazaki Seed Company, was the first who reported that stationary magnetic fields can improve the germination of seeds and speed up the growth of plants. According to Jones *et al.* (1986) found that the electromagnetic fields amplify the plant growth regulator induced Phenylalanine Ammonia-Lyrase during cell differentiation in the suspended cultured plant cell.

Many works have been done to investigate the effect of magnetism and different magnetic forces on water absorption and physiological activities in plants. Alexander and Doijode (2000) consider the electromagnetic field a novel tool to increase germination. They exposed both onion seeds, conserved for 5 years with a reduced viability of 41%, and rice seeds, conserved for 6 years with very low viability of 8.1%, to static magnetic field created by two identical bar magnets connected in a parallel circuit. They found that magnetic stimulus significantly increased the germination in both types. They pointed to use magnetic stimulus in gene banks. Reina *et al.* (2002) studied water absorption by lettuce seeds previously treated in a stationary magnetic field of 010- ml. T. They found significance increase in the rate of water absorption accompanied with an increase in the total mass. They interpret the results by the variations induced by magnetic fields in the ionic currents across the cellular membrane with leads to change in the osmotic pressure. It was conclude that magnetic field alter the water relations in seeds and for that germination rates change by the magnetic field.

Yano *et al.* (2004) investigated the effect of low frequency magnetic field (ELF) on CO^2 uptake rate and early growth parameters of radish *Raphanus sativus* L. Seedlings were exposed to a 60 Hz, 50 micro Tesla (rms) (root mean square) sinusoidal magnetic field and a parallel 48 microT static magnetic field for 6 and 15 days, but not the ELF MF. They found that CO^2 uptake rate of ELF MF exposed seedlings on day 5 and later was lower than that of the control seedlings. While the dry weight and leaf area were lower than that of the control. Taia *et al.* (2005) investigated the effect of different static magnetic forces and different directions on both the rate of germination and the growth of the early stages of *Ocimum basilicum* L. (Lamiaceae) . Taia (2006) made a review on magnetic force and its effect on plants in different aspects of plant research.

Accordingly, this work was undertaken to investigate the effect of different forces of static magnetic field

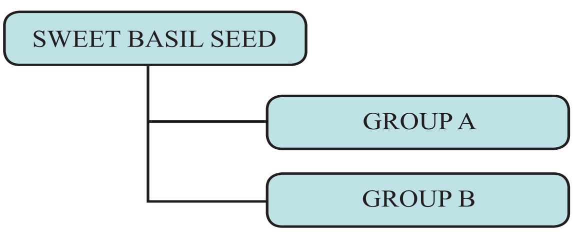

Fig. 1 demonstrates the division of Sweet Basil seeds

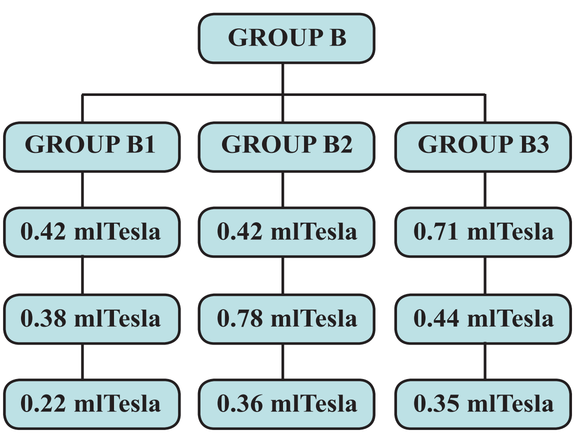

Fig. 2 demonstrates the division of group B of seeds

aerial, surface and buried) on both water contents and photosynthetic pigments on one of the most adapted species to aridity and widely distributed species in the arid areas, *Ocimum basilicum* L. . .

Materials and Methods

Seeds of Sweet Basil *Ocimum basilicum* L. have been collected from rocky habitats along Jeddah-El- Medina road during September 2005. The seeds have been divided into two portions as follows (Fig.1):-

A-The first group, is the control group.

B-The second group, has been subdivided into three groups, each one exposed to three different magnetic forces coming from permanent magnets, from different position ; above soil surface (B1), at soil surface (B2) and beneath soil surface (B3) (Fig. 2).

All the seeds of the whole these treatments are planted in mixture of sand and peat (1:1) and irrigated by 50 ml. water every 48 hours for two months.

To calculate the water contents of the plants 10 plants from each treatments have been weight and put it in an oven for 72 hrs. at 75 ºC , then calculated according to the following equation:-

% of water contents = {Fresh weight-Dry weight / Fresh weight} X 100.

Then the root system has been isolated from the shoot system to calculate the % of the water contents in each of them separately.

0.2 gram leaves from the forth node of each treatment has been weighted and treated by dimethyl formamide and measured by spectrophotometer at 664 nm. For (Chlorophyll a); 674nm (Chlorophyll b) and 452 nm Carotenes).

3-The results are statistically analyzed using SPSS program to calculate the means , standard error and Statistica to recognize the significance and standard deviations for the different magnetic forces.

Results and Discussion

The results are summarized in tables 1 and 2 and figures 3-4. From table 1, we find that the water contents of both the shoot and root systems has been decreased in the three magnetic regimes than the control, except in the aerial magnet with 0.38 ml. Tesla (T) magnetic force. The most affected force on the shoot system is that of the surface

Table 1. Water contents and photosynthetic pigments in the control and all treatments of the second group (B).

Photosynthetic Pigments			Water Contents		Charac. / Treat.	
Carotines	Chloro.B	Chloro.A	Root Syst.	Shoot Syst.		
0.002±0.06	0.001±0.05	0.002±0.15	1.48±63.57	0.12±81.82	0.005	Control
0.000±0.02	0.001±0.02	0.001±0.04	1.76±63.82	0.48±80.33	0.42	GROUP 1
0.000±0.02	0.000±0.01	0.001±0.04	3.93±67.11	0.29±82.08	0.38	
0.001±0.02	0.000±0.01	0.001±0.05	4.89±49.32	0.61±77.42	0.22	
0.000±0.02	0.001±0.01	0.002±0.03	4.48±39.13	1.37±65.43	1.42	GROUP 1
0.001±0.02	0.002±0.02	0.001±0.06	3.38±40.68	0.63±71.15	0.78	
0.001±0.03	0.001±0.02	0.001±0.07	2.12±31.01	0.80±70.51	0.36	
0.000±0.02	0.001±0.01	0.001±0.04	1.57±32.10	0.29±72.78	0.71	GROUP 3
0.001±0.02	0.001±0.01	0.001±0.03	3.01±28.68	1.74±71.56	0.44	
0.000±0.02	0.002±0.02	0.001±0.05	3.15±13.10	0.57±68.63	0.35	

Table 2. Water contents in both shoot and root systems in the control and the deferent magnetic regemes and forces

Mag.Groups→ Charact↓	Group 1		Group 2		Group 3	
	Sig.	St. D.	Sig.	St. D.	Sig.	St. D.
Chlor.A	0.002	0.999	0.080*	0.970	0.0105	0.999
Chlor.B	0.004	0.999	0.036	0.959	0.0066	0.999
Carotines	0.006	0.999	0.095*	0.957	0.0211	0.998
Water contents	14.815**	0.896	2.067**	0.999	1.121**	0.999

magnet with 1.42 ml. T force (65.43) . While the root system is greatly affected by the buried magnet among all the three forces and decreased with the decrease in the magnetic force. The decrease in the water contents with the decrease in the magnetic force co-ordinates with the finding of Monselise *et al.* (2003) who observed that magnetic fields of low frequency induce a stress on higher plants. Meanwhile Scaiano *et al.* (1994) assumed that low intensity and low frequency magnetic fields can potentially alter chemical processes in which free radicals are involved. Jones (2000) explained that the effect of magnetic forces on water is due to the electromagnetic fields originated from the atoms and the existence of defects in molecular structure of water. Hong (1995) retained the effect of magnetic fields on water by the bipolar character of water molecules. All these opinions can be accepted to interpret our results, as the water contents of the root system decreased significantly with the decrease of magnetic

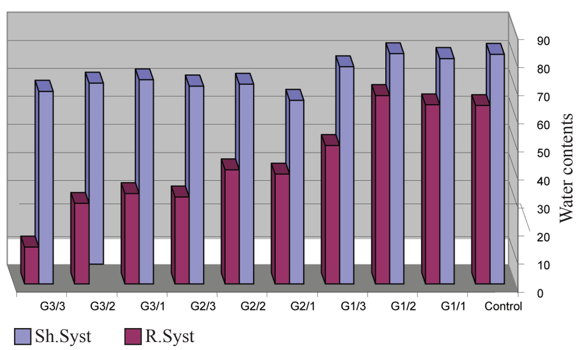

Fig.3 Water contents in both shoot and root systems in the control and the deferent magnetic regemes and forces

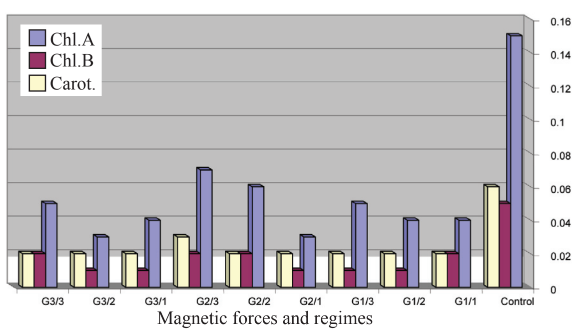

Fig.4 Photosynthetic pigments contents in the control and the the three regimes studied

forces used, whereas a slight and gradual decrease in the water contents was recorded in the shoot system (Fig. 3).

Photosynthetic pigments contents show great alteration than the control in response to the electromagnetic regimes as shown in table 1. While in each magnetic regime, except at the surface magnet, the different forces did not show any alterations (Fig.4). At surface magnet chlorophyll A and carotenes contents have been affected due to the different magnetic forces. Chlorophyll B is the least affected pigment in all the studied regimes. Thus, our results are in accordance with that of Reina et al. (2002) who found significance increase in the rate of water absorption accompanied with an increase in the total mass with the increase of magnetic forces. They explained the results by the variations induced by magnetic fields in the ionic currents across the cellular membrane with leads to change in the osmotic pressure. Yano *et al.* (2004) found a decrease on CO^2 uptake rate and early growth parameters of radish *Raphanus sativus* L. Seedlings when exposed to magnetic force, resulted in the decrease in the photosynthetic pigments as recorded in the present investigation.

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تأثير القوى المغناطيسية الساكنة على المحتوى المائي وصبغيات البناء الضوئي لنبات الريحان البرى

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الملخص

لقد تم دراسة تأثير ثلاث نظم مختلفة للقوى المغناطيسية على نبات الريحان البرى النامي بطريق جدة المدينة. حيث تم جمع البذور في شهر نوفمبر٢٠٠٤ وأنبأتها في أصص كبيرة في أربعة مجاميع معزولة عن بعضها. المجموعة الأولى وهى المجموعة الضابطة , أما الثلاث مجاميع الباقية فهي المجاميع المعرضة للقوى المغناطيسية المختلفة ولقد قسمت كل منهم إلى ثلاث مجاميع أخرى لتعرضهم لقوى مختلفة داخل النظام المتبع. أحدى هذه المجاميع الثلاثة تعرضت لقوى مغناطيسية هوائية والأخرى إلى قوى سطحية أما الثالثة فتعرضت إلى قوى أرضية. بعد ثلاث أشهر من الزراعة تم حصاد النباتات ودراسة المحتوى المائي وصبغيات البناء الضوئي للنظم المغناطيسية المختلفة وللقوى المختلفة داخل كل نظام.

أوضحت النتائج المتحصل عليها أن كل من المحتوى المائي للنباتات ومحتوى صبغيات البناء الضوئي (كلوروفيل أ , ب وكاروتينات) قد تأثر بشكل واضح نتيجة للتعرض للمجالات المغناطيسية في الثلاث نظم المتبعة. وكان أكثر النظم تأثيرا على المحتوى المائي هو النظام الهوائي بكل القوى المدروسة. بينما صبغيات البناء الضوئي فقد قلت محتواها في كل المعاملات عن المعاملة الضابطة. أما اختلاف القوى داخل النظام المغناطيسي الواحد لم يبدى أية تأثير عليهم ولم تربطهم علاقة واضحة فيما عدا النظام السطحي للمجال المغناطيسي حيث أظهر علاقة عكسية مع القوى المستخدمة حيث يزيد محتوى صبغيات البناء الضوئي كلما قلت القوى المغناطيسية المستخد مة.