Effect of Weak Electro Magnetic Field on Grain Germination and Seedling Growth of Different Wheat (*Triticum aestivum* L.) Cultivars

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Abstract: Growth parameters data were used in this study for the evaluation of nine wheat (*Triticum aestivum* L.) cultivars Giza168, Tabouki, Kaseemi, Yamanei, Madini, Nagrani and Seds 12 at the University of King Abdul Aziz in season 2011. Grains of wheat different cultivars were exposed in batches to weak electric magnetic fields (3000 gauss = 0.3T of magnetic force) for 30 min. Then, the magnetic treated grains were placed in Petri dishes between two layers of moist germination paper by magnetic water. They were placed in the germination incubator at 20°C in an upright position. In order to estimate the rate of germination and percentage of germination. After 21 days, different plant growth parameters were tested such as shoot length, root length, shoot / root length, seedling length, seedling fresh and dry weight based on normal seedlings and effect of magnetic treatments on number of protein bands in wheat seedling. The results showed that all magnetic field treatments increased the rate and percentage of germination, all growth parameters and number of protein bands based on normal seedlings in wheat cultivars. The higher increments observed when grain exposed to weak electric magnetic field strengths 0.3 T at 30 min and dipp in magnetic water compared with control and cultivar Sakha93 showed decreased in the percentage of germination, all seedling growth parameters and numbers of seedling protein bands when exposed to all magnetic field treatments compared with controls, while Masr1 cv. No effected when treated compared with control. Magnetic field and water application gave best results in all seedling parameters compared to unexposed control.
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Key words: Weak Electro-Magnetic Field - Wheat (*Triticum aestivum* L.) - Grain Germination - Seedling Growth.

1. Introduction

The major crops in the Kingdom of Saudi Arabia include cereals (wheat, sorghum, barley and millet), vegetables (tomato, watermelon, eggplant, potato, cucumber and onions), fruits (date-palm, citrus and grapes) and forage crops (alfalfa). These crops are cultivated over an area of nearly 1.1 million hectare which represents about 81 percent of the total cultivated area. In 2009 year, wheat was cultivated over an area of about 744 422 hectare (i.e. 55 percent of the total cultivated area), and production was about 3.5 million tones. (FAOSTAT, 2009).

Electric field is one kind of stress, which can affect directly or indirectly on the plant. Different plant species in their sensitivity and response to environmental stresses because they have various capabilities for stress perception, signaling and response. Over many years, the effects of magnetic fields on plant life have been subjected to several studies. As early as **Savostin (1930)** reported a 100% increase in the rate of elongation of wheat seedlings under the influence of a magnetic field.

Several researches tried to define the effect of such field on the growth rate of the wheat plant. Influence of magnetic field (MF) on the early growth processes in wheat plant grains was studied and the stimulating of MF on the early growth processes, plant grains is attenuated when the ratio between the periods of exposure and intervals between them (the on – off time ratio) increases (**Es, Kov and Darkov, 2003**). **Hanafy *et al* (2006)** indicated that the electric magnetic field of both systems showed a high frequency of chromosomal abnormalities and the treated wheat flower buds showed a marked increase in the frequency of the nonviable pollen grains. They also reported that the changes in the morphological characters where the stem length increased but the spike weight and the number of grains in the spike decreased. Furthermore, their data showed an increase in the total chlorophyll of leaf content and the total carbohydrates in the grains. On the other hand, molecular structure of the extracted Water soluble protein changed the amount of protein in the bands of exposed grains decreased and their molecular weights changed. **Hozayn and Abdul Qados (2010)** reported that the growth parameters and yield components of wheat plants is concomitantly increased when wheat plants irrigated with magnetic water with increasing photosynthetic pigment; endogenous total indole; total phenols and protein synthesis. Earlier studies on the effects of static fields on germination of other plants are summarized in table 1.

Table (1): Summary of previous researches involving static magnetic fields

Seed	Magnetic field strength and period	Effect of exposure	Ref.
Soybean *Glycine max* L. Merrill	Exposed to 2.9-4.6 mile Tesla for 2.2,6.6 and 19.8 seconds periods	Shoot and root formation, fresh weights and chlorophyll quantities were increased in all magnetic field experiments.	Atak, *et al.*, 2003
Tobacco *Nicotiana tabacum* L.	Magnetic field with induction of 0.15 Tesla, at expositions 10, 20 and 30 min.	The germination energy and the germination were increased.	Aladjiyan and Yaieva, 2003
Maize *Zea mays*	Exposed to one of two magnetic field strengths, 125 or 250 mT for different periods of time	Rate of germination was increased.	Fl´orez, *et al*., 2007
Chick-Pea *Cicer arietinum L.*	Magnetic water prepared using permanent magnets (0.32T)	Magnetized water has very affective effects on seeds. The crop production and plant length increase noticeably. Treating water with static magnetic field	Nasher, 2008
Snow pea and Celery *Pisum sativum* var. saccharatum and *Apium graveolens*	Magnetic field in the range of 3.5-136 mT was used for the magnetic treatment of irrigation water.	Treatments were increases in plant yield and water productivity.	Maheshwari and Singh Grewal, 2009
Date Palm *Phoenix dactylifera*	Seedlings were treated with static magnetic field at three levels of (10, 50 and 100 mT) and different durations (30, 60, 180, 240 and 360 min). with alternating magnetic field at 1.5 T for different durations (1, 5, 10 and 15 min).	Results indicated that pigments content (chlorophyll a, chlorophyll b, carotenoids and total pigments) was significantly increased under static magnetic field.	Faten Dhawi and Al-Khayri, 2009
Rose coco beans *Phaseolus vulgaris*	Seeds were exposed to field generated by Helmholtz coil, North Pole or the South Pole with constant magnetic fields of 5 mT, 10 mT, 30 mT and 60 mT. The exposure period was fixed at 3, 4.5 and 6 h and exposed after 12 h incubation.	Maximum seed germination occurred when exposed to South Pole field inducing percent germination of approximately 73% compared to 52% of the control at field strength of 30 mT at exposure period of 4.5 h.	Odhiambo *et al*., 2009
Chickpea (*Cicer arietinum* L.)	Seeds of different varieties of chickpea were exposed in batches to static magnetic fields (1500 X10-4 T of magnetic force) for 30, 50 and 70 min.	The results showed that magnetic field application enhanced seed performance in terms of laboratory germination and among the various duration exposures, 50 and 70 min. exposures gave best results.	Tahir and Hama Karim, 2010
Tomato (*Lycopersicon esculentum* Mill) cv. Castlrock	Exposed to different magnetic strengths (0.1, 0.15 and 0.2 Tesla) for periods of 1, 5, 10 and 15 minutes.	The best results were found by magnetic seed treatment with 0.1 Tesla for 15 min.	Abou El-Yazied, *et al*., 2011

The main objective of this work is to quantify the possible effect of magnetic field strengths (0.3 T at 30 min) treatment on the wheat plant performances such as, germination %, shoot length, root length, shoot L./ root L., seedling length, seedling fresh weight, seedling dry weight and relative water content of different wheat plant cultivars. Effect of magnetic field and irrigation by magnetic water treatments on many of protein patterns in different wheat leaves cultivars were observed.

2. Materials and methods

Plant material

The plant material comprised of nine cultivars of wheat (*Triticum aestivum* L.) including Giza168, Sakha 93, Masr1 and Seds 12 were obtained from Agronomy Research Department, Field Crops Institute, Agriculture Research Centre, Giza, Egypt and Tabouki, Kaseemi, Yamanei, Madini and Nagrani were obtained from Agronomy Research Department, Field Crops Institute, Agriculture Research Centre, Jeddah, Kingdom of Saudi Arabia.

Magnetic treatment

Grains without visible defect, insect damage and malformation were selected and divided into four groups in a complete randomized design. Each group consists of three replicates (a replicate is one Petri dish containing 20 healthy grains). The namely of the groups was as follows, group 1: Exposed to magnetic field and dipping in magnetic water; group2: Exposed to magnetic field and dipping in tap water; group3: Not exposed to magnetic field and dipping in magnetic water, and group 4: Not exposed to magnetic field and dipping in tap water (Control). Drought grains were exposed for 30 minutes to a constant of pulsed magnetic field by placing them between the poles of an electromagnet (58 mm in diameter, located 30 mm apart) with the longitudinal (body) axis oriented along the magnetic lines of force at magnetic field strengths, 0.3 T.

Grain germination was achieved in three replications each with 20 grains placed on two layers of moist filter paper in Petri dishes (imbibed with 15 ml of magnetized water exposed at magnetic field strengths, 0.3 T.). They were placed in the germination incubator at 20 °C in an upright position. After 6 days, germinated seeds were grouped as normal, abnormal seedling, fresh ungerminated and dead grains. Germination percentage was calculated based on normal seedlings of plant research.

Growth parameters

This research was carried out in 2010 - 2011 season at Faculty of Science, North Jeddah Branch - Department of Biological Sciences - University of King Abdul Aziz as to determine the impact of magnetic application on nine wheat cultivars grown under optimum conditions. A complete randomized design with three replications was used. Each replicate consist of 20 grains were sown in a plastic pots (19 cm height, 15 cm diameter) of soil containing mix (2 soil: 1 peat moss). The four groups of each wheat grains cultivar are selected with 60 grains for each cultivar under each treatment. Group 1: Grain exposed to magnetic field and treated (pping & irrigation) by magnetic water; Group2: Grain exposed to magnetic field and treated (dipping & irrigation) by tap water; group3: Grain exposed to magnetic field and treated (dipping & irrigation) by magnetic water, and group 4: Grains not exposed to magnetic field and treated (dipping & irrigation) by tap water (Control). Irrigation was provided as and when required. The plastic pots were maintained in greenhouse under natural light. After three weeks from planting the growth parameters, including, shoot length, root length, shoot L./ root L., seedling length, shoot and root fresh weight and shoot & root dry weight of different wheat plant cultivars were measured and relative water content was calculated according to Henson *et al*. (1981) by the following equation: 100 X (Fresh weight – Dry weight)/Fresh weight.

Protein patterns analyses

Fifty mg dry tissues of nine wheat cultivars leaves which treated by magnetic field and magnetic water compared with un treated control leaves were ground to flour in a mortar by using liquid nitrogen. Total soluble proteins were extracted in SDS reducing buffer, (store at room temperature) composed of Deionized water (38 ml), 0.5 M Tris -HCl -pH 6.8 (10 ml), Glycerol (8 ml), 10 % (w/v) SDS (16 ml), 2-mercapto-ethanol (4ml) and 1% (w/v) Bromophenol blue (4ml) until became total volume 80 ml. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) was carried out in 10% acrylamide slab gels following the system of **(Laemmli, 1970)**. Separating gels composed of 0.75M Tris – HCl pH8.8, 10% SDS, 0.025% of N,N,N,N-tetramethylenediamine (TEMED) and 30% ammonium persulfate. Stacking gels contained 0.57M Tris-HCl pH6.8, 10% SDS, 0.025% TEMED and 30% ammonium persulfate. Electrode buffer contained 0.025M Tris, 0.192M glycine, 0.1% SDS and pH8.3. Electrophoresis was carried out with a current of 25 mA and 130 volts per gel until the bromophenol blue marker reached the bottom of the gel after 3hrs. After electrophoresis, the Commassie Brilliant R250 staining method was used for protein bands and polypeptides.

Statistical analyses

All data were subjected to analysis of variance (ANOVA), and means were compared by two conventional methods of analysis. The LSD values for significant mean differences at levels $P< 0.05$ and 0.01 were separated. All statistical tests were carried out using Costat software.

3. Results and Discussions

Data in (Table 2) Pointed out that all magnetic field treatments increased the percentage of germination and rate germination in all wheat cultivars but higher increments observed when grain exposed to weak magnetic field strengths 0.3 T at 30 min and dipped in magnetic water compared with control.Wheat cultivars such as Giza168, Tabouki, Kaseemi, Yamanei and Madini were observed 100% germination percentage compared with control.The magnetic field stimulates the development of the germ and leads to increasing the germination energy and germination. A hypothesis about the explanation of the results obtained has been proposed, especially about the stimulating effect of the magnetic different grain wheat cultivars treatment depended on the dose of magnetic field and the time of exposure used, these results are in agreement with those reported by **Es,Kov and Darkov (2003)**; **Hanafy *et al*. (2006)** and **Hozayn and Abdul Qados (2010)**, but, **Gusta *et al*. (1978)** who reported that the exposure of dry seeds of wheat, barley and wild oats to a magnetic field had no effect on germination and seedling growth.. On the other hand, **Apasheva *et al*. (2006)** reported that the statistically increase significant results demonstrating the effect of alternating electromagnetic field with different duration of exposure on the rate of seed germination depending on seed state (dry or moistened). Cultivars Sakha93 and Masr1 showed decreased in the percentage of germination and germination rate when exposed to all magnetic field treatments compared with controls, is shown to depend on the extent of membrane stretching and release of peripheral protein from membranes this result garmented with **Aksyonov *et al*. (2007).**

Table (2): Effect of magnetic treatments on germination rate in different wheat grain cultivars after 6 days from grains treatment

Treatments / Cultivars	Percentage of germination end after 6 days									
	Exposure + Dipping Magnetic water		Exposure +Dipping Tap water		No exposure + Dipping Magnetic water		No exposure + Dipping Tap water		Mean	LSD
	Germination Rate	Germination %	Germination Rate	Germination %	Germination Rate	Germination %	Germination Rate	Germination %		
Giza168	60/60	100	50/60	83.33	54/60	90	25/60	83.33	a 94.17	
Sakha 93	40/60	66.67	46/60	76.67	54/60	90	58/60	96.67	ab 90.84	
Tabouki	60/60	100	56/60	93.33	46/60	76.67	46/60	76.67	ab 90.84	
Kaseemi	60/60	100	60/60	100	56/60	93.33	50/60	83.33	abc 89.17	
Masr 1	46/60	76.67	36/60	60	42/60	70	56/60	86.67	bcd 86.67	6.78
Yammanei	60/60	100	60/60	100	46/60	76.67	52/60	86.67	cd 83.34	
Madini	60/60	100	52/60	86.67	58/60	96.67	48/60	80	cd 82.50	
Nagrani	56/60	86.67	48/60	80	54/60	90	46/30	76.67	d 81.67	
Seds 12	52/60	83.33	48/60	80	52/60	86.67	46/60	76.67	e 73.34	

In general, growth parameters including: shoot length, root length, shoot length / root length and seedling length were better with magnetic field treatments comparing with control treatment. The data reported in (Tables 3 and 4) showed that the increase in stimulation rate of many different wheat cultivars (Giza168, Tabouki, Kaseemi, Yamanei, Madini, Nagrani and Seds) in all seedling growth parameters.

Maximum shoot length, root length, shoot length / root length and seedling length parameters was obtained when magnetic grain treatment and magnetically treated water were jointly applied as compared to control treatments. While Sakha93 cultivar observed negative stimulating for magnetic field and magnetic water treatments therefore, recorded decreased significant in all seedling growth parameters that were measurements.

On the other hand, the magnetic treatment doesn't effects on seedling growth parameter for Masr1cv. than those of the control treatment. Similar result was noticed by **Ibrahim and Khafagi (2004)** who found that seedlings from *Pergamum harmala* L. seeds treated with magnetic field were higher significant increasing compared with control. **Hanafy *et al.* (2006)** indicated that the electric magnetic field of both systems showed that the changes in the growth characters where the stem length increased and **Hozayn and Abdul Qados (2010)** who reported that the growth parameter and yield components of wheat plants are concomitantly increased when wheat plants irrigated with magnetic water.

On the other hand, **Kordas (2002)** who mentioned that the effect of a constant magnetic field on the root system and green tops, as well as on yield of spring wheat and in all cases there was observed a slight stimulating effect of the factors examined. Moreover, the growth dynamics were weakened and the plants were shorter, and so were their culms and ears.

Table (3): Effect of magnetic treatments on plant performance (Shoot length and Root length) in different wheat grain cultivars after 21 days from grains treatment.

Treatments / Cultivars	plant performance (cm)											
	Shoot length						Root length					
	Exposure MF		Un exposure MF		Mean	LSD 0.05	Exposure MF		Un exposure MF		Mean	LSD 0.05
	Magnetic water	Tap water	Magnetic water	Tap water			Magnetic water	Tap water	Magnetic water	Tap water		
Giza168	20.11± 0.808332	15.17± 0.823165	17.83± 0.944646	12.67± 0.566647	a 18.46		13.17± 0.094163	10.66± 0.276446	11.41± 0.183848	9.81± 0.304083	a 15.61	
Sakha 93	10.20± 0.642979	14.65± 0.629921	19.02± 0.044969	21.73± 0.348935	b 16.73		8.36± 0.151511	11.61± 0.430426	13.036± 0.024386	13.11± 0.045792	ab 15.16	
Tabouki	21.75± 0.349221	18.97± 0.430581	16.2± 0.571859	10.017± 0.671532	c 16.67		10.27± 0.185532	13.97± 0.469207	12.63± 0.409145	4.47± 0.173269	bc 13.69	
Kaseemi	14.79± 0.644429	20.57± 0.236972	20.13± 0.233381	9.1± 0.268494	d 16.45		15.01± 0.008165	16.99± 0.067987	16.15± 0.469065	12.48± 0.15195	cd 12.79	
Masr 1	19± 0.379327	9.07± 0.102089	14.92± 0.433667	21.53± 0.648811	d 16.45		15.89± 0.123648	10.20± 0.258371	9.85± 0.247117	15.20± 0.08165	de 11.53	
Yammanei	21.22± 0.089938	18.8± 0.286744	14.67± 0.173077	10.48± 0.278248	e 16.4	8.03	12.36± 0.214009	10.70± 0.339935	8.09± 0.143836	4.86± 0.092736	de 11.26	1.85
Madini	20.83± 0.34322	18.07± 0.037712	20.77± 0.374789	14.17± 0.369955	f 16.29		15.75± 0.087305	13.82± 0.302692	17.78± 0.044969	7.42± 0.073485	ef 10.34	
Nagrani	19.82± 0.396569	14.68± 0.090921	21.68± 0.365361	9.6± 0.083799	g 16.15		11.08± 0.08165	9.45± 0.061644	10.43± 0.008165	5.06± 0.132749	f 9.01	
Seds 12	20.40± 0.357802	17.30± 0.137356	18.83± 0.206074	10.15± 0.365908	h 16.13		18.07± 0.03559	16.01± 0.012472	17.33± 0.24931	11.01± 0.012472	f 8.98	
Mean	18.68 a	18.23 ab	16.36 b	13.27 c			13.33 a	12.96 a	12.60 a	9.269 b		
LSD 0.05	2.01						1.23					

Table (4): Effect of magnetic treatments on plant performance (Shoot length / Root length & seedling length) in different wheat grain cultivars after 21 days from grains treatment

Treatments	plant performance											
	Shoot length / Root length						Seedling length (cm)					
	Exposure MF		Un exposure MF		Mean	LSD 0.05	Exposure MF		Un exposure MF		Mean	LSD 0.05
Cultivars	**Magnetic water**	**Tap water**	**Magnetic water**	**Tap water**			**Magnetic water**	**Tap water**	**Magnetic water**	**Tap water**		
Giza168	1.53± 0.102307	1.42± 0.020548	1.56± 0.012472	1.29± 0.04899	a 1.87		33.28± 0.19754	25.83± 0.065997	29.24± 0.08165	22.48± 0.040277	a 32.28	
Sakha 93	1.22± 0.012472	1.26± 0.024495	1.46± 0.024495	1.66± 0.008165	a 1.83		18.56± 0.138884	26.26± 0.041899	32.056± 0.015755	34.84± 0.026247	a 32.15	
Tabouki	2.12± 0.016997	1.36± 0.024495	1.28± 0.012472	2.24± 0.029439	a 1.75		32.02± 0.043205	32.94± 0.109646	28.83± 0.053541	14.487± 0.005907	ab 31.31	
Kaseemi	0.99± 0.101434	1.21± 0.016997	1.25± 0.024495	0.73± 0.028674	b 1.45		29.8± 0.331696	37.56± 0.161314	36.28± 0.115854	21.58± 0.2585	abc 28.92	
Masr 1	1.196± 0.002055	0.889± 0.004497	1.51± 0.020548	1.42± 0.026247	bc 1.43	**0.18**	34.89± 0.086023	19.27± 0.030912	24.77± 0.024944	36.73± 0.179877	abc 27.91	**4.63**
Yammanei	1.72± 0.037417	1.76± 0.024495	1.83± 0.020548	2.16± 0.088066	bc 1.40		33.58± 0.073182	29.5± 0.08165	22.67± 0.012472	15.34± 0.462265	abc 27.71	
Madini	1.32± 0.020548	1.31± 0.012472	1.17± 0.01633	1.91± 0.020548	c 1.26		36.58± 0.326633	31.89± 0.179134	38.55± 0.161107	21.59± 0.100333	bc 27.07	
Nagrani	1.79± 0.012472	1.55± 0.016997	2.08± 0.043205	1.897± 0.003091	d 1.06		30.9± 0.014142	24.13± 0.061283	32.11± 0.063421	14.66± 0.12083	c 25.45	
Seds 12	1.13± 0.028674	1.081± 0.003742	1.09± 0.041737	0.922± 0.012037	d 1.05		38.47± 0.30576	33.31± 0.127105	36.16± 0.258242	21.16± 0.258242	c 25.27	
Mean	1.58 a	1.47 ab	1.45 b	1.32 c			32.01 a	31.19 a	28.97 a	22.54 b		
LSD 0.05	**0.12**						**3.08**					

The data reported in Tables (5,6) reveal that the treatment with magnetic water significantly increased the seedling fresh and dry weight and relative water content percentage in these wheat cultivars (Giza168, Tabouki, Kaseemi, Yamanei, Madini, Nagrani and Seds) when magnetic grain treatment and magnetically treated water were jointly applied as compared to control treatments. While Sakha93 cultivar observed negative stimulating for magnetic field and magnetic water treatments therefore recorded decreased significant in seedling fresh and dry weight and relative water content percentage compared with control treatment. The interactive effect of grain and water magnetic treatments, reveal significant interaction where the highest seedling fresh and dry weight and water content were obtained from those resulted from magnetically treated grains grown in magnetized water. Relative water content percentages at 21 days have shown a significant increase in response to exposure to magnetic field and irrigation with magnetic water. This increment may be attributed to increasing ions mobility and ions uptake improved under magnetic treatments which leads to a better water content stimulation in positive stimulate wheat cultivars Moreover, magnetic field has the ability to change water properties. The above results mentioned to the better role of irrigation with magnetize water on seedling growth, whereas in general the magnetic grain and water treatment surpassed the control treatment. These results coincide with those of **Fl´orez *et al.* (2007)** who reported that maize seedling treated with magnetic field were significantly heavier than the control, **Souza *et al* (2005)** indicated that the pre sowing magnetic treatment of tomato seeds, that led to significant increase in seedling root and stem fresh weight. **Abou El-Yazied *et al.* (2011)** who mentioned that in the nursery experiment, applying the optimal magnetic tomato seeds treatment (0.1 T for 15 min) and/or irrigation with magnetized water gave significant increases in transplant stem length, stem diameter, leaf area and fresh and dry weight than those in the control treatment which grew by untreated seeds and irrigated by ordinary (untreated water) water.

Table (5): Effect of magnetic treatments on seedling fresh and dry weight in different wheat grain cultivars after 21 days from grain treatment

Treatments / Cultivars	Seedling fresh and dry weight (gm)											
	Seedling fresh weight						Seedling dry weight					
	Exposure MF		Un exposure MF		Mean	LSD 0.0	Exposure MF		Un exposure MF		Mean	LSD 0.0
	Magnetic water	Tap water	Magnetic water	Tap water			Magnetic water	Tap water	Magnetic water	Tap water		
Giza168	0.723± 0.029691	0.5617± 0.011878	0.6257± 0.028912	0.487± 0.039064	a 0.67		0.0423± 0.009631	0.0303± 0.001349	0.0317± 0.003027	0.0223± 0.001347	a 0.04	
Sakha 93	0.231± 0.01271	0.385± 0.035462	0.5017± 0.032605	0.7127± 0.03045	ab 0.63		0.0213± 0.001271	0.0313± 0.001271	0.0417± 0.003027	0.054± 0.003682	a 0.04	
Tabouki	0.6223± 0.015976	0.6707± 0.038688	0.5073± 0.044577	0.1953± 0.045331	abc 0.61		0.0417± 0.003126	0.0401± 0.001702	0.0315± 0.002123	0.0157± 0.003197	ab 0.04	
Kaseemi	0.4853± 0.043799	0.7217± 0.01635	0.6497± 0.029303	0.2183± 0.020655	abc 0.59	**0.11**	0.0317± 0.00297	0.0557± 0.003197	0.0550± 0.002944	0.0221± 0.003023	abc 0.04	**0.01**
Masr 1	0.7233± 0.020428	0.5047± 0.046073	0.667± 0.033905	0.7853± 0.043514	abc 0.59		0.0541± 0.003679	0.0221± 0.008552	0.0253± 0.015698	0.0551± 0.002642	abcd 0.04	
Yammanei	0.7553± 0.02284	0.687± 0.039064	0.547± 0.030576	0.4297± 0.038337	bcd 0.52		0.0423± 0.001382	0.0317± 0.001855	0.0223± 0.001837	0.0185± 0.003472	bcd 0.03	
Madini	0.6533± 0.022113	0.6013± 0.018557	0.7253± 0.021234	0.5183± 0.034728	cd 0.49		0.0550 0.004288	0.0413 0.002393	0.0577 0.00641	0.0221 0.005504	cd 0.032	
Nagrani	0.6137± 0.012684	0.4587± 0.035531	0.6806± 0.033946	0.229± 0.038404	cd 0.49		0.0320 0.007608	0.0253 0.014143	0.0417 0.004036	0.0173 0.003681	d 0.0290	
Seds 12	0.7963± 0.060943	0.6497± 0.038396	0.711± 0.021453	0.2383± 0.033918	d 0.46		0.0567± 0.010748	0.0423± 0.001452	0.0551± 0.002082	0.0220± 0.00132	d 0.03	
Mean	0.62 a	0.62 a	0.58 a	0.42 b			0.042 a	0.044 ab	0.04 b	0.028 c		
LSD 0.05	**0.08**						**0.01**					

Table (6): Effect of magnetic treatments on % of relative water content in different wheat grain cultivars after 21 days from grains treatment

Treatments / Cultivars	Relative water content %					
	Exposure +Dipping MW	Exposure +Dipping TW	No exposure + Dipping MW	No exposure + Dipping TW	Mean	LSD
Giza168	**94.15± 0.532812**	**94.61± 0.325611**	**94.93± 0.537463**	**95.42± 0.148997**	a 95.35	
Sakha 93	**90.78± 0.147045**	**91.89± 0.155134**	**91.69± 0.176824**	**92.42± 0.975329**	ab 94.78	
Taboky	**93.29± 0.577485**	**94.02± 1.829432**	**93.79± 0.975329**	**91.96± 0.176824**	bc 94.33	
Kassem	**93.47± 1.414269**	**92.28± 0.975329**	**91.54± 0.176824**	**89.88± 1.122567**	cd 93.89	
Masr 1	**92.52± 0.583229**	**95.62± 1.230239**	**96.21± 0.648194**	**92.98± 0.671764**	d 93.27	
Yammany	**94.39± 0.975329**	**95.39± 0.671764**	**95.92± 0.862915**	**95.69± 0.842312**	de 93.12	0.87
Madany	**91.58± 0.47204**	**93.13± 0.84626**	**92.04± 0.763428**	**95.74± 0.990252**	ef 92.35	
Nagrani	**94.79± 0.519123**	**94.48± 0.546036**	**93.87± 0.501487**	**92.45± 0.910641**	f 91.79	
Sods 12	**92.88± 0.789472**	**93.49± 0.476725**	**92.25± 0.869572**	**90.77± 0.47204**	f 91.69	
Mean	93.88 a	93.58 ab	93.09 b	93.03 b		
LSD 0.05	0.58					

Table (7): Effect of magnetic treatments on number of protein bands in different wheat grain cultivars after 21 days from grains treatment.

Treatments / Cultivars	Number of protein bands			
	Exposure +Dipping MW	Exposure +Dipping TW	No exposure + Dipping MW	No exposure + Dipping TW
Giza168	20	12	14	8
Sakha 93	9	10	14	17
Taboky	14	13	14	5
Kassem	19	7	15	5
Masr 1	15	6	15	15
Yammany	12	12	6	9
Madany	13	12	15	8
Nagrani	15	10	12	8
Sods 12	12	8	16	8

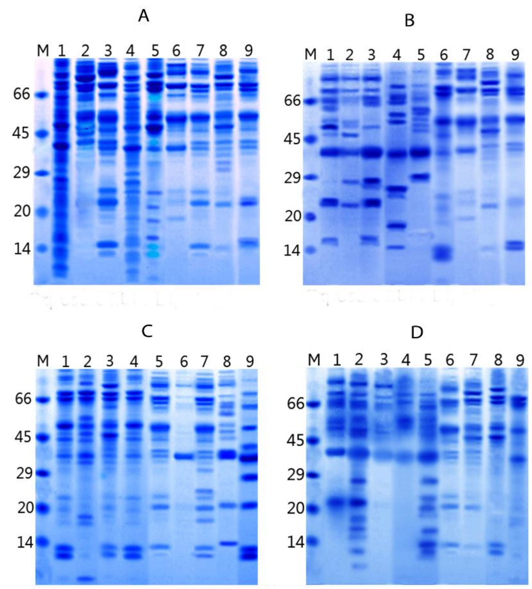

Fig (2): Sodium dodcyle sulphate– polyacrylamide gel electrophoresis (SDS-PAGE) For treated and un treated nine cultivars of wheat seedling cultivars with magnetic field.
(A). Exposed to **magnetic field + Dipping in magnetic water.**
(B). Exposed to **magnetic field + Dipping in tap water.**
(C). No Exposed to **magnetic field + Dipping in magnetic water.**
(D). No Exposed to **magnetic field + Dipping in tap water.**
Lanes 1- 9 (Different wheat cultivars seedling)
Lane M = SDS-Marker.
L1: Giza168, L2: Sakha 93, L3: Tabouki, L4: Kaseemi, L5: Masr1, L6: Yamanei, L7: Madini, L8: Nagrani and L9: Seds 12.

The changes in protein electrophoretic pattern of wheat seedlings treated with magnetic field and water are analyzed and recorded in Table (7) and illustrated in (Figure 2). In the control seedling cultivars (Giza168, Tabouki, Kaseemi, Yamanei, Madini, Nagrani and Seds), the separation of 8, 5, 5, 9, 8, 8, 8 protein bands (PBs) were appeared respectively, while, Sakha93 cv recorded 17 PBs and Masr1 recorded 15 PBs their molecular weights ranged between 78 K Da. and 10 K Da. Magnetic field and water treatments of wheat seedling cultivars (Giza168, Tabouki, Kaseemi, Yamanei, Madini, Nagrani and Seds12) showed an increase in the number of protein bands to 20, 14, 19, 12, 13, 15, 12 PBs were appeared respectively, while, Sakha93 cv recorded 9 PBs and Masr1 recorded 15 PBs their molecular weights ranged between 85 K Da. and 9 K Da. respectively. Therefore, wheat cultivars (Giza168, Tabouki, Kaseemi, Yamanei, Madini, Nagrani and Seds12) gave height increase in protein bands number when grain exposed to magnetic field and irrigated by magnetic water and gave high stimulation rate of novel protein bands forms compared to control treatments. While Sakha93 cultivar observed negative stimulating for magnetic field and magnetic water treatments. On the other hand, the magnetic treatments don’t effects on number of protein bands for Masr1cv. than those of the control treatment. These results indicate that the wheat seedling treated with magnetic field and water characterized by disappearance of certain bands and the appearance of new ones as compared with that of the control plant. Similar result was noticed by **Hozayn *et al.* (2010)** who found that the magnetic water treatment of other wheat cultivars showed an increase in the number of protein bands to 16 bands and the formation of new protein bands in wheat plants treated with magnetic water was accompanied with increasing growth parameters and total indole acetic acid in treated plants. **Shabrangi and Majd (2009)** reported that magnetic field is known as an environmental factor which affects on gene expression, therefore, by augmentation of biological reactions like protein synthesis. **Balouchi *et al.* (2007)** confirmed that MF influences the structures of cell membrane, and increases their permeability and ion transport, which then affects some metabolic pathways. **Moon and chunge (2000)** reported that magnetic field treatments influencing the biochemical processes involve free radicals by stimulating the activity of proteins and enzymes. On the other hand, **Hanafy *et al.*, (2006)** indicated that the data indicated that the molecular structure of the extracted WSP changed the amount of protein in the bands of exposed grains decreased and their molecular weights changed.

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