AJMAS
https://alqalam.utripoli.edu.ly/science/ eISSN 2707-7179

Original article

Protective Role of Magnetic Treatments for Seeds and Sea Water on Germination of *Triticum Aestivum L.* (Wheat)

Widad El-Mugrbi[1], Jamila Bashasha[2*], Seham Mohammeda[3]

[1]*Department of Biology, Faculty of Education Ghemines, Benghazi University, Libya*
[2]*Department of Horticulture, Faculty of Agriculture, Benghazi University, Libya*
[3]*Department of Physics, Faculty of Science, Ajdabya University, Libya*

ARTICLE INFO

Corresponding Email. *jamila.bashasha@uob.edu.ly*
Received: *29-01-2022* ***Accepted***: *07-02-2022* ***Published***: *09-02-2022*
Keywords: *Wheat Cultivars, Sea Water, Magnetic Field.*

ABSTRACT

Objectives. *The present study was conducted to evaluate whether treating sea water or seeds with a magnetic field (14500 Gaus) can improve the germination growth of three cultivars wheat plant Triticum aestivum L.* ***Methods***. *The magnetic treatment involved, exposing the seeds to different periods of magnetization (0, 15, 30 and 45 min) and passing of sea water levels (0, 20, 50 and 80%) through magnetic field (14500 Gaus).* ***Results***. *Using magnetic stimulated seeds or irrigation with magnetized sea water were better compared to the non-treated of three wheat cultivars. The results indicated also that magnetized irrigation water did not affect in germination percentage but the magnetic pre-sowing seed treatment led to an increase in germination percentage, especially under salinity 80% and 45min, compared to the non- treated seeds.* ***Conclusion***. *Magnetic treatment of saline water or seeds improved seed germination, vigor index, shoot and root length of three wheat cultivars under saline conditions.*

Cite this article *El-Mugrbi W, Bashasha J, Mohammeda S. Protective Role of Magnetic Treatments for Seeds and Sea Water on Germination of Triticum Aestivum L. (Wheat). Alq J Med App Sci. 2022;5(1):89-97.*
https://doi.org/10.5281/zenodo.6026924

INTRODUCTION

Salinity is a major environmental stress affecting seriously plant growth and production. It is the most serious water quality problem in agriculture. It affects many irrigated areas mainly due to the use of brackish water. Worldwide, more than 45 million hectares of irrigated land have been damaged by salt, and 1.5 million hectares are taken out of production each year as a result of high salinity levels in the soil [1]. The harmful effects of salinity on plants are associated with ionic, osmotic and oxidative stresses [2]. Ionic components of salinity are related to toxicity of particular ionic species (e.g., Na+ and/ or Cl- stress) to plants as well as nutrient imbalance [3]. Reduces the soil water potential at high soil salt concentration causing in osmotic stress or water deficit. Salinity stress also induces formation of singlet oxygen, superoxide anion, hydrogen peroxide and hydroxyl radical and hence causes oxidative stress in various plants [4].

Improving salinity tolerance of crop plants using magnetic technology is one of the most useful factors affecting plant growth. Magnetically-treated has been used to reduce the effect of salt concentration, increase the quantity and quality of yield and decrease the amounts of irrigation water. It improves the irrigation water quality such as surface tension, conductivity, solubility of salts and pH [5].

Magnetic field pre-sowing seed treatment proved to be attractive in this regard [6, 7]. Researchers revealed that effects of magnetic field treatments either the pre-sowing seed treatment and/or irrigation with magnetized water leads to better plant growth and yield than chemical sorts. Magnetic field pre-sowing seed treatment improved the plant growth under salinity stress [8], stimulation of the process of germination [9], reduced the seed germination time [10], enhanced percentage germination and early seedling growth parameters: root and shoot length, and vigour indices [8, 11], activates protein formation and enzymes activity [12], increased the yield of tomato [13], on wheat [14], on lemon balm [15] and reduced pH value in soil [16].

Besides, this technology is also eco-friendly, non-polluting to the soil and is attractive as being affordable to farmers [17] because at present the safety of environmental is also important along with food production.

Wheat (*Triticum aestivum L.*) plant belong to poaceae family most important food crops, it is a strategic crop that can grow under different soil conditions. For the littleness of water in Libya or the decrease in water resources and the increase in percentage of salinity (salt percentage). The objective of the present study was to examine whether magnetic treatments (seeds or sea water) could alleviate the adverse effects of salt stress on germination and various germination, under laboratory conditions.

MATERIAL AND METHODS

Plant Materials

Three cultivars of *Triticum aestivum* L. (Aksad 901, Karem and Gamina) obtained from faculty of Agriculture - University of Benghazi, to study the effect of magnetic field (14500 Gauss or 1.45 T form Delta water Egypt company, 2018) whether by pre-sowing seeds or irrigation with sea water on cultivars growth under different levels of sea water.

Treatment Types

Water treatments: Two sources of water irrigation were used (magnetized and non-magnetized sea water). Seed treatments: Magnetized before per-sowing for (15, 30 and 45 min.) and non-treated seeds. Saline stress: Three levels of sea water (20, 50 and 80 %) and distilled water as control.

Germination Test

In the first experiment, germination tests of three seed cultivars were carried out under laboratory conditions, to study the effect of magnetically treated seeds and sea water on the germination of wheat grains. Seeds of all cultivars were selected of similar shape and size. The seeds exposed to different times of magnetic treatment (15, 30 and 45min) at strength magnetic (14500 G) were divided into three groups (for each cultivar), each group contain twelve replications (single replication contain ten seeds). Magnetic seeds for each group were divided into two sections, the first section 120 magnetic seeds irrigated with non-magnetic sea water, and the second section contains 120 magnetic seeds irrigated with magnetic sea water. In the second experiment, the seeds of three cultivars non-exposed to magnetic treatment were divided into two groups, each group contain twelve replications (single replication contain ten seeds). In the first group, seeds irrigated with non-magnetic sea water. While, in the second group, the seeds irrigated with magnetic sea water. Each seeds (magnetic or non-magnetic) were placed in petri dishes lined with double layers of filter papers and added different concentrations of magnetic sea water and non-magnetic sea water of every treatments, under control laboratory condition seeds allowed to germinated for one week for germinated measurements.

Measurements

The germination percentage, vigor index, shoot and root length were measured.

*Vigour index = Germination% * Seedling length (Root + Shoot),* [9].

Surface tension of sea water

The surface tension is measured by applying a drop weight method using a Stella meter. The device is placed in a vertical position by a holder and filled with sample water. The cup is placed under the holder after knowing its weight is empty, and then allowed to get water from it and start counting 50 drops and repeat it. The average number of drops is taken and the value of the intermediate mass m' is subtracted from the mass of the empty cup and divided by 50 to estimate the mass of one drop, shown in a table (1).

The surface tension of the water sample is calculated using the following relationship:

$$\gamma = \frac{m\,g}{3.8\,r} \qquad (dyn/cm)$$

m is the mass of one drop, r is the radius of the tube, and g is the gravity which equals 980 cm/s [18].

Statistical analysis

Statistical analysis of the differently treated groups was performed with SPSS 13.0 for Windows software. The results were subjected to an analysis of variance (ANOVA) and mean differences were determined using the least significant difference (*LSD*) test, at the *5%* level of significance.

Table 1: surface tension of sea water.

Sea-water levels%	surface tension	
	Non- magnetized	Magnetized
0	105.0147	95.6274
20	100.4758	95.5242
50	96.7105	92.7389
80	102.4874	96.2463

RESULTS

Magnetic treatment of water and seeds

According to the study results, germination percentages, vigor index, shoot and root length were higher in plants grown with magnetic treatments (seeds or sea water) than those grown without magnetic sea water treatment of all three cultivars (Aksad, karim and Gamina). The germination process generally, decreased linearly in response to increase sea water levels (Figures 1).

The germination percentages of all wheat cultivars in general were one hundred percent, in response to magnetic seed treatment (15, 30 and 45min), and sea water level (magnetized and ordinary). Except for Aksad cultivar at magnetic treatment 15 min was (90%) and (98.3%) at 30 min. Under 80% magnetic sea water level and karim cultivar at 20 and 80 magmatic sea water which were (98.3 %). Moreover, increased salinity without magnetic treatment (20 to 80 %) caused a significant decrease in germination percentages of Aksad and Karem cultivar compared to control at 15min, and Aksad cultivar at 50 and 80% treatments at 30 min reduced to 98.3 compared with control (Fig.1).

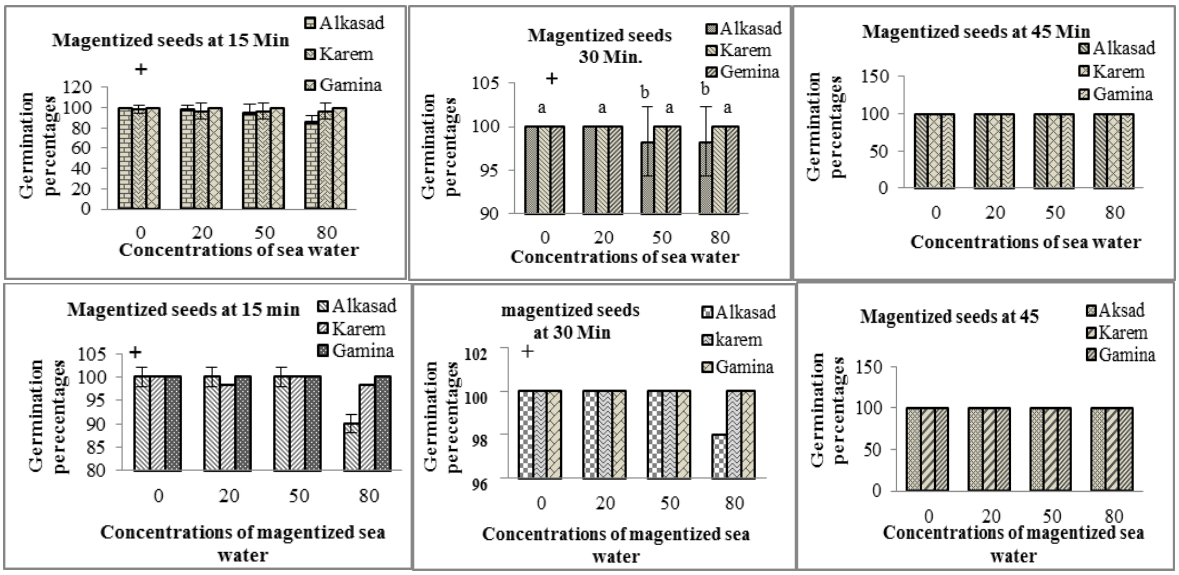

Figure 1. Response of seed germination percentages to magnetic field of seeds and irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). + = Not significant. Different letters = significant, similar letters = not significant

Shoot length was significantly increased when plants were irrigated with magnetically treated sea water compared to seedling irrigated with untreated sea water of all cultivars (Fig. 2). The salinity levels of the irrigation water caused reduced shoot length of all wheat cultivars in both treatments (magnetized and ordinary). From the results obtained it could be observed that, magnetic treatment (seed and sea water) with salinity levels led to general a significant reduced in root length of three wheat cultivars compared with control at 15 ,30 and 45min, except for Aksad cultivar at 45 min was a significant increase with increment salinity level (Fig. 3). Comparing to non- magnetic sea water, it which caused a significant increase in root length especially when irrigating with saline water (50-80%) at different time.

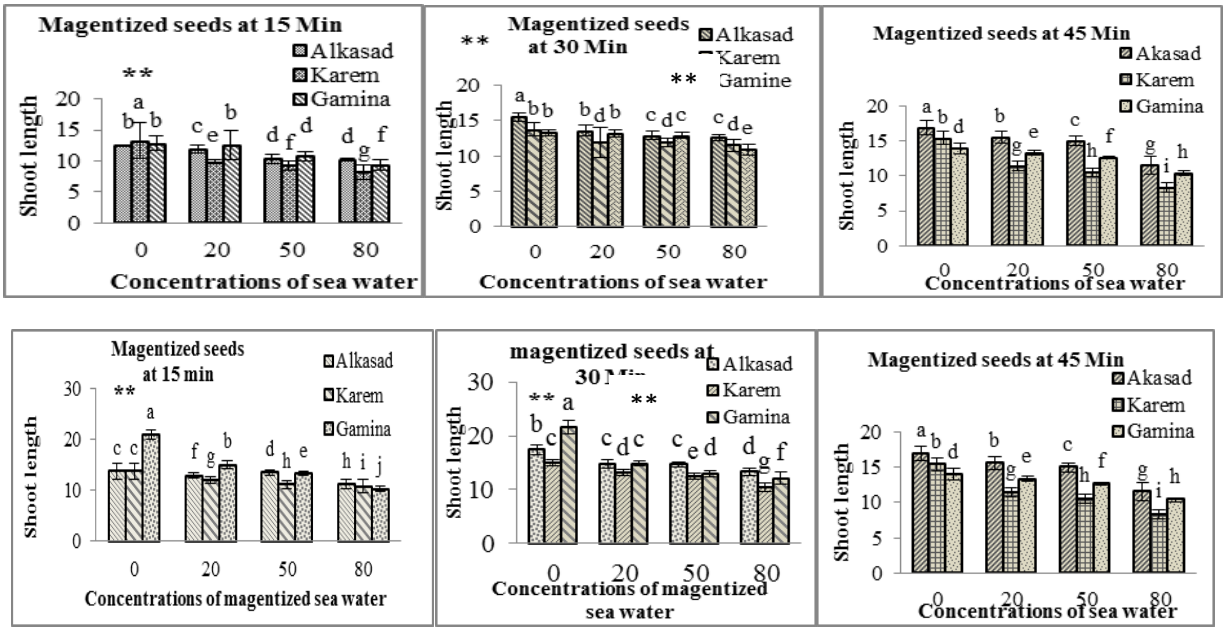

Figure 2. Response of shoot length to magnetic field of seeds and irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). **significant (p<0.01). Different letters = Significant, similar letters = not significant

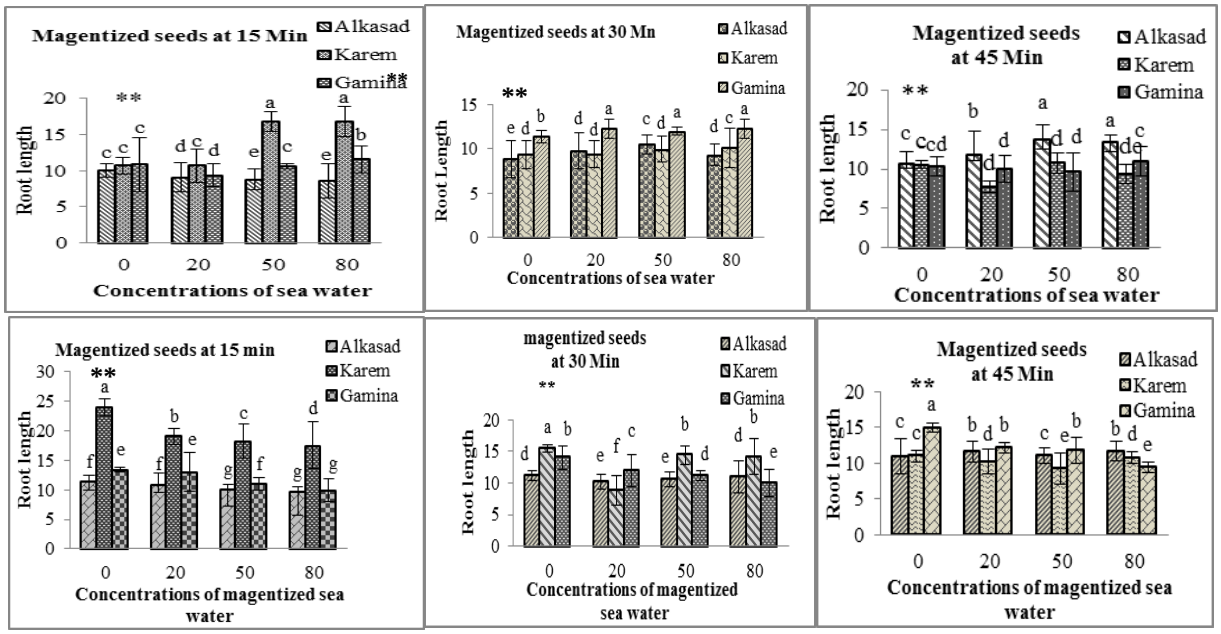

Figure 3. Response root length to magnetic field of seeds and irrigation sea water of three coefficient of germination wheat cultivars (Aksad, Karem and Gamina). **significant (p<0.01). Different letters = significant, similar letters = not significant

It is clear from results presented in Figure 4, that the application of magnetized irrigation sea water significantly increased on vigor index as compared with untreated irrigation sea water of three wheat cultivars, at control and other different sea water concentrations of all times of magnetic treatment (15, 30 and 45 Min). In addition, different levels of sea water (magnetized and ordinary) caused a general significant decreased in vigor index with increase salinity level of all wheat cultivars at different time. The greatest value of vigor index (3783.3) was recorded for the seed irrigated with magnetized

distilled water of Karim cultivar at 15 min, while the lowest value was (1631) at level 80 % of non-magnetized sea water of Aksad cultivar at 15 min.

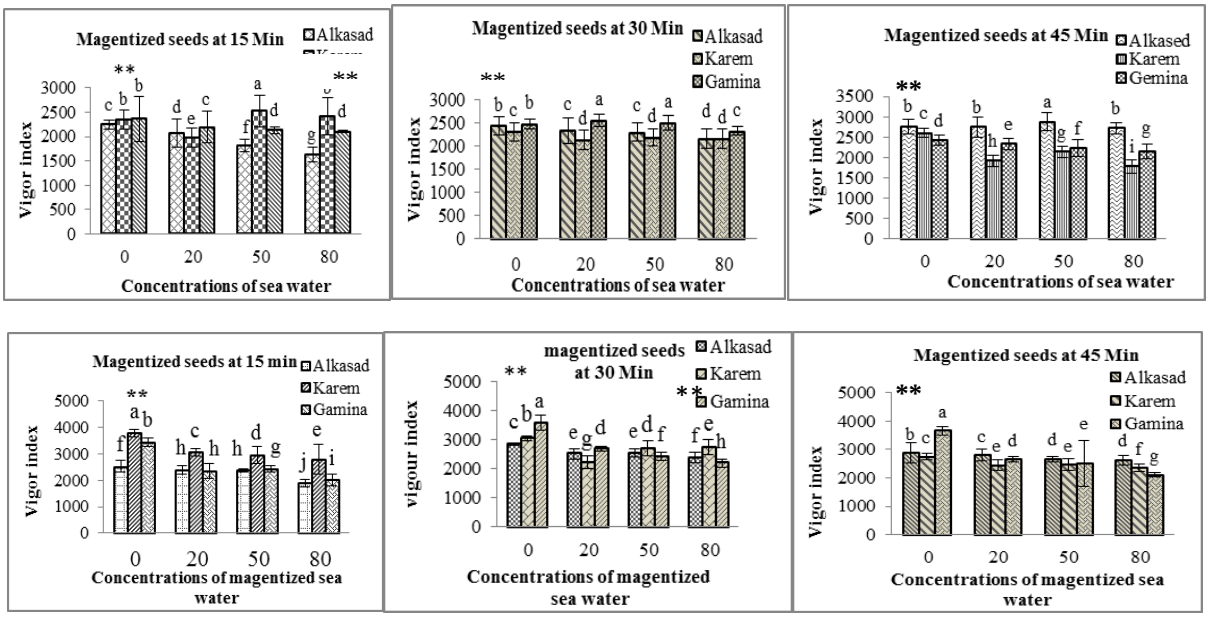

Figure 4. Response of coefficient velocity of germination to magnetic field of seeds and irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). **significant (p<0.01). Different letters = significant similar letters = not significant

Magnetic treatment of water

The effects of magnetic treatment of sea water (0, 20, 50 and 80%) caused a general improved significantly in the all estimated growth parameters (Figures 5-8) as compared to untreated irrigation sea water values of three wheat cultivars. Seeds germination percentage, there was a significant response with respect to the interaction between magnetic treatment of water and salinity levels. The germination percentages of seeds germinated in magnetically-treated water was higher than those germinated in untreated water especially at 50 and 80%. Seeds irrigated with magnetically-treated water had a higher average germination percentage (86.6, 6.66 and 76.6%) than those incubated with untreated water (93.3, 50 and 86.6%) of Aksad, Karim and Gamina cultivars respectively (Figure 5).

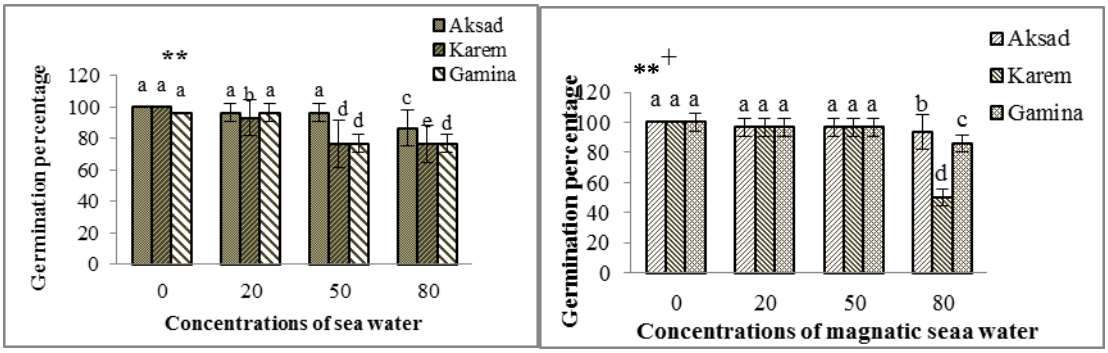

Figure 5. Response seed germination of magnetic and non-magnetic irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). + = Not significant ** = Significant (p<0.01). Different letters = Significant, similar letters = not significant

For shoot length was significantly increased when seeds were irrigation with magnetically treated sea water compared to seeds irrigation with untreated water. The highest shoot length was 17.77cm in magnetically-treated water (0%) of Gamina

cultivar and magnetically-treated sea water at 20% salinity 6.24cm of Aksad cultivar. On the other hand, the lowest shoot length was 0 % in the treated with 80% salinity of three wheat cultivars (Figure 6).
Root length was significantly increased when seeds were irrigation with a magnetic water (0, 20, 50 and 80%) compared to untreated seeds (Fig 7), except Karim and Gamina cultivars by treated with (50 and 20%) respectively , which increased by irrigation untreated sea water as compared to treated , whereas at 80% saline, magnetic treatment of water did not effect on root length of Karim cultivar.

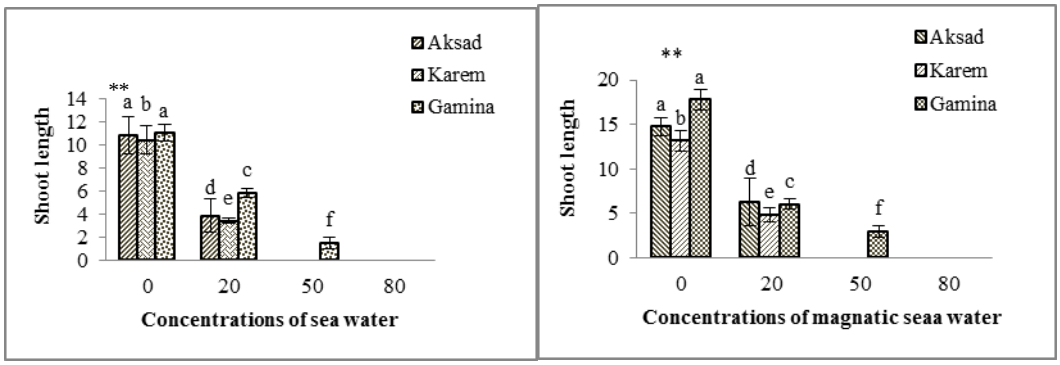

Figure 6. Response Shoot length of magnetic and non-magnetic irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). **significant (p<0.01). Different letters = significant, similar letters = Not significant

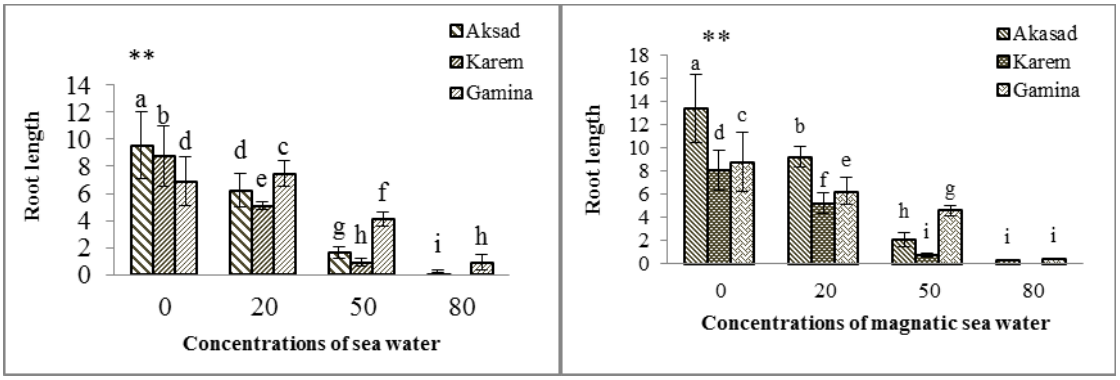

Figure. 7. Response Root length of magnetic and non-magnetic irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). **significant (p<0.01). Different letters = significant, similar letters = not significant

Magnetic treatment of water significantly accelerated germination by increasing vigor index at all levels of sea water compared to untreated water (Fig 8). Generally, exposure time was a determinant factor for the germination process of three wheat seeds and best germination process was obtained with high exposure time (45 min.) in both sea water treatment (magnetized and ordinary) compared to untreated seed.

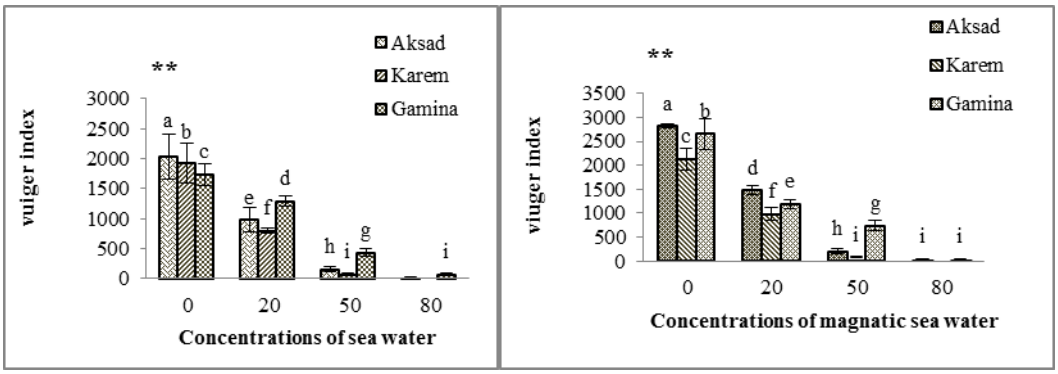

Figure 8. Response coefficient velocity of germination to magnetic and non-magnetic irrigation sea water of three wheat cultivars (Aksad, Karem and Gamina). **significant (p<0.01). Different letters = significant. Similar letters = not significant

DISCUSSION

The results obtained in this experiment showed a negative impact of salinity, the increase in salinity level caused general decrease of seed germination percentage, vigor index, shoot and root length two laboratory experiments. Similar effect of salinity were reported on wheat [19], sweet corn [20], pear seedlings [21], tomato [22]. The reduction in plant growth under salinity could be due to osmotic stress (causing water deficit), ion toxicity, which can cause changes to certain enzymatic or hormonal activities of the seed. These physicochemical effects upon the seed seem to result in a slower and/or lower rate of germination [23]. Salinity can also affect germination by inhibition of cell division, hindering water uptake by seeds [24]. There was a significant reduction in tomato shoot fresh and dry weight [25] and stem and leaf dry weights [26] in response to salinity stress.

A technology of magnetization applied to either water or seeds has been shown to significantly improve seed germination and plant growth of many species [22]. In the present study, magnetic field application (water or seeds) enhanced the percentage of germinated seed, vigor index, shoot and root length on the treated group compared with non-treated group of three wheat cultivars, especially treated with 80% salinity. Enhancement in seed germination and seed vigor by magnetic treatment may be due to changes in intracellular levels of $Ca2^{+}$ and in other ionic current density across cellular membrane caused alteration in osmotic pressure and changed in the capacity of cellular tissues to absorb water [27], biostimulation on the initial growth stages, and activates protein formation and enzymes activity [28] an increase in water uptake rate [29] changes in the course of certain biochemical and physiological processes inside the seeds and plants which have a positive effect on the development and productivity of plants [30] .

The results of the present study indicated that magnetization of water or seeds had a greater impact under salinity stress, this result is in harmony with that of Rochalska [31] found magnetic field treatment improved the germination process under stress conditions. Magnetically-treated water increased seedling length compared with untreated water, as for pre-sowing seeds, the best results were obtained by magnetized seeds as compared to the untreated seeds. These results are agreement with those obtained by Samarah, et al. [22] who showed that the pre-sowing magnetic treatment of tomato led to increase seed germination and productivity under salinity stress. Pietruszewski and Kania [32] observed accelerated germination after magnetic stimulation of wheat seeds. They worked with 30, 45 and 60 mT magnetic field strengths, an increase in germination and shoot development in seeds exposed to 150 mT magnetic field for 10, 15, 20 and 30 minutes [33].

Baghel et al. [34] stated that, pre-treated of maize and soybean seeds with static magnetic field of 200 mT for 1 h enhanced percentage germination and early seedling growth parameters (root and shoot length, and vigour indices) under saline conditions. Also, the exposure of seeds in magnetic field for 15 and 30 minutes gave statistically significant better results than control in in cotton seeds [35] . The greatest stimulation of growth was observed in seeds exposed to a magnetic field for 45min. Similar results were also reported by Esitken and Turan [36] on strawberry, [37] on sugar beet, on cereal seed [38].

CONCLUSION

Salinity stress reduced seed germination percentage, vigor index, shoot and root length of three wheat cultivars. Magnetic treatment of water or seeds improved growth parameters in two laboratory experiments, especially under salinity stress of

80% and 45 minutes. Magnetic treatment of water or seeds were effective methods to enhance the seed germination of wheat.

Disclaimer

The article has not been previously presented or published, and is not part of a thesis project.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

REFERENCES

1. Munns R, Tester M. Mechanisms of Salinity Tolerance. Annual Review of Plant Biology. 2008; 59: 651-681.
2. Mansour M.M.F. Plasma membrane permeability as an indicator of salt tolerance in plants. Biologia Plantarum.2013; 57: 1–10.
3. MansourM.M.F, Salama K. H.A, Allam H.Y.H. Role of the plasma membrane in saline conditions: Lipids and proteins. Botanical Review. 2015; 81: 416-451 .
4. Sharma P, Jha A.B , Dubey R.S, Pessarakli M. Reactive oxygen species, oxidative damage, and antioxidative defense mechanism in plants under stressful conditions. J. Botany. 2012; 1-26.
5. Grewal HS, Maheshwari BL. Magnetic treatment of irrigation water and snow pea and chickpea seeds enhances early growth and nutrient contents of seedlings. Bioelectromagnetics. 2011; 32:58-65.
6. Iqbal M., Haq Z, Jamil Y, Ahmad M. Effect of presowing magnetic treatment on properties of pea. Int Agrophys. 2010; 26:25–9.
7. Prokop M, Pietruszewski S, Konarzynski K. The preliminary investigation of magnetic and electric fields influence on germination, crops, and mechanical features of radish and skall radish roots. Acta Agrophys. 2002; 62:83–93.
8. Kataria S, Baghel L, Guruprasad K. Pre-treatment of seeds with static magnetic field improves germination and early growth characteristics under salt stress in maize and soybean. Biocatalysis and Agricultural Biotechnology, DOI: 10.1016/j.bcab. 2017; 02.010.
9. Pietruszewski S, Martínez E. Magnetic field as a method of improving the quality of sowing material: a review. Int. Agrophys. 2015; 29: 377-389
10. Abou El-Yazied A, Shalaby O. A, El-Gizawy A, Khalf S, El-Satar A. Effect of Magnetic Field on Seed Germination and Transplant Growth of Tomato. Journal of American Science. 2011; 7(12):306-312.
11. Moon J-D, Chung H-S. Acceleration of germination of tomato seed by applying AC electric and magnetic fields. J. Electrostat. 2000; 48:103-114.
12. Aladjadjiyan A. Influence of stationary magnetic field on lentil seeds. Int. Agrophys.2010; 24(3), 321-324.
13. Efthimiadou A, Katsenios N, Karkanis A, Papastylianou P, Triantafyllidis V, Travlos I, Bilalis D. Effects of Presowing Pulsed Electromagnetic Treatment of Tomato Seed on Growth, Yield, and Lycopene Content. The Scientific World Journal. 2014; ID 369745, 6.
14. Hozayn M, Qados A.M.S.A. Magnetic water application for improving wheat (Triticum aestivumL.) crop production. Agriculture and Biology Journal of North America. 2010; 1(4): 677-682.
15. Zakeri A, Khavari-Nejad R, Saadatmand S, Kootanaee F, Abbaszadeh R. The effect of electromagnetic eretreatment on lemon balm (*Melissa officinalis* L.) seeds subjected to static magnetic fields. Biology and Environment. 2020;120(1):39-50 .
16. Abou El-Yozied A, El-Gizawy A, Khalf S, El-Satar A, Shalaby O.A. Effect of magnetic field treatment and irrigation water as well as N, P, and K levels on productivity of tomato plants. J. Appl. Sci. Res. 2012; 8(4):2088-2099.
17. Iqbal M., ul Haq Z, Malik A, Ayoub CM., Jamil Y, Nisar J. Presowing seed magnetic field stimulation: a good option to enhance bitter gourd germination, seedling growth and yield characteristics. Biocatal Agric Biotechnol. 2016; 5:30–7.
18. Zaki A, Sharma N. P, Zein M. M. Practical physic. First edition. 1980.
19. Bashasha J, El-Mugrbi W, Imryed Y. Effect of magnetic treatment in improve growth of three wheat cultivars irrigated with seawater. International Journal of Multidisciplinary Sciences and Advanced Technology. 2021;1: 24–32.

20. Ashraf M, Rauf H. Inducing salt tolerance in maize (Zea mays L.) through seed priming with chloride salts: Growth and ion transport at early growth stages. Acta Physiologiae Plantarum. 2001; 23(4): 407-414. doi:10.1007/s11738-001-0050-9.
21. Osman E, Abd El-Latif K, Hussien S, Sherif A. Assessing the effect of irrigation with different levels of saline water on growth parameters and mineral contents of pear seedlings. Global Journal of Scientific Researches. 2014; 2(5):128-136.
22. Samarah N, Bany Hani M, Makhadmeh I. Effect of Magnetic Treatment of Water or Seeds on Germination and Productivity of Tomato Plants under Salinity Stress. Horticulturae. 2021; 7, 220. https://doi.org/10.3390/horticulturae7080220.
23. Shannon M.C, Grieve C.M. Tolerance of vegetables to salinity. Scientia Hort.1999; 78, 5–38.
24. Romero-Aranda R, Soria T , Cuartero J. Tomato plant-water uptake and plant-water relationships under saline growth conditions. Plant Sci.2001; 160: 265–272.
25. Bolarin M, Perez-Alfocea F, Cano E, Estan M, Caro M. Growth, fruit yield, and ion concentration in tomato genotypes after pre-and post-emergence salt treatments. J. Am. Soc. Hortic. Sci.1993; 118, 655–660.
26. Hajer A, Malibari A, Al-Zahrani H, Almaghrabi O. Responses of three tomato cultivars to sea water salinity 1. Effect of salinity on the seedling growth. Afr. J. Biotechnol.2006; 5: 855–861.
27. Garcia Reina F, Arza Pascual L. Influence of a stationary magnetic field on water relations in lettuce seeds. Part I: Theoretical considerations. Bioelectromagnetics. 2001; 22(8), 596-602.
28. Babarinde A, Onyiaocha GO. Equilibrium sorption of divalent metal ions onto groundnut (Arachis hypogaea) shell: kinetics, isotherm and thermodynamics. Chem Int. 2016; 2:37–46.
29. Ülgen C, birinci yildirim A, Uçar türker A. Effect of Magnetic Field Treatments on Seed Germination of Melissa officinalis L. International Journal of Secondary Metabolite. 2017; 4(3): 43-49.
30. Michalak I, Lewandowska S, Niemczyk K, Detyna J, Bujak H, Arik P, Bartniczak A. Germination of soybean seeds exposed to the static/alternating magnetic field and algal extract . Eng Life Sci. 2019; 19 (12):986–999.
31. Rochalska M. Improving of seeds quality with the frequent magnetic field. Part I. Laboratory experiments.2001.
32. Pietruszewski S, Kania K. Effect of magnetic field on germination and yield of wheat. Int. Agroph. 2010; 24:297–302.
33. Aladjadjiyan A. Study of the influence of magnetic field on some biological characteristics of Zea mais. Journal of Central European Agriculture. 2002; 3 (2):89-94.
34. Baghel L, Kataria S, Guruprasad K. Pre-treatment of seeds with static magnetic field improves germination and early growth characteristics under salt stress in maize and soybean. Biocatalysis and Agricultural Biotechnology. 2017; 10: 83-90.
35. Bilalis D, Katsenios N, Efthimiadou A, Karkanis A, Khah E, Mitsis T. Magnetic field pre-sowing treatment as an organic friendly technique to promote plant growth and chemical elements accumulation in early stages of cotton. AJCS. 2013; 7(1):46-50.
36. Esitken A, Turan M. Alternating magnetic field effects on yield and plant nutrient element composition of strawberry (Fragaria × ananassa cv. Camarosa). Acta Agriculturae Scandinavica. 2004; 54: 135–139.
37. Rochalska M. Influence of frequent magnetic field on chlorophyll content in leaves of sugar beet plants. Nukleonika. 2005; 50: S25–S28.
38. Martinez E, Florez M, Carbonell M. Stimulatory Effect of the Magnetic Treatment on the Germination of Cereal Seeds. International Journal of Environment, Agriculture and Biotechnology. 2017; 2(1):375-381.