The Effect of Different Concentrations of Magnetic Seawater on Different Plant Species Growth

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This Thesis: (The Effect of Different Concentrations of Magnetic Seawater on Different Plant Species Growth) was Successfully Defended and Approved

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بِسْــــــمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿اقرأ باسم ربِّكَ الَّذي خلق (1) خَلقَ الإنسانَ من

عَلق (2) اقرأ وربُّكَ الأكرم (3) الَّذي علَّمَ بالقَلم

(4) علَّم الإنسانَ ما لم يعلم (5) ﴾

صَـــــدَقَ اللهُ العَظِيم

سورة العلق (1–5)

Acknowledgement

First I would like to extend my full thanks to **God**, for his pushing power and great help in accomplishing this work. Also I would like to express my special appreciation and thanks to my supervisor **Dr. Mohamed Hamoda** for his magnificent help and my co-supervisor **Dr. Salem El shatshat** for his guidance, patience, and genuine advice in the preparation of this research.I also would like to thank everyone who work in the **Department of Botany, Faculty of Science, Benghazi University** for their help in the completion of this work.

Dedication

I dedicate my gratitude toward to my father for his co-operation and support during the study, my mother that gives me all tenderness and love, my sisters for their continuous encouragement and every one helped me and provides the advice and support.The product of this research paper would not be possible without all of them.

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Abstract

This study was carried out in the laboratory of botany faculty sciences at university of Benghazi during summer/ 2016. Two experiments were conducted first experiment was to determine the effects of different levels of water sea water dilutions of 1%, 2%, 5%, 10% and 20% on germination percentage, root and shoot lengths of five receptor plants: (tomato, wheat, cucumber, radish and lettuce). In this experiment, petri dishes lined with double layer of filter paper moisten with 5 ml of specific sea water dilution were used as medium for growth, the plates were irrigated daily with sea water dilution, this experiment was conducted in three replicate for each experiment, germination percentages were calculated at the end of the experiment the results of this experiment revealed that germination percentages of tomato varieties, decrease with increased sea water dilutions level, Both tomato verities are moderately sensitive to sea water dilutions, germination decreased at sea water dilution of 5%, no germination had occurred at higher dilutions of (10% and 20%). Both shoot and root length were reduced by increased sea water dilutions but shoot were more affected by sea water dilutions, Imported tomato was more sensitive to

sea water dilutions than local tomato. Wheat and radish showed 100 % germination at all sea water dilutions levels, root and shoot of radish were not significantly affected by sea water dilutions.Cucumber and lettuce showed more sensitivity to sea water dilutions. The second experiment was to compare the effect of salinity with the effect of magnetic sea water. Seedling development experiment was conducted on radish and two varieties of tomato (local and imported), using different dilutions of sea water and magnetic sea water, three seeds of each plant were planted in pots and were irrigated for 40 days and development parameters were measured (whole plant length, shoot length, root length, dry weight, fresh weight, number of leaves, and leaves surface area, the results of the experiment revealed that, Radish development was not significantly affected by salinity, the impact of sea water dilutions stress on radish shoot, whole length and leaves number was significant, but sea water dilutions showed no significant effect on leaves surface area, root lengthen, dry and fresh weight, while in tomato all growth parameters were reduced with increased sea water dilutions levels. Negative impact of magnetic sea water on seedling development of radish and tomato were observed in this experiment.

1. Introduction

Water blessing courtesy of God for life, it's the main element for the stability of humanity, even in the water characteristics and qualities that distinguish it from many other liquids and the most important of these properties is the presence in the same components and features in the three solid, liquid and gaseous cases, a feature that is only available in the water. Water and life are closely linked. This has been recognized throughout history by civilizations and religions and is still the case with scientists today (Miller, 1953). Liquid water is required for life to start and for life to continue. No enzymes work in the absence of water molecules. No other liquid can replace water. The development of life required this water.

Large areas of globally are suffering from serious degradation such as soil salinization and sodicity (Karen, 1994). Secondary salinization is widely considered as a key process leading to degradation and desertification of the world's dry lands (Thomas and Middleton, 1993), water logging and the combination of these factors results from soil salinization and sodicity, which are the most common forms of degradation (Szabolcs, 1994). The magnitude of these factors is especially severe in arid and semi-arid regions of the world , and they result in loss of soil fertility and vegetation cover, and therefore increase environmental problems (Singh and Singh, 1995). It has been estimated that about one billion hectares of the world's land is affected by salt. Of this 60% is cultivated. In a fraction of these soils, salt accumulation in the soil profile can be attributed to natural processes, but in the majority of cases it is brought about by human intervention due to introduction of irrigation, use of saline water or due to other developmental works leading ultimately to accumulation of salts (Goyal *et al.,*2003). Salinity is increasing at an alarming rate and has already converted vast fertile lands into bare degraded soils. The impact of salinity on the economic exploitation of land for agriculture and forestry is very severe (Singh and Singh, 1995).

1.1. Magnetic water:

The magnetic water is a type of water that passes through a constant magnetic field. Irrigation water filtration by magnetic field causes positive changes in physical and chemical properties of the water such as pH, electrical conductivity, interfacial tension, solubility of salts and minerals, wetting properties and so causes increasing of the water quality (Xiao-Feng and Bo, 2008; Samadyar *et al.*, 2014). Researchers believe that by passing the water through a magnetic field, the complex structure of the water is converted to a simple structure. The force of interfacial tension of the water is reduced and freedom of action, fluidity and wetting properties of the water molecules are increased. Thus, the magnetic water is absorbed by the plant more easily compared with nonmagnetic water and causes increasing of the growth and performance of the plan by increasing and improving nutrient absorption and soluble minerals in the soil and the water (Xiao-Feng and Bo, 2008; Ran *et al.*, 2009).

Ran *et al.* (2009) reported that passing the water through a magnetic field increases the number of water molecules in the volume unit and increases the ability of water molecules to absorb nutrients. These researchers believe that irrigation with the magnetic water increases the absorption of minerals and nutrients by the plants and as a result increases the growth and yield. In addition to the water quality, the quantity of water also affects the quantitative and qualitative properties of plants.

Aim of this study:

1. Determine the response of different plant species to different dilutions of magnetic seawater and its effect on the morphological characteristics and growth rate of plant species and verities.
2. Access to the best mixing between fresh water and magnetic sea water and used it to irrigate agricultural crops and how to take advantage of the magnetic sea water.

2. Literature review

2.1. Back ground:

Agriculture is the main user of water. However, because of the increase in demand from other users and the occurrence of drought in many countries, water resource has become scarce and limited. The use of saline water for agricultural production in water scarcity regions requires innovative and sustainable research, and an appropriate transfer of technologies. There is a pressing need for a system (technology roll e.g. magnetic field) that can help by saline water. The use of sea water diluted should be considered as complementary sources for the expansion of irrigated agriculture and agricultural development. The water treated by pass during a magnetic device called magnetized water. The effects of magnetic fields on running water have been observed for years. This technology was used mainly in countries which have very little chemical industry, like Russia, China, Poland and Bulgaria, who all reported the successful use of magnets in treating water for irrigation, industry and home use. Till 1980, a little were known about how the magnetic field can stimulate plant growth or even prevent (Mahmoud and Amira, 2010).

Recent years, there has been a rapid increase in the use of technologies employing magnetic water. The magnetized water is made by ordinary water which is allowed to get through the magnetic field of certain intensity with a certain flow rate, along with a direction perpendicular to the magnetic field lines. The physical and chemical properties of magnetized water have a series of changes which lead to special functions (Dandan and Shi, 2013). A considerable amount of researches on effects of magnetized water on crops physiological and biochemical (Qiu *et al*., 2011; Zhou *et al*., 2012) and few researches on magnetized saline solution treatment on crop growth and development (Shimin and Guocheng, 2000).

2.2. Review of previous studies:

Magnetic sea water improved the plant growth characteristics and nutrients uptake in tomato and soybean (Carbonell *et al.,* 2011; Radhakrishnan and Kumari, 2012), root function (Aladjadjiyan, 2010), influenced the chemical composition of plants, activate plant enzymes (Alikamanoglu and Sen, 2011; Shabrangi *et al*., 2011), wheat (Hozayn and Abdul Qados, 2010), Maize (Zepeda *et al*., 2011).In this sense, Ahmed (2013) reported that improvement in tomato plant growth parameters which reflected in yield per plant was increased until the treatment of 6000 ppm magnetic water. Also he found that significant increase in plant growth, some chemical contents, fresh and dry weights of plant occurred compared to control. Mahmoud *et al*., (2011) found that using magnetic treatment on Wheat, lentil, Flax and Chick-pea increased biochemical components such as photosynthetic pigments, also protein content was increased significantly in plants treated with magnetic water. Magnetic fields have been reported to exert a positive effect on barley plant growth and development (Martínez *et al*., 2000), on tree growth (Ruzic *et al*., 1998a). Mahmoud and Amira (2010) on chick pea plant with magnetized water significantly increased tested for plant height, fresh and dry weight (g/plant) and protein content of Chick-pea. In a few words, irrigation with magnetically treated water or/and magnetic seed treatment are friendly environmental techniques. Therefore, they take an important place in the list of environmental clean methods and harmless technology (Aguilar *et al.*, 2009; Nimmi and Madhu, 2009 and Abou El-Yazied, 2011). Reducing the electrical conductivity of the magnetic field leads to breaking of water structure, and by reducing the surface tension of water causes more freedom and mobility of water molecules, and the solubility of available nutrients for plants is increased. Then, it increases the photosynthesis and food production ability of the plant by increasing the uptake of water and nutrients by the roots of the plant, and these factors increase the vegetative and reproductive growth and yield of the plants (Nasher, 2008; Ran *et al*., 2009; Hozayn and Abdul Qados, 2010; Nikbakht *et al.,* 2013).

The magnetic water with suitable interval for irrigation, by more and better providing nutrients, provides better conditions for the plant compared with nonmagnetic water and causes to maintain and increase the quality and quantity of the periwinkle plant (Hashemabadi *et al*; 2015) Passing water through a magnetic field, absorption of minerals, useful salts and elements in soil and water is increased because of more solubility and freedom of water molecules (Ahmadi, 2010). (Lin and Yotvat, 1990) stated that magnetic water increases the absorption of phosphorus and calcium of the soil that by plant and increases growth and yield of the plant. The use of magnetic water for irrigation of celery and pea increases the concentration of calcium and phosphorus in the shoot (Maheshwari and Grewal, 2009).

Nasher evaluated that using the magnetic water has a positive effect on culturing pea and stated that it is because of increasing of the solving power of the magnetic water and absorbing more nutrients from the soil (Nasher, 2008).

Tuzel and others investigated the effect of irrigation periods of 1, 2 and 4 times a day on the bag culture of tomato. The obtained results of these researchers showed that by increasing the irrigation period from 1 to 4 times per day, yield, number and average weight of the fruits were increased (Tuzel *et al*., 2001).

Saliha investigated the effect of magnetic water on the physical and chemical properties of the soil and reported the positive effect of magnetic water on the solubility and leaching of the soil's minerals. He said that using the magnetic water is suitable for improving the quality of irrigation water and soil properties for agricultural purposes (Saliha, 2005).

Maheshwari and Grewal reported that magnetic water with organic compounds by affecting on organic compounds causes more solubility and accessible of nutrients for plants and thus improves growth and yield (Maheshwari and Grewal, 2009).

Mohamed evaluated the effect of magnetic treatments on Tomato grown under saline irrigation conditions. The results show that the using of magnetic with saline water had the valuable effect on soil and plant. The analysis of the data collected during the study proved that there were statistically significant increases in plant growth and some chemical contents of Tomato plant (Mohamed, 2013).

Terzi studied the effects of increasing sea water dilutions (the Black Sea, Aegean Sea and Mediterranean Sea) on seed germination and seedling growth of tomato (*Lycopersicon esculentum* cv. Rio Grande) and alfalfa (*Medicago sativa* cv. Yerli). Seeds were irrigated with 4 different dilutions of sea waters (1, 10, 50 and 100% diluted with distilled water) in addition to distilled water as a control. The germination rates in the tomato and alfalfa seeds were found different and decreased with increasing sea water salinity concentrations. Lengths of root and stem of the seedlings grown for 7 days after germination decreased with increasing sea water salinity concentrations. Moreover, the sea water applications reduced the elongation of shoots more than roots. Dry weights of root and stem of the seedlings were also decreased with increasing sea water salinity concentrations. The degree of salinity injury became more severe with increasing sea water salinity concentrations (Terzi *et al*., 2013).

3. Materials and methods

3.1. Study location:

This study was conducted in the laboratory Benghazi university during spring-summer 2016.

3.2. Plant material:

Seeds of five plant species were purchased from local market in Benghazi-Libya (2015/2016) and they were as showing in table (3-1):

Table (3-1): Plants used in the experiments and their scientific names.

Common name	Scientific name	Family
Wheat	*Triticum aestivum L.*	Poaceae
Tomato	*Lycopersicon esculentum L.*	Solanaceae
Radish	*Raphanus sativus L.*	Brassicaceae
Cucumber	*Cucumis sativus L.*	Cucurbitaceae
Lettuce	*Lactuca sativa L.*	Asteraceae

3.3. Preparation of sea water dilutions:

Seawater was obtained from Sedi khalifa area 17 Km in North of Benghazi, five dilutions of seawater were prepared 1%, 2%, 5%, 10%, 20% (v/v), for preparation of 1% dilution in a measuring cylinder 1ml of seawater was diluted with distilled water to complete the volume to 100ml, for preparation of 2% dilution, in a measuring cylinder 2ml of seawater was diluted with distilled water to complete the volume to 100ml, the same procedure was performed for the other dilutions as shown in table (3-2), 0% dilution was a pure distilled water which used as a control.

Table (3-2): Preparation of different dilution of seawater.

Dilution	0%	1%	2%	5%	10%	20%
Sea water	0	1ml	2ml	5ml	10ml	20ml
Distilled water	Pure distilled water (Control)	99 ml	98 ml	95ml	90ml	80 ml

3.4. Measurement of EC and pH of sea water dilutions:

Electrical conductivities EC and pH of each sea water and magnetic sea water dilutions were measured by EC and pH meter (HANNA, Germany).

Table (3-3): Measurement of electro conductivity and PH of sea water.

Dilutions	0%	1%	2%	5%	10%	20%
E.C	2	820	1552	3635	3999	Above 3999
PH	7.80	6.40	6.43	6.47	7.63	7.67

Table (3-4): Measurement of electro conductivity and PH of magnetic sea water.

Dilutions	0%	1%	2%	5%	10%	20%
E.C	2	823	1553	3633	3999	Above 3999
PH	7.80	7.31	6.92	6.95	7.91	7.99

3.5. Treatment by magnetic water:

Magnetic sea water was obtained by passing each of the formerly prepared dilution through magnetic field generated by using normal magnetic strips arranged in a way to get the technological magnetic forces as shown in figure (3-1).

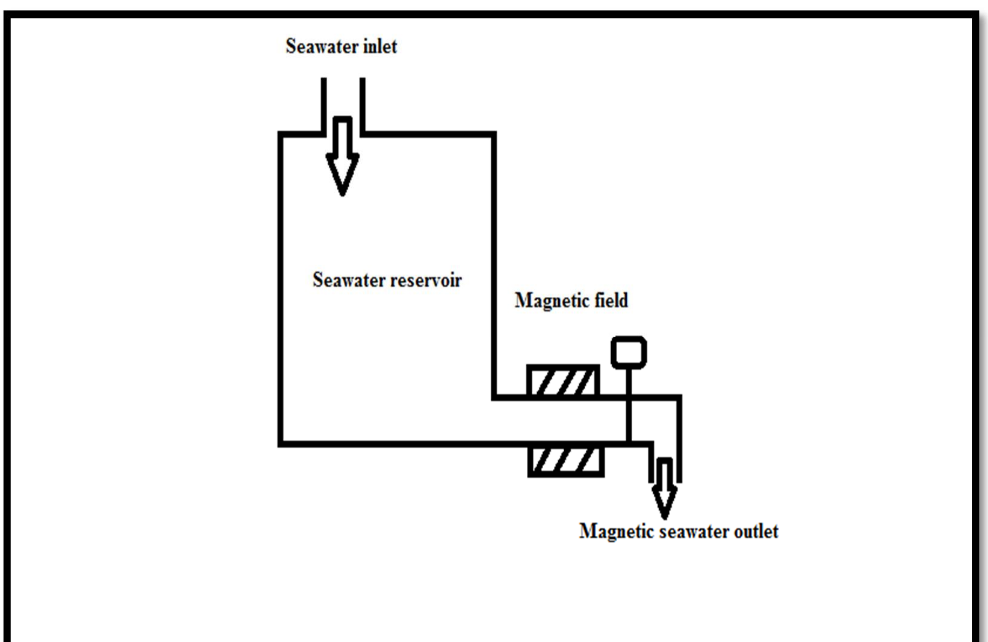


Figure (3-1): Magnetic sea water reservoir.

3.6. Seed germination experiment:

1. Seeds of tested plant species were similarly selected in shape and size were obtained from the local market of Benghazi, seeds were surface-sterilized with 2% sodium hypochlorite solution NaOCl for 12 minutes and rinsed with sterile distilled water several times then blotted using sterile paper towels.
2. In sterile 9 cm Petri dishes lined with double layer whatmann filter paper moisten with 5 ml of each seawater dilution, Seeds were plated onto Petri dishes under aseptic conditions. Each Petri dish contained 10 seeds of one inbred-line, plates were kept at room temperature 25° C, this process was in 3 replicates for each dilution , the total number of plates were 18 plates for each plant.
3. Plates were watered daily with 5 ml of each dilution in addition to the control for 10 days.
4. Every day from the beginning of germination, the number of germinated seeds was determined, Germinated seeds were counted daily for the calculations of daily and final germination percentages considered germinated when the radical had protruded 2 mm.

4.1. % Germination (G%) = $\frac{\text{[illegible]}}{\text{[illegible]}} \times 100$

4.2. Seed germination index (SGI):
Seed germination index (SGI) was calculated according to the following equation (Scott *et al*., 1984).

SGI = [SIGMA] TiNi / S

Where,

Ti= is the number of days after sowing, Ni= is the number of seed germinated on day I, S= is the total number of seeds planted.

4.3. Inhibition of Growth:
Relative reduction or stimulation of seed germination, root length , shoot length and fresh weight and dry weight as affected by the allelopathic substance were calculated according to the general equations, (Nesrine *et al*., 2011).

[1- (no. of non germinated seed/control) × 100].

5. In addition to germination percentage and mean germination time, plants were allowed to grow for another week under the same conditions, at the end of this period root and shoot lengths of the plants were measured in centimeters using a ruler.

3.7. Seedling development study:

Radish and two types of tomato seeds (Local and Imported) were planted, three pots were used for each dilution in addition to the control (distilled water) and each one contains three seeds to help ensure sprouting. The seeds were irrigated by sea water and magnetic sea water individually for 40 day, After 40 days of treatments beginning, plants were harvested for studies, Roots were thoroughly washed. Morphological parameters like root and shoot length (cm) were measured in fresh samples, the total leaf area (cm) and the number of leaves was calculated, plant material were oven-dried for 24 h at 65°C to obtain dry matter. Fresh and dry weights (g) were calculated by an electronic weighing device.

Seedling Vigor Index (SVI):

The seedling vigor index was calculated by using Abdul-Baki and Anderson (1973) formulae (Abdul-Baki and Anderson, 1973).

SVI = (Shoot length+ Root length) × Germination percentage.

3.8. Statistical analysis:

Obtained data were summarized in SPSS (social package statistic software, version 18) and analyzed by ANOVA test to estimate the differences in the response to verities of sea water dilutions, followed by post hoc multiple comparison test (differences in means of several groups), significance was accepted at *P*-values below 0.05 the confidence interval was set at 95%.

4. Results

4.1. The effect of sea water dilutions on *Lycopersicon esculentum* (local tomato):

4.1.1. Effect of sea water dilutions on germination of local tomato:

Tomato seeds showed no difference in germination percentage at dilution of 1% and 2% sea water compared with the control, at dilution of 5 % germination was significantly decreased compared with control treatment growth inhibition at sea water dilution of 5% was (22%), no germination was occurred at higher dilutions (10% and 20%), germination was completely inhibited.

Table (4-1): Effect of sea water dilutions on germination of local tomato.

Dilutions	0%	1%	2%	5%	10%	20%
Germination%	90%	90%	100%	30%	0%	0%

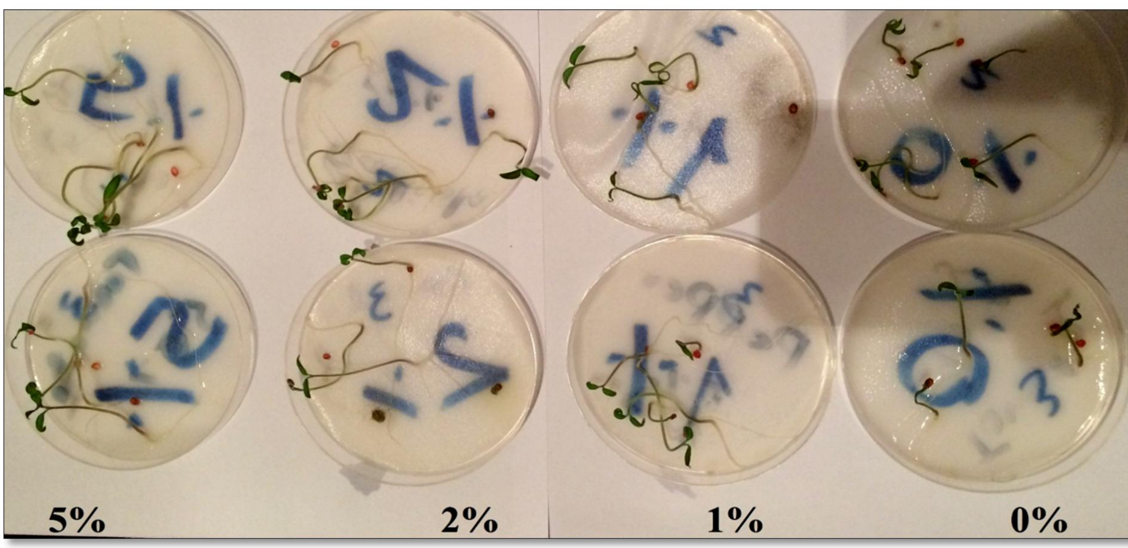


Figure (4-1): Germination of local tomato seeds.

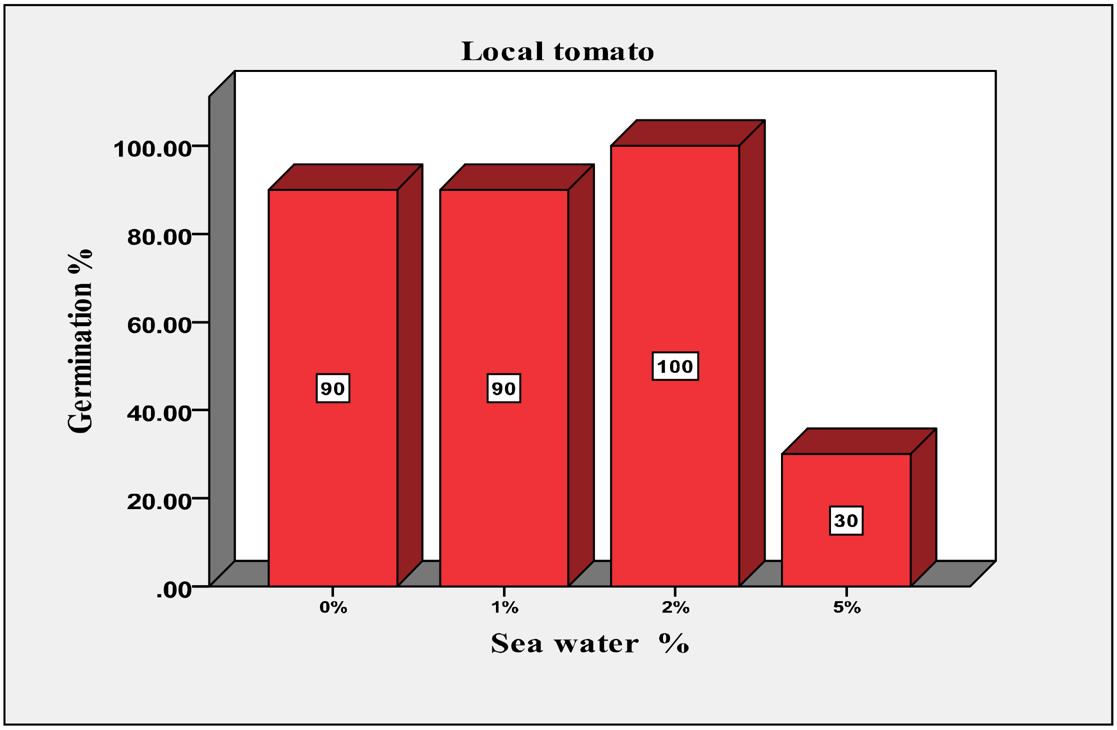


Figure (4-2): Effect of sea water dilutions on germination of local tomato.

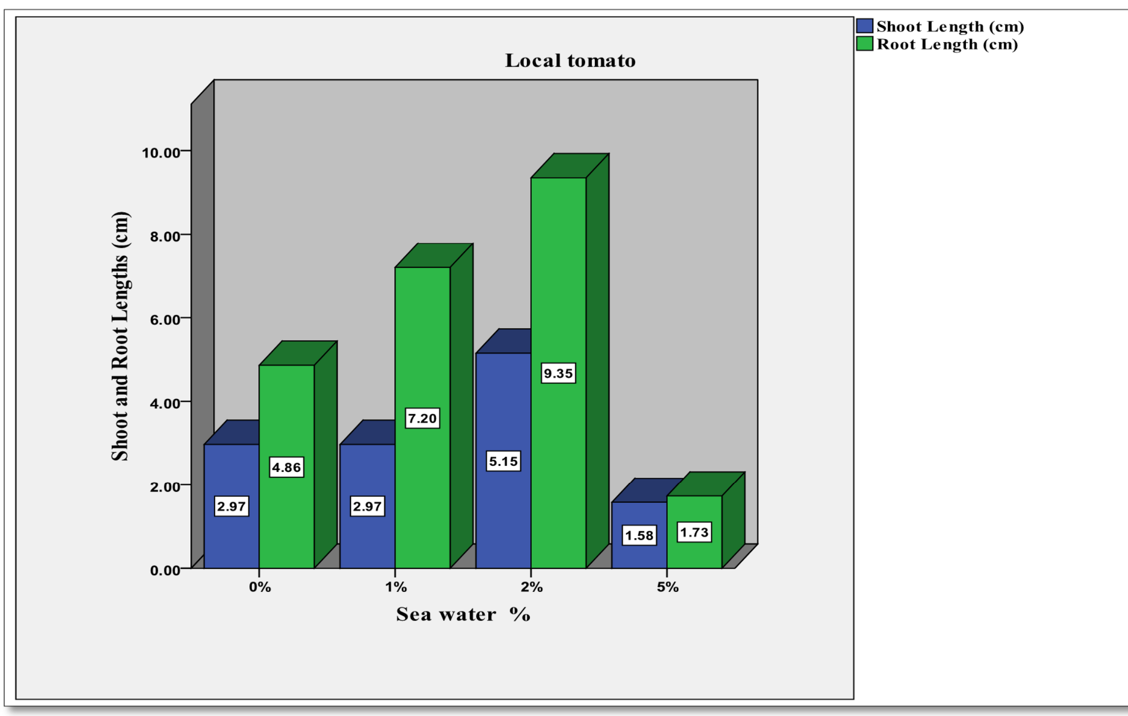
4.1.2. Effect of sea water dilutions on local tomato root and shoot growth:

Shoot height: one way Anova statistical analysis showed significant differences in the mean of shoot height (p-value = 0.001), compared with the control the shoot system showed the equal growth at dilution of 1%, but increased growth at dilution of 2% followed by drop in the growth at dilution of 5%. Post hoc multiple comparison showed no significant differences between the mean of all sea water dilutions and the control treatment.

Root length: Anova test showed a significant differences in the means of root lengths (p-value = 0) the root system length increased with increase in length at low dilutions (1% and 2%), but decreased at 5% dilution, but no germination had occurred higher sea water dilutions. Post hoc multiple comparison showed no significant differences between different sea water dilution and the control treatment.

Table (4-2): Effect of sea water dilutions on local tomato root and shoot growth.

Parameters	Descriptive			ANOVA	
	Conc. %	Mean	S.D (±)	S. error	p- values
Shoot	0%	2.97	1.254	0.397	0.001*
	1%	2.97	1.254	0.3967	
	2%	5.15	1.403	0.444	
	5%	1.58	2.593	0.820	
Root	0%	4.86	2.199	0.695	0.000*
	1%	7.20	3.638	1.150	
	2%	9.35	5.269	1.666	
	5%	1.73	2.874	0.909	
*The mean difference is significant at the 0.05 level.					



Figure(4-3): Effect of sea water dilutions on local tomato shoot and root length.

4.1.3. Effect of sea water dilutions on seeds germination index (mean germination time) of local tomato:

Mean germination time of local tomato seeds were delayed with increased sea water dilution, at sea water dilution of 5%, local tomato delayed for 9.5 days compared with the control treatment (6.86 days).

Table (4-3): Seeds germination index of local tomato.

Dilutions	0%	1%	2%	5%
SGI	6.86	8.8	8.142	9.5

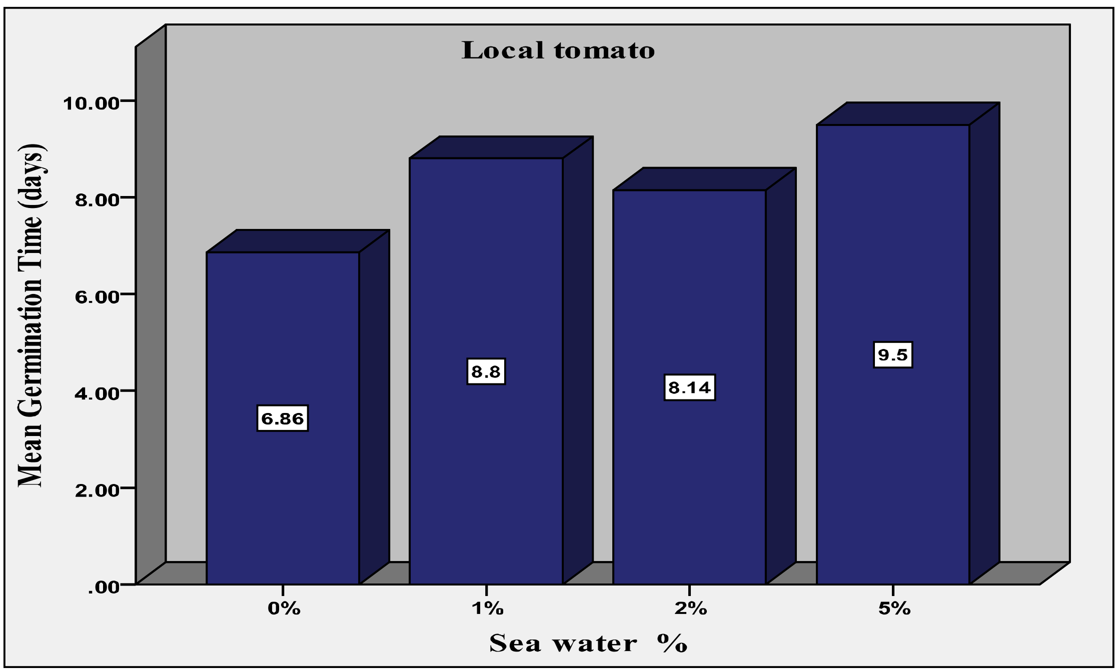


Figure (4-4): Effect of sea water on seeds germination index of local tomato.

4.2. The effect of sea water dilutions on *Lycopersicon esculentum* (imported tomato):

4.2.1. Effect of sea water dilutions on imported tomato germination:

Tomato seeds showed no difference in germination percentage at dilution of 1% , 2% and 5% sea water compared with the control, no germination was occurred at higher dilutions (10% and 20%).

Table (4-4): Effect of sea water dilutions on germination of imported tomato.

Dilution	0%	1%	2%	5%	10%	20%
Germination%	73%	86%	86%	86%	0%	0%

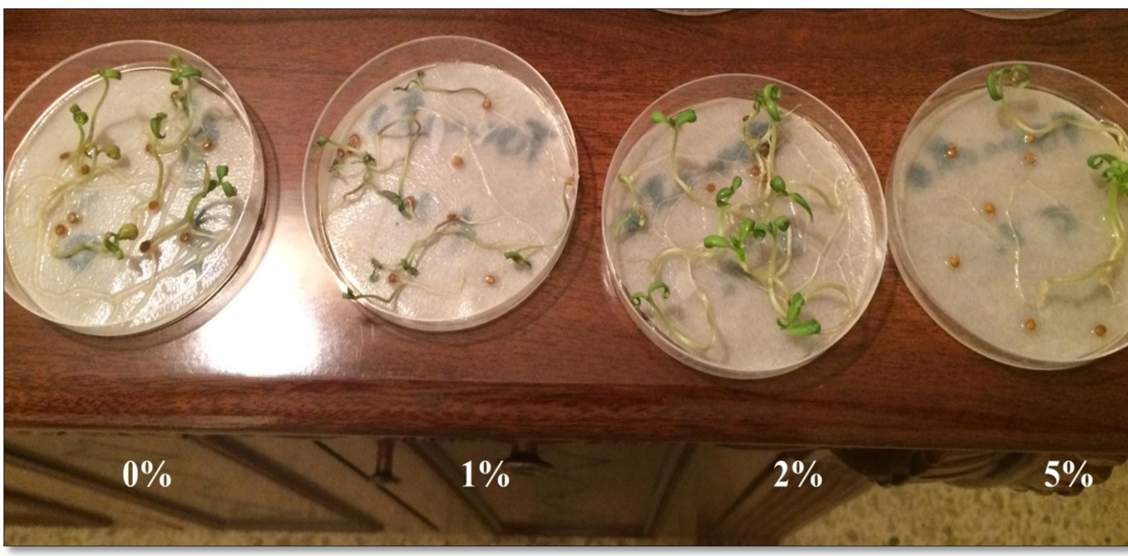
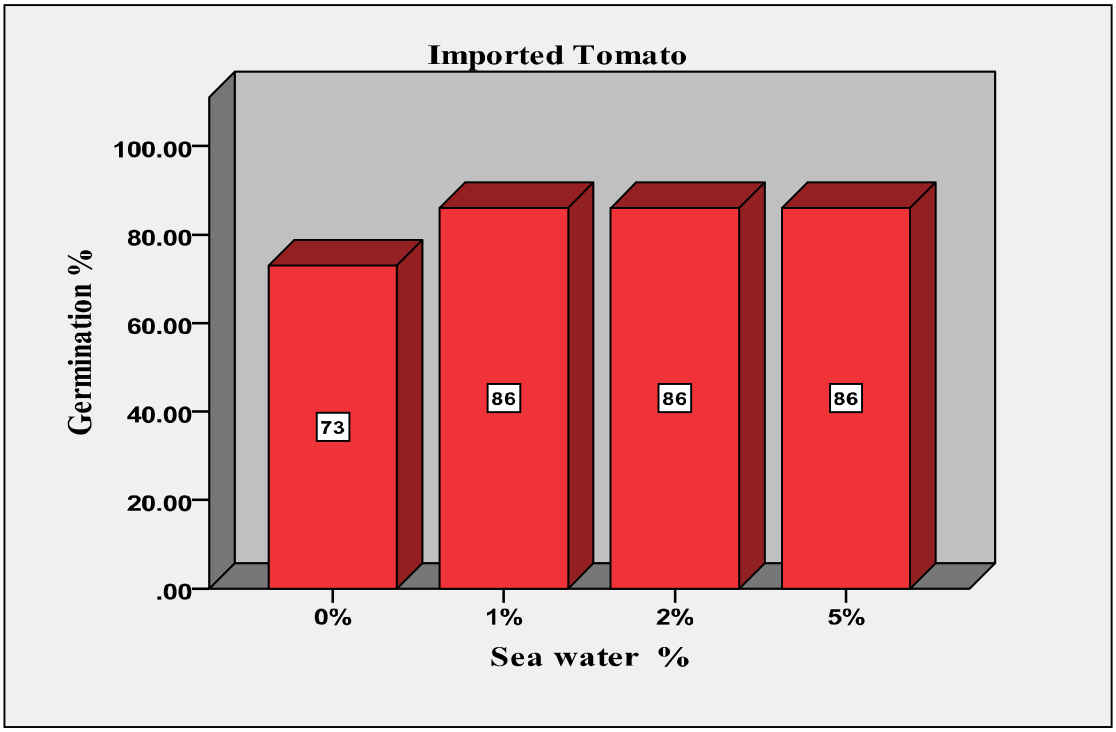


Figure (4-5): Germination of imported tomato seeds.



Figure(4-6): Effect of sea water dilutions on germination of imported tomato.

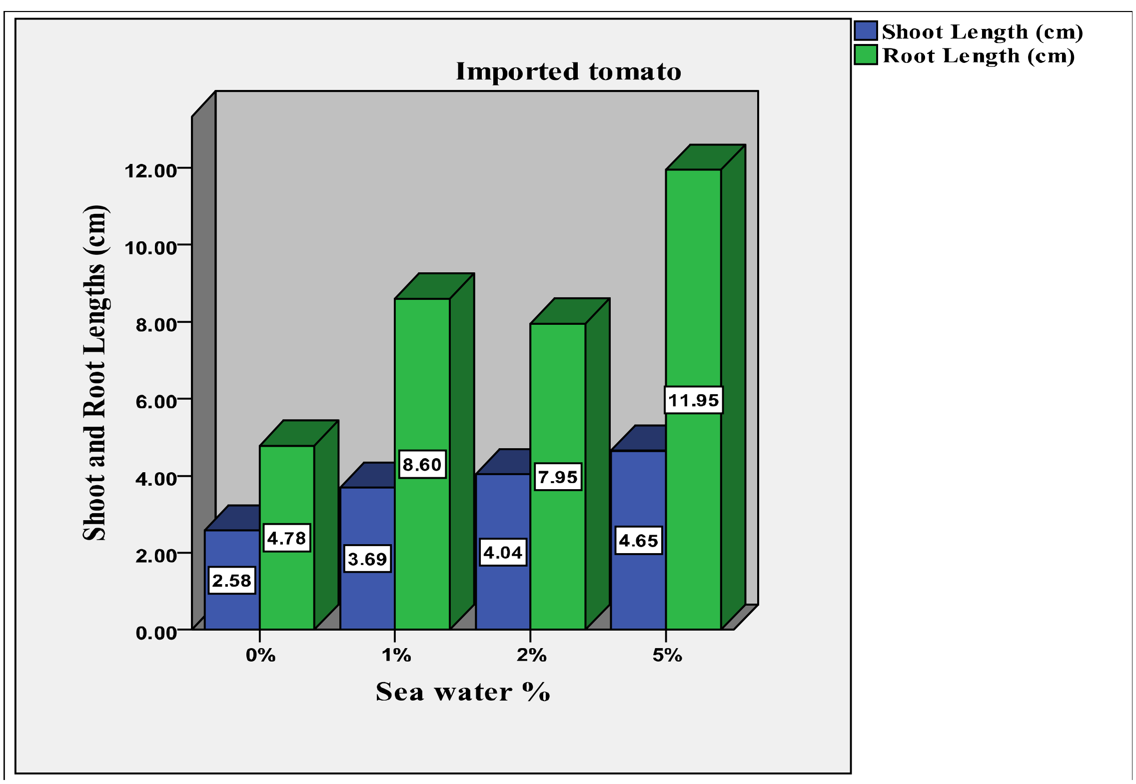
4.2.2. Effect of sea water dilutions on imported tomato root and shoot growth:

Shoot length: Anova statistical analysis showed significant differences in the mean of shoot height (p-value = 0.000), compared with the control the shoot system showed increased growth with increased sea water dilutions, but no germination had occurred at higher dilutions (10% and 20%). Post hoc multiple comparison test showed significant differences between both 2% and 5% dilutions compared with the control treatment (p-value = 0.03 and 0.000) respectively.

Root length: Anova test showed a significant differences in the means of root lengths (p-value = 0.000), compared with the control treatment, the root system length increased with increase in sea water dilutions, no germination had occurred at higher dilutions (10 and 20%). Post hoc multiple comparison test showed a significant difference between 5% dilution and control treatment (p-value= 0.000).

Table (4-5): Effect of sea water dilutions on imported tomato root and shoot length.

Paramètres	Descriptive			ANOVA	
	Conc. %	Mean	S.D (±)	S. Error	p- values
Shoot	0%	2.58	1.341	0.372	0.000*
	1%	3.69	1.236	0.343	
	2%	4.04	1.296	0.359	
	5%	4.65	0.670	0.186	
Root	0%	4.78	3.625	1.005	0.000*
	1%	8.6	3.130	0.868	
	2%	7.95	3.099	0.859	
	5%	11.95	3.468	0.962	
*The mean difference is significant at the 0.05 level.					



Figure(4-7): Effect of sea water dilutions on imported tomato root and shoot lengths.

4.2.3. Effect of sea water on seeds germination index (Speed of germination) of imported tomato:

Mean germination time of imported tomato seeds were delayed with increased sea water dilution, at sea water dilution of 2%, local tomato reached the maximum delayed for 4.4 days, but speed of germination was decrease at sea water dilution of 5%, compared with the control treatment (3.22 days).

Table (4-6): Seeds germination index of imported tomato.

Dilution	0%	1%	2%	5%
SGI	3.22	4	4.4	3.6

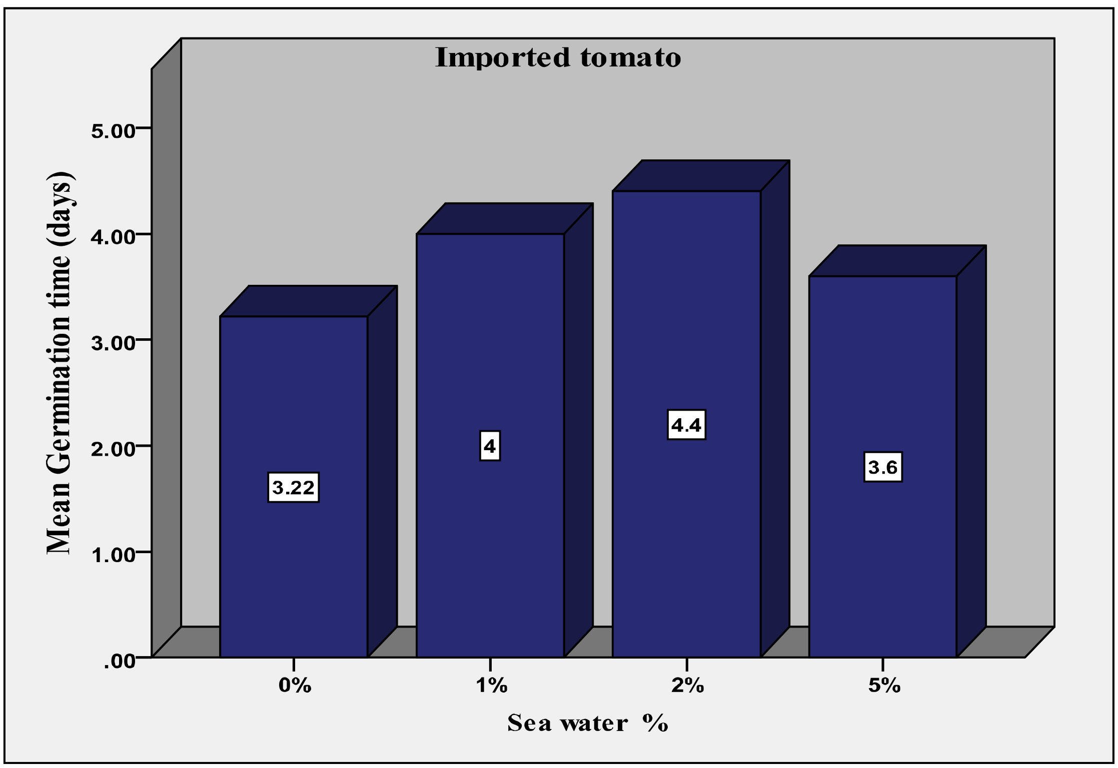


Figure (4-8): Effect of sea water on seeds germination index of imported tomato.

4.3. Effect of sea water dilutions on *Raphanus sativus* (radish):

4.3.1. The effect of sea water dilutions on germination of radish:

Radish showed same germination percentages at all dilutions of sea water , which indicated that radish germination did not affect by sea water dilutions.

Table (4-7): The effect of sea water dilutions on germination of radish.

Dilution	0%	1%	2%	5%	10%	20%
Germination %	100%	100%	100%	100%	100%	100%

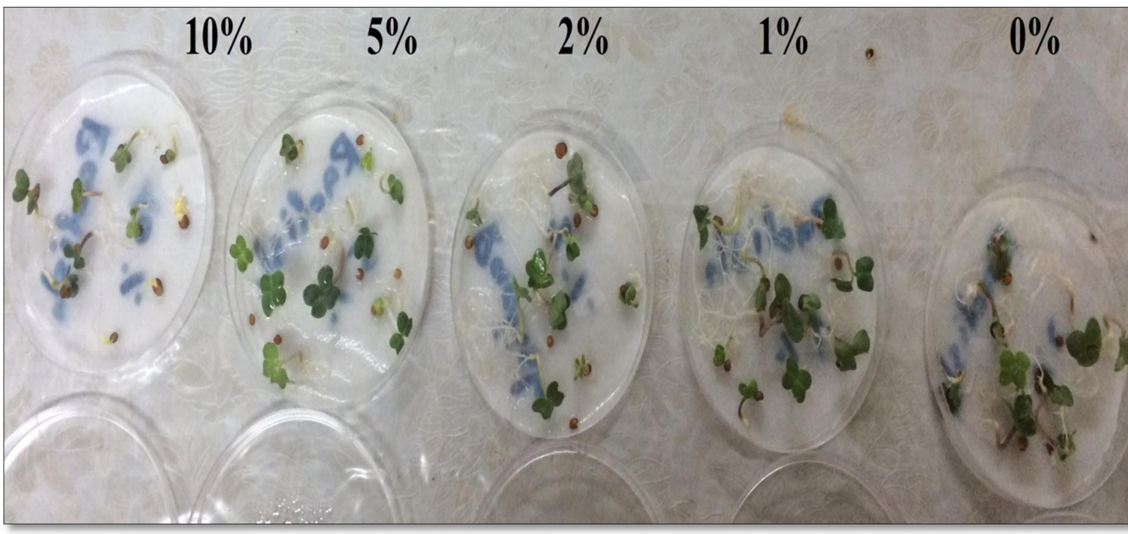


Figure (4-9): Germination of radish seeds.

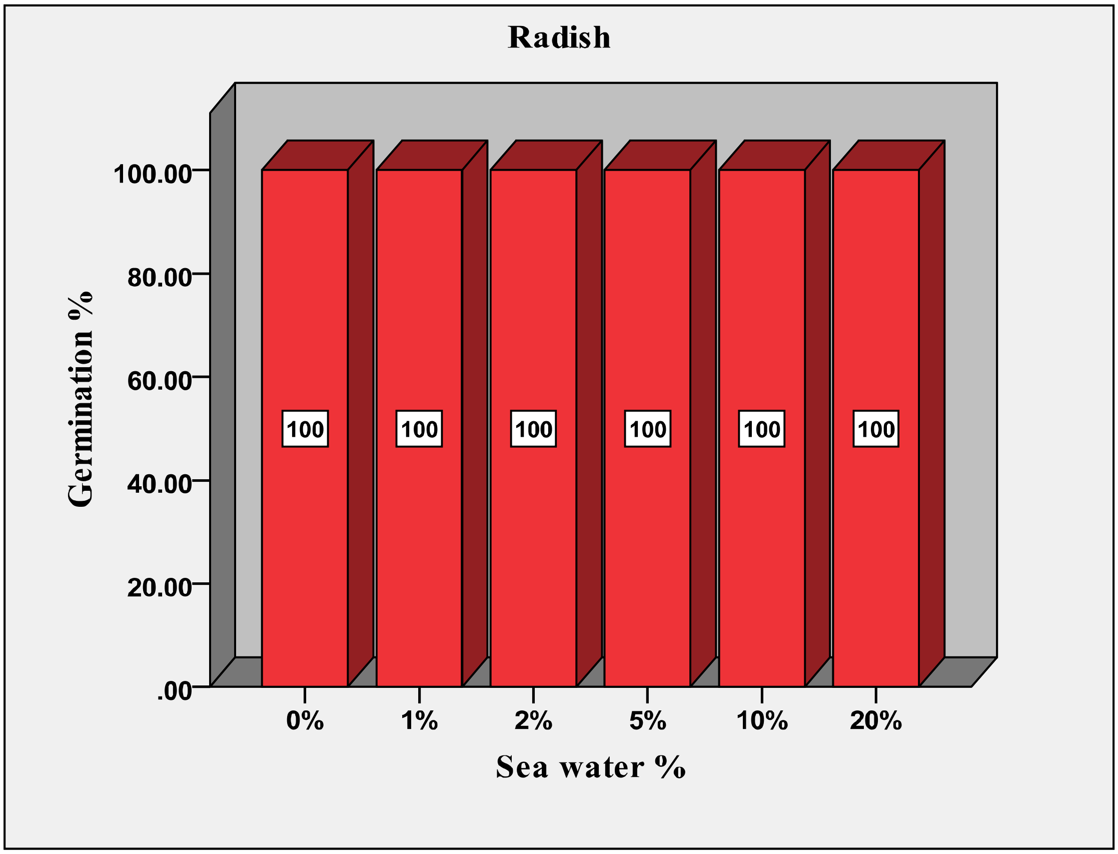


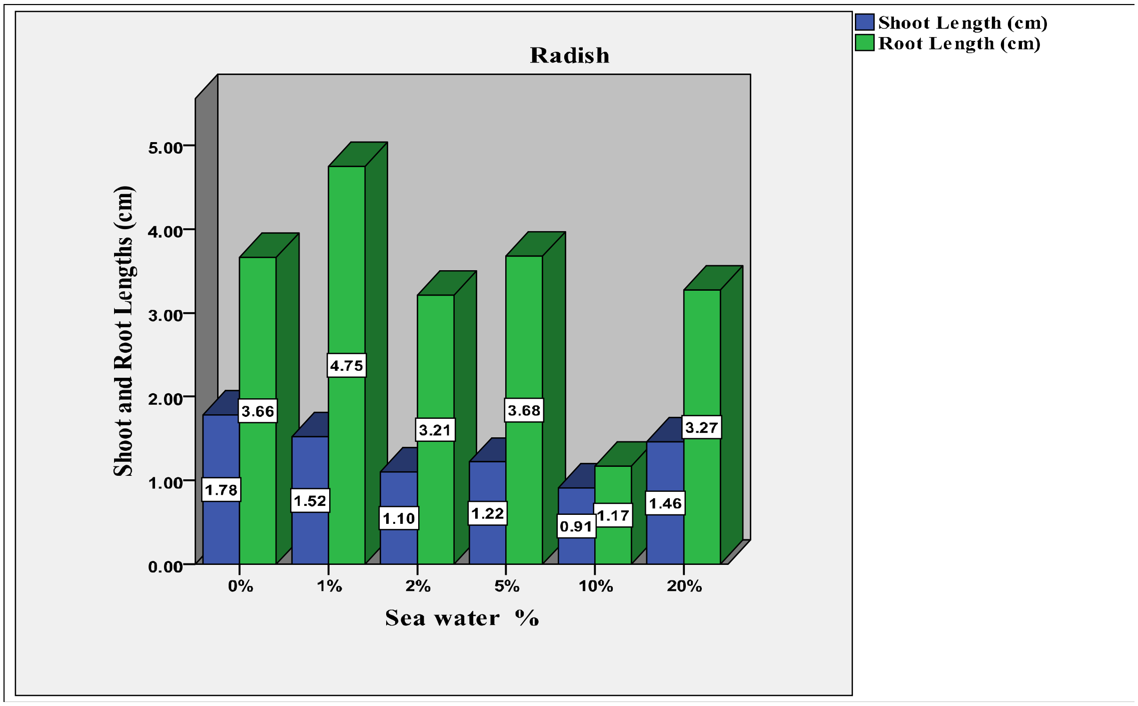
Figure (4-10): Effect of sea water dilutions on radish germination.

4.3.2. Effect of sea water dilutions on radish root and shoot growth:

One way Anova statistical test showed no significant effect of sea water dilutions on radish root and shoot systems growth, which mean that both root and shoot systems did not affect by increased sea water dilutions levels, post hoc multiple comparison showed no significant differences between sea water dilutions and the control treatment.

Table (4-8):The effect of sea water dilutions on radish shoot and root growth.

Parameter	Descriptive			ANOVA	
	Conc. %	Mean	S.D (±)	Std. Error	p- values
Shoot	0%	1.78	0.452	0.143	0.065
	1%	1.52	1.058	0.335	
	2%	1.1	0.566	0.179	
	5%	1.22	0.735	0.232	
	10%	0.91	0.614	0.194	
	20%	1.46	0.35	0.111	
Root	0%	3.66	1.428	0.091	0.095
	1%	4.75	4.619	0.452	
	2%	3.21	2.989	1.461	
	5%	3.68	2.278	0.945	
	10%	1.17	1.051	0.720	
	20%	3.27	1.777	0.332	
*The mean difference is significant at the 0.05 level.					



Figure(4-11):Effect of sea water dilutions on radish root and shoot length.

4.3.3. Effect of sea water on seeds germination index (mean germination time) of radish:

Mean germination time of radish seeds were fasten with increased sea water dilution. At sea water dilution of 20%, radish reached the maximum speed of germination 1.6 days, faster than germination of the control treatment.

Table (4-9): Seeds germination index of radish.

Dilution	0%	1%	2%	5%	10%	20%
SGI	3.8	3	2.8	2.9	1.7	1.6

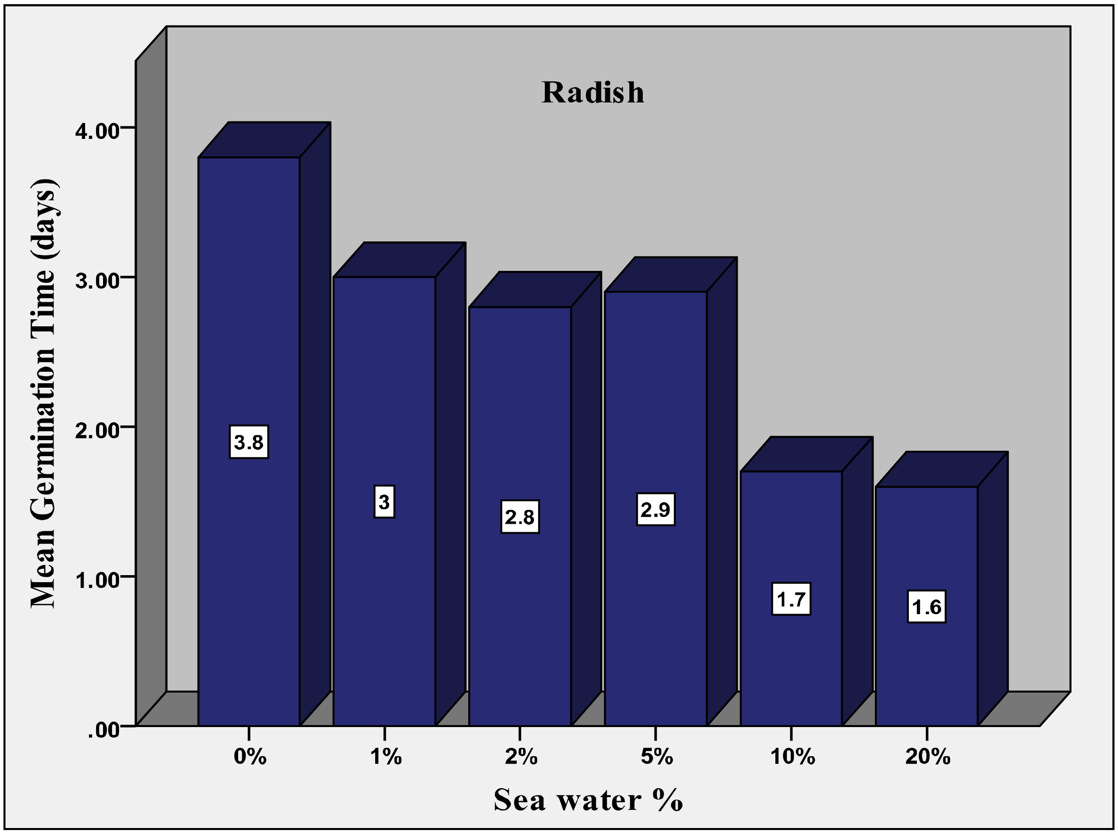


Figure (4-12): Effect of sea water on seeds germination index of radish.

4.4. Effect of sea water dilutions on *Triticum aestivum* (wheat):

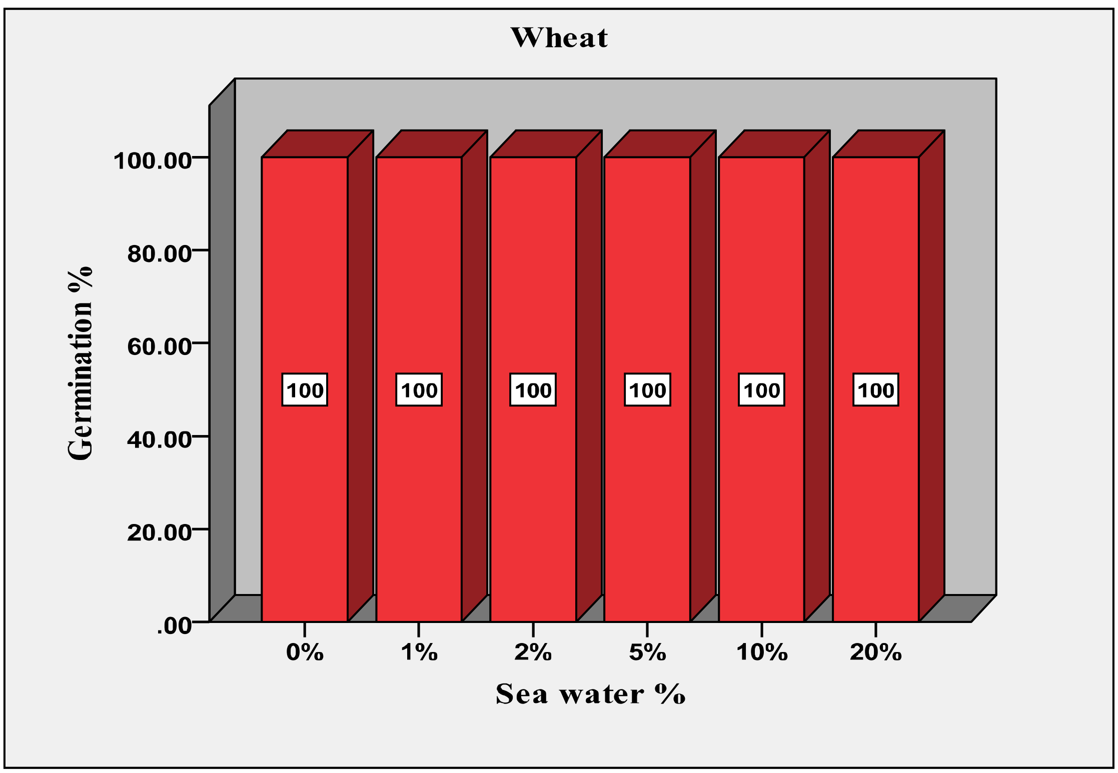
4.4.1. Effect of sea water dilutions on germination of wheat:

wheat showed same germination percentages at all dilutions of sea water , which indicated that germination of wheat did not affect by sea water sea water dilutions.

Table (4-10): Effect of sea water dilutions on germination of wheat.

Dilutions	0%	1%	2%	5%	10%	20%
Germination%	100%	100%	100%	100%	100%	100%

Figure (4-13): Germination of wheat seeds.



Figure(4-14): Effect of sea water dilutions on germination of wheat.

4.4.2. Effect of sea water dilutions on wheat root and shoot lengths:

Shoot height: Anova statistical analysis showed significant differences in the mean of wheat shoot height (p-value = 0.000), compared with the control the shoot system showed decreased growth with increased sea water dilutions. Post hoc multiple comparison test showed significant differences between both 1% and 10% dilutions compared with the control treatment (p-value = 0.01).

Root length: Anova test showed a significant differences in the means of wheat root lengths (p-value = 0.000), compared with the control treatment, the root system length decreased with increase in sea water dilutions. Post hoc multiple comparison test showed a significant difference between all used dilution and control treatment (p-value= 0.000).

Table (4-11): Effect of sea water dilutions on wheat root and shoot length.

Parameters	Descriptive			ANOVA	
	Conc. %	Mean	S.D (±)	Std. Error	p- values
Shoot	0%	4.18	2.38	0.75	0.006*
	1%	1.47	1.36	0.43	
	2%	2.15	1.58	0.50	
	5%	2.10	1.11	0.35	
	10%	1.50	1.17	0.37	
	20%	2.71	2.03	0.64	
Root	0%	5.75	1.84	0.58	0.000*
	1%	2.66	1.31	0.41	
	2%	3.21	0.87	0.28	
	5%	3.51	1.11	0.35	
	10%	2.71	0.56	0.18	
	20%	2.12	1.24	0.39	
*The mean difference is significant at the 0.05 level.					

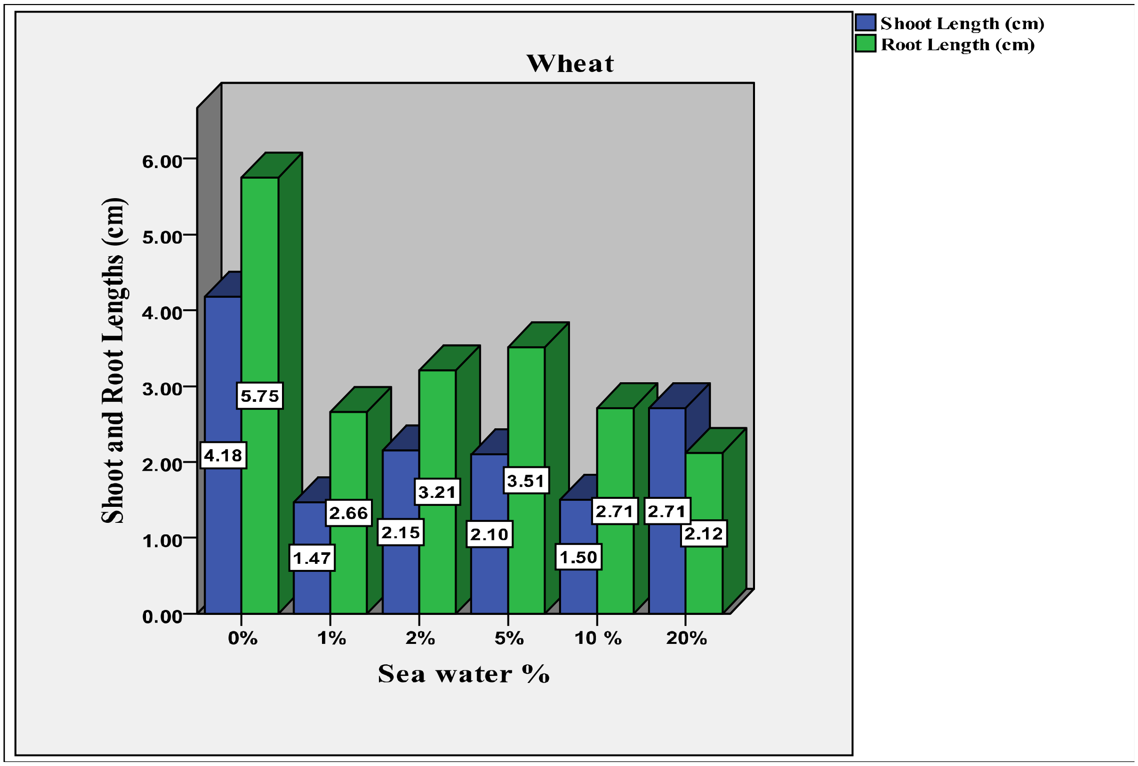


Figure (4-15): Effect of sea water dilutions on wheat root and shoot lengths.

4.4.3. Effect of sea water on seeds germination index (mean germination time) of wheat:

Mean germination time of wheat seeds were reduced with increased sea water dilution compared with the control (1.3 days), reaching the maximum delay at sea water dilution of 5%. At sea water dilution of 20%, mean germination time of wheat seeds reduced to (1.2 days).

Table (4-12): Seeds germination index of wheat.

Dilutions	**0%**	**1%**	**2%**	**5%**	**10%**	**20%**
SGI	1.3	2.4	2.7	2.1	1.7	1.2

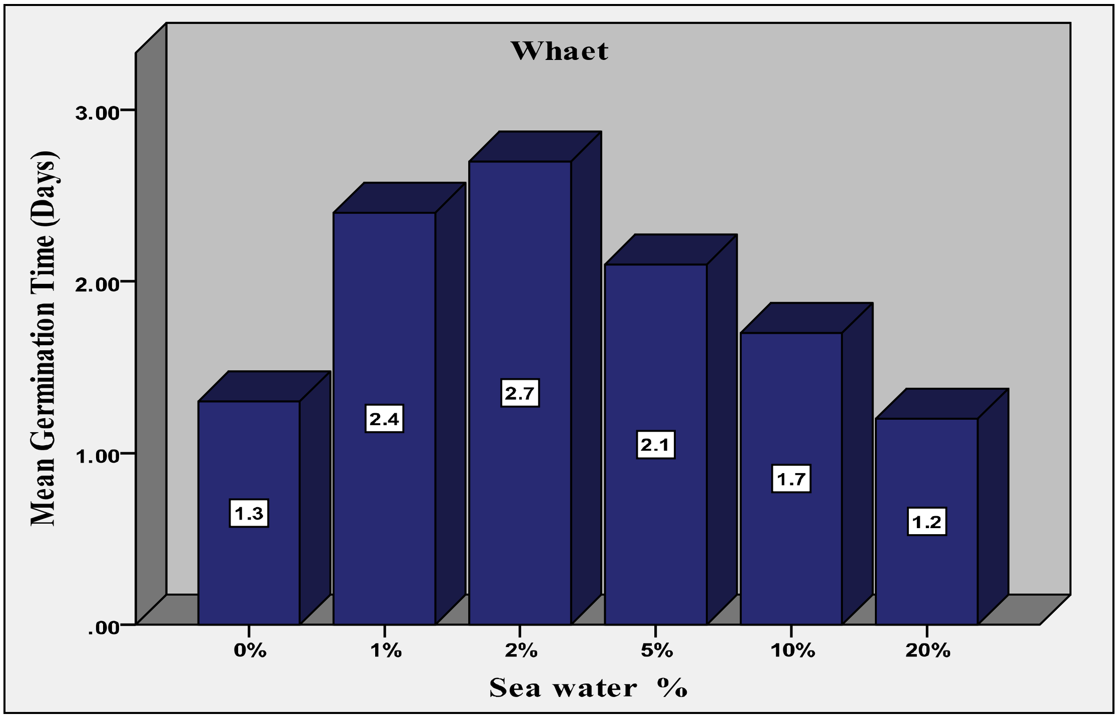


Figure (4-16): Effect of sea water on seeds germination index of wheat.

4.5. Effect of sea water dilutions on *Lactuca sativa* (lettuce):

4.5.1. Effect of sea water dilutions on germination of lettuce:

Lettuce showed approximately the same germination at dilution of 1% and 2% compared with the control but the germination decreased at dilution of 5%, no germination had occurred at higher dilutions (10% and 20%).

Table (4-13): Effect of sea water dilutions on germination of lettuce.

Dilutions	0%	1%	2%	5%	10%	20%
Germination %	93%	100%	93%	26%	0%	0%

Figure (4-17): Germination of lettuce seeds.

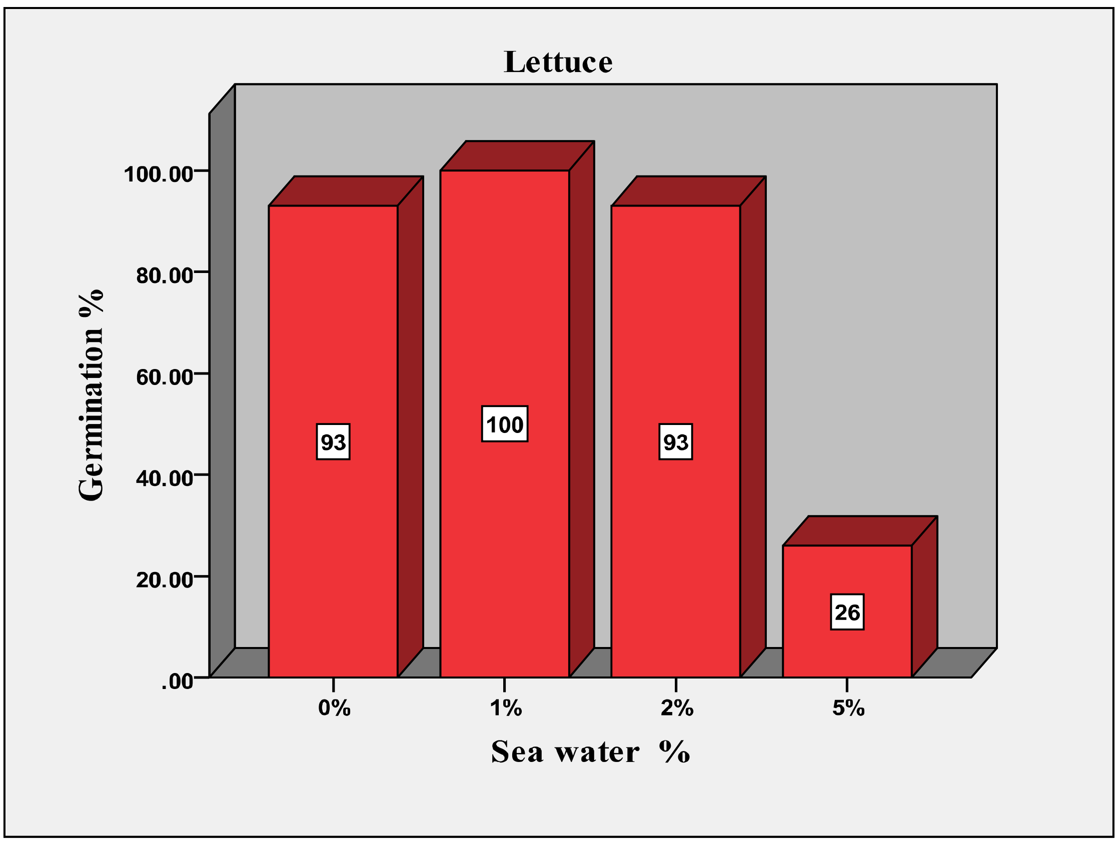


Figure (4-18): Effect of sea water dilutions on germination of lettuce.

4.5.2. Effect of sea water dilutions on lettuce root and shoot length:

Shoot height: Anova statistical analysis showed significant differences in the mean of lettuce shoot height (p-value = 0.000). Compared with the control the shoot system showed decreased growth with increased sea water dilutions, but no germination had occurred at higher dilutions (10% and 20%). Post hoc multiple comparison test showed significant differences between both 2% and 5% dilutions compared with the control treatment (p-value = 0.03 and 0.00) respectively.

Root length: Anova test showed a significant differences in the means of lettuce root lengths (p-value = 0.000). Compared with the control treatment, the root system length increase with increased sea water dilution of 1%, but decreased at dilution of 2% and 5%, no germination had occurred at higher dilutions (10% and 20%). Post hoc multiple comparison test showed a significant difference between both 1%, 5% dilution and control treatment (p-value= 0.000).

Table (4-14): Effect of sea water dilutions on lettuce root and shoot length.

Parameters	Descriptive			ANOVA	
	Conc. %	Mean	S.D (±)	Std. Error	p- values
Shoot	0%	0.52	0.399	0.126	0.000*
	1%	0.45	0.085	0.027	
	2%	0.29	0.191	0.060	
	5%	0.02	0.063	0.020	
Root	0%	4.15	2.351	0.744	0.000*
	1%	6.70	2.424	0.766	
	2%	2.92	1.947	0.616	
	5%	0.11	0.348	0.11	
*The mean difference is significant at the 0.05 level.					

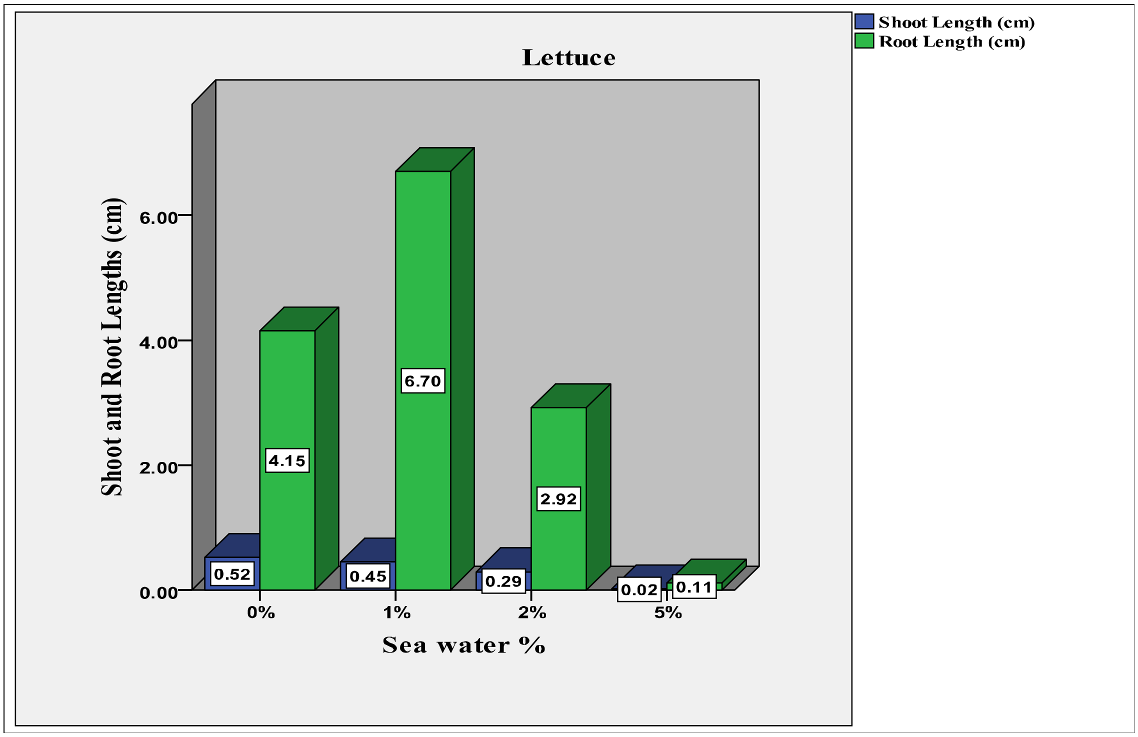


Figure (4-19): Effect of sea water dilutions on lettuce root and shoot length.

4.5.3. Effect of sea water on seeds germination index (mean germination time) of lettuce:

Mean germination time of lettuce seeds were delayed with increased sea water dilutions compared with the control treatment (2.2 days), maximum delay in the germination time were observed at sea water dilution of 5% (4.83 days).

Table (4-15): Seeds germination index of lettuce.

Dilutions	0%	1%	2%	5%
SGI	2.2	3.5	2.9	4.83

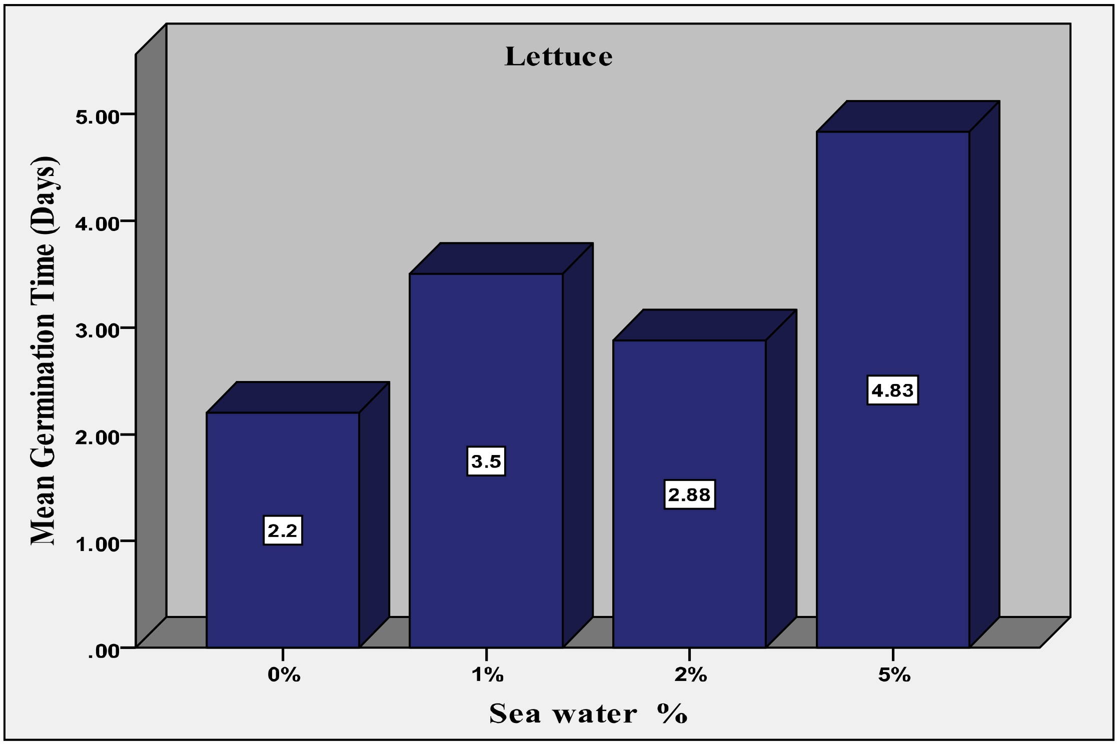


Figure (4-20): Effect of sea water on seeds germination index of lettuce.

4.6. The effect of sea water dilutions on *Cucumis sativus* (cucumber):

4.6.1. Effect of sea water dilutions on germination of cucumber:

cucumber showed approximately the same germination at dilution of 1%, 2% and 5% compared with the control but the germination decreased at sea water dilution of 10%, no germination had occurred at higher dilution (20%).

Table (4-16): Effect of sea water dilutions on germination of cucumber.

Dilutions	0%	1%	2%	5%	10%	20%
Germination%	88%	100%	88%	100%	77%	0%

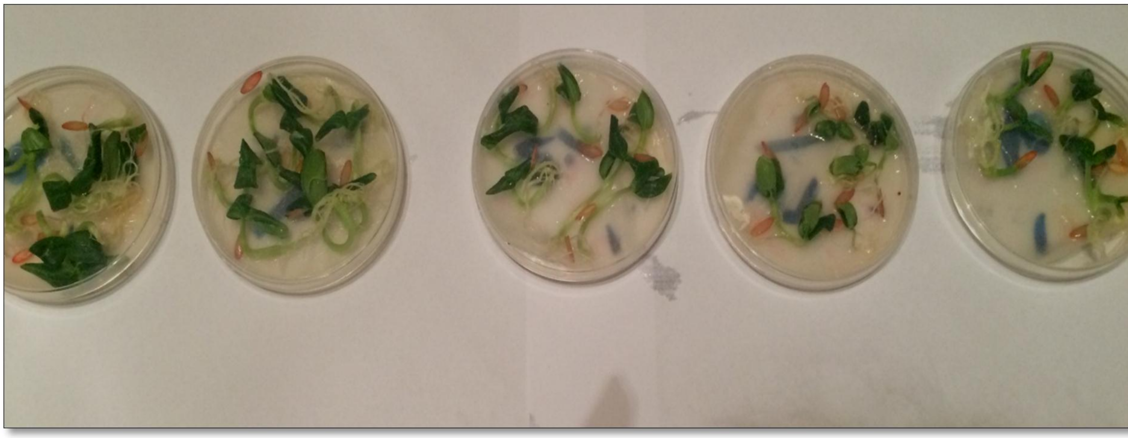


Figure (4-21): Germination of cucumber seeds.

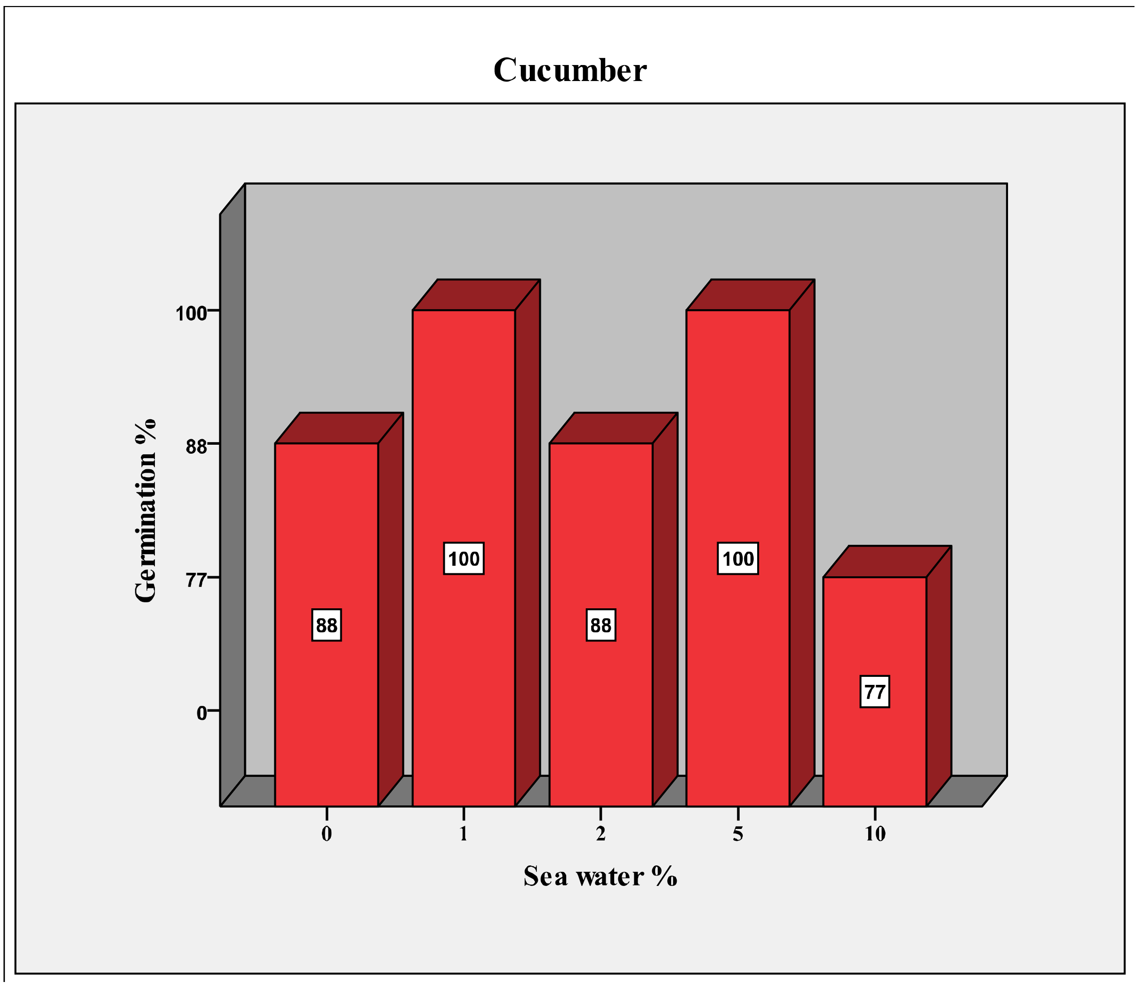


Figure (4-22): Effect of sea water dilutions on germination of cucumber.

4.6.2. Effect of sea water dilutions on cucumber root and shoot length:

Shoot height: Anova statistical analysis showed significant differences in the mean of cucumber shoot height (p-value = 0.009). Compared with the control the cucumber shoot system showed increased growth at dilution of 1% , but decreased shoot growth had occurred at dilution of 2%, 5%, and 10% with increased sea water dilutions, but no germination had occurred at higher dilution (20%). Post hoc multiple comparison test showed no significant differences between sea water dilutions compared with the control treatment.

Root length: Anova test showed a significant differences in the means of cucumber root lengths (p-value = 0.000). Compared with the control treatment, the root system length increased at sea water dilution of 1%, but decreased at dilution of 2%, 5% and 10%, no germination had occurred dilution of (20%). Post hoc multiple comparison test showed a significant difference between 10% dilution and control treatment (p-value= 0.000).

Table (4-17): Effect of sea water dilutions on cucumber root and shoot length.

Parameters	Descriptive				ANOVA
	Conc. %	Mean	S.D (±)	Std. Error	p- values
Shoot	0%	4.62	1.864	0.621	0.009*
	1%	5.17	0.680	0.227	
	2%	3.90	1.814	0.605	
	5%	2.87	1.121	0.374	
	10%	2.83	1.992	0.664	
Root	0%	9.40	4.002	1.334	0.000*
	1%	10.68	1.727	0.576	
	2%	6.78	3.032	1.011	
	5%	5.95	2.394	0.798	
	10%	4.03	2.497	0.832	

*The mean difference is significant at the 0.05 level.

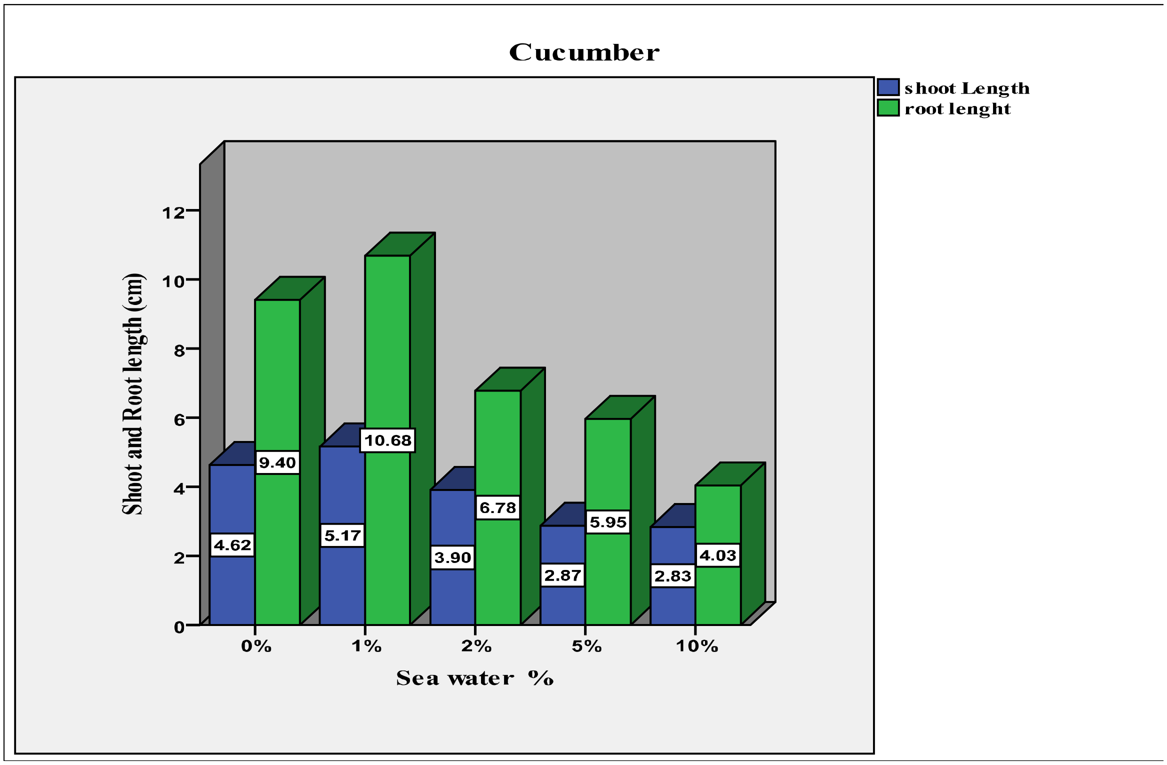


Figure (4-23): Effect of sea water dilutions on cucumber root and shoot length.

4.6.3. Effect of sea water on seeds germination index (mean germination time) of cucumber:

Mean germination time of cucumber seeds were reduced with increased sea water dilution, compared with the control (2.78 days), mean germination time of cucumber seeds reached the maximum reduction at sea water dilution of 10% (1.75 days).

Table (4-18): Seeds germination index of cucumber.

Dilutions	0%	1%	2%	5%	10%
SGI	2.78	2.6	2	2.6	1.75

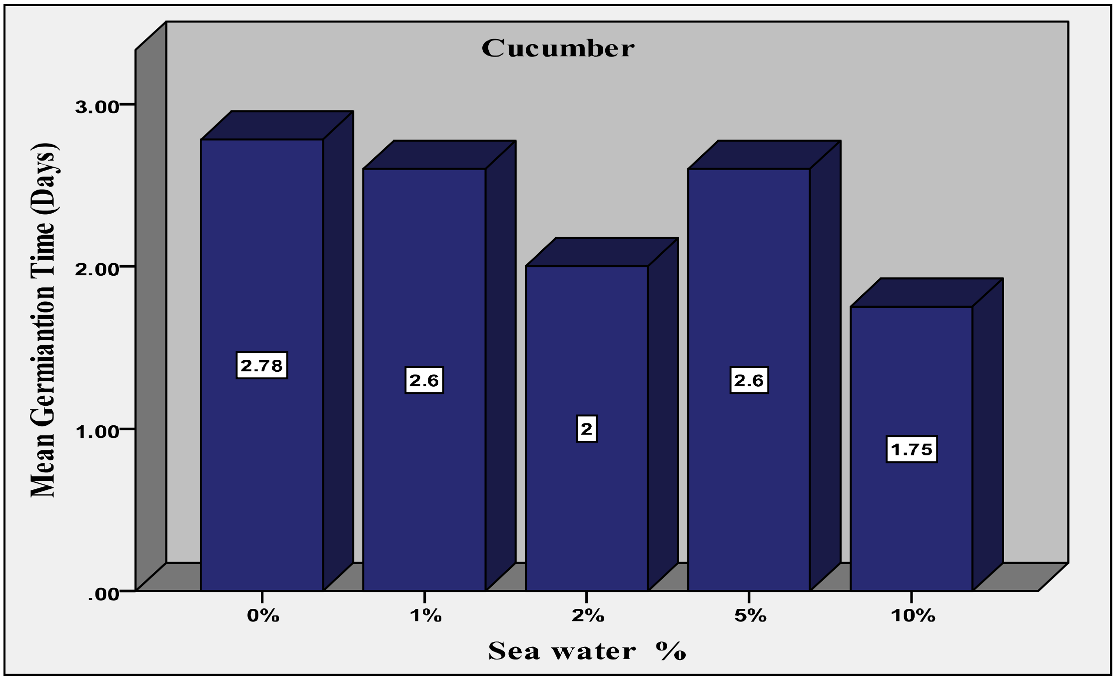


Figure (4-24): Effect of sea water on seeds germination index of cucumber.

4.7. Effect of sea water dilutions on seedling development of local tomato:

4.7.1. Effect of sea water dilutions on local tomato growth:

Whole length: Anova statistical test showed significant differences between the means of whole tomato at different dilutions of sea water (p-value =0.00). Compared with the control the whole plant decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato lengths at all dilutions and the control treatment lenght. (p-value =0.00, 0.001 and 0.00) respectively.

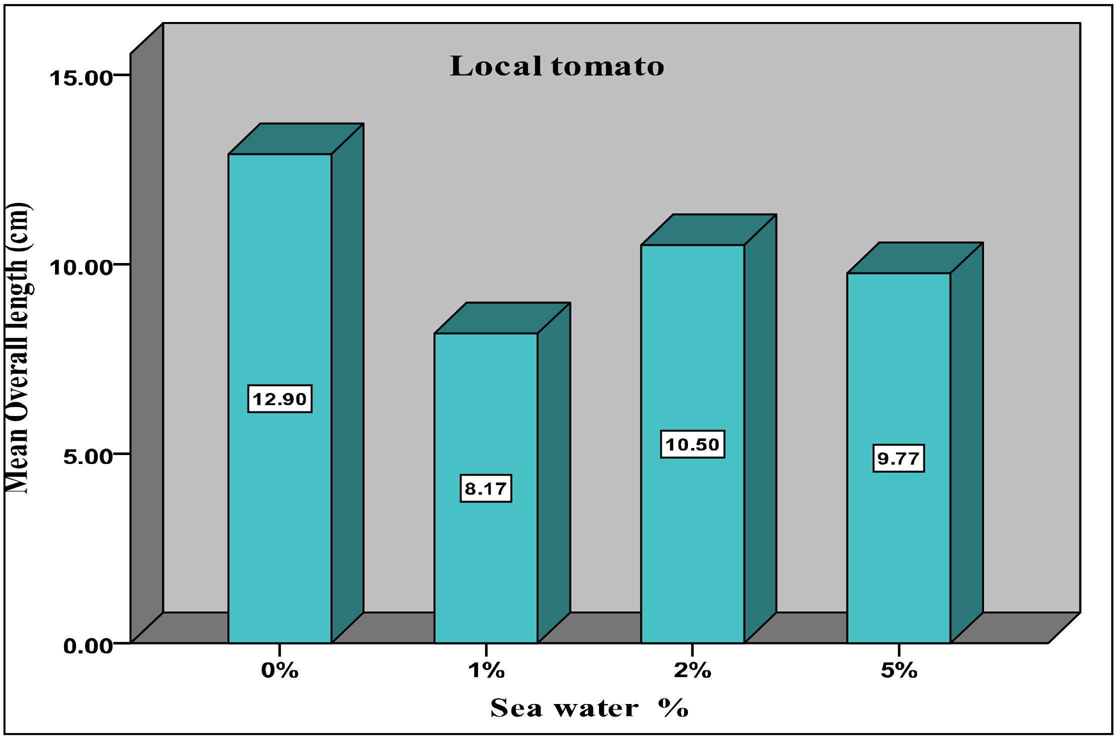
Shoot length: Anova statistical test showed there is significant differences between the means of shoot lengths at different dilutions of sea water (p-value =0.001). Compared with the control the shoot length decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between shoot lengths at all dilutions (1%, 2%, and 5%) and the control treatment shoot length. (p-value =0.00, 0.001 and 0.001) respectively.

Root length: Anova statistical test showed no significant differences between the means of root lengths at different dilutions of sea water (p-value =0.648). Compared with the control the root length increased at dilutions of 1% and 2%) with increased sea water dilutions, but decreased at dilution of 5%. Post hoc multiple comparison showed no significant differences between root lengths all dilutions (1%, 2%, and 5%) and the control treatment root length. (p-value =0.707, 0.461 and 0.748) respectively.

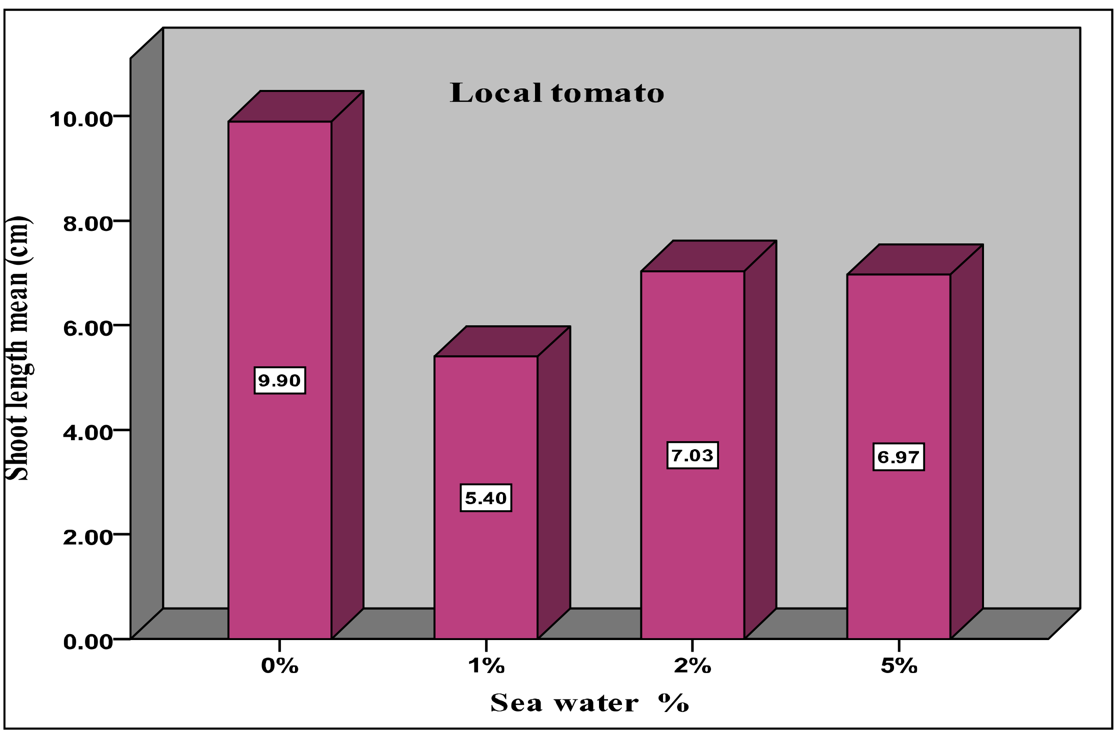
Table (4-25): Effect of sea water dilutions on local tomato.

Table (4-19): Effect of sea water dilutions on local tomato growth.

Parameters	Descriptive				Anova
	Conc.%	Mean	SD±	Std. Error	p-value
Overall length	0%	12.900	0.854	0.493	0.000*
	1%	8.167	0.351	0.203	
	2%	10.500	0.625	0.361	
	5%	9.767	0.252	0.145	
Shoot length	0%	9.900	0.100	0.058	0.001*
	1%	5.400	0.300	0.173	
	2%	7.033	0.551	0.318	
	5%	6.967	1.343	0.775	
Root length	0%	3.000	0.819	0.473	0.648
	1%	2.767	0.306	0.176	
	2%	3.467	0.153	0.088	
	5%	2.800	1.179	0.681	



Figure(4-26): Effect of sea water dilutions on local tomato whole plant length.



Figure(4-27): Effect of sea water dilutions on local tomato shoot length.

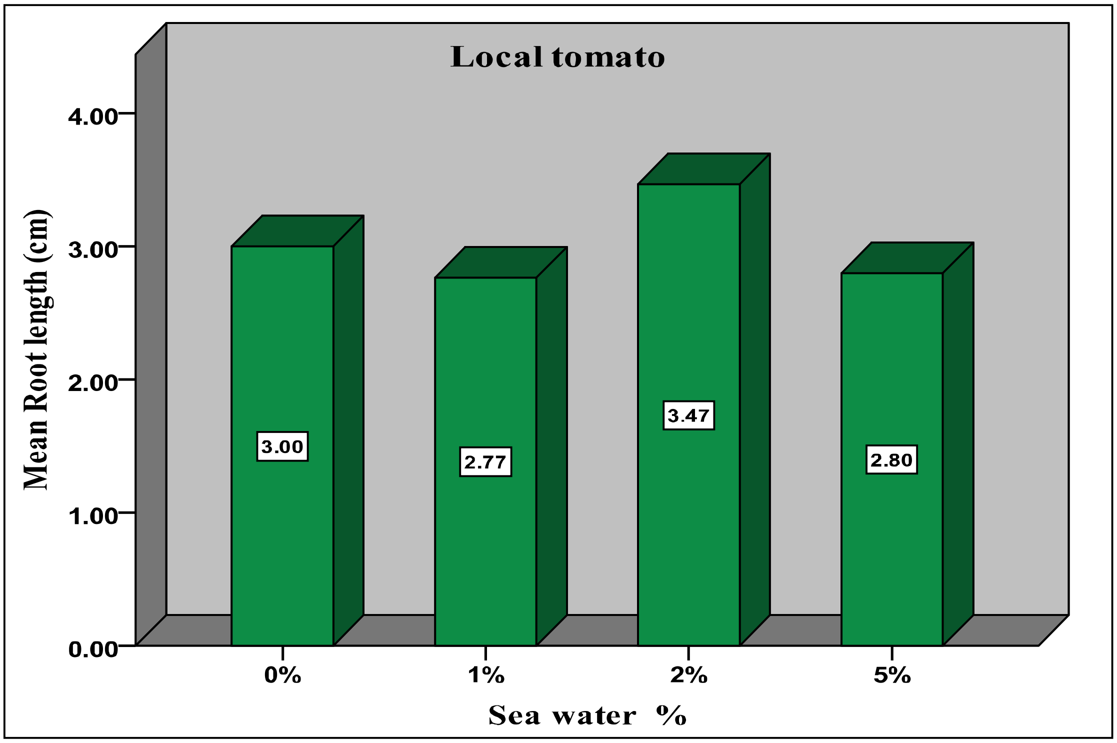


Figure (4-28): Effect of sea water dilutions on local tomato root length.

4.7.2. Effect of sea water dilutions on local tomato fresh and dry weight:

Fresh weight: According to anova statistical analysis there was significant differences in mean tomato fresh weight at different dilution of sea water (p-value= 0.000). compared with the control treatment tomato fresh weight decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato fresh weight at dilution of 1% and control treatment (p-value=000).

Dry weight: According to anova statistical analysis there was significant differences in mean local tomato dry weight at different dilution of sea water (p-value= 0.006). Compared with the control treatment tomato dry weight decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between both of tomato dry weight at dilution of 1%, 5% and control treatment (p-value=0.029 and 0.002) respectively.

Table (4-20): Effect of sea water dilutions on local tomato fresh and dry weights.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	Std. Error	p- value
Fresh weight	0%	0.36	0.03	0.02	0.000*
	1%	0.15	0.02	0.01	
	2%	0.35	0.01	0.01	
	5%	0.32	0.02	0.01	
Dry weight	0%	0.05	0.02	0.01	0.006*
	1%	0.03	0.01	0.01	
	2%	0.05	0.01	0.01	
	5%	0.01	0.01	0.00	

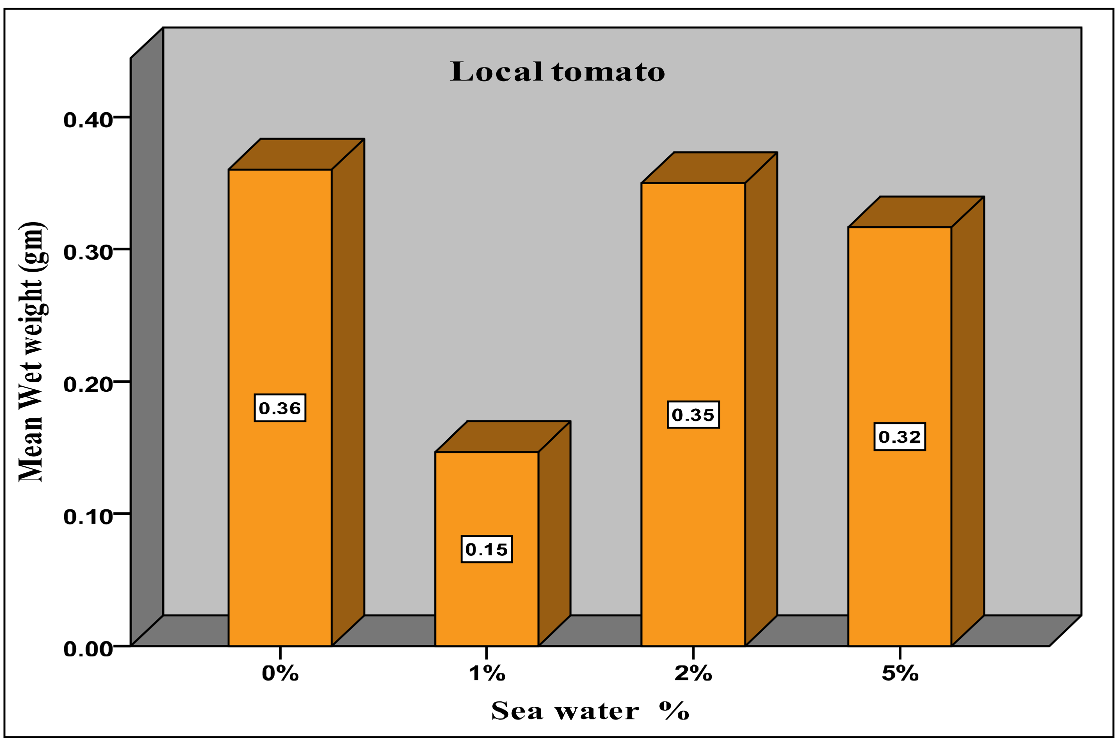


Figure (4-29): Effect of sea water dilutions on local tomato fresh weights.

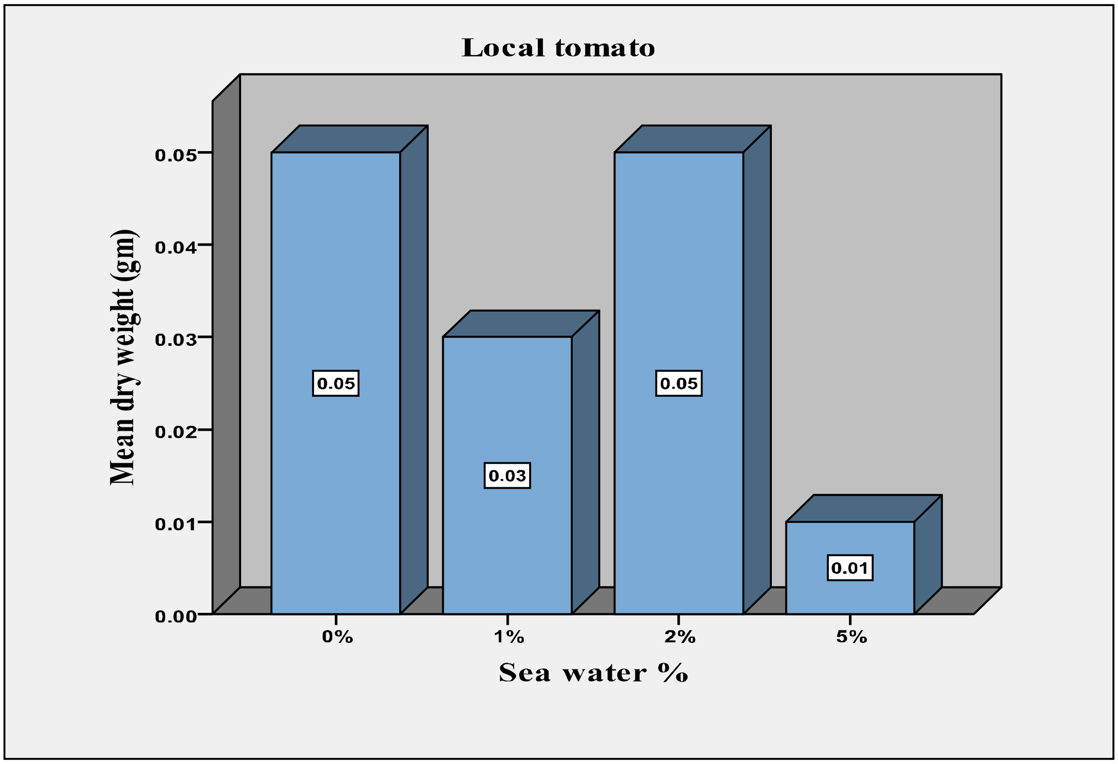


Figure (4-30): Effect of sea water dilutions on local tomato dry weights.

4.7.3. Effect of sea water dilutions on local tomato leaves numbers and surface area:

Leaves number: According to anova statistical analysis there was significant differences in mean tomato leaves number at different dilution of sea water (p-value= 0.006). Compared with the control treatment tomato leaves number decreased at all sea water dilutions. Post hoc multiple comparison showed significant differences between tomato leaves number at all dilutions and control treatment (p-value=0.03)

Leaves surface area: According to anova statistical analysis there was significant differences in mean tomato leaves surface area at different dilution of sea water (p-value= 0.006). Compared with the control treatment tomato leaves area decreased at all sea water dilutions. Post hoc multiple comparison showed significant differences between tomato area at dilutions of 5% and control treatment (p-value=0.02).

Table (4-21): Effect of sea water dilutions on local tomato leaves number and surface area.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	Std. Error	p- value
Leaves number	0%	4.333	0.577	0.333	0.006*
	1%	2.333	0.577	0.333	
	2%	2.333	0.577	0.333	
	5%	2.333	0.577	0.333	
Leaves surface area	0%	0.83	1.0967	0.633	0.006*
	1%	0.9	1.044	0.603	
	2%	2.06	0.351	0.203	
	5%	3.31	1.447	0.835	

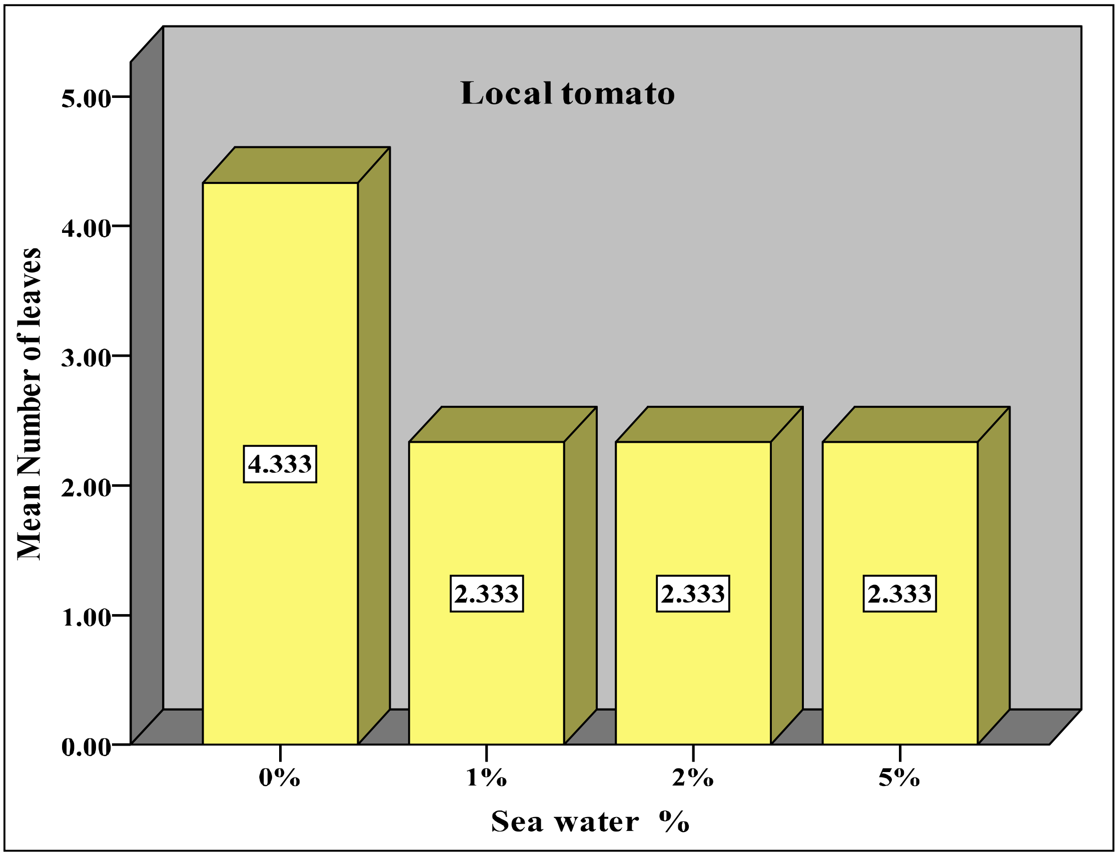


Figure (4-31): Effect of sea water dilutions on local tomato leaves number.

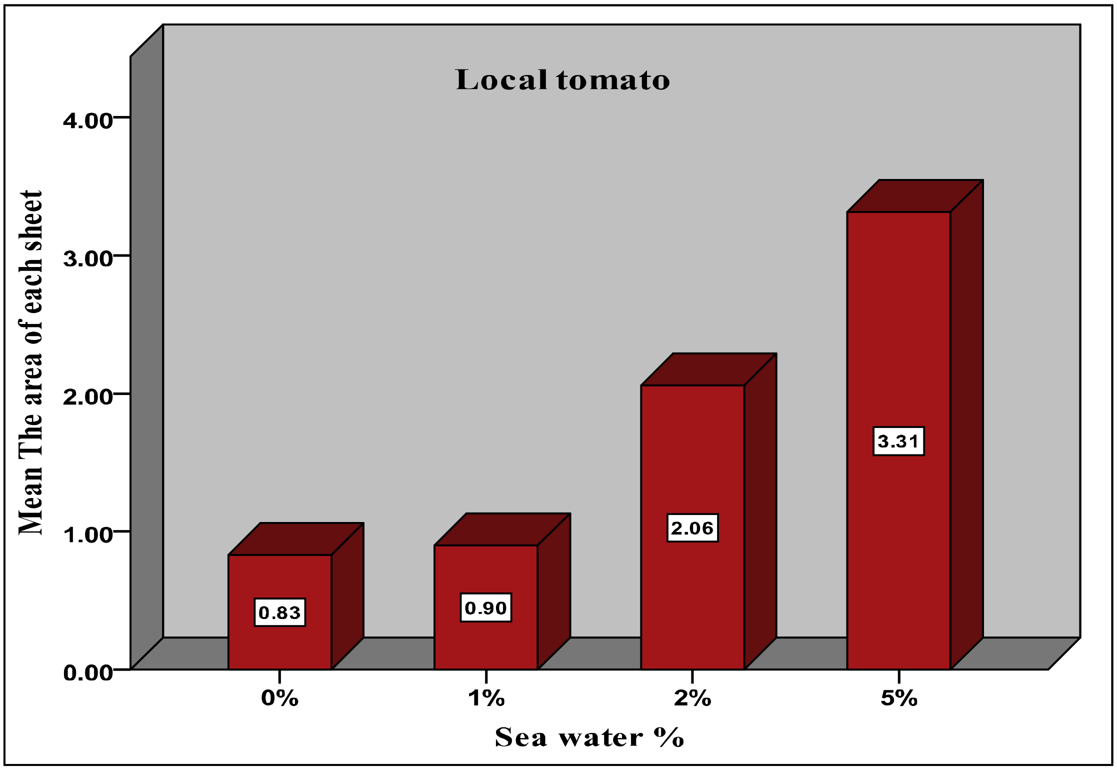


Figure (4-32): Effect of sea water dilutions on local tomato leaves surface area.

4.7.4. Seedling vigor index of local tomato treated with sea water:

The highest seedling vigor index was obtained by the control treatment followed by seedling treated with sea water dilution of 2%, with significant reduce at sea water dilution of 5%.

Table (4-22): Seedling vigor index of local tomato at different dilutions of sea water

Dilutions	0%	1%	2%	5%	10%	20%
SVI	1161	738	1053	293.1	-	-

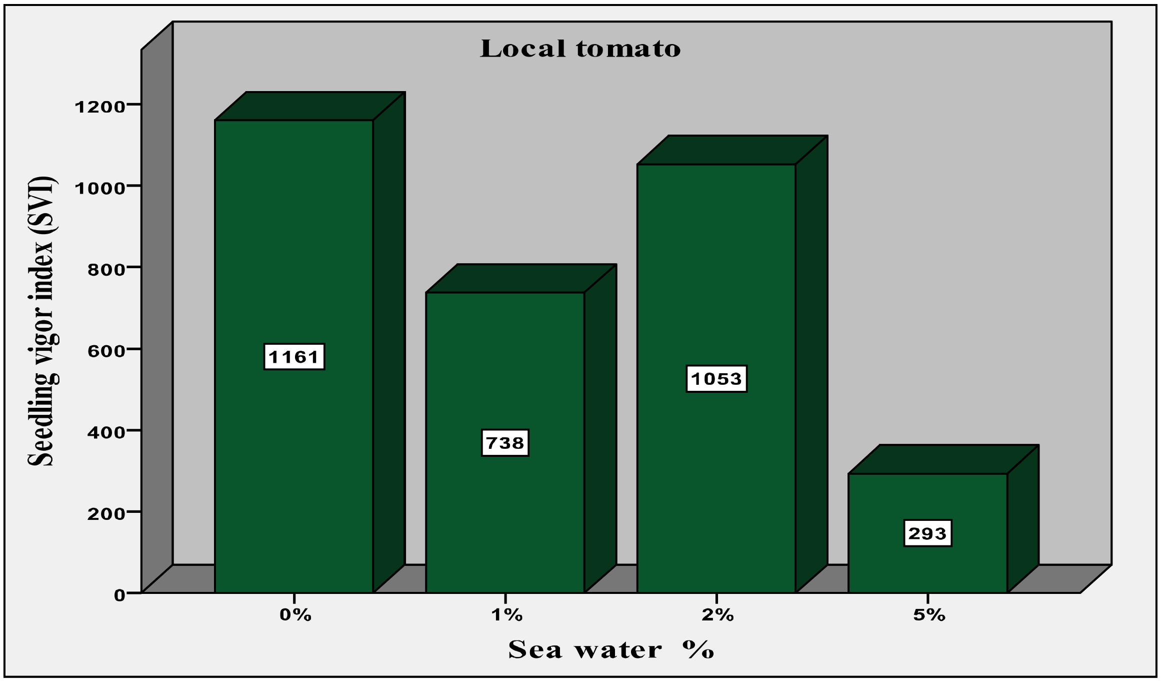


Figure (4-33): Seedling vigor index of local tomato at different dilutions of sea water.

4.8. Effect of magnetic sea water on seedling development of local tomato:

4.8.1. Effect of magnetic sea water on local tomato plant growth:

Whole length: Anova statistical test showed significant differences between the means of whole tomato at different dilutions of magnetic sea water (p-value =0.00). Compared with the control the whole plant decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato lengths at all dilutions and the control treatment length. (p-value =0.00, 0.001 and 0.001) respectively.

Shoot length: Anova statistical test showed significant differences between the means of shoot lengths at different dilutions of magnetic sea water (p-value =0.00). Compared with the control the shoot length decreased with increased magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between shoot lengths at all dilutions (1%, 2% and 5%) and the control treatment root length (p-value =0.00).

Root length: Anova statistical test showed no significant differences between the means of root lengths at different dilutions of magnetic sea water (p-value =0.713). Compared with the control the root length decreased with increased sea water dilutions.

Post hoc multiple comparison showed no significant differences between root lengths at all dilutions (1%, 2% and 5%) and the control treatment root length (p-value =0.617, 0.275 and 0.676) respectively.

Figure (4-34): Effect of magnetic sea water on local tomato.

Table (4-23): Effect of magnetic sea water on local tomato growth.

Parameters	Descriptive				Anova
	Conc.%	**Mean**	**SD±**	**S. error**	**p-value**
Overall length	0%	12.90	0.85	0.49	0.000*
	1%	8.33	0.15	0.09	
	2%	10.30	0.92	0.53	
	5%	10.03	0.25	0.15	
Shoot length	0%	9.90	0.10	0.06	0.000*
	1%	5.63	0.15	0.09	
	2%	7.80	0.53	0.31	
	5%	7.27	0.71	0.41	
Root length	0%	3.10	0.95	0.55	0.713
	1%	2.70	0.26	0.15	
	2%	2.20	1.48	0.85	
	5%	2.77	0.61	0.35	

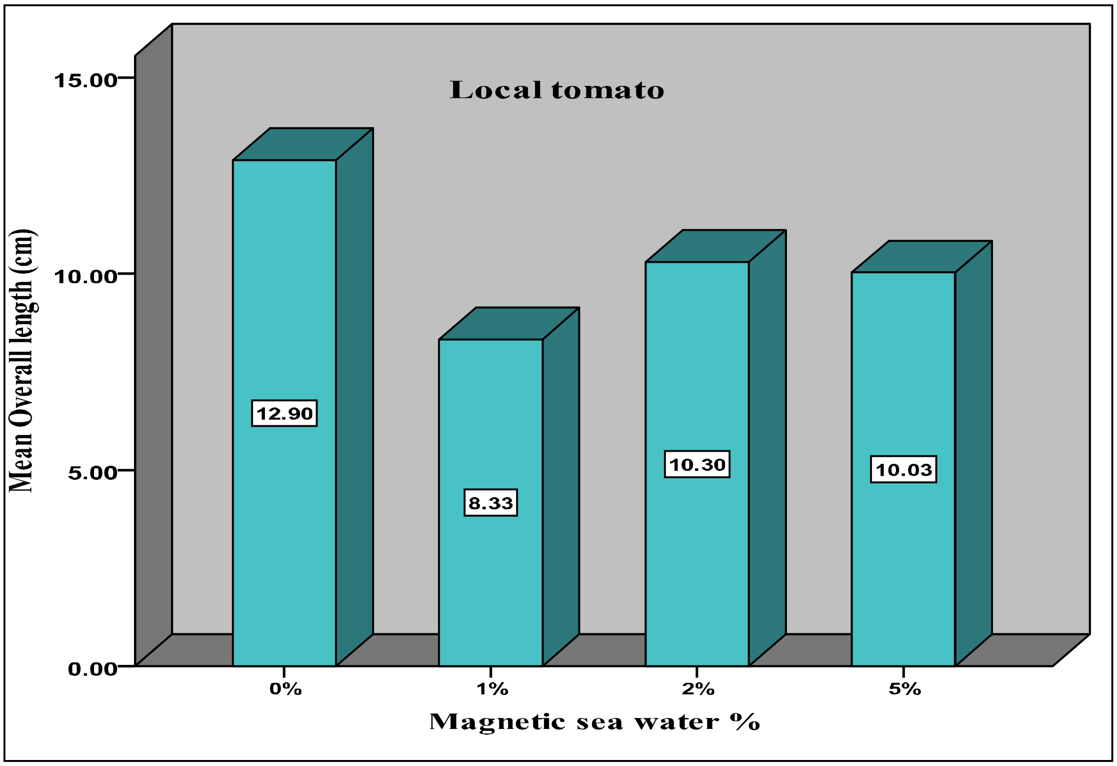
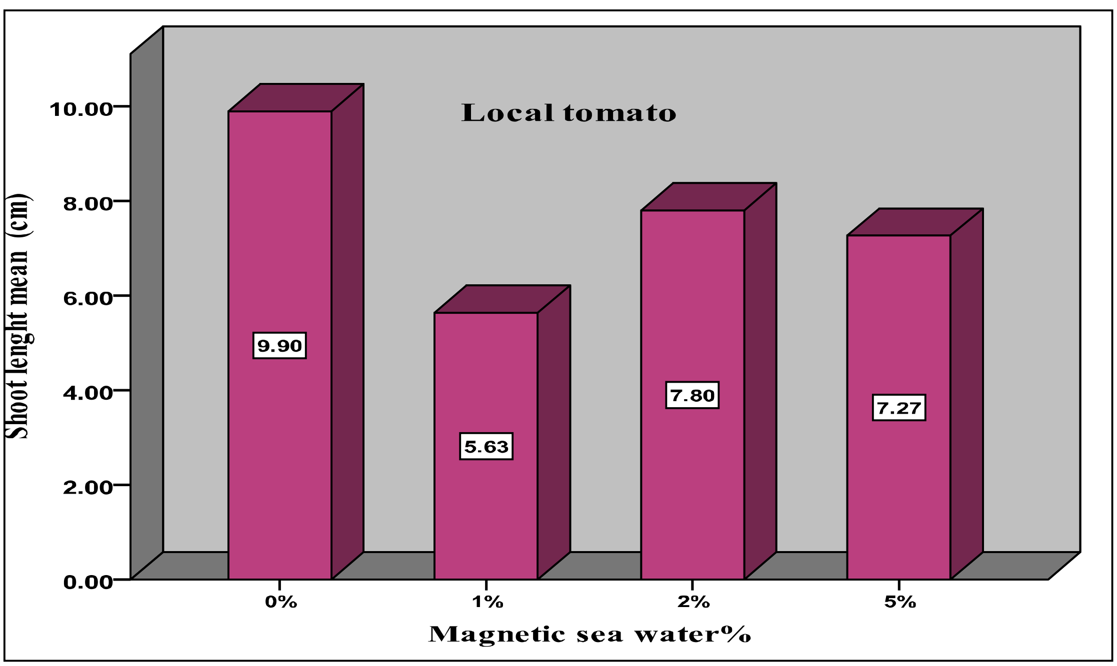


Figure (4-35): Effect of magnetic sea water on local tomato whole plant length.



Figure(4-36): Effect of magnetic sea water on local tomato shoot length.

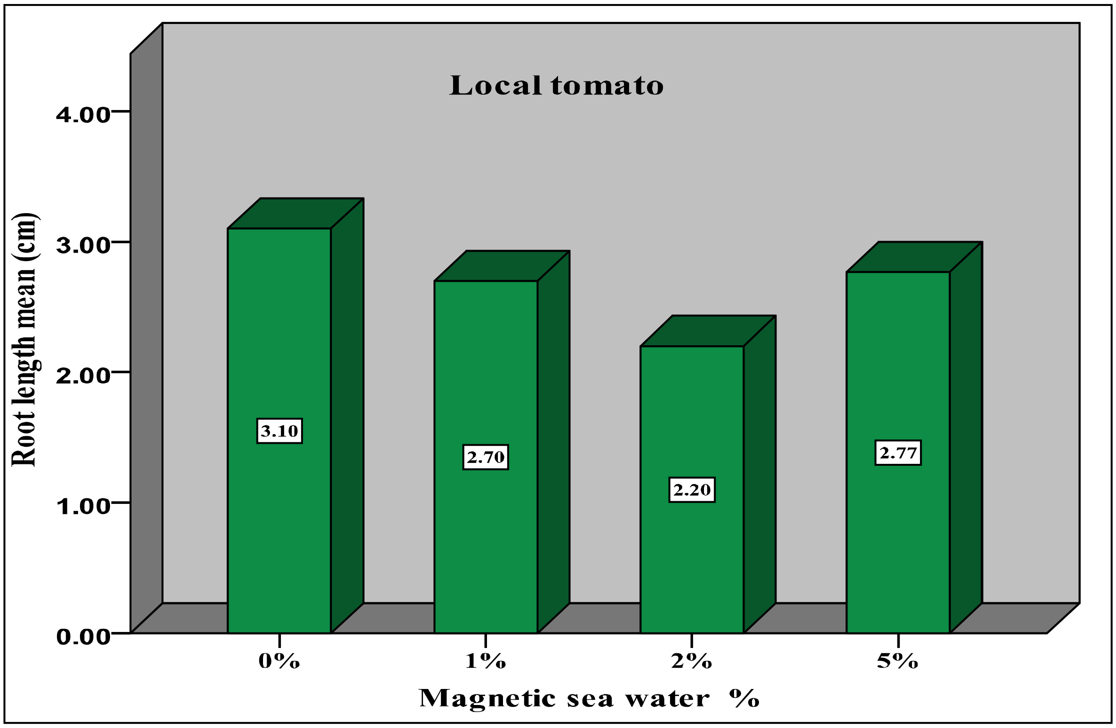


Figure (4-37): Effect of magnetic sea water on local tomato root length.

4.8.2. Effect of magnetic sea water on local tomato fresh and dry weight:

Fresh weight: According to anova statistical analysis there was significant differences in mean tomato fresh weight at different dilution of magnetic sea water (p-value= 0.000). compared with the control treatment tomato fresh weight decreased with increased magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between tomato fresh weight at dilution of 1% and control treatment (p-value=0.000).

Dry weight: According to anova statistical analysis there was significant differences in mean of local tomato dry weight at different dilution of magnetic sea water (p-value= 0.003). compared with the control treatment tomato dry weight decreased with increased magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between tomato dry weight at dilution 5% and control treatment dry weight (p-value=0.013).

Table (4-24): Effect of magnetic sea water on local tomato fresh and dry weight.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Fresh weight	0%	0.36	0.03	0.02	0.000
	1%	0.15	0.01	0.01	
	2%	0.32	0.06	0.04	
	5%	0.34	0.01	0.01	
Dry weight	0%	0.05	0.02	0.01	0.03
	1%	0.03	0.01	0.00	
	2%	0.05	0.02	0.01	
	5%	0.02	0.01	0.00	

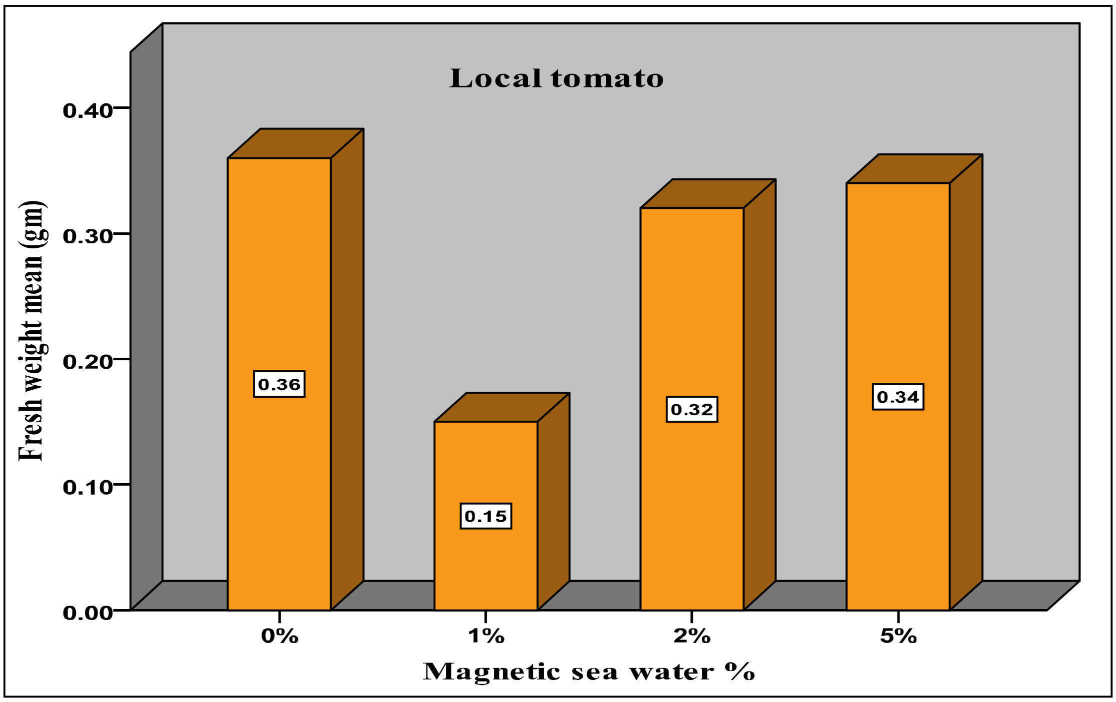


Figure (4-38): Effect of magnetic sea water on local tomato fresh weight.

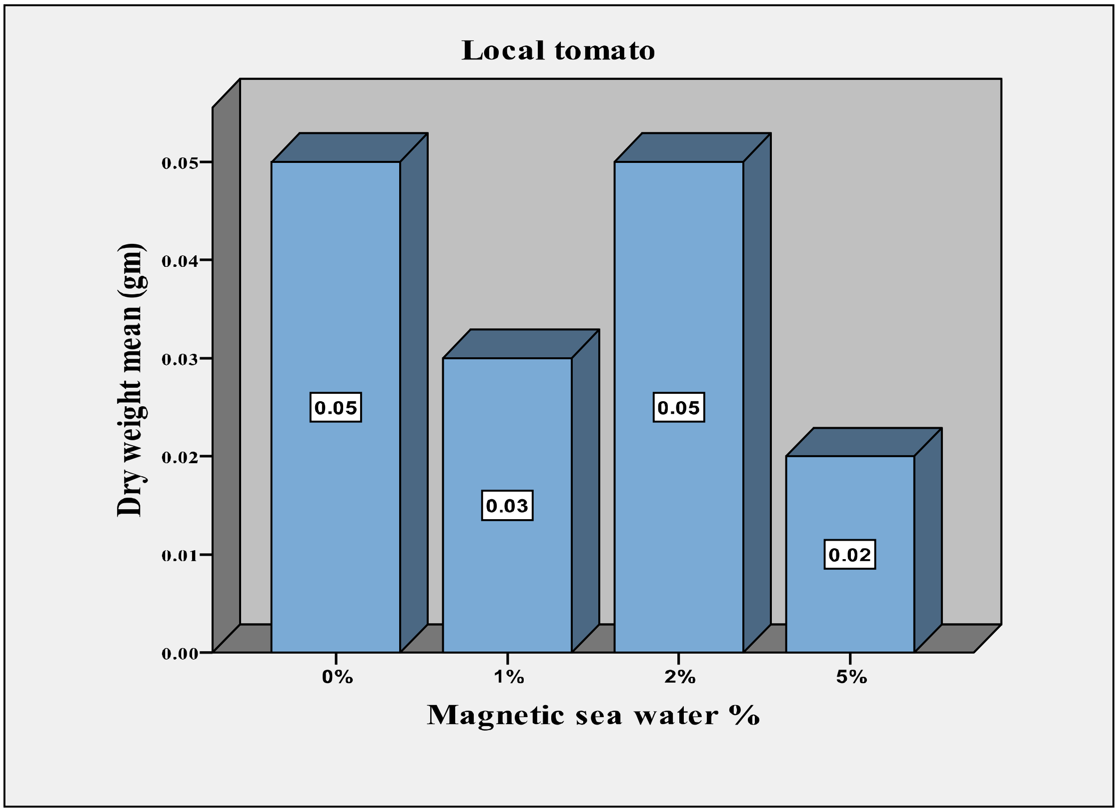


Figure (4-39): Effect of magnetic sea water on local tomato dry weight.

4.8.3. Effect of magnetic sea water on local tomato leaves numbers and surface area:

Leaves number: According to anova statistical analysis there was significant differences in mean tomato leaves number at different dilution of magnetic sea water (p-value= 0.011). Compared with the control treatment tomato leaves number decreased with increased magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between tomato leaves number at dilution of 1% and control treatment (p-value=0.03).

Leaves surface area: According to anova statistical analysis there was significant differences in mean tomato leaves surface area at different dilution of sea water (p-value= 0.03). Compared with the control treatment tomato leaves area increased with increase magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between local tomato leaves area at dilutions of 5% and control treatment (p-value=0.00).

Table (4-25): Effect of magnetic sea water on local tomato leaves numbers and surface area.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Leaves number	0%	4.33	0.58	0.33	0.011
	1%	2.33	0.58	0.33	
	2%	2.67	0.58	0.33	
	5%	2.67	0.58	0.33	
Leaves surface area	0%	1.06	0.93	0.26	0.03
	1%	1.01	0.15	0.06	
	2%	1.72	0.59	0.21	
	5%	3.73	2.97	1.12	

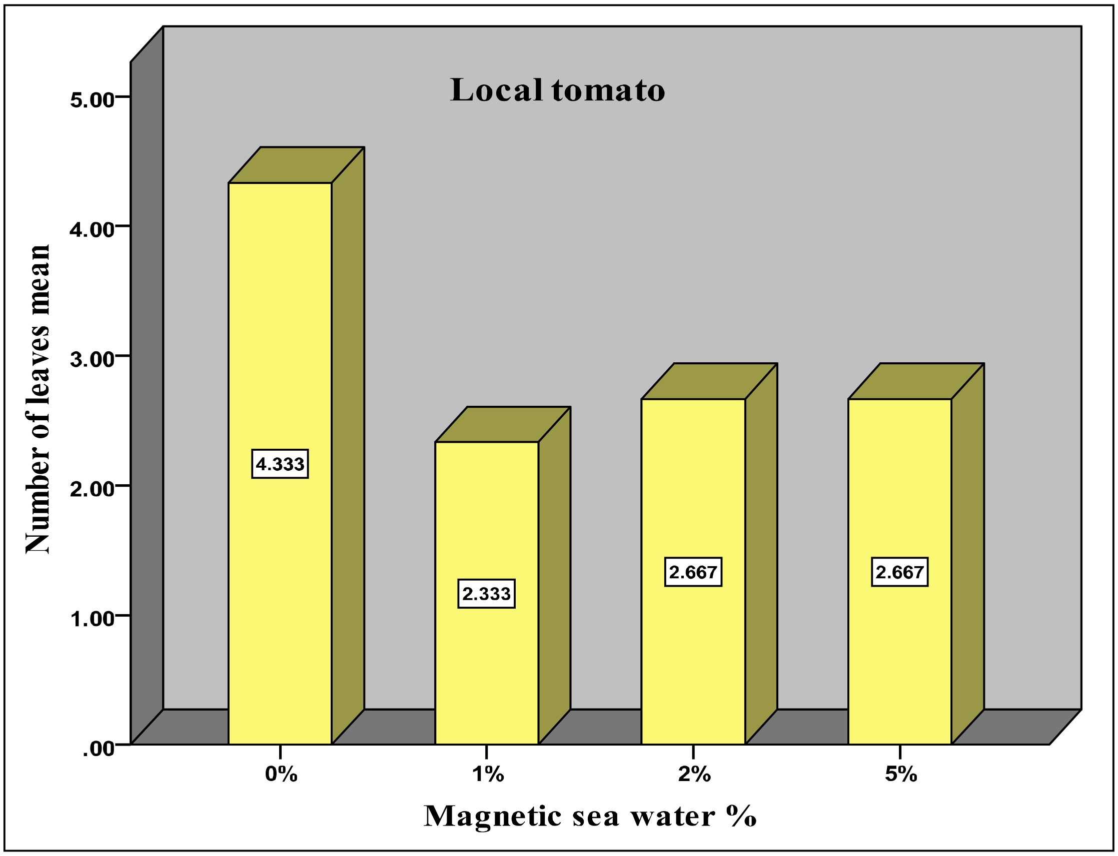


Figure (4-40): Effect of magnetic sea water on local tomato leaves numbers.

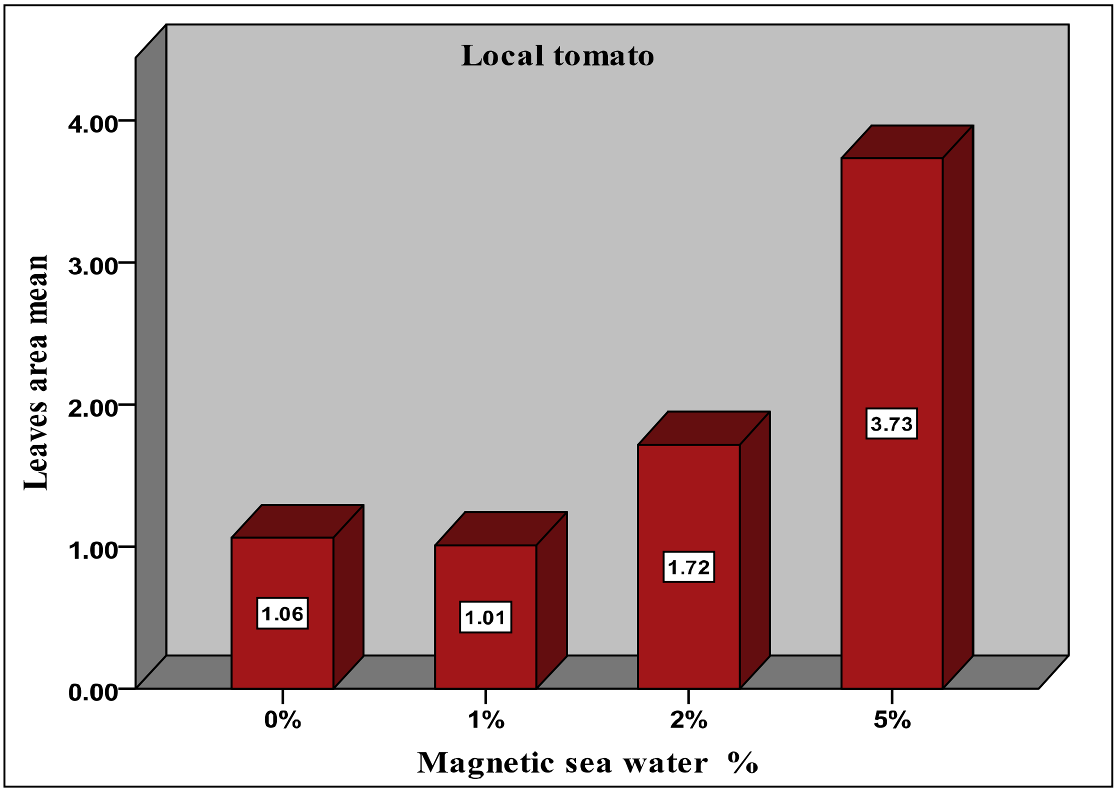


Figure (4-41): Effect of magnetic sea water on local tomato leaves surface area.

4.8.4. Seedling vigor index of local tomato at different dilutions of magnetic sea water:

The highest seedling vigor index was obtained at control treatment followed by that obtained at magnetic sea water dilution of 2%, the lowest seedling vigor index was that obtained at magnetic sea water dilution of 5%.

Table (4-26): Seedling vigor index of local tomato at different dilutions of magnetic sea water.

Seedling vigor index					
0%	1%	2%	5%	10%	20%
1161	747	950	500	-	-

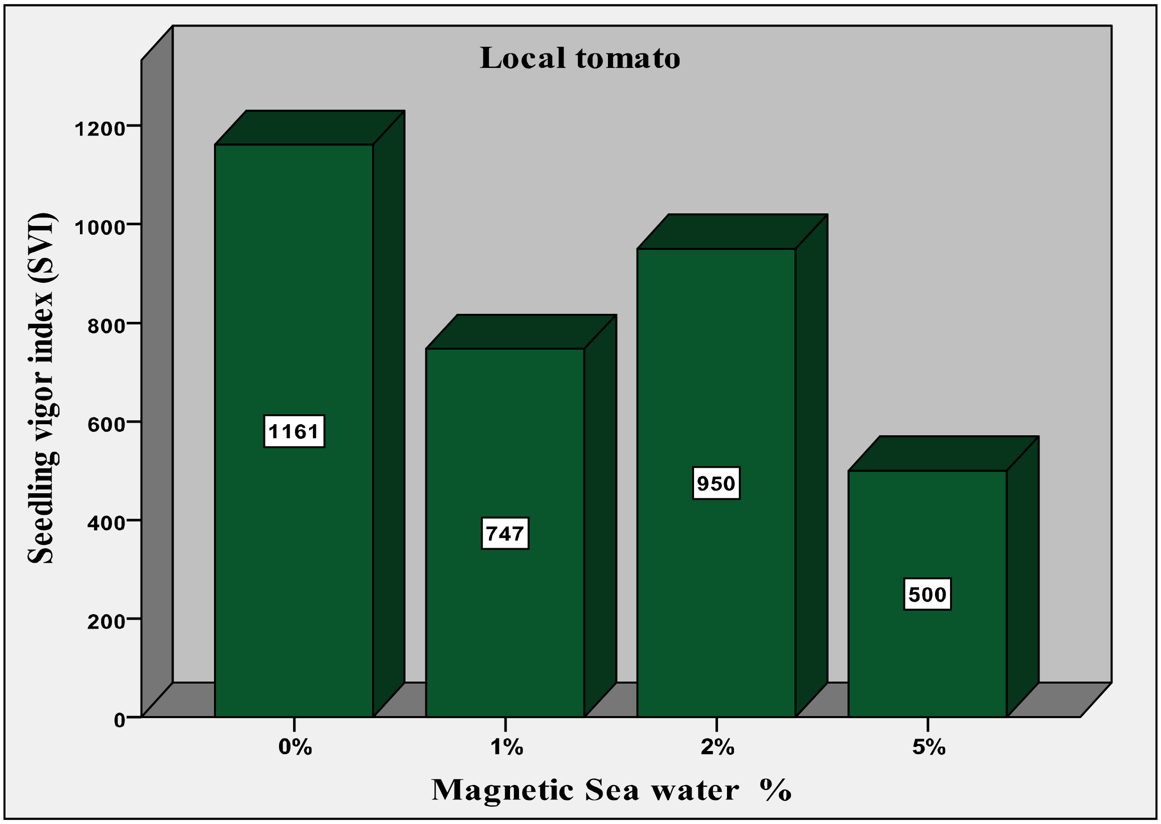


Figure (4-42): Seedling vigor index of local tomato at different dilutions of magnetic sea water.

4.9. Effect of sea water dilutions on seedling development of imported tomato:

4.9.1. Effect sea water dilutions on imported tomato plant growth:

Whole length: Anova statistical test showed significant differences between the means of whole tomato length at different dilutions of sea water (p-value =0.00). Compared with the control the whole plant decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato lengths at all dilutions and the control treatment length. (p-value =0.02, 0.019 and 0.00) respectively.

Shoot length: Anova statistical analysis showed significant differences between the means of shoot lengths at different dilutions of sea water (p-value =0.012). Compared with the control the shoot length decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between shoot lengths at dilution of 5% and the control treatment root length (p-value =0.04).

Root length: Anova statistical analysis showed significant differences between the means of root lengths at different dilutions of sea water (p-value =0.03). Compared with the control the root length decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between root lengths at dilution of 5%) and the control treatment root length (p-value = 0.000).

Figure (4-43): Effect of sea water dilutions on imported tomato growth.

Table (4-27): Effect of sea water dilutions on imported tomato growth.

Parameters	Descriptive				Anova
	Conc.%	Mean	SD±	S. error	p-value
Overall length	0%	13.63	0.96	0.55	0.000*
	1%	11.07	0.21	0.12	
	2%	12.00	0.50	0.29	
	5%	8.90	0.79	0.46	
Shoot length	0%	9.93	0.40	0.23	0.012*
	1%	8.77	0.25	0.15	
	2%	9.83	0.15	0.09	
	5%	7.53	1.36	0.79	
Root length	0%	3.70	0.56	0.32	0.03*
	1%	2.30	0.10	0.06	
	2%	2.17	0.35	0.20	
	5%	1.37	0.71	0.41	

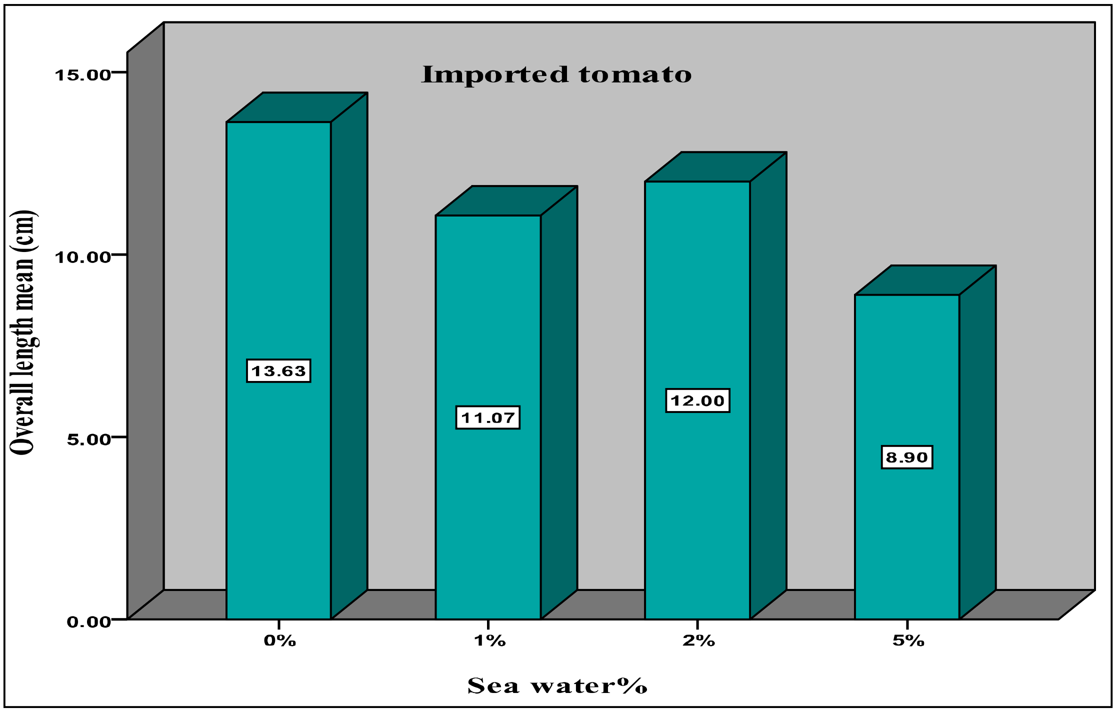


Figure (4-44): Effect sea water dilutions on imported tomato whole length.

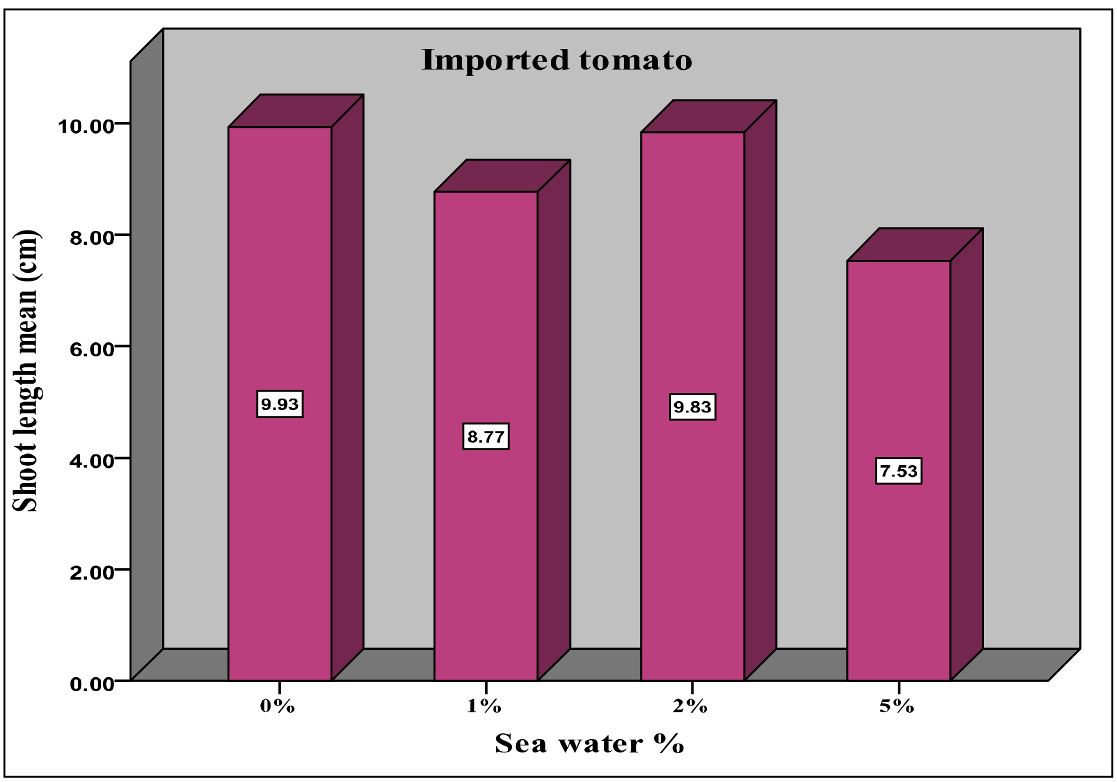


Figure (4-45): Effect sea water dilutions on imported tomato shoot length.

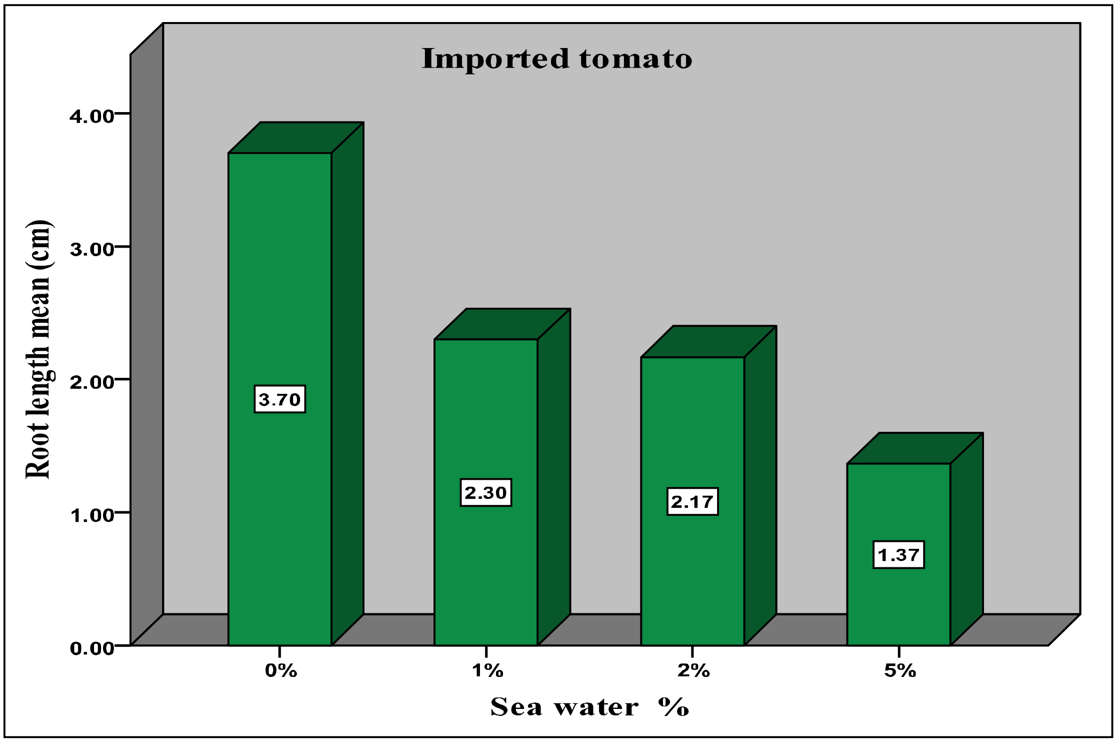


Figure (4-46): Effect sea water dilutions on imported tomato root length.

4.9.2. Effect of sea water dilutions on imported tomato fresh and dry weight:

Fresh weight: According to anova statistical analysis there was significant differences in mean tomato fresh weight at different dilution of sea water (p-value= 0.01). compared with the control treatment tomato fresh weight decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato fresh weight at dilution of 1% and control treatment (p-value=0.002, 0.001 and 0.00) respectively.

Dry weight: According to anova statistical analysis there was significant differences in mean of local tomato dry weight at different dilution of sea water (p-value= 0.023). compared with the control treatment tomato dry weight decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato dry weight at dilution 1% and control treatment dry weight (p-value=0.025).

Table (4-28): Effect of sea water dilutions on imported tomato fresh and dry weight.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Fresh weight	0%	0.35	0.06	0.03	0.01*
	1%	0.23	0.01	0.01	
	2%	0.22	0.02	0.01	
	5%	0.19	0.01	0.01	
Dry weight	0%	0.06	0.02	0.01	0.023*
	1%	0.03	0.01	0.00	
	2%	0.03	0.01	0.01	
	5%	0.03	0.01	0.00	

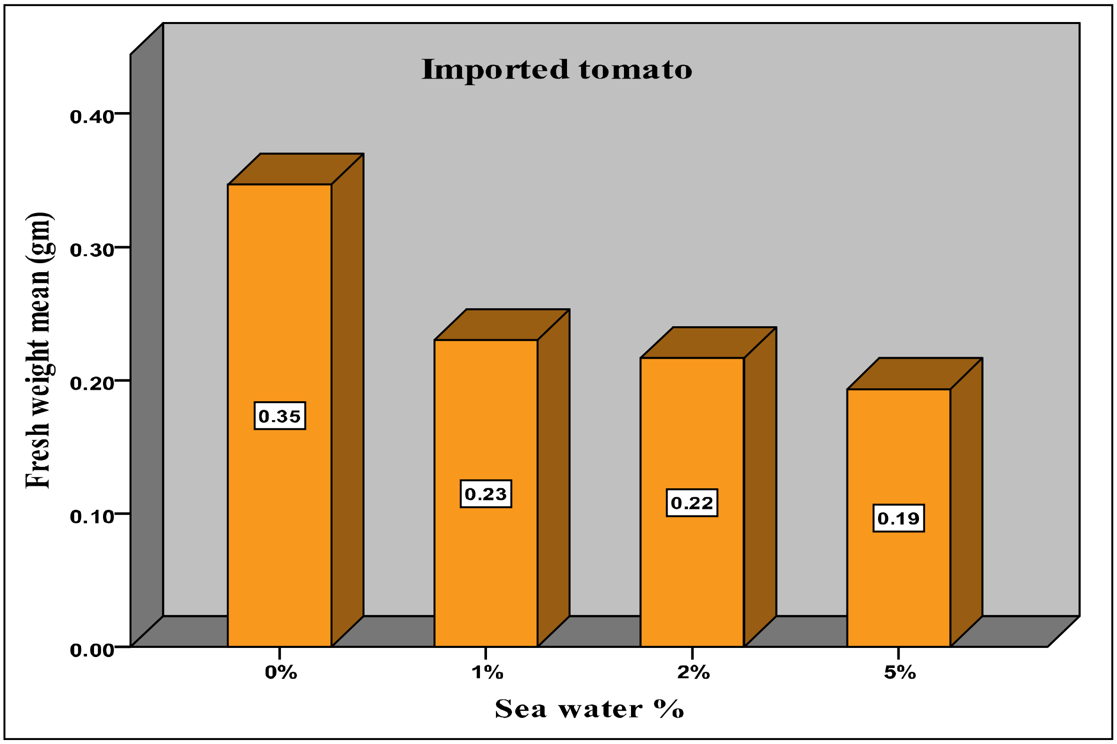


Figure (4-47): Effect of sea water dilutions on imported tomato fresh weight.

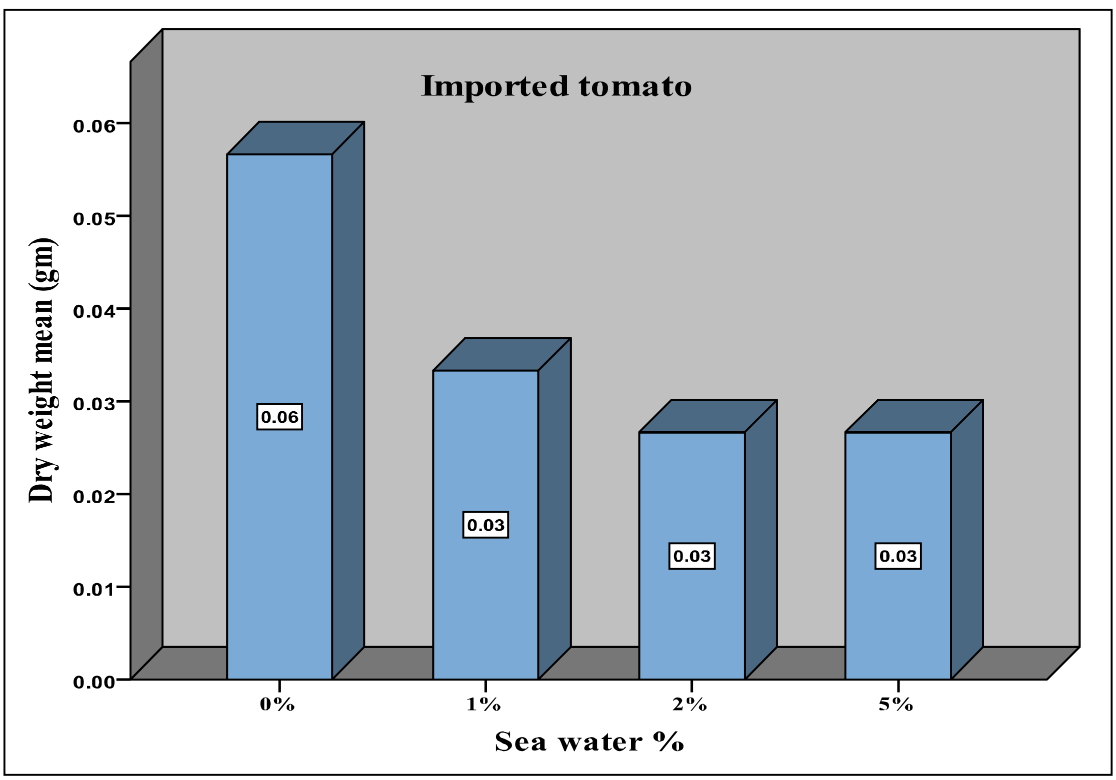


Figure (4-48): Effect of sea water dilutions on imported tomato dry weight.

4.9.3. Effect of sea water dilutions on imported tomato leaves numbers and surface area:

Leaves number: According to anova statistical analysis there was significant differences in mean tomato leaves number at different dilution of magnetic sea water (p-value= 0.043). Compared with the control treatment tomato leaves number decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato leaves number at dilution of 5% and control treatment (p-value=0.12).

Leaves surface area: According to anova statistical analysis there was significant differences in mean tomato leaves surface area at different dilution of sea water (p-value= 0.00). Compared with the control treatment tomato leaves area decreased at sea water dilutions of 1% and 5%. Post hoc multiple comparison showed significant differences between local tomato leaves area at dilutions of 1%, 5% and control treatment (p-value=0.00, 0.045) respectively.

Table (4-29): Effect of sea water dilutions on imported tomato leaves number and area.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	Std. Error	p- value
Leaves number	0%	4.67	0.58	0.33	0.043
	1%	4.33	0.58	0.33	
	2%	3.33	0.58	0.33	
	5%	2.67	1.15	0.67	
Leaves surface area	0%	2.09	0.74	0.20	0.00
	1%	1.25	0.22	0.06	
	2%	2.05	0.14	0.04	
	5%	1.67	0.31	0.11	

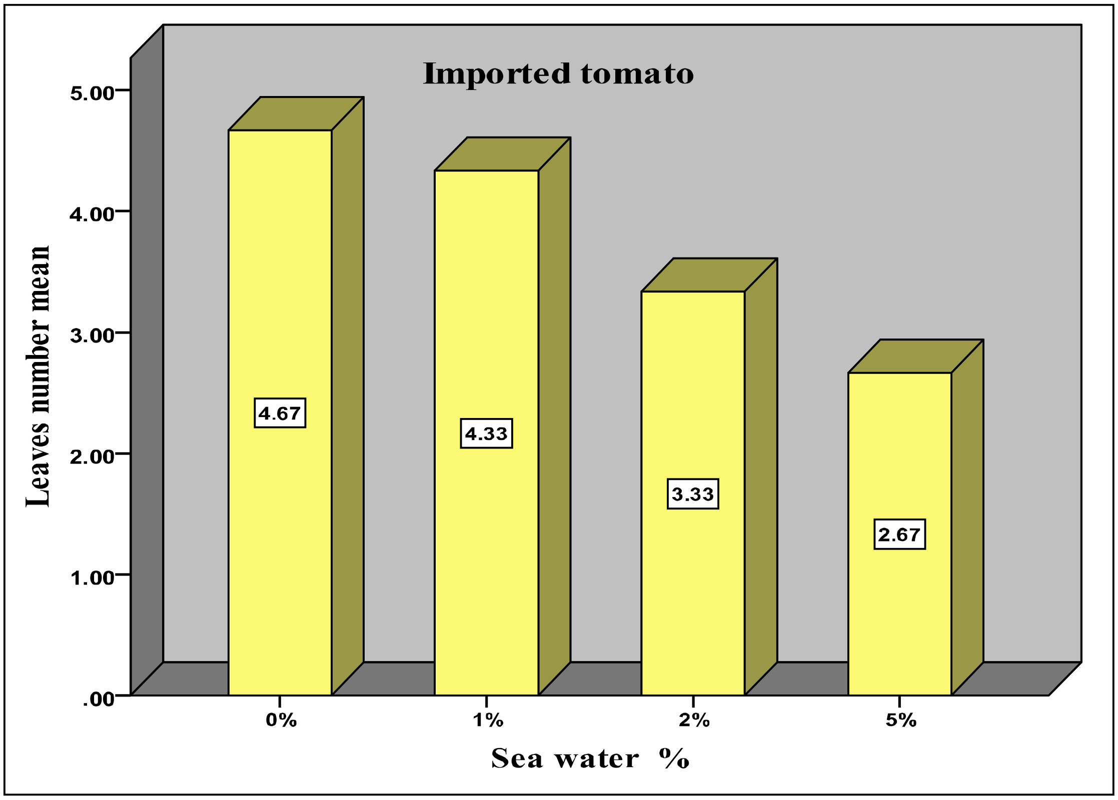


Figure (4-49):The effect of sea water dilutions on imported tomato leaves number.

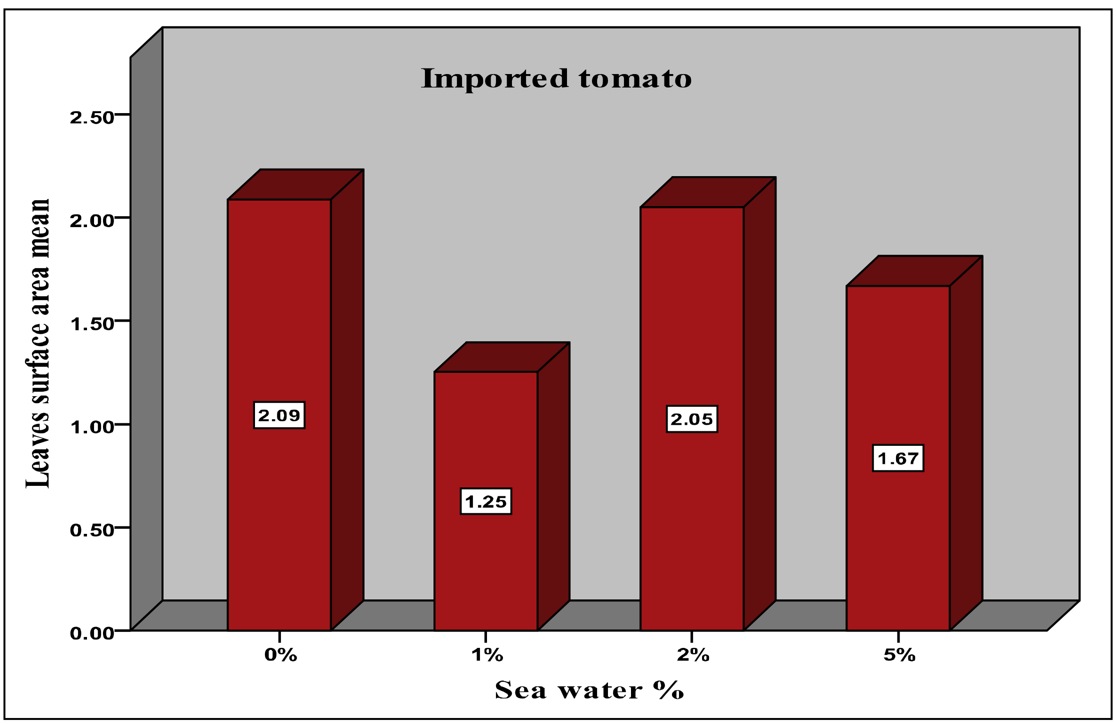


Figure (4-50):The effect of sea water dilutions on imported tomato leaves surface area.

4.9.4. Seedling vigor index of imported tomato at different dilutions of sea water:

The highest seedling vigor index was obtained at magnetic sea water dilution of 2%, followed by that obtained at control treatment, the lowest seedling vigor index was that obtained at sea water dilution of 5%.

Table (4-30): Seedling vigor index of imported tomato at different dilutions of sea water.

Dilutions	0%	1%	2%	5%	10%	20%
SVI	992.8	954.6	1032	762.82	-	-

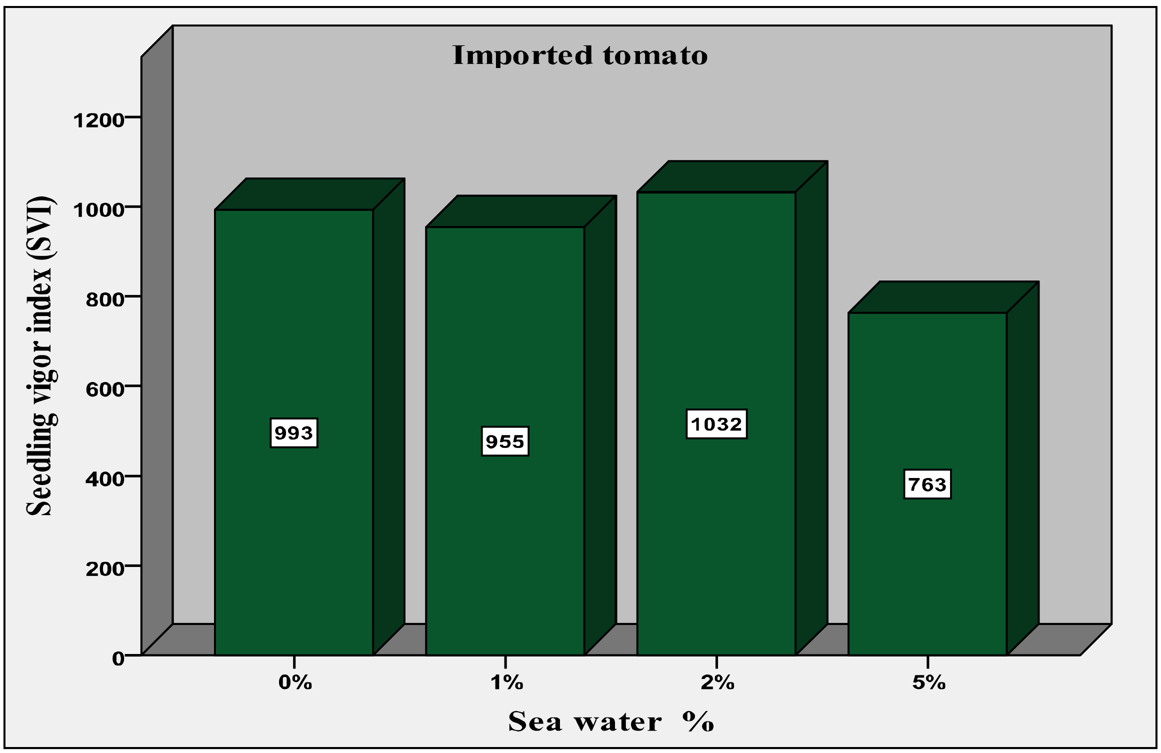


Figure (4-51): Seedling vigor index of imported tomato at different dilutions of sea water.

4.10. Effect of magnetic sea water on seedling development of imported tomato:

4.10.1. Effect of magnetic sea water on imported tomato plant length:

Whole length: Anova statistical test showed significant differences between the means of whole tomato at different dilutions of magnetic sea water (p-value =0.001). Compared with the control the whole plant decreased with increased sea water dilutions. Post hoc multiple comparison showed significant differences between tomato lengths at all dilutions and the control treatment length. (p-value =0.001, 0.016 and 0.00) respectively.

Shoot length: Anova statistical test showed significant differences between the means of shoot lengths at different dilutions of magnetic sea water (p-value =0.013). Compared with the control the shoot length decreased with increased magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between shoot lengths at all dilutions (1% and 5%) and the control treatment root length (p-value =0.021, 0.016) respectively.

Root length: Anova statistical test showed no significant differences between the means of root lengths at different dilutions of magnetic sea water (p-value =0.13). Compared with the control the root length decreased with increased sea water dilutions. Post hoc multiple comparison showed no significant differences between root lengths at dilutions of 5% and the control treatment root length (p-value =0.13).

Figure (4-52): Effect of magnetic sea water on imported tomato.

Table (4-31): Effect of magnetic sea water on imported tomato plant growth.

Parameters	Descriptive				Anova
	Conc.%	Mean	SD±	S. error	p-value
Overall length	0%	13.63	0.96	0.55	0.001*
	1%	11.13	0.15	0.09	
	2%	12.17	0.31	0.18	
	5%	10.57	0.60	0.35	
Shoot length	0%	9.93	0.40	0.23	0.031*
	1%	8.50	0.78	0.45	
	2%	9.67	0.59	0.34	
	5%	8.40	0.62	0.36	
Root length	0%	3.70	0.56	0.32	0.130
	1%	2.63	0.92	0.53	
	2%	2.50	0.87	0.50	
	5%	2.17	0.40	0.23	

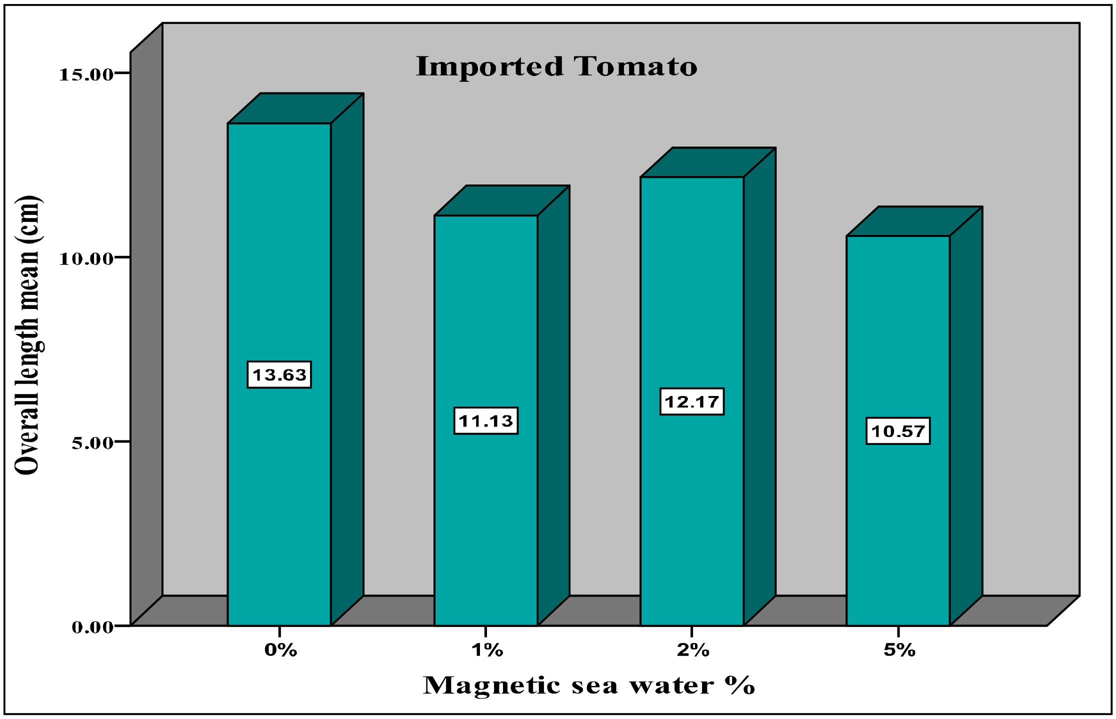
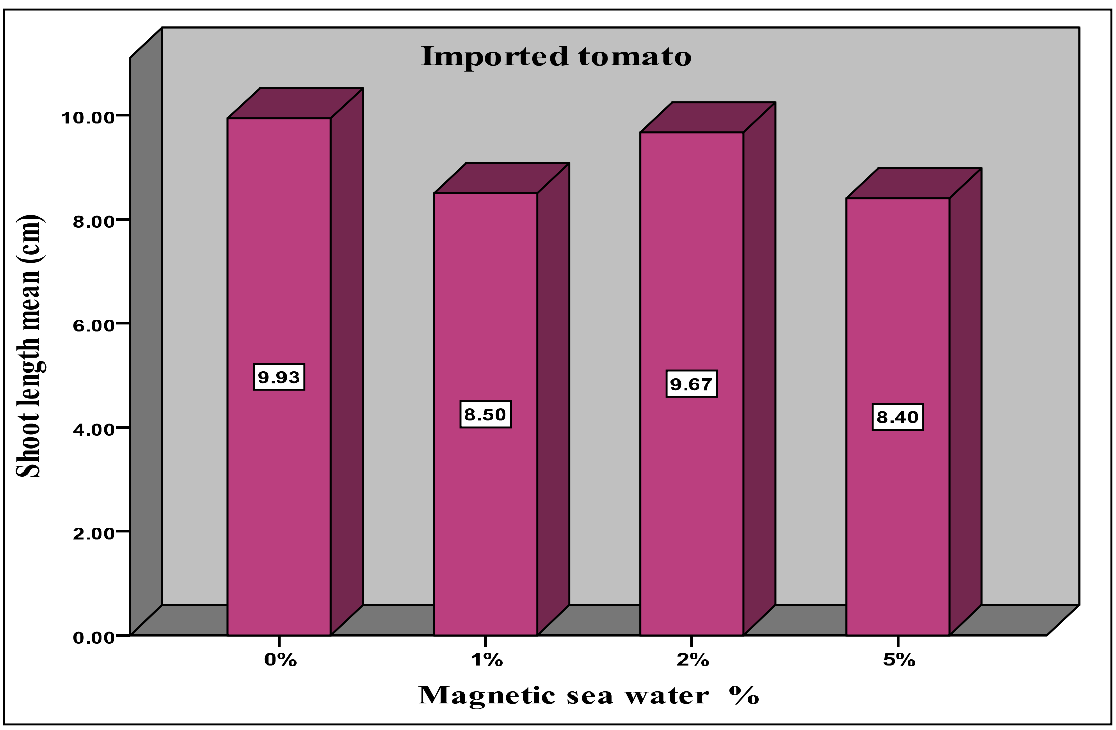


Figure (4-53): The effect of magnetic sea water on imported tomato whole length.



Figure(4-54): The effect of magnetic sea water on imported tomato shoot length.

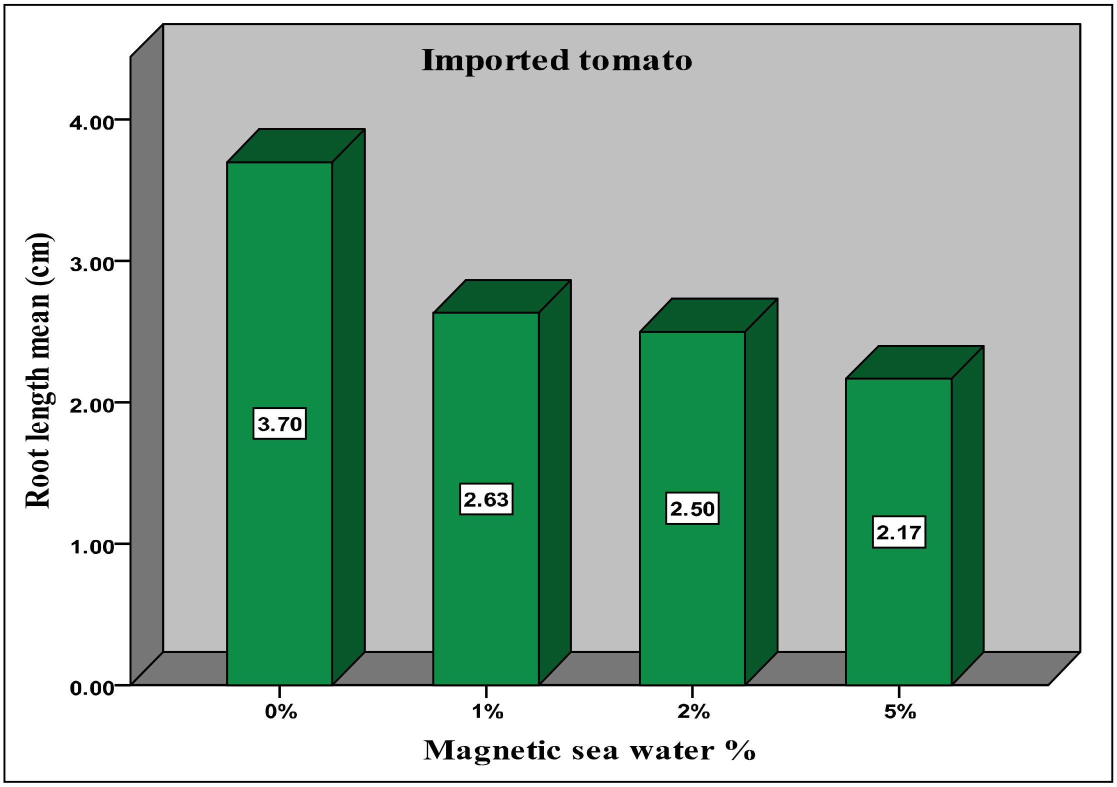


Figure (4-55): The effect of magnetic sea water on imported tomato root length.

4.10.2. Effect of magnetic sea water on imported tomato fresh and dry weights:

Fresh weight: According to anova statistical analysis there was significant differences in mean tomato fresh weight at different dilution of magnetic sea water (p-value= 0.020). compared with the control treatment tomato fresh weight decreased with increased magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between tomato fresh weight at all dilutions and control treatment (p-value=0.004, 0.025 and 0.012).

Dry weight: According to anova statistical analysis there was no significant differences in mean of imported tomato dry weight at different dilution of magnetic sea water (p-value= 0.179). compared with the control treatment tomato dry weight decreased with increased magnetic sea water dilutions but this decrease was not significant. Post hoc multiple comparison showed significant differences between tomato dry weight at dilution 1% and control treatment dry weight (p-value=0.043).

Table (4-32): Effect of magnetic sea water on imported tomato fresh and dry weights.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. Error	p- value
Fresh weight	0%	0.35	0.06	0.03	0.020
	1%	0.23	0.01	0.01	
	2%	0.27	0.02	0.01	
	5%	0.25	0.03	0.02	
Dry weight	0%	0.06	0.02	0.01	0.179
	1%	0.03	0.01	0.01	
	2%	0.04	0.01	0.01	
	5%	0.04	0.01	0.01	

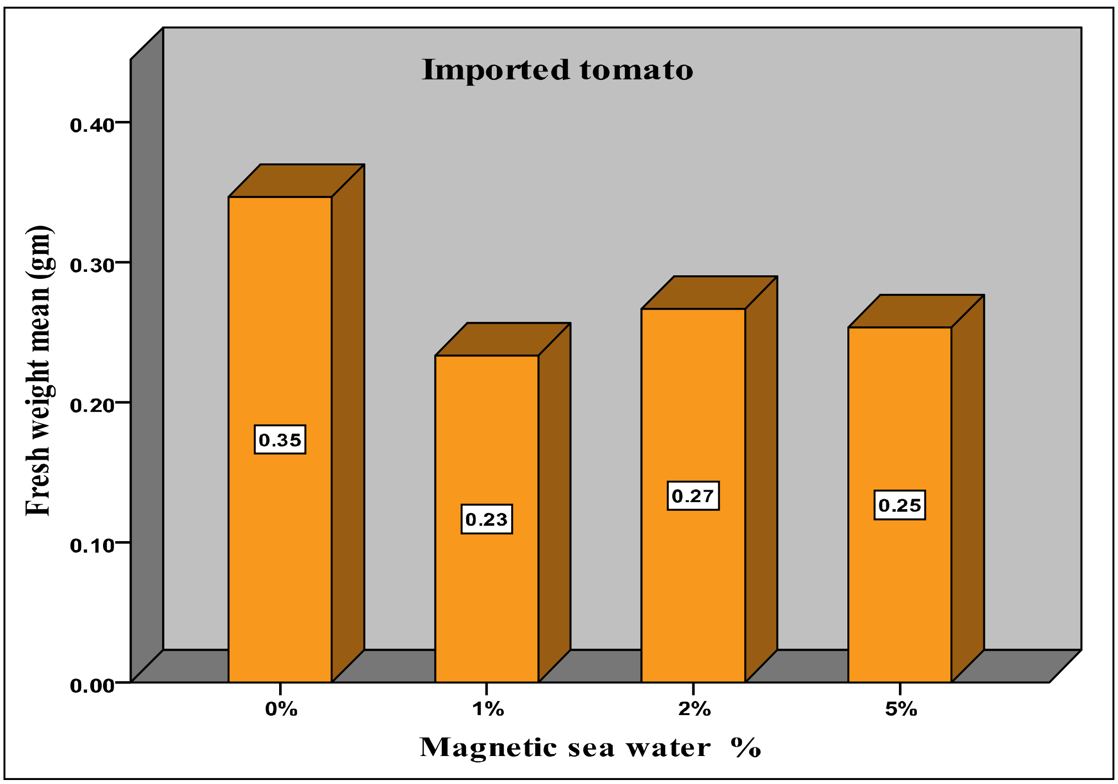


Figure (4-56): Effect of magnetic sea water on imported tomato fresh weights.

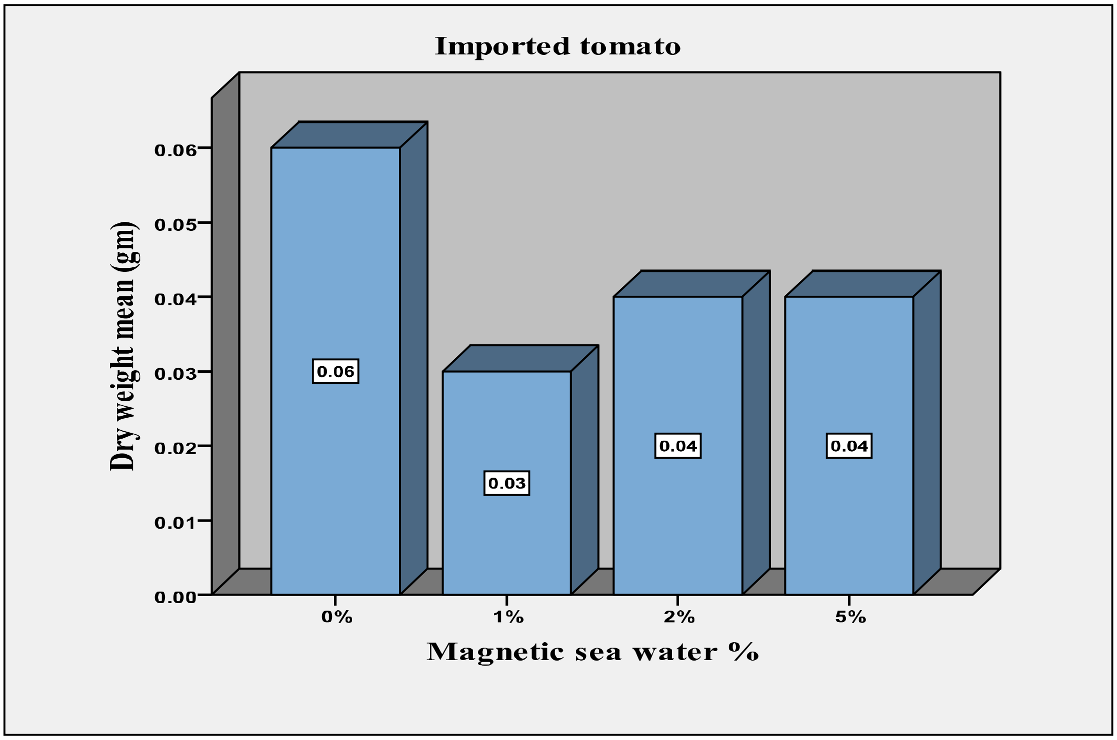


Figure (4-57): Effect of magnetic sea water on imported tomato dry weights.

4.10.3. Effect of magnetic sea water on imported tomato leaves numbers and surface area:

Leaves number: According to anova statistical analysis there was no significant differences in mean tomato leaves number at different dilution of magnetic sea water (p-value= 0.08). Compared with the control treatment tomato leaves number decreased with increased magnetic sea water dilutions but this decrease was not significant. Post hoc multiple comparison showed significant differences between tomato leaves number at dilution of 5% and control treatment (p-value=0.020).

Leaves surface area: According to anova statistical analysis there was significant differences in mean tomato leaves surface area at different dilution of sea water (p-value= 0.00). Compared with the control treatment tomato leaves area decreased with increase magnetic sea water dilutions. Post hoc multiple comparison showed significant differences between imported tomato leaves area at dilutions of 1% and control treatment (p-value=0.00).

Table (4-33): Effect of magnetic sea water on imported tomato leaves numbers and surface area.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	Std. Error	p- value
Leaves number	0%	4.67	0.58	0.33	0.08
	1%	4.33	0.58	0.33	
	2%	3.67	0.58	0.33	
	5%	3.00	1.00	0.58	
Leaves surface area	0%	2.09	0.74	0.20	0.00
	1%	1.28	0.42	0.12	
	2%	2.07	0.23	0.07	
	5%	1.94	0.20	0.07	

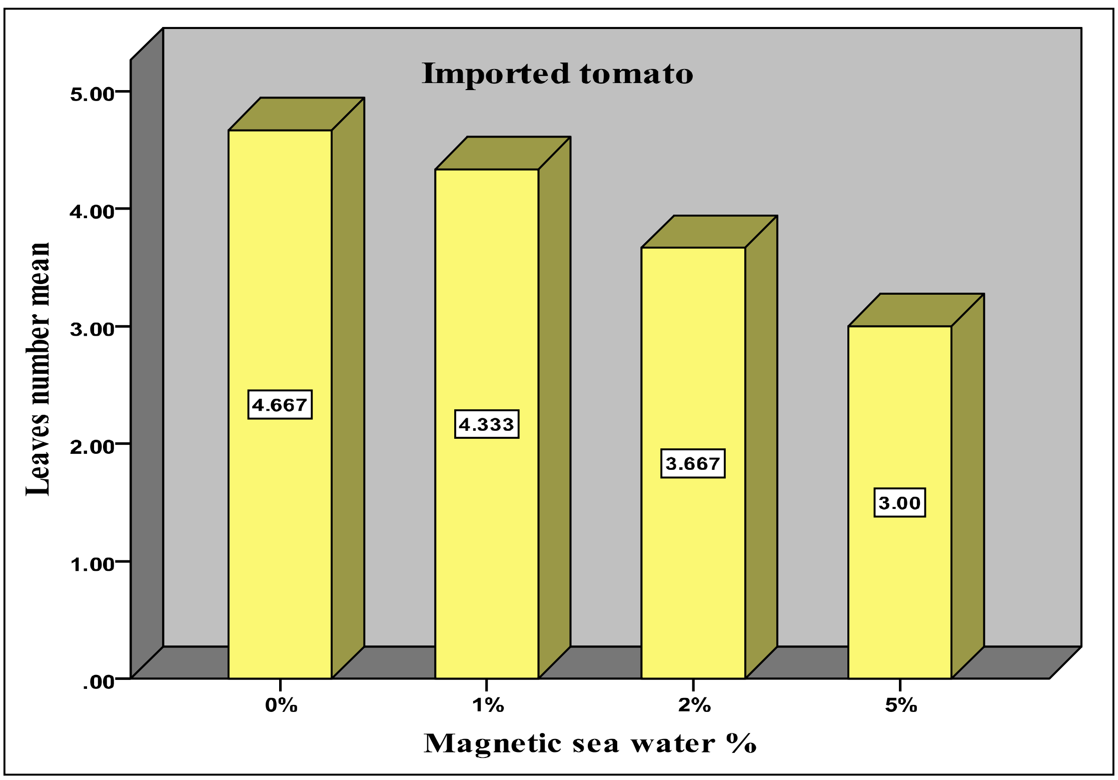


Figure (4-58): Effect of magnetic sea water on imported tomato leaves numbers.

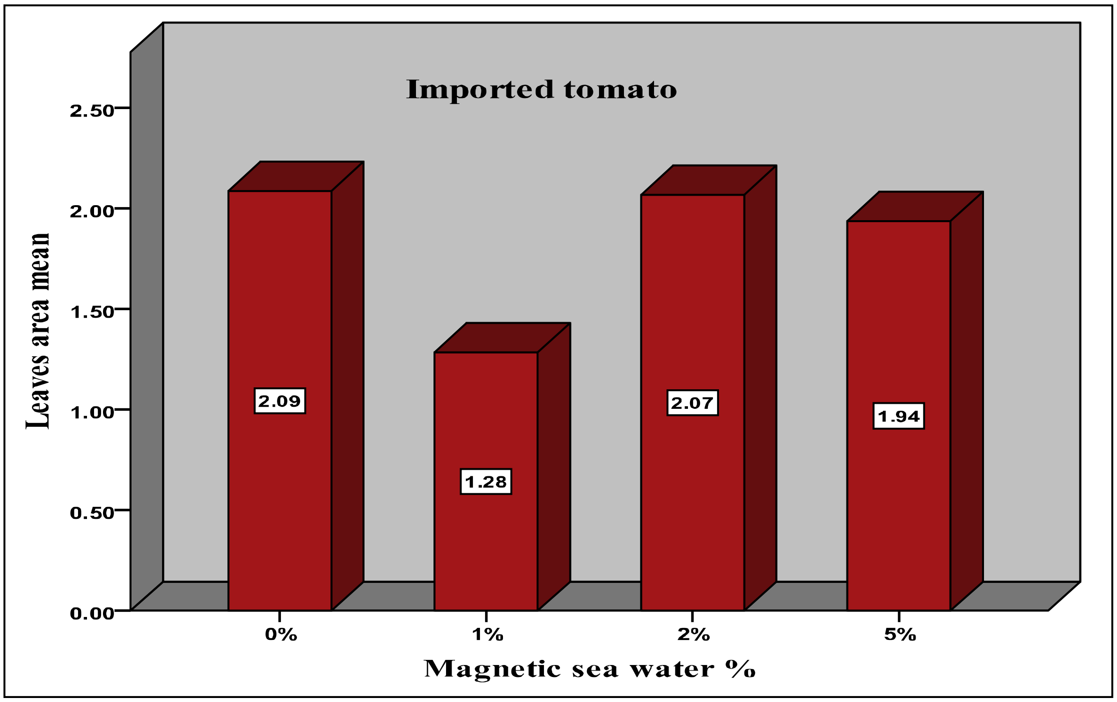


Figure (4-59): Effect of magnetic sea water on imported tomato leaves surface area.

4.10.4. Seedling vigor index of imported tomato at different dilutions of magnetic sea water dilutions:

The highest seedling vigor index was obtained at control treatment (0%), followed by that obtained at magnetic sea water dilution of 2%, the lowest seedling vigor index was that obtained at sea water dilution of 5%.

Table (4-34): Seedling vigor index of imported tomato at different dilutions of magnetic sea water.

Dilutions	0%	1%	2%	5%	10%	20%
SVI	1224	999	1220	742	-	-

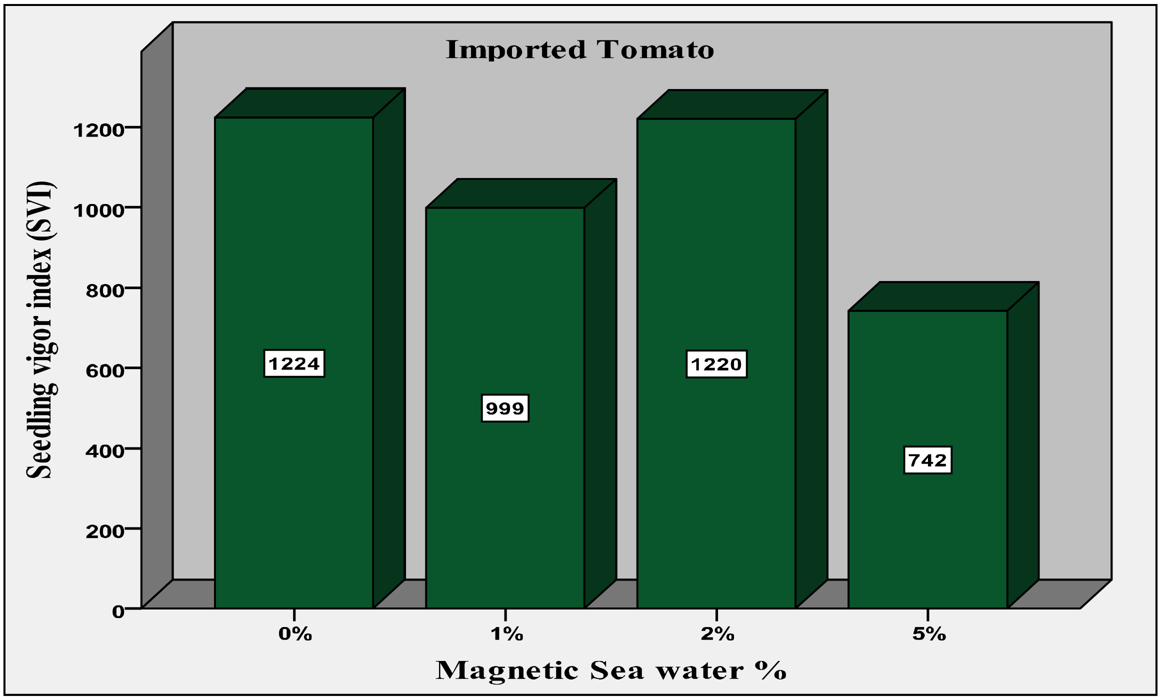


Figure (4-60): Seedling vigor index of imported tomato at different dilutions of magnetic sea water dilutions.

4.11. Effect of sea water dilutions on radish seedling development:

4.11.1.Effect sea water dilutions on radish plant growth:

Whole length: Anova statistical test showed significant differences between the means of whole radish length at different dilutions of sea water (p-value =0.01). Compared with the control the whole plant increased at sea water dilutions of 1% and 2%, but decreased at dilutions of (5%, 10% and 20%). Post hoc multiple comparison showed significant differences between radish lengths at dilutions of (1%, 20%) and the control treatment length. (p-value =0.025 and 0.007) respectively.

Shoot length: Anova statistical analysis showed significant differences between the means of radish shoot lengths at different dilutions of sea water (p-value =0.02). Compared with the control the shoot length increased at sea water dilutions of (1% and 2%), but decreased at the remaining of sea water dilutions. Post hoc multiple comparison showed significant differences between radish shoot lengths at dilutions of (1%, 20%) and the control treatment root length (p-value =0.019 and 0.011) respectively.

Root length: Anova statistical analysis showed no significant differences between the means of radish root lengths at different dilutions of sea water (p-value =0.123). Compared with the control radish root length increased at sea water dilution of 2%, but decreased at sea water dilution of 5%, 10%, and 20%, radish root had the same length at dilution of 1%. Post hoc multiple comparison showed no significant differences between radish root lengths and the control treatment root length (p-value = 0.00).

Figure (4-61): Effect of sea water dilutions on radish.

Table (4-35): Effect sea water dilutions on radish plant growth.

Parameters	Descriptive				Anova
	Conc.%	Mean	SD±	S. error	p-value
Overall length	0%	16.67	2.52	1.45	0.01
	1%	22.70	0.26	0.15	
	2%	20.00	3.00	1.73	
	5%	14.33	4.93	2.85	
	10%	12.83	3.01	1.74	
	20%	9.10	0.96	0.56	
Shoot length	0%	13.00	2.65	1.53	0.02
	1%	19.03	1.34	0.78	
	2%	15.17	3.01	1.74	
	5%	11.00	4.36	2.52	
	10%	9.67	2.08	1.20	
	20%	6.23	1.97	1.13	
Root length	0%	3.67	0.58	0.33	0.123
	1%	3.67	1.15	0.67	
	2%	4.83	0.29	0.17	
	5%	3.33	0.58	0.33	
	10%	3.00	1.00	0.58	
	20%	2.87	1.00	0.58	

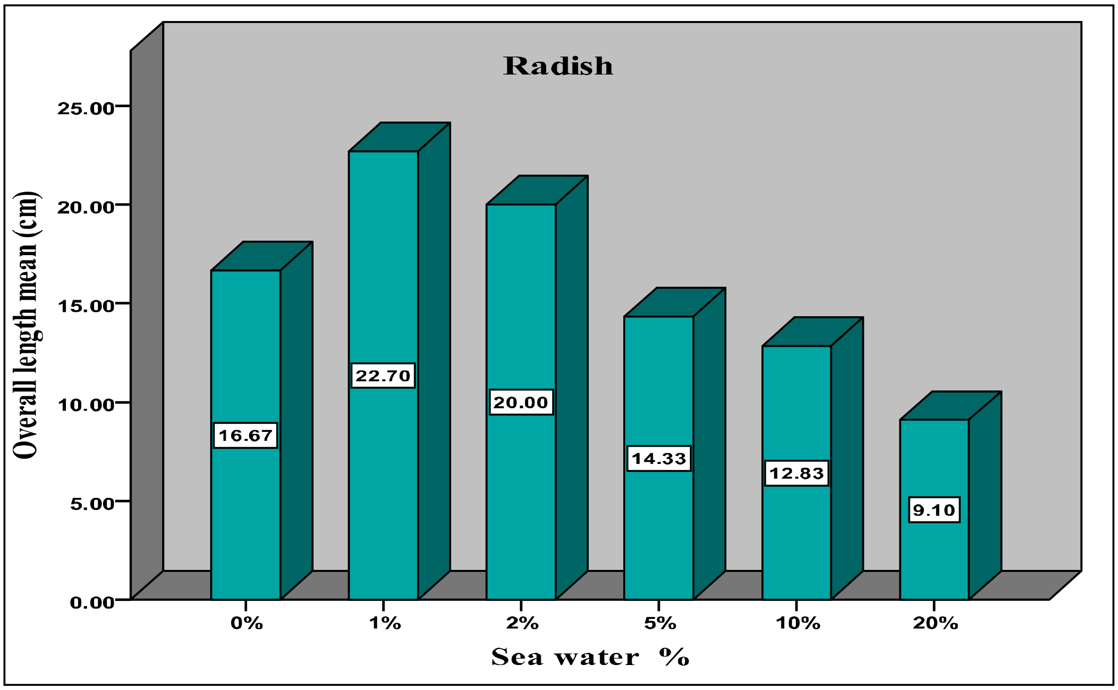


Figure (4-62): Effect sea water dilutions on radish whole length.

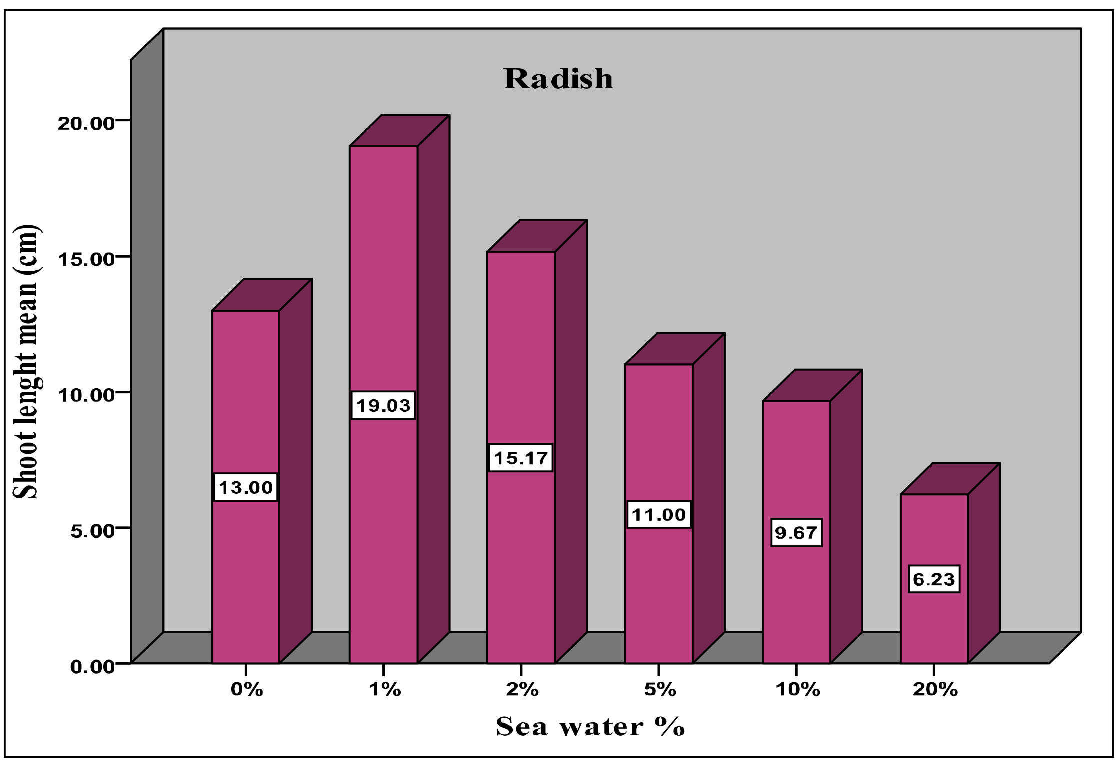


Figure (4-63): Effect sea water dilutions on radish shoot length.

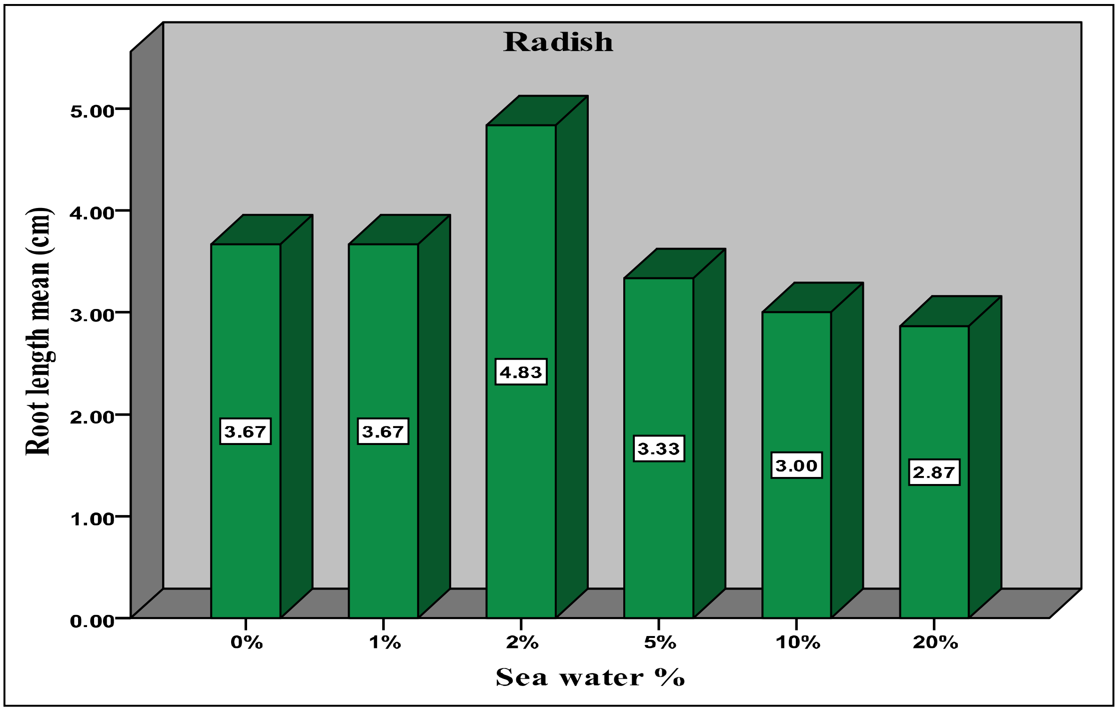


Figure (4-64): Effect sea water dilutions on radish root length.

4.11.2.Effect of sea water dilutions on radish fresh and dry weight:

Fresh weight: According to anova statistical analysis there no was significant differences in mean radish fresh weight at different dilution of sea water (p-value= 0.102). compared with the control treatment radish fresh weight increased at sea water dilutions of 1%, 2% and 5%, but decreased at sea water dilutions of 10% and 20% . Post hoc multiple comparison showed no significant differences between radish fresh weight at all dilution and control treatment.

Dry weight: According to anova statistical analysis there was no significant differences in mean of radish dry weight at different dilution of sea water (p-value= 0.332). Compared with the control treatment radish dry weight increased at sea water dilutions of 1%, 2% and 5%, but decreased at sea water dilutions of 10% and 20%. Post hoc multiple comparison no significant differences between radish dry weight at all dilution and control treatment.

Table (4-36): Effect of sea water dilutions on radish fresh and dry weight.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Fresh weight	0%	0.36	0.21	0.12	0.102
	1%	0.66	0.07	0.04	
	2%	0.46	0.08	0.04	
	5%	0.42	0.34	0.20	
	10%	0.32	0.15	0.08	
	20%	0.19	0.03	0.02	
Dry weight	0%	0.02	0.02	0.01	0.332
	1%	0.04	0.01	0.01	
	2%	0.04	0.01	0.01	
	5%	0.03	0.03	0.02	
	10%	0.02	0.02	0.01	
	20%	0.01	0.01	0.00	

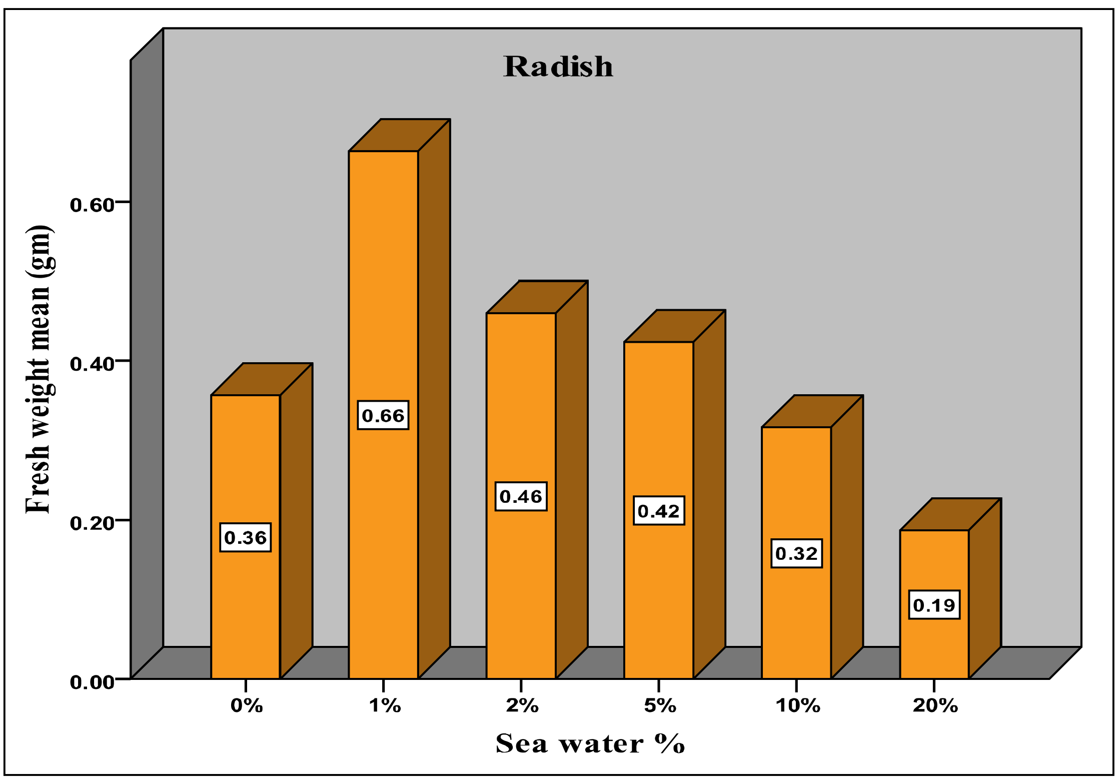


Figure (4-65): The effect of sea water dilutions on radish fresh weight.

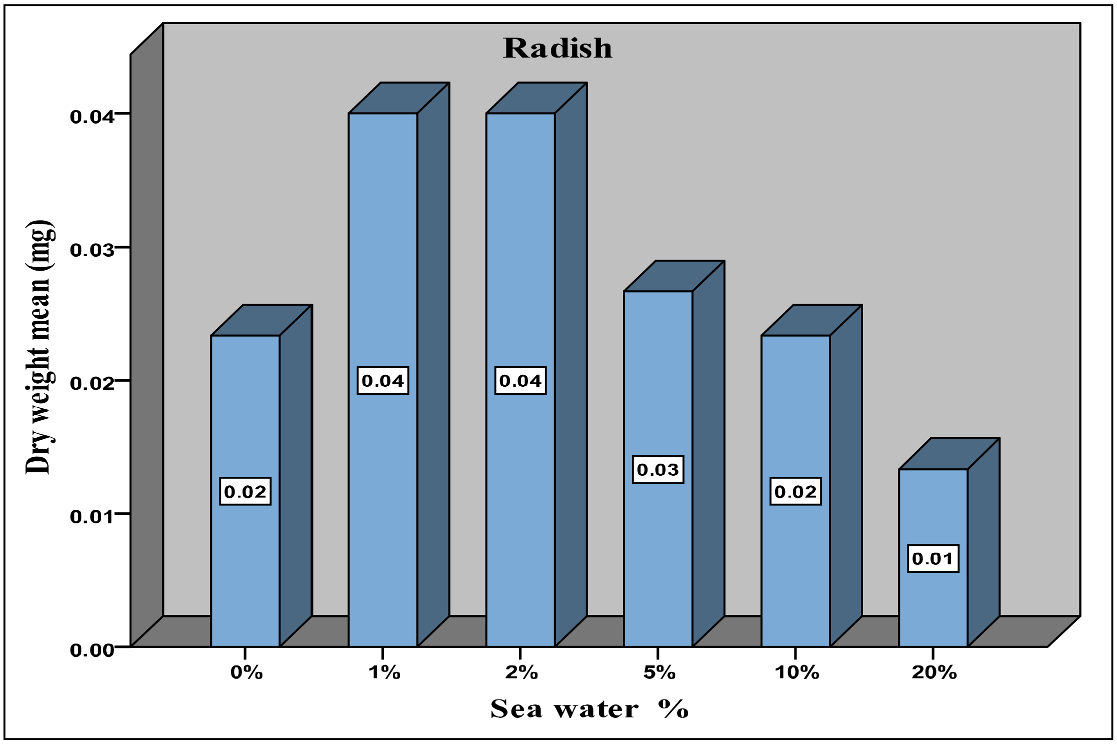


Figure (4-66): The effect of sea water dilutions on radish dry weight.

4.11.3. Effect of sea water dilutions on radish leaves numbers and surface area:

Leaves number: According to anova statistical analysis there was no significant differences in mean radish leaves number at different dilution of magnetic sea water (p-value= 0.553). Compared with the control treatment radish leaves number increased at sea water dilutions of (1%, 2%, 5%, 10%). Post hoc multiple comparison showed no significant differences between radish leaves number at all sea water dilutions and control treatment.

Leaves surface area: According to anova statistical analysis there was significant differences in mean radish leaves surface area at different dilution of sea water (p-value= 0.047). Compared with the control treatment tomato leaves area decreased at sea water dilutions of 1%, 2% 10% and 20%, but increased at sea water dilution of 5%. Post hoc multiple comparison showed significant differences between radish leaves area at dilutions of 20% and control treatment (p-value=0.026).

Table (4-37): Effect of sea water dilutions on radish leaves numbers and surface area.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Number of leaves	0%	3.00	1.00	0.58	0.553
	1%	3.67	0.58	0.33	
	2%	3.67	0.58	0.33	
	5%	3.67	0.58	0.33	
	10%	3.33	0.58	0.33	
	20%	3.00	0.00	0.00	
Leaves surface area	0%	2.34	0.85	0.42	0.047*
	1%	2.79	3.20	1.60	
	2%	1.59	0.80	0.40	
	5%	2.04	2.48	1.24	
	10%	1.35	0.62	0.31	
	20%	0.77	0.64	0.37	

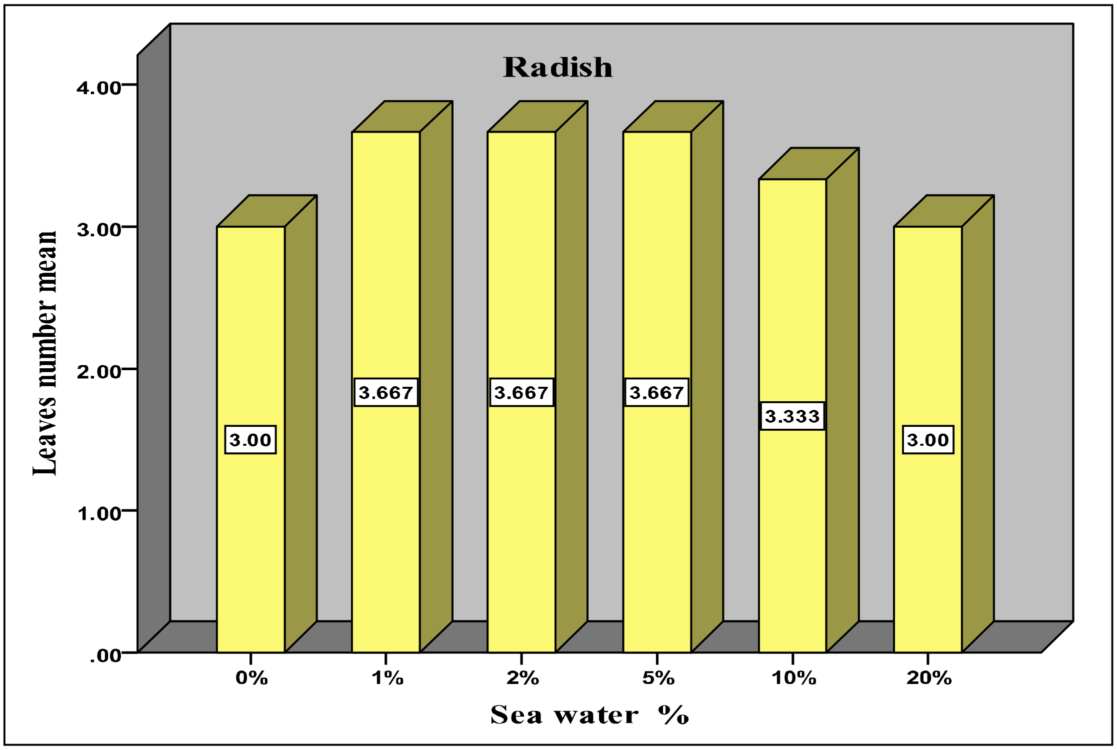


Figure (4-67): Effect of sea water dilutions on radish leaves numbers.

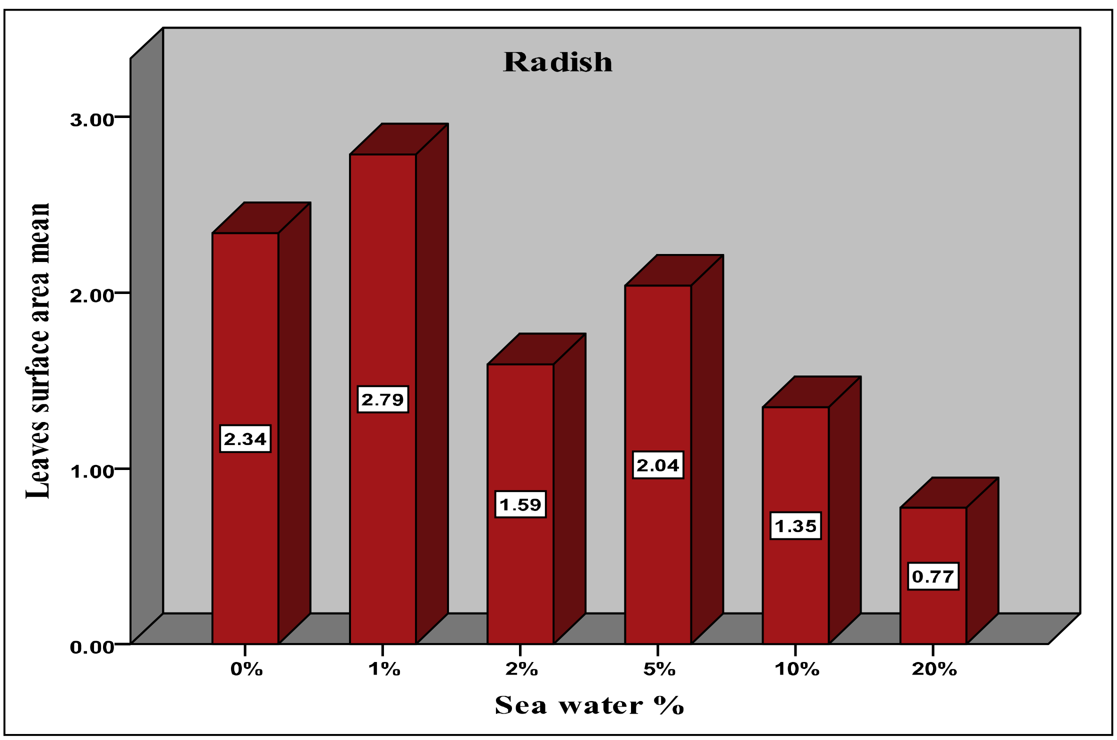


Figure (4-68): Effect of sea water dilutions on radish leaves surface area.

4.11.4. Seedling vigor index of radish at different dilutions of sea water dilutions:

The highest seedling vigor index was obtained at sea water dilution of 1%, followed by that obtained at sea water dilution 2% and control treatment the lowest seedling vigor index was that obtained at sea water dilution of 20%.

Table (4-38): Seedling vigor index of radish at different dilutions of sea water.

Dilutions	0%	1%	2%	5%	10%	20%
SVI	1670	2273	1997	1433	1270	913

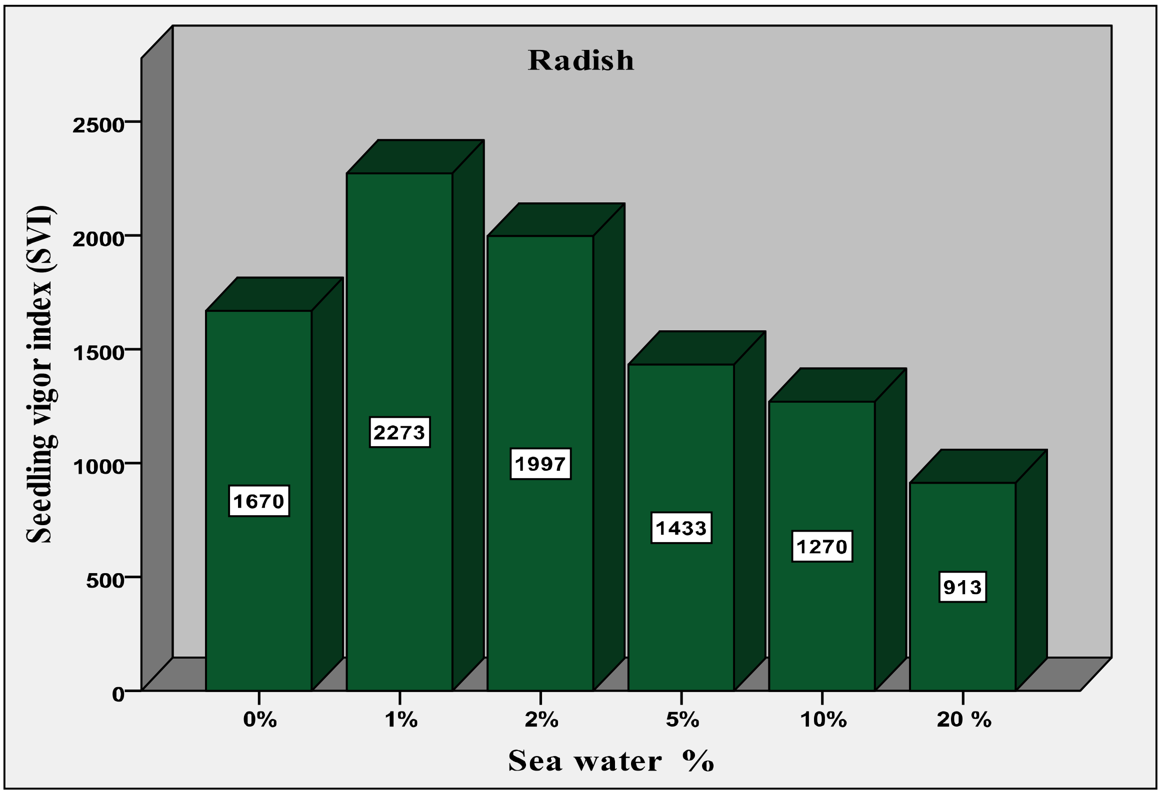


Figure (4-69): Seedling vigor index of radish at different dilutions of sea water dilutions.

4.12. Effect of magnetic sea water on radish seedling development:

4.12.1. Effect of magnetic sea water on radish plant length:

Whole length: Anova statistical test showed significant differences between the means of whole radish length at different dilutions of magnetic sea water (p-value =0.007). Compared with the control the whole plant increased at sea water dilutions of 1% and 2% but decreased at the remaining of the dilutions. Post hoc multiple comparison showed significant differences between the mean of radish lengths at magnetic sea water dilutions of 1%, 20% and the control treatment length. (p-value =0.021 and 0.041) respectively.

Shoot length: Anova statistical test showed significant differences between the means of radish shoot lengths at different dilutions of magnetic sea water (p-value =0.001). Compared with the control radish shoot length increased at magnetic sea water dilutions of 1% and 2%. Post hoc multiple comparison showed significant differences between the mean of radish shoot lengths at dilutions of (1% and 20%) and the control treatment root length (p-value =0.005, 0.008) respectively.

Root length: Anova statistical test showed no significant differences between the means of radish root lengths at different dilutions of magnetic sea water (p-value =0.416). Compared with the control the root length increased at magnetic sea water dilutions of 2%, 10% and 20%. Post hoc multiple comparison showed no significant differences between the mean of radish root lengths at all magnetic sea water dilutions and control treatment root length.

Figure (4-70): Effect of magnetic sea water on radish.

Table (4-39): Effect of magnetic sea water on radish plant growth.

Parameters	Descriptive				Anova
	Conc.%	Mean	SD±	S. error	p-value
Overall length	0%	16.67	2.52	1.45	0.007*
	1%	22.10	1.82	1.05	
	2%	18.57	1.29	0.74	
	5%	15.50	4.44	2.57	
	10%	15.00	2.50	1.44	
	20%	12.00	0.50	0.29	
Shoot length	0%	13.00	2.65	1.53	0.001*
	1%	18.77	1.57	0.91	
	2%	14.30	1.15	0.67	
	5%	11.83	3.33	1.92	
	10%	10.83	1.76	1.01	
	20%	7.67	0.76	0.44	
Root length	0%	3.67	0.58	0.33	0.416
	1%	3.33	0.58	0.33	
	2%	4.27	0.25	0.15	
	5%	3.67	1.15	0.67	
	10%	4.17	0.76	0.44	
	20%	4.33	0.29	0.17	

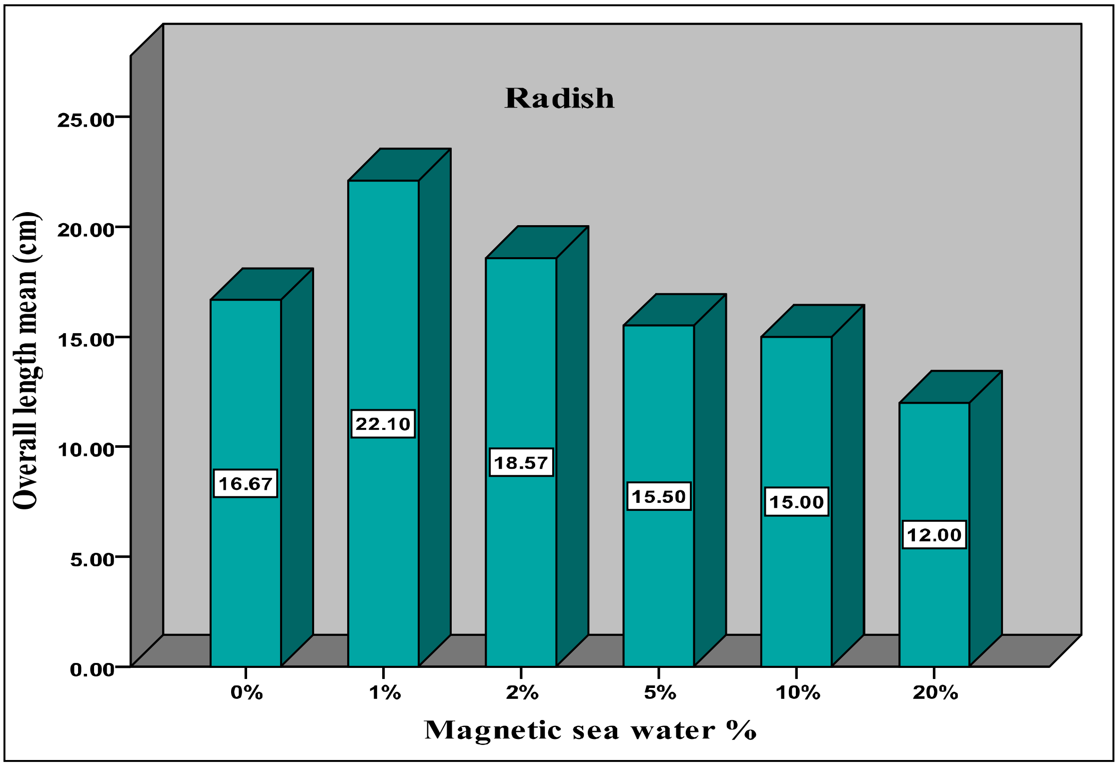


Figure (4-71): Effect of magnetic sea water on radish whole plant length.

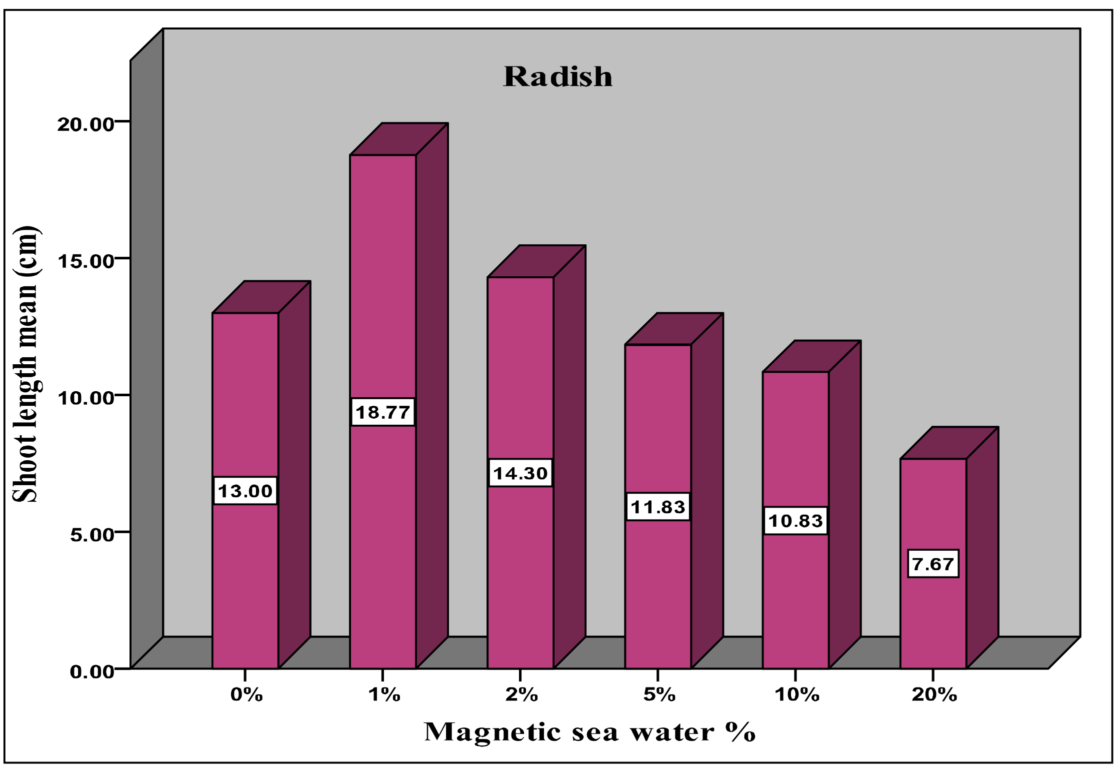


Figure (4-72): Effect of magnetic sea water on radish shoot length.

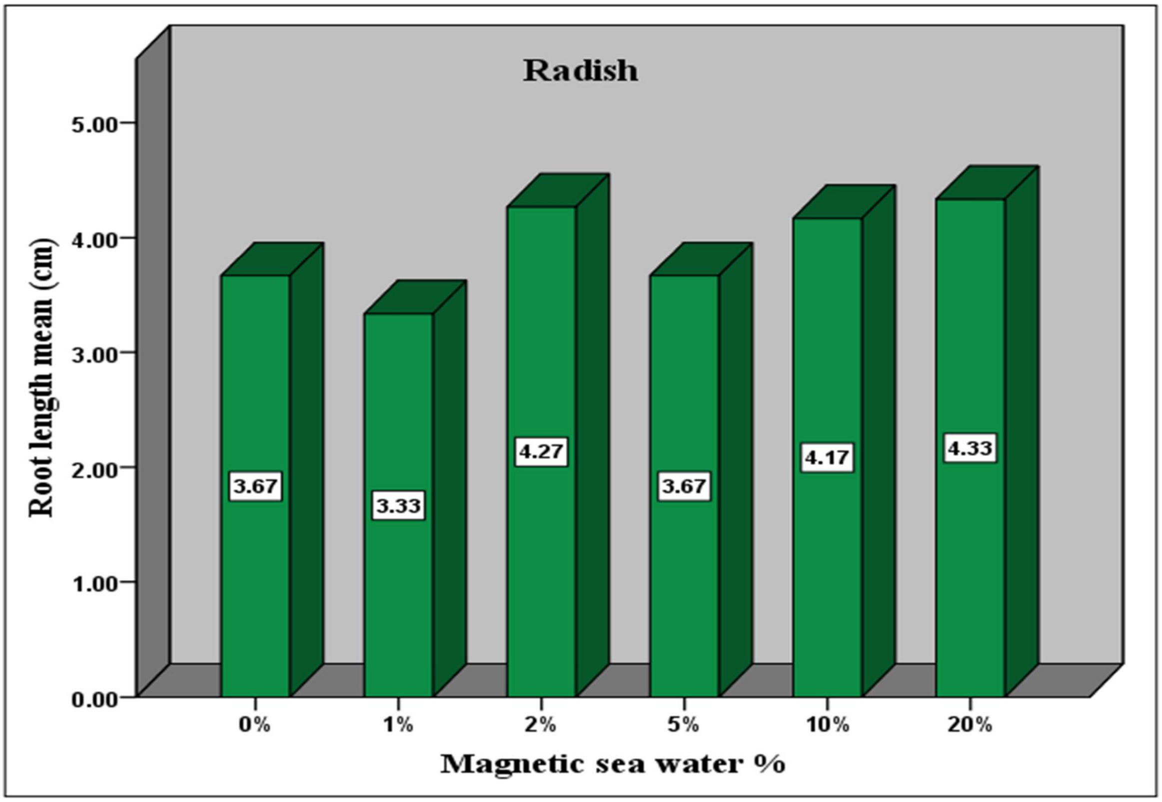


Figure (4-73): Effect of magnetic sea water on radish root length.

4.12.2. Effect of magnetic sea water on radish fresh and dry weight:

Fresh weight: According to anova statistical analysis there was no significant differences in mean radish fresh weight at different dilution of magnetic sea water (p-value= 0.357). Compared with the control treatment the mean of radish fresh weight increased at magnetic sea water dilutions of 1%, 2%, 5% but decreased at magnetic sea water dilutions of 10% and 20%. Post hoc multiple comparison showed no significant differences between the mean of radish fresh weight at all dilutions and control treatment.

Dry weight: According to anova statistical analysis there was no significant differences in mean of radish dry weight at different dilution of magnetic sea water (p-value= 0.59). Compared with the control treatment tomato dry weight increased at magnetic sea water dilutions of 1%, 2%, 5% and 10% but this increase was not significant. Post hoc multiple comparison showed no significant differences between the mean of radish dry weight at all dilutions and control treatment dry weight.

Table (4-40): Effect of magnetic sea water on radish fresh and dry weight.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Fresh weight	0%	0.36	0.21	0.12	0.357
	1%	0.64	0.23	0.13	
	2%	0.44	0.06	0.03	
	5%	0.45	0.33	0.19	
	10%	0.34	0.11	0.06	
	20%	0.28	0.11	0.06	
Dry weight	0%	0.02	0.02	0.01	0.59
	1%	0.04	0.02	0.01	
	2%	0.04	0.01	0.01	
	5%	0.03	0.03	0.02	
	10%	0.03	0.02	0.01	
	20%	0.02	0.01	0.01	

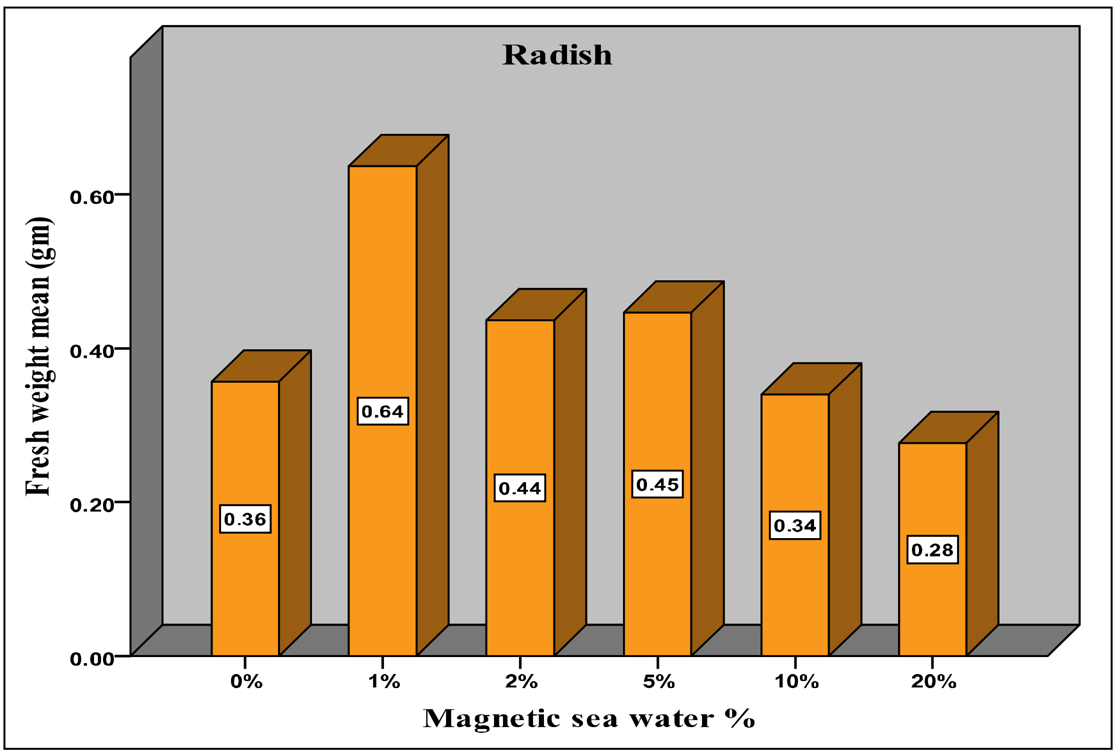
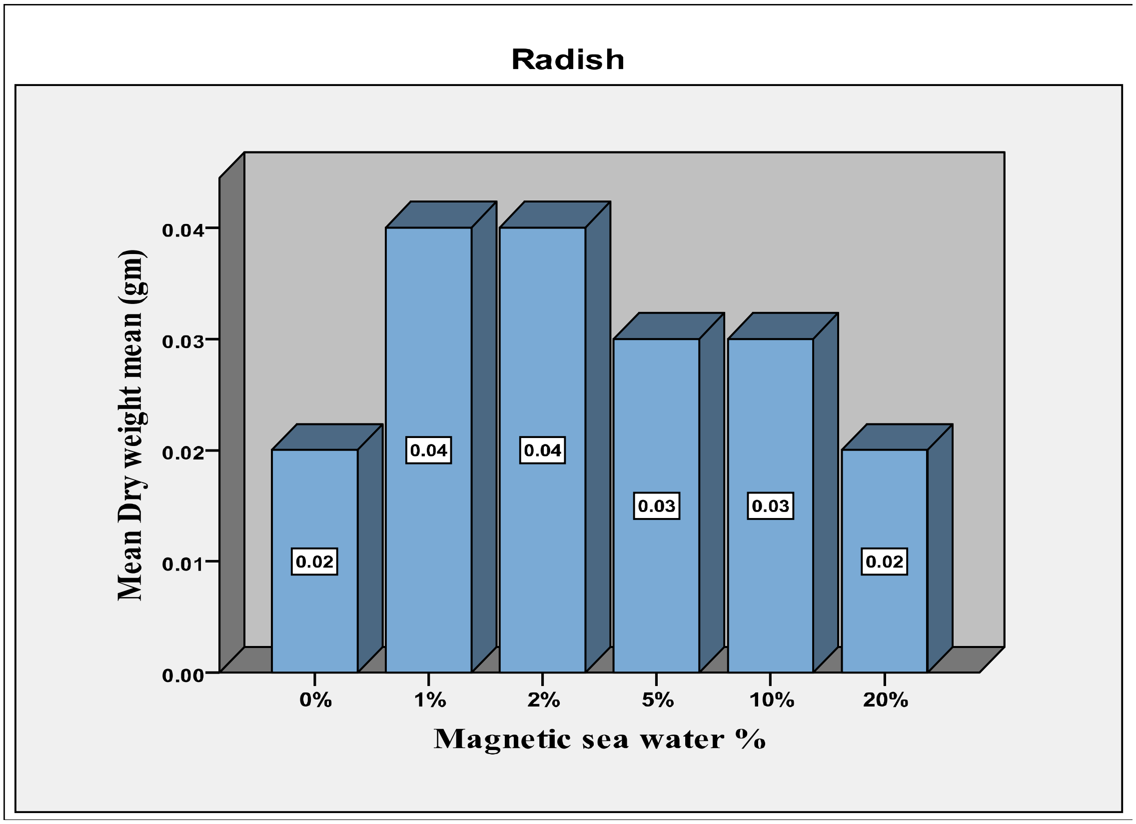


Figure (4-74): Effect of magnetic sea water on radish fresh weight.



Figure(4-75): Effect of magnetic sea water on radish dry weight.

4.12.3. Effect of magnetic sea water on imported tomato leaves numbers and surface area:

Leaves number: According to anova statistical analysis there was no significant differences in mean of radish leaves number at different dilution of magnetic sea water (p-value= 0.553). Compared with the control treatment the mean of radish leaves number increased at magnetic sea water dilutions of 1%, 2%, 5% and 10%, but this increase was not significant. Post hoc multiple comparison showed no significant differences between the mean of leaves number at all dilutions of control treatment.

Leaves surface area: According to anova statistical analysis there was significant differences in mean of radish leaves surface area at different dilution of magnetic sea water (p-value= 0.014). Compared with the control treatment, the mean of radish leaves area decreased at magnetic sea water dilutions of 2%, 5%, 10% and 20% . Post hoc multiple comparison showed significant differences between the mean of radish leaves area at dilutions of 1% and control treatment (p-value=0.039).

Table (4-41): Effect of magnetic sea water on imported tomato leaves numbers and surface area.

Parameters	Descriptive				Anova
	Conc. %	Mean	S.D±	S. error	p- value
Leaves Number	0%	3.00	1.00	0.58	0.553
	1%	3.67	0.58	0.33	
	2%	3.67	0.58	0.33	
	5%	3.67	0.58	0.33	
	10%	3.33	0.58	0.33	
	20%	3.00	0.00	0.00	
Leaves surface area	0%	2.78	2.04	0.68	0.041*
	1%	3.08	2.38	0.72	
	2%	1.46	0.63	0.19	
	5%	1.66	0.77	0.23	
	10%	1.68	0.64	0.20	
	20%	1.77	0.54	0.18	

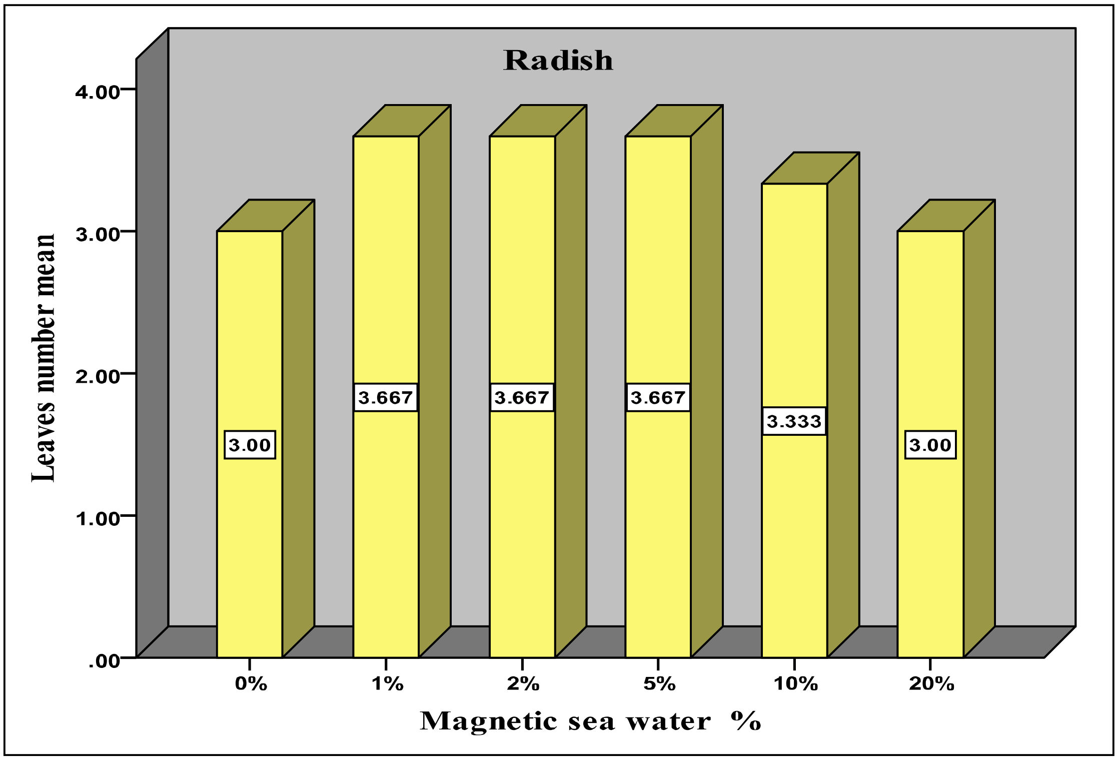


Figure (4-76): Effect of magnetic sea water on radish leaves numbers.

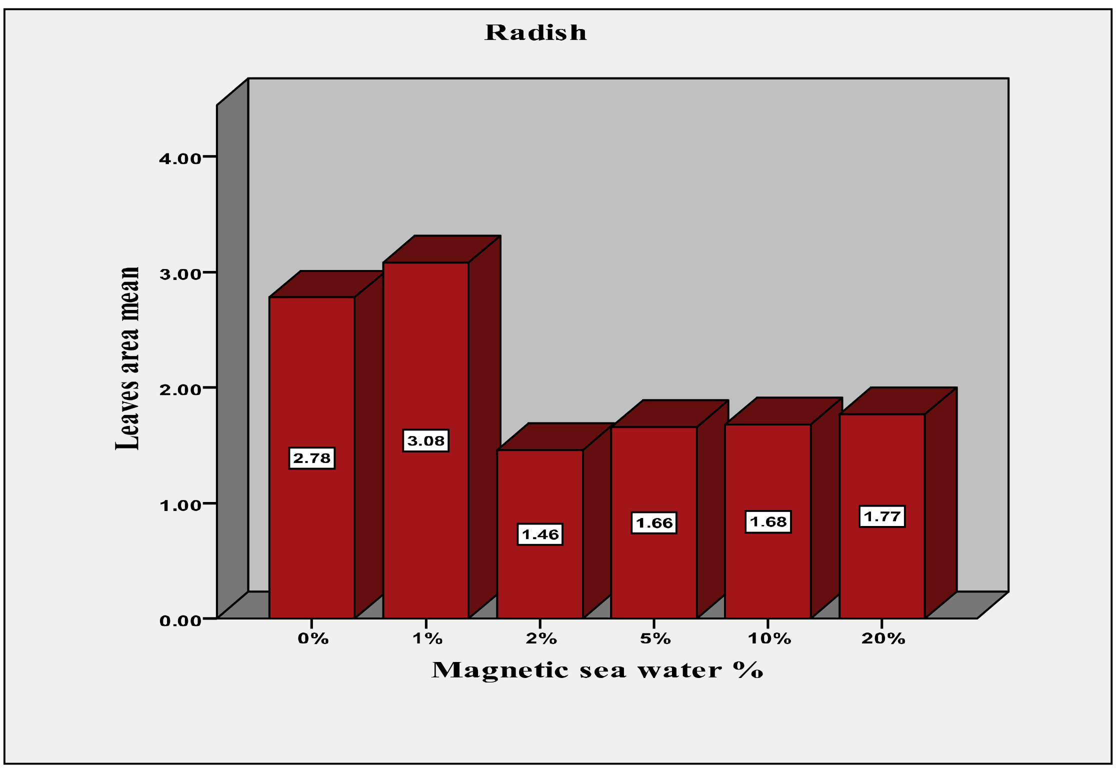


Figure (4-77): Effect of magnetic sea water on radish leaves surface areas.

4.12.4. Seedling vigor index of radish at different dilutions of magnetic sea water dilutions:

The highest seedling vigor index was obtained at magnetic sea water dilution of 1%, followed by that obtained at magnetic sea water dilution 5% and control treatment the lowest seedling vigor index was that obtained at magnetic sea water dilution of 20%.

Table (4-42): Seedling vigor index of radish at different dilutions of magnetic sea water.

Dilutions	0%	1%	2%	5%	10%	20%
SVI	2970	4090	3290	2730	2580	1980

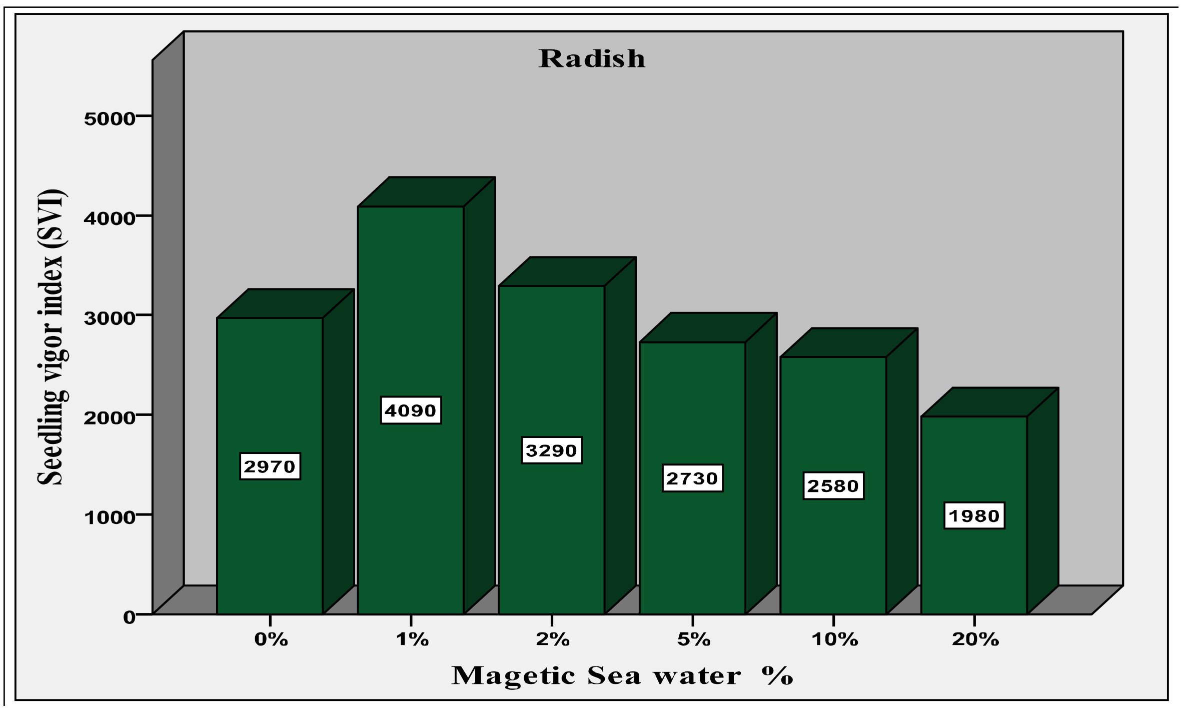


Figure (4-78): Seedling vigor index of radish at different dilutions of magnetic sea water dilutions.

5. Discussion

Sea water concentrations is currently one of the most severe abiotic factors, limiting agricultural production. In arid and semi arid lands, the plants are subjected throughout their life cycle to different stresses; some of these plants can tolerate these stresses in different ways depending upon plant species and type of stress. Excessive sea water dilutions reduce the productivity of many agricultural crops including most of the vegetables (Singh *et al.*, 2012). This research was carried out to observe the effects of sea water dilutions on germination and seedling growth of six receptor plant. Little researches have been performed regarding seed germination responses of seed germination to sea water dilutions stress. In general increasing sea water dilutions often cause osmotic and/or specific toxicity which may reduce germination percentage, The salt constituents or ions may be toxic to the embryo. The osmotic barrier due to NaCl level affected water uptake and mean germination time but not final germination (Mehmet *et al.*, 2006). Seed germination is usually the most critical stage in seedling establishment, determining successful crop and seed quality (Khajeh-Hosseini *et al.*, 2003). It is necessary to identify the sensitivity and tolerance level of a production (Bhattacharjee, 2008).

5.1. Effect of sea water dilutions on germination, shoot and root lengths:

Successful establishment of any plant depends upon its germination which is a critical period of plants life. Seed germination depends upon various factors such as light, temperature, water availability, sea water dilutions, etc (Khan *et al.,* 1984; Al-Ahmed and Kafi, 2007; Parez-Garcia *et al.*, 2007; Guma *et al.*, 2009; Ruano *et al.*, 2009).

5.1.1. Effect of sea water dilutions on germination, shoot and root lengths of local and imported tomato:

Both local and imported tomato were affected significantly by sea water dilutions and showed approximately same germination at control and low sea water dilutions level (1% and 2%), at sea water dilutions 5% local tomato showed decreased germination (only 30%), but imported tomato was less sensitive at this sea water dilutions level, at higher dilution (10% and 20%) both local and imported tomato completely inhibited. Tomato is moderately sensitive to sea water dilutions, sea water dilutions generally reduces crop yield, mostly due to a reduction in fruit size, but it does result in better pigmentation and a higher content of sugars and organic acids (Incerti *et al*., 2009). Salt stress has three fold effects which reduces water potential and causes ion imbalance and toxicity (De la Peña and Hughes 2007). Salt stress affects some major processes such as germination, speed of germination, root/shoot dry weight and Na^+/K^+ ratio in root and shoot (Parida and Das 2005). Large genetic variation of tolerance to salt level exists among tomato genotypes. Most commercial cultivars of tomato are sensitive to moderate levels of sea water dilutions up to 2.5 dSm^{-1}, without significant yield reduction. Shoot and root were also affected by increased sea water dilutions level shoots were more sensitive to sea water dilutions, Shoot growth was reduced by sea water dilutions due to inhibitory effect of salt on cell division and enlargement in growing point. In spite of the negative effects of salt on roots, the root growth in tomato appears to be less affected whereas, shoot was affected drastically. Our study agree with many researches (Terzi *et al*., 2013; Singh *et al*., 2012; Sardoei *et al*., 2012).

5.1.2. Effect of sea water dilutions on germination, shoot and root lengths of wheat:

Final germination of wheat did not affected by increased sea water dilutions at all sea water dilution wheat showed 100% germination. Shoot and root length significantly decreased with increased sea water dilution, shoots was more sensitive to sea water dilutions than roots. Wheat is a moderately salt-tolerant crop (Saboora and Kiarostami, 2006; Maghsoudi and Maghsoudi, 2008) and higher sea water dilutions levels severely impede its emergence and seedling growth leading toward poor stand establishment and consequently reduction in final yield (Hussain *et al*., 2013). High sodium amount was accumulated in wheat shoots, primarily due to higher rates of net ion transported from roots to shoots. Shoot accumulated less Na^+ than the roots, while the Na+ content in the shoots was higher than that in the roots. This indicates that Na+ transportation from roots to shoots was accelerated when NaCl dilution was increased (Begum *et al*., 1992). The K^+ dilution highly increased in the roots, while K^+ content in the shoots and seeds decreased relatively as NaCl dilution increased. It seems that Na^+ and K^+ were exchanged by water uptake during seed germination. The K^+ in the seeds was released into the germination medium while Na^+ from medium was absorbed by seeds. It is reported that increasing NaCl dilutions was resulted in increasing K^+ leakage from seeds (Rehman *et al*.,1996 and Mehmet *et al*., 2006). The results are similar to those reported by researchers (Salim,199; Ghoulam and Fares, 2001; Akbarimoghaddam *et al*., 2011).

5.1.3. Effect of sea water dilutions on germination, shoot and root lengths of radish:

Radish showed 100 % germination at all sea water dilutions, differences in mean root and shoot lengths were not significant compared with the control, which indicated that radish was less sensitive to sea water dilutions, our study disagree with some researches which found significant effect of sea water dilutions on final germination, shoot and root lengths (Jamil *et al*., 2007; Marcelis and Hooijdonk, 1999).

5.1.4 Effect of sea water dilutions on germination, shoot and root lengths of lettuce:

Lettuces showed strongly decreased final germination percentage at sea water dilutions level of 5% (germination was 26%), then germination was completely inhibited at higher dilutions (10% and 20%), Lettuce was determined to be moderately salt sensitive relative to other species (Shannon and Grieve 1999). Against these stresses, plants adapt themselves by different mechanisms including change in morphological and developmental pattern as well as physiological and biochemical responses (Bohnert *et al*., 1995). Many researchers have been reported similar results (Jeannette *et al*., 2002; Datta, *et al*., 2009 and Nasri *et al*., 2015). Sea water dilutions caused a significant reduction on root and shoot length. The results demonstrated that, response of root length to salt stress was more severe than shoot length, The reduction in root and shoot development may be due to toxic effects of the higher level of NaCl dilution as well as unbalanced nutrient uptake by the seedlings. Decrease of growth in root and shoot can be related to NaCl toxicity and disproportion in nutrient absorption by seedlings. Sea water dilutions which is result of osmotic pressure leads reduction in water absorbance so cell division and differentiation reduce and reduction of shoot and root length will be explainable (Munns and Termaat, 1986).

5.1.5 Effect of sea water dilutions on germination, shoot and root lengths of cucumber:

our study showed that cucumber had approximately the same germination at dilution of 1%, 2% and 5% compared with the control but the germination decreased at sea water dilution of 10%, no germination had occurred at higher dilution (20%). Both shoot and root lengths were significantly affected by increased sea water dilutions level, The effect of the external sea water dilutions on cucumber seed germination may be partially osmotic or ion toxicity which can alter physiological processes such as enzyme activation (Begum *et al.*, 1992; Croser *et al.*, 2001 and Essa and Al-Ani, 2001). Reduction in root growth is a common response of cucumber plants subjected to salt stress (Passam and Kakouriotis, 1994). Many researchers have been reported similar results (Al-Harbi and Burrage Stan, 1993; Chartzoulakis, 1992).

5.2 Effect of sea water dilutions on seedling development:

5.2.1 Effect of sea water dilutions on local and imported tomato seedling development:

High sea water dilutions levels showed significant reduction in all growth and development parameters of both local and imported tomato except root length of local tomato showed less significant effect by sea water dilutions. The results indicated that the shoot and root dry weights are decreased in saline condition, due to the exposure to sea water stress. Similar outcome were obtained earlier by (Mohammad *et al.*,1998) in anther tomato cultivars. Saline stress leads to changes in growth, morphology and physiology of the roots that will in turn change water and ion uptake. The whole plants are then affected when roots are growing in saline medium. The results also indicate that salt tolerance of tomato plants tends to increase with age. Stem growth was observed with time even under saline condition. The same trend was observed on the leaves and roots as also documented by another workers (Pessarakli and Tucker 1988; Al- Rawahy, 1989; Munns, 2002;Singh *et al.*, 2012; Terzi *et al.*, 2013). Finally, in this study, sea water dilutions stress results in a clear stunting of plant growth, which results in a considerable decrease in the fresh and dry weights of leaves, stems and roots. Increasing sea water dilutions is accompanied also by significant reductions in shoot weight, plant height and root length.

5.2.2. Effect of sea water dilutions on radish seedling development:

Radish development was not significantly affected by sea water dilutions, the impact of sea water dilutions stress on radish shoot and whole length was significant, but sea water dilutions showed no significant effect on root lengthen, the impact of sea water dilutions on fresh and dry weights was not significant, leaves number was not affected by sea water dilutions while the surface area showed significant increase at 5%

but decreased at other dilutions. About 80% of the growth reduction at high sea water dilutions could be attributed to reduction of leaf area expansion and hence to reduction of light interception. The remaining 20% of the sea water dilutions effect on growth was most likely explained by a decrease in stomatal conductance. The small leaf area at high sea water dilutions was related to a reduced specific leaf area and increased tuber/shoot weight ratio, (Scialabba and Melati, 1990) demonstrated that NaCl sea water dilutions caused a lack of coordination between cellular expansion and differentiation in radish seedlings. As sea water dilutions increased, structural and cellular modifications, in the form of wall thickening and metabolic aggregates inside parenchyma cells, were evident. The latter could be attributed to tuber formation starting at a smaller plant size at high sea water dilutions (Marcelis and Hooijdonk, 1999). Our study agree with (Jamil *et al*., 2007; Marcelis and Hooijdonk, 1999), and disagree with other researcher that demonstrated radish Radish as salt-sensitive crop (Osawa, 1965; Malcolm and Smith, 1971).

5.3. Effect of magnetic sea water on radish and tomato seedling development:

Magnetic seed treatment is one of the physical pre-sowing seed treatments as well as magnetically water treatment. The influence of magnetic field on various growth processes of plants such as seed germination, seedling growth, plant growth, yield and the properties of crop quality have been the object of much research. It is found that the suitable magnetic seed treatment increased germination rates by about 1.1-2.8 times. More than that, it leads to increase the germination under stress conditions (Moon and Chung ,2000). as well as the germination of stored seeds of low viability (Alexander and Doijode, 1995). It is reported that seedlings raised by magnetically treated water are more robust and healthier because the treated water increased nutrient uptake (Fernandez *et al*., 1996). Magnetize water increased pest and disease resistance (Diaz *et al.,*1997). Plants raised from magnetically treated seeds grew higher and heavier (Florez *et al.,* 2007), improved their tolerance to salt stress conditions (Lihua and Jixun, 2001) as well as to low temperatures stress (Rochalska and Rywka, 2005) and the appearance of decay signs and senescence process were delayed (Piacentini e*t al*., 2001). Magnetic field treatments increased the auxin content in plants (Mitrov *et al*., 1988), stimulated synthesis and transport of hormones and enzymes metabolism (Esitken, 2003) and increased the final yield.

Seedling development of radish at different dilution of magnetic sea water showed different effects on growth parameters of radish plant when irrigated with magnetic sea water, parameters like shoot and whole plant length, leaves surface area showed significant response to magnetic sea water, which had higher value at (1% and 2%) which then become decreased at higher dilutions (10 % and 20%). Magnetic sea water showed no significant effect on other parameters like radish root length, fresh and dry weights and leaves number.

Magnetic sea water showed significant negative impact on development parameters of local tomato except the effect on root length which showed no significant reaction to magnetic sea water and the effect on leaves surface area showed decreased surface at magnetic sea water dilution of 1% and 2% but increased at 5%. Magnetic sea water showed significant negative impact on development parameters of imported tomato except the effect on root length, dry weight and leaves number which showed no significant reaction to magnetic sea water. Generally the negative impact of magnetic sea water on local and imported tomato was less than that caused by ordinary sea water. Other studies performed on tomato, prove that magnetic tap water improve the growth and development of crops. (Abou El-Yazied *et al*., 2011) found that applying the optimal magnetic seed treatment and/or irrigation with magnetized water gave significant increases in tomato 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, (Ahmed, 2013) demonstrated that magnetic treatments improved fresh and dry weights of Tomato plant compared to control and increase tomato yield productivity. important for irrigation without any expected problems in the soils and plants.

5.4. Effect of sea water and magnetic sea water dilutions on Seedling vigor index of tomato and radish:

Generally Seed vigor is an important quality parameter which needs to be assessed to supplement germination, in this study seedling vigor index decreased with increased sea water dilution, but increased with increased magnetic sea water dilution in all studied receptors.

Conclusion

- Agriculture is the main user of water. However, because of the increase in demand from other users and the occurrence of drought in many countries, water resource has become scarce and limited.
- Salinity is one of the most severe environmental factors limiting the productivity of agricultural crops. Sea water concentrations can negatively affect plants through three limited components: osmotic, nutritionôs and toxic stresses.
- This study is one of the most important studies that evaluate the sensitivity of some vegetable to sea water concentrations and their ability to tolerate salts in the irrigation water.
- Sea water concentrations do not affect final germination but increase the germination time.
- Saline stress leads to changes in growth, morphology and physiology of the plant that decreased the final yields of the crops.
- Tomato (local and imported tomato) are moderately sensitive to sea water concentrations, germination decreased with increased sea water concentrations, no germination had occurred at higher concentrations (10% and 20%). Both shoot and root lengths were reduced by increased sea water concentrations but shoot were more affected by sea water concentrations.
- Imported tomato was more sensitive to sea water concentrations than local tomato, total plant length, number of leaves, surface area of leaves, dry and fresh weights also reduced by increased sea water concentrations level.
- Radish showed 100 % germination at all sea water concentrations sea water concentrations increase mean germination time but did not affect final germination, effect of sea water concentrations on root and shoot lengths were not significant , which indicated that radish was less sensitive to sea water concentrations, the impact of sea water concentrations stress on radish shoot, whole length and leaves number was significant, but sea water concentrations showed no significant effect on leaves surface area, root lengthen, dry and fresh weight.
- Lettuces showed strongly decreased final germination percentage at sea water concentrations level of 5%, germination was completely inhibited at higher concentrations (10% and 20%), Lettuce was determined to be moderately salt sensitive, sea water concentrations caused a significant reduction on root and shoot length.

- Cucumber had germination decreased at sea water concentration of 10%, no germination had occurred at higher concentration (20%). Both shoot and root lengths were significantly affected by increased sea water concentrations level.
- Final germination of wheat did not affected by increased sea water concentrations at all sea water concentration wheat showed 100% germination. Shoot and root length significantly decreased with increased sea water concentrations level.
- Magnetic sea water showed different effect on growth parameters of radish, at low concentrations (1% and 2%) parameters like shoot and whole plant length, leaves surface area showed positive significant response to magnetic sea water which decreased at higher concentration, other parameters did not affect by magnetic sea water.
- Magnetic sea water showed significant negative impact on development parameters of local tomato except the effect on root length which showed no significant reaction to magnetic sea water and the effect on leaves surface area showed decreased surface at magnetic sea water concentration of 1% and 2% but increased at 5%.
- Magnetic sea water showed significant negative impact on development parameters of imported tomato except the effect on root length, dry weight and leaves number which showed no significant reaction to magnetic sea water.
- Seedling vigor index decreased with increased sea water concentration, but increased with increased magnetic sea water concentration in all studied receptors.

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تأثير تركيزات مختلفة من ماء البحر الممغنط على أنواع نباتية مختلفة

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ملخص البحث

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