Türk Tarım ve Doğa Bilimleri Dergisi 7(1): 178–185, 2020

https://doi.org/10.30910/turkjans.680057

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.dergipark.gov.tr/turkjans

Research Article

Development of Future's Two Model Plant (Lettuce and Potato) in Diluted Seawater *In Vitro* and *In Vivo* Conditions

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Received: 22.03.2019 Received in Revised: 11.12.2019 Accepted: 19.12.2019

Abstract

97 percent of all waters is salt water consisting of sea and oceans. Lettuce, which is a leafy vegetable plant which is very quickly consumed and potato consumed very much, can be used as a future's model plant. Five different seawater concentrations (0%, 5%, 10%, 20%, 40%) were used in both lettuce and potato. The seedlings belonging to the curly lettuce Fiyonk were planted in pots and were irrigated with water containing different seawater concentrations when they reached 2-3 real leaf stages. In potato plants grown in tissue culture, MS media containing five different seawater concentrations were prepared and the growth status of the plants as a result of 45 days growth periods was investigated. According to the results of the study, 5 % (EC 3.2 dS m^{-1}) and 10 % (EC 6.6 dS m^{-1}) lettuce irrigated with seawater showed better plant growth. In potato, the best development was obtained by 5 % seawater application in Agria variety and by 10 % seawater application in 22-99-33. In controlled conditions, up to 15 % of seawater can be used successfully in lettuce. Culture containing 10 % (EC 6.4 dS m^{-1}) seawater in potato increased the plant growth, and the number of nodes compare to control in tissue culture propagation.

Key words: *Solanum tuberosum* L. , model, salt stress, environment, fabric.

In Vitro ve *In Vivo* Koşullarda Seyreltilmiş Deniz Suyunda Geleceğin İki Model Bitkisinin (Marul ve Patates) Geliştirilmesi

Özet

Tüm suların %97'si deniz ve okyanusların oluşturduğu tuzlu sudur. Marul yapraklı bir bitkidir: Marulun hızlı bir şekilde ve patateste çok fazla tüketildiği için geleceğin iki model bitkisi olarak kullanılabilecek bitkilerdir. Patates ve marulda 5 Farklı seyreltilmiş deniz suyu konsantrasyonu (0, % 5, % 10, % 20 ve % 40) kullanılmıştır. Kıvırcık marul çeşidi Fiyonk'a ait fideler saksılara dikilmiş ve 2-3 gerçek yapraklı aşamaya geldiklerinde sulandırılmış deniz suyu ile büyütülmüştür. Doku kültüründe büyütülen patates bitkileri 5 farklı deniz suyu konsantrasyonu içeren MS ortamı hazırlanarak besi ortamında konulmasından sonra, 45 günlük büyüme periyodunda bitkilerin büyüme durumu araştırılmıştır. Araştırma sonuçlarına göre % 5 (EC 3.2 dS m^{-1}) ve % 10 (EC 6.6 dS m^{-1}) deniz suyunda büyütülen marul daha iyi bitki büyümesi göstermiştir. Patateste en iyi gelişme Agria çeşidinde % 5'te, 22-99-33 çeşidinde ise %10 deniz suyunda elde edilmiştir. Kontrollü koşullarda marulda %15 deniz suyu başarılı bir şekilde kullanılabilir. Patateste doku kültürü ile çoğaltmada; kültür ortamında % 10 (EC 6.4 dS m^{-1}) deniz suyu, bitki büyümesini ve boğum sayısını kontrole göre artırmıştır.

Anahtar kelimeler: 22/03/.

Introduction

Potato is important food crop in the world. It is planted approximately 20 million ha with a yield of 382 million tonnes in the world. Asia and Europe are the main potato production regions in the world and constitute more than 80% of the world production. (Özkaynak et al., 2018). Lettuce is an annual leaf vegetable plant. Lettuce leaves are widely used in salads, sandwiches, hamburgers, wraps, and similar food items. When searching for fresh water alternatives, the most free water source in the world is represented by seawater. This resource is increasing in the agricultural sector as a viable alternative to desalinated or blended with other water sources (Yermiyahu et al., 2007). In general, some amount of freshwater may be an interesting option in soilless growing systems where there is no risk of salinization or aggravation of soils in the soils that have been replaced by seawater. In the world of soilless cultivation, hydroponic culture has been made along with a world-wide vegetable production expanding around 35,000 hectares (Hickman, 2011; Atzori et al., 2016). Some of these studies have shown that the use of seawater in growing environments does not adversely affect efficiency up to certain concentrations and has maximum thresholds that vary by species (Sakamoto et al., 2014; Turhan et al., 2014). In any case, although the scientific literature provides a variety of information about the effects of salt for more than 130 plant species (Shannon and Grieve, 1998), there are still missing data about others, especially considering the production of nutrient contents as a response to salinity stress (Atzori et al., 2016).

Some plants are susceptible to salinity, and negative effects on growth can lead to reduced potential benefits. Therefore, salinity is still considered to be one of the most important factors in irrigation water (Beltran, 1999). In particular, in greenhouse conditions, the salinity problem is a critical constraint for crop production due to the rapid accumulation of salt in the soil (Shannon and Grieve 1998). Many studies have been done on the effects of saline irrigation with saline water on crop systems in greenhouses (Adriolo et al., 2005; Ünlükara et al., 2008). Garrido et al. (2014) perused phytochemical, physiological, and structural changes in lettuce by salt stress in a soilless production system. In the projection of the desalination system, the target salinity level of irrigation water greatly affects the cost of product water. Therefore, it is important to determine the optimal salinity of irrigation water and to maximize economic benefits in order to examine the salt tolerance of plants grown in greenhouse conditions and to minimize the negative effects on plant production (Kim et al., 2016). In vitro propagated potato plants are widely used for the production of microtubers, glasshouse production of transplants and minitubers, or field planting in the production programs of potato seeds (Afrasiab and Iqbal 2010; Özkaynak, 2015).

Last ten to fifteen years, there has been increasing interest among scientists and planners in the use of seawater (especially diluted) for plant irrigation (Liu et al. 2003). However, the effect of seawater on lettuce and potato growth has not been sufficiently researched (Turhan et al., 2014; Elkazzaz et al., 2018). Plants grown in a plant factory are less affected by changes in the abiotic environment than products grown on a farm (Gruda, 2009).Therefore, you can always expect a stable supply of the product grown in a factory. Plant factories are classified as those who use sunlight and use artificial light. Of these, the type having a fully controlled light source can produce non-chemical vegetables, regardless of weather or location. Because this type of factory is a closed system where all non-biological environmental and other factors are controlled. Accordingly, the fully controlled plant factory can produce green vegetables such as spinach or lettuce to the maximum amount in the future. However, cost problems need to be clearly identified. (Sakamoto et al., 2014).

In the study, in the context of evaluating the use of seawater in diluted agricultural irrigation, lettuce and potato, which are two model plants of the future, can be grown in saline soils and controlled conditions. In the research, growth and development of lettuce plants developed in seawater solutions prepared in different concentrations in pots and potato plants under tissue culture conditions were evaluated. The aim of the study was to determine the growth and development of different seawater concentrations in the two model plants of the future and to determine the potential of seawater as irrigation water.

Materials and Methods

Experiment structure, plant material and development conditions

The experiment was carried out in 2017 at the greenhouse and plant growth room facilities of the Yuksel Tohum. Seawater used in this experiment was collected at Antalya (Turkey) two day before the beginning of the research and stored in 20 l sterile plastic bottles at 4◦C. Seawater is content with 55.29 chlorite, 30.74% sodium, 3.69% magnesium, 7.75% sulfate, 1.18 % calcium, 1.14 % potassium (Anonymous, 2015). Most of the seawater consists of sodium and chlorine (86%). In this research, two potato variety’s (Agria and 22-99-33) in vitro plants and one Batavia type lettuce variety (*Lactuca sativa* L. var. fiyonk) seedlings were used as the plant materials. Control and four different diluted seawater treatments (5%, 10%, 20% and 40%) were applied in growing room conditions. EC and pH were measured with a portable EC meter and pH meter (Hanna Instruments) in diluted seawater treatments in potato and lettuce (Table 1). In vitro plants of potato varieties 22-99-33 (mid-early) and Agria (mid early) were multiplied routinely single nodes every 2-3 weeks. Single nodes were micropropagated in MS medium 4.4g/l with 3 % sucrose and 0.7 % agar in petri dishes (25x100mm). MS0 (control, MS + 3 % (30g/l) sucrose + 0.7 % (7g/l) agar), 5% MS (MS + 3 % sucrose + 0.7 % agar + 5% diluted with distilled water), 10% MS (MS + 3 % sucrose + 0.7 % agar + 10% diluted with distilled water), 20% MS (MS + 3 % sucrose + 0.7 % agar + 20% diluted with distilled water) and 40% MS (MS + 3 % sucrose + 0.7 % agar + 40% diluted with distilled water) were used as a tested medium. Potato plants have two nodes were cultured in petri dishes. Five explants were put one petri dishes. Cultures were entrenched in development room at 16 hour photoperiods and 23±1 °C temperature system for 45 days.

Table 1. EC and pH values of different diluted seawater treatments in lettuce and potato.

Seawater Concentration	Control (tap water)	% 5 Seawater	% 10 Seawater	% 20 Seawater	% 40 Seawater
			Lettuce		
pH	6.8	6.4	7.5	6.3	7.1
EC (dS/m)	0.8	3.2	6.6	14.9	≥ 25
Seawater Concentration	**Control (MS0 medium with distilled sterile water)**	**% 5 Seawater (5% MS)**	**% 10 Seawater (10% MS)**	**% 20 Seawater (20% MS)**	**% 40 Seawater (40% MS)**
			Potato		
pH	5.8	7.2	6.3	6.3	6.3
EC (dS/m)	2.3	3.6	6.4	12	≥ 25

Fiyonk lettuce seedlings were grown in viol (300 eyes) in seedling nursery. After Fiyonk lettuce seedlings having two to three real leaves transferred to plastic pots (15 cm diameter) in growing medium (3:1:1; peat moss: perlite: vermiculite). Lettuce seedlings were grown one week in seedling nursery with 1:1:1 (18 % N, 18 % P, 18 % K) fertilizer composition. After this period Fiyonk lettuce seedlings were transferred same growth room with potato. 4 diluted seawater treatment and control were applied to the lettuce seedlings. 45 days after diluted seawater treatments (22 times with 2-3 days intervals) research was finished. For potato; plant growth and development (1 to 5 scale) and number of nodes per plant; for lettuce, plant development (1 to 5 scale) and plant fresh weight (g) traits were determined. In potato, 25 in vitro plants (5 petri dishes) were used in each seawater treatment. Totally 125 plants for Agria and 125 plants for 22-99-33 were measured. In lettuce, 15 plants were used each seawater treatment and plant fresh weights were determined cutting plant and measuring in balance. In lettuce, some visual effects like leaf yellowing, desiccation, leaf colour changing, taste and aroma in different diluted seawater concentrations were evaluated too. Taste analysis was made according to Ünlükara et al. (2008). Analysis of variance was enforced to determine any statistically significant differences. The experiment was designed two factors randomized block with 3 replications in potato and lettuce. LSD test was exerted to make comparisons among means at the $p < 0.01$ significance (Freed et al., 1989).

Results and Discussion

In this study were investigated future's two model plant, potato and lettuce. In research tested controls (MS0, for potato; tap water for lettuce) and different diluted seawater combinations (5%, 10%, 20% and 40%) in growth room condition.

Effects of diluted seawater on potato plant development and number of nodes per plant

In the first part of research, diluted seawater effects on the potato were made in vitro condition. In potato experiment, at the end of 45 days of growing time in vitro conditions, plant development were evaluated as a visual effect with 1-5 scale and node number per plant were counted (Table 2). For plant growth and development, the best development in Agria variety was obtained at 5% diluted seawater concentration and 10% seawater level showed similar growth and development compared with control. However, 10% diluted seawater concentration produced thicker and stronger stem growth and plant structure than control in Agria. 22-99-33 variety has shown best growth and development in 10% diluted seawater treatment as visual appearance. In the 22-99-33 variety, the best growth and development were observed in 10% diluted seawater concentration. Seawater concentrations of 5% and 20% were better plant growth and developed than control. 40% diluted seawater had negative effect both of them potato varieties. Salinity threshold value is an important issue in saline irrigation (diluted seawater)-yield studies (Ödemiş et al., 2018). Potato is a plant with a threshold salinity of 1.6 to 2.5 dS m-1. It is considered to be moderately salt sensitive compared to other (Maas and Hoffman 1977; Murshed et al., 2015; Ödemiş et al., 2018). In their study, Ramirez et al. (2018) rooting in the in vitro plants of 65 potato lines in peat pellets. They transferred similar soil like Mars from the La Joya desert in Southern Peru. The Mars-like soil was descriptive of extreme salinity (EC 19.3 and 52.6 dS m^{-1}). In the study, 40% of the potato lines lived. The CIP.397099.4, CIP.396311.1 and CIP.390478.9 lines were determined as promising lines with 9.3%, 8.9 fresh tuber yield depending on the control conditions.

Table 2. Effects of diluted seawater treatments on the plant development and number of nodes per plant on potato varieties in vitro conditions.

Potato varieties	Control (MS0 medium with distilled sterile water)	% 5 Seawater (5% MS)	% 10 Seawater (10% MS)	% 20 Seawater (20% MS)	% 40 Seawater (40% MS)
	Plant growth and development				
22-99-33	3	4	5	4	2
Agria	4	5	4	3	2
	Number of nodes per plant				
22-99-33	40.34	42.67	89.67	53	23.34
Agria	40.67	55.67	51.34	31.67	23.67
Mean	40.51	49.17	70.51	42.34	23.51
CV: %12.82	LSD (0.01): 8.34**				

Plant appearance for according to 1-5 scale; 1: very weak growth, 2: weak growth, 3: moderate growth, 4: good growth and development, 5: very good growth and development

Node number per plant is a very crucial traits for *in vitro* potato propagation (Gopal et al., 2002; Özkaynak, 2015). The two most important characteristics in vitro potato micropropagation are the strong and thick plant structure and the number of nodes that can be obtained from a plant. Because of the much more number of nodes per plant could be obtained, later stages more plants and more minitubers using for commercial seed tuber production. The number of nodes per plant was found to be high in 22-99-33 compare to Agria. Number of nodes per plant was changed from 23.34 into 89.67 in 22-99-33 and the maximum value was obtained in 22-99-33 with 10% diluted seawater treatment with 89.67 units. (Table 2). In Agria, the highest number of nodes was 55.67 and 5% in diluted seawater. After 10% seawater level, both plant growth and node number per plant decreased. 20% diluted seawater concentration; node number per plant were decreased in two variety. 40% diluted seawater level adversely affected both the plant growth and the number of nodes. Elkazzaz et al., (2016) investigated in vitro salt response of some potato varieties. The used seawater dosages were 0, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9,000 ppm and 10,000 ppm. Lady Rosetta variety showed tolerance to 9000 ppm and Cara variety exhibited tolerance to 8000 ppm, of salinity. In this study, were used higher seawater treatments compared to Elkazzaz et al. (2016) and obtained good, stronger plant growth and development and higher number of nodes per plant compare to Elkazzaz et al. (2016)'s research. It is reported that potato lines growing in vitro conditions showed different responses to high salt stress conditions (Morpurgo and Silva-Rodrigues 1987). Moreover, it was determined that a lower concentration of salt was useful and increased plant fresh mass some tested varieties (Sasikala and Parasad 1993).

In the current study, plant development and number of nodes per plant were examined as a result of 45 days of growth period in different seawater concentrations in potato. The best development in Agria variety was observed in 5% seawater concentration and in 22-99-33 variety the best development was in 10% seawater concentration. The number of nodes obtained from the plant, which is the most important feature in the tissue culture in potato, was found to be higher in 22-99-33 variety. The number of nodes was obtained in 22-99-33 variety with approximately 90 pieces in 10% seawater concentration. It was reported that potato varieties react differently when grown in elevated NaCl (salt) stress (Morpurgo and Silva-Rodrigues 1987). In addition, as in our study, it was determined that low salt concentrations had a positive effect on the majority of potato varieties and increased shoot weight. It is indicated that

NaCl-tolerant varieties can be developed by testing the potato in tissue culture conditions of the potato under NaCl stress conditions. (Murshed et al., 2015).

Effect of diluted seawater on lettuce plant head development and plant fresh weight

In the second part of research, lettuce variety Fiyonk was tested diluted seawater treatments in growth room condition in plastic pots. Plant development and plant fresh weight traits were observed and tested with 60 days experiment (Table 3). Generally plant development was affected positively in 5% seawater treatment. 10% diluted seawater treatment were shown same growth and development like control. Better plant growth was observed at 5% and 10% seawater levels. Seawater concentrations in Fiyonk lettuce after 10% started to affect growth and development negatively. Similar to our findings Atzori et al. (2016) reported that 10% and 15% dilute seawater concentrations significantly decreased plant growth from the first week to the end of the plant cycle. Kim et al., (2016) reported that results of crop growth traits such as leaves number, leaf length, and width were affected significantly by saline irrigation water.

Table 3. Effects of diluted seawater treatments on the plant development and plant fresh weight of lettuce variety Fiyonk.

Lettuce	Control (tap water)	% 5 Seawater	% 10 Seawater	% 20 Seawater	% 40 Seawater
Plant development	4	5	4	3	2
Plant fresh weight (g)	173.04	219.64	208	141.44	93.24
CV: %10.02			LSD (0.01): 15.28**		

Plant appearance for according to 1-5 scale; 1: very weak growth, 2: weak growth, 3: moderate growth, 4: good growth and development, 5: very good growth and development

Lettuce is a leafy vegetable, and the most important criterion in lettuce is the quality of the green part we consume. Head of the lettuce might be high fresh weight; bright, live appearance and good quality. The highest value in terms of plant weight in lettuce was obtained at 5% sea water concentration as a 219.64g, followed by 10% seawater level. In salinity stress conditions are reduced stomatal resistance, leaf chlorophyll content and finally photosynthetic activities. The values of the plant fresh weight of the Fiyonk were generally lowered with 20% and 40% salinization level. Data presented in Table 3 shows that the plant fresh weight was obviously suddenly decreased on 40% salinity level on comparing with the control and other treatments. A fresh weight decrease of 18.4 % and of 46.1% was observed in 20% and 40% treatments, respectively, compared to control plants. 10% diluted seawater treatment (EC 6.4 dS m^{-1}) were obtained higher plant fresh weight compare to control and near 5% concentration.

Lettuce is categorized as being moderately salt tolerant (Turhan et al., 2014). Salinity concentration higher than 2.0 and 2.6 dS m^{-1} reduce plant development and fresh yield, respectively (De Pascale and Barbieri 1995). Andriolo et al., (2005) reported that a salinity level higher than 2.0 dS m^{-1} decreased lettuce fresh weight and for commercial production, salinity level should be kept below 2.0 dS m^{-1}. Ünlükara et al., (2008) researched the reaction of lettuce to different salinity levels of (0.75, 1.5, 2.5, 3.5, 5.0, and 7.0 dS m^{-1}). They reported the threshold value as a 1.1 dS m^{-1}. Kim et al. (2016) investigated that the effects of different salinity levels of irrigation water in greenhouse conditions in pots in lettuce. They reported that, the threshold point of salt concentration which crop yield starts to reduction was obtained to be 0.9 dS m^{-1} for lettuce. Up to salinity level of 0.9 dS m^{-1}, the yields of total and shoot fresh weight staggered increased along with the promotion of salinity level, while level of the salinity above 0.9 dS m^{-1} decreased fresh weight yields of total and shoot. These three threshold values obtained from Andriolo et al., (2005), Ünlükara et al., (2008) and Kim et al., (2016) are very low compare to our study. Because in our study 5% (3.2 dS m^{-1}) and 10% (6.6. dS m^{-1}) salinity level was occurred good plant growth and fresh weight. Increased salt concentrations in irrigation water can lead to a significant reduction in lettuce growth, yield, weight and marketable yield (Al-Maskri et al., 2010; Turhan et al., 2014).

Turhan et al., (2014) investigated the effects of different diluted seawater treatments (0, 2.5 %, 5 %, 10 %, 15 % and 20 %) on the yield and some quality parameters in lettuce. They reported that, fresh and marketable yield of lettuce irrigated with 2.5% and 5% seawater were parallel to those of control, but these traits decreased in response to 10% seawater. Similar to our results the lowest values were obtained in highest seawater treatment. Since 70% of total fresh water is used in agricultural production, alternative water resources should be found to irrigate the plants. The use of seawater in plant growth has been studied for a long time. Although agriculture based on 100% pure seawater is currently impossible, the use of seawater in soilless culture may not be the cause of salinity problems in the soil. Atzori et al., (2016) researched on identifying the possibility of growing and development of lettuce with 3 diluted seawater (0, 5%, 10%, 15%). Lettuce growth and yield were negatively affected by 10% and 15% of seawater concentrations. They concluded that certain amounts of seawater could be practically used in hydroponics which save fresh water and increase certain mineral nutrient concentrations.

In lettuce experiment, some visual effects like leaf yellowing, desiccation, plant appearance, leaf colour changing, taste and aroma were also evaluated in different diluted seawater concentrations. Plant appearance was good and any spots were observed on the leaf at the 5% diluted seawater treatment in Fiyonk. Control and 5% diluted treatment little yellowing was observed in the lower old leaves. Compared to the control at 10% seawater level, darker color, better plant growth was achieved and very few yellowing on the lower leaves was observed. In the 20% seawater concentration, although the plant was still dark green, plant size shrinkage occurred and yellowing of the lower leaves was observed. Plant head reduced compares to control and 5% treatment. Some important negative effects were observed in 40% diluted seawater treatment such as small plant head, desiccation and fading on the first/old leaves, shringace on the leaves, bubbles on the leaves and excessive yellow leaf structure of upper leaves. Crispy leaf structure is a quality characteristic in lettuce. Crispy leaf structure was obtained from the seawater level 0 to 20%. From the seawater level of 10%, bubbling in leaves has started to increase. Ödemiş et al., (2018) pointed out that salt stress usually causes early aging in leaves and decreases water uptake of water by roots as a result of increasing osmotic potential some plant species.

Lactuca sativa var. Fiyonk is a fresh consumed green leaf vegetable so its taste and flavour are important. At the end of the experiment, harvested lettuce head was tasted. Taste of lettuce plants 40% in seawater grown in a remarkably intense salt taste in plants grown in 20%, a very mild salt taste. Salty taste was not observed 10 % and 5 % seawater treatments. Flavor, aroma and taste traits were determined to be more delicious at 10% seawater. Similar to our results, the taste and flavour of some vegetables like tomato has been positively affected by salt irrigation or conditions (Mizrahi et al., 1988). But, Ünlükara et al., (2008) tested lettuce taste after salt treatments by 21 tasters. They did not find a meaningful relationship between the scoring of taste and the salinity of irrigation water.

Lettuce is aforethought intermediate sensitive to salinity with a threshold EC of 1.3 dS m^{-1}, and a reduction on yield percentage of 13.0% (Maas and Hoffman 1977). De Pascale and Barbieri (1995) declared that moderately salt-sensitive crop lettuce threshold value was 2.7 dS m^{-1}. Pasternak et al., (1986) made a field study with Romanian and iceberg lettuce varieties, using drip irrigation water. They were used four different EC level (1.2, 3.5, 8.2, and 10.5 dS m^{-1}). In the study, they concluded that the Romanian type lettuce varieties were more tolerant to salinity than the iceberg varieties, and that none of the two groups had any particular species against salt. Andriolo et al., (2005) investigated the reaction of lettuce to increasing level of irrigation with salinity water (0.80, 1.93, 2.81, 3.73, and 4.72 dS m^{-1}) in a hydroponic system bed. EC affected on positively shoot fresh mass. Increasing the EC from 0.80 to 1.93 dS m^{-1} resulted in a 28.5% increase in shoot fresh mass, whereas rising the EC level from 1.93 to 4.72 dS m^{-1} declined the fresh mass by 16.5%.

Sakamoto et al. (2014) reported that the addition of NaCl and other some solutes to the hydroponic growing medium affect plant size, and levels of pigments and sugars. They concluded that, addition of diluted seawater (20%) on the growing medium were produced higher quality and nutritional value lettuces. In hydroponic culture, using diluted seawater can be practical to development of green and leaf vegetables in new generation plant factories. Salinity reactions between lettuce varieties and different types of lettuce may vary. Generally, the best plant growth in seawater concentrations of lettuce variety Fiyonk was 5% in seawater, while the 10% sea water concentration showed the same level of improvement to control. In terms of plant fresh weight in lettuce, the highest value was obtained in 5% seawater concentration, followed by 10% seawater level. In terms of taste and flavor, 10% seawater concentration of the plants is determined to be more delicious. In their study, Turhan et al., (2014) obtained the best improvement in lettuce at 2.5% and 5% seawater level similar to the results of the research. Ünlükara et al., (2008) and Karakoç and Kale (2016) have obtained good plant growth in lettuce at low salt concentrations similar to the results of our research. It is well known that, in the seawater containing minerals like chlorite magnesium can be stimulate growth and development (Sakamoto et al., 2014), the overabundant concentration of mineral salts (mostly sodium chloride) present in seawater is an important source of salt stress (Atzori et al., 2016).

Conclusions

The use of irrigation water containing salt in agriculture requires great attention. Irrigation can lead to soil and groundwater problems which are very difficult and costly to return. On the other hand, good quality irrigation water resources suitable for agriculture are gradually decreasing. This has led researchers to achieve the highest possible yield with existing water resources and to conduct research to ensure continuity in agriculture, which has become a very important concept in today's modern agriculture. It is a known fact that good quality water resources are limited and these waters will run out one day. This is a fact that many researchers have been conducting research far from many years. It has been very well known for many years that there are great dissimilarities between the different varieties of a plant species and the salt tolerances of different plant species.

It will be an important plant in the future due to the rapid growth of lettuce, the production of large underground hangars and warehouses under light conditions and the increasing consumption of greenery. Therefore, the repeated use of water used in lettuce in light-controlled growth chambers comes from the increase of the EC value in the irrigation water and thus the salinity. Lettuce can be successfully used in production in irrigation waters, saline soils and seawater where certain levels of salt can be used. Potato is the only plant in the world, which can be used for feeding people from 7 to 77. Therefore, tubers used in potato production need to be multiplied in tissue culture conditions. The use of seawater in the nutrient medium in the tissue culture and the plants of the two varieties used in the study were obtained better plant growth and more number of nodes than the control medium. With the addition of low-level seawater in the nutrient medium in the tissue culture, the varieties can be developed quickly and strongly and the number of tissue culture plants needed can be obtained. At the end of the study, 5 % (EC 3.2 dS m^{-1}) lettuce and potato irrigated with seawater showed better plant growth and development.

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