The Effect of Simulated Seawater on Two Ornamental Plant Species At Benghazi City

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بسم الله الرحمن الرحيم

اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ (1) خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ (2) اقْرَأْ وَرَبُّكَ الْأَكْرَمُ (3) الَّذِي عَلَّمَ بِالْقَلَمِ (4) عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ (5)

صدق الله العظيم

سورة العلق اَية (1)

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Dedication

I Dedicate My Work To My Parents, And To My Brothers And Sisters, This Dedication Is Also Extended To All Those Who Hopefully Will Benefit From This Humble Research.

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Abstract

Salinity affects about one third of irrigated land, causing a significant reduction in crop productivity. For this reason researchers have paid considerable attention to this important environmental problem over the last decades. Few studies, however, have dealt specifically with ornamental plants used in landscapes, despite the fact that salt stress causes serious damage in these species. This study was carried out in Benghazi/ Libya. This study was conducted during spring-summer 2020, to determine the response of different ornamental like (*Albizia Lebbeck* and *Acacia cyanophyla*) plant species to different concentrations of simulated seawater and determine the resistant of plant species for different levels of salinity, the effect of simulated seawater on the morphological characteristics and growth rate of plant species also to access to the best mixing between fresh water and sea water and used it to irrigate ornamental plants and how to take advantage of the sea water under Libyan environmental conditions, the experiments was conducted at Benghazi university laboratory, five dilutions of simulated seawater were prepared 1%, 2%, 5%, 10%, 20% , the experiment of both plants is including the same steps, with differences in number of days, both plants treated with the same procedures where seeds were surface-sterilized with 2% sodium hypochlorite solution for 12 minutes and rinsed with sterile distilled water several times then blotted using sterile paper towels. The experiment was repeated using different treatments including (potable water, sulfuric acid, boiled water and mechanical scarification method). 10 Seeds were plated on Petri dishes under aseptic conditions, incubated and maintained in the dark at 22±0.5°C, this process was in 3 replicates for each concentration, plates were watered as needed with 5 ml of each concentration, the number of germinated seeds was determined. Germinated seeds were counted daily for the calculations of daily and final germination percentages (G%), mean germination time (MGT) seedling

vigor index (SVI) was calculated, Obtained data were summarized in SPSS, 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, significance was accepted at *P*-values below 0.05 the confidence interval was set at 95%. The results of the study revealed that, mean germination time of both plants was slightly delayed with increased seawater concentrations ranging between (7-10 days) for Lebbeck and (12-18 days) for Acaica. Germination percentage of both plants decreased with increased seawater concentrations, at concentrations of (10% and 20%) no germination percentages which revealed that both plants not tolerate seawater concentrations. Seedling vigor index showed significant reduction at increased sea water concentration in both plants. This study revealed that both fresh and dry lengths of shoot and root were negatively affected by seawater concentrations, shoot were more sensitive to seawater concentrations than roots. Both fresh and dry weights of *Lebbeck* shoot systems were decreased with increased seawater concentrations and this decrease was significant. Both fresh and dry weights of *Acacia* root systems were decreased with increased seawater concentrations level, but this reduction was not significant compared with the control treatment. Decreased dry weights of roots revealed that did not tolerate seawater concentrations. Sulfuric acid pretreatment enhance germination of seeds of both plants even at higher concentrations (10% and 20%).

Chapter One

1. Introduction

Water and water resources is very important for maintaining an adequate food supply and a productive environment for the all living organisms. As human populations and economies grow, global freshwater demand has been increasing rapidly. In addition to threatening the human food supply, water shortages severely reduce biodiversity in both aquatic and terrestrial ecosystems (Pimentel *et al*., 2004). the negative effects of global population increase, climate change impacts, and lifestyle changes are exerting growing pressures upon our vital water resources leading to widespread water stress in many countries. As a result, there ijs growing realization of the urgent need to conserve water. Water is essential to life because it heavily influences public health and living standard. However, water is unequally distributed throughout the world. Water is a very important required substance in order to sustain vital activities of human such as nutrition, respiration, circulation, excretion and reproduction. In addition water is also a life space as well as being one of the basic substances in the formation of life environment**.**

1.1. Climate of Libya:

The climate of North Africa countries including Libya is predominantly arid. Coastal plains have a Mediterranean climate, with mild winters, when most of year's precipitation falls, and hot dry summers with little or no precipitation. The terrestrial biosphere is the key of the global climate system. The arid and semi-arid regions of the Mediterranean combine a low rate of rainfall and high rate of evapo-transpiration and subject to extreme recurrent drought (EUWI, 2006). North Africa is characterized by vast territories of steppe and Sahara land .The vegetation in North Africa very arid and semi-arid desert types of forests, dry bush land and grassland (Boulos, 1999). The climate of Libya is typical of the Mediterranean, characterized by the cool raining winter season and a hot dry summer. The climate over most of the country is that of the hot arid Sahara, but it is moderated along the coastal littoral by the Mediterranean Sea. The annual rainfall is extremely low, the highest rainfall occurs in the western region. An average yearly rainfall of less than 100 mm covers 93% of the country’s land surface (Abdelgawad *et al*., 1979).

1.2. Soil in Libya:

Libyan soils are slightly or moderately weathered soils typical of arid areas. The most arable land in Libya occurs at two locations: Al-Jabal al Akhdar in the northeast region, and Al Jifarah Plain in the northwest region. Almost all of the country is a desert (95%) with 1.2% (2.2 million ha) being cultivated. Yermosols and Xerosols are the major soil orders in the region. Soils in Libya are typically shallow, sandy in texture, low in organic matter content and water holding capacity (Laytimi, 2005). Soils and their characteristics in Libya are affected to the great extent by nature and conditions in which these soils were formed. Generally, aridity is the main characterizes of such soils. Most of these soils are undeveloped or partially developed (Zurqani, 2019, Zurqani *et al*., 2021).

1.3. Salinity:

Salinity is one of the major abiotic factors that limits plant growth and productivity in many regions of the world due to increasing use of poor quality of water for irrigation and soil salinization (Chen and Jiang 2010; D'Odorico *et al.,* 2013; Shrivastava and Kumar, 2015). 20% of croplands in world contain high enough concentrations of salt to cause a salt stress for plants (Shelef *et al.,* 2012). Considerable reduction of the plant growth is generally due to salt stress, except that these reductions vary from a species to the other one. Salinity tolerance of some cultivated legumes varieties turns out thus crucial for the country's economy.

The salinization results not only from the ground but also from irrigation water. Indeed, in the arid and semi-arid lands, the agricultural production requires irrigation especially with the shortage of rain (Chen *et al.,* 2010). These water resources of irrigation come generally from groundwater and contain variable quantities of dissolved salts (Prasanth *et al.,* 2012). In the Mediterranean countries as Algeria, the legume crops are often cultivated near the coastal regions where we attend an increase of the salt stress. Therefore, a vast use of irrigation waters calls up to the intrusion of seawater. Seawater intrusion is the movement of seawater into fresh water aquifers due to natural processes or human activities. Indeed, seawater intrusion is caused by decreases in groundwater levels or by rises in seawater levels (Werner *et al.,* 2013). The use of poor quality water thus results in an increase of salinization level in the soil which can have negative effects

on yield (Arslan, 2013). On the other hand, the available fresh water resources for agriculture declined regarding quantity and quality of both surface water and groundwater systems (Liu *et al.,* 2016). Therefore, the use of lower quality water for irrigation purposes is inevitable to maintain economically viable crops. According to the dilution levels tested on some plants, seawater has proved even an excellent natural fertilizer and can contain several minerals very useful for the plant growth (Glenn *et al.,* 1998; Tawfik *et al.,* 2011; Ventura *et al.,* 2015; Kheloufi *et al.,* 2016a). The plant adaptation in salt environment is crucial at the seedling stage for best species establishment. The first stage of development is thus the most vulnerable in this salt constraint because the passage of this one will determine the evolution of the cultivated species. Indeed, the salinity can affect the seedling by creating osmotic potential which prevent the imbibition of water, or by exercising toxic effects on the viability of the embryo (Chaves *et al.,* 2009). The improvement of certain salt tolerant species is of a major importance.

1.4. Effect of salinity on plants:

Salinity which caused by increased salt concentration affects about one third of irrigated land, causing a significant reduction in crop productivity (Flowers and Yeo, 1995; Ravindran *et al.,* 2007). For this reason researchers have paid considerable attention to this important environmental problem over the last decades. Few studies, however, have dealt specifically with ornamental plants used in landscapes, despite the fact that salt stress causes serious damage in these species (Marosz, 2004; Cassaniti *et al.,* 2009a). Salinity is of rising importance in landscaping because of the increase of green areas in the urban environment where the scarcity of water has led to the reuse of wastewaters for irrigation (Navarro *et al.,* 2008; McCammon *et al.,* 2009). Salinity is also a reality in coastal gardens and landscapes, where plants are damaged by aerosols originating from the sea (Ferrante *et al.,* 2011) and in countries where large amounts of de-icing salts are applied to roadways during the winter months (Townsend and Kwolek, 1987). Although water is used for purposes other than irrigation, "a landscape may serve as a visual indicator of water use to the general public due to its visual exposure" (Thayer, 1976). While in the past only good quality water (in some States of the USA, homeowners used approximately 60% of potable water to irrigate landscapes; Utah

Division of Water Resources, 2003) was used for landscaping and/or floriculture, nowadays the ecological sensitivity widely diffused in landscape management and planning (Botequilla and Ahern, 2002) determines the need to explore alternative water sources for irrigation. Landscape water conservation consequently requires making choices of plant species able to tolerate salt stress in order to allow the use of low quality water. Alternative water sources might be recycled water, treated municipal effluent and brackish groundwater, all of which generally have higher levels of salts compared with potable waters (Niu *et al*., 2007b). Treated effluent may also contain nutrients essential for plant growth; if water quality is good (not too saline), treated effluent can improve plant growth and reduce fertilizer requirements (Quist *et al*., 1999; Gori *et al*., 2000); application of industrial and municipal wastewater to land can be an environmentally safe water management strategy (Rodriguez, 2005; Ruiz *et al*., 2006). The potential physical, chemical or biological problems that are associated with effluent water applied to edible crops (Kirkam, 1986) are of lesser concern for landscape plant production (Gori *et al*., 2000).

The lack of dependable supplies of good quality water in many regions has become a concern as the competition among agricultural, urban, industrial, environmental, and recreational groups continues to increase. Members of the nursery and landscape industries are increasingly turning to recycled, often saline, wastewaters as a valuable alternative to the use of fresh water for irrigation. In California, sources of degraded waters available for incorporation in reuse systems include well waters contaminated by intrusion of sea water, drainage effluents from agricultural fields, runoff from greenhouse operations, and municipal wastewater. Development of water reuse practices will benefit the floral and nursery industries in numerous ways: fresh water conservation, nutrient savings, energy conservation, protection of the environment, and a favorable public image (Skimina, 1992). Little information is available to floral and nursery producers, however, on the limits salinity places on the growth, yield, and quality of many ornamental species. Likewise, landscape designers and gardeners have few guidelines for selection of plant species suitable for sites where soils are saline and/or irrigation waters are high in salinity. Salinity is of concern because of its deleterious effect on plant growth, nutritional balance, and plant and flower marketable quality,

including visual injury, flower distortion, and reduced stem length. Plant growth is detrimentally affected by salinity as a result of the disruption of certain physiological processes that lead to reductions in yield and/or quality. Growth, yield, and quality reduction may occur through a decrease in the ability of plants to take up water from the soil solution and the destruction of soil structure (Barrett-Lennard, 2003). In addition, toxicity resulting from excessive concentration of certain ions, principally Na^{+} , $Ca^{2+,}$ $Mg^{2+,}$ Cl^{-} , $SO4^{2-}$, and $HCO3^{-}$ as well as nutritional imbalances (Grattan and Grieve, 1999) may also play important roles in the response of plants in saline environments. Most horticultural crops are glycophytes (Greenway and Munns, 1980) and range from salt-sensitive to moderately salt-tolerant.

1.5. Ornamental plants:

Ornamental plants are mostly grown for their exquisite blooms and are a source of major attraction for many gardens. Several such ornamental gardens usually prefer a wide variety of flowering plants so that the garden is continuously in flower through the year during spring, summer, monsoon and winter. Several types of plants representing predominantly angiospermic plant families, some selected gymnosperms and pteridophytes (such as ferns) are most commonly grown that have colorful flowers, foliages, shapes, fragrance or aroma, spectacular morphological characters that are visibly attractive are usually selected (Aunu, *et al.*, 2000).

1.6. Effect of salinity on ornamental plants:

The use of saline waters is an option for the irrigation of salt tolerant ornamentals as competition for high quality water increases. However, despite the importance of ornamental shrubs in Mediterranean areas, salt tolerance of such species has received little attention. The global market of ornamental species moves 250 to 400 billion dollars every year (Chandler and Sanchez, 2012) and concentrates in the countries of the European Union, United States and Japan. In Brazil, the agribusiness of ornamental plants has potential of growth due to the diversity of climate, soil and flora, contributing to the expansion in the cultivation of native and exotic species (Ibraflor, 2020). Floriculture is inserted in the segment of irrigated agriculture, consisting in the cultivation of cut flowers, pot flowers, garden plants, among others, and has high

profitability and great potential to generate jobs. However, the available quality and quantity and the inefficient use of water leads to concerns in the agricultural sector (Munns, 2002; Singh and Gupta, 2009; Niu *et al*., 2013). In this context, biosaline agriculture emerges as an alternative for the use of low-quality waters, proposing the utilization of salt-tolerant species, such as ornamental plants (Cassaniti *et al*., 2009a; Álvarez and Sánchez-Blanco, 2014; García-Caparrós *et al*., 2016). Besides the cultivation of tolerant species, selection of adequate irrigation methods and application of leaching fractions to remove the excess of salts in the root zone allow the use of saline and brackish waters in agriculture (Ayers and Westcot, 1999; Muyen *et al*., 2011). In the literature, there is little information on the irrigation management of ornamental plants with lower-quality water. Although there are species that satisfactorily develop under saline conditions, most crops are sensitive to the excess of salts in the irrigation water, requiring studies that evaluate better management strategies. Considering the importance of the cultivation of flowers and ornamental plants, it becomes necessary to identify species with potential for cultivation using moderately saline water, increasing the potentialities of this sector in the semi-arid region of Northeast Brazil. In this context, this study aimed to evaluate the growth of ornamental species as a function of irrigation with increasing levels of water salinity and two methods of water application

Producers of ornamental species are, therefore, reluctant to use water of poor quality for irrigation because they consider floricultural species to be highly sensitive. However, studies have demonstrated that moderately saline waters can be used to irrigate certain ornamental species without compromising economic value (Grieve *et al.*, 2005; Friedman *et al.*, 2007; Carter and Grieve *et al.*, 2008). However, any negative effects of salts on plant growth have to be taken into consideration mainly for their influences on aesthetic value which is an important component of ornamental plants. Salt tolerance does, however, vary considerably among the different genotypes of ornamentals used in landscaping. Ornamental plants can be considered all the species and/or varieties that provide aesthetic pleasure, improve the environment and the quality of our lives. This definition is, however, rather imprecise because these plants are used around the world and consequently the concept of 'ornamental' is ambiguous because it includes very important cultural differences (Savé, 2009).

Ornamental plants are also used to restore disturbed landscapes, control erosion and reduce energy and water consumption, to improve the aesthetic quality of urban and rural landscapes, recreational areas, interior escapes and commercial sites. So the number of plant species is very large due to the great geographical range over which they are used and their different functions. In relation to this high number of species that can potentially be utilized in the landscape, the possibility of finding genotypes able to cope with salt stress is high. Unlike in agriculture, performance of an amenity landscape is not measured with a quantifiable yield but how well it meets expectations of the user or the individual paying for installation and maintenance, who may or not be one and the same person. Expectations include aesthetic appearance and/or utility, such as shading, ground cover and recreation (Kjelgren *et al.,* 2000). Sometimes in marginal conditions plant survival is often the only aim of cultivation. Furthermore, for landscape plants, maximum growth is not always essential and indeed excessive shoot vigor is often undesirable. To keep a compact growth habit, ornamentals often have to be pruned or treated with growth regulators (Cameron *et al.,* 2004) so using an alternative water source may be prove advantageous where a more compact form arises as result of salt stress and where slower growth is desirable for easier landscape management (Niu *et al.,* 2007b). Hence, the use of reclaimed water could conserve potable water and irrigation budgets (Fox *et al.,* 2005). However, to expand the use of such waters while minimizing salt damage, the salt tolerance of ornamentals needs to be determined (Niu and Rodriguez, 2006b). Apart from plant characteristics, soil composition and drainage characteristics also need to be taken into consideration as they can influence the severity of plant damage by saline irrigation water. For example, clay soils and soils with a high percentage of organic matter exhibit faster and greater build up in concentration of sodium than sandy soils (Dirr, 1976). High concentrations of sodium can displace calcium and magnesium ions, whereas bicarbonate ions can destroy soil structure. This is especially important when irrigation water with high soluble salts is applied on a long-term basis (Fox *et al.,* 2005). With this in mind the present chapter analyses this large environmental issue as it relates to the response of ornamental plants (herbaceous annuals and perennials, shrubs and woody trees) to salt. We look at the range of tolerance, the possible management practices that could be used to realize a sustainable

landscape in which saline water is used and the means available to reduce the effect of salt stress: we also consider the choice of plant species and tailoring plant management to the saline conditions.

1.7. Tolerance of ornamental plants to salinity:

The effects of salinity on plant growth have extensively been a focus of research because the responses in plants to salt are a complex phenomenon that involves several physiological and biochemical changes (Hasegawa *et al.,* 2000) Salinity stress effect on plant growth performance is hard compared to other plant stresses (Van der Moezel *et al.,* 1991, Noble and Rogers, 1994). Salt stress induces physiological and metabolic disturbances in crops affecting their development, growth, yield and quality (Pardossi *et al.,* 1999, Mer *et al.,* 2000). However, the severity of salt damage has been found to be dependent on the meteorological conditions, species and cultivar (Vicente *et al.,* 2004), and growth stages of the plant (Carvajal and Alcaraz, 1998). Salt tolerance in plants is difficult to quantify because it varies appreciably with many environmental factors (soil fertility, soil physical conditions, distribution of salt in the soil profile, irrigation methods, and climate) and plant factors (stage of growth, variety, and rootstock) (Kozlowski and Pallardy, 1997a). Woody plants are relatively salt tolerant during seed germination, much more sensitive during the emergence and young seedling stages and become progressively more tolerant as the age increases through the reproductive stage (Shannon *et al.,* 1994). Several woody species showed variations to salt tolerance such as Acacia (Craig *et al.,* 1990), Casuarina (Clemens *et al.,* 1983), and Eucalyptus (Dunn *et al.,* 1994). Variations in salt tolerance have also been demonstrated among proven Salinity is a major problem confronting agriculture in the arid and semi-arid region, and the research is scarce and has no or limited information about crop behaviors and responses especially the multipurpose forest trees (MPFT) adapted to this region. *L. leucocephala* and *A. saligna* are two promising MPFT that could be used as forage source for livestock feed. Lack of research on such species and the effect of both drought and salinity on growth and development of such species was the motivation to conduct such research. Thus, the purpose of this work was to study the effect of salinity on growth performance, plant water relations, and feed quality in these species under

different salinity concentrations. Also, to investigate the best level of tolerance theses species can withstand.

1.8. Mechanism of tolerance:

a. Ion Homeostasis and Salt Tolerance:

Maintaining ion homeostasis by ion uptake and compartmentalization is not only crucial for normal plant growth but is also an essential process for growth during salt stress (Niu *et al.,* 1995; Hasegawa, 2013). Irrespective of their nature, both glycophytes and halophytes cannot tolerate high salt concentration in their cytoplasm. Hence, the excess salt is either transported to the vacuole or sequestered in older tissues which eventually are sacrificed, thereby protecting the plant from salinity stress (Reddy *et al.,* 1992; Zhu, 2003).

b. Compatible Solute Accumulation and Osmotic Protection:

Compatible solutes, also known as compatible osmolytes, are a group of chemically diverse organic compounds that are uncharged, polar, and soluble in nature and do not interfere with the cellular metabolism even at high concentration. They mainly include proline (Ahmad *et al.,* 2010; Gálvez *et al.,* 2012), glycine betaine (Khan *et al.,* 2000; Wang and Nii, 2000), sugar (Bohnert *et al.,* 1995; Kerepesi and Galiba, 2000) and polyols (Ford, 1984; Dopp *et al.,* 1985; Ashraf and Foolad, 2007) Organic osmolytes are synthesised and accumulated in varying amounts amongst different plant species.

c. Antioxidant Regulation of Salinity Tolerance:

Abiotic and biotic stress in living organisms, including plants, can cause overflow, deregulation, or even disruption of electron transport chains (ETC) in chloroplasts and mitochondria. Under these conditions molecular oxygen (O_2) acts as an electron acceptor, giving rise to the accumulation of ROS. Singlet oxygen ($^1O_2$), the hydroxyl radical (OH^-), the superoxide radical, and hydrogen peroxide (H_2O_2) are all strongly oxidizing compounds and therefore potentially harmful for cell integrity (Groß *et al.,* 2013) Antioxidant metabolism, including antioxidant enzymes and nonenzymatic compounds, play critical parts in detoxifying ROS induced by salinity stress. Salinity

tolerance is positively correlated with the activity of antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidise (GPX), ascorbate peroxidase (APX), and glutathione reductase (GR).

d. Roles of Polyamines in Salinity Tolerance:

Polyamines (PA) are small, low molecular weight, ubiquitous, polycationic aliphatic molecules widely distributed throughout the plant kingdom. Polyamines play a variety of roles in normal growth and development such as regulation of cell proliferation, somatic embryogenesis, differentiation and morphogenesis, dormancy breaking of tubers and seed germination, development of flowers and fruit, and senescence (Galston *et al.,* 1997; Knott *et al.,* 2007; Gupta *et al.,* 2013). It also plays a crucial role in abiotic stress tolerance including salinity and increases in the level of polyamines are correlated with stress tolerance in plants (Yang *et al.*, 2007; Groppa and Benavides, 2008).

e. Roles of Nitric Oxide in Salinity Tolerance:

Nitric oxide (NO) is a small volatile gaseous molecule, which is involved in the regulation of various plant growth and developmental processes, such as root growth, respiration, stomata closure, flowering, cell death, seed germination and stress responses, as well as a stress signalling molecule (Delledonne *et al.,* 1998; Lamattina *et al.,* 2003; Besson *et al.,* 2008). NO directly or indirectly triggers expression of many redox-regulated genes. NO reacts with lipid radicals thus preventing lipid oxidation, exerting a protective effect by scavenging superoxide radical and formation of peroxynitrite that can be neutralised by other cellular processes. It also helps in the activation of antioxidant enzymes (SOD, CAT, GPX, APX, and GR) (Bajgu, 2014).

f. Hormone Regulation of Salinity Tolerance

ABA is an important phytohormone whose application to plant ameliorates the effect of stress condition(s). It has long been recognized as a hormone which is upregulated due to soil water deficit around the root. Salinity stress causes osmotic stress and water deficit, increasing the production of ABA in shoots and roots (He and Cramer, 1996; Cramer and Quarrie, 2002; Cabot *et al.,* 2009). The accumulation of ABA can mitigate the inhibitory effect of salinity on photosynthesis, growth, and translocation of assimilates

(Popova *et al.*, 1995; Jeschke *et al.*, 1997). The positive relationship between ABA accumulation and salinity tolerance has been at least partially attributed to the accumulation of K^+, Ca^{2+} and compatible solutes, such as proline and sugars, in vacuoles of roots, which counteract with the uptake of Na^+ and Cl^- (Chen *et al.*, 2001; Gurmani *et al.*, 2011).

1.9. Study objectives:

1. To determine the response of different ornamental plant species to different concentrations of simulated seawater and determine the resistant of plant species for different levels of salinity.
2. To determine the effect of simulated seawater on the morphological characteristics and growth rate of plant species**.**
3. Access to the best mixing between fresh water and sea water and used it to irrigate ornamental plants and how to take advantage of the sea water under Libyan environmental conditions.

Chapter two
2. Literature Review

2.1. Acacia cyanophyla:

A fast-growing, drought-tolerant nitrogen-fixing tree, Family Mimosaceae from southwestern Western Australia has been widely planted through the world's dry lands, especially around the Mediterranean basin, for fodder, fuel wood, sand stabilization, as a windbreak and as an ornamental garden or street tree. Referring to invasion of threatened Cape Floristic vegetation in South Africa, it was called "one of the worst woody invaders, a plant that has run amuck in a threatened biome, rich in endemic plant species" (Cronk and Fuller, 1995). is a leguminous tree that shows a high capacity to withstand adverse environmental conditions, and has the potential to ameliorate soil conditions by fixing drifting sands and fixing atmospheric nitrogen (Koreish, 1997). This species has been extensively planted outside its original distribution area in western Australia (Hopper and Maslin, 1978). *Acacia saligna* has been naturalized in some areas, causing severe problems of habitat alteration, and disruption of the hydrological and nutrient cycles (Van Wilgen *et al.*, 2001; Le Maitre *et al.*, 2002; Yelenik *et al.*, 2004).

Fig. (2-1)*: Acacia cyanophyla.*

2.2. Albizia Lebbeck:

Family Mimosaceae, was known in 1970s and 1980s as the ‘miracle tree’ because of its worldwide success as a long-lived and highly nutritious forage tree, and its great variety of other uses. It originally grows in Central America and the Yucatan Peninsula of Mexico (Shelton and Brewbaker, 1994). It is one of the fastest-growing trees in arid and semi-arid area. It is a long-lived evergreen perennial legume tree and multipurpose tree, valuable for its wood that is used to make good quality charcoal, small furniture and paper pulp (Verma, 2016). *L. leucocephala* grows in climate with rainfall between 650 mm and 3000 mm in humid or sub humid atmosphere and can tolerate dry seasons of up to 6 months (Lascano *et al*., 1995). It is intolerant to soils with low pH (below pH 5.5), low potassium, low calcium, high salinity, high aluminum and water logging (Brewbaker, 1987). It is suggested that *L. leucocephala* is very beneficial as a shade tree for many crops, for soil fertility improvement, erosion control, site preparation in reforestation (Rushkin, 1984). The protein-rich leaves and legumes are widely used as fodder for cattle, water buffalo and goats (Sethi and Kulkarni, 1995).

Fig. (2-2): *Albizia Lebbeck*.

2.3. Review for methods for determination of salt tolerance in plants:

Plant tolerance to salinity is a widely studied topic in the scientific community. These studies focus on the mechanisms of salt tolerance, considering physiological, biochemical and molecular analyses, as well as to evaluate the potential of halophytes and the tolerance level of glycophytes (Munns and Tester, 2008). These evaluations are frequently related to genetic improvement, both in conventional methods and in genetic engineering studies (Soares Filho *et al.*, 2016). The methodological approaches employed to classify the tolerance of glycophytes to salinity assume that there is a wide intra- and inter specific genetic variability, which may result in species or varieties with low, intermediate or high capacity to withstand the excess of salts in the growing medium (Fageria 1985; Dantas *et al.*, 2002; Silva *et al*., 2016; Soares Filho *et al*., 2016). In these studies, plant responses to salinity are mainly observed in terms of survival, leaf injuries, growth, crop yield and physiological variables (Noble and Rogers 1992; Miyamoto *et al*., 2004; Munns and Tester 2008; Barros *et al*., 2010; Rahnama *et al*., 2010). However, the traditional methods of evaluation of salt tolerance of plants are based mainly on growth and traits of agronomic interest, like grain, fruit or forage yield (Maas and Hoffman 1977; Ayers and Westcot, 1999). Among the methods to evaluate plant tolerance to salinity, the following stand out, which are based mainly on plant growth or crop yield data: (Maas and Hoffman, 1977) and Miyamoto *et al*., 2004. The assessment method proposed by Maas and Hoffman (1977) is widely used and based the guidelines for relative tolerance of crops published in the FAO 29 document (Ayers and Westcot, 1985). Such classifications uses relative crop yield values (grain, fruit, and forage, for example) and considers that plant response remain unchanged up to a certain level of salinity, defined as salinity threshold. From this limit on, the response decreases linearly until reaching zero value for the variable. To use this method, therefore, it is necessary to study the plant response within a wide range of salinity in order to obtain the accurate values of salinity threshold, percent reduction in yield and the limit of survival for the genotype. The assessment method proposed by (Miyamoto *et al*., 2004) aimed to obtain tables of tolerance to salinity for various types of crops, which can be used by horticulturists and landscape planners to identify salt-sensitive and salt-tolerant

species. This classification is based on the reduction of growth (50 or 25%) or on damages caused to the leaves (at least 25% of leaves damaged), considering the electrical conductivity of the saturation extract of the soil (ECe). According to this criterion, the plants are classified into five categories: sensitive (0–3 dS m-1), moderately sensitive (3–6 dS m-1), moderately tolerant (6–8 dS m-1), tolerant (8–10 dS m-1) and highly tolerant ([10 dS m-1). Although there are many studies applying the above-mentioned methods, little is known in terms of comparison between them, especially in studies on salt tolerance for ornamental plants. For these species, it has been observed that, besides growth, it is also essential to evaluate the effects on their visual aspect, because this characteristic is relevant in their evaluation for the commercialization process (Bernstein *et al.*, 1972; Niu and Rodriguez 2006a, b; Cassaniti *et al.*, 2013). In this aspect, sensory analysis can be an important tool to identify effects of salinity on plant quality.

2.3. Review of past studies:

Yaseen *et al.,* (1993) in Pakistan studied the effect of salinity on three *Leucaena Leucocephala* varieties (K-28, K-67and K-743). Differences in seed germination, plant growth and ionic composition were considered to determine relative salt tolerance of these varieties. All the varieties gave 100% germination in control and at 5 dS m-l EC. Per cent germination of K-67, K-743 and K-28 decreased with increase in salinity beyond 5 dS mol. However, the variety K-28 gave maximum germination at all the salinity levels. Its germination was 73% compared to 40% and 7% by K-67 and K-743, respectively at 20 dS mol. This variety also produced maximum dry shoot and root weights and hence showed least reduction in growth in response to salinity. It was also observed that salinity affected shoot more than root. The K:Na ratios in leaves, shoot and root also revealed the salt tolerance of K-28 which maintained high K:Na ratio in leaves and low in stem, indicating less of absorbed Na + being trans-located to leaves. Overall, results revealed that K-28 was relatively more salt tolerant than K-67 and K-743.

Rashid *et al.,* (2004) conducted a comparative study in Bangladesh to evaluate the salt tolerance of seeds of six multipurpose tree species: *Acacia auriculiformis* A. Cunn. ex. Benth, *Albizzia lebbek* (L.) Benth, *Albizzia saman* (Jacq.) *F. Muell., Dalbergia sissoo Roxb., Leucaena leucocephala* (Lam.) de Wit and *Swietenia macrophylla* (R.

Vig.) Du Puy and Labat using fresh water and salt (NaCl) solutions of 7.5, 15 and 22.5 mmhos cm^{-1}. Effect of salt on germinative energy, germination period and the reduction of germination with increasing levels of salt have been examined. It was found that germination period and germinative energy are reduced with increasing salinity and the germination trends change. Based on the observation, salt tolerance of the species has been determined and *Al. lebbek* has shown the best capacity to germinate at different salinity condition.

Jaouadi *et al*., (2010) conducted a study in Tunisia to evaluate the germination behavior of Acacia. Several concentrations of NaCl and PEG were applied on seeds. Parameters related to germination capacity and kinetic were assessed and analyzed. the study of the effect of salt stress on germination revealed a highly significant effect of NaCl concentrations on the germination rate and average time of germination, and a good level of salt tolerance since it succeeded to germinate under high salt concentrations (21% of germination rate under 22 g.1-1NaCl).

Tadros ., (2011) conducted a study in Jordan to evaluate the effect of salinity on growth performance, physiological responses and chemical composition were studied on two species *Leucaena leucocephala* (Lam.) de wit and *Acacia saligna* (Labill.) seedlings. Five saline concentrations mixture of sodium and calcium chloride (v/v, 1:1): control (Distilled Water), 2000, 4000, 6000, and 8000 ppm were used in watering plants for 3 months. The results showed a marked variation among species in response to salinity. *L. leucocephala* was able to withstand the highest level of salinity compared to *A. saligna* in all studied parameters except relative water content. All morphological characteristics of the two species decreased markedly under salinity, except the shoot/root ratio that showed a trend of increase. The leaf water potential was more negative with an increase in relative water content under salinity compared with the control. The crude protein and nitrogen content concentration were low at 6000 ppm and while increased at 8000 ppm in *L. Leucocephala* compared to *A. saligna.* The results showed that growing both species provide great benefits to the agricultural sector especially in the arid and

semiarid areas were these species can provide forage with high quality all year around when grown under irrigation with saline or regular water. Thus, it is recommended to utilize such species to be grown for forages under saline conditions for their productivity and quality.

El-Lamey, (2015) conducted a study in Egypt to evaluate the effect of salinity stress on morphology and anatomy of two leguminous range plants; *Leucaena leucocephala* and *Prosopis chilensis* plants. The investigated plants were irrigated with tap water (control) and two levels of salinity (3500 and 7500 ppm). Increasing salinity of irrigation water from 3500 to 7500 ppm led to reduction in plant height and stimulated the production of tannins in stems and leaflets of both investigated plants. This study demonstrated the presence of some anatomical changes induced by salinity in *Leucaena leucocephala*, and Prosopis chilensis leaflets. These anatomical changes included; presence of thick layer of cuticle, reduction in number of cortex layers and intercellular spaces between palisade cells, increase in the elongation of palisade parenchyma tissue and accumulation of tannin - filled cells in it , in cortical region of stem and also in parenchyma cells of its pith. All these anatomical modifications seemed to be crucial for their survival under salinity stress.

Kheloufi *et al*., (2016) conducted a study in Algeria aimed for identifying the kinetics of germination in response to salinity stress on two types of Acacia species (*Acacia decurrens* and *Acacia saligna*) separately using various salinity levels of 0, 50, 100, 150, 200, 250, 300, 400 and 600 meq.L^{-1} using NaCl and CaCl2 at the same levels. Germination of these species decreased with increasing salinity. All Acacia species showed higher tolerance to increased level of CaCl2 than to NaCl. The recovery of the seeds that did not germinate under salinity conditions using NaCl or CaCl2 at (600 meq.L^{-1}). Furthermore, *Acacia decurrens* was more tolerant than *Acacia saligna* with a rate of considerable germination of 46% with the concentration of (300 meq.L^{-1}) of NaCl.

Chérifi *et al*., (2016) conducted a study to determine the germination of seeds from six Acacia species under salt stresses using five treatment levels: 0,100, 200, 300, and 400µm of NaCl. Corrected germination rate (GC), germination rate index (GRI) and mean germination time (MGT) were recorded during 10 days. The results indicate that germination was significantly reduced in all species with the increase in NaCl concentrations. However, significant inter-specific variation for salt tolerance was observed. The greatest variability in tolerance was observed at moderate salt stress (200 µm of NaCl) and the decrease in germination seems to be more accentuated in A. *cyanophylla and A. cyclops. Although, A. raddiana*, remains the most interesting, it preserved the highest percentage (GC = 80%) and velocity of germination in all species studied in this work, even in the high salt levels. This species exhibits a particular adaptability to salt environment, at least at this stage in the life cycle.

Kheloufi *et al.*, (2019) conducted a study in Algeria, in this study, the salinity tolerance index, ionic homeostasis and osmo-protection were evaluated in *A. karroo* and *A. saligna* plants of 90 days old and cultured at various concentrations of NaCl for 21 days. Results showed that salt caused remarkable changes in some growth-related parameters (dry biomass) represented by the salinity tolerance index (STI). Na^+, $Ca^{2+,}$ and Ratio Na^+/K^+ content in the leaves increased with salinity levels, while K^+ contents were significantly reduced compared to the control in both acacia species. Levels of proline, total free amino acids and reducing sugars have been accumulated considerably in the leaves. *A. karroo* was more salt-tolerant than *A. saligna*. the results showed that the adaptability of a species to salinity is closely related to ion selectivity and biomass production. The seedlings also accumulated significantly a set of important osmolytes in leaves under salt stress, showing a marked increase in secondary metabolite accumulation. This adaptation proved very specific to each species for better survival in saline environments.

Chapter Three
3. Materials and methods

3.1. Study location and plant materials:

This study was carried out in Benghazi city, the second largest city in Eastern Libya a part of the Mediterranean sea, about 1000 km far from the capital Tripoli. This study was conducted during spring-summer 2020 the experiments was conducted at Benghazi university laboratory. Plant materials used in this study are described in the table (3-1), The seeds of Lebbeck were collected from Salam District area eastern to Benghazi (12.5 km), while the seeds of Acacia were collected from Garyones area in the west of the city. All the seeds had similarly selected with the shape and size and collected from trees of same age and height.

Tab. (3-1): Plant species used in the study.

Common name	Scientific name	Family
Lebbeck	*Albizia Lebbeck*	Mimosaceae
Acacia	*Acacia cyanophyla*	Mimosaceae

Fig. (3-1): Seeds of *Albizia Lebbeck and Acacia cyanophyla.*

3.2. Preparation of simulated water:

Simulated seawater was prepared in the by adding specific salts in laboratory as shown the following table (3-2).

Table (3-2): Components of simulated seawater.

Salt	Molecular weight	g kg−1 solution
Sodium chloride (NaCl)	58.44	23.926
Sodium sulfate (Na_2SO_4)	142.04	4.008
Potassium chloride (KCl)	74.56	0.677
Sodium bicarbonate ($NaHCO_3$)	84.00	0.196
Potassium bromide (KBr)	119.01	0.098
Boric acid (H_3BO_3)	61.83	0.026
Magnesium chloride ($MgCl_2.6H_2O$)	203.33	0.05327
Calcium chloride ($CaCl_2.2H_2O$)	147.03	0.01033

3.3. Preparation of different dilutions of simulated seawater:

Five dilutions of simulated seawater were prepared 1%, 2%, 5%, 10%, 20% (v/v , for preparation of 1% concentration in a measuring cylinder 1ml of seawater was diluted with distilled water to complete the volume to 100ml, the same procedure was performed for the other concentrations as shown in table (3-3), 0% concentration was a pure distilled water which used as a control.

Table (3-3): Preparation of different concentration of seawater.

Concentration	Seawater	Distilled water
0% Control	0	Pure distilled water
1%	1ml	99 ml
2%	2ml	98 ml
5%	5ml	95ml
10%	10ml	90ml
20%	20ml	80 L

3.4. Measurements of both electro conductivity and PH:

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

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

Concentration	0%	1%	2%	5%	10%	20%
E.C	2	775	1428	3509	3529	Above 3507
PH	7.80	6.19	6.23	6.27	7.31	7.50

3.5. Experimentation of salinity effect on germination parameters:

The experiment of both plants is including the same steps, with differences in number of days, since Acacia taking longer time to germinate seeds should be kept germinating for 21 days, but Lebbeck seeds should be allowed to grow upon 14 days, both plants treated with the same procedures as following:

1. 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. The experiment was repeated using different treatments including (potable water, sulfuric acid, boiling water and mechanical scarification method).
3. In sterile 9 cm Petri dishes lined with double layer whatmann filter paper moisten with 5 ml of each seawater concentration; Seeds were plated on Petri dishes under aseptic conditions. Each Petri dish contained 10 seeds of one inbred-line, Petri dishes were randomized in a precision incubator and maintained in the dark at 22±0.5°C, this process was in 3 replicates for each concentration, and the total number of plates was 18 plates for each treatment.
4. Plates were watered as needed with 5 ml of each concentration for 14 days in case of Lebbeck and 21 days for Acacia.
5. Every day from the beginning of germination, the number of germinated seeds was determined.
6. Germinated seeds were counted daily for the calculations of daily and final germination percentages (g%) and mean germination time (MGT) seeds considered germinated when the radical had protruded 2 mm according to the following formulas

A. % Germination (G%) = $\frac{\text{No.of seeds with extened radicals}}{\text{Total number of seeds}} \times 100$

B. Mean germination time (MGR)= $\sum(T1*n1 + T2*n2 +\ldots+ Tk*nk)/\sum(n1 + n2 +\ldots+nk)$.

Where:

(n)= no. of new germinated seed

T= time from the beginning of the experiment.

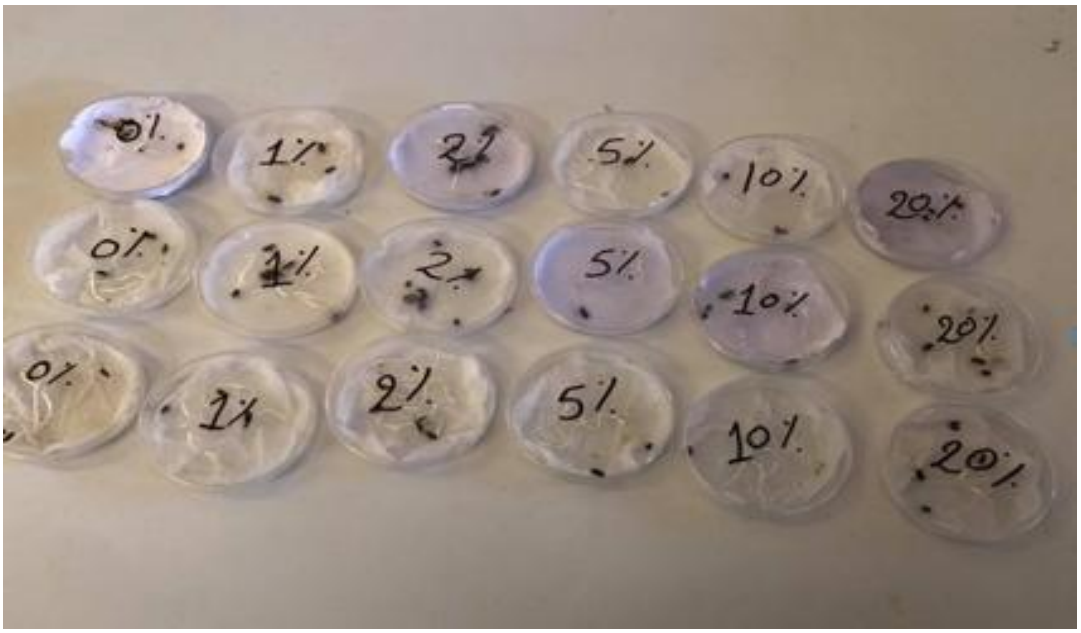

Fig. (3-2): Germination experiment for Acacia seeds.

Fig. (3-3): Germination experiment for Lebbeck seeds.

3.6. Seedling development study:

Germinated seeds of both plants were allowed to develop and grow the seedlings under the same conditions. Seedlings were daily monitored, shoot and root lengths were measured by the end of the experiment. Moreover, seed mass and seed viability were examined At the end of the growth period in this study, root length, shoot length, fresh and dry weight of the grown plant were measured. Fresh weight were measured directly by sensitive balance, dry weight were taken after drying of the plant in an oven at 65° C for 24 hours.

Seedling Vigor Index (SVI):

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

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

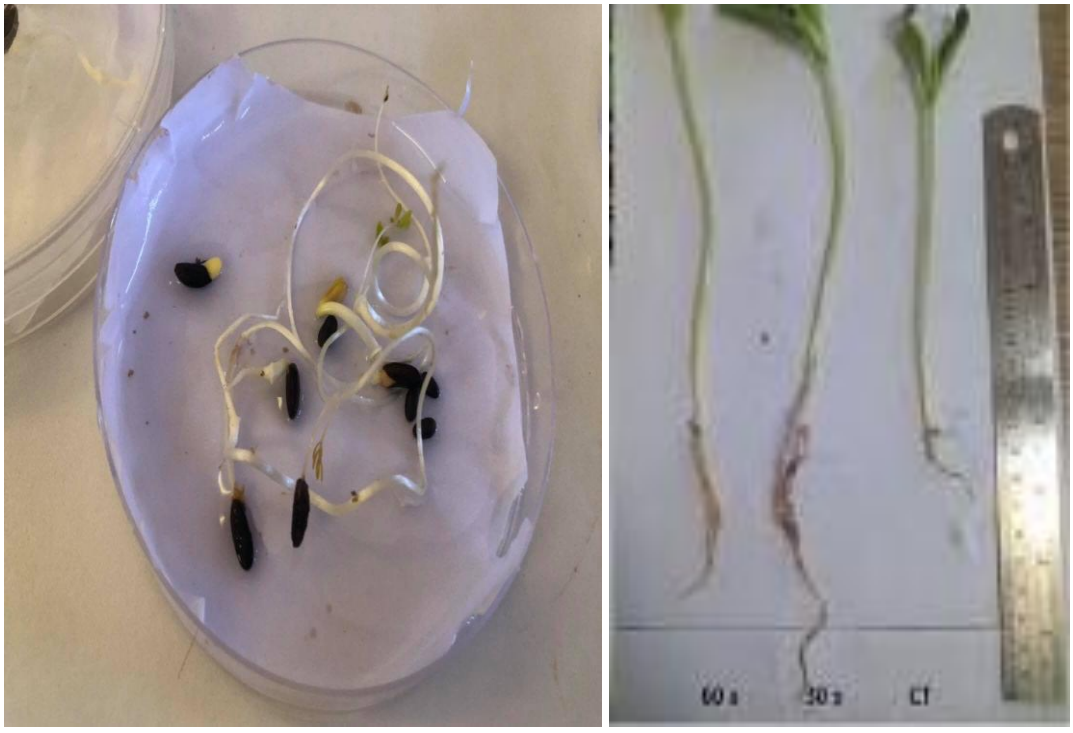

Fig. (3-4): Seedling development study.

3.7. Statistical analysis:

Obtained data were summarized in SPSS (social package statistic software, version 21) 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%.

Chapter four
4. Results

4.1. Results of Lebbeck Seeds treated with boiled water:

4.1.1. Germination experiment:

4.1.1.1. Estimation of mean germination time (MGT):

Majority of seeds showed increased mean germination time at all seawater concentration and in both treatments with boiled water especially at concentration 5% for both treatments. The increase in concentration of sea water slows the germination of the seeds as shown in the table (4-1).

Table (4-1): Mean germination time of Lebbeck seeds treated with boiled water.

Seawater %	MGT 1st treatment	MGT 2nd treatment
0%	9.7	9
1%	9.09	9.7
2%	9.55	9.43
5%	12.4	10.7
10%	0	0
20%	0	0

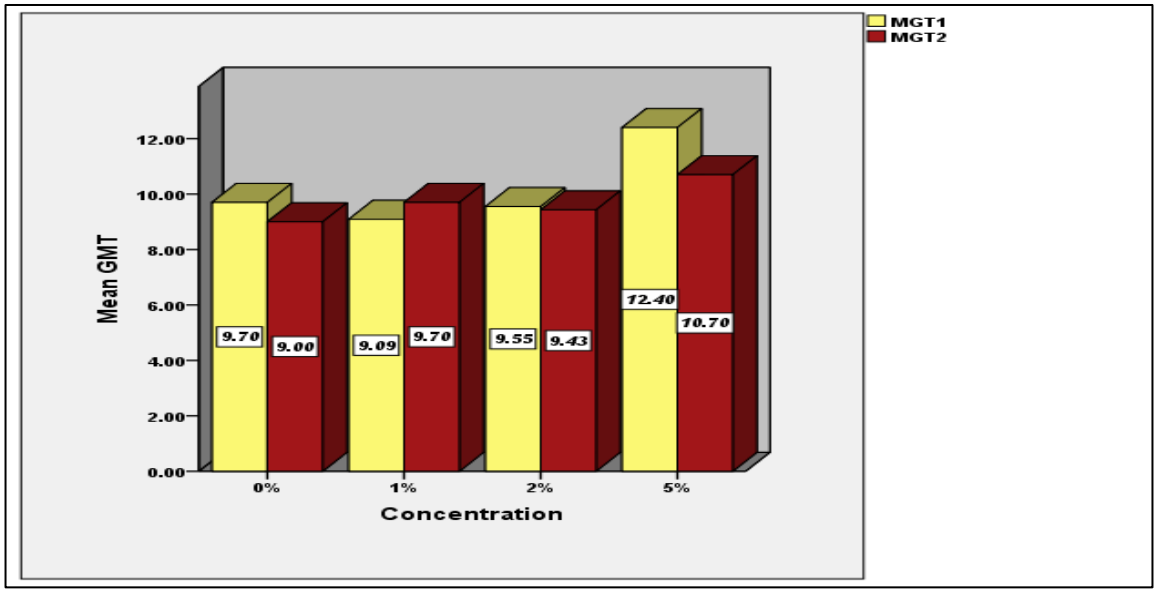

Fig. (4-1): Effect of seawater on MGT of Lebbeck treated with boiled water.

4.1.1.2. Estimation of germination percentage (G %):

Final seed germination of Lebbeck treated with boiled water showed significant decrease at all concentrations of sea water and control the maximum number of germinated seeds were 8 seeds from total 10 seeds; no growth had been recorded at high concentration of sea water in both treatments as shown in the table (4-2).

Table (4-2): Germination percentage at different seawater concentrations for Lebbeck seeds treated with boiled water.

Concentration %	G% 1st treatment		G% 2nd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation
0%	50.7143	30.49950	60.7143	28.67974
1%	52.8571	25.24604	60.0000	36.58499
2%	54.2857	31.30846	49.2857	27.58603
5%	10.0000	14.14214	46.4286	39.92438
10%	-	-	-	-
20%	-	-	-	-

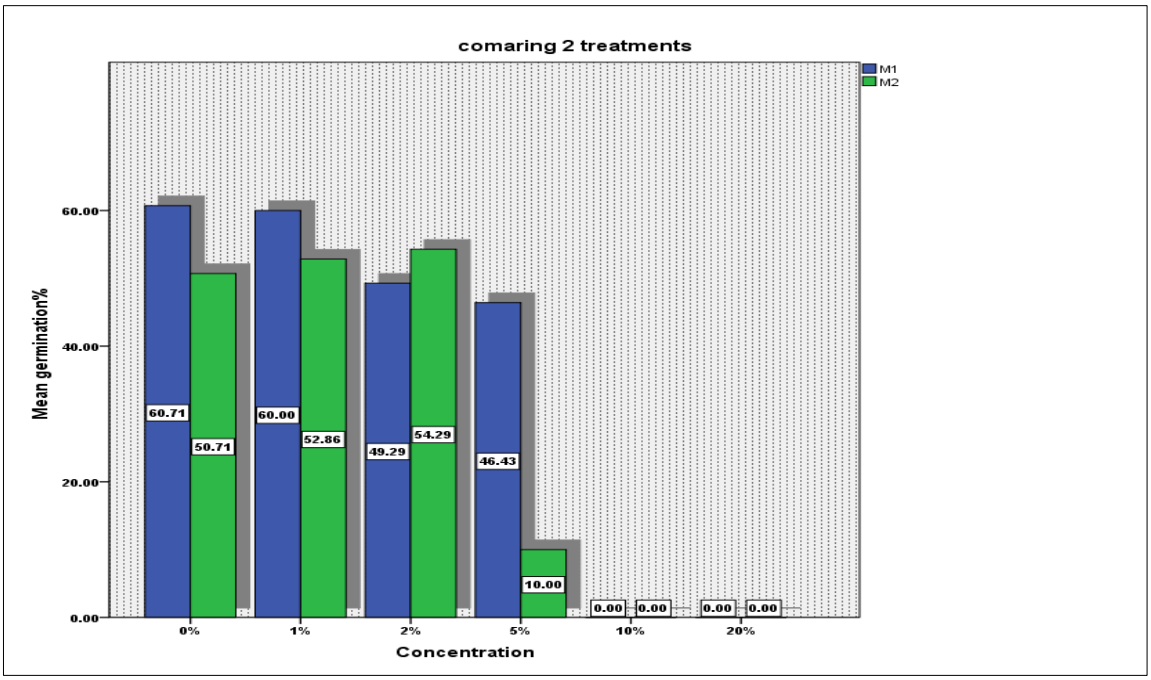

Fig. (4-2): Germination percentage of Lebbeck seeds at different water concentrations.

4.1.2. Seedling experiment:

4.1.2.1. Seedling vigor index (SVI):

Seedling vigor index of Lebbeck showed significant decrease in the value with increased seawater concentrations, compared with the control in both treatments.

The table (4-3) shows the differences in the means of SVI.

Table (4-3): Effect of different concentration of seawater on SVI.

Concentration %	SVI	Std. deviation	SVI	Std. deviation
0%	620.719	228.59755	707.3181	207.82592
1%	394.1622	160.95679	390.0000	258.12206
2%	369.7825	143.41892	235.8639	148.24954
5%	-	-	-	-
10%	-	-	-	-
20%	-	-	-	-

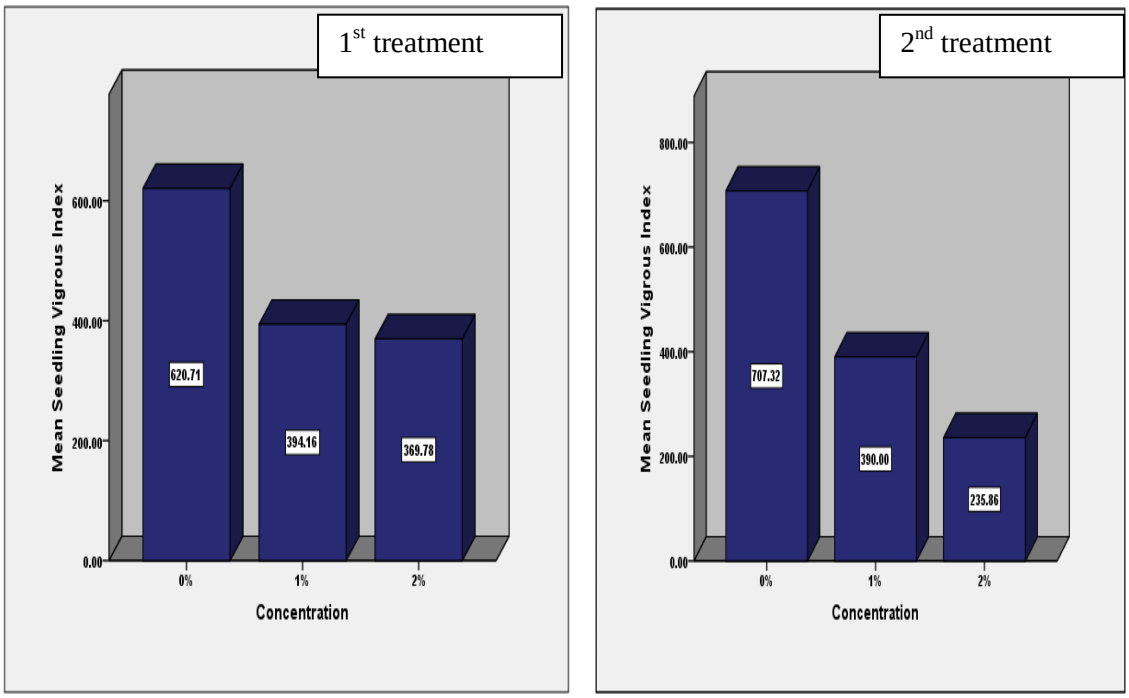

Fig. (4-3): Effect on SVI of Lebbeck seeds treated with boiled water.

4.1.2.2. Effect of seawater concentrations on Lebbeck shoots and roots lengths when treated with boiled water:

The effect of seawater at different concentrations on fresh and dry lengths of both shoot and roots showed highly significant decrease in mean of fresh and dry shoot and shoot lengths of Lebbeck in both treatments compared with the control according to one way Anova test. The table (4-4) describing the differences in mean of the lengths of dry and fresh lengths of the plant and the significances of these differences.

Table (4-4): The effect on Lebbeck shoots and roots lengths treated with boiled water.

Concentration		1st treatment				2nd treatment			
		LSF	LSD	LRF	LRD	LSF	LSD	LRF	LRD
0%	No.	8	8	8	8	8	8	8	8
	Mean	6.3125	5.3125	4.8875	4.088	6.9875	4.6625	4.7375	3.4500
	Std. Deviation	2.3937	2.15369	1.61195	1.1993	2.42218	1.35429	1.62035	1.09022
1%	No.	7	7	7	7	9	9	9	9
	Mean	4.2286	3.2286	3.0143	2.100	3.4667	3.0333	1.7556	1.1889
	Std. Deviation	1.6540	1.42093	1.59836	1.5330	2.23942	2.06458	.85894	0.50854
2%	No.	8	8	8	8	7	7	7	7
	Mean	3.7875	3.0250	2.5250	1.659	2.8000	1.9857	1.4429	0.9714
	Std. Deviation	1.37989	1.29035	0.82245	0.6413	1.80739	1.32467	0.74354	0.48892
ANOVA		**0.032**	**0.025**	**0.007**	**0.001**	**0.002**	**0.016**	**0.000**	**0.000**

4.1.2.3. Effect on fresh length of Lebeck (LSF):

The effect of different concentration of seawater on fresh length of Lebbeck shoots treated with boiled water was significant p-values (0.032 and 0.002) respectively. Post hock multiple comparisons (LSD) test showed theses significance in the differences in means between (0% and 1%), (0%and 2%) but not (1% and 2%) in the both treatments.

Table (4-5): Effect on fresh length of Lebbeck seeds treated with boiled water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	2.08393*	0.96722	0.044	3.52083*	1.06452	0.003
	2%	2.52500*	0.93442	0.014	4.18750*	1.13383	0.001
1%	0%	-2.08393-*	0.96722	0.044	-3.52083-*	1.06452	0.003
	2%	0.44107	0.96722	0.653	0.66667	1.10404	0.552
2%	0%	-2.52500-*	0.93442	0.014	-4.18750-*	1.13383	0.001
	1%	-.44107-	0.96722	0.653	-.66667-	1.10404	0.552

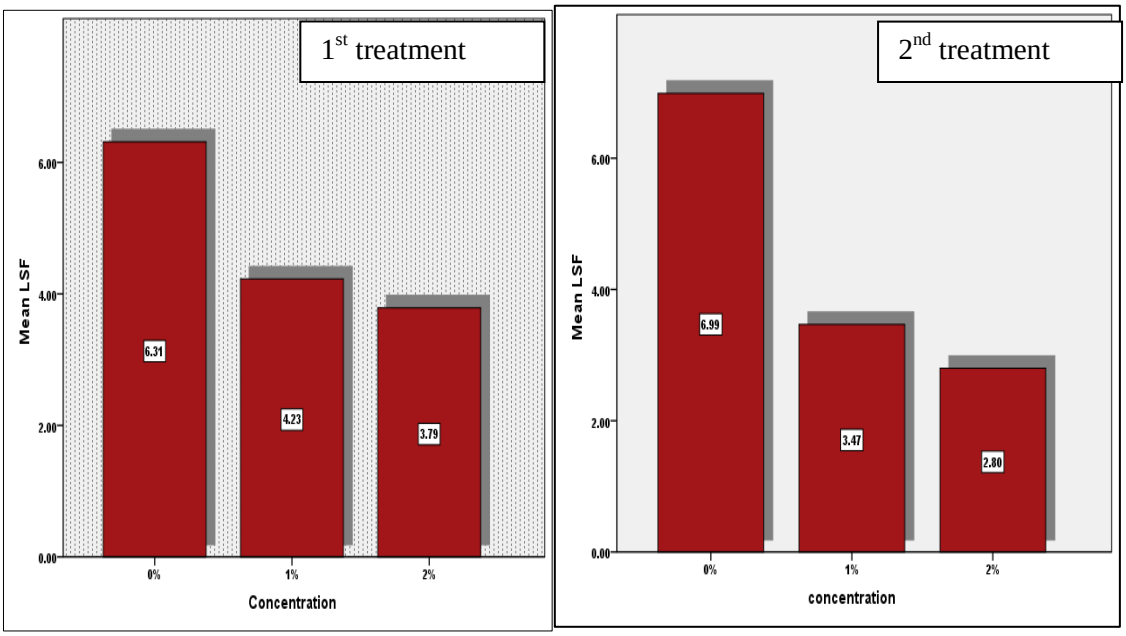

Fig. (4-4): Effect on fresh length of Lebbeck seeds treated with boiled water.

4.1.2.4. Effect on dry length of Lebbeck shoot (LSD):

The effect of different concentration of seawater on dry length of Lebbeck shoots treated with boiled water was significant p-values (0.025 and 0.016) respectively. Post hock multiple comparisons (LSD) test showed theses significance related to the differences in means between (0% and 1%), (0%and 2%) but not (2% and 1%) in first treatment. In the second treatment the differences between (0% and 2%) only as shown in table (4-6).

Table (4-6): Effect on dry length of Lebbeck seeds treated with boiled water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	2.08393*	0.86786	0.026	1.62917	0.80382	0.056
	2%	2.28750*	0.83844	0.013	2.67679*	0.85616	0.005
1%	0%	-2.08393-*	0.86786	0.026	-1.62917-	0.80382	0.056
	2%	0.20357	0.86786	0.817	1.04762	0.83366	0.223
2%	1%	-.20357-*	0.86786	0.817	-1.04762-*	0.83366	0.223

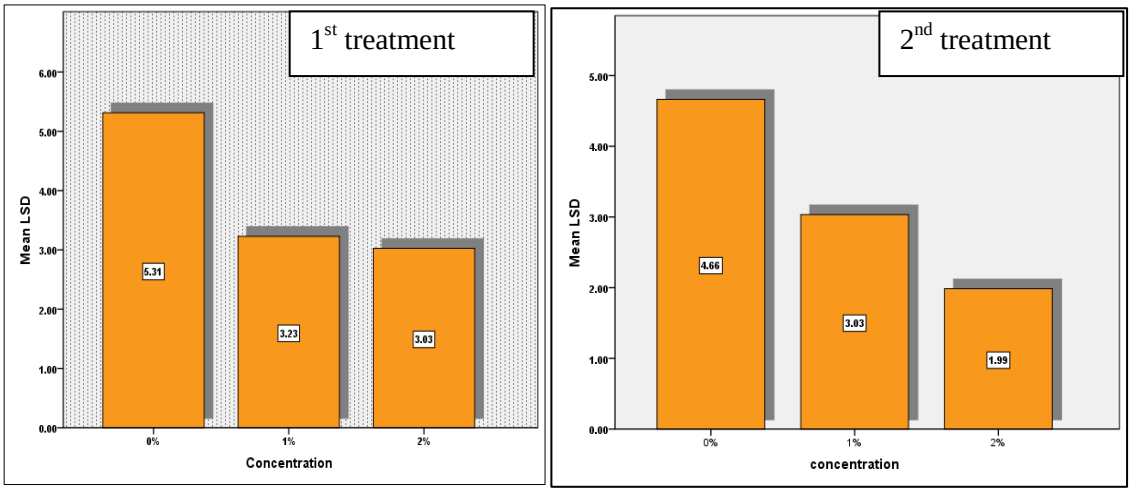

Fig. (4-5): Effect on dry length of Lebbeck seeds treated with boiled water.

4.1.2.5. Effect on fresh length of Lebeck roots (LRF):

The effect of different concentration of seawater on fresh length of Lebbeck roots treated with boiled water was significant p-values (0.07 and 0.00) respectively. Post hock multiple comparisons (LSD) test showed theses significance related to the differences in means between (0% and 1%), (0% and 2%) but not (2 % and 1%) in both treatments. only as shown in table (4-7).

Table (4-7): Effect on roots fresh length of Lebeck seeds treated with boiled water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	1.87321*	0.71576	0.017	2.98194*	0.55704	0.000
	2%	2.36250*	0.69149	0.003	3.29464*	0.59331	0.000
1%	0%	-1.87321-*	0.71576	0.017	-2.98194-*	0.55704	0.000
	2%	.48929	0.71576	0.502	0.31270	0.57772	0.594
2%	0%	-2.36250-*	0.69149	0.003	-3.29464-*	0.59331	0.000
	1%	-.48929-	0.71576	0.502	-.31270-	0.57772	0.594

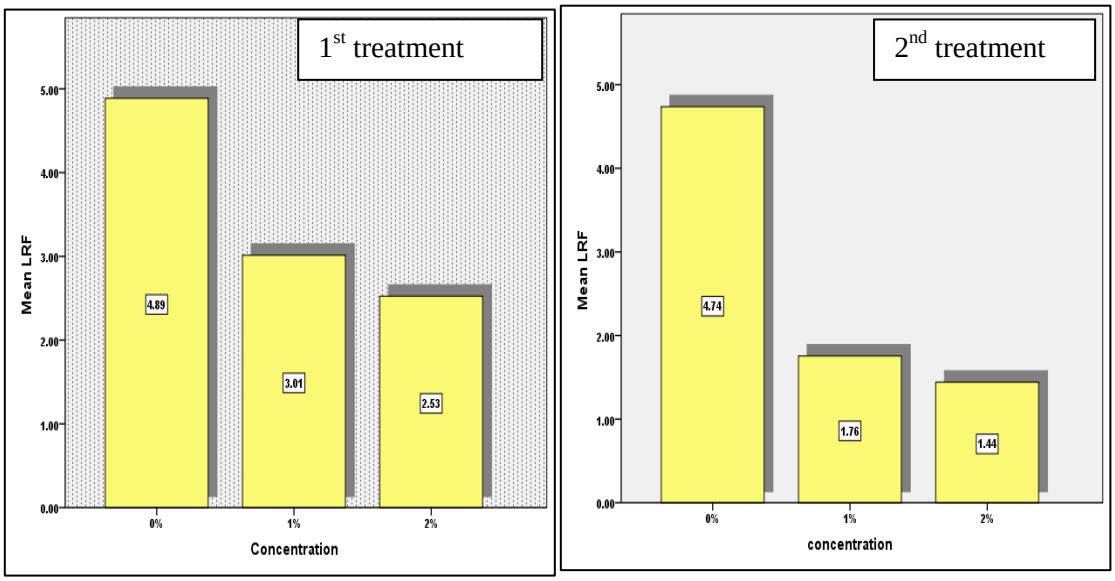

Fig. (4-6): Effect on roots fresh length of Lebeck seeds treated with boiled water.

4.1.2.6. Effect on dry length of Lebeck roots (LRD):

The effect of different concentration of seawater on dry length of Lebbeck roots treated with boiled water was significant p-values (0.01 and 0.00) respectively. Post hock multiple comparisons (LSD) test showed theses significance related to the differences in means between (0% and 1%), (0% and 2%) but not (2% and 1%) in both treatments. only as shown in table (4-8).

Table (4-8): Effect on roots dry length of Lebbeck seeds treated with boiled water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	1.9875*	0.6019	0.004	2.26111*	0.36460	0.000
	2%	2.4288*	0.5815	0.000	2.47857*	0.38834	0.000
1%	0%	-1.9875-*	0.6019	0.004	-2.26111-*	0.36460	0.000
	2%	0.4413	0.6019	0.472	0.21746	0.37814	0.571
2%	0%	-2.4288-*	0.5815	0.000	-2.47857-*	0.38834	0.000
	1%	-.4413-	0.6019	0.472	-.21746-	0.37814	0.571

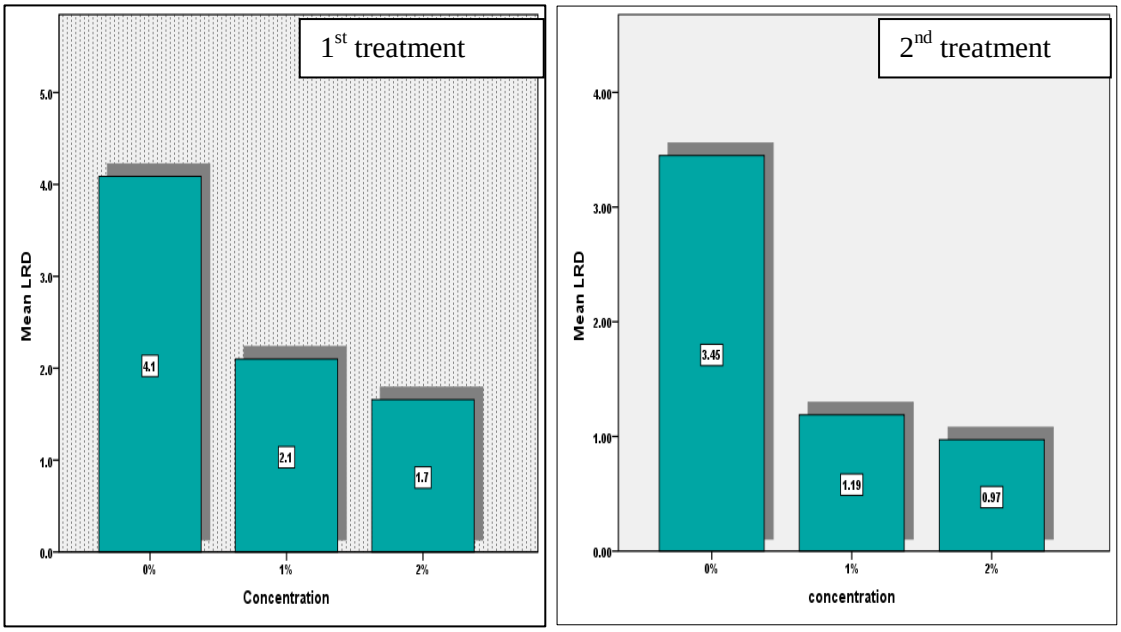

Fig. (4-7): Effect on roots dry length of Lebeck seeds treated with boiled water.

4.1.3. Effect of seawater concentrations on roots and shoot weights:

The effect of seawater at different concentrations on fresh and dry weights of both shoot and roots showed no significant differences in mean of fresh and dry shoot and shoot weights of Lebbeck in both treatments compared with the control according to one way Anova test except in fresh weight of shoot in the second treatment. The table (4-9)

describing the differences in mean of the lengths of dry and fresh weights of the plant and the significances of these differences.

Table (4-9): Effect on roots and shoot weights of Lebbeck seeds treated with boiled water.

Concentration		1st treatment				2nd treatment			
		WSF	WSD	WRF	WRD	WSF	WSD	WRF	WRD
0%	N	8	8	8	8	8	8	8	8
	Mean	0.06965	0.011025	0.007138	0.0032	0.1623	0.0090	0.1131	0.0024
	Std. Deviation	0.0020459	.0023026	0.0057438	0.0010876	0.05099	0.00204	0.19331	0.00082
1%	N	7	7	7	7	9	9	9	9
	Mean	0.04895	0.009600	0.039271	0.0041	0.0858	0.0083	0.0118	0.0015
	Std. Deviation	0.0464946	0.0032542	0.0697634	.0027869	0.04892	0.00373	0.01595	0.00087
2%	N	8	8	8	8	7	7	7	7
	Mean	0.157863	0.008150	0.016800	0.003987	0.0540	0.0058	0.0047	0.0020
	Std. Deviation	0.204771	0.0014639	0.0029857	0.0030126	0.04210	0.00222	0.00316	0.00141
ANOVA		**0.214**	**0.081**	**0.280**	**0.733**	**0.001**	**0.105**	**0.123**	**0.235**

4.1.3.1. Effect on fresh weight of shoots (WSF):

The effect of different concentration of seawater on fresh weight of Lebbeck shoots treated with boiled water was insignificant p-values (0.214) in the first treatment but was significant in the second treatment (0.00) respectively. Post hock multiple comparisons (LSD) test showed theses significance related to the differences in means between (0% and 1%), (0%and 2%) but not (2% and 1%) in second treatments as shown in table (4-10).

Table (4-10): Effect on shoots fresh weight of Lebbeck seeds treated with boiled water.

Concentrations		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	0.0207000	0.0643739	0.751	0.07650*	0.02323	0.003
	2%	-0.0882125-	0.0621911	0.171	0.10829*	0.02474	0.000
1%	0%	-0.0207000-	0.0643739	0.751	-0.07650-*	0.02323	0.003
	2%	-0.1089125-	0.0643739	0.106	0.03179	0.02409	0.201
2%	0%	0.0882125	0.0621911	0.171	-0.10829-*	0.02474	0.000
	1%	0.1089125	0.0643739	0.106	-0.03179-	0.02409	0.201

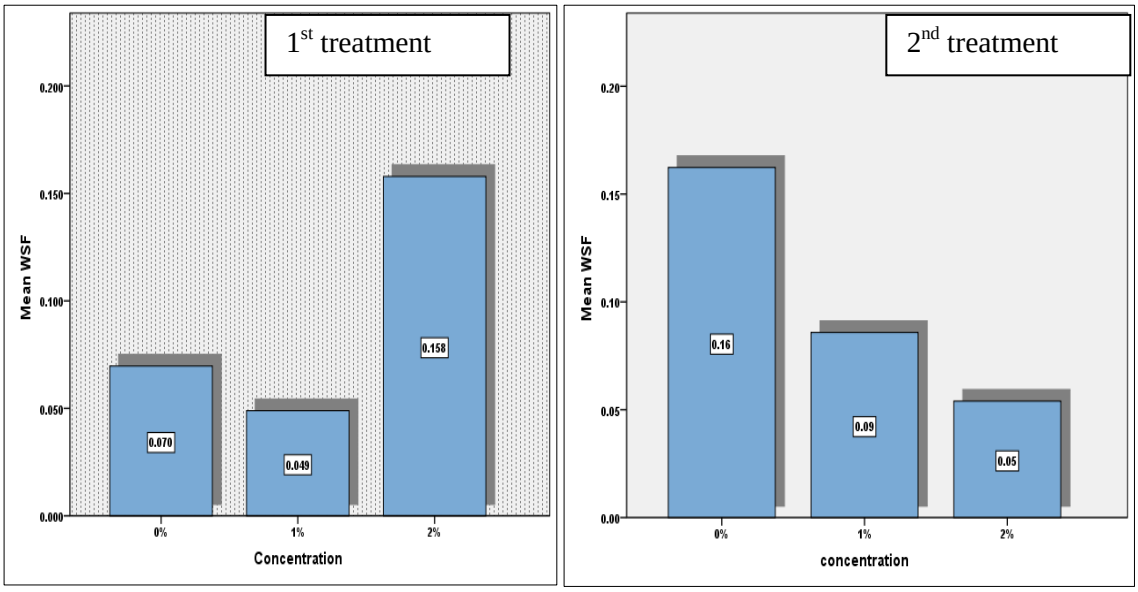

Fig. (4-8): Effect on shoots fresh weight of Lebbeck seeds treated with boiled water.

4.1.3.2. Effect on dry weight of shoots (WSD):

The effect of different concentration of seawater on shoots dry weight of Lebbeck seeds treated with boiled water was insignificant p-values (0.081 and 0.105) respectively post hock multiple comparison was ignored.

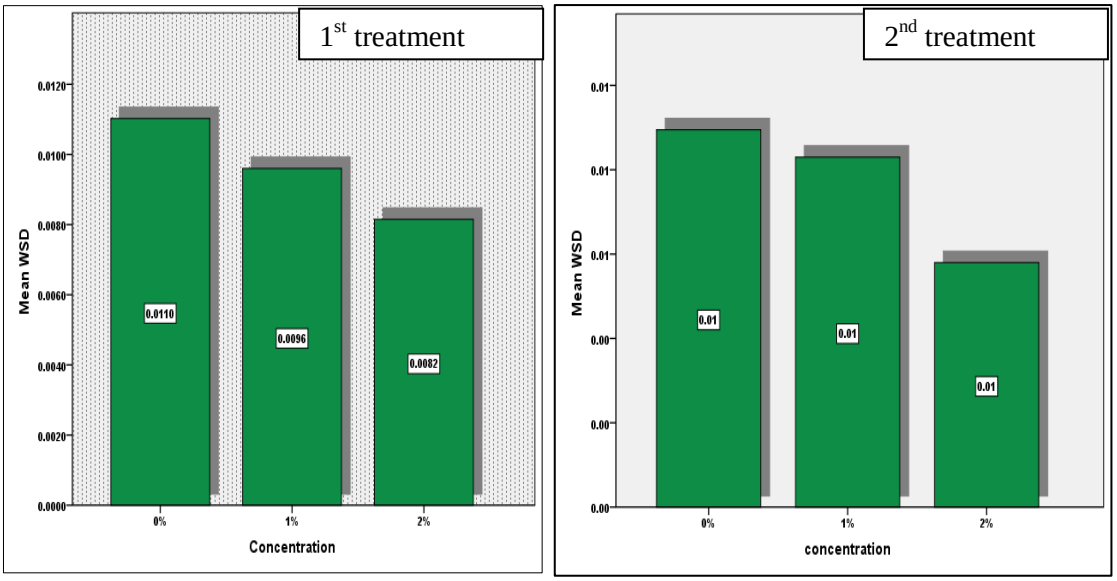

Fig. (4-9): Effect on shoots dry weight of Lebbeck seeds treated with boiled water.

4.1.3.3. Effect on fresh weight of root (WRF):

The effect of different concentration of seawater on fresh weight of Lebbeck roots treated with boiled water was insignificant p-values (0.280 and 0.123) respectively post hock multiple comparison was ignored.

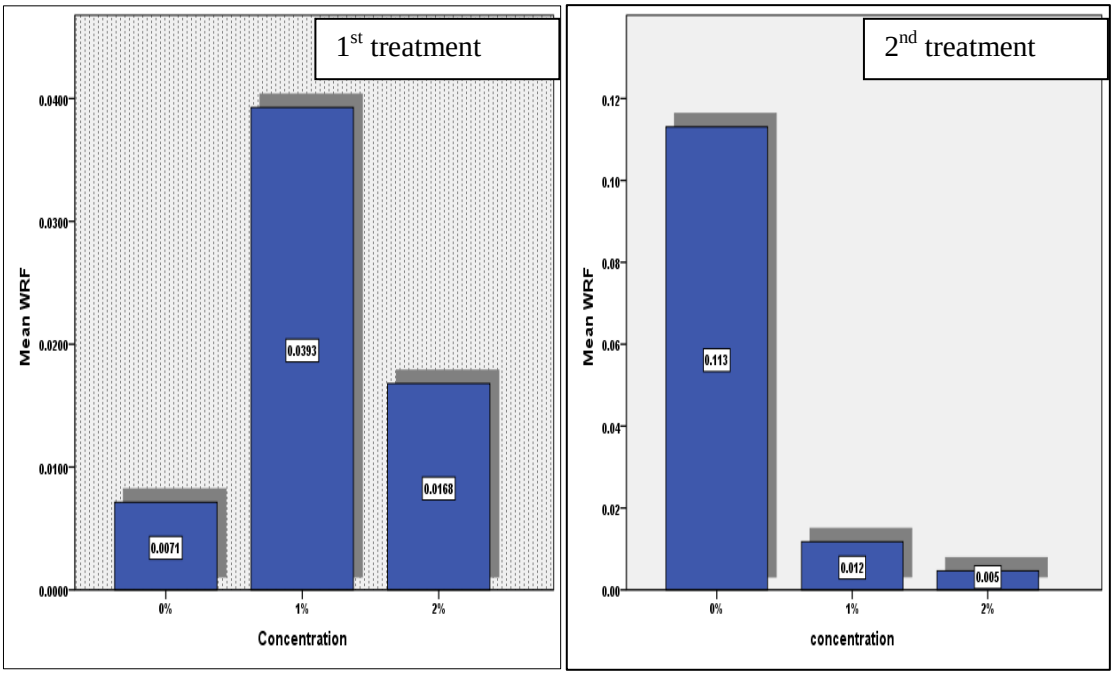

Fig. (4-10): Effect on shoots dry weight of Lebbeck seeds treated with boiled water.

4.1.3.4. Effect on dry weight of root (WRD):

The effect of different concentration of seawater on dry weight of Lebbeck roots treated with boiled water was insignificant p-values (0.733 and 0.235) respectively post hock multiple comparison was ignored.

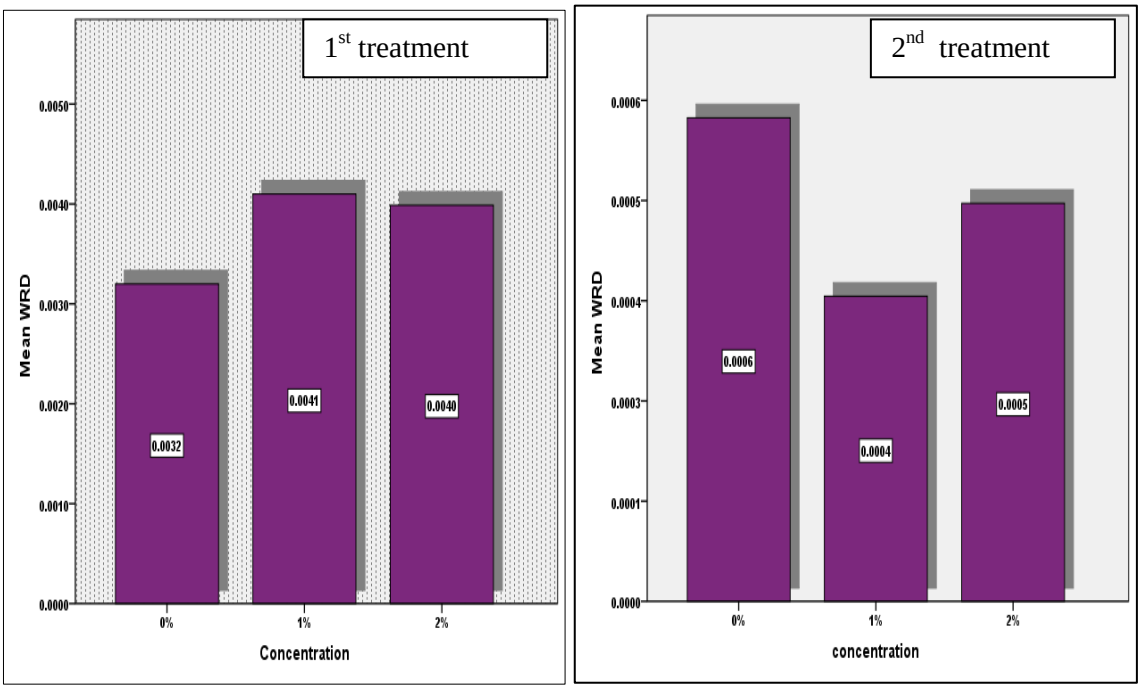

Fig. (4-11): Effect on roots dry weight of Lebbeck seeds treated with boiled water.

4.2. Results of Lebbeck Seeds treated with hot tap water:

4.2.1. Germination experiment:

4.2.1.1. Estimation of mean germination time (MGT):

Mean germination time was seen to be decreased at all concentration of seawater but this decrease was significant at higher concentrations of seawater resulting in delay in germination of Lebbeck seeds treated with hot tap water in both treatments. The delay in germination of seeds is shown in the table (4-11).

Table (4-11): Mean germination time of Lebbeck seeds treated with hot tap water.

Seawater %	MGT 1st treatment	MGT 2nd treatment
0%	8.7	7.3
1%	9.3	8.56
2%	8.3	8.5
5%	10	-
10%	-	-
20%	-	-

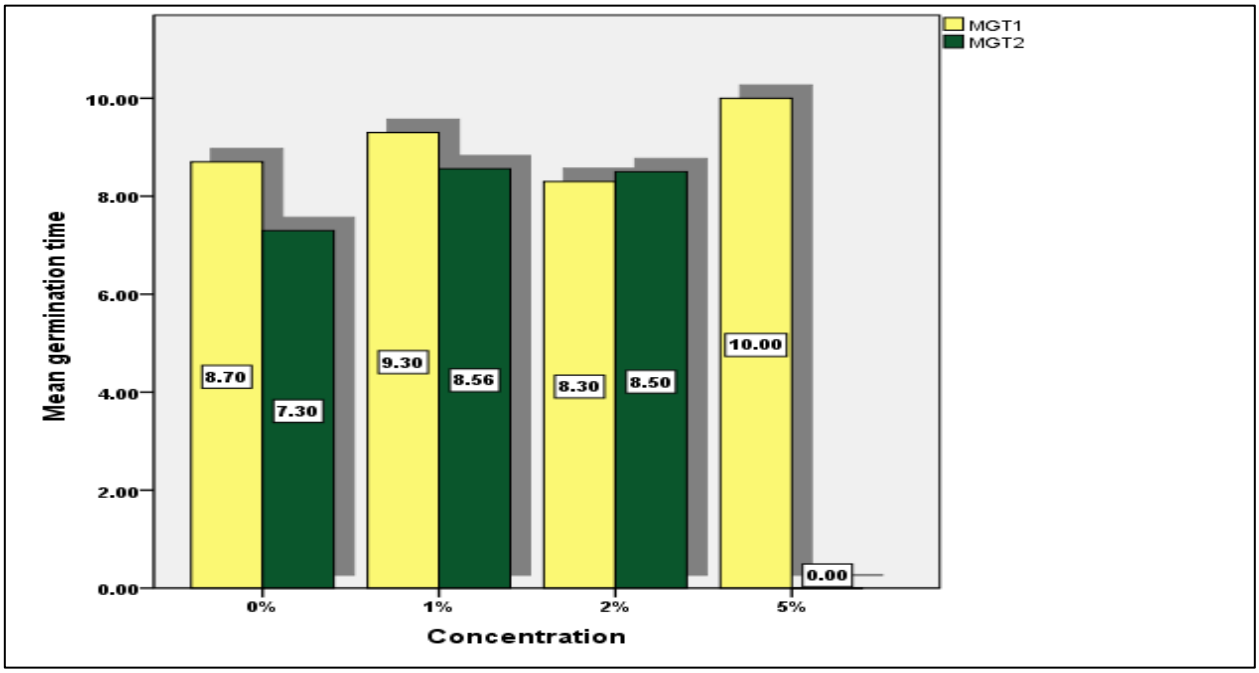

Fig. (4-12) Effect of seawater on MGT of Lebbeck plant treated with hot tap water.

4.2.1.2. Estimation of mean germination percentage (G%):

Final seed germination of Lebbeck treated with hot tap water showed significant decrease at all concentrations of seawater and control the maximum number of germinated seeds were 50 seeds from total 10 seeds, no growth had been recorded at high concentration of sea water in both treatments as shown in the table (4-12).

Table (4-12): Germination percentage at different seawater concentrations for Lebbeck seeds treated with hot tap water.

Concentration %	G% 1st treatment		G% 2nd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation
0%	42.1429	15.28125	26.4286	9.28783
1%	40.7143	18.59044	12.6923	13.93667
2%	25.0000	10.91928	27.6923	5.99145
5%	6.4286	4.97245	-	-
10%	-	-	-	-
20%	-	-	-	-

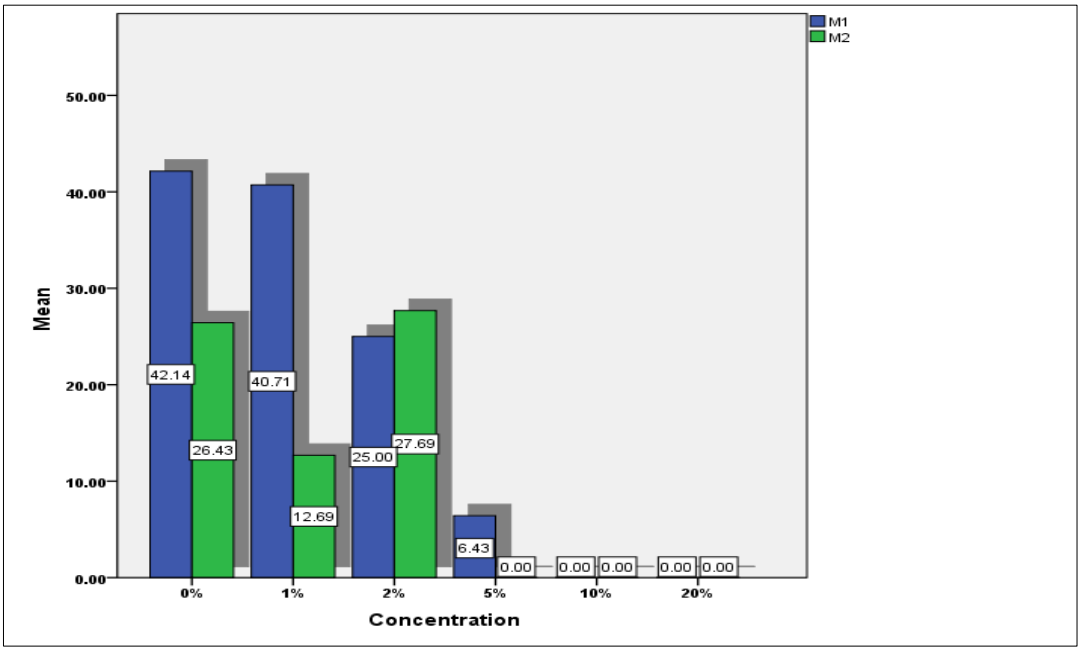

Fig. (4-13): Germination percentage at different seawater concentrations for Lebbeck seeds treated with hot tap water.

4.2.2. Seedling experiment:

4.2.2.1. Seedling vigorous index (SVI):

Seedling vigor index of Lebbeck seeds treated with hot tap water showed significant decrease in the value with increased seawater concentrations, compared with the control in both treatments. The table (4-13) shows the differences in the means of SVI.

Table (4-13): Effect of sea water on SVI in Lebbeck seeds treated with hot tap water.

Concentration %	SVI	Std. deviation	SVI	Std. deviation
0%	494.7572	102.47736	259.8810	17.59701
1%	312.6857	62.04089	74.9673	24.18858
2%	85.0000	52.50000	229.8462	20.90723
5%	-	-	-	-
10%	-	-	-	-
20%	-	-	-	-

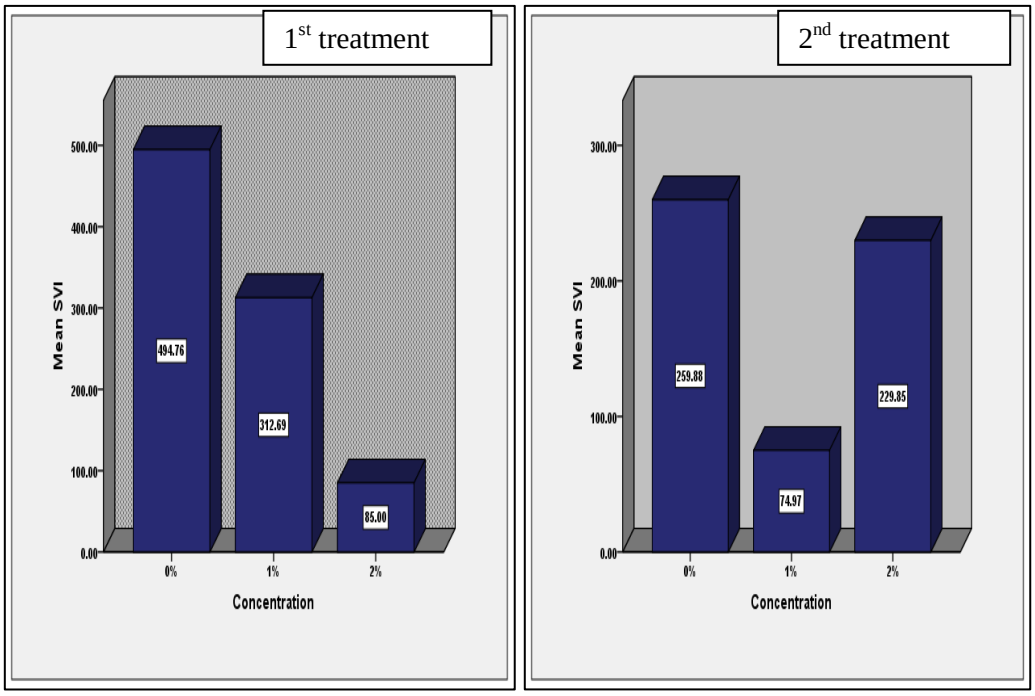

Fig. (4-14): Effect of seawater on SVI in Lebbeck seeds treated with hot tap water.

4.2.2.2. Effect of seawater on shoots and roots lengths of Lebbeck seeds treated with hot tap water:

The effect of seawater at different concentrations on fresh and dry lengths of both shoot and roots showed highly significant decrease in mean of fresh and dry shoot and shoot lengths of Lebbeck in both treatments compared with the control according to one way

Anova test except LSD in the second treatment the differences was insignificant. The table (4-14) describing the differences in mean of the lengths of dry and fresh lengths of the plant and the significances of these differences.

Table (4-14): The effect on shoots and roots lengths of Lebbeck seeds treated with hot tap water.

Concentration		1st treatment				2nd treatment			
		LSF	LSD	LRF	LRD	LSF	LSD	LRF	LRD
0%	N	5	5	5	5	3	3	3	3
	Mean	7.1000	6.0800	4.6400	3.4000	6.8333	6.0333	3.0	2.5333
	Std. Deviation	1.52315	1.46356	1.10589	0.74162	0.30551	0.35119	0.5	0.45092
1%	N	5	5	5	5	5	3	3	3
	Mean	5.7000	4.9400	1.9800	1.0400	4.4200	3.9000	2.04	1.6400
	Std. Deviation	1.26886	1.30115	0.46583	0.08944	2.00175	1.90263	0.2881	0.31305
2%	N	3	3	3	3	3	3	3	3
	Mean	2.3333	1.9667	1.0667	0.8000	6.3667	5.9000	1.9333	1.5333
	Std. Deviation	1.89297	1.77858	0.20817	0.26458	0.65064	0.85440	0.11547	0.20817
ANOVA		**0.005**	**0.011**	**0.000**	**0.000**	**0.100**	**0.114**	**0.006**	**0.010**

4.2.2.3. The effect on shoot fresh length (LSF):

The effect of different concentration of seawater on fresh length of Lebbeck shoots treated with hot tap water was significant p-values (0.005) in the first treatment but insignificant in the second one. Post hock multiple comparisons (LSD) test showed that, the significance in the first treatment was related to the differences in means between (0% and 2%), (2% and 1%) concentrations as shown in table (4-15).

Table (4-15): The effect on fresh shoots lengths of Lebbeck seeds treated with hot tap water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	1.40000	0.95680	0.174	2.41333	1.06650	0.053
	2%	4.76667*	1.10482	0.002	0.46667	1.19238	0.706
1%	0%	-1.40000-	0.95680	0.174	-2.41333-	1.06650	0.053
	2%	3.36667*	1.10482	0.012	-1.94667-	1.06650	0.105
2%	0%	-4.76667-*	1.10482	0.002	-0.46667-	1.19238	0.706
	1%	-3.36667-*	1.10482	0.012	1.94667	1.06650	0.105

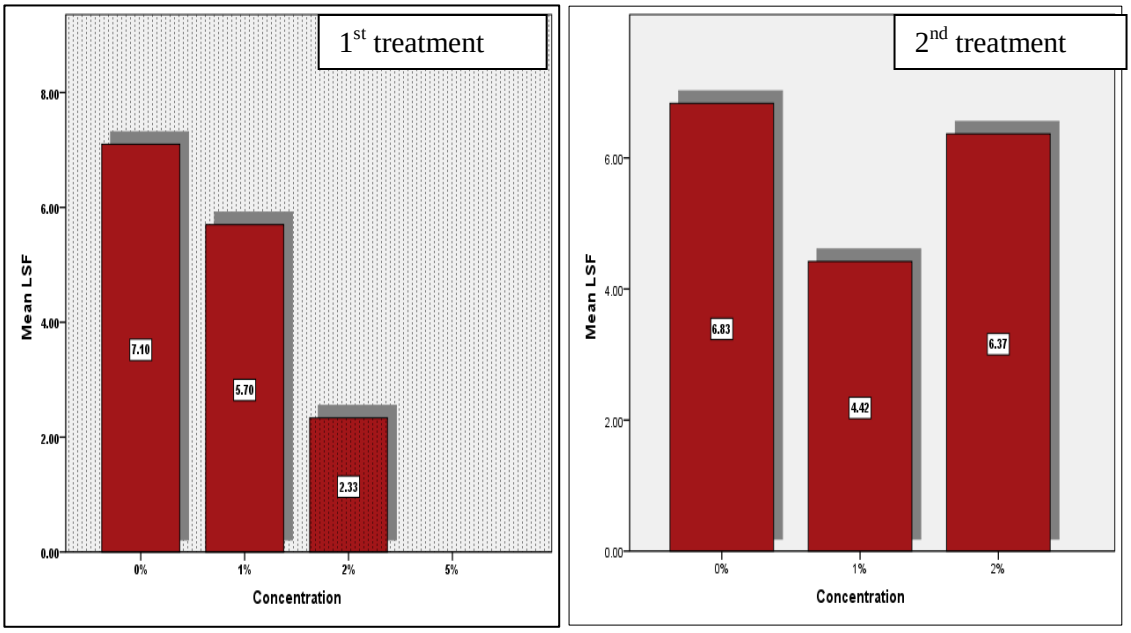

Fig. (4-15): The effect on fresh shoots lengths of Lebbeck seeds treated with hot tap water.

4.2.2.4. The effect on shoot dry length (LSD):

The effect of different concentration of seawater on dry length of Lebbeck shoots treated with hot tap water was significant p-values (0.011) in the first treatment but insignificant in the second one. Post hock multiple comparisons (LSD) test showed that, the significance in the first treatment was related to the differences in means between (0% and 2%), (2% and 1%) concentrations as shown in table (4-16).

Table (4-16): The effect on dry shoots lengths of Lebbeck seeds treated with hot tap water

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	1.14000	0.93095	0.249	2.13333	1.03880	0.074
	2%	4.11333*	1.07497	0.003	0.13333	1.16142	0.911
1%	0%	-1.14000-	0.93095	0.249	-2.13333-	1.03880	0.074
	2%	2.97333*	1.07497	0.020	-2.00000-	1.03880	0.090
2%	0%	-4.11333-*	1.07497	0.003	-0.13333-	1.16142	0.911
	1%	-2.97333-*	1.07497	0.020	2.00000	1.03880	0.090

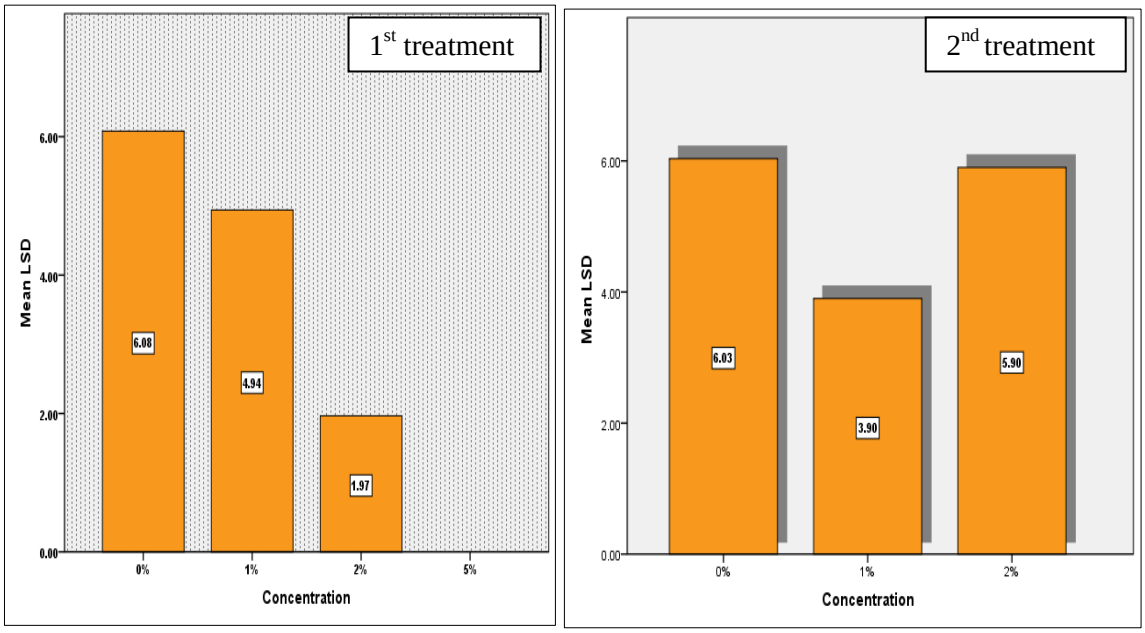

Fig. (4-16): The effect on dry shoots lengths of Lebbeck seeds treated with hot tap water.

4.2.2.5. The effect on root fresh length (LRF):

The effect of different concentration of seawater on fresh length of Lebbeck roots treated with hot tap water was significant p-values (0.00, 0.006) in both treatments. Post hock multiple comparisons (LSD) test showed that, the statistical significance was related to the differences in means between (0% and %), (0% and 2%) concentrations in both treatment as shown in table (4-17).

Table (4-17): The effect on fresh root lengths of Lebbeck seeds treated with hot tap water

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	2.66000*	0.48360	0.000	0.96000*	0.23926	0.004
	2%	3.57333*	0.55841	0.000	1.06667*	0.26750	0.004
1%	0%	-2.66000-*	0.48360	0.000	-0.96000-*	0.23926	0.004
	2%	0.91333	0.55841	0.133	0.10667	0.23926	0.668
2%	0%	-3.57333-*	0.55841	0.000	-1.06667-*	0.26750	0.004
	1%	-.091333-	0.55841	0.133	-0.10667-	0.23926	0.668

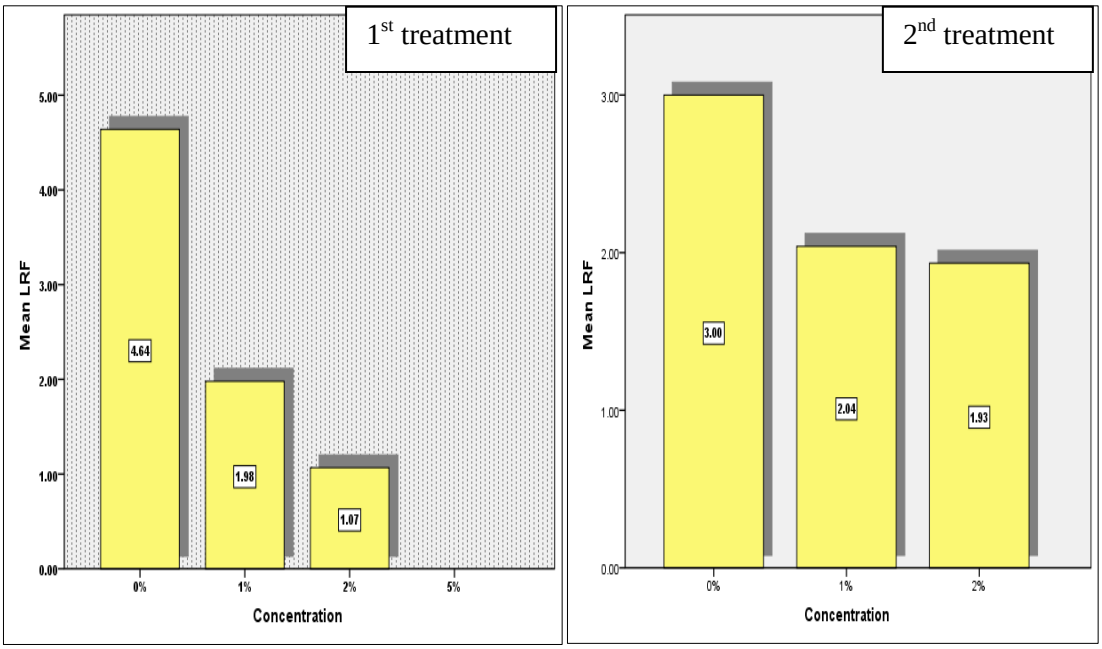

Fig. (4-17): The effect on fresh root lengths of Lebbeck seeds treated with hot tap water.

4.2.2.6. The effect on root dry length (LRD):

The effect of different concentration of seawater on dry length of Lebbeck roots treated with hot tap water was significant p-values (0.00, 0.001) in both treatments. Post hock

multiple comparisons (LSD) test showed that, the statistical significance was related to the differences in means between (0% and %), (0 % and 2%) concentrations in both treatment as shown in table (4-18).

Table (4-18): The effect on dry root lengths of Lebbeck seeds treated with hot tap water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	2.360*	0.30803	0.000	0.89333*	0.24294	0.006
	2%	2.60*	0.35568	0.000	1.00000*	0.27162	0.006
1%	0%	-2.360-*	0.30803	0.000	-0.89333-*	0.24294	0.006
	2%	0.240	0.35568	0.515	0.10667	0.24294	0.672
2%	0%	-2.60*	0.35568	0.000	-1.00000-*	0.27162	0.006
	1%	-.0240-	0.35568	0.515	-0.10667-	0.24294	0.672

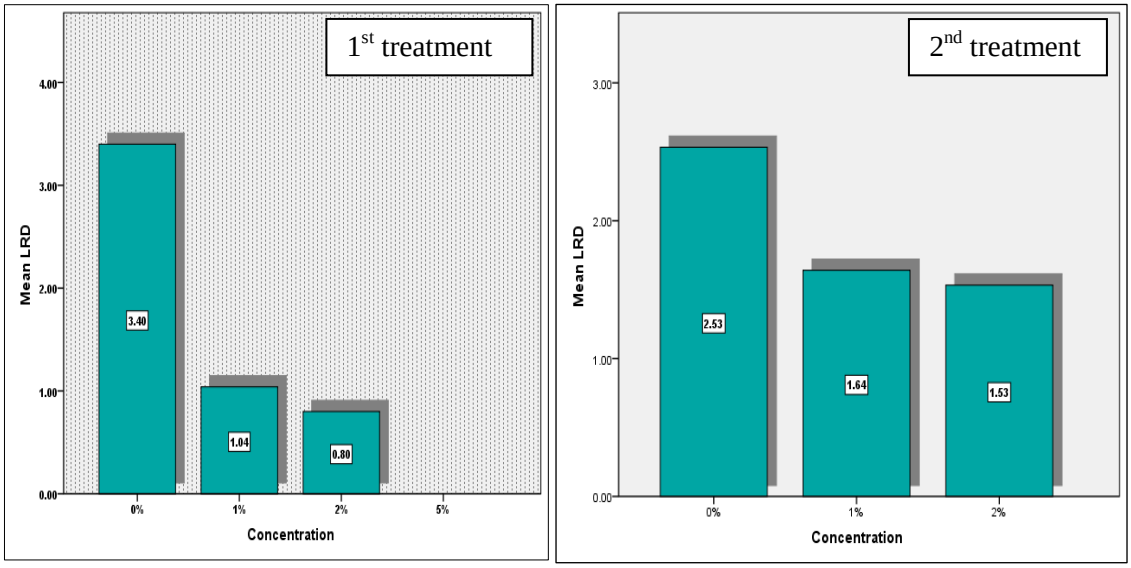

Fig. (4-18): The effect on dry root lengths of Lebbeck seeds treated with hot tap water.

4.2.3. Effect of seawater concentrations on roots and shoot weights

The dry and fresh weights of root and shoot of Lebbeck plant showed different responses to different concentration of seawater both treatments compared with the control according to one way Anova, the effect on fresh weight of roots in the first treatment and

the effect on fresh and dry weights of roots were significant. The table (4-19) describing the differences in mean of the lengths of dry and fresh weights of the plant and the significances of these differences.

Table (4-19): The effect on shoots and roots weights of Lebbeck seeds treated with hot tap water.

Concentration		1st treatment				2nd treatment			
		WSF	WSD	WRF	WRD	WSF	WSD	WRF	WRD
0%	N	5	5	5	5	3	3	3	3
	Mean	0.1588	0.0099	0.0436	0.0065	0.1261	0.0753	0.0283	0.0026
	Std. Deviation	0.02594	0.00204	0.00403	0.00962	0.02210	0.0202	0.00550	0.00139
1%	N	5	5	5	5	5	5	5	5
	Mean	0.1282	0.0151	0.0238	0.0047	0.0750	0.0284	0.0087	0.0045
	Std. Deviation	0.01843	0.00668	0.03025	0.00837	0.04261	0.0323	0.00533	0.00272
2%	N	3	3	3	3	3	3	3	3
	Mean	0.0647	0.0062	0.0100	0.0008	0.1320	.0454	0.0181	0.0058
	Std. Deviation	0.003443	0.00231	0.00265	0.00026	0.01495	.02307	0.00130	0.00231
ANOVA		**0.002**	**0.057**	**0.093**	**0.641**	**0.100**	**0.114**	**0.006**	**0.010**

4.2.3.1. The effect on fresh weight of shoots (WSF):

The effect of different concentration of seawater on fresh weight of Lebbeck shoots treated with hot tap water was significant p-values (0.002) in the first treatment but was insignificant in the second treatment (0.100). Post hock multiple comparisons (LSD) test showed theses significance related to the differences in means between (0%a nd 2%), (2% and 1%) in first treatments as shown in table (4-20).

Table (4-20): The effect on fresh shoot weigh of Lebbeck seeds treated with hot tap water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	0.03060	0.01603	0.085	0.05110	0.02406	0.066
	2%	0.09413*	0.01850	0.000	-0.00587-	0.02690	0.833
1%	0%	-0.03060-	0.01603	0.085	-0.05110-	0.02406	0.066
	2%	0.06353*	0.01850	0.006	-0.05697-*	0.02406	0.045
2%	0%	-0.09413-*	0.01850	0.000	0.00587	0.02690	0.833
	1%	-0.06353-*	0.01850	0.006	0.05697*	0.02406	0.045

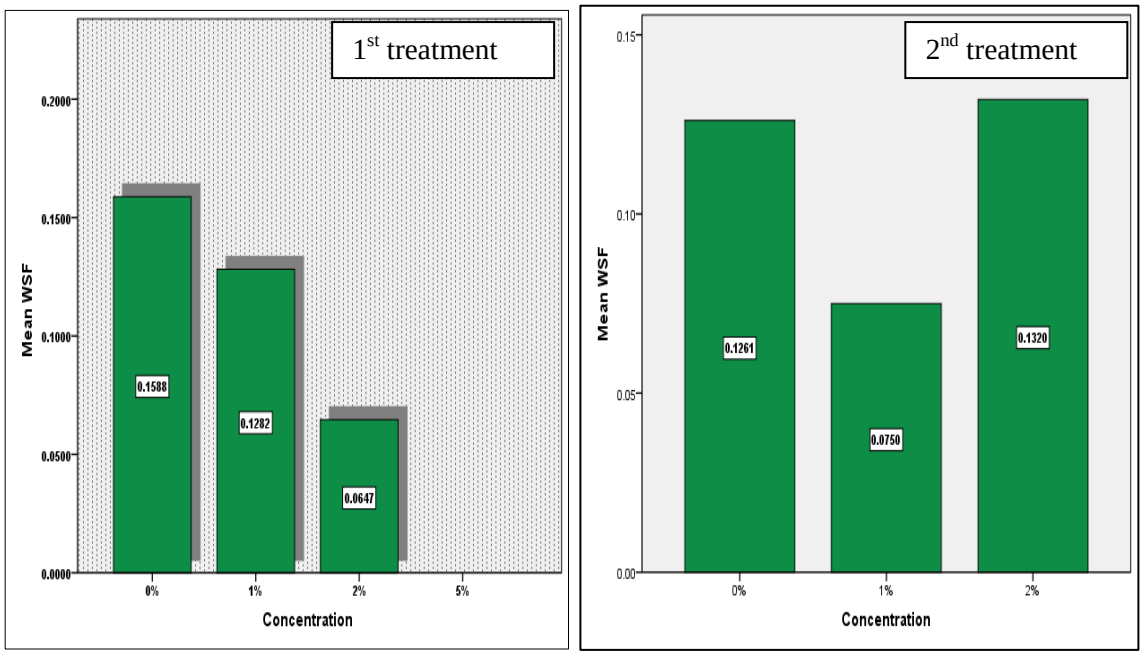

Fig. (4-19): The effect on fresh shoot weigh of Lebbeck seeds treated with hot tap water.

4.2.3.2. The effect on dry weight of shoots (WSD):

The effect of different concentration of seawater on dry weight of Lebbeck shoots treated with hot tap water was insignificant in the both treatments. Post hock multiple comparisons (LSD) test was ignored.

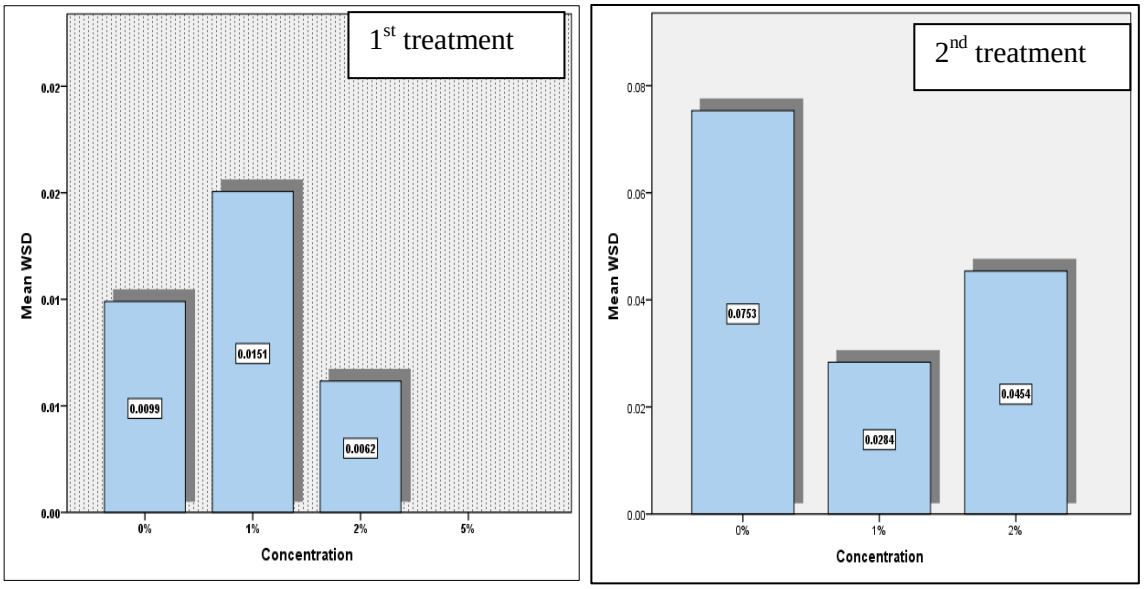

Fig. (4-20): The effect on dry shoot weigh of Lebbeck seeds treated with hot tap water.

4.2.3.3. The effect on fresh weight of roots (WRS):

The effect of different concentration of seawater on dry weight of Lebbeck shoots treated with hot tap water was insignificant in the first treatment, but it was significant in the second treatment p-value (0.006). Post hock multiple comparisons (LSD) for the second treatment showed that these differences in the mean of root weights were related to all concentrations (0% and 1%), (0% and 2%), (1% and 2%). The table (4-21) shows these significant differences.

Table (4-21): The effect on fresh root weigh of Lebbeck seeds treated with hot tap water.

Concentration		G% 1st treatment			G% 2nd treatment		
		Mean Difference	Std. Error	Sig.	Mean Difference	Std. Error	Sig.
0%	1%	0.01982	0.01223	0.136	0.01957*	0.00344	0.000
	2%	0.03362*	0.01412	0.039	0.01020*	0.00385	0.029
1%	0%	-0.01982-	0.01223	0.136	-0.01957-*	0.00344	0.000
	2%	0.01380	0.01412	0.352	-0.00937-*	0.00344	0.026
2%	0%	-0.03362-*	0.01412	0.039	-0.01020-*	0.00385	0.029
	1%	-0.01380-	0.01412	0.352	0.00937*	0.00344	0.026

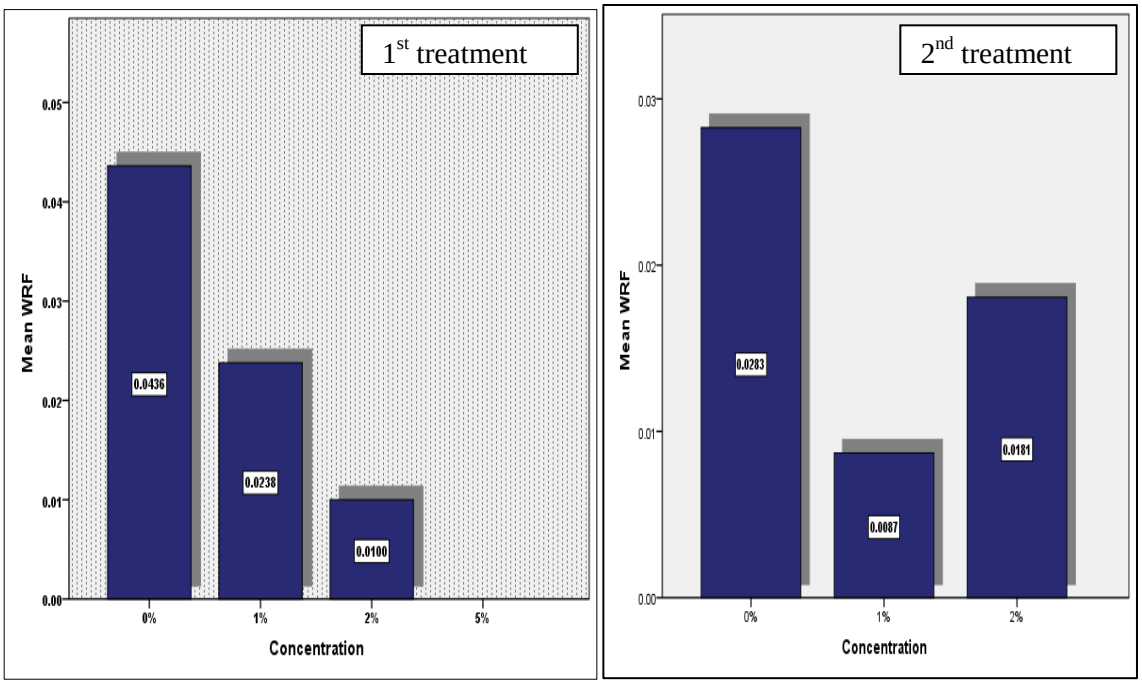

Fig. (4-21): The effect on fresh root weigh of Lebbeck seeds treated with hot tap water.

4.2.3.4. The effect on dry weight of roots (WRS):

The effect of different concentration of seawater on dry weight of Lebbeck shoots treated with hot tap water was insignificant in both treatments; Post hock multiple comparisons (LSD) test was ignored**.**

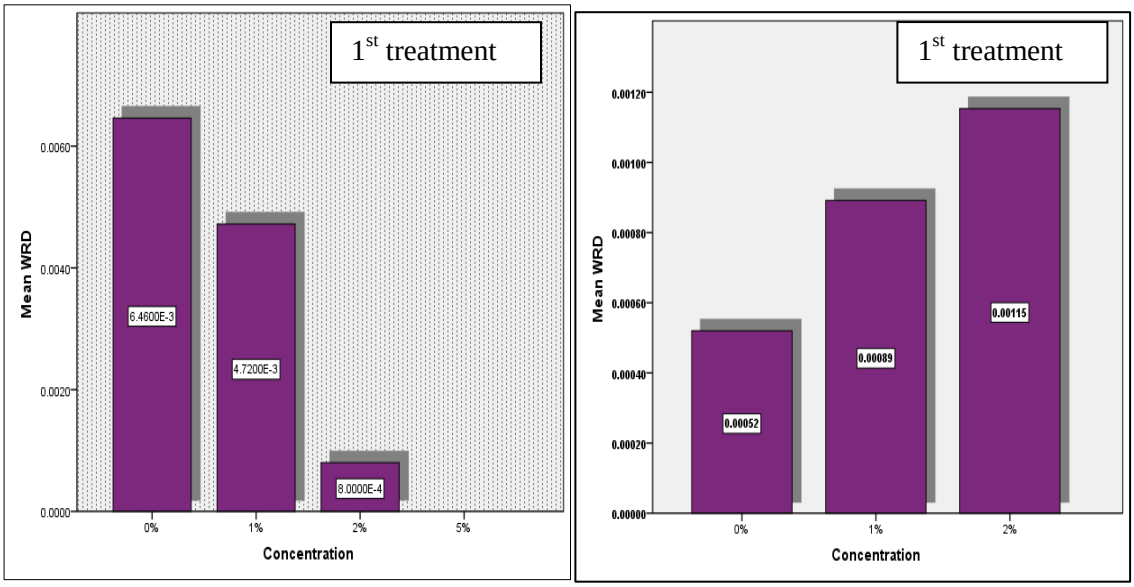

Fig. (4-22): The effect on dry root weigh of Lebbeck seeds treated with hot tap water.

4.3. Results of Lebbeck Seeds treated with mechanical scarification

4.3.1. Germination experiment

4.3.1.1. Estimation of mean germination time (MGT):

The mean germination time was significantly increased at all concentrations at which germination occurred, no germination occurred at higher concentration, a delay in germination process was noticed at all concentrations and control, table (4-22) showed the mean germination time in the 2 treatments.

Table (4-22): Mean germination time for Lebbeck seeds treated with mechanical scarification

Seawater %	MGT 1st treatment	MGT 2nd treatment
0%	8.46	9.09
1%	9.09	8.74
2%	9.9	-
5%	10.23	10.6
10%	-	-
20%	-	-

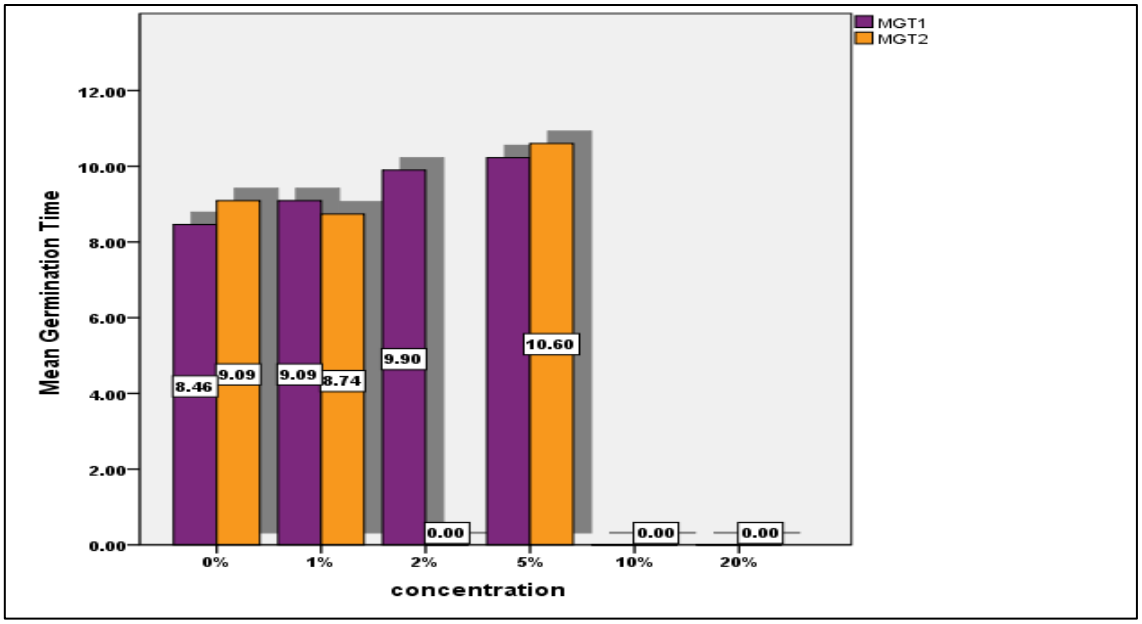

Fig. (4-23): Mean germination time for Lebbeck seeds treated with mechanical scarification

4.3.1.2. Estimation of mean germination percentage (G%):

Final seed germination of Lebbeck treated with mechanical scarification method showed significant decrease at all concentrations of seawater and control the maximum number of germinated seeds were 3 seeds from total 10 seeds; no growth had been recorded at high concentration of sea water in both treatments as shown in the table (4-23).

Table (4-23): Germination percentage of Lebbeck seeds treated with mechanical scarification.

Concentration %	G% 1st treatment		G% 2nd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation
0%	17.1429	6.11250	22.8571	11.38729
1%	22.1429	12.51373	16.4286	7.44946
2%	12.8571	9.13874	0.0000	0.00000
5%	12.1429	9.74961	1.0714	.91687
10%	-	-	-	-
20%	-	-	-	-

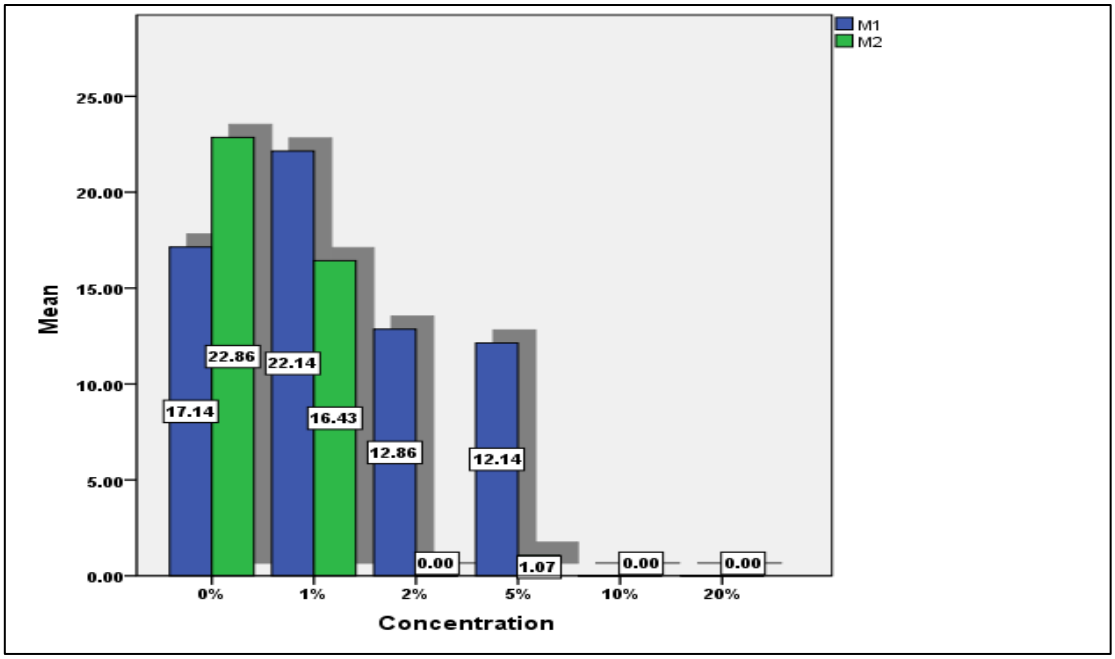

Fig. (4-24): Germination percentage of Lebbeck seeds treated with mechanical scarification method.

4.3.2. Seedling experiment:

4.3.3. Seedling vigorous index(SVI):

Seedling vigor index of Lebbeck seeds treated with mechanical scarification showed significant decrease in the value with increased seawater concentrations, compared with the control in both treatments. The table (4-24) shows the differences in the means of SVI.

Table (4-24): SVI of Lebbeck seeds treated with mechanical scarification.

Concentration %	SVI	Std. deviation	SVI	Std. deviation
0%	245.1020	31.51151	273.5238	42.47576
1%	223.6429	7.98372	167.5714	25.55686
2%	199.6429	49.59849		
5%		-	-	-
10%	-	-	-	-
20%	-	-	-	-

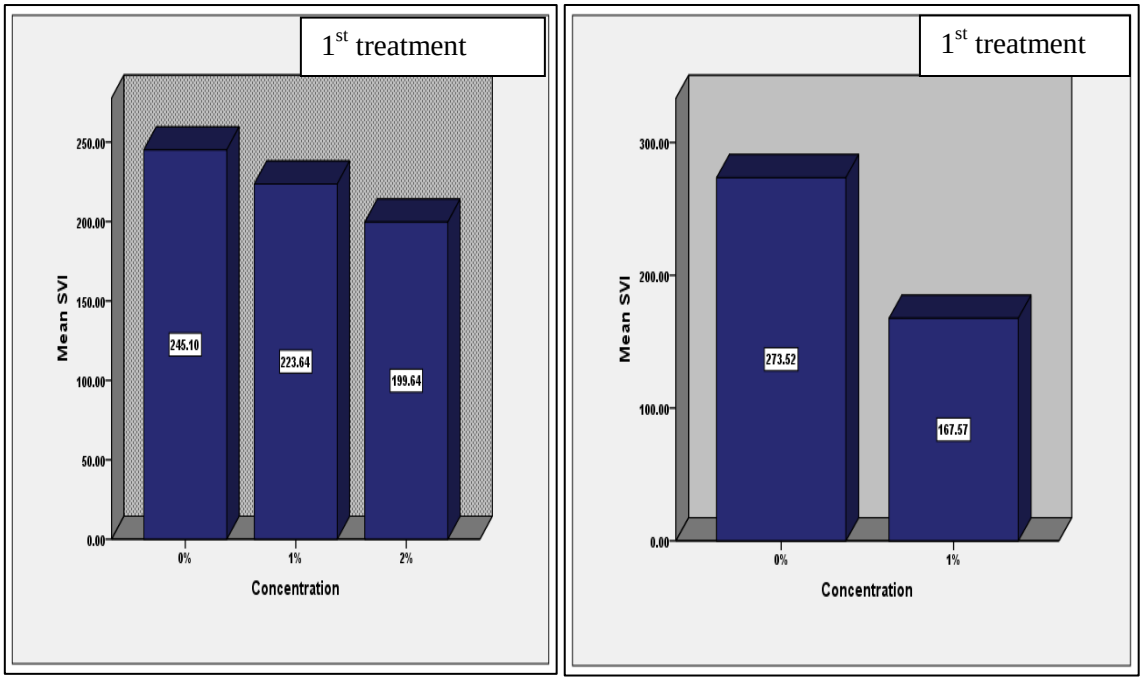

Fig. (4-25): SVI of Lebbeck seeds treated with mechanical scarification

4.3.3.1. Effect of seawater on shoots and roots lengths of Lebbeck seeds treated mechanical scarification:

The effect of seawater at different concentrations on fresh and dry lengths of both shoot and roots showed no significant change in mean of fresh and dry shoot and shoot lengths of Lebbeck in both treatments compared with the control according to one way Anova for the first treatment and independent T tests for the second treatment.

Table (4-25): Effect of seawater on shoots and roots lengths of Lebbeck seeds treated mechanical scarification.

Concentration		1st treatment				2nd treatment			
		LSF	LSD	LRF	LRD	LSF	LSD	LRF	LRD
0%	N	2	2	2	2	3	3	3	3
	Mean	8.0500	7.4500	6.2500	5.7000	6.5667	5.7333	5.4000	4.8333
	Std. deviation	1.34350	.91924	3.18198	1.34350	1.25033	1.30512	1.82483	1.70978
1%	N	3	3	3	3	2	2	2	2
	Mean	6.0000	5.4667	4.1000	3.1000	6.5000	5.4000	3.7000	3.1000
	Std. deviation	.55678	.68069	.20000	.55678	1.27279	.98995	.28284	.14142
2%	N	2	2	2	2	-	-	-	-
	Mean	7.5500	6.5500	4.1500	3.6500	-	-	-	-
	Std. deviation	2.05061	1.20208	.49497	2.05061	Independent Samples Test			
Anova		0.284	0.159	0.381	0.319	0.957	0.782	0.302	0.268

A. The effect on shoots fresh length (LSF):

The effect on shoot length was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

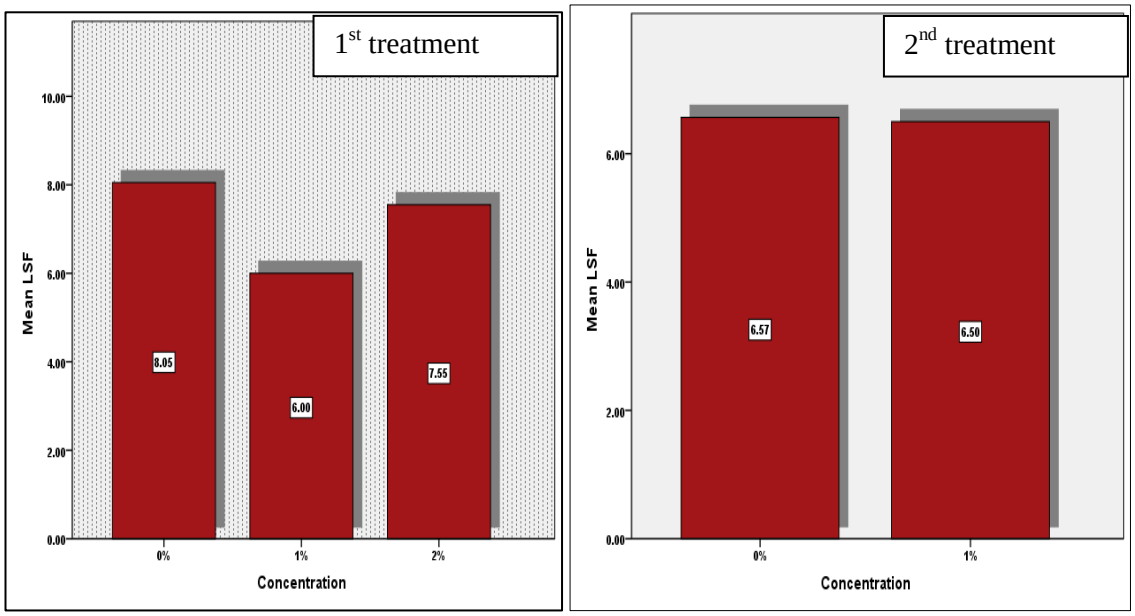

Fig. (4-26): The effect on fresh shoot length of Lebbeck seeds treated with mechanical scarification.

B. The effect on shoots dry length (LD):

The effect on dry shoot length was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

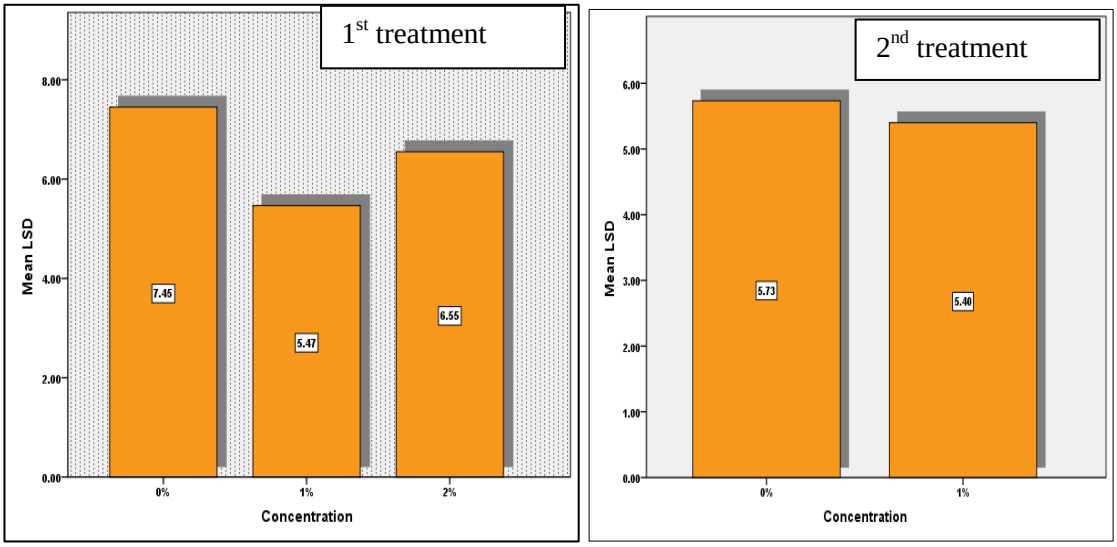

Fig. (4-27): The effect on dry shoot length of Lebbeck seeds treated with mechanical scarification method.

C. The effect on root fresh length (LRF):

The effect on fresh root length was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

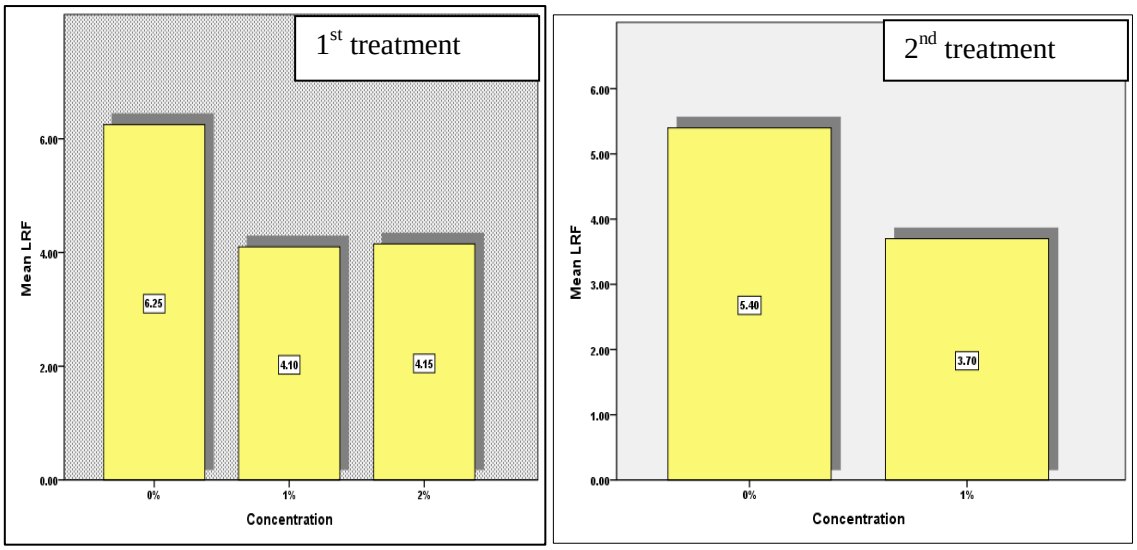

Fig. (4-28): The effect on fresh root length of Lebbeck seeds treated with mechanical scarification.

D. The effect on root dry length (LRD):

The effect on dry root length was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

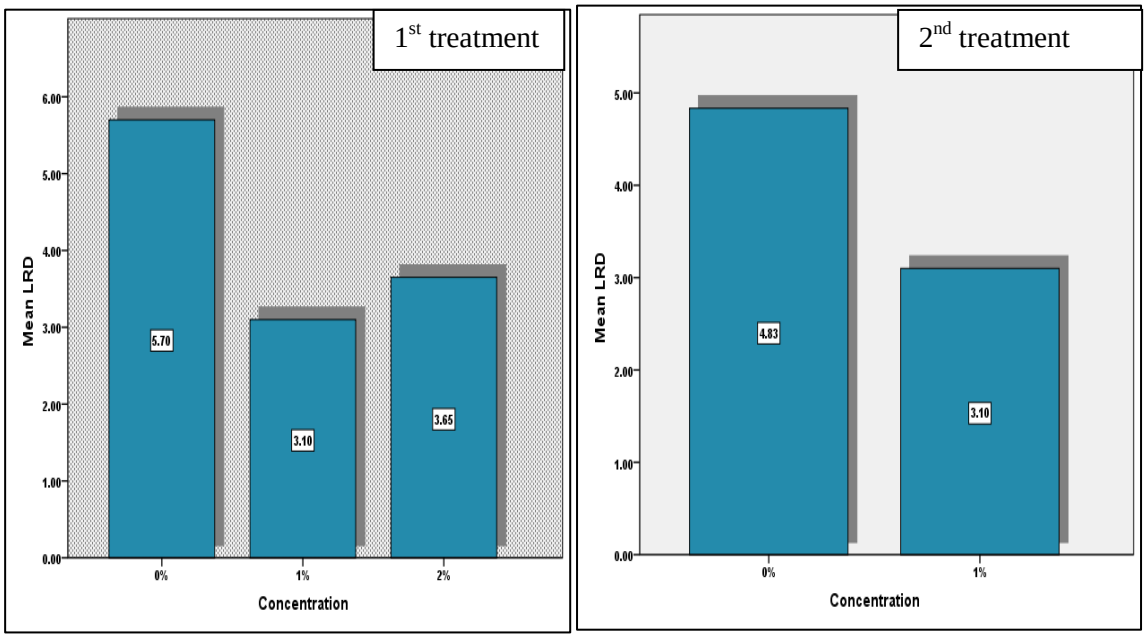

Fig. (4-29): The effect on dry root length of Lebbeck seeds treated with mechanical scarification.

4.3.3.2. Effect of seawater on shoots and roots weights of Lebbeck seeds treated mechanical scarification.

The effect of seawater at different concentrations on fresh and dry weights of both shoot and roots showed no significant change in mean of fresh and dry shoot and shoot lengths of Lebbeck in both treatments compared with the control according to one way Anova for the first treatment and independent T tests for the second treatment except for fresh shoot weight in the first treatment.

Table (4-26): Effect of seawater on shoots and roots weights of Lebbeck seeds treated mechanical scarification

Concentration		1st treatment				2nd treatment			
		WSF	WSD	WRF	WRD	WSF	WSD	WRF	WRD
0%	N	2	2	2	2	3	3	3	3
	Mean	0.1638	0.0372	0.0137	0.0038	0.1263	0.0460	0.0144	0.0039
	Std. Deviation	0.00608	0.02390	0.00113	0.00141	0.03113	0.0135	0.0024	0.00332
1%	N	3	3	3	3	2	2	2	2
	Mean	0.1345	0.0252	0.0136	0.0028	0.1455	0.0525	0.0240	0.0021
	Std. Deviation	0.00740	0.02027	0.00162	0.00044	0.03041	0.05728	0.01556	0.00021
2%	N	2	2	2	2				
	Mean	0.1677	0.0658	0.0139	0.0023				
	Std. Deviation	0.01202	0.04278	0.00078	0.00057	Independent Samples Test			
ANOVA		**0.022**	**0.381**	**0.984**	**0.285**	**0.545**	**0.851**	**0.337**	**0.509**

A. The effect on shoots fresh weight (WSF):

The effect of different concentration of seawater on fresh weight of Lebbeck shoots treated with mechanical scarification was significant p-values (0.022) in the first treatment but insignificant in the second one. Post hock multiple comparisons (LSD) test showed that, the significance in the first treatment was related to the differences in means between (0% and 1%), (2% and 1%) concentrations as shown in table (4-27).

Table (4-27): The effect on fresh shoots weight of Lebbeck seeds treated with mechanical scarification.

Concentration		G% 1st treatment		
		Mean Difference	Std. Error	Sig.
0%	1%	0.02927*	0.00778	0.020
	2%	-0.00390-	0.00853	0.671
1%	0%	-0.02927-*	0.00778	0.020
	2%	-0.03317-*	0.00778	0.013
2%	0%	0.00390	0.00853	0.671
	1%	0.03317*	0.00778	0.013

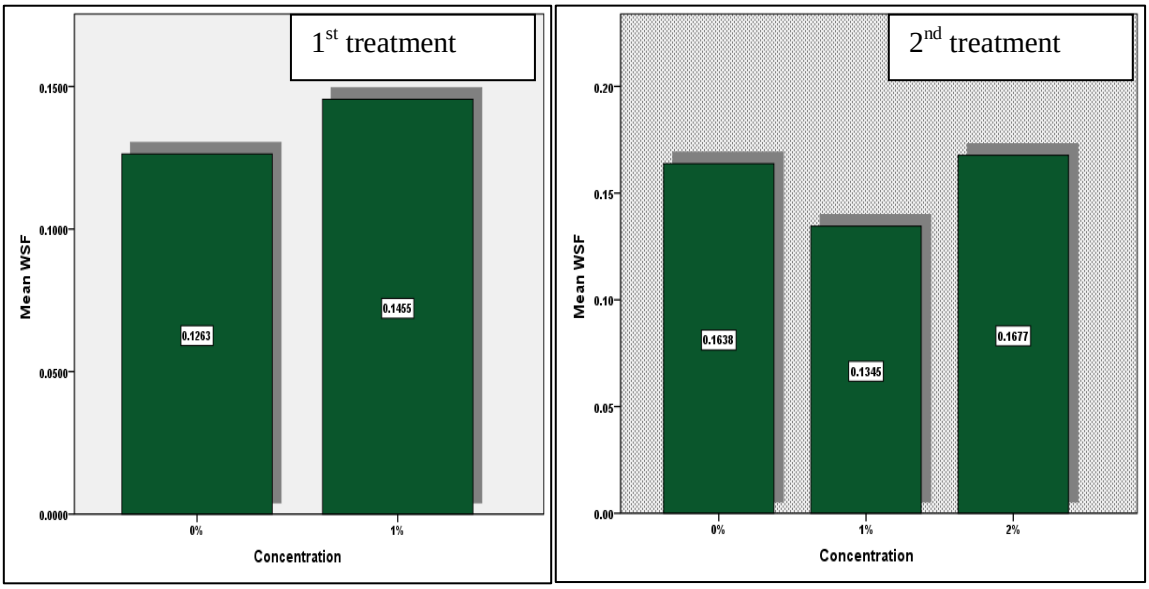

Fig.(4-30): The effect on fresh shoots weight of Lebbeck seeds treated with mechanical scarification.

B. The effect on shoots dry weight (WSD):

The effect on dry shoot weight was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

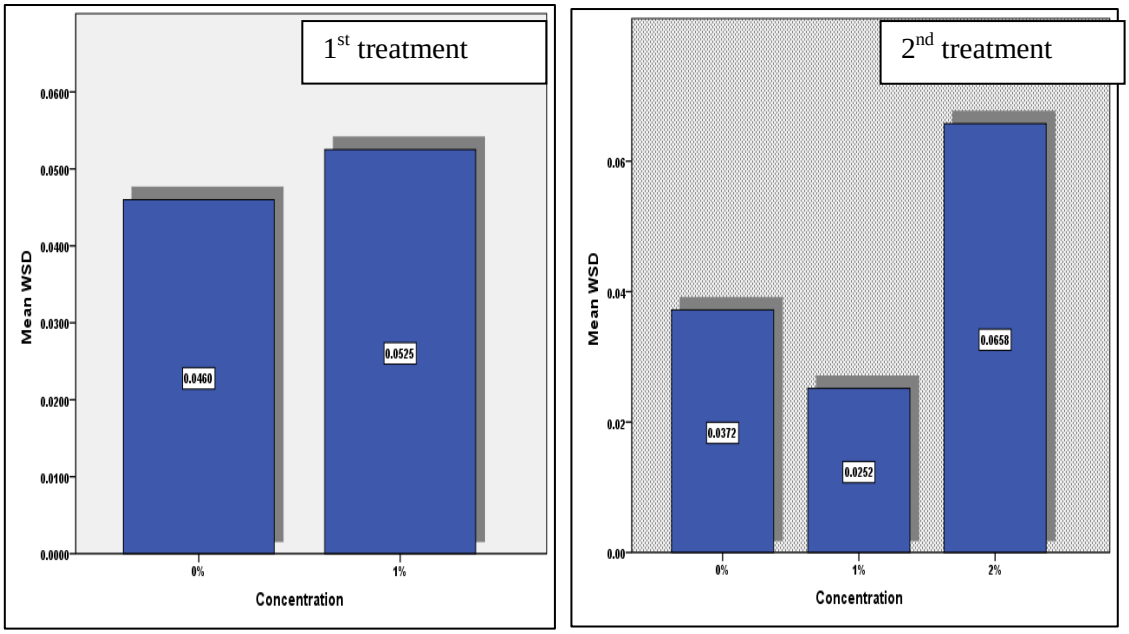

Fig.(4-31): The effect on dry shoots weight of Lebbeck seeds treated with mechanical scarification.

C. The effect on roots fresh weight (WRF):

The effect on fresh root weight was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

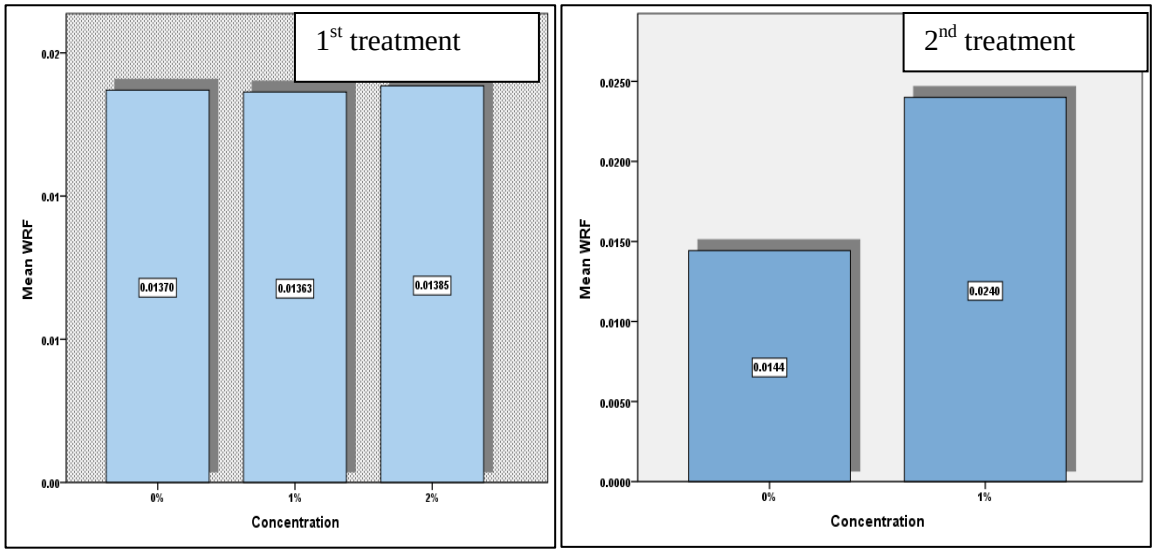

Fig. (4-32): The effect on fresh roots weight of Lebbeck seeds treated with mechanical scarification.

D. The effect on roots dry weight (WRD):

The effect on dry shoot weight was not significant in both treatments; multiple comparison post hock (LSD) test was ignored.

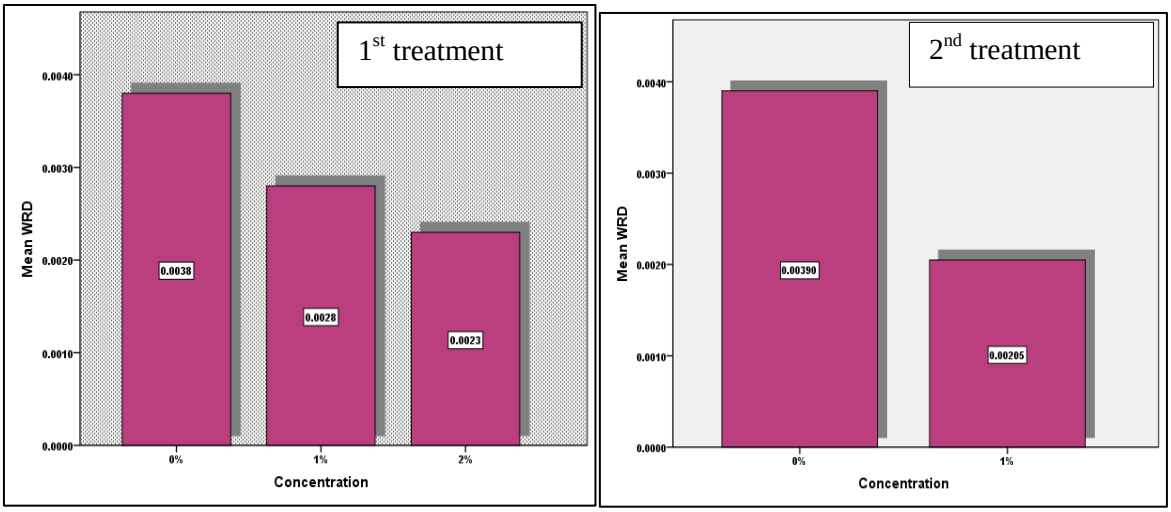

Fig. (4-33): The effect on dry root weight of Lebbeck seeds treated with mechanical scarification.

4.4. Results of Lebbeck Seeds treated with H_2SO_4:

4.4.1. Germination experiment:

4.4.1.1. Estimation of mean germination time (MGT):

All seeds showed increased mean germination time at all seawater concentration and in both treatments with sulfuric acid. The increase in concentration of sea water slows the germination of the seeds as shown in the table (4-28).

Table (4-28): Mean germination time (MGT) of Lebbeck seeds treated with H_2SO_4.

Seawater %	MGT 1st treatment	MGT 2nd treatment
0%	9.14	8.9
1%	9.94	9.15
2%	7.94	9.5
5%	9.28	9.6
10%	9.5	9.78
20%	9.14	8.9

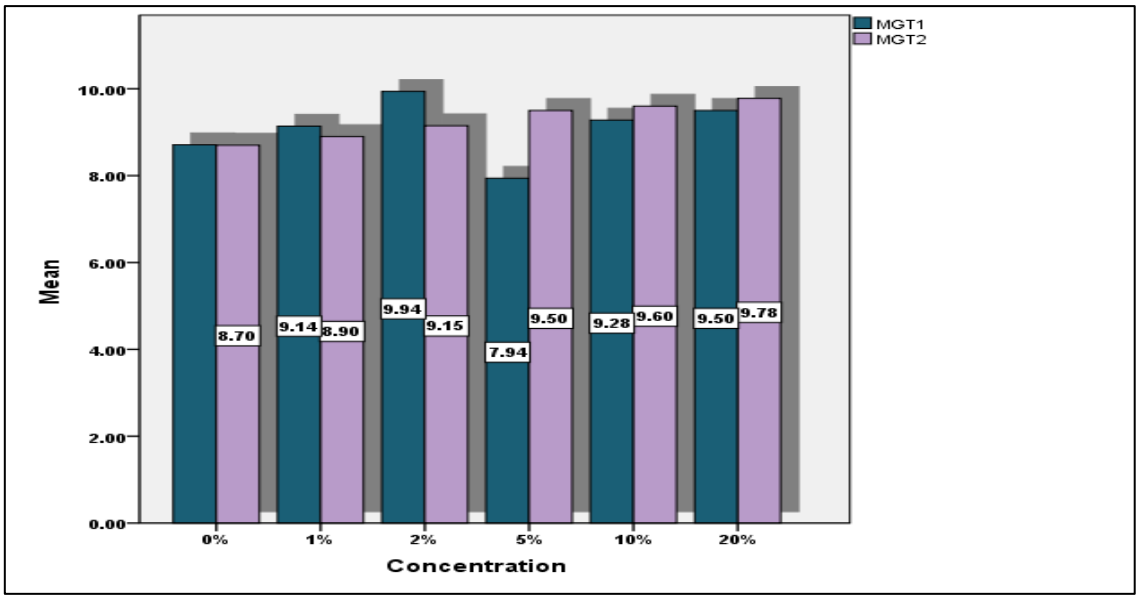

Fig. (4-34): Mean germination time (MGT) of Lebbeck seeds treated with H_2SO_4.

4.4.1.2. Estimation of germination percentage (G %):

Final seed germination of Lebbeck treated with H2SO4 showed significant decrease at all concentrations of seawater and control the maximum number of germinated seeds were 5 seeds from total 10 seeds; growth had been recorded at even high concentration of seawater in both treatments as shown in the table (4-29).

Table (4-29): Germination of Lebbeck seeds treated with H_2SO_4.

Concentration %	G% 1st treatment		G% 2nd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation
0%	24.29	9.376	32.14	11.883
1%	30	15.191	31.43	13.506
2%	12.86	9.139	22.86	12.666
5%	29.29	13.281	14.29	9.376
10%	48.57	23.812	45.71	26.52
20%	33.57	18.649	20.71	11.411

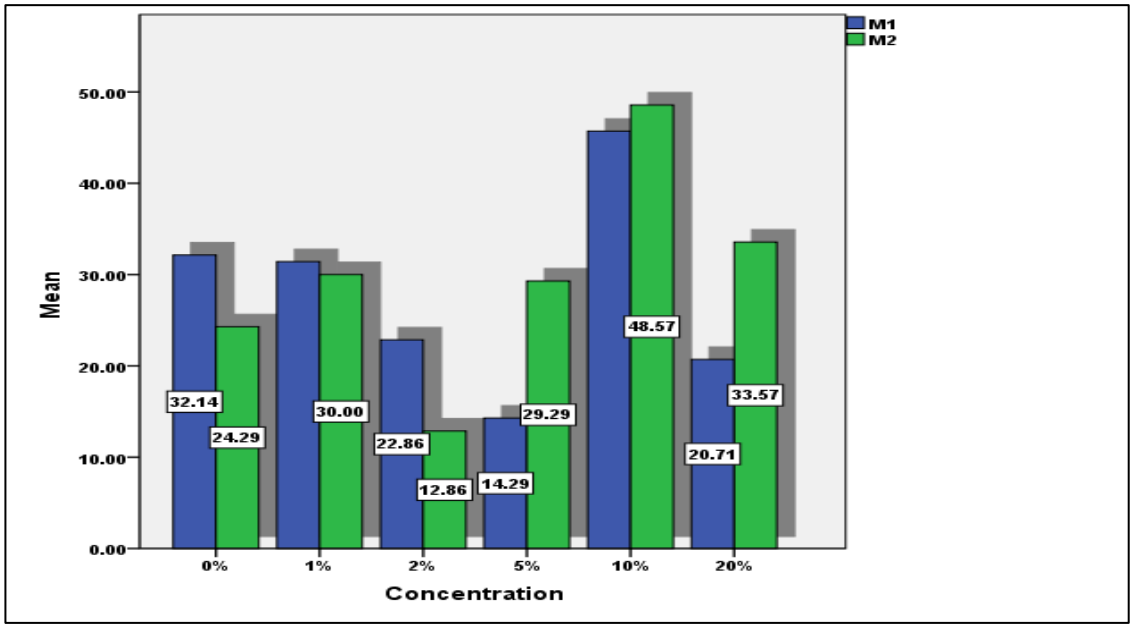

Fig. (4-35): Germination of Lebbeck seeds treated with H_2SO_4.

4.4.2. Seedling experiment:

4.4.2.1. Seedling vigorous index(SVI):

Seedling vigor index of Lebbeck seeds treated with H_2SO_4 showed variety of responses to irrigation with seawater, compared with the control in both treatments the SVI had increased at 1%, 5% and 10% in the first treatment and increased at1%, 2% and 10% in the second treatment. The table (4-30) shows the differences in the means of SVI.

Table (4-30): Effect on SVI in Lebbeck seeds treated with H_2SO_4.

Concentration %	SVI	Std. deviation	SVI	Std. deviation
0%	121.8930	80.69940	209.7321	22.17236
1%	146.2500	49.37864	220.0000	31.32363
2%	63.0000	5.45482	147.8095	22.20008
5%	164.9722	4.47336	86.4285	3.03046
10%	354.5708	53.28108	322.6123	42.62778
20%	70.4900	13.13613	91.1429	4.14286

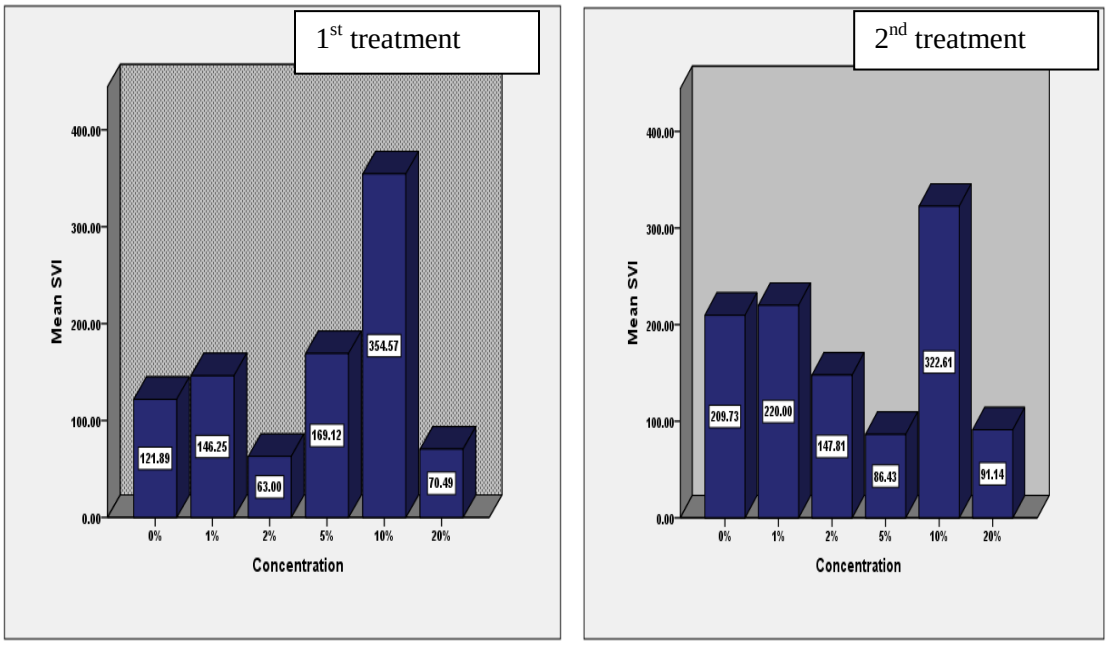

Fig. (4-36): Effect on SVI in Lebbeck seeds treated with H_2SO_4.

4.4.2.2. Effect of seawater on shoots and roots lengths of Lebbeck seeds treated H_2SO_4.

The effect of seawater on fresh and dry lengths of Lebbeck shoots and roots treated with sulfuric acid, showed variable responses according to one way anova test, the effect on shoot length (LSF, LSD) were not significant in the first treatment. Other lengths showed significant response when compared to control.

Table (4-31): Effect on shoots and roots lengths of Lebbeck seeds treated H_2SO_4.

Concentration		1st treatment				2nd treatment			
		LSF	LSD	LRF	LRD	LSF	LSD	LRF	LRD
0%	N	3	3	3	3	4	4	4	4
	Mean	3.93	5.0000	2.1333	1.4333	3.9750	3.5000	2.5500	2.1000
	Std. Deviation	0.493	2.70740	1.53080	1.44684	0.41130	.49666	.50000	.45461
1%	N	4	4	4	4	4	4	4	4
	Mean	3.175	2.6000	1.7000	1.3750	3.9500	3.3750	3.0500	2.5500
	Std. Deviation	0.9979	0.90185	1.05515	1.08743	0.77244	.73655	.53229	.53229
2%	N	2	2	2	2	3	3	3	3
	Mean	2.9000	2.3500	2.0000	1.5500	4.1000	3.6000	2.3667	1.6667
	Std. Deviation	0.283	0.35355	0.14142	.35355	0.40000	.36056	.58595	.37859
5%	N	4	4	4	4	2	2	2	2
	Mean	3.7	3.0750	2.0750	1.9500	3.4500	3.0000	2.6000	2.1000
	Std. Deviation	0.29439	0.46458	0.41932	1.12101	0.35355	.28284	.14142	.00000
10%	N	7	7	7	7	7	7	7	7
	Mean	4.0000	3.4000	3.3000	2.7429	4.2286	3.7571	2.8286	2.39
	Std. Deviation	0.59442	0.57735	.96782	1.00806	0.55592	.62944	.46803	0.49
20%	N	5	5	5	5	3	3	3	3
	Mean	3.2400	2.6600	4.1800	3.6800	2.7667	2.3667	1.6333	1.2
	Std. Deviation	0.95289	0.84439	0.62610	0.72250	.30551	.28868	.11547	0.1
ANOVA		**0.231**	**0.075**	**0.004**	**0.021**	**0.020**	**0.042**	**0.016**	**0.008**

A. The effect on shoots fresh length (LSF):

The effect on shoot length for Lebbeck seeds treated with H_2SO_4 was significant only in the second treatment according to one way anova test p-value (0.020). Multiple comparasion Post hock (appendix) revealed that these differences related to effect of 20%concentration compared to other concentrations.

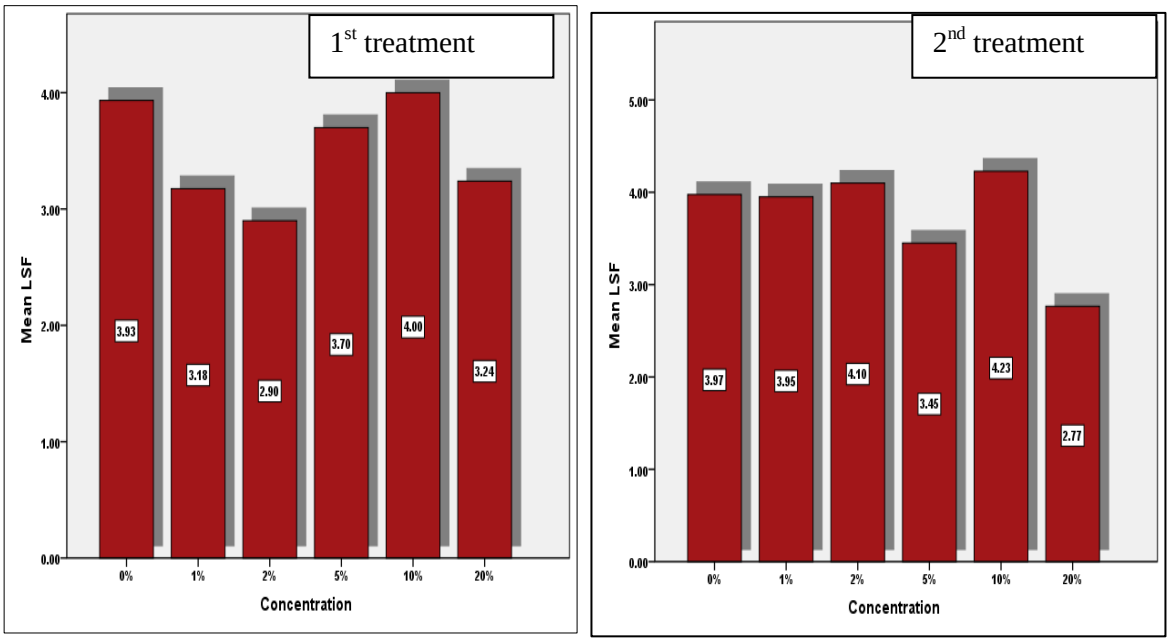

Fig. (4-37): Effect on fresh shoots lengths of Lebbeck seeds treated H_2SO_4.

B. The effect on shoots dry Length (LSD):

The effect on shoot dry length for Lebbeck seeds treated with H_2SO_4 was significant only in the second treatment according to one way anova test p-value (0.042). Multiple comparisons Post hock (appendix) revealed that these differences related to effect of 20% concentration compared to other concentrations.

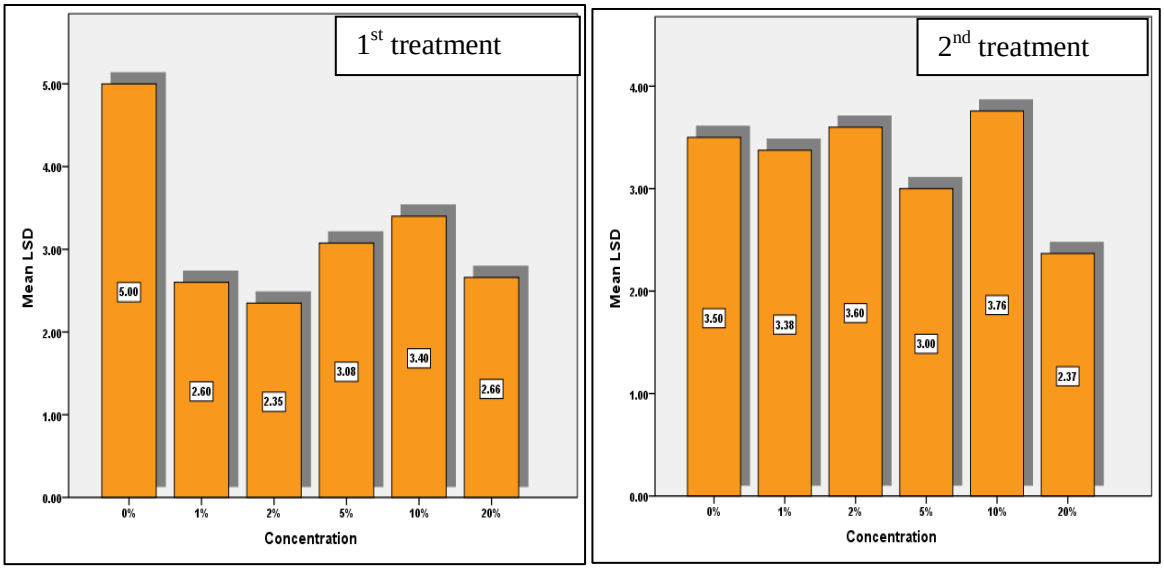

Fig. (4-38): Effect on dry shoots lengths of Lebbeck seeds treated H_2SO_4.

C. The effect on roots fresh Length (LRF):

The effect on root fresh lengths for Lebbeck seeds treated with $H_2SO_4$was significant in both treatments according to one way anova test p-value (0.004 and 0.016) respectively. Multiple comparison Post hock (appendix) revealed that these differences related to effect of 10 and 20% concentrations in the first treatment and of 20% concentration in the second treatment.

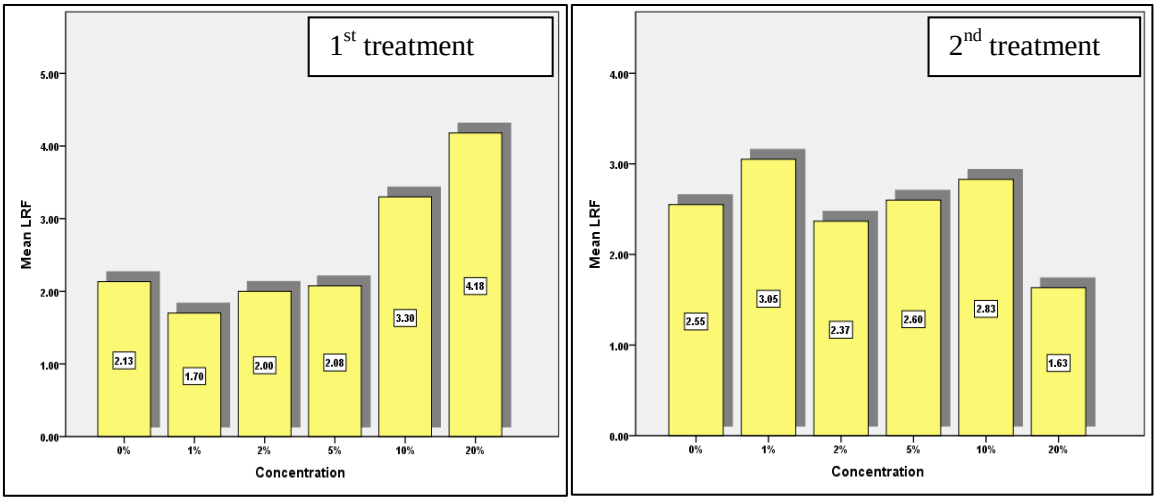

Fig. (4-39): Effect on fresh roots lengths of Lebbeck seeds treated H2SO4.

D. The effect on roots dry Length (LRF):

The effect on root fresh lengths for Lebbeck seeds treated with H_2SO_4 was significant in both treatments according to one way anova test p-value (0.021 and 0.008) respectively. Multiple comparison Post hock (appendix) revealed that these differences related to effect of 10 and 20% concentrations in the both treatments.

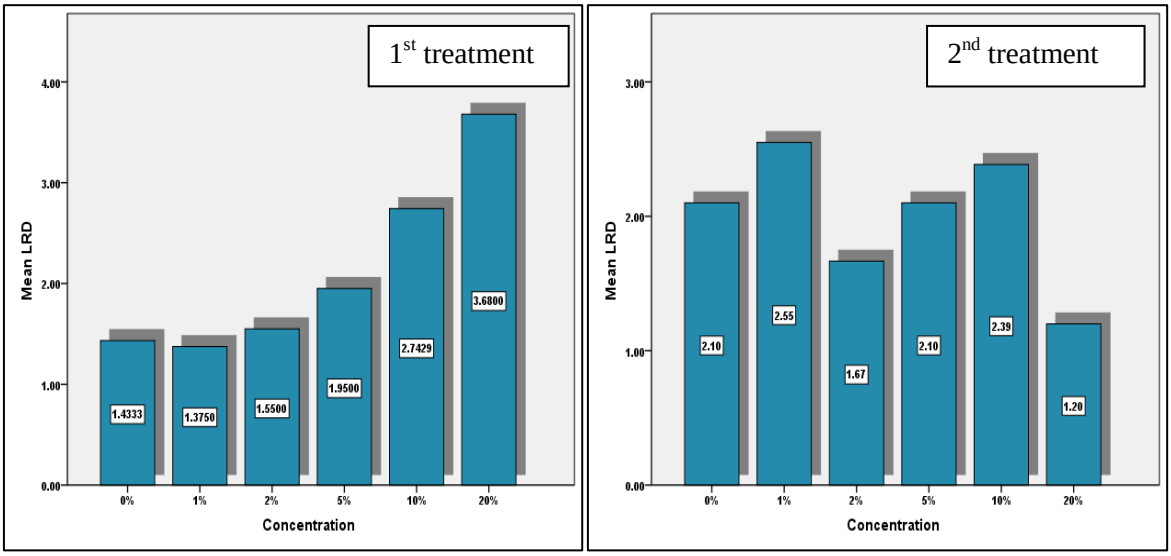

Fig. (4-40): Effect on dry roots lengths of Lebbeck seeds treated H_2SO_4.

4.4.2.3. Effect of seawater on shoots and roots weights of Lebbeck seeds treated H_2SO_4:

The effect of seawater on fresh and dry weights of Lebbeck shoots and roots treated with sulfuric acid, showed variable responses according to one way anova test, the effect on shoot and root weights (WSF, WRD) were significant only in the second treatment.

Table (4-32): Effect on shoots and roots weights of Lebbeck seeds treated H_2SO_4.

Concentration		1st treatment				2nd treatment			
		WSF	WSD	WRF	WRD	WSF	WSD	WRF	WRD
0%	N	3	3	3	3	4	4	4	4
	Mean	0.1248	0.0070	0.0252	0.0054	0.1382	0.0713	0.0246	0.0052
	Std. Deviation	0.00261	0.00241	0.02213	0.00450	0.00833	0.00384	0.02100	0.0040
1%	N	4	4	4	4	4	4	4	4
	Mean	0.0907	0.0084	0.0210	0.0068	0.0995	0.0350	0.1844	0.0070
	Std. Deviation	0.03161	0.00125	0.00591	0.00127	0.03571	0.03386	0.06437	0.0023
2%	N	2	2	2	2	3	3	3	3
	Mean	0.1213	0.0079	0.0524	0.0081	0.1133	0.2937	0.1087	0.0052
	Std. Deviation	0.00361	0.00092	0.06576	0.00141	0.02994	0.41065	0.05869	0.0017
5%	N	4	4	4	4	2	2	2	2
	Mean	0.1400	0.0072	0.0268	0.0064	0.1550	0.0755	0.0417	0.0039
	Std. Deviation	0.02244	0.00141	0.03179	0.00077	0.01131	0.01202	0.01315	0.0012
10%	N	7	7	7	7	7	7	7	7
	Mean	0.1034	0.0085	0.0316	0.0076	0.1753	0.0898	0.0993	0.0071
	Std. Deviation	0.01902	0.00130	0.01261	0.00098	0.04488	0.04567	0.03824	0.0020
20%	N	5	5	5	5	3	3	3	3
	Mean	0.0758	0.0086	0.0274	0.0057	0.1010	0.0152	0.0327	0.0059
	Std. Deviation	0.06135	0.00147	0.00976	0.00147	0.05484	0.01631	0.01888	0.0007
ANOVA		**0.119**	**0.497**	**0.720**	**0.325**	**0.035**	**0.245**	**0.001**	**0.522**

A. The effect on shoots fresh weight (WSF):

The effect on shoot fresh weights for Lebbeck seeds treated with H2SO4 was significant in the second treatment only according to one way anova test p-value (0.035). Multiple comparison Post hock (appendix) revealed that these differences related to effect of 10 and 20% concentrations in the both treatments.

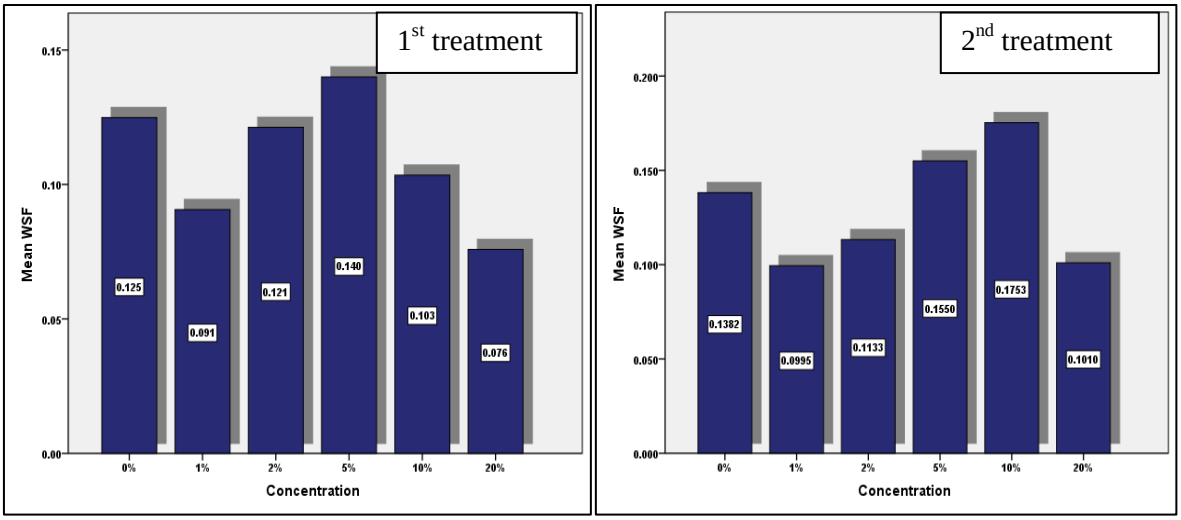

Fig. (4-41): Effect on shoots fresh weights of Lebbeck seeds treated H_2SO_4.

B. The effect on shoots dry weight (WSD):

The effect on shoot dry weights for Lebbeck seeds treated with H_2SO_4 was insignificant in both treatments, multiple comparison post hock were ignored.

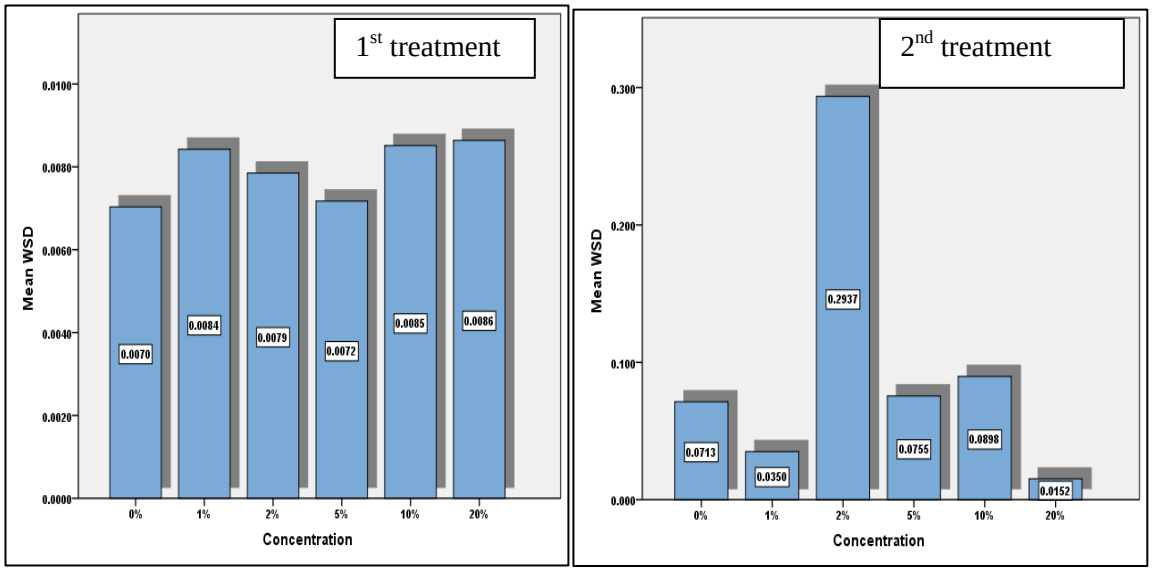

Fig. (4-42): Effect on shoots dry weights of Lebbeck seeds treated H_2SO_4.

C. The effect on roots fresh weight (WRF):

The effect on root fresh weights for Lebbeck seeds treated with H_2SO_4 was significant only in the second treatments according to one way anova test p-value (0.001), Multiple comparison Post hock (appendix) revealed that these differences related to effect of 10 and 20% concentrations in the both treatments.

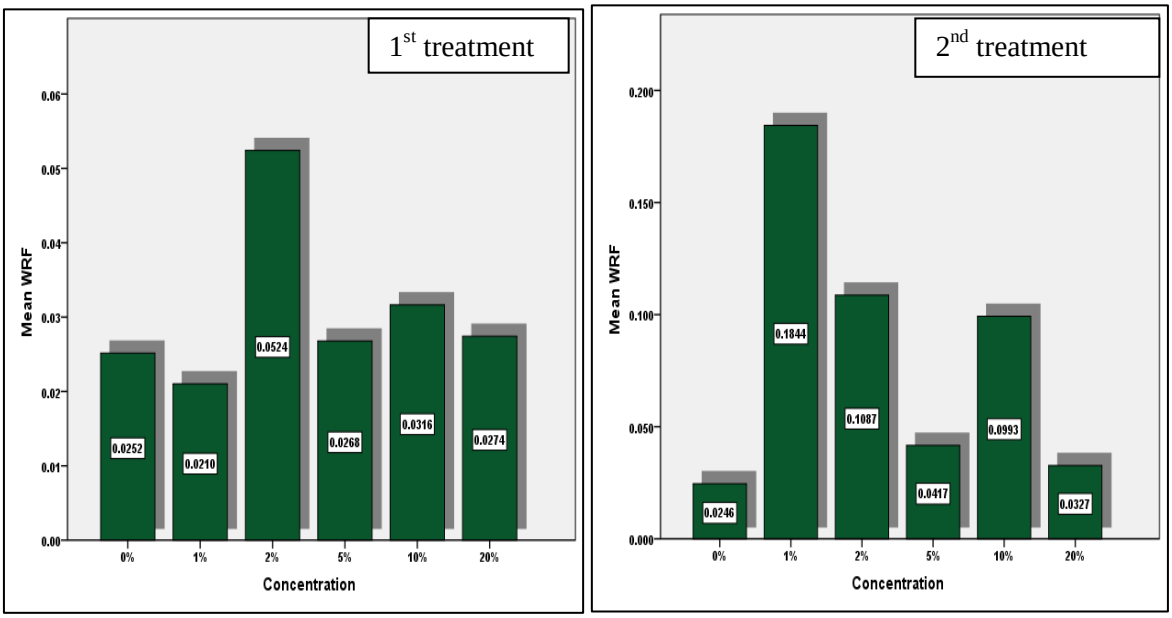

Fig. (4-43): Effect on root fresh weights of Lebbeck seeds treated H2SO4.

D. The effect on roots dry weight (WRD):

The effect on shoot dry weights for Lebbeck seeds treated with H2SO4 was insignificant in both treatments, multiple comparison post hock were ignored.

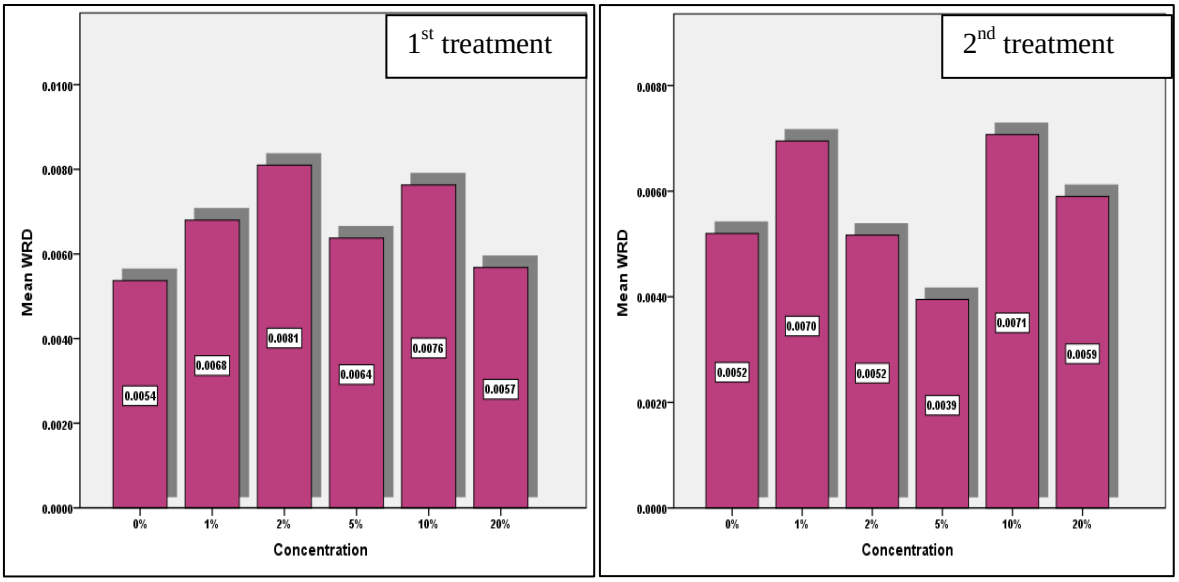

Fig. (4-44): Effect on root dry weights of Lebbeck seeds treated H2SO4.

4.5. Comparisons:

A. Mean germination time:

Comparing mean germination time of Lebbeck seeds pretreated with different methods and water with different concentration of seawater we found that the shortest mean germination time (8 days) was found in both tab water and boiled water at low sea water concentrations (1%), apparently mean germination time show increase as sea water concentration increased at all pretreatments, mean germination time show increase at all seawater concentration in seeds pretreated with sulfuric acid as shown in the figure (4-45).

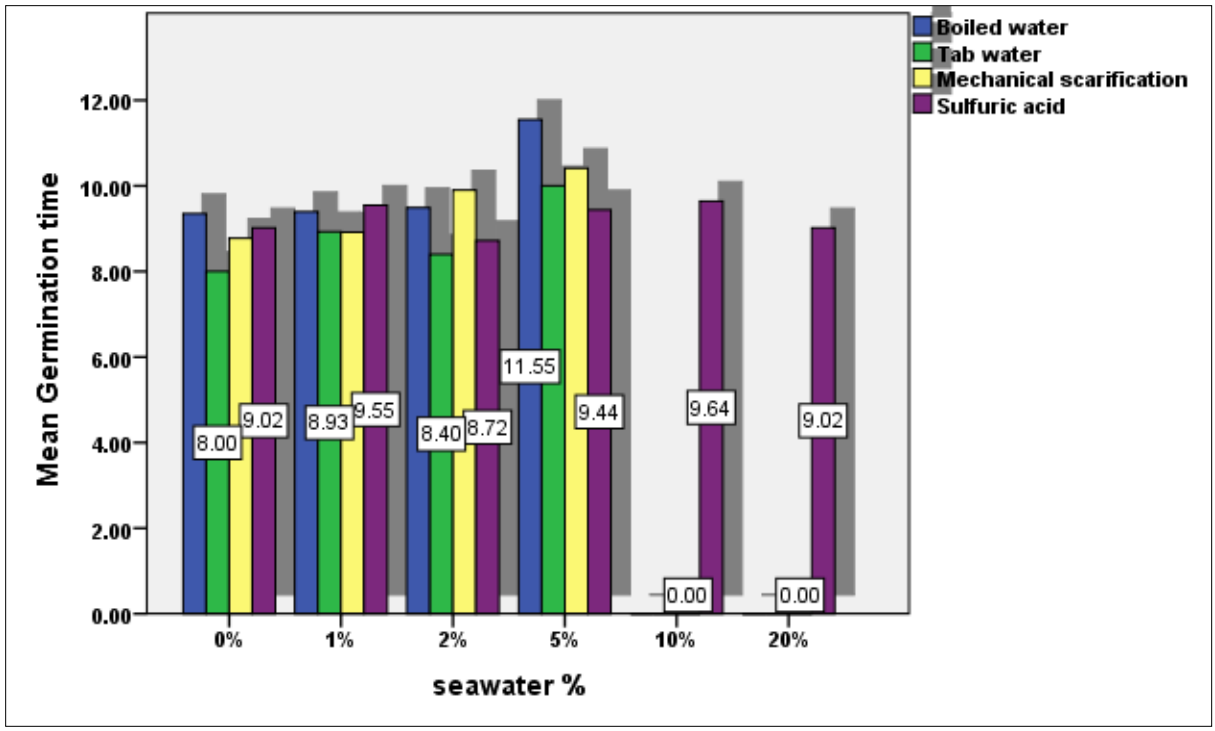

Fig. (4-45): Comparing mean germination time of all pretreatments at different water concentrations.

B. Germination percentages:

Higher germination percentages were noticed at low seawater concentrations of Lebbeck seeds pretreated with boiled water, followed by seeds pretreated with hot water, seeds pretreated with sulfuric acid showed increased in germination by increase seawater concentration as shown in the figure (4-46).

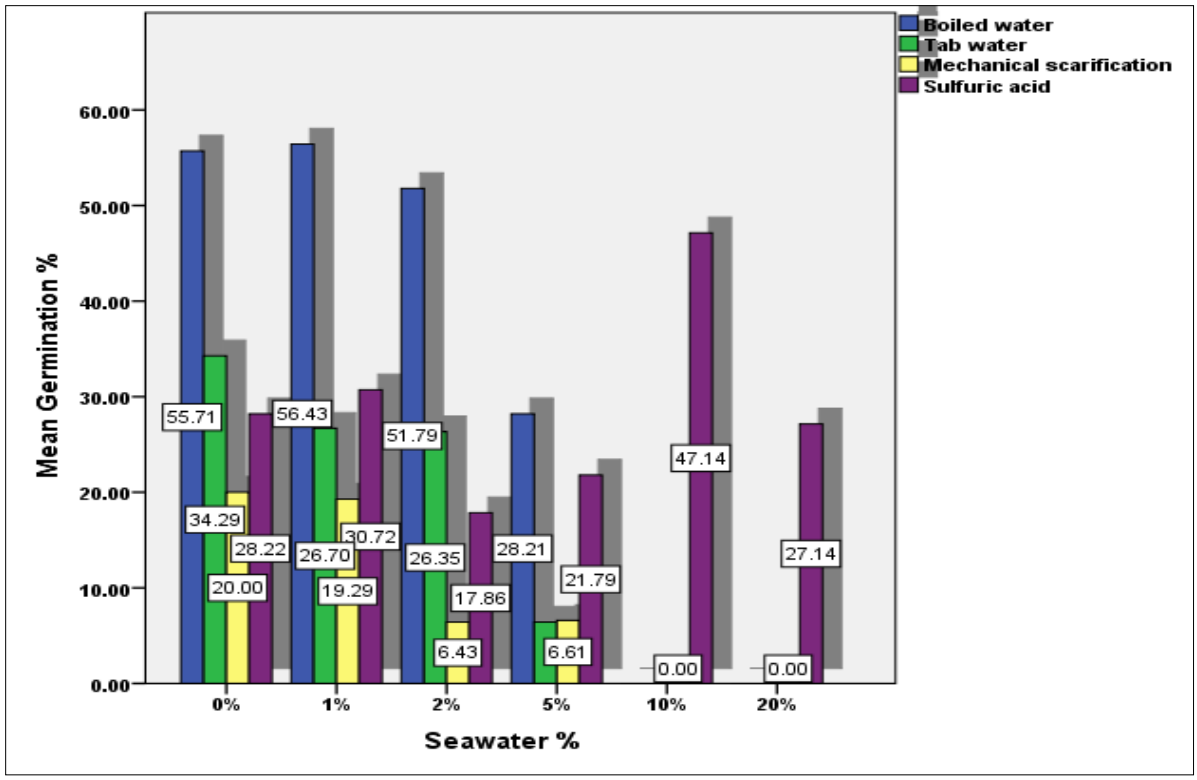

Fig. (4-46): Comparing germination percentages of all pretreatments at different water concentrations.

C. Seedling vigoros index (SVI):

Seedling vigoros index of Lebbeck seeds pretreated with boiled water show increased value at all seawater concentrations compared to other treatments followed with seeds that treated with hot water as shown in the figure (4-47).

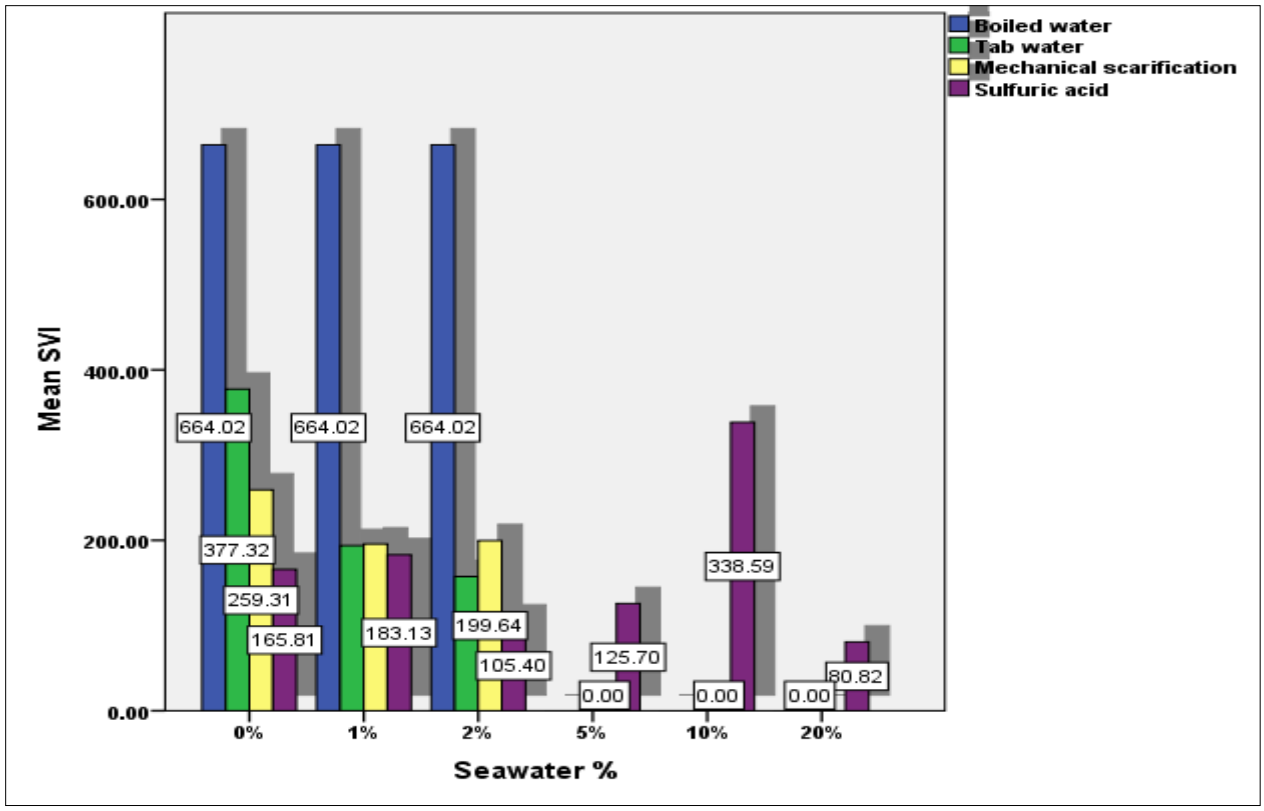

Fig. (4-47): Comparing seedling vigoros index of all pretreatments at different water concentration

4.5. Results of Acacias seeds treated with boiled water:

4.5.1.Germination experiment:

4.5.1.1. Estimation of mean germination time (MGT):

Majority of Acacias seeds showed increased mean germination time at all seawater concentration in all treatments with boiled water, the minimum mean germination time was recorded in the control (0%) compared with other groups. The increase in concentration of sea water slows the germination of the seeds as shown in the table (4-33).

Table (4-33): Mean germination time of Acacia seeds treated with boiled water.

Seawater %	MGT 1st treatment	MGT 2nd treatment	MGT 3rd treatment
0%	13	13.4	14.4
1%	14.2	14.5	14.38
2%	15.3	14.4	14.28
5%	15.8	15	15.6
10%	16.45	17	16.7
20%			

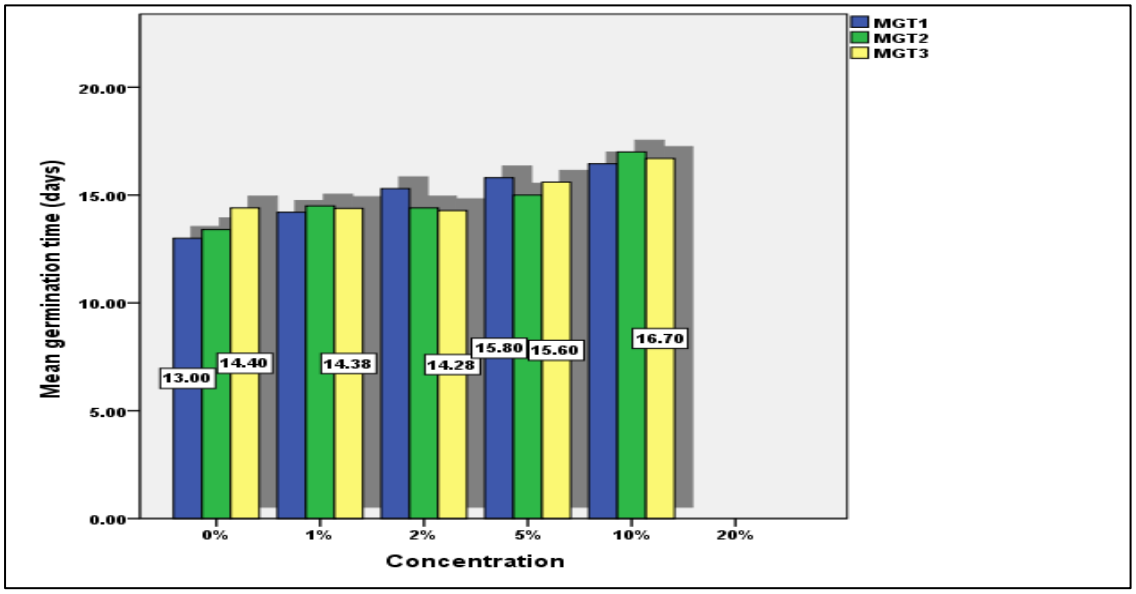

Fig. (4-48): Mean germination time of Acacia seeds treated with boiled water.

4.5.1.2. Estimation of germination percentage (G%):

Final seed germination of Acacia treated with boiled water showed significant decrease at all concentrations of sea water and control the maximum number of germinated seeds were 7 seeds from total 10 seeds; no growth had been recorded at 20% concentration of seawater in all treatments as shown in the table (4-34).

Table (4-34): Germination percentage at different seawater concentrations for Acacia seeds treated with boiled water.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
0%	69.5238	37.61332	49.0476	27.55082	64.7619	39.32163
1%	33.8095	21.32515	39.0476	25.47641	40.0000	25.88436
2%	47.6190	38.45839	44.7619	28.56905	33.8095	21.32515
5%	26.1905	23.12492	35.2381	26.76174	21.9048	18.33550
10%	9.5238	9.73457	7.6190	9.43650	13.3333	13.90444
20%	-	-	-	-	-	-

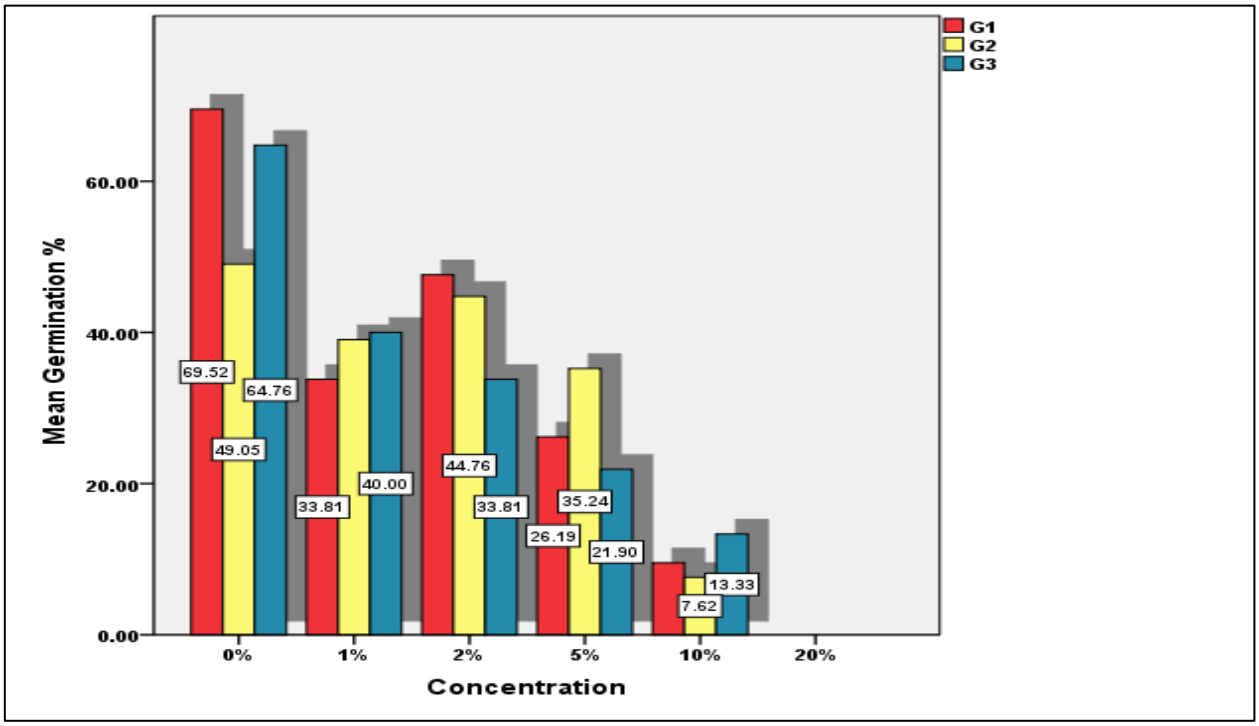

Fig. (4-49): Germination percentage at different seawater concentrations for Acacia seeds treated with boiled water.

4.5.2. Seedling experiment:

4.5.2.1. Seedling vigorous index (SVI):

The mean of seedling vigor index of Acacia seeds treated with boiled water showed significant decrease in the value with increased seawater concentrations, compared with the control in both treatments. The table (4-35) shows the differences in the means of SVI.

Table (4-35): Effect on SVI of Acacia seeds treated with boiled water.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	SVI	Std. deviation	SVI	Std. deviation	SVI	Std. deviation
0%	1414.8095	226.59033	1121.8280	174.08057	1322.1141	272.1886
1%	655.6836	141.68345	735.7222	123.80876	797.6000	55.07086
2%	485.9971	244.13399	519.2380	200.80173	380.7328	138.3114
5%	78.8889	30.71830	361.4842	192.13787	232.8476	131.5667
10%	78.8889	30.71830	58.0952	21.81929	105.0000	43.84063

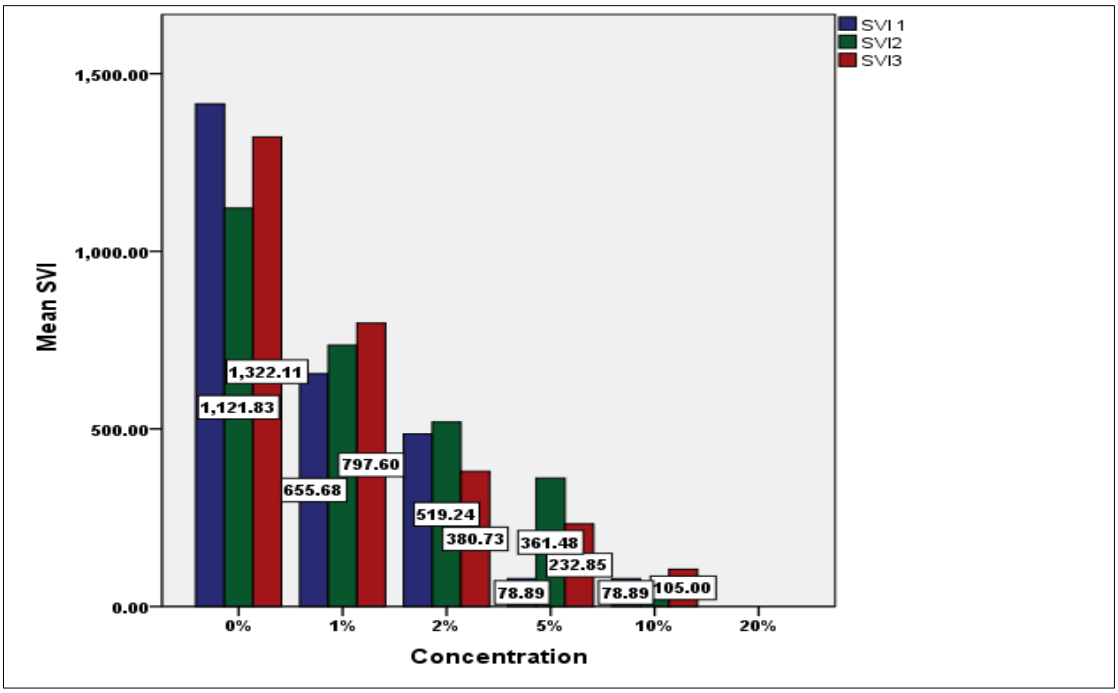

Fig. (4-50): Effect on SVI of Acacia seeds treated with boiled water.

4.5.2.2. Effect on seedling of Acacia seeds treated with boiled water:

Roots and shoots length of Acacia showed higher lengths in both first and second treatment, especially at low water concentrations, there was no statistical significances in the mean of root lengths among different seawater concentrations at the three treatments, while shoot lengths showed highly statistical differences among different sea water concentrations at the three treatments. Roots weight showed increased in third treatment, while the shoots lengths showed increased in the first treatment at low seawater concentration, there was no significant of roots weight at different seawater concentrations, Shoots lengths showed also statistical significant at different seawater concentration in the second and third treatments.

Table (4-36): Effect on seedling of Acacia seeds treated with boiled water.

Concentration		1st treatment				2nd treatment				3rd treatment			
		RL	RW	SL	SW	RL	RW	SL	SW	RL	RW	SL	SW
0%	N	10	10	10	10	9	9	9	9	10	10	10	9
	Mean	0.9700	0.0069	19.380	0.1696	1.0278	0.0067	21.844	0.0985	0.9350	0.0064	19.480	0.0690
	Std. Dev.	0.761	0.005	3.1039	0.1802	0.7863	0.0031	3.4409	0.0096	0.7004	0.0034	3.9999	0.0285
1%	N	7	7	7	7	6	6	6	6	5	5	5	5
	Mean	0.5214	0.0054	18.429	0.0943	1.0000	0.0063	17.842	0.0772	0.5700	0.0058	19.370	0.0985
	Std. Dev.	0.2564	0.0063	5.2367	0.0178	0.5177	0.0027	2.7938	0.0225	0.2334	0.0023	1.4580	0.0211
2%	N	8	8	8	8	7	7	7	7	9	9	9	9
	Mean	0.4625	0.0057	12.300	0.0599	0.5000	0.0036	11.10	0.0376	0.3611	0.0049	10.900	0.0639
	Std. Dev.	0.0791	0.0028	3.969	0.0274	0.1732	0.0012	4.5294	0.0341	0.0697	0.0025	4.1319	0.0273
5%	N	3	3	3	3	6	6	6	6	5	5	5	5
	Mean	0.4667	0.0060	7.8167	0.0424	0.4583	0.0038	9.8000	0.0447	0.4800	0.0074	10.150	0.0491
	Std. Dev.	0.1041	0.0036	3.32127	0.02142	0.16253	0.00145	5.46836	0.03213	0.14405	0.00502	6.12046	0.01821
10%	N	-	-	-	-	2	2	2	2	2	2	2	2
	Mean	-	-	-	-	0.3750	0.0033	7.2500	0.0262	0	0	0	0
	Std. Dev.	-	-	-	-	0.0354	0.0006	2.8284	0.0310	0.4250	0.0076	7.4500	0.0419
Anova		**0.121**	**0.926**	**0.000**	**0.160**	**0.101**	**0.036**	**0.000**	**0.000**	**0.074**	**0.705**	**0.000**	**0.031**

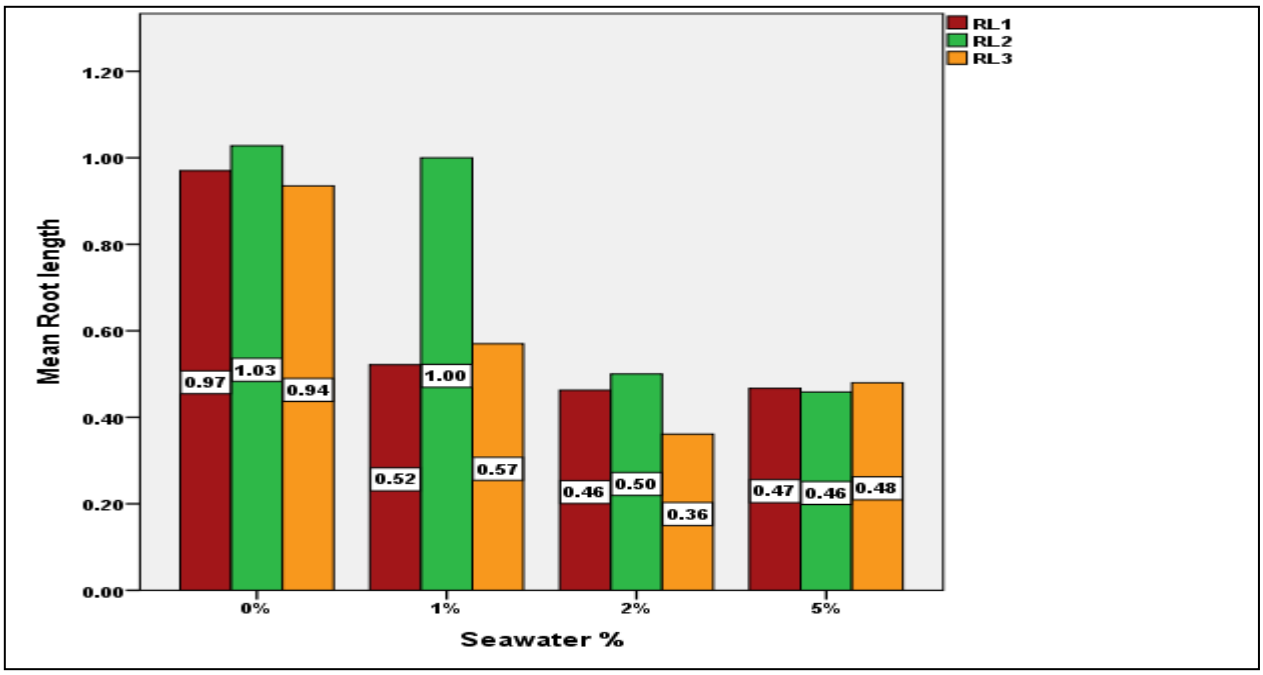

Fig. (4-51): Effect of different seawater concentration on root lengths of Acacia treated with boiled water.

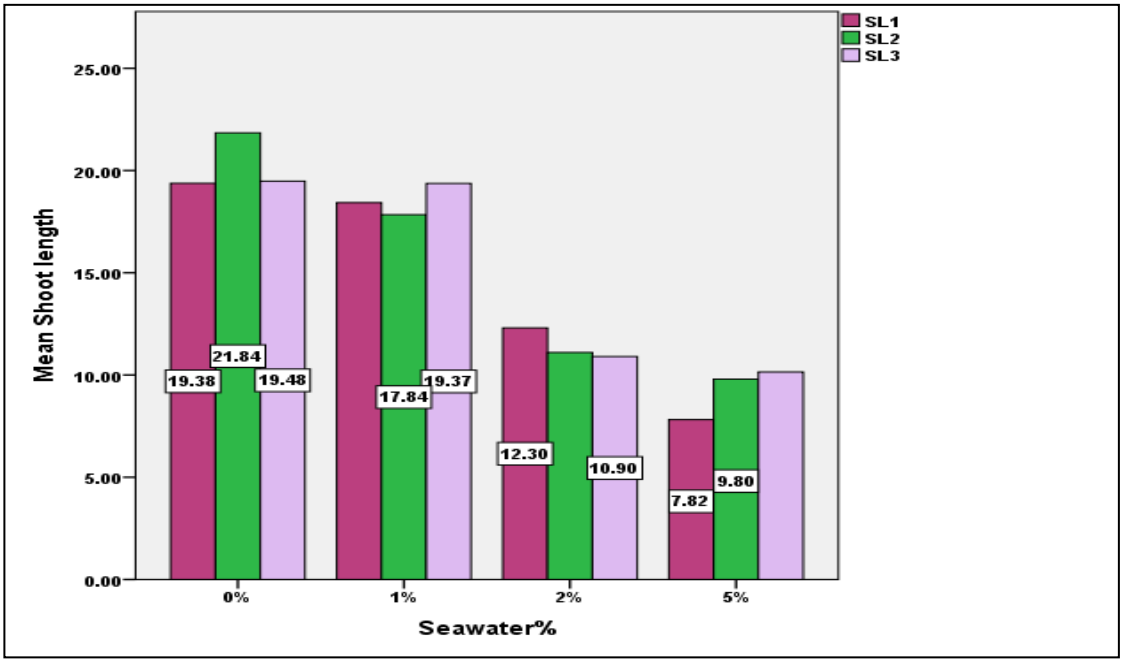

Fig. (4-52): Effect of different seawater concentration on shoots lengths of Acacia treated with boiled water.

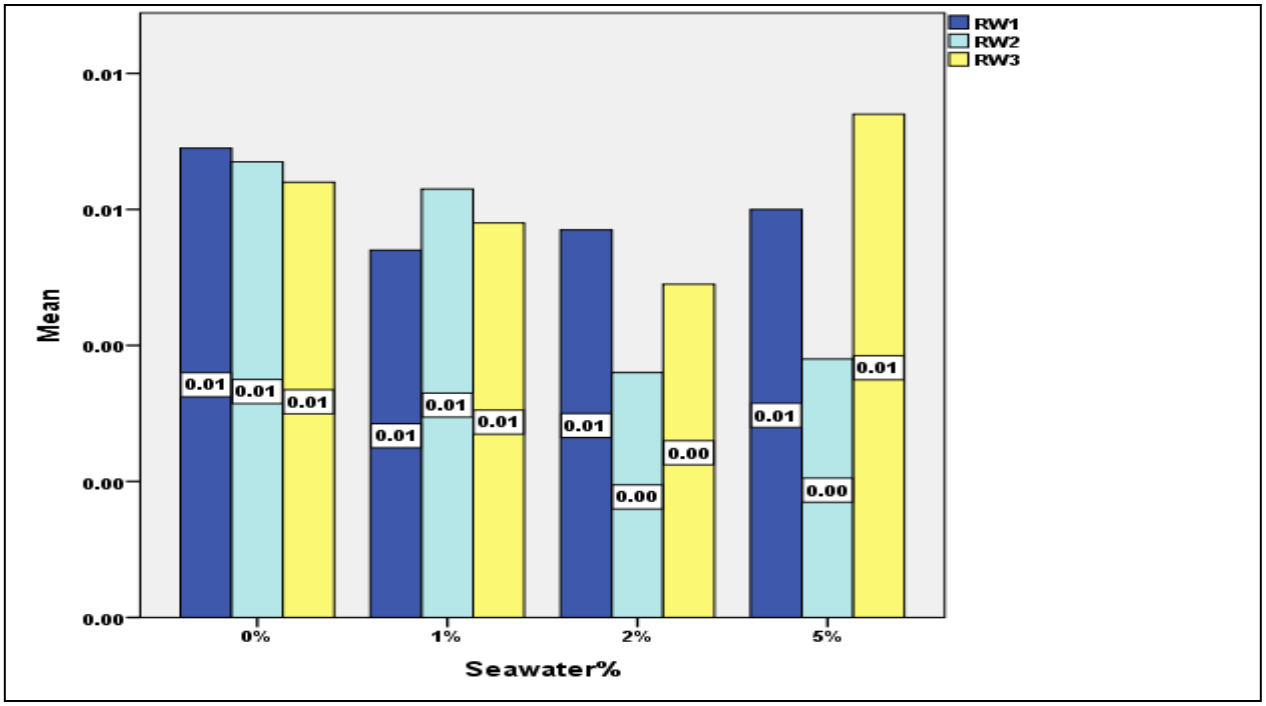

Fig. (4-53): Effect of different seawater concentration on root weights of Acacia treated with boiled water.

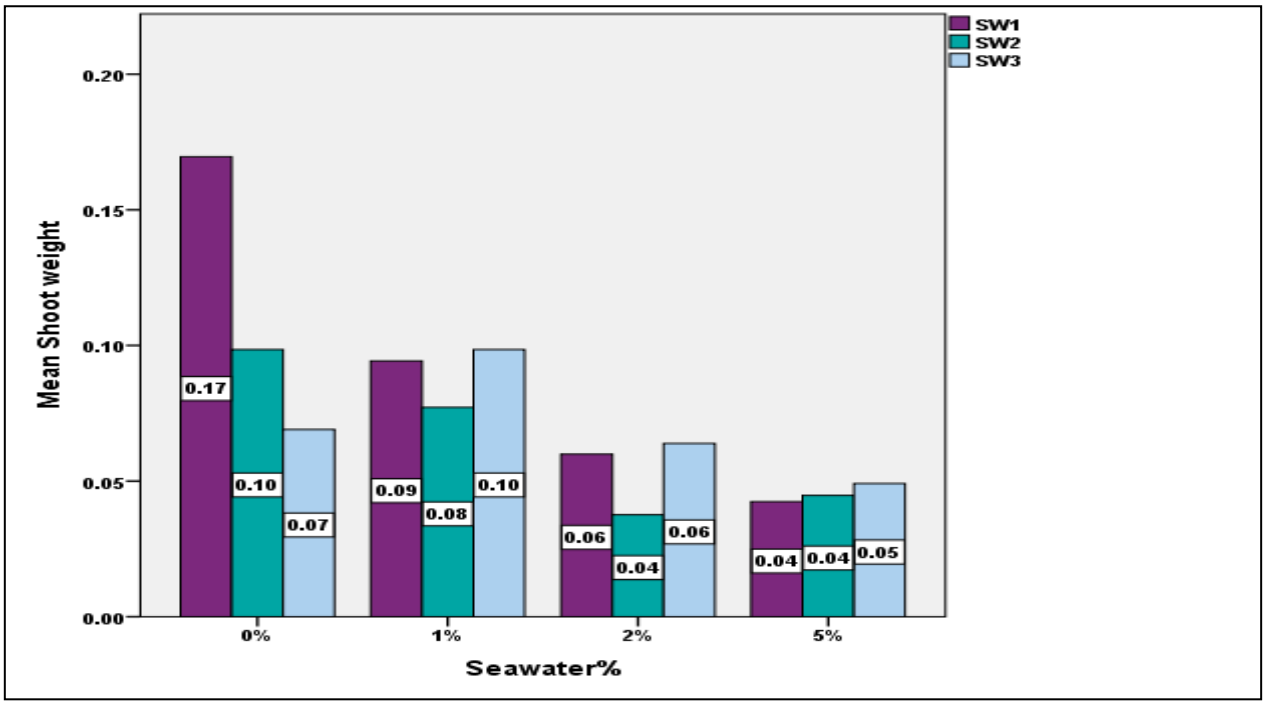

Fig. (4-54): Effect of different seawater concentration on shoot weights of Acacia treated with boiled water.

4.6. Results of Acacias seeds treated with hot tap water:

4.6.1. Germination experiment:

4.6.1.1. Estimation of mean germination time (MGT):

Majority of Acacia seeds showed increased mean germination time at all seawater concentration in all treatments with boiled water. The increase in concentration of seawater slows the germination of the seeds as shown in the table (4-37).

Table (4-37): Mean germination time of Acacia seeds treated with hot tap water.

Seawater %	MGT 1st treatment	MGT 2nd treatment	MGT 3rd treatment
0%	15.45	15.9	17.75
1%	17.4	17.9	16
2%	16.45	16.9	17.5
5%	17	17.44	17
10%	-	-	-
20%	-	-	-

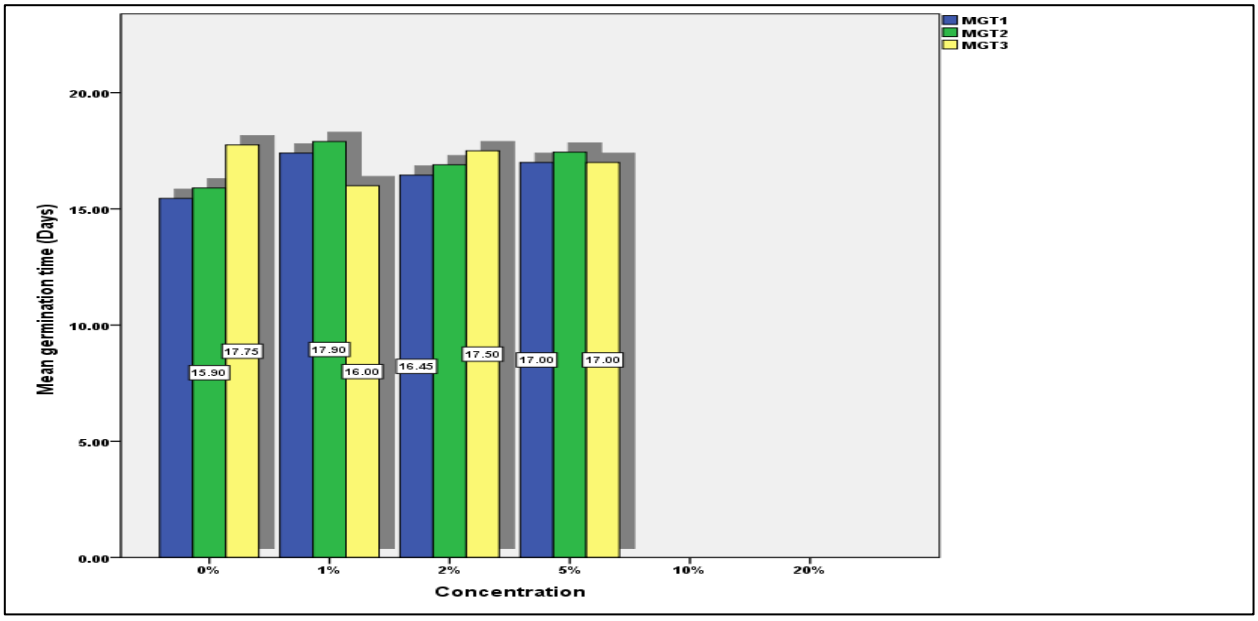

Fig. (4-55): Mean germination time of Acacia seeds treated with hot tap water.

4.6.1.2. Estimation of germination percentage (G%):

Final seed germination of Acacia treated with boiled water showed significant decrease at all concentrations of sea water and control the maximum number of germinated seeds were 5 seeds from total 10 seeds; no growth had been recorded at 10% and 20% concentrations of seawater in all treatments as shown in the table (4-38).

Table (4-38): Germination percentage at different seawater concentrations for Acacia seeds treated with hot tap water.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
0%	42.3810	32.84886	50.0000	43.70355	54.7619	45.12417
1%	10.9524	13.00183	7.6190	9.43650	5.2381	5.11766
2%	9.5238	9.73457	8.5714	9.63624	3.8095	4.97613
5%	4.2857	5.07093	7.6190	9.43650	4.2857	5.07093
10%	-	-	-	-	-	-
20%	-	-	-	-	-	-

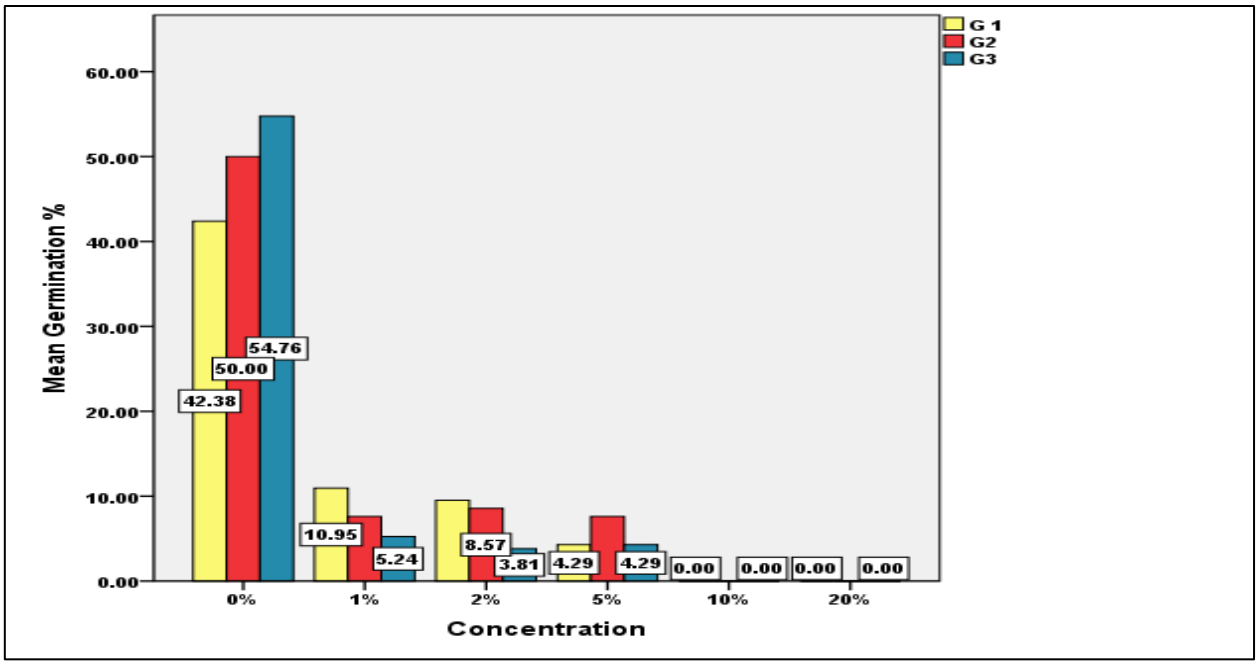

Fig. (4-56): Germination percentage at different seawater concentrations for Acacia seeds treated with hot tap water.

4.6.2. Seedling experiment:

4.6.2.1. Seedling vigorous index(SVI):

The mean of seedling vigor index of Acacia seeds treated with hot tap water showed significant decrease in the value with increased seawater concentrations, compared with the control in both treatments. The table (4-39) shows the differences in the means of SVI.

Table (4-39): Effect on SVI of Acacia seeds treated with hot tap water.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	SVI	Std. deviation	SVI	Std. deviation	SVI	Std. deviation
0%	909.0715	129.23479	912.5000	261.66401	1036.6427	313.80412
1%	197.5079	24.83279	132.1905	10.77496	93.7619	-
2%	160.0000	8.75469	136.7143	17.57669	58.6667	-
5%	78.8571	-	107.6191	16.97060	73.9286	-
10%	-	-	-	-	-	-
20%	-	-	-	-	-	-

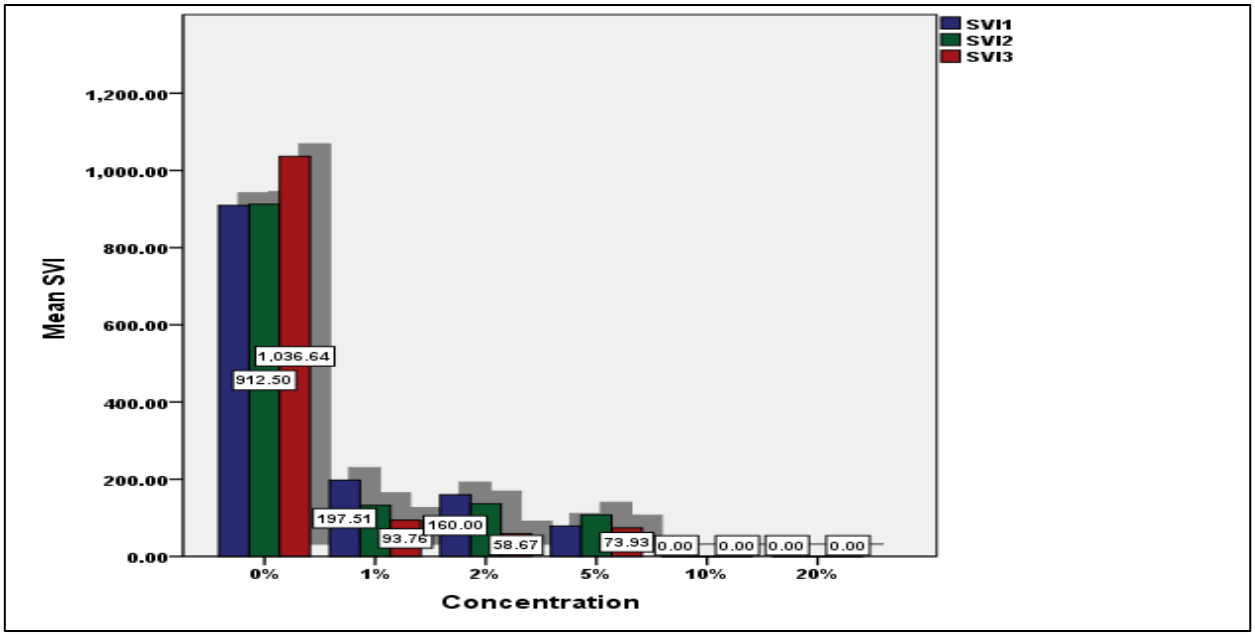

Fig. (4-57): Effect on SVI of Acacia seeds treated with hot tap water.

4.6.2.2. Effect on seedling of Acacia seeds treated with tab water:

All seedlings parameter of Acacia seeds treated with tab water showed no significant differences in their means at all seawater concentrations according to one way anova test recorded in the table (4-40).

Table (4-40): Effect on seedling of Acacia seeds treated with tab water.

Concentration		1st treatment				2nd treatment				3rd treatment			
		RL	RW	SL	SW	RL	RW	SL	SW	RL	RW	SL	SW
0%	N	8	8	8	8	10	10	10	10	10	10	10	10
	Mean	0.6438	0.1499	20.8063	0.0591	0.5800	0.2653	17.6700	0.0576	0.5350	0.0050	18.3950	0.0599
	Std. Dev.	0.17410	0.10971	3.09648	0.01124	0.19322	0.21815	5.24088	0.02454	0.11068	0.00000	5.72006	0.02299
1%	N	3	3	3	3	2	2	2	2	1	1	1	1
	Mean	0.6500	0.0293	17.3833	0.0509	0.6500	0.0249	16.7000	0.0645	0.3500	0.0025	17.5500	0.0658
	Std. Dev.	0.18028	0.02182	2.36238	0.00462	0.21213	0.02811	1.20208	0.03981				
2%	N	2	2	2	2	2	2	2	2	1	1	1	1
	Mean	0.6250	0.0059	16.1750	0.0772	0.5000	0.0050	15.4500	0.0419	0.5000	0.0050	14.9000	0.0545
	Std. Dev.	0.31820	0.00042	1.23744	0.04681	0.00000	0.00000	2.05061	0.03147				
5%	N	1	1	1	1	2	2	2	2	1	1	1	1
	Mean	0.6000	0.0059	17.8000	0.0384	0.5000	0.0050	13.6250	0.0314	0.5000	0.0050	16.7500	0.0712
	Std. Dev.					0.00000	0.00000	2.22739	0.01255				
Anova		0.790	0.134	0.698	0.512	0.790	0.134	0.512	0.698	0.495	0.064	0.572	0.780

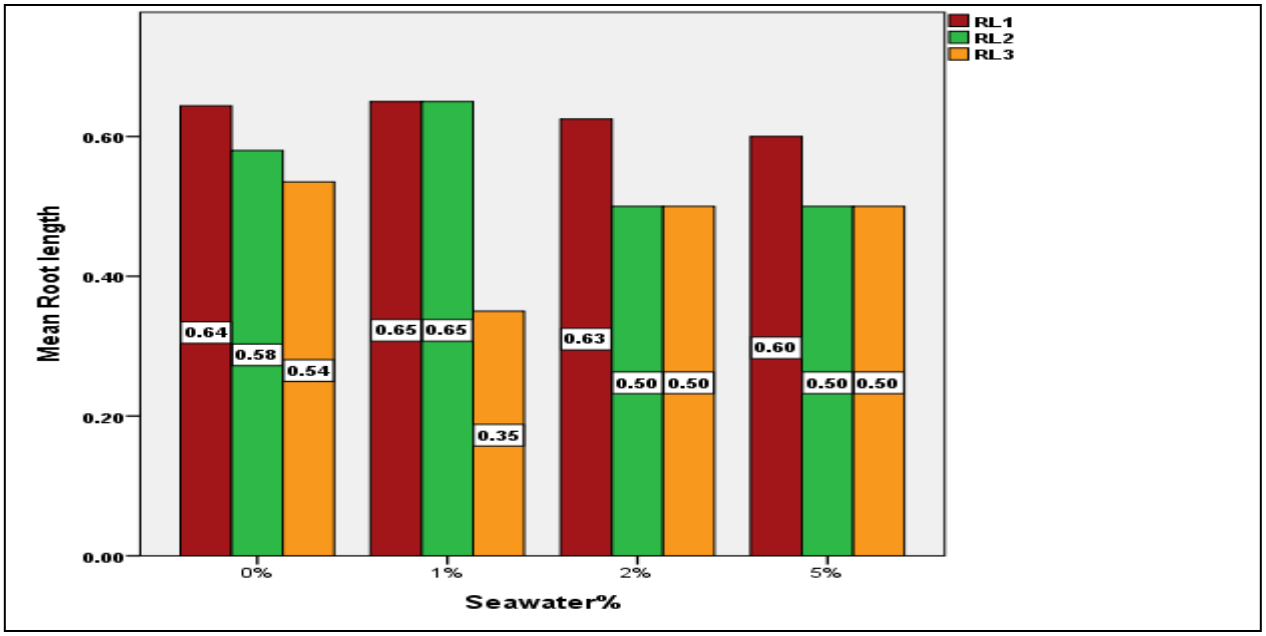

Fig. (4-58): Effect of different seawater concentration on root length of Acacia treated with tab water.

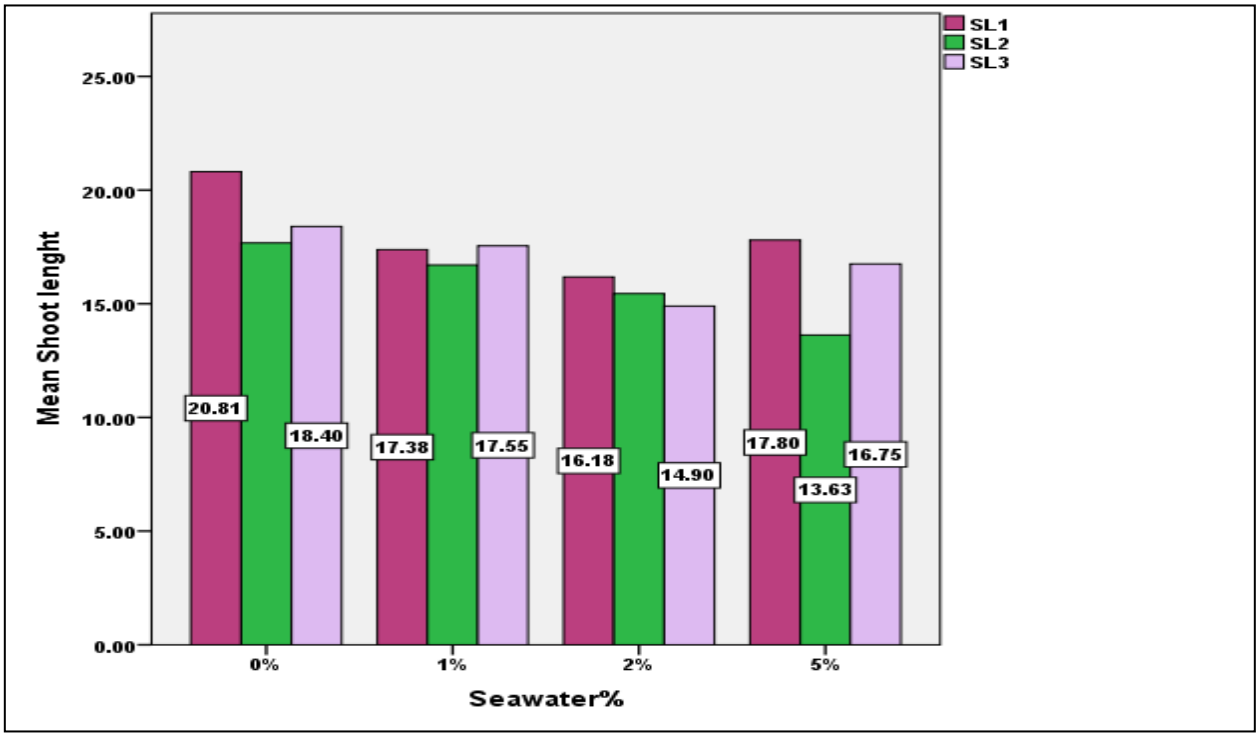

Fig. (4-59): Effect of different seawater concentration on root length of Acacia treated with tab water.

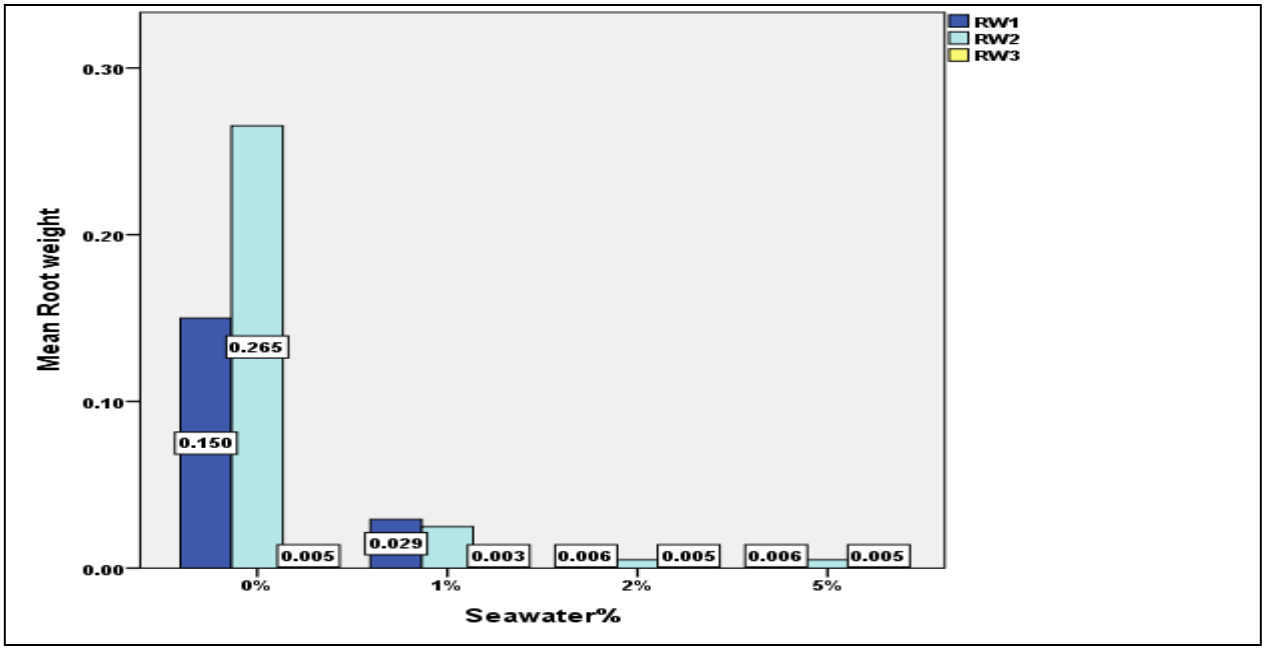

Fig. (4-60): Effect of different seawater concentration on root weight of Acacia treated with tab water.

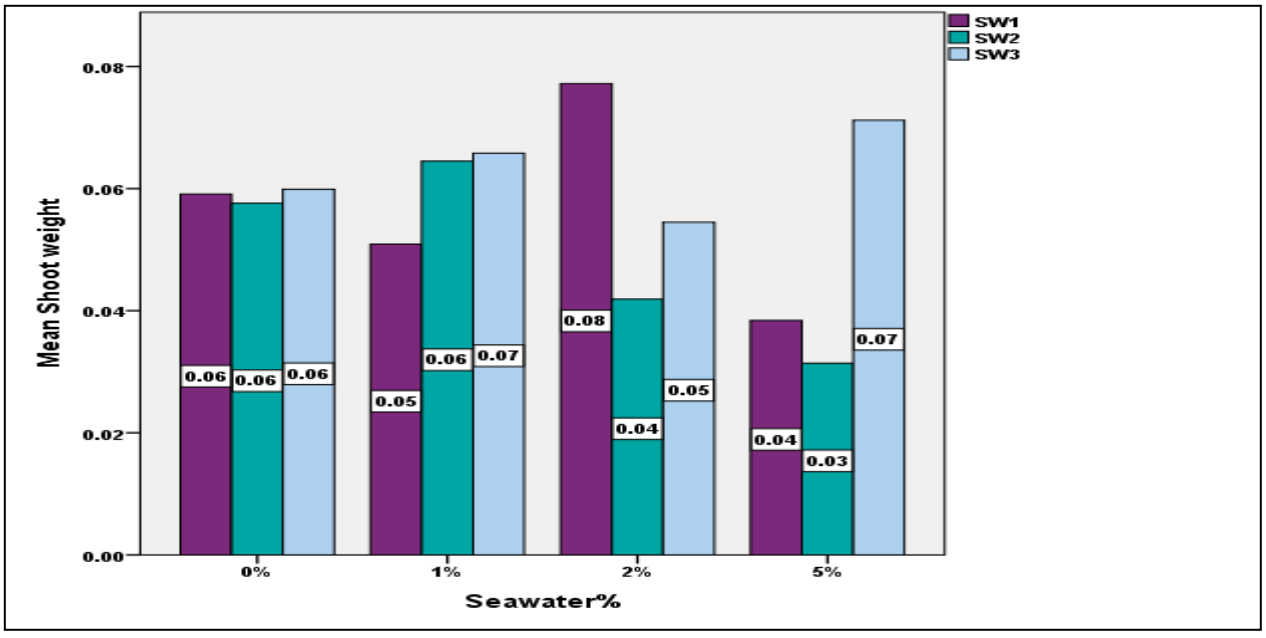

Fig. (4-61): Effect of different seawater concentration on shoot weight of Acacia treated with tab water.

4.7. Results of Acacias seeds treated with mechanical scarification:

4.7.1. Germination experiment:

4.7.1.1. Estimation of mean germination time (MGT):

Majority of Acacia seeds showed increased mean germination time at all seawater concentration in all treatments with mechanical scarification. The increase in concentration of seawater slows the germination of the seeds as shown in the table (4-41).

Table (4-41): Mean germination time of Acacia seeds treated mechanical scarification.

Seawater %	MGT 1st treatment	MGT 2nd treatment	MGT 3rd treatment
0%	15.85	16.12	16.7
1%	16.52	17.21	17.32
2%	18.5	17.16	17.16
5%	15.76	18.5	18.75

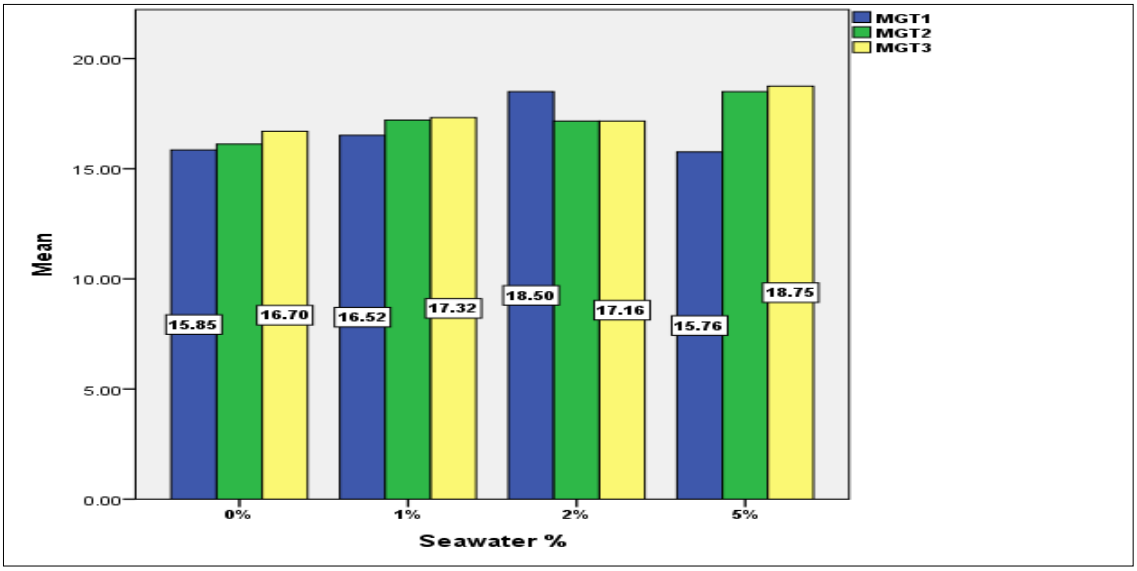

Fig. (4-62): Mean germination time of Acacia seeds treated with mechanical scarification.

4.7.1.2. Estimation of germination percentage:

Final seed germination of Acacia treated with mechanical scarification showed significant decrease at all concentrations of sea water and control the maximum number of germinated seeds were 4 seeds from total 10 seeds; no growth had been recorded at 10% and 20% concentrations of seawater in all treatments as shown in the table (4-42).

Table (4-42): Germination percentage at different seawater concentrations for Acacia seeds treated with mechanical scarification.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
0%	33.8095	28.54403	23.8095	21.55834	28.0952	25.61622
1%	12.8571	12.70545	15.2381	17.49830	14.7619	17.21019
2%	5.7143	9.25820	11.9048	13.64516	11.9048	13.64516
5%	10.0000	16.43168	2.8571	4.62910	8.0000	13.21881

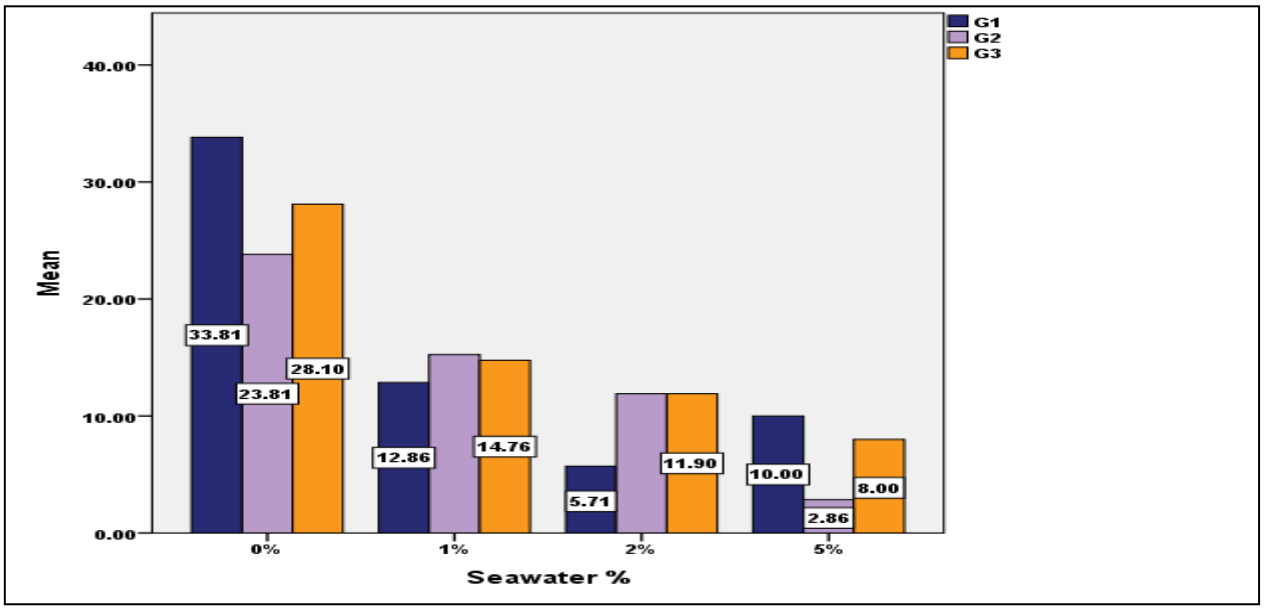

Fig. (4-63): Germination percentage at different seawater concentrations for Acacia seeds treated with mechanical scarification.

4.7.2. Seedling experiment:

4.7.2.1. Seedling vigorous index(SVI):

The mean of seedling vigor index of Acacia seeds treated with mechanical scarification showed significant decrease in the value with increased seawater concentrations, compared with the control in both treatments. The table (4-43) shows the differences in the means of SVI.

Table (4-43): Effect on SVI of Acacia seeds treated with mechanical scarification.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	SVI	Std. deviation	SVI	Std. deviation	SVI	Std. deviation
0%	411.9931	142.24030	258.7301	137.82949	324.22	167.256
1%	129.0000	40.26117	151.8086	68.88176	147.42	45.078
2%	96.5000	12.72792	104.3584	45.15812	92.85	29.503
5%	35.0697	12.96372	19.6181	5.30920	57.60	-

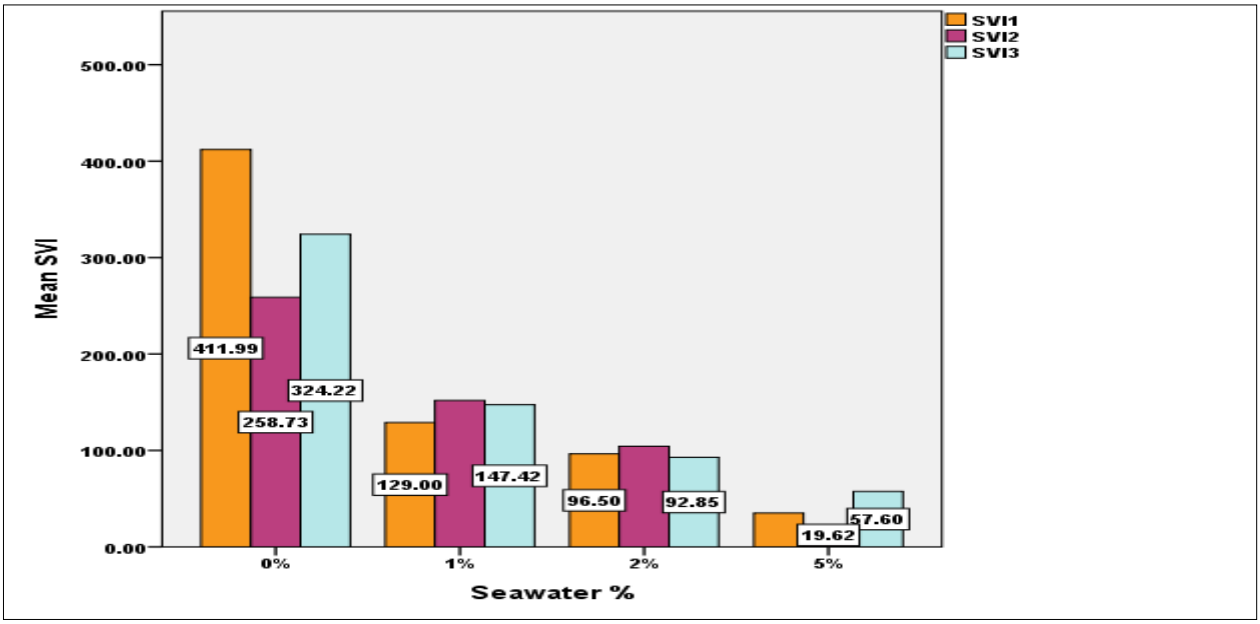

Fig. (4-64): Effect on SVI of Acacia seeds treated with mechanical scarification.

4.7.2.2. Effect on seedling of Acacia seeds treated with mechanical scarification:

Generally all the seedling parameters of Acacia seeds pretreated with mechanical scarification showed reduction as the concentration of seawater increased compared to the control treatment, no significant differences in means of all seedlings parameters at all seawater concentration was recorded as shown in the table (4-44).

Table (4-44): Effect on seedling of Acacia seeds treated with mechanical scarification.

Concentration		1st treatment				2nd treatment				3rd treatment			
		RL	RW	SL	SW	RL	RW	SL	SW	RL	RW	SL	SW
0%	N	7	7	7	7	7	6	6	6	6	6	6	6
	Mean	0.5357	0.0099	11.6500	0.0359	0.5357	0.6500	0.0045	10.2167	0.491667	0.004365	10.3250	0.0134502
	Std. Dev.	0.14351	0.01279	4.12068	0.0158	0.1435	0.1549	0.0006	5.91056	0.049159	0.00099	5.59453	0.0152427
1%	N	3	3	3	3	3	4	4	4	4	4	4	4
	Mean	0.4667	0.0042	9.5667	0.0203	0.4667	0.600	0.0046	9.3625	0.50	0.005	9.4875	0.01633
	Std. Dev.	0.0577	0.0013	3.0880	0.0200	0.0577	0.1414	0.0007	4.42914	0.000	0.000	3.05406	0.012801
2%	N	2	2	2	2	2	3	3	3	3	3	3	3
	Mean	0.6250	0.0234	9.0250	0.0146	0.6250	0.5500	0.0043	8.2167	0.500	0.005	7.3000	0.007421
	Std. Dev.	0.17678	0.02606	1.09602	0.0184	0.1768	0.050	0.0006	3.74477	0.000	0.000	2.47841	0.00607
5%	N	4	4	4	4	4	3	3	3				
	Mean	0.5000	0.0050	5.6375	0.0084	0.5000	0.500	0.0050	6.3667				
	Std. Dev.	0.00	0.000	2.26876	0.0108	0.000	0.0000	0.0000	1.85831				
ANOVA		**0.503**	**0.311**	**0.094**	**0.078**	**0.385**	**0.515**	**0.705**	**0.866**	**0.912**	**0.314**	**0.640**	**0.679**

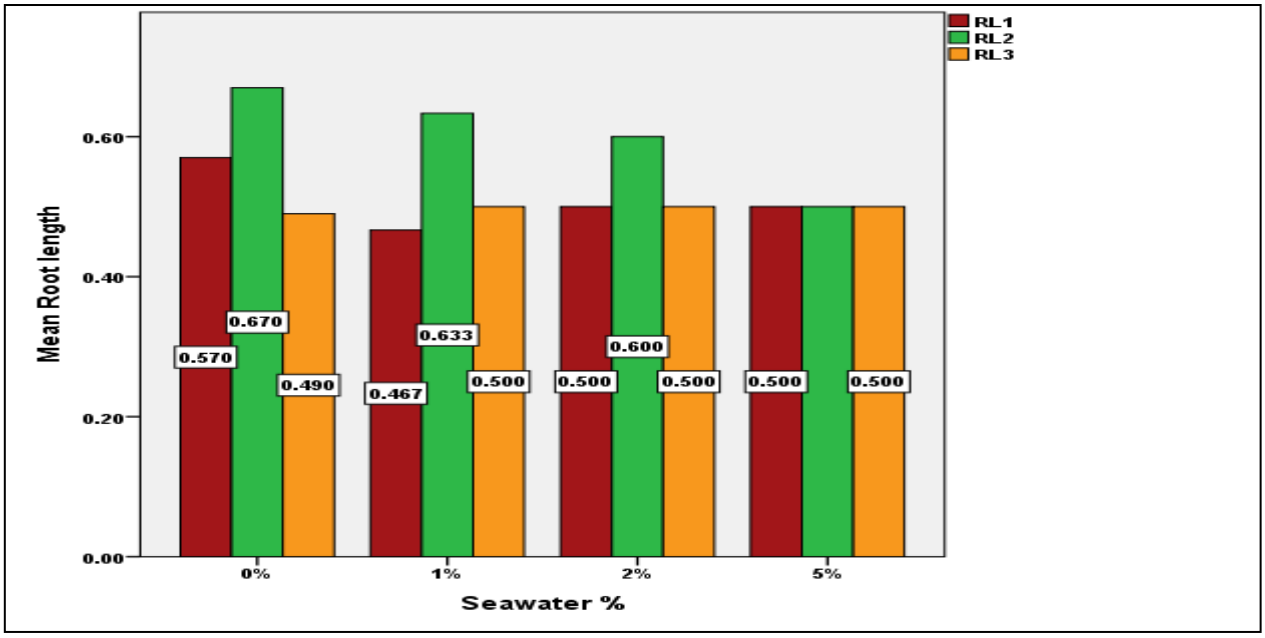

Fig. (4-65): Effect of different seawater concentration on root length of Acacia treated with mechanical scarification.

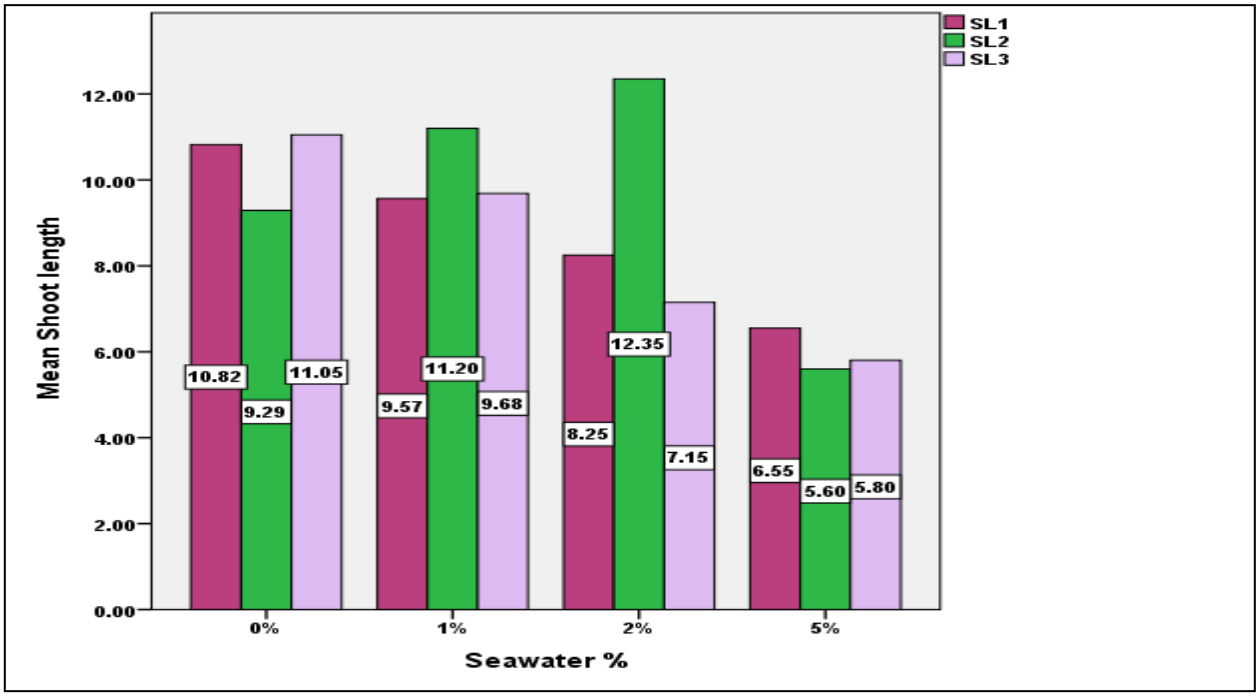

Fig. (4-66): Effect of different seawater concentration on shoot length of Acacia treated with mechanical scarification.

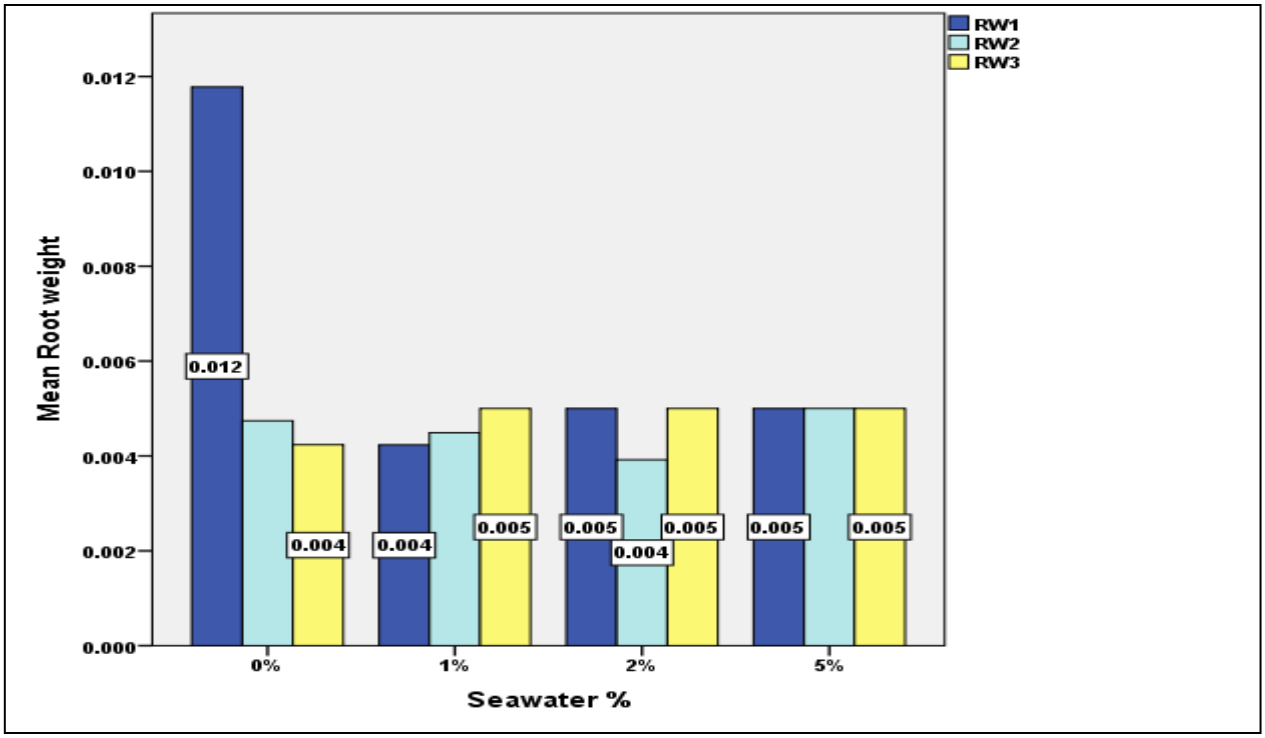

Fig. (4-67): Effect of different seawater concentration on root weight of Acacia treated mechanical scarification.

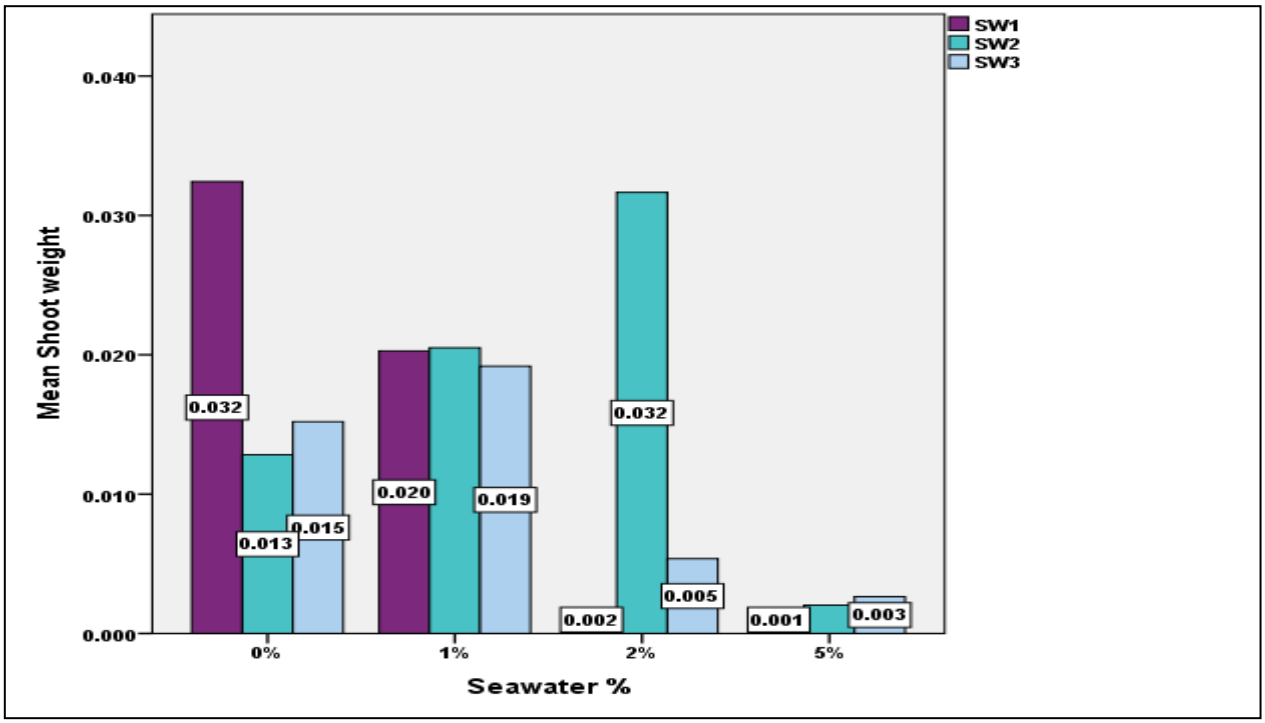

Fig. (4-68): Effect of different seawater concentration on shoot length of Acacia treated with mechanical scarification.

4.8. Results of Acacias seeds treated with H_2SO_4:

4.8.1. Germination experiment:

4.8.1.1. Estimation of mean germination time (MGT):

Generally the germination of Acacia seeds pretreated with sulfuric acid started from 12-18 days, the time prolonged as the concentration of seawater increases, the control treatments showed shorter time for germination.

Table (4-45): Mean germination time of Acacia seeds treated H_2SO_4.

Seawater %	MGT 1st treatment	MGT 2nd treatment	MGT 3rd treatment
0%	13.5	12.9	13.9
1%	14.08	13.5	13.19
2%	14.125	15.2	14.3
5%	14.22	15.6	16.1
10%	18.2	16.9	16.5
20%	16.54	18	18.55

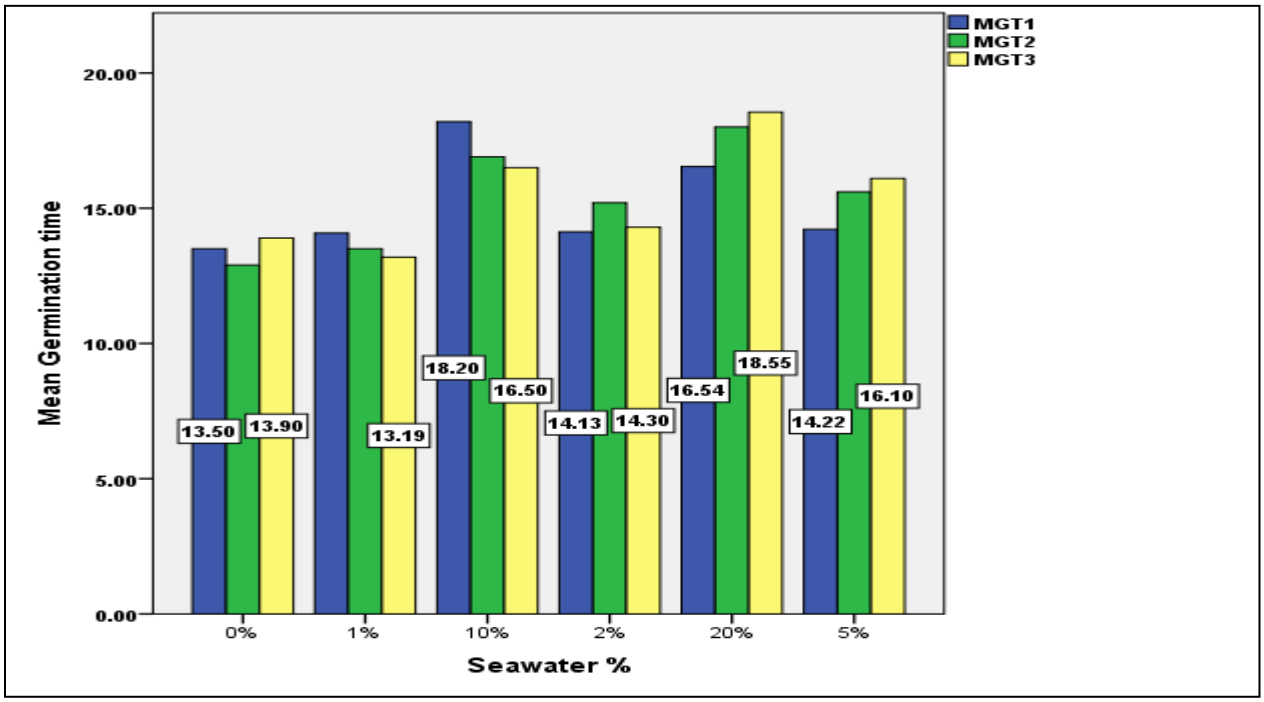

Fig. (4-69): Mean germination time of Acacia seeds treated with H_2SO_4.

4.8.1.2. Estimation of germination percentage:

The germination percentage Acacia seeds pretreated with seawater showed decreased germination percentage by increasing seawater concentration when compared to control treatment which showed higher germination percentage at all treatments.

Table (4-46): Germination percentage at different seawater concentrations for Acacia seeds treated with H_2SO_4 acid.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
0%	66.1905	30.89922	64.7619	29.76895	48.0952	25.61622
1%	47.6190	27.18543	43.8095	21.32515	48.5714	30.70598
2%	34.2857	20.38907	31.9048	20.40075	39.5238	24.18185
5%	27.6190	18.13967	21.9048	18.87301	19.0476	17.00140
10%	21.4286	21.28044	16.1905	17.45743	20.4762	20.36570
20%	13.3333	13.54006	12.8571	17.36170	5.2381	8.13575

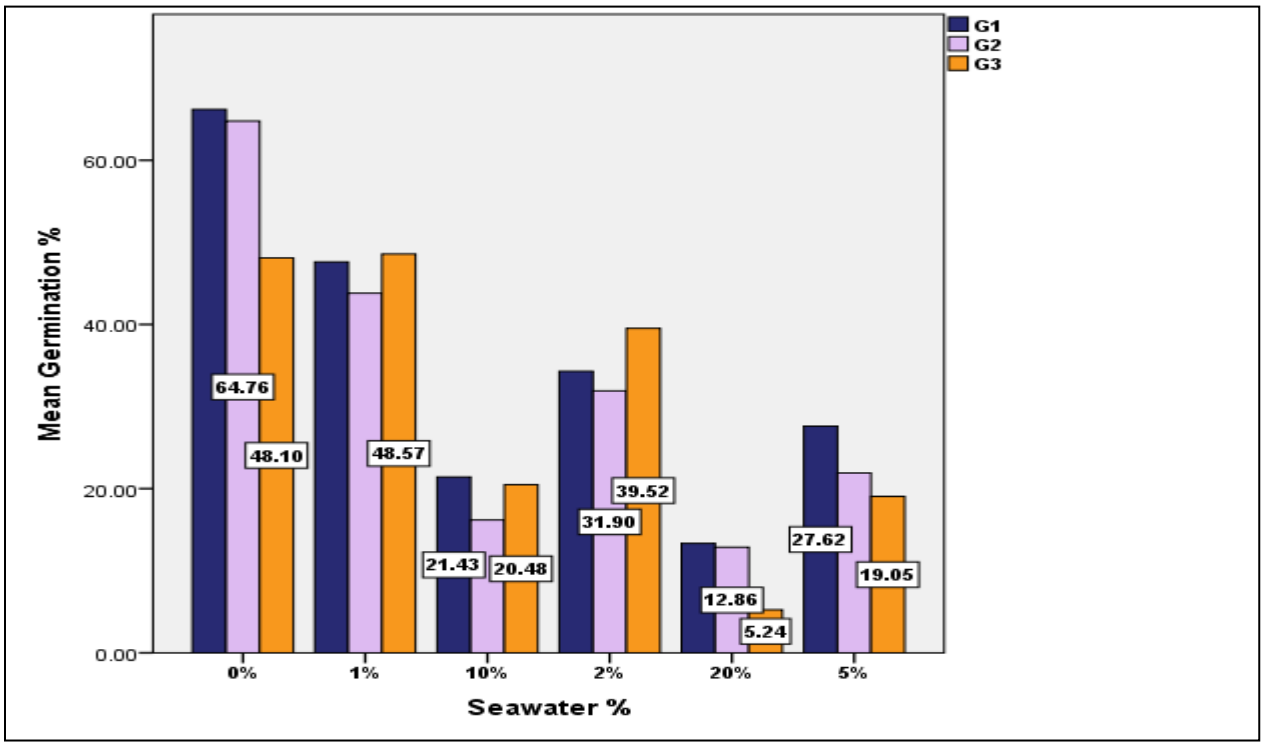

Fig. (4-70): Germination percentage at different seawater concentrations for Acacia seeds treated with H_2SO_4.

4.7.2. Seedling experiment:

4.7.2.1. Seedling vigoros index(SVI):

The seedling vigorous index of Acacia seeds pretreated with sulfuric acid showed significant differences at all treatments compared to control rapid seedling was recorded at the control treatment, reduced seedling speed was recorded as the seawater concentration increased.

Table (4-47): Effect on SVI of Acacia seeds treated with H_2SO_4.

Concentration %	G% 1st treatment		G% 2nd treatment		G% 3rd treatment	
	SVI	Std. deviation	SVI	Std. deviation	SVI	Std. deviation
0%	1650.349	326.022	1463.5133	221.08184	1288.9526	295.67171
1%	839.318	267.1929	990.4421	166.26168	1150.7959	253.05137
2%	653.41	348.786	732.6992	196.71305	746.0000	190.51121
5%	329.393	78.8	267.1963	44.56924	205.0000	95.37250
10%	171.46	68.36	230.5990	22.09708	289.7381	85.32702
20%	102.696	38.09	92.5725	38.25190	49.5000	11.85245

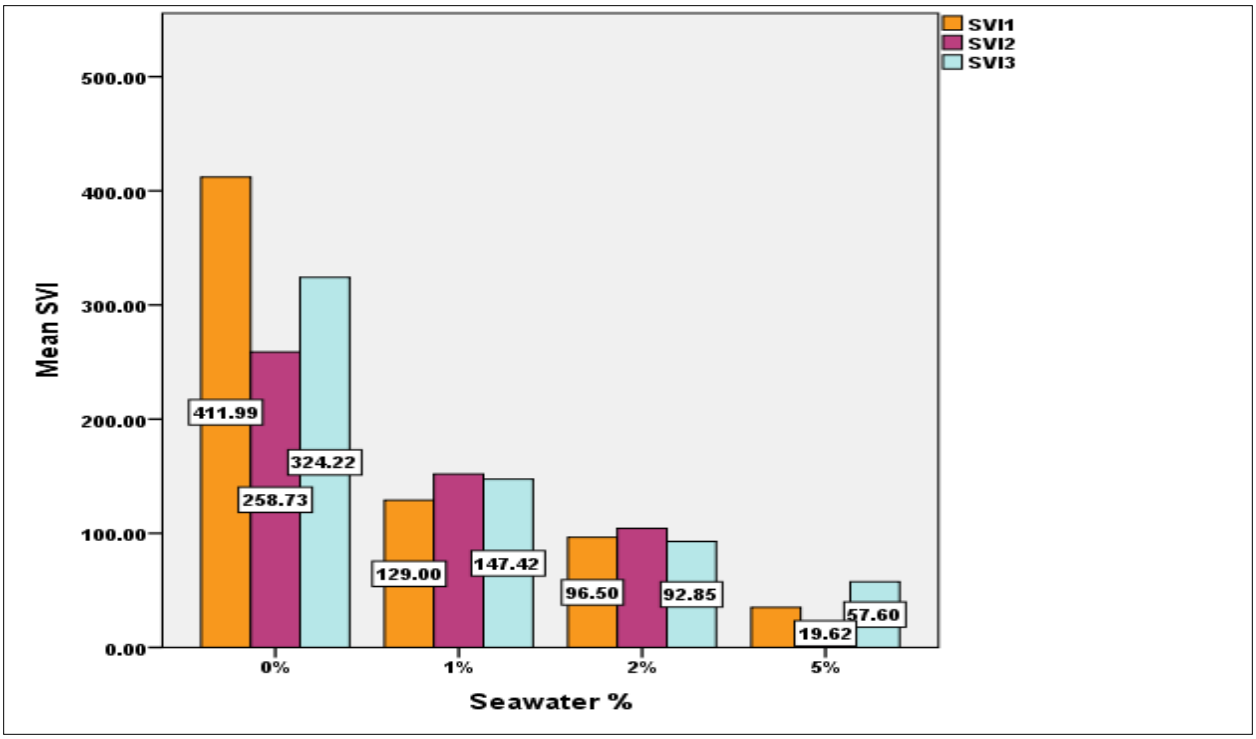

Fig. (4-71): Effect on SVI of Acacia seeds treated with H_2SO_4.

4.8.2.2. Effect on seedling of Acacia seeds treated with H_2SO_4:

Generally all the seedling parameters of Acacia seeds pretreated with H_2SO_4 showed reduction as the concentration of seawater increased compared to the control treatment, highly significant differences in means of all seedlings parameters at all seawater concentration was recorded as shown in the table (4-48), a significant reduction in the means of theses parameters was recorded as the seawater concentration increased.

Table (4-48): Effect on seedling of Acacia seeds treated with H_2SO_4.

Concentration		1st treatment				2nd treatment				3rd treatment			
		RL	RW	SL	SW	RL	RW	SL	SW	RL	RW	SL	SW
0%	N	9	9	9	9	7	7	7	7	9	9	9	9
	Mean	3.3444	0.0610	22.1389	0.0685	2.9143	0.0384	23.8857	0.0607	3.1222	0.0489	22.1583	0.0628
	Std. Dev.	0.55025	0.06010	4.56712	0.01698	0.89940	0.01503	5.35247	0.02457	0.53582	0.03120	4.40527	0.01372
1%	N	6	6	6	6	7	7	7	7	7	7	7	7
	Mean	2.7500	0.0327	16.4083	0.0499	2.6500	0.0388	21.0429	0.0562	2.7571	0.0364	19.4571	0.0550
	Std. Dev.	0.88713	0.01478	5.28918	0.02994	0.82462	0.01327	4.61532	0.02340	0.67681	0.00988	4.37994	0.02550
2%	N	5	5	5	5	6	6	6	6	6	6	6	6
	Mean	2.3200	0.0270	18.1600	0.0143	2.2583	0.0310	16.6167	0.0472	2.3250	0.0292	17.2542	0.0342
	Std. Dev.	1.24780	0.02158	9.73405	0.00416	0.99419	0.01404	4.05607	0.02008	0.73739	0.01463	5.52366	0.01201
5%	N	4	4	4	4	4	4	4	4	4	4	4	4
	Mean	1.7000	0.0225	13.3375	0.0191	1.3000	0.0103	9.4625	0.0166	1.5000	.0150	11.4000	0.0163
	Std. Dev.	0.40620	0.00954	3.21776	0.01255	.75166	0.00686	4.26739	0.00694	0.29368	0.00000	1.96352	0.00479
10%	N	5	5	5	5	5	5	5	5	5	5	5	5
	Mean	1.5000	0.0161	9.0900	0.0508	1.7800	0.0191	12.3700	0.0360	1.6400	0.0160	10.7300	0.0440
	Std. Dev.	0.55340	0.00766	3.93754	0.06895	.81899	0.01050	3.56592	0.01003	0.37980	0.00418	1.46814	0.03471
20%	N	4	4	4	4	2	2	2	2	4	4	4	4
	Mean	0.7250	0.0088	7.2625	0.0087	.6250	0.0083	8.8250	0.0247	.6313	0.0100	7.4750	0.0138
	Std. Dev.	0.38622	0.00367	2.76658	0.00330	.24749	0.00163	2.01525	0.00219	.28385	0.00000	2.63613	0.00479
ANOVA		**0.00**	**0.125**	**0.001**	**0.013**	**0.01**	**0.002**	**0.00**	**0.011**	**0.00**	**0.005**	**0.00**	**0.001**

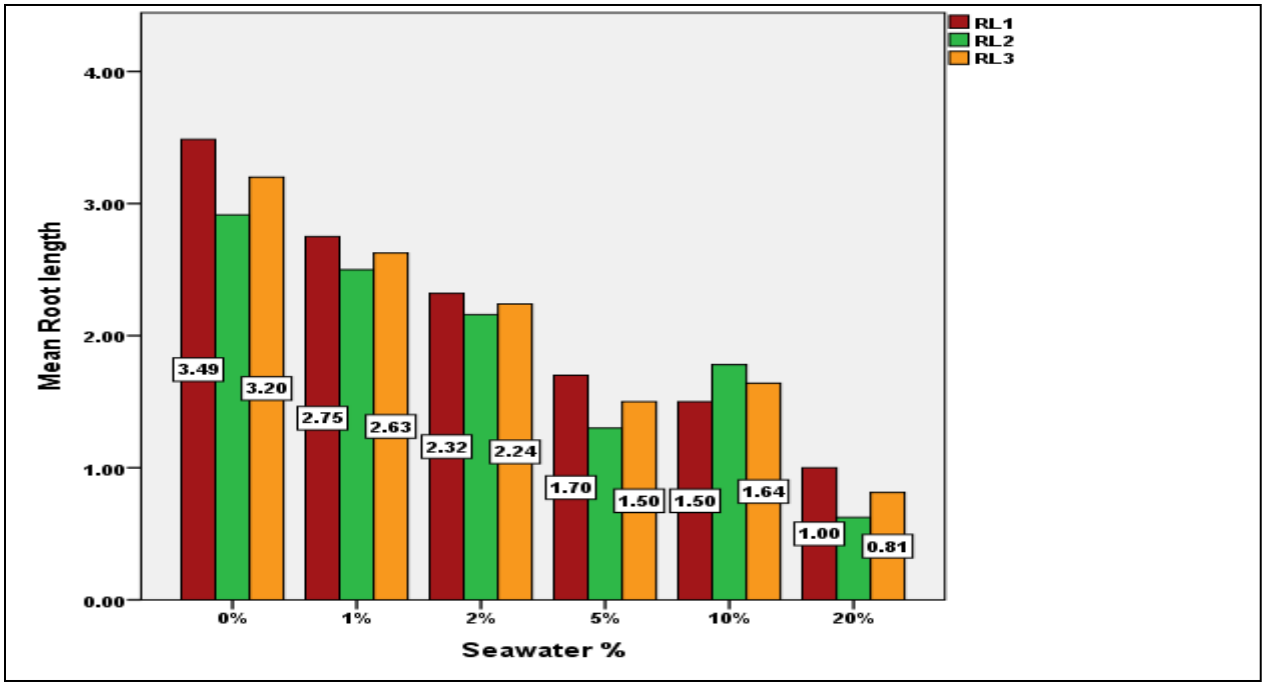

Fig. (4-72): Effect of different seawater concentration on root length of Acacia treated with H_2SO_4.

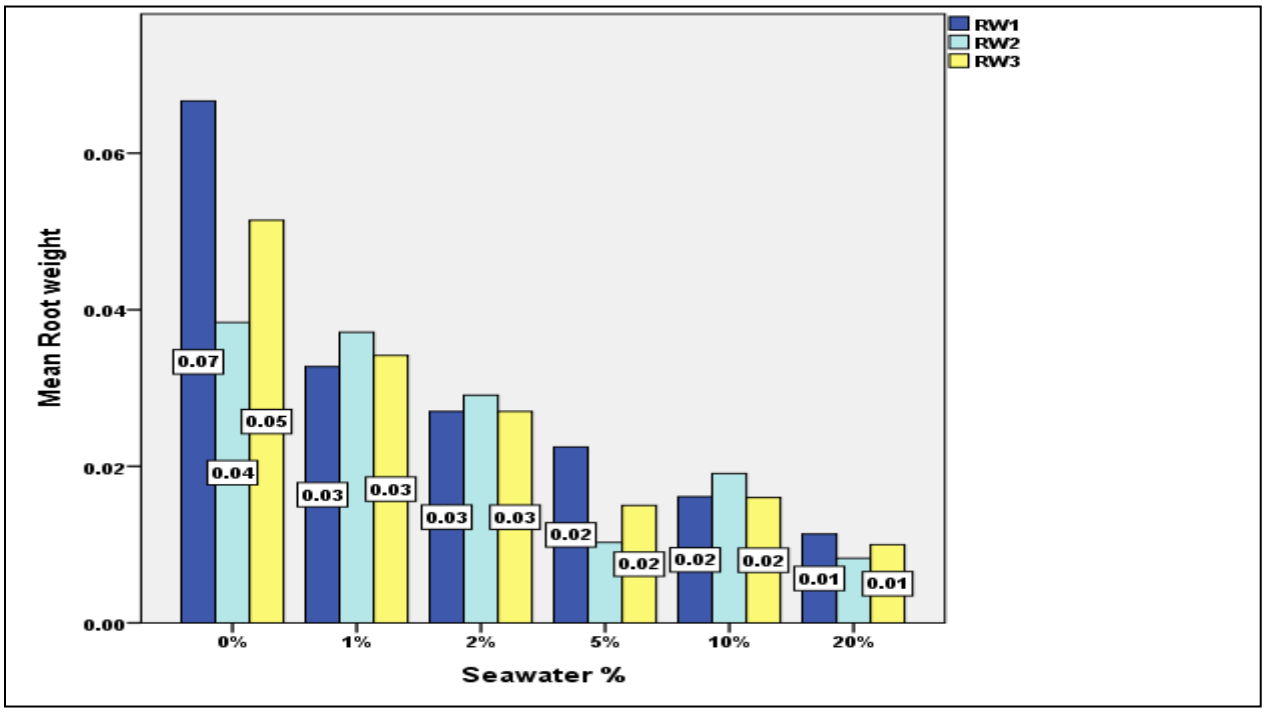

Fig. (4-73): Effect of different seawater concentration on shoot length of Acacia treated with H_2SO_4.

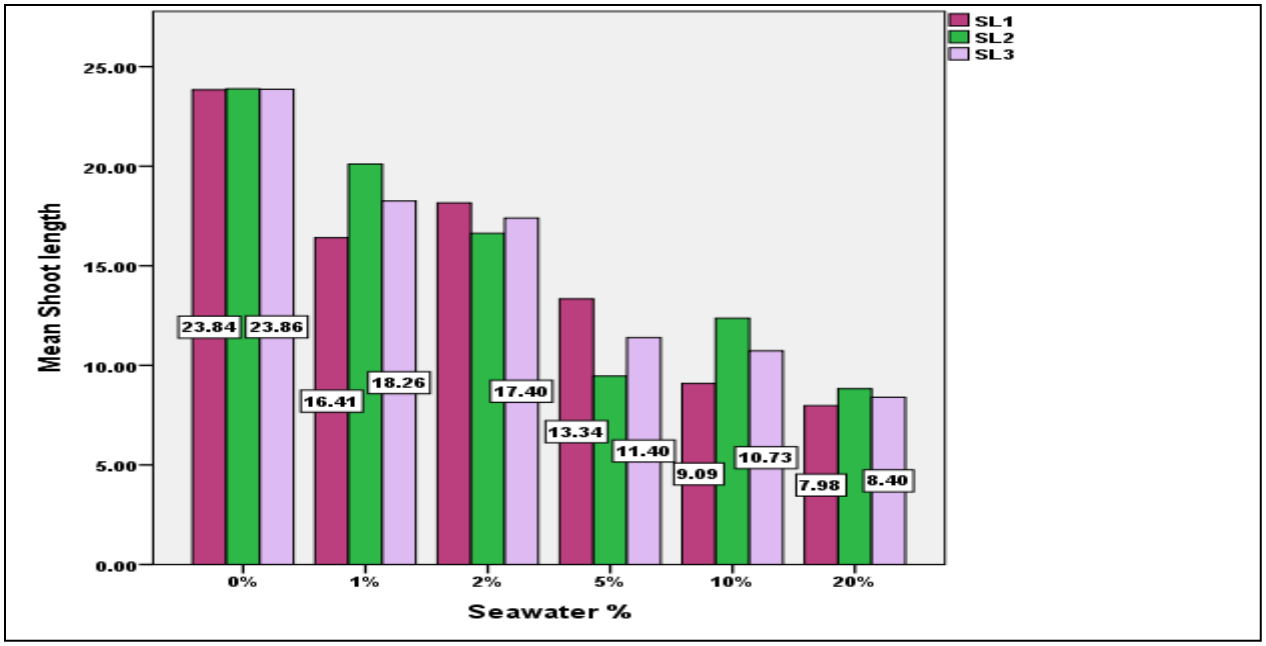

Fig. (4-74): Effect of different seawater concentration on shoot length of Acacia treated with H_2SO_4.

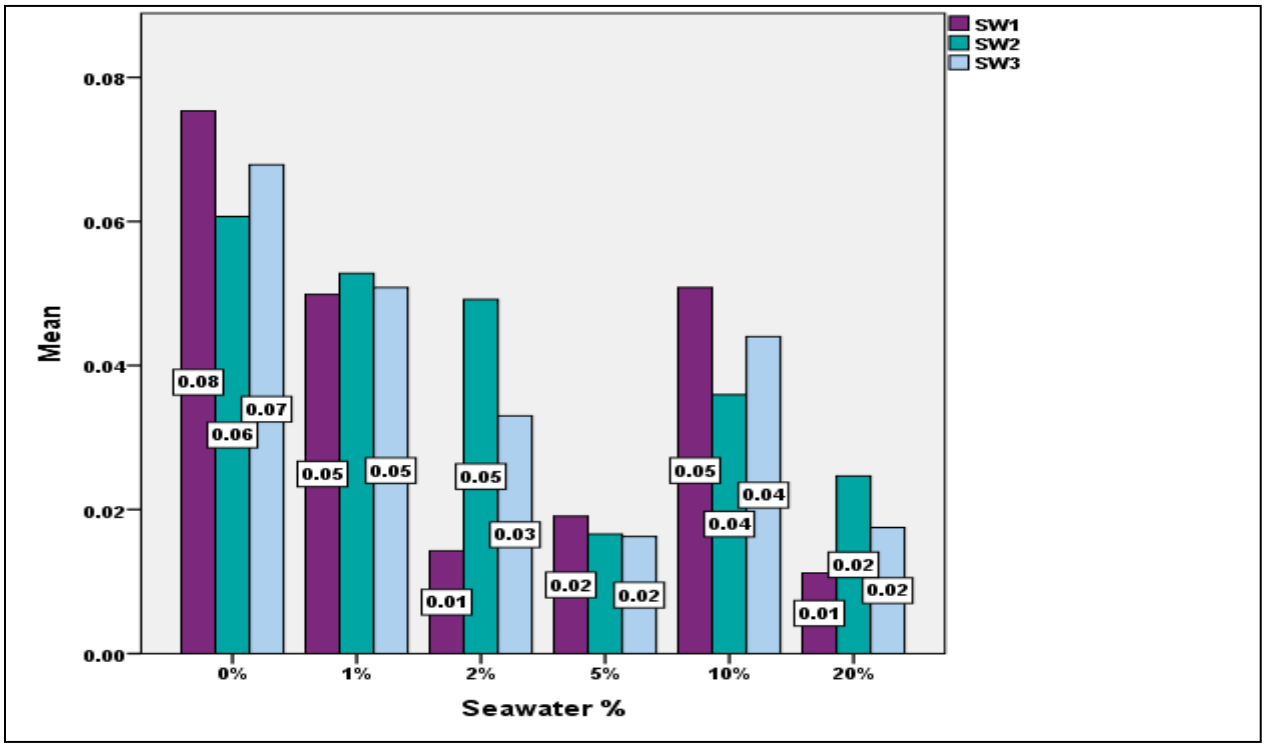

Fig. (4-75): Effect of different seawater concentration on shoot weight of Acacia treated with H_2SO_4.

4.9. Comparisons:

A. Mean germination time:

The figure (4-76) comparing the mean germination time of Acacia seeds at different water concentrations of pretreatments, the shortest mean germination time were noticed in boiled water and hot water pretreatments, longer mean germination times were found in both mechanical scarification especially at higher concentrations of seawater.

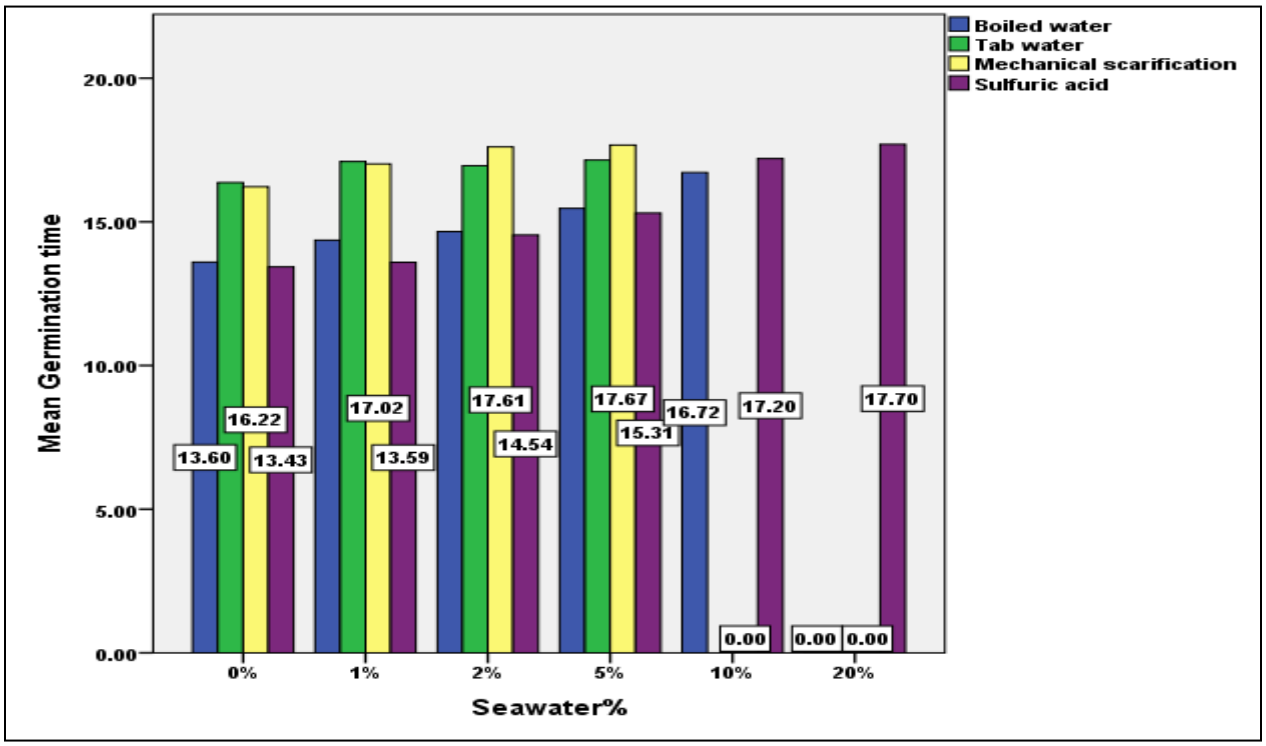

Fig. (4-76): Comparing mean germination time of Acacia at different water concentrations.

B. Germination percentages:

The figure (4-77), comparing germination percentages of Acacia seeds treated with different concentration of seawater for all pretreatments, generally higher percentages of germination were shown in boiled water and tab water pretreatments at all seawater concentrations, whereas mechanical scarification and sulfuric acid pretreatments showed reduced germination percentages especially at higher seawater concentrations.

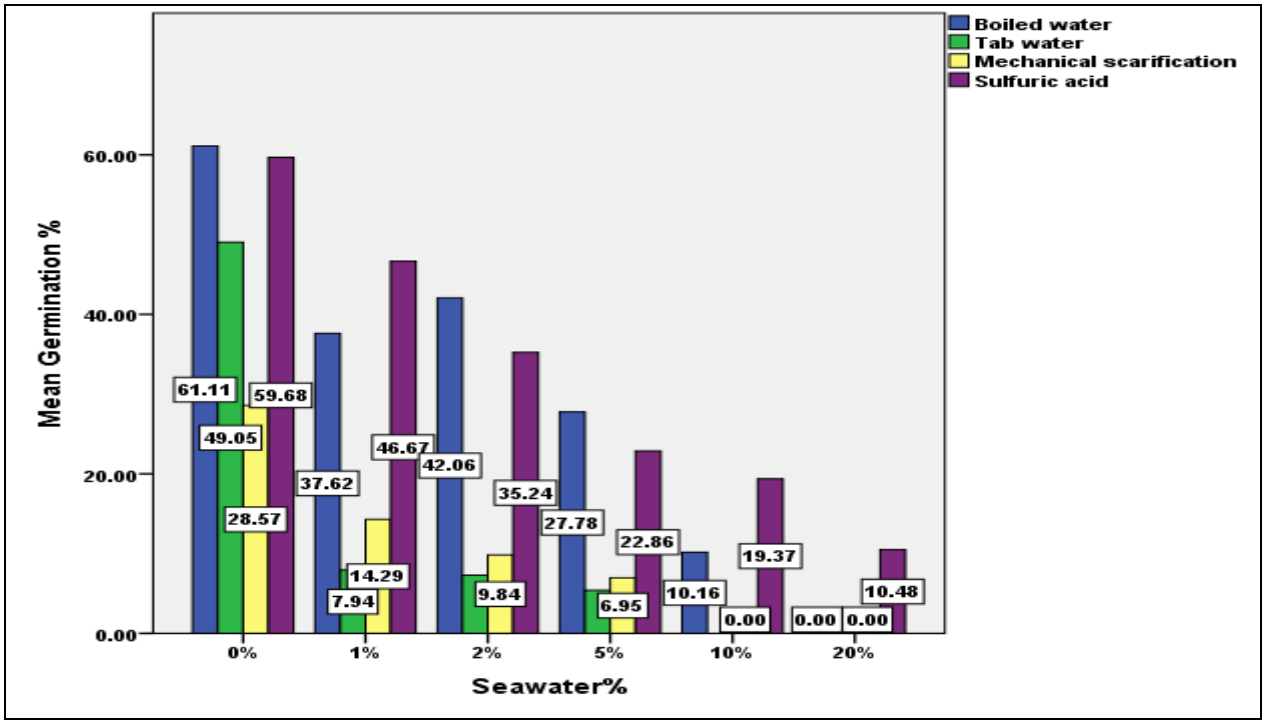

Fig. (4-77): Comparing germination percentages of Acacia at different water concentrations.

C. Seedling vigorus index:

The figure (4-78) describes comparison of seedling vigorus index of Acacia seedlings at different seawater concentrations for all pretreatments, generally higher seedling vigorous index were noticed in both boiling water and tab water at all seawater concentrations, lower seedling vigoros index were shown in both mechanical scarification and sulfuric acid pretreatments especially at higher seawater concentrations

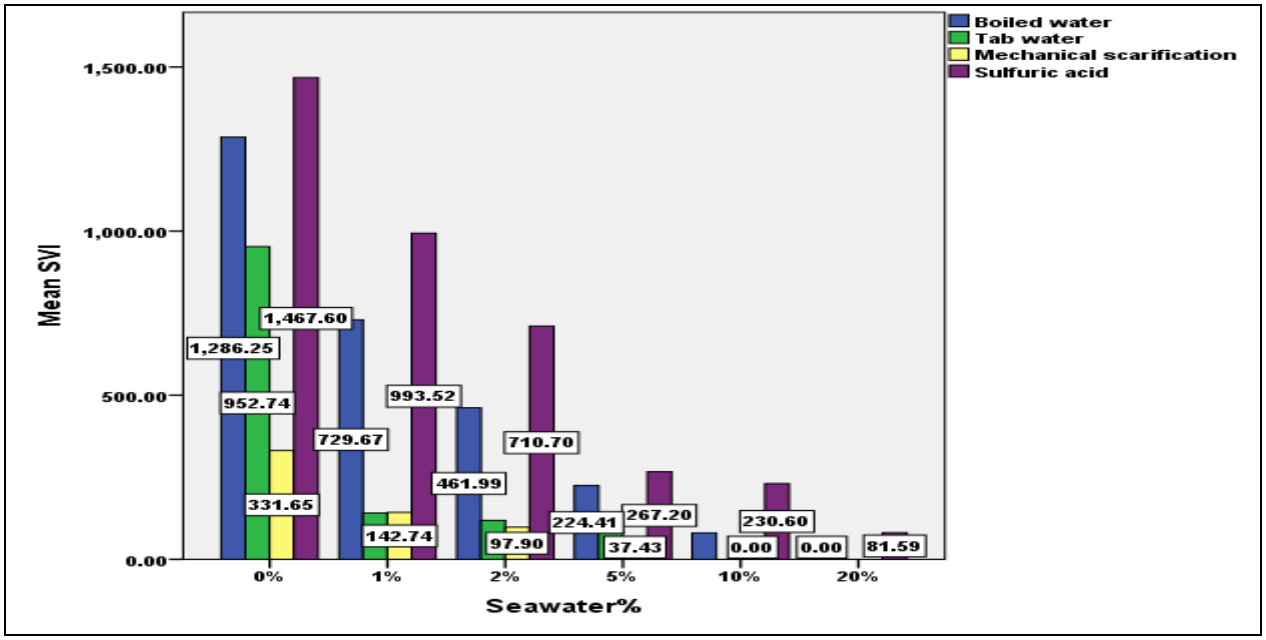

Fig. (4-78): Comparing seedling vigorous index of Acacia at different water concentrations.

Chapter Five

5. Discussion

Salinity inhibits plant growth in many ways. Possible causes for reduction in growth may be water stress, specific ion stress or ion toxicity and induced nutrient deficiency (Wyn Jones, 1981). Plant species and even the varieties of species vary in their salt tolerance at various growth stages. It is, therefore, necessary to identify the differences in salt tolerance among the varieties. Some studies have revealed that a number of ornamental plants can grow at high levels of salinity (Grieve *et al.*, 2005; Shillo *et al.*, 2002) without substantial loss of quality.

Seed germination, as a critical stage in plant life is the most vulnerable to such stresses (Catalan *et al.,* 1994). Successful seedling establishment depends on the frequency and the amount of precipitation as well as the species and the ability of seeds to germinate and grow while soil moisture and osmotic potentials decrease (Roundy, 1987). Germination and seedling characteristics are the most viable criteria used for selecting salt tolerance in plants (Boubaker 1996). It was also reported that *A. Lebbeck* has reasonably good tolerance to drought and salinity (Prinsen ,1986), Hussein S. and Ibrahim (1999) reported that certain Acacia species are tolerant to moderate salinity, Generally the seedling height decrease with increase in. salinity which affects growth and seedling establishment adversely.

The results exhibited that increasing salt concentration interfered with the mean germination potential of *A. Lebbeck* seeds. Final seed germination of Lebbeck pretreated with boiling water showed no significant effect at all concentrations of seawater compared to control which itself showed only 50.7 % and 60.7% germination respectively, higher concentration of seawater irrigation showed no germination 10% and 20%, (Yaseen *et al.,*1990 and 1993) reported similar conclusion in *Sesballia aculeata* varieties and three *Leucaena ieucocephala* varieties respectively. Sudden dip of dry seeds in boiling water may lead to the rapture of the coat wall allowing water to permeate the seed tissues causing physiological changes and subsequent germination of the embryo (Agboola and Etejere, 1991; Agboola and Adedire, 1998; Sabongari, 2001).

Plants that pass through their rest period at low temperature may have their rest broken by warm water baths (Leopold and Kreidman, 1975). Germination decreases when seeds were allowed in water for more than 4 secs, suggesting that embryo may get destroyed on contact with boiling water for a prolonged period.

The seeds of Lebbeck plant pretreated with hot tap water showed significant reduced germination percentage even in the control treatment 42% and 26.4% respectively, which mean hot water treatment reduces the germination percentage. Higher level of salinity showed no germination.

Leebeck seeds subjected to mechanical scarification showed reduced final germination percentage even in the control treatment 17% and 22.8% respectively, which indicated that mechanical scarification of seeds reduces the germination of Lebbeck seeds. Higher level of salinity showed no germination. Seed dormancy resulting from an impermeable seed coat may be overcome by peeling off the coat (Nikoleave, 1977). Germination of seeds whose coat was mechanically scarified is therefore not surprising. Where seed coat is softened, the process of hydrolysis could commence to release simple sugars that could be readily utilized in protein synthesis. Release of hormones such as auxins and ethylene which could increase nucleic acid metabolism and protein synthesis (Irwin, 1982 and Jackson, 1994).

Leebeck seeds pretreated with H2S04 recorded significant increase in the final germination percentage in both treatments at all concentrations compared to the control treatment 24.28% and 32% respectively, but in this treatment germination was noticed in all concentrations of seawater. This indicates that sulfuric acid enhance the germination of Leebeck seeds subjected to salt stress.

Immersion of seed in highest concentrated sulphuric acid disrupts the seed coat. The fact that 98% concentrated sulfuric acid gave the highest percentage of germination and within the shortest period as compared to other pretreatments, indicate that the more rapidly the seed coat is ruptured the faster the rate of germination, however, prolonged Emerson may be injurious to the seeds as the acid may rapture vital parts of the embryo. Sulfuric acid is thought to disrupt the seed coat and expose the lumens of the macrosclereids cells, permitting imbibition of water (Nikoleave, 1977) which triggers germination. In the untreated seeds water may not be available to the embryo. Salts can

affect seed germination either by restricting the supply of water (osmotic effect) or causing specific injury through ions to the metabolic machinery (ionic effect) (Zekri 1993) The major effects of salinity on seed germination could be attributed to decreasing rate and total amount of water absorbed and increasing the entry of certain ions into the seed, which are toxic in high concentration.

Lebbeck showed slight salinity tolerance at germination where less than 50% total germination in most treatments except in case of pretreatment with boiled water sulfuric acid. These results are in disagreement with(Ramoliya and Pandey , 2002 and 2006) and (Hardikar and Pandey 2008) who reported that *A. Lebbeck* are salt tolerant at the seed germination phase of plant growth. High concentration of NaCl causes an osmotic barrier and delays the imbibition stage of germination. Many studies have reported that NaCl can inhibit growth by reducing cell proliferation and cell elongation (Abbasi *et al.,* 2015; Zorb *et al.* 2015; Valenzuela *et al.* 2016)

Mean germination time (MGT) describes the time spread of germination in unit of days. A low value of MGT indicates that the germination is faster when compared to a high value of MGT. Generally, MGT was longer when salinity levels increased because high salinity results in the lowering of water potential during seed imbibition (Cokkizgin 2012; Aamir *et al.,* 2019). Under the control, most seeds germinated between 7-10 days in all the study, no significant differences between the control and the other concentrations in all pretreatments. Mean germination time (MGT), was no affected by salt stress compared to control. This study is in disagreement with (KU-OR *et al*, .2020 which stated that mean germination time increases with higher salinity levels.

Vigor testing does not only measure the percentage of viable seed in a sample, it also reflects the ability of those seeds to produce normal seedlings under less than optimum or adverse growing conditions similar to those which may occur in the field. Seedling vigor index of Lebbeck showed significant decrease in the value with increased seawater concentrations, compared with the control in all pretreatments except in pretreatment with sulfuric acid SVI was not affected by salinity a variety of responses to different sea water concentrations was observed.

The effect of different concentration of seawater on fresh and dry length of Lebbeck shoots and roots in all pretreatments was significant in most treatments Many workers have reported decrease in tree height due to water stress in seedlings

(Metcalfe *et al*., 1990; Steinberg *et al*., 1990; Muhiuddin 1992; Ibrahim
1995; Ibrahim *et al*., 1997- 1998; Srinivasan *et al*., 1989 and Omari 1994). By contrast, Osonubi *et al*., (1992) found that *Faidherbia albida* (*A. albida*) tolerated the drought stress by producing long taproots whereas *A. nilotica* tolerated the drought stress by developing larger root systems able to explore a greater volume of soil. Seiler and Gazell (1990) concluded that extreme soil drying ultimately reduced root growth. This was supported by the results of the present study. Others obtained similar results with acacia species like Pokhriyal *et al*. (1997) working with *A. nilotica;* Awodola (1991) with *A. albida* and *A. seyal*.

The effect of different concentration of seawater on fresh and dry weights of Lebbeck shoots and roots in all pretreatments was significant in most treatments These result were in agreement with (Khalil and Grace ,1992; Pallardy and Rhods, 1993; Ibrahim, 1995; Aref and El-Juhany, 2001). Such reduction in root fresh and dry weight might be due to a decrease in water uptake and osmotic potential under salt stress, which directly affects the growth and development of plants (Terry and Waldron, 1984; Riaz *et al*., 2010).

Mean germination time of acacia seeds at different pretreatments and different seawater concentration showed that no significant differences in mean germination time when seeds pretreated with boiled water at al seawater concentration when compared to control, generally mean germination time delayed as seawater concentration had increased, no growth was recorded at higher seawater concentration 20% except in seeds pretreated with sulfuric acid, at 10% seawater concentration only seeds pretreated with boiled water and sulfuric acid, generally the sulfuric acid enhances the germination time better than boiled water.

Germination percentages of acacia seeds pretreated with boiled water showed higher percentages of germination compared with the other pretreatments followed by sulfuric acid pretreatment, generally the germination percentages were drastically reduced as

seawater concentration increased in all pretreatments, seeds pretreated with sulfuric acid showed some seed germination at high concentration 20% .This result is in agreement with (Unger, 1991; Zekri, 1993; Hussein and Ibrahim, 1999) who reported that salinization results in delayed seed germination; the activity of solution constituents including water is reduced by the increase of ionic strength (salt concentration), the results was in disagreement with (Nasreldin *et al*., 2013) who reported that higher seeds germination were recorded in seeds pretreated with fresh water. The effect of the external salinity on the seed germination may be partially osmotic or ion toxicity which can alter physiological processes such as enzyme activation (El-Keblawy, 2004; Chinnusamy *et al*., 2005; Nichols *et al*., 2009). This toxic effect can lead to metabolic processes changes in seedlings and at the extreme case in the death of embryo by ion accumulation (El-Keblawy, 2004). The osmotic or toxic effect can be verified by salinity recovery test (Khelouf *et al*., 2016b).

in Acacia, faster seedlings vigorous indexes were recorded in seeds pretreated with sulfuric acid, followed by boiled water, slower seedlings were recorded in mechanical scarification. Seedling development parameters generally affected by the concentration of seawater applied to seeds from the start of the study. In all pretreatments, reduced root and shoot length, seeds dry and fresh weights were recorded as seawater concentration had increased drastically with significant differences in the means of theses parameters recorded only in boiled water and sulfuric acid pretreatments. This results were in agreement with (Ragab ,1996) who reported that salinity does not affect the crop performance significantly until the threshold salinity is reduced, beyond this the growth decreased linearly as the salinity increased. The reduction of the dry weights due to increased salinity may be a result of a combination of osmotic and specific ion effects (Khan *et al*., 2015). One of the initial effects of salinity on plants is the reduction of growth rate (Munns *et al*., 1995). These results are in agreement with the findings of (Hirich et al., 2014) who reported a significant decline in shoot length at high salinity levels. Huffaker and Rains (1989) reported that, the salinity problems inhibit the uptake of eventual macronutrients such as nitrate and ammonium and inorganic phosphorus needed for seedlings.

Conclusion

1. Mean germination time of both plants was slightly delayed with increased seawater concentrations ranging between (7-10 days) for Lebbeck and (12-18 days) for Acaica.
2. Germination percentage of both plants decreased with increased seawater concentrations, at concentrations of (10% and 20%), no germination percentages which revealed that both plants not tolerate seawater concentrations.
3. Seedling vigor index showed significant reduction at increased sea water concentration in both plants.
4. This study revealed that both fresh and dry lengths of shoot and root were negatively affected by seawater concentrations, shoot were more sensitive to seawater concentrations than roots.
5. Both fresh and dry weights of *Lebbeck* shoot systems were decreased with increased seawater concentrations and this decrease was significant.
6. Both fresh and dry weights of *Acacia* root systems were decreased with increased seawater concentrations level, but this reduction was not significant compared with the control treatment. Decreased dry weights of roots revealed that did not tolerate seawater concentrations.
7. Sulfuric acid pretreatment enhance germination of seeds of both plants even at higher concentrations (10% and 20%).

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Appendix

1. Lebbeck: Boiled water

A. Germination %

1st treatment: boiled water G%

Statistics							
Treatment		0%	1%	2%	5%	10%	20%
M1	Valid	14	14	14	14	14	14
	Missing	0	0	0	0	0	0
Mean		50.7143	52.8571	54.2857	10.0000	.0000	.0000
Std. Deviation		30.49950	25.24604	31.30846	14.14214	.00000	.00000

2nd treatment: boiled water G%

Statistics								
Treatment			0%	1%	2%	5%	10%	20%
M2	N	Valid	14	14	14	14	14	14
		Missing	0	0	0	0	0	0
	Mean		60.7143	60.0000	49.2857	46.4286	.0000	.0000
	Std. Deviation		28.67974	36.58499	27.58603	39.92438	.00000	.00000

B. Seedling 1st treatment:

Statistics:										
Concentration			LSF	LSD	LRF	LRD	WSF	WSD	WRF	WRD
0%			8	8	8	8	8	8	8	8
			0	0	0	0	0	0	0	0
	Mean		6.3125	5.3125	4.8875	4.088	.069650	.011025	.007138	.003200
	Std. Deviation		2.39370	2.15369	1.61195	1.1993	.020459	.002302	.005743	.001087
1%	N	Valid	7	7	7	7	7	7	7	7
		Missing	0	0	0	0	0	0	0	0
	Mean		4.2286	3.2286	3.0143	2.100	.048950	.009600	.039271	.004100
	Std. Deviation		1.65400	1.42093	1.59836	1.5330	.046494	.003254	.069763	.002786
2%	N	Valid	8	8	8	8	8	8	8	8
		Missing	0	0	0	0	0	0	0	0
	Mean		3.7875	3.0250	2.5250	1.659	.157863	.008150	.016800	.003987
	Std. Deviation		1.37989	1.29035	.82245	.6413	.204771	.001463	.002985	.003012

a. Effect on shoot fresh length: 1st treatment

ANOVA					
LSF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28.788	2	14.394	4.121	.032
Within Groups	69.852	20	3.493		
Total	98.640	22			

Multiple Comparisons								
LSF LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.08393*	.96722	.044	.0663	4.1015
			2%	2.52500*	.93442	.014	.5758	4.4742
	1%	dimension3	0%	-2.08393-*	.96722	.044	-4.1015-	-.0663-
			2%	.44107	.96722	.653	-1.5765-	2.4587
	2%	dimension3	0%	-2.52500-*	.93442	.014	-4.4742-	-.5758-
			1%	-.44107-	.96722	.653	-2.4587-	1.5765
*. The mean difference is significant at the 0.05 level.								

b. Effect on shoot dry length: 1st treatment

ANOVA					
LSD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	25.235	2	12.618	4.487	.025
Within Groups	56.238	20	2.812		
Total	81.473	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.08393*	.86786	.026	.2736	3.8943
			2%	2.28750*	.83844	.013	.5386	4.0364
	1%	dimension3	0%	-2.08393-*	.86786	.026	-3.8943-	-.2736-
			2%	.20357	.86786	.817	-1.6068-	2.0139
	2%	dimension3	0%	-2.28750-*	.83844	.013	-4.0364-	-.5386-
			1%	-.20357-	.86786	.817	-2.0139-	1.6068
*. The mean difference is significant at the 0.05 level.								

c. Effect on root fresh length: 1st treatment

ANOVA					
LRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.657	2	12.329	6.446	.007
Within Groups	38.252	20	1.913		
Total	62.910	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	1.87321*	.71576	.017	.3802	3.3663
			2%	2.36250*	.69149	.003	.9201	3.8049
	1%	dimension3	0%	-1.87321-*	.71576	.017	-3.3663-	-.3802-
			2%	.48929	.71576	.502	-1.0038-	1.9823
	2%	dimension3	0%	-2.36250-*	.69149	.003	-3.8049-	-.9201-
			1%	-.48929-	.71576	.502	-1.9823-	1.0038
*. The mean difference is significant at the 0.05 level.								

d. Effect on root dry length: 1st treatment

ANOVA					
LRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	26.506	2	13.253	9.800	.001
Within Groups	27.048	20	1.352		
Total	53.554	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	1.9875*	.6019	.004	.732	3.243
			2%	2.4288*	.5815	.000	1.216	3.642
	1%	dimension 3	0%	-1.9875-*	.6019	.004	-3.243-	-.732-
			2%	.4413	.6019	.472	-.814-	1.697
	2%	dimension 3	0%	-2.4288-*	.5815	.000	-3.642-	-1.216-
			1%	-.4413-	.6019	.472	-1.697-	.814
*. The mean difference is significant at the 0.05 level.								

e. Effect on fresh shoot weight: 1st treatment

ANOVA					
WSF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.052	2	.026	1.667	.214
Within Groups	.309	20	.015		
Total	.361	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.0207000	.0643739	.751	-.113582-	.154982
			2%	-.0882125-	.0621911	.171	-.217941-	.041516
	1%	dimension3	0%	-.0207000-	.0643739	.751	-.154982-	.113582
			2%	-.1089125-	.0643739	.106	-.243194-	.025369
	2%	dimension3	0%	.0882125	.0621911	.171	-.041516-	.217941
			1%	.1089125	.0643739	.106	-.025369-	.243194

f. Effect of dry shoot weight: 1st treatment

ANOVA					
WSD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	2	.000	2.859	.081
Within Groups	.000	20	.000		
Total	.000	22			

g. Effect on fresh root weigh: 1st treatment

ANOVA					
WRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.004	2	.002	1.357	.280
Within Groups	.029	20	.001		
Total	.033	22			

Multiple Comparisons								
WRF LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.0321339-	.0198751	.122	-.073593-	.009325
			2%	-.0096625-	.0192012	.620	-.049716-	.030391
	1%	dimension3	0%	.0321339	.0198751	.122	-.009325-	.073593
			2%	.0224714	.0198751	.272	-.018987-	.063930
	2%	dimension3	0%	.0096625	.0192012	.620	-.030391-	.049716
			1%	-.0224714-	.0198751	.272	-.063930-	.018987

h. Effect on dry root weight: 1st treatment

ANOVA					
WRD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.000	2	.000	.315	.733
Within Groups	.000	20	.000		
Total	.000	22			

Multiple Comparisons								
WRD LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.0009000-	.0012593	.483	-.003527-	.001727
			2%	-.0007875-	.0012166	.525	-.003325-	.001750
	1%	dimension3	0%	.0009000	.0012593	.483	-.001727-	.003527
			2%	.0001125	.0012593	.930	-.002514-	.002739
	2%	dimension3	0%	.0007875	.0012166	.525	-.001750-	.003325
			1%	-.0001125-	.0012593	.930	-.002739-	.002514

Seedling: 2nd treatment

Statistics										
Concentration			LSF	LSD	LRF	LRD	WSF	WSD	WRF	WRD
0%	N	Valid	8	8	8	8	8	8	8	8
		Missing	0	0	0	0	0	0	0	0
	Mean		6.9875	4.6625	4.7375	3.4500	.1623	.0090	.1131	.0024
	Std. Deviation		2.42218	1.35429	1.62035	1.09022	.05099	.00204	.19331	.00082
1%	N	Valid	9	9	9	9	9	9	9	9
		Missing	0	0	0	0	0	0	0	0
	Mean		3.4667	3.0333	1.7556	1.1889	.0858	.0083	.0118	.0015
	Std. Deviation		2.23942	2.06458	.85894	.50854	.04892	.00373	.01595	.00087
2%	N	Valid	7	7	7	7	7	7	7	7
		Missing	0	0	0	0	0	0	0	0
	Mean		2.8000	1.9857	1.4429	.9714	.0540	.0058	.0047	.0020
	Std. Deviation		1.80739	1.32467	.74354	.48892	.04210	.00222	.00316	.00141

a. Effect on shoot fresh length: 2nd treatment

LSF

ANOVA					
LSF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	79.271	2	39.635	8.258	.002
Within Groups	100.789	21	4.799		
Total	180.060	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	3.52083*	1.06452	.003	1.3070	5.7346
			2%	4.18750*	1.13383	.001	1.8296	6.5454
	1%	dimension 3	0%	-3.52083-*	1.06452	.003	-5.7346-	-1.3070-
			2%	.66667	1.10404	.552	-1.6293-	2.9627
	2%	dimension 3	0%	-4.18750-*	1.13383	.001	-6.5454-	-1.8296-
			1%	-.66667-	1.10404	.552	-2.9627-	1.6293
*. The mean difference is significant at the 0.05 level.								

b. Effect on shoot dry length: 2nd treatment

ANOVA					
LSD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	27.562	2	13.781	5.036	.016
Within Groups	57.467	21	2.737		
Total	85.030	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension 2	0%	dimension 3	1%	1.62917	.80382	.056	-.0425-	3.3008
			2%	2.67679*	.85616	.005	.8963	4.4573
	1%	dimension 3	0%	-1.62917-	.80382	.056	-3.3008-	.0425
			2%	1.04762	.83366	.223	-.6861-	2.7813
	2%	dimension 3	0%	-2.67679-*	.85616	.005	-4.4573-	-.8963-
			1%	-1.04762-	.83366	.223	-2.7813-	.6861
*. The mean difference is significant at the 0.05 level.								

c. Effect on root fresh length: 2nd treatment

ANOVA					
LRF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	52.260	2	26.130	19.883	.000
Within Groups	27.598	21	1.314		
Total	79.858	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.98194*	.55704	.000	1.8235	4.1404
			2%	3.29464*	.59331	.000	2.0608	4.5285
	1%	dimension3	0%	-2.98194-*	.55704	.000	-4.1404-	-1.8235-
			2%	.31270	.57772	.594	-.8887-	1.5141
	2%	dimension3	0%	-3.29464-*	.59331	.000	-4.5285-	-2.0608-
			1%	-.31270-	.57772	.594	-1.5141-	.8887
*. The mean difference is significant at the 0.05 level.								

d. Effect on root dry length: 2nd treatment

ANOVA					
LRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	29.796	2	14.898	26.462	.000
Within Groups	11.823	21	.563		
Total	41.620	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.26111*	.36460	.000	1.5029	3.0193
			2%	2.47857*	.38834	.000	1.6710	3.2862
	1%	dimension3	0%	-2.26111-*	.36460	.000	-3.0193-	-1.5029-
			2%	.21746	.37814	.571	-.5689-	1.0038
	2%	dimension3	0%	-2.47857-*	.38834	.000	-3.2862-	-1.6710-
			1%	-.21746-	.37814	.571	-1.0038-	.5689
*. The mean difference is significant at the 0.05 level.								

e. Effect on shoot fresh weight: 2nd treatment

ANOVA					
WSF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.048	2	.024	10.411	.001
Within Groups	.048	21	.002		
Total	.096	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.07650*	.02323	.003	.0282	.1248
			2%	.10829*	.02474	.000	.0568	.1597
	1%	dimension3	0%	-.07650-*	.02323	.003	-.1248-	-.0282-
			2%	.03179	.02409	.201	-.0183-	.0819
	2%	dimension3	0%	-.10829-*	.02474	.000	-.1597-	-.0568-
			1%	-.03179-	.02409	.201	-.0819-	.0183
*. The mean difference is significant at the 0.05 level.								

f. Effect on shoot dry weight: 2nd treatment

ANOVA					
WSD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	2	.000	2.517	.105
Within Groups	.000	21	.000		
Total	.000	23			

Multiple Comparisons								
WSD LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.00065	.00138	.643	-.0022-	.0035
			2%	.00315*	.00147	.044	.0001	.0062
	1%	dimension3	0%	-.00065-	.00138	.643	-.0035-	.0022
			2%	.00250	.00144	.096	-.0005-	.0055
	2%	dimension3	0%	-.00315-*	.00147	.044	-.0062-	-.0001-
			1%	-.00250-	.00144	.096	-.0055-	.0005
*. The mean difference is significant at the 0.05 level.								

g. Effect on root fresh weight: 2nd treatment

ANOVA					
WRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.058	2	.029	2.324	.123
Within Groups	.264	21	.013		
Total	.322	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.10132	.05445	.077	-.0119-	.2146
			2%	.10843	.05799	.076	-.0122-	.2290
	1%	dimension3	0%	-.10132-	.05445	.077	-.2146-	.0119
			2%	.00711	.05647	.901	-.1103-	.1245
	2%	dimension3	0%	-.10843-	.05799	.076	-.2290-	.0122
			1%	-.00711-	.05647	.901	-.1245-	.1103

h. Effect on root dry weight: 2nd treatment

ANOVA					
WRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	2	.000	1.551	.235
Within Groups	.000	21	.000		
Total	.000	23			

Multiple Comparisons								
LSD								
(I) concentration		(J) concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.00089	.00051	.093	-.0002-	.0019
			2%	.00043	.00054	.437	-.0007-	.0015
	1%	dimension3	0%	-.00089-	.00051	.093	-.0019-	.0002
			2%	-.00046-	.00053	.387	-.0016-	.0006
	2%	dimension3	0%	-.00043-	.00054	.437	-.0015-	.0007
			1%	.00046	.00053	.387	-.0006-	.0016

2. Hot tap water

A. Germination %:

1st treatment:

Statistics[a]							
		0%	1%	2%	5%	10%	20%
N	Valid	14	14	14	14	14	14
	Missing	0	0	0	0	0	0
Mean		42.1429	40.7143	25.0000	6.4286	.0000	.0000
Std. Deviation		15.28125	18.59044	10.91928	4.97245	.00000	.00000
a. Treatment = treatment1							

2nd treatment:

Statistics[a]							
		0%	1%	2%	5%	10%	20%
N	Valid	14	13	13	14	14	14
	Missing	0	1	1	0	0	0
Mean		26.4286	12.6923	27.6923	.0000	.0000	.0000
Std. Deviation		9.28783	13.93667	5.99145	.00000	.00000	.00000

B. Seedling: 1st treatment

Statistics									
Concentration			LSF	LSD	LRF	LRD	WSF	WSD	WRF	WRD
1	N	Valid	5	5	5	5	5	5	5	5
		Missing	0	0	0	0	0	0	0	0
	Mean		7.1000	6.0800	4.6400	3.4000	.1588	.0099	.0436	.0065
	Std. Deviation		1.52315	1.46356	1.10589	.74162	.02594	.00204	.00403	.00962
2	N	Valid	5	5	5	5	5	5	5	5
		Missing	0	0	0	0	0	0	0	0
	Mean		5.7000	4.9400	1.9800	1.0400	.1282	.0151	.0238	.0047
	Std. Deviation		1.26886	1.30115	.46583	.08944	.01843	.00668	.03025	.00837
3	N	Valid	3	3	3	3	3	3	3	3
		Missing	0	0	0	0	0	0	0	0
	Mean		2.3333	1.9667	1.0667	.8000	.0647	.0062	.0100	.0008
	Std. Deviation		1.89297	1.77858	.20817	.26458	.03443	.00231	.00265	.00026

a. Effect on shoot fresh length: 1st treatment

ANOVA					
LSF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	43.064	2	21.532	9.408	.005
Within Groups	22.887	10	2.289		
Total	65.951	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	1.40000	.95680	.174	-.7319-	3.5319
			2%	4.76667*	1.10482	.002	2.3050	7.2284
	1%	dimension3	0%	-1.40000-	.95680	.174	-3.5319-	.7319
			2%	3.36667*	1.10482	.012	.9050	5.8284
	2%	dimension3	0%	-4.76667-*	1.10482	.002	-7.2284-	-2.3050-
			1%	-3.36667-*	1.10482	.012	-5.8284-	-.9050-
*. The mean difference is significant at the 0.05 level.								

b. Effect on shoot dry length: 1st treatment

ANOVA					
LSD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.223	2	16.111	7.436	.011
Within Groups	21.667	10	2.167		
Total	53.889	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	1.14000	.93095	.249	-.9343-	3.2143
			2%	4.11333*	1.07497	.003	1.7182	6.5085
	1%	dimension3	0%	-1.14000-	.93095	.249	-3.2143-	.9343
			2%	2.97333*	1.07497	.020	.5782	5.3685
	2%	dimension3	0%	-4.11333-*	1.07497	.003	-6.5085-	-1.7182-
			1%	-2.97333-*	1.07497	.020	-5.3685-	-.5782-
*. The mean difference is significant at the 0.05 level.								

c. Effect on root fresh length: 1st treatment

ANOVA					
LRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	29.303	2	14.651	25.059	.000
Within Groups	5.847	10	.585		
Total	35.149	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.66000*	.48360	.000	1.5825	3.7375
			2%	3.57333*	.55841	.000	2.3291	4.8175
	1%	dimension3	0%	-2.66000-*	.48360	.000	-3.7375-	-1.5825-
			2%	.91333	.55841	.133	-.3309-	2.1575
	2%	dimension3	0%	-3.57333-*	.55841	.000	-4.8175-	-2.3291-
			1%	-.91333-	.55841	.133	-2.1575-	.3309
*. The mean difference is significant at the 0.05 level.								

d. Effect on root dry length: 1st treatment

ANOVA					
LRD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	18.577	2	9.289	39.159	.000
Within Groups	2.372	10	.237		
Total	20.949	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.36000*	.30803	.000	1.6737	3.0463
			2%	2.60000*	.35568	.000	1.8075	3.3925
	1%	dimension3	0%	-2.36000-*	.30803	.000	-3.0463-	-1.6737-
			2%	.24000	.35568	.515	-.5525-	1.0325
	2%	dimension3	0%	-2.60000-*	.35568	.000	-3.3925-	-1.8075-
			1%	-.24000-	.35568	.515	-1.0325-	.5525
*. The mean difference is significant at the 0.05 level.								

e. Effect on shoot fresh weight: 1st treatment

ANOVA					
WSF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.017	2	.008	12.992	.002
Within Groups	.006	10	.001		
Total	.023	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.03060	.01603	.085	-.0051-	.0663
			2%	.09413*	.01850	.000	.0529	.1354
	1%	dimension3	0%	-.03060-	.01603	.085	-.0663-	.0051
			2%	.06353*	.01850	.006	.0223	.1048
	2%	dimension3	0%	-.09413-*	.01850	.000	-.1354-	-.0529-
			1%	-.06353-*	.01850	.006	-.1048-	-.0223-
*. The mean difference is significant at the 0.05 level.								

f. Effect on shoot dry weight: 1st treatment

ANOVA					
WSD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.000	2	.000	3.853	.057
Within Groups	.000	10	.000		
Total	.000	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.00516-	.00287	.102	-.0116-	.0012
			2%	.00373	.00331	.286	-.0036-	.0111
	1%	dimension3	0%	.00516	.00287	.102	-.0012-	.0116
			2%	.00889*	.00331	.023	.0015	.0163
	2%	dimension3	0%	-.00373-	.00331	.286	-.0111-	.0036
			1%	-.00889-*	.00331	.023	-.0163-	-.0015-
*. The mean difference is significant at the 0.05 level.								

g. Effect on root fresh weight: 1st treatment

ANOVA					
WRF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.002	2	.001	3.048	.093
Within Groups	.004	10	.000		
Total	.006	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.01982	.01223	.136	-.0074-	.0471
			2%	.03362*	.01412	.039	.0022	.0651
	1%	dimension3	0%	-.01982-	.01223	.136	-.0471-	.0074
			2%	.01380	.01412	.352	-.0177-	.0453
	2%	dimension3	0%	-.03362-*	.01412	.039	-.0651-	-.0022-
			1%	-.01380-	.01412	.352	-.0453-	.0177
*. The mean difference is significant at the 0.05 level.								

h. Effect on root dry weight: 1st treatment

ANOVA					
WRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	2	.000	.465	.641
Within Groups	.001	10	.000		
Total	.001	12			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	.00174	.00510	.740	-.0096-	.0131
			2%	.00566	.00589	.359	-.0075-	.0188
	1%	dimension 3	0%	-.00174-	.00510	.740	-.0131-	.0096
			2%	.00392	.00589	.521	-.0092-	.0170
	2%	dimension 3	0%	-.00566-	.00589	.359	-.0188-	.0075
			1%	-.00392-	.00589	.521	-.0170-	.0092

C. Seedling 2nd treatment

Statistics									
Concentration			LSF	LSD	LRF	LRD	WSF	WSD	WRF	WRD
0%	N	Valid	3	3	3	3	3	3	3	3
		Missing	0	0	0	0	0	0	0	0
	Mean		6.8333	6.0333	3.0000	2.5333	.1261	.0753	.0283	.0026
	Std. Deviation		.30551	.35119	.50000	.45092	.02210	.02021	.00550	.00139
1%	N	Valid	5	5	5	5	5	5	5	5
		Missing	0	0	0	0	0	0	0	0
	Mean		4.4200	3.9000	2.0400	1.6400	.0750	.0284	.0087	.0045
	Std. Deviation		2.00175	1.90263	.28810	.31305	.04261	.03232	.00533	.00272
2%	N	Valid	3	3	3	3	3	3	3	3
		Missing	0	0	0	0	0	0	0	0
	Mean		6.3667	5.9000	1.9333	1.5333	.1320	.0454	.0181	.0058
	Std. Deviation		.65064	.85440	.11547	.20817	.01495	.02307	.00130	.00231

a. Effect on shoot fresh length: 2nd treatment

ANOVA					
LSF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	13.288	2	6.644	3.115	.100
Within Groups	17.061	8	2.133		
Total	30.349	10			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.41333	1.06650	.053	-.0460-	4.8727
			2%	.46667	1.19238	.706	-2.2830-	3.2163
	1%	dimension3	0%	-2.41333-	1.06650	.053	-4.8727-	.0460
			2%	-1.94667-	1.06650	.105	-4.4060-	.5127
	2%	dimension3	0%	-.46667-	1.19238	.706	-3.2163-	2.2830
			1%	1.94667	1.06650	.105	-.5127-	4.4060

b. Effect on shoot dry length: 2nd treatment

ANOVA					
LSD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	11.675	2	5.838	2.885	.114
Within Groups	16.187	8	2.023		
Total	27.862	10			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.13333	1.03880	.074	-.2622-	4.5288
			2%	.13333	1.16142	.911	-2.5449-	2.8116
	1%	dimension3	0%	-2.13333-	1.03880	.074	-4.5288-	.2622
			2%	-2.00000-	1.03880	.090	-4.3955-	.3955
	2%	dimension3	0%	-.13333-	1.16142	.911	-2.8116-	2.5449
			1%	2.00000	1.03880	.090	-.3955-	4.3955
*. The mean difference is significant at the 0.05 level								

c. Effect on root fresh length: 2nd treatment

ANOVA					
LRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.203	2	1.102	10.263	.006
Within Groups	.859	8	.107		
Total	3.062	10			

Multiple Comparisons								
LRF LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.96000*	.23926	.004	.4083	1.5117
			2%	1.06667*	.26750	.004	.4498	1.6835
	1%	dimension3	0%	-.96000-*	.23926	.004	-1.5117-	-.4083-
			2%	.10667	.23926	.668	-.4451-	.6584
	2%	dimension3	0%	-1.06667-*	.26750	.004	-1.6835-	-.4498-
			1%	-.10667-	.23926	.668	-.6584-	.4451
*. The mean difference is significant at the 0.05 level.								

d. Effect on root dry length: 2nd treatment

ANOVA					
LRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.922	2	.961	8.683	.010
Within Groups	.885	8	.111		
Total	2.807	10			

Multiple Comparisons								
LRD LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.89333*	.24294	.006	.3331	1.4536
			2%	1.00000*	.27162	.006	.3736	1.6264
	1%	dimension3	0%	-.89333-*	.24294	.006	-1.4536-	-.3331-
			2%	.10667	.24294	.672	-.4536-	.6669
	2%	dimension3	0%	-1.00000-*	.27162	.006	-1.6264-	-.3736-
			1%	-.10667-	.24294	.672	-.6669-	.4536
*. The mean difference is significant at the 0.05 level.								

e. Effect on shoot fresh weight: 2nd treatment

ANOVA					
WSF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.008	2	.004	3.691	.073
Within Groups	.009	8	.001		
Total	.017	10			

Multiple Comparisons								
WSF LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.05110	.02406	.066	-.0044-	.1066
			2%	-.00587-	.02690	.833	-.0679-	.0562
	1%	dimension3	0%	-.05110-	.02406	.066	-.1066-	.0044
			2%	-.05697-*	.02406	.045	-.1125-	-.0015-
	2%	dimension3	0%	.00587	.02690	.833	-.0562-	.0679
			1%	.05697*	.02406	.045	.0015	.1125
*. The mean difference is significant at the 0.05 level.								

f. Effect on shoot dry weight: 2nd treatment

ANOVA					
WSD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.004	2	.002	2.732	.125
Within Groups	.006	8	.001		
Total	.010	10			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	.04697*	.02010	.048	.0006	.0933
			2%	.02997	.02247	.219	-.0219-	.0818
	1%	dimension 3	0%	-.04697-*	.02010	.048	-.0933-	-.0006-
			2%	-.01701-	.02010	.422	-.0634-	.0293
	2%	dimension 3	0%	-.02997-	.02247	.219	-.0818-	.0219
			1%	.01701	.02010	.422	-.0293-	.0634
*. The mean difference is significant at the 0.05 level.								

g. effect on root fresh weight: 2nd treatment

ANOVA					
WRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.001	2	.000	16.380	.001
Within Groups	.000	8	.000		
Total	.001	10			

Multiple Comparisons								
WRF LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	.01957*	.00344	.000	.0116	.0275
			2%	.01020*	.00385	.029	.0013	.0191
	1%	dimension 3	0%	-.01957-*	.00344	.000	-.0275-	-.0116-
			2%	-.00937-*	.00344	.026	-.0173-	-.0014-
	2%	dimension 3	0%	-.01020-*	.00385	.029	-.0191-	-.0013-
			1%	.00937*	.00344	.026	.0014	.0173
*. The mean difference is significant at the 0.05 level.								

h. Effect on root dry weight: 2nd treatment

ANOVA					
WRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	2	.000	1.381	.305
Within Groups	.000	8	.000		
Total	.000	10			

Multiple Comparisons								
WRD LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension 2	0%	dimension 3	1%	-.00186-	.00172	.310	-.0058-	.0021
			2%	-.00317-	.00192	.137	-.0076-	.0013
	1%	dimension 3	0%	.00186	.00172	.310	-.0021-	.0058
			2%	-.00131-	.00172	.468	-.0053-	.0026
	2%	dimension 3	0%	.00317	.00192	.137	-.0013-	.0076
			1%	.00131	.00172	.468	-.0026-	.0053

Mechanical scarification:
Germination percentage
1st treatment:

Statistics							
		0%	1%	2%	5%	10%	20%
N	Valid	14	14	14	14	14	14
	Missing	0	0	0	0	0	0
Mean		17.1429	22.1429	12.8571	12.1429	.0000	.0000
Std. Deviation		6.11250	12.51373	9.13874	9.74961	.00000	.00000

2nd treatment

Statistics[a]							
		0%	1%	2%	5%	10%	20%
N	Valid	14	14	14	14	14	14
	Missing	0	0	0	0	0	0
Mean		22.8571	16.4286	.0000	1.0714	.0000	.0000
Std. Deviation		11.38729	7.44946	.00000	.91687	.00000	.00000
a. VAR00011 = M2							

Seedling 1st treatment:

Statistics									
		LSF	LSD	LRF	LRD	WSF	WSD	WRF	WRD
N	Valid	7	7	7	7	7	7	7	7
	Missing	0	0	0	0	0	0	0	0
Mean		7.0286	6.3429	4.7286	4.0000	.1524	.0402	.0137	.0029
Std. Deviation		1.43958	1.15882	1.67999	1.79907	.01815	.02951	.00109	.00092

a. Effect on shoot fresh length: 1st treatment

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5.804	2	2.902	1.751	.284
Within Groups	6.630	4	1.658		
Total	12.434	6			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension 2	0%	dimension 3	1%	2.05000	1.17527	.156	-1.2131-	5.3131
			2%	.50000	1.28744	.718	-3.0745-	4.0745
	1%	dimension 3	0%	-2.05000-	1.17527	.156	-5.3131-	1.2131
			2%	-1.55000-	1.17527	.258	-4.8131-	1.7131
	2%	dimension 3	0%	-.50000-	1.28744	.718	-4.0745-	3.0745
			1%	1.55000	1.17527	.258	-1.7131-	4.8131

b. Effect on shoot dry length: 1st treatment

ANOVA					
LSD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.840	2	2.420	3.010	.159
Within Groups	3.217	4	.804		
Total	8.057	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	1.98333	.81862	.073	-.2895-	4.2562
			2%	.90000	.89675	.372	-1.5898-	3.3898
	1%	dimension 3	0%	-1.98333-	.81862	.073	-4.2562-	.2895
			2%	-1.08333-	.81862	.256	-3.3562-	1.1895
	2%	dimension 3	0%	-.90000-	.89675	.372	-3.3898-	1.5898
			1%	1.08333	.81862	.256	-1.1895-	3.3562

c. Effect on root fresh length: 1st treatment

ANOVA					
LRF					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.484	2	3.242	1.241	.381
Within Groups	10.450	4	2.613		
Total	16.934	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension 2	0%	dimension3	1%	2.15000	1.47549	.219	-1.9466-	6.2466
			2%	2.10000	1.61632	.264	-2.3876-	6.5876
	1%	dimension3	0%	-2.15000-	1.47549	.219	-6.2466-	1.9466
			2%	-.05000-	1.47549	.975	-4.1466-	4.0466
	2%	dimension3	0%	-2.10000-	1.61632	.264	-6.5876-	2.3876
			1%	.05000	1.47549	.975	-4.0466-	4.1466

d. Effect on root dry length: 1st treatment

ANOVA					
LRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.455	2	4.228	1.542	.319
Within Groups	10.965	4	2.741		
Total	19.420	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	2.60000	1.51141	.161	-1.5964-	6.7964
			2%	2.05000	1.65567	.283	-2.5469-	6.6469
	1%	dimension 3	0%	-2.60000-	1.51141	.161	-6.7964-	1.5964
			2%	-.55000-	1.51141	.734	-4.7464-	3.6464
	2%	dimension 3	0%	-2.05000-	1.65567	.283	-6.6469-	2.5469
			1%	.55000	1.51141	.734	-3.6464-	4.7464

e. Effect on shoot fresh weight: 1st treatment

ANOVA					
WSF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.002	2	.001	11.590	.022
Within Groups	.000	4	.000		
Total	.002	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.02927*	.00778	.020	.0077	.0509
			2%	-.00390-	.00853	.671	-.0276-	.0198
	1%	dimension3	0%	-.02927-*	.00778	.020	-.0509-	-.0077-
			2%	-.03317-*	.00778	.013	-.0548-	-.0116-
	2%	dimension3	0%	.00390	.00853	.671	-.0198-	.0276
			1%	.03317*	.00778	.013	.0116	.0548
*. The mean difference is significant at the 0.05 level.								

f. Effect on shoot dry weight: 1st treatment

ANOVA					
WSD					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.002	2	.001	1.242	.381
Within Groups	.003	4	.001		
Total	.005	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension 2	0%	dimension 3	1%	.01203	.02591	.667	-.0599-	.0840
			2%	-.02855-	.02839	.371	-.1074-	.0503
	1%	dimension 3	0%	-.01203-	.02591	.667	-.0840-	.0599
			2%	-.04058-	.02591	.192	-.1125-	.0314
	2%	dimension 3	0%	.02855	.02839	.371	-.0503-	.1074
			1%	.04058	.02591	.192	-.0314-	.1125

g. Effect on root fresh weight: 1st treatment

ANOVA					
WRF					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.000	2	.000	.016	.984
Within Groups	.000	4	.000		
Total	.000	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	.00007	.00122	.959	-.0033-	.0035
			2%	-.00015-	.00134	.916	-.0039-	.0036
	1%	dimension 3	0%	-.00007-	.00122	.959	-.0035-	.0033
			2%	-.00022-	.00122	.868	-.0036-	.0032
	2%	dimension 3	0%	.00015	.00134	.916	-.0036-	.0039
			1%	.00022	.00122	.868	-.0032-	.0036

h. Effect on shoot fresh weight: 1st treatment

ANOVA					
WRD					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	2	.000	1.746	.285
Within Groups	.000	4	.000		
Total	.000	6			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension 3	1%	.00100	.00075	.253	-.0011-	.0031
			2%	.00150	.00082	.142	-.0008-	.0038
	1%	dimension 3	0%	-.00100-	.00075	.253	-.0031-	.0011
			2%	.00050	.00075	.541	-.0016-	.0026
	2%	dimension 3	0%	-.00150-	.00082	.142	-.0038-	.0008
			1%	-.00050-	.00075	.541	-.0026-	.0016

C. Seedling 2nd treatment

Statistics									
		LSF	LSD	LRF	LRD	WSF	WSD	WRF	WRD
N	Valid	5	5	5	5	5	5	5	5
	Missing	0	0	0	0	0	0	0	0
Mean		6.5400	5.6000	4.7200	4.1400	.1340	.0486	.0183	.0032
Std. Deviation		1.08995	1.06301	1.59750	1.53883	.02874	.03040	.00953	.00256

a. Effect on shoot fresh length: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
LSF	dimension 1	0%	3	6.5667	1.25033	.72188
		1%	2	6.5000	1.27279	.90000

Independent Samples Test										
	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower		Upper
Equal variances assumed	.029	.876	.058	3	.957	.06667	1.14827	-3.58763-		3.72097
Equal variances not assumed			.058	2.238	.959	.06667	1.15374	-4.42513-		4.55846

b. Effect on shoot dry length: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
LSD	dimension1	0%	3	5.7333	1.30512	.75351
		1%	2	5.4000	.98995	.70000

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
LSD	Equal variances assumed	.175	.704	.302	3	.782	.33333	1.10387	-3.17966-	3.84633
	Equal variances not assumed			.324	2.788	.769	.33333	1.02848	-3.08496-	3.75163

c. Effect on root fresh length: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
LRF	dimension1	0%	3	5.4000	1.82483	1.05357
		1%	2	3.7000	.28284	.20000

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
LRF	Equal variances assumed	6.646	.082	1.242	3	.302	1.70000	1.36829	-2.65451	6.05451
	Equal variances not assumed			1.585	2.141	.246	1.70000	1.07238	-2.63446	6.03446

d. Effect on root dry length: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
LRD	dimension 1	0%	3	4.8333	1.70978	.98714
		1%	2	3.1000	.14142	.10000

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
LRD	Equal variances assumed	7.657	.070	1.358	3	.268	1.73333	1.27657	-2.32928	5.79595
	Equal variances not assumed			1.747	2.041	.220	1.73333	.99219	-2.45491	5.92158

e. Effect on shoot fresh weigth: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
WSF	dimension 1	0%	3	.1263	.03113	.01798
		1%	2	.1455	.03041	.02150

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WSF	Equal variances assumed	.001	.983	-.680-	3	.545	-.01917-	.02820	-.10892-	.07058
	Equal variances not assumed			-.684-	2.320	.556	-.01917-	.02802	-.12513-	.08680

f. Effect on shoot dry weight: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
WSD	dimension1	0%	3	.0460	.01353	.00781
		1%	2	.0525	.05728	.04050

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
	Equal variances assumed	33.410	.010	-.204-	3	.851	-.00650-	.03183	-.10779-	.09479
	Equal variances not assumed			-.158-	1.075	.899	-.00650-	.04125	-.45159-	.43859

g. Effect on root fresh weight: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
WRF	dimension1	0%	3	.0144	.00238	.00137
		1%	2	.0240	.01556	.01100

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WRF	Equal variances assumed	122.149	.002	-1.140-	3	.337	-.00957-	.00839	-.03626-	.01713
	Equal variances not assumed			-.863-	1.031	.543	-.00957-	.01109	-.14070-	.12157

h. Effect on root dry weight: 2nd treatment

Group Statistics						
	Concentration		N	Mean	Std. Deviation	Std. Error Mean
WRD	dimension1	0%	3	.0039	.00332	.00191
		1%	2	.0021	.00021	.00015

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WRD	Equal variances assumed	5.185	.107	.748	3	.509	.00185	.00247	-.00602-	.00972
	Equal variances not assumed			.964	2.024	.436	.00185	.00192	-.00632-	.01002

H_2SO_4

Germination 1st treatment

Statistics[a]							
		0%	1%	2%	5%	10%	20%
N	Valid	14	14	14	14	14	14
	Missing	0	0	0	0	0	0
Mean		24.29	30.00	12.86	29.29	48.57	33.57
Std. Deviation		9.376	15.191	9.139	13.281	23.812	18.649

Germination 2nd treatment

Statistics[a]							
		0%	1%	2%	5%	10%	20%
N	Valid	14	14	14	14	14	14
	Missing	0	0	0	0	0	0
Mean		32.14	31.43	22.86	14.29	45.71	20.71
Std. Deviation		11.883	13.506	12.666	9.376	26.520	11.411

Seedling 1st treatment

a. Effect on shoot fresh length 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.824	5	.765	1.519	.231
Within Groups	9.566	19	.503		
Total	13.390	24			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.75833	.54194	.178	-.3760-	1.8926
			2%	1.03333	.64774	.127	-.3224-	2.3891
			5%	.23333	.54194	.672	-.9010-	1.3676
			10%	-.06667-	.48965	.893	-1.0915-	.9582
			20%	.69333	.51819	.197	-.3913-	1.7779
	1%	dimension3	0%	-.75833-	.54194	.178	-1.8926-	.3760
			2%	.27500	.61450	.660	-1.0112-	1.5612
			5%	-.52500-	.50174	.309	-1.5752-	.5252
			10%	-.82500-	.44474	.079	-1.7559-	.1059
			20%	-.06500-	.47599	.893	-1.0613-	.9313
	2%	dimension3	0%	-1.03333-	.64774	.127	-2.3891-	.3224
			1%	-.27500-	.61450	.660	-1.5612-	1.0112
			5%	-.80000-	.61450	.209	-2.0862-	.4862
			10%	-1.10000-	.56892	.068	-2.2908-	.0908
			20%	-.34000-	.59366	.574	-1.5826-	.9026
	5%	dimension3	0%	-.23333-	.54194	.672	-1.3676-	.9010
			1%	.52500	.50174	.309	-.5252-	1.5752
			2%	.80000	.61450	.209	-.4862-	2.0862
			10%	-.30000-	.44474	.508	-1.2309-	.6309
			20%	.46000	.47599	.346	-.5363-	1.4563
	10%	dimension3	0%	.06667	.48965	.893	-.9582-	1.0915
			1%	.82500	.44474	.079	-.1059-	1.7559
			2%	1.10000	.56892	.068	-.0908-	2.2908
			5%	.30000	.44474	.508	-.6309-	1.2309
			20%	.76000	.41548	.083	-.1096-	1.6296
	20%	dimension3	0%	-.69333-	.51819	.197	-1.7779-	.3913
			1%	.06500	.47599	.893	-.9313-	1.0613
			2%	.34000	.59366	.574	-.9026-	1.5826
			5%	-.46000-	.47599	.346	-1.4563-	.5363

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.75833	.54194	.178	-.3760-	1.8926
			2%	1.03333	.64774	.127	-.3224-	2.3891
			5%	.23333	.54194	.672	-.9010-	1.3676
			10%	-.06667-	.48965	.893	-1.0915-	.9582
			20%	.69333	.51819	.197	-.3913-	1.7779
	1%	dimension3	0%	-.75833-	.54194	.178	-1.8926-	.3760
			2%	.27500	.61450	.660	-1.0112-	1.5612
			5%	-.52500-	.50174	.309	-1.5752-	.5252
			10%	-.82500-	.44474	.079	-1.7559-	.1059
			20%	-.06500-	.47599	.893	-1.0613-	.9313
	2%	dimension3	0%	-1.03333-	.64774	.127	-2.3891-	.3224
			1%	-.27500-	.61450	.660	-1.5612-	1.0112
			5%	-.80000-	.61450	.209	-2.0862-	.4862
			10%	-1.10000-	.56892	.068	-2.2908-	.0908
			20%	-.34000-	.59366	.574	-1.5826-	.9026
	5%	dimension3	0%	-.23333-	.54194	.672	-1.3676-	.9010
			1%	.52500	.50174	.309	-.5252-	1.5752
			2%	.80000	.61450	.209	-.4862-	2.0862
			10%	-.30000-	.44474	.508	-1.2309-	.6309
			20%	.46000	.47599	.346	-.5363-	1.4563
	10%	dimension3	0%	.06667	.48965	.893	-.9582-	1.0915
			1%	.82500	.44474	.079	-.1059-	1.7559
			2%	1.10000	.56892	.068	-.0908-	2.2908
			5%	.30000	.44474	.508	-.6309-	1.2309
			20%	.76000	.41548	.083	-.1096-	1.6296
	20%	dimension3	0%	-.69333-	.51819	.197	-1.7779-	.3913
			1%	.06500	.47599	.893	-.9313-	1.0613
			2%	.34000	.59366	.574	-.9026-	1.5826
			5%	-.46000-	.47599	.346	-1.4563-	.5363
			10%	-.76000-	.41548	.083	-1.6296-	.1096

b. Effect on shoot dry length 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.396	5	2.879	2.407	.075
Within Groups	22.725	19	1.196		
Total	37.120	24			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	2.40000*	.83527	.010	.6518	4.1482
			2%	2.65000*	.99834	.016	.5604	4.7396
			5%	1.92500*	.83527	.033	.1768	3.6732
			10%	1.60000*	.75468	.047	.0204	3.1796
			20%	2.34000*	.79867	.009	.6684	4.0116
	1%	dimension3	0%	-2.40000-*	.83527	.010	-4.1482-	-.6518-
			2%	.25000	.94711	.795	-1.7323-	2.2323
			5%	-.47500-	.77331	.546	-2.0936-	1.1436
			10%	-.80000-	.68547	.258	-2.2347-	.6347
			20%	-.06000-	.73363	.936	-1.5955-	1.4755
	2%	dimension3	0%	-2.65000-*	.99834	.016	-4.7396-	-.5604-
			1%	-.25000-	.94711	.795	-2.2323-	1.7323
			5%	-.72500-	.94711	.453	-2.7073-	1.2573
			10%	-1.05000-	.87685	.246	-2.8853-	.7853
			20%	-.31000-	.91500	.738	-2.2251-	1.6051
	5%	dimension3	0%	-1.92500-*	.83527	.033	-3.6732-	-.1768-
			1%	.47500	.77331	.546	-1.1436-	2.0936
			2%	.72500	.94711	.453	-1.2573-	2.7073
			10%	-.32500-	.68547	.641	-1.7597-	1.1097
			20%	.41500	.73363	.578	-1.1205-	1.9505
	10%	dimension3	0%	-1.60000-*	.75468	.047	-3.1796-	-.0204-
			1%	.80000	.68547	.258	-.6347-	2.2347
			2%	1.05000	.87685	.246	-.7853-	2.8853
			5%	.32500	.68547	.641	-1.1097-	1.7597
			20%	.74000	.64036	.262	-.6003-	2.0803
	20%	dimension3	0%	-2.34000-*	.79867	.009	-4.0116-	-.6684-
			1%	.06000	.73363	.936	-1.4755-	1.5955
			2%	.31000	.91500	.738	-1.6051-	2.2251
			5%	-.41500-	.73363	.578	-1.9505-	1.1205
			10%	-.74000-	.64036	.262	-2.0803-	.6003
*. The mean difference is significant at the 0.05 level.								

c. Effect on root fresh length 1st treatment

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	20.818	5	4.164	5.019	0.004
Within Groups	15.762	19	0.830		
Total	36.580	24			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.43333	.69565	.541	-1.0227-	1.8893
			2%	.13333	.83146	.874	-1.6069-	1.8736
			5%	.05833	.69565	.934	-1.3977-	1.5143
			10%	-1.16667-	.62852	.079	-2.4822-	.1488
			20%	-2.04667-*	.66517	.006	-3.4389-	-.6545-
	1%	dimension3	0%	-.43333-	.69565	.541	-1.8893-	1.0227
			2%	-.30000-	.78879	.708	-1.9510-	1.3510
			5%	-.37500-	.64404	.567	-1.7230-	.9730
			10%	-1.60000-*	.57088	.011	-2.7949-	-.4051-
			20%	-2.48000-*	.61099	.001	-3.7588-	-1.2012-
	2%	dimension3	0%	-.13333-	.83146	.874	-1.8736-	1.6069
			1%	.30000	.78879	.708	-1.3510-	1.9510
			5%	-.07500-	.78879	.925	-1.7260-	1.5760
			10%	-1.30000-	.73028	.091	-2.8285-	.2285
			20%	-2.18000-*	.76204	.010	-3.7750-	-.5850-
	5%	dimension3	0%	-.05833-	.69565	.934	-1.5143-	1.3977
			1%	.37500	.64404	.567	-.9730-	1.7230
			2%	.07500	.78879	.925	-1.5760-	1.7260
			10%	-1.22500-*	.57088	.045	-2.4199-	-.0301-
			20%	-2.10500-*	.61099	.003	-3.3838-	-.8262-
	10%	dimension3	0%	1.16667	.62852	.079	-.1488-	2.4822
			1%	1.60000*	.57088	.011	.4051	2.7949
			2%	1.30000	.73028	.091	-.2285-	2.8285
			5%	1.22500*	.57088	.045	.0301	2.4199
			20%	-.88000-	.53332	.115	-1.9963-	.2363
	20%	dimension3	0%	2.04667*	.66517	.006	.6545	3.4389
			1%	2.48000*	.61099	.001	1.2012	3.7588
			2%	2.18000*	.76204	.010	.5850	3.7750
			5%	2.10500*	.61099	.003	.8262	3.3838
			10%	.88000	.53332	.115	-.2363-	1.9963
*. The mean difference is significant at the 0.05 level.								

d. Effect on root f dry length 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.160	5	3.632	3.483	0.021
Within Groups	19.814	19	1.043		
Total	37.974	24			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.05833	.77996	.941	-1.5741-	1.6908
			2%	-.11667-	.93223	.902	-2.0678-	1.8345
			5%	-.51667-	.77996	.516	-2.1491-	1.1158
			10%	-1.30952-	.70470	.079	-2.7845-	.1654
			20%	-2.24667-*	.74578	.007	-3.8076-	-.6857-
	1%	dimension3	0%	-.05833-	.77996	.941	-1.6908-	1.5741
			2%	-.17500-	.88439	.845	-2.0260-	1.6760
			5%	-.57500-	.72210	.436	-2.0864-	.9364
			10%	-1.36786-*	.64007	.046	-2.7075-	-.0282-
			20%	-2.30500-*	.68504	.003	-3.7388-	-.8712-
	2%	dimension3	0%	.11667	.93223	.902	-1.8345-	2.0678
			1%	.17500	.88439	.845	-1.6760-	2.0260
			5%	-.40000-	.88439	.656	-2.2510-	1.4510
			10%	-1.19286-	.81879	.161	-2.9066-	.5209
			20%	-2.13000-*	.85440	.022	-3.9183-	-.3417-
	5%	dimension3	0%	.51667	.77996	.516	-1.1158-	2.1491
			1%	.57500	.72210	.436	-.9364-	2.0864
			2%	.40000	.88439	.656	-1.4510-	2.2510
			10%	-.79286-	.64007	.231	-2.1325-	.5468
			20%	-1.73000-*	.68504	.021	-3.1638-	-.2962-
	10%	dimension3	0%	1.30952	.70470	.079	-.1654-	2.7845
			1%	1.36786*	.64007	.046	.0282	2.7075
			2%	1.19286	.81879	.161	-.5209-	2.9066
			5%	.79286	.64007	.231	-.5468-	2.1325
			20%	-.93714-	.59796	.134	-2.1887-	.3144
	20%	dimension3	0%	2.24667*	.74578	.007	.6857	3.8076
			1%	2.30500*	.68504	.003	.8712	3.7388
			2%	2.13000*	.85440	.022	.3417	3.9183
			5%	1.73000*	.68504	.021	.2962	3.1638
			10%	.93714	.59796	.134	-.3144-	2.1887
*. The mean difference is significant at the 0.05 level.								

e. Effect on shoot fresh weight 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.012	5	0.002	2.041	0.119
Within Groups	.022	19	0.001		
Total	.033	24			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.03418	.02585	.202	-.0199-	.0883
			2%	.00358	.03089	.909	-.0611-	.0682
			5%	-.01517-	.02585	.564	-.0693-	.0389
			10%	.02140	.02335	.371	-.0275-	.0703
			20%	.04899	.02471	.062	-.0027-	.1007
	1%	dimension3	0%	-.03418-	.02585	.202	-.0883-	.0199
			2%	-.03060-	.02931	.310	-.0919-	.0307
			5%	-.04935-	.02393	.053	-.0994-	.0007
			10%	-.01278-	.02121	.554	-.0572-	.0316
			20%	.01481	.02270	.522	-.0327-	.0623
	2%	dimension3	0%	-.00358-	.03089	.909	-.0682-	.0611
			1%	.03060	.02931	.310	-.0307-	.0919
			5%	-.01875-	.02931	.530	-.0801-	.0426
			10%	.01782	.02713	.519	-.0390-	.0746
			20%	.04541	.02831	.125	-.0139-	.1047
	5%	dimension3	0%	.01517	.02585	.564	-.0389-	.0693
			1%	.04935	.02393	.053	-.0007-	.0994
			2%	.01875	.02931	.530	-.0426-	.0801
			10%	.03657	.02121	.101	-.0078-	.0810
			20%	.06416*	.02270	.011	.0166	.1117
	10%	dimension3	0%	-.02140-	.02335	.371	-.0703-	.0275
			1%	.01278	.02121	.554	-.0316-	.0572
			2%	-.01782-	.02713	.519	-.0746-	.0390
			5%	-.03657-	.02121	.101	-.0810-	.0078
			20%	.02759	.01982	.180	-.0139-	.0691
	20%	dimension3	0%	-.04899-	.02471	.062	-.1007-	.0027
			1%	-.01481-	.02270	.522	-.0623-	.0327
			2%	-.04541-	.02831	.125	-.1047-	.0139
			5%	-.06416-*	.02270	.011	-.1117-	-.0166-
			10%	-.02759-	.01982	.180	-.0691-	.0139
*. The mean difference is significant at the 0.05 level.								

f. Effect on shoot dry weight 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	5	.000	.908	.497
Within Groups	.000	19	.000		
Total	.000	24			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.00139-	.00114	.235	-.0038-	.0010
			2%	-.00082-	.00136	.555	-.0037-	.0020
			5%	-.00014-	.00114	.902	-.0025-	.0022
			10%	-.00148-	.00103	.165	-.0036-	.0007
			20%	-.00161-	.00109	.155	-.0039-	.0007
	1%	dimension3	0%	.00139	.00114	.235	-.0010-	.0038
			2%	.00058	.00129	.660	-.0021-	.0033
			5%	.00125	.00105	.249	-.0010-	.0035
			10%	-.00009-	.00093	.925	-.0020-	.0019
			20%	-.00021-	.00100	.832	-.0023-	.0019
	2%	dimension3	0%	.00082	.00136	.555	-.0020-	.0037
			1%	-.00058-	.00129	.660	-.0033-	.0021
			5%	.00067	.00129	.606	-.0020-	.0034
			10%	-.00066-	.00119	.584	-.0032-	.0018
			20%	-.00079-	.00124	.533	-.0034-	.0018
	5%	dimension3	0%	.00014	.00114	.902	-.0022-	.0025
			1%	-.00125-	.00105	.249	-.0035-	.0010
			2%	-.00067-	.00129	.606	-.0034-	.0020
			10%	-.00134-	.00093	.167	-.0033-	.0006
			20%	-.00146-	.00100	.158	-.0036-	.0006
	10%	dimension3	0%	.00148	.00103	.165	-.0007-	.0036
			1%	.00009	.00093	.925	-.0019-	.0020
			2%	.00066	.00119	.584	-.0018-	.0032
			5%	.00134	.00093	.167	-.0006-	.0033
			20%	-.00013-	.00087	.887	-.0019-	.0017
	20%	dimension3	0%	.00161	.00109	.155	-.0007-	.0039
			1%	.00021	.00100	.832	-.0019-	.0023
			2%	.00079	.00124	.533	-.0018-	.0034
			5%	.00146	.00100	.158	-.0006-	.0036
			10%	.00013	.00087	.887	-.0017-	.0019

g. Effect on root fresh weight 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.001	5	.000	.573	.720
Within Groups	.010	19	.001		
Total	.011	24			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.00414	.01732	.814	-.0321-	.0404
			2%	-.02723-	.02071	.204	-.0706-	.0161
			5%	-.00161-	.01732	.927	-.0379-	.0347
			10%	-.00648-	.01565	.684	-.0392-	.0263
			20%	-.00225-	.01657	.893	-.0369-	.0324
	1%	dimension3	0%	-.00414-	.01732	.814	-.0404-	.0321
			2%	-.03138-	.01964	.127	-.0725-	.0097
			5%	-.00575-	.01604	.724	-.0393-	.0278
			10%	-.01062-	.01422	.464	-.0404-	.0191
			20%	-.00640-	.01522	.679	-.0382-	.0255
	2%	dimension3	0%	.02723	.02071	.204	-.0161-	.0706
			1%	.03138	.01964	.127	-.0097-	.0725
			5%	.02562	.01964	.208	-.0155-	.0667
			10%	.02076	.01819	.268	-.0173-	.0588
			20%	.02498	.01898	.204	-.0147-	.0647
	5%	dimension3	0%	.00161	.01732	.927	-.0347-	.0379
			1%	.00575	.01604	.724	-.0278-	.0393
			2%	-.02562-	.01964	.208	-.0667-	.0155
			10%	-.00487-	.01422	.736	-.0346-	.0249
			20%	-.00064-	.01522	.967	-.0325-	.0312
	10%	dimension3	0%	.00648	.01565	.684	-.0263-	.0392
			1%	.01062	.01422	.464	-.0191-	.0404
			2%	-.02076-	.01819	.268	-.0588-	.0173
			5%	.00487	.01422	.736	-.0249-	.0346
			20%	.00422	.01328	.754	-.0236-	.0320
	20%	dimension3	0%	.00225	.01657	.893	-.0324-	.0369
			1%	.00640	.01522	.679	-.0255-	.0382
			2%	-.02498-	.01898	.204	-.0647-	.0147
			5%	.00064	.01522	.967	-.0312-	.0325
			10%	-.00422-	.01328	.754	-.0320-	.0236

h. Effect on root dry weight 1st treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	5	.000	1.250	.325
Within Groups	.000	19	.000		
Total	.000	24			

LSD Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.00143-	.00140	.319	-.0044-	.0015
			2%	-.00273-	.00167	.119	-.0062-	.0008
			5%	-.00101-	.00140	.481	-.0039-	.0019
			10%	-.00226-	.00126	.089	-.0049-	.0004
			20%	-.00031-	.00134	.819	-.0031-	.0025
	1%	dimension3	0%	.00143	.00140	.319	-.0015-	.0044
			2%	-.00130-	.00158	.422	-.0046-	.0020
			5%	.00043	.00129	.746	-.0023-	.0031
			10%	-.00083-	.00115	.479	-.0032-	.0016
			20%	.00112	.00123	.373	-.0014-	.0037
	2%	dimension3	0%	.00273	.00167	.119	-.0008-	.0062
			1%	.00130	.00158	.422	-.0020-	.0046
			5%	.00172	.00158	.290	-.0016-	.0050
			10%	.00047	.00147	.751	-.0026-	.0035
			20%	.00242	.00153	.130	-.0008-	.0056
	5%	dimension3	0%	.00101	.00140	.481	-.0019-	.0039
			1%	-.00043-	.00129	.746	-.0031-	.0023
			2%	-.00172-	.00158	.290	-.0050-	.0016
			10%	-.00125-	.00115	.288	-.0037-	.0011
			20%	.00070	.00123	.578	-.0019-	.0033
	10%	dimension3	0%	.00226	.00126	.089	-.0004-	.0049
			1%	.00083	.00115	.479	-.0016-	.0032
			2%	-.00047-	.00147	.751	-.0035-	.0026
			5%	.00125	.00115	.288	-.0011-	.0037
			20%	.00195	.00107	.085	-.0003-	.0042
	20%	dimension3	0%	.00031	.00134	.819	-.0025-	.0031
			1%	-.00112-	.00123	.373	-.0037-	.0014
			2%	-.00242-	.00153	.130	-.0056-	.0008
			5%	-.00070-	.00123	.578	-.0033-	.0019
			10%	-.00195-	.00107	.085	-.0042-	.0003

Seedling 2nd treatment

a. Effect on shoot fresh length 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.131	5	1.026	3.647	.020
Within Groups	4.783	17	.281		
Total	9.915	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.02500	.37509	.948	-.7664-	.8164
			2%	-.12500-	.40514	.761	-.9798-	.7298
			5%	.52500	.45939	.269	-.4442-	1.4942
			10%	-.25357-	.33248	.456	-.9550-	.4479
			20%	1.20833*	.40514	.008	.3536	2.0631
	1%	dimension3	0%	-.02500-	.37509	.948	-.8164-	.7664
			2%	-.15000-	.40514	.716	-1.0048-	.7048
			5%	.50000	.45939	.292	-.4692-	1.4692
			10%	-.27857-	.33248	.414	-.9800-	.4229
			20%	1.18333*	.40514	.010	.3286	2.0381
	2%	dimension3	0%	.12500	.40514	.761	-.7298-	.9798
			1%	.15000	.40514	.716	-.7048-	1.0048
			5%	.65000	.48423	.197	-.3716-	1.6716
			10%	-.12857-	.36605	.730	-.9009-	.6437
			20%	1.33333*	.43311	.007	.4195	2.2471
	5%	dimension3	0%	-.52500-	.45939	.269	-1.4942-	.4442
			1%	-.50000-	.45939	.292	-1.4692-	.4692
			2%	-.65000-	.48423	.197	-1.6716-	.3716
			10%	-.77857-	.42531	.085	-1.6759-	.1187
			20%	.68333	.48423	.176	-.3383-	1.7050
	10%	dimension3	0%	.25357	.33248	.456	-.4479-	.9550
			1%	.27857	.33248	.414	-.4229-	.9800
			2%	.12857	.36605	.730	-.6437-	.9009
			5%	.77857	.42531	.085	-.1187-	1.6759
			20%	1.46190*	.36605	.001	.6896	2.2342
	20%	dimension3	0%	-1.20833-*	.40514	.008	-2.0631-	-.3536-
			1%	-1.18333-*	.40514	.010	-2.0381-	-.3286-
			2%	-1.33333-*	.43311	.007	-2.2471-	-.4195-
			5%	-.68333-	.48423	.176	-1.7050-	.3383
			10%	-1.46190-*	.36605	.001	-2.2342-	-.6896-
*. The mean difference is significant at the 0.05 level.								

b. Effect on shoot dry length 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.568	5	.914	2.957	.042
Within Groups	5.251	17	.309		
Total	9.819	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.12500	.39300	.754	-.7042-	.9542
			2%	-.10000-	.42449	.817	-.9956-	.7956
			5%	.50000	.48133	.313	-.5155-	1.5155
			10%	-.25714-	.34836	.470	-.9921-	.4778
			20%	1.13333*	.42449	.016	.2377	2.0289
	1%	dimension3	0%	-.12500-	.39300	.754	-.9542-	.7042
			2%	-.22500-	.42449	.603	-1.1206-	.6706
			5%	.37500	.48133	.447	-.6405-	1.3905
			10%	-.38214-	.34836	.288	-1.1171-	.3528
			20%	1.00833*	.42449	.030	.1127	1.9039
	2%	dimension3	0%	.10000	.42449	.817	-.7956-	.9956
			1%	.22500	.42449	.603	-.6706-	1.1206
			5%	.60000	.50736	.253	-.4704-	1.6704
			10%	-.15714-	.38353	.687	-.9663-	.6520
			20%	1.23333*	.45380	.015	.2759	2.1908
	5%	dimension3	0%	-.50000-	.48133	.313	-1.5155-	.5155
			1%	-.37500-	.48133	.447	-1.3905-	.6405
			2%	-.60000-	.50736	.253	-1.6704-	.4704
			10%	-.75714-	.44562	.108	-1.6973-	.1830
			20%	.63333	.50736	.229	-.4371-	1.7038
	10%	dimension3	0%	.25714	.34836	.470	-.4778-	.9921
			1%	.38214	.34836	.288	-.3528-	1.1171
			2%	.15714	.38353	.687	-.6520-	.9663
			5%	.75714	.44562	.108	-.1830-	1.6973
			20%	1.39048*	.38353	.002	.5813	2.1997
	20%	dimension3	0%	-1.13333-*	.42449	.016	-2.0289-	-.2377-
			1%	-1.00833-*	.42449	.030	-1.9039-	-.1127-
			2%	-1.23333-*	.45380	.015	-2.1908-	-.2759-
			5%	-.63333-	.50736	.229	-1.7038-	.4371
			10%	-1.39048-*	.38353	.002	-2.1997-	-.5813-
*. The mean difference is significant at the 0.05 level.								

c. Effect on root fresh length 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.145	5	.829	3.864	.016
Within Groups	3.648	17	.215		
Total	7.793	22			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.50000-	.32754	.145	-1.1911-	.1911
			2%	.18333	.35378	.611	-.5631-	.9298
			5%	-.05000-	.40115	.902	-.8964-	.7964
			10%	-.27857-	.29033	.351	-.8911-	.3340
			20%	.91667*	.35378	.019	.1702	1.6631
	1%	dimension3	0%	.50000	.32754	.145	-.1911-	1.1911
			2%	.68333	.35378	.070	-.0631-	1.4298
			5%	.45000	.40115	.278	-.3964-	1.2964
			10%	.22143	.29033	.456	-.3911-	.8340
			20%	1.41667*	.35378	.001	.6702	2.1631
	2%	dimension3	0%	-.18333-	.35378	.611	-.9298-	.5631
			1%	-.68333-	.35378	.070	-1.4298-	.0631
			5%	-.23333-	.42285	.588	-1.1255-	.6588
			10%	-.46190-	.31965	.167	-1.1363-	.2125
			20%	.73333	.37821	.069	-.0646-	1.5313
	5%	dimension3	0%	.05000	.40115	.902	-.7964-	.8964
			1%	-.45000-	.40115	.278	-1.2964-	.3964
			2%	.23333	.42285	.588	-.6588-	1.1255
			10%	-.22857-	.37140	.546	-1.0121-	.5550
			20%	.96667*	.42285	.035	.0745	1.8588
	10%	dimension3	0%	.27857	.29033	.351	-.3340-	.8911
			1%	-.22143-	.29033	.456	-.8340-	.3911
			2%	.46190	.31965	.167	-.2125-	1.1363
			5%	.22857	.37140	.546	-.5550-	1.0121
			20%	1.19524*	.31965	.002	.5208	1.8696
	20%	dimension3	0%	-.91667-*	.35378	.019	-1.6631-	-.1702-
			1%	-1.41667-*	.35378	.001	-2.1631-	-.6702-
			2%	-.73333-	.37821	.069	-1.5313-	.0646
			5%	-.96667-*	.42285	.035	-1.8588-	-.0745-
			10%	-1.19524-*	.31965	.002	-1.8696-	-.5208-
*. The mean difference is significant at the 0.05 level								

d. Effect on root dry length 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.373	5	.875	4.610	.008
Within Groups	3.225	17	.190		
Total	7.598	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.45000-	.30799	.162	-1.0998-	.1998
			2%	.43333	.33267	.210	-.2685-	1.1352
			5%	.00000	.37721	1.000	-.7959-	.7959
			10%	-.28571-	.27301	.310	-.8617-	.2903
			20%	.90000*	.33267	.015	.1981	1.6019
	1%	dimension3	0%	.45000	.30799	.162	-.1998-	1.0998
			2%	.88333*	.33267	.017	.1815	1.5852
			5%	.45000	.37721	.249	-.3459-	1.2459
			10%	.16429	.27301	.555	-.4117-	.7403
			20%	1.35000*	.33267	.001	.6481	2.0519
	2%	dimension3	0%	-.43333-	.33267	.210	-1.1352-	.2685
			1%	-.88333-*	.33267	.017	-1.5852-	-.1815-
			5%	-.43333-	.39762	.291	-1.2722-	.4056
			10%	-.71905-*	.30057	.029	-1.3532-	-.0849-
			20%	.46667	.35564	.207	-.2837-	1.2170
	5%	dimension3	0%	.00000	.37721	1.000	-.7959-	.7959
			1%	-.45000-	.37721	.249	-1.2459-	.3459
			2%	.43333	.39762	.291	-.4056-	1.2722
			10%	-.28571-	.34923	.425	-1.0225-	.4511
			20%	.90000*	.39762	.037	.0611	1.7389
	10%	dimension3	0%	.28571	.27301	.310	-.2903-	.8617
			1%	-.16429-	.27301	.555	-.7403-	.4117
			2%	.71905*	.30057	.029	.0849	1.3532
			5%	.28571	.34923	.425	-.4511-	1.0225
			20%	1.18571*	.30057	.001	.5516	1.8199
	20%	dimension3	0%	-.90000-*	.33267	.015	-1.6019-	-.1981-
			1%	-1.35000-*	.33267	.001	-2.0519-	-.6481-
			2%	-.46667-	.35564	.207	-1.2170-	.2837
			5%	-.90000-*	.39762	.037	-1.7389-	-.0611-
			10%	-1.18571-*	.30057	.001	-1.8199-	-.5516-
*. The mean difference is significant at the 0.05 level.								

e. Effect on shoot fresh weight 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.022	5	.004	3.124	.035
Within Groups	.024	17	.001		
Total	.046	22			

Multiple Comparisons								
LSD								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.03868	.02660	.164	-.0174-	.0948
			2%	.02482	.02873	.400	-.0358-	.0854
			5%	-.01685-	.03257	.612	-.0856-	.0519
			10%	-.03714-	.02358	.134	-.0869-	.0126
			20%	.03715	.02873	.213	-.0235-	.0978
	1%	dimension3	0%	-.03868-	.02660	.164	-.0948-	.0174
			2%	-.01386-	.02873	.636	-.0745-	.0468
			5%	-.05553-	.03257	.106	-.1243-	.0132
			10%	-.07581-*	.02358	.005	-.1256-	-.0261-
			20%	-.00152-	.02873	.958	-.0621-	.0591
	2%	dimension3	0%	-.02482-	.02873	.400	-.0854-	.0358
			1%	.01386	.02873	.636	-.0468-	.0745
			5%	-.04167-	.03434	.242	-.1141-	.0308
			10%	-.06195-*	.02596	.029	-.1167-	-.0072-
			20%	.01233	.03071	.693	-.0525-	.0771
	5%	dimension3	0%	.01685	.03257	.612	-.0519-	.0856
			1%	.05553	.03257	.106	-.0132-	.1243
			2%	.04167	.03434	.242	-.0308-	.1141
			10%	-.02029-	.03016	.510	-.0839-	.0433
			20%	.05400	.03434	.134	-.0184-	.1264
	10%	dimension3	0%	.03714	.02358	.134	-.0126-	.0869
			1%	.07581*	.02358	.005	.0261	.1256
			2%	.06195*	.02596	.029	.0072	.1167
			5%	.02029	.03016	.510	-.0433-	.0839
			20%	.07429*	.02596	.011	.0195	.1290
	20%	dimension3	0%	-.03715-	.02873	.213	-.0978-	.0235
			1%	.00152	.02873	.958	-.0591-	.0621
			2%	-.01233-	.03071	.693	-.0771-	.0525
			5%	-.05400-	.03434	.134	-.1264-	.0184
			10%	-.07429-*	.02596	.011	-.1290-	-.0195-
*. The mean difference is significant at the 0.05 level.								

f. Effect on shoot dry weight 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.155	5	.031	1.489	.245
Within Groups	.354	17	.021		
Total	.509	22			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	.03630	.10203	.726	-.1790-	.2516
			2%	-.22238-	.11020	.060	-.4549-	.0101
			5%	-.00418-	.12496	.974	-.2678-	.2595
			10%	-.01845-	.09044	.841	-.2093-	.1724
			20%	.05616	.11020	.617	-.1764-	.2887
	1%	dimension3	0%	-.03630-	.10203	.726	-.2516-	.1790
			2%	-.25868-*	.11020	.031	-.4912-	-.0262-
			5%	-.04048-	.12496	.750	-.3041-	.2232
			10%	-.05475-	.09044	.553	-.2456-	.1361
			20%	.01986	.11020	.859	-.2127-	.2524
	2%	dimension3	0%	.22238	.11020	.060	-.0101-	.4549
			1%	.25868*	.11020	.031	.0262	.4912
			5%	.21820	.13172	.116	-.0597-	.4961
			10%	.20393	.09957	.056	-.0061-	.4140
			20%	.27853*	.11781	.030	.0300	.5271
	5%	dimension3	0%	.00418	.12496	.974	-.2595-	.2678
			1%	.04048	.12496	.750	-.2232-	.3041
			2%	-.21820-	.13172	.116	-.4961-	.0597
			10%	-.01427-	.11569	.903	-.2584-	.2298
			20%	.06033	.13172	.653	-.2176-	.3382
	10%	dimension3	0%	.01845	.09044	.841	-.1724-	.2093
			1%	.05475	.09044	.553	-.1361-	.2456
			2%	-.20393-	.09957	.056	-.4140-	.0061
			5%	.01427	.11569	.903	-.2298-	.2584
			20%	.07460	.09957	.464	-.1355-	.2847
	20%	dimension3	0%	-.05616-	.11020	.617	-.2887-	.1764
			1%	-.01986-	.11020	.859	-.2524-	.2127
			2%	-.27853-*	.11781	.030	-.5271-	-.0300-
			5%	-.06033-	.13172	.653	-.3382-	.2176
			10%	-.07460-	.09957	.464	-.2847-	.1355
*. The mean difference is significant at the 0.05 level								

g. Effect on root fresh weight 2nd treatment

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.069	5	.014	7.731	.001
Within Groups	.030	17	.002		
Total	.099	22			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.15983-*	.02985	.000	-.2228-	-.0968-
			2%	-.08409-*	.03225	.018	-.1521-	-.0161-
			5%	-.01713-	.03656	.645	-.0943-	.0600
			10%	-.07471-*	.02646	.012	-.1305-	-.0189-
			20%	-.00809-	.03225	.805	-.0761-	.0599
	1%	dimension3	0%	.15983*	.02985	.000	.0968	.2228
			2%	.07573*	.03225	.031	.0077	.1438
			5%	.14270*	.03656	.001	.0656	.2198
			10%	.08511*	.02646	.005	.0293	.1409
			20%	.15173*	.03225	.000	.0837	.2198
	2%	dimension3	0%	.08409*	.03225	.018	.0161	.1521
			1%	-.07573-*	.03225	.031	-.1438-	-.0077-
			5%	.06697	.03854	.100	-.0143-	.1483
			10%	.00938	.02913	.751	-.0521-	.0708
			20%	.07600*	.03447	.042	.0033	.1487
	5%	dimension3	0%	.01713	.03656	.645	-.0600-	.0943
			1%	-.14270-*	.03656	.001	-.2198-	-.0656-
			2%	-.06697-	.03854	.100	-.1483-	.0143
			10%	-.05759-	.03385	.107	-.1290-	.0138
			20%	.00903	.03854	.817	-.0723-	.0903
	10%	dimension3	0%	.07471*	.02646	.012	.0189	.1305
			1%	-.08511-*	.02646	.005	-.1409-	-.0293-
			2%	-.00938-	.02913	.751	-.0708-	.0521
			5%	.05759	.03385	.107	-.0138-	.1290
			20%	.06662*	.02913	.035	.0052	.1281
	20%	dimension3	0%	.00809	.03225	.805	-.0599-	.0761
			1%	-.15173-*	.03225	.000	-.2198-	-.0837-
			2%	-.07600-*	.03447	.042	-.1487-	-.0033-
			5%	-.00903-	.03854	.817	-.0903-	.0723
			10%	-.06662-*	.02913	.035	-.1281-	-.0052-
*. The mean difference is significant at the 0.05 level.								

h. Effect on root dry weight 2nd treatment

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	5	.000	.869	.522
Within Groups	.000	17	.000		
Total	.000	22			

Multiple Comparisons								
(I) Concentration		(J) Concentration		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	0%	dimension3	1%	-.00175-	.00168	.314	-.0053-	.0018
			2%	.00003	.00182	.986	-.0038-	.0039
			5%	.00125	.00206	.553	-.0031-	.0056
			10%	-.00187-	.00149	.227	-.0050-	.0013
			20%	-.00070-	.00182	.705	-.0045-	.0031
	1%	dimension3	0%	.00175	.00168	.314	-.0018-	.0053
			2%	.00178	.00182	.341	-.0021-	.0056
			5%	.00300	.00206	.164	-.0014-	.0074
			10%	-.00012-	.00149	.936	-.0033-	.0030
			20%	.00105	.00182	.572	-.0028-	.0049
	2%	dimension3	0%	-.00003-	.00182	.986	-.0039-	.0038
			1%	-.00178-	.00182	.341	-.0056-	.0021
			5%	.00122	.00218	.583	-.0034-	.0058
			10%	-.00190-	.00164	.263	-.0054-	.0016
			20%	-.00073-	.00195	.711	-.0048-	.0034
	5%	dimension3	0%	-.00125-	.00206	.553	-.0056-	.0031
			1%	-.00300-	.00206	.164	-.0074-	.0014
			2%	-.00122-	.00218	.583	-.0058-	.0034
			10%	-.00312-	.00191	.121	-.0072-	.0009
			20%	-.00195-	.00218	.383	-.0065-	.0026
	10%	dimension3	0%	.00187	.00149	.227	-.0013-	.0050
			1%	.00012	.00149	.936	-.0030-	.0033
			2%	.00190	.00164	.263	-.0016-	.0054
			5%	.00312	.00191	.121	-.0009-	.0072
			20%	.00117	.00164	.486	-.0023-	.0046
	20%	dimension3	0%	.00070	.00182	.705	-.0031-	.0045
			1%	-.00105-	.00182	.572	-.0049-	.0028
			2%	.00073	.00195	.711	-.0034-	.0048
			5%	.00195	.00218	.383	-.0026-	.0065
			10%	-.00117-	.00164	.486	-.0046-	.0023

تأثير ماء البحر المنمذج علي نوعين من نباتات الزينة في مدينة بنغازي

قدمت من قبل:

رجاء بالعيد علي الفرجاني

تحت اشراف:

أ.د.سالم الشطشاط

ملخص الدراسة

تؤثر الملوحة على حوالي ثلث الأراضي المروية ، مما يؤدي إلى انخفاض كبير في إنتاج المحاصيل. لهذا السبب أولى الباحثون اهتمامًا كبيرًا لهذه المشكلة البيئية المهمة على مدار العقود الماضية على الرغم من حقيقة أن الإجهاد الملحي يسبب أضرارًا جسيمة لهذه الأنواع فقد تناولت دراسات قليلة جدا تأثير الملوحة على نباتات الزينة المستخدمة في المناظر الطبيعية ، أجريت هذه الدراسة في مدينة بنغازي / ليبيا. خلال ربيع وصيف 2020 \2019 لتحديد مدى استجابة أنواع نباتات الزينة (Albizia Lebbeck و Acacia cyanophyla) لتركيزات مختلفة من مياه البحر المنمذج وتحديد مدى تكيف هذه الأنواع النباتية لمستويات مختلفة من الملوحة. و تأثيرها على الخصائص الخارجية ومعدلات النمو للوصول إلى أفضل اختلاط بين المياه العذبة ومياه البحر واستخدامها لري نباتات الزينة وكيفية الاستفادة من مياه البحر في ظل الظروف البيئية ، أجريت التجارب في معمل جامعة بنغازي حيث تم تحضير خمس تراكيز لمياه البحر المنمذجة و هي 1٪ ، 2٪ ، 5٪ ، 10٪ ، 20٪ ، اجريت كلتا التجربتين بنفس الخطوات ، مع اختلافات في عدد الأيام ،

كلا النباتين تمت معاملتهما بنفس الطريقة. حيث تم تعقيم البذور السطحي بمحلول هيبوكلوريت الصوديوم بنسبة 2٪ لمدة 12 دقيقة وشطفها بمياه مقطرة معقمة ثم جففت. تم معاملة البذور باستخدام معاملات مختلفة منها (مياه الشرب ، حامض الكبريتيك ، طريقة الخدش الميكانيكي و الماء المغلي) وضعت 10 بذور على أطباق خاصة تحت ظروف معقمة ، وحفظت في الظلام عند درجة حرارة 22 ± 0.5 درجة مئوية ، مع تكرار التجربة 3 مرات لكل تركيز وتم تسقي الأطباق حسب الحاجة من كل تركيز. تمت مراقبة الاطباق يوميا و تسجيل عدد البذور المنبته في كل يوم لحساب نسب الإنبات اليومية والنهائية (G٪) ، ومتوسط وقت الإنبات (MGT) تم حساب مؤشر قوة الشتلات (SVI) ، وتم تسجيل البيانات التي تم الحصول عليها ، وتحليلها بواسطة اختبار التباين لتقدير الفروق. في الاستجابة لتركيزات مياه البحر ، متبوعًا باختبار المقارنة المتعدد ، (تعتبر النتائج ذات دلالة احصائية معنوية عند قيم P أقل من 0.05 ، و فترة الثقة عند 95 ٪) . أوضحت نتائج الدراسة أن متوسط وقت الانبات لكلا النباتين قد تأخر بشكل طفيف مع زيادة تركيزات مياه البحر تتراوح بين (7–10 أيام) في نبات اللبخ و (12–18 يوم) في نبات الاكاسيا. انخفضت نسبة إنبات كلا النباتين مع زيادة تركيزات مياه البحر بتركيزات مع عدم وجود انبات عند النسب (10٪ و 20٪) ما عدا معاملات حمض الكبريتيك و قد تبين أن كلا النباتين لا يتحملان تركيزات مياه البحر العالية. أظهر مؤشر قوة الشتلات انخفاضًا معنويًا عند زيادة تركيز ماء البحر في كلا النباتين و أن الأطوال الجافة للساق والجذر تأثرت سلبًا بتركيزات مياه البحر ، وكانت السيقان أكثر حساسية لتركيزات مياه البحر من الجذور. انخفض كل من الأوزان الرطبة والجافة للنباتين نبات اللبخ مع زيادة تركيزات مياه البحر وكان هذا الانخفاض معنويًا في اللبخ و لم يكن

معنويا في الاكاسيا،. تحسن المعالجة المسبق لحمض الكبريتيك إنبات بذور كلا النباتين حتى بتركيزات عالية (10٪ و 20٪) و كذلك عند المعالجة بالماء المغلي.

تأثير ماء البحر المنمذج علي نوعين من نباتات الزينة

في مدينة بنغازي

قدمت من قبل:

رجاء بالعيد علي الفرجاني

تحت اشراف:

أ.د.سالم الشطشاط

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في علم النبات

جامعة بنغازي

كلية العلوم

فبراير 2022