Effect of salinity stress on Dill seeds germination and growth in vivo in Libya

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Abstract

The aim of this study is to detect the effect of salinity stress on Dill (*Anethum graveolens*) seeds germination and growth *in vivo* in Libya. For this purpose, five treatments of different concentrations of NaCl were used. The following parameters : Seeds germination, roots number and length, plant length, number of leaves, plant strength , shoot tip necrosis and the percentage of survivals were recorded. The Obtained results showed that all growth parameters were reduced by increasing NaCl concentration. In the same time, The percentage of shoot tip necrosis was increased with a significant differences among all treatments. In a parallel study, the results observed that Dill (*Anethum graveolens*) plants were more salt-tolerant than Coriander (*Coriandrum sativum*) plants, where they resist salinity till 4000 ppm NaCl, while Coriander plants resist till 3000 ppm NaCl only.

Key words

Dill- Seeds – germination – growth – salinity – NaCl- Salt-tolerant.

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Introduction

Dill (Anethum graveolens) belongs to family Apiaceae (Umbelliferae). It is a plant species often cultivated in Libya for the flavoring and curative properties (digestive disturbances accompanied by meteorism, flatulence and gastro-intestinal spasms, urinary infections, insomnia, galactogenical hyposecretion, etc). The performed experimental studies demonstrated the antimicrobial, stomachic, antioxidant, carminative properties of dill **(L.Jirovetz *et al.* (2003),**

M. Monsefi *et al.* (2006), M.Stavri & S.Gibbons (2005), G.Q.Zheng *et al.* (1992), Alina Ortan *et al.* (2009).

Based on higher content of compounds with antimicrobial activity a strong inhibitory effect of essential oils of dill and parsley grown in summer time could assist in preserving foods although different nutrient content of food may influence microbial resistance, **(Vokk et al. 2011).**

Salinity is one of the most serious and wide spread agricultural problems resulting in losses of yield and arable land. One strategy available to cope with the saline soil is to choose salt-tolerant crops or to select salt-tolerant cultivars within a crop**, (Morpurgo, 1991).**

Salt stress is one of the most serious limiting factors for crop growth and production in the arid regions. About 23% of the world’s cultivated lands is saline and 37% is sodic **(Khan and Duke, 2001).**

Selection and breeding of salt tolerant plants is becoming one option to minimize the negative impact of salinity **(Epstein et al., 1980).**

The effects of salt and drought on plant growth have been investigated for almost 100 years, because environmental stress is a major problem in crop productivity **(Boyer 1982).** Even today the problem is serious as a result of the expansion cultivated fields in developing countries and increased intensive agriculture in developed countries **, (Hanson and Hitz 1982).**

Salinity also has an adverse impact on photosynthetic rate. Several authors showed the impact of salinity on chlorophyll contents **(Khavari-Nejad and Mostofi, 1998).**

Essa (2002) stated that Soil salinity is a major limitation to legume production in many areas of the world.

Salinity affects over 70 million hectare of agricultural land which is about 20% of irrigated land and about 2% of dry land **(FAO, 2002).** Currently, salinity affects about 33% of all irrigated lands in the world **(Munns, 2005).**

Soil or water salinity is known to cause considerable yield losses in most crops, thereby leading to reduced crop productivity **(Ashraf, 2009; Cha-um et al., 2011).**

Nasser J.Y. Sholi (2012) demonstrated that Plant growth and seed germination are severely affected by saline conditions.

Zeinolabedin Jouyban (2012) stated that Plants affects adversely as a result of salinity, seed germination, survival percentage, morphological characteristics, development and yield and its components.

Moradi and Zavareh (2013) showed that increased salt concentration caused a decrease in germination. Strong reduction was observed mainly at the higher level of salt concentration compared to lower level.

Materials and Methods

In this experiment, the effect of salinity stress using sodium chloride (NaCl) on Dill (Anethum graveolens) seeds germination and growth in vivo was studied .Five concentrations of NaCl were used. The different concentrations of NaCl were added to distilled water, these concentrations are : 0 , 1000, 2000, 3000, 4000 and 5000 ppm NaCl respectively. Dill seeds (Figure 1) were cultivated in pots (size 25) 2-3 cm depth, filled with peat moss and sand (2:1). The seeds were irrigated with the last NaCl concentrations. Irrigation with the previous concentrations continued after seeds germination and till plants collecting. Data were recorded including: Seeds germination, roots number and length, plant strength, number of leaves, plant length , shoot tip necrosis and the percentage of survivals.

For both plants strength and shoot tip necrosis, degrees were given to the plants using the method described by **Klein and Livingston (1982).** In this method, the plants were rated from culture on 0 to 5 relative growth scale as shown in **Table (1).**

After 21 days , Data were recorded including seeds germination and all growth parameters of all treatments of dill plants.

Figure (1). Dill seeds and plants cultivated in Libya.

Table (1). Descriptive grades used for determination of the in vivo relative growth of Dill explants.

Rating	Description
0	The cultures turned brown and appeared to be invisible.
1	The culture stills green, showed no readily observable growth and development differentiation from the initially excised tissue.
2	One or two leaves were evident.
3	More than two leaves were evident.
4	The culture showed evidence of shoot formation and development.
5	Both shoots and roots have been developed.

Statistical analysis

Data of Dill seeds germination and growth characters were statistically analyzed by factor randomize. Complete designs and the means were compared using L.S.D. according to the method described by **SAS (1990).**

Results and Discussion

Data in Table (2) and in Histogram (Figure 2) showed that Sodium chloride (NaCl) reduced all the parameters including : seeds germination , plant length, number of leaves, plant strength, roots number ,root length and percentage of survivals. These parameters were (99% , 9.8 cm, 24,5,10,4 cm and 99%) in case of control treatment (0 ppm NaCl) respectively, while it reached to (23 %,2.5 cm,5,1,2,1.4 cm and 14%) respectively) in case of the highest NaCl concentration (3000 ppm), with a significant difference among all treatments. So, increasing NaCl concentration leads to more reduction in seeds germination percentage and plant growth rate, also it leads to a decreasing in the percentage of survivals. While the percentage of shoot tip necrosis increased by increasing NaCl concentration also. In case of the NaCl concentration 5000 ppm, there is no any germination occurred. These results are in harmony with **El-Barkouki (2000)** who mentioned that Sodium Chloride reduced the percentage of survivals.

Salinity tended to lower water and osmotic potentials of leaves and tubers while increasing the content of total soluble solids and proline. It also increased the content of dry matter and reduced tuber yields, **Levy et al., (1988).**

Zhang and Donnelley, (1997) found that plantlet growth parameters were not affected by 40 mM NaCl, while 80 and 120 mM NaCl significantly reduced all plantlet growth parameters compared with the control (0mM) and with each other, the only exception to this was root length which was similarly affected by 80 and 120 mM NaCl and less affected by salinity than the other growth parameters. It was also noticed that shoot tip necrosis increased by increasing NaCl concentration in the medium, its scale was (2.6 in case of control treatment, and 3.3, 3.7 4.2 and 4.7 in case of NaCl concentrations (1462, 2924, 5848 and 11696 ppm respectively), this is may be due to that Ca content was decreased in NaCl- salt tolerant cells**, (Able- Piqueras et al., 1996).** There is significant difference between treatment 1(control) and all treatments except treatment 2 (1462 ppm NaCl).

There is significant difference between treatment 1(control) and all treatments except treatment 2 (1462 ppm NaCl).

Table (2). Effect of salinity stress on Dill (Anethum graveolens) seeds germination and growth in vivo in Libya

Treatment	**% of seeds germ.**	**Plant length (cm)**	**Leaves no.**	**Plant strength**	**Roots no.**	**Roots length (cm)**	**Shoot tip necrosis**	**% 0f survivals**
(1) Control	99[a]	9.8[a]	24[a]	5[a]	10[a]	4[a]	0[a]	99[a]
(2)	88[b]	9.2[b]	17[b]	4[b]	5[b]	3.1[b]	0[a]	85[b]
(3)	72[c]	6.7[c]	12[c]	3[c]	3[c]	2.5[c]	1[b]	68[c]
(4)	48[d]	5.5[d]	9[d]	2[d]	2[d]	1.9[d]	1[c]	39[d]
(5)	23[e]	2.5[e]	5[e]	1[e]	2[e]	1.4[e]	2[d]	14[e]
(6)	0	0	0	0	0	0	0	0

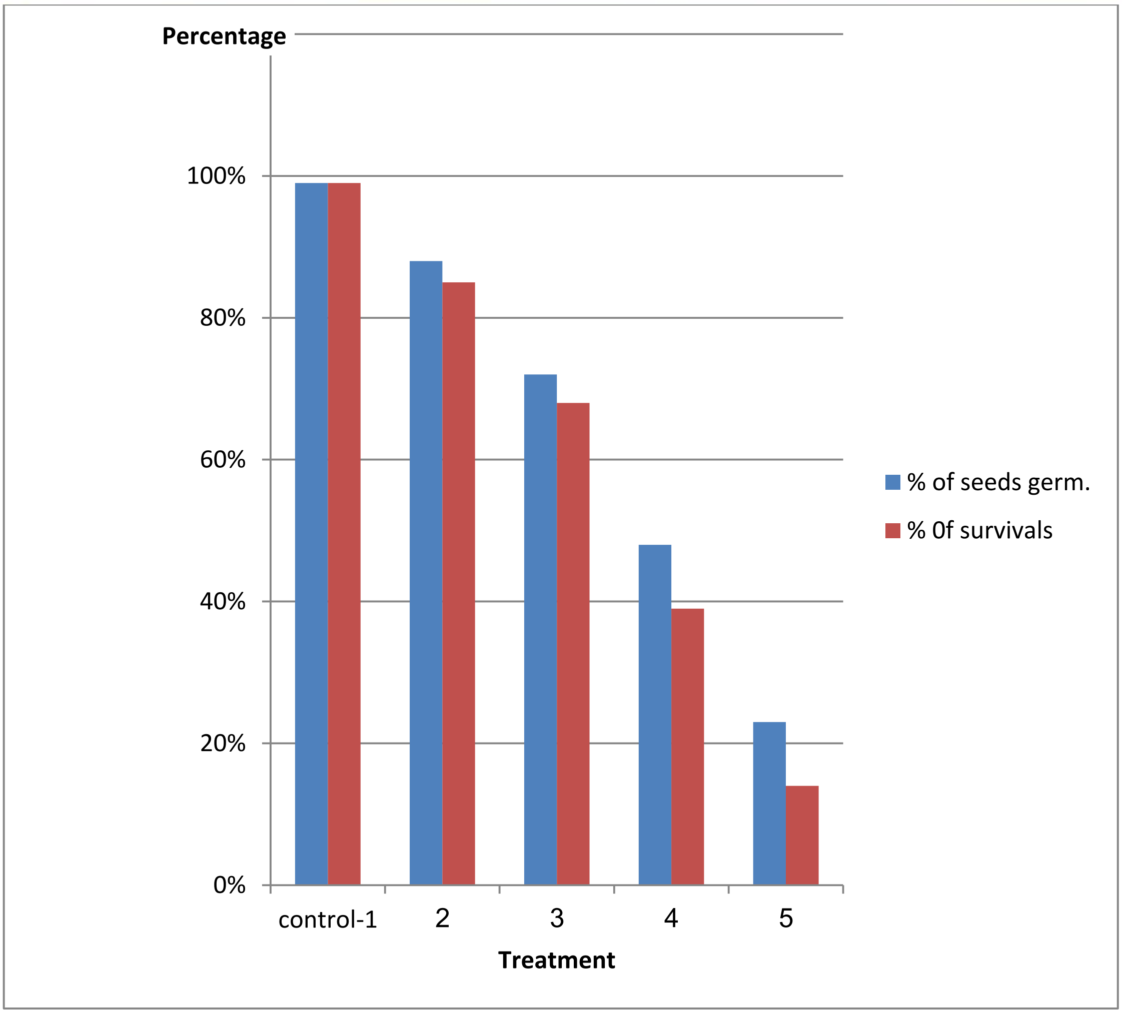

Figure (2). Histogram showing percentage of germination and survivals.

Also, the obtained results are in harmony with **Polturi and Prassad (1993)** who stated that salt stress had more effect on cell division and elongation, this reduction was more in shoot height than in dry matter. The reduction in shoot height was compensated by an increase in number of branches , total available photosynthetic tissue actually increased, which again may have contributed to dry matter production. Also, it has been proposed by **(Munns & Termaat. 1986, Munns, 1993)** that the response of plants to salinity is biphasic. Initially, salinity exerts an osmotic effect on roots inducing water stress in the plant. Leaf growth and stomatal conductance are reduced by low water potential of the growth medium, but direct toxic effects of Na and Cl are avoided by isolation of the ions in cell vacuoles. Later, a salt-specific effect develops when vacuoles are saturated and salt accumulates in the cell walls and the cytoplasm resulting in the death of tissues. It is unlikely that differences in stomatal conductance were important in conferring improved tolerance to low water potential, as the environment in the growth cabinet would not have imposed a large evaporative demand on the seedlings. Moreover, leaf conductance in mature plants both in the control and in the saline treatment was greater in selected than unselected progeny, **Jefferies, (1996).**

The results are in agreement with **Khodeir (2002)** who observed that increasing NaCl concentration leads to reducing all growth parameters of potato plants, percentage of survivals and increasing also the percentage of shoot tip necrosis which come in contact with **Joshi et al. (2012)** who demonstrated that Salt stress reduced N, P, K+ and Ca2+ content in plant tissues. Also **Joshi et al. (2012)** added that Salinity significantly retarded seed germination and plant growth.

Also, the results are in contact with **Zeinolabedin Jouyban (2012)** who showed that Plants affects adversely as a result of salinity, seed germination, survival percentage, morphological characteristics, development and yield and its components. In general, salt stress decreases the photosynthesis and respiration rate of plants. Total carbohydrate, fatty acid and protein content were adversely affected due to salinity effect, but increased the level of amino acids, particularly proline. The content of some secondary plant products is significantly higher in plants grown under salt stress than in those cultivated in normal conditions. The salinity tolerance depends on the interaction between salinity and other environmental factors.

The same results of **Moradi and Zavareh (2013)** who stated that increased salt concentration caused a decrease in germination. Strong reduction was observed mainly at the higher level of salt concentration compared to lower level.

Also, the obtained results are in harmony with **Kosovaá et al. (2013)** who demonstrated that Salinity profoundly affects various aspects of plant cell structure and metabolism. Salinity with its osmotic and ionic aspects induces cellular adjustment associated with a profound reorganization of cell structure and metabolism.

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الملخص العربي

تأثير الملوحة على إنبات و نمو بذور الشبث في ليبيا.

علاء الدين سيد عويس*, عقارب أبو بكر, حواء بنايل و مريم امحمد .

- **قسم علم النبات ـ كلية العلوم ـ جامعة سرت ـ ليبيا.**

كان الهدف من هذه الدراسة معرفة تأثير الملوحة على انبات و نمو بذور الكسبر في ليبيا و ذلك لمعرفة أقصى تحمل للملوحة بطريقة الاختيار, حيث استخدمت تركيزات مختلفة لكلوريد الصوديوم و هي (5000, 4000 , 3000, 2000, 1000, 0 جزء في المليون) ، حيث اتضح أن زيادة تركيز كلوريد الصوديوم في الوسط تؤدى إلى تقليل معدل إنبات البذور و أيضا معدل نمو النباتات المتمثل في طول النبات ، عدد الأوراق، قوة النبات، طول وعدد الجذور و أخيرا نسبة النباتات الحية . فلقد كانت هذه القياسات كالتالي في معاملة الكونترول(99%, 9.8سم , 24, 5, 4,10سم و 99%) ، فيما وصلت الى (23%, 2.5سم , 5, 1, 1.4,2سم و 14%) في حالة أعلى تركيز لكلوريد الصوديوم حدث معه إنبات و هو 4000 جزء في المليون . كما لم يحدث إنبات إطلاقا فى حالة تركيز كلوريد الصوديوم (5000) جزء في المليون ، كما اتضح أن زيادة تركيز كلوريد الصوديوم تؤدى الى زيادة في نسبة اصفرار القمة الناميةً. ولقد اتضح وجود فروق معنوية بين جميع المعاملات لجميع القياسات .