**Effect of water salinity on seed germination and early growth of medicinal plants Cumin (*Cuminum cyminum* L.), Persian Fenugreek (*Trigonella foenum-graecum* L.) And Anise (*Pimpinell anisum*)**

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**ABSTRACT:**

Medicinal and aromatic plants have received much attention in several fields such as agro alimentary, perfumes, pharmaceutical industries and natural cosmetic products. This research was carried out in order to test the effects of different water salinity levels on germination and early growth of Cumin (*Cuminum cyminum* L.), Persian Fenugreek (*Trigonella foenum-graecum* L.) And Anise (*Pimpinel anisum*) seedling. The experiment was carried out using completely randomized design with four replications in 2014 at kufa University laboratory in Iraq Experimental treatment includes 4 levels of NaCl concentration (50, 100,200 and300 mM). Result showed that the most percentage and speed of germination, Seed vigor, plumule length, radical length, referred to control treatment. In 100mM and more concentration, germination decreased significantly which in300 mM, germination had been stopped also. This reduction in germination indicates their plant’s extreme insensitivity to salinity, so it isn’t advisable for cultivating in salinity soil. All the result data analyzed by SAS software and comparison of means had been done with Duncan test in 0.05% probable level.

Key words: Cumin (*Cuminum cyminum* L.), Persian Fenugreek (*Trigonella foenum-graecum* L.) And Anise (*Pimpinella anisum*), germination, NaCl, salinity stress.

**INTRODUCTION:**

Cumin is the dried seed of the herb *Cuminum cyminum*, a member of the parsley family. Medicinal Uses:  Protects Healthy Cells and Stimulates Production of Natural Interferon. Cumin stimulates neutrophil activity. Extracts of cumin have also been shown to modulate production of interleukins (1).the fruit of this plant has been used to treat diarrhea, toothache and epilepsy (2).

Fenugreek ([*Trigonella foenum-graecum*](http://www.sandmountainherbs.com/fenugreek.html) )is an annual crop, self pollinating and dicotyledonous plant belonging to the Leguminacae family (the Fabaceae) (3, 4). [Fenugreek](http://www.sandmountainherbs.com/fenugreek.html) is utilized all around the world for various uses from culinary, medicinal, to even hay for animals. Medicinally, this herb has phytoestrogens and is famous as a breast milk stimulant .It is also helps to bring down the blood sugar levels of both types 1 & 2 patients consuming it. In recent studies it has also been found to help lower elevated cholesterol as well as triglyceride blood levels(even in diabetics).Fenugreek is great for anyone having issues with any sort of gastro intestinal inflammation such as acid reflux. It will coat & soothe the stomach & intestine lining. It is thought to have some weight loss properties because it supports glucose and carbohydrate metabolism. It is thought to have anti-aging properties. It can also be applied to the skin to treat inflammation.  It soaks into the skin to help reduce swelling, redness, and even pain on the skin. Therefore it is used to treat skin conditions such as sunburns, boils & abscesses, acne, and eczema. (5, 6).

Fennel (*Foeniculum vulgare*) is a [plant](http://en.wikipedia.org/wiki/Plant) [species](http://en.wikipedia.org/wiki/Species) in the [genus](http://en.wikipedia.org/wiki/Genus) [*Foeniculum*](http://en.wikipedia.org/wiki/Foeniculum) . It is a member of the [family](http://en.wikipedia.org/wiki/Family_(biology)) [Apiaceae](http://en.wikipedia.org/wiki/Apiaceae) (formerly the Umbelliferae). It is ahighly [aromatic](http://en.wikipedia.org/wiki/Odor) and [flavorful](http://en.wikipedia.org/wiki/Taste) [herb](http://en.wikipedia.org/wiki/Herb) with [culinary](http://en.wikipedia.org/wiki/Cookery) and [medicinal](http://en.wikipedia.org/wiki/Medicine) uses and, is used as a food plant (7).Fennel may be an effective diuretic and a potential drug for treatment of [hypertension](http://en.wikipedia.org/wiki/Hypertension)( 8).Syrup prepared from fennel juice was formerly given for chronic coughs. It is one of the plants which is said to be disliked by [fleas](http://en.wikipedia.org/wiki/Flea) (9).

The interest in medicinal plant products has considerably increased all over the world due to the fact that many herbal medicines are free from side effects. Although, secondary metabolites in the medicinal and aromatic plants were fundamentally produced by genetic processing but, their biosynthesis is strongly influenced by environmental factors (10). Its means biotic and a biotic environmental factors affect growth parameter (11, 12). A biotic environmental stresses, especially salinity and drought has the most effect on medicinal plants (13).Salinity is one of the major environmental factors that limit crop production (14).Some of areas where under effect by salinity and salt increase steadily, but statistical data show that in includes almost 50% of world fields which is equal to 3 times more than under cultivation areas (15).The different results were dedicated from the effect of salinity stress on the quantitative and qualitative parameters. For instance, it was found that, increasing of salinity stress decreased almost all of growth parameters in study plants, some growth parameters and essential oil amount in chamomile (16). Also Younis et al. (17)reported that enhancing salinity treatments lead to growth reduction. It also reduces germination amounts and seedling weight. Ashraf and Orooj(4 ) reported that salinity treatment lead to reduction of growth and plant developments. Overall, salinity through enhancement of osmotic pressure leads reduction of water absorbance and metabolically and physiological processes will be under its effect. So it cause more delay in germination beginning following by enhancing seed germination duration (18). This research considers effect of salinity on early growth (germination and seedling stages) of Cumin (*Cuminum cyminum* L.), Persian Fenugreek (*Trigonella foenum -graecum* L.)And Anise (*Pimpinella anisum*).according to importance of drug plants and salinity field’s extent.

**MATERIAL AND METHODS**

The experiment was carried out using completely randomized design with four replications and 4 salinity levels (50, 100, 200 and 300mM) in 2014 at Kufa University in Science college laboratory. Each experimental unit includes four Petri dish with 100 × 150mM dimension each contains 25 healthy and homogenous seeds which were on the No1 filter paper. First of all, to disinfect seeds, we put them in Hypochlorite Sodium solvent then we washed them three times by distilled water. Next we added sex ml NaCl solvent to each Petri dish. Eventually, their lids were closed by Para film and had been located in growth room. The temperature adjusted in 25o C. This experiment took 14 days. Germination percentages (gp)

From second day, we started counting the germinated seeds daily in specific time. At that time, those seeds were considered germinated which their radical length was more than 3mM. Counting continued till we could count more germinated seeds and the resulted final counting considered as final germination percentage.GP=∑Si/Di

GP: Ni / N × 100, Ni: number of germinated seed till I Th day), N= total number of seeds, (gr) = Germination race

In order that, from the second day to 14th once a 24 hours we counted germinated seeds and its race was determined by Maguire equation (19 ):

GR: Germination Race (number of germinated seed in each day), Si: number of germination seeds in each numeration, Di: number of days till nth numeration. , N: number of numeration times.

Seed vigor (sv)

This index was determined by the following formulation and with the help Abdulbaki and Anderson (20 ) method: Strong seed index = [germination percentage ×Means of seedling length (radical + plumule) mM] / 100

At the end of experiment we chose 10 plants from each Petri dish, separated their radical and plumule and measure each plat’s radical and plumule length separately. , we used SAS software for analyzing them at significant level (P < 0.01) and used Excel software to draw graphs.

**RESULTS AND DISCUSSIONS:**

Results of comparison between considered characteristics means have been written in table 1, 2, 3. As table 1 show, salinity made significant differences on all considered characteristics in 1% of probable level .GR: Germination rate, GP: Germination percentage, PL: Plumule length, RL: Radical length, SV: Seed vigor .

Table 1: Effect of different salinity concentration on some germination and growth of (*Cuminum cyminum* L.) seedling characteristics.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Salinity concentration | GP (%) | GR | RL(mM) | PL(mM) | SV |
| 50(mM) | 84 a | 6a | 2.2a | 1.8a | 3.36a |
| 100(mM) | 80 b | 5.7b | 2.1a | 1.5a | 2.88b |
| 200(mM) | 54 c | 3.8c | 1.4b | 0.9b | 1.24c |
| 300(mM) | 0.7%d | 0.5d | 1b | 0.5b | 0.01d |

Table 2: Effect of different salinity concentration on some germination and growth of (*Trigonella foenum-graecum* L.) seedling characteristics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Salinity concentration | GP (%) | GR | RL(mM) | PL(mM) | SV |
| 50(mM) | 98 a | 6.31a | 6.8a | 5.6a | 12.15a |
| 100(mM) | 92 b | 4.25b | 4.6b | 4.0b | 7.91b |
| 200(mM) | 55 c | 1.44c | 1.0c | 0.7c | 0.93c |
| 300(mM) | 0d | 0d | 0d | 0c | 0d |

Table 3: Effect of different salinity concentration on some germination and growth of (Pimpinella anisum) seedling characteristics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Salinity concentration | GP (%) | GR | RL(mM) | PL(mM) | a |
| 50(mM) | 93 a | 6.64a | 6.7a | 6.4a | 12.22a |
| 100(mM) | 86 b | 6.14b | 5.8b | 3.0b | 7.56b |
| 200(mM) | 55 c | 3.92c | 4.7d | 1.8c | 3.57c |
| 300(mM) | 0d | 0d | 0c | 0d | 0d |

Note: Similar letters in each column hadn’t any significant statistical difference.

Germination percentage and race According to results of analysis, effect of salinity stress level on germination percentage and race were significant (P < 0.01)

(Table 1,2,3). Comparison between means of different level of salinity’s effects on germination race and percentage has been showed in table (1, 2, and 3). As you see in salinity stress the most germination percentage was (84%) and the less

germination percentage was related to 100mM, 200mM concentration (80%), (54%) respectively. In 300mM treatment we observed lesser germination (Table 1).In (Table 2) the most germination percentage was (98%) and the less germination percentage was related to 100mM, 200mM concentration (94%), (55%) respectively. In 300mM treatment we observed no germination (Table 2).In (Table 3) the most germination percentage was (93%) and the less germination percentage was related to 100mM, 200mM concentration (86%), (55%) respectively. In 300mM treatment we observed no germination (Table 3).

The most germination rate was related to control ( 6) and the less related to 100mM with (5.7) also in 200mM (3.8) and its lesser in 300mM with ( 0.5) (table 1). In (Table 2) the most germination rate was (6.31) and the less germination rate was related to 100mM, 200mM concentration (4.25), (1.44) respectively. In 300mM treatment we observed no germination rate (Table 2). In (Table 3) the most germination rate was (6.64) and the less germination rate was related to 100mM, 200mM concentration (6.14), (3.92) respectively. In 300mM treatment we observed no germination (Table 3). Its cause could be more than usual presence of anion, cation which in addition to toxicities, decreased water potential that is because of its solubility in water. Ion’s so plant can’t absorb water and encounters to lake of water (21). We also can say that this reduction in germination race relies on salinity bad effect on some physiological processes which are effective on seed germination (22).This conclusion is consistent with the results of Chadhou and Rajender research (23 ) that suggest negative impact of osmotic potential caused by the presence of salt and their toxicity on enzymatic hydrolysis processes of seed storage substances and they believe that salts toxicity cause impaired Starch hydrolysis processes, thus it puts a negative effect on germination and growth of plant cells. In figure (1,2) comparison between study plants on germination percentage and rate shows decreased by increasing salinity, but by comparing Cumin (*Cuminum cyminum* L.) , Persian Fenugreek(*Trigonella foenum-graecum* L.)And Anise (*Pimpinella anisum*), it is clear that in (*Cuminum cyminum* L.), the highest GP and Gr of seeds. This shows the tolerance of (*Cuminum cyminum* L.) at the primary stages of germination to salinity stress more than the other studied plants.

Radical and Plumuler length The effects of salinity stress on radical and plumule length have been showed in table (1, 2, 3) Results a significant difference in radical and plumule length in 0.05% probable level. Comparison of radical and plumule length means in salinity different level (50, 100,200 and 300mM) showed that when salinity level increase, seeding radical and plumule length decrease. The most reduction in radical length and plumule related to 100mM. In this relation Munns and Termaat (24)suggested that salinity decrease radical and plumule growth and if we increase salinity level (200,300) mM the amount of reduction will increase table (1, 2, and 3). Also Salinity, declines plumule and radical growth, and by increasing salinity these reduction increase. Salinity which is result of osmotic pressure leads reduction in water absorbance so cell division and differentiation reduce and reduction of plumule and radical length will be Explainable. Salinity environment

have shorter plumule and NaCl more than other salinity factors gas deterrent impact on embryo tissues appearance (25) .In addition, Hajar et al. (26 ) by studding Nigella sativa L. different salinity treatment till 300mM NaCl conclude that, in Nigella sativa L. root growth will decrease if salinity increase till 100mM NaCl. Some studies showed that germinated seeds in salinity environments have short root and shoot and NaCl, has on extreme deterrence effect on embryo tissues’ development rather than other salinity materials (27, 28).(29).(30), observed that by increasing salinity, plumule length in wheat, barley, pea and cabbage seeds decreased. They pointed out that decreasing the growth of young seedlings by increasing salinity, was because of the most decreasing of water absorption by radical, and subsequently by accumulation of soluble salts in cells, water potential of root cells decreases and biological processes occur in roots even in low water potentials. In figure(3,4) comparison between study plants on Radical and Plumule length shows larger decreased by increasing salinity in Persian Fenugreek(*Trigonella foenum-graecum* L.)And Anise (*Pimpinella anisum*), this shows the tolerance of (*Cuminum cyminum* L.) at the primary stages of germination to salinity highest than the other studied plants.

Seed vigor

In strong seed vigor index, had been observed that there exists a significant difference (P ≤ 0.01) between different salinity levels (table 1, 2, 3). By increasing NaCl concentration, seed vigor index declines (Table 1, 2, 3). Generally, race and percentage of germination and seed vigor index is related to special impact of ions and reduction of environmental water potential in the presence of salinity. Result showed that if salinity increases (reduction of environmental osmotic potential), seed characteristics will decrease these results is according to Kader and Jutzi (31)founding’s. In addition, Etesami and Galeshi (32)reported that salinity is the cause of reduction in germination percentage, race and homogeneity of germination and dry weight of barley (Hordeumvulgare) seedling. Massai et al. ( 33) say that salinity is delaying plant growth under reduction of photosynthesis effects, it is cause of closing stomata and reduction of water entrance into the plant and so that it cause duplicate reduction in plant weight. Redman et al. (34)showed that this reduction in dry weight of plumule and radical which is results of enhancing the salinity concentration is a normal phenomenon and probably it is the result of low water absorbance by germinated seeds.

**REFERENCE:**

1. Iacobellis, Nicola S.et al. (2005)."Antibacterial Activity of Cuminum cyminum L. and Carumcarvi L. Essential Oils". Journal of Agricultural and Food Chemistry 53 (1): 57–61. [Doi](http://en.wikipedia.org/wiki/Digital_object_identifier): [10.1021/jf0487351](http://dx.doi.org/10.1021%2Fjf0487351). [PMID](http://en.wikipedia.org/wiki/PubMed_Identifier) [15631509](http://www.ncbi.nlm.nih.gov/pubmed/15631509).
2. Zargari, A.1989. Medicinal plants, Vol. II. Tehran University Press, Tehran, pp. 519-521.
3. Rechinger, K.H. (1984). Flora Iranica (Trigonell afoenum-graecum L.).Akademische Druck-u, Verlagsanstalt, Austria.No. 157/Dezen.pp.252.
4. Ashraf, M.and Orooj, A. (2006) .Salt stress effects on growth, ion accumulation and seed oil concentration in anarid zone traditional medicinal plant ajwain (Trachyspermum amMi [L.] Sprague). Journal of Arid Environments. 64: 209–220.
5. Sadeghzadeh, A.D., Kashi, A.K., Hassandokht, M.R., Amri, A.and Alizadeh, K. (2009). Assessment of drought tolerance in Iranian fenugreek landraces. J. Food, Agric. Environ., 7: 414-419.
6. Mehrafarin, A., Rezazadeh, Sh., NaghdiBadi, H., NoormohamMadi, Gh. Zand, E.and Qaderi, A. (2011). A Review on Biology, Cultivation and Biotechnology of Fenugreek (Trigonella foenum-graecum L.) as aValuable Medicinal Plant and Multipurpose. J. Med. Plant., 10(37): 6-24.
7. Agarwal, R.; Gupta, S.K.; Agrawal, S.S.; Srivastava, S.and Saxena, R. (2008). "Oculohypotensive effects of foeniculumvulgare in experimental models of glaucoma". Indian J. Physiol. Pharmacol. 52 (1): 77–83.[PMID](http://en.wikipedia.org/wiki/PubMed_Identifier) [18831355](http://www.ncbi.nlm.nih.gov/pubmed/18831355).
8. Wright, C.I.; Van-Buren, L.; Kroner, C.I.and Koning, M.M. (October 2007).["Herbal medicines as diuretics: a review of the scientific evidence"](http://linkinghub.elsevier.com/retrieve/pii/S0378-8741(07)00366-2).JEthnopharmacol 114 (1): 1–31. [Doi](http://en.wikipedia.org/wiki/Digital_object_identifier): [10.1016/j.jep.2007.07.023](http://dx.doi.org/10.1016%2Fj.jep.2007.07.023).[PMID](http://en.wikipedia.org/wiki/PubMed_Identifier) [17804183](http://www.ncbi.nlm.nih.gov/pubmed/17804183).
9. Anne, P. Mark (2000). [The Complete Idiot's Guide to Breast feeding](http://books.google.com/?id=s5RSGLuMnnEC&pg=PA142).Alpha Books. [ISBN](http://en.wikipedia.org/wiki/International_Standard_Book_Number) [0-02-863948-0](http://en.wikipedia.org/wiki/Special:BookSources/0-02-863948-0). Page 142.
10. Yazdani, D.; Jamshidi, H.and Mojab, F. (2002). Compare of Essential oil Yield and Menthol Existent in Peppermint (Menthapiperita L.) Planted in Different Origin ofIran.Journal of Medicinal Plants ofMedicinal Plant Institute of Jahaddaneshgahi. 3: 73-78.
11. Aziz, E.A.; Hendawi ,S.T.; Azza, E.E.D.and Omer, E.A. (2008).Effect of Soil Type and Irrigation Intervals on Plant Growth, Essential Oil and Constituents of Thymus vulgaris Plant.Amrican Eurasian J. Agric. Environ. Sci. 4(4): 443-450.
12. Clark, RJ.and Menary, R.C. (2008). Environmental Effects on Peppermint (Menthapiperita L.). II. Effects of Temperature on Photosynthesis, Photorespiration and Dark Respiration in Peppermint with Reference to Oil Composition. AustralianJ. Plant Physiol. 7(6): 693-697.
13. Heidari, F.; ZehtabSalmasi, S.; Javanshir, A.; Aliari, H.and Dadpoor, M.R. (2008) The Effects ofApplication Microelements and PlantDensity on Yield and Essential oil of Peppermint (Menthapiperita L.). IranianJ. Med. Aromatic Plants. 24: 1-9.
14. Koyro, H.W. (2006) Effect of salinity on growth, photosynthesis, water relations and solute composition of the potential cash crop halophyte Plant agocoronpus (L.). Environ. Exp. Bot. 56: 136–146.
15. Kamkar, B.; Kafi, M.and Nassirimahallati, M. (2004) Determination of the most sensitive developmental period of wheat (Triticumaestivum) to salt stress to optimize saline water utilization. 4th International Crop Science Congress. PP. 1-6.
16. Razmjoo, K.; Heydarizadeh, P.and Sabzalian, M.R. (2008) Effect of Salinity and Drought Stresses on Growth Parameters and Essential oil Content of Matricariachamomila. Int. J. Agri. Biol. 10: 451-4
17. Younis, M.E.; Hasaneen, M.N.A.; Ahmed, A.R.and El-Bialy, D.M.A. (2008) Plant growth, metabolism and adaptation in relation tostress conditions. XXI. Reversal ofharmful NaCl-effects in lettuce plants by foliar application with urea. Australian Journal of Crop Science. 2(2): 83-95.
18. Kang, H.M.and Saltveit, M.E. (2002) Chilling tolerance of maize, cucumber and rice seedlings leaves and roots are differently affected by salicylic acid. Physiol. Plantarum. 115: 571-576.
19. . Maguire, I.D. (1962) Speed of germination – Aid in selection and evolution for seedling emergence and vigor. Crop Sci. 2: 176- 177.
20. Abdul-baki A.A, Anderson J.D. (1970) Viability and leaching of sugars from germinating barely. Crop Science. 10:31-34.
21. Singah, K.N., Sharma, D.K. and Chillar RK (1988) Growth, yield and chemical composition of different oil seed crop as influenced by sodicity. J. Agric. Sci. Camb. I11: 459- 463.
22. Khan, M.A.; Gul, B.and Weber, DJ. (2002) Effect of temperature, and salinity on the germination of Sarcobatusvermiculatus. Biological Plant. 45: 133-135.
23. Chadho, K., and Rajender, G. Advance in Horticulture Medicinal and Aromatic Plants, 1995, 11. Maldorta.Pub. New Delhi.
24. Munns, R.and Termaat, A. (1986) Whole-plant response to salinity. Aus. J. Plant Physiol.13: 143-160.
25. Khan, M.A.andUngar, I.A. (1997) Germination responses of subtropical annual halophytezygophyllum simplex. Seed Science and Technology. 25: 83-91.
26. Hajar, A.S.; Zidan, M.A.andAl-Zahrani, H.S. (1996) Effect of salinity stress on thegermination, growth and physiologicalactivities of Nigella sativa L. PersianGulf. J. Sci. Res. 14: 445-454.
27. Katergi N, Van Hoorn JW, Hamdy a, Karam F, Mastrortilli M (1994) Effect of salinity on emergence and on water stress early seedling growth of sunflower and maize. Agricultural Water Management.26: 81- 91.
28. Khan, M.A.andUngar, I.A. (1985) the role of hormones in regulators the germination of polymorphic seeds and early seedling growth of Atriplextriangularis under saline condition. Physiology Plantarum. 63: 109-113.
29. Akita, A. S. and G. S. Cabuslay. 1990. Physiological basis of differential response to salinity in rice cultivars. Plant Soil 123:227-294.
30. Mer, R. K., P. K. Prajith, D. H. Pandya and A. N. Dandey. 2000. Growth of young plants of Hourdeumvulgare, Triticumaestivum, Cicerarietiumand Brassica juncea. J. Agron. Crop Sci. 185:209-217.
31. Kader, M.A.andJutzi, S.C. (2004) Effects of termaland salt treatments during imbibition ongermination and seedling growth of sorghum at 42/19oC J. Agron. Crop Sci.190: 35-38.
32. Etesami, M.and Galeshi, S. (2008) Assessment of 10barely (Hordeum vulgar L.) genotypesreaction to salinity in germination andseedling growth stages. Journal ofagriculture science and natural resource.15th vol. No 5.
33. Massai R, Remorin D, Tattini H (2004) Gas exganges, water relation and osmotic adjustment in two scion rootstock combinations of pronus under water vrious salinity. Plant and Soil.259: 153- 162.
34. Redmann RE, Belyk M (1994) Growth of transgenic and standard canola (Brassica napus L.) varieties in response to soil salinity. Can. J. Plant Sci. 74(4): 797- 799.