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# Different Nacl Concentrations Impact on Seed Germination of Basil (Ocimum Basilicum L.) and Fennel (Foeniculum VulgareL.) Cultivars

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**Abstract**

*In this research, has been studied the effects of NaCl of different concentrations on all characteristics of germination of basil (Ocimum basilicum L.) and fennel (Foeniculum vulgare). Basil and Fennel varieties have been studied under four salinity treatments (0, 50, 100 and 150 mM) in the laboratory conditions. In the experiments, plant fresh weight, germination rate, hypocotyl and radicula length for all genotypes were decreased at the increase of salt dose. The results show that maximum germination speed of 0 mM (96.70 %) was observed in a salt dose of Basil. The results pointed out that maximum germination speed of 0 mM (94.70 %) was observed in a salt dose at Fennel.*

**Keywords:** *Foeniculum vulgare, Ocimum basilicum, NaCl, germination, seed.*

## 1. INTRODUCTION

Throughout history, environmental stress due to the high concentration of salt ions in soils has been one of the most important factors limiting the productivity of agricultural crops, especially plants susceptible to soil salinity. Today, the high salinity level in agricultural soils adversely affects agricultural production in the world1.

The period in which the plants are the most sensitive to salinity is the germination period. Germination on salty soils cannot be sufficient. The reason for this is that salt solutions in the soil move from bottom to top by evaporation2.

Salinity affects the germination rate, percentage and seedling growth in different ways depending on the plant species3,4,5. High levels of salinity affect seed germination and plant growth by water deficit, ion toxity and ion imbalance or a combination of these factors 6,7.

Ocimum (Basil) species are fragrant and perennial plants belonging to Lamiaceae family can grow in a wide area of the world8,9. Basil is used as a spice and has a unique smell due to its essential oils. Many plant species belonging to the Lamiaceae family can grow wild in the Mediterranean region 10,11,12,13,14.

Foeniculum vulgare (Fennel) is a Mediterranean plant used in traditional medicine and as a spice. The fruit of fennel plant can be used as antioxidant, diuretic, analgesic15. Essential oils are mainly concentrated in the pericarps and provide the unique aroma and taste16. It also increases milk flaw and libido and relives menopausal symptoms in women17.

The aim of this research was to characterize the effect of salinity on seed germination of Ocimum basilicum and Foeniculum vulgare cultivars and it has been studied under four salinity treatments, including, 0, 50, 100 and 150 mM in the laboratory conditions. In the experiments, germination rate, plant fresh weight, hypocotyl length and radicula length for all genotypes were decreased at the increase of the salt dose.

## 2. Material and Methods

O. basilicum and F. vulgare cultivars were provided by the Altinoluk Vocational School, Deparments of Plant and Animal Production, Medicinal and Aromatical Plant Programme, Balikesir University, Turkey. Seeds were sown on sterilized filter paper placed in petri dishes (6 mm). It was then wetted with a solution of different salinity concentrations (0, 50, 100 and 150 mM) as well as distilled water. The study was conducted in four replications. After 4 days germination rate of seeds gives germinating rate; on the other hand, at the end of 8 days, it gives germination power. Germination rate, plant fresh weight, hypocotyl and radicle lengths were evaluated using ten seedlings. Experimental data were analyzed by ANOVA and compared with the Least Significant Difference (LSD) test ($p<0.05$). For all parameters investigated, variance analysis was performed using MSTAT-C software.

## 3. Results and Discussion

The results of this study reveal that salinity concentration characteristics significantly affected all characters ($p<0.05$). The differences between the means were compared by Duncan's multiple range tests and are shown in Table 1. The results show that maximum germination speed of 0 mM (96.70 %) was observed in a salt dose. The lowest germination speed of 150 mM (88.75 %) was obtained in salt dose. The lowest germination rate of 150 mM (93.50 %); radicula length of 150 mM (0.53 cm %); hypocotyl length rate of 150 mM (0.08 cm %) and plant fresh weight of 150 mM (0.008 g %) were obtained in salt dose. The results show that maximum maximum germination rate of 0 mM (100 %); radicula length of 0 mM (0.96 cm); maximum hypocotyl length of 0 mM (0.24 cm) and plant fresh weight of 0 mM (0.019 g) were observed in a salt dose.

**Table 1.** *Physical measurements of O. basilicum seeds during germination*

| Salt Dose | Germination Speed (%) | Germination Rate (%) | Radicula length (cm) | Hypocotyl length (cm) | Plant fresh weight (g) |
|---|---|---|---|---|---|
| 0 | **96.70a*** | **100.00a** | **0.96a** | **0.24a** | **0.019a** |
| 50 | 95.30b | 98.00b | 0.88b | 0.22ab | 0.016b |
| 100 | 93.10c | 94.00c | 0.71c | 0.15b | 0.011c |
| 150 | 88.75d | 93.50c | 0.53d | 0.08a | 0.008d |
| Mean | 93.46 | 96.38 | 0.77 | 0.17 | 0.014 |
| LSD | 1.24 | 0.97 | 0.07 | 0.018 | 0.002 |
| CV | 7.86 | 6.55 | 8.81 | 10.14 | 9.84 |

**Differences among the parameters are statistically significant at p<0.05*

*There is no statistically significant difference (p<0.05) between figures including the same letters in the columns*

The results of this study showed all characters were significantly affected by different NaCl concentrations ($p<0.05$). The differences between these tools were compared with Duncan's multi-class test (Duncan's test) and presented in Table 2.

**Table 2.** *Physical measurements of F. vulgare seeds during germination*

| Salt Dose | Germination Speed (%) | Germination Rate (%) | Radicula length (cm) | Hypocotyl length (cm) | Plant fresh weight (g) |
|---|---|---|---|---|---|
| 0 | **94.30a*** | **100.00a** | **2.31a** | 0.53b | **0.034a** |
| 50 | 92.80b | 97.50b | 2.08b | **0.64a** | 0.029b |
| 100 | 92.10b | 96.30c | 1.24c | 0.31c | 0.021c |
| 150 | 89.30c | 93.40d | 0.91d | 0.14d | 0.013d |
| Mean | 92.13 | 96.80 | 1.64 | 0.41 | 0.024 |
| LSD | 1.07 | 1.13 | 0.15 | 0.09 | 0.0038 |
| CV | 6.21 | 7.02 | 5.89 | 7.14 | 8.86 |

** Differences among the parameters are statistically significant at p<0.05*

There is no statistically significant difference ($p>0.05$) between figures including the same letters in the columns

The results show that maximum germination speed of 0 mM (94.70 %); germination rate of 0 mM (100 %); radicula length of 0 mM (2.31 cm); hypocotyl length of 50 mM (0.64 cm) and plant fresh weight of 0 mM (0.034 g) were observed in a salt dose. The lowest germination speed of 150 mM

(89.30%);germination rate of 150 mM (93.40 %); radicula length of 150 mM (0.91 cm %); hypocotyl length rate of 150 mM (0.14 cm) and plant fresh weight of 150 mM (0.013 g) were obtained in salt dose.

Similar results were found by Maas and Hoffman18 and Huggen19. High salt concentration in germination medium can reduce or delay germination percentage20,21,22. Some plants showed different resistance to salinity during germination23. Under saline conditions, shoot growth was frequently inhibited more than root growth24. Salinity stress had remarkable effects on other plant growth parameters such as plant and root fresh weight25. High foliar concentration of Na+ is capable of reducing CO2 assimilation because of ionic toxicity26. Reduction in plant and root fresh weight in response to salt stress has been reported for other crops, such as okra, broadbean, soybean chickpea, cowpea, black cumin melon, tomato and watermelon27-34.

## 4. CONCLUSION

The results show that maximum germination speed of 0 mM (96.70 %) was observed in a salt dose of Basil. The results pointed out that maximum germination speed of 0 mM (94.70 %) was observed in a salt dose at Fennel. Results showed that O. basilicum and F. vulgare all characters were depressed when we increased NaCl concentration. Although further investigations are needed to ascertain the present result, some conclusions may be drawn from these findings.

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