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# Evaluation the interaction of salinity and salicylic acid on Sweet basil (*Ocimum basilicum*) properties

**Raziaeh Fatemi and *Abdolhossein Aboutalebi**

*Depatment of Horticulture, Jahrom Branch, Islamic Azad Univertsity, Jahrom, Iran*

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**ABSTRACT**

*In this study were evaluated the interaction of salinity and salicylic acid (SA) on morphological and physiological properties of Sweet basil plants. The experiment was done as factorial arrangement in completely randomized design with three replicates. First factor was salinity (2, 4, 6 and 8 g/L NaCl) and second factor was salicylic acid (50, 100 and 150 mg/L) as spraying and one treatment was considered as control. Results showed that increasing levels of NaCl resulted in reduction of shoot fresh weight; root fresh and dry weight; plant height; number of lateral branches; chlorophyll content and potassium levels and with increasing sodium chloride levels, increased in sodium content. The most effective concentration of SA was 50 mg/L for reduction of salinity effects on evaluated characters. Increasing of SA concentration from 50 to 150 mg/L led to decreasing of fresh and dry weight in shoot and root; plant height; lateral shoot number; chlorophyll and sodium content but potassium content increased.*

**Keywords**: Chlorophyll, Potassium, Salinity stress, Sodium.

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## INTRODUCTION

Using of medicinal and condimental plants for diseases therapy and pleasing of foods and also for making of health and makeup materials has been accompanied to mankind history [9]. In recent decades, attentive to side effects of chemical drugs, human has been tended toward medicinal plants gradually again so that 25% of the present modern drugs have been made from medicinal plants [14]. Labiateae family is including herbal, ornamental and edible plants that are the source of essences production. There are various genuses in this family that Sweet basil is one of the most important medicinal and condimental species of this family. Sweet basil is an annual and fragrant herbal plant that it has more than 60 species. Origin center of this plant has been reported India and Iran. This plant is used as the medicinal and condimental plant and also as fresh vegetable [9]. Salinity is the original osmotic stress that limits growth and production of plant [10]. Reducing of growth and yield is depending to saline concentration. Whatever the saline concentration is more, reducing of growth is the more noticeable. Sodium and chloride affect leaf development Rapidity [2]. Reports show that salinity lead to reducing of growth and dry matter production in plant [11] that from causes of growth inhibitory in different salinity level can be cited to photosynthetic reduction, increasing of sodium and chloride concentration in plant and non-producing of some proteins and enzymes [1]. Compatibility to these stresses is relation to regulating of the metabolites that change various enzymes [4]. Plants may be resisting to salinity via avoidance from salinity by saline regulation and or tolerance of saline and overcoming of plant cells on high concentration of ions [8]. The plants which can be absorbed mineral elements in saline condition, are counted resistant plant so that resistant plants usually have high potassium/sodium ratio in own different parts. Salicylic acid (SA) is one of phenolic compounds that are producing in plants. These compounds can be performing as growth regulator [5, 7]. SA also has been known as an important molecular signal in the plant reaction for the response to environmental stresses (Senaratna, 2000) that have desirable effects on plant growth and development [6, 15]. It has been reported that SA significantly reduces ion leakage and toxic ions accumulation [6, 16] and lead to reducing of environmental stresses effects via increasing of growth regulator hormones such as auxins and cytokinins [13]. The aim of this study was the examination of this hypothesis that SA completely or approximate can be reducing the negative effects of salinity stress on morphological and physiological properties of Sweet basil plant.

## MATERIALS AND METHODS

This study was performed in order to evaluate the interaction of salinity stress and salicylic acid (SA) on characteristics of Sweet basil (*Ocimum basilicum*) as factorial arrangement in completely randomized design in field with three replications, in Darab region placed in south-eastern of Fars province (Iran). Salinity levels (2, 4, 6 and 8 g/L NaCl) was added to irrigated water with 0.4 ds/m. SA was used in three levels (50, 100 and 150 mg/L). A treatment also was considered as control. In each 5 kg pot containing sandy-loam soil was sown 10 seeds of Sweet basil in June. After reaching to four leaves stage and establishment of plantlet was done thinning operation and then salinity treatments were performed. One week after salinity treatment operation, each 10 days once was sprayed SA treatments until flowering stage. At the end of experiment, the plants were discharge from pots and were washed by distilled water and were separated their shoots and roots. Shoot height, fresh and dry weight of shoot and root and lateral shoot number were measured. To measuring of leaf sodium and potassium, one gram of powdered dried leaf was changed to ash in oven with 100-150 °C primary temperature and 550 °C finally temperature. Then was added 5 ml HCl 2N to samples and was filtrated and concentrated by 50 ml double distilled water. Potassium and sodium in obtained extract was measured by Flame photometer Sherwood 410. Chlorophyll content was recorded by SPAD. Final data was analyzed by MSTAT-C software and the means were compared by Duncan's new multiple range test (DMRT).

## RESULTS

Evaluation the interaction of NaCl and SA showed that the highest shoot fresh weight was in without salinity stress + 50 and 100 mg/L SA (51.68 and 51.37 g respectively) and the lowest was in 8 g/L NaCl + 150 mg/L SA (18.44 g). Shoot fresh weight decreased in all NaCl concentrations with increasing of SA concentrations (Table 1). The greatest root fresh weight was related to NaCl 0.0 + 150 mg/L SA (35.24 g) and the lowest was related to 8 g/L NaCl without SA (14.22 g) (Table 1).

The highest shoot dry weight was related to NaCl 0.0 + 50 and 100 mg/L SA (7.42 and 7.52 g respectively) and the lowest were related to 8 g/L NaCl + 150 mg/L SA (1.65 g) (Table 1).

The greatest root dry weight was related to NaCl 0.0 + 50 mg/L SA (6.62 g) and also 2 g/L NaCl + 50 mg/L SA (6.46 g) and the lowest was related to 8 g/L NaCl + 150 mg/L SA (1.94 g) (Table 1). The most root dry weight in all levels of NaCl was related to 50 mg/L SA and root dry weight decreased from 50 to 150 mg/L SA (Table 1).

The highest plant height was observed in NaCl 0.0 + 50 and 100 mg/L SA (51.8 cm) and the least in 8 g/L NaCl without SA (23.0 cm). Plant height decreased from 50 to 150 mg/L SA in all levels of NaCl (Table 1).

The most lateral shoot number was observed in NaCl 0.0 + 100 mg/L SA (22.2 shoot) and the lowest in 8 g/L NaCl without SA. Lateral shoot number reduced in all levels of NaCl with increasing of SA concentration (Table 2).

The greatest chlorophyll content was related to NaCl 0.0 + 100 mg/L SA (6.76) and the lowest were related to 8 g/L NaCl + 150 mg/L SA (4.07) (Table 2).

The highest sodium content was observed in 8 g/L NaCl + 150 mg/L SA (1.625 dry matter percent) and the least in NaCl 0.0 + 150 mg/L SA (0.030 DM%). Plant height decreased from 50 to 150 mg/L SA in all levels of NaCl (Table 2).

The most potassium content was related to NaCl 0.0 + 150 mg/L SA (2.36 dry matter percent) and the lowest in 8 g/L NaCl without SA (1.94 DM%). increasing of SA concentration led to increasing of potassium content in all levels of NaCl (Table 2).

**Table 1- Interaction of NaCl and SA on evaluated characters**

| Salinity (g/L) × SA (mg/L) | Character | Fresh weight (g) Shoot | Fresh weight (g) Root | Dry weight (g) Shoot | Dry weight (g) Root | Plant height (cm) |
|---|---|---|---|---|---|---|
| 0 | 0 | 42.89$^{b}$ | 24.41$^{d}$ | 5.33$^{bc}$ | 4.93$^{cd}$ | 48.8$^{b}$ |
| | 50 mg/L | 51.68$^{a}$ | 26.14$^{c}$ | 7.42$^{a}$ | 6.62$^{a}$ | 51.8$^{a}$ |
| | 100 | 51.37$^{a}$ | 27.80$^{b}$ | 7.52$^{a}$ | 5.72$^{b}$ | 51.8$^{a}$ |
| | 150 | 42.58$^{b}$ | 35.24$^{a}$ | 6.08$^{b}$ | 5.22$^{bc}$ | 44.0$^{c}$ |
| 2 g/L | 0 | 37.58$^{cd}$ | 25.01$^{cd}$ | 4.30$^{cd}$ | 4.83$^{cd}$ | 42.0$^{d}$ |
| | 50 | 39.50$^{bc}$ | 23.17$^{e}$ | 5.68$^{b}$ | 6.46$^{a}$ | 41.8$^{d}$ |
| | 100 | 31.89$^{ef}$ | 19.67$^{f}$ | 4.06$^{d}$ | 4.86$^{cd}$ | 40.8$^{d}$ |
| | 150 | 37.97$^{bcd}$ | 25.74$^{c}$ | 4.33$^{cd}$ | 4.35$^{de}$ | 35.0$^{efg}$ |
| 4 g/L | 0 | 34.65$^{cde}$ | 20.43$^{f}$ | 3.62$^{de}$ | 3.62$^{ef}$ | 36.0$^{ef}$ |
| | 50 | 35.74$^{cde}$ | 20.52$^{f}$ | 4.48$^{cd}$ | 4.00$^{e}$ | 36.7$^{e}$ |
| | 100 | 33.24$^{def}$ | 19.38$^{fg}$ | 4.19$^{cd}$ | 3.18$^{fg}$ | 29.3$^{jk}$ |
| | 150 | 31.74$^{ef}$ | 16.24$^{h}$ | 3.45$^{de}$ | 2.62$^{ghi}$ | 28.7$^{k}$ |
| 6 g/L | 0 | 28.73$^{fgh}$ | 16.86$^{h}$ | 2.87$^{ef}$ | 3.02$^{fg}$ | 30.2$^{ijk}$ |
| | 50 | 31.31$^{efg}$ | 18.27$^{g}$ | 3.51$^{de}$ | 3.73$^{ef}$ | 33.3$^{gh}$ |
| | 100 | 28.32$^{fgh}$ | 17.02$^{h}$ | 2.49$^{efg}$ | 3.14$^{fg}$ | 34.5$^{fg}$ |
| | 150 | 25.12$^{h}$ | 14.50$^{i}$ | 2.80$^{efg}$ | 2.80$^{gh}$ | 32.0$^{hi}$ |
| 8 g/L | 0 | 26.45$^{gh}$ | 14.22$^{i}$ | 2.49$^{efg}$ | 2.06$^{hi}$ | 23.0$^{l}$ |
| | 50 | 24.32$^{hi}$ | 16.48$^{h}$ | 2.68$^{efg}$ | 2.19$^{hi}$ | 31.2$^{ij}$ |
| | 100 | 19.72$^{ij}$ | 16.90$^{h}$ | 2.20$^{fg}$ | 2.17$^{hi}$ | 31.0$^{ij}$ |
| | 150 | 18.44$^{j}$ | 14.23$^{i}$ | 1.65$^{g}$ | 1.94$^{i}$ | 28.7$^{k}$ |

*Means in each column, followed by similar letters are not significantly different at the 1% level according to Duncan's test (DMRT).*

**Table 2- Interaction of NaCl and SA on evaluated characters**

| Salinity (g/L) × SA (mg/L) | Character | Lateral shoot number | Chlorophyll (SPAD No.) | Na (DM%) | K (DM%) |
|---|---|---|---|---|---|
| 0 | 0 | 20.0$^{bc}$ | 5.55$^{de}$ | 0.035$^{i}$ | 2.82$^{ef}$ |
| | 50 mg/L | 21.3$^{ab}$ | 6.14$^{b}$ | 0.040$^{i}$ | 3.00$^{cd}$ |
| | 100 | 22.2$^{a}$ | 6.76$^{a}$ | 0.035$^{i}$ | 3.14$^{bc}$ |
| | 150 | 20.8$^{b}$ | 6.34$^{ab}$ | 0.030$^{i}$ | 3.36$^{a}$ |
| 2 g/L | 0 | 15.2$^{de}$ | 5.18$^{efg}$ | 0.825$^{de}$ | 2.72$^{f}$ |
| | 50 | 19.0$^{c}$ | 5.34$^{defg}$ | 0.570$^{g}$ | 2.91$^{de}$ |
| | 100 | 20.0$^{bc}$ | 6.03$^{bc}$ | 0.425$^{h}$ | 3.22$^{ab}$ |
| | 150 | 15.2$^{de}$ | 5.49$^{def}$ | 0.650$^{fg}$ | 3.19$^{ab}$ |
| 4 g/L | 0 | 14.0$^{efg}$ | 5.35$^{defg}$ | 0.980$^{c}$ | 2.32$^{h}$ |
| | 50 | 15.3$^{de}$ | 5.68$^{cd}$ | 0.775$^{de}$ | 2.41$^{gh}$ |
| | 100 | 15.5$^{d}$ | 5.38$^{defg}$ | 0.755$^{e}$ | 2.37$^{h}$ |
| | 150 | 13.3$^{fgh}$ | 5.16$^{efg}$ | 0.585$^{g}$ | 2.55$^{g}$ |
| 6 g/L | 0 | 13.7$^{fg}$ | 5.25$^{defg}$ | 0.860$^{d}$ | 2.07$^{ij}$ |
| | 50 | 14.3$^{def}$ | 5.26$^{defg}$ | 0.725$^{ef}$ | 2.29$^{h}$ |
| | 100 | 14.2$^{def}$ | 5.03$^{fgh}$ | 0.650$^{fg}$ | 2.24$^{hi}$ |
| | 150 | 12.2$^{hij}$ | 4.89$^{ghi}$ | 0.755$^{e}$ | 2.40$^{gh}$ |
| 8 g/L | 0 | 11.2$^{j}$ | 4.58$^{hi}$ | 1.535$^{ab}$ | 1.94$^{j}$ |
| | 50 | 12.8$^{ghi}$ | 4.61$^{hi}$ | 1.575$^{a}$ | 2.10$^{ij}$ |
| | 100 | 12.8$^{ghi}$ | 4.50$^{ij}$ | 1.450$^{b}$ | 2.08$^{ij}$ |
| | 150 | 11.5$^{ij}$ | 4.07$^{j}$ | 1.625$^{a}$ | 2.25$^{hi}$ |

*Means in each column, followed by similar letters are not significantly different at the 1% level according to Duncan's test (DMRT).*

The aim of this study was the examination of this hypothesis that SA completely or approximate can be reducing the negative effects of salinity stress on morphological and physiological properties of Sweet basil plant.

Results showed that increasing of NaCl levels lead to reducing the shoot and root fresh weight; root dry weight, plant height, lateral shoot number, chlorophyll content and potassium amount and sodium amount increases with enhancement of NaCl level. The most effective concentration of SA was 50 mg/L in all evaluated characters. If SA concentration increases from limit, the effects of salinity stress aggravate. Therefore, fresh and dry weight of shoot and root; plant height, lateral shoot number; chlorophyll content and sodium amount decreased by increasing of SA concentration from 50 to 150 mg/L, but potassium amount increased. It has been reported that low concentrations of SA usually lead to increasing of growth and plant resistance to stresses [3, 5, 12, 15].

## REFERENCES

[1] H. Azarnivand, K. Nosrati, A. Bijanzadeh, A. Shahbazi. *Desert Journal*. **2005**. 10(2): 383-396.
[2] H.J. Bohnert, R.G. Jensen. *Aust. Plant Physiol*. **1996**. 59: 661-667.
[3] J.F. Dat, C.H. Foyer, I.M. Scott. *Plant Physiol*. **1998**. Vol. 118, pp. 1455-1461.
[4] A.A. Ehsanpour, F. Amini. *African Journal of Biotechnology*. **2003**. 2: 133-135.
[5] G. Kang. *Environmental and Experimental Botany*. **2003**. 50: 9-15.
[6] A. Krantev, R. Yordanova, T. Janda, G. Szalai, L. Popova. *Journal of Plant Physiology*. **2008**. 165(9): 920-930.
[7] A. Majd, S.M. Maddah, F.A. Falahian, S.H. Sabbaghpour, F. Chalbian. *Iranian Biology Journal*. **2006**. 19(3): 183-192.
[8] S.A.M. Mirmohammady, B. Ghareyazie. Physiological Apects and Breeding for Salinity Stress in Plants. Isfahan University of Technology Press. **2002**. pP 230.
[9] R. Omidbeigi. Production and Processing of Medicinal Plants. Tarrahan Nashr Press, **2000**. Vol. 1. p. 283.
[10] M. Pour-esmaeil, M. Ghorbanli, R. Khavarinejad. *Desert Journal*. **2005**. 10(2): 257-264.
[11] A. Safarnejad, H. Hamidi. National Congress of Permanent Development in Medicinal Plants. Mashhad. Iran. **2005**. p 67.
[12] T. Senaratna, D. Touchell, E. Bunn, K. Dixon. **2000**. 30: 157-161.
[13] M.F. Shakirova, A.R. Sakhabutdinova, M.V. Bezrukova, R.A. Fatkhutdinova, D.R. Fatkhutdinova. *Plant Science*. **2003**. 164(3): 317-322.
[14] A.R. Valadabadi, F. Mohammad-beigi, J. Daneshian. Medicinal Plants. Shahre-Ghods City, Islamic Azad University of Shahre-Ghods. **2010**. 964 p.
[15] S. Zare, A. Tavili, A. Shahbazi, A. Riahi. Grassland, Yielding-water Issue, *Natural Resources of Iran Journal*. **2010**. 63(1): 29-39.
[16] H.J. Zhao, X.W. Lin, H.Z. Shi, S.M. Chang. *Acta Agron. Sin*. **1995**. 21: 351-355.