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The content of mineral and total sugars in salicylic acid treatment under salt stress in *Myrtus communis* L.

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Abstract

In this study we investigated the effects of different concentrations of salicylic acid (0, 50, 100 and 150 ppm) that were sprayed on one age seedlings of myrtle (*Myrtus communis* L.) with different levels of NaCl (0, 25, 50, and 100mM) on content of total sugers, sodium, potassium, Phosphorous and potassium to sodium. total sugers showed The interaction effect of salt level and salicylic acid concentration on the total sugars was significant ($P<0.05$) indicating the total sugars was obtained at 50 mM salt and 50 ppm salicylic acid. Salt stress had a significant effect ($P<0.01$) on the ratio of potassium to sodium, potassium, sodium and Phosphorousus and the highest effect was obtained at 100mM salt concentration (in contrast to the ratio of potassium to sodium).

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Introduction

Salinity effects on mineral absorption. Salinity can decrease the absorption of water and minerals by interfering with the action of carriers and ion channels in the root such as selective K+ channels (sodium-potassium-free competition), or inhibition of root growth by Na+ osmotic effects or with Na+ effect on soil structure. Water and minerals (Parida and Das., 2005; Orcutt and Nilsen., 2000; Maharajan and Tuteja., 2005; Tester and Davenport., 2003). Salinity causes a high drop in potassium in many plants.

There is a great correlation between the accumulation of sugars and tolerance to salinity and drought (Seki *et al.*, 2007; Orcutt and Nilsen., 2000). Soluble sugars and sugars such as glucose and fructose showed increase under salinity stress in tomato (Shibli *et al.*, 2007), beans (Palma *et al.*, 2009), canola (Baghizadeh A., 2014) and wheat (Aldesuquy *et al*; 2013). Salicylic acid has increased, total sugars in tomato plants (Tari *et al.*, 2002), canola (Baghizadeh *et al.*, 2014), wheat (Aldesuquy *et al.*, 2013) and flax (Bakry *et al.*, 2012) Under salt and and drought stress.There is a direct relationship between physiological processes such as changes in the amount of carbohydrates, and changes in the metabolism and conversion of sugars in osmotic conditions play a crucial role in tolerance to stress (Kerepesi and Galiba, 2000) . studies in different wheat cultivars in salinity and drought stress showed the increase in soluble carbohydrates (glucose, fructose, sucrose and Fructans) and This increase in resistant cultivars was more than sensitive so carbohydrate accumulation is a common response to drought or salinity stress. (Kafi *et al.*, 2003; Kerepesi and Galiba., 2000; Keles and Oncel., 2004). But there are also reports that there is no change in the amount of soluble sugars in salinity and drought stresses, and even in severe stresses, the amount of these compounds has decreased (Karimi *et al.*, 2005; Slama *et al.*, 2007).

Changes occur under the influence of salicylic acid in the mineral nutrition of plants (Raskin., 1992). It was first observed in the study of barley roots that salicylic acid prevents the absorbtion of K+ by roots, and this inhibitory effect depends on both the concentration and the pH of the solution containing salicylic acid (Harper and Balke, 1981; Glass, 1974). In alfalfa, the application of this substance has been shown to decrease the concentration of potassium uptake in the root and increase the concentration of elements such as Ca 2+ and Fe 2+ in the root and decrease the amount of Ca 2+ and Fe 2+ in the aerial (Drazic *et al.*, 2006). In another study, the effect of different types of phenolic compounds on Phosphorous absorption in barley roots was investigated, and showed that all phenolic compounds used in this study reduced Phosphorous absorption and the amount of this reduction was depend on the solubility of faty in these phenolic. (Glass, 1973). Also, the use of salicylic acid quickly reduced the amount of Na + in barley plants under both control and salt stress conditions, suggesting that this material could decrease the ion toxicity and its negative effect to reduce other metabolic processes by reducing the absorption of this ion (El-Tayeb., 2005).

Salicylic acid also increased the accumulation of Ca2+ and K+ in the stem of barley plants in salt stress and reduced the accumulation of these ions in the roots of it (El-Tayeb., 2005). The purpose of this study is to investigate how the effect of salt stress and salicylic acid on the accumulation of minerals and sugars in *Myrtus communis* L.

Materials and methods

Plant materials and treatments

Pot experiment done by 12-centimeter vases that were filled by sand, peat and field soil (proportion was 1:1:1). At the age of one-year, salicylic acid was sprayed to pots at levels of: zero, 50, 100 and 150 ppm then salinity treatments at amounts of: zero, 25, 50 and 100mM of sodium chloride were applied. The plants were irrigated by 3:1 Hoagland solution two times per week for two months and salicylic acid was sprayed on the plants two time per weeks. Sodium chloride was added to 3:1 Hoagland solution (Tattini *et al.*, 2006). The amount of Glysin-betaein in dried leaves (third leaf from plant top) was measured (Gerive and Grattan, 1983) and at a wavelength of 365 nm was measured. Measurement of prolin was done via spectrophotometry at 25 ± 1°C (Bates, 1973) and at a wavelength of 520nm was measured. To measure damage to membrane, ion leakage was assessed (Campos *et al*., 2003).

Chemical analyses

Measurement of total sugar content by phenolic-sulfuric acid (based on AOAC method, International Association of Agricultural Chemists, 1995). To prepare the extract, weighed the dry and milled sample and then each of the samples was poured into a crucible and placed in a furnace for three hours at 550°C until the samples turned To ashes. Five calcium chloride adds 2 normal to each sample and the final volume was distilled to 50cc by distilled water. Sodium and potassium were measured by the Cornuning M405 film maker.

Measurement of Phosphorousus by ammonium molybdate and ammonium vanadate (yellow method) using spectrophotometer (Chapman, 1961; Olsen *et al*., 1954) (made in England, Pharmacia Biotech).

Statistical analysis

This study was done using a factorial experiment in a randomized complete block design with four replications. Factors were included: four levels of salinity (0, 25, 50 and 100mM) and four levels of salicylic acid (0, 50, 100 and 150 ppm). Analysis of variance was done by SAS (ver. 9.1) and the comparison of means was carried out using Duncan's multiple range test.

Results and discussion

Analysis of variance showed that for K / Na , Na, K and P, salinity treatments were significant at 1% level. Salicylic acid treatment and their interaction were not significant. salinity and salicylic acid treatments were significant at 1% level and their interaction was significant at 5% level For total sugar (Table 1).

Table 1. Analysis of variance mean squares of myrtle traits.

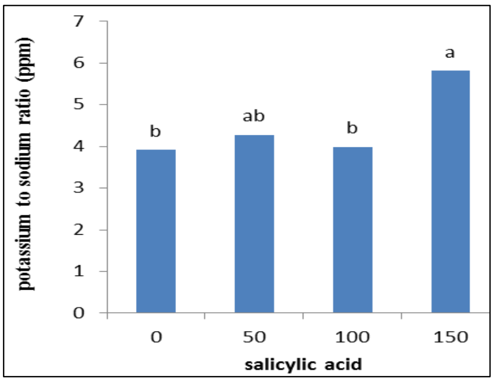
(MS)					Df	source
Total sugars	P	Na	K	K/Na		
278.85 ns	0.0005 ns	0.11 ns	0.59 *	10.92 ns	3	Replication
10589.50**	0.01**	3.7**	1.33**	132.56**	3	S
6404.32**	0.0005 ns	0.1 ns	0.18 ns	12.74 ns	3	SA
1565.23 *	0.001 ns	0.09 ns	0.25 ns	10.09 ns	9	S*SA
691.72	0.001	0.06	0.18	5.59	3	Error
13.95%	25.55%	33.08%	19.36%	52.57%	45	CV

ns=non-significant , P distinctly significant, S=Salinity ,SA= Salicylic acid.

The lowest amount of K / Na was observed at 100 mM and subsequently at 50, 25 and 0, respectively and salinity of 100mM showed a significant with salinity of 25 and 0mM (Fig. 1). The highest level of K / Na were observed at 150 ppm In salicylic acid treatment and then at 50, 100 and 0 ppm respectively (Fig. 1). The highest amount of K was observed in salinity in 100mM. This difference was significant with other treatments and there was no significant between the other treatments (Fig. 1).

The highest amount of Na was observed at 100 mM and then at 50, 25 and 0 MM respectively. There was a significant between all salinity treatments (Fig. 2). In this study, was observed the highest amount of Na at 50 ppm of salicylic acid, followed by 100, 0 and 150 ppm treatment respectively. However, no significant was observed between salicylic acid treatments (Fig. 2). In salicylic acid, the highest K content was observed at 0 ppm, followed by 150, 50 and 100 ppm respectively. However, no significant was observed between salicylic acid treatments (Fig. 3). the effect of salinity on Phosphorous, the highest amount of Phosphorous was observed in 100 mM salinity, which showed a significant with other treatments (Fig. 4) and the highest amount of Phosphorous in salicylic acid was 50 ppm treatment (Fig. 4). As the salinity increased, the K / Na decreased as the sodium ion absorption was higher than of potassium ion absorption. Also, in salinity of 100mM, potassium absorption increased, which is somewhat tolerant to salinity, due to increased potassium ion absorption at high salinity concentrations. The levels of K / Na, Na, and K is very different that depending on the species and have a significant bearing on the tolerance of the plants in their resistance to salinity. In 2002, Cicek *et al.* Stated that with increasing salinity levels, maize cultivars increased content of Na, but K did not significantly change. and potassium have a important role on the tolerance of the plants in their resistance to salinity. In 2002, Cicek *et al*, Stated that with increasing salinity levels in maize cultivars increased Na but K did not significantly change. In 2009, Karlidag *et al*, Reported that salinity while increasing Na, reduced K in strawberries. Essa (2002) also reported that NaCl would damage plants by producing high levels of Na / Ca and Na / K. Studies by El-Tayeb *et al.* (2005) reported that NaCl increased potassium, calcium and Phosphorous, but under stress conditions, pretreatment of salicylic acid reduced calcium and increased potassium and soluble sugars accumulation. They also reported that pretreatment of grass plants with salicylic acid would reduce the Na adsorption, thereby preventing of sodium damage. In the present study salicylic acid showed a minimum of content at 150 ppm Na, although this decrease was not significant at sodium. Also, Tayeb *et al* (2005) reported that potassium content was decreased under salinity stress in grass plants.

But in the present study, the highest amount of potassium was observed in salinity with 100mM treatment, it is true that increasing salinity in Myrtle increased Na but the plant use of this mechanism to deal with high salinity by increasing potassium probably. The highest amount of total sugars was observed in salinity of 100mM and then at 50, 25 and 0mM, respectively. There was no significant between treatments of 100 and 50mM and also between 0 and 25mM treatments (Fig. 5). The main effect of salicylic acid was observed on 50 ppm treatment in total sugar. After wards the highest concentration of total sugar were observed at 100, 0 and 150 ppm, respectively. There was no significant between treatments of salicylic acid 50 and 100 ppm as well as between 0 and 150 ppm salicylic acid (Fig. 5). Carbohydrates, such as (glucose, fructose, sucrose), and starch is accumulated under salt stress. Salinity stress cause the change in structure of sugars such as glucose, fructose, sucrose and fructans in a number of plants (Singh *et al.*, 2000). The amount of sugar increased in rice genotypes under salt stress (Alamgir and Ali., 1999). in *Bruguiera parviglora* has been reported Increased of total sugar in leaves content under salt stress (Parida *et al.*, 2004). It has been reported that the sugar increased plant resistance in environment stresses (Parida and Das., 2005). In the present study, it appears that salinity increased the total sugar content (Fig. 5), which could be due to the production of soluble sugars to cope with salt stress. high soluble sugars in salt stress play a important role in the protection, regulation osmotic, carbon storage, sweeping free radicals, protecting the membranes and proteins of cells exposed to salinity and reducing the accumulation of proteins and stomachs (Kumer *et al* ., 2005). It can be concluded that the increase in total sugar under salt stress and salicylic acid (salinity and salicylic acid interaction of 50mM) increased the plant's compatibility, Which is consistent with the progeny obtained in *Oryza sativa* (Nemati *et al.*, 2011).



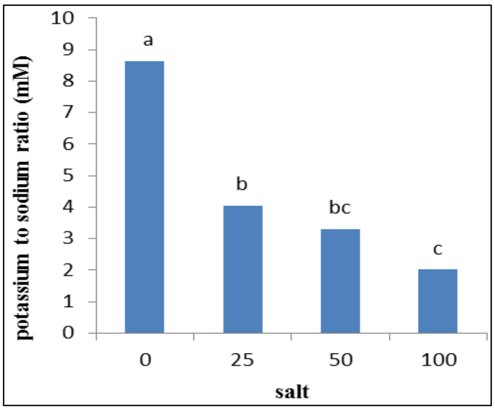


Fig. 1. Effect of salinity and salicylic acid treatments on potassium to sodium content.

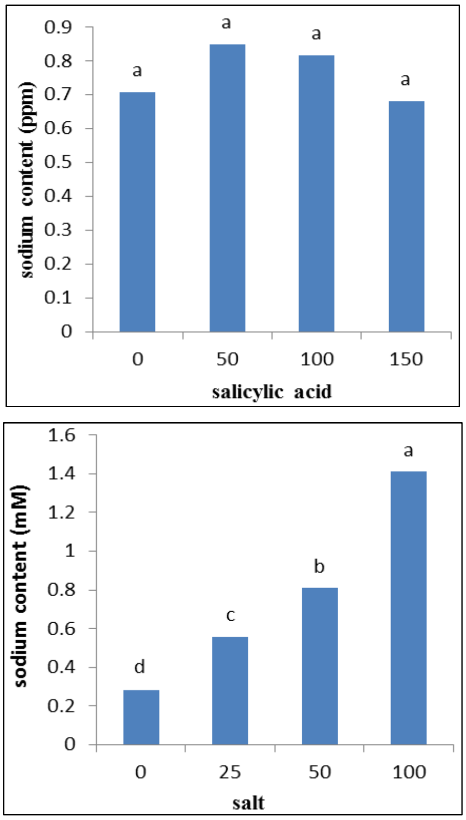


Fig. 2. Effect of salinity and salicylic acid treatments on sodium content.

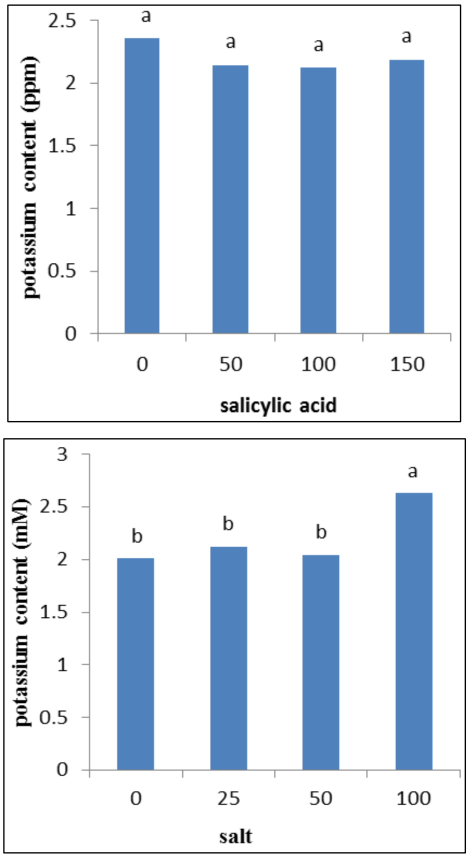


Fig. 3. Effect of salinity and salicylic acid treatments on potassium content.

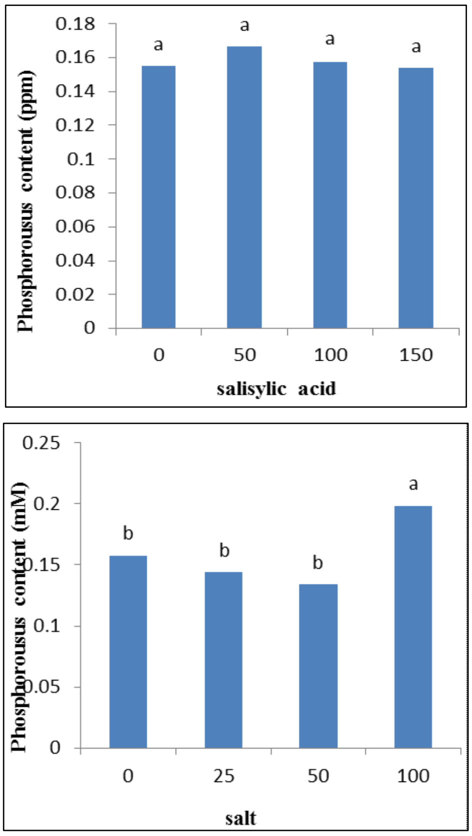


Fig. 4. Effect of salinity and salicylic acid treatments on Phosphorous content.

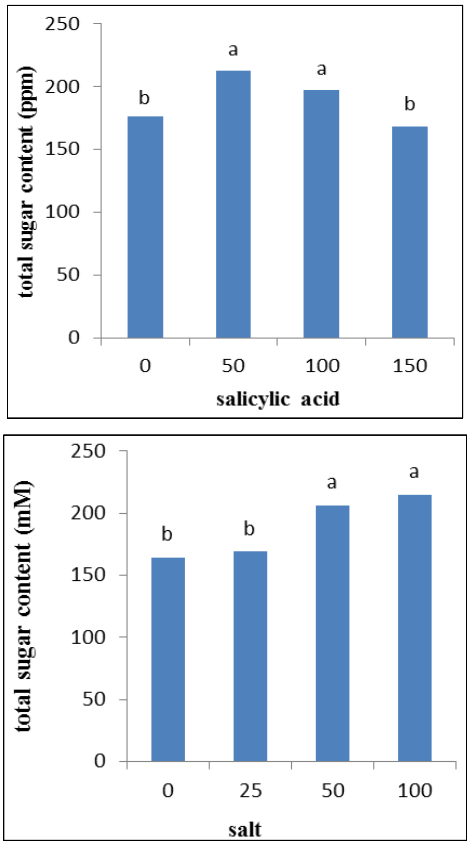


Fig. 5. Effect of salinity and salicylic acid treatments on total sugar.

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