Article

Effect of different levels of salinity and combination of salicylic and ascorbic acid supplementation on some morphological characteristics of *Aloe vera*

Shahin Shirvani Naghani
Department of Agriculture, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
E-mail: private.platinum@yahoo.com

Received 31 October 2018; *Accepted 10 December 2018*; *Published 1 June 2019*

Abstract
This study was performed to evaluate the effect of different level of salicylic and ascorbic acid on *Aloe vera* morphological characteristics. To do this he completely randomized factorial design with 5 replicates was used. Data showed that ascorbic acid had significant effect on *A. vera* biochemical and morphological characteristics. The ascorbic acid supplementation could have significant effect on leave thickness and diameter. The higher salinity reduced wet and dry gel weight, and also reduced the interaction between salinity and ascorbic acid. We may conclude that the using of ascorbic acid could change some effect of salinity on *A. vera* plant.

Key words *Aloe vera*; gel weight; ascorbic acid; salinity; salicylic acid; morphological characteristics.

Ornamental and Medicinal Plants
ISSN 2522-3682
URL: http://www.iaees.org/publications/journals/omp/online-version.asp
RSS: http://www.iaees.org/publications/journals/omp/rss.xml
E-mail: omp@iaees.org
Editor-in-Chief: WenJun Zhang
Publisher: International Academy of Ecology and Environmental Sciences

1 Introduction

Aloe vera L. is a perennial liliaceous plant with succulent green leaves joined at the stem in a whorled pattern (Surjushe et al., 2008). It is highly appreciated due to its short growth period and high economic value among all the aloe species, and is used in pharmaceuticals, folk medicine, healthcare, cosmetic products and food products (Ashraf, 2004). There is, however, little scientific evidence of the effectiveness or safety of *A. vera* extracts for either cosmetic or medicinal purposes, and what positive evidence is available is frequently contradicted by other studies (Chaum, 2009). *A. vera*, an anti-oxidant rich plant, contains vitamins such as A, C, and E along with the minerals, zinc, and selenium. Anti-oxidants help boost the immune system and combat free radicals in the body. Another component of *A. vera* consists of the lignins, a major structural material of cellulose content that allows for penetrative properties (Hayat, 2007). *A. vera* contains salicylic acid which is an aspirin-like and vitamin C compound with anti inflammatory, analgesic, and anti-bacterial properties. It has anti-pyretic properties for reducing fevers (Tyler, 1993).

Extreme salinity reduces the proficiency of several plants with different irregular morphological, physiological and biochemical changes that delay germination, high seedling transience, poor plant population, diminutive growth and lower yields. Biosaline agriculture (utilization of these salt-affected lands without disturbing present condition) is an economical way to use the salt- affected soils and bring this area under cultivation (Ullah et al., 2018).

Vitamin C is the most abundant antioxidant in plants and yet its functions are poorly understood, by discovering that the new enzyme is encoded by two genes, we were able to engineer plants that were unable to grow beyond the seedling stage without vitamin C supplementation (Ishikawa et al., 2006). Fruit and vegetables form the major part of the vitamin C supply in the diet, so the factors that control their ascorbate content are of interest. It seems that relatively few people suffer from vitamin C deficiency and also, considering that the evidence for benefits of increased intake above the currently recommended levels is very mixed and there is currently not a strong incentive for publicly funded agencies to invest in efforts to increase the vitamin C content of crops. Salinity and salt stress is a limiting factor of plant growth and yield and becoming a serious problem in the world (Nobel and Berry, 1985). Salinity stress is one of the most important abiotic factors that it can reduce the growth on dry and semi dry plants (Joseph et al., 2010; Gones et al., 2007). Since, there are many dry lands are available in Iran study about salinity for growth factor is important. Since ascorbic acid is one of the important compounds to resistance from plant stress this study is about effect of combination ascorbic and salicylic acid and salinity on Aloe vera morphological characteristics.

2 Materials and Methods

This experiment was conducted in bi-factorial design in completely randomized design with three replications. The sprouts of *A. vera* with 25 cm length obtained in vitro culture were used and treated Aloe sprouts were cultured in greenhouse in pots with 25 cm diameter containing cocopeat and perlite and were irrigated with nutrient solutions containing different levels of NaCl (0, 26, 14, and 38 d_s per m) and spraying combination of salicylic acid and ascorbic acid (0,0.7, 1.5 and 1.8 mM) on leaves. After 8 month from growth period some characteristics such as leaves diameter and depth, wet and dry gel weight, gel Ph and EC were investigated.

Data obtained and analyzed by using the SAS (2009) program. The differences between means were analyzed by Duncan's multiple ranges test (1995) and the P value less than 0.05 were considered as significant.

3 Results

Data showed that leaves depth in S0. A0 and S0. A0.7 was higher than others and leaves diameter was higher for S0. A1.8, S0. A1 and S14.A0.7 respectively ($p \leq 0.05$). Also EC gel were higher when S26 and S38 were used. The pH was changed by of experimental treatments ($p \leq 0.05$). Wet gel and dry gel weight was higher when S0.A0 and S0.A0.7 were applied and the minimum weight of wet and dried gel was for S38.A1.8 ($p \leq 0.05$).

Table 1 Mean comparison of morphological characteristics of *Aloe vera*.

Treatments	Leave depth mM	Leave diameter mM	Wet gel weight g	Dried gel weight g	pH	EC gel
S0.A0*	0.40 ^{de}	14.26 ^{c}	11.58 ^{b}	1.51 ^{a}	4.76 ^{c}	3.34 ^{j}
S0.A0.7	0.40 ^{de}	15.76 ^{a}	13.06 ^{a}	1.14 ^{b}	4.64 ^{d}	2.74 ^{l}
S0. A1.5	0.13 ^{e}	14.41 ^{b}	8.70 ^{de}	0.60 ^{h}	4.74 ^{c}	2.76 ^{l}

S0. A1.8	0.17 ^{e}	15.76 ^{a}	7.45 ^{f}	1.02 ^{c}	4.94 ^{a}	3.22 ^{k}
S14.A0	0.63 ^{cd}	11.44 ^{d}	8.19 ^{ef}	0.93 ^{e}	4.74 ^{c}	6.52 ^{h}
S14.A0.8	0.63 ^{cd}	14.00 ^{c}	10.72 ^{c}	0.97 ^{d}	4.90^{a}	5.93 ^{i}
S14.A1.5	0.73 ^{cd}	11.31 ^{d}	4.26 ^{g}	0.79 ^{f}	4.75^{c}	5.92 ^{j}
S14. A1.5	0.80 ^{c}	9.68 ^{e}	8.77 ^{d}	0.78 ^{g}	4.82^{b}	6.52 ^{i}
S26. A0	1.80 ^{b}	8.57 ^{g}	1.72 ^{j}	0.20 ^{n}	4.61 ^{d}	7.94 ^{d}
S26. A0.7	2.20 ^{a}	6.81 ^{h}	4.31 ^{g}	0.27 ^{j}	4.84^{b}	7.32 ^{g}
S26. A1.5	1.83 ^{ab}	9.06 ^{f}	2.54 ^{i}	0.24 ^{l}	4.76^{c}	7.57 ^{e}
S26. A1.8	1.73 ^{b}	5.30 ^{i}	3.44 ^{h}	0.27 ^{i}	4.64^{d}	7.45 ^{f}
S38. A0	2.23 ^{a}	5.58 ^{i}	2.56 ^{l}	0.19 ^{o}	4.65^{d}	10.33 ^{a}
S38. A0.7	1.97 ^{a}	5.37 ^{i}	2.64 ^{i}	0.22 ^{m}	4.74 ^{c}	9.44 ^{c}
S38. A1.5	2.23 ^{a}	4.55 ^{j}	2.79 ^{i}	0.25 ^{k}	4.65^{d}	9.74 ^{b}
S38.A1.85	1.77 ^{b}	4.89 ^{j}	1.38 ^{j}	0.16 ^{p}	4.64 ^{f}	9.45 ^{c}

*S = Salinity, A= Ascorbic acid and Salicylic acid combination **Means within row with no common on letter are significantly different ($p \leq 0.05$).

4 Discussion

Salinity is one of the main problems which can negatively affect soil fertility and productivity. Salinity of soil can lead to osmotic stress, decrease in available water, ionic stress and cells' ionic imbalance (El-Tayeb, 2005). Salinity decreases germination, fresh and dry weight of radical and plumule in germination phase (Sahu et al., 2003; Talebi et al., 2012).

Ullah et al. (2018) showed that the salinity- sodicity showed staid effect on the growth reduction from 9.99 to 36.02%. This reduction fissure was impacted by the harmful effect of salinity and sodicity on *A. vera* (*Aloe barbadeenis* Mill) growth.

Some researchers showed that the impact of salt stress has been correlated with some morphological and physiological traits like reduction in fresh and dry weight (Raskin, 1992). In fact, the salinity affects plant metabolism by disturbing physiological and biochemical processes of plants due to ionic and osmotic imbalances which results in the reduction of plant growth and productivity (Fuentes et al., 1998; Misra and Saxena, 2009). The deleterious effects of salinity on plant growth are associated with low osmotic potential of soil solution, nutritional imbalance, specific ion effect, or a combination of these factors. Zan et al (2007) studied the physiological and ecological characters on *A. vera* under seawater irrigation (EC= 23.4 ds m-1) reported that salinity stress caused a decrease in tissue water, total soluble sugars and glucose. Mothbeli et al. (2012) showed that salinity affected the number of leave, plant height, and number of sprout, root weight, plant weight, leave weight, total gel weight, and root dry weight. They also showed, salinity decreased plant leaves and roots growth and their dry matter all measured characteristics showed differences between control and 2,4,6 and 8 d^{s} per m salinity. Zan et al. (2007) indicated that salt stress led to decreasing TSS in both cultivars of Aloe Vera and it is a limiting factor of plant growth and yield. Fuentes et al. (1988) and reported similar report and revealed that the height of leaves and sprouts

reduced with increasing salinity in different *A. vera*. Senaratna et al. (2000) reported that the effective dose of SA for alleviating the injury of tomato and bean plants under water stress, ranged from 0.1 to 0.5 mM.

These results of Dalila et al. (2015) suggested that Aloe can be planted in soils affected by salinity and irrigated with salt water at least at a moderate concentration

Abdullahi et al. (2011) showed that the comparison of means showed that the effect of various levels of salicylic acid on all characteristics was separate at different statistical levels. Salicylic acid is a phenolic substance and phenols are defined as compounds with a hydroxyl group with active derivatives. Salicylic acid is found in many plants. Also Talebi et al. (2012) showed that treating the borage seeds with salicylic acid has increased root's fresh weight. Abdullahi et al. (2011) showed that plant growth and plant gel TSS levels increased as a result of salicylic acid treatment. The axial role of salicylic acid in translating messages as a defense response against pathogenic factors is well known. Salicylic acid also plays an active role in controlling transpiration, stomata closure, seed germination, fruit yield, glycolysis, flowering, heat generation and heat tolerance (Raskin, 1992). The role of salicylic acid in plant leaves and generative systems is well known and its highest level is found in tropical plants infected by necrotizing pathogens. The type of effect that salicylic acid had on plants provides a good indication that this substance increased the chlorophyll level, and as a result the degree of photosynthesis, carbohydrate reserve, cellular division and leaf surface (Abdullahi et al., 2011; Popova et al., 2003; Zhang et al., 2010).

5 Conclusion

We could demonstrated that the level of salinity and ascorbic acid had effect on *A. vera* characteristics as there were differences in biochemical characteristics and morphological characteristics on treats.

References

Abdollahi M, Jafarpour M, Zeinali H. 2011. Effect of various Salicylic Acid concentrations on growth of *Aloe vera* L. International Journal of Agricultural Science, 1(5): 311-313

Ashraf M, Harris PJC . 2004. Potential biochemical indicators of salinity tolerance in plants. Plant Science, 166: 3-16

Chaum C. 2009. Effect of salt stress on praline accumulation, photosynthetic ability and growth characters in two maize cultivars. Journal of Botany, 42: 78-98

Dalila Souguir, Howaida Ibrahim Abd-Alla, Ezzedine El Ferjani, Mohamed Larbi Khouja, Mohamed Hachicha. 2015. *Aloe vera* long-term saline irrigation increases contents of hydrogen peroxide, lipid peroxidation and phenolic compounds. Acta Agriculturae Scandinavica Section B — Soil and Plant Science, 65(8): 688-696

El-Tayeb MA. 2005. Response of barley grains to the interactive effect of salinity and salicylic acid. Plant Growth Regulation, 45: 215-225

Fuentes V, Rodriguez N, Rodriguez C, Ramos R .1988. Salinity tolerance including *Aloe arborescens* and other species. Agrotecnia Cuba, 20: 1-6

Gunes A, Inal A, Alpaslan M, Eraslan F, Guneri E. Cicek N.2007. Salicylic acid induced changes on some physiological parameters symptomatic for oxidative stress and mineral nutrition in maize (*Zea mays* L.) grown under salinity. Journal of Plant Physiology, 164: 728-736

Hayat S. Ahmad A .2007. Salicylic Acid: A Plant Hormone (1st edition). Springer, Netherlands

Joseph B, Justin R S .2010. Pharmacognostic and phytochemical properties of *Aloe vera* Linn. - An overview. International Journal of Pharmaceutical Sciences Review and Research, 2: 106-110

Moghbeli E, Fathollahi S, Salari H, Ahmadi G. Saliqehdar F, Safari A, Hosseini Grouh M. 2012. Effects of salinity stress on growth and yield of *Aloe vera* L. Journal of Medicinal Plants Research, 6(16): 3272-3277

Misra N, Saxena P. 2009. Effect of salicylic acid on proline metabolism in lentil grown under salinity stress. Plant Science, 177: 181-189

Nobel PS, Berry WL.1985. Element and salinity responses of Agave species. American Journal of Botany, 72: 686-694

Popova L, Ananieva V, Hristova V, Christov K, Georgieva K, Alexieva V, Stoinova Zh. 2003. Salicylic acid- and Methyl jasmonate- induced protection on photosynthesis to paraquat oxidative stress. Bulgaria Journal of Plant Physiology, Special Issue: 133-152

Rajeswari RM, Umadevi C, Sharmila R, Pushpa S, Selvavenkadesh K. P, Sampath K, Debjit B. 2012. *Aloe vera*: The miracle plant its medicinal and traditional uses in India. Journal of Pharmacognosy and Photochemistry, 1(4): 185-221

Raskin I. 1992. Role of salicylic acid in plants. Annual Review of Plant Physiology and Plant Molecular Biology, 43: 439-463

SAS Institute. 2001. SAS/STAT User's Guide for Personal Computer. Release 6.12 SAS Institute Inc, Cary, NC, USA

Sahu P, Kumar NJ, Shrivastava A. 2011. Comparatives performance of *Aloe vera* and *Aloe ferox* species under pH along with desiccation stresses International Journal of Drug Discovery and Herbal Research, 1(1): 14-17

Senaratna T, Touchell D, Bunn E, Dixon K. 2000. Acetyl salicylic acid (Aspirin) and salicylic acid induces multiple stress tolerance in bean and tomato plant. Plant Growth Regulation, 30: 157-161

Surjushe AR, Vasani R, Suple DG. 2008. *Aloe vera*: A short review. Indian Journal of Dermatology, 53: 163-166

Talebi S, Jafarpour M, Mohammadkhani A, Sadeghi A. 2012. The effect of different concentrations of salicylic acid and sodium chloride on Iranian Borage. International Journal of Agricutural Crop Science, 4(18): 1348-1352

Tyler V. 1993. The Honest Herbal: A Sensible Guide To The Use of Herbs And Related Remedies (3rd ed). Pharmaceutical Products Press, Binghamton, NY, USA

Ullah MA, Rasheed M, Mahmood IA. 2018. *Aloe vera* (*Aloe barbadeenis* Mill) screens at suitable salinity and sodicity level. Horticulture International Journal, 2(6): 365-367

Zan MJ, Chang HW, Zhao PL, Wei JG . 2007. Physiological and ecological characters studies on Aloe vera under soil salinity and seawater irrigation. Process Biochemistry, 42: 710-714

Zhang S, Jie S, Wang H, Feng G. 2010. Effect of salinity on seed germination, ion content and photosynthesis of cotyledons in halophytes or xerophytes growing in Central Asia. Journal of Plant Ecology, 3: 259-326