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# Effect of Silicic Acid on some Anatomical and Biochemical Characteristics of *Pelargonium graveolens* under Salinity Stress

**F. Hassanvand[1]- A. Rezaei Nejad[2*]– M. Feizian[3]**

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**Introduction:** Scented geranium (*Pelargonium graveolens*) is a perennial plant of the family Geranium (Geraniaceae). Although $CaCl_2$ at higher concentrations than NaCl in the soils and ground water in many areas of the word, most studies have been based on experiments that NaCl is the predominant salt. Relatively few studies have focused on the effects of $CaCl_2$ on plant growth and physiology. Silicon (Si) is considered as an essential element in several crops enhancing growth and alleviating different biotic and abiotic stresses. In this study, the role of Si in alleviation the deleterious effects of salinity on geranium have been studied.

**Materials and Methods:** This experiment was conducted in spring-summer 2014 in research greenhouse situated on the Faculty of Agriculture, Lorestan University, Khorramabad, Iran. The greenhouse temperature was 16.5–37.5 ◦C and relative humidity of greenhouse was 30–80%. Terminal stem cuttings with five nodes were obtained from mother plants in the same greenhouse and placed in a sand substrate for rooting in April. Uniform rooted cuttings were then transplanted into plastic pots (22 cm diameter and height) filled with sand substrates and grown hydroponically. Transplanting was done in May and one plant per pot was cultivated. Cultivated plants were irrigated with Hoagland's medium electrical conductivity (EC) 1.8 dS/m, (pH) 5.8 twice a day. Experiment was arranged as factorial based on a completely randomized design with five replications. Factors consisted of daily application of 1.8, 4 and 6 ds/m $CaCl_2$ and weekly application of 0, 0.5 and 1 mM silicic acid in nutrient solution. Plants were harvested in November. In this research some characteristics include the number of leaf, leaf area, photosynthetic pigments (chla, chlb. Total chl, carotenoids), MDA, EL, RWC, proline, number of stomata in surface unit of leaf, density of stomata and stomata index and antioxidant enzyme include CAT and POD measured.

**Results and Discussion:** In current study salinity decreased the number of leaf and leaf area and Si increased these characteristics. In general, decrease in the leaf area can result in a reduction in size of individual leaf of plants, decrease in the production of leaves and fall the old leaves. It also reduce the growth rate of leaf in salinity which causes osmotic effect around the roots (rhizosphere). Over time, the rate of cell division and elongation decreased, and finally this changes leads to decrease in the final size of leaf. In this study, salinity increased electrolyte leakage and the use of silicic acid prevents electrolyte leakage. Probably saturation of phospholipids with increasing salinity increased, as a result the fluidity of membrane decreased and finally increased the electrolyte leakage, silicic acid absorbed in plant and deposited in the cell membrane, causing the silica hardened. This causes in stress condition, cell membrane maintains stability and significantly reduced the amount of electrolyte leakage. In this study application Si in various concentrations under salinity stress brought a significant decrease in MDA compared with salinity alone. Salinity increased the MDA and EL so that application of1 mM silicic acid decreased EL to 16.7 and 11.9 percent plants grown in 4 and 6 dS/m EC, respectively, compared with controls. Application of 1 mM silicic acid decreased the MDA to 23.6 and 35 percent plants grown in 4 and 6 dS/m EC, respectively, compared with controls. Therefore, the present results indicate that Si can effectively ameliorate membrane lipid peroxidation, thus protecting plants from oxidative stress. Salinity affected on leaf anatomy and chloroplast ultrastructure, photosynthesis also affected by these factors. Reduction in chlorophyll at height salinity levels due to chloroplast destructive. The results showed that salinity decreased the density and stomatal index in plants and silicic acid increased these characteristics. Salinity decreased the RWC and antioxidant enzymes and application of silicic acid improved them. Increase in salinity increased the leaf proline and application of silicic acid alone in plant on stress decreased it.

**Conclusion:** Overall, the results of present research showed that high EC induced by $CaCl_2$ negatively

1-Former M.Sc. student, Department of Horticultural Science, Faculty of Agriculture, Lorestan University
2-Associate Professor, Department of Horticultural Science, Faculty of Agriculture, Lorestan University
(*-Corresponding Author Email: Rezaeinejad.Hossein@gmail.com)
3-Assistant Professor, Department of Soil Sciences, Faculty of Agriculture, Lorestan University

affected geranium growth, and weekly application of 1 mM silicic acid alleviated the destructive effects of stress and in high salinity the positive effect of silicic acid is more than in low salinity.

**Keywords:** Antioxidant enzyme, $CaCl_2$, Photosynthetic pigments, Proline, Stomata