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# Effectiveness of various salinity on leaf growth of *Gazania*

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**Abstract**

Salt stress is induced by Nacl and it minimizes the growth owing to variation in interior plant structure. The present work was designed in line to investigate the behavior of *Gazania harlequin* (L.) seedlings were raised with dissimilar salt combinations (25 ppm, 50 ppm, 75 ppm & 100 ppm of NaCl solution). The CRD experiment with 4 repetitions was done. The NaCl treatments were repeated in 4 times with 20 days interval totally for 80 days after transplanting in pots. Anatomical observations were recorded by the microscope of in Nacl affected growth leaf. The results illustrated that salinity levels had negative effect on anatomical characters as (xylem region, phloem region, cortex region, epidermis region and density of leaf lamina). So, it is concluded from study that control treatment (without salinity effect) showed improved outcome comparatively others treatments which were under saline situation. As the salinity increases ultimately it affects leaf anatomy of plant.

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## Introduction

Ecological aspects affect the characters, components and growth of living entities e.g. plants and its communities. If any of these factors go beyond the optimal tolerance in plant, consequently it forms salinity situation, which change its developmental structure, physiological and biochemical functions. Salinity is one type of environmental stresses (Lawlor, 2002). Salinity is severely affecting agricultural productivity and accretion of salts has damaging effect on agricultural soils that has been developed into vital ecological concerns (Jaleel *et al.,* 2007). Land is becoming non productive yearly due to its internal salt addition. The pivotal influence of salinity is retardation of crop production by reducing the release of hormone from lower parts to upper parts (Azooz *et al.,* 2004). Salt causes change an extensive range of metabolity, excessive stunted development, and diminished enzyme actions and biochemical compositions (Muthukumarasamy & Panneerselvam, 1997). Salinization acts as chief responsibility in soil deterioration. It disturbs 19.5 % of irrigated soil and 2.1 % of dry soil of agriculture. Along with different biotic stresses, salinity is the foremost cause that minimizes or damages the plant development, declines germination and at last lower down the crop production. Soil salinity is a state which indicated by immense composition of soluble salts.

Agriculture input in Pakistan's GDP is 20.6 % (Anonymous, 2009). At present, saline soils comprise of almost 11 m ha i.e. about 55 % of total arable soils leaving dangerous effects on national economy and retards national productivity (Sahi, 2006; FAOSTAT, 2008). Soil salinity and drought are hurdling plant production round the world (Pitman and Lauchli, 2002; Tanji, 2002; Hu and Schmidhalter, 2005). The overall worldwide range of soils damaged by salinization has been reported to be round about 830 million hectares (Martinez-Beltran and Manzur, 2005). In Pakistan, it is estimated that out of 6.67 million hectares saline patches exists on area of 222 million hectares in Punjab, 2.11 million hectares in Sindh, 2.31 million hectares in Baluchistan and 0.4 million hectares in KPK (Anonymous, 2005).

Ornamental plants can be considered all the species and diversity that present aesthetic pleasure, boost the atmospheric beautification and the nature of our lives (Save, 2009). Mostly the showy plants are glycophytes and diverge as susceptible to resistant against salt. The harmful outcome of salinity on development was presented by various researchers on diff. plants (Bry *et al.,* 2000, Wu *et al.,* 2007). Tremendous salinity levels have an effect on all facets of plant growth and plant accustomed to their surroundings by complex regulatory set-up (Gong *et al.,* 2001). Decline in growth and yield traits might take place owed to a decrease in capability of plants to uptake of water from the soil media and the devastation of soil composition (Barrett-Lennard, 2003). Salt resistant plants have the ability of good production because of uptake more water in such condition under saline soil while in most cases salinity retards the growth attributes resources required by salinity as there is an inadequate accessibility of pure water and low permeability in soil (Ashraf and Yasmin, 1997).

*Gazania harlequin (L)* is showy and decorative plant which is grown in parks. So, these annual ornamental are generally used for decoration purpose in diff. places (Vicki and Chan, 2008). Its blossoming starts in diff. times (early, mid) and in a few varieties in late summer. More sun light is compulsory for vigorous plants (Edward and Howe, 1999). Salinity creates internal variations in plant body and is capable of minimizing detrimental effects of salt stress (Poljakoff-Mayber, 1988). The pessimistic result of salinization on production was reported by (Hussein *et al.,* 2010; Abdel-Monem *et al.,* 2010) and (Saffan, 2008). If we want to face the challenges of 21$^{st}$ century we should have to devote interest to increase the yield of crops by developing salt tolerant cultivars (Ashraf, 2002). Most of researches have been conducted for salinity effect evaluation in main crops but there is tiny information in ornamental crops so, the attention is needed to check the salinity variation in ornamental plants. The study was taken in to judge the salinity influence on leaf anatomy in *Gazania*.

## Materials and methods

An experiment in pots was held at Floriculture Research Area, UAF, Faisalabad during year (2012-13) in order to investigate the effects of salinity on development and flowering quality of *Gazania*. The CRD experiment with 4 repetitions was done.

After one month the seedlings of *Gazania harlequin (L)* was transplanted in the pots (20cm diameter and 22cm depth) containing a mixture of silt and leaf manure in 1:1. These seedlings were allowed to establish for 20 days before the start of applying diff. salinity levels (25 ppm, 50 ppm, 75 ppm, 100 ppm of NaCl solution). The soil wt. was measured and 1.5 kg (growth medium) put in all pots and the salinity zones were made artificially by adding up the solution of 25 ppm, 50 ppm, 75 ppm, and 100 ppm NaCl salt and one was as a control.

*Statistical Analysis*

For statistical analysis standard procedure was followed to record the data. Data collected was analyzed statistically using Fisher' (ANOVA) techniques (Steel *et al.,* 1997). The data was inserted for statistical analysis of variances procedure and the values of L.S.D were obtained (Snedecore & Cochran, 1980).

*Anatomical Parameter*

*Leaf anatomy*

Developed plants were detached from the soil and their whole leaf from plant was collected on the visual observation for anatomical study. Collected leaves were cleaned with distilled $H_2O$. After final washing, leaf was dipped into 70 % ethanol solution for fifteen days and their sectioning was done. After washing dipped it into 70 percent ethanol ($C_2H_6O$) solution for two weeks and their sectioning was done. Sections stained with safranine and fast green by follow the method of (Corgen & Widmayer, 1971). After sectioning, we prepared five different solutions of ethanol ($C_2H_6O$) for staining the slides to take the pictures of leaf. Sections were fixed in Canada balsam anatomical study under microscope and were photographed. The anatomical observations recorded during the study were the area of xylem, phloem, cortex, epidermis and lamina density of leaf in (μm²) according the methods described by (Johansen, 1940).

## Results

*Effectiveness of salinity on leaf growth of Gazania*

Salinity showed adverse effect on leaf anatomy of *Gazania*. The statistical investigation showed the boost in salinity level there was significantly changes in different anatomical characteristics of leaf xylem region. Leaf area decreased time after time but considerably with increase in NaCl levels and was more affected than the Salt Range.

**Table 1.** Effect of different salinity levels on leaf anatomy of Gazania Same letter means don't vary significantly at $P<0.05$.

| Treatment | PARAMETERS | | | | |
|---|---|---|---|---|---|
| | leaf xylem area (μm²) | leaf phloem area (μm²) | leaf cortex area (μm²) | leaf epidermis area (μm²) | Leaf lamina thickness (μm²) |
| Control | 178537.81a | 184870.61a | 1634814.91a | 329181.49a | 5866.06a |
| 25 ppm | 123994.42b | 141275.23b | 786136.78ab | 150063.82b | 4505.75b |
| 50 ppm | 96119.67bc | 71902.88c | 650293.67ab | 134352.42bc | 3913.43bc |
| 75 ppm | 52769.91cd | 46115.14c | 301248.804b | 55116.318c | 3698.96bc |
| 100 ppm | 47016.92d | 35111.37c | 202322.57b | 62833.13c | 2654.30c |
| LSD at 0.05 | 45693.28 | 38077.12 | 1079396.20 | 86156.03 | 1301.680 |

The region of xylem cell in the *Gazania* was generally decreased with increase in salt contents (Fig.2). With the increase in salinity level there was noticeably reduction in xylem, phloem, cortex and epidermal area of leaf (Table 1).

Maximum xylem, phloem, cortex and epidermal region of leaf was observed in untreated plants while, minimum xylem, phloem, cortex, epidermal region of leaf was recorded in 50ppm, 75ppm and 100ppm solution of salt.

There was statistically no difference in leaf xylem and phloem region in those pots where levels of salinity were 25ppm and 50ppm applied. However there were statistically higher significant differences in 75ppm and 100ppm. Data pertaining to leaf lamina density indicates that with increasing in level of salinity there was significantly decreased in lamina thickness (Table 1).

Highest lamina density was founded in control while the average values of other treatments followed by 25ppm, 50ppm and 75ppm while, lowest lamina thickness was observed in plants with 100ppm salinity application. There was statistically highly noteworthy dissimilarity was observed in those plants where the salinity was not applied and where at 100ppm. It was also cleared that lamina density significantly decrease as compare to control (Fig.1). Whereas lower doses have lesser effect comparatively to higher concentrations on plants (Figs.2,3,4,5).

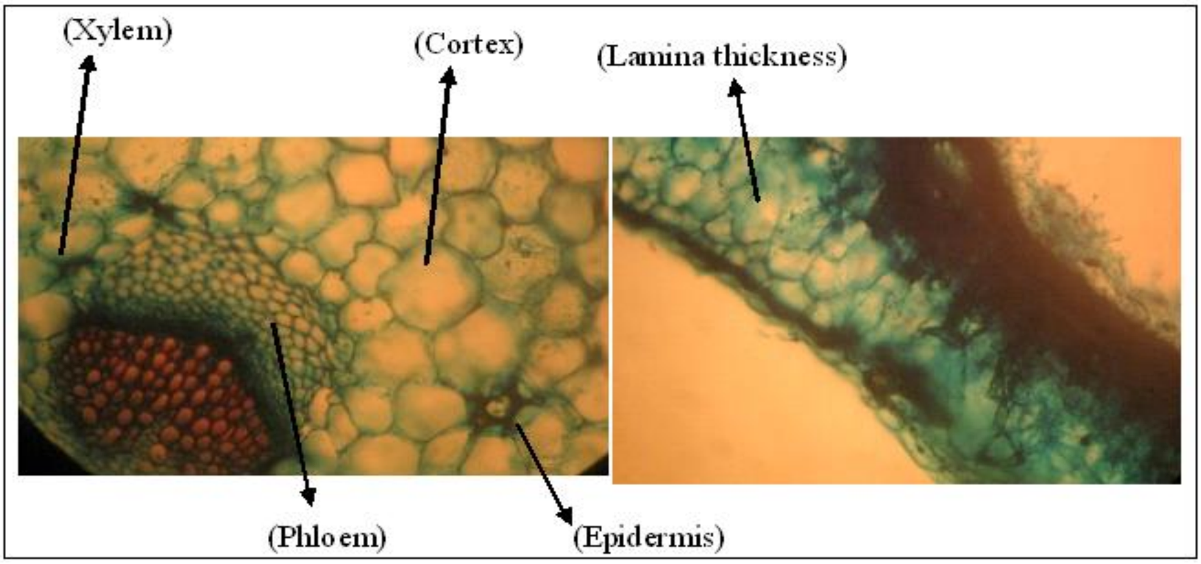


**Fig. 1.** Leaf anatomy of control plant.

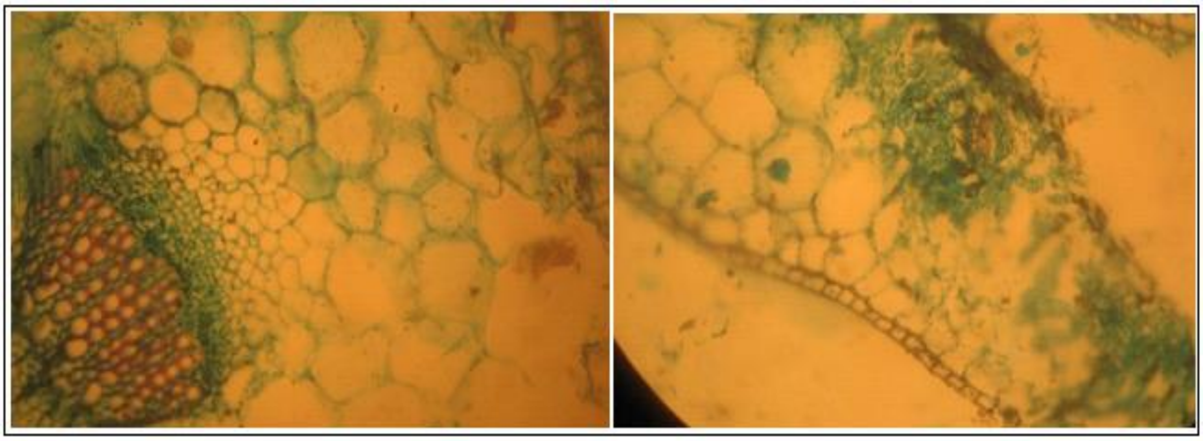

**Fig. 2.** Leaf anatomy of Gazania (25 ppm NaCl).

**Discussion**

In our experiment leaf anatomy was analyzed under different salinity situations. In plants under saline situations diff. anatomical variations take place (Huang and Van Steveninck, 1990; Winter, 1988).

These variations are different in each part of plant at diff. levels of development (Mills, 1989). Results in this study are clear that high salinity in soil has dissimilar effects on anatomy of the leaf as the region of xylem, phloem, cortex, lamina density, epidermis reduce in stress situation of salinity.

This caused by decrease of uptake of $H_2O_2$ by plants in high salinity situation and this lessening in $H_2O_2$ intake via cells formed osmotic form. Salinity cause reduction in phloem region and block that region at elevated levels, such conclusion were interrelated with tolerant susceptible spp. (Goncharova and obrenkova, 1981). Salinity induced the steady variations in interior configuration of plants which minimizes the region of xylem and phloem (Hameed *et al.,* 2010).

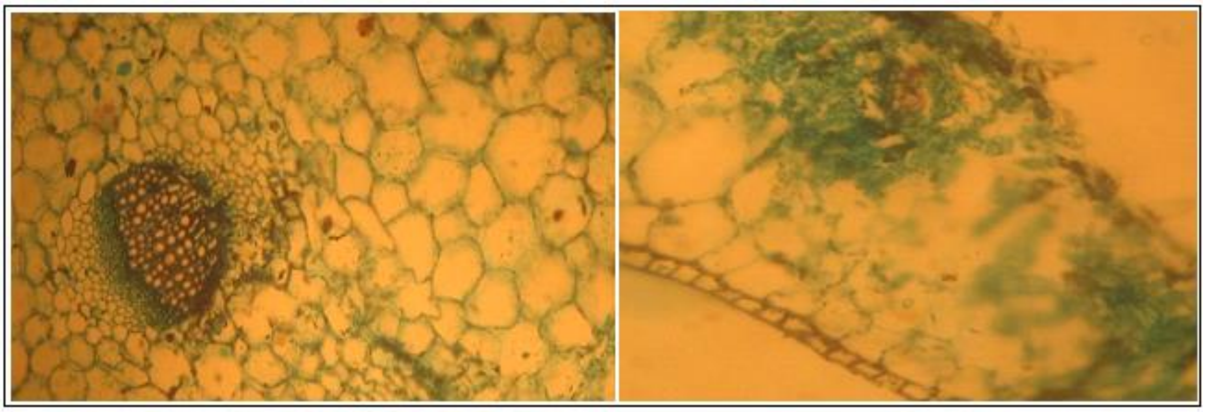

**Fig. 3.** Leaf anatomy of gazania (50 ppm NaCl).

These results are in accordance with findings of (Gadallah and Ramadan, 1997; Baum *et al.,* 2000; Gadalla, 2009) who reported that xylem area of leaf condensed due to reduction in xylem width and length. (Casenave *et al.,* 1999) observed that with amplification of salinity there was a reduction in development of xylem and cortex cotton seedlings. (Lingan *et al.,* 2002) reported that salinity stunted growth and caused variations in inner mechanism of plant. Other similar results are in line with findings of (Hameed *et al.,* 2010) who observed that after a specific level of salinity noteworthy decline takes place in phloem area. Salt tolerant species are often characterized by thick inner tangential walls of endodermis, epidermis and lignified walls of cortical parenchyma, but at extreme level cortical thickness reduced (Baumeister and Merten, 1981; Hwang and Chen, 1995; Baloch *et al.,* 1998).

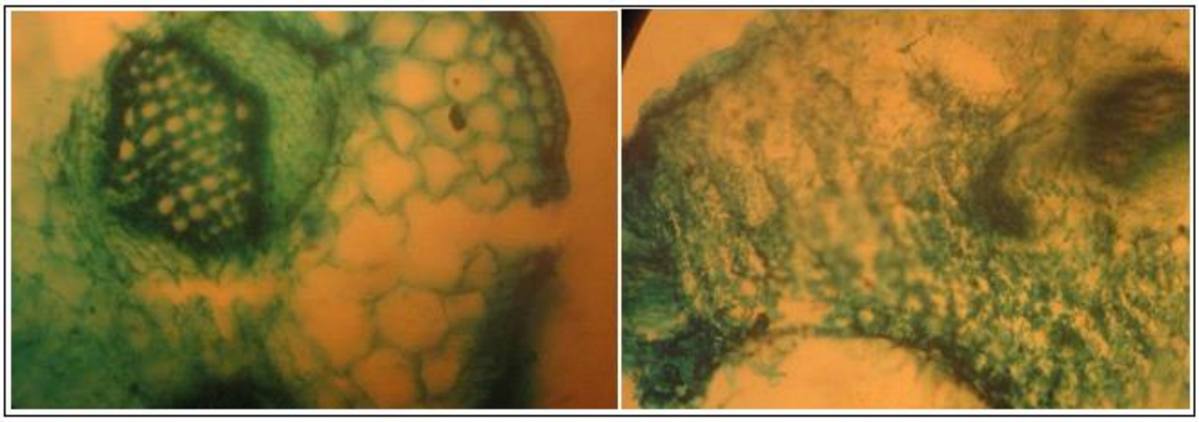

**Fig. 4.** Leaf anatomy of gazania (75 ppm NaCl).

Akram *et al.,* (2002) reported that cortical and pith region decreased in *Triticum aestivum* (L.) by reason of salinity, so acute parenchyma is a trait of salt tolerant spp. e.g salt grass (Alshammary *et al.,* 2004). Similar results were suggested by (Curtis and Lauchli, 1987) who observed that salt stress condition reduced the epidermis cell width and length due to which area of epidermal cell also reduced.

This feature is crucial under partial humidity accessibility as density of epidermis region is able of inspection $H_2O$ loss via stems (Hameed *et al.,* 2002; Nawazish *et al.,* 2006). Mansoor *et al.,* (2002) found that salinity reduces the development of epidermis due to changes in interior mechanism of plant.

Similar effect on leaf thickness has been reported previously for bean by (Meir, 1967) and (Wignarajah *et al.,* 1975) for *Phaseolus vulgaris* L. and for cotton by (Strogonov, 1964), as well as another species (Hayward, 1941; Poliakoff, 1975). (Nieman, 1962) observed that lamina thickness decreased under salt stress condition and suggested that salinity change the plant internal mechanism.

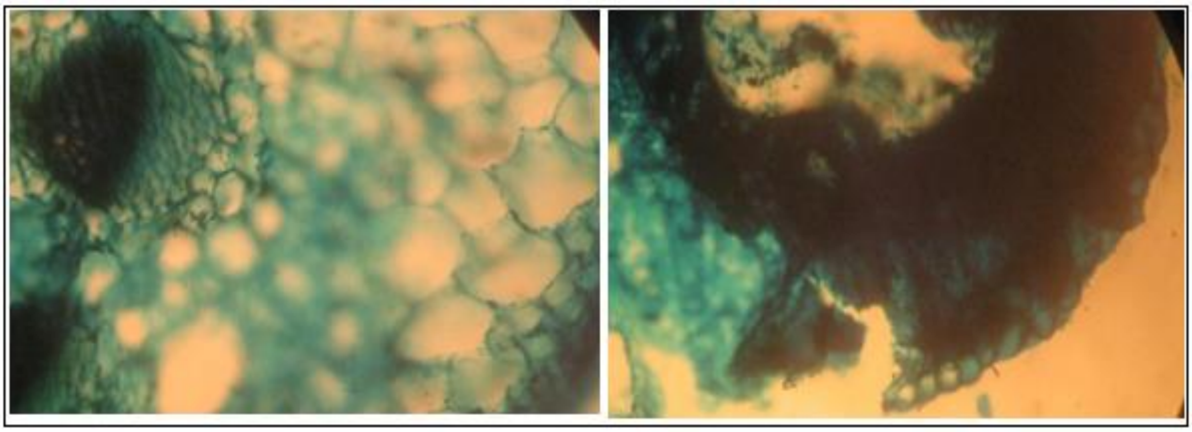

**Fig. 5.** Leaf anatomy of gazania (100 ppm NaCl).

**Conclusion**

From the above discussion, it is clear that stress situation due to salinity has crucial result t on overall pattern of plant development. Salinity has unenthusiastic relationship with morphological attributes. When we raise level of NaCl then it has unfavorable effect on anatomical characteristics of the plant. Between 5 levels of salinity, control exhibited good consequences beside other salinity treatments.

**References**

**Akram M, Akhtar S, Javed IH, Wahid A, Rasul E.** 2002. Anatomical attributes of different wheat (*Triticum aestivum*) accessions/varieties to NaCl salinity. International Journal of Agriculture and Biology **4,** 166-168.

**Anonymous.** 2005. Agricultural Statistics of Pakistan. Ministry of food, Agriculture and livestock, Government of Pakistan, Islamabad.

**Anonymous.** 2009. Economic Survey. 2009. Minister of Finance, Government of Pakistan **3,** 17-19.

**Ashraf M.** 2002. Salt tolerance of cotton: Some new advances. Critical Review in Plant
Sciences **21,** 1-30.

**Ashraf M, Yasmin N.** 1997. Responses of some arid zone grasses to brackish water. Der Tropenlandwirt, Beitrage, zur tropischen landwirschaft and veterinarmedizine. **98(1),** 3-12.

**Azooz MM, Shaddad MA, Abdel-Latef AA.** 2004. The accumulation and compartmentation of proline in relation to salt tolerance of three sorghum cultivars. Indian Journal of Plant Physiology **9,** 1-8.

**Barret-Lennard EG.** 2003. The interaction between water logging and salinity in higher plants: Causes, consequences and implications. Plant and Soil. **253,** 35-54.

**Baum SF, Tran PN, Silk WK.** 2000. Effects of salinity on xylem structure and water use in growing leaves of sorghum. New Phytologist. **146,** 119–127.

**Bry EA, Bailey-Serres J, Weretinlnyk E.** 2000. Responses to a biotic stress, in: W. Gruissem, B. Buchannan, R. Jones (Eds). Biochem. Mol. Biol. Plants. America Society of Plant Physiologists, Rock Ville 1158-1249 p.

**Cornish K, King AI, Reid MS, Paul JL.** 1985. Role of ABA in stress induced water loss from potted chrysanthemum plants Acta Horticulture. 167: 381-386.

**Datta SK, Som J.** 1973. Note on the effect of salinity on the structural changes in the stem of rice varieties. The Indian Journal of Agricultural Sciences. **43,** 614-617.

**De Villiers AJ, Von Teichman I, Van Rooyen MW, Theron GK.** 1995. Salinity-induced changes in anatomy, stomatal counts and photosynthetic rate of Atriplex semibaccata R. Br. South Africa Journal of Botany. **62,** 270-276.

**Devitt DA, Morris RL.** 1987. Morphological response of flowering annualsto salinity. Journal of the American Society of Horticultural Sciences. **112,** 951-955.

**Edward FG, Howe T.** 1999. Response of Plants under stress condition. Horticulture and Crop Science. **2,** 399-412.

**Ellis RA, Roberts EH.** 1981. The quantification of ageing and survival in orthodox seeds. Seed Science and Technology. **9,** 373-409.

**FAOSTAT.** 2008. http./www.fao.org/economic/ess/publications studies/statistical yearbook/fao-statisticalyearbook-2007-2008/g-human-welfare/en/.

**Goncharova EA, Dobrenkova LG.** 1981. Functional role of anatomical changes instrawberry in the course of adaptation to drought and salinity. Bulletin of Applied Botany, of Genetics and Plant Breeding. **71,** 100-108.

**Goncharova EA, Dobrenkova LG.** 1981. Functional role of anatomical changes in strawberry in the course of adaptation to drought and salinity. Trudy po Prikladnoi Botanike, Genetike i Selektsii, 71: 100-108.

**Hameed M, Ashraf M, Naz N, Al-Qurainy F.** 2010. Anatomical adaptations of Cynodon dactylon (L.) pers., from the salt range pakistan, to salinity stress. i.e root and stem anatomy. Pakistan Journal of Botany. **42(1),** 279-289.

**Hayward HB.** 1941. Anatomical and physiological response of the tomato to varying concentrations of sodium chloride, Sodium Sulphate and nutrient solutions. The Botanical Gazet. **102,** 437-462.

**Huang CX, Van Steveninck RFM.** 1990. Salinity induced structural changes in meristematic cells of barley roots. New Phytologist. **15,** 17-22.

**Hussein MM, Abd El-Kader AA, Kady KA, Youssef RA, Alva Ak.** 2010. Sorghum response to foliar application of phosphorus and potassium with saline water irrigation. Journal of Crop Improvement. **24,** 1-23.

**Hu Y, Schmidhalter U.** 2005. Spatial distributions and net deposition rates of mineral elements in the elongating wheat (*Triticum aestivum* L.) leaf under saline soil conditions. Planta, **204,** 212-219.

**Imam RM, Kandil SA, Abo El-Khair MSA, Abd El Halim S.** 1995. Growth parameters, metabolic changes and productivity of wheat plants as affected by uniconazole treatments under water stress conditions. Egyptian Journal of Basic and Applied Sciences. **10(4),** 12-27.

**Jaleel CA, Gopi R, Manivannan P, Panneerselvam R.** 2007. Antioxidative potentials as a protective mechanism in *Catharanthus roseus* (L.) G. Don. Plants under salinity stress. Turkish Journal of Botany. **31,** 245-251.

**Johansen DA.** 1940. Plant Microtechnique. MC. Graw. Hill Book Company New York.

**Lawlor DW.** 2002. Limitation to photosynthesis in water stressed leaves: stomata vs. metabolism and the role of ATP. Annals of Botany.
**89,** 1-15.

**Lorenzo HC, Ruano JM.** 2000. Effects of sodium on mineral nutrition in rose Plants. **137(1),** 65-72.

**Martinez-Beltran J, Manzur CL.** 2005. Overview of the salinity problem in the world and FAO strategies to address the problem, Proceedings of the international society forum, Riverside, California, 311-313.

**Meir AA,** 1967. The effect of chlorine salinity on growth of bean leaves in thickness and in area. Israel Journal of Botany. **16,** 115-125.

**Meyer FH, Hoster HR.** 1978. Roadside salt damage to trees in Hanover. Gartenament **29(3)**, 165-170.

**Mills D.** 1989. Differential response of various tissues of *Asparagus officinalis* to sodium chloride. Journal of Experimental Botany. **40,** 485-91.

**Muthukumarasamy M, Panneerselvam R.** 1997. Amelioration of NaCl stress by triadimefon in peanut seedlings. Plant Growth Regulator **22,** 157-162.

**Nadejda Z, Atanassova B.** 2008. Effect of salt stress on growth and flowering of ornamental annual species. Journal of Horticultural Science and Biotechnology **23,** 178-189.

**Nadia MA.** 1998. Productivity of sunflower crop under irrigation with salinized water condition. Ph.D. Thesis, Faculty of Agric.Zagazig University.

**Nieman RH.** 1962. Some effects of sodium chloride on growth, photosynthesis and respiration of twelve crop plants. Botanical Gazette. **123,** 279-285.

**Pimmongkol A, Terapongtanakhon S, Udonsirichakhon K.** 2002. Anatomy of salt-and non-salt-tolerant rice treated with NaCl. In: 28th Congr. Science and Technology of Thailand, Bangkok, Thailand.

**Pitman, Lauchli.** 2002. Germination and seedling emergence of primed tomato and asparagus seeds under adverse conditions. Horticultural Science **26,** 1160-1162.

**Poliakoff MA.** 1975. Morphological and anatomical changes in plants as a response to salinity stress. In A palzakoff-Mayber.J. Gate, eds. Plants in saline environments (Ecological studies 15). Springer-Veriag. New York. 97-117.

**Poljakoff-Mayber A.** 1988. Ecological-physiological studies on the responses of higher plants to salinity and drought. Arid Zone Research. 6, 163-183.

**Rengasamy P.** 2006. World salinization with emphasis on Australia. Journal of Experimental Botany **57,** 1017–1023.

**Rutland RB.** 1972. Salt induced stress as a determinant of flower quality and longitivity in chrysanthemum. Horticultural Science **7(1),** 57-59.

**Sahi A.** 2006. Bio saline. A biotechnological break through in scientists find ways to live with salinity. Country water action, Asian Development bank. Pakistan.

**Snedecor GW, Cochran WG.** 1980. Statistical Methods ($7^{th}$ Ed.). Ames, lowa: lowa State University Press.

**Soha El-sayed MAK.** 2006. Physiological studies on sesame plants grown under saline water irrigation conditions. Ph.D.Thesis, Faculty of Science, Cairo University.

**Strogonov BP.** 1964. Physiological basis of salt tolerant of plants (as affected by various types of salinity) Akad Nauk SSSR.Translated from Russian. Israel Program for Scientific Translations. 73-97.

**Steel RGG, Torrie JH, Dickey DA.** 1997. Principles and procedures of statistics. McGraw-Hill Book Company Incorporation., New York.

**Tanji KK.** 2002. Salinity in the soil environments in lauchli a and uluttge (eds.) salinity environment plants molecules. kluwer, Dordrecht. 21-51.

**Vicki AF, Chan R.** 2008. Phylogeny of the Spiny African Daisies. Molecular Phylogenetics and Evolution. **48(1),** 47-60.

**Wu G, Zhang C, Chu LY, Shao HB.** 2007. Responses of higher plants to abiotic stress an agricultural sustainable development. Journal of Plant Interctions **2(3),** 135-147.

**Wignarajah K, Hjennigs D, Handly JF.** 1975. The effect of salinity on growth of *Phaseolus valgaris* L.1.Anatomial changes in the first trifoliate leaf. Annals of Botany **39,** 1029-1038

**Winter E.** 1988. Salt-induced hypodermal transfer cells in roots Prosopis farcta and ion distribution within young plants. Botany **101,** 174-81.