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STUDY OF ANATOMICAL CHANGES OF BREAD WHEAT (*Triticumaestivum.*L) DUE TO DIFFERENT SALINE CONDITIONS

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Abstract

Present study focused on the response of two different varieties of wheat (*Triticum aestivum*. L) against salinity. Salinity treatments were made by measuring half the amount of NaCl ds m^{-1} needed to be prepared in distilled water. Anatomical alterations were seen in all treatments and the alterations increased as saline concentration increased. However, both the varieties managed to survive and bring about changes in stem, root and leaf. The anatomical features of both the varieties were observed under microscope and photographs were taken.

Keywords: *Triticum aestivum*. L, Salinity, Anatomical alterations

INTRODUCTION

Salinity is one of the major concerns that the world is facing due to changing environmental conditions such as low precipitation, high surface evaporation, poor cultural practices, irrigation with saline water etc (Memon et al., 2010; Amira et al., 2011; Pooja Srivastava and Rajesh Kumar, 2015). A saline soil has high concentration of soluble salts, enough to affect plant growth. Soil salinity is a big abiotic restriction that affect crop. Salt concentration in a soil is measured in terms of its electrical conductivity (Negrao, 2017). The USDA Salinity Laboratory defines a saline soil as having an EC_e of 4 dS/m or more.

The study was conducted in bread wheat, which is a crop of global significance. It is plant showing typical monocot anatomy in root, leaf and stem. The anatomical features helped in determining the alterations caused due to salinity (Munns, 2002). The soil salinity causes various deleterious effects on physiologically and morphologically and anatomical (Shannon, 1997 and Isla et al., 1998). It is very important to study the water salinity stress as many parts of the world are arid and semi aridcondition. The soil affected areas account for approximately 7% of the world (Munns et al 2002).

MATERIAL AND METHODS

A Pot experiment was conducted during the winter season of 2016-17 in the agricultural field of Department of life science of Shri Guru Ram Rai Institute of Technology and Science, Patel Nagar, Dehradun (Uttarakhand). The plan of work adopted during the whole research included both field work as well as the laboratory work. The field work included growing two different varieties of wheat PBW 154 and PBW 373 in pots. Each variety was grown in four conditions i.e. controlled, 8ds saline solution, 10ds saline solution and 13ds saline solution. Each treatment comprised of three replications i.e. R_1, R_2 and R_3. The transverse sections of the wheat varieties i.e. PBW 154 and PBW 373 in different saline water concentrations were grown and harvested.

These plants were taken and transverse sections of stem, root and leaf were cut in botany laboratory of life science department of SGRRITS (Shri Guru Ram Rai Institute of Technology and Science); Dehradun.

Figure1: Initial days of sowing varieties in salt

Anatomical parameters

Digital images of the slides preparations were acquired using light microscope (Magnus Microscope MLX-B Plus (SP) Inclined Binocular Microscope). The anatomical sections digital photographs were achieved by taking photographs and using the same for comparative study purposes. Salinity induced anatomical adjustments were deduced by sectioning leaf, stem, and root tissues. The sections from control and NaCl treated plants were stained separately with safranin and fast green. The finest leaf sections were selected and stained initially with the safranin for 2 minutes followed by fixing on the glass slides containing a drop of glycerol and finally covered with a cover glass slip. Similarly, stem and root sections were performed. All sections were observed under bright field.

Observations

As observed in the figures shown and observations made during the conduction of experiment, it was clear that salinity have impact on anatomy of the plant. As the salinity rises from 8ds treatment to 10 ds treatment the pith size increased in stems as seen in figure 2 and 3. When cross section of roots treated with normal and salt were observed the difference was easily made out. It was observed that as we move to higher saline treatment; the epidermal layer thickens as seen in figure 4 and 5. The leaf showed anomaly too due to salinity. The epidermal layers thickens as we move to higher salinity and the section becomes more compact as seen in figure 6 and 7.

Figure 2: Pith is Undisturbed in Control Treatment Variety (PBW154)

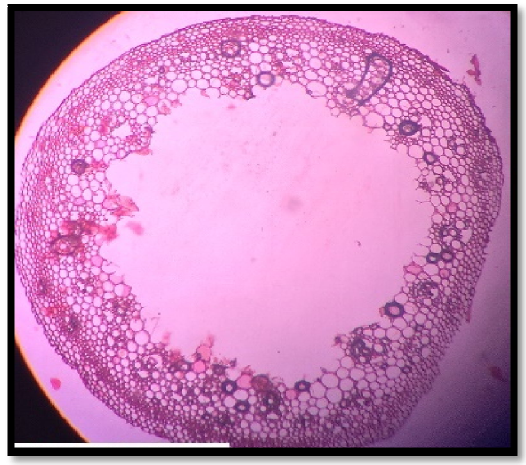

Figure 3: Hollow Pith in 10ds Treated Wheat Variety (PBW154)

Figure 4: Epidermal Layer of Control Treated Root With Normal Anatomy (PBW 373)

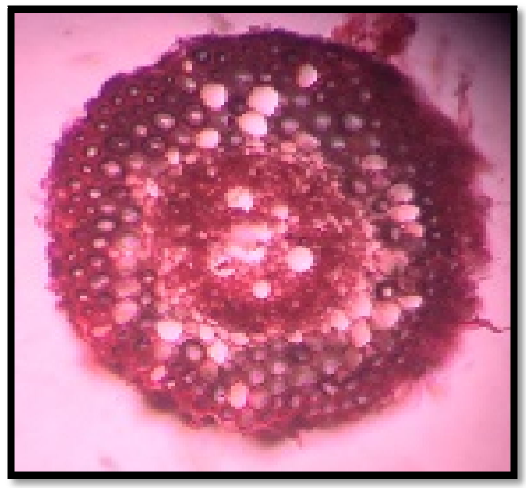

Figure 5: Thicken Epidermal Layer Showing Anomaly in 10 ds Saline Treatment (PBW373)

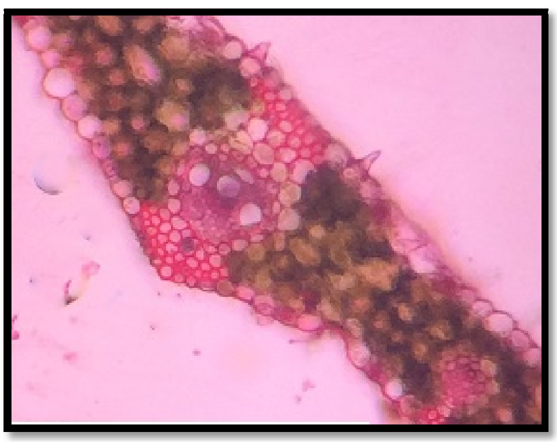

Figure 6: Leaf of Control Treated Wheat Variety (PBW154)

Figure 7: Leaf Variety Treated With 10ds Saline Treatment (PBW154)

RESULT AND DISCUSSION

Table 1: Comparative Table Showing Anatomical Alterations in PBW154 and Control Variety

S. No.	Parameters	Control	8ds Treatment	10ds Treatment	13ds Treatment
1	Leaf	Lower and upper epidermis present, chloroplast present, conjoint, closed and collateral V.B., xylem & phloem same radii	Lower and upper epidermis thickens, chloroplast present, spongy layer same	Lower and upper epidermis thickens, chloroplast present, spongy layer no differentiated, intercellular space is less	Lower and upper epidermis thickens, chloroplast present, thickest spongy layers, no intercellular space
2	Stem	Epidermis Single layered, stomata, closed and collateral V.B., pith hollow, ground tissue not differentiated	Thick epidermis, closed and collateral V.B., pith not hollow	Epidermis multilayered, Vascular bundles not differentiated well, pith size is large	Epidermis single layered, cortical cells thicken, pith cell diameter maximum
3	Root	Parenchymatous cortex, intercellular spaces, radially arranaged V.B., prominent endodermis	Root epidermis thickens, compact cortical cells, disarranged endodermis	*Extremely small root*	*Extremely small root*

Table 2: Comparative Table Showing Anatomical Alterations in PBW 373 and Control Variety

S. NO.	Parameters	Control	8ds Treatment	10ds Treatment	13ds Treatment
1	Leaf	Lower and upper epidermis present, chloroplast present, conjoint, closed and collateral V.B., xylem & phloem same radii	Thick epidermis, bundle sheath shrinken, closed and collateral V.B.	Thick epidermis, mesophyll cells reduced, cell shape and size distorted	Thick epidermis, mesophyll cells reduced, cell shape and size distorted, no intercellular space, V.B. reduced
2	Stem	Single layered, stomata, closed and collateral V.B., pith hollow	Single layered epidermis, pith enlarged, vascular bundle less and scattered	Multi layered epidermis, pith size reduced, vascular bundle closed and towards periphery	Single layered epidermis, pith very enlarged, reduced cortex area, vascular bundle scattered
3	Root	Parenchymatous cortex, intercellular spaces, radially arranaged V.B., prominent endodermis	Root hair present, cortex with less intercellular spaces, endodermis not prominent	*Extremely small root*	*Extremely small root*

Effects of Salinity on morphology

The seedlings of with stand salinity level upto 10ds NaCl without any lethal effects. After 21 days treatment, there were no significant changes in plant height between control and 8ds to 13ds NaCl treated plants. In contrasts, the plant height declined significantly by in plants treated with high salinity of 10-13 ds NaCl. The root length didn't remain unchanged at all levels of salinity. It decreased as salinity concentration increased.

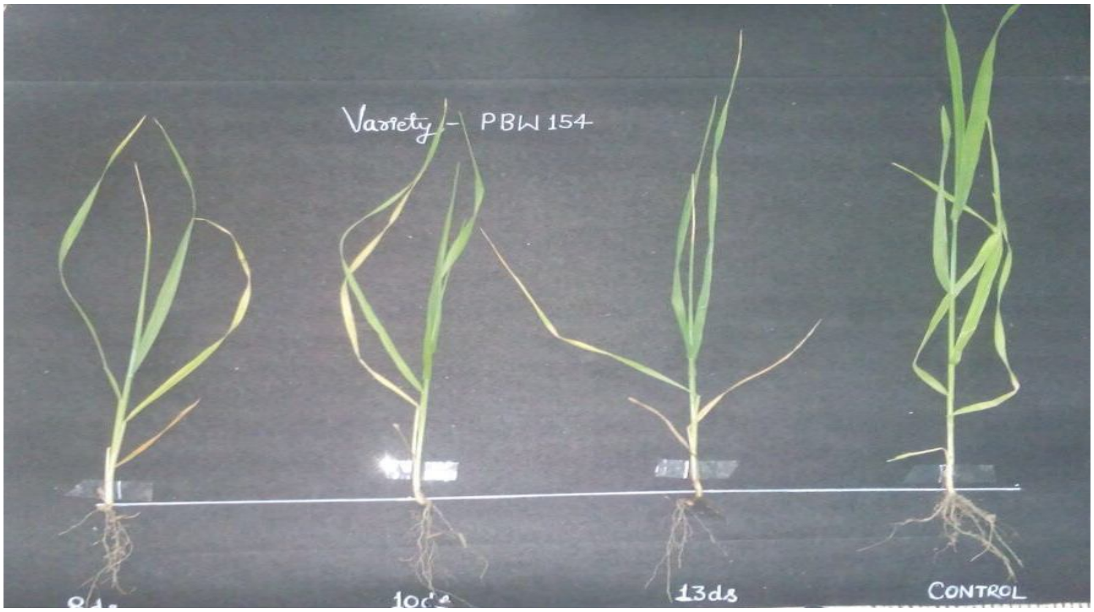

Figure 8: Variety PBW 154 Plants Showing Growth in Salinity

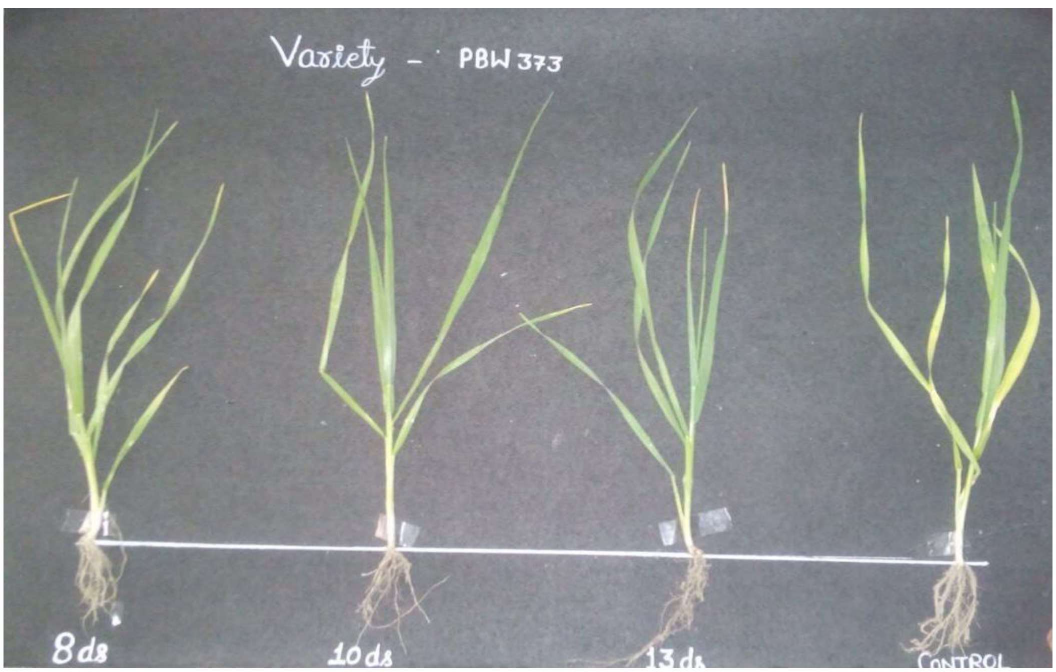

Figure 9: Variety PBW 373 Plants Showing Growth in Salinity

Anatomical Modifications

Cross section of leaf, stem and root of *Triticum aestivum* were analyzed to assess the effects of various salt concentration and the anatomical adaptations of this plant to be acclimatized under external salinity. There were significant alterations in anatomical features of leaf, stem and root of wheat seedlings imposed to various levels of salinity. By examining the transverse sections of leaf from control and treated samples, it was observed that thickness of upper epidermal layer and thickness of lower epidermal layer was increased respectively in 8, 10, and 13ds NaCl-treated plants as compared to control (Figures 5).

On the other hand, thickness of mesophyll tissue layer of leaf of *Triticum aestivum* was increased by at low salinity (8ds NaCl) (figure 6) whereas at moderate salinity (10ds NaCl) it became compact and shrunken (figure7). Surprisingly, at 13ds the pith was completely distorted (figure 3).Transverse section of stem of *T. aestivum* showed increase in thickness of upper epidermal layer at low salinity (8ds NaCl) whereas, at moderate (10ds NaCl) and high (13ds NaCl) salinity there was no significant changes in thickness of upper epidermal layer ascompared to control.The thickness of cortex layers of stem was reduced in NaCl treated plants as compared to control (figure 2&3). Likewise, the pith area increased in 8, 10, and 13ds NaCl treated plants in comparison to control(figure 3).The epidermal cell size of the stem was maximum in 8ds NaCl treated plants as compared to control and then decreased at higher salinity.

CONCLUSION

Salinity is one of the main problems in cereal production especially in arid and semiarid regions which severely limit their production.

In summary, our results suggest that *Triticum aestivum L.* can tolerate extreme salinity by maintaining osmotic balance and changing its anatomy accordingly. The amount of Na^+ increase significantly with increase in salinity. The result shows that there are anatomical differences between PBW 154 and PBW 373 variety and it effect on their resistance to salinity. There was no significant effect in some traits between control and 8 ds salinities. The Varieties can be resistant to salinity by showing more anatomical variations to adapt to extreme saline conditions. Thus these varieties could be cultivated in saline dominated area and solving the problem of local people encountering due to poor soil conditions and limiting their reproduction. The replications growing in control showed standard anatomy as seen in monocots irrespective of the variety grown. As the salinity increases the plant adapts itself to the saline conditions and makes anatomical modifications.

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