



## Architectural traits in response to salinity of wheat primary roots

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### Abstract

This article provides a study on morphological and anatomical changes during post-embryonic development of roots in plants under saline stress. The influence of salinity on the architecture of root related to the species-specificity of wheat plants is shown. The important roles of thickness of the epiblemma and length of root hairs, the thickness of the endoderm and the diameter of the central cylinder under salt stress appear worthy of note. It is shown that both the water content of roots cells and its chromosomal apparatus are affected by salt stress. In addition to a very strong plasmolysis, the compression and fragmentation of the nuclei were noted, which resulted into their destruction and cell death. On the basis of all considered parameters the studied species can be arranged in the following according their resistance to salinity: *T. polonicum* < *T. compactum* < *T. aestivum* < *T. dicoccum*. This is confirmed by the data of ion balance of Na<sup>+</sup>, K<sup>+</sup>, and Ca<sup>2+</sup> in primary roots of different wheat species.

**Keywords** Wheat species · Primary roots · Salinity · Morphology · Anatomy · Ion balance

### Introduction

down others (Woodrow et al. 2017). At the same time, adap-

- (*Triticum aestivum*) and its wild congeners. J Agr Sci Tech B 6:198–204. <https://doi.org/10.17265/2161-6264/2011.06B.006>
- Terletskaia N, Sarsenbayev B, Kirshibayev B (2011b) Influence of saline stress on saline stress on ionic balance of wheat (*Triticum aestivum*) and its wild congeners. J Life Sci 5(8):618–624. <https://doi.org/10.17265/1934-7391/2011.08.008>
- Valenti GS, Ferro M, Ferraro D, Riveros F (1991) Anatomical changes in *Prosopis tamarugo* PHIL., seedlings growing at different levels of NaCl salinity. Ann Bot 68:47–53
- Vallardon AQ, Firon N, Clark CA, Smith A (2014) Manipulating root system architecture in sweetpotato for global food security: progress prospects and applications. Paper Presented at the society for experimental biology meeting, roots for global food security session, Manchester. <https://doi.org/10.6084/m9.figshare.1462655>
- Wang Y, Zhang W, Li K, Sun F, Han C, Wang Y, Li X (2008) Salt-induced plasticity of root hair development is caused by ion disequilibrium in *Arabidopsis thaliana*. J Plant Res 121:87–96
- Wasson AP, Richards RA, Chattrath R, Misra SC, Prasad SV, Rebetzke GJ, Kirkegaard JA, Christopher J, Wutt M (2012) Traits and selection strategies to improve root systems and water uptake in water-limited wheat crops. J Exp Bot 63:3485–3498
- Woodrow P, Ciarmiello LF, Annunziata MG, Pacifico S, Iannuzzi F, Mirto A, D'Amelia L, Dell'Aversana E, Piccolella S, Fuggi A, Carillo P (2017) Durum wheat seedling responses to simultaneous high light and salinity involve a fine reconfiguration of amino acids and carbohydrate metabolism. Physiol Plant 159(3):290–312. <https://doi.org/10.1111/ppl.12513>
- Wu H, Shahala L, Liu X, Azzarello E, Zhou M, Pandolfi C, Chen ZH, Bose J, Mancuso S, Shahala S (2015) Linking salinity stress tolerance with tissue-specific Na<sup>+</sup> sequestration in wheat roots. Front Plant Sci 6:71
- Yang Y, Chen L, Li N, Zhang Q (2016) Effect of root moisture content and diameter on root tensile properties. PLoS One 11(3):e0151791
- Yi LP, Ma J, Li Y (2007) Impact of salt stress on the features and activities of root system for three desert halophyte species in their seedling stage. Sci China Ser D 50:97–106
- Zhao Y, Dong W, Zhang N, Ai X, Wang M, Huang Z, Xiao L, Xia G (2014) A wheat allene oxide cyclase gene enhances salinity tolerance via jasmonate signaling. Plant Physiol 164:1068–1076
- Zhuchenko A (2004) Ecological genetics of cultivated plants and problems agrosphere (theory and practice). Moscow, Agrorus

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