Salt stress using Chenopodium quinoa as a model plant

Lucia Acosta-Gamboa[1], Kirk Czymmek[1], Anastasiya Klebanovych[1], Samuel Kenney[1], Jared Gordon[1], Autumn Brown[1], Noah Fahlgren[1], Jorge Gutierrez[1], Haley Schuhl[1], and Malia Gehan[1]

[1]Affiliation not available

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Abstract

Chenopodium quinoa is an important crop known for its salt tolerance. Salinity is an osmotic stress and ions accumulation in the root zone causes a reduction in soil water availability, affecting the uptake of essential nutrients, changing seed composition, and reducing biomass. Hence, the need for high-yield crops in poor soils. This research examines the effect of salt stress on quinoa photosynthetic efficiency and salt bladder development. Sensitive and tolerant quinoa lines were examined under salt stress conditions when a concentration of 155mM NaCl was applied. Soil conductivity was monitored for salt stress during the experiment. At approximately two months old, CropReporter images were taken and analyzed using PlantCV to estimate photosystem II efficiency, non-photochemical quenching (NPQ), chlorophyll content, and anthocyanin content. The analysis showed that the salt treatment did not negatively affect the plant photosynthetic efficiency (no changes in Fv/Fm, NPQ, Fq'/Fm') but leaf area and chlorophyll content was statistically negatively affected by the treatment when comparing genotypes. Live tissue was also analyzed using reflection and fluorescence confocal microscopy, where epidermal salt bladders images were acquired, visualized and analyzed in 3-D and the salt tolerant line showed bigger bladder volumes compared with control conditions. A more high-throughput approach using PlantCV, an open-source image analysis software package targeted for plant phenotyping. This software helped count epidermal salt bladders using stereoscope images. A comprehensive understanding of the quinoa salt tolerant mechanisms by employing multidisciplinary approaches is necessary for their effective incorporation into salt-sensitive crops for better crop yields under stressful environments.

***Lucia Acosta-Gamboa*[1]**, *Kirk Czymmek[1], Anastasiya Klebanovych[1], Samuel Kenney[1], Jared Gordon[1], Autumn Brown[1], Noah Fahlgren[1], Jorge Gutierrez[1], Haley Schuhl[1], Malia Gehan[1]*

[1]*Donald Danforth Plant Science Center, Saint Louis, MO, USA*

ORCiD: [0000-0001-7704-1845]

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