Abstract

In arid regions like the Southwest, drought conditions force growers to rely on saline subsurface water, which is harmful to plants. Halophytes (salt-tolerant plants) could be a viable alternative; however, limited data exist on their responses to natural brackish groundwater (BGW) and desalination brine concentrate. Moreover, BGW could be a value-added resource since halophytes produce secondary metabolites such as phenolics and antioxidants that can benefit human health.

This experiment aimed to investigate the biomass, water use efficiency (WUE), ion uptake, total shoot phenolic concentration (TPC), and total shoot antioxidant concentration (TAC) responses of three halophyte species, *Atriplex canescens* (Pursh) Nutt. (fourwing saltbush), *A. lentiformis* (Torr.) S. Watson (big saltbush), and *Lepidium alyssoides* A. Gray var. *alyssoides* (mesa pepperwort), grown in a nonsaline control treatment (EC = 0.6 dS m-1), BGW CaSO4-dominated water (EC = 4 dS m-1), desalination brine concentrate (EC = 8 dS m-1), NaCl counterpart solutions (EC = 4 or 8 dS m-1), and a 300 mM NaCl solution (EC = 30 dS m-1). Plants were seeded approximately 6 wk before saline irrigation. Harvest occurred after 0-wk, 3-wk, and 6-wk of saline irrigation.

The results showed that BGW and low NaCl caused *A. lentiformis* to increase biomass; *A. canescens* biomass was unaffected by salinity, and *L. alyssoides* biomass declined with increased salinity. WUE increased with salinity in the *Atriplex* spp. but not in *L. alyssoides*. The halophytes' similar behavior with NaCl and CaSO4-BGW solutions suggests that total salinity was a dominant factor in their salinity responses. However, the irrigation solutions did not affect the halophytes' TPC or TAC, even at 300 mM NaCl. A supplemental 15-day study with desalination brine concentrate and high NaCl (8 dS m-1) was conducted on Swiss chard (a halophyte) and leaf lettuce (a non-halophyte) to compare the effects of salinity stress (long-term exposure and acclimation to salt) and salinity shock (rapid onset of salinity before harvest). Results indicated that salinity stress increased TPC in leaf lettuce as expected, but not in Swiss chard. Salt shock increased TPC in Swiss chard, suggesting a potential to improve product quality in this halophyte.

The study indicates that diverse saline water sources can improve plant nutritional quality. Further research is needed to test salt shock effects on TPC in other halophytes to increase product quality. The study highlights the possibility of using BGW as a value-added resource for halophyte cultivation in arid regions, contributing to water conservation and sustainability in agriculture.