Soil- and Plant-based Treatment Options for Marginal Waters

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Introduction

Plants have a significant capacity to remediate marginal waters through several phytoremediation processes including uptake (e.g., nutrients, trace elements), accumulation (e.g. salts), and assist with biotransformation of inorganic compounds (e.g., nutrients, trace elements). The halophyte, *Salicornia europaea*, grows under extreme salt conditions and has been explored as a saline agriculture crop. Salicornia could be a suitable halophilic plant to capitalize on its salt-tolerance potential for treating marginal waters while producing stock for biofuel and high-value biobased products.

Objective

- To determine ability of S. europaea to grow in flue gas desulfurization (FGD) wastewater, which is high in salts and other potentially toxic trace constituents selenium (Se) and boron (B); or brackish waters.

Materials and methods

Plant species: *Salicornia europaea*

Plants were arrived on September, 26, 2016 from California, transplanted and grown under greenhouse condition.

Experimental design: Complete randomized block design with five treatments

Treatments:

- Tap water100% (control)
- Brackish water100%
- FGD100%
- Hoagland solution and brackish water (50:50 v/v)
- Hoagland solution and FGD (50:50 v/v).

FGD wastewater was collected from Jeffery Energy Center on September 20, 2017. Brackish water was prepared by (AQUARIUM SALT).

- The above-ground biomass were harvested, at 4weeks (partially) and 8 weeks washed and oven-dried at 70°C.
- The ground material (<1 mm) and NIST 1575a Pine Needles (for QA/QC) digested in Conc. HNO_3 in a microwave and analyzed by ICP-MS and ICP-OES.
- Statistical Analysis: One-way ANOVA using PROC GLIMMIX, SAS Version 9.4.

Results and Discussion

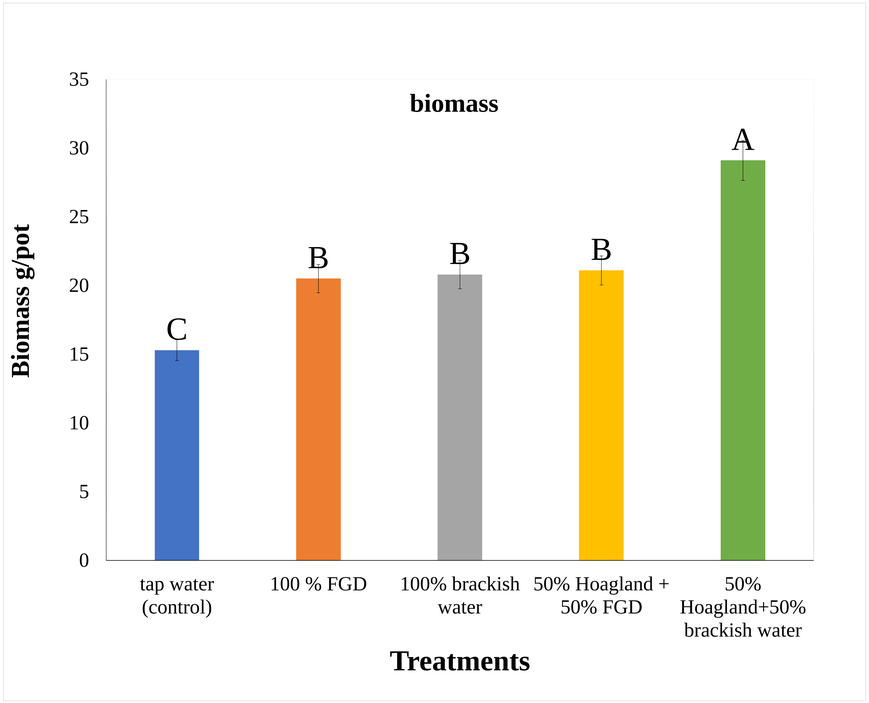

Fig. 1 Total biomass after two cuttings of Salicornia. Means with different letters are significantly different (LSD, α=0.05).

- Dry matter yield was significantly higher in wastewater treatments than the control.
- *Salicornia* tolerated high salinity and maintained relatively high growth rate at intermediate salinity.

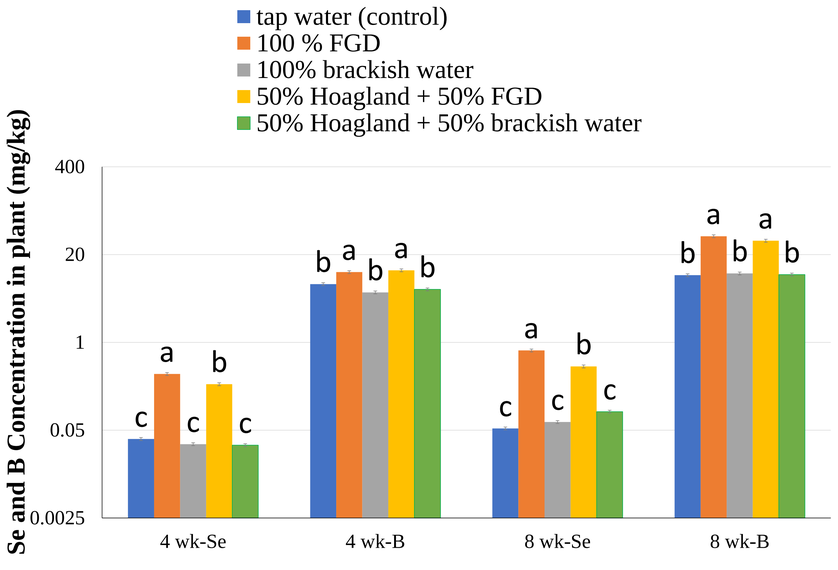

Fig. 2 Se and B concentration in Salicornia (mg/kg dry weight basis) in two cuttings. Means with different letters are significantly different (LSD, α=0.05).

- 4 wk and 8wk Se concentration in Salicornia shoots grown in 100%FGD and 50%FGD+ 50%Hoagland treated soils were 818% , 548%, 1332% and 730%, respectively, higher than that of the shoots grown in the control pots.
- 4 wk and 8wk B concentration in Salicornia shoots grown in 100%FGD and 50%FGD+ 50%Hoagland treated soils were 50.6% , 60.2%, 277% and 224%, respectively, higher than that of the shoots grown in the control pots.

Results and Discussion

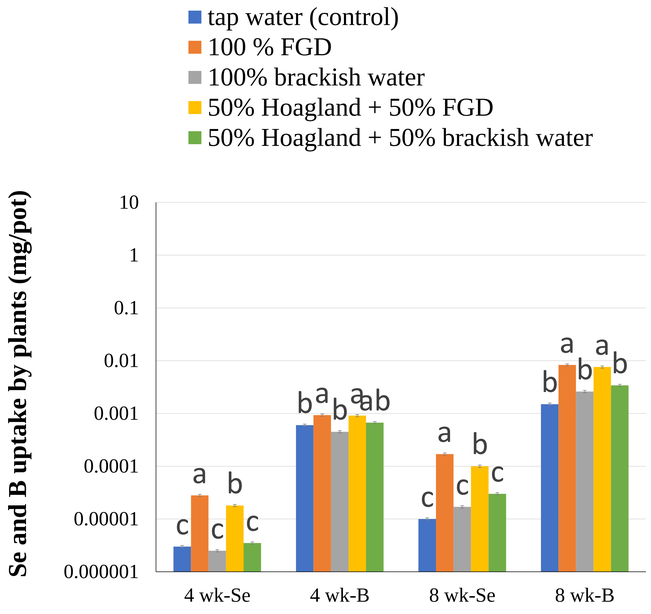

Fig. 3 Se and B uptake by Salicornia (mg/pot, dry weight basis) by 4 wk and 8 wk cuttings. Means with different letters are significantly different (LSD, α=0.05).

- 4 wk and 8wk Se uptake in Salicornia shoots grown in 100%FGD and 50% FGD + 50%Hoagland treated soils were 833% , 500%, 1600% and 900%, respectively, higher than that of the shoots grown in the control pots.
- 4 wk and 8wk B uptake in Salicornia shoots grown in 100%FGD and 50%FGD+ 50%Hoagland treated soils were 55% , 51%, 453% and 406%, respectively, higher than that of the shoots grown in the control pots.

Summary

- *Salicornia europaea* has the ability to remove excess trace elements such as Se and B and salts in marginal waters, therefore, has the potential for reclaiming marginal waters.
- Enhanced biomass is encouraging as it has the potential to provide valuable stock for biofuel and biobased products from marginal waters.

Acknowledgements

- Ministry of Environment, Water and Agriculture, Saudi Arabia, and Electric Power Affiliate Program-Kansas State University for funding.
- Dr. Buddhika Galkaduwa for analytical help.

Reference

Kadereit, G., Ball, P., Beer, S., Mucina, L., Sokoloff, D., Teege, P., and Freitag, H. (2007). A taxonomic nightmare comes true: phylogeny and biogeography of glassworts (Salicornia L., Chenopodiaceae). *Taxon*, *56*(4), 1143-1170.