POTENTIAL OF HALOPHYTE PHYTOEXTRACTION FOR SALINE SOIL REMEDIATION

Sarah-Jane Copeland

Kwantlen Polytechnic University, Department of Sustainable Agriculture and Food Systems

INTRODUCTION

Viable agricultural land is increasingly being lost to salinity as a result of natural and anthropogenic causes. It is estimated that 7% of total land area around the globe is affected by salts, and that 12 million ha of irrigated agricultural land may become futile as a result of high salt content. Soils with a high concentration of sodium, calcium, and potassium ions experience adverse effects on soil structure and fertility, which greatly impacts plant health and productivity. The use of halophytes as a mode of phytoremediation may be an ecologically sound and cost-effective alternative to traditional engineering-based remediation methods.

Phytoremediation: a form of green remediation that utilizes living plants to harness and debilitate pollutants surround the plant rhizosphere.

Phytoextraction: a class of phytoremediation where soil pollutants are absorbed by plant roots and sequestered into their plant tissue.

Halophyte: a group of extremophiles that thrive in saline/ sodic conditions unsuitable to most plants. General features:

- Quick growing
- Produce significant biomass
- Long root systems
- Succulent vegetative structures
- Drought tolerant

OBJECTIVES

This study aimed to explore the potential of phytoextraction as a means of saline soil remediation by the halophyte *Salsola komarovii*, in comparison to the salt-sensitive glycophyte *Phaseolus vulgaris*. The key points of the study were to:

- Compare the difference over time in soil electroconductivity between a halophyte (*S. komarovii*) and glycophyte (*P. vulgaris*).
- Study variation in plant growth with an increasing ratio of salts.
- Explore the relationship between increasing salinity and biomass in order to determine if halophyte development is correlated to salt content.

METHODS

Location: KPU Farm, Garden City Lands, Richmond, BC.

Experimental design:

- Randomized complete block split-plot design.
- 4 blocks measuring 2m x 8m, divided into 16 plots measuring 2m x 2m and 64 sub-plots measuring 1m x 1m. *The large number of sub-plots is due to three separate student research projects being conducted at the same research site. A technical adjustment due to the Covid-19 pandemic.*
- Seedlings for both *P. vulgaris* and *S. komarovii* were started indoors and field transplanted June 19th, 2020. Each sub-plot received two transplants of the same species.
- Data was collected bi-weekly following this date until August 28th, 2020.

Treatments:

Spent mushroom compost (SMC) was obtained from Highline Mushrooms. It functioned as the source of salts due to containing a high level of soluble salts. The compost is considered spent as it is the residual waste from the spawning, casing, and harvesting phase of mushroom production.

- Control: no added spent mushroom compost mulch
- 5 cm spent mushroom compost mulch
- 10 cm spent mushroom compost mulch
- 20 cm spent mushroom compost mulch

Data collection:

- Electroconductivity: soil electroconductivity (EC) was measured using an EC meter (mS/cm).
- Biomass: plant fresh weight (kg) was measured upon completion of the experiment by harvesting mature pods of *Phaseolus vulgaris* and cutting *Salsola komarovii* at the soil level.

Statistical analysis: *All data was analyzed using jamovi software.*

- Electroconductivity: data was analyzed using a linear mixed-model approach. The fixed effects were crop type and depth of SMC, while the random effect was soil spatial variability between treatment plots.
- Biomass: data was analyzed using a regression analysis. The independent variables were crop type and depth of SMC, while the dependent variable was plant biomass measured as fresh weight (kg).

RESULTS

Electroconductivity: soil EC was significantly ($P \leq .05$) higher in the SMC treated plots compared to the control plots (Fig.1). Soil EC increased with SMC depth for both *P. vulgaris* and *S. komarovii*. There was no significant ($P \leq .05$) interaction between crop – depth – date over the course of the trial (Fig.2).

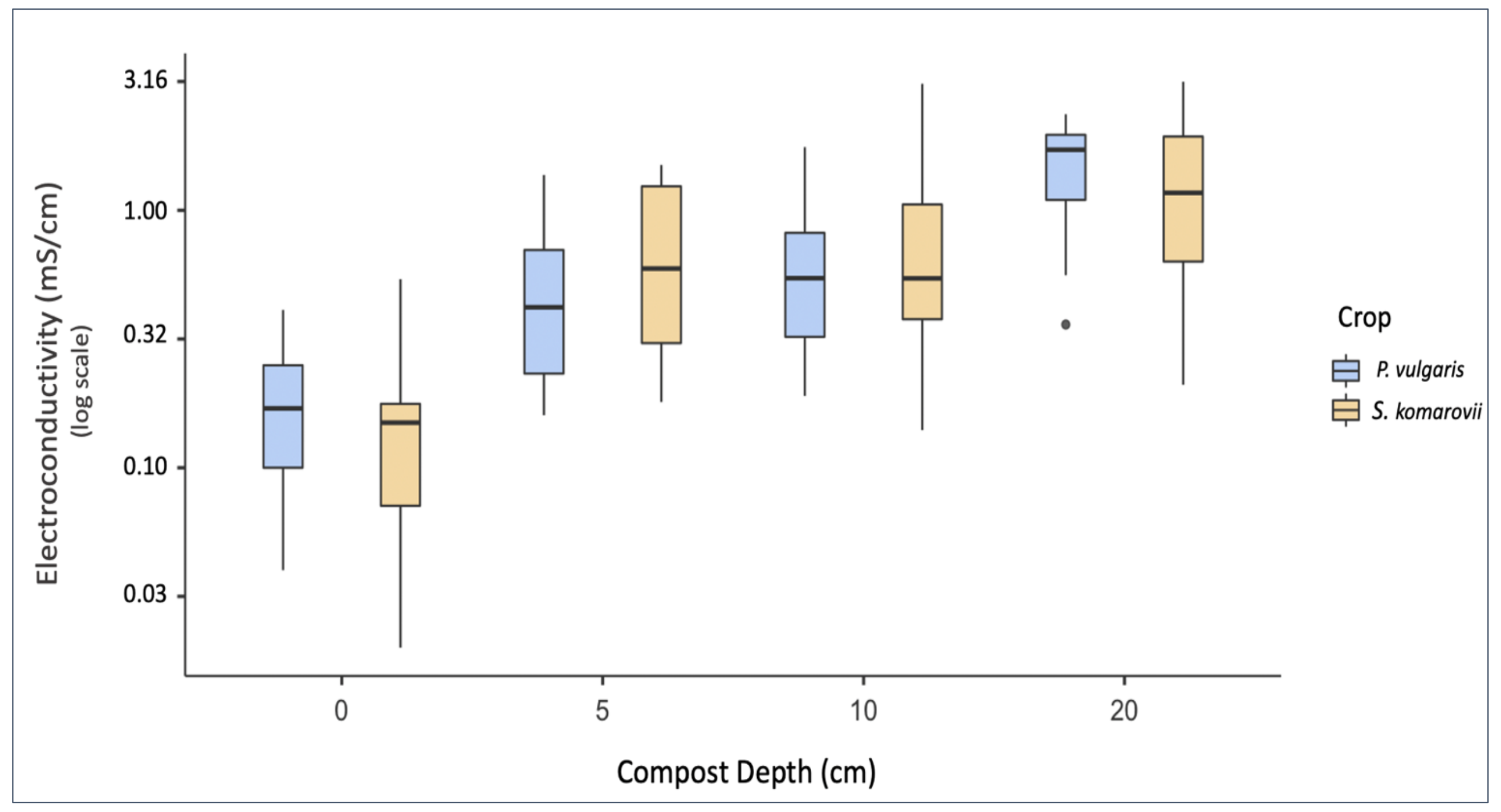


Fig 1. Effects of increasing compost depth on soil electroconductivity

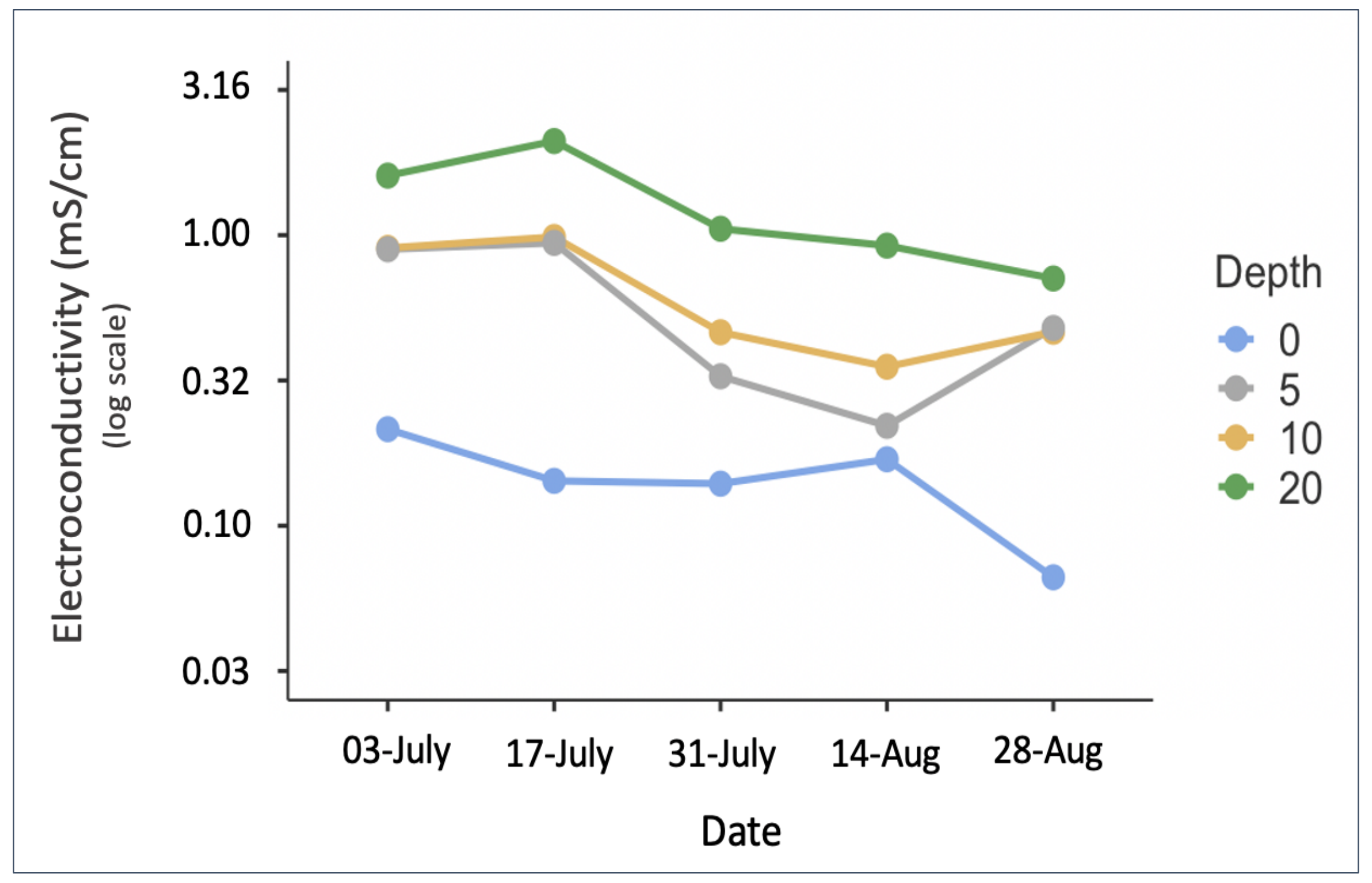


Fig 2. Change in soil electroconductivity over 10- weeks of treatment

Biomass: plant fresh weight was significantly ($P \leq .001$) higher in the SMC treated plots compared to the control plots for both *P. vulgaris* and *S. komarovii*. No significant ($P \leq .05$) effect was observed between the crop – depth interaction, except at the 0 cm – 5 cm level (Fig.3).

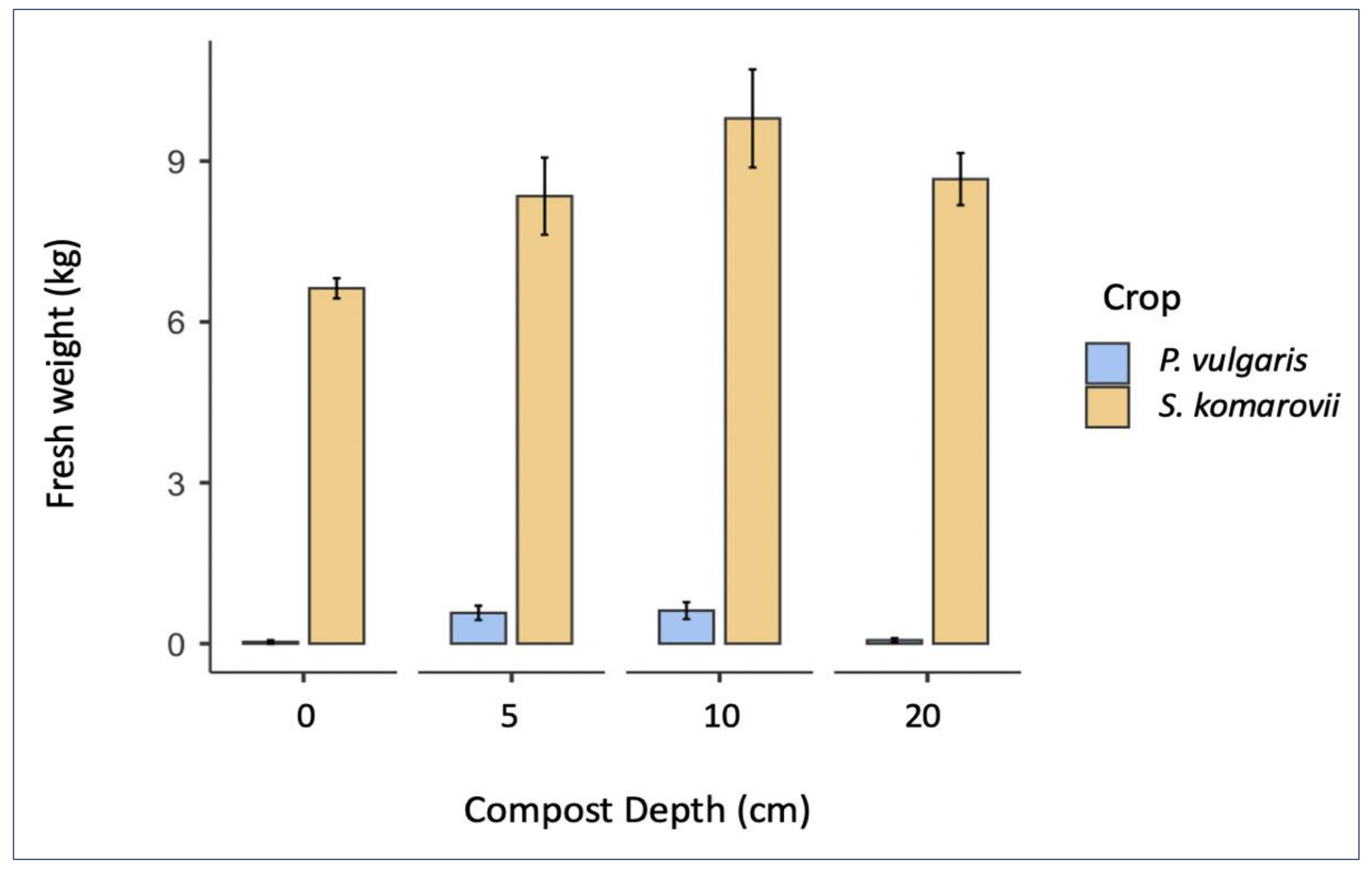
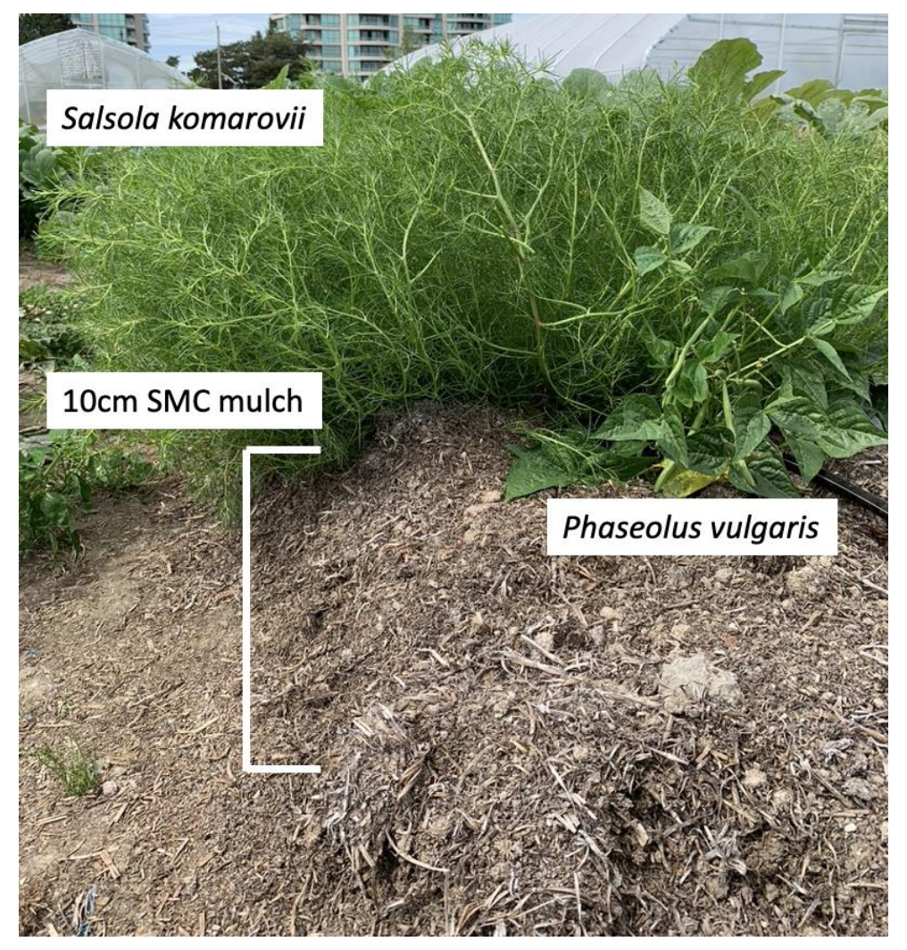
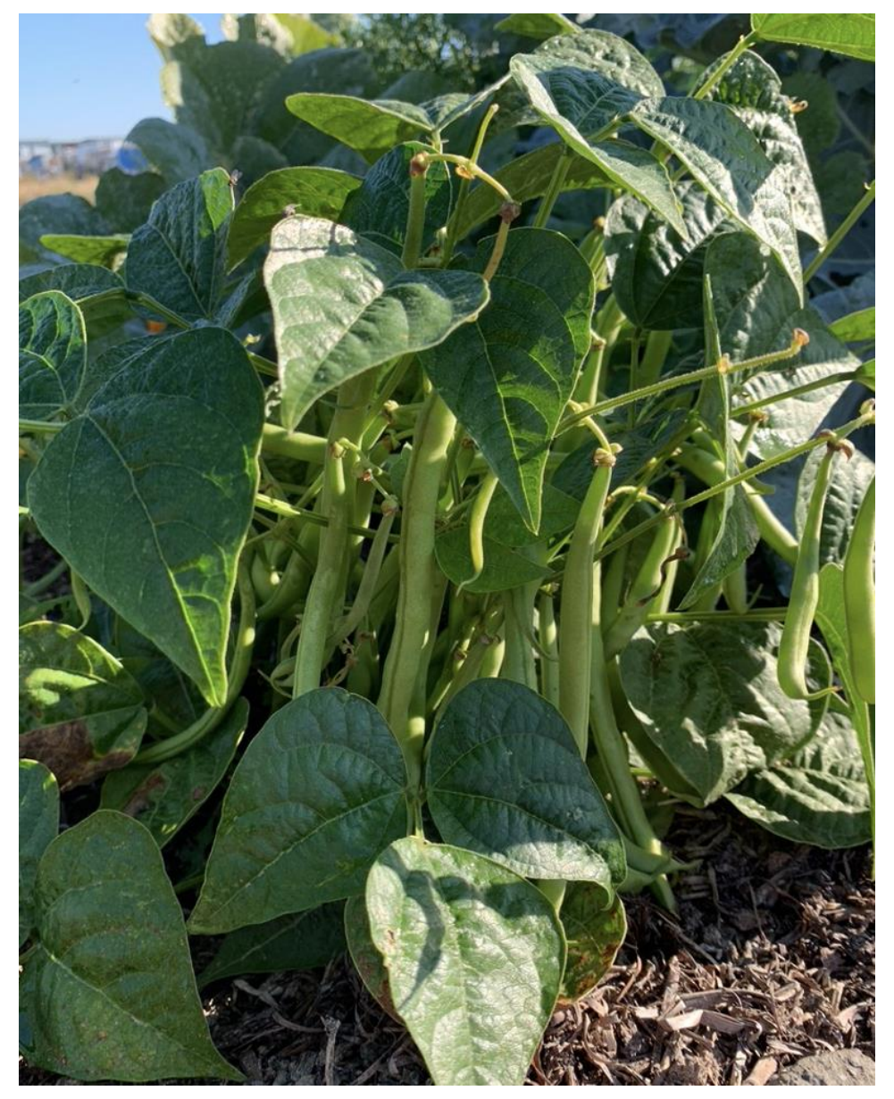


Fig 3. Final fresh weight at each treatment level after 10-weeks of treatment





CONCLUSION

Despite the difference in salt tolerance mechanisms between halophytic and glycophytic species, the results of the experiment do not support the two hypotheses that:

- Soil electroconductivity would change depending on crop type (halophyte vs. glycophyte) over the course of the trial.
- Plant growth of *P. vulgaris* would decline at a greater rate than *S. komarovii* with increasing salinity.

Utilizing halophytes as a form of phytoremediation is still in the preliminary stage and future research will continue to reveal its feasibility under various circumstances

ACKNOWLEDGEMENTS

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