Effects of Mycorrhizal Presence on Salinity Tolerance in Coastal Dune Plants

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Research Questions

How does the absence of a microbiome affect salinity tolerance in dune plants?

How can we increase plant survivorship in dune restoration efforts?

Introduction

In the US alone, erosion of coastlines is estimated to cost $530 million per year.[1] Dune replenishment is a costly and labor-intensive process where sand and plants are transplanted to combat future erosion. However, these efforts often fail, experiencing near 100% plant mortality.[2] Meanwhile, the presence of mycorrhizae, soil-bound fungi that interface with plant roots and promote increased nutrient acquisition, have well-documented impacts on ecosystem biodiversity, and primary production.[3] Incorporation of mycorrhizal fungi may aid dune replenishment improving plant survival and growth.

Methods

We planted the following numbers of 2 month old seedlings:104 *I. imperati,* 84 *I. pes caprae,* and 89 *U. paniculata,* separated as per figure 1

Bi-weekly data collection of the following: Survival, % senescence, height, leaf number for *Ipomea* / leaf bundle circumference for *U. paniculata*

We analyzed our growth and survival data using a repeated-measures mixed effect model

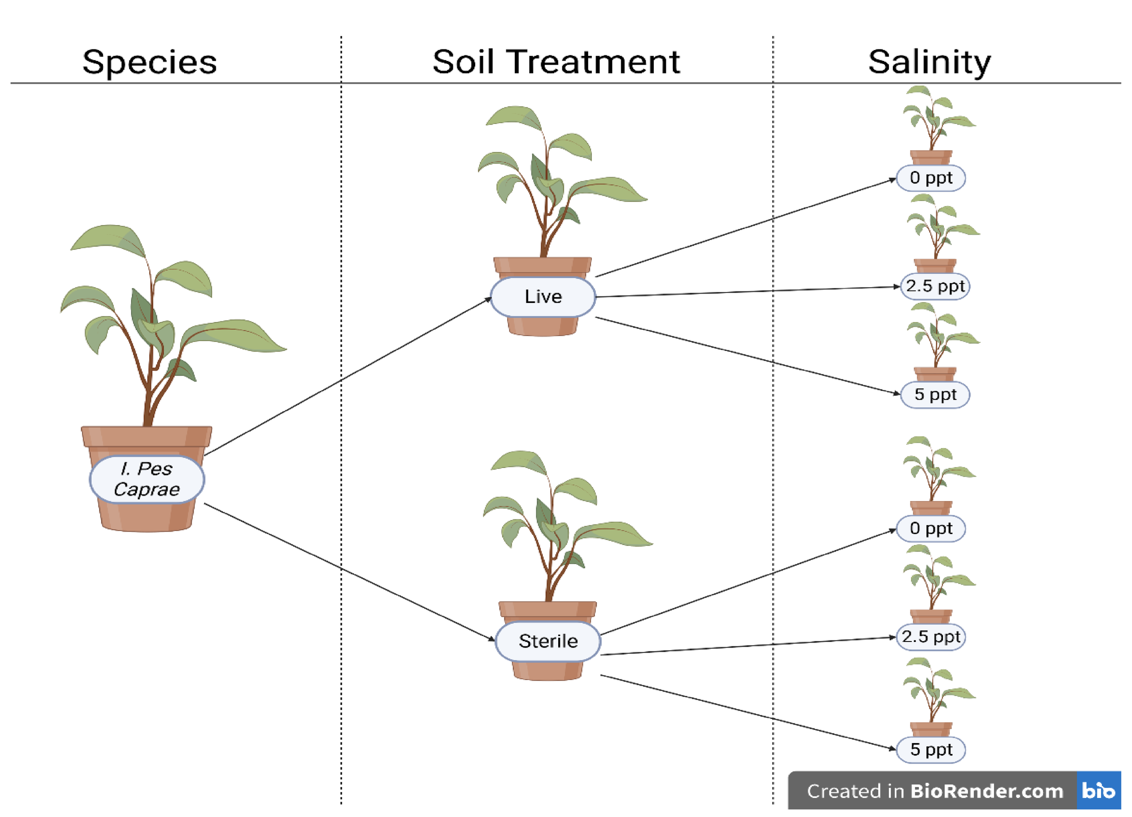

Figure 1: Illustration of experimental groupings

Take home point

In *Ipomea imperati,* mycorrhizae seem to reduce salinity tolerance (reduced survival, higher senescence, longer runners), while in *Uniola paniculata,* mycorrhizae improve salinity tolerance.

Ipomea imperati results

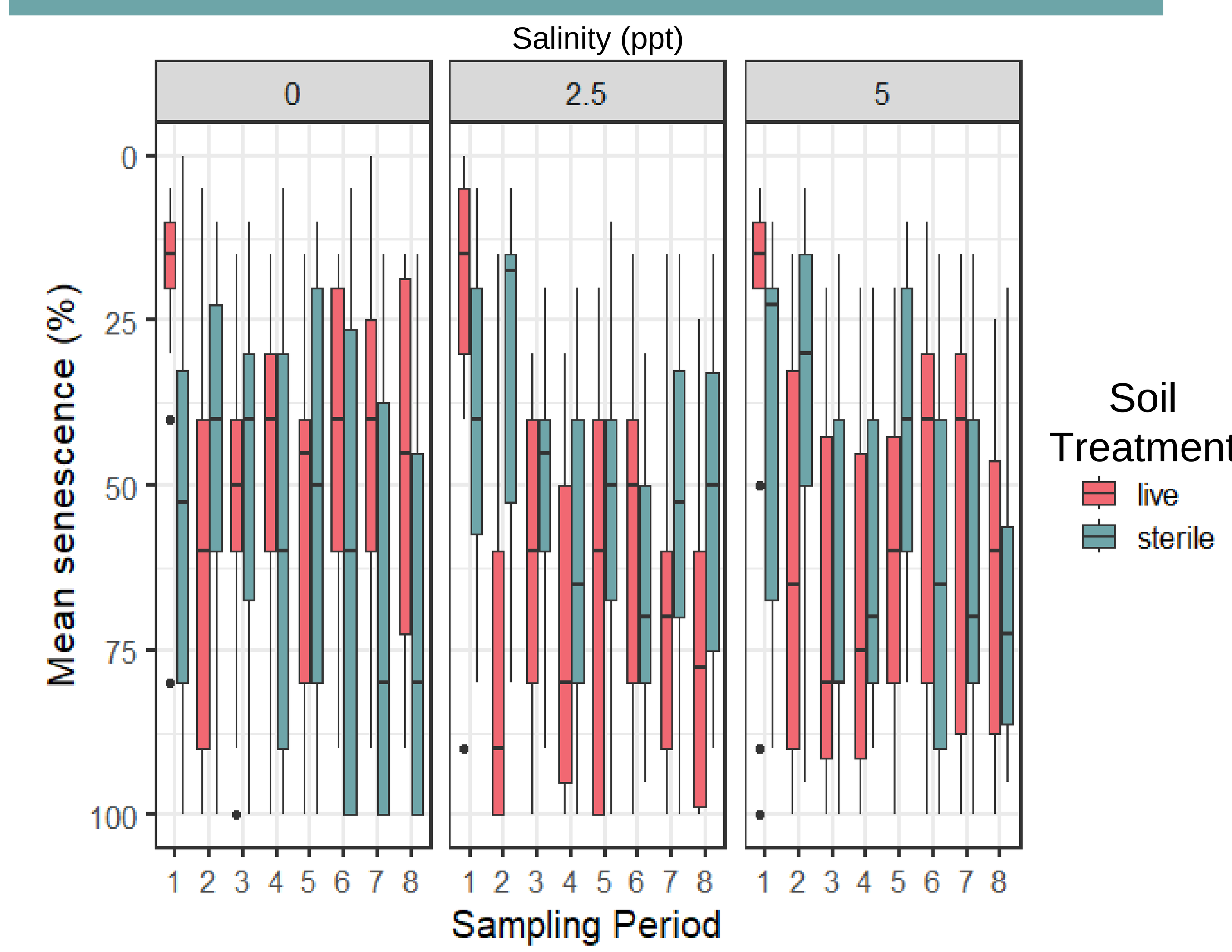

Figure 2: Mean senescence (%) in *I. imperati* across 0, 2.5, 5ppt salinity gradient in either live or sterile soils. We found a strong interaction between soil treatment and salinity ($X^2 = 21.92$, $p < 0.0001$)

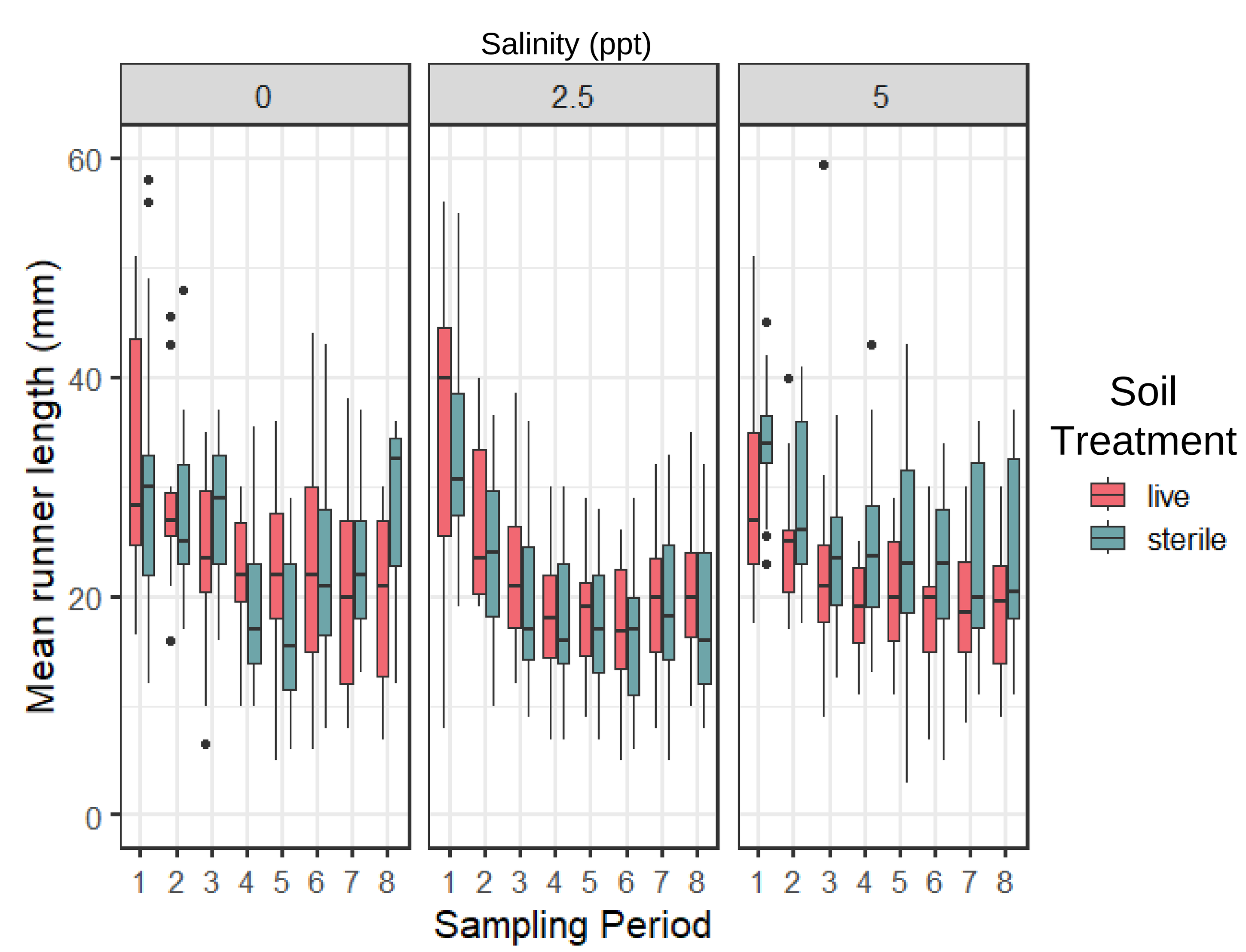

Figure 3: Mean runner length (mm) in *I. imperati* across 0, 2.5, 5ppt salinity gradient in either live or sterile soils. We found a main effect with salinity ($X^2 = 14.05$, $p < 0.001$) and a strong interaction between soil treatment and salinity ($X^2 = 14.22$, $p < 0.001$)

Uniola Paniculata results

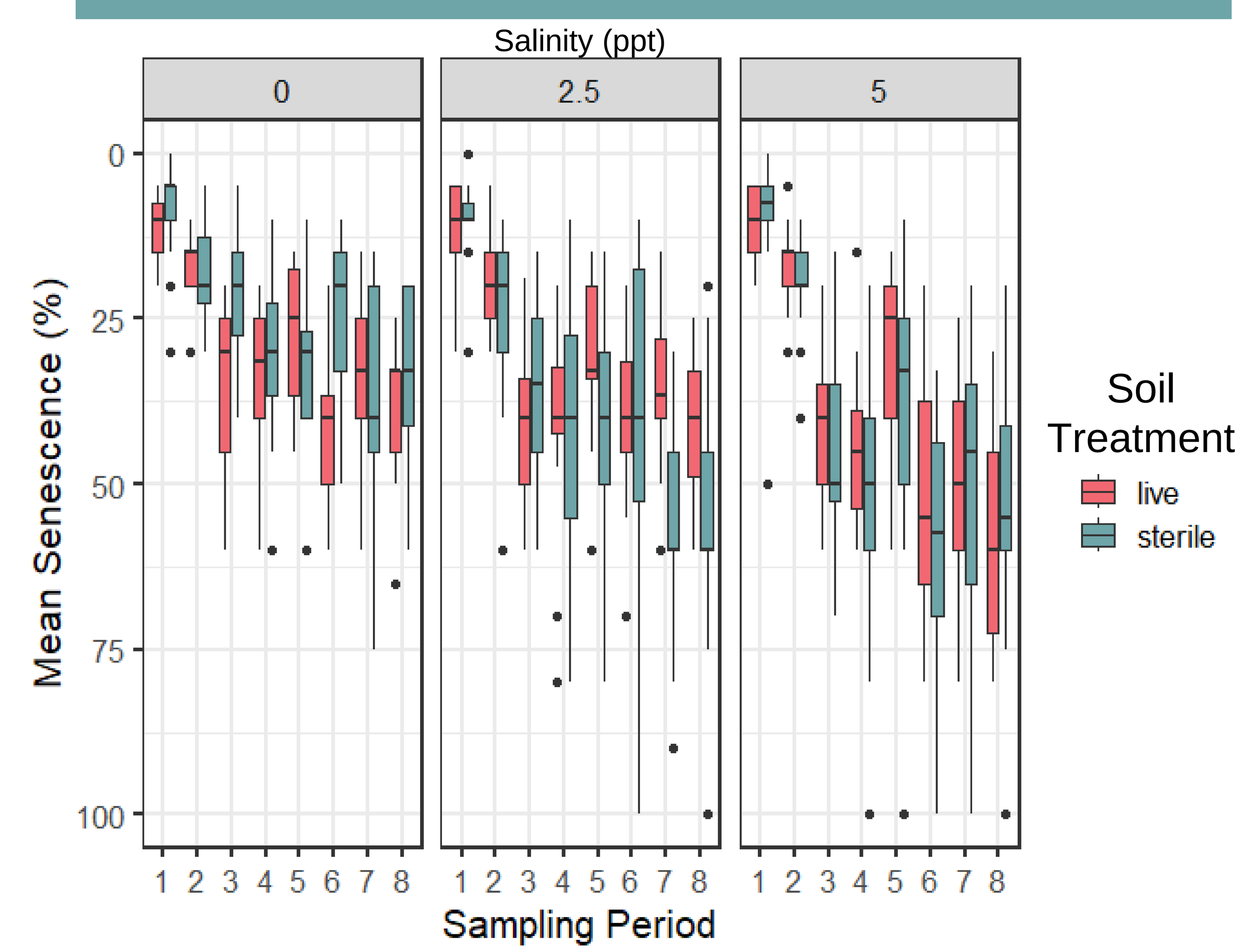

Figure 4: Mean senescence (%) in *U. paniculata* across 0, 2.5, 5ppt salinity gradient in either live or sterile soils. We found a main effect with salinity ($X^2 = 77.15$, $p<0.0001$) and strong interactions between soil treatment and salinity ($X^2 = 21.92$, $p < 0.0001$) and between sample period and salinity ($X^2 = 20.65$, $p < 0.0001$),

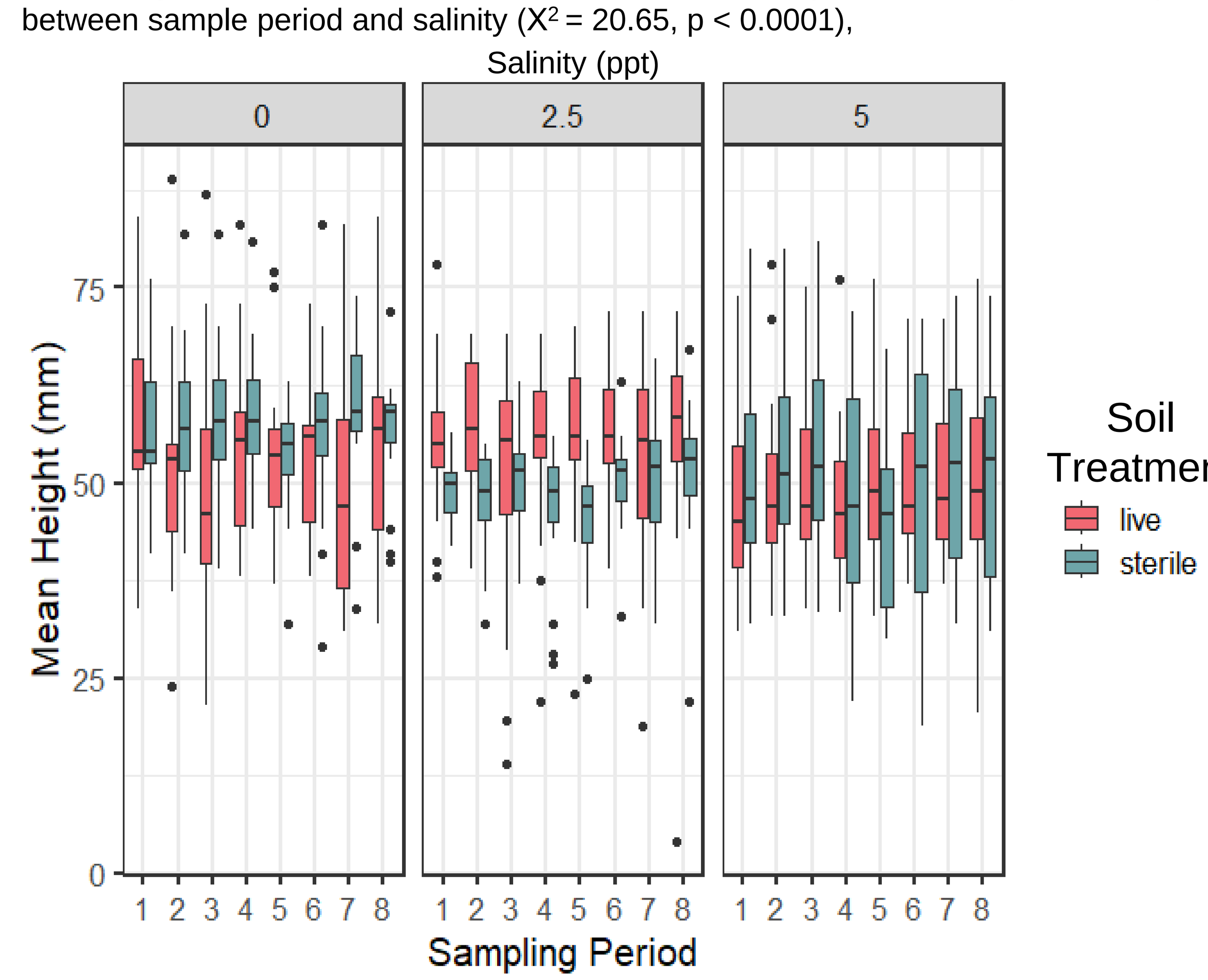

Figure 5: Mean height (mm) in *U. paniculata* across 0, 2.5, 5ppt salinity gradient in either live or sterile soils. We found a main effect with salinity ($X^2 = 23.19$, $p < 0.00001$) and a strong interaction between soil treatment and salinity ($X^2 = 28.09$, $p < 0.000001$),

Focal taxa

Figure 6: *I. imperati* in beach habitat

Figure 7: *U. paniculata* in beach habitat

Discussion

Our results suggest that interactions with soil fungi may support plant growth and survival during periods of more frequent salt inundation, while some species may be more negatively influenced. It is known that mycorrhizal fungi are beneficial for some taxa and may be more parasitic with others, which may drive how future dune replenishment occurs, especially in coastal areas prone for salt inundation. Future studies should target these methods within the field.

References