Dune It Right: How Substrate Impacts Coastal Grass

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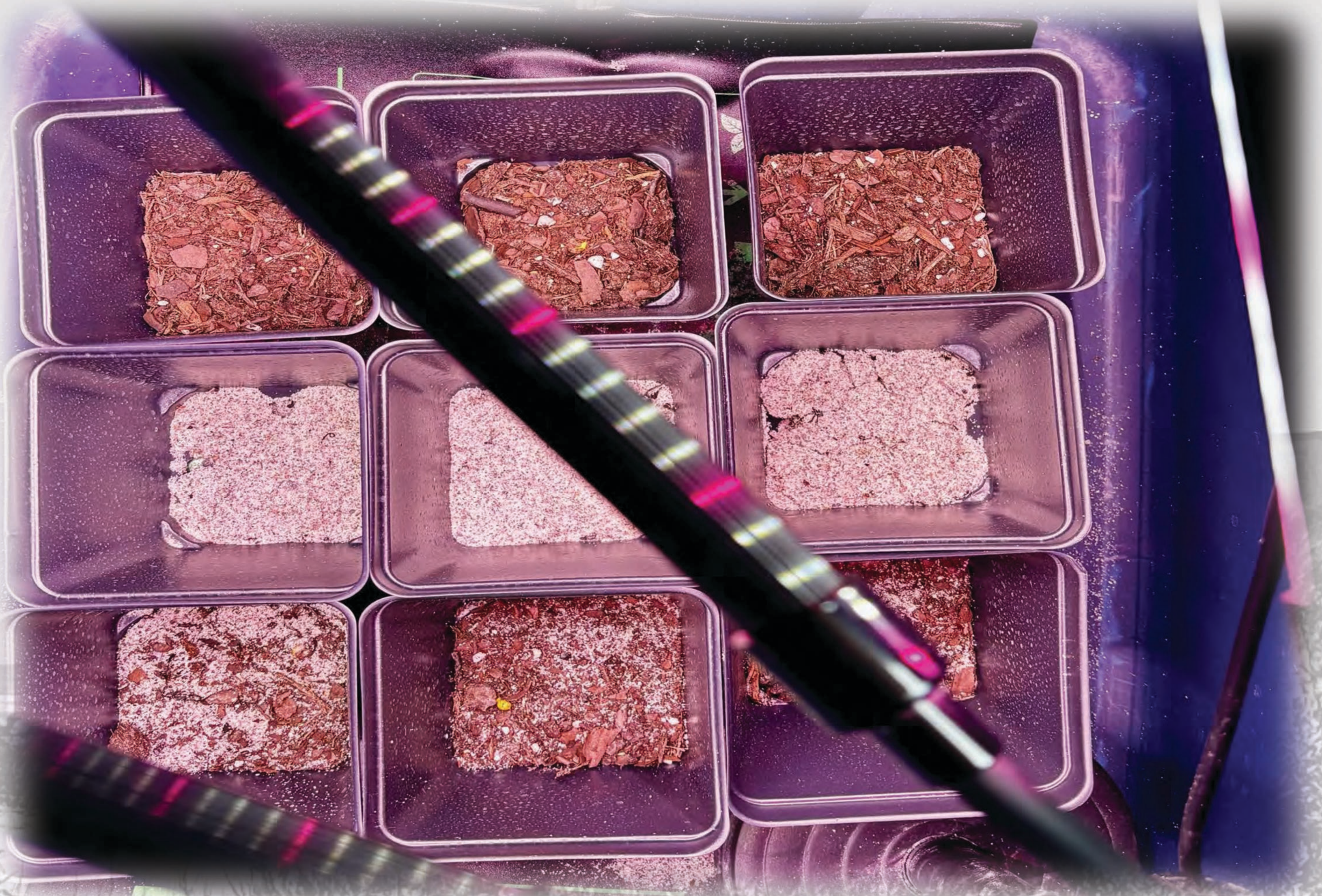
Introduction

Central Florida is a dynamic Atlantic barrier island system characterized by quartz-dominated sandy substrates, high salinity exposure, wind-driven sediment transport, and nutrient-poor soils. Vegetation in this environment plays a critical role in dune stabilization, sediment retention, and erosion resistance (Florida Department of Environmental Protection, U.S. Army Corps of Engineers). *Panicum amarum* (bitter panicgrass) is a dominant native dune species in foredune and secondary dune zones, where its extensive root system promotes sediment trapping, vertical dune growth, and overall resilience; coarser, larger sand granules further enhance stabilization and support plant health. Although *P. amarum* is adapted to low-nutrient conditions, nursery propagation often uses nutrient-rich substrates to increase early biomass, which may alter root-to-shoot allocation and reduce adaptation to nutrient-limited environments. Understanding how substrate composition during early growth influences plant morphology and transplant survival is important for improving restoration outcomes. This study evaluates the effects of three substrate treatments (natural sand, soil, and a natural sand–soil mix) on the growth and transplant survival of *P. amarum*, with the hypothesis that plants grown in natural sand will exhibit greater root development and higher survival after transplant than those grown in nutrient-rich substrates.



Materials

P. amarum seeds (n = 45; 15 per treatment group); uniform planting containers (9 total); natural sand collected from non-dune zone; 1:1 ratio sand mixed with soil 0.21-0.11-016 NPK fertilizer; potting soil (well-draining, containing perlite) with 0.21-0.11-016 NPK fertilizer; full-spectrum grow light; heat mat (maintained at 21°C–32°C / 70°F–90°F).

Methods

This study employs a controlled growth experiment with three substrate treatments: (1) natural sand (control – representing native non-dune substrate), (2) sand 0.21-0.11-016 NPK, and (3) well-drained soil + 0.21-0.11-016 NPK. Fifteen individual seeds are planted per treatment (n = 15). Containers are randomly arranged beneath a full-spectrum grow light and placed on a heat mat maintained between 21°C and 32°C to simulate optimal germination conditions for *P. amarum*. Watering with distilled water is standardized to maintain moisture without waterlogging, replicating well-drained dune conditions.

Growth Monitoring (Ongoing Study)

Plant growth is monitored over an extended period under identical environmental conditions, with continued observation as part of an ongoing study. At designated intervals, five randomly selected replicate plants from each treatment group are observed, and additional individuals may be transplanted for continued observation under natural conditions. It is projected that *P. amarum* grown in natural sand will exhibit greater growth, structural robustness, and overall health compared to plants grown in amended or non-native substrate treatments, reflecting adaptation to native coastal conditions.

Discussion

Results of this ongoing study indicate that *P. amarum* grown in natural sand exhibit greater root development and higher survival compared to plants grown in nutrient-amended substrates, suggesting that larger sand granules and low nutrient conditions promote structural adaptation. Natural dune sand, characterized by larger grain size and increased pore space, likely enhanced drainage and root penetration, supporting stronger anchoring and reducing transplant shock (University of Florida). In contrast, soil and nutrient-amended mixes may have promoted above ground growth at the expense of root development, limiting performance after transplantation. These findings align with previous research showing that coastal dune species are adapted to coarse, well-drained substrates and that early growth conditions influence long-term establishment and stability (University of Florida).

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