The Role of Native and Non-Native Species In Improving Stormwater Quality and Enhancing Bioretention Systems Sustainability

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INTRODUCTION

- Vegetation is essential in bioretention systems
- Plant selection is a key design factor
- Research shows plant functional trait diversity is more prominent than species origin
- Most guidelines prioritize a native-only species approach for plant selection
- Do natives truly outperform non-natives with similar functional traits in improving system functions?

METHODS

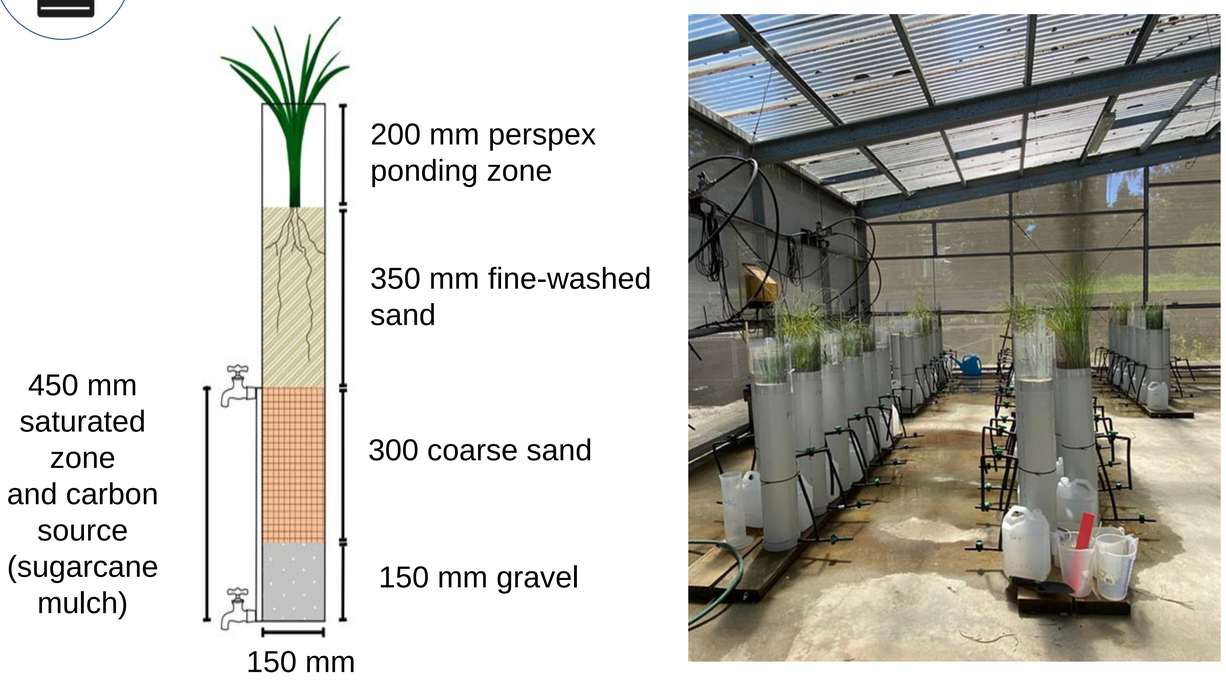

Fig. 1 Column design and experiment

Native Species	Non-native counterpart
Carex appressa	*Carex oshimensis*
Lomandra longifolia	*Dietes iridioides*
Dianella revoluta	*Agapanthus* sp.
Poa labillardieri	*Festuca glauca*
Juncus australis	*Juncus articulatus*

Measured Parameters

- Hydraulic functions
  - Evapotranspiration (ET) and infiltration rate (IR)
- Pollutant removal
  - Total suspended solids (TSS), Total N (TN), Total P (TP), NO_x, NH_3, FRP
- Plant parameters
  - Stem height, plant biomass

RESULTS & DISCUSSION

A. Plant origin effect on hydraulic functions (infiltration rate)

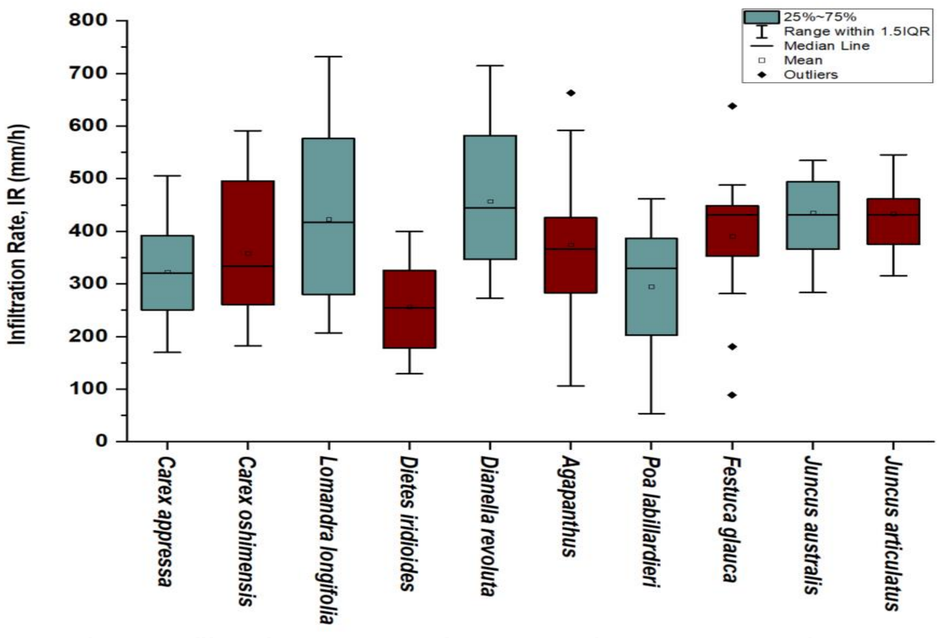

Fig. 2 Infiltration rate performance between species

- *L. longifolia* (native) and *D. iridioides* (non-native) were the only significantly different pair in infiltration performance (p=0.004) (Fig.2).
- Plant origin and hydrological regimes (dry, wet, re-wet) have an insignificant impact on infiltration performance

B. Plant origin effect on pollutant removal

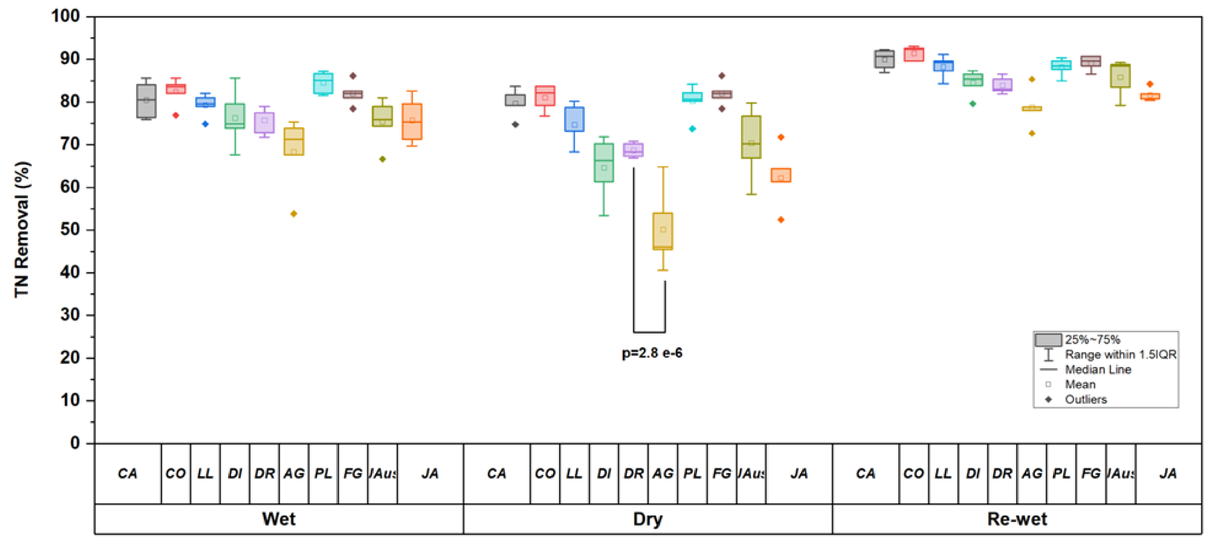

Fig. 3 The interaction between plant species and hydrological conditions for total nitrogen (TN) removal

- Native and non-native pairs showed consistently high total nitrogen removal across all hydrological regimes (Fig. 3), a similar trend to NO_x.
- *D. revoluta* (*DR*, native) and its non-native counterpart, *Agapanthus* (*AG*, non-native), had the lowest performance, with a significant decline during the dry period (p=2.8e-6)
- No significant differences were found in TSS, TP, FRP, and NH_3 removal between native and non-native species (p>0.05)

C. Plant origin effect on plant growth

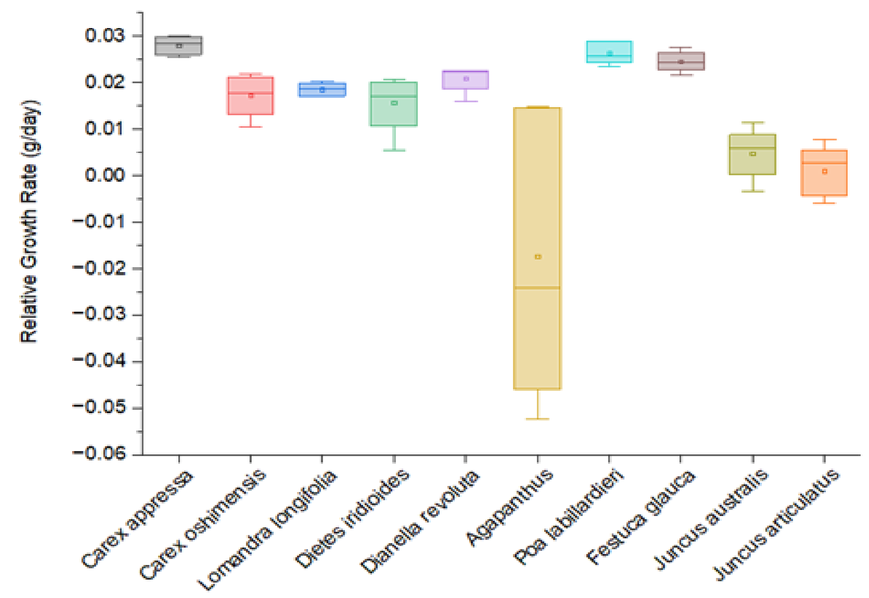

Fig. 4 The Relative growth rate (RGR) for tested native and non-native counterpart species

- Relative growth rates varied among species, but were only significant for *D. revoluta* vs *Agapanthus* (p=3.7e-5) (Fig. 4).
- *Agapanthus* showed negative growth rate (did not survive), explaining its poor nitrogen removal performance.

CONCLUSIONS

- Native and non-native species with similar traits performed comparably across bioretention functions.
- Functional traits, not plant origin, were the main drivers of system performance.
- Non-native species can serve as viable alternatives to natives when non-invasive and suited to site conditions.
- Trait-based selection supports broader, resilient planting palettes while meeting ecological objectives.
- Long-term studies are needed to evaluate planting strategy, ecological interactions and system resilience.

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