Growth of Two Aquatic Macrophyte Species in Artificial Floating Islands in an Ohio Wetland: Potential for Nutrient Sequestration

Zhaozhe Chen[1], Ozeas S. Costa, Jr[2]

[1]*School of Earth Sciences, The Ohio State University, Columbus, OH* [2]*School of Earth Sciences, The Ohio State University, Mansfield, OH*

Introduction

- Nutrient pollution is one of America's most widespread, costly, and challenging environmental problems[1], affecting all 50 states[2].
- Artificial Floating Island (AFI) is a promising strategy to tackle the issue of nutrient pollution in an efficient, environment-friendly, and cost-effective way (Figure 1).
- But most AFI studies were conducted in controlled experimental conditions (lab-scale) and application of AFIs in Ohio is limited.
- This study aims to assess the nutrient sequestration performance of two plant species in AFI applications in natural conditions and investigate the seasonality effect on plant growth and their nutrient sequestration performance.

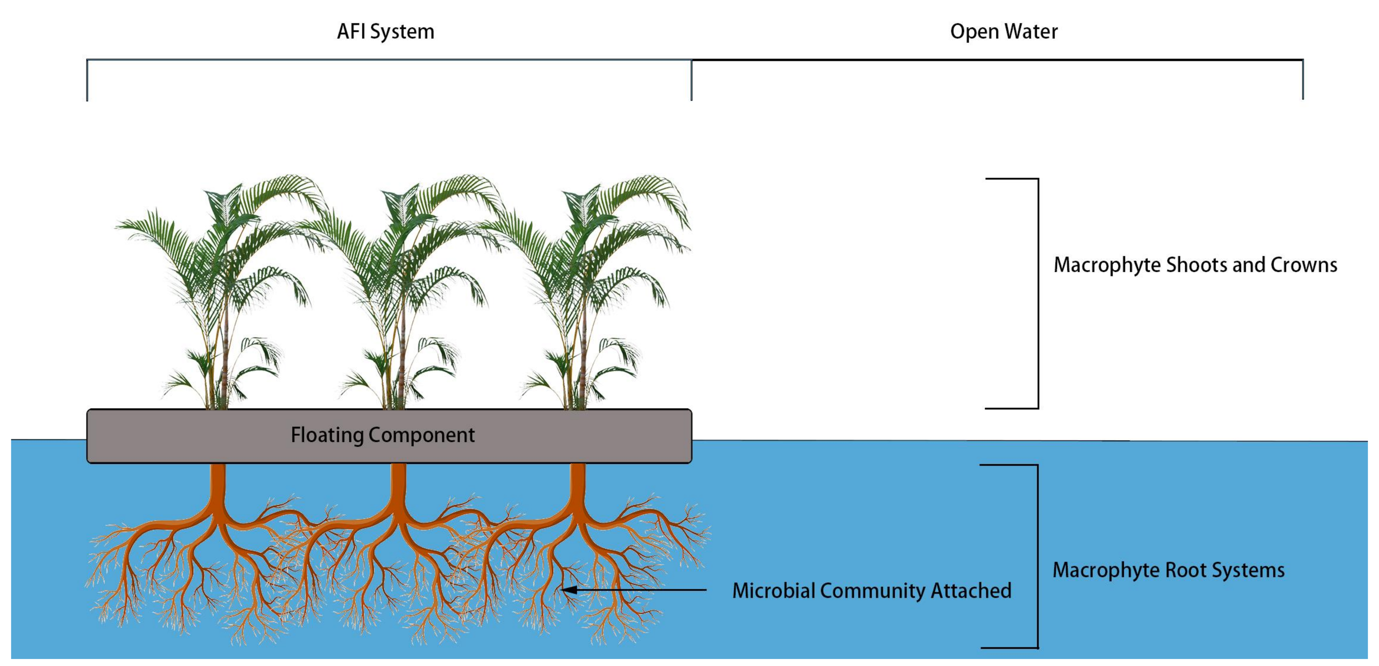

Figure 1: Schematic of an Artificial Floating Island (AFI)

Methods

- Study site: the Milliron Research Wetland, a 0.6-acre constructed wetland, located at the Ohio State University Mansfield campus, OH.
- Two species of native aquatic plants common in Ohio's wetlands: *Carex comosa* (bristly sedge) and *Eleocharis palustris* (common spike-rush).
- A combination of field and mesocosm experiments (Figure 2)
  - Field experiments: 18 2ft x 2ft AFI units in three hexagonal cells.
  - Mesocosm experiments: 9 1ft x 1ft AFI units in 40-gallon tanks.
- Plant samples were collected biweekly for length and biomass (dry and wet) measurements.

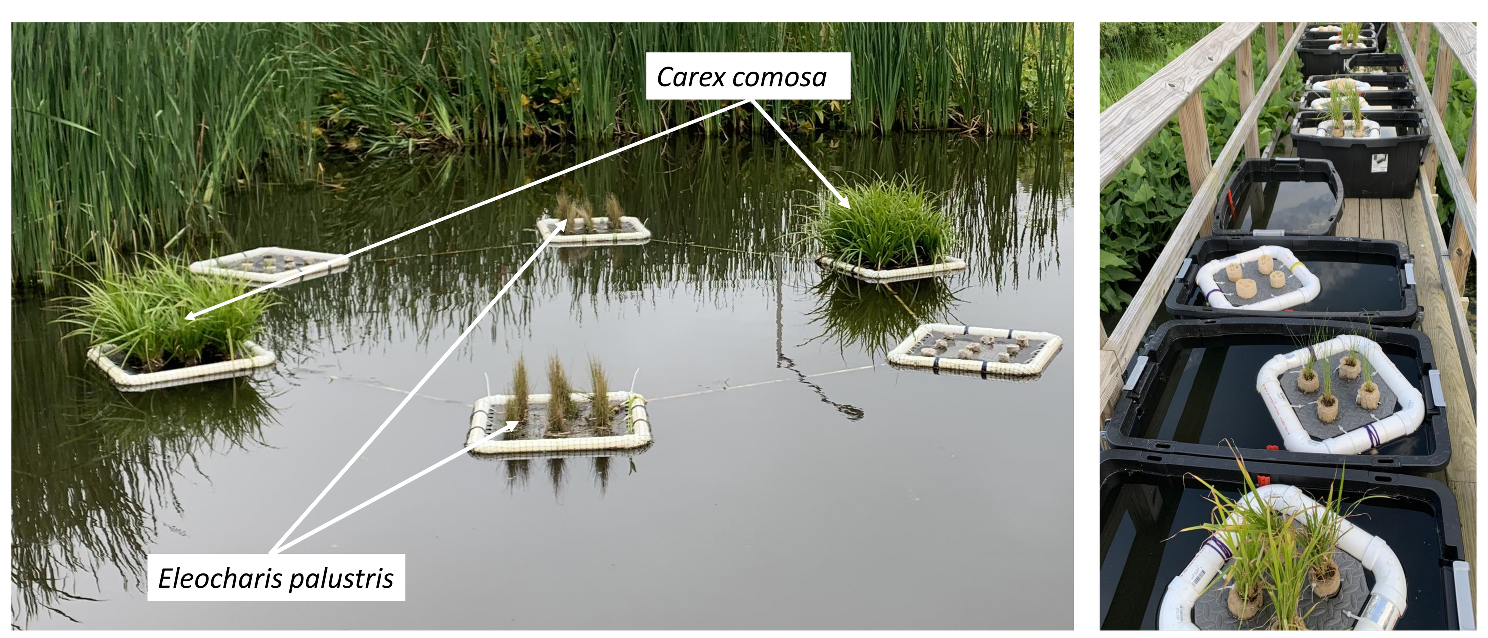

Figure 2: Left: AFI applications in one of the three hexagonal cells in the field experiment. Right: AFI applications in the mesocosm experiment

Results

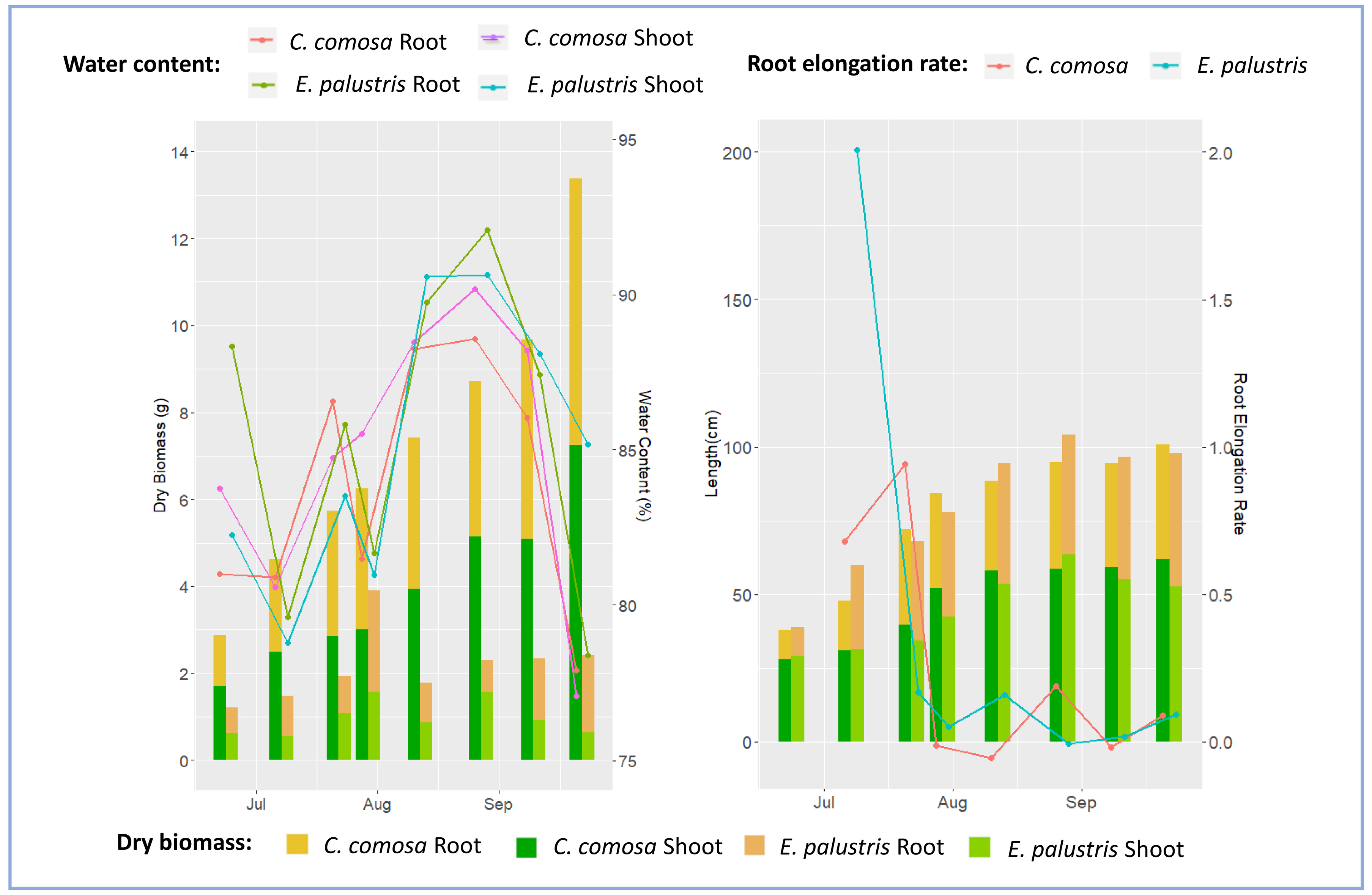

Figure 3: General growth conditions of *C. comosa* and *E. palustris* during the study period

- *C. comosa* dry biomass accumulation
  - Shoot: 33.2 ± 18.8 g/plant (56.8%)
  - Root: 25.3 ± 11.9 g/plant (43.2%)
- *E. palustris* dry biomass accumulation
  - Shoot: 2.0 ± 1.8 g/plant (32.8%)
  - Root: 4.1 ± 2.6 g/plant (67.2%)
- Ratio of root dry biomass to root length
  - *C. comosa*: 0.36 g/cm
  - *E. palustris*: 0.09 g/cm
- Estimated maximum nitrogen storage[3,4]
  - *C. comosa*: 19587 mg/m^2
  - *E. palustris*: 2239 mg/m^2

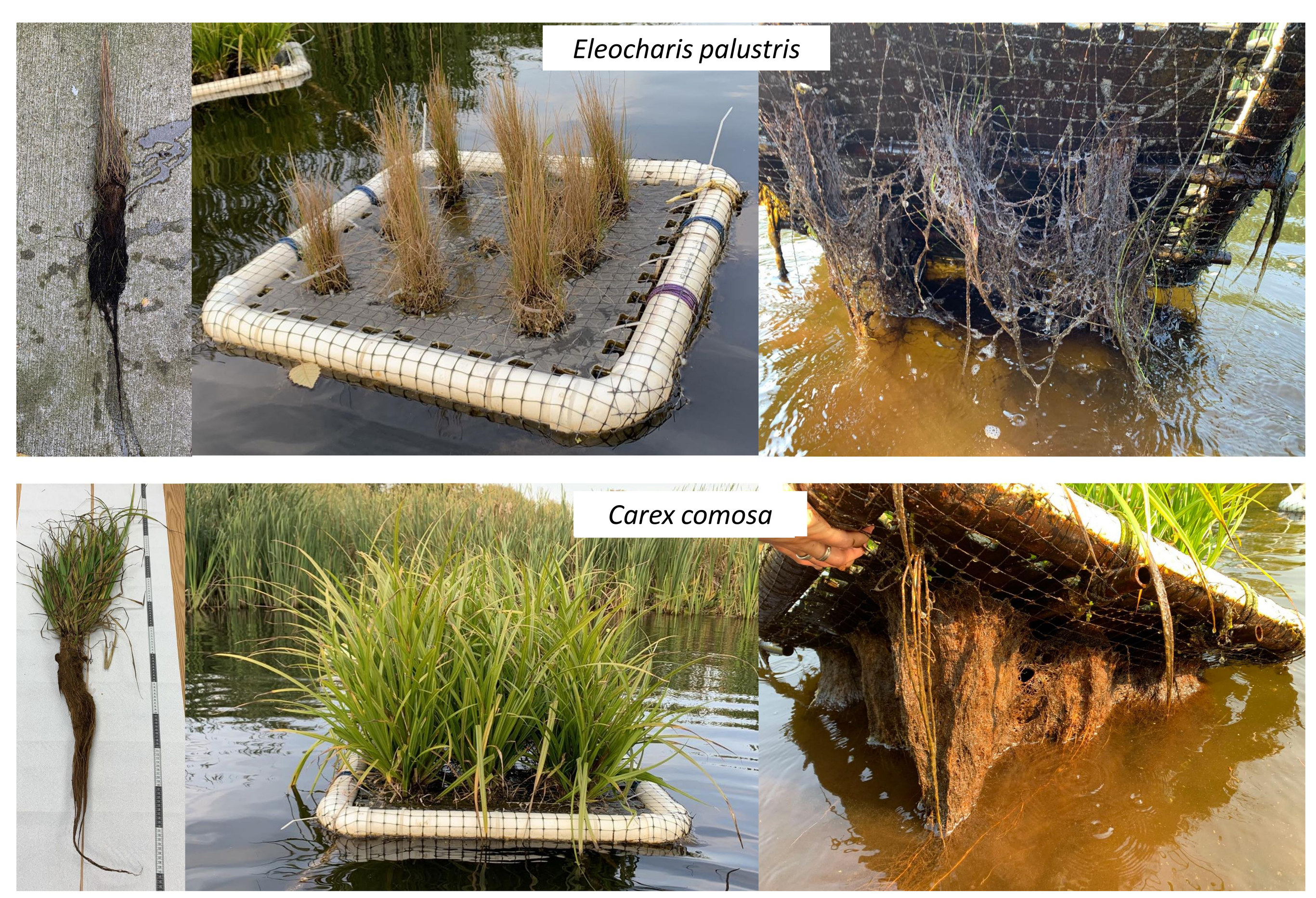

Figure 4: Photos of *C. comosa* and *E. palustris* in AFIs in the wetland on Oct 6, 2020

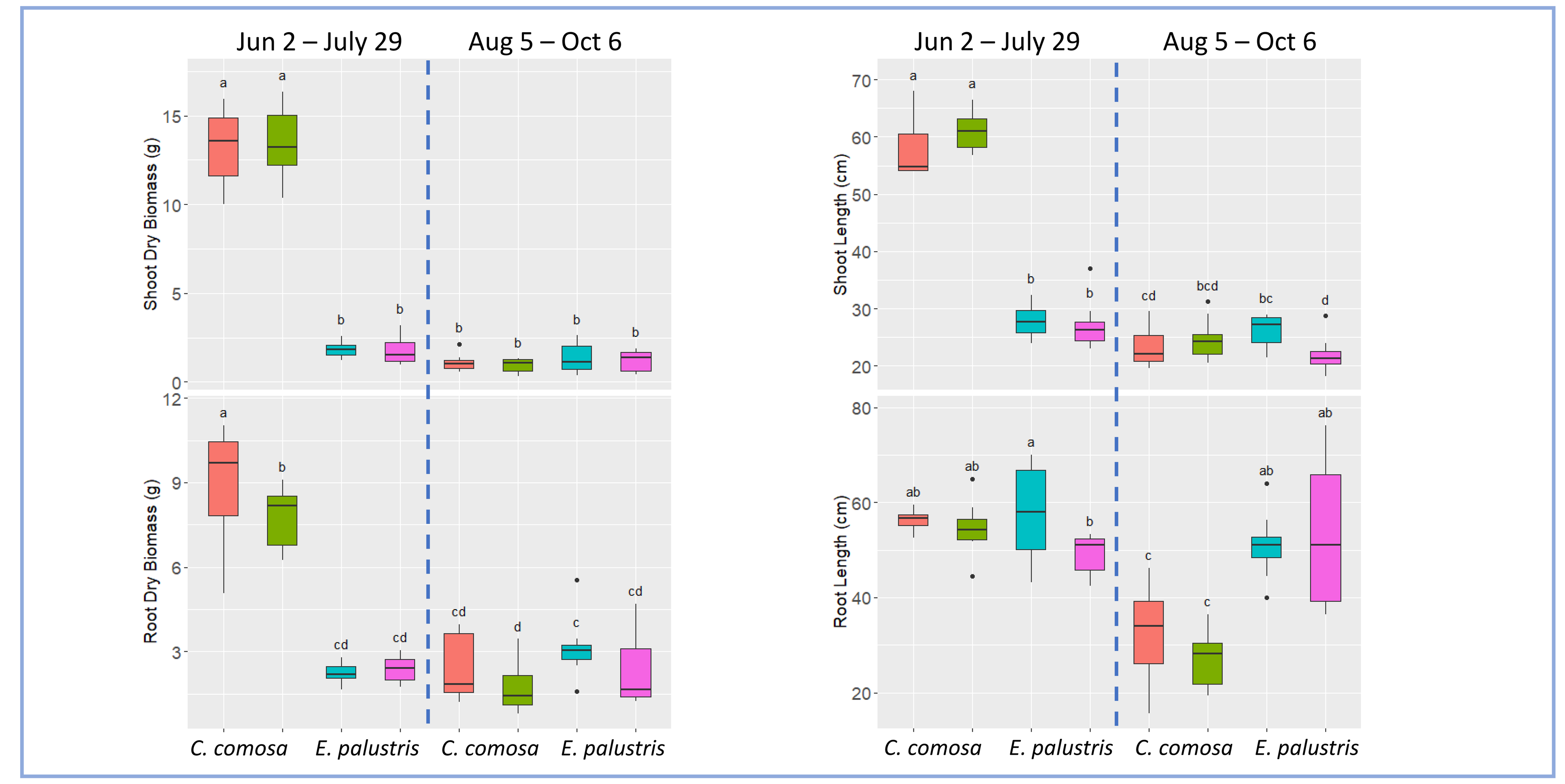

Figure 5: Biomass accumulations and plant elongation for *C. comosa* and *E. palustris* between the two periods (Period 1: Jun 2 – Jul 29, 2020; Period 2: Aug 5 – Oct 6, 2020)

Conclusions

- *C. comosa* outperformed *E. palustris* with respect to biomass accumulation and root system development, suggesting greater capacity in direct uptake of nutrients by the plant.
- Besides direct uptake of nutrients, the more developed root system of *C. comosa* suggested AFIs containing *C. comosa* potentially has a greater total nutrient removal capacity.
- Both species were largely affected by seasonal dynamics that their biomass accumulation and elongation rate decreased significantly from mid-summer.
- This study suggested that *C. comosa* is a promising candidate for AFI applications in nutrient pollution remediation.

Acknowledgements

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