Bioremediation potential of ribbon-shaped contact materials as growth substrates for submerged aquatic weeds

ひも状接触材を水生雑草の生育基盤としたバイオメディエーションの可能性

○Assogba Cedric*, Nakashima Yoshitaka*

アッソグバ　セドリック、中嶋　佳貴

1. Introduction

Invasive submerged aquatic weeds such as *Egeria densa*, *Elodea nuttallii*, and *Vallisneria natans* pose serious ecological and economic problems by obstructing waterways and degrading freshwater ecosystems. While submerged plants can naturally enhance water quality and support biodiversity, their overgrowth demands efficient management. Ribbon-shaped bioremediation materials offer a promising solution by supporting plant growth and enhancing nutrient uptake. This study evaluates the effectiveness of two ribbon-shaped contact materials (BioCord K-45 and BioCord SP-100) as growth bases for these invasive species, focusing on their potential to purify water and enable sustainable biomass utilization.

2. Materials and methods

A randomized complete block design (RCBD) with three replications was used to assess the performance of two ribbon-shaped contact bioremediation materials, BioCord K-45 and SP-100, on the growth of three submerged aquatic weeds (*Egeria densa* , *Elodea nuttallii* , and *Vallisneria natans*). Each 30 cm BioCord sample was placed in a tank containing 3 L of nutrient-rich pond water and Urayasu canal mud samples in Okayama city, with or without a plant species. Plants were cultivated under controlled conditions for eight weeks (September 4-October 30, 2024). Plant length was measured weekly, and fresh/dry biomass recorded at harvest. Water samples were taken on days 1, 3, and 7, and weekly thereafter to analyze ammonium, nitrite, nitrate, and phosphorus levels. Nutrient conditions were maintained via weekly water renewal. Growth and nutrient removal performance were statistically compared across treatments to evaluate the suitability of each material.

3. Results and discussion

3.1 Growth performance on BioCord K-45

Both *Egeria densa* and *Elodea nuttallii* showed enhanced growth, particularly in shoot elongation and biomass accumulation, when cultivated with BioCord K-45. Among the species tested, *Egeria densa* exhibited the highest growth rate. However, there was no significant difference in the growth of *Vallisneria natans* between treatments (Figure 1 and 2). The combination of BioCord K-45 with plant species also improved water quality.

*岡山大学大学院環境生命自然科学研究科 (Graduate School of Environmental, Life, Natural Science and Technology, Okayama University) キーワード：10. 環境保全；環境保全、水環境

3.2 Growth performance on BioCord SP-100

BioCord SP-100 also exhibited enhanced growth, particularly in shoot elongation and biomass accumulation for both *Egeria densa* and *Elodea nuttallii*. For *Vallisneria natans*, both BioCord K-45 and SP-100 provided similar levels of growth support with no significant difference as compared to the control (Figure 1 and 2). This result suggests that *Vallisneria natans* benefits from its well-developed root system, which enables it to access nutrients directly from the soil. The combination of BioCord SP-100 with plants species also improved water quality.

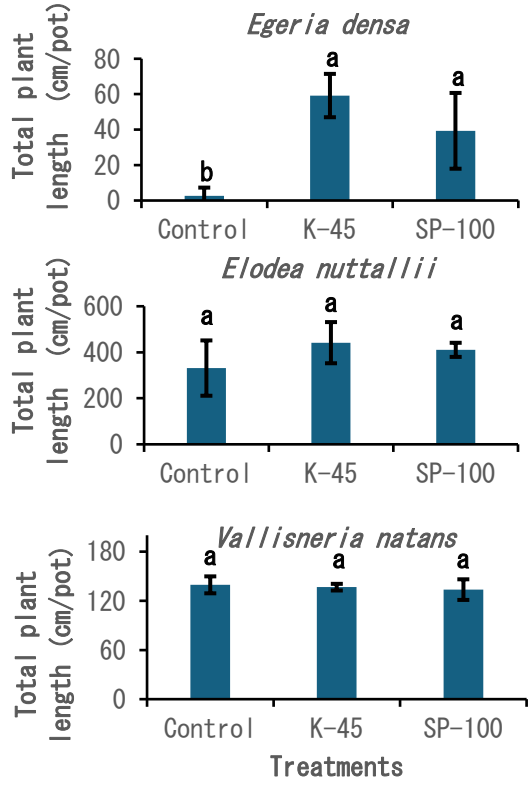

Figure1: Growth response of *Egeria densa*, *Elodea nuttallii*, and *Vallisneria natans* under different BioCord treatments.

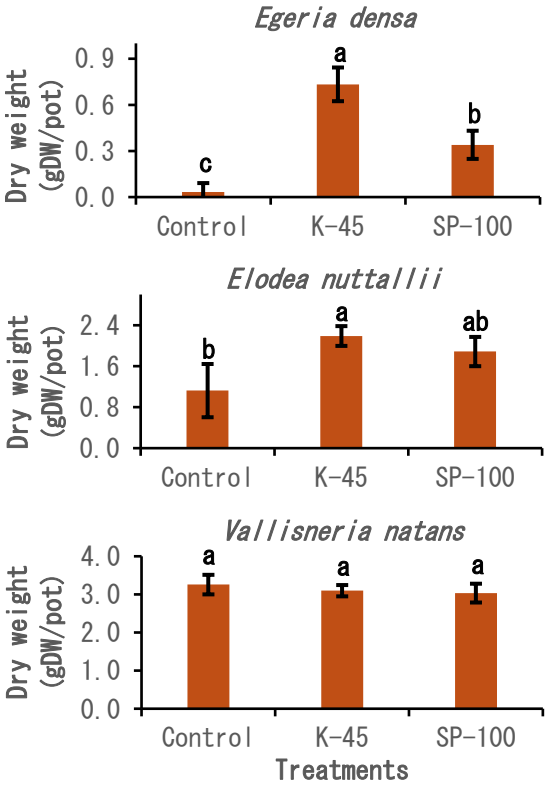

Figure 2: Dry weight dynamics of *Egeria densa*, *Elodea nuttallii*, and *Vallisneria natans* under different BioCord treatments.

4. Conclusion

Ribbon-shaped contact materials offer an effective solution for supporting the growth of submerged aquatic weeds, particularly *Egeria densa* and *Elodea nuttallii*, with significant potential for bioremediation. While BioCord SP-100 provides stable anchorage, it did not outperform K-45 in supporting growth overall. For *Vallisneria natans*, which has a well-developed root system, both BioCord treatments provided less growth support compared to the control. These results could help transform invasive aquatic weeds into resources for water purification and ecological restoration.

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