Title: Effects of temperature on plant growth and arsenic removal efficiency of *Pteris vittata* in purifying arsenic-contaminated water in winter: A two-year year-round field study

Author Names: Yi Huang-Takeshi Kohda, Keisuke Miyauchi, Farzana Rahman , Haruki Naruse , Mitsuaki Mito , Nobuyuki Kitajima , Mei-Fang Chien , Ginro Endo , Chihiro Inoue

Abstract: Phytoremediation is a cost-effective and eco-friendly alternative method for arsenic (As) contaminated water treatment. This study conducted a two-year year-round field study (cycle1 and cycle2) in a temperate area (Sendai, Japan) using small As-hyperaccumulator Pteris vittata seedlings to reduce pre-cultivation time and associated costs. The number of seedlings was changed from 256 in the cycle1 period to 165 in the cycle2 period to evaluate the As removal efficiency of *P. vittata* for As-contaminated water in field conditions with different plant densities. Before the winter season, with continuously increasing fronds, rhizomes, and roots growth, this reduction did not affect the plant's As removal efficiency for As-contaminated water to decrease the As concentration from 30 μg/L to the environmental quality standard for As in water, set at 10 μg/L in Japan. During the winter season, we found that cold weather caused *P. vittata* to wither and release the accumulated As into water without a greenhouse (cycle1). In the meantime, the bioaccumulation factor (BAF) and the translocation factor (TF) values for fronds of *P. vittata* decreased (BAF for fronds: from 66,089 to 8,460; TF for fronds: from 13.4 to 3.4). On the other hand, with greenhouse protection (cycle2), *P. vittata* did not severely wither and kept accumulating As. Moreover, BAF and TF values for fronds of *P. vittata* increased (BAF for fronds: from 24,372 to 36,740; TF for fronds: from 5.2 to 17.2). Maintaining the air temperature inside the greenhouse, particularly around the rhizomes, above 0 °C may be the reason why *P. vittata* remained alive and functional during the cold winter. These results indicate that a single-layer polyethylene greenhouse was sufficient for the tropical-subtropical As-hyperaccumulator fern *P. vittata* to survive the cold winter and snow in the temperate area, enabling year-round phytoremediation treatment of As-contaminated water in the open field.

Keywords: Phytoremediation, Arsenic contamination, *Pteris vittata*, Hyperaccumulator fern, Greenhouse protection, Bioaccumulation factor (BAF), Translocation factor (TF), Temperate climate, Water treatment, Field study

https://www.sciencedirect.com/science/article/abs/pii/S004565352401796X
https://doi.org/10.1016/j.chemosphere.2024.142902