Aqua-Arsenic Remediation: Analysis of the Oryza sativa metagenome and Wet-Lab Approach to increase O. sativa Tolerance to Drought and Arsenic Through Hyper Expression of Aquaporin OsNIP2;1, OsNIP3;2, OsPIP2;2 genes (Year IV)

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According to the US Department of Agriculture, drought decreases the crop yield of rice, the most common source of nutrition worldwide, by nearly 18%. Coupled with arsenic contamination in the soil, total rice yield is reduced by over 40%, and the World Health Organization reports that arsenic contamination threatens the livelihoods of over 150 million people worldwide. Existing solutions focus on either drought or heavy metal remediation, but not both. Examination of the Oryza sativa metagenome via the National Center for Biotechnology Information (NCBI) database revealed promising candidates within the aquaporin gene family capable of efficiently mitigating both arsenic toxicity and drought stress. Rice cotyledons were genetically augmented with arsenic-resistant OsNIP2;1 and OsNIP3;2 genes, and drought-resistant OsPIP2;2 genes both individually and in combination. In moderate drought conditions and 25 ppm arsenic-contaminated soil, transgenic plants were observed to have length and color similar to the positive control plants, corroborated by chlorophyll content. In contrast, the non-transgenic plants were much shorter in length and appeared wilted. After eight weeks, the roots of the transgenic plants contained more than 20 ppm arsenic, but arsenic was undetectable in the leaves due to decreased arsenic translocation from root to shoot. In addition, the soil arsenic content showed an 80% decline from a 25 ppm baseline to 5 ppm with transgenic rice plants. Statistical significance was proven using two-sample T Tests. Thus, aquaporin-augmented O. sativa offers a promising solution to mitigate both arsenic and drought stress in rice plants, improving crop yield and facilitating soil decontamination.

Awards Won:
Third Award of $1,000
Long Island University: Presidential Scholarships
The University of Texas at Dallas: Scholarship awards of $5,000 per year, renewable for up to four years