Radionuclide Waste Disposal: Impact of Plants on Flow, Transport, and Potential Uptake of Uranyl-phosphate in the Vadose Zone

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Radionuclide contaminants are common in the environment and the effects of plants on the fate and transport of these contaminants has not been well studied. This research aims to determine the flow and infiltration of water in the vadose zone and understand the fate and transport of uranium with interaction of plant roots and their exudates in a water stressed environments. Benchtop experiments using three 2D tanks, uniformly packed with ASTM sand, were performed. Uranyl-phosphate, doped with U235, were placed in the tank. The plants in question of species A. virginicus were planted at the surface of two tanks, allowing their roots to spread to the radionuclide source. One tank containing A. virginicus was water stressed while the other was not. The 2D tank light transmission method was created using a flow-through tank with transparent faces. A LED light and CMOS DSLR Nikon D5500 camera were used to photograph the flow patterns. The photographs were converted from RGB into HVI and analyzed in Matlab to quantify the flow patterns and water saturation distribution. Radionuclide transport was monitored using an automated gamma scanner and NI LabVIEW 2015. Effluent was captured and analyzed using an ICPMS. Data generated will provide information on the fate and transport of uranium, the preferential flow phenomena, and the infiltration process in plant-water-sand porous media systems.