CFAES

SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

GRADUATE EXIT SEMINAR

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Ability of Soil Properties and Soil Extraction Methods to Predict Phytoavailability and Bioaccessibility of As, Cd & Pb

Naturally occurring levels of heavy metals in soils coupled with anthropogenic influence has contributed to the accumulation of heavy metals in some regions, which has led in their concentrations exceeding natural levels, resulting in soil metal toxicity. As such, there are thousands of sites US (and globe) that contain unacceptable levels of toxic metal(loid)s – As, Cd and Pb – many of which are awaiting remediation and closure. Previous research has shown that the ubiquitous metal-sequestering properties of soil can significantly lower the bioavailability and risk of heavy metals to human and ecological receptors.

The aims of the study were to (i) provide validation that the soil properties and soil extraction methods can serve as a screening tool for estimating toxic metal phytoavailability in contaminated soils, and (ii) provide validation that the relationships between soil properties and *in vitro* bioaccessibility methods can serve as a screening tool for estimating toxic metal bioavailability from incidental soil ingestion of contaminated soils.

Plant bioassays were used performed on both lettuce and ryegrass to determine As, Cd and Pb contamination in 11 study soils. For ecological risk estimates, multiple linear regression and ridge regression models, developed from a ESTCP study that used bioaccumulation data from previous studies, were used to predict metal phytoavailability of the contaminated soils. The measured metal phytoavailability values and the predicted values were then quantified using RSME. Additionally, soil extraction methods were used to estimate metal phytoavailability, and then used to predict plant phytoaccumulation in the study soils. To do this, predictive equations developed using bioaccumulation data from a previous NCEA study were used. RSME was used to compare the measured contamination phytoaccumulation data from the bioassays with the predicted values obtained from the extraction data. The ability of soil properties to predict in vitro gastrointestinal methods was also examined. Predictive equations used to predict %IVBA Pb and As from soil properties were assessed. Their accuracy in predicting %IVBA Pb and As was quantified again using RSME.

The results showed that RSME values obtained from the RR and MLR models for As, Cd and Pb plant tissue data all fell below the acceptable <25% limit. This indicated that the predicted and measured values were similar. Therefore, soil properties can be used as screening tools for estimating toxic metal phytoaccumulation in contaminated soils. Based on the extraction data obtained, calcium nitrate extractions may be used as a predictive extraction method for Pb tissue uptake in lettuce as the RSME value 23.6%. Porewater and calcium nitrate extractions may be used to predict Cd uptake for ryegrass as the RSME values were 12.4 and 10.1%, respectively. As uptake in lettuce and ryegrass may be predicted using both Mehlich 3 and porewater extractions all the RSME values were <10%. Hence, soil extraction methods may serve as screening tools for metal phytoaccumulation in plants. However, the plant species and extraction method may impact the accuracy of the predicted data obtained. Soil properties may be used to predict IVBA Pb and IVBA As in soils, depending on the source of Pb and As contamination. When the predicted and measured %IVBA Pb values were compared, the RSME obtained was 9.22%. For As, the calculated RSME was 27% when all soils were included, however, this decreased to 18.03% when the Deseret soil was excluded.

Ultimately, based on the accuracy of the predictive equations used in this study, the goal is to use this information to design soil amendments based on soil properties for future work.

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FRIDAY, JULY 16, 2021
1:00 P.M. EST

Join the seminar via Zoom:
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