

**Predicting crop root depth for improved nutrient and water acquisition and carbon sequestration  
using handheld X ray fluorescence**

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Maize is one of the world's most important crops, accounting for 39 million hectares of land in the US alone. Increasing the root depth of maize will sequester more carbon in the soil while also decreasing the need for application of nitrogen fertilizers and water, as these are generally available in deeper soil layers. Identifying maize lines that have deeper roots is and has been difficult, laborious, and time consuming. Current methods to measure root-depth in the field include digging trenches, using rhizotron-based imaging, and soil coring, all of which require specialized equipment and can only be completed with low throughput. We are developing a method using handheld X-ray fluorescence technology to analyze leaf elemental content and correlating these measures with root depth in the field. This technology, LEADER (leaf elemental accumulation from deep roots), relies on natural gradients of elements and their availability in soil to determine root depth based upon the accumulation and ratios of these elements in leaf tissue. Using a set of maize lines differing in root depth planted at four sites across the US, we can predict metrics of root depth using multivariate modeling of XRF output. We will be deploying this on larger populations to enhance breeding for deeper roots. Though XRF has been used in agriculture to measure plant nutrition, this is the first application related to root traits.