DEEPER is a multiplatform phenotyping and technology effort to discover traits and genes resulting in deeper rooted maize cultivars that are better at obtaining water and nitrogen under limiting conditions. We are advancing current technologies and software, including laser ablation tomography (LAT), xray fluorescence, DIRT3D, and SimRoot, and developing new technologies, including RootRobot, to advance and improve phenotyping. Information about traits and genes will be incorporated into genomic selection models to produce elite lines with deeper roots.

**Architectural and anatomical root trait discovery via field work and in silico modeling in SimRoot.** Root anatomical traits captured via laser ablation tomography in 3D and analyzed via machine learning algorithms in RootScan3D.

**LEADER (leaf elemental accumulation for deep roots)** uses handheld xray fluorescence technology to identify deep rooted cultivars in the field in less than two minutes.

**DeepGenes** incorporates genes and traits into genomic selection models, resulting in maize lines with deeper roots.

**Trait Discovery**
- Comparison of contrasting phenotypes in multiple environments: in silico, multiple field sites, N stress, water stress.

**Phenotyping Traits Regulating Root Depth**
- LAT 2.0: high throughput imaging of root anatomy and composition.
- RootScan3D: software for 3D analysis of root anatomy and composition.

**Phenotyping Root Depth**
- Field phenotyping of root depth.
- Nondestructive.
- 2 min/plant.
- Portable.

**RootRobot/Dirt3D**
- RootRobot: automatic excavation and imaging of root architecture in the field.
- DIRT3D: software for automated 3D analysis of root architecture.

**SimRoot/deep**
- Model interaction of root anatomy and architecture with deep rooting.
- Ideotype generation and testing.

**New maize lines with deeper rooting**