Using RGB and Hyperspectral Data to Determine Effects of Cadmium on Six Different Carrot Breeding Lines in the Ag Alumni Phenotyping Facility

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Carrot (*Daucus carota* L.) is a hyperaccumulator of toxic heavy metals like cadmium, taking up and storing high concentrations in the taproot. Cadmium is toxic in very small concentrations in edible plant parts, translocated there from contaminated soils. Cadmium poisoning in humans is strongly linked to damage to the liver, lungs, and bones, as well as prostate, kidney, pancreatic, and testicular cancer. Cadmium has also been shown to be detrimental to carrot plant growth and nutrient content.

We chose 6 different carrot breeding lines shown in previous trials to differ in their ability to hyperaccumulate heavy metals. Carrots were grown in the AAPF (Ag Alumni Phenotyping Facility) growth chambers. Carrots were either treated with CdCl2 (cadmium chloride) or control, and grown in a mix of 1/3 sand, 1/3 field soil, 1/3 potting media. Plants were imaged with RGB cameras and hyperspectral imaging throughout their growth, then destructively harvested after 2 months and prepared for heavy metal analysis.

Results include hyperspectral data including several vegetative indices and reflectance values often used to detect stress, and RGB images and color values (potentially indicating differences in the health of the plant). Heavy metal concentrations in carrot leaves and roots were also estimated using ICP-OES.

Carrot breeding lines differ in their tendency to hyperaccumulate cadmium in their roots, which is promising for breeding efforts. Phenotyping technologies detecting cadmium stress may be useful in determining stress response to heavy metals. In the future, growers may be able to select cultivars less likely to accumulate cadmium.