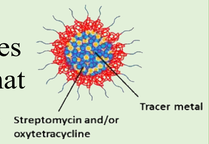
Testing nano-enabled carriers for efficient delivery of Oxytetracycline and Streptomycin to prevent citrus greening disease in citrus plants

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Introduction

- Huanglongbing (citrus greening) has infected nearly 100% of commercial citrus trees in Florida and caused a 74% decline in production.
- Antibiotics have proven to be effective in treating the disease, but currently there is no efficient way to deliver them.
- We are testing nanoparticles with a core shell structure that contains an antibiotic and tracer metal.
- Using a rare metal for tracing allows us to easily identify it through ICP-MS measurements.

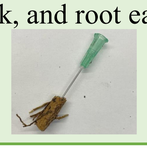


Goals

1. Characterize the size of the particles and determine the effect of chosen surfactant (silwet) on the particle size.
2. Develop an accurate method to measure the tracer metal in the testing particles.

Methods

1. Dynamic light scattering measurements were taken with particles to determine the effect of silwet on particle size. Control and fluorescent samples were tested, both with and without silwet. Two particles were tested: hydroxypropyl methylcellulose acetate succinate (HPMCAS) and lecithin (LEC).
2. Initial Gadolinium tests were completed using ICP-MS after drying, combustion, and acid digestion of the samples. Leaf, root, and trunk samples were taken to determine if we would extract all the tracer metal from each organ. 40 µL of Gd solution were applied to the leaves, trunk, and root each.

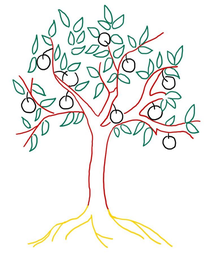
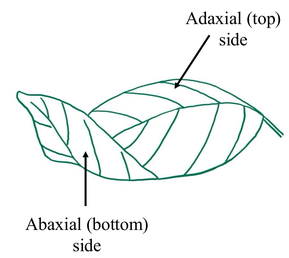

Results

Tracer Metal Extraction Assessment

- Table 1 shows the expected Gd concentration and the measured concentration between two digestion methods, nitric acid and peroxide and aqua regia.
- Figure 1 shows the expected and measured Gd concentration of each plant organ.
- Figure 2 shows the percent yield when compared with the control values. The control value using Aqua Regia (AR) was lower than that of nitric acid and peroxide.

Table 1: Control values of Gadolinium concentration.

	Expected Gd concentration (ppb)	Actual Gd concentration avg (ppb)
Nitric Acid Control	160	101.4 ± 1.1
Aqua Regia Control	160	88.5 ± 4

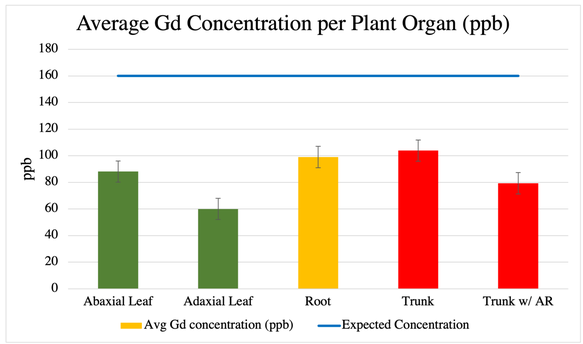


Figure 1: Avg. Gd Concentration for leaf, trunk, and root. All digestions were used with nitric acid and peroxide except the trunk with AR.

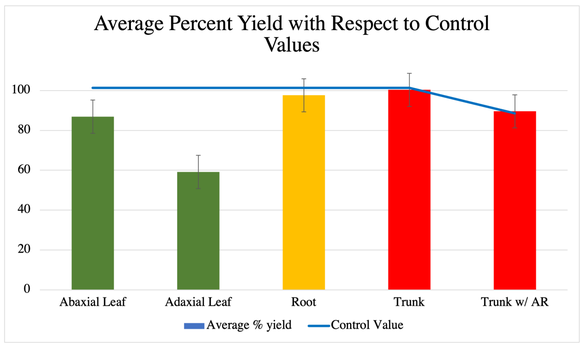


Figure 2: Avg. percent yield with respect to control values for leaf, trunk and root. All digestions were done with nitric acid and peroxide except the trunk with AR.

Particle Size Variation

- Samples were measured in triplicates and averaged.
- Z-average and PdI values are included in Figure 3.
- Z-average refers to the size of the particles.
- PdI (polydispersity) refers to the degree of non-uniformity of the particles.

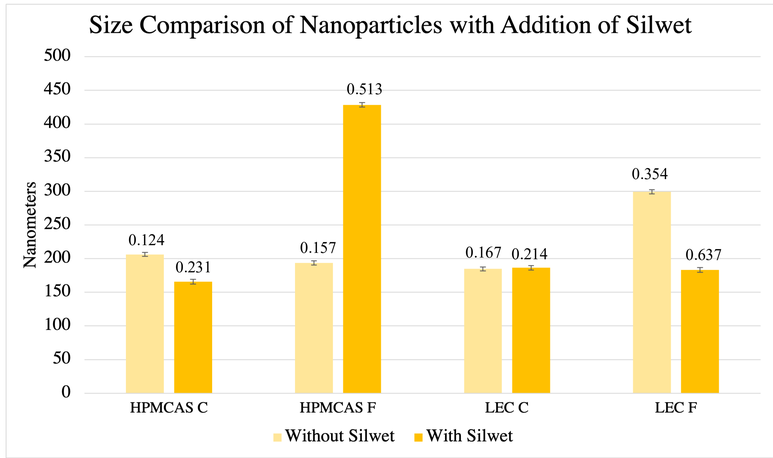


Figure 3: Z-average size comparison of HPMCAS and LEC particles. Decimals above each bar represent the sample PdI.

Conclusions

- When comparing to the control value, we can extract a reasonable amount of tracer metal from the plant with our procedure.
- With our current procedure, we are not able to extract the full concentration expected from the control. The leaves had the lowest yield for extraction, but the likely reason for the lower value of the adaxial leaf is because some volume of sample was lost after the combustion stage.
- Silwet has an effect on the nanoparticle size, making the size significantly larger with the fluorescent HPMCAS particle and smaller with the fluorescent LEC particle. The PdI was also very high for those samples.

Future Work

- The next step is to measure the ability of the particles to travel throughout the plant when applied foliarly. This will be an extended version of previous experiments, measuring the tracer metal concentration with the ICP-MS several days after the particles have been applied.
- Future versions of the particles will have an antibiotic (streptomycin or oxytetracycline) incorporated into the core. We will use an enzyme-link immunosorbent assay (ELISA) to determine the concentration of antibiotic throughout the plant after the nanoparticles have been applied.

Acknowledgments

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