Nanoparticles: Lignification of Wheat with *Pseudomonas chlororaphis* O6 (PcO6)

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I. Introduction
- Wheat production decreases due to many stresses. Drought stress and lodging (Fig. 1), caused by storms and overgrowth, both reduce yield [1]. My previous work showed induction of drought tolerance in wheat by root colonization of PcO6; drought tolerance was maintained when wheat seedlings were grown with CuO nanoparticles (NPs) (Doxey, Biology Undergraduate Research Symposium Dec 2016). The shoots of wheat grown with PcO6 and CuO NPs were more rigid than shoots grown without either treatment. This work examines whether the rigidity in the shoots was due to lignification as well as a higher water content.

- Toluidine Blue O (TBO) and phloroglucinol stain lignin, blue and red respectively [3,4,5]. Consequently, I used these stains to determine whether the lignin content in wheat was increased by growth of PcO6- colonized plants with CuO NPs.

- Increased lignification of shoots could reduce lodging of wheat and decrease pressure under field conditions.

II. Methods
- Surface-sterilized wheat seeds (12) were inoculated with PcO6, planted into sterile sand (300 g) wetted with sterile water (50 ml).
- Sand amended with 0, 10, and 300 mg Cu/kg from CuO NPs.
- Wheat seedlings grown for 7 d (Fig. 2).

III. Results

**Question:** What happens when wheat plants, grown with a beneficial microbe, PcO6, are exposed to CuO NPs?

**Findings:**
- Growth
  - Little variation in shoot growth between treatments (Fig. 3).
  - Plants with PcO6 colonization retained NP-inhibition of root growth (Fig. 3).

- Increased lignification in specific cells
  - Control leaves show lignification in vascular bundles (Fig.4). With addition of Cu from CuO NPs, lignification of sclerenchyma cells increased.

IV. Conclusions
- Cu NPs increased lignification in sclerenchyma cells of the leaves of wheat colonized by PcO6.
- Sclerenchyma provides strength and support to the plant [6]. This induced lignification may explain increased stiffness of wheat shoots when grown with CuO NPs.

V. Future Work
- Improve consistency for tissue preparation for staining with repetition of CuO NP doses, with and without PcO6 colonization.
- Grow plants with Cu ions to look for sclerenchyma lignification.
- Examine differences in lignin composition by FTIR Spectroscopy.
- Quantify lignification by acetyl bromide degradation and assessment.

VI. References


This work was supported by an URCO Grant Spring 2017.