NanoAOX: Localization of Antioxidants via Nanoparticles to Enhance Plant Growth

Jayasankar, Dheiksha (School: Sir Winston Churchill Secondary School)

The global food crisis is an issue affecting 1 billion people worldwide – it is critical that more efficient solutions to food production be developed. Both nanoparticles, molecules <100nm used in drug delivery, and antioxidants, molecules that inhibit oxidation reactions, have been individually studied to enhance plant growth; however, the combined effect has not been investigated. Using hydroponic, tissue culture and hydrogel experiments, this project investigates whether a combined carbon nanoparticle-antioxidant treatment (NP-AOX) has a synergistic effect in enhancing plant growth. Synergy was further confirmed by transmission electron microscopy (TEM) to identify nanoparticle localization patterns. In the hydroponic experiment, NP-AOX showed significant increases in chlorophyll levels, media consumption, and plant weight compared to the control and individual treatments. Tissue culture experiments showed that nanoparticles resulted in long roots, antioxidants resulted in dense roots, while NP-AOX resulted in a combination of both, an optimal result. TEM revealed that antioxidants enabled the delivery of nanoparticles into cell organelles which may have contributed to their enhanced growth. NP-AOX also increased soil moisture levels in the hydrogel experiments. Using NP-AOX is economically feasible, costing less than $0.03/L while conventional fertilizers will cost over a dollar for the same effects. The NP-AOX treatment can boost food production, decreasing the need for imports, and reduce the environmental impact of fertilizers, with particular benefits in communities combatting food insecurity due to conditions such as permafrost and drought.

Awards Won:
Fourth Award of $500