Effect of ZnS and ZnS: Mn nanomaterials on Germination Percentage of *Lactuca sativa*

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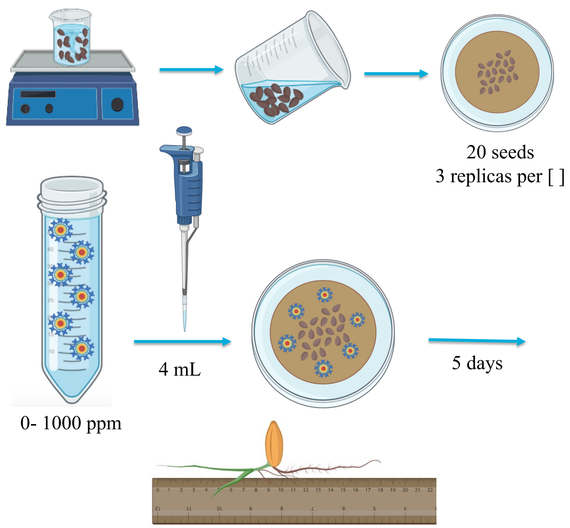
Abstract

Nanoparticles have the potential to be used in broad applications nowadays. One of these fields is Agriculture. Improving plant production safety is a primary concern in sustainable horticultural crop production systems. Semiconductor quantum dots have shown potential for increase crop yield and to provide an environmentally friendly alternative. Quantum dots might be used in plants as nanofertilizers. They are being studied as an alternate route to inorganic bulk fertilizers. Nanoparticles are, likewise, able to expand crop production and biomass in plants. Nonetheless, in large amounts, these can be toxic. *Lactuca sativa*, will be exposed to pure ZnS and Mn-doped quantum dots synthesized with a reflux system.

Objectives

- Compare the percentage of germination in *Lactuca sativa* between ZnS and Mn-doped ZnS stabilized.
- Evaluate the growth of hypocotyl and radicle of *Lactuca sativa* at concentrations of 0 - 1000 ppm.

Methodology



Results

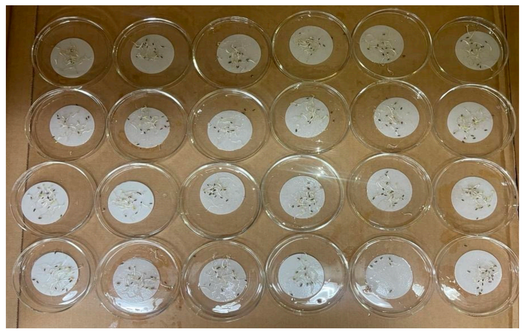


Fig 1: Petri dishes for the different concentrations with the germinated seeds after 5 days of exposure to pure and Mn-doped ZnS nanoparticles.

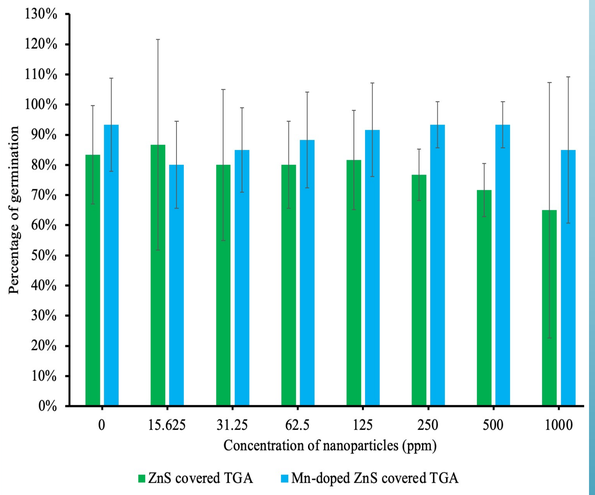


Fig 2: The germinated percentage of pure ZnS nanoparticles decreased significantly on concentrations above 125 ppm. The quantity of germinated seeds exposed to Mn-doped ZnS nanoparticles increased, in exception to 500 ppm.

Results

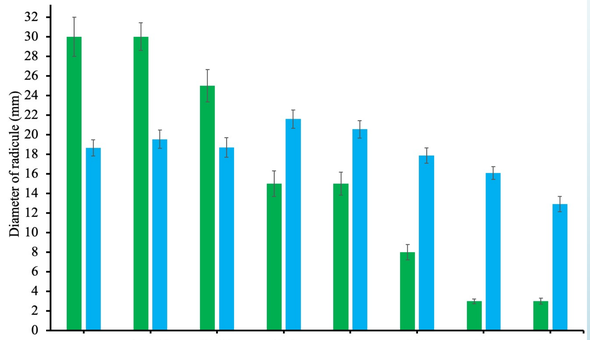


Fig 3: Radicle length of the seeds exposed to pure ZnS nanoparticles stayed constant at 15.625 ppm and continued to decrease as the concentration increased. Meanwhile, lettuce plants exposed to doped nanoparticles showed to have an increment of growth at 62.5 ppm and then also decreased with larger concentrations.

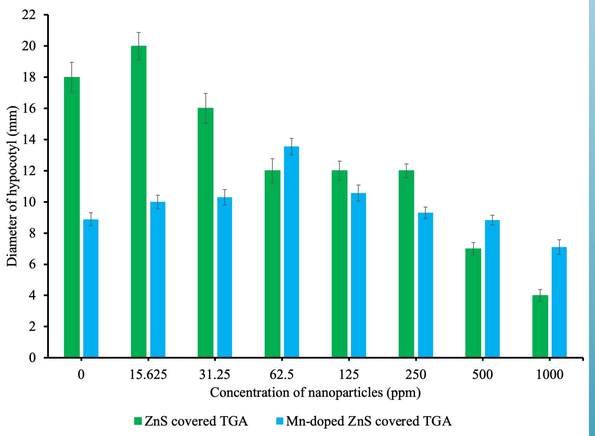


Fig 4: ZnS nanoparticles had an increment of the hypocotyl's growth at 15.625 ppm. Larger concentrations caused the hypocotyl to grow less. The Mn-doped nanoparticles incremented the length of the hypocotyl until 62.5, it then decreased as well.

Conclusion

- In concentrations bigger than 62.5 ppm, the quantity of germinated seeds and length of the hypocotyl and radicle decreases.
- Nanoparticles promote seed germination, but in high concentrations induce phytotoxic effects in the physiological processes of the seedlings.

Ongoing Research

- Perform germination percentage with the salts of each nanoparticle.
- Use a different nanoparticle exposition method to the seeds.
- Use lower nanoparticle concentrations and different seeds.
- Expose *Lactuca sativa* to various nanoparticle concentrations until reaching full growth.

Acknowledgements

We want to greatly acknowledge the University of Puerto Rico at Mayagüez, University of Puerto Rico in Ponce, Puerto Rico Louis Stokes Alliance for Minority Participation (Grant # HRD-1906130), National Science Foundation, and LINC Laboratory.