Nanoparticles for Sustained Agrochemical Release

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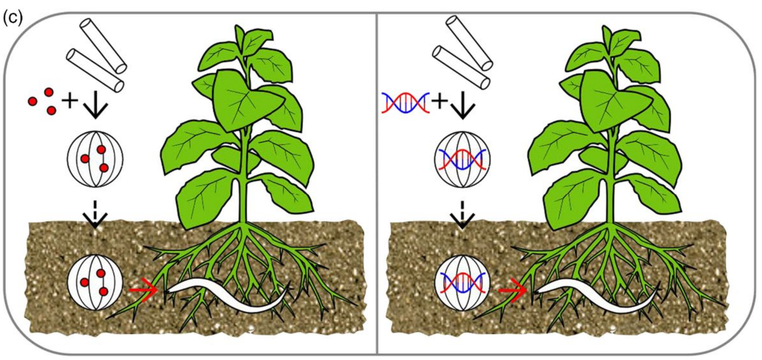
Abstract

Pesticides are currently the primary solution towards eliminating phytoparasitic nematodes, agriculturally harmful roundworms. Excess treatment creates unfavorable side effects though, such as toxic run off and pesticide poisoning. Previous studies have shown that Tobacco Mild Green Mosaic Virus (TMGMV), a nanoparticle, encapsulates and protects RNA from soil before entering nematodes. Another method of encapsulation and delivery is through ZRC10ZR and EGFPZE protein supraparticles. The purpose of this study is to compare how well two different encapsulation methods flow through soil, as nematodes often reside deep in the ground. Escherichia Coli (E. Coli) was transformed to produce EGFPZE and ZRC10ZR. After protein extraction and purification, supraparticles were formed and their soil mobility was compared to TMGMV nanoparticles. Particles were assessed for their mobility, and TMGMV has a better elution profile than water.

Background

- Nematodes destroy $157 billion U.S. crops yearly, thus current pesticides must be improved. Excess pesticides enter local water sources and distributors' lungs, causing internal damage.
- TMGMV is an RNA encapsulating viral nanoparticle that can eliminate nematodes through oral uptake.
- ZRC10 supraparticles are artificial structures that can encapsulate proteins and immobilize nematodes, but their soil mobility levels are not yet known.
- Hypothesis: ZRC10ZR supraparticles will have similar soil mobility rates compared to TMGMV nanoparticles.

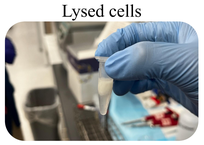


TMGMV nanoparticles

Experimental Methods

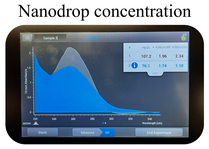
DNA Purification

Lysed cells



DNA solution

Nanodrop concentration



Bacteria Cultivation

Bacteria Media

Bacteria Colonies

Incubation Prep

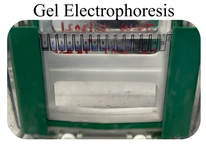
Protein Purification

Buffer + Bacteria

Sonication

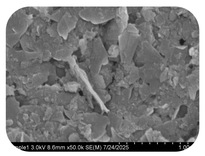
Nickel Column

Gel Electrophoresis

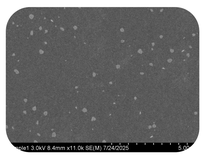


Particle Synthesis

TMGMV Particle

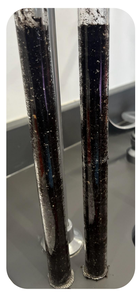


TMGMV Spherical Nanoparticles

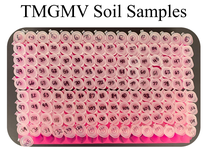


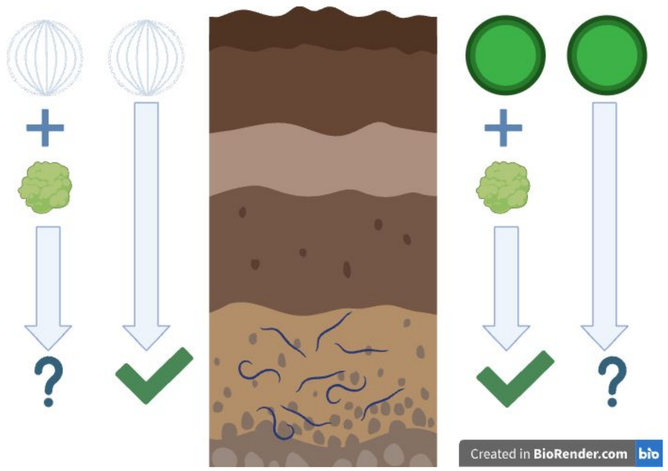
Soil Mobility Comparison

Soil Column

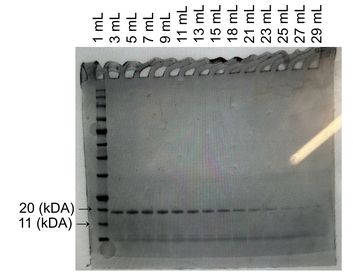


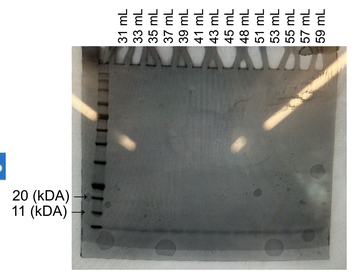
TMGMV Soil Samples





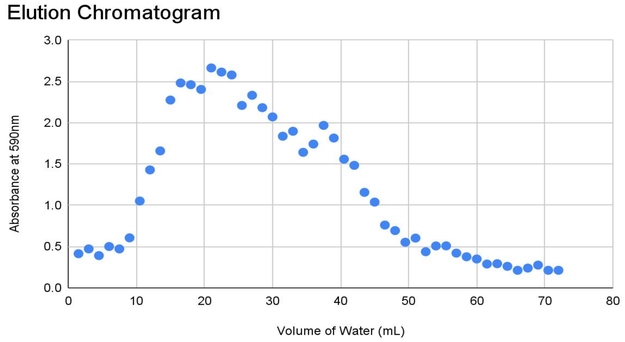
Results



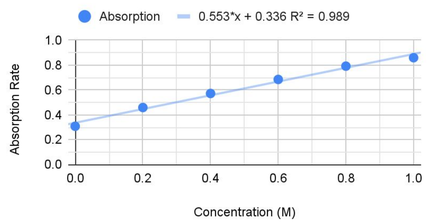


TMGMV Gels

Elution Chromatogram



Bradford Calibration Curve



Conclusion and Future Steps

Our data shows that TMGMV nanoparticles have a faster elution profile than water, implying that it will come in contact with the nematodes quicker. We are currently working on testing our supraparticles and expect to have results soon. The next steps will be to A) create a protein toxic to nematodes but not to other organisms, B) encapsulate the protein, C) measure the elution profile of the supraparticle, and D) determine if nematodes are harmed by the particle. This encapsulation process through coat proteins has been seen in not only agricultural settings, but also medicinal settings. Various vaccines use coat proteins to encapsulate desired molecules. If executed correctly, this pesticide could help the international nematode issue.

References

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Acknowledgements

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