



CHEMISTRY/PHYSICS SEMINAR SERIES

Dr. Ruby Sullan

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Wednesday, October 14, 2026

11:00 a.m. to 11:50 a.m. in ENW 115

How Nanoscale Interactions Influence Plant-Microbe Partnerships

ABSTRACT

Beneficial bacteria can support plant growth and health, but these benefits depend on their ability to attach to and colonize root surfaces. The chemical and physical interactions governing these early encounters can also be altered by environmental contaminants such as nanoplastics. In this talk, I will present our work examining the nanoscale interactions that support plant-microbe partnerships, how nanoplastics disrupt them, and potential approaches to reduce these effects. Using atomic force microscopy and fluorescence imaging, we examine how individual bacterial cells attach to different regions of plant roots. These measurements reveal differences in attachment frequency and strength, highlighting the contributions of both bacterial and root-surface properties to early colonization. I will also introduce ORBIT (One-step Root-Bacteria Interaction Tracking), a root-on-a-chip platform developed in our laboratory to observe bacterial attachment and early colonization in real time under controlled flow. I will then discuss how positively charged polystyrene nanoplastics form coatings on beneficial bacterial cells, reduce viability and biofilm formation, and impair root colonization, with effects that vary across growth conditions. Finally, I will present our work exploring biochar as a means of immobilizing nanoplastics and reducing their availability and toxicity to bacteria. Together, these studies connect surface chemistry and nanoscale forces with processes at plant roots and highlight opportunities to protect beneficial microorganisms from environmental contaminants.

BIOGRAPHY

Dr. Ruby Sullan is an Associate Professor of Chemistry in the Department of Physical and Environmental Sciences at the University of Toronto Scarborough, where she leads the Nano-Bio Interactions Lab. She earned her BSc from the University of the Philippines and her PhD from the University of Toronto, both in Chemistry. She completed postdoctoral research at JILA at the University of Colorado Boulder, Université catholique de Louvain in Belgium as a Marcel de Merre Fellow, and the Max Planck Institute of Colloids and Interfaces in Germany as an Alexander von Humboldt Fellow. Across these roles, she used force measurements to study model membranes, DNA and proteins, and to understand how bacteria attach to surfaces. Since joining U of T in 2017, she has combined nanoscale measurements and materials chemistry to investigate bacterial interactions with materials and living surfaces. Her research spans antimicrobial materials, environmental nanoscience and plant health. She was named a Cottrell Scholar in 2021.