UNIVERSITY OF DELAWARE
ENGINEERING
DEPARTMENT OF CHEMICAL & BIOMOLECULAR ENGINEERING

DEPARTMENTAL SEMINAR

GÖZDE DEMIRER

University of California, Berkeley

Monday, February 10, 2020 | 10:00 AM
366 Colburn Lab

Gözde S. Demirer is a PhD candidate in the department of Chemical and Biomolecular Engineering at the University of California, Berkeley. She received her B.S. in Chemical and Biological Engineering from Koc University, Turkey, as the 2015 valedictorian, where she worked on the advancement of cancer therapeutics by targeted nanoparticles for drug delivery. She has also held interim student and researcher positions at Stanford University and at the University of Pennsylvania. Demirer's current PhD thesis research in the Landry lab pioneers the development of nanoparticle-based delivery vehicles for plant genetic engineering applications for food security and advances in sustainable agriculture. She has been awarded a 4-year Schlumberger Foundation Faculty for the Future fellowship in 2016, and she is expected to graduate in May 2020. Demirer was recently selected as one of MIT's ChemE Rising Stars, for the ACS Merck Research Award, and for Women's Initiative Committee's Travel Award. She has also won the Carbon Nanomaterials, and Bionanotechnology Graduate Student Award Sessions at AIChE 2017, 2018 and 2019 annual meetings. She has authored over 10 peer-reviewed publications and is a co-inventor on 2 patents, including the first nanomaterial-based gene delivery platform for GMO-free agricultural biotechnologies. Demirer is interested in advancing her academic career as an independent researcher and educator, and she is eager to solve critical life sciences problems using engineering principles.

NANOMATERIAL PLATFORMS FOR TRANSGENE-FREE PLANT GENETIC ENGINEERING

Food security is threatened by increasing consumption and decreasing crop yields amid population growth and climate change. To mitigate these threats, genetic engineering of plants can be employed to create crops that have higher yields and nutritional value, and are resistant to biotic and abiotic stresses such as diseases and drought. Despite recent progress in the genome editing field, most plant species remain difficult to genetically engineer due to the rigid plant cell wall with a strict size exclusion limit that challenges efficient biomolecule transport into plant cells. The current workhorse method of DNA delivery to plants limits the range of transformable plant species and results in uncontrolled transgene integration, hence eliciting regulatory review of edited plants as genetically modified organisms (GMOs), which is lengthy and costly. Therefore, the development of a delivery tool that is non-pathogenic, non-integrating, and species-independent will greatly advance agricultural biotechnology. In this seminar, I present the development of a nanomaterial platform that can efficiently deliver genes into both model and agriculturally-relevant crop plants, without mechanical aid, in a non-toxic and non-integrating manner; a combination of features that is not attainable with existing plant transformation approaches. I discuss how single-walled carbon nanotubes can be chemically modified to both load and deliver DNA to plant cells for expression of functional proteins in various plant species including tobacco, arugula, wheat, and cotton. Efficient delivery and transient expression of plasmid DNA is achieved in mature plants, notably without transgene integration into the plant genome, a feature that could assuage regulatory oversight of the transformed plant as a GMO. This seminar also elucidates the underlying principles of nanoparticle transport across the plant cell wall. I discuss the effect of nanoparticle physiochemical properties (size, shape, aspect ratio and stiffness) on plant cell uptake, which we systematically investigate by leveraging the facile programmability of DNA nanostructures. Importantly, the identification of optimal nanomaterial parameters for maximum plant cell uptake enables rational design of nanomaterials. These developments demonstrate the unique abilities of nanomaterials to address the main bottlenecks of plant genetic engineering for a sustainable future with food security.