Outbreaks: Tackling Emerging Plant Diseases that Threaten Food Security

January 10, 2020
1-7PM
Ocracoke Room, Talley Student Center

NC STATE UNIVERSITY Global Food Security

Sponsored by the Chancellor's Faculty Excellence Program at NC State University

Emerging Plant Disease and Global Food Security

Agenda

1:00 - 1:10 Welcome, *Dr. Jean Ristaino*

1:10 - 1:20 Opening remarks, *Dr. Warwick Arden, Provost NC State University*

1:20-1:40 Digital innovation to tackle the global threat of late blight, *Dr. Jean Ristaino*

1:40-2:00 New approaches for rapid response to plant disease threats, *Dr. Anna Whitfield*

2:00-2:20 Landscape forecasting of plant diseases and their effects *Dr. Robert Scheller*

2:20-2:50 AgBio sensors: Opportunities and progress, *Dr. Qingshan Wei, Yong Zhu*

2:50-3:40 Poster session and coffee break

3:40-4:00 The challenges of cassava viruses in East Africa, *Dr. Trino Ascencio-Ibáñez*

4:00-4:20 Economics of plant disease management using Technological Innovation, *Dr. Kelly Zering*

4:20-5:20 Smart surveillance and mitigation for plant diseases that threaten food security *Dr. Karen Garrett, University of Florida*

5:30-6:00 Reception

6:30-7:30 Dinner

Posters

	Presenter	Poster Title
1)	Oliver Baars	Induced tomato root exudates with triple roles: Phytoalexins, nutrient-dissolution, and
2)	Yuting Chen	Identify viral determinant of tomato spotted wilt virus (TSWV) transmission by thrips
3)	Evangelista Chiunga	SEGS-2 encodes a protein that interacts with CPI1 and WOX13 proteins to impact the host
4)	Kimberly D'Arcangelo	Investigating the genetic structure of *Pseudoperonospora cubensis* populations after
5)	Anna Dye	Synergism between Tomato yellow leaf curl virus and Tomato mottle virus affects plant host
6)	Jinlong Han	Transcriptomic response of *Frankliniella occidentalis* guts to tomato spotted wilt virus
7)	Ordom Huot	Developing transgenic vectors of maize Rhabdoviruses
8)	Leo Kerner	The effects of MMV infection on *P. maidis* host plant preference
9)	Hannah McMillan	Bacterial vesicles: Double agents for plant defense
10)	Rajesh Paul	Plant DNA extraction by microneedle patch for rapid detection of plant pathogens
11)	S. Priya Rajarapu	Sex specific salivary gland proteome of a thrips vector
12)	Amanda Saville	Global spread of the famine lineage of *Phytophthora infestans*
13)	Laura Tateosian	Text mining to track historical late blight outbreaks

Keynote Speaker

Dr. Karen Garrett, Plant Pathology Department, Institute for Sustainable Food Systems, and Emerging Pathogens Institute, University of Florida

Smart surveillance and mitigation for plant diseases that threaten food security

Resource limitations and economic constraints are always a factor for managing plant diseases. This talk will address three aspects of strategy formulation. (1) Effective altruism offers an ethical lens on research priorities, including identification of key stakeholders, pathosystems, and topics to provide the greatest possible benefit. This framework can also help to address the potential 'tragedy of the microbiome commons' in which the decisions of many disease managers combine to determine (or undermine) the success of regional management. (2) System models and scenario analysis can also support strategies for regional disease management. For example, seed systems are a key factor for the spread of improved disease-resistant varieties through disease-free planting material but are also a risk factor for the spread of disease. A compromise between these two considerations is needed, and systems analysis can help to formulate strategies for a good compromise. (3) Integrating disease surveillance in a global system is proposed and offers many advantages for better management within and among countries. A global system can support both improved information spread and model use, as well as capacity building for epidemiology and risk modeling. More information about our work on these components is available at garrettlab.com.

Speaker Abstracts

Dr. Jean Ristaino: Digital innovation to tackle the global threat of late blight

Phytophthora infestans, the causal agent of potato late blight was responsible for the Irish potato famine and is still a threat to food security globally. We have developed a disease surveillance and mapping system called USAblight.org to report disease outbreaks in the USA and alert stakeholders. The US populations are dominated by the largely mefenoxam sensitive US-23 clonal lineage. We identified and tracked the spread of the historic FAM-1 lineage of *P. infestans* using multilocus genotyping, next generation sequencing, geospatial analytics, and data mining methods. The FAM-1 lineage caused both US and European historic outbreaks, shared allelic diversity and grouped with the oldest samples collected in Colombia, and formed a genetic group that was distinct from more recent aggressive lineages. We are developing novel detection technologies and combined with tree-based phylogenetics, these tools will help us respond to and mitigate outbreaks, improve deployment of host resistance, and inform policy.

Dr. Anna Whitfield: New approaches for rapid response to plant disease threats

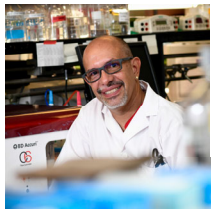
Our goal is to develop insect-transmitted virus systems for gene expression, gene silencing, and genome editing in maize that allow rapid and transient modification of traits to avert threats to growing maize crops. Developing plants with improved resistance to biotic and abiotic threats using current molecular breeding and genetic modification strategies is effective, but requires years to accomplish, and resistance genes generally suppress yield. We will employ engineered viruses introduced by insect transmission. The key technical challenges are: 1) to identify virus systems and develop virus clones that allow stable expression of large (>4 kb) and multiple genes; 2) to develop insect vectors that efficiently and specifically acquire and transmit the modified viruses, but can be quickly removed after delivery; 3) limiting the spread of modified viruses in a mixed host system; and 4) modifying maize phenotypes at relevant developmental stages. While the technical challenges are large, the payoffs for developing the system are large, and will greatly facilitate our understanding of virus, vector and maize biology while producing an advanced system for modifying agronomical traits in a major crop.

Dr. Robert Scheller: Landscape Forecasting of Plant Diseases and their Effects

Landscape forecasting of plant diseases and their interactions with management and disturbance is now sufficiently advanced to allow learning about the future that can inform multi-scale decision-making. The combination of data integration, powerful forecasting software, and ready access to computational resources allows both near and far-future forecasting of the potential effects of plant diseases (and other mortality agents) including the decline of food security and loss of ecosystem services. I will provide examples of how this suite of technologies is being used to reimagine forestry nationwide, given an unprecedented wave of novel insects and diseases that threaten forest health. However, formidable challenges remain, including climate uncertainty, the integration of advanced forecasting into local decision-making frameworks, and human response to changing landscapes.

Dr. Qingshan Wei, Yong Zhu: AgBio sensors: Opportunities and progress

Crop diseases caused by pathogenic microorganisms pose severe threats to the global food supply. Effective diagnostic tools for timely determination of plant diseases become essential to the assurance of agricultural sustainability and global food security. Nucleic acid- and antibody-based molecular assays are gold standard methodologies for the diagnosis of plant diseases. However, conventional analysing procedures are complex and laborious. Recently, cost-effective and field-portable diagnostic tools are emerging. Miniaturized molecular diagnostic assays combined with portable sensor devices (e.g., smartphones) have paved the way for fast and on-site diagnosis of plant diseases and long-term monitoring of plant health conditions, especially in resource-poor settings. This talk will highlight our recent effort in creating low-cost in-field plant sensors for early detection of emerging plant diseases.



Dr. Trino Ascencio-Ibáñez: AgBio Sensors: The challenges of cassava viruses in East Africa

Cassava is a staple food in Africa and has become one of the more important crops by area in the last decade, feeding about 700 million people in the continent. Although it is a hardy plant, which is cultivated in part due to its low need for input, it has become the target of several devastating diseases. Two main families of viruses have found its way into the cassava fields. In both cases, more than one viral species is responsible for the disease. Geminiviruses (8-10 species) and Ipomoviruses (*Potyviridae*, at least 2 species) have devastated the small plots used by farmers in East Africa. On top of this, the insect involved in the pathosystem (*Bemisia tabaci*, whitefly) is originally from the region and contributes to the distribution of both viruses. Furthermore, cassava is a propagative plant so many times the viruses are also transmitted by infected material distributed, exchanged or purchased for planting. With this amount of pressure, the cassava production is highly affected and in some cases the losses are at the 100% level. Our projects are aimed to understand some of the main components of the pathosystem in the hope to identify chinks in the armor that can be used to protect cassava against these devastating pathogens.

Dr. Kelly Zering: Economics of plant disease management using Technological Innovation

An economic model of plant disease detection, treatment, and effects is used to understand potential use and relative value of new technologies. Objective variables in the model include profit and risk at the field level, the farm level, the industry or market level, and at the societal level over time. Specific features of the technologies, the plant and cropping system, the plant disease, and available treatments for the disease are critical elements of the model. Sensitivity and specificity of diagnostic technologies, methods of deploying and monitoring diagnostics, behavioral response of individual plants and populations to the disease at various stages of infection, disease incidence and prevalence, effects of the disease on quality and quantity of yields, effect of treatment on disease spread, effect of treatment on yield quantity and quality of affected crops, and prices for each of the inputs, products, and external effects of the system, are examples of model components. The model yields guidance on relative value of various features of new technologies as incorporated in specific innovative systems. This information drives design of innovative systems and further development of emerging technologies. The model also provides relative values of various regional and temporal disease management strategies. This large scale information can be used to design optimal policy at the industry and societal levels.