Emerging Plant Disease and Global Food Security Symposium

March 23-24, 2016
Hunt Library, NC State University
Raleigh, NC

Hosted by:

Emerging Plant Disease and Global Food Security Chancellors Faculty Excellence Program Cluster

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Emerging Plant Disease Global Food Security

Mission

The "Emerging Plant Disease Biology and Global Food Security" cluster will develop and deploy next generation disease management tools, technologies, and knowledge that reduce crop losses from pests and diseases, are environmentally sustainable, increase farmer incomes, improve nutrition and food safety, improve human health, and increase quality of life of people at a global scale. By combining expertise in biological sciences, geospatial analytics, bioengineering, evolutionary biology, epidemiological modeling, bioinformatics, and humanities and social sciences, our work will train the next generation of globally-engaged scientists and support gender equity, policy reforms, and development of sustainable, climate smart food production in the world.

History

The Emerging Plant Disease and Global Food Security Cluster works to improve both local and global efforts to manage emerging pests and pathogens that threaten crop production and lead to food insecurity. NC State has a strong history in conducting research in international agricultural research and outreach. Many emerging "armed and dangerous" plant diseases and pests threaten US and global agriculture and reported outbreaks have become more severe with trade and changing climate. Historically, late blight of potato caused widespread famine in Ireland. Today this disease and others pests and diseases such as cassava brown streak, stem rust, Black Sigatoka and Panama disease of banana and maize lethal necrosis threaten food security in SE Asia and Africa. Outstanding NC State faculty have research programs on many of these emerging plant pathogens and have been funded by The Bill and Melinda Gates Foundation, The National Science Foundation, USDA NIFA, UDSAAPHIS, USDA Foreign Agriculture Service and USAID to conduct basic and translational integrated plant science research that impacts global food security. Our strong team of existing distinguished and new cluster faculty will focus on both pandemic and emerging pests and pathogens that are responsible for large yield gaps.

The new interdisciplinary faculty cluster on "Emerging Plant Disease and Global Food Security" will develop new basic knowledge to understand the fundamental basis of emerging infectious diseases caused by pests or pathogens of plants– including the development of tools – enabling a more rapid response to contain and limit potential damage by emerging threats. The team will build upon existing strengths in multiple departments, centers, and existing faculty and several new clusters but also expands our engagement across four colleges. Four new faculty are in the process of being hired to conduct integrated research on emerging diseases and develop a new graduate certificate in global food security across 4 colleges including:

- CALS: Make significant impacts on improvements in crop production and play a lead role in developing breakthrough technologies to manage pests and diseases of plants and food-borne pathogen outbreaks.

- COE: Develop sensing and detection devices for pathogens and use these devices in combination with robotics to deliver devices to the field.

- COS: Develop bioinformatic tracking tools and workbench applications for modeling spread of genotypes of pests and pathogens.

- CNR: Develop new geospatial analytic tools to monitor "real-time" disease emergence, sources of outbreaks and spread using "big data" mining tools and mathematical modeling.

Welcome to this exciting symposium.

Jean Beagle Ristaino

Director, Emerging Plant Disease and Global Food Security, NC State University

Agenda

Emerging Plant Disease and Global Food Security
March 23-24, 2016
Hunt Library – Second Floor – Duke Energy Hall

Day 1

7:30 - 8:30	Registration
8:30 - 8:45	***Emerging Plant Disease and Global Food Security – Dr. Jean Ristaino***
8:45 - 9:00	***Welcome Address by University Chancellor Randy Woodson***
9:00 - 9:45	***Opening Keynote: Food and Civilization,*** Dr. Nina Fedoroff, Willaman Professor of Life Sciences and Evan Pugh Professor, Penn State University, Former Science and Technology Adviser to Secretaries of State Condoleeza Rice and Hillary Clinton
9:45 - 10:15	Coffee Break
10:15 - 11:00	***Plenary Session 1: Emerging Pathogens that Threaten Global Food Security.*** Keynote Speaker: Dr. Christopher Gilligan, Chair of the Cambridge University Strategic Initiative in Global Food Security
11:00 - 11:15	Discussion
11:15 - 11:45	***Invited short talk: The role of science and technology in safeguarding U.S. agriculture and facilitating safe trade.*** Dr. Philip Berger, Executive Director, Center for Plant Health Science and Technology, USDA APHIS
11:45 - 12:00	Discussion
12:00 - 1:00	***Provost Warwick Arden Welcome*** – Chancellors Faculty Excellence Program - Lunch
1:00 - 1:30	Video and poster preview in the Teaching and visualization Lab
1:30 - 2:15	***Plenary Session 2: Understanding plant disease management in the context of food systems.*** Keynote Speaker: Dr. Karen Garrett, Preeminence Professor, The Global Food Systems Institute and the Department of Plant Pathology, University of Florida
2:15 - 3:00	Discussion
3:00 - 3:30	***Invited short talk: Global Earth Observations Based Data Mining Framework for Food, Energy, and Water (FEW) Security***, Dr. Raju Vatsavai, Associate Director Center for Geospatial Analytics, NC State
3:30 - 3:45	Discussion
3:45 - 4:00	Coffee Break
4:00 - 5:30	Poster Session – Authors at posters
6:00 - 7:00	Evening ***Reception*** at The State Club
7:00 - 8:00	Dinner at The State Club
8:00	***Dean Linton Welcome remarks and Keynote Address: Monitoring Emerging Diseases: The challenges and the need for a 21st century global surveillance system.*** Dr. Pamela Anderson, Former Director Agriculture Development, Bill and Melinda Gates Foundation and former Director General International Potato Center

Agenda

Day 2

7:30 - 8:30	Registration
8:30 - 9:15	***Plenary Session 3: Evolutionary Genomics of Phytophthora infestans***, Dr. Michael Martin, Norwegian University of Science and Technology, Tronheim Norway
9:15 - 9:30	Discussion
9:30 - 10:00	***Invited short talk: Population structure and characterization of viruses associated with Maize lethal necrosis (MLN) in East Africa,*** Dr. Lucy Stewart, Ohio State University, Wooster OH
10:00 - 10:15	Discussion
10:15 - 10:45	Coffee Break
10:45 - 11:30	***Plenary Session 4: Drone-ing for Plant Pathogen Highways in the Sky***, Keynote Speaker: Dr. David Schmale, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech
11:30 - 11:45	Discussion
11:45 - 12:15	***Invited short talk: Transformative ICT technologies are changing the landscape of pathogen identification and diagnostics,*** Dr. Don Cooper Mobile Assay, Boulder Colorado
12:15 - 12:30	Discussion
12:30 - 1:30	Lunch
1:30 - 2:00	***Invited short talk: Plantwise: Getting pest and disease data fresh from the field,*** Patricia Neenan Kilmartin, Head of Strategic Partnerships – the Americas, CABI
2:00 - 2:15	Discussion
2:15 - 4:00	***Closing "Panel Challenges in Tackling Emerging Diseases in Africa"***, Moderated by Jean Ristaino
	Emerging Plant Diseases and Feed the Future, Dr. Angela Records, International Agriculture Research Advisor, Bureau of Food Security, USAID, Washington
	Role of the Biosciences eastern and central Africa (BecA) Hub in enhancing agricultural productivity in Africa, Dr. Josephine Birungi, Technology Manager, Biosciences East Africa- ILRI Hub, Nairobi Kenya
	RTI's Food Systems Approach to Reduce Global Hunger, Paul Weisenfeld, Executive Vice President, International Development Group, RTI
4:00 - 5:00	Final Reception

Speakers and Abstracts

Opening Keynote: Food and Civilization

Dr. Nina Federoff, Willaman Professor of Life Sciences and Evan Pugh Professor, Penn State University, Former Science and Technology Adviser to Secretaries of State Condoleeza Rice and Hillary Clinton

Nina V. Fedoroff received her Ph.D. in Molecular Biology from the Rockefeller University and has served on the faculties of the Carnegie Institution of Washington, the Johns Hopkins University, the Pennsylvania State University, where she was the Director of the Biotechnology Institute and the founding Director of the Huck Institutes of the Life Sciences, and the King Abdullah University of Science and Technology (Saudi Arabia), where she was the founding Director of the Center for Desert Agriculture. Fedoroff has published three books and more than 160 papers in scientific journals. She is a member of several academies, including the U. S. National Academy of Sciences and the American Academy of Arts and Sciences. Among her awards is a 2006 National Medal of Science, the highest honor awarded to US scientists. She is an Evan Pugh Professor Emerita, Penn State and a member of the External Faculty of the Santa Fe Institute. Fedoroff served as the Science and Technology Adviser to the Secretary of State and to the Administrator of the US Agency for International Development (USAID) from 2007 to 2010. She established and serves as Science Adviser to the Global Knowledge Initiative (http://globalknowledgeinitiative.org), an organization focused on forging collaborations between scientists in developed and developing countries. She has served as President of the American Association for the Advancement of Science (AAAS) and as a Trustee of the Library of Alexandria, Egypt. She is a member of the Science Advisory Board of the Santa Fe Institute and serves as Senior Science Advisor to OFW Law, Washington DC.

The climate is warming. Fossil waters are being exhausted everywhere. Biodiversity is under pressure. We're out of arable land. And yet today's human population of 7 billion will race past 9 billion by 2050. I take a historical view of food production and a glance at current trends to ask what we need to do to produce enough food for the more than 10 billion expected for dinner before century's end......sustainably.

Plenary Session 1: Emerging Pathogens that Threaten Global Food Security

Dr. Christopher Gilligan, Chair of the Cambridge University Strategic Initiative in Global Food Security

Chris Gilligan holds a personal chair in Mathematical Biology in the Department of Plant Sciences at Cambridge, where he leads the Epidemiology and Modelling Group and was previously Head (Dean) of the School of Biological Sciences. Professor Gilligan chaired the recent UK Government Taskforce on Tree Heath and Plant Biosecurity. He was chair of the Science Advisory Council for the UK Department of Environment, Food and Rural Affairs (Defra) from 2011-14 and a member of the UK Biotechnology and Biological Sciences Research Council (BBSRC) from 2003-2009. He is a Trustee of the Natural History Museum in London and also chairs the UK Joint Nature Conservation Committee (the public body that advises the UK Government and Devolved Administrations on UK-wide and international nature conservation). He has held a Royal Society Leverhulme Trust Senior Research Fellowship and a BBSRC Professorial Fellowship. He was made a Commander of the Order of the British Empire (CBE) in the Queen's Birthday Honours (2015) for services to plant heath in the field of epidemiology.

I shall consider emerging pathogens from an epidemiological perspective designed to advise government and other agencies on risk assessment and effective deployment of control measures. We briefly discuss the extent to which prevention and mitigation of crop loss from disease and food waste is considered in short, medium and long-term planning for global food security. Then, drawing on examples of emerging pathogens of wheat, cassava, citrus and sugar-beet that threaten crop production in Africa, India, US and UK, we show how to assess the risk of pathogens arriving, what the impacts are likely to be, where to survey, when, where and how to deploy control. Particular challenges arise in estimating dispersal parameters, allowing for uncertainty including cryptic infection and in coupling epidemiological with economic models. We consider control at the regional and country-wide scales and show that success involves matching the scale of control with the intrinsic spatial and temporal scales of epidemic spread. Grower behaviour is also important and we show how a small change in compliance can undermine the effectiveness of control strategies such as the introduction of clean seed schemes. The intention is to show that instead of starting afresh each time, there is an emerging epidemiological framework and a set of epidemiological tools that can be adapted for each new pathogen.

Invited Short Talk: The role of science and technology in safeguarding U.S. agriculture and facilitating safe trade

Dr. Philip Berger, Executive Director, Center for Plant Health Science and Technology, USDA APHIS

Dr. Philip Berger is Executive Director of the APHIS-Plant Protection and Quarantine Science & Technology division and has been Director of PPQ's Center for Plant Health Science and Technology (CPHST) since 2008. As Executive Director of PPQ S&T, he leads overall scientific support for PPQ programs, policies and actions, and serves as a member of the PPQ Management Team. He came to PPQ in 2003 as National Science Program Leader for Molecular Diagnostics and Biotechnology at CPHST. Prior to joining USDA, Dr. Berger was a faculty member at the University of Idaho. His research focused on virus-vector interactions and epidemiology, crop biotechnology for virus resistance, and molecular evolution of plant viruses. During his 15 years at the University of Idaho, he served as Chair of the Plant Pathology Division in the Dept. of Plant, Soil and Entomological Sciences, Associate Director of the Institute for Molecular and Agricultural Genetic Engineering, and Associate Director of the Idaho Agricultural Experiment Station.

The mission of the Animal and Plant Health Inspection Service-Plant Protection and Quarantine program is to safeguard U.S. agriculture and natural resources against the entry, establishment, and spread of pests, and facilitate the safe trade of agricultural products. This work involves a continuum of activities from pest risk analysis, inspection and treatments to mitigate pests in imports, pest surveillance systems for detection, emergency response for new pest detections, and pest management and eradication programs. This presentation will describe the role of science and technology in supporting these activities, including new initiatives in molecular diagnostics for plant inspection, canines for pest detection, and unmanned aerial vehicles for detection and management programs.

Invited Short Talk: Global Earth Observations Based Data Mining Framework for Food, Energy, and Water (FEW) Security

Dr. Karen Garrett, Preeminence Professor, The Global Food Systems Institute and the Department of Plant Pathology, University of Florida

Karen A. Garrett is a Preeminent Professor in the Plant Pathology Department, Institute for Sustainable Food Systems, and Emerging Pathogens Institute at the University of Florida in Gainesville, USA. Garrett works in plant disease epidemiology, and more broadly in the analysis of networks in agricultural and ecological systems. Recent work includes the analysis of strengths and vulnerabilities of networks for the potential spread of mycotoxins and invasive pests through stored grain movement, for the spread of aerially dispersed pathogens such as soybean rust, for the deployment of resistance genes through crop breeding networks, and for healthy seed distribution in developing countries. Garrett is developing a new platform, Impact Network Analysis, for evaluating linked socioeconomic and biophysical networks through which new technologies may or may not achieve impact. She was a faculty member for 15 years in the Department of Plant Pathology at Kansas State University, Manhattan, USA. She did her PhD work at Oregon State University, and Centro Internacional de la Papa (CIP) in Lima, Peru, and Quito, Ecuador.

Plant disease management occurs across a wide range of levels in global food systems, as illustrated in the following examples. Integrating consideration of these food system components in scenario analyses supports the formulation of better strategies. Global networks for crop pre-breeding and breeding determine what resistance genes are developed for deployment in new crop varieties. Seed systems are often inadequate for making improved varieties available to farmers in developing countries, motivating a focus on an integrated seed heath strategy. During crop production, the landscape of crop geographic distribution is a key factor for disease risk. Postharvest transportation networks help to determine the risk of pathogen and mycotoxin movement. Impact Network Analysis offers a platform for evaluating strategies for disease management in challenging scenarios, such as adapting management to climate change. An "impact network" is the linked socioeconomic and biophysical networks through which new technologies can impact system outcomes. An "Impact Network Analysis" (INA) is an evaluation of how impact networks function in a particular setting, such as management of pathogens in a particular crop, and where the control points for improvement are. Applying INA to system components such as those discussed above can guide strategic priorities.

Dean Linton Welcome remarks and Keynote Address: Monitoring Emerging Diseases: The challenges and the need for a 21st century global surveillance system

Dr. Raju Vatsavai, Associate Director Center for Geospatial Analytics, NC State University

Raju is a Chancellor's Faculty Excellence Program Cluster Associate Professor in Geospatial Analytics in the Department of Computer Science, North Carolina State University (NCSU). He works at the intersection of spatial and temporal big data management, analytics, and high performance computing with applications in the national security, geospatial intelligence, natural resources, climate change, location-based services, and human terrain mapping. As the Associate Director of the Center for Geospatial Analytics (CGA), Raju plays a leadership role in the center's strategic vision for spatial computing research. Before joining NCSI, Raju was the Lead Data Scientist for the Computational Sciences and Engineering Division (CSED) at the Oak Ridge National Laboratory (ORNL). Raju has more than 25 years of research and development experience in large-scale spatiotemporal data management and geographic knowledge discovery. He holds MS and PhD degrees in computer science from the University of Minnesota.

Understanding the complex interactions between food, energy, and water systems is critical for building a sustainable future. The distribution of these resources is not uniform across the globe, for example many African countries have water resources but lack sustainable agricultural practices where as some middle eastern countries have abundant energy resources (fossil fuels) but do not have capability to produce food, and countries that have once abundant water resources are now facing water scarcity. Global earth observations with constellation of more than 100 operational satellites are providing unprecedented spatiotemporal data coverage, which can be exploited to continuously monitor these key resources and understand the complex interactions and interdependencies between them. We present recent advances in big data management and data mining approaches that can be leveraged for FEW security. In particular we present a novel biomass-monitoring (BioMon) framework, which includes a suite of data mining algorithms to identify changes in biomass at global scale. The capability includes processing more than billion time series using shared and distributed memory architectures to identify crop conversions and damages. The framework also allows incorporation of climate changes and its impacts on agricultural systems.

Dinner Keynote Address: Monitoring Emerging Diseases: The challenges and the need for a 21st century global surveillance system

Dr. Pamela Anderson, Former Director Agriculture Development, Bill and Melinda Gates Foundation and former Director General International Potato Center

Dr. Pamela Anderson served as Director General of the International Potato Center (CIP) in Lima, Peru, one of the research centers within the Consultative Group on International Agricultural Research (CGIAR), from 2005–2013; and as CIP's Director of Research from 2002–2005. Dr. Anderson also served as a senior entomologist and Coordinator of the Tropical Whitefly IPM Program at the International Center for Tropical Agriculture (CIAT) in Cali, Colombia from 1996-2002. Prior to joining the CGIAR system, Dr. Anderson spent two decades working with national programs in Latin America. She has also served as an advisor to the Federation of American Scientists, a research consultant at Harvard University, a member of the Government of Ireland Hunger Task Force, and a Board member of the CGIAR Consortium and the Alliance for a Green Revolution in Africa (AGRA). She is currently a member of the President-appointed advisory board to USAID (BIFAD). Returning to the United States in 2013, Dr. Anderson served as Director for the Agricultural Development Program of the Bill & Melinda Gates Foundation from 2014 –2016, where she lead the team that works to reduce hunger and poverty for farming families in Sub-Saharan Africa and South Asia. Pamela holds a B.A. in Biology from Northwestern University, an M.Sc. in Entomology from the University of Illinois, and an M. Sc. in Human Ecology as well as an D.Sc. in Population Sciences/ Vector Entomology from the Harvard School of Public Health.

When the Institute of Medicine released their report on "Emerging Infections" in 1992, they framed and stimulated a new set of conversations on emerging and re-emerging infectious diseases in humans, animals and plants. However, over the past two decades, a series of attempts to develop programs for monitoring or surveillance of emerging plant diseases have been largely unsuccessful. Although the 2008 grain price crisis elevated food security on the global political and financial agendas, emerging infectious diseases (EIDs) in plant crops have not managed to capture the attention and resources that they merit within the new food security agendas or within the growing climate-smart agriculture agendas. Leadership to reposition plant EIDs within the contemporary food security agenda is critical, and re-newed effort to stand up a global surveillance system is both necessary and timely. I will share experiences related to some of the previous EID monitoring efforts, and table some thoughts/proposals for after-dinner discussion.

Plenary Session 3: Evolutionary Genomics of Phytophthora infestans

Dr. Michael Martin, Norwegian University of Science and Technology, Tronheim, Norway

Michael Martin received his B.Sc. in Electrical Engineering at Boston University. At Johns Hopkins University, he attained an M.Sc. in Environmental Engineering and then a Ph.D. on diverse aspects of common ragweed (population genetics, paleo-ecology, fluid dynamics of pollination). His first postdoc was with Prof. Tom Gilbert at the University of Copenhagen (ancient genomics of *Phytophthora infestans* and other species). His second postdoc was with Prof. Monty Slatkin at UC Berkeley (theoretical population genomics). He has just begun an Associate Professorship in Trondheim, Norway at the Museum of Natural History and Archaeology, Norwegian University of Science and Technology (NTNU). There he is building a research program that will continue to apply ancient DNA approaches to herbarium collections to investigate the genomics of various plants and their pathogens.

The genomic revolution introduces boundless opportunity for evolutionary genetic discovery in plant pathogens. Over the last 150 years, much scientific and popular interest has centered on the sudden outbreak and spread of potato disease following the introduction of the oomycete pathogen Phytophthora infestans to Europe in 1845. This event led to the infamous Irish potato famine, emigration and death of millions of Europeans, widespread economic losses, and persistent global food insecurity. A brief review of previous and ongoing analyses of P. infestans will illustrate how new population genomic, evolutionary genomic, and bioinformatic approaches can be applied to elucidate the origins, ancestry, and functional evolution of important plant pathogens, especially when historical collections are available.

Invited Short Talk: Population structure and characterization of viruses associated with Maize lethal necrosis (MLN) in East Africa

Dr. Lucy Stewart, Ohio State University, Wooster, Ohio

Lucy Stewart is a USDA ARS Research Molecular Biologist and Adjunct Assistant Professor at Ohio State University. She works in the Corn, Soybean and What Quality Research Unit and focuses on virus diseases of maize. The objectives of her work include characterizing virus insect transmission determinants and functional assessment of viral genomes in order to understand how these viruses move between hosts and cause disease. She earned a PhD in Biology from the University of California Davis and a BS in Plant Breeding and Genetics from Brigham Young University in Utah

Maize lethal necrosis (MLN) has emerged as a devastating disease in East Africa in recent years. MLN is caused by co-infection of a maize-infecting potyvirus and maize chlorotic mottle virus (MCMV). Deep sequencing of MLN-associated samples collected in Kenya and Uganda indicate high sequence conservation of MCMV sequences, whereas the associated potyvirus population is diverse and complex (as are maize-associated potyvirus populations in the United States). Sugarcane mosaic virus (SCMV)-like sequences across samples clustered into four groups with over 10% nucleotide sequence divergence. Sequence analyses indicate that other viruses that require further characterization are also present in MLN-diseased tissue.

Plenary Session 4: Drone-ing for Plant Pathogen Highways in the Sky

Dr. David Schmale, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech

David Schmale is an associate professor in the Department of Plant Pathology, Physiology, and Weed Science at Virginia Tech. He received his B.S. from the University of California, Davis, and his Ph.D. from Cornell University. His laboratory uses drones to sample microorganisms in the lower atmosphere. Many microbes relevant to crops, domestic animals, and humans are transported over long distances in the atmosphere. The ability to track the movement of these microbes in the atmosphere is essential for establishing effective quarantine measures and forecasting disease spread. Popular Science magazine named David one of 2013's Brilliant Ten. David has attracted more than $11M in sponsored research grants in the last decade to support his research program. He is a member of the Academy of Teaching Excellence at Virginia Tech, and works closely with teachers in Virginia to develop unique interdisciplinary lessons for high school students. One of these lessons (Caging the Blob) has been distributed to over 10,000 student users in Virginia in the last four years.

Crops are constantly threatened by plant pathogens, and the ability to track the movement of these pathogens in the atmosphere is important for establishing effective quarantine measures and forecasting disease spread. We have used drones (unmanned aerial vehicles (UAVs)/ unmanned aircraft systems (UAS)) to study the transport of plant pathogens tens to hundreds of meters above crop fields. These drones are equipped with devices for collecting microbes in the atmosphere during flight. Autonomous systems enable teams of drones to perform complex atmospheric sampling tasks and coordinate flight missions with one another. Data collected with drones can be used to validate and improve disease forecasting models along highways in the sky, connecting transport scales across farms, states, and continents. Growers can use information from drones to make appropriate plant disease management decisions, such as the timely application of fungicides. Drones may be used to excite the next generation of biologists and engineers, and raise important ethical considerations about the future of human-robot interactions.

Invited Short Talk: Transformative ICT technologies are changing the landscape of pathogen identification and diagnostics

Dr. Don Cooper, Mobile Assay, Boulder, Colorado

Dr. Don Cooper is the Chairman and Chief Science Officer of Mobile Assay Inc., a biotech company launched from the University of Colorado, Boulder in 2012, and a former Associate Professor at the University of Colorado, Boulder, Institute for Behavioral Genetics. His current work is focused on developing new molecular genetic tools and mobile technology to understand fundamental pathological biological processes. He has developed the Lab-on-Mobile-Device platform, which transforms mobile Smart devices into sensitive diagnostic instruments that can be conveniently used to detect and track a variety of pathogens, chemicals and toxins important health applications. Dr. Cooper is interested in developing research partnerships with companies, laboratories and individuals who have an interest in using the power of Mobile technology for diagnostics purposes in low resource settings. He is interested in collaborating with researchers investigating a variety of pathogens in crops, and human diseases. The explosive growth of mobile technology throughout the developing world empowers individuals allowing them to communicate rapidly and better manage their lives. When coupled with the sensitive imaging capabilities and sensors available on mobile Smartphones a wide variety of capabilities can be utilized. It is Dr. Cooper's goal to understand how mobile technology and diagnostic testing can be employed in the developing world and utilized as a "big data' resource for computational predictive modeling.

The absence of centralized food control systems throughout the developing world results in significant food and health

safety vulnerabilities. Furthermore, the lack of available health diagnostics, inadequate monitoring and epidemiology, poor surveillance data, and lack of laboratory services put the health of millions at risk. Our Lab-on-Mobile Device platform is being used with rapid immune-based tests to quantify food pathogens (e.g. mycotoxins) and human diseases and DNA-based plant pathogens (e.g. phytophthora infestans) in low resource settings in over 10 countries. The storage capacity, camera resolution, processor speed, sensors and network capability of mobile phones now rival sophisticated laboratory diagnostic and data collection equipment available at a fraction of the cost. Mobile infrastructure in sub Saharan Africa is estimated to be 80% coverage, which means that the availability of mobile devices, cell-phone towers, data providers and support services is robust. Most farmers, government extension agents, millers and government health workers have the necessary mobile technology readily available. Despite the ubiquitous use of mobile technology across the globe no one has yet effectively leveraged and scaled the diagnostic capabilities of these mobile devices for data collection in human health monitoring. Our technology seeks to utilize global adoption of mobile technology and empower individuals to monitor pathogens using the LMD platform.

Invited Short Talk: Plantwise: Getting pest and disease data fresh from the field

Patricia Neenan Kilmartin, Head of Strategic Partnerships – the Americas, CABI

Patricia works for CABI, an international, not-for-profit organization with scientific research, publishing and international development at its core. CABI's mission is to improve people's lives by solving problems in agriculture and the environment. As Head of Strategic Partnerships, the Americas, Patricia is responsible for coordinating CABI's activities in the areas of International Development, Bioscience and Knowledge Management throughout the region. Patricia has worked for CABI for 28 years in a variety of information management and business development roles. Prior to moving to the US in 2000, Patricia was the Compendium Program Manager for CABI in the UK, responsible for a multidisciplinary team of editors, IT professionals, image specialists and administrative staff who compiled the Crop Protection Compendium, Forestry Compendium and the Animal Health and Production Compendium. She has provided training on information use in Africa, Europe, Asia and North America. She is a former Director of USAIN (the United States Agricultural Information Network). Patricia has a B.Sc Hons in Zoology and a Post Graduate Diploma in Science Education from the National University of Ireland, Galway.

Lack of access to timely, appropriate and actionable extension advice is a major cause of poor productivity and crop loss for smallholders. Pest and disease outbreaks can flare up unpredictably, cross borders quickly and often there is no mechanism to rapidly identify the problem and suggest effective, pragmatic solutions. Plantwise in partnership with agro-advisory services in 34 countries in Africa, Asia and Latin America, supports establishment of local 'plant clinics', staffed by trained 'plant doctors' where farmers get practical advice. Crop losses are reduced by timely identification of problems and implementation of appropriate management practices. Plant clinics are reinforced by a global knowledge bank, through which plant health information is collected and disseminated. It includes factsheets, distribution maps, diagnostic tools and pest management information. A data management tool allow partner countries to store and analyse clinic 'prescription' records, informing front-line vigilance against new or re-emerging pests. These resources are delivered online, offline by App and by SMS. ePlant clinics use tablets to record/report pest data in a timely fashion to authorised stakeholders providing opportunities for early warning and response. Combined with text-mining and 'crowd sourcing', this is a powerful resource for global biosecurity vigilance, policy planning, research and implementation of plant health services.

Closing Panel: Emerging Plant Diseases and Feed the Future

Dr. Angela Records, International Agriculture Research Advisor, Bureau of Food Security, USAID, Washington

Dr. Angela Records is an International Agricultural Research Advisor at the United States Agency for International Development (USAID) in the Bureau for Food Security, where she manages plant disease, plant breeding, and postharvest handling research programs. Dr. Records holds a B.S. in Biology from Baylor University, an M.S. in Biology from the University of Nevada, Las Vegas, and she earned her Ph.D. in Plant Pathology from Texas A&M University, where she studied plant-pathogen interactions. After completing her doctoral studies, Dr. Records accepted a postdoctoral appointment at the University of Maryland in the Maryland Pathogen Research Institute, where she studied the molecular mechanisms controlling biofilm formation by the human bacterial pathogen *Pseudomonas aeruginosa*. In 2012, she was selected as a Scholar Fellow for the *Think, Write, Publish* science communications program and a Science Policy Fellow with the American Phytopathological Society.

Feed the Future, the U.S. Government's global hunger and food security initiative, works with partner countries to develop their agriculture sectors and break the vicious cycle of poverty and hunger. Emerging plant diseases can have devastating impacts in developing countries, where the livelihoods and food security of smallholder farmers and their families depend on healthy plants. The U.S. Agency for International Development (USAID) leads the Feed the Future program and its research agenda, which includes addressing emerging plant diseases like coffee rust in Central America, Panama disease in Mozambique, and others. USAID's response to these outbreaks will be discussed, as will opportunities for partnership with the Feed the Future initiative.

Closing Panel: Role of the Biosciences eastern and central Africa (BecA) Hub in enhancing agricultural productivity in Africa

Dr. Josephine Birungi, Technology Manager, Biosciences East Africa- ILRI Hub, Nairobi, Kenya

Josephine Birungi is the Technology Manager, Biosciences eastern and central Africa – International Livestock Research Institute (BecA-ILRI) Hub based in Nairobi Kenya. She manages laboratory operations, research facilitation and research related services, application and monitoring of new technologies, and leading the BecA-ILRI Hub's genomics and bioinformatics efforts. Prior to joining the BecA-ILRI Hub, Josephine worked at the Uganda Virus Research Institute-International AIDS Vaccine Initiative HIV vaccine trial unit as a Senior Scientist, a role that involved setting up the first laboratory in Africa to attain Good Clinical Laboratory Practice (GCLP) international accreditation. Josephine holds a BSc (Hons) (Zoology/ Psychology) and MSc (Zoology) from Makerere University Kampala, Uganda and a PhD in Molecular Genetics, Evolutionary Biology and Conservation genetics at Makerere University/ University of Copenhagen, Denmark. She conducted postdoctoral research at Yale University School of Medicine and is an honorary Senior Lecturer at Makerere University Kampala.

Emerging plant diseases are a major challenge to food security in Africa. Two thirds of Africa's population is dependent on agriculture for food, nutrition and livelihoods, however the continent produces less food per person today. One of the major challenges to food security in Africa is an underdeveloped and less productive agricultural sector. Challenges in food security are aggravated by the lack of capital for buying agricultural inputs such as pesticides and fertilizers, inputs unavailability, limited expertise in plant science, poor infrastructure, among others. Leveraging on its partnerships and expertise, the role played by the Biosciences eastern and central Africa – International Livestock Research Institute (BecA-ILRI) Hub in developing the capacity of African scientists to solve agricultural problems in the region to address

key challenges of African agriculture are presented. The BecA-ILRI Hub in partnership with African National Agricultural Research System (NARS) has been actively involved in the development of agricultural technologies suitable to resource-poor farmers and consumers. The BecA-ILRI Hub initiative underpins individual and institutional capacity building in African NARS and the uses of high end biosciences research tools to increase the agricultural productivity. Some of the current research programs include: emerging and reemerging pathogens in mixed crop systems, an integrated approach to reducing aflatoxins among others.

Closing Panel: RTI's Food systems Approach to Reduce Global Hunger

Paul Weisenfeld, Executive Vice President, International Development Group, RTI

Paul Weisenfeld is executive vice president for the International Development Group. In his role, Weisenfeld applies his extensive knowledge of international development to advance RTI's mission of tackling some of the world's most pressing global challenges. Weisenfeld leads RTI's efforts in more than 75 countries across Africa, Asia, Latin America and the Middle East to solve complex health and education problems, improve early childhood development, enhance accountability in governance and tackle the global youth employment crisis. Previously, Weisenfeld was assistant to the administrator directing USAID's Bureau for Food Security. While there, he led one of America's signature international development initiatives, Feed the Future, which aims to reduce food insecurity through innovative, evidence-based strategies and state-of-the-art monitoring and evaluation programs. Weisenfeld's career as a foreign service officer spans more than 20 years. He has served in a wide variety of senior positions, including tours as mission director in Zimbabwe and Peru. During his distinguished career, he achieved the rank of career minister, the highest level position in the Senior Foreign Service. Weisenfeld's roles at USAID have also included deputy assistant administrator for the Bureau for Latin America and the Caribbean and coordinator for the Haiti Task Team, during which he led post-earthquake recovery efforts. He was also a regional legal advisor for USAID's Egypt and South Africa programs. In 2014, Weisenfeld served as the commencement speaker at Monmouth College, Illinois, receiving an honorary Doctorate in Public Administration. He also holds a J.D. from Harvard Law School and a B.A. from Queens College of the City University of New York.

Over the past decade, the challenge of feeding an ever increasing population in the face of climate change has drawn worldwide attention and action. While today, some 800 million people suffer from chronic hunger, the world will need to increase food production more than 60% by 2050 in order to meet the demand of a future population of 9 billion. However, the challenge is more complex than simply increasing on-farm production. RTI's research and programs take a food systems approach; in addition to working with producers and processors along agricultural value chains, we tackle the issues that surround food, including climate change, food safety regulations, and agricultural research and innovation. RTI works to improve the commercialization of agricultural innovations, including research conducted in agricultural universities, to ensure it can be scaled and marketed to reduce food insecurity.

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