Plant Biosecurity Programs and Infrastructure: Overview from Academia

Ray Hammerschmidt
Michigan State University

Four Examples

- National Institute for Microbial Forensics & Food and Ag Biosecurity
  - Oklahoma State University
- Biosecurity Research Institute
  - Kansas State University
- Emerging Pathogens Institute
  - University of Florida
- The National Plant Disease Diagnostic Network
  - Land Grant Universities

National Institute for Microbial Forensics & Food and Agricultural Biosecurity

NIMFFAB - *Est.* 2007

NIMFFAB Mission

To identify, assess, prioritize and conduct:

- **Research**
- **Education**
- **Outreach**

related to national needs in microbial forensic science with respect to

- **pathogens of crops, forests, and rangelands**
- **human pathogens in fresh produce**

*The **NIMFFAB** will build on, connect and enhance existing programs that support and address issues of crop and food security.*

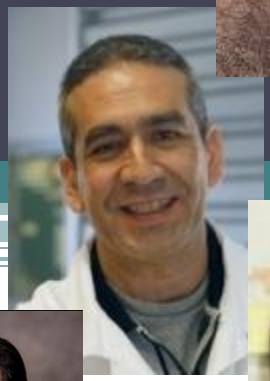
NIMFFAB faculty & expertise

Jacqueline Fletcher, Ph.D., Director & Regents Professor

Plant pathology, microbiology, bacteriology

Astri Wayadande, Ph.D., Asst. Director & Asst. Professor

Vector-pathogen interactions for plant pathogens & human pathogens on plants



Francisco Ochoa Corona, Ph.D., Asst. Professor

Diagnostics & detection technology, plant virology, molecular biology

Li Ma, Ph.D., Asst. Professor

Produce safety, human pathogens on plants, traceback of human pathogen outbreaks

Rakesh Kaundal, Asst. Research Scientist

Metagenomics, bioinformatics, machine learning, artificial intelligence

NIMFFAB Linkages

- **USDA APHIS Plant Protection & Quarantine** (**PPQ**)
  - MOU in preparation – Diagnostic tool development
- **National Plant Diagnostic Network** (**NPDN**) – part of the LAN
- **National Plant Disease Recovery System** (**NPDRS**) – HSPD9 mandate
- **American Phytopathological Society**
  - APS Microbial Forensics Interest Group & Food Safety Interest Group
- **IC Biological Sciences Experts Group**
- **National Biosurveillance Integration Center** (**NBIC**)
- **National Academy of Sciences -** Institute of Medicine – Forum on Microbial Threats
- **Defense Threat Reduction Agency** (**DTRA**)

Kansas State University

Biosecurity Research Institute

- BSL-3 & BSL-3Ag biocontainment research & education facility
- Animal Health, Plant Health, Food Safety, Environmental Health
- Very unique research space (academic, industry, government)
- Facility-wide physical & electronic security

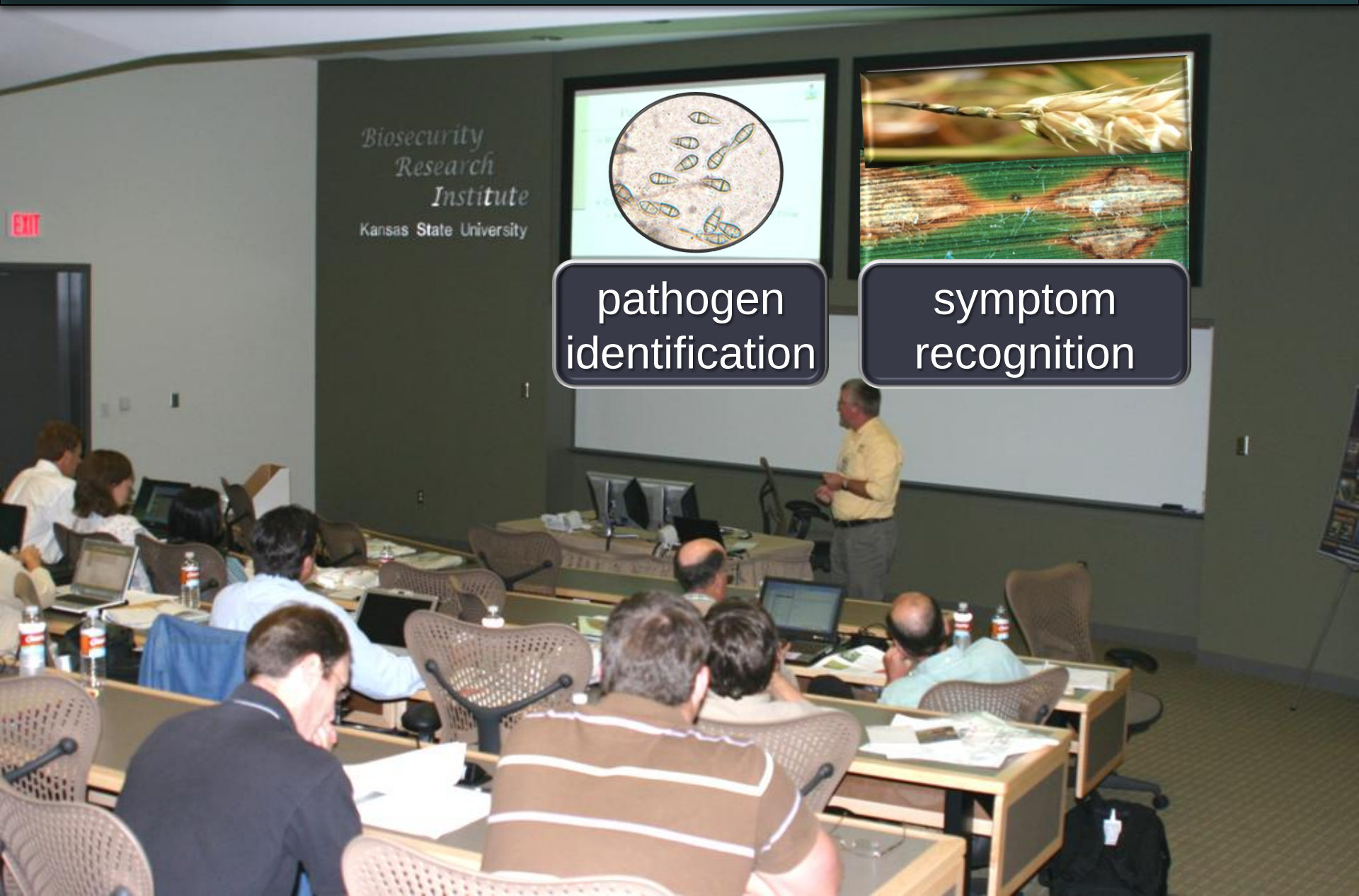
Wheat Blast Research Project

- Multi-Institutional Research Team -

Dedicated Wheat Blast Research Lab

- University-USDA Collaboration
- International collaborators – Wheat Blast Consortium
- Comprehensive Research Agenda
  - Genomics
  - Diagnostics
  - Epidemiology
  - Disease Forecasting & Management
- USDA NIFA funded

Stakeholder Training Events at BRI



Emerging Pathogens Institute University of Florida

- Understand the genetic changes that lead to new pathogen emergence
- Investigate complex interaction of environmental and host factors that allow these pathogens to spread within populations
- Use these data to develop and implement interventions to minimize risk of disease transmission;
- Train the next generation of investigators in emerging diseases
- Disseminate information about emerging pathogens, and their control, to the people of Florida

Areas of research

- Vector-Borne Diseases
  - West Nile, Malaria, Dengue
- Influenza, other viral pathogens
- Tuberculosis/drug-resistant TB/non-TB mycobacterial disease
- Enteric and Foodborne Illnesses
- Cholera, diarrheal disease
- Foodborne disease policy and control
- **Plant pathogens**
- Antibiotic Resistance/hospital infection control
- MRSA

Plant Diseases

- Citrus canker
- Soybean rust
- Sudden oak death
- Lethal yellowing
- Maize stripe
- Citrus greening
- Pierce's disease

NPDN
National Plant Diagnostic Network

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

NPDN
The National Plant Diagnostic Network

GPDN

National Repository
CERIS

NCPDN
North Central Plant Diagnostic Network

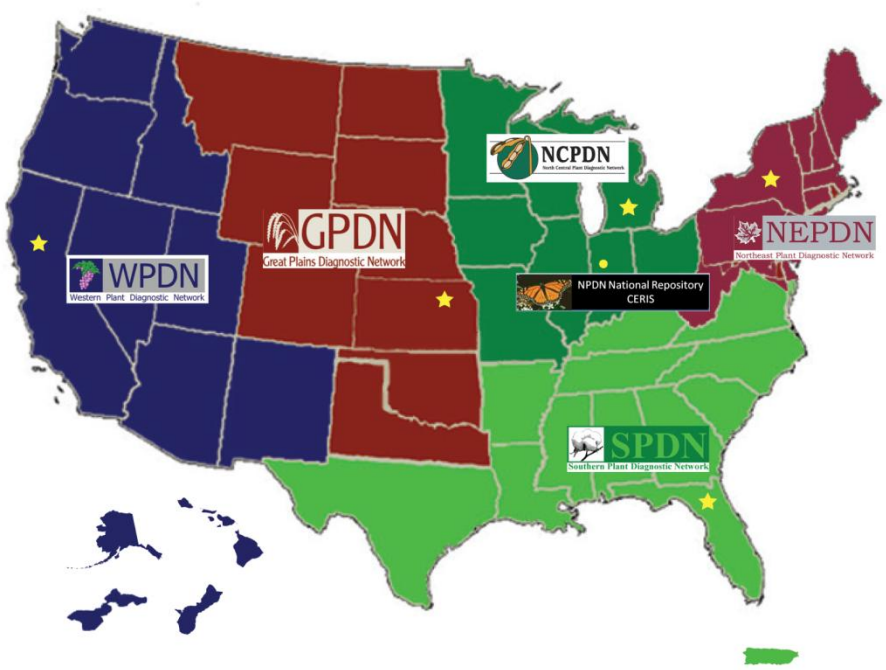
NEPDN
Northeast Plant Diagnostic Network

SPDN
Southern Plant Diagnostic Network

WPDN
Western Plant Diagnostic Network

The NPDN By Region

- Kitty Cardwell and Marty Draper, USDA NIFA
- Jeff Jones,
  - Executive Director and SPDN Director
- Jim Stack
  - GPDN Director
- Ray Hammerschmidt
  - NCPDN Director
- March Fuchs
  - NEPDN Director
- Rick Bostock
  - WPDN Director
- Eileen Luke
  - CERIS, National Repository



How is this Accomplished?

Education

- ***First detector training***

Diagnostics

- ***Training***
- ***Support for diagnostic infrastructure***
- ***SOP development***
- ***Surge capacity***
- ***Accreditation***

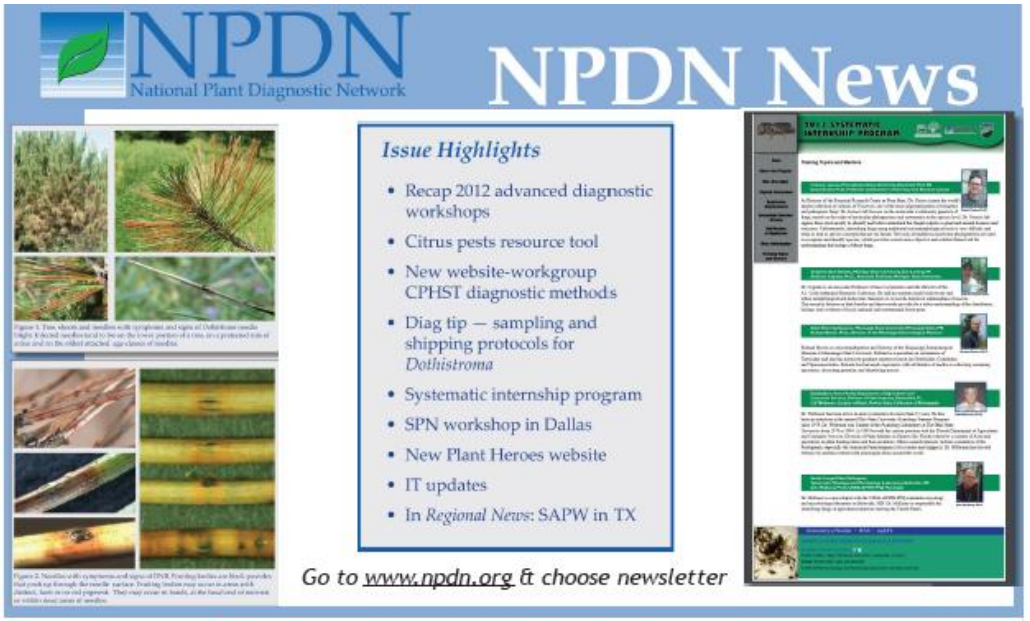
Communication

- ***Secure national data repository cataloguing pest and disease occurrences***
- ***Exercise scenarios***
- ***Coordination and cooperation among agencies***
- ***Newsletters and public relations***

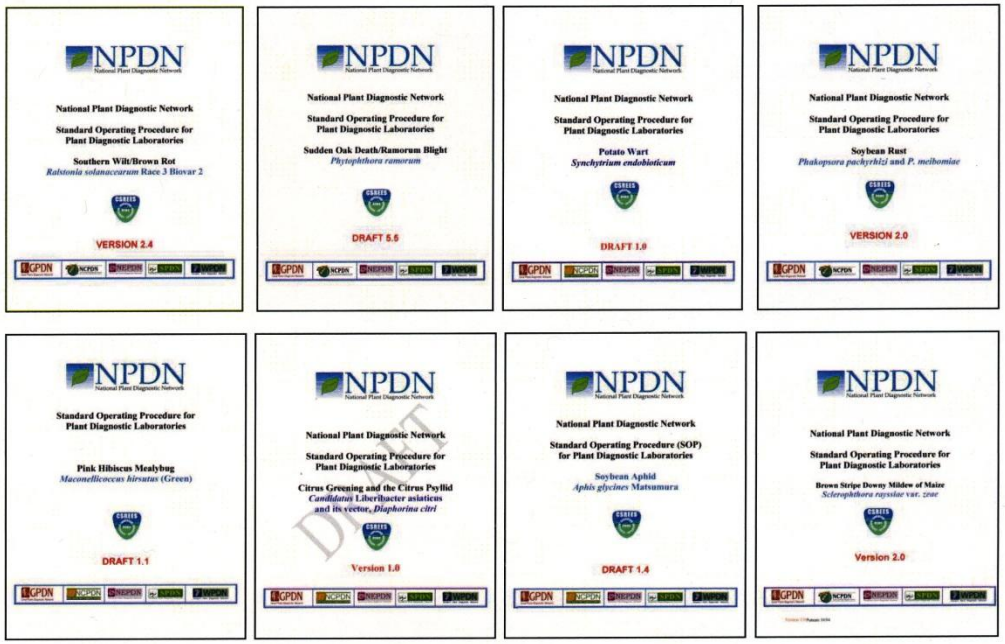
First Detector and FD Educators: modules and manuals

Module 1: The Mission of the NPDN and Agricultural Biosecurity
Module 2: Monitoring for High Risk Pests
Module 3: Quality and Secure Sample Submission
Module 4: The Art and Science of Diagnosis: Plant Pathogens and Arthropods
Module 5: First Detector Exercises
Module 6: Effective Photography for Digital Sample Submission

Newsletters



Diagnostic SOP's



Diagnostic training with USDA-APHIS

Regional Training and workshops

Infrastructure upgrades:

Web enabled microscopy
RT-PCR
Biosafety cabinets

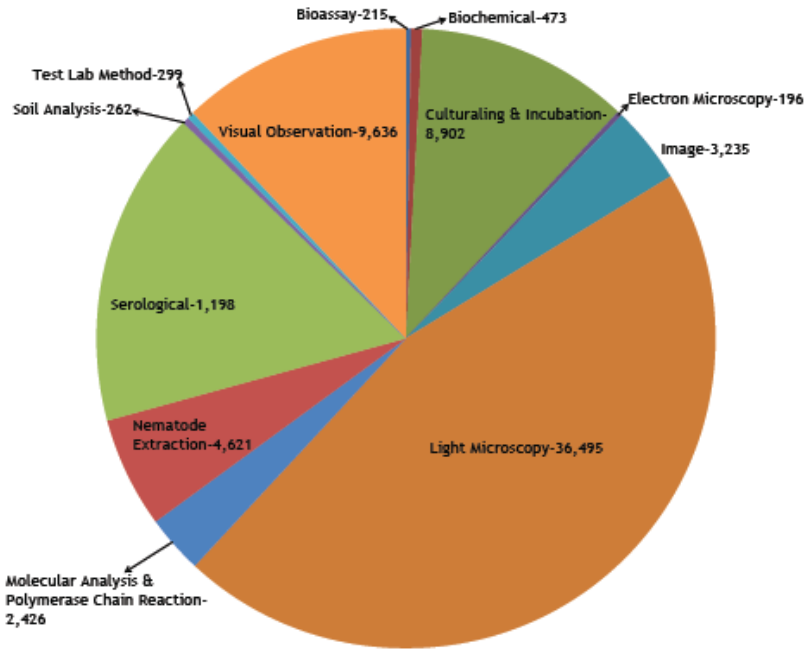
Diagnostics

- Proficiency panels and provisional authorization for diagnostics of high consequence pathogens
- Increased capacity for surge
  - Ramorum blight
  - Plum pox virus

Lab Accreditation

- Quality Management System Workshop, AALVD facility, Ames, IA
- GAP Audit and Document Review, Cornell University, Ithaca
- ISO-17025 Auditor Training, University of Florida, Gainesville
- GAP Audit with Auditor Checklist Review, University of Florida, Gainesville
- GAP Audit with Auditor Checklist Review, Kansas State University

Diagnostics: Methods and Training



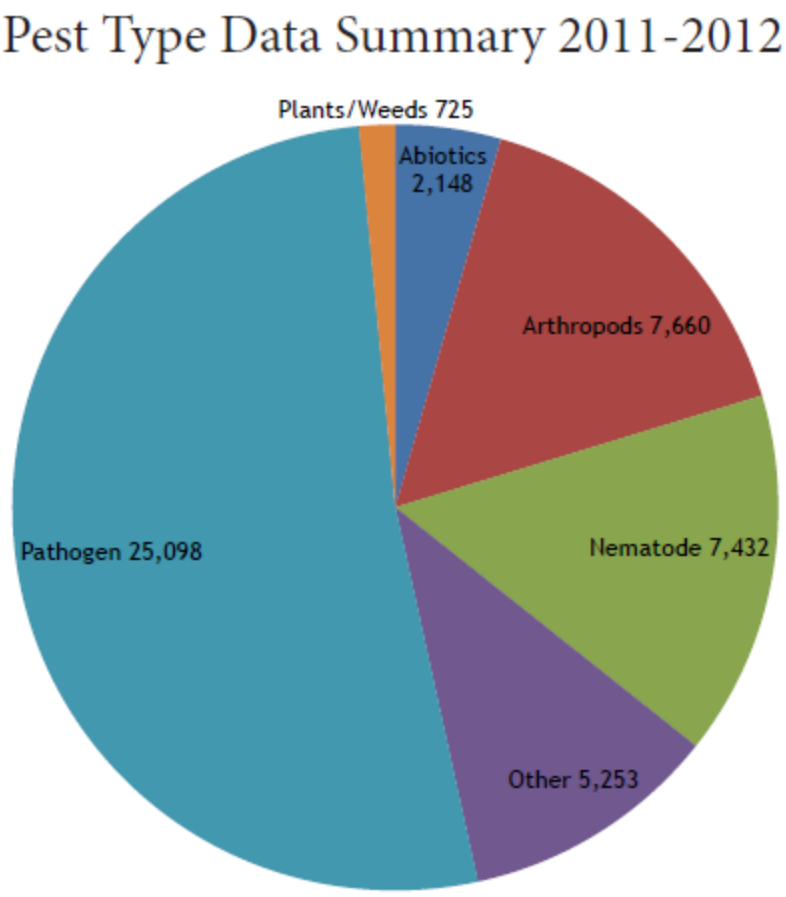
APHIS Sponsored Diagnostic Training Sessions	Number of Training Sessions	Number of Diagnosticians Trained
*Bioinformatics 1	6	43
*Bioinformatics 2	2	17
*Citrus Leprosis, Sweet Orange Scab, Citrus Black Spot	2	15
*Citrus Greening Disease (Huanglongbing)	6	25
**Phytophthora ramorum*	6	38
**Phytophthora ramorum* & *Phytophthora kernoviae*	4	24
*Plum Pox Virus, Potyvirus	1	8
*Potato Cyst Nematode	4	32
*Potato Wart (*Synchytrium endobioticum*)	4	15
**Ralstonia solanacearum*; Race 3, Biovar 2	5	32
*Soybean Rust (*Phakopsora pachyrhizi*)	2	34
*Soybean Rust (*Phakopsora pachyrhizi*) & *Ralstonia solanacearum*; Race 3, Biovar 2	1	10

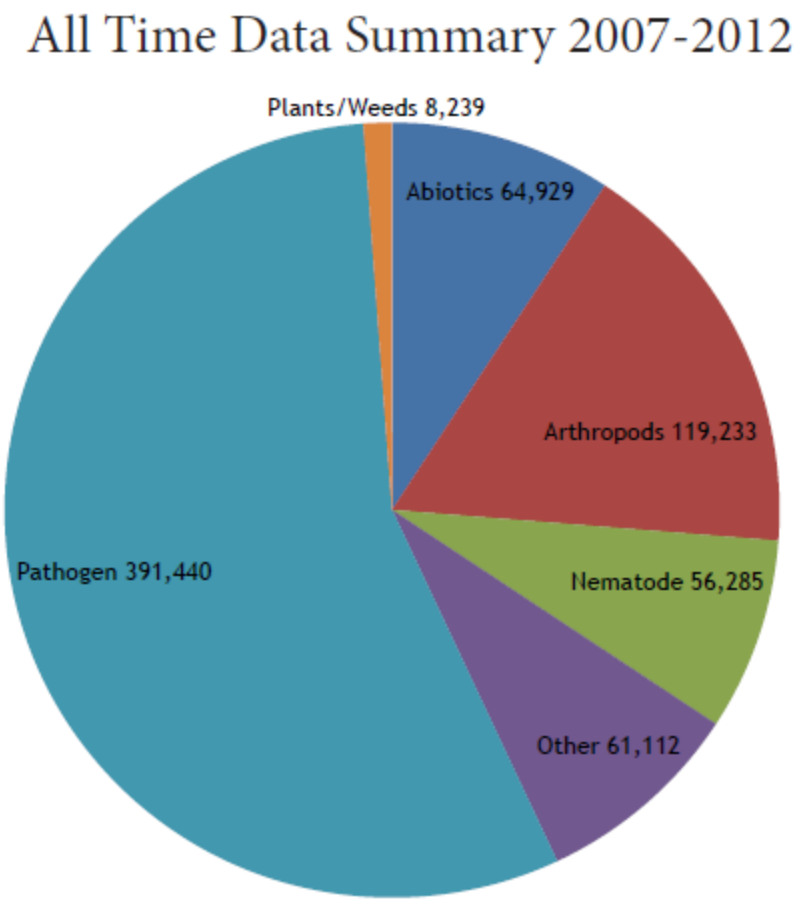
Types of method used in 2011-12

National Data Repository
Located at CERIS at Purdue University

- LGU Labs in every state and many territories report diagnostics data
- Many state departments of Ag report data
- Industry labs also contribute
- Over 7,400 types of pests or pathogens reported
- 15 classes of diagnostic methods
- 769,621 records in the Repository (as of 4/14/13)

Data in the Repository





More information

- National Institute for Microbial Forensics & Food and Ag Biosecurity Research Institute
  - http://entoplp.okstate.edu/nimffab
- Biosecurity Research Institute
  - http://www.bri.k-state.edu/
- Emerging Pathogens Institute
  - http://www.epi.ufl.edu/
- The National Plant Disease Diagnostic Network
  - http://npdn.org