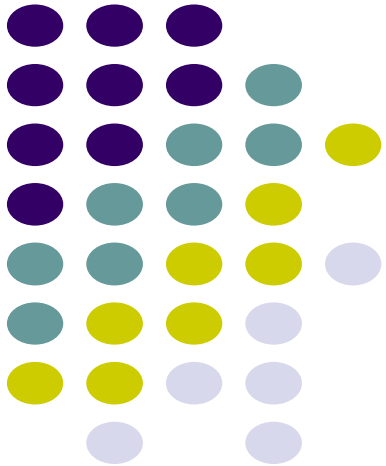
Plant and microbial Forensics



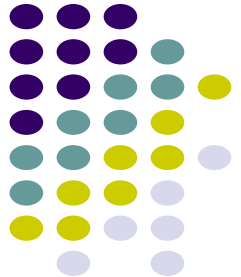
- Microbial forensics is defined as the application of scientific approaches to solving a crime that involves a microorganism
- Its goal is to investigate and present unbiased scientific evidence useful for attributing the crime to a perpetrator. Recent programs intended to enhance general capabilities in microbial forensics have included specific attention to plant pathogens.

- Compared to the strategies employed by traditional plant disease diagnosticians, forensic applications of plant pathogen diagnostics require unusually high levels of stringency, reliability, and prior validation.
- These assays must be paired with
  - court-defensible sampling methods,
  - chain of custody, and
  - other traditional and non-traditional methods of forensic investigation.

Forensic plant pathology

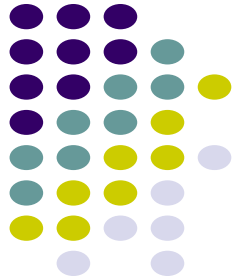
- It is a blend of the disciplines of plant pathology and forensic science that supports the investigation of plant diseases and pathogens by providing unbiased scientific methodology and evidence for criminal attribution. Important to this effort are traceback strategies for determining pathogen origin and movement pathway(s) as well as the possible role of human intent.
- Multidisciplinary teams including representatives of the diagnostic, regulatory, and law enforcement communities must work in coordination to achieve the most effective response.
- More creative strategies for both vertical and horizontal communication among the involved biosecurity and law enforcement agencies are needed

Forensics vs. Traditional Plant Disease Diagnosis



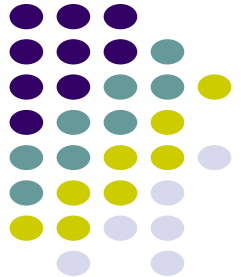
- Traditional plant disease diagnosticians use multi-faceted approaches to detect and identify diseases and the causal pathogens. Primary stakeholders include farmers, extension educators, crop consultants, and regulatory officials, and the primary goal is to identify the pathogen to recommend effective means of disease management.
- Forensics is the application of scientific methods and strategies to solve a crime, with the primary goal of connecting the crime to a perpetrator(s) for the purpose of criminal attribution. The major stakeholders of forensic science include members of the law enforcement, security, investigative and regulatory communities.

Why Do We Need Plant Pathogen Forensics?



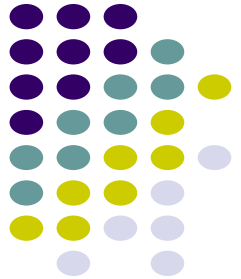
- The plant-based resources of any nation (forests, rangelands, crops raised for food and fiber, etc.) are among the most critical components of its infrastructure, contributing to a healthy environment and robust national and international trade markets. Any critical element of a national infrastructure might become a target for those having a motive to harm a nation, region, company, person or other entity.
- Crimes are not always committed intentionally. Negative consequences can result from unintentional actions. For example, if a grower purchases seed that is certified as disease-free, but later, after losing the crop to disease, learns that the order was filled inadvertently with pathogen contaminated seed, there may be cause for a lawsuit based on criminal negligence.
- Other crimes may include multiple elements; for example, smuggling of exotic plant material such as seeds, fruits, or propagative plant parts is a frequent biocrime at airports and ports of entry, but if the smuggled material is contaminated with pathogens or other exotic microbes there may be additional criminal charges for which forensic investigation is needed.

Has a Crime Occurred?



- A prerequisite to any forensic investigation is an informed judgment that a crime has been committed. It is important to know if the presence of a plant pathogen or the occurrence of a plant disease may have resulted from criminal activity
- Since agricultural producers and consultants, environmental specialists and plant disease diagnosticians are generally unused to considering the possibility of intentional intervention (a term called “suspicion inertia”), it is important to consider what features of a plant disease event might prompt a contact that would lead to investigation

Sampling for Plant Pathogen Forensics

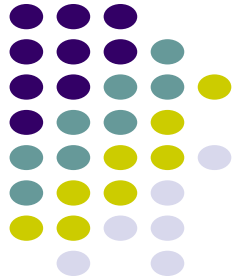


- Sample Collection
- Chain of Custody

Assay Features

- **Pathogen Detection Assays**
  - Pathogen detection methods used in microbial forensics include an array of serological and molecular detection assays, mass spectrometry, nucleic acid sequencing and bioinformatics. Selection of the most appropriate method(s) depends on the type of pathogen, the tools available, and the scope of the screening.
- **Pathogen Discrimination Assays**
  - Because microbial forensics is often a question of fine-level “matching” of microbes found at a crime scene with those associated with a suspect, microbes may be subjected to molecular fingerprinting techniques such as restriction fragment level polymorphisms (RFLP), multi-locus variable repeat assays (MLVA), single nucleotide polymorphism (SNP) assays, single sequence repeat or inter-single sequence repeat (SSR and ISSR) assays that will discriminate among strains of a pathogen.

Evidence Interpretation and Criminal Attribution



- Forensic evidence is judged in the courtroom and the judgment is conferred by a jury panel. In the investigation of a crime that may involve plant pathogens, forensic plant pathologists must gather, safeguard, analyze and interpret a comprehensive package of information to be used by prosecutors or defendants as evidence in a court of law.
- In addition to diagnostic assays providing pathogen identification data with acceptable confidence levels interpretation of field and laboratory tests must be done in consideration of other evidence such as the chain of sample custody, the history of the disease site and crop, possible motives and access of individuals other than the suspect (including those impacted by the disease outbreak) and other relevant factors.
- At times, even a comprehensive package of evidence and court testimony is unlikely to result in 100 % confidence in a verdict.