Thematic Area: Pathogen Identification and Disease Diagnostic

Overview of Research:

Pathogen detection and disease surveillance are key components of early outbreak detection for pandemic prevention of human, animal, and plant diseases. Effective high throughput detection of high-risk pathogens requires innovative sensor technology and deep knowledge of the pathogens that we want to detect. To obtain that knowledge, emerging pathogens need to be identified first. This requires extensive genome reference databases and efficient algorithms. Only upon identification, can pathogen-specific detection assays be developed and outbreaks can be attempted to be contained using vaccines and drugs in the case of human and animal pathogens or using disease-resistant crops in the case of plant pathogens. Scientists in the CeZAP Pathogen Identification and Disease Diagnostic thematic are at Virginia Tech are developing and applying innovative technology and software in pathogen identification, detection, and disease surveillance and diagnostics to help detect new disease outbreaks before they turn into the next pandemic.

Faculty focusing on plant pathogen identification and plant disease diagnostics:

Boris Vinatzer (School of Plant and Environmental Sciences - SPES)
Song Li (SPES)
Lenwood Heath (Computer Science)
Juhong Chen (Biological Systems Engineering)
Lina Rodriquez Salamanca (SPES)
Elizabeth Bush (SPES).

Highlight Research relating to the specific thematic area (focus on plant diseases):

- Lenwood Heath and Boris Vinatzer develop and implement software, databases, and web servers for genome-based pathogen identification
- Boris Vinatzer and Song Li use metagenomic sequencing for precise and sensitive detection of plant pathogens.
- Song Li uses machine learning to analyze sequence data and symptoms of infected plants
- Juhong Chen develops CRISPR-Cas12a-based tests to detect various human and plant pathogens
- Lina Rodriquez Salamanca and Elizabeth Bush lead the VT plant disease clinic and diagnose diseases in plants from the field, nurseries, forests, and home gardens using everything from microscopy to molecular assays.

Recent Grants:

Kelly Eversole, Boris Vinatzer, Caitilyn Allen, Gwyn Beattie	USDA-APHIS	$253,781	7/1/2022	6/30/2023	5%	Updating the Ralstonia solanacearum race 3 biovar 2 select agent circumscription
Boris Vinatzer, Juhong Chen, Song Li	USDA-APHIS	$50,550	8/1/2022	7/31/2023	5%	CRISPR-Cas12a for sensitive and specific detection of Xylella fastidiosa subspecies and strains
Eric Newberry, Boris Vinatzer	USDA-APHIS	$55,877	7/1/2022	6/30/2023	5%	Leveraging high-throughput sequencing technologies to detect and genotype Ralstonia solanacearum directly from plant samples
Song Li, Boris Vinatzer, Chang	USDA-NIFA-CPS	$1,023,319	1/15/2021	1/14/2024	5%	CPS: Medium: Collaborative Research: Early stage plant disease

Lu, George Kantor						detection via robotic sampling and in situ sequencing
Chang, J., Bush, E., Grunwald, N., Jacobs, Pierzynski, J., J., Putnam, M., Li, S., and Vinatzer, B.	USDA-NIFA-AFRI	$900,001	01/2021	12/2023	5%	FACT-CIN: Developing genome and metagenome sequencing and computational tools for disease detection in plant clinics (This proposal)
Boris Vinatzer, Lenwood Heath	NSF-DBI	$657,963	8/1/2020	7/30/2023	10%	BBSRC-NSF/BIO/Collaborative Research: genomeRxiv: a microbial whole-genome database and diagnostic marker design resource for classification, identification, and data sharing

Recent publications:

1. Kasputis T, Hilaire SS, Xia K, Chen J (2022) Colorimetric Detection of Antimicrobial Resistance from Food Processing Facilities Using a CRISPR System. ACS Food Science & Technology https://pubs.acs.org/doi/abs/10.1021/acsfoodscitech.2c00302
2. Johnson MA, Liu H, Bush E, Sharma P, Yang S, Mazloom R, Heath LS, Nita M, Li S, **Vinatzer BA** (2022) Investigating plant disease outbreaks with long-read metagenomics: sensitive detection and strain-level identification of *Xylella fastidiosa*. Microbial Genomics doi.org/10.1099/mgen.0.000822
3. Sharma P, Johnson MA, Mazloom R, Allen C, Heath LA, Lowe-Power TM, **Vinatzer BA** (2022) Meta-analysis of the *Ralstonia solanacearum* species complex (RSSC) based on comparative evolutionary genomics and reverse ecology. Microbial Genomics 8(3). doi.org/10.1099/mgen.0.000791
4. Yang S, Johnson MA, Hansen MA, Bush E, Li S, **Vinatzer BA** (2022) Metagenomic sequencing for detection and identification of the boxwood blight pathogen *Calonectria pseudonaviculata*. Scientific Reports 12:1399. doi.org/10.1038/s41598-022-05381-x
5. Tian L, Huang C, Mazloom R, Heath LS, **Vinatzer BA** (2020) LINbase: a web server for genome-based identification of prokaryotes as members of crowdsourced taxa. Nucleic Acids Research, https://doi.org/10.1093/nar/gkaa190

Honors or recognitions:

Vinatzer received the CALS Outstanding Graduate Student Mentor Award in 2022

Overview of mentor activities (undergraduate, graduate, and/or professional students):

The PIs have several undergraduate students, graduate students, and postdocs, some of them co-advised.

Overview of CeZAP and/or ID-IGEP involvement:

Vinatzer heads this thematic area and was a reviewer for the last seed grant competition.