

# Network Analysis in Plant Pathology Research: Disentangling Complex Data

Course materials at:

[github.com/GarrettLab/NetworkWorkshopAPS2024](https://github.com/GarrettLab/NetworkWorkshopAPS2024)

Thanks to UF Plant Pathology  
for co-sponsoring this workshop!



# Workshop teachers

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Ashish Adhikari, PhD

Romaric Mouafo Tchinda, PhD

Aaron Plex Sulá (goes by Plex)

Jacob Robledo Buritica, MS

# Learning goals

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- Experience with R
  - No? Our goal is for you to get started with R, so you are ready to explore R more in the future
  - Yes? Our goal is for you to come away ready to use some new applications
- Experience with network analysis
  - No? Our goal is for you to get a taste of how network models may be useful in your research, ready for more exploration
  - Yes? Our goal is for you to come away ready to use some new applications in R

*Annual Review of Phytopathology*

# Network Analysis: A Systems Framework to Address Grand Challenges in Plant Pathology

K.A. Garrett,<sup>1,2,3</sup> R.I. Alcalá-Briseño,<sup>1,2,3</sup>  
K.F. Andersen,<sup>1,2,3</sup> C.E. Buddenhagen,<sup>1,2,3,4</sup>  
R.A. Choudhury,<sup>1,2,3</sup> J.C. Fulton,<sup>1,2,3</sup>  
J.F. Hernandez Nopsa,<sup>1,2,3,5</sup> R. Poudel,<sup>1,2,3</sup>  
and Y. Xing<sup>1,2,3</sup>

## Major societal projects

- Food security
- Food safety
- Wildlands conservation
- Scientific understanding of the world

## Threats due to plant disease

- Lower crop yields, higher yield variability, lower farm profit margins
- Toxin production in foods, synergies with human pathogens
- Plant species extinction or diminished ecological function, disease management effects on nontarget species

## Inherent challenges for plant pathology

- Global change: climate, trade, land use, political instability, human population growth
- Pathogen invasions
- Pathogen evolution

## Operational challenges for plant pathology

**A** Limited resources

**B** System complexity

**C** Global economic inequality

**D** Data: global availability

**E** Data: phytobiomes

**F** Leveraging progress in other disciplines, including the science of science

## New opportunities

## Benefits of network analysis

- A** Identify geographic and temporal priorities for interventions
- B** Provide new tools to operationalize concepts such as sustainability and resilience
- C** Link plant pathology with socioeconomics to reach low-income farmers and increase agricultural development impacts
- D** Integrate global data layers across scales
- E** Clarify phytobiome interactions and identify key players
- F** Integrate plant pathology with progress in disciplines such as human epidemiology, physics, electrical engineering, and sociology

# Outline for workshop (1-5 pm)

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Introduction to networks (Plex)

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Introduction to R (Romaric)

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Break

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Networks in R (Romaric and Plex)

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Break

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Epidemic networks (Jacob)

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Break

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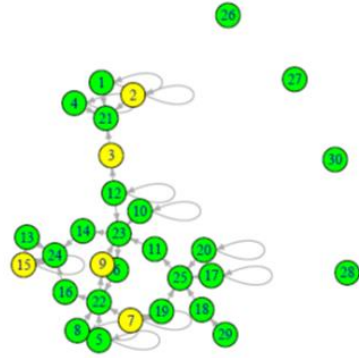
Microbiome networks (Ashish)

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R2M toolbox and conclusions (Karen)

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# Group introductions



- Your name
- Your institution
- The general topics you address in your work
- What type of questions would you like to answer with network analysis?
- If you already use network analysis, what is an example of your application?
- Fun fact about you

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# Join us at APS Plant Health 2024 – Garrett Lab



## **Ashish Adhikari** - Postdoctoral Researcher

1. WORKSHOP: Network Analysis : Microbiome network in R. July 27 1:00 PM – 5:00PM CDT
2. R2M toolbox for rapid risk assessment supporting mitigation of pathogens and pests: Perspectives on rice health in Nepal. July 30 10:45AM – 11:00 AM CDT
3. Wildfire smoke in a One Health framework: Network analysis to disentangle fungal-bacterial microbiome complexity and predict pathogen associations.

July 29, 2024, 4:00 PM – 4:45PM CDT



## **Jacobo Robledo** - PhD Student

1. Digital Innovations in the Surveillance and Management of Banana and Plantain Diseases in Colombia. July 30 at 1:45 PM – 2:15 PM CDT in "Melhus Graduate Student Symposium"



## **Berea Etherton, PhD**

Disaster plant pathology: smart solutions for threats to global plant health from natural and human-driven disasters.

July 30 @ 4:00, poster P-212, in Epidemiology II



## **Aaron I. Plex Sulá** - PhD Student

1. Global host-pathogen infection networks in major terrestrial agroecosystems. July 28 @ 1:45 – 2:00 PM in session "Microbiome"
2. The global population genetic structure of Potato spindle tuber viroid in major agroecosystems. P-529 July 29 @ 4:45 – 5:30 PM CDT.
3. The multi-centennial accumulation of new infectious diseases in major agroecosystems (1500-2020). P-400 July 30 @ 4:45 – 5:30 PM CDT.



## **Romaric Mouafo-Tchinda** - Postdoctoral Researcher

1. Global proactive surveillance and mitigation strategies for laurel wilt under climate change. July 29 @ 4:45PM, poster P-581, in Late-Breaking I
2. Pathogen and pest risk across climate gradients in the Great Lakes region of Africa for banana, cassava, potato, and sweetpotato. July 30 @ 4:00PM, poster P-216, in Epidemiology II
3. Humanitarian crises in Cameroon and Ethiopia: pathogen and pest threats to vegetatively propagated crops. July 30 @ 4:45PM, poster P-456, in Pathogen Survey II



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