

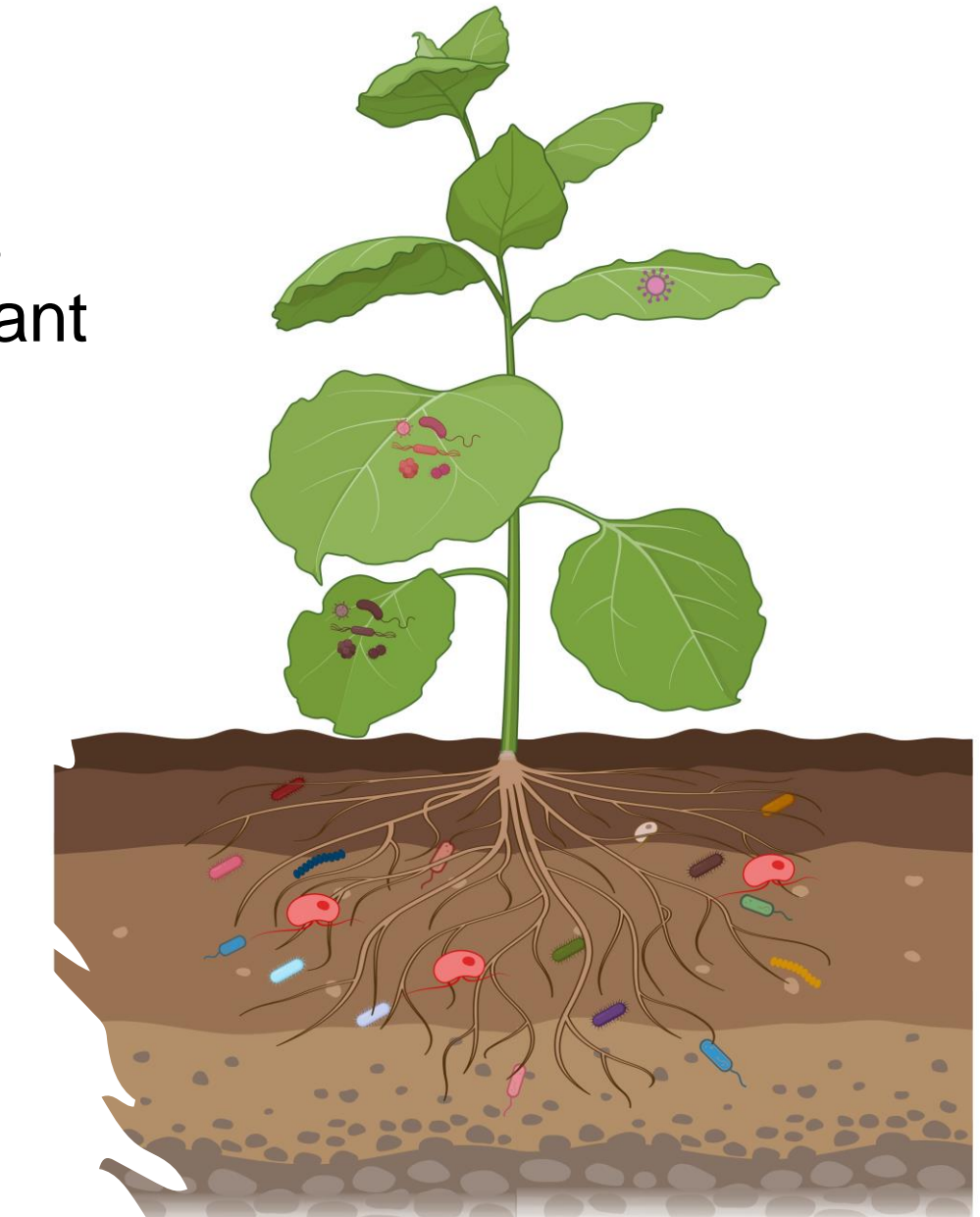
The rhizosphere microbial community varies among tobacco cultivars with different resistant mechanisms to *Phytophthora nicotianae*

Yuan Zeng

Assistant Professor & Extension Specialist

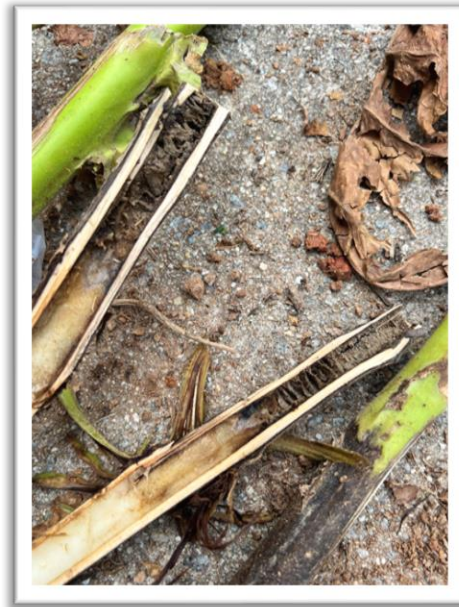
Southern Piedmont AREC

Virginia Tech

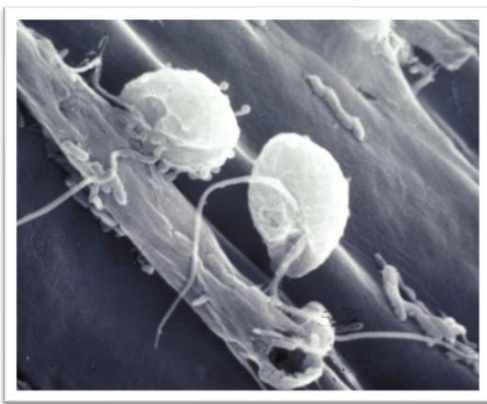
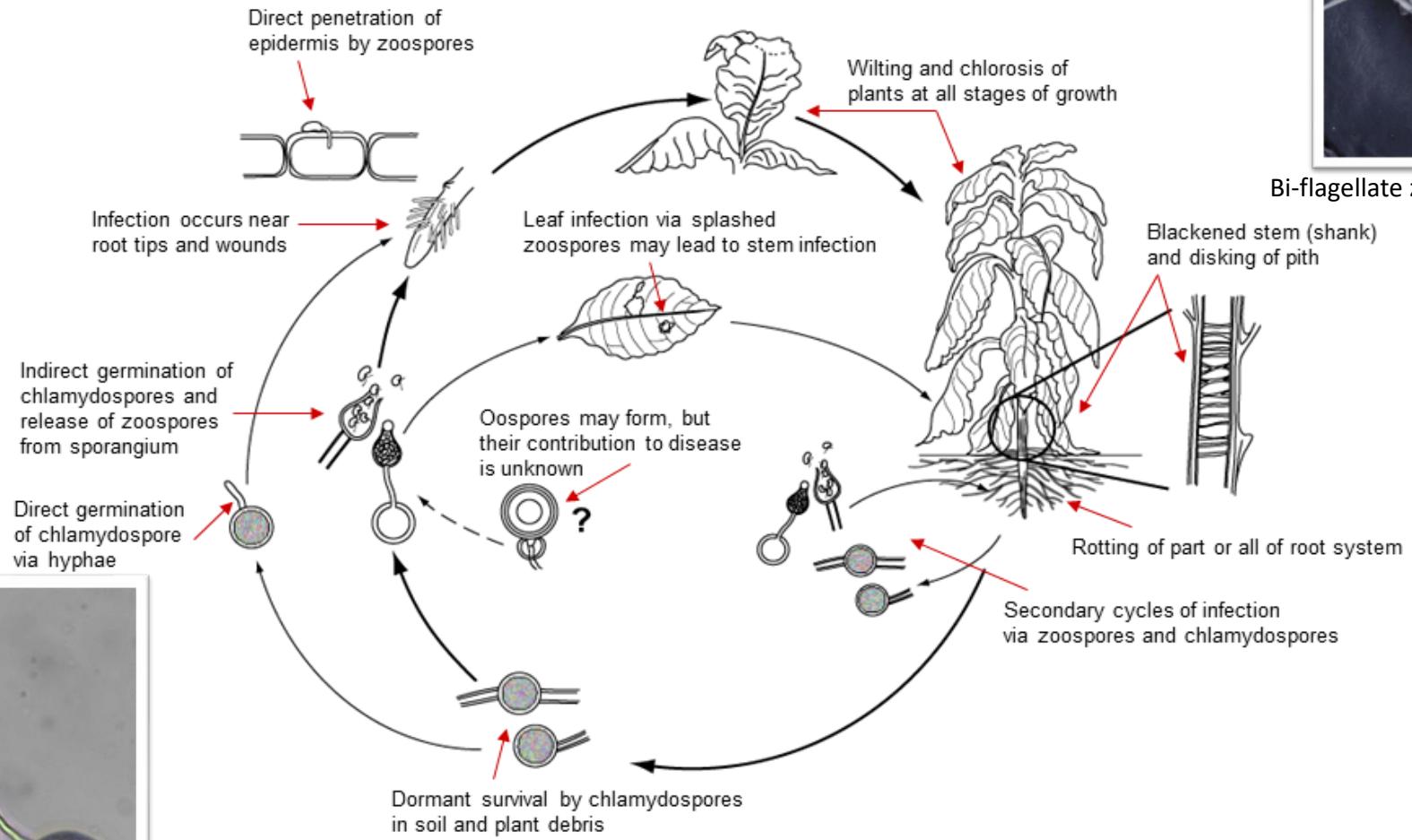


Black shank

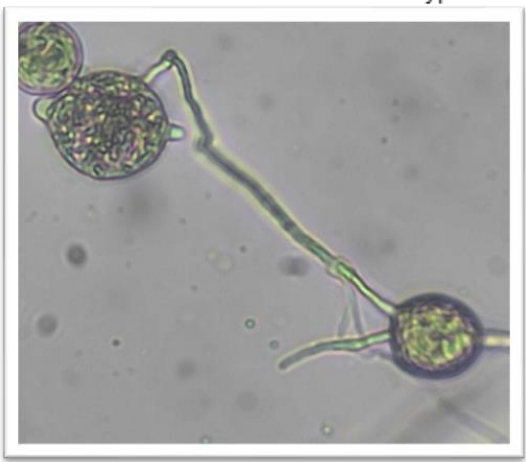
- Caused by the oomycete pathogen *Phytophthora nicotianae*
- The pathogen survives at temperatures between 5–40°C (41–104 F) with optimum growth at 25–32°C (77–89.6 F)
- *Phytophthora nicotianae* race 1: the prevalent race
- Yield loss: up to 100%



Black shank disease cycle



Bi-flagellate zoospores (*this photo: David Shew*)



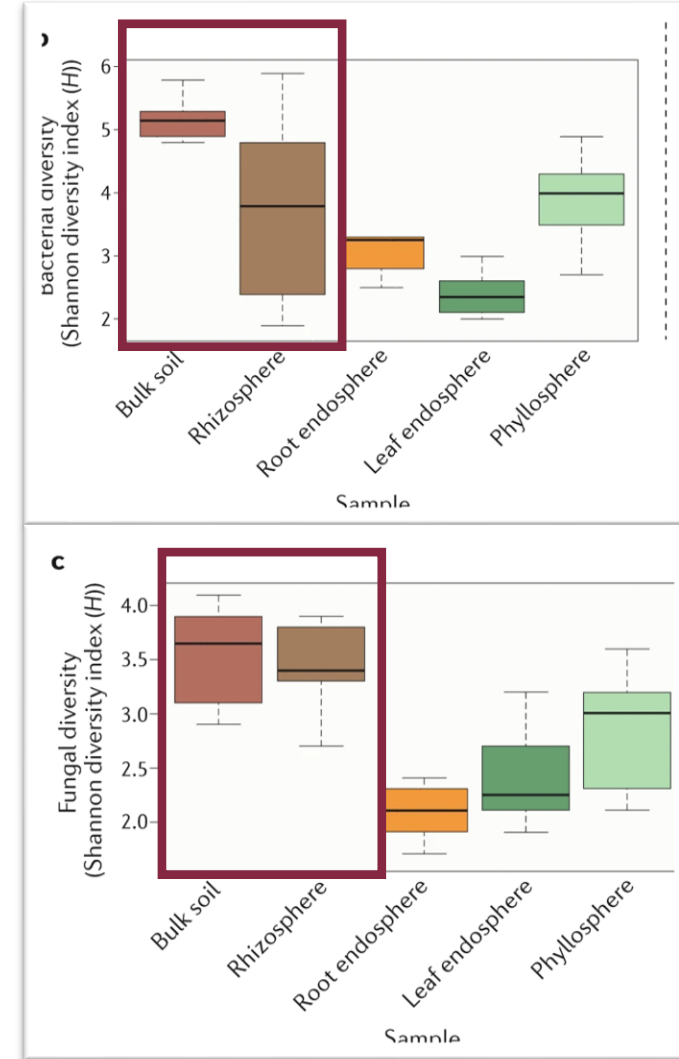
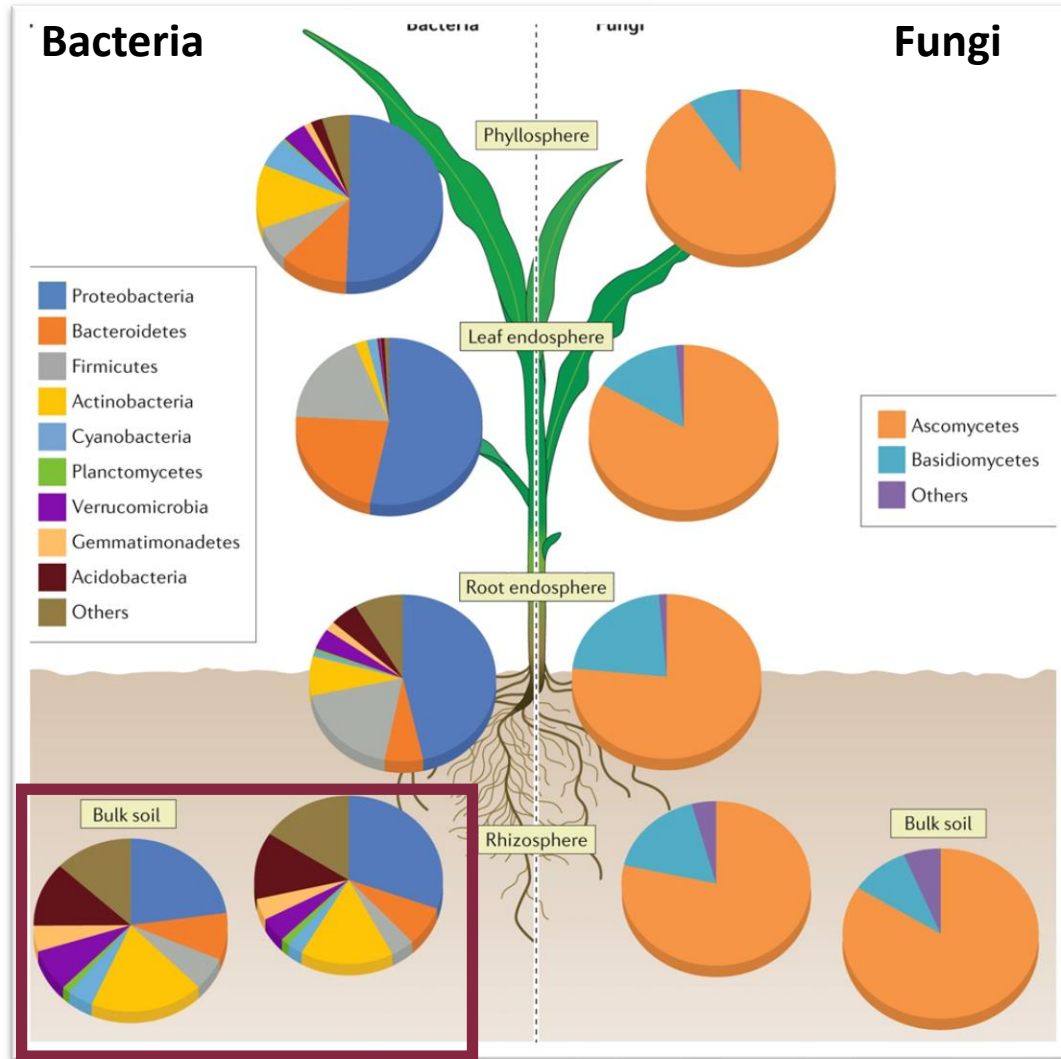
A chlamydozoospore produced a sporangium

Black shank disease cycle (*by David Shew*)

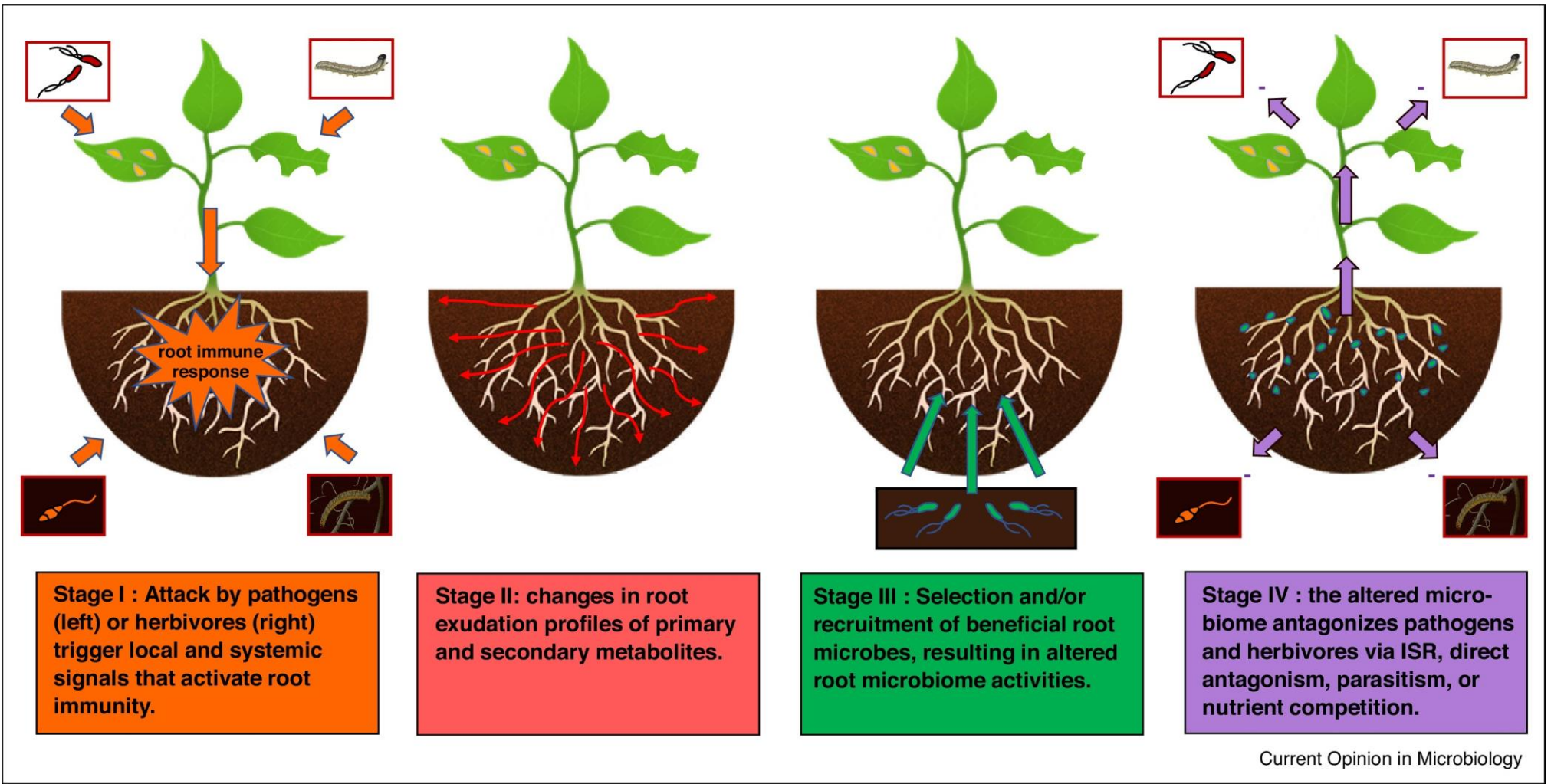
Management practices

- **Selection of tolerant varieties to *P. nicotianae***
 - **Wz**
 - **FI 301**
 - Phl
 - Php
- **Crop rotation**
 - Avoid tobacco following tobacco/potato/tomato at the same location
- **Chemical applications**
 - At transplant (e.g., Orondis Gold, Ridomil Gold)
 - Pre- and post-plant spray (e.g., Ridomil Gold, Orondis Gold, Ultra Flourish, etc.)
 - Soil fumigants

General structure of microbial community from various niche



Stressed plants assemble protective rhizobiomes: “cry for help”



Research questions



Are there any variations of the rhizosphere microbiome among cultivars with different resistant genes?

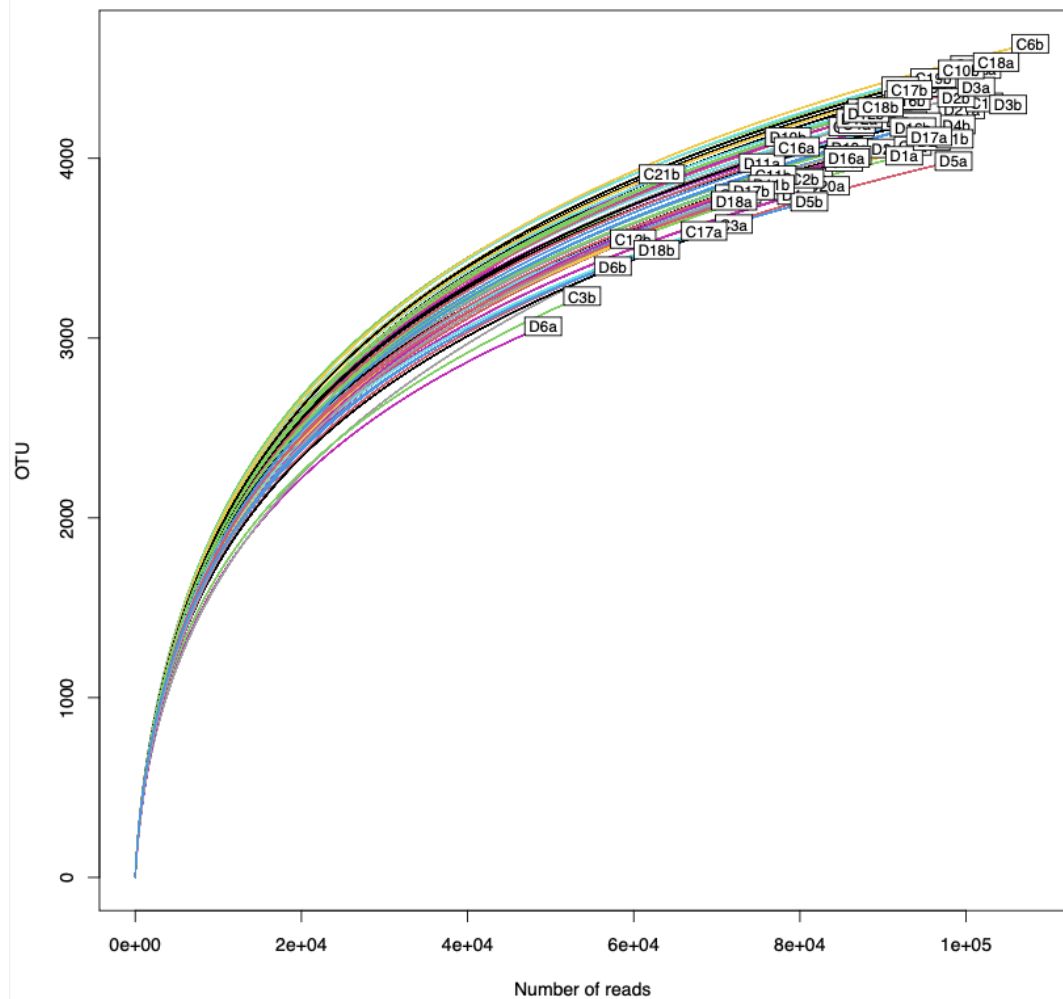
Do rhizobionomes play a role in disease suppression or pathogen inhibition?

Selection of varieties

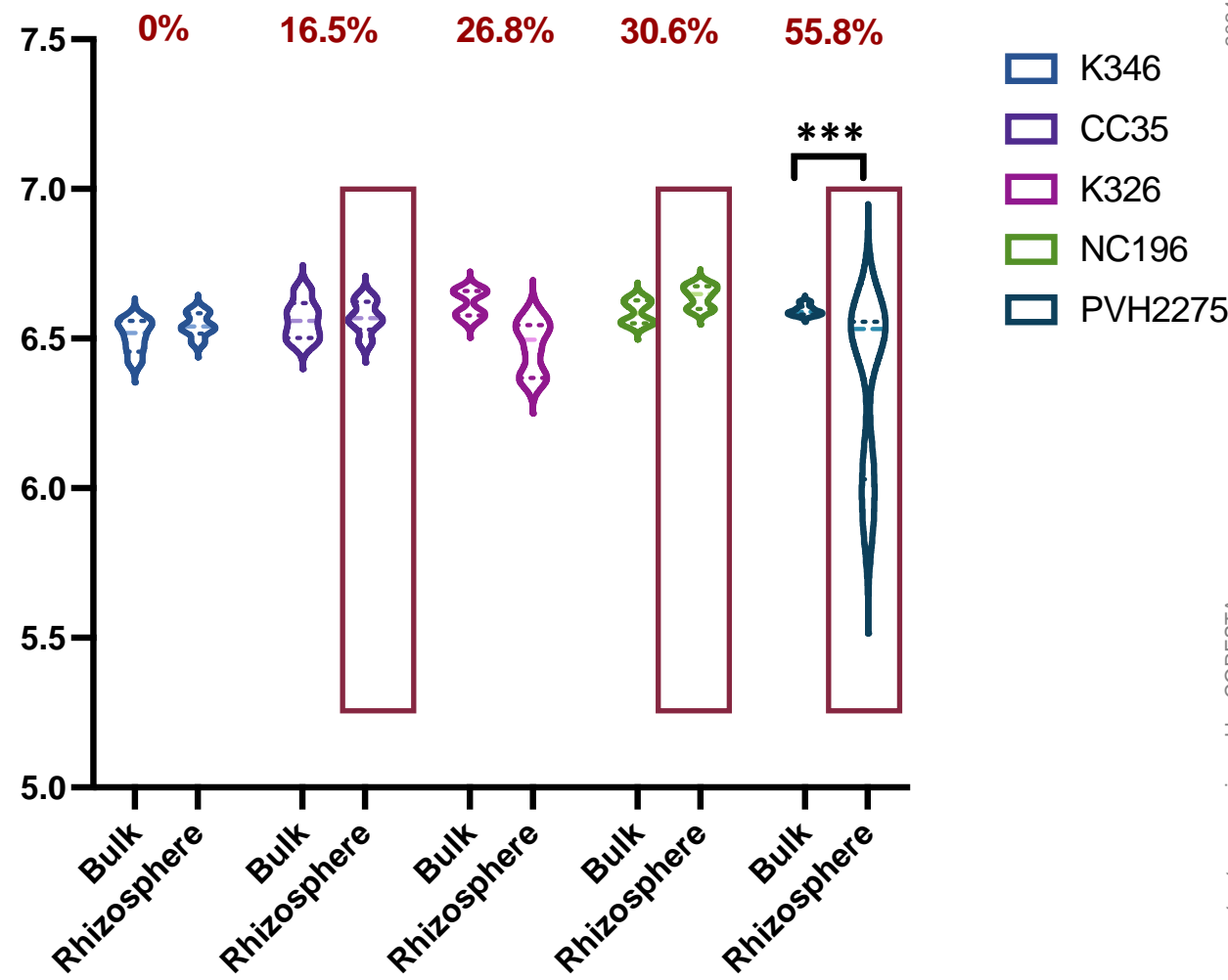
Cultivar	Resistance mechanism	Resistance level
PVH2275	<i>Php</i>	Immunity (race 0); no resistance (race 1)
K326	Partial polygenic	Low to moderate (races 0, 1)
NC196	<i>Php</i> & partial polygenic	Immunity (race 0); moderate (race 1)
CC35	<i>Wz</i>	High (races 0, 1)
K346	Polygenic	High (races 0, 1)

- Six plants/variety (after topping); 6 bulk soil & 6 rhizosphere soil per variety
- 16S and ITS amplicon sequencing

Bacterial community – alpha diversity

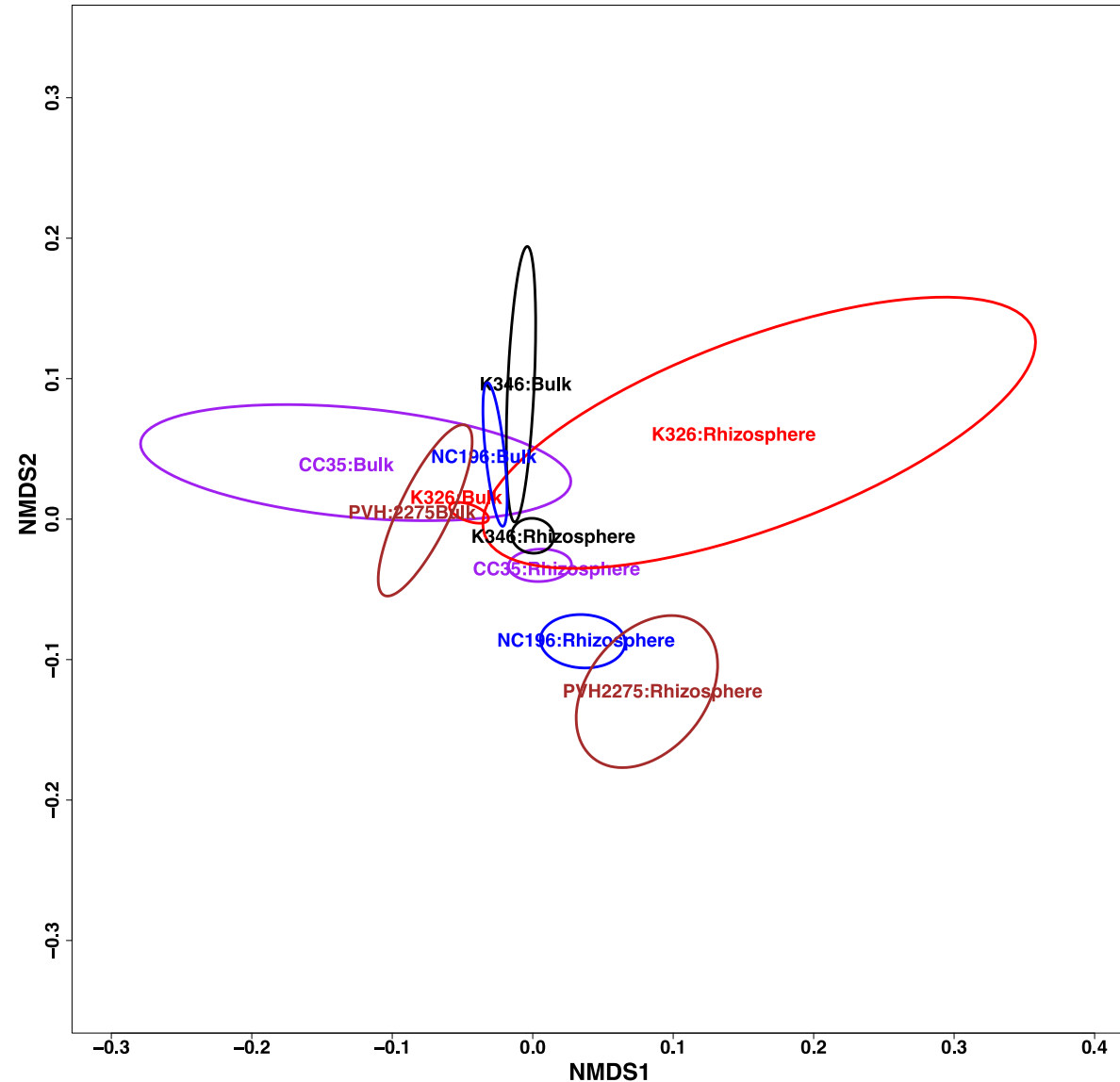


The rarefaction curves of 16S rRNA



Shannon diversity

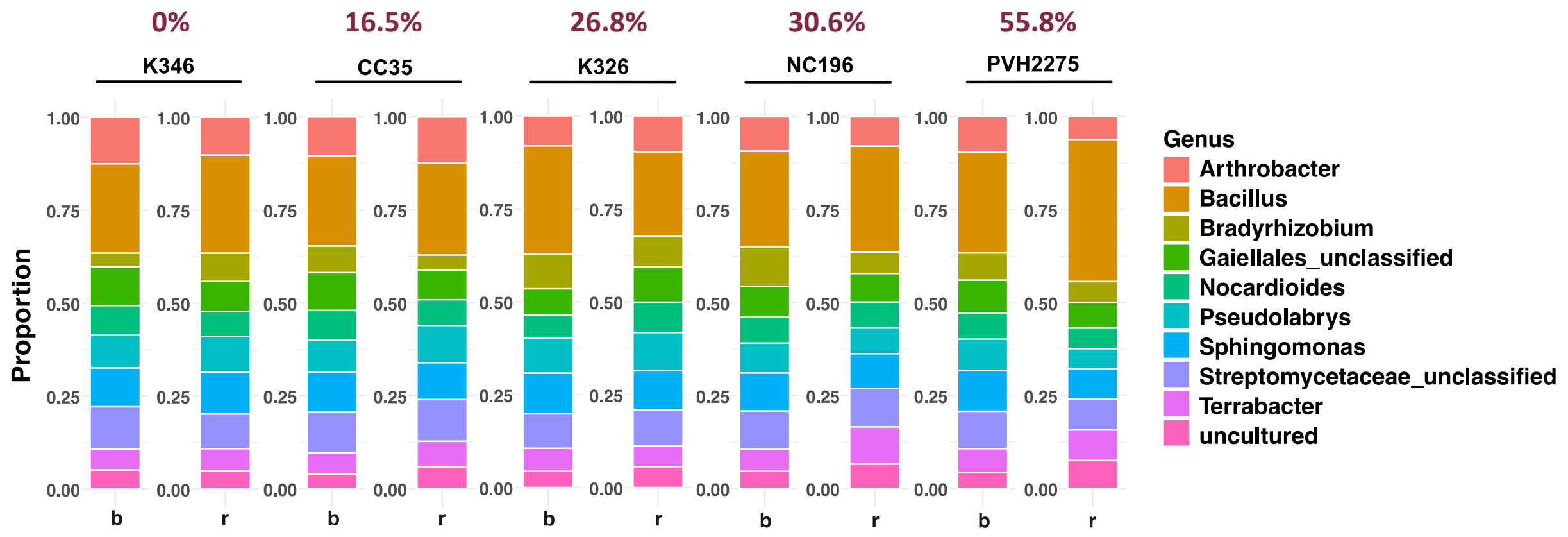
Bacterial community – beta diversity



Three-dimensional nonmetric multidimensional scaling (NMDS) based on Bray-Curtis dissimilarities of bacterial community.

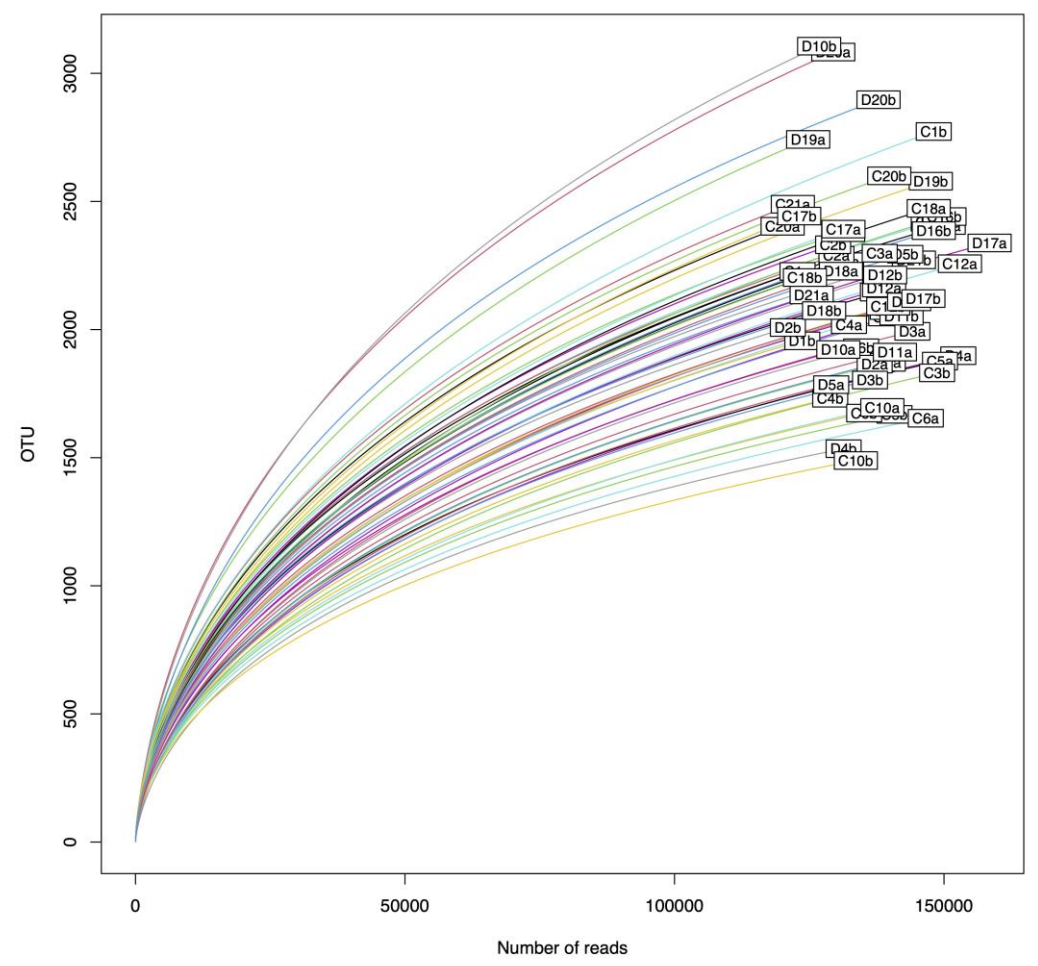
- More distinct clusters of bacterial community of rhizosphere and bulk soil were found in tobacco cultivars with more severe wilting symptoms (e.g., 'PVH2275' and 'NC196')

Bacterial community compositions at genus rank

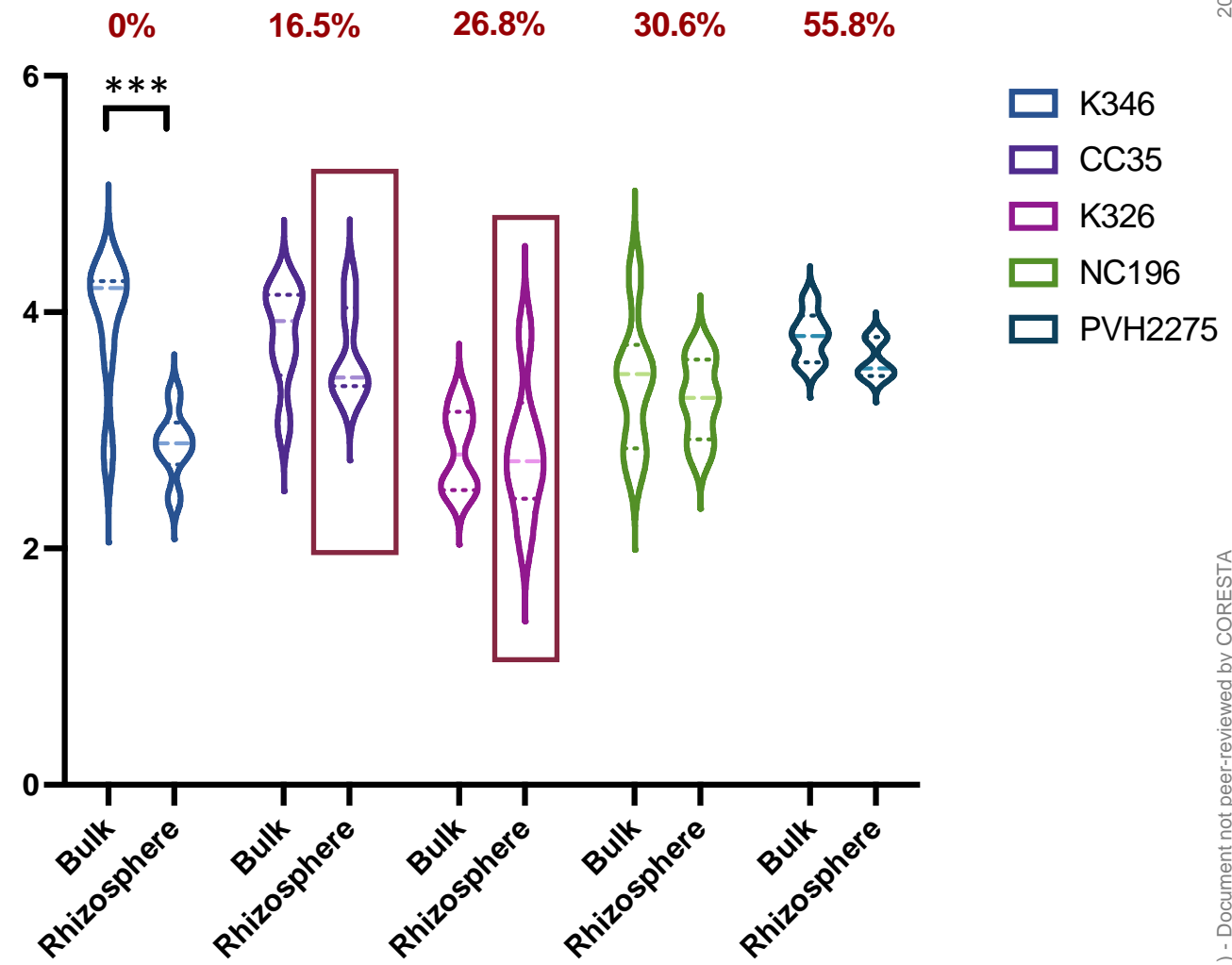


Bacterial community compositions at genus rank (relative abundance > 2%) in bulk (b) and rhizosphere (r) soil of five tobacco cultivars

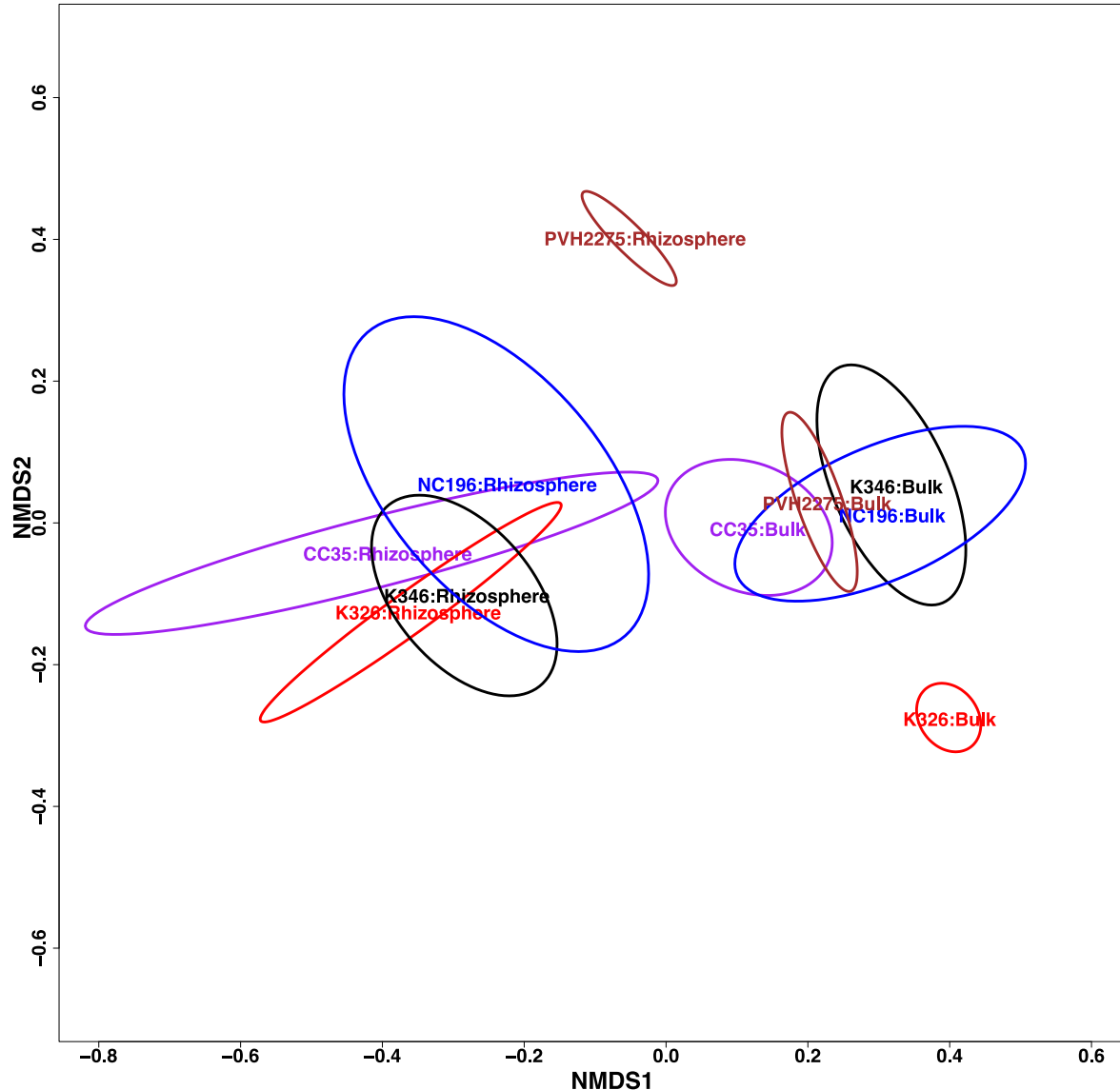
Fungal community – alpha diversity



The rarefaction curve of ITS rRNA



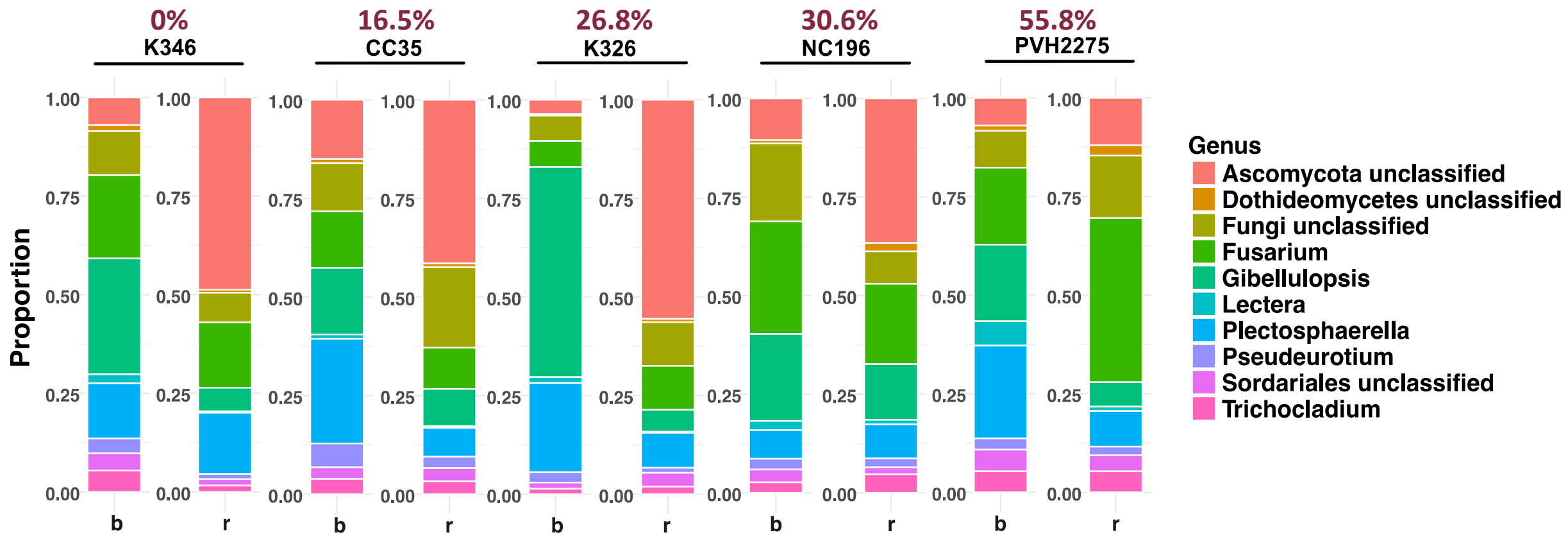
Fungal community – beta diversity



Three-dimensional nonmetric multidimensional scaling (NMDS) based on Bray-Curtis dissimilarities of fungal community.

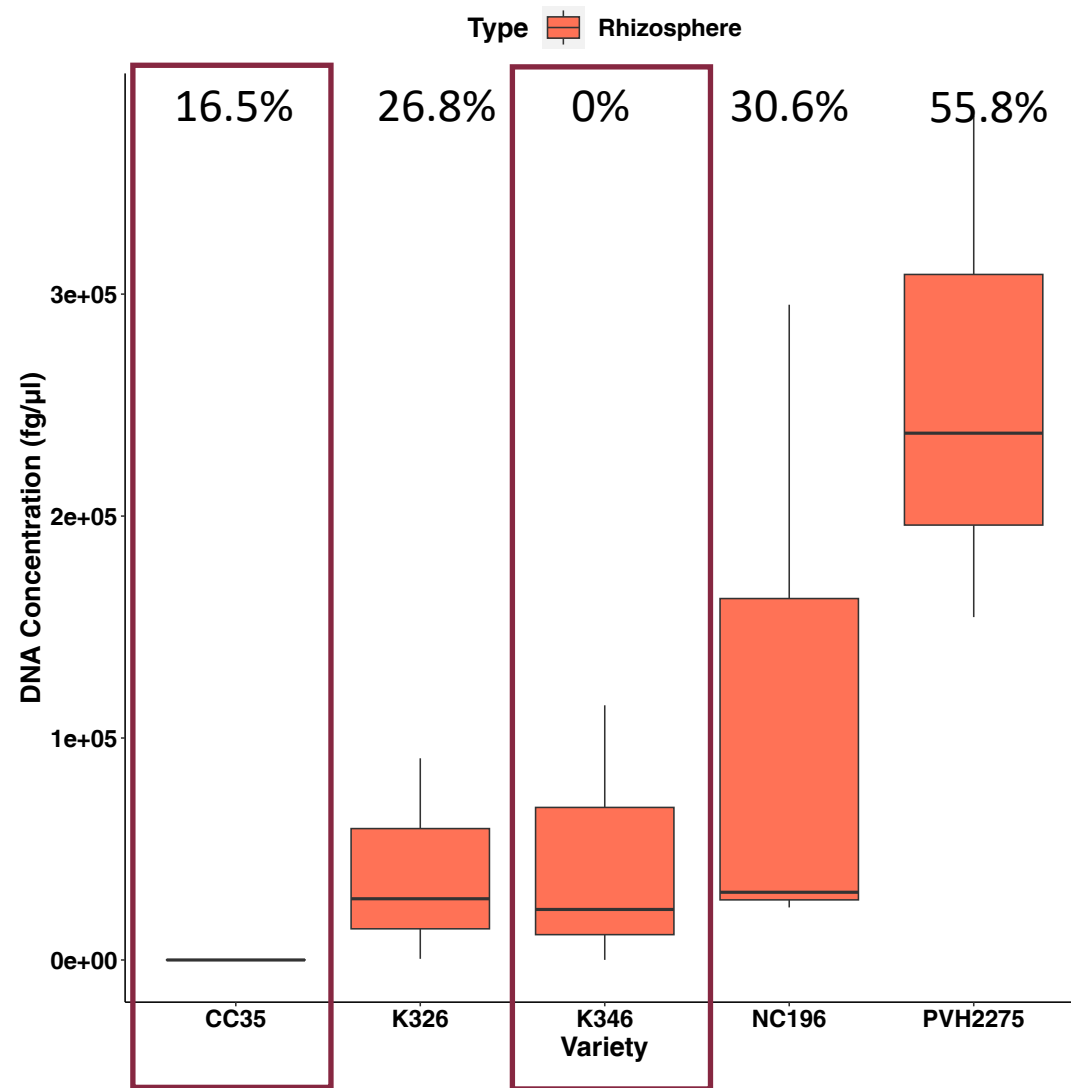
- The overall fungal community structure between the rhizosphere and bulk soil was significantly different regardless of tobacco cultivars.
- The rhizosphere fungal community structure of 'PVH2275' significantly differed from other cultivars.

Fungal community compositions at genus rank

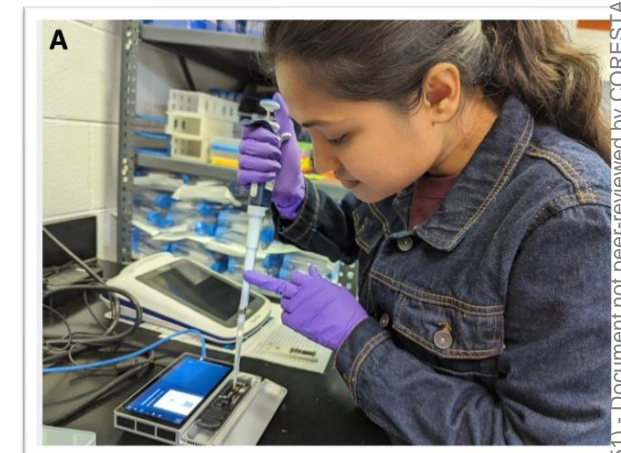


Fungal community compositions at genus rank (relative abundance > 2%) in bulk (b) and rhizosphere (r) soil of five tobacco cultivars

Phytophthora nicotianae DNA levels in rhizosphere soil samples



All plants displayed root rot symptoms

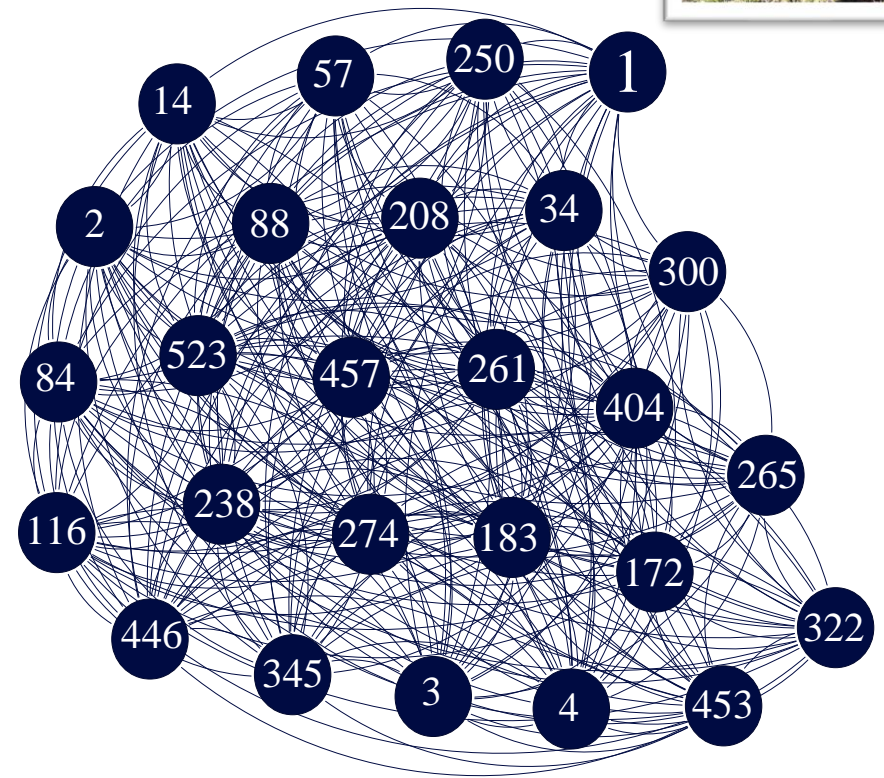
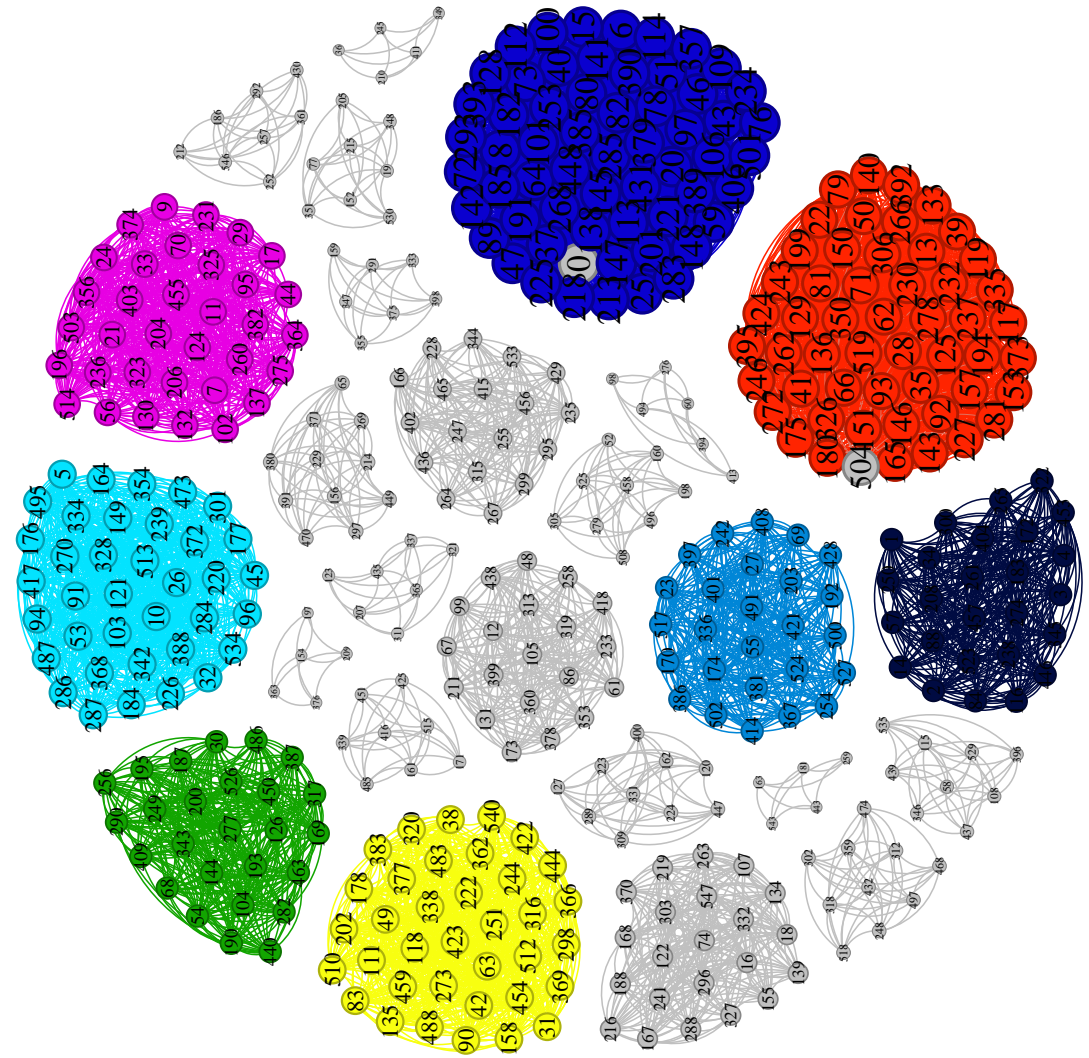


- Priyanka Gangwar (priyankagangwar@vt.edu)



Co-occurrence network analysis

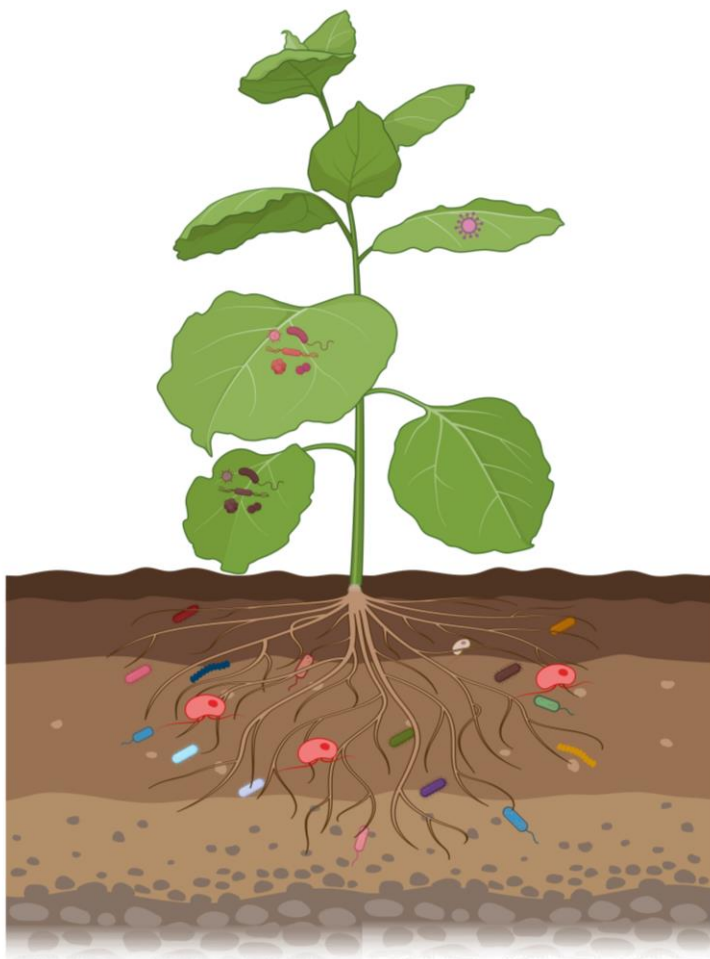
Rhizosphere



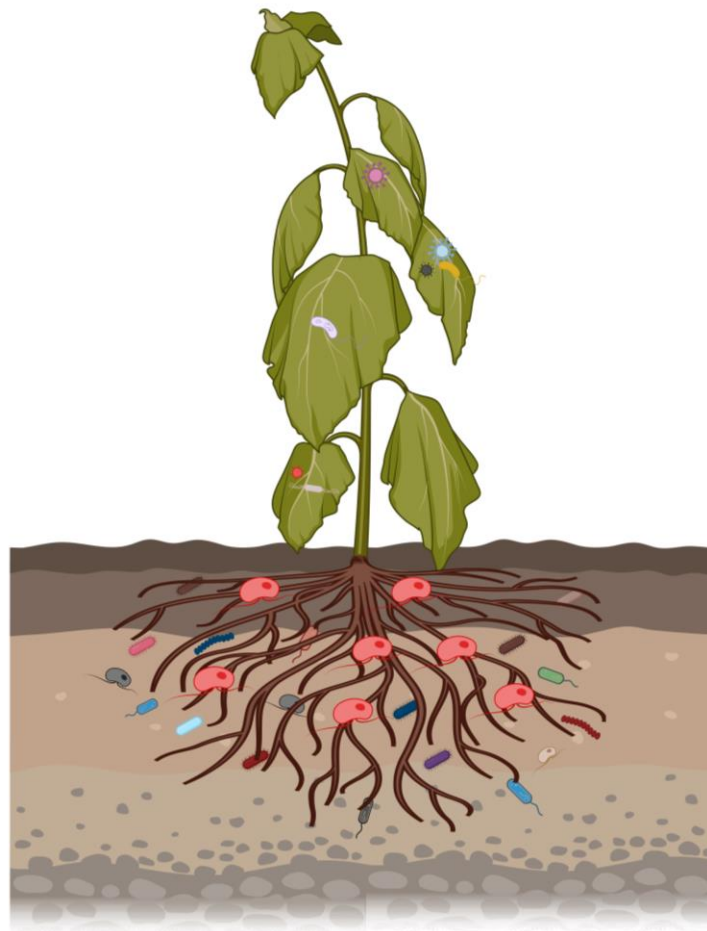
2: *Bacillus*; 250: *Cellulomonas*; 345: *Herpetosiphone*

- Ayodeji Bello (belloayodeji@vt.edu)

Revisit our research questions



Resistant variety



Susceptible variety

Are there any variations of the rhizosphere microbiome among cultivars with different resistant genes?

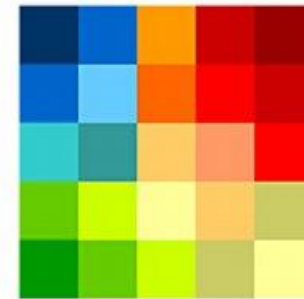
Yes

Do rhizobiomes play a role in disease suppression or pathogen inhibition?

The interactions are more complicated.

Acknowledgement

- Southern Piedmont AREC
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Altria

