Use: Questions and Answers for Presenters
Use: Chat for sharing information with all participants
Microbial ecology of urban agricultural soils in New York City

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Microbial composition differences in NYC agriculture soils across a 25+ year gradient

Do microbial communities converge over time to resemble similar taxa and functions?
Site locations

We sampled nine locations in four boroughs in 2020 ranging from 1 to 25+ years old, including 8 ground level and 1 rooftop soil system.
Bacteria and fungi were examined using amplicon sequencing methods of extracted soil DNA.
Results: Bacteria

Bacterial composition differs more with contrasting farm site age.
Results: Fungi

Fungal composition shows even greater contrasts by farm site age
Results: OM declines over time

Despite routine applications of new composts and soil mixtures, older farms show lower soil organic matter levels.
Takeaways:

Do microbial communities converge on functions over time?
Acknowledgments

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Bryan Yee
Aleah Butler-Jones

Farm participants:
Kelly St Garden
New Roots Community Farm
Forest Houses
Randall’s Island Park Alliance
East NY Farms
Hellgate Farms Rooftop
Queens Botanical Garden
Kingsborough Community College
Soil health for apple orchard systems

Gregory Peck, PhD
Associate Professor
Sustainable Fruit Production Systems

Orchards have different soil requirements than annual crops
Fewer opportunities to add organic matter
High-density orchard systems with shallow root systems
Increasing desire among producers to minimize fertilizer input
Apple Orchard Soil Health

“Our soil health policy, research, and outreach efforts need to be expanded to reach these and other underserved audiences and regions, such as apple and grape growers, organic farmers, and managers of grasslands, pastures, forests, and urban landscapes.”
Mulching studies

- Increase in tree growth and yield is inconsistent
- Increase soil organic matter
- Increase water holding capacity, making the orchard more resilient to drought
- Increase soil biological activity
- Increase plant available minerals
- Increase disease suppression
- Reduce soil erosion in hillside plantings
- Increase weed suppression, especially in organic systems
- Reduce leaching of nutrients (nitrate) and pesticides
Mulches foster beneficial microbial communities

Weed Management in Organic Apple Orchards

Cultivation or Mulch used alone were not sufficient to control weeds, but when stacked with an herbicide performed adequately.

Wood chip mulch improved soil quality and limited weed pressure for three years after application.

- May have not allowed soil to dry in a wet year (2018)
- Performed best in a dry year (2019)

Cultivation resulted in the largest trees by the 5th leaf.

Fertilizer applications alter orchard soil microbiomes

- Carbon-based versus synthetic fertilizer
- Compost composition can alter bacterial communities
  - Chicken litter (CL)
  - Control (CON)
  - Calcium nitrate (FERT)
  - Yardwaste (YW)

Soil Health Testing for Orchards

- Debbie Aller & Joseph Amsili (Soil Health Initiative)
- Mike Basedow (CCE Eastern NY Commercial Hort)
- Janet Van Zoeren & Mario Miranda Sazo (CCE Lake Ontario Fruit Team)

Statewide Sampling to Develop Orchard Specific Recommendations from the Comprehensive Assessment of Soil Health
Apple Orchard Soil Health is Being Studied From Multiple Perspectives

- **Composts and Mulches**
  - Greg Peck, Debbie Aller

- **Soil Health and Herbicide Applications**
  - Mike Basedow, Janet Van Zoeren

- **Mycorrhizal Products and Associations**
  - Mike Basedow

- **Rootstock - Soil Interactions**
  - Greg Peck, Gennaro Fazio, Terence Robinson
Next Steps

1. Develop orchard-specific recommendations based on soil health indices
2. Explore microbial contributions to soil health, orchard productivity, and ecosystem services
3. Incentivize growers to improve soil health
4. Expand into other perennial fruit crops
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- Many other colleagues at Virginia Tech and Cornell
- Apple growers in NY, VA, and MD
Opportunities in Plant Breeding for Soil Health

NY Soil Health Summit
December 13, 2022
Soil health & plant breeding

1. Maximizing **living cover**
   - Breeding improved cover crop varieties
   - Breeding perennial cash crops

2. Maximizing **crop diversity**
   - Breeding for intercropping systems
   - Breeding new cash crops

3. Minimizing **tillage**
   - Breeding cash & cover crops for no-till systems
Maximizing living cover: cover crop breeding

--------- **all cover crops**: high biomass, early vigor, winter hardiness, flowering time  ---------

Crimson Clover  Hairy Vetch  Winter Pea  Cereal Rye  Brassicas

*soft & hard seed*  *soft seed, reduced shatter*  *disease resistance*  *allelopathy*

--------- **all legumes**: nitrogen fixation  ---------
Cover Crop Breeding Network

Legend
- Research station breeding
- On-farm breeding
- Advanced line trials
Identifying optimal varieties & planting dates for winter survival

- **Sites** located in Zones 3-5:
  - Freeville, NY
  - St. Paul, MN
  - Carrington, ND

- **4 winter pea** cultivars:
  - Blaze
  - Icicle
  - Windham
  - WyoWinter

- **4 fall plant dates**

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Cereal rye variety evaluation for NYS

- **Study locations** include:
  - 3 research stations:
    - Canton
    - Chazy
    - Freeville
  - 3 on-farm locations

- **6 varieties:**
  - AC Hazlet
  - Aroostook
  - Danko
  - Elbon
  - Guardian
  - ND Gardner

- Up to **4 planting dates:** late September to early November
Cereal rye breeding for northern US

• Breeding nurseries in Freeville, NY and St. Paul, MN
  • NY location evaluating multiple planting dates for tolerance of late planting

• **Key traits:**
  • Early vigor
  • Winter survival
  • Biomass
  • Early maturity
  • Allelopathy
Maximizing living cover: perennial forage breeding & variety testing
Maximizing crop diversity: breeding for diversity in time

- Diversity in **time**
  - Within growing season
  - Multi-year rotation
Diversity in time:

hemp breeding & variety testing
Assessing breeding & research needs for organic hemp production

Interested in organic hemp production?

We are seeking feedback from farmers, industry, extension, educators, and others.

Keep your eyes out for a survey & focus groups starting in January!

To learn more, contact: Emily Fratz (ef389@cornell.edu) or me (vm377@cornell.edu)
Maximizing crop diversity: breeding for diversity in space

• Diversity in **time**
  • Within growing season
  • Multi-year rotation

• Diversity in **space**
  • Field-scale diversity:
    • Mixtures
    • Row intercropping
    • Strip intercropping
  • Landscape-scale diversity
Diversity in space: intercropping alfalfa & perennial grains

Evaluating & selecting optimal alfalfa varieties for intercropping
Maximizing crop diversity: breeding for diversity in time & space

- **Diversity in time**
  - Within growing season
  - Multi-year rotation

- **Diversity in space**
  - Field-scale diversity:
    - Mixtures
    - Row intercropping
    - Strip intercropping
  - Landscape-scale diversity

- **Diversity in time & space**
  - Relay intercropping
  - Perennial groundcover systems
Diversity in time & space: red clover-corn interseeding

- 2 seasons of data in Aurora, NY
  - Year 1: 2021-2022 (wet)
  - Year 2: 2022-2023 (dry)
- Evaluation of 11 varieties of red clover
- Interseeding between corn rows at ~V6 growth stage
Minimizing tillage: dry beans for organic no-till systems

Organic dry bean variety trials (ME, NY, VT, WI)

• Starting in 2023: evaluation in organic tilled production systems
• Starting in 2024: evaluation in no-till (rolled rye) systems

Photo: Kristen Loria
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Supporting NY State farmers in their experimentation towards soil health

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