Interactions between potato cropping systems, soil health, and microbial structure

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1. **On-Farm TEST**: How does rotation length and crop type affect microbial dynamics, soil fertility, and economic benefits

2. **Grower Driven Rotations**: How do grazed cover crops and quinoa affect microbial dynamics, soil fertility, and economic benefits

3. **Grower Driven Rotations**: How do **hemp** affect microbial dynamics, soil fertility, and economic benefits
Goals for all projects

- Measure Pathogen Pressure
- Rotation Contribution to Soil Fertility
- Economic benefits (input and water savings)
- Best management practices
Sampling scheme and collaborators

Top 0-6 inches

Bottom 6-12 inches

Mix

- Isolate Nematodes
- Extract Microbe DNA
- Soil Fertility Tests

Mix

- Nematode Numbers
- Extract nematode DNA

<table>
<thead>
<tr>
<th>Grower 1</th>
<th>On-Farm Test</th>
<th>Grazed Cover Crop</th>
<th>Hemp</th>
<th>Quinoa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Grower 2</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Grower 3</td>
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<tr>
<td>Grower 4</td>
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<td>Grower 5</td>
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</table>
On-Farm Test: 2 year vs. 3 year

<table>
<thead>
<tr>
<th>Design</th>
<th>Year</th>
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<tbody>
<tr>
<td>Potato</td>
<td>2016</td>
</tr>
<tr>
<td>Barley 2-Year</td>
<td>2017</td>
</tr>
<tr>
<td>Barley 3-Year</td>
<td></td>
</tr>
<tr>
<td>Potato 2-Year</td>
<td>2018</td>
</tr>
<tr>
<td>Potato and companion crop 2-Year</td>
<td></td>
</tr>
<tr>
<td>Polyculture mix 3-Year</td>
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</tr>
<tr>
<td>Barley 2-Year</td>
<td>2019</td>
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<tr>
<td>Potato 3-Year</td>
<td></td>
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<tr>
<td>Potato and companion crop 3-Year</td>
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</table>
## On-Farm Test and Grower Driven Rotation

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Farm 1</td>
<td>Potato</td>
<td>Barley</td>
</tr>
<tr>
<td>On-Farm 2</td>
<td>Potato</td>
<td>Barley</td>
</tr>
<tr>
<td>On-Farm 3</td>
<td>Potato</td>
<td>Barley</td>
</tr>
<tr>
<td>Hemp 1</td>
<td>Hemp</td>
<td>Potato</td>
</tr>
<tr>
<td>Hemp 2</td>
<td>Hemp</td>
<td>Barley</td>
</tr>
<tr>
<td>Grazed cover 1</td>
<td>Grazed cover</td>
<td>Potato</td>
</tr>
<tr>
<td>Grazed cover 2</td>
<td>Grazed cover</td>
<td>Potato</td>
</tr>
<tr>
<td>Grazed cover 3</td>
<td>Grazed cover</td>
<td>Grazed cover</td>
</tr>
<tr>
<td>Quinoa 1</td>
<td>Quinoa</td>
<td>Potato</td>
</tr>
<tr>
<td>Quinoa 2</td>
<td>Quinoa</td>
<td>Potato</td>
</tr>
</tbody>
</table>
Baseline Data Collection

“No, it isn’t going to snow” – Grant Mattive
Year One Data Collection
1. Potatoes only in *Grower Driven Rotations*

2. Three replicates per field

3. Potatoes were sampled for yield and quality
   - **Yield**
     - Total, Marketable (>4oz), and Premium (>10 oz)
   - **Quality**
     - Internal and external defects
Grazed cover 1
Grazed cover 2
Hemp 1
Quinoa 1
Quinoa 2

Significant difference in total tuber yield

• Lower yields at quinoa 2

ANOVA, p < 0.0134

Grower Driven Rotations
Significant difference in marketable yield

- Lower yields at quinoa 2
- Increased yield in hemp site and quinoa 1
No difference in premium yield

- Lower yields at quinoa 2
- Increased yield in hemp site
• Careful with yield data
• Similar yields between Canela and Nugget
• When Canela Russet followed HEMP total, marketable, and premium size tuber yields increased by 17%, 29%, and 133%, respectively
• The preceding crop did not impact tuber quality—

No internal or external defects were observed in any of the potatoes harvest.
1. Soil samples from two depths
   Upper (0-6 inches) and Lower (6 – 12 inches)

2. Haney Test - 42 different soil fertility parameters
   - Overall assessment of soil health
   - Can be used to track changes based on management decisions
   - Also looks at available plant nutrients
   - Solvita CO2 burst looks at microbial activity
   - Carbon and Nitrogen

3. Permanganate oxidizable carbon (POXC)
   - POXC greater sensitivity to changes in management and environmental variation (POC, MBC, or soil organic carbon)
   - Higher levels of reactive carbon improves water infiltration and reduces soil degradation
Grower Driven Rotations and On-Farm Test

Significant variation for soil fertility parameters

- **PC1**: Depth
- **PC2**: Spring and Fall
Variation among samples was largely attributed to a reduction in 1) total and inorganic phosphors, 2) available aluminum, iron, and zinc, 3) and nutrient value of On-farm site 3.