SOIL HEALTH WITH OILSEED CROPS IN A CEREAL GRAIN ROTATION

PHOSPHOLIPID FATTY ACID ANALYSIS TO MONITOR MICROBIAL COMMUNITY CHANGES

Jeremy C. Hansen
William Schillinger, Ann C. Kennedy, Tarah S. Sullivan
USDA-ARS, Washington State University
hansejc@wsu.edu
When growers were asked what research is needed to improve their oilseed production, some of the suggestions included the following:

• varieties with improved pod shatter control, oil and meal content and quality, shorter stems, adaptation to marginal land, and improved herbicide resistance
• farm-scale variety testing
• rotational effects on soil health and biology
• more weed control options and seed treatment efficacy
• reduced oilseed yield variability
• the economic feasibility of growing different oilseed crops with fluctuating market prices (currently under investigation at WSU)
Experimental Design

- Canola (Amanda) - Winter Wheat (Finch) 6 replications.
  - Complete Randomized Block located in Davenport, Washington.
- Typical Rotation: Winter Wheat > Spring Cereal > Fallow.
- Sampling
  - 3 Sampling times. Within crop, 1 year after plot, 2 years after plot.
  - Composite bulk soil samples at 3 depths (0 to 5 cm, 5 to 10 cm, 10 to 15 cm).
Analyses

- Phospholipid Fatty Acid Analysis (PLFA)
  - Microbial Biomass
  - Bacteria to Fungi Ratio
  - Changes in Saturation (Stress Indicators)
- Carbon, Nitrogen
  - Soil Organic Matter
  - Carbon to Nitrogen Ratio
- Microbial Enzyme Assays
  - Dehydrogenase
  - Beta-Glucosidase
    - Soil Microbial Heath indicators
PLFA (The Soil Micro Census)

- Pop 652 K
- White Caucasian 69%
- Asian 13%
- H.S.D. 93%
- B.A. 57%
- Mean House Value 433 K
- Crime Rate 40/10k

- Pop 31 K
- White Caucasian 79%
- Asian 11%
- H.S.D. 97%
- B.A. 66%
- Mean House Value 219 K
- Crime Rate 7/10k

Washington - The Evergreen State
Soil Micro Census Data Collection

Cell
- Extracellular fluid
- Nucleus
- Cytoplasm

Cell membrane
- Carbohydrate
- Glycoprotein
- Globular protein
- Protein Channel (Transport protein)
- Cholesterol
- Glycolipid
- Surface protein
- Globular protein (Integral)
- Filaments of cytoskeleton
- Alpha-helix protein (Integral protein)
- Peripheral protein

Phospholipid bilayer
- Phospholipid (Phosphatidylcholine)

Plasma membrane
- Water soluble molecules

Fat soluble molecules

Channel protein
Preliminary Results
• Differences in the surface 0to5 cm
• Less significant differences in subsurface soil to 15 cm
- A closer look indicates there are differences in microbial communities
• Differences in microbial communities 1 year following the plots returning to the growers rotation.
• A closer look indicates some separation but leans more toward commonality.
• Differences in microbial communities 2 years following the plots returning to the growers rotation.
• Differences at all three depths indicating a shift in microbial communities.
A closer look at differences
• Differences in the surface 0to5 cm, with difference diminishing with depth
A closer look at differences
Conclusions

- There are differences in microbial communities under a canola crop when compared to communities under a winter wheat crop.
- Differences are greatest in the crop year.
- This data represent preliminary analysis. The extent of microbe differences and the cause of those differences needs further exploration.
Future Work

- Additional samples this spring
- Statistics of PLFA Data.
  - Stress indicators
  - Bacteria to Fungi Ratio
  - Microbial biomass
- Carbon analysis
- Rhizosphere soil microbes, comparing canola and cereal grain.
- Lipid analysis for a tool to ID cold tolerant canola varieties.

Acknowledgments:
John Jacobsen, Tim Smith, Hal Johnson
Bill Schillinger, Ann Kennedy