A soil health update from the Glenlea long-term organic study Martin Entz, University of Manitoba Presented to Summit on Canadian Soil Health, 2019



My research work



 1980
 1990
 2000
 2010
 2020

The Glenlea experiment



- 2 rotations
 - Forage-grain
 - Flax-2 year forage-wheat
 - Hay removal
 - One manure return treatment
 - Grain only
 - Flax-oat-soybean-wheat (conv)
 - Flax-oat-green manure-wheat (org)
 - 2 systems
 - Organic and conventional
- Prairie grassland benchmark
- 3 replicates

48 Organic-Conventional comparison studies around the World



Lori M, Symnaczik S, Mäder P, De Deyn G, Gattinger A (2017) Organic farming enhances soil microbial abundance and activity—A meta-analysis and meta-regression. PLOS ONE 12(7): e0180442. https://doi.org/10.1371/journal.pone.0180442 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0180442



Welcome to the Glenlea Study

UNIVERSITY

Canada's oldest organic-conventional cropping comparison study



Organic grain only system - Wheat, 2013



September 21, 2019

<u>Prairie grassland</u> -mixture of 3 warm season and 3 cool season grasses

1 1

Biodiversity/ Ecosystem health

- Soil microbial C
- Mycorrhizal fungi (AMF)
- Soil bacterial communities
- Soil nematodes communities
- Carabid beetles
- Weed flora

Biogeochemical/ Thermodynamics

- Cropping system energy balance
- Soil C and N fluxes
- Hydrology
- Soil metabolic quotient
- Soil enzyme activity

Agronomic/ Economic

- External inputs
- Net primary production
- Crop yield



- 16 Scientific journal papers
- 2 Book chapters



Figure 1. Mean weight diameter (MWD) of stable aggregates in treatments at Glenlea Long-term Rotation in the wheat and flax phases of the rotation at two depths. Annconv stands for the annual conventional grain rotation, annorg for the organic annual grain rotation, perconv for the conventional forage-grain rotation, perorg for the organic forage-grain rotation, perorgman for the organic forage-grain rotation with manure added, and grassland for the grassland/prairie plots. Letters indicate significance at alpha = 0.05. The Tukey-Kramer post hoc test was used, and error bars represent one standard deviation on either side of the treatment mean.



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Microbial biomass carbon Sarah Braman

2000









Ground beetle populations Shauna Humble





Harpalus pensylvanicus



red root pigweed



Calosoma calidum



Agonum placidum



Wild Mustard

Four consistent associations were observed between beetle and weed species, however. These were *Harpalus pensylvanicus* with red root pigweed; *Amara carinata* with stinkweed; *Agonum placidum* and *Calosoma calidum* with wild mustard. *Harpalus* and *Amara* are weed seed eaters.

Conventional high yield system



Organic high yield system



"Available" P

Water soluableNa bicarbonateNa hydroxide



•hydrochloric acid extractable P Two Questions...

1. How does organic compare with no-till?

TABLE: ROTATION IMPACT ON INCREASING SOIL ORGANIC MATTER^{1.}

Rotation ²	Estimated Carbon Sequestration (Ibs/acre/year)	Estimated Time4 to increase SOM 1% (years)
C-C-C-C		
C-C-Sb-Sb	-240	not possible with only rotation
C-C-Sb-W	425	81
C-C-Sb-Wrc	555	62
C-C-A-A	945	36
A-A-A-A	1,680	21

1 extrapolated information using "Cost efficient rotation and tillage options to sequester carbon and mitigate GHG emissions from agriculture in E. Canada", Meyer-Aurich, A., Janovicek, K., Deen, B., Weersink, A., 2006

2 C=Corn, Sb=Soybean, W=Winter Wheat, Wrc=Winter Wheat underseeded Red Clover; A=Alfalfa

3 Assumes 58% of SOM is made up of organic carbon



In a 2-crop rotation, no-till did not increase SOM after 40 years

Two Questions...

- 1. How does organic compare with no-till?
 - Dryland Prairies: No-till > organic
 - Plant diversity = or > no-till

Two Questions...

2. How will P shortage be dealt with?

Urban to rural nutrient recycling





Current research focus on



- Struvite (Sewage)
- Digestate (Municipal compost)
- Insect Frass (Food waste)



Split production: One farm with an organic and "conventional" division



ONIONS HEMP POTATOES

ORGANIC CROPS

At Poplar Grove Farm we grow a diversity of organic crops ranging from red, yellow, and russet potatoes to onions, grains, and hemp. Our organics are grown in isolation from commercial production at our Poplar Grove Farm. Integrity of product is maintained from field

