

Effects of Grassland Set-asides on Soil Quality

T. Porter, P. Hanuszak, D. Bondar, Dr. Maja Krzic and Dr. Sean Smukler

The Delta Farmland & Wildlife Trust (DF&WT) has offered the Grassland Set-Aside (GLSA) Stewardship Program since 1994. This program incentivizes farmers in the Fraser River delta, British Columbia to seed a grass-legume mixture on agricultural land and leave it fallow for 1-4 years to improve soil quality and provide wildlife habitat. The DF&WT in partnership with researchers from the Faculty of Land and Food Systems, at the University of British Columbia, undertook a research project (2015-2020) to provide farmers with detailed information about effects of integrating GLSAs on soil structure and other soil properties.

Overview of GLSA soil quality study

- 5-8 agricultural sites across the Fraser River delta region
- GLSA fields paired with annual crop rotation (ACR) fields
- Baseline soil properties were highly variable between study sites. As a result, sites were categorized as productive and unproductive based on variance in soil salinity, aggregate stability and total carbon.
- Productive and unproductive fields responded differently to GLSA management¹



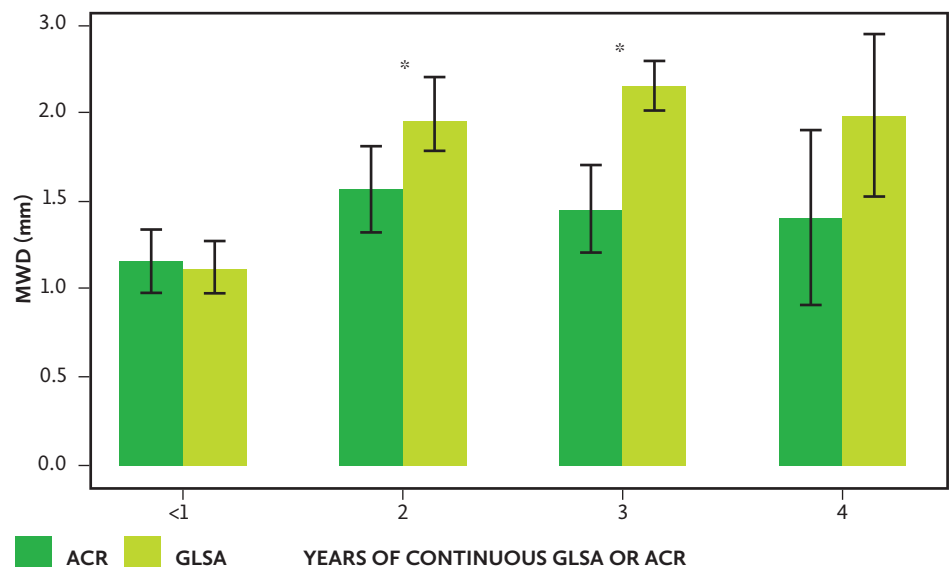
Annual crop rotation field (left) compared to a grassland set-aside (right)

Key findings of the GLSA soil quality study

Productive fields

- Aggregate stability increased in GLSA after 1 year compared to paired ACR sites¹; and this trend continued over the 4 years of GLSA (Figure 1)
- No changes in soil organic matter after 2 years of GLSA²

Figure 1. Soil aggregate stability (as described by mean weight diameter - MWD) on productive sites improved under GLSAs over time relative to ACR.





L to R: Grassland Set-aside; Jason Lussier showing good aggregate formation under GLSA

Unproductive fields

- Notable soil properties:
 - ▶ Low aggregate stability
 - ▶ Low total soil organic carbon
 - ▶ High exchangeable sodium
- GLSA growth was lower in the first 2 seasons compared to productive fields (Figure 2)
- High exchangeable sodium was found to correlate to low vegetation growth¹
- Aggregate stability did not improve until the third year of the GLSA

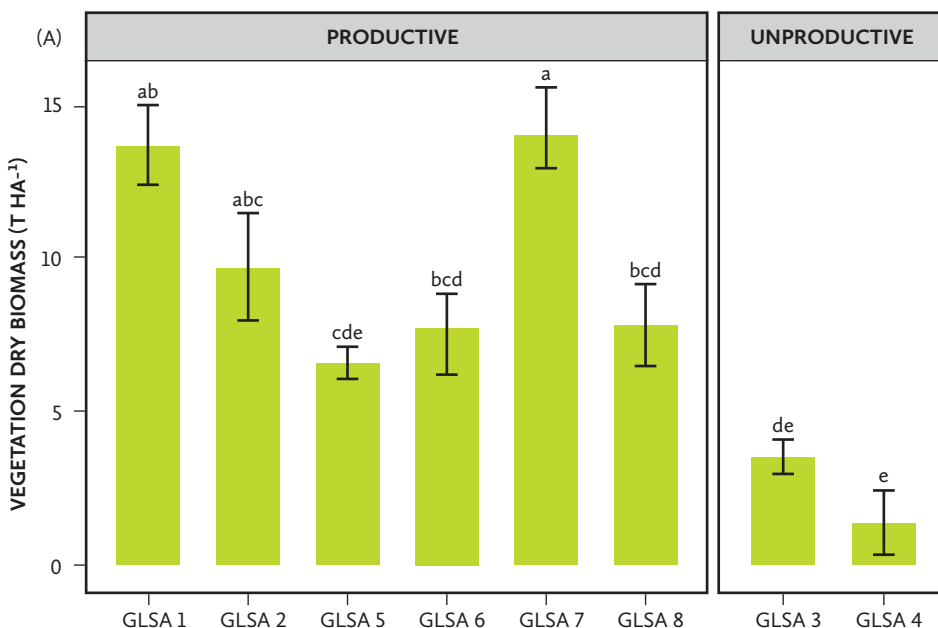


Figure 2. After 2 years of GLSA, productive GLSA fields have more vegetation than unproductive fields.

Conclusions

- Soil structure improved relative to annual cropped fields over the 4-year duration of GLSA in productive fields; while there was minimal improvement of soil structure in the unproductive fields
- Two years of GLSA did not lead to increases of soil organic matter
- Unproductive fields with high exchangeable sodium likely require:
 - ▶ a GLSA seed mix that is more tolerant to salinity and water-logging
 - ▶ additional management practices to improve drainage and reduce salinity (laser levelling, sub-surface drainage system)

References:

- ¹ Lussier, J.M., M. Krzic, S.M. Smukler, A.A. Bomke, and D. Bondar. 2019. Short-term effects of grassland set-asides on soil properties in the Fraser River Delta of British Columbia. *Canadian Journal of Soil Science* 99:136-145 <https://doi.org/10.1139/cjss-2018-0097>
- ² Lussier, J.M., M. Krzic, S.M. Smukler, K. Neufeld, C. Chizen, and A.A. Bomke. 2020. Soil organic carbon and aggregate stability in two seasons of grassland set-aside and annual crop rotations. *Soil Research* <https://doi.org/10.1071/SR19180>

Soil Quality Parameters

Aggregate Stability

A measure of the resistance of aggregates to external forces including physical disturbance (such as tillage), wetting, and raindrop impact. Mean weight diameter (MWD) of water stable aggregates is an index of aggregate stability.

Individual soil particles bind together to form clumps called aggregates, which are the building blocks of soil structure.

Aggregates influence:

- Carbon storage within the soil
- Size of soil pores which impact:
 - ▶ Water infiltration
 - ▶ Water retention and drainage
 - ▶ Space for root growth
 - ▶ Habitat for soil organisms
 - ▶ Aeration

Soil Organic Matter

The component of soil that is made up of fresh and decomposing plant, animal, and microbial detritus. It impacts:

- Nutrient and water availability
- Soil structure
- Microbial diversity
- Chemical processes

Total carbon is a commonly-used indicator of soil organic matter.

Exchangeable Sodium

A measure of sodium in the soil. High levels of sodium may:

- Negatively impact plant growth
- Prevent aggregate formation



**Delta Farmland
& Wildlife Trust**
Partners in Stewardship

Canada



THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Land and Food Systems

Mitacs