

Effects of Grassland Set-asides on Soil Nutrient Availability and Crop Yields

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 productivity 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 2-, 3- and 4-year GLSAs on soil nutrient dynamics and crop yield.

Overview of GLSA nutrient dynamics and crop yields study

- 13 agricultural sites across the Fraser River delta region
- GLSA sites paired with annual crop rotation (ACR) site
- Included controlled, plot-scale experiments as well as field level observational studies
- Crops included in studies:
 - ▶ barley, beans, broccoli, corn, peas, and potatoes

Key findings of the GLSA nutrient dynamics and crop yield study

GLSAs in crop rotation and nutrient dynamics

GLSA mix of grasses and legumes contribute to soil organic matter and nutrient cycling. Several of our studies evaluated effects of 2-, 3-, and 4-year GLSAs on the soil nutrients,

specifically nitrogen. Plant available nitrogen comes in two forms, nitrates (NO_3) and ammonium (NH_4), which comprise 1-5% of the total nitrogen found in the soil.

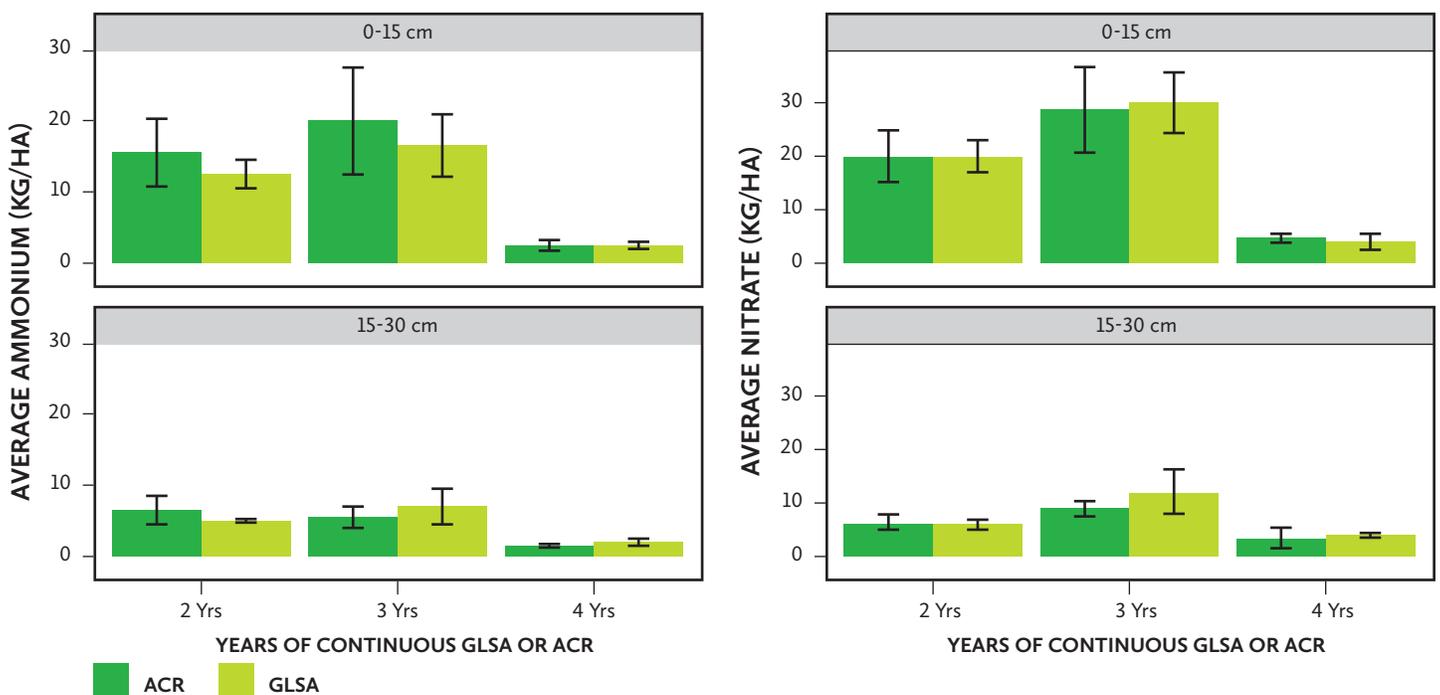


Figure 1. Average plant available nitrogen in the growing season after incorporating 2-, 3-, and 4-year GLSAs and paired ACR fields at 0-15 cm and 15-30 cm depths ^{1,2}



L to R: Grassland Set-aside; UBC students sampling in GLSA field; Various fertilizer treatments for controlled field experiment

GLSAs and seasonal nutrient dynamics

Depending on the time of incorporation, GLSAs have the potential to contribute to adequate synchronization of the plant available nitrogen and nitrogen requirements of the crops grown after GLSA incorporation. Each of the 2-, 3-, and 4-year GLSA studies tracked plant available nitrogen throughout the production season (April-September). No differences in average seasonal plant available nitrogen (Figure 1) or crop yield were observed in the first growing season between the 2-, 3-, and 4-year GLSA fields and the ACR fields in the regional analyses. There were however significant differences in the timing of plant available nitrogen. Under some conditions GLSA showed increased plant available nitrogen during key times of the growing season (Figure 2).^{1,2} Plant available nitrogen was also found to be higher in the second season following GLSA incorporation.

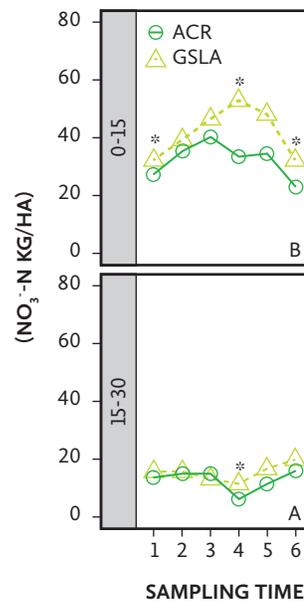


Figure 2. Average soil nitrate (NO₃-) during 2015 production season from ACR fields and 3-year GLSAs at the 0-15 cm depth (A) and 15-30 cm depth (B). Soils were sampled 6 times between April and September.

Implications of GLSA on Crop Yield and Plant Available Nitrogen

Synchronizing plant available nitrogen with crop needs is imperative to ensure crop yield and quality. Transitioning GLSA fields back into production has the potential to provide plant available nitrogen to the subsequent crops while minimizing the need for added fertilizer applications. The timing of GLSA incorporation has an effect on when crops can get the plant available nitrogen and should be considered when farmers are selecting type of crop and planting date.

Our studies carried out during 2015-2020, have shown that there is no reduction in crop yields between former GLSA fields and the paired ACR fields. In some cases yields were actually improved and plant available nitrogen increased at key points in the production season. This information can be used by local farmers to adjust fertilizer use, which will in turn reduce production costs and minimize potential impacts to the environment.

Plant Available Nutrients and Grassland Set-asides

It is important to quantify the impact of GLSAs on plant available soil nutrients. Nutrients such as nitrogen can drastically affect crop yield and quality if not managed properly. Grasses and legumes from GLSAs can contribute nutrients to subsequent crops and thereby have the potential to reduce the amount of synthetic fertilizers used while maintaining crop yields.

Residual Soil Nitrogen: What is it? And how can it be managed?

Inefficient use of nitrogen leads to post-harvest residual nitrogen which is nitrogen that has not been utilized by a crop during a growing season. Residual soil nitrogen can be lost to the environment by leaching into waterways and through gaseous emissions to the atmosphere. Both forms of nitrogen loss contribute to environmental degradation. GLSAs can be used as part of a farm nutrient management plan in two ways: contribute nutrients to crops after GLSA termination or absorb residual nitrogen if a GLSA is established after an early summer crop.

References:

¹ Fausak, L.K. 2019. The effects of 2- and 3-year grassland set-asides on plant available nitrogen and greenhouse gas emissions in Delta, British Columbia. MSc Thesis, The University of British Columbia, Vancouver, BC. 90 pp. <https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0380750>

² Walji, K. 2017. Nitrogen dynamics following incorporation of 3-year old grassland set-asides in Delta, British Columbia. MSc Thesis, The University of British Columbia, Vancouver, BC. 70 pp. <https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0347623>