THE UNIVERSITY OF BRITISH COLUMBIA

Overwinter soil cover with silage tarps and cover crops

Soil nitrogen dynamics

Summary results from Too Much Water or Too Little?

Project context: Winter cover is important to protect soil from heavy fall and winter precipitation of South Coastal British Columbia (BC). For annual vegetable farms, crops provide cover during the growing season but if soil is left bare in the off season it is susceptible to nutrient leaching and erosion. The loss of residual nitrate is of particular concern because it is highly mobile in the soil, prone to leaching, and can contaminate groundwater. Climate change and production constraints make cover crop establishment across an entire farm challenging. Fall crop production can interfere with cover crop planting dates or growers may want to reserve a portion of the field for early spring production. Further, tillage used to move fields from vegetable crops into cover crop is made more difficult by increasing fall rains caused by climate change. Silage tarps are an alternative when winter cover crops cannot be established, however because of the novelty of this approach, the impacts of overwinter tarping on soil properties remain relatively unstudied in BC. Silage tarps are polyethylene plastic sheets that are opaque and impermeable to water.

Project overview: The Too Much Water or Too Little? project was conducted by the Sustainable Agricultural Landscapes Lab at the University of British Columbia. In 2019-2021 this study investigated the impact of overwinter cover crops and silage tarps on soil nitrogen dynamics and other agronomic outcomes on 14 farms in 3 regions of BC: Lower Fraser Valley (LFV), Vancouver Island (VI), and Kootenay Mountains (KM).

Methods: A mother-daughter experimental design was used evaluate silage tarps and cover crops across a variety of climates and soil types. Twelve daughter farms hosted unreplicated trials and two mother farms (UBC, GRF) hosted replicated trials (n=16). Silage tarps were laid in the field in the Oct-Nov and removed mid-late April of the following year. On the mother farms, fall rye (Secale cereale; 4.45 kg ha-1) and crimson clover (Trifolium incarnatum; 0.75 kg ha-1) were seeded in mid-Oct. On the daughter farms, cover crops were not readily established and silage tarps were compared to a no-tarp plot which was cover cropped, bare fallowed, or mulched with crop residue.

Composite soil samples were taken at a depth of 0-15 cm the time of tarp removal (1-TR) . On the mother farms additional samples were taken at the time of crop planting (2-PL), mid-season (3-MS), and post-harvest (4-PH). Soil samples were analyzed for plant available nitrogen (PAN; nitrate and ammonium). Samples were extracted with KCl and analyzed by colorimetry.

Spring nitrate results: Nitrate was significantly higher under the tarps than the cover crop or no-tarps treatments in both study years and in both the mother and daughter farms (Figure 1). This finding was consistent across the three regions. It is likely that this observed outcome is due to the impermeable nature of the silage tarps which inhibited some water flow through the soil profile while in the field. This protection from rainfall likely reduced leaching of nitrate which is highly mobile in the soil. The observed amount of nitrate under overwinter tarps is agronomically sizable ranging from 19.3 to 39.8 kg N ha-1. At the higher end of the range, this would represent >70% of the recommended ~50.0 kg N ha-1 for a beet crop in BC.

No significant differences were observed in ammonium in either trial or in either year. Region and region-treatment interaction were not significant in either year of study, indicating that the effect of the overwinter cover treatment was significant despite the regional variability.

PAN in growing season: Overwinter cover type was significant in explaining PAN trends across the growing season (Figure 2). PAN was generally higher in the tarp treatment compared with the cover crop at 1-TR and 2-PL sampling dates, but observations were comparable between treatments at 3-MS and 4-PH timings. PAN increased in the tarp treatment between the 4-PH sampling in 2020 and 1-TR sampling in 2021. No fertility amendments were applied between sampling dates, so the increase is likely due to mineralization of N from soil organic matter or previously applied amendments. This indicates important agronomic and economic implications for growers. PAN is often a limiting growth factor for early spring crops; the boost of nitrate from tarped soil may be important in planning fertility applications. Under tarp residual nitrate has the potential to reduce spring fertility application, reducing costs. Soil sampling to account for residual spring nitrate could enable farmers to reduce fertility inputs for early spring crops. Many factors must be considered when determining farm-specific optimal timing for tarp removal in the spring, the length of time between tarp removal and planting is an important consideration. The density and modality of planting will impact the capture of PAN by plants; transplants with developed roots systems may be able to utilize residual nitrate more quickly than direct-seeded crops.

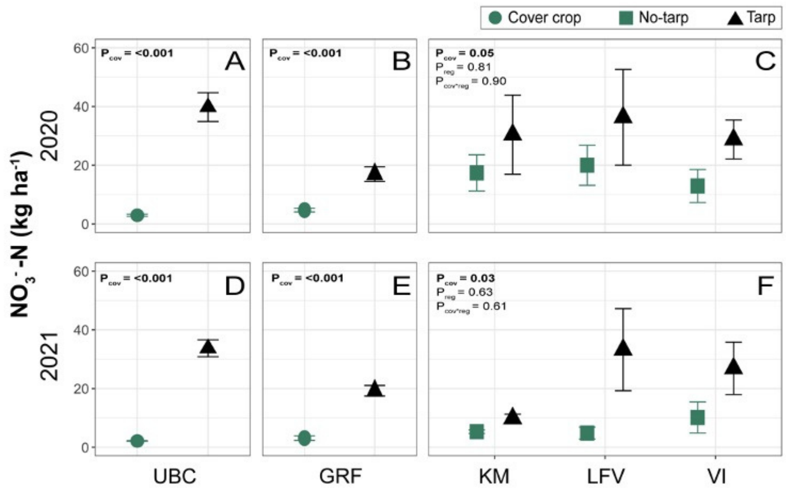

Figure 1. Soil nitrate in kg/ha means ± one standard error by overwinter cover type (cover crop, no-tarp, tarp). P-values determined by linear mixed-effect models show the significance of cover type (cov) treatment and/or region (reg) and their interactions. Significant findings (P<0.05) are shown in bold.

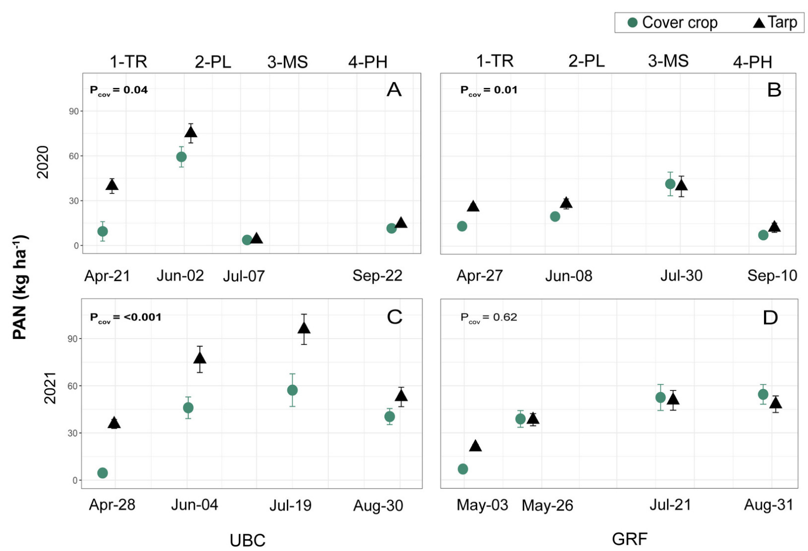

Figure 2. PAN; kg/ha dry soil by overwinter cover type (cover crop, tarp). Sample timing aligns with dates of tarp removal (1-TR), planting (2-PL), mid-season, (3-MS), and post-harvest (4-PH) in each year. P-values determined by linear mixed-effect models show the significance of cover type (cov), significant findings (P<0.05) are shown in bold.

Funding for this project has been provided in part by the Natural Sciences and Engineering Research Council of Canada, the University of British Columbia Work Learn Program and in part by the Governments of Canada and British Columbia through the Canadian Agricultural Partnership, a federal-provincial-territorial initiative. The program is delivered by the Investment Agriculture Foundation of BC.

Delivered by: Investment Agriculture Foundation

Funding provided by: Canadian Agricultural Partnership, NSERC CRSNG, British Columbia, Canada

For detailed results visit https://sal-lab.landfood.ubc.ca/