

Soil Quality Study 2015 - 2020

Peace River Forage Association
of British Columbia



Soil Quality Study Overview

The soil quality field kit was initiated by Sandra Burton & Dr. Bill McGill, over 5 years ago as a communication tool during PRFA-UNBC Soils, Forage & Water Dynamics Courses. It was further tested during 2 larger producer innovation based projects: Innovative Management Practices for Resiliency & Improving Productivity & Profitability of Forages. We have enjoyed collaboration with many people, especially Julie Robinson, Matthias Loeseken, Aaron Mackay and the 17 farm cooperators involved in the study.



Initial Questions

1. Is the kit farmer field friendly?

We addressed this in the 2015 season and found that some of the methods were time consuming for a field test. We modified the methods supplied with the kit.

2. Which soil properties are relevant to each on-farm demo?

We selected a core of 7 "must do" soil properties, then added more as requested by the cooperator or relevant to the questions at the on farm demonstrations.

3. Does the field kit assist in dialog with farmers to improve their management practices?

The methods and results were conversation starters at more than a dozen workshops and field days over the last 5 years.

4. Can the field kit help establish benchmarks with cooperators that can be revisited later to measure changes?

This report shares the field work methods and preliminary answers to these questions. To date, 32 pairs or 64 benchmarks each have summary Soil Quality Report Cards, involving 17 cooperators spread across the Peace (primarily in BC).



Soil Quality Improving Practices

The cooperators that came forward with their questions can be grouped into 6 soil quality improving practices. This is a sampling of possible practices to improve soil quality, not a complete list.

1. Adding topsoil, composted manure or pulp residual:

Glenn & Ann Hogberg, Progress area, benchmarks in valley bottom, Devereau soil on lacustrine;

Stan & Shirley Smithard, Sunset Prairie area, benchmark pairs on ridge, Murdale soil on morainal till;

Fred & Liz Schneider, Pouce Coupe, adding topsoil, 1 pair of benchmarks;

Richard Kabzems & Sandra Burton, Kiskatinaw, adding composted residual, 1 pair of benchmarks.

2. Increasing non bloating legume content:

Andrew & Brian Clarke, Baldonnel, birdsfoot trefoil plots & benchmarks on 2 fields, different soils & years;

Gordon & Brenda Lazinchuk, Bessborough, 2 fields of birdsfoot trefoil, different years, 2 x 2 pairs of benchmarks;

Fred & Liz Schneider, Pouce Coupe, sainfoin plot, 2 soil benchmark pairs, monitored plant growth of 2 mixes;

Shellie English, Montney, sainfoin seedings in 3 fields, 3 different methods, with & without a cover crop.

3. Winter feeding or bale grazing:

Ron & Karen Buchanan, Lower Cache, 4 sets of benchmarks with winter feeding of different years & different landscape positions;

Gordon & Brenda Lazinchuk, Bessborough, benchmark pairs with & without bale grazing on 2 different soils;

Rob Larson, Rose Prairie, 2 benchmarks of starting points for 2 fields;

Heather Fossum, Briar Ridge, paired benchmarks representing with & without bale grazing;

Bill Wilson & Julie Robinson, 2 pastures in Sweetwater & Silver Valley; 2 sets of benchmarks.

4. Improved grazing management:

Tara Holmes & Ben Harrington, Siphon Creek, 3 fields, histories & soil types, 3 benchmark pairs;

Clay & Ashley Armstrong, Demmitt, 5 benchmarks;

Jodi Kendrew, Pouce Coupe, 2 soil types, 2 benchmark pairs;

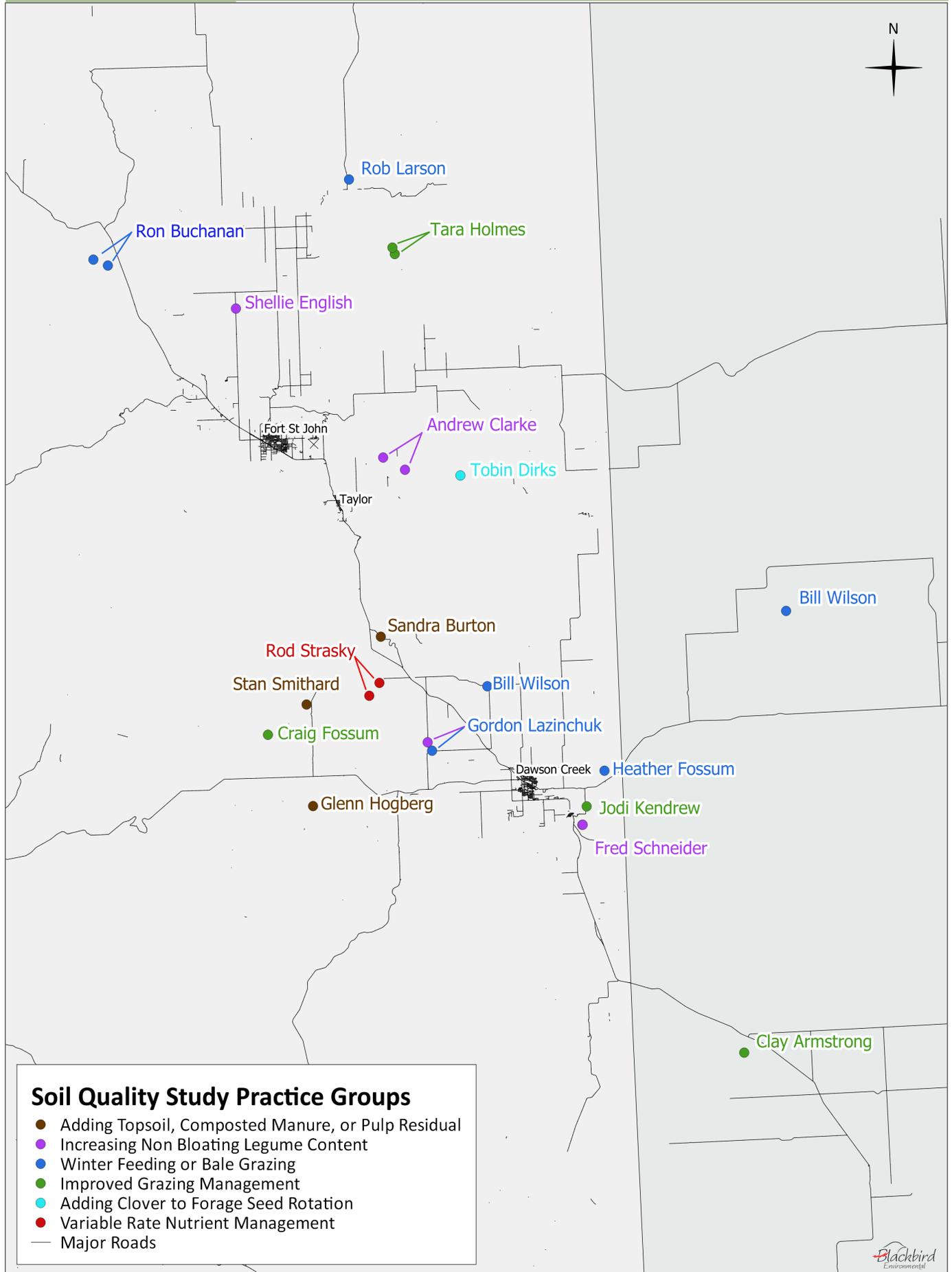
Craig Fossum & Brette Madden, McLeod, 2 benchmarks of starting points for improving soil quality.

5. Adding clover to forage seed rotation:

Tobin Dirks, Flatrock, direct seeding creeping red fescue for seed into clover stand, 1 pair of benchmarks.

6. Variable rate nutrient management:

Rod & Kim Strasky, Farmington, using variable rate nutrient management, 2 fields, 2 sets of soil benchmarks, also monitored nitrogen losses in 2015 & 2016.



What Did We Learn From The Paired Comparisons?

The highlights from the paired benchmarks of the Soil Quality Study are discussed here for each cooperator.

1. Adding topsoil, composted manure or pulp residual:

Glenn Hogberg created topsoil by turning his manure piles before spreading them onto the field. Adding well rotted manure caused dramatic soil improvements including: lower bulk density, better soil moisture status and higher available water holding capacity. These additions increased the enriched topsoil depth by 1.5" and increased the pH levels by 0.7 (see *Forage Fact #102*).

Stan & Shirley Smithard wanted to know if on-farm nutrients in manure could be captured in better pasture growth and if there were advantages to composting the manure piles before spreading the material. Stan's practices appear to be increasing infiltration rates in his fields. This is likely caused by the increases in organic matter. Soil organic matter can act as a sponge and absorb water at the top of the soil. Organic matter was increased by 5% and infiltration rates were increased by 12 and 32 inches per hour respectively at each benchmark pair between 2017 and 2019. He has also increased the amount of water that the soil can hold by about an inch per foot of soil. Since typically water holding capacities are often only 2-4 inches per foot this is a significant increase and gives plants a buffer between rainfalls (see *Forage Fact #115 for more details*).

Fred Schneider brought in topsoil to increase the soil quality of his field and we found improvements in topsoil depth, soil texture and bulk density. Even more dramatically organic matter increased by over 4% and available water holding capacity increased by 0.6 inches per foot of soil.

Richard Kabzems & Sandra Burton wanted to improve their pasture by composting and incorporating pulp residual from the plant in Taylor. The addition of this soil amendment dramatically improved the topsoil, rooting depth and the soil respiration.

2. Increasing non bloating legume content:

Andrew & Brian Clarke wanted to know if the birdsfoot trefoil out performed the alfalfa due to a higher soil quality, but this was not the case at either of their demo plots.

Gordon & Brenda Lazinchuk wanted to compare the lower poorly drained areas with higher better drained areas to see if the birdsfoot trefoil had a preference. It did not seem to at either of the pairs in the 2 different fields.

Fred & Liz Schneider's sainfoin demo plots had one area of the field where the sainfoin established really well. The fertility samplings showed no differences but when the total soil quality was assessed, there were differences.

Shellie English wants to improve a field that has been "mined" resulting in very poor soil quality. We established a pair of "starting point" benchmarks so that she can monitor her success.

3. Winter feeding or bale grazing:

Ron Buchanan's initial question was "Can feeding, grazing and nutrient management be effective alternatives to tilling and seeding to rejuvenate a hayfield?" He was looking at their nutrient flows on a whole farm basis. In total 4 pairs of benchmarks were compared with winter feeding in different years and on different landscape positions. In each set of comparisons, pH saw significant increases (which would have a ripple effect on nutrient availability). Soil respiration rates were as much as 10 times those of the control areas.

Where **Gordon Lazinchuk** bale grazed to improve his soil, his soil had much higher organic matter and pH especially on the poorer soil. There was increased soil respiration and biological activity. He also got gold stars for improved spring moisture and dramatically improved available water holding capacity. (see *Forage Fact #107 for detail on soil water relationships*).

Rob Larson's questions were: is there an alternative to ploughing to rejuvenate my pastures and control rose bush? Will bale grazing increase the bacterial activity and the plant rooting depth and preserve the protective organic layer on the soil? We set up 2 benchmarks as starting points to monitor again in a few years (see *Forage Fact #116*).

Heather Fossum wanted to compare soil quality changes after winterfeeding with bales. Heather fed bales to the horses on a very poor area next to the road in the 2017/ 2018 winter. There were dramatic improvements. Under the bale grazing there was less compaction (i.e. lower bulk density) and better structure. Infiltration rates for the soil increased by 3 fold (which can be very significant during a rainfall event). In terms of soil fertility, organic matter levels increased for both the 0-6" and 6-12" layers. The pH was improved as well. The upper topsoil (including fine thatch layer under bale residue) was increased as well as the rooting depths. These improvements resulted in higher biological activity (i.e. soil respiration) in the soil that had been winter fed and manured on compared to the area without feeding. (see *Forage Fact #116*).

Bill Wilson had been bale grazing at Price's pasture for five winters. when the soil sampling was done. The impact of Bill's practices on this field include: the organic matter levels improved by 2.5% and pH levels increased by 0.8. Soil moisture status on the day of sampling in the fall of 2017 was also 0.5 higher where Bill had bale grazed his herd. **Bill Wilson & Julie Robinson** are also implementing practices to improve their home quarter near Silver Valley. A pair of benchmarks was established as starting point to monitor soil health in the future.

4. Improved grazing management:

Tara Holmes & Ben Harrington's goals for their land are to increase organic matter and the quality of their soil with improved rotational grazing practices on the "20 Year Pasture". They saw significant improvements in many areas when comparing the newly (and brutally) cleared Frank's Field. In the 20 Year Pasture soil structure was considerably better; infiltration dramatically increased by about 100 times. Bulk density improved (i.e. decreased by 0.2 g/cm³). The depth of topsoil was 4 times the depth of topsoil in the harshly cleared Frank's Field (i.e. organic material stripped and burned). Both areas showed an excellent pH for growing legumes.

Comparing the Chamomile Pen to the Clearcut Pen there were some similar trends with better management. Both pens had relatively thin topsoil (5 & 6 inches respectively). There was a drastic increase in organic matter (over 15%) as shown in the Clear cut Pen vs the Chamomile Pen. There was actually getting to be more organic matter and thatch than was optimal in the Clearcut Pen. In contrast, the Chamomile Pen was at the opposite end of the spectrum with lots of exposed bare surface. Rotational grazing had improved soil respiration and bulk density in the Clearcut Pen with rotational grazing. Additionally the Clearcut Pen had double the water holding capacity per foot of topsoil. Infiltration was remarkably better in the Clearcut Pen. In the Chamomile Pen very slow infiltration coupled with the high bulk density and more clayey soil texture could lead to too much water in this pen for extended periods of time hampering healthy pasture growth (see *Forage Fact #119*).

Clay & Ashley Armstrong have 40 laying hens and 300 meat birds in mobile cages so the birds can be moved regularly. The health of the soil, forages and ultimately the birds have all improved under this system. Clay had always wanted to raise cattle and was keen to try more intensively managed rotational grazing in the summer and bale grazing in the winter to improve his soil quality. Our results showed that Clay's 65 cow/ calf pairs had dramatically improved the infiltration and the soil bulk density. However Ashley's "Gypsy Chicks" improved soil respiration and biological activity even more than Clay's cattle.

Jodi Kendrew wondered why an area of her pasture produced more grazing days than another area. When we took a closer look at soil health, we found the better area had double the organic matter in the topsoil horizon (i.e. upper 6") and 3 inches more rooting depth. This led to double the soil respiration and microbiological activity. Infiltration rates into the better areas were as much as 15 x better than the poorer areas. In this particular case, the dramatic difference may have been a result of both higher organic matter and a more ideal texture.

Craig Fossum & Brette Madden approached us to help them establish benchmarks in a new piece of land they had recently purchased. They wanted to use improved grazing and nutrient management practices to improve their soil, and be able to come back in several years to see what their progress was. Our soil field tests identified a few soil properties that could be improved including infiltration, depth of topsoil and organic matter.

5. Zero tilling fescue into clover:

Tobin Dirks wanted us to test the change in soil quality when he added clover to forage seed rotation. In one field he direct seeded creeping red fescue into the clover stubble with his zero till drill. Having the clover added to the rotation improved bulk density by 0.1 g/cm³, increased the organic matter by 3%, and increased rooting depth by 2 inches. The clover in the rotation also significantly improved the respiration rate, showing a higher biological activity. One area that could continue to be improved would be the infiltration rate which was very low at both benchmark locations.

6. Variable rate nutrient management:

Rod Strasky wanted us to use our soil quality field kit to help him understand why certain areas of his fields consistently yielded better or poorer than others (*refer to Forage Fact #98 page 3 to the map with the good and poor power or yield zones*). The results indicated that soil health was a reason for this. In the good power/ yield zone benchmarks, infiltration was 3 to 10 times higher, soil moisture was 0.7 to 1.1 more inches per foot of soil. There was 1 to 3 % more organic matter and the depth to a root restricting layer was 1.5 in. deeper.

Summary

Even tiny changes in indicators can have ripple effects and huge impacts on soil health, crop productivity and ultimately profitability. The 64 benchmarks established during this study can be revisited to monitor changes in soil quality after improving management practices. The soil quality field kit was a great tool for discussing soil health with farmers at field days or with students during soils courses.

