

Date:  
March 2017

# Soil Quality For Resiliency

**Disclaimer:**

The Governments of Canada & British Columbia & the Investment Agriculture Foundation of BC, are pleased to participate in the production of this publication. We are committed to working with our industry partners to address issues of importance to the agriculture & agri-food industry in British Columbia. Opinions expressed in this report are those of the Peace River Forage Association of BC & not necessarily those of the Investment Agriculture Foundation, or the Governments of Canada & British Columbia.

*“As producers we sell pounds of beef, which is directly related to forage quality & quantity. The interface between beef and forage is soil quality.”*  
Ron Buchanan

**Relevant Factsheets:**

- Forage Fact #95: Soil Quality Field Kit Part I
- Forage Fact #96: Soil Quality Field Kit Part II
- Forage Fact #107: Soil Water & Resiliency

**Contacts:**

- Sandra Burton  
250 789 6885
- Bill McGill  
250 960 5308
- Julie Robinson  
250 262 7576

**Published by  
P.R.F.A. of BC**

For more Forage Facts visit:  
[www.peaceforage.bc.ca](http://www.peaceforage.bc.ca)

## Initial Questions

This forage fact is part of the project “Innovative Management Practices for Resiliency”. The project works with farmers and ranchers to identify and evaluate nutrient or cropping management practices that will be more resilient to climate change extremes.

Questions addressed in this soil quality component of the study and this factsheet are:

1. Are the methods truly field friendly?
2. Which soil properties are relevant to each on-farm demo?
3. Does the field kit help communicate with farmers and compare management practices?

This forage fact shares the field work methods and the answers to these questions.

## Methods & Field Testing

Testing the field kit progressed as follows:  
Fall 2015 : Respecting the first question, we found that some of the methods were time consuming for a field test. We modified the methodology supplied with the kit.

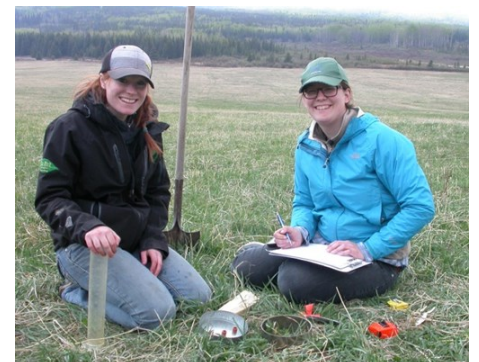
Spring 2016: For question #2 above, we selected properties with each cooperator & 11 pairs of management practices were sampled.

Fall 2016: We addressed the 3rd question & 2 more pairs were added to the data set.

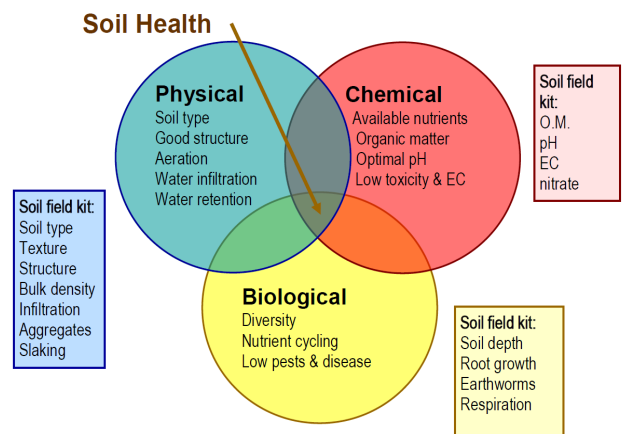
The next pages share the results of one of the 13 pairs sampled during testing of the field kit. The soil properties are coded to match the diagram at the right & previous factsheets.



Ron Buchanan & Julie Robinson digging.

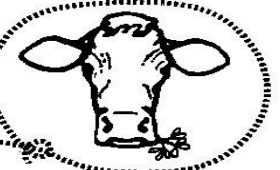


Cali Seater & Serena Black measuring soil respiration & water infiltration.



Modified diagram showing concept of soil quality from "What is Soil Health?" by Yamily Zavala, CARA at the Western Canada Conference on Soil Health in Edmonton, December, 2015.

**Peace River Forage Association  
of British Columbia**



Description/ Innovation: GPS:		No feeding	Winter feeding	Ratings With Ranges			Gold Stars, Key Messages & Management Implications
		334	272				
Soil Quality Indicator		Test Value	Test Value	Poor	Mid Way	Good	
Physical Traits	Structure Index	125	129	0 - 30	30 - 60	60	Structure is rated to depth of 24"
	Texture of surface horizon	sandy loam	sandy loam	clays & sands	clay loams	loam	
	Infiltration (in/ hr for 2nd rate)	0.5	0.4	0 - 0.6	0.6 - 6	6 - 20 +	→ Infiltration needs to be improved for both soils.
	Bulk Density (g/cm <sup>3</sup> )	1.1	1.4	1.6 - 1.8 +	1.4 - 1.6	< 1.1 -1.4	→ The winter feeding site is slightly denser than ideal with a loam.
	Soil Moisture inches per foot of soil	1.6	2.4	< .9	.9 - 1.9	> 1.9	★ Dramatic increase in spring soil moisture with 2 yr winter feeding.
	Available Water Holding Capacity inches per foot of soil	2.3	2.6	< .9	.9 - 1.9	> 1.9	★ Winter feeding increased the water holding capacity of the soil.
Chemical Traits	Organic Matter %	0.4	0.4	< 4 > 29	4 - 8 17 - 29	8.0 - 17	→ Both soils very fragile with very low organic matter levels.
	pH	6.7	7.2	< 5 > 8	5 - 6 7.5 - 8	6 - 7.5	★ Winter feeding improved the pH for plant roots & microbes. This would effect nutrient availability.
	Electrical Conductivity or Salinity (dS/m)	0.21	0.32	> 1.71	0.98 - 1.71	0 - 0.98	
Biological Traits	Respiration lb CO <sub>2</sub> -C/ acre/ day	2.0	19.5	< 9.5	9.5 - 32	32 - 64+	★ Winter feeding has increased the soil respiration & biological activity 10 times.
	Topsoil depth inches	0.4	1.6	0 - 4	4 - 8	8 - 12 +	★ Winter feeding has increased the topsoil depth by up to 4 times. → Needs more enriched topsoil or upper layer for resiliency.
	Rooting depth inches	8.0	9.0	0 - 4	4 - 8	8 - 12 +	

The **depth of soil evaluated** varied as appropriate for each property & method: Structures, Textures, Soil Moisture, Rooting (24"); Infiltration, Bulk Density & Soil Respiration (4 to 5" using rings); Organic Matter, pH, Salinity & AWHC (surface according to horizon).

## What does the soil quality report mean to a rancher?

### Why are columns on the far left: pale shades of blue, red and yellow?

These colors divide the soil quality indicators into physical, chemical and biological properties. For ease of reference, this is consistent with the diagram on page 1 and in other factsheets about soil quality (see page 1).

### What are the next 2 columns representing?

These are the results from the 2 field benchmarks comparing management practices. The 1<sup>st</sup> column in the soil quality reports is the starting point or control. The 2<sup>nd</sup> column is after the improved soil management practice.

### What does the color coding mean in these 2 columns?

**Green** is good or great! Congratulations! **Amber** means caution or watch this indicator. **Red** means poor and needs your attention.

### What is the story with the Ratings & Ranges columns in the center?

These columns explain how the colored ratings for the field benchmark results are derived. For example, if we look at texture, loams (including a sandy loam) are ideal or **green**, whereas clays and sands present some challenges for management, and thus would have been rated **red**.



Winter feeding adds nutrients & organic matter to the forage land through bale residues & livestock manure.

### ★ What do the gold stars mean?

The gold stars represent the key good news stories from the soil quality evaluation. The intent is to draw attention to the health indicators that have responded to the improved soil management practice. In this example, winter feeding improved soil moisture, available water holding capacity (AWHC), pH, soil respiration and The topsoil depth was dramatically improved and will be discussed below.

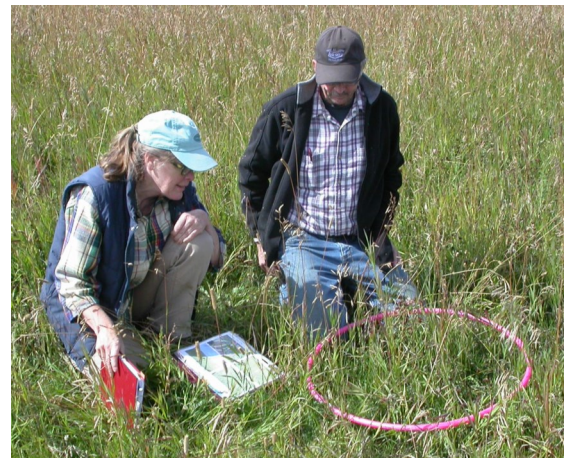
### ➔ What do the red arrows mean?

The red arrows indicate soil properties that need attention and improvement. In this example, infiltration needs to be improved for true resiliency to climate extremes. Bulk density is slightly higher than it should be considering the sandy loam texture. Both field benchmarks have very low organic matter levels and are very fragile. And finally more topsoil depth would improve this landscapes ability to buffer weather extremes.

### ★ What are the key messages here? (or Integrating the gold star messages)

Even though there were no increases in organic matter, there were some ripple effects from the topsoil depth being increased up to 4 x (*photo at right*). This probably effected the dramatic increases in soil moisture status in the spring and available water holding capacity. Winter feeding improved pH which effects plant root and microbe growth. See the 10 x increase in soil respiration as an indicator of microbiological activity. With better root growth and happy active microbes, there is improved nutrient availability for plant growth.

**Note:** We addressed field variability of soils by using detailed case studies, benchmarking with detailed aerial imagery and duplicating comparisons with other cooperators. More soil quality work with more cooperators' demos to validate key messages would be ideal.



Sandra Burton & Ron Buchanan measure the crop response at the winter feeding benchmarks.



Winter feeding increased the enriched upper layer depth from 0.4 to 1.6 inches. This seemingly small change had a dramatic effect on soil activity.

## What Did We Learn From The Other Paired Comparisons?

The soil quality report on the previous pages was an example from one of four pairs examined at Ron Buchanan's ranch. The highlights from other paired comparisons with other cooperators on other farms/ ranches are discussed in three groups below.

### 1. Better compared to poorer yielding areas:

**Rod Strasky** wanted us to test with our soil quality field kit to help him understand why certain areas of his fields consistently yield 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 .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 inches deeper.

**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 increase may have been a result of both improved organic matter and a more ideal texture.

### 2. Bale grazing:

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

**Bill Wilson** has been bale grazing for five winters. The gold star changes at his field include: organic matter levels improved by 2.5% and pH levels increased by 0.8. Soil moisture status on the day of sampling last fall was also 0.5 higher where Bill had bale grazed his herd.



Turned vs unturned manure.

### 3. Applying topsoil or composted manure:

**Fred Schneider** brought in topsoil to improve his field and got gold stars for improving the soil texture, the bulk density and the organic matter.

**Glenn Hogberg** created topsoil by turning his manure piles before spreading them onto the field. Adding well rotted manure got many gold stars including: dramatic improvements in bulk density, soil moisture status and available water holding capacity. These additions increased the enriched topsoil depth and increased the pH levels by as much as 0.7.

## Summary: Soil Quality Field Kit in Review

Even seemingly small changes in these indicators can have ripple effects and huge impacts on soil health and crop productivity and quality.

In conclusion, we found the soil quality field kit was helpful in enabling cooperators to compare management practices. With a little modification, the kit was appropriate for use in the field. It also helped communicate with both individual cooperators in their fields and it was a great tool for discussing soil health with groups of farmers and ranchers at field days or tail gate talks and with groups of students during field based soils courses.

**Compiled by:** Sandra Burton, Bill McGill & Julie Robinson in March 2017.

**With Contributions from:** Ron Buchanan, Rod Strasky, Gordon Lazinchuk, Jodi Kendrew, Fred & Lise Schneider, Glenn Hogberg, Bill Wilson, Cali Seater, Serena Black & Darwin Anderson.

**Industry Funding Partners of the Innovative Management Practices for Resiliency Project are:**

Peace Region Forage Seed Assoc., BC Grain Producers Assoc., South Peace Grain, Blackbird Environmental, University of Northern BC, Ducks Unlimited.

**The Innovative Management for Resiliency Project is partially funded through:**

the Farm Adaptation Innovator Fund, managed and delivered by the BC Agriculture & Food Climate Action Initiative, through the Investment Agriculture Foundation of BC; & the BC Business Knowledge and Strategic Adaptation program, with funding provided by the governments of Canada & British Columbia through *Growing Forward 2*, a federal-provincial-territorial initiative.



Climate Action Initiative  
BC AGRICULTURE & FOOD

