EFAO's Pilot Soil Health Benchmark Study: Part 2

In 2019 EFAO piloted a Soil Health Benchmark Study. The study was funded by the Canadian Agricultural Partnership for farmers in the Lake Erie Basin and in collaboration with the National Farmers Union-Ontario Chapter 316 for farmers in the Kingston area.

In the first part of this two-part series, we summarized the usefulness of benchmark studies and detailed EFAO's Soil Health Benchmark Study (Part 1 – Summer 2020). In this issue, we will share the group's results from 2019 and next steps for continuing this program (Part 2 – Fall 2020).

As described in Part 1, 31 farms participated in the pilot study. Each farm selected three fields or areas of interest and chose three representative plots (i.e. replicates) per field, for a total 9 samples from every farm. We measured three indicators of soil health: organic matter (OM), active carbon (AC) and water infiltration. For more details on the design and the soil health indicators, see Part 1 at: efao.ca/soil-health-benchmark-2019-results.

By taking samples from three plots per field, we were able to analyze data from each farm in addition to the group's data. For the analysis of individual farms, we used a simple statistical model called the one-way analysis of variance (ANOVA) (footnote 1) to determine whether fields differed with respect to OM, AC and water infiltration. Summary statistics of the group's organic matter and active carbon data for 31 farms are shown in Table 1.

We detected these differences with 95% confidence, which means that if we took 100 samples we'd expect to see the difference 95 times. Of the 31 farms in the pilot study, 23 (74%) detected differences among fields. For the 8 farms (8%) that observed no detectable difference, one may exist but was too small to detect; or one may exist but there was too much variability among the replicate samples to discern a difference – i.e. we couldn't detect the "signal from the noise".

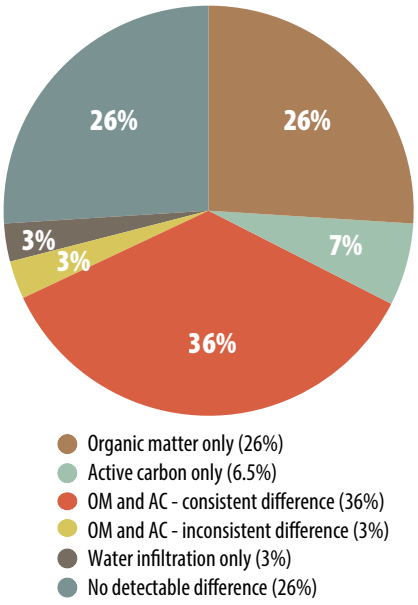

Figure 1. The breakdown of the ability of the three soil health to detect differences among fields for the 31 farms in the pilot study.

To compare soil health differences among fields, the group's data revealed that OM was the most useful indicator followed by AC. Indeed, the majority of the 31 farms detected differences among fields using OM and AC, as shown in Figure 1. Water infiltration was useful on only one farm and, in general, farmer-participants noted frustrations taking infiltration measurements including long and variable infiltration times. This might be because we took measurements in the fall, when the ground was too saturated.

Intrigued by a relatively high AC value (500+ mg C/kg soil) for the sample with the lowest OM (1.6%), we also explored the OM:AC ratio by dividing OM by AC for each sample. (See efao.ca/soil-health-benchmark-2019-results for supplement table of the group's OM:AC ratio data.)

Since AC denotes the small portion of OM that is usable by soil microbes as an energy source, relatively high values indicate that the soil microbial community is actively cycling nutrients and, in turn, stabilizing carbon and forming organic matter. In a game of "chicken or egg", we interpreted the higher ratio (i.e. high AC relative to OM) as evidence for active microbes that will eventually lead to detectable increases in OM. Only time will tell.

Tracking soil health over time

Speaking of time, the first sampling year of a benchmark study is used to determine a baseline from which to assess future change in soil health and regeneration.

While many participants gained insights into how the soil health on their fields compared in 2019, the real power of this study will come in future years when the farmers re-sample the same areas and compare the new data to the 2019 baseline data.

When to sample next depends on specific management practices and any changes in practice. As a general rule of thumb, especially for those making dramatic changes in management, we suggested that participants might see changes in AC every three years and in OM every five years. As for the baseline samples, farmers will need to sample from at least three representative plots per field in order to run statistics and assess differences.

What would you like to see come of the pilot Soil Health Benchmark Study?

A continuation and chance for more farms to participate? The opportunity for local groups to coordinate soil sampling? Including other indicators as part of the study? Meetings to collaboratively discuss results and regenerative farming?

We'd love to hear your thoughts! Please fill out the short feedback form found at: efao.ca/soil-health-benchmark-2019-results to guide the future of this important work.

Table 1. Summary statistics of the group's organic matter and active carbon data for 31 farms. Note that not enough data was collected to provide summary statistics for water infiltration.

Statistic	Organic matter (%)	Active carbon (mg C/kg soil)	AC : OM (ratio)
Minimum value	1.4 Sandy	264 Clay – clay loam	48 Organic (raised bed)
Mean	4.4	794	201
Maximum value	20.1 Organic (raised bed)	970 (unknown)	354 Sandy loam

- You can find a digital copy of the Soil Health Benchmark Study – Part 1 at efao.ca/soil-health-benchmark-2019-results
- You can find a Soil Health Benchmark Report in the Research Library at efao.ca/research-library.
- You can find details of the pilot program and links to the protocols at efao.ca/soil-health-benchmark-study.

Footnotes:

To run the ANOVAs, EFAO staff used R statistical software, an open source statistical package. You can also run ANOVA as a function in standard spreadsheet programs and there are many free online sources including:

www.socscistatistics.com/tests/anova/default2.aspx

goodcalculators.com/one-way-anova-calculator

Other references:

Fine et al. 2017, accessed online at: acsess.onlinelibrary.wiley.com/doi/full/10.2136/sssaj2016.09.0286

Hargreaves et al. 2019, accessed online at: www.nrcresearchpress.com/doi/10.1139/cjss-2019-0062#.Xwc8mS0ZMh8

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