How soil health parameters vary by cropping system in Atlantic Canada

Carolyn Marshall[1], David Durton[1], and Derek Lynch[1]
[1]Department of Plant, Food, and Environmental Sciences, Dalhousie Agricultural Campus, 50 Pictou Rd. Truro ,NS B2N 5E3

The Project

Soil health has implications for climate change, food security, and economic prosperity. Atlantic Canada, which has a diverse agricultural industry consisting of often smaller, mixed farms, faces many soil health challenges but the extent and distribution of soil health issues is unknown.

The Atlantic Soil Health Lab has undertaken a survey of soil heath across the diversity of soils and cropping systems in the region.

Cropping system can influence soil health through innate soil properties (i.e. certain types of production are only undertaken on certain types of soil) or through management practices. For example, pasture is managed with low disturbance while potato production has a high level of disturbance. However, there is a lot of variation in management within a cropping system as well, leaving the main drivers of differences in soil health largely unknown in this region.

Here we present data from NS sites collected between 2016-18 which represented 8 different cropping systems:
1.Field Crops (mostly corn and soybean)
2.Vegetables
3.Forages
4.Pasture
5.Orchards
6.Small Fruit (strawberries, highbush blueberries, etc.)
7.Wild Blueberries
8.Vineyards

Soil health parameters measured included soil carbon (SC), particulate organic matter (POM), and permanganate oxidizable carbon (POX – also called Active Carbon), ACE protein, aggregate stability, compaction, water holding capacity, soil nitrogen supply, and respiration.

Table 1. Considering pasture as a ”gold standard” for soil health, it was given a value of 1 for each soil health parameter. All other cropping systems were given a “score” based on how they compared to pasture.

Cropping System	Soil Health vs. Pasture	Major Constraints
Wild Blueberry	1.16	
Pasture	**1.00**	
Forage	0.92	
Vineyard	0.79	WSA, AWC
Field Crops	0.67	POM, WAS
Small Fruit	0.66	Resp, SNS
Vegetable	0.58	Resp, SC, WSA, ACE
Orchard	0.43	Resp, SC, WSA, ACE

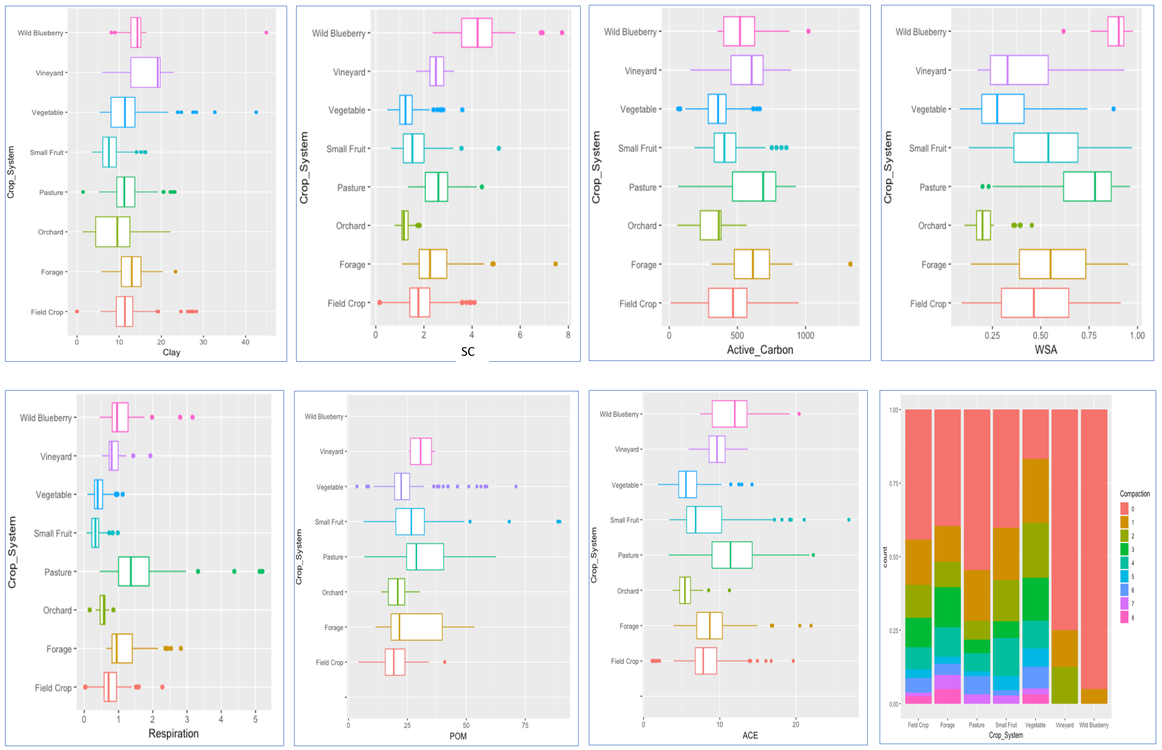
*SC = Soil Caron, POM = Particulate Organic Matter, Resp = Soil Respiration, WSA = Water Stable Aggregates, SNS = Soil Nitrogen Supply, AWC = Available Water Capacity

Results

Soil carbon, POX-C, and ACE protein were all highly correlated (68-70%). POX has been proposed as an cheaper, faster way to indirectly track changes in SC. In a PCA, those three parameters along with respiration were associated with the first principle component (50.2% of variance) and clay content and available water capacity were associated with the second principle component (15.9% of variance).

The grouping of cropping systems is also clearly shown in the PCA, with vegetable and small fruit production separated from other cropping systems. Orchards were not included in the PCA due to missing data as analysis is yet to be completed on these samples. POM was also omitted as a variable while we are waiting for more data.

The impacts of cropping system were strong. Each soil health parameter measured was significantly affected by cropping system. To better see overall trends, pasture was treated as a “gold standard” for soil health and given an overall score of 1 for each parameter. Other cropping systems were then given a score based on how they compare to pasture and this was averaged across all parameters to give an overall soil health score (Table, left).



Discussion

There are concerning trends with regard to the impact of cropping system on soil health. For example, vegetable fields had 49% less SC and field crops had 30% less SC when compared to pastures. With recent trends in this region of increasing production of corn and soybean and a reduction in animal husbandry, these large differences present a challenge for maintaining soil health in the relatively fragile soils of the Atlantic region.

While wild blueberry fields often outscored pasture on soil health parameters, this could be due to the unique locations suited for wild blueberry production (forested areas) or due to the low disturbance associated with this production system.

Differences between cropping systems do not appear to be due to inherent soil pedogenic characteristics. For example, soil texture (clay) was not significantly different between vegetable and pasture but they were significantly different on all soil health parameters.

Overall low soil health scores in orchards (although sample size was low, n=24) and vegetables give us a starting point to begin to work with government and extension agencies to target these areas for improvement.

Further analysis of farming practices reported by producers will help us detect differences within cropping systems and identify best management practices to encourage in these under-performing soil systems.

Conclusions

- Close relationships between soil health parameters could potentially be used to make soil health testing more accessible by decreasing costs and time required.
- Differences in cropping systems are likely due to management.
- Significantly lower soil health in certain production systems is a challenge to maintain sustainability of agriculture in the Atlantic region.

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