# The Effect of the Application of Different Agroforestry Techniques on Soil pH

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## Introduction

- Agroforestry is the practice of leaving strips of native forest (hedgerows, HG) or planting rows of trees (shelterbelts, SH) between crop fields.
- The objective of this project is to see if agroforestry will impact soil pH.

- pH affects the balance between bacterial and fungal populations in soil.
- Less acidic soils are more hospitable to nitrogen-fixating bacteria (Rousse, Brookes, & Baath, 2009), which increase levels of plant-accessible nitrogen in the soil (AAF, 2002).

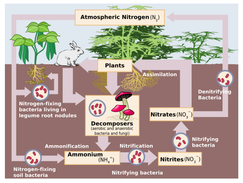


Figure 1: The nitrogen cycle (EPA, 2003).

## Methods

- Soil samples were taken from 10 sites located in central Alberta (Figure 2). Sites S1-5 consist of cropland and adjacent shelterbelts, while sites H1-5 have hedgerows.
- In each of the areas indicated in Figure 3, soil samples were taken using an auger at depths of 0-10 cm, 10-30 cm, 30-50 cm, and 50-100 cm.

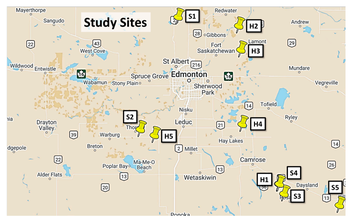


Figure 2: The locations of each of our sample sites.

Site Diagram:

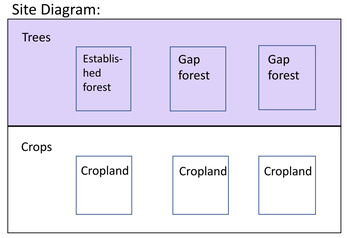


Figure 3: A diagram detailing the types of samples taken from each site. "Established forest" refers to a part of the SH/HG with established tree growth, while "gap forest" refers to an area of the SH/HG where trees naturally have not grown.

Steps:

- Samples were put through an 8 mm sieve. Objects >2mm in diameter were also removed.
- Subsamples (~5g) were taken from each sieved soil sample and oven dried, and their weight was recorded.

Figure 4: The 8mm sieve used to sieve our soil samples.

- Water was added to each dried soil subsample at a 1:1 ratio between mass of dried soil and volume of water.
- Samples were agitated for 30 minutes in order to ensure they were evenly mixed.
- The pH of each sample was then taken using an automated pH meter.

## Results

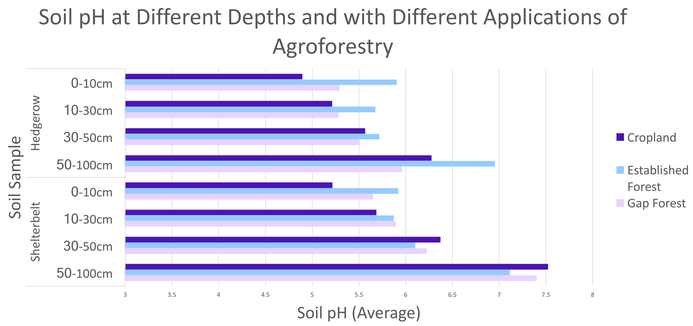


Figure 5: A graph of our soil pH data. A distinction is also made between gap forest and established forest, as explained in Figure 3.

- Figure 5 is a graph of our consolidated soil pH data. Each pH value is an average of the 5 HG/SH sites at that depth.

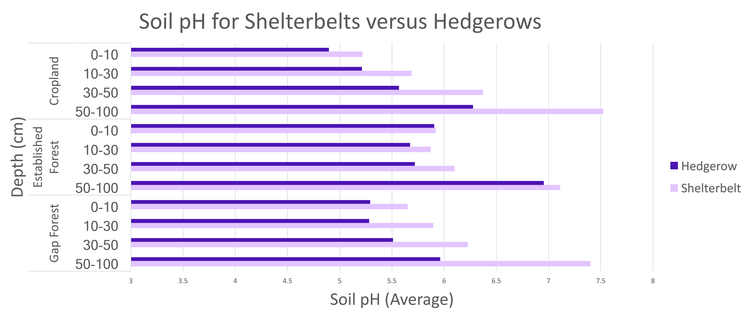


Figure 6: A comparison of soil pH between shelterbelt and hedgerow systems.

- Figure 6 displays our data at each depth and from each site type, with a comparison between the shelterbelt and hedgerow data for each.

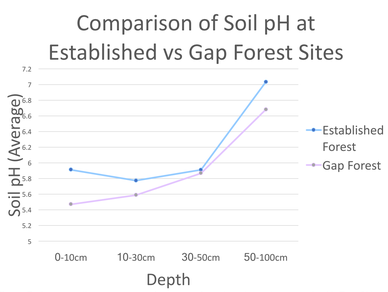


Figure7: A graph directly comparing established and gap forest soil pH. The SH and HG values have been averaged.

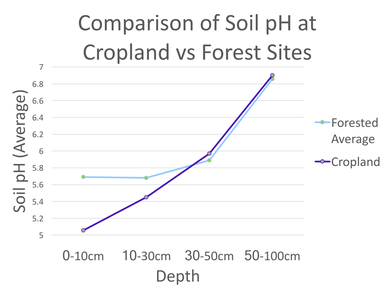


Figure 8: A graph comparing forest and cropland soil pH directly. To obtain the "Forested Average" pH values, the data for gap and established forest was averaged.

- Figures 7 and 8 directly compare data for different site types. The SH and HG values were averaged to show trends more clearly.

## Discussion & Conclusions

- Some trends in the data are as follows:
  - Shelterbelt soil is consistently less acidic than hedgerow soil, especially in cropland soil (Figure 6).
  - Soil from established forests is typically less acidic than gap (Figure 7). However, causation may not be the case – the pH could be higher due to the presence of trees, or vice versa as the gaps in the trees were naturally occurring.
  - From 0-50cm the cropland soil is substantially more acidic than the forested soil. However, the pH values converge at greater depths, possibly because the effects of farming (such as fertilizers) do not reach that deeply into the soil.

Figure 9: A hedgerow sample site.

Figure 10: a shelterbelt sample site..

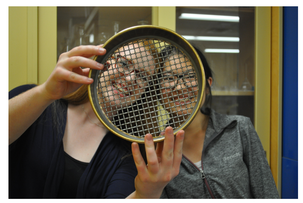

Figure 11: The two WISEST students with our sieve!

- Planting shelterbelts may be beneficial to crop yields by making neighboring cropland soil less acidic. This could foster more nitrogen-fixating bacteria in the soil, making more nitrogen available to crops.
- These cropland soil samples were only sampled 30-40m away from the SH/HG. The benefits of shelterbelts may diminish further out.
- Because they are self-sustaining, shelterbelts could be less expensive over the long term than alternatives like liming.

## Literature Cited


- Environmental Protection Agency, 2003. https://upload.wikimedia.org/wikipedia/commons/f/fe/Nitrogen_Cycle.svg. Accessed on August 5, 2018.
- Alberta Agriculture and Forestry- Government of Alberta, April 25, 2002. https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3684. Accessed on August 5, 2018.
- Rousk, J. .et al. 2009. Applied and Environmental Microbiology, 75, 1589-1596.
- Weil, R.R. & Brady, N.C. 2016. The Nature and Properties of Soils. 15th edition.


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