How pH Affects Aluminum Within The Soil

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Introduction

pH is a key factor in determining soil nutrition. The best pH range for the majority of crops is between 6.0 and 7.0 [1]. As pH decreases (acidity increases) within the soil, the solubility of aluminum increases. This decrease in pH has an inverse relation to the aluminum toxicity as pH decreases the toxicity increases and vice versa. This increase in toxicity restricts root growth and reduces the plant's phosphorus uptake immensely [3]. This then leads to lower crop yields.

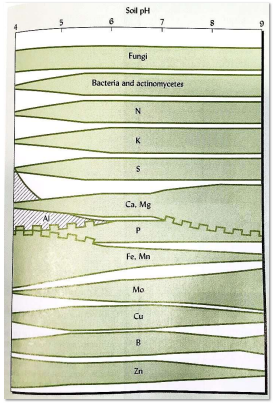

Figure 1. Brady and Weil, 2008: The image above demonstrates when pH decreases, aluminum (Al) increases and disturbs phosphorus (P) intake by the plant.

Study Site

Figure 2. A typical crop rotation in central Alberta consists of wheat, barley, and canola.

Figure 3: The Study Sites used were H2, H3, H4, and H5.

The soil data from this research came from an University of Alberta Soils Lab that is currently working on a 4 year agroforestry research program trying to develop methods to increase carbon storage within soils and reduce greenhouse gases. Agroforestry systems are when trees or shrubs are growing around or among crops. The soil samples are taken from different hedgerows and shelterbelts within forested and cropland areas in central Alberta. The focus of this poster is the cropland soil pH data from hedgerow agroforestry systems.Hedgerows are trees that naturally grew in areas, that later farmers planted their crops around.

Methods

The steps for preparing the soil samples for pH testing:

- An 8 mm sieve was used to sieve the soil while also maintaining the soil aggregates.
- Large rocks and roots were removed using a 2 mm sieve because anything bigger than 2 mm is not classified as soil.
- Soil subsamples were weighed and put in a pre-weighed vial and put into an oven for 3 days to remove (and measure) water weight.
- After 3 days, the dry soil was reweighed and the weight of the soil in grams was how much distilled water we put into the vials in mL for a 1:1 ratio.
- The soil and water were then shaken in a mechanical shaker for 30 minutes.
- Immediately after shaking, soil pH was measured with a pH meter.

Figure 4: Emma (right) and Wendi holding the sieve used for pH preparation.

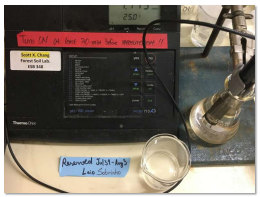

Figure 5. The pH meter used to measure the soil pH of the subsamples.

Results

The pH data reveals that the soil is more acidic closer to the surface and becomes more neutral or even more basic as the soil increases in depth. The cropland soil of hedgerow systems consistency had a pH greater than 4 and less than 8.

Results cont.

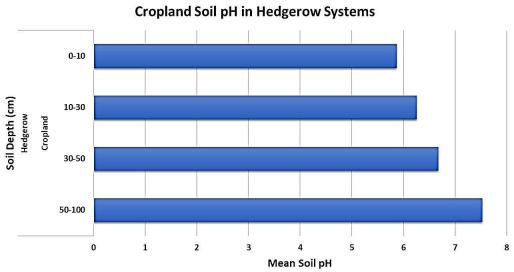

Figure 6: The Graph above shows that pH close to the surface is very low, and more acidic. As it increases in depth, the pH gets closer to neutral, but surpasses it to become more basic.

Discussion & Conclusions

- The cropland hedgerows have been found to have lower pH until reaching a deeper depth and at that point the soil is more neutral to basic. But on average, the soil is very acidic, which increases the aluminum toxicity which restricts root development and mineral uptake in the roots. This may result in the plants grown in these areas to suffer, and not be as healthy even with the fertilizers being added by farmers. The fertilizers are most likely the reason for the acidity in the first place as well.
- To counteract the acidic soil, one must attempt to neutralize it. Methods that can be taken are such things like adding limestone which is made up of calcium and magnesium carbonate or calcium carbonate. Adding too much limestone could end up leaving the soil with zinc, manganese, and iron deficiencies. Soil must be as close to the pH of 7 for best plant productivity.

Acknowledgements

I would like to thank Cole Gross for giving me the opportunity to experience a lab setting, alongside Beta Sigma Phi for sponsoring me.

Literature Cited