Ammonium Determination Lab

Introduction

In this lab, we tested soil samples for ammonium concentration using the Berthelot reaction, Beer's Law, and UV-Vis spectrophometry. Ammonium(NH_4^+) is an important compound to measure because it contains nitrogen, an element essential for plant life. Nitrogen's availability on Earth's land surfaces is less than 100 kg/ha*yr, which is less than many of the elements required for plant production (excluding Phosphorus). However, the plant requirements for nitrogen exceed 20 kg/Mg NPP, which is far greater than the other elements required for plant growth (class handout). Due to this imbalance in availability and demand, nitrogen is a key factor to the relative health of soil. In this lab, we measured the nitrogen found in the form of ammonium. This form of nitrogen occurs after the fixation step of the nitrogen cycle, but before nitrification. Nitrifying bacteria in soil turn ammonium into nitrites and then nitrates, a form of nitrogen that plants can use for growth. Too much ammonium can cause acidification of soil from excess aqueous acid production. Because plants cannot use ammonium directly, and because large quantities of ammonium may actually impair soil health, the nitrogen measurements in this lab may not give a clear conclusion to the amount of nitrogen available for plant consumption or the relative health of the soil.

Discussion

The Berthelot reaction used in this lab relies on a color change produced by nitrogen and an organic compound, which in the case of this lab was Phenol/Nitroprusside. In order to create a standard curve, we split into groups of seven and produced varying standard solutions of known NH_4^+ concentration. The concentration range was 1-10 mM NH_4^+/g of soil. Because of Beer's Law, we could conclude that the darker the color of the NH_4^+-Phenol/Nitropusside solution, the more NH_4^+ present. Using a UV-Vis spectrophotometer we plotted the absorbancy readings versus the NH_4^+ concentration. Unfortunately, the concentration range of 1-10 mM NH_4^+ was too great for a linear standard curve. Our non-linear curve could not tell us how much NH_4^+ was actually in our soil samples. For that reason, we used the data from the 12:30 Gen Chem section. They used a concentration range of 0.5 mM NH_4^+ to 3 mM NH_4^+. This concentration did not max out the spectrophotometers and provided us with an equation of the standard curve. This equation was $y=0.8738x+0.0041$.

Because the data for the standard curve was taken from another class, the confidence in the curve is greatly decreased, and any conclusions we glean from this curve are tenuous at best. We do not know the procedures conducted and any procedural errors are completely beyond our ability to ascertain.

We did, however, make three comparisons using the NH_4^+ concentrations of our class' soil samples. Figure 1 shows the NH_4^+ concentrations in two 2-3" soil samples. The average NH_4^+ concentration of the Grassy Flood Plain (GFP) was greater than that of the Lawn. The GFP concentration was 0.765 mM NH_4^+, while the Lawn concentration was only 0.258 mM NH_4^+. This could indicate that the GFP has more available nitrogen, with increased possibility for plant production. The standard deviations, however, were very large and overlapping, leaving the data statistically inconclusive.

Figure 2 shows the NH_4^+ concentrations in three 12-14" soil samples. All three have overlapping standard deviations, however, both the Lawn and Cedar Grove samples have higher NH_4^+ concentrations than the GFP sample, indicating that at lower soil levels, the they may have more available nitrogen than the GFP. All were relatively close in average concentration, with the Lawn possessing a concentration of 0.204 mM NH_4^+ and the GFP possessing a concentration of 0.150 mM NH_4^+.

Finally, Figure 3 shows the concentrations of NH_4^+ at different depths of the Lawn soil sample. Once again, the results are statistically inconclusive, with the average concentrations being 0.258 mM NH_4^+ at 2-3" and 0.204 mM NH_4^+ at 12-14". This possibly indicates that nitrogen is available at similar amounts through a wide range of depths beneath the lawn.

We do not know how the nitrogen load affects the primary productivity with the particular vegetation present, so we this data is only useful in comparison of nitrogen found in the form of ammonium relative to the location and depth of soil. Because of this lack of knowledge, along with the large amount of human error, lack of confidence in the standard curve, and the statistically inconclusive data, further research must be conducted before we can make any reliable conclusions of soil health.

Evaluation of the traits	
T*he* ***Focus*** *of this work is "Effective"*	Starts strong but gets distracted in the discussion, probably due to the complexity of the lab operations and the fact that they had to use standard data from another class. The writer does come back to how the results relate to nitrogen however, so he recovers from the loss of focus.
The ***Organization*** *of this work "Effective"*	Overall organization is very good with a strong introduction, a brief discussion of the experiment followed by the results. An added benefit is the summative statement at the end reminding the reader that although there were results, there are some inherent problems. There are seemingly "random" statements that pop out, mostly they were thought to be important but weren't linked to the logical flow within the paragraph.
The ***Voice*** *of this work "Effective"*	This has a strong voice with complex and variable sentences that generally lead or flow from one to the next with transition statements that seem natural. There is some wording in the introduction that gets muddled and the discussion of specific results could be better worded.
T*he* ***Convention*** *of this work is "Mastery"*	The mechanistic aspects of this paper are excellent and the concepts are correctly applied, especially the use of statistics. Although they are not included in this document, the figures that were included in the original were properly formatted. You will also notice that the author highlights the data rather than restating it in the text. The only fault I find with the convention is the failure to define NPP and the awkward statement regarding using the UV-spec for plotting the absorbance of the samples.