How Does Aluminum Affect the Fungi in the Ecosystem?

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Abstract

Aluminum is one of the most prevalent minerals on the planet. Yet low pH levels in the soil lead to high levels of active aluminum in the soil that are harmful. One such group of organisms are the Fungi. There was a high level of active aluminum in the sites of the E.S.S.R.E program, and in one location it was as high as 103 ppm. We hypothesized that such a corresponding low level of yeast and mold in the soil was being caused by the aluminum. In order to test for this, we collected 3 soil samples from 5 of the E.S.S.R.E. sites for 4 days and tested for active aluminum levels and mold and yeast densities. After testing we came to the conclusion that our hypothesis was wrong and that the high levels of the active aluminum were not causing the amount of Fungi to be low.

Introduction

Aluminum is one of the most prevalent minerals on the planet. Yet low pH levels in the soil lead to high levels of active aluminum in the soil that are harmful. Active aluminum can damage plant roots, preventing them from taking in nutrients such as potassium, magnesium, and nitrogen. (The Lake Erie Regional Grape Program, 2008,). In addition, active aluminum can harm other soil organisms such as fungi.

Yeast and Mold are two fungi commonly found in the soil. Yeast are helpful because they create proteins and vitamins in the soil for plants. (Diameter of Yeast, 2000,), and mold can be helpful to the soil because it brings moisture. (Pollen and Mold Center, 2000). Both forms of Fungi help shield plants by eating nematodes. But yeasts and molds can also be harmful because some of them damage certain plants by infecting the roots. All Fungi mainly grow in damp soil and heavy rain causes them to grow rapidly. They are involved in decomposing dead plant and animal remains, using the sugars from living plants to help in this process. (The World Beneath Our Feet, 2003).

The 2008 E.S.S.R.E. Biota Survey showed that in Site 1 (N 39.35794; W 076.63977) there was an unusually low level of yeast given the high level of moisture and decomposition in Site 1. Normally there could be at least up to 1,000,000 per gram of yeast in the soil (NC State University, 2000), but there were on average only 1,300 of yeast in the soil and 3,000 molds. At the same time the Biota survey showed unusually high levels of active aluminum (103ppm). We hypothesized that the low levels of yeast was being caused by the excessive amount of active aluminum in the same location because active aluminum in the soil has been shown to be harmful to yeast (Spectrum Analytic, n.d.).

Methods

Three soil core samples 15cm deep and 2.5cm diameter were taken from each of 5 E.S.S.R.E research sites corresponding to previously known Aluminum levels: Site 4 (N 39.35733; W 076.63840) Quadrant 4 [High], Site 1 (N 39.35794; W 076. 623971) Quadrant 2 [Medium High], Site 4 Quadrant 2 [Medium], Site 3 (N 39.3797) Quadrant 1 [Medium Low], Site 4 Quadrant 1 [Low]. Serial dilutions were completed on each sample to the 10^{-2} dilution. 100 μl of each dilution was plated on an individual 3M Petrifilm™ Yeast and Mold Count Plate.

Simultaneously, each soil sample was tested using the LaMotte Model STH-14 Series test kit to determine the amount of active Aluminum (ppm) in that sample. The entire process was repeated 3 additional consecutive days.

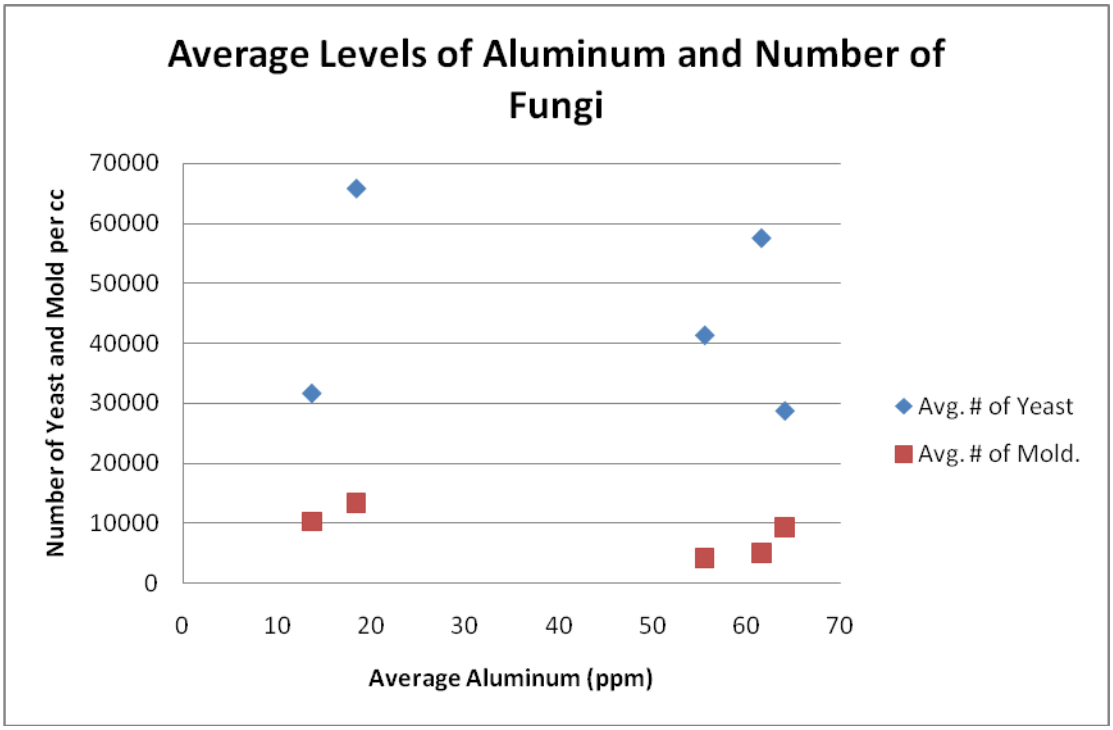
Results

Table 1:

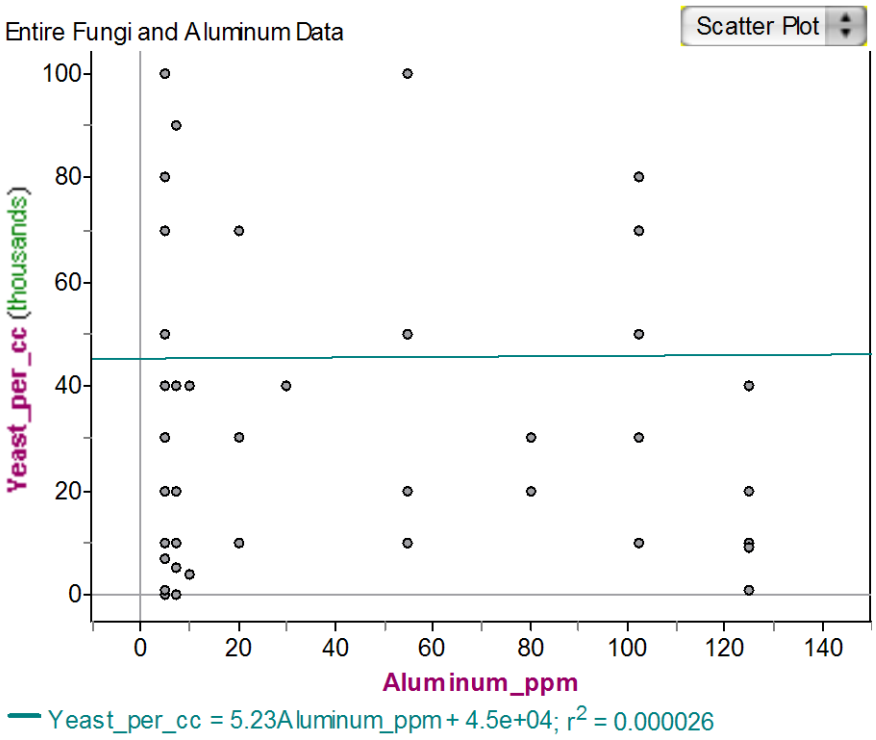
Aluminum and Fungus Data Averages

Site/Quadrat by Level of Aluminum	Avg. Aluminum	Avg. # of Yeast	Avg. # of Mold.
Low (S4Q1)	64.166	28833.33	9333.33
Med-Low (S3Q1)	18.5146	65833.33	13500
Medium (S4Q2)	61.66	57583.33	5083.33
Med-High (S1Q2)	55.625	41416.66	4166.66
High (S4Q4)	13.75	31750	10333.33

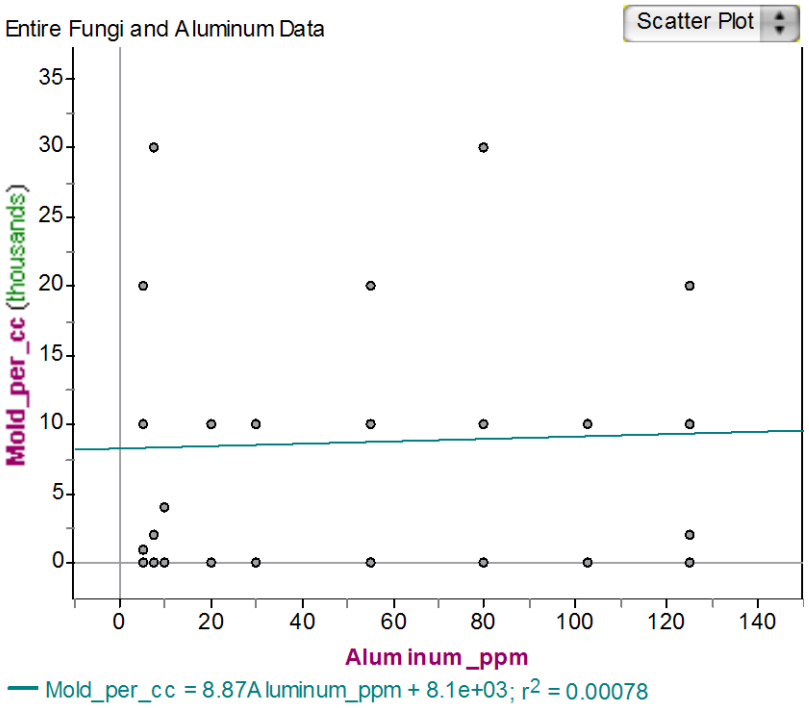
Graph 1



Graph 2



Graph 3



T-Testing was performed between the five different sites (which were determined by previous aluminum levels), and the following p-values were determined…

Table 2

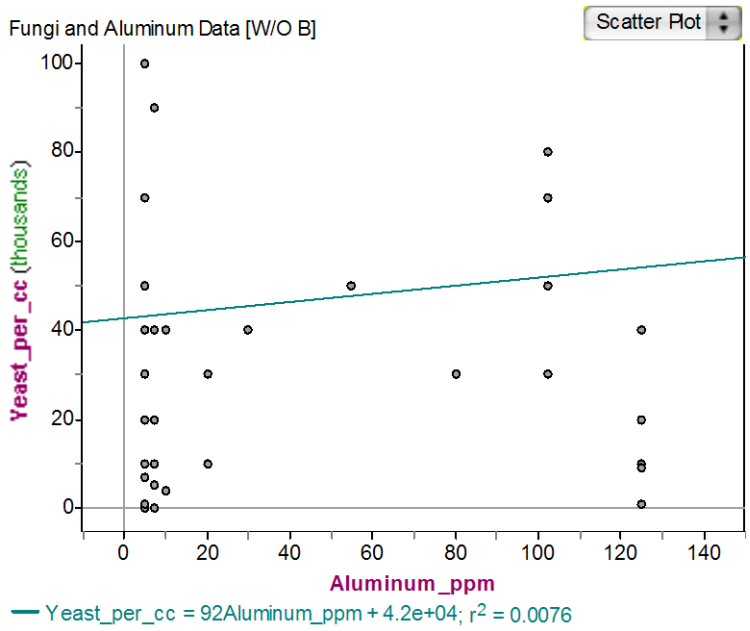
Aluminum

T-Testing Results

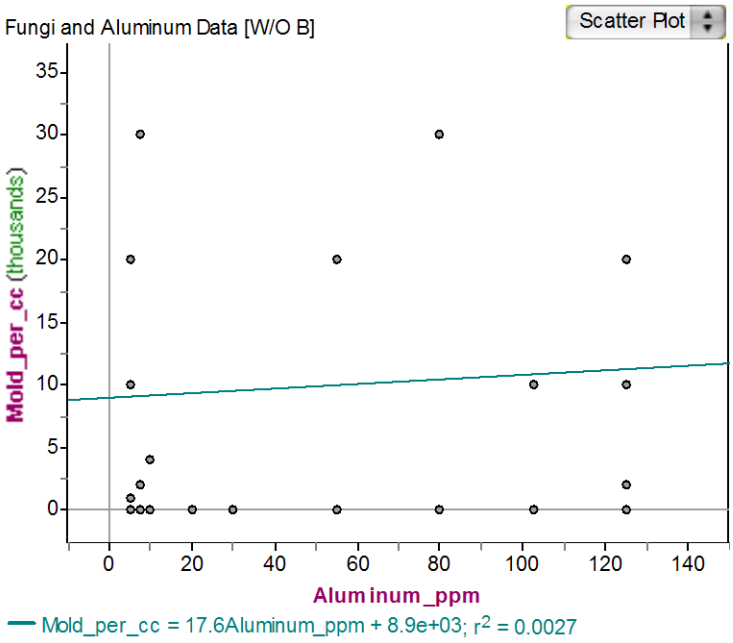
		Al T-Test	P-Values
S4Q4 (High)	A		
S1Q2 (M-H)	B	A-B	0.01237
S4Q2 (Med)	C	B-C	0.761194
S3Q1 (M-L)	D	C-D	0.021497
S4Q1 (Low)	E	D-E	0.023677

Graphs 4 and 5 represent the statistically modified analysis of the data based on the lack of significant difference between S1Q2 and S4Q2 aluminum readings.

Graph 4



Graph 5



Discussion

Our experimental findings contradicted our hypothesis. We hypothesized that the high active aluminum levels were decreasing the yeast and mold populations. However, our experiment showed that differences in active aluminum levels had no impact on the number of yeast or mold found in the soil. In fact, Graph 3 shows that as the aluminum levels increased, the mold density actually appeared to slightly increase. Furthermore, both Graphs 4 and 5 show that when the data was statistically corrected, both yeast and mold population appeared to increase slightly when the aluminum levels increased. This directly contradicts our hypothesis. Indeed, as shown in Table 1, the predicted aluminum levels we used based on previous years' calculations to choose our research sites proved incorrect. Therefore, our data showed the exact opposite of our hypothesis.

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