Affect of Soil Moisture on Algae Density

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Abstract:

High levels of moisture and phosphorus in the soil greatly affect algae density found in there. However the high levels of phosphorus in E.S.S.R.E Site 3 and the corresponding low levels of algae density found there and the low levels of phosphorus in Site 4 and the corresponding levels of algae found there caused us to hypothesize the it is the water content of the soil that causes the differences in algae density observed in these sites. We tested this hypothesis by planting 12 algae slides in each site; 3 per quadrat, 2 days in a row. On the same day the algae slides were planted we extracted 12 soil samples, corresponding to the site of an algae slide. We weighed the soil samples and then baked them for 24 hours in order to determine the amount of moisture that was in the soil. After 4 days of the slides residing in the soil, we retrieved them and counted the number of algae present on each slide. After examining our data, we concluded that our hypothesis was valid. Further research should be done to determine if sunlight may also be altering the algae density in our research sites.

Introduction:

As the only photosynthetic eukaryotes living in it, algae play a fundamental role in the ecology of the soil. They add nutrients through the conversion of the sun's energy into sugars, proteins and other complex organic compounds, and they provide food for many arthropods and other algal eaters that inhabit the soil (Nardi, 2003). They also improve soil structure by manufacturing slimy substances that fasten soil particles together into water-stable groups (Sullivan, 2010). The most common algae species found in the soil are members of the phylum, chlorophyta, but, certain species of chrysophyta can also be found there (Lenntech BV, 2009).

Many factors affect the amount of algae that grow in the soil. These include: pH, moisture levels, and seasonal changes in temperature. But depth where they live, attacks by parasites, and the absence or presence of certain inorganic nutrients can also influence algal density. Algae thrive at an optimum pH, between 7 and 10, but are not present when soil has a pH level less than five, and they are found at their most dense in areas with an ample supply of water and inorganic nutrients, especially high levels of phosphorus and nitrogen (Microbiologyprocedure, n.d.).

During the 2010 E.S.S.R.E biota survey (E.S.S.R.E. 2010), we discovered that the average algae density in E.S.S.R.E. Site 1 (0.2 mm^2) and E.S.S.R.E. Site 2 (0.12073 mm^2) were statistically significantly lower than the average density of algae in E.S.S.R.E. Site 3 (3.875 mm^2) and E.S.S.R.E. Site 4 (4.41 mm^2)(E.S.S.R.E., 2001). An examination of pH levels quickly explained this difference because the average pH levels in Sites 1 and 2 were both extremely acidic (Site 1: pH 4.72, Site 2: pH 5.75), an environment few algae can survive. But this analysis revealed a further anomaly: namely that in Site 3 where average algae levels were statistically significantly lower than in Site 4, the average available phosphorus in the soil of Site 3 was statistically significantly higher than that of Site 4 (Site 3: P 79ppm, Site 4: P 66ppm). Since normally high phosphorus levels in the soil would correlate with high densities of algae in the soil, this inverse of the usual relationship between soil phosphorus levels and soil algae density led us to wonder what could be the source of the anomaly. We decided to focus on a another major contributor to algae growth, moisture, because there is a stream that flows out of Site 3 into Site 4 which might account for the higher algae density found there.

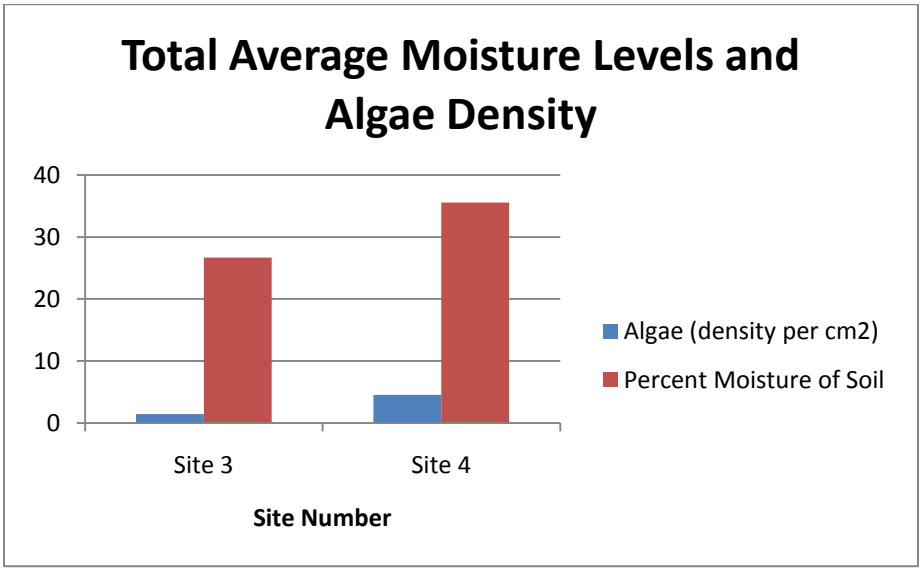
Methods:

12 soil samples (columns 15 cm deep by 2.5 cm in diameter) were taken from E.S.S.R.E. Sites 3 and 4 (E.S.S.R.E., 2001). 3 samples were taken from each of the 4 quadrats. At each sampling location, 7.5 cm X 2.5 cm microscope slides were planted vertically 6 cm into the soil leaving 1.5cm above the soil exposed to sunlight (Hall, 1996). To determine the amount of moisture in each soil sample, a gravimetric analysis was used. All soil samples were massed and then baked for 24 hours at a temperature of 105 ^oC (Schneekloth, Bauder, Broner, & Waskom, 2010). After baking, the soil samples were massed again and the percent change in mass was calculated. After 3 days, the microscope slides were removed and observed under a microscope at 40X for individual algae colonies. In 5 fields of view, the total numbers of algae colonies were determined for each sample and the average density of algae per square

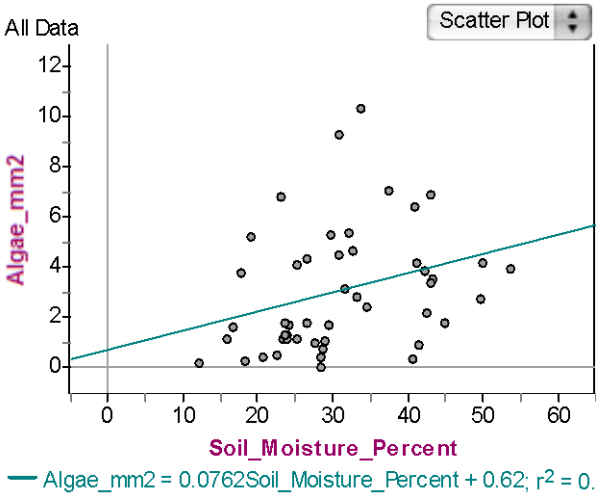
centimeter on the slide was calculated. The entire process was repeated twice, once on July 22, 2010 and again on July 23, 2010.

Results:

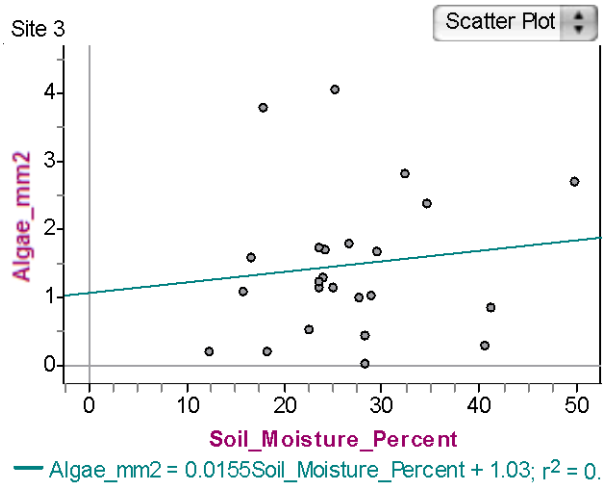
Graph 1: Comparison of Moisture Levels and Algae Density in Sites 3 and 4.



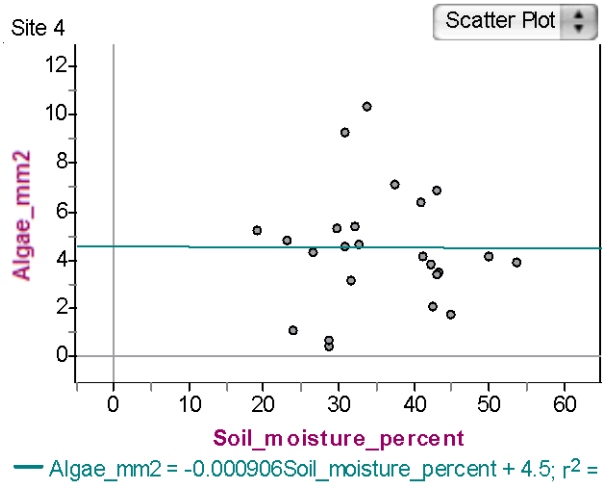
Graph 2: Total Average Moisture Levels vs. Algae Density



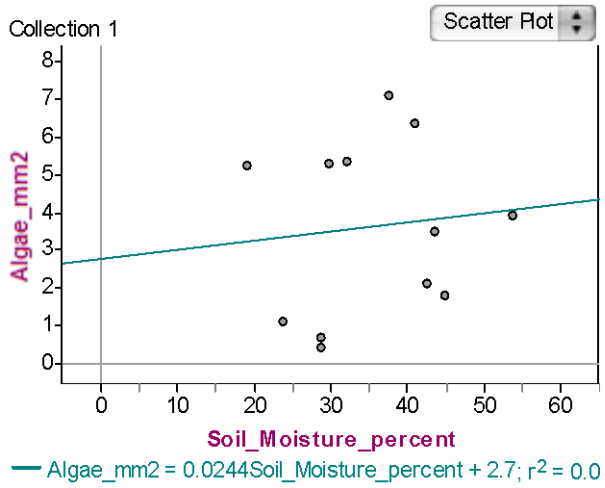
Graph 3: Average Site 3 Soil Moisture Levels vs. Algae Density



Graph 4: Average Site 4 Soil Moisture Levels vs. Algae Density



Graph 5: Average Site 4 Day 1 Soil Moisture Levels vs. Algae Density



Graph 6: Average Site 4 Day 2 Soil Moisture Levels vs. Algae Density

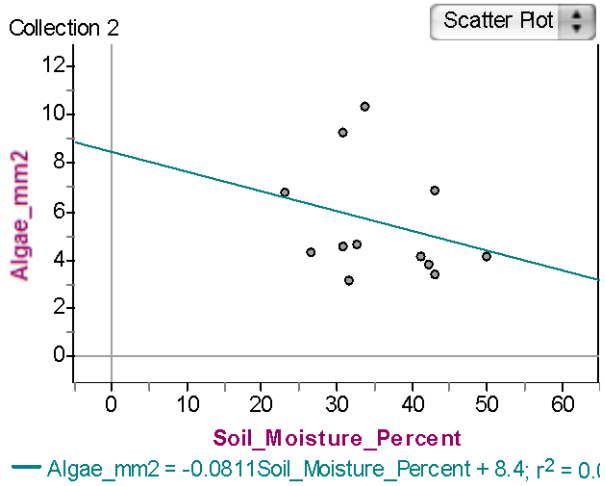


Table 1: Statistical Analysis for Sites 3 and 4 Soil Moisture Levels

Soil Moisture T- test	P value
Sites 3 and 4	0.00097

Table 2: Statistical Analysis for Sites 3 and 4 Algae Density

Algae Density T- test	P value
Sites 3 and 4	0.0000038

Table 3: Statistical Analysis from Sites 3 and 4 Day 1 Algae

Algae density T- test	P value
S4Q2- S4Q3	0.00161
S4Q2- S4Q4	0.0597
S4Q3- S4Q4	0.0757

Table 4: Statistical Analysis from Sites 3 and 4 Day 2 Algae

Algae density T- test	P value
S3Q1- S3Q3	0.027
S3Q1- S3Q4	0.25
S3Q2- S3Q3	0.099
S3Q2- S3Q4	0.082

Table 5: Statistical Analysis from Sites 3 and 4 Day 1 Soil Moisture

Soil Moisture T- test	P value
S4Q1- S4Q2	0.0042
S4Q1- S4Q3	0.066
S4Q2- S4Q4	0.011
S4Q3- S4Q4	0.018

Table 6: Statistical Analysis from Sites 3 and 4 Day 2 Soil Moisture

Soil Moisture T- test	P value
S4Q1- S4Q4	0.038
S4Q2- S4Q3	0.047
S4Q2- S4Q4	0.0094
S4Q3- S4Q4	0.0093

Discussion:

Overall, our data supports our hypothesis; the reason algae density in Site 4 is higher than Site 3, despite of the lower amounts of phosphorus, is due to the amount of moisture in the soil. As graph 1 indicates, as the percent of moisture in the soil increases, the algae density also increases, and because the increase in moisture in Site 4 was greater than the increase in moisture in Site 3, this accounts for the greater density of algae found in Site 4 as well. Hence our hypothesis is valid.

However, while graphs 2 and 3 show that the expected relationship between moisture in the soil and algae density was observed throughout the experiment, graphs 5 and 6 for Site 4

would seem to indicate that the expected relationship fluctuated over the course of our sampling days. We suspect that the differences in the sunlight over the course of the experiment probably accounts for this phenomenon. The microscope slides set up on Thursday, July 22, 2010 in Site 4, where there is more sun exposure, had an ablative sky cover value of 0.6, while the slides placed in the same site the next day were exposed to weather conditions with an ablative sky cover of 0.5 (National Weather Service Forecast Office, 2010). Since the amount of available light was greater on July 22 than on July 23, this difference in light is the most probable explanation for the patterns observed in graphs 5 and 6. Hence data from Site 4 over the course of the experiment reveals that there could be a larger factor than moisture affecting the algae, namely sunlight. Further research into the relationship between algae and sunlight in Sites 3 and 4 would therefore be our next logical step.

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