SOIL TEXTURE’S IMPACT ON EARTHWORM POPULATIONS

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Abstract

It is recognized by the scientific community that earthworm populations are impacted by their environment's soil characteristics. Since they respire through their skin, earthworms require a moist habitat to allow for the flow of oxygen. Soil types that have a higher percentage of clay content retain moisture more effectively than soil types with other higher components. When analyzing data collected from E.S.S.R.E.'s Microclimates, we saw a positive correlation between one Microclimates' average population of worms and the higher average clay soil percentage. Therefore, we hypothesized that earthworms would prefer clay soil over sandy or silty soils. We examined 50cm x 50cm areas as well as a 10cm diameter x 15 cm. long soil core samples from the center of each square area for earthworms in 5 different locations each day. From the soil extracted from the soil core, we collected soil texture samples using a water/ detergent separation technique. This was done daily for 4 days in July 2019. We determined that our hypothesis was incorrect, as we found no correlation between a Microclimate's percentage of clay and earthworm population. But we did observe that our highest worm populations wee in silty/ loam soils. We would identify such locations in the Microclimates to confirm this.

Introduction

Earthworms play an important role in their ecosystems (Penn State Extension, 2013). They move through soil creating pathways for air and water, eating organic matter such as leaves, grass, and roots, and their castes make nutrients such as nitrogen and phosphorous more readily available for plants (Nature's path, 2019). This movement, though, requires moisture which clay rich soil can provide. Clay rich soils retain moisture better than other soils such as sand, which can dry out easily, decreasing the amount of moisture needed by the worms to enable them to breathe (Penn State Extension, 2013). Furthermore, when sand grains rub against worms' skin, it can feel abrasive and cause damage (Penn State Extension, 2013).

Since we knew that rich clay soils retain moisture better than other soils, we were intrigued when the 2019 ESSRE Biota Survey (ESSRE, 2019) revealed differences in the percent of clay soil and the number of worms in the various ESSRE Microclimates. Knowing that locations where clay soil percentages were low, the average worm population should also be low; while sites with a higher clay soil percentage ought to have a higher worm population, we were puzzled when this years' survey revealed that Microclimate 2 had the highest average worm population while also having a low percentage of clay soil. We hypothesized: that this might be due to differences in how the soil was retaining moisture; so we decided to examine the Microclimates already known to have a higher composition to see what earthworm counts there were.

Methods

5 plots were selected based on their percentage of clay found in the E.S.S.R.E. 2019 Biota Survey (E.S.S.R.E. 2019): Microclimate 2, Quadrant 1 (N 39°21.531 W 076°38.363, 4.1% clay), Microclimate 2, Quadrant 3 (N 39°21.475 W 076°38.356, 3% clay), Microclimate 3, Quadrant 4 (N 39°21.481 W 076°38.303, 2% clay), Microclimate 5, Quadrant 2 (N 39°21.514 W 76°38.383, 8.7% clay) and Microclimate 5, Quadrant 3 (N 39°21.501 W 076°38.390, 7.7% clay). In each quadrant, the top 2 centimeters of leaf litter and soil within 0.5m^2 areas on the soil surface at each location were removed by hand and examined for worms. Next, a 10cm diameter x 15 cm deep cylinder was removed from the approximate center of the square plot. The column of soil was then examined for the number of worms present. Finally, the extracted soil was tested for soil texture in a 7cm tall x 5.5 cm diameter plastic jar using tap water and approximately 1mL of phosphate detergent solution. Data was collected on July 18th, 19th, 22nd, and 23rd of 2019, totaling 20 samples.

Results

Figure 1: *Correlation Between Earthworm Density and Clay Content Percentage in Soil*

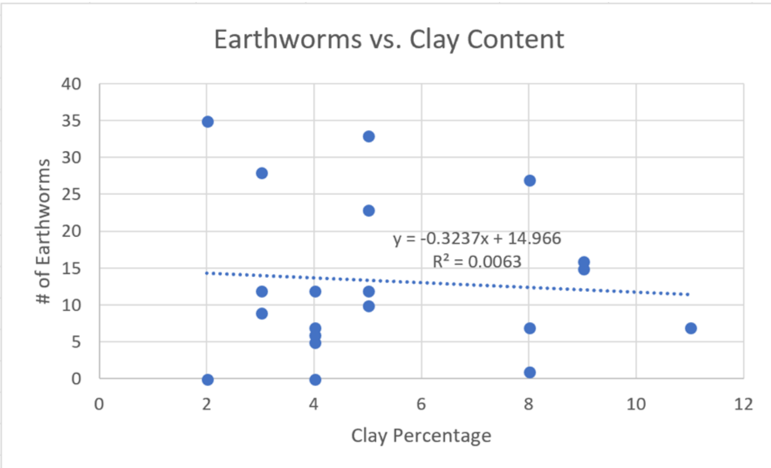

Figure 2: *Correlation Between Earthworm Density and Clay Silt Composite Percentage in Soil*

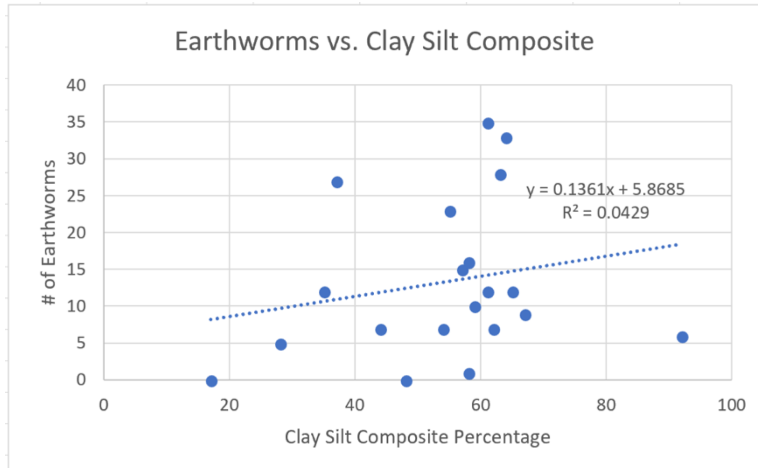

Figure 3: *Correlation Between Earthworm Density Silt Content Percentage in Soil*

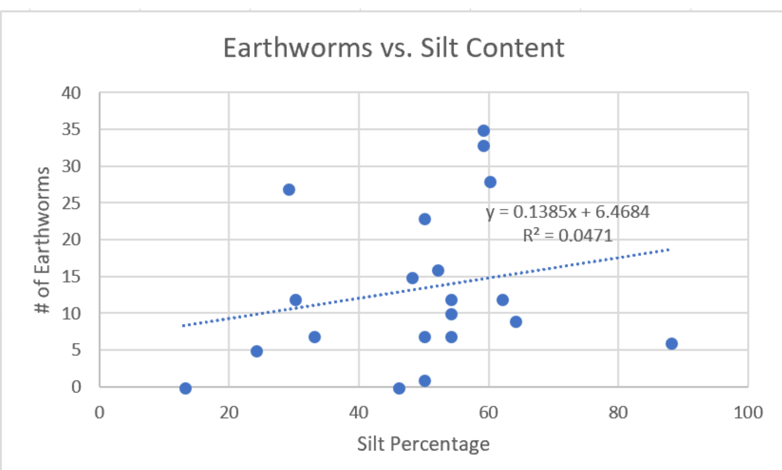

Figure 4: *Correlation Between Earthworm Density and Sand Content Percentage in Soil*

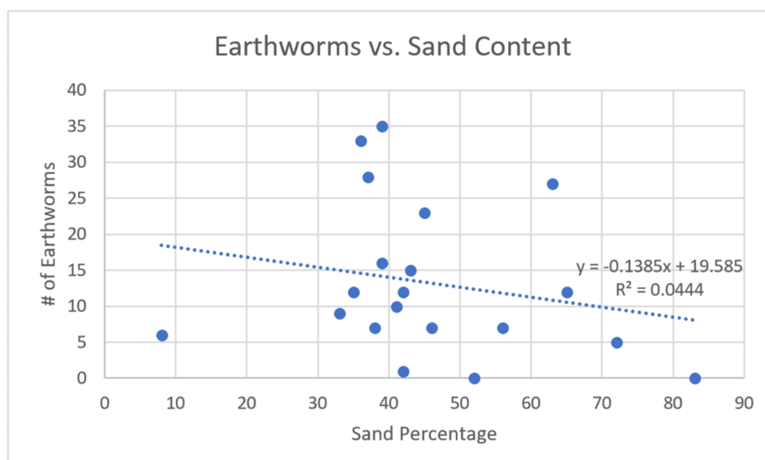

Table 1: *Comparison of Scatter Plot Data Clusters*

Site	# of Earthworms	Clay Percent	Silt Percent	Sand Percent
S2 Q3	35	2	61	39
S2 Q3	28	3	60	37
S3 Q4	33	5	59	36

Discussion

Our initial hypothesis, that microclimates with a higher clay composition would have a higher concentration of earthworms compared to sites with a lower clay composition, was not supported. As Figure 1 shows, not only was the anticipated correlation not observed; there was in fact, effectively, no correlation at all (r^2 = 0.0471).

However, as Figure 2 shows, when both soil substances known to retain water in the soil are examined (clay and silt), a weak positive correlation is observed (r^2=0.0429). Furthermore, as Figure 3 demonstrates, when only the correlation between silt percentage and earthworms is examined, there is a stronger positive correlation (r^2=0.0471), implying that the survival of earthworms is dependant more heavily on the percentage silt content in the soil rather than percent of clay.

Additionally, as displayed in Figures 2, 3, and 4, the highest earthworm populations all cluster together for all 3 types of soil components, and upon further investigation, we realized these data points all had very similar soil composition (see Table 1). Therefore, it is reasonable to presume that such soil composition is more “ideal” for earthworms in a deciduous environment, which, based on the percentages in Table 1, the USDA Soil Textural Class triangle (Staley, 1996) identifies as “silty loam.”

In addition to our own findings, Edwards (2019) has also shown that earthworms prefer silty loam soil as opposed to more clay dominated ones. Silt loam soil is classified as a medium textural class, which has a balance between high moisture retaining soils such as clay and thinner, more permeable soils such as sand (Plant and Soil Sciences eLibrary, 2019), allowing the earthworms to thrive. In the future, we would identify where in the microclimates silty loam soils predominate and study the earthworm populations there to see if they support our original findings.

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