Fall 2021

Soils Varying Importance and Differences

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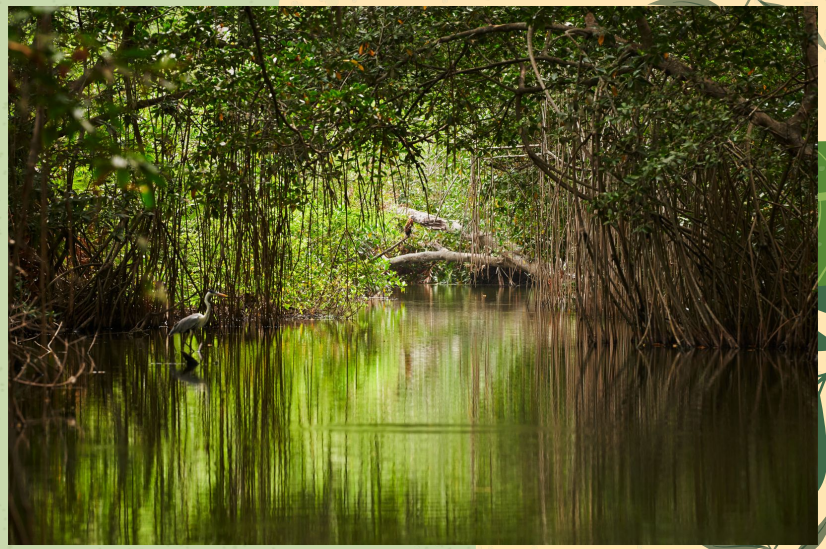
Professor Carlson

Literature Research: Coastal Soils. What Are They? How Are They Important?

- Mangroves are soils that pertain to the coastal areas; they contain plants animals and other living organisms such as microbes (Singh, 381).
- Microbes are single celled eukaryotes, mangrove microbes assist in recycling nutrients, consuming gases that affect climate change and break down pollutants (Singh, 381).
- Microbes produce biosurfactants such as microflora; microflora is useful in many human products such as drugs, vaccines, and vitamins (Singh, 381).



Above is an image of a mangrove ("Conserving Mangroves…").

Literature Research: Pollution of Oceans and Coastlines

- Oceans and coastal soils are affected by many pollutants that stem from human industrialization, such as oil spills, solid waste and radioactive waste (Kumar, 11).
- Humans emit pollution through sewage waste and industrial waste (Kumar, 12).
- These pollutants impact the soils biological, chemical and physical quality that then harms marine life and organisms (Kumar, 12).

Photos of pollutants found on varying sites (Garcés-Ordóñez et al. 458).

Literature Research: Effects on Coastal Life

- These pollutants affect microorganisms and how they produce different compounds; this is due to their defense mechanisms against the toxins (Eugenio, 4.2).

- These different compounds lead to a reduction in microorganisms and changes in the soil community (Eugenio, 4.2).

- This ultimately leads to lower rates of decomposing organic materials and inefficient biochemical cycles (Eugenio, 4.2).

Literature Research: How to Reduce Pollutants

- Strong enforcement of regulations regarding where waste can be disposed of can help prevent contamination of soils (Garcés-Ordóñez et. al. 461).

- If laws and regulations do not exist, advocacy for regulations to be in place and support of laws help to prevent pollutants from spreading (Garcés-Ordóñez et al. 461).

- When exposing of pollutants be sure to take precaution and correctly follow procedures in doing so (Kumar, 12).

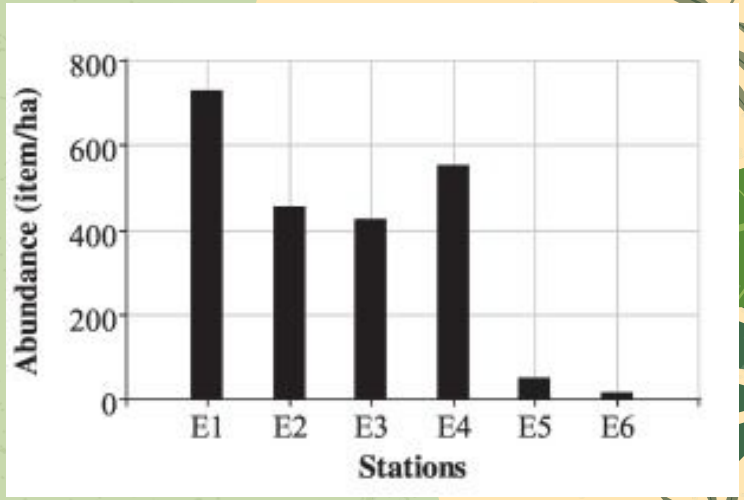
Primary Research Article: "Marine Litter and Microplastic Pollution on Mangrove Soils of the Ciénaga Grande De Santa Marta, Colombian Caribbean"

- A study was performed on mangroves in the Ciénaga Grande De Santa Marta (CGSM) to evaluate the pollution contents of the soils (Garcés-Ordóñez et al. 456).

- Six sampling stations were placed on the coast of CGSM, four were moderately affected by human populations, one was highly affected by human populations and one lowly affected by human populations (Garcés-Ordóñez et al. 456).

Primary Research Article: Results

- 2220 units of litter were discovered above the surface (Garcés-Ordóñez et al. 456).
- 3470 pieces of microplastics were discovered in 4567.3 grams of dried soil (Garcés-Ordóñez et al. 456).
- The higher levels of plastic pollution were found when the sample areas were more affected by human populations (Garcés-Ordóñez et al. 458).



This graph shows the abundance of pollutants found at each sample site (Garcés-Ordóñez et al. 456).

Primary Research Article: Conclusions

- The varying pollutants have a negative effect on the plants of CGSM including the mangrove trees pneumatophores (aerial roots used for gas exchanges) (Garcés-Ordóñez et al. 461).

- The microplastics destroy mollusk and crab habitats (Garcés-Ordóñez et al. 461).

- These results conclude that Columbia needs to increase public knowledge of pollution and regulate solid waste being discarded onto coastlines (Garcés-Ordóñez et al. 461).

Experimental Research: Introduction

- Samples choices include the Continuous Corn: Nitrogen Trial soil and the Corn/Soybean Rotation: Soybean soil.

- The soils appeared extremely similar in color and moisture; each soil had corn growing in it at some point , I wondered if the small differences between the two would be represented in my data by comparison or if the subtle differences would create a noticeable difference in the soil composition.

Experimental Research Results: Sieving

- Continuous Corn: Nitrogen Trial:
  - >6mm: large chunks, dark brown in color
  - Between 2mm & 6mm: small equal sized pieces, dark brown in color
  - <2mm: fine, dark brown powder

- Corn/Soybean Rotation: Soybean
  - >6mm: multiple solid chunks, dark in color, has grass
  - Between 2mm & 6mm: equivalent pieces, dark brown, no grass
  - <2mm: fine, dark brown powder has grass

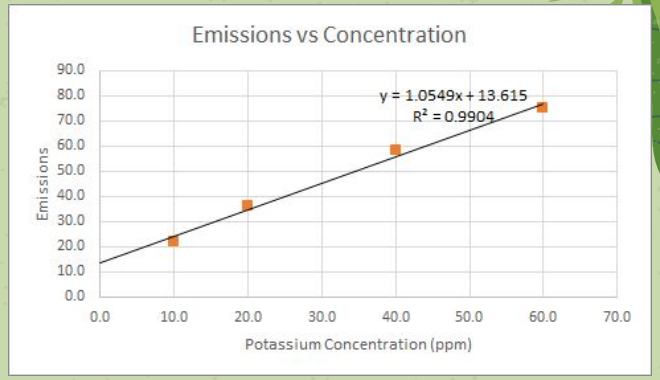
Experimental Research Results: Texture

- Continuous Corn: Nitrogen Trial soil was classified as clayloam
  - 32.3% clay
  - 32.5% sand
  - 35.2% silt
- Corn/Soybean Rotation: Soybean soil was classified as clayloam
  - 31.8% clay
  - 34.1% sand
  - 34.1% silt
- Clayloam soil represents the middle part of the soil texture triangle indicating that the soils have almost equal percents of clay, sand, and silt.
- Classmate Comparison: All soils from clay family varying between clayloam, clay and clay silt for both soil samples.
- Note of Error: many bubbles and foam made hydrometer reading difficult and could have impacted readings.

Experimental Research Results: pH & Conductivity

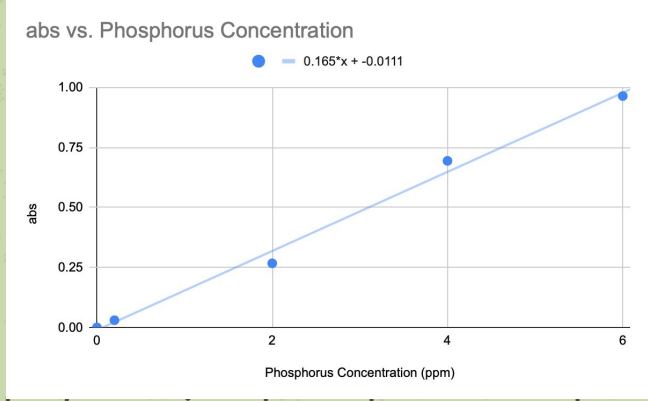
- Continuous Corn: Nitrogen Trial:
  - pH: 7.27
  - 556 µS
- Corn/Soybean Rotation: Soybean:
  - pH: 8.23
  - 470 µS
- Optimum Ph for soil with crops is around 6-7, the Soybean soil is slightly basic for the crops.
- Both levels of conductivity are safe for each of the soils with optimum levels being between 200µS-1000µS.
- Classmate Comparison:
  - Nitrogen Trial
    - pH all ranging from 5.8-7.9, many reported around 6.5.
    - Conductivity ranging from 80µS-1400µS, few reported close to my sample.
  - Soybean
    - pH all ranging from 7-8.3 with my sample being the highest.
    - Conductivity ranging from 120µS-500µS, many reported around 130µS.

Experimental Research Results: Potassium Analysis



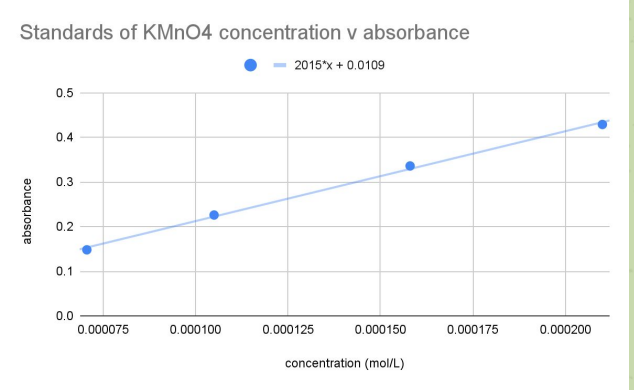
- Continuous Corn: Nitrogen Trial
  - 31.7 ppm of K
  - 634 lbs/acre of K
- Corn/Soybean Rotation: Soybean
  - 31.0 ppm of K
  - 620 lbs/acre of K
- Each soils has high (278+)lbs/acre levels of K and does not need fertilization.
- Classmate Comparison
  - Nitrogen Trial: K lbs/acre all ranging from 400-640 with my sample being highest.
  - Soybean: K lbs/acre all ranging from 380-620 with my sample being highest.

Experimental Research Results: Phosphorus Analysis



- Continuous Corn: Nitrogen Trial
  - 2.75 ppm of P
  - 55.0 lbs/acre of P
- Corn/Soybean Rotation: Soybean
  - 3.98 ppm of P
  - 79.6 lbs/acre of P
- The Nitrogen Trial soil is very high (21-30)lbs/acre in phosphorus and the Soybean soil is very high(21-30) lbs/acre in phosphorus both do not need fertilization.
- Classmate Comparison:
  - Nitrogen Trial: values ranging from 1-100 P lbs/acre with mine lying in the middle.
  - Soybean: values ranging from 5-90 P lbs/acre.
- Error Analysis: Concentrations may be inaccurate due to dilution process and imprecise measuring of volumetric flask, this in turn affected the concentration of the standards and effected the standard curve graph shown above.

Experimental Research Results: POXC Lab



- Continuous Corn: Nitrogen Trial
  - Wavelength: 550 nm
  - Absorbance: 0.193
- Corn/Soybean Rotation: Soybean
  - Wavelength: 550 nm
  - Absorbance: 0.171
- Observed: The Soybean sample was lighter in color than the Nitrogen sample, each were clear.
- From these results, the Soybean soil contains more nutrients and organic compounds than the Nitrogen soil.

Experimental Research: POXC Calculations Results

- Continuous Corn: Nitrogen Trial
  - 956. mg RC / kg soil
- Corn/Soybean Rotation: Soybean
  - 907. mg RC / kg soil
- These results indicate that my Nitrogen soil contains more reactive carbon than my Soybean soil.
- These results do not match my spectrophotometer results; the Soybean soil had a lower absorbance meaning it would contain more reactive carbon. These results do not prove this, there may have been an issue within my calculations due to a rounding error.
- Classmate Comparison:
  - Nitrogen Trial: my Nitrogen soil reported one of the highest RC values with the true highest being 1800. mg RC / kg soil.
  - Soybean: my Soybean soil's RC value lies in the middle of the data collection with the highest being 1375. mg RC / kg soil and the lowest being 353. mg RC / kg soil.

Experimental Research Results: Cotton Test

- Continuous Corn: Nitrogen Trial
  - Cotton is...
    - Brown in color
    - Broken into 3 separate pieces
    - Very thin and fragile
    - Many holes within fabric
- Corn/Soybean Rotation: Soybean
  - Cotton is...
    - Brown in color
    - Has one large hole in center
    - Very thin and fragile
    - When pulled tears immediately and easily
- The test indicates that the soils contain compounds that can over time erode materials such as cotton, showing they are active soils.

Experimental Research Results: Slake Test

- Continuous Corn: Nitrogen Trial Observations
  - A steady single air bubble
  - Constant fragmentation
  - Clear water containing soil particles
  - When lifted, soil experienced a lot of fragmentation
- Corn/Soybean Rotation: Soybean Observations
  - No air bubbles
  - Only initial fragmentation from drop
  - Clear water containing soil particles
  - When lifted, soil experienced less fragmentation that Nitrogen soil
- This test indicates that the soybean soil is more aggregately stable and can withstand erosion better than the Nitrogen soil. This also indicates that the Nitrogen soil has been tilled more making it less stable.

Experimental Research: Microbial Titration

- Continuous Corn: Nitrogen Trial
  - 3. mg CO_2 / kg soil per day
- Corn/Soybean Rotation: Soybean
  - 38. mg CO_2 / kg soil per day
- These results indicate that the Soybean soil has more microbial activity that the Nitrogen soil.
- Class Comparison:
  - Nitrogen Trial: my Nitrogen soil had the lowest mg CO_2 / kg soil per day than any of my other classmates. Many of their responses were averaging around 100 mg CO_2 / kg soil per day.
  - Soybean: my Soybean soil was in the middle of my peers results, the lowest being 11.3 mg CO_2 / kg soil per day and the highest being 50.27 mg CO_2 / kg soil per day.

Experimental Research: Conclusions

- From these results I can conclude that each soil was different within each experiment, sometimes the Nitrogen Trial soil would have greater results than the Soybean soil but sometimes the Soybean soil would have greater results that the Nitrogen Trial soil. It depended on what experiment but overall there was no clear outcome of which soil was healthier.
- To answer my previous question, although the soils came from similar areas with similar compositions, their slight differences did make differences in their results depending on the experiment. Overall, each soil had distinct qualities and results that were close in number.

Experimental Research: Error Analysis

- Each experiment included readings that could have been read and recorded incorrectly.
- Different instruments were used for each person and different instruments could have skewed readings of results.
- Timing affected different experiments and resulted in different recordings.
- Each of these could have impacted individuals results on soils and comparisons with classmates.

Experimental Directions: Future Directions

- To obtain a more accurate representation of each soil type, multiple experiments should be run on each different type of coming from different areas within that solid type.
    - ex : Continuous Corn: Nitrogen Trial soil is sampled from each for corners of the plot and one from the middle creating 5 different sampling areas, each area is run through all experiments 4 times to obtain the most accurate and precise results.
- From my analysis I wonder how ‘far apart’ soil must be to obtain drastic results in character? Would all soil from Southern Illinois be categorized in the clay family? All soil in the Midwest? etc...

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