

Soil texture charges

How might we determine if our soil has enough surface charge to hold the necessary nutrients for plant growth?

Background

The particles that make up soil are categorized into three groups by size: sand (2–0.05 mm), silt (0.002–0.05 mm), and clay (<0.002mm). Most soils are composed of a combination of these particles as well as organic matter. Of these, clay and organic matter have the strongest surface charge which allows them to attract or repel nutrients found within the soil. Nutrients are expensive for farmers to purchase and apply to soils so it is important to determine how well the soil will hold the nutrients for plant growth. If the overall soil charge is not adequate to retain nutrients important for plant growth, they can be lost to the environment due to leaching.

Materials

- 2 6-volt batteries
- 4 copper bands, 4–8 inches long
- 4 alligator clips
- Distilled water
- Clay–water slurry (clay and distilled water mixed to the consistency of glue)
- Soil slurry from local area (soil and distilled water mixed to the consistency of glue)
- Small beakers

Note: air-dry modeling clay can be used to create the clay–water slurry.

Instructions

1. Cut 2 lengths of copper bands about 4–8 inches long, depending on the height of the small beaker. You will want the copper to run down the side of the beaker and stick out an inch or more.
2. Place two of the copper bands into each of the small beakers filled to the top with either the soil or clay slurry. Make sure not to cross the copper bands and have at least one inch of the copper bands sticking out of each slurry.
3. Using the alligator clips, attach one copper band to the positive pole of the battery and attach the second copper band to the negative pole. Be sure that the insulation of the alligator clips is not in the slurry.
4. Make a prediction below about what will happen with each slurry.
5. After 10 minutes, check to see whether the clay or soil particles have moved to the wire attached to the positive or negative pole. Remember that unlike charges are attracted to one another. (Organic matter has the same charge as clay).

Prediction

How will soil particles and organic matter react to each of the charged copper wires in the following slurries?

Clay slurry:

Soil slurry:

Data

Create a drawing of the clay and soil slurries with the charged copper bands in the appropriate box below. Describe what you observe in each slurry to explain how the charged wires attracted or repelled soil particles.

Clay slurry	Soil slurry
Drawing:	Drawing:
Written description:	Written description:

Reflection

1. How did the clay interact with the copper bands on the positive and negative charged copper bands in the clay slurry?
2. How did the soil interact with the copper bands on the positive and negative charged copper bands in the soil slurry?
3. Does the local soil have enough surface charge to retain nutrients for plant growth? If not, how might a farmer overcome this challenge?