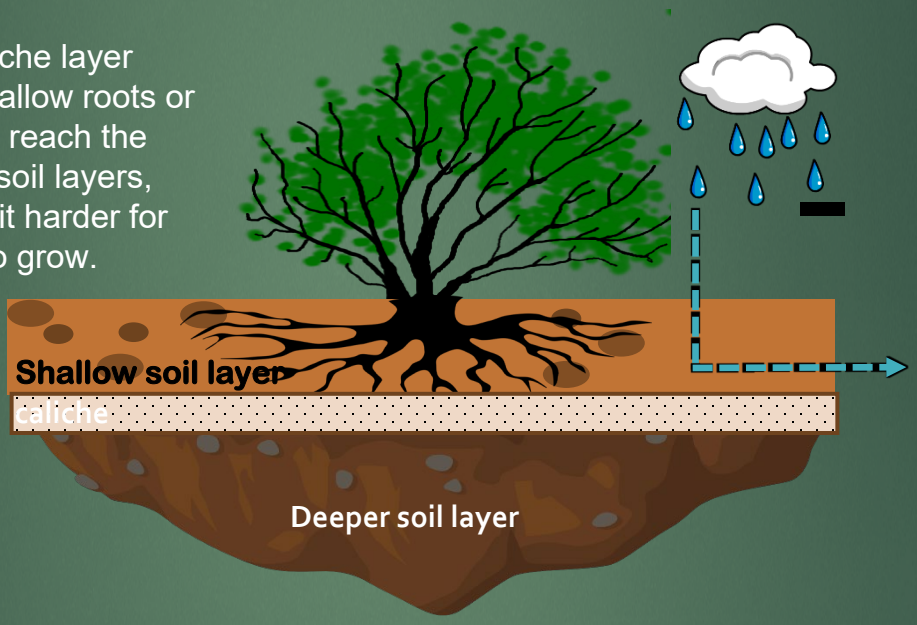
Plant Growth and Root Development

Water is a critical element for plant growth, but certain soils or sediments can actually block water from getting to the deeper soil layers. For example, caliche is a hard, shallow layer of soil often found in the southwest and other arid and semiarid parts of the world. Caliche inhibits water from reaching the deeper soils, making it harder for plants to grow. It also prevents roots from reaching the deeper soils, depriving the plant of nutrients. Consequently, this “barrier” could stunt a plant’s growth, or cause the plant to wilt and die. (see Appendix A for more information)

The caliche layer doesn’t allow roots or water to reach the deeper soil layers, making it harder for plants to grow.



For this experiment, we’re going to test the effect a hard soil layer has on plant growth and root development.

About This Experiment

Ages 10+

Time
1 hour set up
few minutes a day for 3+ weeks

Difficulty
easy/moderate

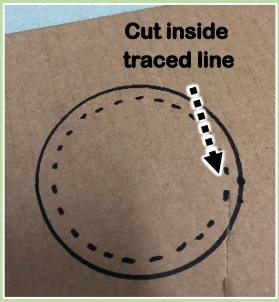
Materials Needed

3 clear plastic cups, 3 non-clear plastic cups, potting soil (small bag 6-8 qt), wheatgrass or cat grass seeds (100 seeds; available on amazon or local pet store), piece of cardboard, duct tape, measuring cups, drill & small bit.

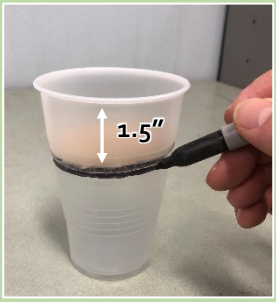
Let's Do This!

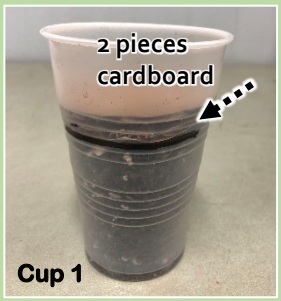
Step 1: Drill 3 small holes in the bottom of 3 clear plastic cups. (Have an adult help with this step for safety)

Step 2: Cut 2 pieces of cardboard so it fits tightly about <u>1.5" from the top</u> of one clear cup (cup with holes). Trace the opening of the cup and cut 1/4" inside the line.



Make sure the cardboard fits tightly. Mark where the cardboard is on the cup, remove cardboard and fill up to the line with soil. Place cardboard on top of the soil.





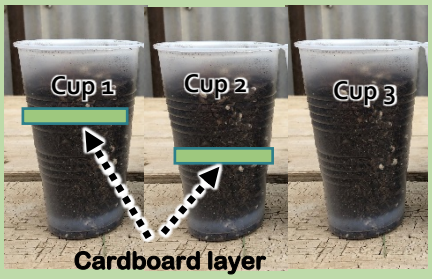
Step 3: Using duct tape, tear skinny strips and place around the edge of the cardboard to seal to the cup.

Make sure to only cover edges of the cardboard with tape

Step 4: Fill the cup with soil ½" from the top *(label this "Cup 1")*. Repeat the process, but place cardboard <u>about 3" (halfway) from the top</u> of the second cup.

For a tight fit, trace the top of the cup and cut cardboard 1/2" inside line. *(label this "Cup 2").* Fill 3rd clear cup ½" from the top with soil (No cardboard) *(Label this "Cup 3").*

Place the cups inside 3 nonclear cups.



Step 5: Pour ½ cup water in each cup. Wait 1 minute and pour another ½ cup of water in each cup. ***OBSERVE: Which cup has standing water after a minute? Record answer on data sheet.***

Step 6: Place 30 grass seeds in each cup and cover with 1/8" soil. Gently add a little more water to wet topsoil.

Let seeds germinate and grow for 1 week.

Let's Look At The Results!

After **1 week**, count the number of plants in each cup and measure the height of the tallest blades of grass in each cup.

Remove clear cups from nonclear cups and observe the amount of water in the nonclear cup. Which cup has the most?

Observe the amount of roots in the clear cups. Are the roots below the "caliche" layer? Which cup has the most roots?

Record your answers and observations on the data sheet (see next page).

After 1 week, add ¼ cup water to each cup. ***Do not** add any more water*

Observe how many days till plants in each cup wilt (may take a week or more) and record answers on data sheet.

Record any other observations you have during the experiment on the data sheet.

Finally, summarize what you think occurred in your experiment and why based on the observations you made and the data you collected.

Data sheet

Start date: _____

Researcher's name:_____

	Standing water after 1 minute	**# of seedlings Week 1**	**Height Week 1**	**Days till wilt**	**Root observations Week 1**
(Cup 1) Shallow Caliche					
(Cup 2) Deeper Caliche					
(Cup 3) No Caliche					

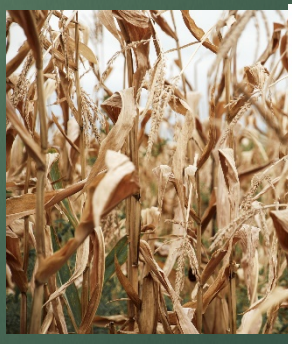
Observations:_____
_____
_____
_____
_____

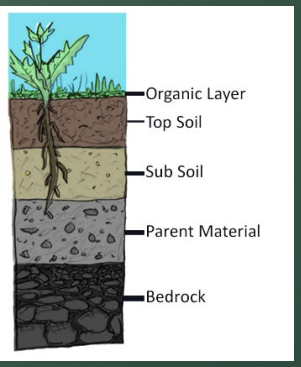
Summary:_____
_____
_____
_____
_____
_____
_____
_____

Caliche

Caliche is a shallow layer of soil or sediment in which the particles have been cemented together by mineral matter. Also known as calcrete, hardpan, and duricrust, this layer is a common feature in arid or semiarid areas throughout the world. In the United States, caliche is a familiar deposit in many parts of the Southwest, especially Arizona, California, Nevada, New Mexico, and Texas. Caliche results from minerals precipitated in soils where evaporation exceeds precipitation, as found in arid regions. The cement is usually calcium carbonate; however, cements of magnesium carbonate, gypsum, silica, iron oxide, and a combination of these materials are known. In some locations there are multiple ancient caliche layers.

Caliche is often a challenge to agriculture. It interferes with proper soil drainage, the formation of plant roots, and it also can contain soluble minerals that are not beneficial to plants. The impermeable caliche prevents plant roots from penetrating to deeper soil layers, which limits the supply of nutrients, water, and space, making it difficult for the plants to develop normally.





Even with irrigation, crops struggle when the caliche layer is shallow.

This project was brought to you by the Great Basin Rangelands Research Unit. For more information on rangelands search USDA ARS Reno Nevada or visit nevada.rangelands.org

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