Soil Erosion (At Home)

Middle School

Introduction

Soil erosion is the movement and transportation of soil by various natural processes. Erosion is responsible for the loss of an average of 12 tons per acre of agricultural soils per year. The soil that is most affected by erosion is the topsoil layer. Soil erosion is accelerated by a sloped landscape, removal of vegetation for landscaping, soil tillage for agriculture and drought. Wind and water play a monumental role in soil erosion.

On agricultural land, erosion causes loss of nutrient rich topsoil, which results in an increased need for fertilizer being added back to soils. This can lead to further problems as fertilizer runoff leads to water contamination, which affects the habitats of area livestock and wildlife.

Water erosion is the focus of our lab today. Erosion from water removes topsoil from agricultural land and can cause runoff of nutrients to nearby water supplies, jeopardizing surrounding wildlife habitats.

Soil is an important part of the Kansas economy. Nearly 50 percent of the state is covered in crops, while 34 percent is covered in range and pasture lands, according to the Natural Resources Conservation Service. This land provides nearly $8.7 billion in annual income through our number one industry, agriculture.

Although Kansas is blessed with abundant soil, each year, 190 million tons of Kansas topsoil is degraded through human activities. It took hundreds of years to create the Harney silt loam soil in Kansas, and it's not easily renewed.

To help preserve the soil, farmers use sustainable techniques, such as cover cropping and no-till. Each of these allow soil to build nutrients and improve soil structure. No-till crop ground allows soil nutrients to stay below the surface, reduces the erosion of soil nutrients and is often used in conjunction with cover cropping. The use of cover crops helps reduce water runoff that not only carries water away from the plants, but often takes nutrients needed for crop growth along with it. In this lab, we are going to test the protective capabilities of a cover crop against soil erosion from water.

Watch these two videos to get a better idea of what these two farming techniques are and why we need to utilize them. (Videos also available at kansascornstem.com)

- No-till farming reduces soil erosion and improved soil health and water quality. Provided by Iowa Farm Bureau
  - https://www.youtube.com/watch?v=ILgasUNJfXs
- Ag AM in Kansas - Cover Crops - January 21, 2016. Provided by Farming Unlimited TV
  - https://www.youtube.com/watch?v=MFkylnZFCHU

Activity

In order to gain a better understanding of soil runoff and the role of cover crops and no-till farming you will be constructing a set up for demonstrating this process. During this experiment you will see first-hand what farmers are doing to prevent the loss of nutrient rich topsoil.

Materials

- 2-3 empty 2 liter bottles
- 2-3 plastic cups, quart jar or other water catching devices
- Knife or scissors
- Soil
- Wheat stubble, straw, tall dead grass (you can obtain this from a local farmer)
- Wheat seed or any type of grass seed(optional)
- Water
- Measuring cup

Directions

Lab Set Up

Length of Time for Preparation: 30-40 minutes.

1. Remove a section from one side of each of your 2 liter bottles. Cut the section approximately 6-7 inches from top to bottom and roughly 3.5 inches across. Make sure to cut according to the pictures below. This will prepare your bottles for holding your soil samples. Label your bottles A, B, etc.

2. Put 3 cups of soil into each of your 2 liter containers. This will act as the "fields" that farmers use each day to plant and grow the foods needed to support the food needs of the world.

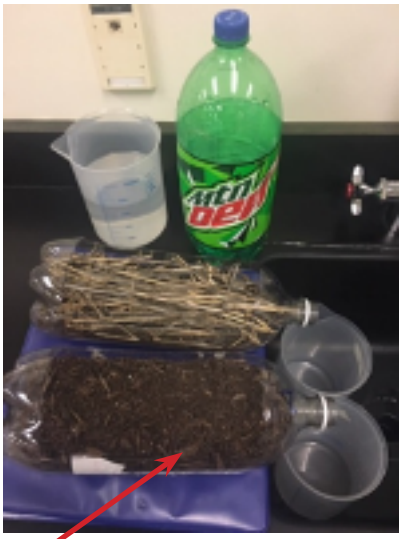
NOTE: If you are using wheat or some other form of grass which you grow from seed, you will need to allow plenty of time for root growth to begin. The germination time for wheat and many grasses is about a week. You will need to allow about two weeks for a good root system to develop before you move on to step 3.

3. Bottle A will only have soil in it.
4. Bottle B will have the soil you put in during step 2, with an added layer of wheat stubble, stray or tall dead grass laid in on top of the soil.

Note: See the extended Learning section below for other options.

Perform the lab

1. Position the bottles so there is enough overhang so you can get a quart jar or 32 oz. plastic cup under EACH 2 liter bottle you have set up. (I use the sink and the neck of the bottle drains into the beaker sitting in the sink.)



2. The bottles need to be angled slightly with the neck of the bottle pointing downward. (You can use a textbook under the end to elevate the bottle. I used a 1" to 1/2" 3-ring binder to sit my bottles on so they were angled downward.)
3. Starting in the back end of the bottle (farthest away from the neck), pour 3 cups of water into bottle A.
4. Let the water drain out the neck into the "collection bucket."

5. Repeat for bottle B.
6. Measure the amount of runoff water in each of your collection buckets and record in a data table that you create.
7. Observe the sediment in the runoff water and record an observation of how the water "looks" and the amount of sediment in the cup. The sediment will be more obvious if you wait about an hour and let it settle to the bottom.
8. Optional: You can repeat the above steps for multiple days if you choose to see how much erosion would take place over a certain time period.

Extended Learning

There is an option to add two additional bottles to this lab to show how vegetation can help with soil erosion. This would involve growing wheat or grass in the 3rd and 4th bottles, and in the 4th bottle, you would add wheat stubble (prior year cover crop). Adding two additional bottles would allow the students to compare:

- Bottle 1 - soil without vegetation
- Bottle 2 - soil without vegetation but with stubble from prior year cover crop
- Bottle 3 - soil with vegetation
- Bottle 4 - soil with vegetation but with stubble from prior year cover crop

Note: This would add about 2 weeks to the lab prep in order to grow the wheat seed in the two bottles. The rest of the procedures remain the same for the lab.

Take it Further

You can also take the collection cups and measure the mass of the amount of soil and sediment that drained out of the bottles. One way to do this would be to filter the runoff water through a paper towel. This would make this a multiple day lab which you might need to move your set up to an alternate location which does not impede the normal function of your sink. You can then graph the amount of soil that eroded away each day.

Questions

1. Which bottle had the most erosion evident by the amount of water and sediment that is present in each collection bucket? Which had the least?
2. Compare the color and clarity of the water in the collection buckets - what do these results tell us about: the power of water?
3. How does the use of cover crops in a field impact the amount of run off and why is that important to farmers?
4. Why is protecting the soil important to a farmer?
5. Is there evidence of erosion present around your home?
6. Investigate the grounds around your home and identify erosion processes that are occurring. Using your knowledge of erosion, what are some ways that you can slow or stop the erosion that is occurring?

Resources

Visit kansascornstem.com for link to additional resources.

Science and Agriculture Careers

- Agricultural inspector
- Agricultural specialist
- Soil and plant scientist
- Crop production specialist

To learn more about agriculture careers, visit www.agexplorer.com. You can also find career profiles at www.kscorn.com .

Questions - Answer Key

1. Which bottle had the most erosion evident by the amount of water and sediment that is present in each collection bucket? Which had the least?
   - ANSWER: The bottle (field) containing the wheat stubble or straw should have the least amount of run off as the straw acts as the cover crop preventing direct force of the "rain" on the field, thus reducing the erosion. If you took it a step further and planted grass or wheat and let it develop a good root system, this bottle would certainly have the least runoff as the roots will hold the soil in place.

2. Compare the color and clarity of the water in the collection buckets. What do these results tell us about the power of water?
   - ANSWER: The collection bucket with no protection from wheat stubble, straw or grass will be the dirtier and have less clarity than the "field" that utilized the cover crop materials. The results of the research should demonstrate the powerful force of water that erodes away the topsoil farmers need to grow the best possible crops.

3. How does the use of cover crops in a field impact the amount of run off and why is that important to farmers?
   - ANSWER: Cover crops and the chaff left behind from the harvest of the previous year's crop (no-till farming) both prevent/reduce the amount of soil runoff, enabling the soil to maintain the rich nutrients located in topsoil.

4. Why is protecting the soil important to a farmer?
   - ANSWER: Farmers need to protect the soil not only for the benefit of their crop yields, but to ensure that future generations of farmers have soil rich with the nutrients needed to grow the needed crops.

5. Is there evidence of erosion present around your home?
   - ANSWER: Will vary.

6. Investigate you're the grounds around your home and identify ero¬sion processes that are occurring. Using your knowledge of erosion, what are some ways that you can slow or stop the erosion that is occurring?
   - ANSWER: Will Vary.