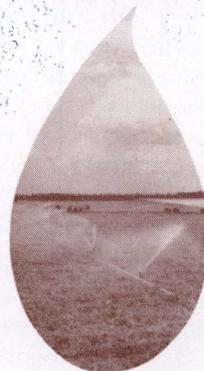
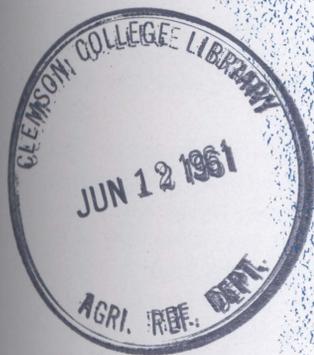


**SOIL AND WATER**

# *Conservation*

**DEMONSTRATIONS**



TEXAS AGRICULTURAL EXTENSION SERVICE  
E. Hutchison, Director, College Station, Texas



## CONTENTS

A Simplified Story of Soil.....	3
Making Soil Artificially.....	4
Size of Soil Particles.....	5
How Water Moves through the Soil.....	6
Effect of Plow Pan on Water Movement.....	6
Organic Matter and Its Effect on the Soil.....	7
How Plant Cover Affects Soil Loss.....	7
How Mulches Prevent Soil Loss.....	8
What Contouring Does.....	8
Comparing the Growth of Plants in Different Kinds of Soil.....	9
Influences of Fertilizer on Plant Growth.....	9
Acknowledgments.....	10



## PREFACE

*The wise use of our soil today will affect how well we live tomorrow. Whether you live in the city or on the farm you can help to protect and manage our soil.*

*This publication was written to help you understand the soil, to show why we need to use it wisely and to show us the part we can play in its wise use.*

*"A Simplified Story of Soil" should give you a basic understanding of the soil. This story may be used in introducing demonstrations and speeches on soil.*

*Photographs are by courtesy of the Soil Conservation Service, Temple, Texas.*

# Soil and Water Conservation Demonstrations

Lynn P. Pittard\*

## A SIMPLIFIED STORY OF SOIL

**T**HE SOIL is a living, working factory that helps to produce our food, much of our fiber for clothing and many things which make our homes. When seed are put into the soil, it feeds them, nourishes them and helps them to grow into plants that are useful to man.

Since the soil is alive, it lives, breathes and works. How does the soil feed and support the different plants growing in it? Has the soil always been the same or does it change all of the time?

Actually, the soil is made up of rocks that have been worn down by weather — heat from the sun, cooling winds and washing by the rains have caused the rocks to soften and fall apart. Other minerals, such as pieces of plants that have died and tiny creatures living in the soil, are mixed in with these pieces of rock. Dead plants and animal wastes that fall to the earth are decayed by the action of these creatures living in the soil. Nothing is wasted and the same materials are used many times. The soil also holds water and air. The air consists of many gases and the water is not pure but contains many dissolved gases and salts — all which help the soil to do its work.

The main reason the top part of the soil is darker than the lower part of the soil is because most plant roots are found near the surface of the ground and as the roots and the top part of the plants decay or rot, they add organic matter. The organic matter coats the tiny soil particles and makes them hold together like popcorn balls or a cake. Soils rich in organic matter (decayed plant material) are dark brown or black. There are other substances in the soil that can make the soils many colors. Iron may make a soil yellow or red. When soils produce crops and care is not taken to return plant material to them, they may lighten in color as they lose more and more of the decaying plant material.

Organic matter is important. The living creatures make their homes in decaying organic matter and use it as food. Organic matter helps to keep the soil from washing away, acts as a sponge to ab-

sorb water so that plants will suffer less during dry weather, supplies the soil with material that later may become food and helps to hold this plant food for the next crop. Decaying plant material helps to bind sand grains together so that they won't blow so badly and helps to loosen a tight clay soil so that water can enter faster.

Soil is not a solid piece of ground. That is why you sink a little when you walk on good soil. Between the soil particles are spaces or tiny openings. These spaces are important because that is where the air and water are found. The opening allows the water to soak in and allows the soil to breathe. We know that water is important for plants. Growing plants use more water than anything else. In addition to keeping the temperature of the soil and the plants regulated, the water between particles and the thin film around each particle contains the dissolved gases and salts that are the plant foods. Some of the water, as it drains through the soil, carries food as well as the waste that the soil needs to have removed.

If there is too much water in the soil, air cannot enter. When some of the tiny creatures in the soil do not get enough air, they die, and a harmful kind of bacteria begins to grow rapidly which removes oxygen from the chemical compounds in the soil. This creates a poor condition for the plant roots and the plants look sick and often die. So it is important that the soil contain plenty of water and air, as well as plenty of plant food, to produce healthy plants.

Thus, you can see that the soil protects the plant, feeds it, holds it in place and builds it up. The soil also changes waste materials from plants and animals into plant foods that can be used again. But the soil cannot continue to grow healthy plants if you do not take good care of it and keep it supplied with food. It must have enough food to feed the plants and there should be enough left over to feed the tiny creatures in the soil.

You need to learn all that you can about your soil because soils are as different as you are from your neighbor. The more you learn about the soil the more interesting it becomes and you can do a better job in keeping soil productive to provide enough food for everyone.

\*Assistant extension soil and water conservation specialist, the Texas A. & M. College System.

The following ten demonstrations should help you to know, appreciate and manage your soil better. These demonstrations may be used to help you to tell others about soil through club meetings, radio, television, civic groups, demonstrations and any group interested in soil.

## MAKING SOIL ARTIFICIALLY

### A. By friction.

#### Purpose

To show how some of the forms of nature break down rocks into soil material.

#### Equipment and Material

Two pieces of limestone or sandstone. (If these are not available, use building bricks or concrete.)

#### Procedure

Take a rock in each hand and rub together. (See Figure 1.)

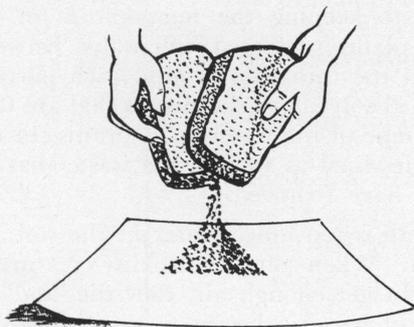


Figure 1.

#### Results

By rubbing the two pieces of rock together, small particles will be broken off. This is not soil, but the beginning of a soil formation.

#### Conclusion

This demonstration shows that the formation of soil begins with the breaking up of rocks into small particles. This process usually takes long periods of time.

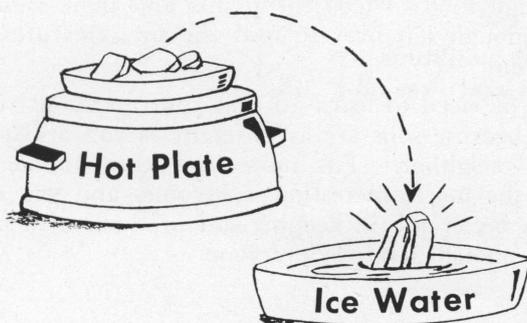


Figure 2.

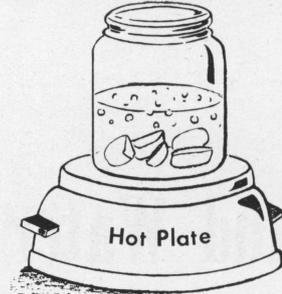


Figure 3.

### B. By heating and cooling.

#### Purpose

Same as by friction.

#### Equipment and Material

Several pieces of limestone  
1 hot plate  
2 pie plates  
1 pair of tongs

#### Procedure

Place the pieces of limestone in one of the plates and heat thoroughly. With the tongs, take a piece of the limestone and quickly drop it into the water in the other plate, Figure 2.

#### Results

The limestone will break into smaller pieces.

#### Conclusion

In nature, the heating and cooling processes play a part in the breaking down of rocks into the beginning of a soil formation.

### C. By chemical action.

#### Purpose

Same as above.

#### Equipment and Material

1 hot plate  
1 cup of vinegar  
1 wide mouth fruit jar  
Several pieces of limestone

#### Procedure

Place the limestone in the jar. Cover it with the vinegar about 1 inch above the limestone. Place this on the hot plate and heat. (See Figure 3.)

#### Results

Bubbles will form and will be released from the limestone.

#### Conclusion

These bubbles are carbon dioxide gas which was released from the limestone because of the chemical action of the acid in the vinegar on the rock. When you put the limestone in the vinegar you were duplicating in a small way what plants do. Plant roots

take in oxygen from the soil air and give off carbon dioxide gas. This gas is one of the important end products in the decay of organic matter. Carbon dioxide gas dissolves in the soil moisture, forming weak carbonic acid. This acid reacts just as the acetic acid in vinegar did with limestone rock and will decompose limestone, marble and other rocks. It takes 40 to 50 feet of limestone to make only a few inches of soil.

## SIZE OF SOIL PARTICLES

### Demonstration A.

#### Purpose

To show that the particles in the soil are of different sizes.

#### Equipment and Material

- 1 quart fruit jar
- 1 sample of soil

#### Procedure

Fill the jar within one-third from top with clear water. Pour in the soil until the jar is almost full. Screw the lid on the jar and shake vigorously. After the soil is well mixed in the water, put it down and let the soil settle. (See Figure 4.)

*Note:* Plenty of time should be allowed because the small particles will settle slowly.

#### Results

After the soil has settled you should be able to see the layers of different sized particles. In addition to this demonstration you can take a piece of white cardboard, as shown in Figure 4, and label these layers. The layers are formed because soil particles vary greatly in size. The largest particle, which is the sand, settles to the bottom first. The medium sized, or silt, falls on top of the sand. You will notice that the fine particles of clay settle slowly. In fact, some are suspended in the water indefinitely.

#### Conclusion

The size of soil particles is important in growing plants. The amount of open spaces between the particles affects the movement of water through the soil or the amount of water it will hold. (See demonstration on page 6.)

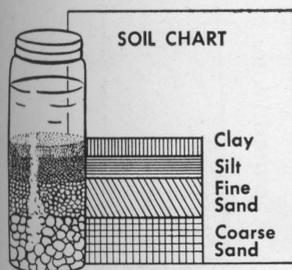


Figure 4.

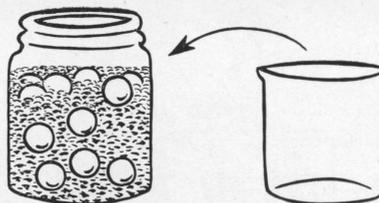


Figure 5.

Soils that have a large percentage of clay particles in proportion to silt and sand take in water slowly and give water to plants slowly. The size of soil particles also is important because it affects the ease of working the soil, what crops can be grown and the efficiency of certain fertilizers.

*Note:* In selecting the soil sample to be used in this demonstration, be sure to include clay, silt and sand. Do this demonstration with samples of soil taken from different places and compare them.

### Demonstration B.

#### Purpose

To show that coarse soils have pore spaces that can be filled with finer soils.

#### Equipment and Material

- 1 pint fruit jar
- Marbles and sand

#### Procedure

Fill the jar within one-third from the top with marbles. Pour sand into the jar over the marbles. (Tap the jar lightly on the table as you add the sand so that it will get in between all the marbles.) Add sand until the marbles are covered, Figure 5.

#### Results

In this demonstration, marbles were substituted for sand particles and sand for clay particles so that you might see more clearly what happens. This demonstration shows that the pore space is larger in coarse soils and that the spaces may be partly filled with finer soil particles. This makes a more dense soil.

#### Conclusion

Coarse soils cannot hold as much moisture since there is not enough surface area for the water to cling to and the pores are so large that weight of the water causes much of it to run out of the soil. For this reason, medium and coarse sandy soils low in clay are known as drouthy soils—crops cannot live long in them without frequent rains. When fine soil particles fill the large pore spaces, the soil can hold more water for plants because there is more surface area for the water to cling. Since the size of the pores is reduced, the weight of the water is less and it doesn't run out of the soil so readily.

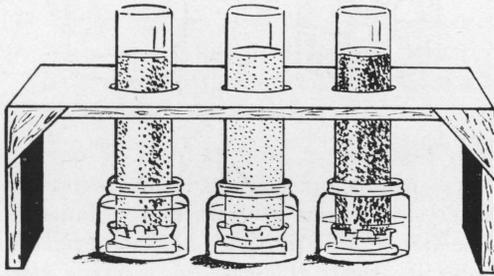


Figure 6.

Note: Although coarse textured soils will hold less water, they will give this water more readily to the plant. Also see the following demonstration.

## HOW WATER MOVES THROUGH THE SOIL

### Purpose

To show that water moves through coarse, medium and fine soil at different speeds and distances.

### Equipment and Material

- 3 glass or plastic lamp chimneys or tubes open at both ends (approximate size, 2" x 12")
- 3 small pans or low, wide mouth glass jars
- 3 strips of thin cloth to cover one end of each chimney or cylinder
- String and rubber bands to secure cloth over the end of lamp chimney or cylinder
- 3 equal amounts of water to go in the pans or jars
- 1 sample of sandy soil
- 1 sample of medium textured soil
- 1 sample of clay soil

### Procedure

Fill the cylinders or chimneys, respectively, with the coarse, medium and fine textured soils. Jar the cylinders slightly by bumping on a table to settle the soil. Be sure the soils are dry and not cloddy. Place a cylinder in each of the wide mouth glass jars or pans and pour an equal amount of water into each container. Keep a record of how long it takes the water to move 1 inch, 2 inches, 3 inches, etc., in each cylinder, Figure 6. Note how long it takes the water to reach the top or if it ever reaches the top.

### Results

Through capillary action, the water will move farther to the top in the fine textured soil than in the medium or coarse textured soils. Water in the medium soil also will move farther upward than the coarse textured soil. The move-

ment may be faster in the beginning in the coarse textured soil, and the medium textured soil may move faster than the fine textured soil in the beginning of the test.

### Conclusion

Moisture moves through the soil in all directions, even against gravity, by capillary movement. Capillary movement is caused by the attraction of soil particles for water. The lower the amount of water, the greater the attraction for water. The movement of water films through soils is much like the movement of kerosene up the wick of an old-fashioned oil lamp. This movement of water in soils is important in supplying plants with moisture.

## EFFECT OF PLOW PAN ON WATER MOVEMENT

### Purpose

To show how a plow pan affects water movement.

### Equipment and Material

- 1 quart fruit jar
- 1 quart wheat
- ½ cup flour
- Water with cake coloring added

### Procedure

Pour the wheat into the fruit jar within one-third from the top. Pour the flour on the wheat until the top is covered. Now finish filling the jar with the wheat. Pour the colored water over the wheat. (See Figure 7.)

### Results

The flour acts as a plow pan just as it does in compacted soil. The water does not get into the lower half of the jar. Now take a pencil and push a hole down through the flour. You will note that the water moves into the lower part freely.

### Conclusion

Plow pans or compacted layers of soil are caused many ways. One of the most frequent causes is plowing at the same depth year after year. The

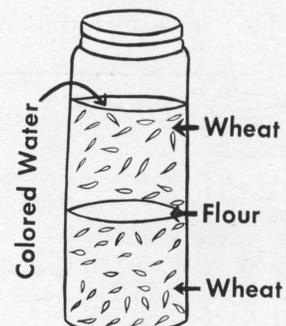


Figure 7.

pencil acted as would a deep-rooted legume that penetrated the plow pan so that water and air might move freely within the soil.

## ORGANIC MATTER AND ITS EFFECT ON THE SOIL

### Purpose

To show how organic matter affects the stability of the soil. Soils low in organic matter tend to melt and run together; soils high in organic matter tend to resist running together and melting.

### Equipment and Material

- 2 wide mouth jars
- 2 pieces of ¼-inch hardware screen (approximately 3" x 10")
- 1 soil sample from a cultivated field that has been farmed heavily (approximately 2" x 2" sample)
- 1 soil sample high in organic matter as from a fence row

### Procedure

Fill jars with clear water within 1 inch from the top. Bend the screen wire to form a basket that will fit into the jar. Place one sample in each basket and lower it gently into the jar. (See Figure 8.)

### Results

The soil sample from the heavily cultivated field will fall apart and drop to the bottom of the jar, while the sample that is high in organic matter will hold its shape and remain in the basket.

### Conclusion

This demonstration shows that soils high in organic matter help the soil to be more stable or to have better tilth. Tilth means that the soil is more crumbly, which allows water and air to move through the soil readily. The organic matter also tends to bind the granules of soil together which increases the water-holding capacity of the soil and decreases erosion from the wind and water. That is why farmers are advised to add organic matter to their soils.

*Note:* Good results of this demonstration may be obtained from medium and fine textured soils.



Figure 8.

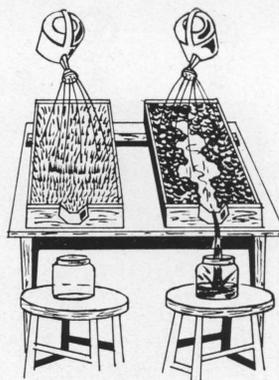


Figure 9.

Soils that have been improved through the addition of organic matter also show good contrast.

## HOW PLANT COVER AFFECTS SOIL LOSS

### Purpose

To show how plant cover reduces soil loss.

### Equipment and Material

- 2 boards 1 inch thick
- 2 watertight boxes (approximately 16 inches long, 12 inches wide and 4 inches deep). These boxes may be used for several demonstrations. Cut a "v" notch 1 to 1½ inches deep at one end of the boxes and fit a tin spout in it.
- 2 one-quart or larger sprinklers (flower sprinklers or jars with holes punched in lids)
- 1 piece of sod cut from a pasture or lawn to fit one of the boxes
- 1 soil sample (no grass or cover, but not necessarily a poor soil)
- 2 half-gallon fruit jars or equal sized pans

### Procedure

Fill one box with the sod sample. Trim the grass so that it is not more than 1 inch high. Place the soil sample without cover in the other box. Place the end of the box with a "v" notch so that the spout will throw "runoff" water into the containers. Set the boxes on a table so that the spouts are over the edge. Put the empty fruit jars just beneath the spouts. Place a board 1 inch thick under the end of each box opposite the spout. Take the two sprinklers filled with water and pour steadily at the same rate and same height from both boxes (approximately 1 foot). (See Figure 9.)

### Results

Water from the bare soil will run rapidly down the box, over the spout and into the fruit jar taking large amounts of soil with it. The water poured on to the sod will take longer to start flowing; however, it will be reasonably clear, less water will reach the fruit jar and the flow will continue for a longer time.

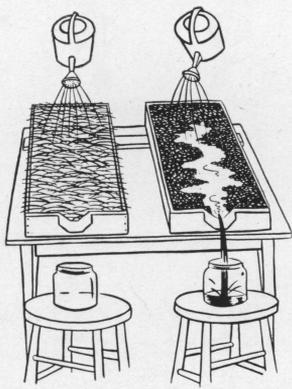


Figure 10.

### Conclusion

The sod breaks the force of the raindrops; therefore, the soil is not broken apart and washed out of the box. The plant cover also tends to slow down the rate of water so that it does not have enough speed to disrupt the soil.

*Note:* The amount of water in the sample of sod and soil will affect this demonstration some, but unless the soils are waterlogged, the demonstration should be successful.

## HOW MULCHES PREVENT SOIL LOSS

### Purpose

To show how mulches reduce soil loss.

### Equipment and Material

- 2 boards 1 inch thick
- 2 watertight boxes (approximately 16 inches long, 12 inches wide and 4 inches deep). These boxes may be used for several demonstrations. Cut a "v" notch 1½ inches deep at one end of the boxes and fit a tin spout in it.
- 2 one-quart or larger sprinklers (flower sprinklers or jars with holes punched in their lids)
- 2 half-gallon fruit jars or equal sized pans
- 2 samples of the same kind of soil to fit in the boxes

### Procedure

Place sample of soil in each box. Cover one box of soil with a thin layer of straw, grass, cotton burs or any other good mulch. Place a 1-inch thick board under each box opposite the end of the spout. Take the sprinklers filled with water and pour steadily and at the same rate and height on the boxes of soil. (See Figure 10.)

### Results

Water sprinkled on the bare soil will run off rapidly carrying soil with it and the flow will last only a short time. The water sprinkled on the soil with the mulch will take longer to begin flowing, will flow for a longer time and will carry less soil with it. Also, less water will run off this box.

### Conclusion

Mulches will reduce "runoff," slow down the rate of movement of water and because of this lack of speed, the water will carry only a little soil with it.

## WHAT CONTOURING DOES

### Purpose

To show that by contouring our land we can decrease soil and water runoff.

### Equipment and Material

- 2 boxes (approximately 16 inches long, 12 inches wide and 4 inches deep). These boxes may be used for several demonstrations. Cut a "v" notch 1 to 1½ inches deep at one end of the boxes and fit a tin spout in it.
- 2 soil samples
- 2 sprinklers
- 2 boards 1 inch thick
- 2 wide mouth fruit jars (approximately ½ gallon)

### Procedure

Make furrows across the soil in one box and down the soil in the other, using your finger or a pencil. Place one wide mouth fruit jar under each spout. Place the 1-inch board under each box opposite the spout. Taking a sprinkler filled with water, pour steadily at the same rate and height on the boxes of soil. (See Figure 11.)

### Results

The water sprinkled over the box of soil with furrows running "up and downhill" will run down the furrows at a great enough speed that it will pick up soil and carry it up the spout and into the fruit jar. The water sprinkled over the box of soil with the contours running perpendicular to the slope will be slowed down, held in the furrows and will give the water more time to soak into the soil. This will result in the water flowing less rapidly; therefore, there will be less soil movement and less water runoff.

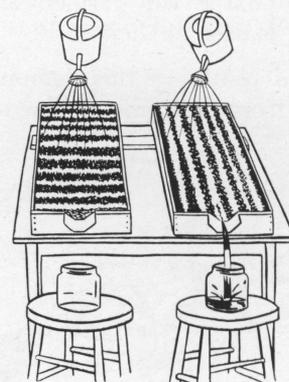


Figure 11.

## Conclusion

Running your rows up and down the slope gives water falling on the land a chance to pick up enough speed to remove considerable soil with it. Running your rows on the contour, that is, perpendicular to the slope, tends to reduce the speed of the water and reduces soil runoff. By reducing the speed of the water and keeping it on land longer, you get the added advantage of giving the water more time to soak in the land. This is why contour farming is recommended on sloping land as a conservation practice. Contour farming alone will not stop erosion; therefore, for best results it should be used with combinations of other conservation practices.

## COMPARING THE GROWTH OF PLANTS IN DIFFERENT KINDS OF SOIL

### Purpose

To show that plants grow differently in varying kinds of soil.

### Equipment and Material

- 3 quart-size flower pots
- 3 soil samples (1 sample of good top soil; 1 sample subsoil, which may be obtained on a roadbank; 1 sample of soil from a badly eroded area)
- 12 bean seeds

### Procedure

Place sample of soil in each of the flower pots. Plant four beans  $\frac{3}{4}$  inch deep in each of the pots. Keep the soil moist and in sunlight. Keep a separate record of the growth of the plants in each pot. (See Figure 12.)

### Results

Plants get their food from the soil. You should get best growth from the top soil, next, the eroded soil and last, the subsoil.

### Conclusion

The top soil should yield the best growing plants because it has more plant food and more or-

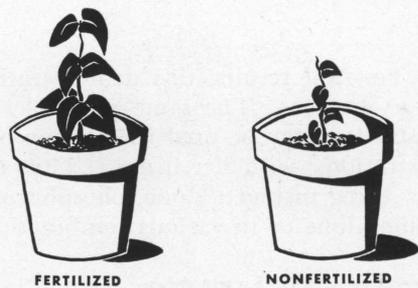


Figure 13.

ganic matter. The eroded soil will have less growth because of less organic matter and plant food. Last, subsoil plants will make the least growth because of virtually no organic matter and little plant food.

*Note:* If the subsoil plant makes the best growth, this may be due to the fact that plant food has been moved by water going through the soil carrying the plant food from the top soil and depositing it in the subsoil.

## INFLUENCES OF FERTILIZER ON PLANT GROWTH

### Purpose

To show how fertilizers increase plant growth.

### Equipment and Material

- 2 quart-size flower pots
- $\frac{1}{8}$  teaspoon (level) of complete commercial fertilizer
- 2 soil samples low in plant food
- 8 bean seeds

### Procedure

Put a sample of soil into each of the flower pots. Put 4 bean seeds  $\frac{3}{4}$  inch deep in one pot plant. In the other pot, mix the fertilizer thoroughly with the soil and then plant the bean seeds  $\frac{3}{4}$  inch deep. Keep the soil moist and in the sunlight. (See Figure 13.)

### Results

If the samples of soil are low in plant food, you should see quite a difference in the plants. On soils in good condition, you will probably see less difference.

### Conclusion

Soil furnishes plant food, but because the soil has had plant foods removed from it, the addition of fertilizers helps to replenish this plant food. Soil furnishes plant food for crop growth. If the soil cannot furnish an adequate supply of food, the addition of fertilizer will help the plant grow and develop faster. To find out how much fertilizer to apply and what kind, check with your local county agricultural agent.

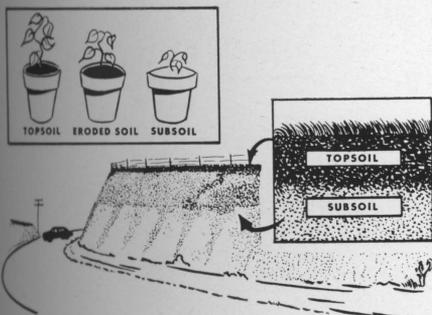


Figure 12.

*Note:* For best results, this demonstration will take 2 to 4 weeks. The same principles of this demonstration may be used in carrying on other demonstrations with fertilizers. This may be done by using nitrogen alone, phosphorus alone, potassium alone or in various combinations.

### **ACKNOWLEDGMENTS**

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## *Your County*

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