Unit D: Soil

Lesson 7 – Explaining a Soil Profile

Use the slides below to answer the following questions:

What is a soil profile?

How do soils within a soil profile change over time?

What are the major horizons of a soil profile and how do they differ?

Horticulture Science
Lesson 26
Explaining a Soil Profile

Student Learning Objectives

- Explain the soil profile.
- Explain how soils within the profile change over time.
- Distinguish between the major horizons of a soil profile.

What is a soil profile?

- A ***soil profile*** is a vertical cross-section of the soil. When exposed, various layers of soil should be apparent.
- Each layer of soil may be different from the rest in a physical or chemical way.

What is a soil profile?

- The differences are developed from the interaction of some of the following soil forming factors.
  1. Parent material
  2. Slope
  3. Native vegetation
  4. Weathering (time)
  5. Climate
- A soil profile is usually studied to a depth of three to five feet.

How do soils within a soil profile change over time?

- Soils change over time in response to their environment.
- The environment is influenced by soil-forming factors.
- The causes of these changes can be classified into four processes.

1. Materials such as fallen leaves, wind-blown dust, or chemicals from air pollution that may be added to the soil are ***additions***.

How do soils within a soil profile change over time?

2. Materials may be lost from the soil as a result of deep leaching or erosion from the surface, which results in ***losses***.
3. Materials may be moved within the soil.
   - This can occur with deeper leaching into the soil or upward movement caused by evaporating water, resulting in ***translocations***.
4. Materials may be altered in the soil, resulting in ***transformations***.
   - Examples include organic matter decay, weathering of minerals to smaller particles, or chemical reactions.

How do soils within a soil profile change over time?

- Each of these processes occurs differently at various depths.
  - As a soil ages, horizontal layers develop and changes result.

What are the major horizons of a soil profile and how do they differ?

- There are three primary soil horizons called master horizons.
- They are A, B, and C.
- These are part of a system for naming soil horizons in which each layer is identified by a code: O, A, E, B, C, and R.
- "O" horizon is an organic layer composed of partially decayed plant and animal debris.
  - It generally occurs in undisturbed soil such as in a forest.

What are the major horizons of a soil profile and how do they differ?

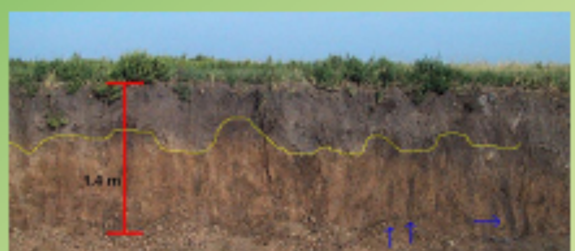
- "A" horizon is often referred to as ***topsoil*** and is the surface layer where organic matter accumulates.
  - Over time, this layer loses clay, iron, and other materials due to leaching, which is called ***eluviation***.
  - The A horizon provides the best environment for the growth of plant roots, microorganisms, and other life.

What are the major horizons of a soil profile and how do they differ?

- "E" horizon is the zone of greatest eluviation.
  - Because the clay, chemicals, and organic matter are leached, the color of the E horizon is very light.
  - It usually occurs in sandy forest soils with high amounts of rainfall.

What are the major horizons of a soil profile and how do they differ?

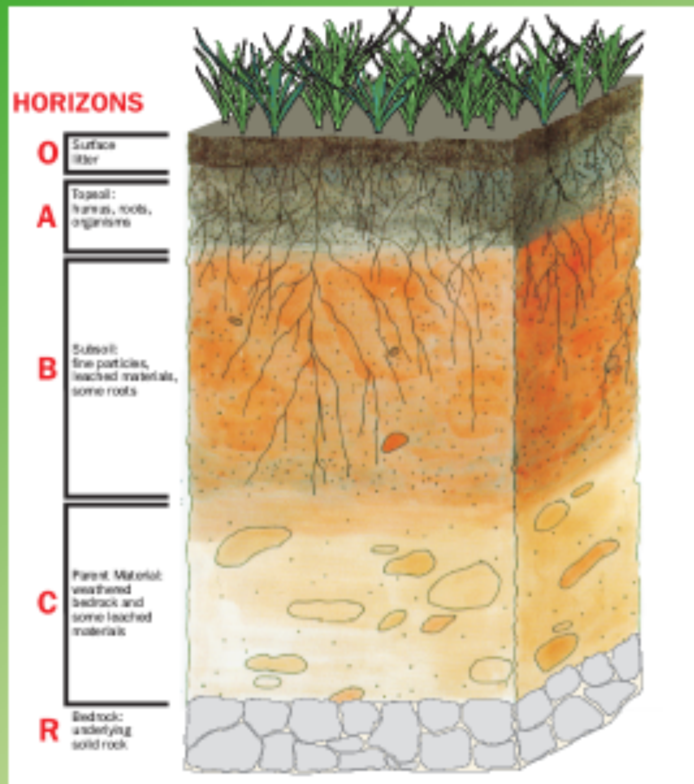
- "B" horizon is referred to as the ***subsoil***.
  - It is often called the "zone of accumulation" since chemicals leached from the A and E horizons accumulate here.
  - This accumulation is called ***illuviation***.
  - The B horizon will have less organic matter and more clay than the A horizon. Together, the A, E, and B horizons are known as the ***solum***.
  - This is where most of the plant roots grow.



What are the major horizons of a soil profile and how do they differ?

- "C" horizon is referred to as the ***substratum***.
  - It lacks the properties of the A and B horizons since it is influenced less by the soil forming processes.
  - It is usually the parent material of the soil.
- "R" horizon is the underlying bedrock, such as limestone, sandstone, or granite.
  - It is found beneath the C horizon.

What are the major horizons of a soil profile and how do they differ?



Unit D: Soil

Lesson 8 – Understanding Moisture Holding Capacity

Use the slides below to answer the following questions:

What is moisture-holding capacity?

What is used to determine how much moisture a soil can hold?

How do you determine the amount of moisture a soil profile can hold?

Student Learning Objectives

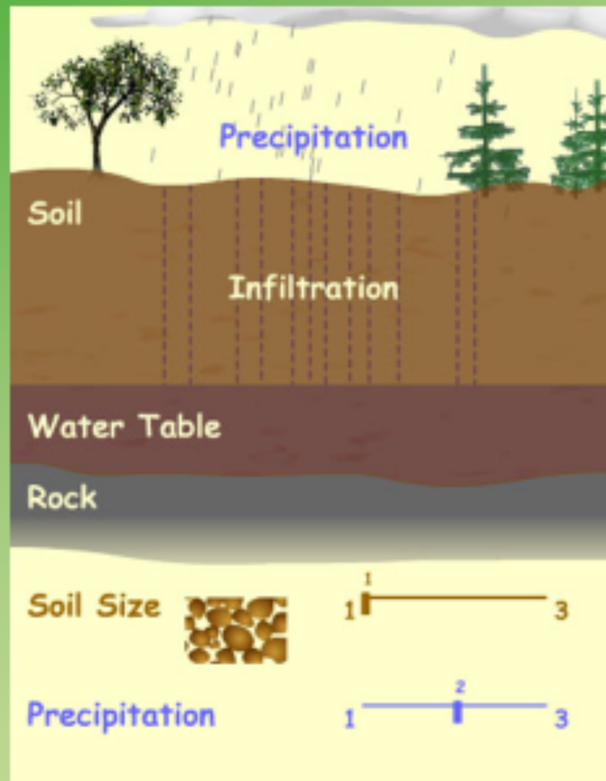
- Describe moisture-holding capacity.
- Explain what determines a soil’s moisture-holding capacity.
- Determine the moisture-holding capacity of a given soil profile.

What is moisture-holding capacity?

- ***Moisture-holding capacity*** is the ability of the soil within the soil profile to retain water.
- Water, which accounts for about 25% of the soil, is also part of the pore space in the soil.
- When it rains, water will enter the soil or flow off of the soil’s surface.

What is moisture-holding capacity?

- The process of water soaking into the soil is known as ***infiltration***.



What is moisture-holding capacity?

- Once water is in the soil, it moves downward in a process known as ***percolation***.
- A quality soil allows both kinds of water movement and is said to be ***permeable***.
- Water in the soil may be one of three types: gravitational, capillary, or hygroscopic.

What is moisture-holding capacity?

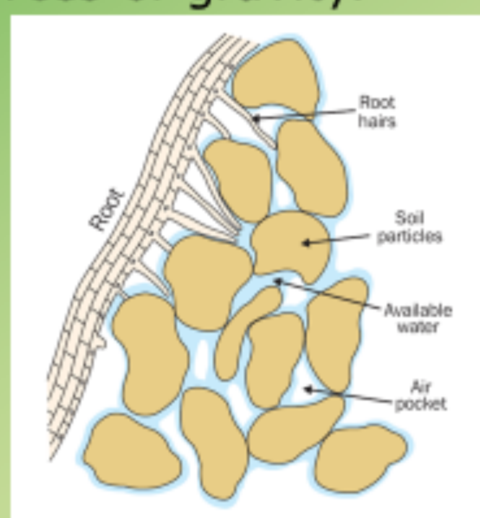
1. ***Gravitational moisture*** is the water that moves downward through the soil as a result of gravity.

- It may help replenish groundwater supplies.
- It is also available to plants.
- Gravitational water flows quickly through soil that has large pores and slowly through soil with small pores.
- As water moves through the soil, it carries dissolved minerals, chemicals, and salts.
- This movement of water is referred to as ***leaching***.

What is moisture-holding capacity?

2. ***Capillary moisture*** is the water held within the pore spaces between soil particles against the forces of gravity.

- It is available to plants and may move upward or sideways by capillary action.
- Clay soil holds more capillary water since it has more pore spaces.



What is moisture-holding capacity?

3. ***Hygroscopic moisture*** is the soil water that tightly clings to the soil particles.

- It forms a thin film around individual soil particles.
- This moisture is usually unavailable to plants.

What is moisture-holding capacity?

- Water may be available for plant use or unavailable.

1. ***Available soil moisture*** is the water in the soil that can be used by plants.

- When moisture levels are high, plants can easily extract moisture from the soil.
- As the water is used, soil moisture tension increases.
- ***Soil moisture tension*** is the force by which soil particles hold on to moisture.

What is moisture-holding capacity?

2. Hygroscopic moisture has high soil moisture tension.

– Although the water is present in the soil, it is considered to be ***unavailable soil moisture*** for plant use.

What is used to determine how much moisture a soil can hold?

- Moisture-holding capacity is determined primarily by the soil's texture.
- As a rule, the finer the texture of the soil, the more moisture it will hold.
- A soil with a high percentage of sand holds less water than one with a low percentage of sand.

What is used to determine how much moisture a soil can hold?

- Water percolates rapidly through the large pore spaces created by sand.
- Plants growing in sandy soils experience water stress more quickly than those growing in loam and clay soils.
- Soils with a high percentage of clay hold water and keep it from percolating out of the root zone.

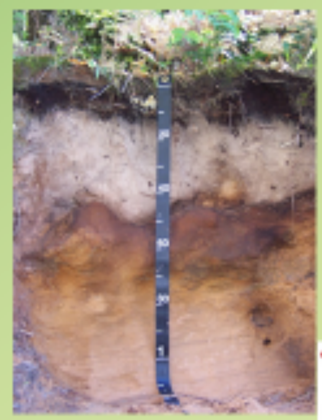
What is used to determine how much moisture a soil can hold?

- However, some of the water is held too tightly for plant use.
- This means less water is available to plants than if silt were present.
- A good silt loam holds the most moisture available for plants.

How do you determine the amount of moisture a soil profile can hold?

- The amount of moisture the soil can hold for plants is referred to as ***available waterholding capacity***.
- Available water-holding capacity depends on:

1. The depth of the soil profile



How do you determine the amount of moisture a soil profile can hold?

2. The type of soil texture found throughout the soil profile.
   - On average, the following textures will hold the designated amount of moisture per inch of soil:
     a. fine textured .20 inches of water
     b. moderately fine textured .25 inches of water
     c. medium textured .30 inches of water
     d. moderately coarse textured .20 inches of water
     e. coarse textured .10 inches of water

How do you determine the amount of moisture a soil profile can hold?

- To determine the available water-holding capacity for a given area, multiply the depth of each horizon, to a maximum depth of 60 inches, by the amount of water the texture within that horizon can hold.
- Add the totals for each horizon to calculate total water-holding capacity.

Unit D: Soil

Lesson 7 – Understanding Soil Degradation

Use the slides below to answer the following questions:

What is soil degradation?

How can construction result in soil degradation?

What are the sources of contamination and how do they result in soil degradation?

What is soil erosion and how does it result in soil degradation?

What are other sources of soil degradation?

Horticulture Science
Lesson 28
Understanding Soil Degradation

Student Learning Objectives

- **Define soil degradation.**
- **Explain how construction can result in soil degradation.**

Student Learning Objectives

- Identify sources of contamination, and explain how they result in soil degradation.
- Explain soil erosion and how it results in soil degradation.

Student Learning Objectives

- Identify other sources of soil degradation.

What is soil degradation?

- ***Soil degradation*** is a lowering of the quality of soil or the loss of soil productivity.
- Soil degradation occurs because people do not understand soil or the consequences of their actions.
- Minimizing soil degradation is important in maintaining a good environment.
- Soil degradation results from construction, contamination, and erosion.

How can construction result in soil degradation?

- Construction can result in soil degradation.
- ***Construction*** is altering land by building roads, houses, offices, factories, and other structures.
- Construction degrades the soil by replacing productive land with structures that prevent the production of plants or animals.

How can construction result in soil degradation?

- Construction degrades the soil when native grasses and trees are removed, which leaves the soil unprotected from erosion.
- Large equipment may move topsoil around and cover it with subsoil.
- Soil can be compacted (when wet) by heavy equipment.
- Digging deep into the earth brings up subsoil and parent material.
  - When it is spread on the surface, fertility is lowered.

What are the sources of contamination and how do they result in soil degradation?

- ***Contamination*** results when chemicals, oil, and other substances leak into the land.
- Some contaminants soak into the soil and destroy its ability to support plant growth.

- Other materials may pass through the soil and enter the ground water.
  - This can contaminate water supplies.

What are the sources of contamination and how do they result in soil degradation?

- Land formerly used as dumps, mines, and factory sites may be rehabilitated.
  - This involves removing contaminated soil and covering what remains with noncontaminated soil.
  - This process is expensive.
- ***Soil contamination*** may occur as a result of one of the following agricultural practices.
  1. Use of too much fertilizer
  2. Use of excess chemicals
  3. Use of irrigation water containing salt

What is soil erosion and how does it result in soil degradation?

- ***Soil erosion*** is the process by which soil is moved.
  - When it is moved, it may become pollution in water or air.
  - Soil erosion results from natural causes and human activities.

What is soil erosion and how does it result in soil degradation?

- ***Natural erosion*** shapes the earth's landscape by rounding off mountains and filling in valleys which may form new, highly fertile areas.
  - The Mississippi Delta is an example.

What is soil erosion and how does it result in soil degradation?

- Human activity, such as construction and plowing may cause ***accelerated erosion***, which removes topsoil at an excessive rate.
  - In many places, soil is being lost faster than it is being formed.
  - This will result in loss of soil fertility and productivity.

What are other sources of soil degradation?

- Improper irrigation practices that result in salinization, alkalization, and water logging harm soil.
- ***Salinization*** is an accumulation of soluble salts.
- ***Alkalization*** is an accumulation of exchangeable sodium.
- Both of these, as well as ***waterlogging***, are harmful to plant growth.

What are other sources of soil degradation?

- Growing crops without replacing plant nutrients and soil organic matter is harmful.
- These soils are "mined" of nutrients. As fertility drops, soil organic matter is lost and soil structure deteriorates.
- In many tree nurseries, trees and shrubs are grown in the field.
  - The plants are dug with a ball of soil around the roots and shipped.
  - Over time, the steady removal of trees and shrubs from the fields reduces the depth of the topsoil.

What are other sources of soil degradation?

- Pollution of soils with chemicals, industrial waste, human waste, and improperly handled livestock waste is also a problem.
  - A large accumulation of heavy metals, salts, or an acute accumulation of chemicals can render soil unproductive.

What are other sources of soil degradation?

- Overgrazing, deforestation, and other practices that remove productive plant cover cause a condition called ***desertification***.
  - This problem is most common in low rainfall areas.
  - Humus content and fertility drops.
  - Surface soil is exposed to the elements and becomes subject to erosion.

What are other sources of soil degradation?

- ***Compaction*** is the packing of soil particles tightly together after years of tillage with heavy machinery.
  - It can break down soil structure.
  - Plant growth is reduced, organic matter drops, permeability is lost, and runoff increases.

Unit D: Soil

Lesson 10 – Understanding Soil Erosion & Management Practices

Use the slides below to answer the following questions:

What is soil erosion?

What are the causes of soil erosion and steps in the erosion process?

What are the ways that different types of wind erosion occur and what problems are caused?

What are the different types of water erosion?

What are some management practices that can be implemented in urban areas to reduce soil erosion?

What management practices in horticulture will help minimize soil erosion?

Horticulture Science
Lesson 29
Understanding Soil Erosion and Management Practices

Student Learning Objectives

- Explain soil erosion.
- Identify the causes of soil erosion and steps in the erosion process.

Student Learning Objectives

- Examine ways in which different types of wind erosion occur and the associated problems.
- Distinguish between the different types of water erosion.

Student Learning Objectives

- Evaluate urban management practices that reduce soil erosion.
- Assess horticultural management practices that will minimize soil erosion.

What is soil erosion?

- ***Soil erosion*** is the process by which soil is moved.
- When soil is eroded, it may become pollution in the water or air.
- The land where it came from loses fertility.
- Vegetation and other coverings help prevent soil erosion.
- There are two basic classes of erosion.

What is soil erosion?

- ***Natural erosion*** occurs naturally and has made beneficial changes in the earth such as rounding off mountains and filling in valleys.
  - The redepositing of soil forms new, highly fertile areas, such as the Mississippi Delta.
  - Natural erosion is sometimes referred to as ***geologic erosion***.
  - This means it has occurred on land not disturbed by humans.

What are the causes of soil erosion and steps in the erosion process?

- Erosion is caused by many different weather factors, such as wind, water, and glacial movement.
- When land is cleared of protective covering, it is much more susceptible to erosion.
- The erosion process involves three distinct steps.
  1. The first step is the loosening of soil particles.
  2. The second step is the moving of soil particles.
  3. The third is the deposition of soil particles.

What is soil erosion?

- ***Accelerated erosion*** removes topsoil at an excessive rate and usually results from human activity on the land.
  - Such activity includes construction and plowing.
  - Accelerated erosion causes large losses of soil fertility.

What are the causes of soil erosion and steps in the erosion process?

- ***Water erosion*** is the loss of soil due to water movement.
  - It is the major cause of soil loss in North America.
  - Water erosion occurs when excess rainfall creates runoff that carries soil away.
  - ***Runoff*** occurs when rain falls faster than it can be absorbed into the soil.
    - Runoff water carries soil particles into streams and rivers, which causes water pollution and sediment.
  - ***Sediment*** is the deposition of soil in the bottom of streams, riverbeds, ditches, etc.

What are the causes of soil erosion and steps in the erosion process?

- There are four basic types of erosion.
- ***Wind erosion*** is the loss of soil due to the movement of wind over the land.
  - It usually occurs in dry climates where the soil is loose.
  - Wind erosion occurs on
    1. Newly-plowed fields
    2. Construction sites cleared by large equipment
    3. Land where vegetation has been grazed too short

What are the causes of soil erosion and steps in the erosion process?

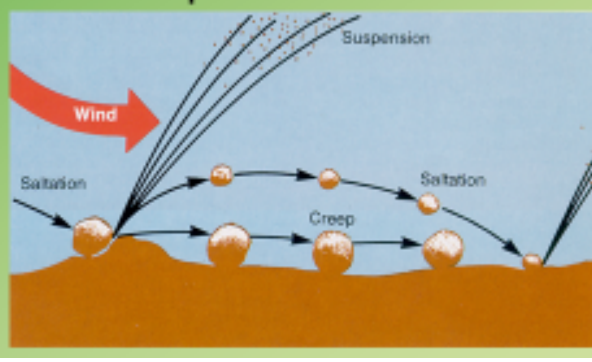
- ***Land slippage*** occurs on sloping land that is wet.
- Soil becomes saturated with water and slips down the hillside or mountain slope.
- Land slippage is also known as mud slides or landslides.
- Banks along highways, streams, and oceanfronts are often subject to slides.

What are the causes of soil erosion and steps in the erosion process?

- ***Glacial erosion*** occurs when the front edge of a glacier may push soil, rocks, fallen trees, and other materials.
- Soil erosion from glaciers is of minor importance except in areas where glaciers exist.

What are the ways that different types of wind erosion occur and what problems are caused?

- ***Saltation*** occurs when the wind lifts medium-sized soil particles into the air.
  - They are too heavy to remain in suspension, so they fall to the ground loosening other soil particles.
  - This process repeats itself.



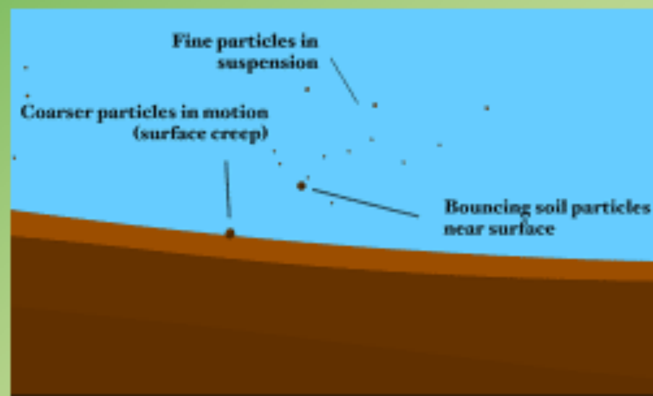
What are the ways that different types of wind erosion occur and what problems are caused?

- Wind erosion causes air pollution, produces highway safety hazards, and fills drainage ditches.
- It occurs when persistent or frequent high-velocity winds and a dry, residue free soil surface exist.
- Soil is moved by saltation, suspension, and surface creep.

What are the ways that different types of wind erosion occur and what problems are caused?

- ***Surface creep*** occurs as saltation takes place.

- The soil particles that are too heavy to be moved by saltation are moved along the surface by the impact of soil particles being displaced by saltation.

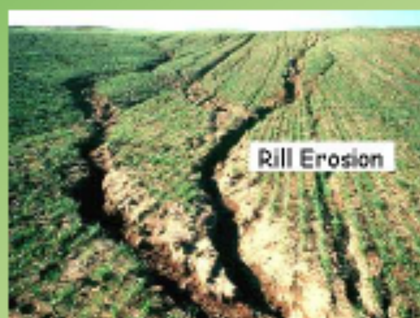


What are the ways that different types of wind erosion occur and what problems are caused?

- ***Suspension*** occurs when very small soil particles become airborne and enter the main air stream.
  - They are carried in the same general direction as the wind.
  - Because the soil particles are small, they remain in suspension.

What are the different types of water erosion?

- ***Rill erosion*** usually occurs on sloping land where small channels are formed by running water.
- The signs of rill erosion can be masked by normal tillage practices.



What are the different types of water erosion?

- Three kinds of water erosion can occur.
- ***Sheet erosion*** results when thin layers or sheets of soil are worn away.
  - Sheet erosion can occur on nearly level land or on sloping land.
  - If muddy water is moving off a field, sheet erosion is occurring.
  - It may go unnoticed since no channels form.
  - However, it may be just as problematic as erosion that is more apparent.

What are some management practices that can be implemented in urban areas to reduce soil erosion?

- In urban areas, the main concern is keeping the soil covered and controlling water runoff.
- This applies to construction sites, roads, parking lots, and recreational areas.
- Some of the following practices help conserve soil in urban areas.

What are the different types of water erosion?

- ***Gully erosion*** occurs when rills continue to wash away and become more severe.
- It is more likely on steeper slopes and cannot be smoothed by normal tillage practices.

What are some management practices that can be implemented in urban areas to reduce soil erosion?

- ***Silt fences*** are placed at the bottoms of slopes to hold the soil yet allow the water to flow.
  - This keeps sediment out of streams and lakes and prevents the loss of soil.
  - Silt fences may be made out of bales of hay, plastic strips, or other materials.
- ***Cover crops*** or vegetation can be planted on excavated soil to hold it in place.
  - Winter grass can be planted in the fall on new lawn areas to prevent erosion until the following spring when a permanent sod can be established.

What are some management practices that can be implemented in urban areas to reduce soil erosion?

- ***Mulching*** is placing a layer of straw, burlap, or other material on top of soil to protect it from wind and water.
- Mulch helps hold water and reduce the impact of water flow.

What are some management practices that can be implemented in urban areas to reduce soil erosion?

- Trees and shrubs can be planted in areas where erosion is possible.
  - The roots hold the soil.
  - The limbs and leaves on the tree slow the impact of rain and fallen leaves cover the ground.

- Curbs, ditches, and other structures may be installed to properly manage excess precipitation, which is part of storm water management.

What are some management practices that can be implemented in urban areas to reduce soil erosion?

- Building on the contour can help; streets, buildings, and other structures can be located on the contour of the land to slow water flow.
- Stabilizing banks is necessary because creeks and roadsides often have banks that will quickly erode.
  - Riprap, fabrics, straw, vegetation, and concrete are some materials used to stabilize banks.

What management practices in horticulture will help minimize soil erosion?

- Planting on the contour

Contour planting on terraces in Montgomery County, Iowa. USDA Photo by Tim McCabe.

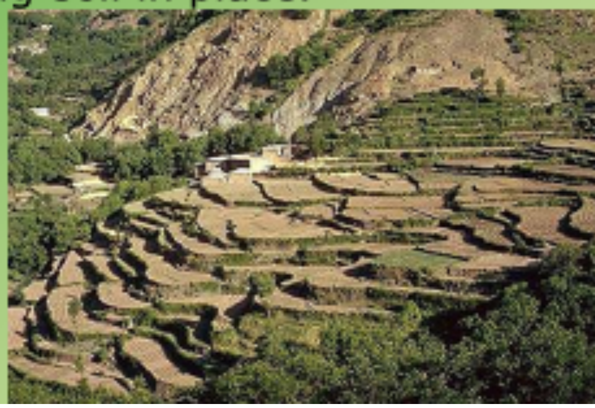
What management practices in horticulture will help minimize soil erosion?

- Horticulture utilizes the soil for growing crops, which creates loose soil that can be easily eroded.
- Several management practices can be implemented to reduce soil erosion.

  1. Plant on the contour, which involves planting around slopes rather than up and down them.
     - This helps slow the flow of water and allows it to be absorbed rather than runoff.

What management practices in horticulture will help minimize soil erosion?

3. A ***terrace*** is a ridge or row of earth mounds placed across a slope.
   - Terraces allow a gradual drop for the flow of water.
   - This helps prevent rapid water flow and aids in holding soil in place.



What management practices in horticulture will help minimize soil erosion?

2. The rotation of crops is vital.
   - Planting different crops on land from one year to the next helps reduce soil erosion.
   - It leaves residue on the surface to help hold the soil in place.

What management practices in horticulture will help minimize soil erosion?

4. ***Grassed strips*** are small strips covered with grass that may be left near plowed areas.
   - This slows the flow of water and helps keeps gullies from forming.

5. ***Diversion ditches*** are small ditches that may be built across slopes to slow water movement and divert it in to a safe outlet.
   - They are similar to grassed waterways, but may be lined with riprap or other material.

6. ***Strip cropping*** is planting alternating strips of crops on sloping land.
   - The strips slow the flow of water and hold the topsoil in place.

What management practices in horticulture will help minimize soil erosion?

7. Vegetative covers involve fields that may be planted in winter-cover crops after fall harvest.
   - The cover crop adds fertility and protects the soil from erosion.

8. ***Conservation tillage*** involves planting crops with little or no plowing.
   - Crop residue from the previous year is left on the surface to protect the land.

9. ***Windbreaks*** include rows of trees that may be planted to slow blowing wind and help prevent wind erosion.