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Soil erosion: effect on soil productivity

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Abstract

Soil erosion is a major environmental issue because it can lead to water pollution. But did you know that soil erosion also can seriously impair crop productivity? Most agriculture activities, especially on sloping landscapes, increase the potential for soil erosion. When soil erosion is severe, soil erodes faster than it can be renewed. For most areas of Iowa, the loss of 1 inch per acre of topsoil represents approximately 167 tons per acre and approximately 30 years is required to develop 1 inch of soil with properties of typical topsoil.

Keywords

Agronomy, Agricultural and Biosystems Engineering

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences | Bioresource and Agricultural Engineering

INTEGRATED CROP MANAGEMENT

A person is visible in the background of the title image, working in a field. The text 'INTEGRATED CROP MANAGEMENT' is overlaid in large, bold, serif font. 'INTEGRATED CROP' is in green and 'MANAGEMENT' is in white.

Soil erosion: effect on soil productivity

Soil erosion is a major environmental issue because it can lead to water pollution. But did you know that soil erosion also can seriously impair crop productivity? Most agriculture activities, especially on sloping landscapes, increase the potential for soil erosion. When soil erosion is severe, soil erodes faster than it can be renewed. For most areas of Iowa, the loss of 1 inch per acre of topsoil represents approximately 167 tons per acre and approximately 30 years is required to develop 1 inch of soil with properties of typical topsoil. Therefore, most Iowa soils (those with deep rooting potential, formed in permeable parent materials with favorable soil characteristics) can experience soil removal rates of 2 to 5 tons per acre per year.

Even limited soil erosion can be harmful to productivity in other soils. Soils with little rooting depth potential, slowly permeable subsoils, and fragile soils structure, or those that are shallow to bedrock or coarse sands and gravels, definitely are adversely affected by erosion. No amount of management can compensate for the lack of suitable soil material.

Soil characteristics and productivity.

To understand the effect of soil characteristics and erosion on soil productivity, producers need to understand soil properties. In Iowa, long-term effects of soil erosion on productivity can be measured by changes in three soil profile properties:

1. topsoil thickness;
2. rooting depth, which relates to plant-available water capacity; and
3. depth to maximum clay content in the soil profile.

Topsoil thickness

The vertical cross section of soil (soil profile) is divided into three parts: topsoil (A-horizon), subsoil (B-horizon), and parent material (C-horizon). Topsoil is generally enriched with organic matter and has granular aggregates that provide larger soil pores, reduce soil density, and enhance water infiltration and aeration. When topsoil is eroded, yield suffers due to nutrient loss and damage to soil physical properties. The loss of topsoil and its impact on yield are more pronounced on soils with steep slopes.

Rooting depth

As crops mature, roots extend through the topsoil layer into the subsoil, seeking available water and nutrients. Subsoil properties, such as coarse sand and gravel, shallow depth to

bedrock, soil densities greater than 1.65 grams per cubic centimeter, and clay content in excess of 42 percent, can limit root elongation and development and thereby impact yield. Thin topsoils mean lower organic matter content, low water holding capacity, and less rooting depth. Textural distribution within the soil profile also determines how much plant-available water is present. Soils with coarse textures tend to drain water more quickly, whereas soils with fine textures hold water too tightly for roots. Poor drainage occurs in medium-textured as well as fine-textured soils on concave landforms, and, in the absence of an artificial drainage system, root development is affected because of the lack of oxygen.

Depth to maximum clay content in soil the profile

Clay particles tend to accumulate below the topsoil due to the leaching. When topsoil has eroded, the loss of organic matter can alter the soil's physical properties, especially soil density. Higher clay content at the surface can reduce infiltration of topsoil reducing soil recharge, thus reducing water availability to the plants.

Soil and nutrients

Soil fertility is vital to a productive soil, but a fertile soil is not necessarily a productive soil. The majority of organic matter, approximately 50 percent of plant-available phosphorus (P), and potassium (K) are concentrated in the topsoil (A-horizon). Losing topsoil to erosion contributes to a loss of inherent soil fertility levels of nitrogen, P, K, and thus to a decline in potential crop yield. The addition of manure and fertilizer can supply needed crop nutrients and help offset some loss of inherent fertility caused by soil erosion. But the productivity of eroded soils can be restored by added inputs only if favorable subsoil material is present. Productivity lost by excessive soil erosion cannot be restored with additional inputs when soils have subsoil material with unfavorable physical and chemical properties for plant root growth. In soils that have fragile subsoils, limited rooting depth, coarse sand and gravel, or high densities, there is little or no ability to recover yield losses with increased inputs. The loss of yield is devastating.

In summary, preventing soil erosion means preserving inherent soil fertility and minimizing fertilizer and management inputs. Understanding the impact of erosion on soil productivity means knowing the characteristics of your soils. Information about soil profile characteristics is available in every county soil survey report.

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