SOIL ARE IMPORTANT TO SOUTH DAKOTA: (3) HOW DO SOILS DIFFER?

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Soil forming processes interact to produce soils in different environments with unique characteristics and management requirements. Large areas of variation in the physical relief or topography are called physiographic regions. Such large areas are described by terms such as hills, plateaus, or plains. Often these large areas are subdivided into smaller areas.

South Dakota is divided into 3 major physiographic regions: The Central Lowlands of eastern South Dakota; the Great Plains of central and western South Dakota; and the Black Hills. These 3 regions are subdivided into a total of 12 distinguishable areas called physical divisions. These are listed below:

1. The ***Minnesota River-Red River Lowlands*** (Division 1, Fig. 2) is a broad, gently undulating, valley-like area. Elevations range from 900 to 1,100 feet.
2. The ***Coteau des Prairies*** (Division 2) is a highland area between the Minnesota-Red River Lowland and the James River Lowland to the west. Elevations range from 1,600 to 2,000 feet.
3. The ***James River Lowland*** (Division 3) is a gently undulating plain lying considerably lower than the *Coteau* des Prairies on the east and the *Coteau* du Missouri on the west. Elevations range from 1,300 to 1,400 feet.
4. The ***Lake Dakota Plain*** (Division 4) is the nearly level surface formed by deposition of sediment when Glacial Lake Dakota was filled with water. The area is sandy at the northern end with silty clay loam and silty clay textures elsewhere. Elevation is about 1,310 feet.
5. The ***James River Highlands*** (Division 5) consist of a group three ridges located at the southern end of the James River Lowland. These highlands are *glacial drift* deposits over bedrock. These ridges are up to 300 feet higher than the surrounding country.
6. The ***Coteau du Missouri*** (Division 6) is part of the Missouri Plateau of the Great Plains Province, separated from the main body of the Missouri Plateau by the Missouri River. Elevations is about 1400 to 1800 feet.
7. The ***Missouri River Trench*** (Division 7) averages a little over a mile in width. Rapid erosion apparently was in progress before the advent of agriculture. Cultivation in the tributary regions has added significantly to the sediment load in the river. The dams have slowed the flow of the river and siltation is now a problem. Elevations range from 1200 to 1600 feet.
8. The ***Northern Plateaus*** (Division 8) is a series of plateaus and isolated *buttes*. Elevations are 2000 to 3000 feet.
9. The ***Pierre Hills*** (Division 9) consist of a series of smooth hills and ridges with rounded tops. Elevations are 1,800 to 2,800 feet.
10. The ***Black Hills*** (Division 10) is a mountainous area. Elevations range from 3,200 to 7200 feet above sea level.

11. The ***Southern Plateaus*** (Division 11) are divided into two regions. The large area in the southwestern part of the state consists of a series of benches and buttes. The Badlands comprise the northern part of the southwestern region. Elevations are 2,800 to 3,600 feet. The second region of the Southern Plateaus is located in southeast SD primarily in Lincoln and Union Counties. This area is a stream dissected highland underlain by a thick mantle of *loess*. Elevations range from 1,200 to 1,500 feet.
12. The ***Sand Hills*** (Division 12) is an example of the Sand Hills region of Nebraska. It consists of a series of rounded hills interspersed with low, swampy areas. Elevations range from 3,000 to 3,600 feet.

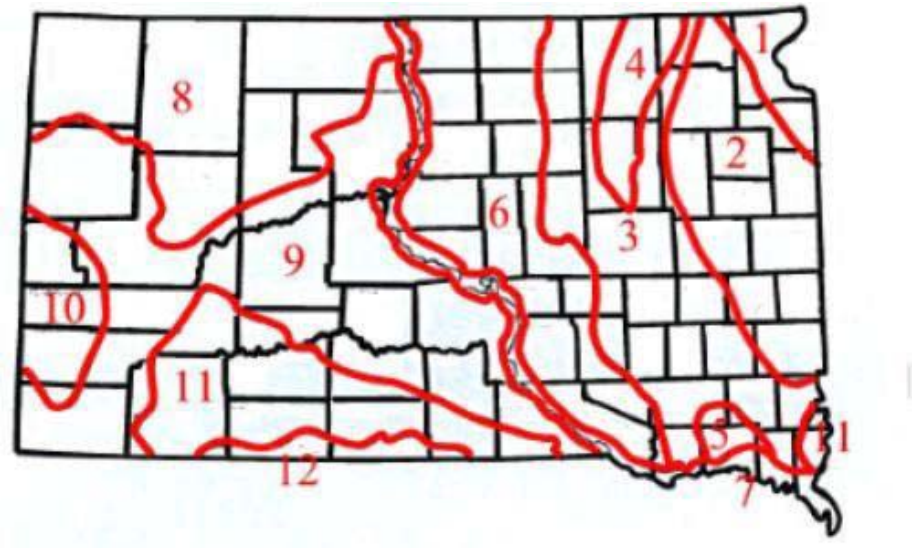

Figure 1. Physical divisions of South Dakota. 1. Minnesota River/ Red River Lowlands; 2. Coteau des Prairies; 3. James River Lowlands; 4. Lake Dakota Plains; 5. James River Highlands; 6. Coteau de Missouri; 7. Missouri River Trench; 8. Northern Plateaus; 9. Pierre Hills; 10. Black Hills; 11. Southern Plateaus; 12. Sand Hills.

How Do Soils Differ?

Soils have many different physical characteristics and properties. These characteristics are used to distinguish between different soil types. Some soil characteristics are listed below:

1.**Aeration:** Aeration is the exchange of air in the soil with air from the atmosphere. Well-drained (aerated) soils contain air that is similar in composition to that in the atmosphere. Air in poorly-drained (poor aerated) soils tends to have high carbon dioxide and low oxygen levels. Soils that have large spaces between the soil particles like sand tend to be well aerated whereas soils that have small spaces between the soil particles like clay tend to be less well aerated.

2. Organic Matter and Nitrogen: Native grassland vegetation, which was greatly influenced by climate, has influenced soil organic matter content and distribution. In general, eastern SD is more humid and this climate supported a tall grass prairie ecosystem. This tall grass prairie left large amounts of organic matter (humus) in the soils. Moving westward, the grass type changed to mid- and finally to short grasses in response to the drier climate. This change is reflected in the lower contents of soil organic matter in these regions.

Temperature has also influenced soil organic matter content. In the cooler northern regions, more soil organic matter and total nitrogen (N) are present when compared to southern regions under comparable precipitation. This is due to slower biological activity under cooler temperatures.

Organic matter and total N content of most cultivated soils in SD today are substantially lower than when original prairie sod was first tilled. These losses are generally about one-third to one-half of the original total and apply equally over the state. Therefore, present contents of organic matter and total N in cultivated soils reflect the original amounts but are one-third to one-half less.

3. **Nitrogen Release:** Research in SD has shown that nitrogen release from the soil to plants is a function of temperature rather than precipitation. Thus, southern and western soils release nitrogen faster than northern and eastern soils.

4. Permeability: Soils differ in their ability to transmit fluids (permeability). Factors such as texture, structure, and amount of organic matter influence a soil's *permeability*. For example, water flows quickly through sandy soils while soils with high clay content will barely let water pass through.

5. pH Level: The pH scale is a numerical measure of acidity or alkalinity ranging from 0 (very acid) to 14 (very alkaline). A soil pH of 7 is considered neutral while one at pH 4.5 or lower would be very strongly acid. Soils with a pH of 9.1 or higher are very strongly alkaline.

6. Salinity: Soils differ in amount of dissolved salts present. Some soils have dissolved salt content so high that plant growth is impaired. These soils are referred to as a *saline*.

7. Sodium Content: Some salt-affected soils have sodium levels that are so high that the soil's physical and chemical properties are changed. The soil's ability to support plant growth is also adversely affected. These soils are called *sodic*.

8. Soil Colors: Soil color correlates well with total amounts of organic matter, organic nitrogen and drainage present. Differences are apparent in when surface soil color is compared across various regions. Soil colors can be determined scientifically by comparing the soil color with specially prepared color charts.

The darkest soils are found in northeast SD where the climate is cool and moist or where soils are poorly drained. These dark soils have the highest organic matter and total organic nitrogen supplies in the state. In contrast, soils from warm and dry southwestern SD have the lightest color and have less organic matter and total organic N.

9. Soil Texture and Particle Size: Soils also differ in texture. Texture is determined by the relative amounts of sand, silt, and clay in the soil. Soils with high clay contents have very fine particles, can have a powdery consistence when dry, and become very sticky or slippery when wet. A soil composed of high silt content feels smooth and silky, like wet talcum powder or flour. Sandy soils have large, granular particles, a gritty texture, and are not slippery when wet.

A loam soil is a mixture of sand, silt and clay that exhibits the properties of those separates in about equal proportions (Brady and Weil, 1999). A loam soil has a medium texture, the highest *plant-available water holding capacity,* and is usually quite productive. Loam soils often contain a good amount of organic matter.

10. Soil Layers: Anyone who has looked closely at a recently dug hole or at a roadside cut has noticed that soils contain layers that differ in their appearance. These layers, or *horizons*, occur in a vertical sequence through the soil. The type and depth of these *horizons* create the *soil profile*. Soils vary in the types and number of *horizons* present.

11. Productivity: Not all soils are equally well-suited for plant growth. A soil's ability to sustain plants is referred to as its productivity level. Soil productivity depends on many factors including soil texture, soil pH, amount of organic matter and nitrogen, aeration and permeability as well as other factors not discussed in the scope of this article.

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