1969

Nature of Panspots and Their Improvement in Range

Cooperative Extension South Dakota State University

Follow this and additional works at: https://openprairie.sdstate.edu/extension_fact

Recommended Citation
South Dakota State University, Cooperative Extension, "Nature of Panspots and Their Improvement in Range" (1969). SDSU Extension Fact Sheets. 1152.
https://openprairie.sdstate.edu/extension_fact/1152

This Fact Sheet is brought to you for free and open access by the SDSU Extension at Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. It has been accepted for inclusion in SDSU Extension Fact Sheets by an authorized administrator of Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. For more information, please contact michael.biondo@sdstate.edu.
Nature of PANSPOTS and Their Improvement in Range

Cooperative Extension Service: South Dakota State University and U. S. Department of Agriculture
Nature of Panspots and Their Improvement in Range

By E. M. White, Professor of Agronomy

No general recommendations can be made for panspot improvement practices because the soils vary from area to area. Forage may be increased in one area and decreased in another by any particular practice. A mechanical treatment which alters the soil should be done on an experimental basis. Before a large area is treated, it should be established that forage will be increased for a long enough time to be profitable.

Rangeland in South Dakota must be utilized efficiently if ranching is to be profitable. As land costs increase a rancher may be able to increase the production of his present ranch more economically than he can purchase additional land.

Because forage production is low from panspot rangeland, these areas are frequently considered first in range improvement. Good grazing management will increase forage production a small amount, but the poor physical properties of the soils preclude a large increase. Improvement of the physical properties will be more expensive and may only last a few grazing seasons. Therefore, the improvement may not be economically profitable to the rancher.

WHAT ARE PANSPOT SOILS?

Many different kinds of soils are included in the general term “panspots” (Figure 1). These soils have parent materials which range from gravel to fine clay, are on nearly level to steep slopes, and have vegetation that may be sparse or very dense. Small barren areas, which lack vegetation, are often called “panspots” because water from rain collects in these “pan” areas. These soils have a dense claypan layer that is so very slowly permeable to water that most water from summer rains evaporates before it can soak into the soil. Panspot soils have a different chemical composition than soils which lack the claypan layer.

The difference in the two soils is in the chemical makeup of the clay particles. The individual clay particles are too small to be seen and will “float” in water to make it look muddy. Most clay particles suspended in water do not touch one another and are separated by a water layer. This water layer contains the chemicals which cause the difference between panspot soils and other soils.

Sodium is the chemical which is more abundant in the panspot soils than in other soils. Each very small unit of sodium has a single positive charge and acts like the positive end of a very weak magnet. Be-

Panspot soils have uneven vegetation and nearly barren areas where the claypan layer is near the soil surface.

Fig. 1
cause each clay particle has many negative charges, many positively charged sodium units are pulled near the clay particle (Figure 2, A). These sodium units form a positively charged layer in the water around the clay particle. The positive charged shells surrounding adjacent clay particles act like positively charged magnets to "push" the clay particles apart (Figure 3). These individual clay particles in a panspot soil are then free to be moved downward by water to plug up small pores and form the claypan layer.

Adjacent to panspot soils, those soils without a claypan layer have less sodium surrounding the clay particles. Instead the clay is surrounded mainly by calcium and usually by some magnesium.

Calcium and magnesium have two positive charges for each individual small unit. Because the units have two positive charges instead of one like sodium, calcium and magnesium are attracted more strongly by the clay and they are held mainly on the surface of the clay (Figure 2, B). The charge of the calcium units is neutralized if it touches the clay particle. Thus, the positive shell around a clay is weaker with calcium than it is with sodium (Figure 3).

Clay particles, which are not surrounded by a strong positive shell, do not repel each other. For this reason, the clay particles will stick together and they can not move rapidly downward to plug the pores and form a claypan. If more than 90% of the positive charges surrounding the clay are from calcium and magnesium, a panspot soil will not form.

Most panspot soils have claypans with sodium for about 10 to 30% of the positive charges surrounding the clay. In these soils, the calcium "pushes" the sodium from the surface of the clay so that a small amount of sodium will produce the positive shell (Figure 2, C).

Sand, silt, and some clay are left in the upper soil layers as the clay with a sodium shell is moved down to form a claypan. Thus, most panspot soils have a friable surface layer above the claypan. This friable layer may only be a fraction of an inch thick or be as much as 20 to 30 inches thick.

Some of the sodium in the shell around clay particles may be replaced by calcium or magnesium that is released in the soil as minerals gradually dissolve. The replaced sodium is free to be washed out of the soil if it has a well-drained subsoil and rainfall is sufficient to supply the water. If drainage through the soil is poor, water may be lost from the soil surface by evaporation. This moves sodium upward instead of downward in the soil.

Most panspot soils have lower layers that contain considerable sodium. If panspot soils are to be improved, sufficient water must drain through the soil to keep the sodium from moving upward into the surface layers.

Clay particles in water or in moist soils are surrounded by a shell of positive-charged atoms which neutralize the negative charge in the clay. More than 12,000 small clay particles, placed side by side, are needed to make 1 inch.
If gypsum (calcium sulfate) is added to the soil, the calcium that dissolves from it is attracted to the clay more strongly than sodium. The sodium is “pushed” away from the clay and into water that flows down and out of the soil. If water does not drain through the soil, sodium will remain and the added gypsum may decrease plant growth. However, the gypsum may make the soil more friable and permeable by causing the clay to stick together and not plug the pores. If enough positively charged calcium, magnesium, or sodium is added to fill the water between the positive shells surrounding the clay particles (Figure 3), then the positive shells are made weaker and the clay particles will not repel one another.

**HOW CAN PANSPOT SOILS BE IMPROVED?**

Forage production is poor on most panspot soils. The claypan retards root growth and the movement of water. An improvement practice needs to alter or counteract the effect of the claypan layer.

The claypan can be mixed with the friable surface or subsoil material to increase water penetration. Mixing the claypan with the friable surface layer usually will increase production for at least a few years. However, the claypan will reform rapidly if sodium is abundant and moves into the friable material. If sodium makes up less than 10% of the total positive charges surrounding the clay particle, the mixing may hasten the loss of sodium and give lasting improvement.

Normally the sodium will be abundant if there are many bare areas in well managed panspot range. However, some barren areas may be temporarily improved by mixing the claypan with the underlying subsoil if it contains salts, such as gypsum, that will cause the clay to aggregate. If this mixing is successful, water will penetrate into the soil so that plant growth will be stimulated. If the claypan has sodium for more than about 10% of the total positive charges on the clay, the claypan will usually reform after a few years.

The benefit to grasses from water penetration into panspot soils can be observed during years with above average precipitation. Vegetation is then vigorous and invades the barren areas. During most years, the summer precipitation is not sufficient to soak into the subsoil of the panspot soil. Any practice which retains runoff water so it will soak into the soil or improves water penetration into the soil will increase the moisture stored for vegetation. If too much water is added to a soil with poor subsoil drainage, the evaporation of water from the wet soil will carry sodium into the soil surface layer and reduce plant growth. This occasionally happens when water seeps upward below stock dams or irrigation ditches.

To be effective, mechanical treatments need to be deep enough to break up and cause other soil to penetrate into the claypan. If friable material is not mixed into the claypan layer, the claypan will reform rapidly as the soil settles back into place. A treatment (plows, disks, lister), which throws soil material on the surface of adjacent undisturbed soil, may destroy short grasses and trap water to stimulate growth of species such as the wheatgrasses. Because mechanical treatments that alter the soil usually alter the vegetation, any practice needs to be evaluated carefully as to what is causing an increase or decrease in the forage production.