TECHNICAL NOTES

UNITED STATES DEPARTMENT OF AGRICULTURE — NATURAL RESOURCES CONSERVATION SERVICE
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GRAZING LANDS TECHNICAL NOTE NO. 4

DETECTION OF SOIL COMPACTION ON GRAZING LANDS

Soil that is excessively compacted is limited in its ability to function. Soil compaction occurs when animals or equipment move across soils that are wet or saturated, with moist soils more easily compacted than saturated soils. Compaction can also occur when animals or equipment continually move across a lane or stand around watering tanks or under shade.

Animals trampling over the ground press down on soils, squeezing soil pore spaces together which limits root growth and the movement of air, water and dissolved nutrients. Compressing and clogging soil surface pores also decrease water infiltration and increase the potential for runoff. The formation of hardpans, plow pans, traffic pans or other compacted layers within the soil decreases downward movement of water through the soil, causes rapid soil saturation and the inability of soils to absorb additional water. Compaction also decreases the rate of organic matter decomposition by limiting the access soil organisms have to air, water or nutrients.

DETECTING SOIL COMPACTION

Generally, compaction is a problem within the top 24 inches of the soil. Signs of compaction are:

- Discolored or poor plant growth
- Excessive runoff from sloping areas
- Excessive water standing on the surface on flat or depressional areas
- Soil surface saturated for long periods of time
- Difficulty penetrating the soil with a firm wire (survey flag)
- Lateral root growth with little, if any, penetration of roots into compacted layers

- Platy, blocky, dense or massive layers
- Penetration resistance with a commercially available cone penetrometer. There are potential penetration problems at 145 psi or greater.

SOIL CONE PENETROMETER

The soil penetrometer consists of a cone attached to a rod that is pushed through the soil. The force required to push the cone through the soil divided by the area of the base of the cone is the cone index. The cone index is the standard measurement used for soil compaction and is read on the dial indicator of the penetrometer. Cone index is reported in units of pounds/square inch or psi. Roots usually cannot penetrate soil compacted to 300 psi or more. This critical value varies with soil type and moisture content of the soil when tested. There are potential penetration problems at 145 psi.

THE FOLLOWING INSTRUCTIONS FOR USING A PENETROMETER WILL ENSURE GOOD RESULTS:

- Soil moisture will impact readings and should be near field capacity. If the user is sure there is compaction and is only trying to determine the depth of the compacted layer, then moisture content is not critical.
- Insert the soil penetrometer smoothly without jerking motions. An uneven force will result in a reading that is not representative
- The penetrometer should be inserted at a constant rate of 1.2 inches/sec (3 cm/sec). Small variations will not affect the reading. Starting and stopping also will not affect the reading.
- Insert the penetrometer until the cone index reads 145 psi, record the depth. This is the bottom of the hardpan or compacted layer.
- If 145 psi or greater is never reached down to 18 inches, stop, record the maximum reading, and remove the penetrometer.
- Repeat the procedure at all sample location.
- If soil sticks to the penetrometer, clean off the rod and cone with water after use.

Johanna G. Pate
Rangeland Management Specialist

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