W•Y•O RANGE FACTS
MP-111.07
July 2006

University of Wyoming
Cooperative Extension Service

Increasing water infiltration and forage production of rangeland through mechanical "renovation"

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Soil moisture is the most common limiting factor of rangeland forage production. When precipitation reaches the ground, one of three things will happen: precipitation will be absorbed into the soil (infiltration), run off (overland flow), or evaporation. Forage production benefits from practices that increase infiltration and decrease runoff and evaporation. In other words, "**get the water into the ground**!"

Vegetation cover and soil surface properties are the variables that can be manipulated. Good grazing management is probably the best long-term method of improving soil/water/plant relations. Management can influence grazing impacts, such as the amount of plant cover removed and the physical impact of animal hooves.

Research indicates moderate and light grazing result in better infiltration rates than heavy grazing; however, excessive accumulation of dead plant mulch on ungrazed pastures has been shown to block precipitation and allow it to evaporate. Grazing management is discussed further in other fact sheets. This fact sheet explains how mechanical treatments can be used in some circumstances to improve infiltration and forage production.

What is mechanical renovation?

Mechanical renovation is a treatment intended to break up high-clay or compacted soils or sites covered with dense sod on rangeland. The goal is to stimulate overall forage production by improving water infiltration. Mechanical range renovation normally involves using a disk, harrow, chisel or plow to create furrows of varying depth and spacing. Renovation roughens and loosens the surface so water infiltration occurs more readily and stimulates the remaining desirable vegetation. **Mechanical renovation is <u>not</u> a complete cultivation designed to kill and replace the original vegetation.**

When and where mechanical renovation may be reasonable:

1) In general, **dense, fine-textured soils** (clays) **have lower infiltration rates than coarse-textured soils** (sands). This slow infiltration on fine-textured soils may be made even worse by compaction (from hooves, vehicle tracks, etc.), fire, and sometimes even volatile oils from certain plants.

2) **Dense grass sod can also reduce infiltration.** It is surprising to some that areas covered with sod-forming grasses such as blue grama, buffalograss, western wheatgrass or matted forbs such as Hood's phlox often have poor infiltration. Research shows that sod-bound areas commonly yield more than twice the runoff and many times the soil loss compared with ranges dominated by healthy bunchgrass cover. While there appear to be unoccupied spaces between bunchgrass clumps, the apparently bare spaces are actually dominated by grass rootlets that hold soil well, allow infiltration and absorb it efficiently for use by bunch grasses. Bare ground allows even less infiltration and results in much more

erosion than either sod or bunchgrass-covered ranges.

3) **Desirable forage species must be present in sufficient quantity and have a distribution pattern that allows them to take advantage of improved moisture and spread to disturbed areas.** If the range is so degraded that desirable perennials species are rare and/or annual or other weedy plants are dominant, mechanical renovation could make the situation worse.

4) **In the mixed-grass prairies of the central and northern Plains, favoring taller bunchgrasses over low-growing sod-formers often increases forage production.** Even with the interspaces between plants, the total biomass production of bunchgrass is often several times that produced by short-statured sod-formers.

Pro's

1) Doubled or tripled forage production is not uncommon when dense sod or heavy, compacted soil is mechanically treated with one of these practices and the balance in the vegetation community shifts toward more productive perennial grasses (if they are already present in the community).

2) The monetary and management costs of mechanical treatments are usually substantially less than the cost of completely re-seeding a pasture.

3) A positive response may be almost immediate if treatment is followed by adequate precipitation. Similar positive changes through grazing management may or may not be possible, but they generally require years to accomplish.

4) The practice is usually designed to stimulate production on diverse native range rather than to replace vegetation with a monoculture of introduced species.

5) Some ground-nesting birds benefit from the mechanical renovation.

Con's

1) There are potential hazards anytime rangeland is mechanically disturbed, including possible weed invasion and accelerated erosion.

2) Costs of mechanical treatments include machinery, fuel, and labor. Costs are likely to be at least $10 per acre, although they will vary greatly depending upon the price of fuel, the types of tractors and implements used, and whether the manager contributes his/her own labor. Wear and tear on machinery can be significant, especially if soils are rocky, shallow, or of extremely dense texture.

3) The surface roughness and increased infiltration created by mechanical treatments should persist for five years or more, but treatment may need to be periodically repeated.

4) Surface roughness can be a disadvantage for some kinds of recreational activity.

5) Full realization of the benefits and longevity of mechanical treatments is dependent upon follow-up grazing management. Without a reasonable grazing plan, forage production increases may not occur and/or will not persist for as long.

Do's

1) To minimize erosion, furrows should be constructed on the contour, and the tool should be lifted for short distances at random intervals to create natural dams.

2) If the problem is vegetation composition, create furrows 3 to 6 inches deep and spaced 16 to 18 inches apart. Half or less of the existing vegetation should be disturbed.

3) If the problem is lack of moisture penetration, treat 9 inches deep or more; the distance between furrows may be wider.

4) To reap the benefits of increased infiltration and production and to increase the desired forage species, defer grazing of mechanically treated range until desired species reach seed maturity the first year and from green-up to seed maturation the following year.

5) Autumn is probably the best time for mechanical renovation. The surface roughness should capture more blowing snow and allow moisture to infiltrate. Clods should mellow over the winter. Fall renovation should also provide spring moisture for plant species and reduce erosion from spring rainstorms.

6) Thereafter, grazing management should be designed to ensure periods of rest and moderate use.

7) Monitor the vegetation response, erosion potential, forage utilization, etc., after the treatments and make appropriate grazing adjustments.

8) Extended recovery periods may be necessary if drought occurs in the year of treatment.

9) To encourage relative uniformity in the vegetation and proper livestock distribution, renovation should be applied to as many acres as possible in a given pasture.

Don'ts

1) Don't allow noxious weeds to invade the site. Treat weed invasions early.

2) Mechanical renovation is a tool – a management option. Don't assume it's a panacea or that it is appropriate for all sites.