

Managing rangelands: promoting sustainable rangeland management practices

Soil surface scarification: improving plant succession and ecosystem health toward sustainability



Purpose of soil surface scarification

Soil surface scarification breaks up the compacted/crusted surface soil to enhance ecosystem processes. Soil respiration is improved, water can penetrate faster, the germination and emergence of seeds are facilitated, and succession can move forward more quickly. Scarification is commonly used to ensure successful regeneration of vegetation either through natural rehabilitation or by direct seeding.

Procedure

Different soil surface treatments can be used to improve degraded rangelands, with surface disturbance being achieved either naturally or mechanically. These actions may have different impacts on mixed plant communities and may have a significant effect on biodiversity and rangeland structure.

BACKGROUND

Crusted or capped soils are common in arid or semi-arid degraded rangelands, either occurring naturally or as a result of poor management. Without measures to improve soil conditions, rangeland rehabilitation efforts often result in unacceptably low seed germination and/or seedling performance. Success rates may be improved by human intervention, using methods such as soil surface scarification to promote physical and chemical processes within the soil that enhance plant survival and growth.

Benefits:

- Improves water infiltration
- Creates micro-sites for seed germination
- Enhances seed survival and germination
- Facilitates root-soil contact
- Reduces soil erosion on sites with steep slopes
- Represents a cost-effective technique for restoring degraded rangelands

Natural scarification (herd effect)

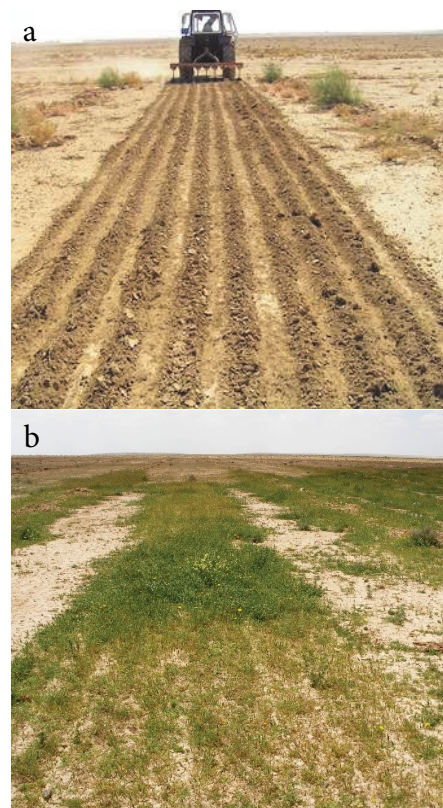
Ideally, soil surface scarification should be achieved naturally through the action of the hooves of grazing animals. In the past, this was facilitated by the behavior of grazing wildlife which, when chased by predators, would stampede and break up the soil surface. However, nowadays, with domestic livestock grazing calmly at a slow pace, the impact of the herd is negligible, especially when the soil surface is already capped or crusted. There are certain practices that can mimic predator-induced behavior such as the use of a mobile watering facility or additional feeding and/or mineral supplementation (for example, salt in a granular form)



Herd effect: sheep disturbing top soil surface (Jordanian Badia)

Mechanical scarification (machinery)

Mechanical scratching or plowing are the most common scarification techniques. The choice of field cultivator or ripper is based on how compacted the soil is, how hard the crusted layer is, and whether rocks are present. Usually a tractor is fitted with a tool bar carrying tines, rippers, or other devices capable of disturbing the upper 5–10 cm of the crusty soil. Cultivators consist of a frame, tines with reversible shovels, and heavy-duty springs. The teeth work on the soil surface to loosen the soil without inversion.



a) Soil surface scarification implemented just before the rainy season (fall 2010, Syrian Badia) b) Natural regeneration as a response to soil surface scarification (spring 2011, Syrian Badia)



In sites characterized by encroaching sand dunes, soil surface scarification is not an option (southern Tunisia)



Mechanical scarification should be avoided when the soil surface is covered with rocks (southern Tunisia)

Effective implementation

- Recommended for bare (denuded) and crusted soil
 - Depending on the geographic location, scarification should be implemented in advance of the early fall rainfall (usually 1–2 weeks before the first rain is expected)
 - If the soil seed bank is depleted, scarification should be combined with direct seeding
 - Scarified areas should be protected to allow seeds to emerge and seedlings to establish
 - The established plants should be lightly grazed initially, with moderate grazing permitted thereafter
 - Cautionary note—there could be limitations according to soil depth or the risk of wind erosion
-



A denuded and crusted soil surface where scarification is needed (Majidya, Jordan)

SUMMARY

Soil surface scarification under arid climate conditions facilitates plant succession and enhances ecosystem health. Lightly breaking up the surface soil creates narrow furrows that trap moisture and improve seedbed conditions. This practice, if complemented by seeding, is a cost-effective technique for rehabilitating degraded rangelands.

Citations

Gauthier, M.M., M.C. Lambert, and S. Bédard. 2016. "Effects of Harvest Gap Size, Soil Scarification, and Vegetation Control on Regeneration Dynamics in Sugar Maple-Yellow Birch Stands." *Forest Science* 62 (2): 237–246

Liu, Z., and X. Zhang. 2010. "Steppe Degradation and Rehabilitation in Northern China." In *Desertification and Its Control in China*, edited by L. Ci, and X. Yang. Beijing: Higher Education Press.

Louhaichi, M., K. Clifton, and S. Hassan. 2014. "Direct Seeding of *Salsola vermiculata* for Rehabilitation of Degraded Arid and Semi-Arid Rangelands." *Range Management and Agroforestry* 35 (2): 182–187.

Savory, A. 1988. *Holistic Resource Management*. Washington DC: Island Press.



Contact

Mounir Louhaichi
Range Ecology and Management
Research Scientist
E-mail: m.louhaichi@cgiar.org

Photos: Mounir Louhaichi/ICARDA



RESEARCH
PROGRAM ON
Livestock