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Soil Health – Minimizing Soil Disturbance

Maninder Kaur Walia, Assistant Professor – Field Crop Specialist;
Ericka R. Kay, University of Nevada, Reno

Soil Health

In healthy soils, pore spaces contain water and air. Over time, soil disturbances reduce pore spaces, restricting infiltration and destroying the biological glues that hold the soil together and the soil organism's habitat. Soil organic matter is the critical component of soil and consists of undecomposed and partially decomposed residues of plants and animals and the tissue of living and dead microorganisms. Soil organic material affects the physical and chemical properties of the soil and its overall health, including soil structure, moisture-holding capacity, soil organism diversity, nutrient availability, etc. Healthy soils need both soil organic matter and pore space.

Soil Disturbance

Soil disturbance negatively impacts soil functions. It occurs in three forms: biological, chemical and physical disturbances.

- *Biological* disturbance results from overgrazing. The loss of green tissue limits the plant's photosynthetic capacity, limiting vegetation's ability to reestablish, which leads to desertification and loss of net productivity.
- *Chemical* disturbance is due to the overapplication of chemical inputs, including fertilizers and pesticides, and disrupts soil food webs, including organisms necessary for soil health.
- *Physical* disturbance is caused by tillage and often results in compaction. Compaction reduces soil pore spaces, restricting water and air infiltration and destroying soil organism's habitat. In long-term tillage systems, this can further result in degraded soils through loss of fertility, increased water and wind erosion, water ponding, and crusting.

Benefits of Minimizing Soil Disturbance

Minimizing soil disturbance helps:

- *Increase water and air infiltration* by preventing the loss of stable soil aggregates and their associated macropores and increasing rainfall or irrigation capture.
- *Decrease ponding* by protecting pores and increasing infiltration, which reduces runoff and thus, the loss of water and nutrients.
- *Protect soil organic matter,* which provides nutrients to plants and organisms and also provides habitat to soil organisms, increases soil water-holding compacity, and builds larger soil aggregates that are protective against soil crusting.

- *Reduce erosion* by protecting soil structure, which holds soil, nutrients and water in place.
- *Reduce crusting* by maintaining larger soil aggregates. Crusting is caused by the destruction of soil aggregates from tillage.
- *Reduce annual fuel and labor investments* by switching from continuous conventional till to seasonal no-till or minimal tillage practices; a producer can save a lot of time, fuel and energy.
- *Mitigate climate change* by sequestering more carbon in the soil, which means less CO_2 is released into the atmosphere.

Minimizing Soil Disturbance

Biological disturbance **–** Manage livestock to prevent overgrazing. Grazing plants without providing time for recovery is, by definition, overgrazing. When managing grazing systems, the following should be considered: stocking rate and density, grazing intensity, and the rotation of livestock. The rotation of livestock includes managing when you graze, how long you graze, and how long the area is allowed to rest and recover before being grazed again. Ideally, limiting grazing to no more than half of the total plant biomass is recommended.

Chemical disturbance **–** Reduce the use of synthetic fertilizers, pesticides, herbicides and fungicides by implementing a diverse cropping system, including cover crops and green manures. Cover crops are any living ground cover planted into or after the main crop. Green manure is a cover crop that is not harvested but plowed into the soil as a soil amendment. Legumes are preferred because they are nitrogen fixers and reduce the dependence on nitrogen fertilizer.

Cover crops maximize the time continual living roots are growing and ensure the soil organisms have food and can continue to decompose soil organic matter, increasing soil fertility and tilth. Cover crops can also break pest life cycles by depriving pests of their host crop. Increased biological activity during decay makes soil less susceptible to crop pathogens by increasing the population of beneficial soil organisms. Cover crops can also reduce herbicide use by keeping ground covered while suppressing weed seed germination and growth.

Integrating livestock can also feed soil organisms and increase diversity and soil fertility. In addition, applying manure or compost can alleviate the dependence on synthetic fertilizers and reduce chemical disturbance.

Physical disturbance **–** Physical disturbance includes compaction and tilling. Tillage operations are performed for various reasons; however, producers should evaluate the need for all field operations implemented to improve profitability. The effects tillage operations have on soil health and the environment must be considered. Tillage practices include strip, reduced and conventional tillage, and best practices vary by crop, region and other factors.

Reducing soil compaction will protect soil structure and health. The old adage “staying off the field until it is fit to work” rings true even in an arid state such as

Nevada. Staying off the soil when it is wet is one of the most important factors for preventing soil compaction.

Limiting field operations traffic patterns to areas that have already been traveled will reduce soil compaction because almost two-thirds of soil compaction occurs during the first pass over loose soil. This will also greatly decrease the total field area experiencing compaction due to the use of heavy equipment. When possible, standardizing equipment wheel spacing will also alleviate compaction.

Maintaining tire inflation rates and keeping axle loads below 10 tons will localize compaction to the top 6 to 10 inches. Producers can consider upgrading or updating their equipment. The tire industry designed radial tires for larger equipment that reduce tire pressure to almost half the inflation rate of bias-ply tires, and manufacturers of liquid manure spreaders have added four axles to reduce load per axle.

Low-disturbance manure application is another way to minimize physical soil disturbance while reducing chemical disturbance. Surface application of manure can be susceptible to nutrient loss via surface runoff, especially in operations transitioning from conventional till operations that have not yet achieved improved soil infiltration. In contrast, manure injection is a low-disturbance system that injects manure below the soil surface. This still offers the benefits of incorporation but without the damaging effects of tillage-based practices.

Including perennial crops also helps reduce compaction, as these crops do not need to be replanted yearly, protecting soil from erosion and improving soil structure.

Soil can be disturbed by natural forces, including precipitation and wind. So, plan to protect fields from water and erosion damage by planting windbreaks, cover crops and barrier strips where feasible.

Conclusion

Implementing alternative practices to minimize soil disturbance provides many benefits. However, there are many factors to consider to determine which are appropriate before transitioning to low-disturbance systems, so growers are encouraged to consider these factors before implementing these practices on their ground.

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