Assessing Soil Quality

Introduction

The quality of your soil affects every facet of your landscape, from the plants that will grow to the features that can be constructed. A visual assessment of your soil quality is a good first step in designing or remodeling your landscape. Soil quality assessments study many variables, including soil biota or biology, soil porosity and water-holding capacity, soil organic-matter content, and soil chemistry. The assessment can pinpoint further testing needed or determine the steps necessary to improve your soil.

Annual soil assessments are a good way to monitor your landscape management practices to ensure they are actually improving your soil. Follow these steps when assessing soil quality:

- Perform annual assessments at the same time each year to ensure valid comparisons.
- Make all observations under appropriate moisture conditions, when soil is neither too wet nor too dry.
- Assess all soil life, including earthworms, before tilling occurs. Tilling soil can disrupt soil life.
- If you have distinctly different soils on portions of your property, do a separate soil assessment for each of those different soils. You might want to do a separate soil assessment for each bed or planting area.

To assess the soil for a single bed, dig a hole straight down through the soil. Soil depth varies, but dig down at least 6 to 18 inches. It is especially important to dig a deep hole in treeplanting areas to determine the suitability of the soil for trees. Make sure the soil is representative of the whole area you are assessing. If you are not sure the hole you have dug is representative, dig two or more additional holes in the area to ensure you have made a representative assessment of your soil.

An ideal soil has:

- diverse soil biota, with abundant soil organisms including earthworms, insects and other soil life.
- good porosity, with space between the soil crumbles or aggregates that are filled with air and water.
- good permeability, allowing water to infiltrate and move through it.
- good water-holding capacity, retaining some water in the pore spaces, where it is available to plants.
- good tilth or physical condition, with soil aggregates or crumbles that aid in increasing porosity, permeability and water-holding capacity.
- good organic matter content, with plant residues decomposing, cycling nutrients back into the soil, and improving the water-holding capacity and nutrient levels of the soil.

These factors are interrelated. For example, low porosity will result in low permeability, low water-holding capacity and decreased soil biota, as the living creatures in the soil will have nowhere to live. This, in turn, causes low organicmatter content, further reducing the waterholding and nutrient-holding capacity of the soil. Identifying problems is the first step to correcting them and improving your soil. This simple assessment exercise will help you evaluate your soil's quality.

In the table below, circle the appropriate description for each of the indicators listed. Are most answers in the low- to medium-quality range, or in the medium- to high-quality range? What is the overall assessment of your soil quality?

INDICATOR	LOW QUALITY	MEDIUM QUALITY	HIGH QUALITY
Is the soil full of living organisms?	Few insects, worms or other soil life.	Some insects, worms or other soil life.	Many insects, worms and other soil life; soil full of a variety of organisms.
Is plant residue present and decomposing?	No visible roots or plant residue on soil surface; very slow decomposition (last year's leaves still present).	Some roots and plant residue on soil surface; some visible, undecomposed residue.	Lots of roots and plant residue on surface; residue at various stages of decomposition.
What is the color of the topsoil?	Topsoil color similar to subsoil color.	Topsoil color slightly darker than subsoil color.	Topsoil clearly defined; topsoil darker than subsoil.
Is your soil compacted?	Hard layers; very firm soil; high shovel or screwdriver resistance; restricted root penetration; hardpan; roots turned awkwardly.	Firm soil; slightly restricted root penetration; moderate shovel or screwdriver resistance beneath the tillage layer.	Loose soil; easy shovel or screwdriver penetration; unrestricted root penetration; no hardpan; mostly vertical root growth.
Is your soil workable?	Many passes and much effort needed to till the soil; soil difficult to work.	Soil works reasonably well; some resistance to tillage.	Tills easily and requires little effort to work the soil.
Does your soil have good structure and tilth?	Soil clods difficult to break; visible crusting; tillage creates large clods; or soil falls apart in hands and is very powdery.	Some crusting; small clods; soil breaks apart with medium pressure.	Soil crumbles well (is friable) and is porous; soil surface has many soft small aggregates that crumble easily.
Does your soil have good porosity?	Few worms and root channels; not much visible pore space in the soil.	Some new and old root and worm channels; some visible pore space in the soil.	Many worm and root channels; many pores between soil aggregates.
Does your soil have good water-holding capacity?	Plants show signs of stress shortly after rain or irrigation; soil becomes dry quickly and requires frequent irrigation.	Plants are not first to suffer in a dry spell; soil requires average irrigation for the area.	Soil holds water for a long time; plants do well in dry spells; soil requires less-thanaverage irrigation for the area.
Are there signs of wind and water erosion on your property?	Obvious soil drifting or soil deposition; large rills* and gullies* formed; colored runoff observed.	Some evidence of soil drifting; some soil deposition; few rills* or gullies*; some colored runoff.	No obvious soil drifting; no visible soil movement; no rills* or gullies*; clear or no runoff.

*Rill: Erosion feature caused by water. Rills are not very deep or wide. They can be smoothed away by ordinary farm tillage.

*Gully: Erosion feature caused by water. Gullies are deeper and wider than rills. Gullies are not smoothed away by ordinary farm tillage.

INDICATOR	LOW	MEDIUM	HIGH
How does your soil drain? Does water infiltrate your soil quickly?	Water remains on the surface for a long time after rain or irrigation; excessive wet spots, ponding or puddling; root disease.	Water drains slowly after rain or irrigation; some ponding, puddling or wet spots; some root disease.	No ponding or puddling after heavy rain or irrigation; water is evenly distributed throughout the area and the soil profile; no evidence of root disease.
How does your soil smell?	Swampy smell, probably due to poor drainage.	Little or no smell.	Fresh earthy smell.
Do plants, including weeds, appear healthy and vigorous?	Stunted growth; uneven vegetation growth pattern; discoloration; low yields.	Some uneven or stunted plant growth; slight discoloration; signs of stress.	Healthy and vigorous plant growth; uniform growth pattern.
Do plant roots grow well in your soil?	Poor growth/structure; brown or mushy roots.	Some fine roots, mostly healthy.	Vigorous and healthy root system; firm roots with a desirable color.
Is there a substantial root mass in your soil?	Very few roots, mostly horizontal.	Some roots, some vertical, some horizontal.	Many vertical and horizontal roots; deep roots.
Does your soil show any signs of excessive salt content?	Visible salt/alkali on soil surface; dead plants.*	Stunted growth; signs of leaf burn.*	No visible salt or alkali on the soil surface; no plant damage.
Does your soil show signs of excessive sodium content?	Soil surface seals after rain or irrigation; soil is fluffy when dry; uneven vegetation growth pattern.*	Only some spots with sealed surface.*	No sealing or fluff at surface; no plant damage; soil has open or porous surface all season.

*These signs generally indicate laboratory testing for sodium content should be done. Contact your local Cooperative Extension office for a list of soil testing labs in your area.

(Assessment table adapted from Guidelines for Soil Quality Assessment in Conservation Planning, NRCS Soil Quality Institute.)

What is the overall assessment of soil quality? Make a list of the problems identified by the assessment.

Now that you have assessed your soil, you may have found some problems. The chart on the next page will help you identify potential solutions to your soil quality problems.

PROBLEM	POSSIBLE CAUSES	POTENTIAL SOLUTIONS
Compaction (low porosity)	Low organic-matter content Working or tilling wet soil High traffic area	Add organic matter. Avoid working soil when wet. Avoid using the area or designate a walking or driving path in the area.
Crusting	Poor soil structure High soil sodium content	See: Salinity. Avoid working soil when wet. Add organic matter.
Poor drainage (low infiltration rates)	Compaction Poor soil structure Clay content	See: Compaction. Add organic matter. Do a soil textural analysis.
Erosion	Lack of plant cover or residues Low organic matter content Poor soil structure Excessive tillage	Don't remove all residues from previous planting. Add organic matter. Avoid excessive tillage, especially when soil is wet.
Poor infiltration (low infiltration rates)	Compaction/low porosity Surface crusting Poor soil structure High soil sodium content	See: Compaction; Crusting; Salinity. Add organic matter. Avoid working soil when wet.
Salinity	Poor drainage Shallow water table Naturally high salt content For more information on saline or sodium-affected soils, see *Nevada Soil Amendment Myths*, University of Nevada Cooperative Extension Fact Sheet-09-15	Test soil to confirm that it has high sodium or salt content. Improve drainage by adding organic matter. Wash out salts by irrigating to move the salts below the root zone (do not use this method in areas with a high water table). Plant salt-tolerant plants. Contact your local Cooperative Extension office for a list of salttolerant plants for your area.
Inadequate soil biota	Compaction (low porosity) Excessive tillage Low organic-matter content	See: Compaction. Avoid working soil when wet. Add organic matter.

Adding organic matter will help remedy most soil quality deficiencies. Be careful not to increase problems when you add organic matter. You can add disease-free grass clippings and leaves, but most other materials should be composted first, especially manures. Hot composting ensures the organic material is relatively free of diseases (E. coli, viruses), insect pests and their larva, and weed seeds or weed plant parts. Additionally, uncomposted manure is high in salts, which can increase your soil quality problems.

Hefner, M., Donaldson, S., and Skelly, J. *2009, Assessing Soil Quality, Extension | University of Nevada, Reno, FS-09-17*

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Also of Interest:

Soil Properties, Part 1 of 3: Physical Characteristics

A brief overview of the physical, biological and chemical characteristics of soils. The information is provided for agronomic producers to help them understand soil properties and characteristics.

Foster, S., Schultz, B., McCuin, G., Neibling, H., and Shewmaker, G. 2013, University of Nevada Cooperative Extension

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Extension Director's Office | On the campus of University of Nevada, Reno

Location: Max C. Fleischmann Agriculture Building
Room Number: 201
Mailstop: 404
Mailing Address: 1664 N. Virginia St., Reno, NV 89557

Email: Contact Us
Phone: 775-784-7070
Fax: 775-784-4227
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