



Colorado MASTER GARDENER

Soil Drainage

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Pore Space Controls Soil Drainage Characteristics

Pore space controls soil drainage characteristics. In other words, drainage problems often arise from lack of large pore space.

In soils dominated by large pore space (i.e., sandy soils), water moves rapidly. Soils that allow rapid **leaching** (water movement down through the soil profile) also pose environmental hazards as rain or irrigation water takes water-soluble pollutants with it. Ground water pollution is a sensitive issue on coarse-textured sandy soils prone to over-irrigation.

On the other hand, in soils dominated by small pore space (i.e., compacted soils and soils with greater than 20 percent clay content), water is slow to move or may not move at all. Soils easily waterlog.

Roots must have oxygen to survive and root activity shuts down in waterlogged soils. Plants growing on wet soils are typically shallow rooted. Many plants are prone to root rots in wet soils. Prolonged periods of waterlogged soil conditions lead to the decline or even death of most plants.

When water doesn't leach through the soil profile, salts left behind by surface evaporation accumulate creating a white crust on the soil. This is frequently observed as a white deposit on low spots of pastures and fields. High soil salt content limits plant growth in some areas of Colorado. For details, refer to fact sheet 7.729, *Saline Soils*.

Poor drainage is a common problem in many Colorado soils. In some areas, the surface soil allows water infiltration only to have the water stopped as it reaches a less permeable sub-surface soil layer.

A simple test to evaluate soil drainage is to dig a hole 12 inches deep and fill it with water. If the water fails to drain in 30 minutes, the soil has a drainage problem. If the hole fails to drain in 24 hours, waterlogged soils may impact plant growth.



Figure 1. This simple test can determine if a soil will have drainage problems or is waterlogged.

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Correcting Drainage Problems

Managing Soil Tilth

Attention to managing soil tilth plays a key role in soil drainage. On coarse-textured sandy soils, routine applications of organic matter increase the

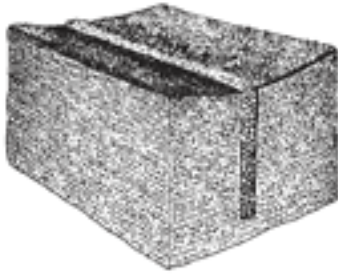


Figure 2. A French drain.

water holding capacity. On compacted and fine-textured clayey soils, attention to organic matter and the *living soil* helps create large pore space, improving drainage. For additional information, refer to fact sheets 7.720, *The Living Soil*; 7.722, *Managing Soil Tilth*; and 7.741, *Soil Amendments*.

French Drains

In some situations, a **French drain** facilitates water drainage. A French drain is a ditch-like trench, filled with rock or gravel. The rock should round the top, preventing soil from covering the drain. The trench must slope at least 1 to 3 percent, and flow to an outlet.

Surface Drainage and Runoff

To minimize surface runoff and soil erosion, sloping areas should be planted with perennial ground covers or turf. Mowed lawns or un-mowed naturalized grass areas make the best ground cover for slowing runoff. Some landscapes may also need terracing to control runoff.

To improve **surface** drainage problems, first identify, then correct the contributing factors.

Irrigation – Many surface drainage problems arise from over irrigation (too much or too often).

Compaction – Compaction is difficult to deal with, so prevention is the key. Soils around new homes are typically compacted from construction traffic. Break up the compacted layer by tilling, adding organic matter, and encouraging earthworms. For more information, refer to fact sheets 7.741, *Soil Amendments* and 7.721, *Earthworms*.

Organic mulches, like wood/bark chips, help manage compaction around trees and shrubs, perennials, small fruits, and garden paths. For details on mulching refer to fact sheet 7.760, *Mulching with Wood/Bark Chips, Grass Clippings, and Rock*. On lawns and around shade trees, lawn aeration helps manage compaction.

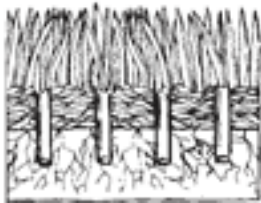


Figure 3. Lawn aeration helps manage soil compaction.

Thatch in lawn – A heavy thatch layer in a lawn slows water infiltration. To remove thatch, aerate the lawn (making enough passes that plugs are at 2-inch intervals).

Grading – It is surprising how often we forget that water only flows down hill. Sometimes the grade may be deceiving.

Low spot without an outlet – It is common to find standing water in low spots. Look at the irrigation schedule, is the area being over-watered or is irrigation running off instead of soaking in (aerate and use multiple shorter irrigation cycles)? Fill in the low spot, or install a French or underground drain with a gravity-flow outlet.

High water table – High water tables may be difficult to accommodate. Sometimes the only solution is to raise the soil level (raised bed or berm gardening).

Impervious subsoil – In Colorado, there are many soil profiles with an impervious soil layer under the surface. See sub-surface drainage below.

Sub-Surface Drainage

Sub-surface drainage problems are generally correctable only to the extent that large soil pore spaces can be increased to allow for better water movement. Use of soil drainage tiles are only effective to the extent that the soil will allow water to flow through it to the drain tile, and water in the drain tile can flow down hill to an outlet.

To improve **sub-surface** drainage problems, first identify, then correct the contributing factors.

Impervious sub-soil layer underlain with permeable soil

- If less than 2 feet thick, rip or double-dig when soil is dry. Irrigate to settle, and do final grade when soil redries.

- If greater than 2 feet thick, bore holes through layer.
- Holes are typically 4 to 6 inches in diameter, at 6 feet intervals. Fill with coarse sand or fine gravel.

Impermeable sub-soil

- Increase soil depth.
- Select shallow-rooted and water tolerant plants.
- These soils may have a salt problem.

Change in soil texture – A change in soil texture creates water movement problems. This is a common problem when soils are added to a raised-bed box or applied as a top dressing.

- Cultivate to mix layers.

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