

GardenNotes #219

Soil Drainage

Outline: Pore space controls soil drainage characteristics, page 1
Correcting drainage problems, page 2
 Managing soil tilth, page 2
 French drains, page 2
 Surface drainage and runoff, page 2
 Sub-surface drainage, page 3

Pore Space Controls Soil Drainage Characteristics

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

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

In comparison, in soils dominated by small-sized pores (i.e., compacted soils and soils with greater than 20% 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 rot in wet soils. Prolonged periods of waterlogged soil conditions lead to the decline or even death of most plants.

When water does not leach through the soil profile, salts left behind by surface evaporation accumulate and create 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 CMG GardenNotes #224, *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 affect plant growth.

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 water holding capacity. On compacted and fine-textured clayey soils, attention to organic matter and the “living soil” helps create large pores, improving drainage. For additional information, refer to CMG GardenNotes #211, *The Living Soil*; #213 *Managing Soil Tilth*; and #241, *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 1-3% and flow to an outlet. [Figure 1]

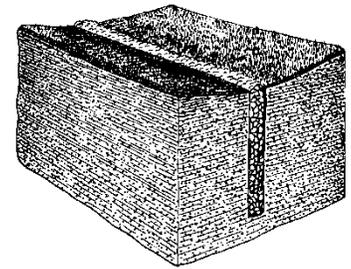


Figure 1. A French drain is a ditch-like trench filled with rock. Water must flow downhill to an outlet.

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, and then correct, the contributing factors.

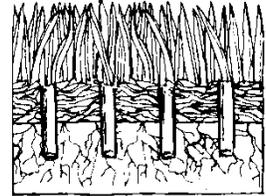
Irrigation – Many surface drainage problems arise from over-irrigation (too much and/or too often).

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 and soil organisms. For details, refer to CMG GardenNotes #2234, *Soil Amendments* and #218, *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 the CMG GardenNotes #245, *Mulching with Wood/Bark Chips, Grass Clippings, and Rock*. On lawns and around shade trees, lawn aeration helps manage compaction.

Thatch in lawn – A heavy thatch layer in a lawn slows water infiltration. Improve by aerating the lawn (making enough passes that plugs are at 2-inch intervals). (See lawn care information for additional details.) [Figure 2]

Figure 2. A heavy thatch layer slows water infiltration. Routine aeration maybe needed on compacted clayey soil to help reduce thatch and open the soil to air and water.



Grading – It is surprising how often the landscaper forgets 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 deal with. Sometimes the only solution is to raise the soil level (raised bed or berm gardening).

Impervious subsoil – In Colorado, we find 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, and 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 re-dries.
- If greater than 2 feet thick, bore holes through layer
- Holes are typically 4-6 inch 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

Additional Information – *CMG GardenNotes* on Soils, Fertilizers and Soil Amendments:

#211	Introduction to Soils	#231	Plant Nutrition
#212	The Living Soil	#232	Understanding Fertilizers
#213	Managing Soil Tilth	#233	Calculating Fertilizer Rates
#214	Estimating Soil Texture	#234	Organic Fertilizers
#215	Soil Compaction	#241	Soil Amendments
#218	Earthworms	#242	Using Manure
#219	Soil Drainage	#243	Using Compost
#221	Soil Test	#244	Cover Crops and Green Manure Crops
#222	Soil pH	#245	Mulching with Wood/Bark Chips, Grass Clippings and Rock
#223	Iron Chlorosis	#251	Asking Effective Questions About Soils
#224	Saline Soils		

Authors: David Whiting, Adrian Card and Carl Wilson: Colorado State University Extension, and Jean Breeder, Ph.D., USDA-ARS (retired)

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