



Soils, Fertilizers, and Soil Amendments



Learning Objectives

At the end of this unit, the student will be able to:

- Describe characteristics of a typical landscape soil and how it differs from native or agricultural soils.
- Describe how soil organisms directly and indirectly benefit the soil and plant growth.
- Describe management practices effective in nurturing soil organisms.
- Describe the relationship between soil *texture, structure, pore space, and tilth*.
- Describe effective management practices for sandy soils, clayey soils, and decomposed granite rocky soils.
- Describe effective management practices to prevent and reduce soil compaction.
- Describe considerations in selecting soil amendments.
- Describe considerations in selecting mulch.
- Describe considerations in selecting appropriate fertilizers.

Soils, Fertilizes, and Soil Amendments curriculum developed by David Whiting, Carl Wilson and Joel Wright (Colorado State University Extension); Catherine Moravec (former CSU Extension Employee) and Jean Reeder, Ph.D., (USDA-ARS, retired).

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References

Colorado State University Extension

Fertilizers

CMG GardenNotes

- Calculating Fertilizer Application Rates – #233
- Iron Chlorosis – #223
- Organic Fertilizers – #234
- Plant Nutrition – #231
- Soil Tests – #221
- Understanding Fertilizers – #232

Extension Fact Sheets

- Nitrogen Sources and Transformations – #0.550
- Organic Materials as Nitrogen Fertilizers – CSU-CE #0.546
- Soil Testing – #0.501
- Soil Testing – Selecting an Analytical Laboratory – #0.520
- Soil Testing – Soil Test Explanation – #0.502
- Soil Testing – Soil, water and plant testing – #0.507

Soil Amendments

CMG GardenNotes

- Cover Crops and Green Manure Crops – #244
- Making Compost – #246
- Soil Amendments – #241
- Using Compost in the Home Garden – #243
- Using Manure in the Home Garden – #242

Extension Fact Sheets

- Choosing A Soil Amendment – #7.235
- Composting Yard Waste – #7.212
- Preventing E. coli From Garden to Plate – #9.369

Soil Management

CMG GardenNotes

- Asking Effective Questions about Soils – #251
- Earthworms – #218
- Estimating Soil Texture – #214
- Introduction to Soils – #211
- Iron Chlorosis – #223
- Managing Soil Tilth – #213
- Mulches for the Vegetable Garden – #715

- Mulching with Wood/Bark Chips, Grass Clippings, and Rock – #245
- Soil Compaction – #215
- Soil Drainage – #219
- Soil pH – #222
- Soil Tests – #221
- The Living Soil – #212

Extension Fact Sheets

- Expansive Soils – Landscaping on Expansive Soils – #7.236
- Landscaping on Expansive Soils – #7.236
- Mulches for Home Grounds – #7.214
- Salt – Diagnosing Saline and Sodic Soil Problems – #0.521
- Salt – Managing Saline Soils – #0.503
- Salt – Managing Sodic Soils – #0.504
- Soil Testing – #0.501
- Soil Testing – Selecting an Analytical Laboratory – #0.520
- Soil Testing – Soil Test Explanation – #0.502
- Soil Testing – Soil, Water and Plant Testing – #0.507

Books

- *Urban Soil Primer*. The Natural Resources Conservation Service, U.S. Department of Agriculture. 2005. Available on-line at <http://soils.usda.gov/use/urban/primer.htm>
- *Urban Soils: Applications and Practices*. Phillip J Craul. John Wiley & Sons Publishing. 1999. ISBN: 0471189030

Review Questions

Introduction To Soils

1. Explain how soils may vary horizontally and vertically. Describe characteristics of the A, B and C soil horizons.
2. Describe how landscape soils differ from agricultural and native soils.
3. Describe the typical percentage of air, water, organic matter, and mineral solids for a native soil. How does this change for a compacted landscape soil?

The Living Soil

4. Describe how organisms directly benefit the soil and plant growth.
5. Describe how organisms indirectly benefit the soil and plant growth.
6. Should gardeners inoculate their soil with rhizobia, mycorrhizae and decomposers?
7. What makes up the soil organic matter? Give a soil scientist's definition of *humus*. What are the benefits of humus?
8. How does a gardener enhance the *living soil*?

Managing Soil Tilth

9. Define the terms soil texture, soil structure, and soil profile. Explain how they are interrelated.
10. Describe characteristics of the following soil types:
 - a. Coarse-textured, sandy soil
 - b. Fine-textured, clayey soil
 - c. Gravelly and decomposed granite soils
11. Explain what is significant about large pore spaces and small pore spaces?
12. Describe how water moves through small pore spaces and large pore spaces.
13. In relation to root growth, air infiltration, and water movement, what happens when the soil has a texture interface?

14. Explain management of fine-textured, clayey soils, coarse-textured, sandy soils, and gravelly and decomposed granite soils.

Soil Compaction

15. In terms of pore space, water movement, and air infiltration, describe soil compaction.
16. List techniques to prevent soil compaction. List techniques to reduce soil compaction.

Soil Drainage Problems

17. Describe drainage problems as related to *pore space*, *surface runoff*, and *leaching*.
18. Why is it so important to identify the causes of a drainage problem before attempting corrections?
19. List common causes of surface drainage problems with possible corrective actions. List common causes of sub-surface drainage problems with possible corrective actions.

Soil Tests

20. List situations when a soil test would be helpful. List examples of plant growth problems for which a soil test would not be helpful.
21. Describe the steps to a soil test.
22. Where does one find a list of soil testing laboratories?

pH and Iron Chlorosis

23. What does soil pH measure? What is an acceptable range for most plants? What are the implications for gardening in Colorado?
24. Describe the function of the "free lime" vinegar test. Can the pH of an alkaline soil be effectively lowered?
25. Describe the symptoms of iron chlorosis. What other situations can be confused with iron chlorosis? How can you tell them apart?
26. List primary factors that contribute to iron chlorosis.

27. What simple method identifies soils prone to iron chlorosis problems?
28. Describe the limitations and application criteria for the following iron treatments.
- Soil applications of sulfur
 - Soil applications of iron sulfate plus sulfur
 - Soil applications of iron chelates
 - Foliar sprays
 - Trunk injections
39. What does *grade* or *analysis* indicate about a fertilizer? What is a fertilizer *ratio*?
40. What is a fertilizer *formulation*? What is a *complete* fertilizer? When applying a complete fertilizer, what is the application rate always based on?
41. What is the routine application rate for nitrogen fertilizer? How does it change based on soil organic matter? What is the routine application rate when using a) ammonium sulfate, 21-0-0, b) ammonium nitrate, 34-0-0, and c) urea, 45-0-0 fertilizers?

Saline Soils

29. Describe plant problems associated with excess soil salt levels.
30. List sources/causes of high soil salts.
31. Describe the leaching process for salty soils. What about situations when excess salts cannot be leached out?
32. Describe other management strategies for salty soils.

Plant Nutrition

33. Define *plant nutrient* and *fertilizer*.
34. Will addition of nitrogen fertilizer help plant growth when soil compaction is the limiting factor? Explain.
35. What are the typical symptoms of nitrogen deficiency? What are the problems associated with excessive nitrogen fertilization?
36. In Colorado soils, under what situations will phosphorus levels likely be adequate and likely be deficient? How does one determine the need for phosphate fertilizer?
37. In Colorado soils, under what situations will potassium levels likely be adequate and likely be deficient? How does one determine the need for potash fertilizers?

Fertilizers

38. Define the following terms: fertilizer, organic fertilizer, certified organic fertilizer, and soil amendment.

42. In relation to phosphorus water pollution, what happens to phosphate fertilizers applied 1) to a lawn or garden area, and 2) over-spread onto the street, sidewalk, or driveway? According to the research base, what is the major source of phosphate water pollution from the landscape setting?

Soil Amendments

43. Define *soil amendment*, *mulch*, and *compost*.
44. Explain how organic soil amendments improve a clayey soil and a sandy soil.
45. Describe considerations in selecting a soil amendment as it relates to the following:
- a. Desired results
 - b. Potential for routine application
 - c. Longevity
 - d. Salt
46. What is the routine application rate for soil amendments? What is the precaution about adding additional amounts?
47. Explain the use and limitations of using manure as it relates to:
- *E. coli*
 - Nitrogen release rates
 - Salt
 - Weed seeds
48. What are cover crops and green manure crops? List benefits of cover cropping and green manuring.