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.

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

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- Extension programs are available to all without discrimination.
- No endorsement of products named is intended, nor is criticism implied of products not mentioned.

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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
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?


Soil Compaction

15. Describe soil compaction in terms of pore space, water movement, and air infiltration.

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?


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

**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.

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?

42. Address your answers relative 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? 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 a precaution about adding additional amounts?

47. Explain the use and limitations of using manure as it relates to:
   o E. coli
   o Nitrogen release rates
   o Salt
   o Weed seeds

48. What are cover crops and green manure crops? List benefits of cover cropping and green manuring.