

7 December 2001

(126 points total)

I. Single-Answer Multiple Choice (2 points each): Circle the **one** solution that correctly answers each question or completes each sentence.

1. Which of the following is not a soil order in U.S. Soil Taxonomy?
 - a. Ultisols.
 - b. Alfisols.
 - c. Andisols.
 - d. Aridisols.
 - e. None of the above.

2. For the production of crops, which would likely be the most desirable?
 - a. prime farmland
 - b. Mollisols
 - c. Alfisols
 - d. unique farmland

3. With continued weathering and leaching, one soil order can become another. Which set of soil orders is from younger soils to older soils?
 - a. Mollisols, Inceptisols, Alfisols.
 - b. Inceptisols, Ultisols, Alfisols.
 - c. Aridisols, Andisols, Spodosols.
 - d. Entisols, Inceptisols, Alfisols.

4. Soils are classified in Soil Taxonomy based on
 - a. their potential for crop production.
 - b. their suitability for soil conservation practices.
 - c. their physical, chemical, and biological properties.
 - d. all of the above.
 - e. both b and c.

5. Compared to synthetic (inorganic) fertilizers, organic fertilizers
 - a. generally have higher nutrient contents per unit weight than do chemical fertilizers.
 - b. generally contribute similar amounts of organic matter to the soil.
 - c. generally must be decomposed to inorganic nutrient ions before nutrient absorption can take place by plants.
 - d. all of the above.
 - e. a and c.

6. Advantages of synthetic fertilizers include
 - a. their relative ease to apply.
 - b. their ability to increase crop yields.
 - c. their quick availability to plants once applied.
 - d. all of the above.
 - e. both a and b.

7. The prominent characteristic of a spodic horizon is the accumulation of
 - a. humus, Fe, and Al.
 - b. oxide clays or sesquioxides.

- c. silicate clays.
 - d. calcium carbonate.
8. Which statement about the USDA Land Capability Classification System is not true?
- a. Classes I and II are generally considered prime farmland.
 - b. Class III requires less conservation practices than Class IV.
 - c. Class II has more soil limitations than Class III.
 - d. There are 8 classes of land: Class I through Class VIII.
9. When looking at a response curve of wheat yield to nitrogen, the yield that produces the most profit is called the
- a. maximum yield.
 - b. optimum yield.
 - c. sufficient yield.
 - d. toxic yield.
10. If a bag of fertilizer is labeled “10-10-10”, then it has
- a. 10% N, 10% P, and 10% S.
 - b. 10% N, 10% P₂O₅, and 10% K₂O.
 - c. 10% N, 10% P₂O, and 10% K₂O₅.
 - d. 10% N, 10% H₃PO₄, and 10% K₂SO₄.
 - e. none of the above.
11. Concerning macronutrients and micronutrients,
- a. both are equally essential for plants.
 - b. macronutrients are needed in larger quantities than micronutrients.
 - c. iron is a macronutrient and boron is a micronutrient.
 - d. all of the above.
 - e. both a and b.
12. For plants to take up nutrients from the soil solution, they must provide energy which comes from
- a. transpiration.
 - b. evapotranspiration.
 - c. photosynthesis.
 - d. respiration.
13. When an organic fertilizer is added to a soil, the plants growing in that soil depend on what process to make the nutrients in the organic fertilizer available?
- a. nitrification.
 - b. immobilization.
 - c. mineralization.
 - d. nitrogen fixation.
14. Which of the following soil orders has the most highly weathered soils?
- a. Oxisols
 - b. Ultisols
 - c. Alfisols
 - d. Vertisols
 - e. Alfisols
15. Prime farmland

- a. can be defined based on land classification systems that use soil and climatic characteristics as their criteria.
 - b. is usually the poorest land on which to build houses.
 - c. is the best agricultural land.
 - d. all of the above.
 - e. both a and c.
16. Which of the following soil orders can be found in Washington State?
- a. Andisols
 - b. Aridisols
 - c. Mollisols
 - d. All of the above
 - e. Both a and c
17. A sample of a loam surface soil is taken from a farmer's field and analyzed in the lab. The lab results indicate a CEC of 15 cmol/kg soil and the following concentrations of exchangeable cations: $\text{Ca}^{+2} = 6 \text{ cmol}_c/\text{kg}$; $\text{Mg}^{+2} = 2 \text{ cmol}_c/\text{kg}$; $\text{Al}^{+3} = 3 \text{ cmol}_c/\text{kg}$; $\text{H}^+ = 2 \text{ cmol}_c/\text{kg}$; $\text{K}^+ = 2 \text{ cmol}_c/\text{kg}$. The percentage base saturation is
- a. 86.7%
 - b. 66.7%
 - c. 53.3%
 - d. 46.7%
 - e. 33.3%
18. Shrink-swell clays are an important constituent of which soil order?
- a. Spodosols
 - b. Inceptisols
 - c. Vertisols
 - d. Andisols
 - e. Alfisols
19. Which agricultural enterprise would be very dependent (vs. moderately or slightly dependent where the enterprise relies more on commercial fertilizers) on mineralization and weathering to supply plants with essential nutrients?
- a. Commercial corn and soybean farm
 - b. Christmas tree farm
 - c. Large tobacco farm
 - d. Commercial fruit orchard
 - e. b and c
20. Which diagnostic horizon is most similar to a Bt horizon?
- a. Oxic
 - b. Cambic
 - c. Argillic
 - d. Mollic
21. Class VIII lands
- a. are used to grow trees.
 - b. are used for recreation and wildlife.
 - c. are used for cultivating crops.
 - d. all of the above.
 - e. both a and c.

22. Soils with more than 20 percent organic matter are classified as
- Histosols.
 - Humusols.
 - Spodosols.
 - Vertisols.
23. The optimum pH range for soluble nutrients in the soil is between
- 5 and 7.
 - 6 and 7.
 - 6 and 8.
 - 8 and 9.
24. A common inorganic fertilizer carrier is
- urea.
 - superphosphate.
 - blood meal.
 - all of the above.
 - both a and b.
25. Essential nutrient ions for plant growth include
- NO_3^- .
 - Si^{+4} .
 - Al^{+3} .
 - all of the above.
 - a and b.
26. An example of an essential macronutrient to plant growth is
- Mn
 - Ca
 - K
 - all of the above.
 - b and c.
27. In the general use of synthetic fertilizers, the lowest expected fertilizer efficiency would be for
- nitrogen.
 - phosphorus.
 - potassium
28. A 150-pound bag of 10-10-10 fertilizer will supply how much K? (The molecular weight of K is 39 and the molecular weight of O is 16.)
- 6.2 pounds
 - 12.5 pounds
 - 15 pounds
 - 125 pounds

II. **Multiple-Answer Multiple Choice** (1 point for each answer): Each problem set below consists of one problem with four possible answers. Each problem has at least one correct answer listed for its solution but may have two,

three, or all four correct answers. Mark "T" (for true) for each answer that solves the problem correctly and "F" (for false) for each answer that answers the problem incorrectly.

29-32. Concerning fertilizers,

- ___ 29. organic fertilizers can improve soil structure.
- ___ 30. yearly applications of fertilizers to a field will progressively become larger.
- ___ 31. synthetic fertilizers usually increase organic matter content in the soil.
- ___ 32. organic fertilizers can increase the water holding capacity of the soil.

33-36. Mechanisms for improving fertilizer efficiency include

- ___ 33. correct timing of fertilizer applications.
- ___ 34. proper placement of fertilizers.
- ___ 35. using only organic fertilizers.
- ___ 36. regular soil testing.

37-40. Concerning soil fertility and plant nutrition,

- ___ 37. generally a large portion of the total amount of a nutrient present in the soil will be in forms available for plant uptake.
- ___ 38. there are 16 essential elements for plant growth.
- ___ 39. research has shown that each essential element must be present in a specific concentration range for optimum plant growth.
- ___ 40. nutrients are absorbed by plants primarily as ions.

41-44. Unavailable forms of nutrient elements for plants include those ions in

- ___ 41. primary minerals.
- ___ 42. the soil solution.
- ___ 43. large organic particles.
- ___ 44. adsorbed form on surfaces of humus.

45-48. A good choice of fertilizer is one that

- ___ 45. contains more than the needed nutrients.
- ___ 46. releases nutrients slowly.
- ___ 47. can be obtained at the right price.
- ___ 48. has acceptable side effects.

49-52. Concerning fertilizers,

- ___ 49. organic and inorganic fertilizers have similar effects on soil quality.
- ___ 50. organic fertilizers usually release 100% of their nutrients in the first two years.
- ___ 51. most are mined from renewable sources.
- ___ 52. inorganic fertilizers are chemical compounds containing readily available plant nutrients.

53-56. Nutrient uptake by plants

- ___ 53. is basically ions passively soaking in root cells along with soil water.

- ___ 54. requires energy to move ions across a semipermeable membrane and release them in the interior of the root cell.
- ___ 55. can be explained by the nutrient-carrier hypothesis.
- ___ 56. is selective so that specific nutrients can be preferentially absorbed over others present in the soil solution.
- 57-60. Concerning percentage base saturation,
- ___ 57. it is optimal for plant growth when 80% or more.
- ___ 58. a soil with a sandy loam texture can have a higher % B.S. than a soil with a clay loam texture but have fewer exchangeable base-forming cations.
- ___ 59. Two soils with the same textures can have the same CEC but different %B.S.
- ___ 60. generally the higher the pH in a soil, the higher the %B.S.
- 61-64. The Important Farmlands Classification System
- ___ 61. categorizes lands into eight classes.
- ___ 62. identifies unique farmland based on soil and climatic characteristics alone.
- ___ 63. defines prime farmland based on specific soil and climatic criteria.
- ___ 64. identifies locally important farmlands.
- 65-68. Mollisols
- ___ 65. are the dominant soil order in the Palouse.
- ___ 66. represent the largest area of all soil orders in the world.
- ___ 67. are the most naturally productive agricultural soil
- ___ 68. have to have a mollic epipedon.

III. Fill-Ins (2 points each space, except where noted): Fill-in each space below with the correct word or words.

69. The soil order with the most land area in the U.S. is _____, whereas the soil order with the least amount of land area in the U.S. is _____. Mollisols; Oxisols
70. The six categories of U.S. Soil Taxonomy are the following: order, suborder, _____, _____, family, and series. great group; subgroup;
71. The three ways in which nutrients are supplied to the root surface are (1) root interception, (2) _____, and (3) _____. mass flow; diffusion
72. An _____ element is a chemical element required for the normal growth of plants. Essential
73. Most _____ fertilizers dissolve readily in water and are immediately available to plants for uptake. inorganic or synthetic
74. When applying an organic fertilizer, the rate of application is usually governed by the amount of the following nutrient: _____. nitrogen
75. For a nutrient to be absorbed by plants, it must be both _____ available and _____ available. Chemically; positionally

76. The nutrient content and the _____ content of organic fertilizers vary widely among the different carriers.
moisture

(6 pts) 77. A grower has a field producing corn and wants to produce 6000 kg/ha of grain in the coming year. This yield requires the application of 120 kg/ha of available nitrogen, which she expects to obtain from wet feedlot cattle manure containing 1.9% total N and 0.1% mineral N (ammonium and nitrate) on a dry-weight basis. This manure is 75% water and 25% solids. The rate of release of nitrogen from this manure in the first year is 40%. Calculate the amount of wet manure in Mg or kg to apply in one hectare (ha). No credit will be given unless you show your work! 58.5 Mg wet manure/ ha or 58,500 kg wet manure/ha

$$1.9\% \text{ total N} - 0.1\% \text{ mineral N} = 1.8\% \text{ organic N}$$

$$1000 \text{ kg dry manure} \times 0.018 = 18 \text{ kg N/Mg dry manure} \quad (1000 \text{ kg} = 1 \text{ Mg})$$

$$1000 \times 0.001 = 1 \text{ kg available N/Mg dry manure}$$

$$18 \times 0.4 = 7.2 \text{ kg available N/Mg dry manure}$$

$$\text{Total available N} = 1 + 7.2 = 8.2 \text{ kg N/Mg dry manure}$$

$$120 \text{ kg N per ha} / 8.2 \text{ kg N per Mg dry manure} = 14.63 \text{ Mg dry manure/ha}$$

$$14.63 / 0.25 = 58.5 \text{ Mg wet manure/ha or } 58,500 \text{ kg wet manure/ha}$$