

## Study Questions Exam 4

1. To what does the greenhouse effect refer? List those greenhouse gases that arise from soil. What effects do deforestation, land drainage and tillage have on soil organic matter and, in turn, on CO<sub>2</sub> loading into the atmosphere?
2. Decomposition of organic matter is faster under anaerobic conditions  
(True / False).
3. The C / N ratio of wheat straw is larger than the C / N ratio of clover. Which is microbially decomposed faster?
4. Depression of soluble soil N is greatest following the incorporation of plant residues of which C / N ratio?  
A) 640 / 1                      B) 160 / 1                      C) 40 / 1                      D) 10 / 1
5. List the three humic substances in order of increasing molecular weight and resistance to decomposition.
6. Give three benefits of soil organic matter to plants.
7. What effect does adsorption of soil organic matter onto soil mineral solids have on the decomposition rate of soil organic matter?
8. Give three effects of soil organic matter on soil chemical and physical properties.
9. Soil organic matter leads to soil aggregation and, therefore, enhances infiltration and limits runoff and erosion (True / False).
10. The organic C content of soil A is 1 % and the organic C of soil B is 2 %. All else being equal, through which soil would a pesticide more quickly move?
11. Under which climate would one expect the greatest accumulation of soil organic matter?  
A) Cool Dry                      B) Cool Wet                      C) Hot Dry                      D) Hot Wet
12. Under which of the below conditions would one expect to find the highest soil organic matter content?  
A) Forest Well-drained                      B) Forest Poorly-drained                      C) Prairie Well-drained                      D) Prairie Poorly-drained
13. What effect does tillage have on the content of organic matter in soil?

14. Give a couple of general physical characteristics of organic soils.
15. What are two problems encountered when using an organic soil for agricultural production?
16. In what inorganic forms is N taken-up by plants?
17. What is chlorosis? Would chlorosis due to N deficiency be first seen on young or old growth?
18. Most soil N is in inorganic forms like  $\text{NO}_3^-$  (nitrate) or  $\text{NH}_4^+$  (ammonium) (True / False).
19. If a soil contains 2 % organic matter, the organic matter is 5 % N by weight and 2 % of the organic matter is decomposed annually, how many kgs of N are mineralized per HFS annually? Ignore immobilization and assume 2,000,000 kg / HFS.
20. What is  $\text{NH}_4^+$  fixation? Rank vermiculite, smectite and illite in order of increasing tendency for  $\text{NH}_4^+$  fixation.
21. Given the equilibrium  $\text{NH}_4^+ + \text{OH}^- = \text{NH}_3 + \text{H}_2\text{O}$  under which set of conditions would one expect the greatest amount of  $\text{NH}_3$  volatilization?
- |                            |                            |                        |                        |
|----------------------------|----------------------------|------------------------|------------------------|
| A) alkaline pH<br>wet soil | B) alkaline pH<br>dry soil | C) acid pH<br>wet soil | D) acid pH<br>dry soil |
|----------------------------|----------------------------|------------------------|------------------------|
22. Nitrification is carried out in two steps, first to nitrite, then to nitrate, by different chemautotrophs
- $\text{NH}_4^+ + 3/2 \text{O}_2 \rightarrow \text{NO}_2^- + 2\text{H}^+ + \text{H}_2\text{O}$  A
- $\text{NO}_2^- + 1/2 \text{O}_2 \rightarrow \text{NO}_3^-$  B
- What organisms are responsible for step A and step B? Does nitrification typically occur quickly after addition of ammonium to soil?
23. What are the environmental concerns over nitrate loading in ground and surface water?
24. The series of reactions  $\text{NO}_3^- \rightarrow \text{NO}_2^- \rightarrow \text{NO} \rightarrow \text{N}_2\text{O} \rightarrow \text{N}_2$  describes what N transformation process?
25. Under which set of conditions would you expect the above process to proceed fastest?
- | Factor               | Set A   | Set B   | Set C     | Set D     |
|----------------------|---------|---------|-----------|-----------|
| Soil aeration status | aerobic | aerobic | anaerobic | anaerobic |
| Soil organic matter  | high    | low     | high      | low       |
26. What is biological N fixation? Name the enzyme complex responsible.

27. Why is biological N fixation such an important process?
28. Biological N fixation is favored by high concentration of inorganic N in the soil (True / False).
29. Name two genera of bacteria involved with symbiotic N fixation in legumes.
30. In what inorganic form is S taken up by plant roots?
31. Conversion of  $S_2^-$  (sulfide) to  $SO_4^{2-}$  (sulfate) occurs in anaerobic soil (True / False).
32. Conversion of  $S_2^-$  to  $SO_4^{2-}$  is acidifying (True / False).
33. List a couple of environmental problems associated with S oxidation?
34. What three macronutrients are usually the most limiting to plant growth. Which among these is usually the most limiting? Next?
35. In what inorganic form (or forms) is P taken up by plant roots?
36. Why are P concentrations in the soil solution typically low?
37. What fixation reactions does phosphate undergo in acid soil? Slightly acid to neutral soil? Alkaline soil?
38. Explain why mycorrhizae enhance P nutrition of plants.
39. What soil pH range is optimal for P availability?
40. What major advantage does localized (banded) placement of P fertilizer offer?
41. Which macronutrient, N, P or K is most abundant in soil?
42. List the three general inorganic forms in which K is found in soil. Which form is most abundant? Which is most available for uptake by plants?
43. Which aluminosilicate clay minerals fix  $K^+$ ?
44. What is meant by luxury consumption?
45. Explain why application of 10 times the recommended amount of a micronutrient may not be such a good idea.
46. Why are deficiency symptoms of most micronutrients first seen on young growth?
47. What effect does liming have on Mo availability for plant uptake?

48. What effect does liming have on Fe availability for plant uptake? Why?
49. Under which of the below soil conditions is the soil solution concentration of Fe and Mn greatest? Why?
- High pH and dry
  - High pH and wet
  - Low pH and dry
  - Low pH and wet
50. Why might the soil solution concentration of P increase under waterlogged conditions?
51. What is a chelate and why are chelates used to supply micronutrients?
52. List two ways fixation of micronutrients added to soil is either reduced or avoided.
53. What soil pH range is optimal for micronutrient availability?
54. What soil and management conditions are associated with micronutrient deficiencies.