Agriculture Review

Soil Science (Soil Chemistry and Fertility) Review

1. Which of the following refers to the capacity of soil to hold and exchange positively charged ions?

A. Anion Exchange Capacity

B. Base Saturation

C. Cation Exchange Capacity

D. Electrical Conductivity

2. What is the primary agricultural amendment used to raise the pH of acidic soils?

A. Gypsum

B. Elemental Sulfur

C. Agricultural Lime

D. Ammonium Sulfate

3. Which nutrient deficiency typically causes interveinal chlorosis in the older leaves of plants?

A. Iron

B. Nitrogen

C. Magnesium

D. Calcium

4. What type of soil acidity is represented by the hydrogen and aluminum ions present in the soil solution?

A. Reserve acidity

B. Active acidity

C. Exchangeable acidity

D. Residual acidity

5. Which clay mineral typically exhibits the lowest Cation Exchange Capacity (CEC)?

A. Montmorillonite

B. Vermiculite

C. Illite

D. Kaolinite

6. Which of the following essential plant nutrients is classified as a micronutrient?

A. Magnesium

B. Sulfur

C. Zinc

D. Potassium

7. The percentage of the cation exchange capacity occupied by basic cations such as calcium, magnesium, potassium, and sodium is known as:

A. Exchangeable sodium percentage

B. Percentage base saturation

C. Buffering capacity

D. Anion exchange capacity

8. Which soil amendment is primarily used to reclaim sodic soils by displacing sodium with calcium?

A. Dolomite

B. Gypsum

C. Urea

D. Calcitic Lime

9. A deficiency of which element causes general yellowing (chlorosis) starting at the older leaves and progressing to the whole plant?

A. Nitrogen

B. Sulfur

C. Iron

D. Boron

10. What is the form of nitrogen most commonly absorbed by plants in well-aerated upland soils?

A. Ammonium (NH_4^+)

B. Nitrite (NO_2^-)

C. Nitrate (NO_3^-)

D. Nitrogen gas (N_2)

11. Purpling or reddish coloration on the undersides of older leaves is a classic deficiency symptom of which nutrient?

A. Potassium

B. Phosphorus

C. Calcium

D. Molybdenum

12. Which of the following is considered a basic cation in soil chemistry?

A. Hydrogen (H+)

B. Aluminum (Al3+)

C. Iron (Fe3+)

D. Potassium (K+)

13. What is the optimal soil pH range for the maximum availability of most essential plant nutrients?

A. 4.5 - 5.5

B. 6.0 - 7.0

C. 7.5 - 8.5

D. 8.5 - 9.5

14. Interveinal chlorosis appearing first on younger leaves is typically associated with a deficiency in:

A. Iron

B. Magnesium

C. Nitrogen

D. Potassium

15. Which of the following components of soil organic matter contributes most significantly to soil CEC?

A. Cellulose

B. Lignin

C. Humus

D. Hemicellulose

16. Which macronutrient is primarily responsible for stomatal regulation and osmoregulation in plants?

A. Phosphorus

B. Potassium

C. Calcium

D. Sulfur

17. Blossom end rot in tomatoes and tip burn in lettuce are physiological disorders caused by a deficiency in which relatively immobile nutrient?

A. Copper

B. Calcium

C. Magnesium

D. Manganese

18. Which of the following fertilizers is known to have an acidifying effect on the soil over time?

A. Ammonium sulfate

B. Calcium nitrate

C. Potassium chloride

D. Rock phosphate

19. In highly weathered tropical soils, which property is often higher compared to temperate soils due to the abundance of iron and aluminum oxides?

A. Base Saturation

B. Cation Exchange Capacity

C. Anion Exchange Capacity

D. Electrical Conductivity

20. Which of the following is an acidic cation?

A. Calcium (Ca^{2+})

B. Magnesium (Mg^{2+})

C. Sodium (Na^{+})

D. Aluminum (Al^{3+})

21. What type of lime contains both calcium carbonate and magnesium carbonate?

A. Calcitic lime

B. Quicklime

C. Slaked lime

D. Dolomitic lime

22. Which essential element is a structural component of the chlorophyll molecule?

A. Iron

B. Magnesium

C. Sulfur

D. Zinc

23. Marginal necrosis or 'scorching' along the edges of older leaves indicates a deficiency of which nutrient?

A. Phosphorus

B. Potassium

C. Nitrogen

D. Boron

24. Which soil property acts as a resistance to sudden changes in soil pH?

A. Base saturation

B. Flocculation

C. Buffering capacity

D. Salinization

25. In strongly acidic soils (pH < 5.0), phosphorus availability is severely reduced primarily due to fixation by:

A. Calcium and Magnesium

B. Iron and Aluminum

C. Sodium and Potassium

D. Manganese and Zinc

26. Which essential plant nutrient is taken up as either a divalent cation (Ca^{2+}) or not at all?

A. Nitrogen

B. Phosphorus

C. Calcium

D. Boron

27. What happens to the Cation Exchange Capacity (CEC) of soil organic matter as soil pH increases?

A. It decreases

B. It remains constant

C. It increases

D. It becomes zero

28. A plant exhibiting 'whiptail' disease in cauliflower is likely deficient in which micronutrient?

A. Zinc

B. Molybdenum

C. Copper

D. Iron

29. Which form of soil acidity represents the H+ and Al3+ ions bound to the surfaces of soil colloids?

A. Active acidity

B. Reserve acidity

C. Free acidity

D. Neutral acidity

30. Sulfur deficiency symptoms typically appear first on which part of the plant?

A. Older leaves

B. Younger leaves

C. Roots only

D. Stems only

31. Which element is essential for nitrogen fixation by root nodule bacteria in legumes?

A. Cobalt

B. Molybdenum

C. Chlorine

D. Sodium

32. Soil colloids generally carry what type of net electrical charge?

A. Positive

B. Negative

C. Neutral

D. Variable only

33. Which essential nutrient is involved primarily in the transport of sugars across cell membranes?

A. Zinc

B. Manganese

C. Boron

D. Copper

34. The chemical formula for Agricultural Lime is:

A. CaO

B. Ca(OH)2

C. CaSO4

D. CaCO3

35. Which among the following nutrients is considered a macronutrient because it is required in large quantities?

A. Manganese

B. Chlorine

C. Sulfur

D. Iron

36. Which of the following clay minerals is a 2:1 expanding type, resulting in significant shrinking and swelling?

A. Kaolinite

B. Montmorillonite

C. Illite

D. Chlorite

37. If a soil has a total Cation Exchange Capacity of 20 cmol(+)/kg and the sum of exchangeable bases is 15 cmol(+)/kg, what is the percentage base saturation?

A. 25%

B. 50%

C. 75%

D. 100%

38. How does the application of gypsum ($CaSO_4 \cdot 2H_2O$) affect the pH of a non-sodic, neutral soil?

A. It significantly raises the pH.

B. It significantly lowers the pH.

C. It has little to no direct effect on soil pH.

D. It buffers the pH strictly at 7.0.

39. Calcareous soils, characterized by the presence of free calcium carbonate, are most likely to induce a deficiency of which set of nutrients?

A. N, P, K

B. Ca, Mg, S

C. Fe, Zn, Mn

D. Mo, Cl, B

40. Isomorphic substitution in phyllosilicate clay minerals primarily results in which of the following?

A. pH-dependent positive charge

B. Permanent negative charge

C. Increased soil acidity

D. Decreased surface area

41. Which process describes the conversion of organic nitrogen into inorganic ammonium (NH_4^+) by soil microorganisms?

A. Nitrification

B. Denitrification

C. Immobilization

D. Mineralization

42. In highly alkaline soils (pH > 8.5), phosphorus availability is restricted due to its precipitation with which element?

A. Iron

B. Aluminum

C. Calcium

D. Hydrogen

43. When measuring soil pH using a 1:1 soil-to-water ratio versus a 1:1 soil-to-1N KCl ratio, what is the typical result?

A. pH in water is lower than pH in KCl

B. pH in water is higher than pH in KCl

C. Both methods yield identical pH values

D. pH in KCl becomes highly alkaline

44. Which condition must be met to classify an element as essential according to Arnon and Stout's criteria?

A. The element must be present in large quantities in the soil.

B. The plant cannot complete its life cycle without the element.

C. The element enhances plant growth but can be replaced by another.

D. The element must improve the plant's resistance to pests.

45. A plant's continued uptake of a nutrient (like Potassium) beyond what is needed for maximum yield, without further increase in growth, is termed:

A. Antagonism

B. Synergism

C. Luxury consumption

D. Nutrient toxicity

46. Which of the following equations accurately depicts the generation of active acidity from exchangeable acidity?

A. $Al3+(clay) + 3H2O \rightarrow Al(OH)3 + 3H+$

B. $Ca2+(clay) + 2H2O \rightarrow Ca(OH)2 + 2H+$

C. $CO2 + H2O \rightarrow H2CO3 \rightarrow HCO3- + H+$

D. $NH4+ + 2O2 \rightarrow NO3- + H2O + 2H+$

47. The Relative Neutralizing Value (RNV) or Effective Calcium Carbonate Equivalent (ECCE) of a liming material is determined by its Calcium Carbonate Equivalent (CCE) and its:

A. Solubility product

B. Fineness factor (particle size)

C. Moisture content

D. Base saturation

48. Calculate the exact milliequivalents per 100 grams (meq/100g) of Calcium (Ca^{2+}, atomic weight = 40) if a soil contains 400 mg of exchangeable Ca per kg of soil.

A. 1.0 meq/100g

B. 2.0 meq/100g

C. 0.2 meq/100g

D. 4.0 meq/100g

49. In evaluating lime requirement, why is the measurement of buffer pH more critical than water pH?

A. Buffer pH measures active acidity which directly harms plants.

B. Buffer pH determines both active and reserve acidity to calculate total neutralization needed.

C. Buffer pH solely isolates the specific toxic aluminum concentration.

D. Buffer pH estimates the soil's organic matter content for nitrogen release.

50. If an agronomist recommends 4 tons per hectare of pure $CaCO_3$ (CCE = 100%) to neutralize a severely acidic soil, how many tons of dolomitic limestone with a CCE of 109% would theoretically be required to achieve the exact same neutralizing effect?

A. 3.67 tons

B. 4.00 tons

C. 4.36 tons

D. 5.09 tons

Answer Key

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1. C
2. C
3. C
4. B
5. D
6. C
7. B
8. B
9. A
10. C
11. B
12. D
13. B
14. A
15. C
16. B
17. B
18. A
19. C
20. D
21. D
22. B
23. B
24. C
25. B
26. C
27. C
28. B
29. B
30. B
31. B
32. B
33. C
34. D
35. C
36. B
37. C
38. C
39. C
40. B
41. D
42. C
43. B
44. B
45. C
46. A
47. B
48. C
49. B
50. A