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1st SEMESTER 2019/2020

UNIVERSITY OF ESWATINI
MAIN EXAMINATION
PROGRAMME: BACHELOR OF SCIENCE IN AGRONOMY & HORTICULTURE, LEVEL 3

COURSE CODE:	**CPR 301**
TITLE OF PAPER:	**CROP NUTRITION**
TIME ALLOWED:	**2 HOURS**
INSTRUCTIONS:	**Answer ALL Questions in Sections A & B and any TWO Questions in Section C**

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

Section A:

True-False Questions

1. In alkaline pH soils, the following nutrients are available for plant uptake Fe, Mn, Zn, Cu, and Mg.
2. Nickel is an essential element for plant growth.
3. A beneficial element is one that is essential for limited groups of plants.
4. Deficiency symptoms of phloem-immobile elements such as potassium and nitrogen appear first in older leaves.
5. The C horizon of soil is also called the subsoil.
6. Loam soils, the best agricultural soils, contain sand, silt, and clay particles.
7. Wilted plants in a soil at its permanent wilting percentage will not recover even when placed in a humid chamber.
8. Clay particles have an excess of surface negative charges, and humus has an excess of positive charges.
9. Molybdenum is an immobile nutrient element.
10. In the process of ammonification, ammonium ions are used to form amino acids.
11. Organic matter is not important in soil fertility.
12. Phosphorus is only available in soil solutions in acidic pH soils.
13. Bacteria that induce nodule formation in clover will also induce nodule formation in soybeans.
14. Some nitrogen-fixing symbioses involve plants other than legumes.
15. Excess of Fe^{2+} in soil solution is found in oxidized soils.
16. Mass flow is driven by driven by plant transpiration, but not a major path way for P movement into plants.
17. In most soils, most of the phosphorus is present in forms that are not available to the plant.
18. A bag of fertilizer labeled 20:10:5 contains 20% phosphorus.
19. Some plants accumulate toxins to such levels that their foliage becomes toxic.
20. Ammonium, Boron, and Phosphorus can grouped as immobile nutrients

[10 Marks]

Section B: Multiple-Choice Questions

[30 Marks}

Instruction: Each question in this section is 1 mark

1. Which of the following is NOT an essential element?
   a.molybdenum
   b.copper
   c.iron
   d.aluminum
   e.chlorine

2. A micronutrient is a plant nutrient required in concentrations equal to or less than _____ mg per kg of dry matter.
   a.1
   b.10
   c.100
   d.1000
   e.10,000

3. Which of the following is NOT a micronutrient?
   a.zinc
   b.copper
   c.manganese
   d.calcium
   e.nickel

4. Which of the following statements concerning beneficial elements is FALSE?
   a.Silicon is a beneficial element only for horsetails.
   b.Sodium is a beneficial element for certain halophytes.
   c.They are essential for most plants.
   d.Aluminum is a beneficial element for the tea plant.
   e.They are essential for plants grown only under specific environmental conditions.

5. Legumes grown in culture benefit from the addition of cobalt because the cobalt:
   a.inhibits the growth of pathogenic bacteria.
   b.stimulates cell division of the apical meristem.
   c.stimulates the growth of root cells.
   d.is required by mycorrhizae.
   e.is required by symbiotic nitrogen-fixing bacteria.

6. Chlorosis refers to the:
   a.localized death of tissues.
   b.yellowing of leaves.
   c.stunted growth of stems and leaves.
   d.development of tumors.
   e.healing of wounds.

7. In magnesium-deficient plants, older leaves become more severely chlorotic than younger leaves because:
   a.magnesium is less phloem-mobile than chlorophyll.
   b.magnesium is more phloem-mobile than chlorophyll.
   c.younger leaves withdraw magnesium from older leaves.
   d.older leaves withdraw magnesium from younger leaves.
   e.magnesium is more mobile in younger leaves than in older leaves.

8. Which of the following is NOT a phloem-mobile element?
   a.nitrogen
   b.magnesium
   c.phosphorus
   d.potassium
   e.iron

9. Humus consists mostly of:
   a.living organic matter.
   b.dead organic matter.
   c.sand.
   d.silt.
   e.clay.

10. Which of the following statements about soil is FALSE?
    a.The A horizon has the greatest physical, chemical, and biological activity.
    b.The A horizon is the topsoil.
    c.The B horizon is a region of deposition.
    d.The B horizon is the subsoil.
    e.The C horizon is part of the true soil.

11. Field capacity is the:
    a.total amount of water present in a one-hectare field after a soaking rain.
    b.percentage of water that a soil can hold against the action of gravity.
    c.percentage of water remaining in a soil when plants undergo irreversible wilting.
    d.total amount of fertilizer required for maximal plant growth in a one-hectare field.
    e.total amount of mineral nutrients present in a one-hectare field after a soaking rain.

12. The permanent wilting percentage is the percentage of:

    a.colloidal particles remaining in the soil after a heavy rain.
    b.colloidal particles that would cause irreversible wilting.
    c.colloidal particles that would cause reversible wilting.
    d.water remaining in a soil when irreversible wilting occurs.
    e.water remaining in a soil when reversible wilting occurs.

13. An example of cation exchange is _____ replacing _____ on a clay particle.
    a. H^+; K^+
    b. H^+; NO_3-
    c. NO_3-; SO_4^{2-}
    d. $OH-$; SO_4^{2-}
    e. HCO_3-; Mg_2+

14. Which of the following statements concerning iron is FALSE?
    a. Iron in the soil is usually insoluble and thus unavailable to plants.
    b. Iron ranks fourth in abundance among all elements on the surface of the Earth.
    c. All plants use Strategy I for iron mobilization and uptake.
    d. Phytosiderophores are iron-chelating compounds.
    e. Iron in the soil is normally present in the oxidized (Fe^{3+}) form.

15. Which of the following ions is MOST likely to be precipitated in alkaline soils?
    a. hydroxide
    b. bicarbonate
    c. sulfate
    d. iron
    e. potassium

16. Which of the following statements about nutrient cycles is FALSE?
    a. They are also called biogeochemical cycles.
    b. All nutrients recycled to the soil are available for plant use.
    c. Some cycles involve the atmosphere.
    d. Each element has a different cycle.
    e. Macronutrients and micronutrients are recycled.

17. The chief reservoir of nitrogen is:
    a. the soil.
    b. the ocean.
    c. living organisms.
    d. dead organic material.
    e. the atmosphere.

18. As dead organic materials are broken down by bacteria and fungi, the nitrogen not used by these organisms is released as _____ in a process called _____.
    a. NH_4+; ammonification
    b. NO_3-; nitrification
    c. NO_2-; nitrification
    d. N_2; denitrification
    e. N_2O; denitrification

19. Which of the following is(are) a product of denitrification?
    a.NH_4+
    b.NO_3–
    c.NO_2–
    d.N_2
    e.Amino acids

20. Which of the following is NOT a way in which nitrogen is lost from an ecosystem?
    a.harvesting of plants
    b.soil erosion
    c.burning of plants
    d.leaching
    e.nitrification

21. In the process of nitrogen fixation, _____ is converted to _____.
    a.NH_4^+; NO_3^-
    b.NO_3^-; NO_2^-
    c.N_2; NO_2^-
    d.N_2; NO_3^-
    e.N_2; NH_4^+

22. Rhizobia enter legumes by invading the:
    a.seeds.
    b.root hairs.
    c.stems.
    d.leaves.
    e.flowers.

23. Which of the following groups contains species that are nonsymbiotic, photosynthetic, nitrogen-fixing bacteria?
    a.genus Azotobacter
    b.genus Azotococcus
    c.genus Beijerinckia
    d.genus Clostridium
    e.cyanobacteria

24. _____ is the principal source of nitrogen available to crop plants.
    a.Organic nitrogen
    b.Nitrate
    c.Ammonium
    d.Glutamine
    e.Glutamate

25. In soils where nitrogen is limiting, _____ is a major and direct source of nitrogen.
a.nitrate
b.ammonia
c.organic nitrogen
d.nitrite
e.N_2

26. . _____ is one of the ways in which phosphorus is lost from terrestrial ecosystems.
a.Leaching
b.Evaporation
c.Burning
d.Recycling
e.The action of microorganisms

27. Which of the following is NOT a strategy utilized by plants for the uptake of phosphate from the soil?
a.rapid root growth
b.rapid lateral root growth
c.proliferation of root hairs
d.inhibition of extraradical hyphae
e.symbioses with arbuscular mycorrhizal fungi

28. If a bag of fertilizer is labeled 5-10-6, then you know that the fertilizer contains:
a.5% potassium.
b.10% nitrogen.
c.6% phosphorus.
d.5% nitrogen.
e.10% potassium.

29. Lime is added to soils in order to:
a.provide nutrients.
b.raise the pH.
c.remove excess salts.
d.provide ions for cation exchange.
e.kill insect pests.

30. _____ is the most common metal in soils and causes problems where the soil is acidic.

a.Lead
b.Cadmium
c.Zinc
d.Cobalt
e.Aluminum

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SECTION C [60 Marks]

Instruction: Answer any Two questions from THIS SECTION

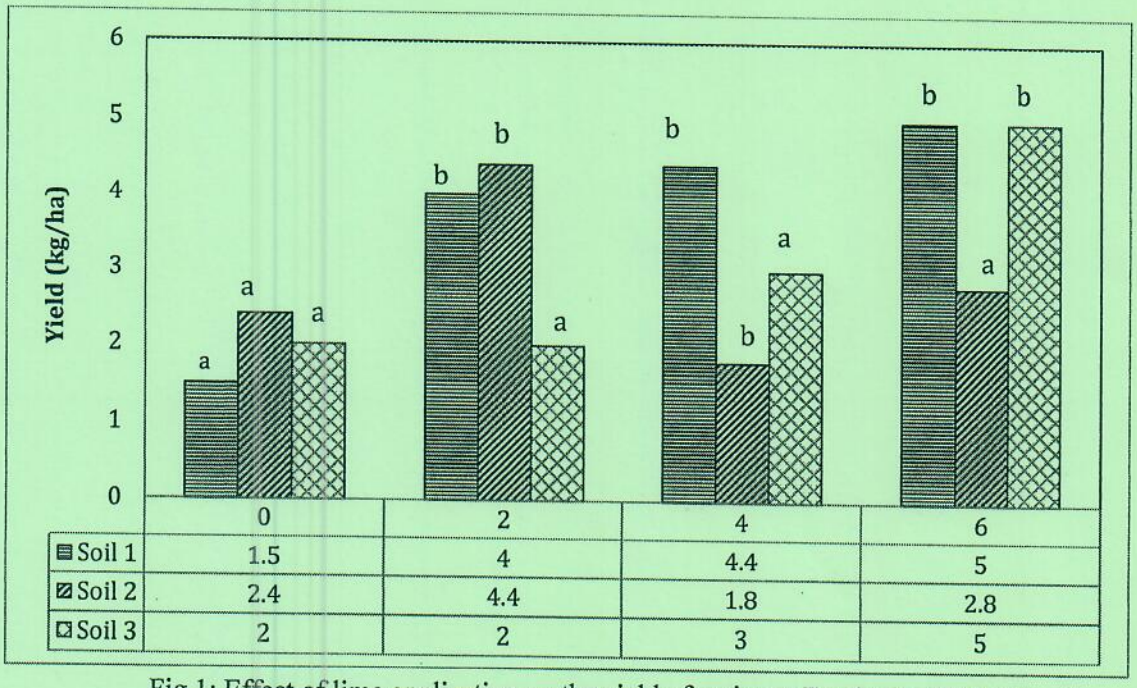
Question 1:

a. In the soils of Swaziland, P is very low. Itemize and briefly discuss factors that are responsible for P Phosphorus transformation in the soils of Swaziland

b. Discuss practical ways of making Phosphorus to be available in soils

c. After applying lime at the rates of 0, 2 4 and 6 t/ha, the yield of maize is shown below (Fig 1). Has the lime application resulted in yield increase and why ?

d. Itemize and briefly four CAUSES of soil acidity



	0	2	4	6
Soil 1	1.5	4	4.4	5
Soil 2	2.4	4.4	1.8	2.8
Soil 3	2	2	3	5

Fig 1: Effect of lime application on the yield of maize at Zombodze High School

[30 Marks]

Question 2: In the diagram below (Fig 2) is shown the relationship between tissue nutrients concentrations and yield of a crop. From the figure, explain these terminologies:

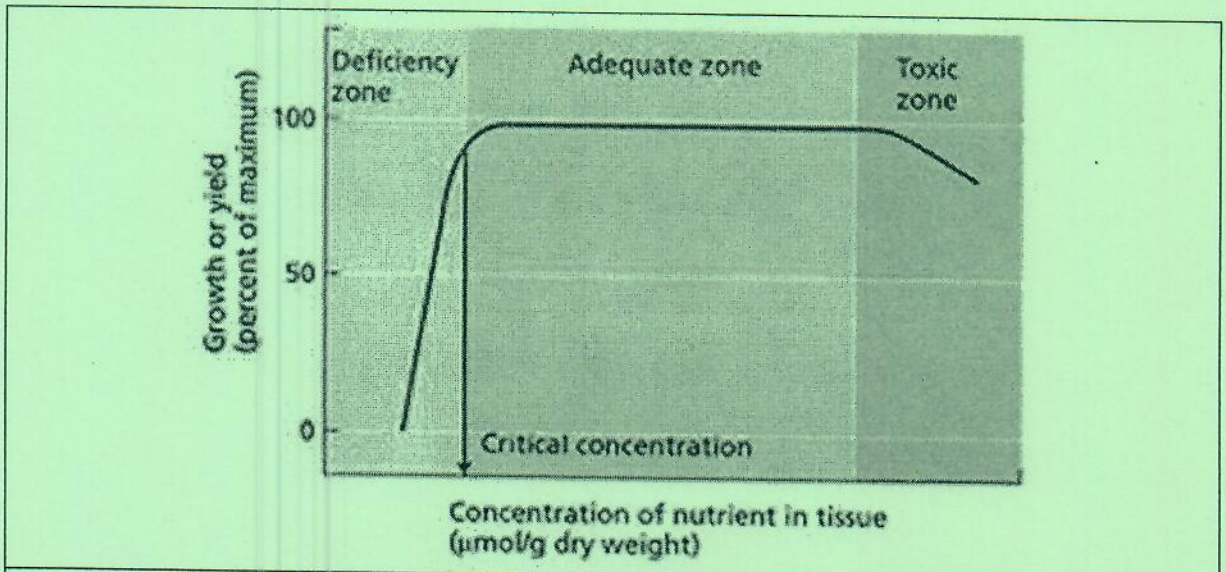


Fig 2: Relationship between tissue nutrient concentrations and growth/yield of crop plant

i. Deficiency of nutrient elements

ii. Critical range,

iii. Toxicity nutrient elements

iv. Write a short note on the effect of soil pH on nutrient availability in soils.

v. Explain the terms **antagonistic** and **synergistic** reactions.

vi. In the table below (Table 1), is a table showing nutrient interactions between N, P, K, Mg, Fe and Zn. Reproduce the table in your answer sheet and indicate/show which of these would exhibit/show **antagonistic** (-ve) or **synergistic** (+ve) reactions. (NB: **Show as either –ve or +ve in your table**).

Table 1: Negative (antagonistic) and Positive (synergistic) between selected nutrient elements

Table 1: Negative (antagonistic) and Positive (synergistic) between selected nutrient elements

Interactions	---------- Application Nutrients ----------					
	N	P	K	Mg	Fe	Zn
N						
P						
K						
Mg						
Fe						
Zn						

[30 Marks]

Question 3a:

A field trial was conducted on a soil classified as Malkerns series (i.e. Oxisol/Ferrasol) to evaluate the effect of three ameliorants (NPK, Poultry manure, NPK+ Poultry manure) on the yield of maize (*Zea mays* L). Details of the initial soil properties across two sites are shown in Table 2 and the yield of maize grown across two years are shown in Table 3. Briefly explain factors that may have been responsible for differences in yields across these two sites. Which of these treatments would you recommend for adoption and why?

Table 2: Selected soil properties (0-20cm) across the two sites

Soil properties	**Luyengo**	**Malkerns**
Sand (%)	82	82
Silt (%)	15	13
Clay (%)	3	5
pH-water	5.2	5.7
Total N (%)	0.84	0.92
Organic carbon (%)	1.25	0.67
Available P (mg/kg)	7.48	4.71
Exchangeable K (cmol/kg)	0.16	0.21

Table 3: Grain yield across sites at different rates of ameliorants

Treatments /Ameliorants	-------- 2016 cropping -------	-------- 2017 cropping -------
	---------- **MALKERNS** ----------	
Control	0.93c*	1.25c
N-P-K	2.61a	2.39a
Poultry Manure	1.99b	2.06b
N-P-K+ Poultry manure	2.79a	2.53a
	---------- **LUYENGO** ----------	
Control	0.86c	0.95c
N-P-K	2.50a	2.49a
Poultry Manure	2.00b	2.19b
N-P-K+ Poultry manure	2.66a	2.60a

*Means with same letter in same column are not different at 5% (DMRT).

Question 3b: Briefly write short notes on the following: (a) Denitrification

(b) Management of Nitrogen fertilizer in arable crop production **[30 Marks]**