THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER FINAL EXAMINATION- 2020

DEPARTMENT OF AGRICULTURE

AG 213 SOIL FERTILITY MANAGEMENT

2nd Year B.Sc.(Ag.)

Venue: AG1-25/ AG1-32

Date: Friday, 26th June 2020

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES:

1. You have 10 minutes to read the paper. You must not begin writing during this time.
2. Answer all questions in numerical order.
3. Answers must be written in the book provided. No other written materials will be required.
4. Rules, calculators and correction fluids are required in the examination room. Notes and text books are not allowed.
5. Write your name and student number clearly on the front page of your answer book and examination attendance slip. **DO IT NOW**.
6. The marks of each question are given at the end of question.
7. Maximum marks = **50**.

I Define <u>any five</u> terms. **10 Marks**

1. Soil productivity
2. Nitrate depression
3. Exchangeable sodium percentage
4. Nitrification
5. Available nutrient
6. Symport

II Answer the following questions. **30 Marks**

1. Write the chemical forms (ionic formula required) of plant uptake for the nutrient elements Si, B, Cu, S and N. **5 Marks**
2. Enlist the criteria of essentiality of plant nutrients. **3 Marks**
3. What is **van Bemmelen** factor? What is the use of this factor? **2 Marks**
4. What are the reasons for the negative charges on the silicate clay minerals? How these negative charges do contribute to soil fertility? **3 Marks**
5. Describe the mechanisms of phosphorous fixation in the soils? Explain **any three** management strategies to manage phosphorous fixation problem. **5 Marks**
6. Enlist different phases in a soil testing program. Explain **one of them**. **5 Marks**
7. For the bell pepper nursery 200 kg N, 100 kg P_2O_5 and 100kg K_2O per ha as urea (46% N), single super phosphate (16% P_2O_5), and muriate of potash (60% K_2O) are recommended, respectively. Calculate the quantities of fertilizers required for the nursery area of 20 X 15 m^2. **7 Marks**

III Choose the correct answer from the multiple options and write in your answer book. **10 Marks**

1. Volatilization is the gaseous loss of _____ from the soil.
   a. N_2 b. NH_3 c. NH_4^+ d. N_2O

2. _____ is an integral part of chlorophyll.
   a. Nitrogen b. Sulfur c. Phosphorous. d. Potassium

3. The membrane proteins that carry out primary active transport are called _____.
   a. carriers b. antiports c. symports d. pumps

4. The nitrogen immobilization is common when a residue with C: N ratio _____ is applied to soil.
   a. < 10:1 b. > 30:1 c.< 20:1 d. <5:1

5. The enzyme required for the biological nitrogen fixation by soil microbes is_____.
   a. Nitrate reductase b. Nitrite reductase c. Nitrogenase d. Leghaemoglobin

6. The K_2O content of sulphate of potash fertilizer is _____.
   a. 25% b. 35% c.60% d. 50%

7. The neutralizing value (NV) of calcium oxide for the liming purposes is_____.
   a. 100% b. 179% c. 136% d.86%

8. A saline soil will have the following chemical characters:
   a. pH>8.5, ESP> 15%, EC<4 dS/m b. pH<8.5, ESP> 15%, EC<4 dS/m c. pH>8.5, ESP< 15%, EC<4 dS/m d. pH<8.5, ESP< 15%, EC>4 dS/m

9. The role of concentrated H_3PO_4 in the organic carbon determination is to _____.
   a. remove interference b.standardize ferrous ammonium sulphate c. act as an indicator d. oxidize the carbon

10. The cation exchange capacity of kaolinite clay is _____.
    a.120-150 me/100g b. 20-40 me/100g c. 1-10 me/100g d. 80-120 me/100g

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MODEL ANSWERS/SOLUTION SHEET QP-2020

I.

Soil productivity- *It is the response of soil in terms of yield per unit management*

Nitrate depression- *Temporary locking up of soluble inorganic N or nitrate-N of the soil in the form of organic N (microbial biomass) upon addition of residues with wide C:N ratio*

Exchangeable sodium percentage- *(Exchangeable Na^+/CEC) x 100*

Nitrification- *Microbial (aerobic cheamoautotrophs) oxidation process of mineral N (NH_4^+) via NO_2^- to NO_3^- in the soil.*

Available nutrient- *Portion of soil nutrient that is available to crops or bioavailable.*

II.

1.

Si- $Si(OH)_4$, B-H_3BO_3 & $H_2BO_3^-$, Cu- Cu^{2+}, S-SO_4^{2-} and SO_2, N-NH_4^+ and NO_3^-.

2.

a. deficiency of the element makes it impossible for the plant to complete its life cycle

b.The deficiency is specific for the element in question ie., elemental function must not be replaceable by any other element

c..The element is directly involved in the nutrition of the plant as for example as a constituent of an essential metabolite or required for the action of an enzyme system.

3. A value of 1.724 (100/58) is the van Bemmelen factor. This is used to convert organic carbon content to organic matter content of a soil.

4.

a. Isomorphous substitution

b. broken edges of silicate clays

Negative charges arising from *a* and *b* contributes to permanent and variable charge to soil silicates. These charges are pivotal in retention of cation exchange capacity of the soil. Nutrients ions are protected from leaching losses and supplied to crops by exchange processes.

5.

1. In neutral to alkaline soils

$Ca(H_2PO_4)_2 + 2\ Ca\ CO_3 \rightarrow Ca_3(PO_4)_2 + 2\ CO_2 + 2\ H_2O$

Monocalcium phosphate — Tricalcium phosphate

2. In acid soils

$Al^{3+} + H_2PO_4^- + 2\ H_2O \rightarrow 2\ H^+ + Al(OH)_2H_2PO_4$

Dihydrogen P (Soluble) — Aluminium Hydroxy P (insoluble)

3. In neutral soils: P is fixed in the crystal lattices of 1:1 type of clay minerals like the Kaolinite having high AEC by anion exchange phenomenon.

To minimize P fixation-

Organic matter addition

Placement of P fertilizer

Use of mycorrhiza

Other P solubilizing microbial cultures

Liming acid soils

Use of rock phosphate and other partially acidulated P fertilizers

4.

Soil sampling

Extraction and chemical analysis

Interpretation of analytical work

Fertilizer recommendation

The soil testing program (STP) starts with collection of soil samples from the field. The first basic principle of STP is that a field can be sampled so that chemical analysis of the sample will accurately reflect the field's true nutrient status. This doesn't mean that all the samples must or will yield the same test results but rather the results must reflect the true variations in the field. Sampling systems that are adequate for untreated soil will probably inadequate for fertilized fields. Many of our sampling procedures should be reexamined because fertilizer usage will be increasing. Variability within a field will keep on growing problems of assessing true or average value to a field become much more difficult. So it is advisable to increase composite samples collected from an area and also increase the number of cores to maintain the present level of accuracy in field sampling.

5. For the bell pepper nursery 200 kg N, 100 kg P_2O_5 and 100kg K_2O per ha as urea (46% N), single super phosphate (16% P_2O_5), and muriate of

potash (60% K_2O) are recommended. Calculate the quantities of fertilizers required for the nursery of 20 X 15 m^2.

100 x 200/46 = 435 kgx 20 x15/10,000=13 kg urea

100 x 100/16 =625 kg x 20 x15/10,000= 18.8 kg SSP

100 x 100 /60 = 167 kg x 20 x15/10000 = 5 kg MOP

III

1. b

2. a

3. a

4. b

5. c

6. d

7. b

8. d

9. a

10. c