



UNIVERSITY OF ESWATINI

Supplementary Examination Paper

Programme: Bachelor of Science in Agronomy, Year 4

Course Code:	CPR 402
Title of Paper:	Soil Management
Time Allowed:	2 hours
Instructions:	Answer All Questions

**Do Not Open This Question until Permission has been granted
by the Invigilator**

Question 1:

- Outline in reasonable detail why care should be taken in removing soil samples from a field before testing the soil fertility levels (5 marks).
- What is meant by the term *lime requirement* (1 mark)?
- List the elements found in ground limestone (1 mark).
- Explain the term *Cation exchange capacity* (CEC) (1 mark).
- Mention a **three soil types** where CEC is very low (3 marks).
- Describe a method by which the low CEC in an Oxisol may be increased in a soil (9 marks).

Question 2: Data below showed the mean soil properties of the top 50cm depth of a soil classified as Typic Ustalf:

Table 1: physical properties of a soil classified as Typic Ustalf, Luyengo, Campus

Nutrient	C mol/kg
Ca ²⁺	9.9
Mg ²⁺	2.1
K ⁺	2.0
Al ³⁺	7.6
NH ₄ ⁺	0.6
Na ⁺	0.1
CEC	21.7
H ⁺	1.0
SO ₄ ⁻ (mg/kg)	4.2
H ₂ PO ₄ ⁻ (mg/kg)	2.1
pH-water	5.5
pH-CaCl ₂	3.5

- Calculate the ECEC of the soil (1 marks)
- Calculate the CEC of the soil in Cmol/kg.(1 mark).
- Calculate the base saturation percentage of the soil (2 marks)
- Calculate the Delta pH of the soil. What is the implication of this value for managing this soil (1 mark)?
- Define the critical value of any nutrient element (2 marks)
- What is difference between Land Capability Classification and Fertility Capability Classification (2 marks)?
- Using the data above, evaluate how suitable this soil type is for maize cultivation (11 marks)

Question 3: A field experiment (rotation of sweet corn-groundnut-sweet corn-groundnut-sweet corn) was initiated in April 1997. Some physico-chemical properties are shown in Table 1. The treatments were as follows: Recommended inorganic fertilizer NPK with crop residues (T1), recommended inorganic fertilizer NPK without crop residue (T2) and one half-dose of recommended inorganic fertilizer NPK with crop residue combined with 10 t/ha (T3). Results of the effect of the treatments on extractable phosphorus are shown in Table 2. Briefly interpret the data (Tables 2 & 3) and state with reasons the best treatment combination that improved the extractable P in the soils planted to these crops (20 marks).

Table 2: selected physico-chemical properties of the experimental sites

Variables	Soil Depth (cm)		
	0-20	20-40	40-60
pH-water	5.30	4.90	4.79
Org. C (g/kg)	1.66	1.01	0.67
Available P (mg/kg)	12.60	7.88	2.53
	Cations & CEC (C mol/kg)		
	0-20	20-40	40-60
K	0.12	0.09	0.06
Ca	0.85	0.98	0.63
Mg	1.28	2.29	1.36
CEC	6.68	5.51	4.18
	%		
	0-20	20-40	40-60
Sand	61.80	59.0	54.70
Silt	4.60	3.90	3.70
Clay	33.60	37.10	41.60
Bulk Density (g/cm ³)	1.28	1.49	1.61

Question 4. The following soil orders of the USDA Soil Taxonomy are given:

- i. Spodosols
 - ii. Alfisols
 - iii. Ultisols
 - iv. Andisols
 - v. Oxisols
- a) Arrange these soil orders in the order of their ages (i.e. from the oldest to the youngest). (2 marks)
 - b) Briefly enumerate at least three characteristics that can be used to distinguish each of these Soil Orders of the USDA Soil Taxonomy (15 marks).
 - c) Explain how you will manage these soils if they have variable charges (3 marks)

Table 3: Soil extractable P (mg/kg) as influenced by the application of crop residues

Treatment	Crop cycle				
	1st Crop (maize)	2nd Crop (groundnut)	3rd Crop (maize)	4th Crop (groundnut)	5th Crop (maize)
			Soil depth 0-15 cm		
T1	9.48 b (2.99)	19.15 a (5.15)	22.20 b (4.75)	21.26 b (3.80)	40.34 b (4.00)
T2	8.85 b (2.67)	34.66 a (11.45)	21.53 b (6.50)	22.20 b (5.05)	45.18 b (12.57)
T3	26.44 a (2.70)	40.94 a (7.35)	56.58 a (7.55)	64.87 a (14.35)	151.84 a (10.08)
			Soil depth 15-30 cm		
T1	5.49 a (1.00)	4.58 b (0.65)	7.48 b (1.75)	6.97 b (0.80)	8.09 b (2.05)
T2	5.39 a (0.91)	4.25 b (5.05)	4.57 b (0.80)	8.41 b (2.50)	14.16 b (1.59)
T3	0.99 a (1.40)	10.22 a (1.20)	16.77 a (2.60)	20.65 a (3.60)	30.32 a (3.57)
			Soil depth 30-50 cm		
T1	4.49 a (0.00)	1.53 a (0.15)	2.24 b (0.05)	4.25 b (0.35)	4.46 a (0.39)
T2	4.49 a (0.00)	2.44 a (0.80)	2.04 b (0.55)	4.08 b (0.95)	9.63 a (1.65)
T3	7.49 a (2.37)	2.99 a (0.90)	8.02 a (1.80)	8.60 a (0.65)	11.57 a (3.66)

Note: Means in columns, within each depth, followed by the same letters are not significantly different at $P \leq 0.05$ by least significant difference (LSD). Values in parentheses are standard errors.