

UNIVERSITEIT VAN PRETORIA / UNIVERSITY OF PRETORIA  
DEPARTEMENT PLANTPRODUKSIE EN GRONDKUNDE /  
DEPARTMENT OF PLANT PRODUCTION AND SOIL SCIENCE

GKD 250  
Introductory Soil Science / Inleidende Grondkunde  
April 2009  
Time / Tyd: 50 min  
Total / Totaal: 35

**Question 1 / Vraag 1**

Differentiate between soil organic material and humus. / *Differensieër tussen grond organies materiaal en humus.* (4)

Humus forms part of soil organic material (1 mark)

Soil organic material encompasses all:

- Living and dead macro, meso and micro fauna and flora (2 mark) and;
- Humus, the colloidal sized end product of organic material decomposition (1 mark).

**Question 2 / Vraag 2**

Discuss the process of nitrification, give the appropriate reactions, organisms involved and soil conditions that will influence it. / *Bespreek die nitrifikasieprosesse aan hand van gepaste reaksie, organismes betrokke en grond toestande wat dit beïnvloed.* (10)

- Nitrification is the process where ammonium ( $\text{NH}_4^+$ ) (1 mark) in solution is oxidised (1 mark) to nitrate ( $\text{NO}_3^-$ ) (1 mark);
- This process occurs in a well oxidised soil environment (1 mark);
- The first step of nitrification,  $\text{NH}_4^+$  is oxidised to nitrite ( $\text{NO}_2^-$ ) (1 mark);
- *Nitrosomonas* bacteria mediate this first step (1 mark);
- $\text{NH}_4^+ + 3/2 \text{O}_2 \rightleftharpoons \text{NO}_2^- + 2\text{H}^+ + \text{H}_2\text{O} + \text{energy}$  (1 mark);
- In the second step of nitrification,  $\text{NO}_2^-$  is oxidised to  $\text{NO}_3^-$  (1 mark);
- *Nitrobacter* bacteria mediate the second reaction (1 mark);
- $\text{NO}_2^- + 1/2 \text{O}_2 \rightleftharpoons \text{NO}_3^- + \text{energy}$  (1 mark).

**Question 3 / Vraag 3**

Discuss briefly the influence of the carbon (C) and nitrogen (N) content of organic material on its decomposition. / *Verduidelik kortliks die invloed van die koolstof (C) en stikstof (N) inhoud van organiese materiaal op die afbraak daarvan.* (5)

- The ratio of the carbon to nitrogen content (C : N ratio) of the organic material will influence the the rate of organic material decomposition **(1 mark)** and wheter nitrogen will be mineralised ( released) from the organic material **(1 mark)**;
- At C:N ratios < 25 net mineralisation of N is like to occur **(1 mark)**;
- Organisms in the soil utilise easily available N in the soil in order to decompose organic material **(1 mark)**;
- When C:N ratios > 25, the decomposition of organic material can be delayed if enough N is not present in the soil **(1 mark)**;
- Microorganisms can compete with plants for N during the decomposition of high C:N ratio organic material resulting in nitrogen negative or depression period **(1 mark)**.

#### Question 4 / Vraag 4

Differentiate between micro and macro aggregates and the processes involved in their formation. /  
*Differensieër tussen mikro – en makro-aggregate en die prosesse betrokke tydens formation.*

(6)

- Micro aggregates ranges between 20 – 250  $\mu\text{m}$  **(1 mark)**;
- Macro aggregates are > 250  $\mu\text{m}$ ) **(1 mark)**;
- Micro aggregates are formed when particles < 20  $\mu\text{m}$  are bonded together by persistent bonding agents **(1 mark)**, e.g. bridging cations, ferric- and aluminium (oxy) hydroxides **(1 mark)**;
- These macroaggregates are bonded together by temporary binding agents, e.g. fine roots and fungal hyphae **(1 mark)**, and meta stable organic binding agents, e.g. polysaccharides **(1 mark)**;
- Large macro aggregates, especially those greater than 2 mm in diameter, appear to be held together largely by fine roots and fungal hyphae **(1 mark)**.

#### Question 5 / Vraag 5

5.1. Which of the following descriptions define a spheroidal structure best / *Watter van die volgende beskrywings definieer 'n sferiodale struktuur die beste:*

- Horizontal dimensions is greater than its vertical dimensions / *Horisontale dimensies is groter as sy vertikale dimensies;*
- Vertical dimensions is greater than its horizontal dimensions / *Vertikale dimensies is groter as sy horisontale dimensies;*
- Vertical dimensions is similar than its horizontal dimensions / *Vertikale dimensies is dieselfde as sy horisontale dimensies;*
- It is very porous / *Dit is baie poreus.*

(2)

5.2. Structure grade refers to the: / *Struktuurgraad verwys na die:*

- Shape of the peds / *Voorkoms / vorm van die peds;*
- Size of the structural units / *Grootte van die struktuureenheid;*

- c) Distinctiveness of the peds / *Hoe duidelik die peds is;*
- d) Outer surfaces of the peds / *Buite oppervlaktes van peds.*

(2)

5.3. Which of the following descriptions defines a platy structure: / *Watter van die volgende beskrywings definieer 'n plaatstruktuur:*

- a) Horizontal dimensions is greater than its vertical dimensions / *Horisontale dimensies is groter as sy vertikale dimensies;*
- b) Vertical dimensions is greater than its horizontal dimensions / *Vertikale dimensies is groter as sy horisontale dimensies;*
- c) Vertical dimensions is similar than its horizontal dimensions / *Vertikale dimensies is dieselfde as sy horisontale dimensies;*
- d) It does not have any specific form / *Het geen spesifieke vorm nie.*

(2)

5.4. Concretions forms as a result of : / *Konkresies vorming is die gevolg van:*

- a) Dispersion of aggregates / Dispersie van aggregate;
- b) High organic material content / Hoë organiese materiaalinhoud;
- c) Alternating reducing and oxidation conditions / *Afwisselende reduserende en oksiderende toestande;*
- d) The activity of compacting earthworms / Die aktiwiteit van kompakterende erdwurms.

(2)

5.5. The shiny surfaces on peds are the result of: / *Die blink oppervlakte van peds is die gevolg van:*

- a) Earthworm activity on peds surfaces / Erdwurms aktiviteit;
- b) Pressure exerting by swelling clays / *Druk wat uitgeoefen word deur swellende kleie;*
- c) Manganese (oxy) hydroxides / Mangaan (oksi) hidroksiedes;
- d) Plant roots exerting pressure / Plantwortels wat druk uitoefen

(2)