RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

Bachelor of Science Honours in Microbiology
Third Year – Semester I Examination – July/ August 2023

MIB3202 – SOIL MICROBIOLOGY

Index No.: ..... **Time: Two (02) hours**

Answer ALL questions.

1. Select the most appropriate response for the each of following parts (a to r) and underline it. **(100 marks)**

a) Microbial communities are unique to different habitats. This is because
   i. microorganisms choose where they live.
   ii. microorganisms disperse efficiently, and they colonize where they land on.
   iii. microorganisms have high growth rates.
   iv. the existing environmental parameters should be suitable for populations.

b) Enrichment culture techniques
   i. are used basically to isolate dominant microorganisms in a community.
   ii. are based on known characteristics of the organism of interest.
   iii. may be used to isolate microorganisms not cultured yet.
   iv. are usually done using solidified selective media

c) Luciferin: Luciferase assay is useful in estimation of
   i. microbial biomass of a soil sample.
   ii. redox potential of a soil sample.
   iii. metabolic activity of a microbial community in a soil sample.
   iv. microorganisms showing bioluminescence in a soil sample.

d) Select the **incorrect statement** on K strategists from the following.
   i. They rely of physiological adaptations for the available resources of the environment.
   ii. They reproduce fast, so that they can use the available resources optimally.
   iii. They are usually permanent members of the community.
   iv. Their population density does not fluctuate much.

e) The presence of clay particles is favourable for microbial activities when nutrient concentration is low because
   i. clay particles can increase the solubility of nutrients.
   ii. surface of clays adsorb nutrients.
   iii. surface of clays adsorb nutrients and attach microorganisms.
   iv. clays retain water in drying conditions

f) Select the statement that correctly describes the distribution of microorganisms in soil from the following.
   i. They are not uniformly distributed because nutrients are not evenly distributed.
   ii. Their uniform colonization is ensured if they have efficient dispersal mechanisms.
   iii. Those having high growth rates can be found in any habitat in soil.
   iv. K strategists make sure their uniform distribution as they are adapted to use complex organic compounds which are not available to others.

g) A combination of substrates for primary populations in a soil microbial community is
   i. rhizodeposition, manure, humus.
   ii. root exudates, pesticides, animal excreta.
   iii. root exudates, growth factors produced by other microbes, manure.
   iv. freshly fallen leaves, growth factors produced by other microbes, pesticides.

h) A rhizosphere fungus can successfully compete with a pathogenic soil-borne fungus, if the pathogen
   i. shares the same niche as the rhizosphere fungus before gaining entry into the host.
   ii. faster than the rhizosphere fungus.
   iii. has chitin in the cell wall.
   iv. secretes chitinase enzyme.

j) Rhizosphere provides an excellent environment for nitrogen fixation for *Azospirillum*, because of the following conditions prevail in there.
   i. competition for Ca^{++}, competition for fixed carbon, microaerophilic condition
   ii. competition for fixed nitrogen, competition for fixed carbon, availability of growth factors
   iii. competition for fixed nitrogen, Competition for Ca^{++}, microaerophilic condition
   iv. microaerophilic condition, availability of growth factors, competition for fixed nitrogen

k) Protocooperation is an association between two organisms
   i. belonging to different taxonomic groups.
   ii. from which both are benefited.
   iii. in which one hosts the other.
   iv. depending heavily on each other for survival.

l) Select the **incorrect** statement on microbial succession in soil from the following.
   i. One community provides a nutrient(s), which feeds another community.
   ii. Community produces autoinhibitors due to metabolite production.
   iii. One community changes physical parameters of soil, paving the way for another community to thrive well.
   iv. Microbiostatis facilitates succession.

m) The maximum growth rate of a microorganism in soil is well below its maximum growth rate in a laboratory. Which of the following statement **does not describe** this phenomenon?
   i. Other microorganisms compete for limited resources.
   ii. Soil microorganisms, in general are adapted to live at oligotrophic conditions and laboratory culture media are rich.
   iii. Growth rate cannot be determined accurately in soil, thus the above statement cannot be accepted.
   iv. Environmental conditions are rarely be optimum for microbial growth in soils.

n) A factor contributing to microbiostatis is
   i. addition of energy substrate at times.
   ii. landing of many allocthonous microorganisms.
   iii. pesticide contamination of soils.
   iv. predation of microorganisms by protozoans in a community.

o) Disease suppressive soil is characterized by its ability to
   i. prevent invading pathogens from colonizing the soil.
   ii. protect susceptible plants from virulent pathogens present in the soil.
   iii. make the plant resistant to virulent pathogens.
   iv. eradicate the pathogen from the soil.

p) Microbial guilds are
   i. metabolically related microbial populations.
   ii. the microbial assemblages in the rhizosphere.
   iii. the antagonistic populations in a successful microbial community.
   iv. the dominant populations of a microbial community.

q) Species richness of a microbial community is
   i. low in a stable community.
   ii. always high when there is low competition.
   iii. determined by the kinds of nutrients available.
   iv. determined by the amount of available carbon.

r) Which statement below is **incorrect** regarding the metagenomic analysis of soil?
   i. It gives precise information about location of the microorganisms in soil.
   ii. It gives information on microbial inhabitants in terms of both qualitaty and quantitaty.
   iii. It gives information on unculturable microorganisms.
   iv. It can reveal new functions of soil microorganisms.

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2. a) List **three (03)** reasons as to why scientists are interested in studying microorganisms in nature. **(12 marks)**

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b) If a substrate which is easily fermentable by a particular microbial population is available in excess, it may lead to a high population size fluctuation of that population. State the series of events leading to this situation. **(20 marks)**

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c) Write **three (03)** criteria that are useful in deciding the status of a microbial population as autochthones. **(12 marks)**

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d) The optimum pH for growth of a microorganism in a liquid medium in the laboratory was different from the optimum pH required by the same organism when growing in soil. How would you interpret this observation? **(12 marks)**

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e) Explain why a mutualistic association is considered as a forced relationship. Use lichen as the example in your explanation. **(16 marks)**

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f) State **two (02)** advantages and **two (02)** disadvantages of small pores in soil on microbial colonization. **(16 marks)**

i. Advantages

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ii. Disadvantages

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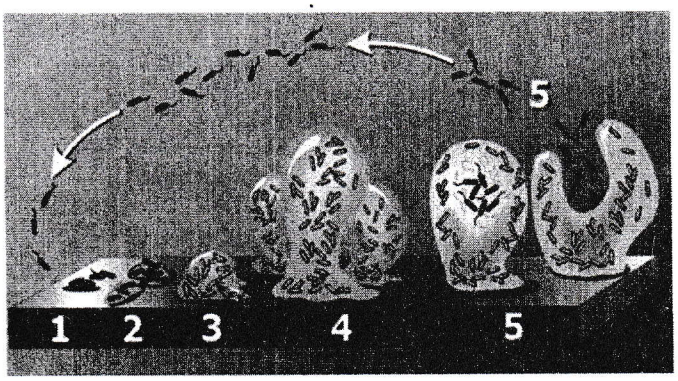
g) Following diagram depicts five stages in the development of a biofilm.
State the most remarkable feature in stage 1, stage 3 and stage 5, respectively **(12 marks)**



Stage 1: .....

Stage 3: .....

Stage 5: .....

3. Give a comprehensive account on the microbial homeostasis in soil. **(100 marks)**

4. Mixtures of microorganisms with the ability for plant growth promotion are being developed by soil microbiologists. However, they do not seem to perform as expected in the farmers' fields.

   Critically evaluate the possible reasons for this failure using your knowledge in soil microbiology. **(100 marks)**

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