**MAHARASHRATRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE**
**SEMESTER END EXAMINATION**
**B.Sc. (Hons.) Agriculture**

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| **Semester** | **: IV (New)** | **Term** | **: II** | **Academic year** | **: 2022-23** |
| **Course No.** | **: ELE PATH-243** | **Title** | **: Biofertilizers, Biocontrol agents and Biopesticides** | | |
| **Credits** | **: 3 (2+1)** | | | | |
| **Day & Date** | **:** | **Time** | **: 3 h** | **Total Marks** | **: 80** |

**Note :**
1. Solve **ANY EIGHT** questions from **SECTION"A"**
2. All questions from **SECTION"B"** are compulsory
3. All questions carry equal marks
4. Draw neat diagrams wherever necessary

## MODEL ANSWERS

## SECTION 'A'

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| **Q. 1** | **a)** | **Write the contributions made by following scientist.** | **4 Marks** |
| **Ans.** | | **i) S.N. Winogradsky:** 1) Discovered the autotrophic mode of bacteria. 2) Established the microbiological transformation of nitrogen and sulphur. 3) Isolated for the first time nitrifying bacteria. 4) Demonstrated role of these bacteria in nitrification (1890). 5) Demonstrated that free-living *Clostridium pasteuriamum* could fix atmospheric nitrogen (1893). | **1 Mark** |
| **Ans.** | | **ii) J.B. Boussingualt:** 1) The first analysis of crops in rotation the increase in soil nitrogen following the growth of legume crops. 2) Concept of Biological nitrogen fixation. | **1 Mark** |
| **Ans.** | | **iii) M.W. Beijerinck:** 1) He was the first to isolate N-fixing bacteria from root nodules of legumes and name is *Bacillus radicicola* (now known as *Rhizobium* sp.) -1888. 2) Also isolated *Azatobacter* in1902 and *Azospirillum* (then *spirillum*) in 1925. Made a commendable contribution in the field of bacteriology and biofertilizers. 3) In addition to having discovered a biochemical reaction vital to soil fertility and agriculture. 4) Revealed the symbiosis between plants and bacteria. | **1 Mark** |
| **Ans.** | | **iv) S.A. Waksman:** 1) Published book "Principles of soil Mocrobiology (1927). 2) Studied the role of soil as the source of antagonistic organisms with special reference to soil actinomycetes (1942). 3) Discovered the antibiotic "Streptomycin" produced by *Strptomyces griseus*, a soil actinomycetes (1944). | **1 Mark** |
| | **b)** | **Enlist the different microorganism used as a biofertilizer, bioagent and biopesticide in organic farming system.** | **4 Marks** |
| **Ans.** | | (Enlist with genus and species of microorganism at least 10)<br>Biofertilizers: *Rhizobium japonicum, R. phaseoli, R. leguminosarum, Azotobacter chroococcum, A. beijerinckii, Azospirillum brasilense, Cynobacteria, Anabaena azollae* etc.<br>Bioagents: *Trichoderma harzianum, T. aspirillum, T. hamatum, T. viride Pseudomonas fluorescence, Bacillus subtiliis*, etc.<br>Biopesticides: *Beauveria bassiana, Paecilomyces fumosoroeus, Metarhizium ansipoliae, Verticillium lacanii, Nomouraea releyi, Bacillus thuringiensis,* NPV of *Helicoverpa armigera* (*Hear*NPV), NPV of *Spodoptera litura* (*Spli*NPV), etc. | |
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| **Q.2** | **a)** | **Describe the growth characteristics of *Azotobacter* and *Rhizobium.*** | **4 Marks** |
| **Ans.** | | Answer should be included morphological and physiological characteristics of each organism.<br>Morphology - Unicellular, cell size, shape, motility, Gram reaction.<br>Physiology - Nature, C-source, N-source, respiration, media. | |

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| | b) | **Give brief account of classification of biofertilizers based on microorganism used by citing suitable example.** | **4 Marks** |
| **Ans.** | | The explanation should be included in brief bacterial, actinomycetal, fungal, algal biofertilizers in related to nitrogen fixing (symbiotic, associative symbiotic, non symbiotic), nutrients solubilisation, mobilization, P absorbing and antagonistic microorganisms | |
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| **Q.3** | | **What is the Nitrogen cycle in nature? Draw a neat diagram of nitrogen cycle. Describe the biochemical reactions in nitrogen cycle.** | **8 Marks** |
| **Ans.** | | Definition of nitrogen cycle. | **1 Mark** |
| | | Draw a neat diagram of nitrogen cycle. | **2 Marks** |
| | | Description of Biochemical process involved in nitrogen cycle, It should be included following reactions by citing example of microorganism responsible for their biochemical reactions:<br>a) Proteolysis , b) Ammonification, c) Nitrification, d) Nitrate reduction,<br>e) Denitrification. | **5 x 1 = 5 Marks** |
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| **Q.4** | **a)** | **Write in short.** | |
| | **i)** | **Enzyme nitrogenase and its component.** | **2 Marks** |
| **Ans:** | | Answer should be included in brief description on following points:<br>Nitrogenase - Enzymes which mediates the reduction of $N_2$ to $NH_3$, acetylene to ethylene.<br>Components - Fe (Iron), protein, Mo-fe-protein and general mechanism. | |
| | **ii)** | **Cross inoculation groups of *Rhizobia*.** | **2 Marks** |
| **Ans.** | | Leguminous plants of one or more genera or species develop root nodules in association with the same varieties or species of *Rhizobium*.<br>Answer should be include following legume *Rhizobia* cross inoculation:<br>a) *Rhizobium* - Pea, bean, clover, alfalfa, lupine, soybean & cowpea.<br>b) *Mesorhizobium* - Cicer, chickpea, Birds foot.<br>c) *Sinorhizobium* - Alfafa, Sweet clover.<br>d) *Bradyrhizobium* - Soybean, lupins. | **4 x 0.5 = 2 Marks** |
| | **b)** | **Explain in detail any two methods used for studying selection of efficient strain of *Rhizobium*.** | **4 Marks** |
| **Ans:** | | Explanation in details of **any two** of following methods should be included: | |
| | | a) Test tube method for small seeded legumes, b) Testing for large seeded legume, c) Infection test, d) Nodulation test, e) Callus and cell structure, f) Determination of total nitrogen by Kjeldahl method, g) Acetylene reduction technique, h) The use of N to measure BNF. | |
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| **Q.5** | **a)** | **Write in brief different methods of application of carrier based biofertilizers.** | **4 Marks** |
| **Ans:** | | Answer should be included following methods with example:<br>i) Seed treatment/pelleting, ii) Root dipping, iii) Set treatment,<br>iv) Soil application, v) Biofertigation, vi) Foliar application. | |
| | **b)** | **Explain the i) Mechanism of nodule formation.** | **2 Marks** |
| **Ans:** | | Answer should included the process of nodule development:<br>Bacteria attracted towards **flavonoids** ----- secrete specific **oligosaccharide** --- root hair becomes deformed and curl at the tip --- enclosed in small pocket --- **Penetrate** --- **Invasion** --- cortical **cell division** --- Infected root cells swell --- become endosymboitic **bacteroids** --- nodule provides an **oxygen-controlled** environment. | |
| | | **Explain the ii) Mechanism of disease controlled by bioagents.** | **2 Marks** |
| **Ans:** | | Answer should included in brief :<br>a) Competition, b) Antagonism/Antibiosis, c) Hyperparasitism (Mycoparasitism), d) Parasitism and Predation (Exploitation). | **4 x 0.5 = 2 Marks** |
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| **Q.6** | **a)** | **Discuss the role of microorganism in decomposition of organic farm waste.** | **4 Marks** |
| **Ans:** | | Answer should be included on following points:<br>Decomposition of cellulose, hemicelluloses, chitin, lignin, protein, lipids, starch, pectin with microorganism involved. | **4 x 1 = 4 Marks** |
| | **b)** | **What are the factors responsible for effectiveness of biocontrol agent on soil borne plant pathogen? Explain in brief.** | **4 Marks** |
| **Ans:** | | A brief account on following points should be included: | |
| | | i) Soil factor: Soil nutrients, soil moisture, soil air, soil temperature, soil pH, soil reaction, soil flora and fauna and soil borne pathogen.<br>ii) Bioagent factor: Bioagent nature, habitat, formulations, packaging of bioagents, Agressiveness of bioagents and culture of bioagents.<br>iii) Plant factor: Plant root system, type of crop and methods of application.<br>iv) Environmental factor: Rainfall, temperature and humidity.<br>v) Other factor: Methods of application and rate of application. | **4 x 1 = 4 Marks** |
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| **Q.7** | | **Describe (Any Two)** | **8 Marks** |
| | **a)** | **Registration with CIB of biopesticides.** | **4 Marks** |
| **Ans:** | | Write the complete criteria for the Registration of biopesticides based on fungi, bacteria and viruses.<br>Discuss: Manpower requirement, General requirement, Plant equipment/instrument requirement, Laboratory equipment/instrument requirement. | |
| | **b)** | **Ideal features for establishing insectary.** | **4 Marks** |
| **Ans:** | | Following points should be included:<br>Design, rearing technique, environmentally controlled insect rearing chambers, high PAR lighting system, transportation, insect proof net house, place to grow flora and fauna. | |
| | **c)** | **Ideal features for establishing biofertilizer laboratory.** | **4 Marks** |
| **Ans:** | | Institute should have following working area:<br>i. Main working laboratory, ii. Incubation room, iii. Fermentation room, iv. Media preparation room, v. Chemical store, vi. Carrier/row material store, vii. Packaging room, viii. Finished good store and other infra-structure requirement such as electric connection, water connection etc.<br>Req. Registration certificate, Scope certificate, Transaction/Import certificate, Product certificate, etc. | |
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| **Q.8** | | **Explain in short Standard Quality parameters for the following microbial inoculants**<br>**a) *Rhizobium* spp. b) *Ha*NPV c) *Metarhizium* spp. d) *Pseudomonas* spp.** | **4 X 2 = 8 Marks** |
| **Ans:** | | Answer should be included according to Beuro Indian standard on following parameters:<br>Base, cell/cfu count at the time of manufacture and at the time of expiry, Expiry period, Permissible contamination, $p^H$, strain, carrier, others etc. | |
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| **Q.9** | | **Explain in detail mass multiplication and packing of the following**<br>**(Any Two) a) *Trichoderma* spp. b) *Ha*NPV**<br>**c) *Azotobacter* spp. d) *Metarhizium* spp.** | **2 X 4 = 8 Marks** |
| **Ans:** | | Answer should be included on following points: i. Product formulation technology - eg. agar based and broth culture, frozen concentrater, granular inoculants, carrier based, paste, pelleting, precoated seeds etc.<br>ii. Raw materials highly absorptive, nontoxic, easy to sterilize, availability, good adhesion, have $p^H$ buffering capacity.<br>iii. Facilities - Market size, mode of production, capital, fixed cost, output, equity, net income etc.<br>iv. Demand, v. Marketing facilities and vi. Packaging- material like HDPE, bottle, aluminum foil etc. | |

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| **Q.10** | | **Describe the importance of the following (Any Four)** | **4 X 2 = 8 Marks** |
| | **a)** | ***S*INPV** | **2 Marks** |
| **Ans:** | | ***S*INPV:** One of the insect pathogen infecting *Spodoptera litura* larva, it is species specific virus, compatible with IPM concept because host specificity, does not affect predator and parasitoids, pathogenicity may alleviate insecticide resistant problem, how to incorporate polyhydra into diet. | |
| | **b)** | ***Verticillium* spp.** | **2 Marks** |
| **Ans:** | | Answer should be include the economic importance of the *Verticillium* spp., types of insect controlled with examples, microbial insecticide, IPM and economy. | |
| | **c)** | ***Beauveria* spp.** | **2 Marks** |
| **Ans:** | | Answer should be include the economic importance of the *Beuveria* spp., types of insect controlled with examples, microbial insecticide IPM and economy. | |
| | **d)** | ***Pseudomonas* spp.** | **2 Marks** |
| **Ans:** | | Brief description as a biocontrol agents includes:<br>Morphology, mechanism, disease control, Plant growth promoter, Secretion of pyoverdine, fluorescent yellow green siderophore, produces -pyocyanin, thioquinolobactin, induces systemic resistance in the host plant production of antagonistic compound viz. phenanzine. | |
| | **e)** | ***Trichogramma* spp.** | **2 Marks** |
| **Ans:** | | ***Trichogramma:*** Egg parasitoid, one of the most important group biotic agent for suppression of general lepidopteron pest, large number of species of *Trichogramma* are distributed throughout world of which 26 species recorded in India. (*T. chilonis* and *T. japonicum*)<br>Biology - Egg period, larval period, pupal and adult period. | |

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| **Q.11** | **Answer in one sentence.** | | **1 X 8 = 8 Marks** |
| | **1)** | Name the fungal bioagent used for the management of soil borne pathogens. | |
| **Ans.** | | ***Trichoderma* spp.** | |
| | **2)** | Name the biopesticides which cause the white muscardine disease in insect. | |
| **Ans.** | | ***Beauveria bassiana*** | |
| | **3)** | Name thebiopesticides which cause the green muscardine disease in insect. | |
| **Ans.** | | ***Metarhizium anisopliae* or *Nomuraea* sp.** | |
| | **4)** | Write any one bacterial bioagent used for the management of plant diseases. | |
| **Ans.** | | ***Pseudomonas fluorescence* or *Bacillus subtiliis*** | |
| | **5)** | Name the medium used for the isolation of BGA. | |
| **Ans.** | | **Fogg's medium** | |
| | **6)** | Write the full form of CIB. | |
| **Ans.** | | **Central Insecticides Board.** | |
| | **7)** | The NPV is effective for the management of which insect. | |
| **Ans.** | | **Cotton bollworms (*H. armigera*) or Tobacco leaf eating caterpillar (*S. litura*).** | |
| | **8)** | The *Cryptolaemus* sp. is effective for the management of which insect. | |
| **Ans.** | | **Aphids, Mealy Bugs and White flies.** | |

| Q.12 | | Choose correct answer | 1 X 8 = 8 Marks |
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| | 1) | The *Paecilomyces lilacinus* is effective to manage _____ disease. | |
| Ans. | d) | **Nematode disease** | |
| | 2) | _____ is a selective medium for isolation of *Azospirillum* sp. | |
| Ans. | a) | **NFB semi solid medium** | |
| | 3) | The _____ encoding enzymes involved in fixation of atmospheric nitrogen into available form of nitrogen. | |
| Ans. | a) | **Nif gene** | |
| | 4) | In carrier based biofertilizer, by weight proportion of broth culture and carrier powder is _____. | |
| Ans. | d) | **1 : 2** | |
| | 5) | A genus belongs to Vesicular Arbuscular Mycorrhiza (VAM) is _____. | |
| Ans. | b) | ***Gigaspora* spp.** | |
| | 6) | Vinegar is obtained from molasses with the help of _____. | |
| Ans. | a) | **Yeast & *Acetobacter*** | |
| | 7) | Which is the Potash Solubilizing as well as Mobilizing Bacteria? | |
| Ans. | a) | ***Fraturia aurantia*** | |
| | 8) | Who discovered the antibiotic "Streptomycin" produced by *Strptomyces griseus?* | |
| Ans. | c) | **S.A. Waksman** | |


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