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

Semester	:	IV (New)	**Academic Year**	:	2018-19
Course No.	:	**ELE PATH – 243**	**Title**	:	**Biofertilizers, biocontrol agents and biopesticides**
Credit	:	3(2+1)	**Time**	:	
Day & Date	:		**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'

Q. 1	a)	**Write in brief contribution made by following scientist.**	**(4Marks)**
Ans.		**i) J.B. Boussingualt:** 1) French chemist. 2) First Agril experiment station. 3) The first analysis of crops in rotation the increase in soil nitrogen following the growth of legume crops. 4) Concept of Biological nitrogen fixation.	**(2Marks)**
Ans.		**ii) 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.	**(2Marks)**
	b)	**i) Explain importance of biofertilizers in agriculture.**	**(2Marks)**
Ans:		Explanation should be included on following points: Important component in organic farming, supplement fertilizers, add 20-200 kg N/ha under optimum conditions, solublise/mobilize 30-50 kg P_2O_5/ha, liberate growth promoting substances and vitamins, help to maintain soil fertility, suppress the incidence of plant pathogen, increase the crop yield by 10-50%, reduce the depletion of soil nutrients, provide sustainability to the farming system, cheaper, pollution free a based on renewable energy sources, importance soil physical properties, tilth & soil health, reduce C:N ratio, improve mineral nutrition, tolerance to stress like salinity, heavy metal pollution.	
		ii) Describe role of Nif and Nod gene in BNF.	**(2Marks)**
Ans:		Answer should be include: **Nif genes:** Cluster having at least 17 genes involved in atmospheric nitrogen, nitrogenase complex and converting to ammonia, synthesis and regulation of nitrogenase, location regulatory proteins involved in nitrogen fixation, example. **Nod gene:** Nod gene signaling molecules, flavorioid secretion, protein Nod D and nodulation process, Structure of nod factor and enzymes encoded by the common nod genes, host specificity.	

Q.2	**a)**	**Describe nitrogen cycle especially reference to biochemical process involved.**	**4 marks**
Ans:		Definition of nitrogen cycle with figure.	**1 marks**
		Description of Biochemical process involved in nitrogen cycle, It should be include following reactions by citing example of microorganism responsible for their biochemical reactions: a) Proteolysis , b) Ammonification, c) Nitrification , d) Nitrate reduction, e) Denitrification.	**5x0.6 = 3 marks**
	b)	**Give brief account of classification of biofertilizers based on microorganism used by citing suitable example.**	**4Marks**
Ans.		The explanation should be include 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	
Q.3	**a)**	**Describe the growth characteristics of *Rhizobium* and *Azospirillum.***	**4Marks**
Ans.		Answer should be include morphological and physiological characteristics of each organism. Morphology - Unicellular, cell size, shape, motility, Gram reaction. Physiology - Nature, C-source, N-source, respiration, media.	
	b)	**Describe biochemistry of nitrogen fixation.**	
Ans:		Description should be include on following points with figures: a) Enzymology, b) Substrate, c) Non symbiotic fixation, d) symbiotic N_2fixation, e) Exchange of metabolites between bacteria and host cells.	**0.8x5=4 Marks**
Q.4	**a)**	**Write in short.**	
	i)	**Enzyme nitrogenase and its component.**	**2Marks**
Ans:		Answer should be include in brief description on following points: Nitrogenase - Enzymes which mediates the reduction of N_2 to NH_3, acetylene to ethylene. Components - Fe (Iron), protein, Mo-fe-protein and general mechanism.	
	ii)	**Cross inoculation groups of Rhizobia.**	
Ans:		Leguminous plants of one or more genera or species develop root nodules in association with the same varieties or species of *Rhizobium.* Answer should be include following legume rhizobia cross inoculation: a) *Rhizobium* - Pea, bean, clover, alfalfa, lupine, soybean & cowpea. b) *Mesorhizobium* - Cicer, chickpea, Birdsfoot. c) *Sinorhizobium* - Alfafa, Sweetclover. **d)** *Bradyrhizobium* - Soybean, lupins.	**0.5x4=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 include:	
		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.	
Q.5	**a)**	**Write in brief different methods of application of carrier based biofertilizers.**	**4 Marks**
Ans:		Answer should be include following methods with example: i) Seed treatment/pelleting, ii) Root dipping, iii) Set treatment, iv) Soil application, v) Biofertigation, vi) Foliar application.	

	b)	**(i) Explain in short Indian standard specification for *Azotobacter* inoculants.**	**2 Marks**
Ans:		Answer should be include according to Indian standard specifications on following parameters: Base, cell number at the time of manufacture and at the time of expiry, Expiry period, Permissible contamination, pH, strain, carrier, others (nodulation, dry matter etc)	
		(ii) Write in brief the quality assessment tests for *Azotobacter*.	**2 Marks**
Ans:		Following points should be include i) Streak on Jensen's N-free medium- Colonies are gummy, raised with or without striations, viscous & often sticky, pigmentation, ii) Gram stain-reaction - Gram negative, iii) pH of carrier - 6.5 to 7.5, iv) N-fixation - should not be less than 10 mg/g of sucrose utilized, v) Total plate count- 10^7/g carrier.	
Q.6		**Write in brief on**	
	a)	**Strategies of mass multiplication of biofertilizers.**	**4 Marks**
Ans:		Answer should be include on following points: i) Product formulation technology - eg. agar based and broth culture, frozen concentrater, granular inoculants, carrier based, paste, pelleting, precoated seeds etc. ii) Raw materials highly absorptive, nontoxic, easy to sterilize, availability, good adhesion, have pH buffering capacity. iii) Demand. iv) Facilities - Market size, mode of production, capital, fixed cost, output, equity, net income etc. v) Marketing facilities.	
	b)	**Strategies of marketing of bioagents.**	**4Marks**
Ans:		Answer should be include on following points: Farmers acceptance, large demand, economically marketed, good quality products, well labeled packaging material, shelf life, storage and transport facilities, retail outlet, marketing network, pricing of biofertilizer, lucrative trade discount, institutional and agencies.	
Q.7	**a)**	**Discuss on microbiology of decomposition of major constituents of soil organic matter/plant residues.**	**4Marks**
Ans:		Answer should be include on following points: Decomposition of cellulose, hemicelluloses, chitin, lignin, protein, lipids, starch, pectin with microorganism involved.	**1x4=4 Marks**
	b)	**Discuss the importance of *Pseudomonas* as a biocontrol agent.**	**4 Marks**
Ans:		Brief description as a biocontrol agents includes: Secretion of pyoverdine, fluorescent yellow green siderophore, produces -pyocyanin, thioquinolobactin , induces systemic resistance in the host plant production of antagonistic compound viz. phenanzine.	
Q.8	**a)**	**Write in short mode of action and plant diseases controlled by *Trichoderma*.**	**4 Marks**
Ans:		Mode of action- Competition, mycoparasitism, antibiosis, stimulation of plant resistance and defence mechanism, lysis.	**2Marks**
		Plant diseases control - explaination with examples.	**2Marks**

	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 include:	
		1) Abiotic factors- soil temperature, type, pH, moisture, nutritional status, concentration of heavy metals, interaction among the abiotic factors. 2) Biotic factors- soil organisms, host plant.	
Q.9	**a)**	**Write in brief importance of HaNPV and *Trichogramma.***	**4 Marks**
Ans:		Explanation on following points should be include:	
		HaNPV: One of the insect pathogen infecting *Helicoverpa armigera* 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.	**2 Marks**
		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. Biology - Egg period, larval period, pupal and adult period.	**2 Marks**
	b)	**Explain in detail mass multiplication of carrier based *Trichoderma* culture.**	**4 Marks**
Ans:		Following points in description should be include: Preparation broth culture, broth quality checking, mixing of mycelial mat along with culture filtrate, drying, packaging and storage.	
Q.10	**a)**	**Describe the importance of *Verticillium* and *Metarhizium* biopesticides.**	**4 Marks**
Ans:		Answer should be include the economic importance of the bioagent, types of insect controlled with examples, microbial insecticide.	
	b)	**Describe.**	
	i)	**Packaging material and labeling requirement for biopesticides.**	**2 Marks**
Ans:		Different packaging materials and standard	**1 Marks**
		Labeling: Name of biopesticides, name of crop ,net weight, batch number, lot number, instruction on storage, direction for use and application rate, expiry date, manufacturers name, registration number, address with seal	**1Marks**
	ii)	**Ideal features for establishing insectary.**	**2 Marks**
Ans:		Following points should be include: Design, rearing technique, environmentally controlled insect rearing chambers, high PAR lighting system, transportation, insect proof net house, place to grow flora and fauna.	

Q.11 **Choose correct answer** **1x8 =8 Marks**

1) A symbiosis between a root and bacteria
Ans. c) **Bacteriorhiza**

2) A thick walled, reproductive spore formed by transformation of a vegetative cell
Ans. b) **Akinete**

3) Is the actinomycetes which is responsible for nitrogen fixation
Ans. c) ***Frankia***

4) Which aquatic fern is used to increase the yield in paddy crop
Ans. b) **Azolla**

5) Cyanobacteria secretes

Ans. b) **IAA**

6) Vinegar is obtyained from molasses with the help of

Ans. c) **a & b**

7) Which one is green manure crop

Ans. a) **Sesbaenia**

8) Species of Thiobacillus are noted for their ability to oxidise

Ans. d) **Sulfur compounds**

Q.12 **Match the pairs** **Answers** **1x8 =8 Marks**

1	*Cryptolaemus*	**(f)**	**a)**	*Fusarium*
2	*Beauveria*	**(h)**	**b)**	Cyanobacteria
3	*Paecilomyces lilacinus*	**(g)**	**c)**	PSM
4	*Pseudomonas*	**(a)**	**d)**	*Azotobacter*
5	*Pikovaskya's medium*	**(c)**	**e)**	*Azospirillum*
6	Foggs medium	**(b)**	**f)**	Mealy bugs
7	NFB semi solid medium	**(e)**	**g)**	Nematode disease
8	Ashby's medium	**(d)**	**h)**	White muscardine disease