AS-2900

B.Sc.(Hon's) (Third Semester) Examination, 2013

BOTANY- II

Paper : LBBS-304

(Plant Ecology)

Time allowed : Three hours

Maximum Marks : 30

Model answers

Section - A

Q.1) Multiple choice type questions.

Answers:

i) a) A.G.Tansely
ii) a) Living component
iii) a) Autecology
iv) a) Synecology
v) a) Genetic biodiversity
vi) b) Species biodiversity
vii) a) Succession
viii) a) Ponds
ix) a) Air
x) c) Water

Q.2) Describe the components of Ecosystem.

Ecosystem: Ecosystem is the structural and functional unit of ecology. It is related to the form, function and factor of the organisms. The ecosystem was discovered *by* **A. G. Tansely** (1935).

Component of the ecosystem are -

1. Biotic component and
2. Abiotic component

Biotic components:

The Biotic environment involves all the living organisms that come regularly into contact with each other, how they interact and their mutual influences. An ecosystem consists basically of the following-

Producers:-

Producers are organisms which are able to manufacture organic compounds from inorganic substances from their environment. Green plants are able to do this by means of photosynthesis, where the sun provides the necessary energy. Therefore these green plants are the autotrophic organisms or primary producers in most ecosystems.

Consumers:-

This component is made up of organisms which cannot make organic compounds from inorganic substances. They are dependent upon autotrophic organisms and are the consumers or heterotrophic organisms in an ecosystem. The consumers are further subdivided according to their diet, into:

Primary consumers: the organisms which eat the producers are called "primary consumers". Example: Rabbit, dear, mouse, grasshopper etc.

Secondary consumers: the organisms which kill and eat herbivores are called "secondary consumers". They are also called carnivores. Example: wolf, frog, lizard, snake, birds, cat etc.

Tertiary consumers: The organisms which kill and eat the secondary consumers are called "tertiary consumers". They are also called secondary carnivores. Example: Lion, Tiger.

Decomposers:-

The organisms which break down the dead bodies of plants, animals and animal wastes into simple organic compounds are called *decomposers*. Ex. Fungi, bacteria etc.

Abiotic components:

Abiotic or non-living components of the ecosystem comprises of following components:

1. Climatic conditions and physical factors: such as air, water, soil, temperature, light, moist, pH etc.
2. Inorganic substances: such as water, carbon, nitrogen, sulphur, phosphorus, all of which are involved in cycling of materials in the ecosystem.
3. Organic substances: such as proteins, carbohydrates, lipids, humic substances, etc., present either in the biomass or in the environment, i.e., biochemical structure that link the biotic and abiotic components of the ecosystem.

Q.3) Describe the biotic component.

Ecosystem: Ecosystem is the structural and functional unit of ecology. It is related to the form, function and factor of the organisms. The ecosystem was discovered *by* **A. G. Tansely** (1935).

Component of the ecosystem are -

1. Biotic component and
2. Abiotic component

Biotic components:

The Biotic environment involves all the living organisms that come regularly into contact with each other, how they interact and their mutual influences. A biotic system consists basically of the following-

Producers:-

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Q.4) Discuss Autecology.

Ans. Autecology is the study of a single species in relation to environment. The term '**autecology**' was first introduced by **Kirchner** and **Schroter** in 1902. Autecology gives fine details about the ecology of each species in vegetation. It becomes building stones of synecology. Autecology includes complete ecological study of a species.

Autecological Study of Plants:-

The different aspects of plants studied in autecology are given below:

1. **Systematic Study-**
   No one plant can be described well in plant science unless we know the correct scientific and local names and the systematic position of the plant.
2. **Distribution-**
   The geographic distribution, altitudes and latitudes at which the species occur, centre of origin, direction of migration, migration agencies, etc. are clearly studied.
3. **Position and Roles-**
   The species may be dominant at one particular seral stage, remain fewer at some other stages, and mat be totally absent from the other seral stages.
4. **Morphological Features-**
   Special features, variations in the structure of organs at the different stages of growth, and the variations in morphological features when it is grown under different habitat conditions are searched out clearly.
5. **Cytogenetics-**
   Cytogenetical characters help us to determine various biotypes of the species growing in different habitats.
6. **Physiology-**
   The speed of various physiological processes in the different biotypes, and the influence of various factors on the speed of the processes are clearly studied.
7. **Ecological Life Cycle-**
   The life cycle of plants in response to the rhythmic seasonal variations is called **ecological cycle** or **biological clock**. Every stage of biological clock is governed by an intensity of environmental factors. The rhythmic seasonal variations bring about rhythmicity in the stages of life cycle of plants. It influences –
   i) **Flowerin**g- The period of flowering and the influence of each and every factor in the initiation of flowering in the species are recorded properly.
   ii) **Pollination-** In plants pollination may be carried out by wind, water, insects, bats and man.
   iii) **Fruit setting-** The structure of fruits, season of fruit setting, number of seeds produced per fruit, etc. are studied in details.
   iv) **Seed Output-** The number of seeds produced by a plant in one flowering season or reproductive flux is called **seed output** of the plant.
   v) **Seed Dispersal-** Seeds are generally dispersed through the agencies such as wind, water, birds and animals. For example: seeds of *orchids* and *asclepids* are dispersed by wind, seeds of *teak, Dalbergia & mangroves* are dispersed by water, seeds of *Prunus, mulberry* are dispersed by birds.
   vi) **Seed Germination-**
   Even after dispersal, a large number of seeds is destroyed by mites, insects, birds and rodents. The rest of the seeds germinate normally. It further includes:

a) **Viability of seeds**- The potential capacity of seeds to germinate and produce seedlings is called ***seed viability***.
b) **Seed Dormancy**- Dormancy is an inability of mature viable seeds for some time to germinate even if all conditions are suitable for seed germination.
c) Size of seeds- Seed size is usually expressed by number of seeds per gram or kilogram.
d) **Germination Capacity-**The percentage of seeds capable of germination among the total number of seeds produced by a plant irrespective of time is called ***germination capacity.***

vii) Plant Percent and Seedling Establishment- Germinated seeds establish young seedlings, but all the seedlings do not survive for a long time due to some unfavourable environmental factors. Plant percent is always less than the germinative capacity of the plant.

viii) Vegetative Growth- A growth in the size of shoots and roots is called ***vegetative growth.***

Q.5) Discuss the concepts of Biodiversity.

Ans. The word biodiversity is derived from – *bios* meaning *life* and *diversity* meaning *variety*. It refers to wide variety of life on earth: to all plants, animals and micro-organisms which exist on this planet, to the various species and the ecosystems they live in.

Definition:

Biodiversity or biological diversity is the existence of a wide variety of species (species diversity) or other taxa of plants, animals and micro-organisms in a natural community or habitat, or of communities within a particular environment (ecological diversity), or of genetic variation within a species (genetic diversity).

Types of Biodiversity:

1) Genetic diversity-

It is an evident fact that each species stores an immense amount of genetic information.

2) Species diversity -

Species is a category used in the classification of organisms that consists of a group of similar individuals that can asexually or sexually breed among themselves and produce fertile offspring.

Community and Ecosystem diversity-

Diversity at the community and ecosystem level has three perspectives-

i) **Alpha diversity** (within community diversity) refers to the diversity of organisms sharing the same community.

ii) **Beta diversity** refers to the rate of replacement of species along a gradient of community.

iii) **Gamma diversity** refers to the diversity of the communities over the total landscape or geographical area.

Value of Biodiversity:

The value of biodiversity is classified into direct and indirect values.

i) Direct Values:

These are also known as commodity values or use values and invalues products harvested by the people. These are further classified as:

a) Consumptive Use Value
b) Productive Use Value

ii) Indirect Values:

Biodiversity also provides critical indirect benefits to humans that are difficult to quantify because we have never priced them. These benefits ecosystem services, such as air and water purification, climate regulation, and the generation of moisture and oxygen.

Indirect values can further be categorized as:

a) Non-consumptive Use Value
b) Aesthetic Value.
c) Social and Cultural Values.
d) Ethical Values.
e) Option Values.

Importance/Uses of Biodiversity:

1. **Food-** One of the most important values of biological resource is in providing the food. Originally plants were directly consumed from the wild. In due course of time, the wild species became the foundation for agriculture. Evaluation of food crops under century of domestication has increased the range of diversity and the development of high yielding varieties is now rapidly reversing this trend, leading to a dangerous trend of reliance on genetically uniform crops.
2. **Medicines-** In modern medicines around 200 pure chemical substances extracted from 90 species of plants are used in medicines. A host of microbial, antiviral, cardioactive and neurophysiological substances have been derived from marine fauna. Common examples of drugs and medicines derived from living organisms are Penicillin, Digitalis, Tetracycline, Quinine, Belladona, Cinnamon, etc,
3. **Timber-** Wood export produces a significant part of the export earnings of many tropical developing countries such as Malaysia, Papua New Guinea and Indonesia.
4. **Fisheries-** Fish and fishery products forms another category of great economic importance in international trade that are harvested mainly from wild sources.
5. **Fuel-** Forests have been used since ages for fuel wood. The fossil fuels like coal, petroleum, natural gas are also the products of fossilized biodiversity.
6. **Indirect uses** of biodiversity can be enumerated as follows:
    - Carbon fixation through photosynthesis
    - Pollination, gene flow, etc.
    - Maintaining essential nutrient cycles.
    - Regulating climate
    - Absorbing and decomposing pollutants.

Q.6) Describe the types of biodiversity.

Ans. **Biodiversity** or biological diversity is the existence of a wide variety of species (species diversity) or other taxa of plants, animals and micro-organisms in a natural community or habitat, or of communities within a particular environment (ecological diversity), or of genetic variation within a species (genetic diversity).

The maintenance of high level of biodiversity is important for the stability of ecosystems. Biodiversity in natural habitats represents an important pool of species and genetic material of potential use to human societies.

Types of Biodiversity:-

Biological diversity includes three hierarchical levels –

1. **Genetic biodiversity**
2. **Species biodiversity**
3. **Ecological biodiversity**

1.Genetic diversity-

It is an evident fact that each species stores an immense amount of genetic information. For instance, the number of genes is about 700 in Mycoplasma, 45000 in modern humans and 50000 in rice. Genetic diversity actually takes into consideration the variation of genes within species;

the differences could be in all alleles, in entire genes or in chromosomal structures. The genetic diversity enables a population to adapt to its environment and to respond to natural selection. Uniformity among species is established with the help of lower diversity, as is the case with large monocultures of genetically similar crop plants.

2. **Species diversity –**

Species is a category used in the classification of organisms that consists of a group of similar individuals that can asexually or sexually breed among themselves and produce fertile offspring. Species are distinct units of diversity, each playing a specific role in an ecosystem. Therefore loss of species has consequences for the ecosystem as a whole. Simplest measure of species diversity is species richness, i.e., the number of species per unit area.

3.Ecological biodiversity-

Ecological biodiversity is related to the diversity and health of the ecological complexes within which species occurs. Variation in the different ecosystem is also known as the ecological diversity.

Community and Ecosystem diversity-

Diversity at the community and ecosystem level has three perspectives-

i) **Alpha diversity** (within community diversity) refers to the diversity of organisms sharing the same community. A combination of species richness and equitability is used to represent diversity within a community.

ii) **Beta diversity** refers to the rate of replacement of species along a gradient of community.

iii) **Gamma diversity** refers to the diversity of the communities over the total landscape or geographical area.

Ecosystem diversity describes the number of niches, trophic levels and various ecological processes that sustain energy flow, food webs and the recycling of nutrients.

Q.7) Describe ecological succession.

Succession is the universal process of directional change in vegetation during ecological time. It can be recognized by the progressive change in the species composition of the community.

Theories of succession: Two types of the theories-

1. Monoclimax theory and 2. Polyclimax theory

Ecological successions may be -

1. Primary succession and 2. Secondary succession

Primary succession: if succession proceeds from a bare area where no life existed or from an area which has not been changed physically by organisms, it is called a primary succession.

Secondary succession: If succession starts on the area previously colonized, but has been cleared off, it is called secondary succession.

Process of succession:

a) Nudation
b) Migration
c) Ecesis
d) Aggregation
e) Competition
f) Interaction
g) Stabilization climax

Types of succession:

a) Hydrosere and b) Xerosere

a) **Hydrosere:** Hydrarch succession or hydrosere is a type of succession in which a pond and its community are converted into a land community.

Stages:

i) Phytoplankton stage: in this initial stage phytoplankton (e.g., some blue green algae), green algae, diatoms and bacteria are pioneer colonizers of a bare water body, such as a pond.

ii) Rooted submerged stage: the submerged stage is inhabited by the plants like *Potamogoten, Hydrilla, Vallisneria,* etc.

iii)Rooted floating stage: The floating plants are rooted in the mud, but some or all their leaves float on the surface of the water. These include species *like Nymphaea, Nelumbo and Trapa, Eichhornia, Pistia etc.*

iv) Reed swamp stage: At this stage the pond becomes a swampy ecosystem. The reed swamp species such as *Scripus, Typha, Phragmites, Rumex* and *sedges* invade the pond and latter are gradually replaced by mesic communities.

v) Sedge-meadow stage: Successive decreases in water level and changes in substratum help members of *Cyperaceae* and *Graminae* such as *Carex* spp. and *Juncus* to establish themselves. They form a mat of vegetation extending towards the centre of the pond.

vi) Woodland stage: The soil now remains drier for most of the year and becomes suitable for development of wet woodland. It is invaded by shrubs and trees such as *Salix* (willow*), Almus* (alders), and *Populus.*

vii) Climax stage: Climax is the stable community. It is the final stage of the community succession. Example forests, big trees.

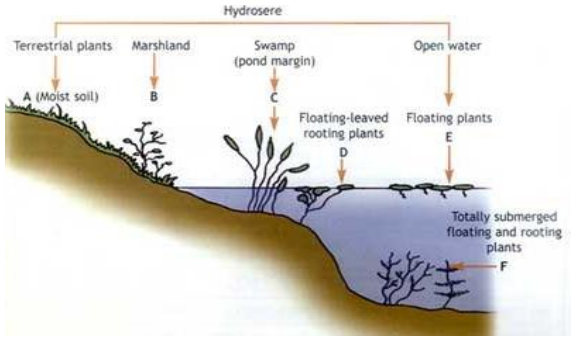

Fig: Stages of hydrosere

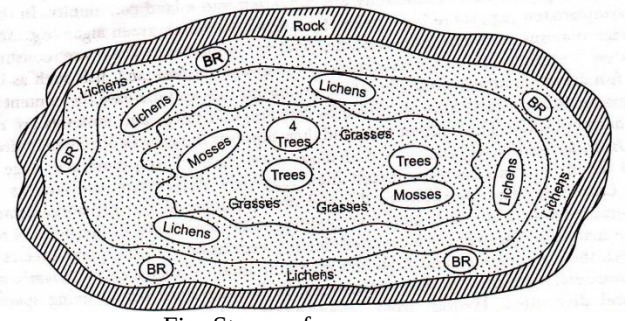

Fig: Stages of xerosere

h) Xerosere:

Xerosere is a plant succession which is limited by water availability. It includes the different stages in a *xerarch succession*.

Stages:

i)Crustose lichen stage:- A bare rock consists of solid surface or very large boulders and there is no place for rooting plants to colonize. The thalli of crustose lichens can adhere to the surface of rock and absorb moisture from atmosphere; therefore, these colonize the bare surfaces of rocks first.

Foliose lichen stage :- *Foliose* lichens have leaf-like thalli, while the *fruticose* lichens are like small bushes. They are attached to the substratum at one point only, therefore, do not cover the soil completely. They can absorb and retain more water and are able to accumulate more dust particles. Their dead remains are decomposed to humus which mixes with soil particles and help building substratum and improving soil moisture contents further. The shallow depressions in the rocks and crevices become filled with sold and topsoil layer increases further.

ii) Moss stage:- The spores of xerophytic mosses, such as *Polytrichum, Tortula,* and *Grimmia*, are brought to the rock where they succeed lichens. Their rhizoids penetrate soil among the crevices, secrete acids and corrode the rocks. The bodies of mosses are rich in organic and inorganic compounds. When these die they add these compounds to the soil, increasing the fertility of the soil.

iii)Herb stage :-In this stage, herbaceous plants form a dense growth on the soil. Example- *Fistuca, Aristida,*

iv)Shrub stage:- Due to the accumulation of more and more organic matter, the soil become suitable for the growth of shrubs. *Polycarpus.*

v)Climax stage :- Climax is the stable community. It is the final stage of the community succession. Example**:** Xerophytic trees.

Q.8) Describe Air pollution.

Air pollution can be define as "the presence of materials in air in such concentration which are harmful to man and environment".

Air pollutants: Any substance which causes undesirable change in the air known as air pollutants. Major types of air pollutants are:

1. Gaseous pollutants: pollutants which remain in gaseous form.
2. Mist: Solid particles having a diameter of more than 1 µm are known as dust whereas liquid particles with the same range of size are known as mist.
3. Aerosol: Smokes and fumes of solid or liquid particles having a diameter less than 1 µm are known as aerosol.

Sources of Air pollution: Important sources of air pollution are as follows:

1. Industries : the industries are depend upon combustion of various fuels which on burning emit varieties of air polluting gases such as CO, SO_2,H_2S, hydrocarbons,CO_2, NO_2 etc.
2. Mobiles: Locomotives, automobiles, aeroplanes etc run by petroleum products. Their exhausts release in the air CO_2, CO, nitrogen oxide, hydrocarbons and lead compounds. The hydrocarbon produced in air produce highly toxic peroxy-acetyl-nitrate.
3. Ionizing radiations: ionizing radiation emitted during atomic expulsion and testing of nuclear weapons. The main ionizing radiations are X-rays, β-rays, neutrons, gamma rays, etc.
4. Radioactive substances: these substances spread in the air during atomic explosion and testing of nuclear weapons. Example. Phosphorus-32, Iodine-131, Strontium-90, Cesium-137, etc.
5. Smog: the accumulation of smoke in air is called smog, formed by the interaction of sunlight with various constituents of the atmosphere.
6. Insecticides: use of various types of insecticides also causes air pollution.
7. Biological pollutants: air borne bacteria, fungi and pollen grains also serves as source of pollution.
8. Deforestation: Deforestation is also one of the causes of air pollution.

Types of pollutants: Air pollutants are further divided into following categories:

1. Primary air pollutants: pollutants released directly in the air are called primary pollutants. Example- carbon compounds (CO, CO_2), nitrogen compounds(N_2O, NO_2, ammonia), sulphur compounds(SO_2, S_2O_3, H_2S, Mercaptanes), halogen compounds(HF, HCl), hydrogen compounds, organic compounds etc.

2. Secondary air pollutants: The pollutants released as a result of reaction between primary pollutants in the air are known as secondary air pollutants. Ex. Nitrogen compounds, ozone, etc.

3. Biological air pollutants: The air borne pollutants such as bacteria, virus, fungi, pollen grains are known as biological pollutants.

Control of air pollution:

1. CO_2 level can be checked or minimized by increasing the area of forest and green fields.
2. SO_2 should be removed before burning of fossil fuels.

3. The use of chief fuels with sulphate contents should be replaced with the use of smokeless fuels, natural gas and nuclear power.
4. Automobile exhausts should be checked strictly with air cleaner filters.
5. Industries should separate out harmful particles before releasing their waste gases in the atmosphere by utilizing various devices such as cyclone collectors and electrostatic precipitators.
6. The poisonous gases must be treated chemically before releasing it in the air.