8 REPRODUCTION IN PLANTS

Synopsis

INTRODUCTION

I. Definition:

1. Production of new, viable and fertile off spring from the pre - existing generation.

Significance of reproduction

2. It's the most important tool for maintenance of a species, i.e. Perperuation of species.

II. Apomixis:

1. Seed formation without meiotic division and fusion of gametes.

III. Amphimixis:

1. The process of sexual reproduction, which involves meiosis and syngamy (fertilization).

MODES OF REPRODUCTION (ASEXUAL AND SEXUAL)

I. Reproduction in lower organisms

1. Binary fission:

Here two offspring are produced. The organism divides in any possible plane.

E.g. *Amoeba.*

2. Budding:

Small miniature of an adult form, still attached to the body of the parent. But may remain attached to form colony or detach from the parent.

E.g. Yeast or Hydra

3. Spore Formation:

i. Zoospores:

Motile and flagellated spores found inside a Zoosporangium. Usually naked without a cell wall. Found in alage and fungi.

E.g. *Ulothrix, Chlamydomonas*

ii. Conidia:

In ascomycetes fungi, spores are not formed inside sporangium.They are borne free at the end of specialized branches called conidophores.They are non-motile E.g. *Aspergillus, Penicillium*

II. Reproduction in plants:

1. Vegetative reproduction: ability of plants to reproduce without sexual reproduction, by producing new plants from existing vegetative structures.

2. Asexual reproduction: Mode of reproduction by which offsprings arise from a single parent, and inherit the genes of that parent only production of new cells by simple division of parent cell into two daughter cells.

3. Sexual reproduction: Creation of a new organism by involving the fusion of two gametes and thus combining the genetic material of two organisms.

III. Vegetative reproduction:

1. Natural

i. Root

ii. Stem

iii. Leaf

2. Artificial

i. Cutting

ii. Grafting

iii. Micropropagation

IV. Natural vegetative reproduction:

1. Roots:

i. Adventitious Roots :

In some plants adventitious roots store food and become fleshy. They get swollen and assume following shapes:

a. Tuberous roots:

These adventitious roots are without any shape. Here adventitious roots arise from nodes. Some of these roots develop into root tubers.

E.g. Sweet potato

b. Fasciculated Roots:

In some cases tuberous roots occur in clusters at the base of stem, they are known as fasciculated roots.

E.g. *Dahlia, Asparagus* etc

c. Non-fleshy roots:

In some plants like *Dalbergia sissoo*, the adventitious roots have the capability of giving rise to new plants. Adventitious buds develop on ordinary roots.

E.g. *Populus*, guava, *Murraya*

2. Underground stems:

i. Rhizome:

E.g. Ginger, Banana, Turmeric, Sugarcane

ii. Corm:

E.g. *Colocassia*, Saffron, *Gladiolus, Amorphophallus*

iii. Bulb:

E.g. Onion, Garlic

iv. Tuber:

Top underground branches most often located near the soil surface which swell at the ends forming the storage organs called as tubers.

E.g. Potato (has photosensitive areas called as eyes from which new shoots arise)

3. Sub-aerial stems:

i. Runners:

a. A slender creeping stem that puts forth roots from nodes spaced at intervals along its length giving rise to plantlets at the nodes. Modified stem arising from axillary bud.

b. Usually possess greatly lenghtened internodes.

E.g. Grasses, *Oxalis, Cynodon* (doob grass)

ii. Stolons:

E.g. Strawberry, *Vallisneria*

iii. Offsets(aquatic runner):

E.g. *Pistia, Eichhornia*

iv. Suckers:

E.g. *Chrysanthemum*

4. Leaves:

i. In some plants, the leaf has many adventitious buds on its margins.

ii. A new plant arises from these buds when the leaf falls on the moist soil.

E.g. *Bryophyllum*

V. Artificial vegetative reproduction:

1. Cutting:

A detached portion of a living plant, such as a bud or leaf, that can produce a new daughter plant if grown in soil or in a suitable culture medium.

E.g. Carnations, rose, lemon

2. Grafting:

i. It is most commonly used for the propagation of trees and shrubs grown commercially.

ii. In most cases, one plant is selected for its roots, and this is called the stock or rootstock (efficient rooting system; disease resistant).

iii. The other plant is selected for its stems, leaves, flowers, or fruits and is called the scion (poorly developed root system).

iv. For successful grafting, the vascular cambium tissues of the stock and scion plants must be placed in contact with each other.

v. Successful grafting only requires that a vascular connection take place between the two tissues.

vi. Used only in dicots as cambium needed for wood healing is absent in monocotyledons.

3. Micropropagation:

i. A tissue culture tenchique for plant propagation in which offspring are cloned from tissue taken from a single plant.

ii. The explant material including stem tips, anthers, petals, pollen and other plant tissues are placed on a growth medium, typically containing sucrose as an energy source and one or more plant growth regulators (plant hormones). Auxin is rooting agent and cytokinin is shooting agent.

iii. The medium is thickened with agar to create a gel which supports the explant during growth.

iv. The plant tissue grows and differentiates into new tissues and then finally the whole plant.

SEXUAL REPRODUCTION

Reproductive organ of the angiosperms: Flower

Flower is modified shoot which shows favourable adaptation for reproduction

Male sex organs: Androecium

Female sex organ: Gynoecium

I. Events in sexual reproduction

1. Pre-fertilization events:

i. Gametogenesis.

ii. Gamete transfer- self pollination or cross pollination.

2. Syngamy/fertilization

3. Post fertilization events:

i. The zygote and embryogenesis.

ii. The PEN and endosperm development.

iii. Fruits and seeds.

II. Sexual reproduction in flowering plants - Male reproductive system:

1. Androecium:

i. Male reproductive organ: Androecium.

ii. Its unit is called stamen: the pollen producing reproductive organ of a flower.

a. Male gamete: Male nucleus.

b. Microgametophyte: Pollen grain with pollen tube.

c. Microsporangium: pollen sac.

d. Microsporophyll: Androecium.

2. Parts of stamen:

i. Stamens: male reproductive organs of flowering plants.

ii. They consist of anther and filament.

iii. Each anther is bi-lobed structure i.e. Dithecous.

iv. Attached to the filament either at the base of in the middle portion.

v. The sterile tissue between the lobes is called the connective.

vi. Each lobe has two chambers or pollen sacs. Therefore, tetrasporangiate.

3. Structure of anther:

i. Epidermis.

a. Outermost layer.

b. Protective in function.

ii. Endothecium:

a. Single celled thick layer below the epidermis.

b. Callose bands are also present along the radial walls.

c. Endothecium becomes hygroscopic in nature due to the presence of fibrous thickenings.

d. Helps in dehiscence of anther.

iii. Middle layer:

a. Consist of parenchymatous cells.

b. Food storing 1 to 3 cell layered thick.

iv. Tapetum:

a. Innermost nutritive layer.

b. Single celled thick layer surrounding pollen.

c. Cells of tapetum are initially diploid but become polyploid due to endomitosis.

d. Secretion of enzymes and hormones.

v. Pollen sac:

a. Four pollen sacs are present in the anther, called microsporangia.

b. Inside the pollen sacs, pollen grains (microspores) are formed by meiotic division of microspore mother cells.

4. Microsporogenesis:

i. Each microspore mother cell divides to form four haploid pollen grains by meiotic division.

ii. Initially all four microspores are attached together with callose layer.

iii. This group of microspores is called tetrad.

iv. Most common type of tetrad is tetrahedral.

5. Microgametogenesis:

i. We have four haploid microspores/ pollen grain arranged in group of four pollen callled pollen tetrad.

ii. Through mitosis each microspore divides into two cells.

iii. A large tube/vegetative cell and a small generative cell.

iv. Vegetative cell is used for formation of pollen tube during pollen germination on stigma.

v. Later the generative cell divides and forms two sperm cells.

vi. They remain in the tube cell cytoplasm.

vii. This three celled structure is the mature male gametophyte; mature pollen.

6. Pollen:

i. Partly germinated microspore representing the male gametophyte.

ii. It has vegetative cell, generative cell and primary distal aperture for germination.

iii. Sporoderm-two major walls of pollen.

iv. The pollen wall consists of two layers:

v. Exine: Formed by cutin and sporopollenin.

vi. Sporopollenin is highly resistant material and non-biodegradable.

vii. Intine: Made up of pectin and cellulose or pecto-cellulose.

III. Sexual reproduction in flowering plants - Female reproductive system:

1. Gynoecium:

i. Female reproductive organ: Gynoecium or pistil.

ii. Its unit is called carpel.

a. Megaspore: Egg nucleus.

b. Megagametophyte: Embryo sac.

c. Megasporangium: Ovule.

d. Megasporophyll: Gynoecium.

2. Parts of carpel:

i. Stigma: Receptive spot of carpel where pollen grains get lodged during pollination.

ii. Style: Long narrow tubular structure in between stigma and ovary.

iii. Ovary: The basal swollen portion of carpel which bears one or more oval structures called ovules.

3. Structure of ovule or megasporangium:

i. The ovule is attached to placenta by means of a stalk called funicle or funiculus.

ii. The main body of ovule is made up of parenchymatous tissue called nucellus.

iii. Nucellus, on the outside covered by one or two covering called integuments and hence ovule is called integumented megasporangium.

iv. The place of junction of integuments and nucellus is chalaza.

v. In inverted ovules, the stalk or funiculus is attached to the main body of ovule for some distance to form a ridge like structure called raphe.

vi. The point of attachment of the funicle with the ovule is called hilum.

vii. The integuments cover entire nucellus except a small pore at the upper end, called micropyle; generally formed by the inner integument.

4. Types of ovules:
   i. Orthotropous or atropous or straight.
   a. Most primitive and simplest type of ovule.
   b. Erect; micropyle, chalaza and funiculus are in one line.
   E.g. Gymnosperms
   ii. Antropous or inverted.
   a. Most common type found in angiosperms.
   b. Ovule is completely inverted in its orientation due to ~ 180⁰ curvature of funiculus.
   c. Longitudinal axis of the nucellus is parallel to the funicular axis.
   d. The micropyle comes near the hilum and faces towards the placenta.
   E.g. Angiosperms
5. Megasporogenesis:
   i. Formation of megaspores (n) from megaspore mother cell (2n) inside the megasporangium (ovule) is called megasporogenesis.
   ii. The megaspore mother cell (2n) undergoes meiosis to form a linear tetrad of 4 haploid megaspores.
   iii. Generally, 3 megaspores towards micropylar end degenerate and 4 th towards chalazal end remains i.e. functional megaspore which develops into embryo sac or female gametophyte.
6. Megagametogenesis:
   i. The remaining one megaspore is known as functional megaspore.
   ii. Nucleus of the megaspore divides mitotically to form two nuclei, each nucleus moves toward their respective opposite poles.
   iii. Here they divide mitotically twice and 4- 4 nuclei are formed at each pole.
   iv. Out of the four, 1-1 nuclei from each end i.e. chalazal and micropylar come to the center and are known as polar nuclei.
   v. Resulting three nuclei at each pole get surrounded by cytoplasm to form cells as a result of cytokinesis.
   vi. Three cells are formed at the micropyle in which one cell is large and more distinct, that is the egg cell and the other cells are the synergids.
   vii. These three micropylar cells are collectively known as egg apparatus(1 egg cell + 2 synergids).
   viii. The three cells formed towards chalaza are called antipodal cells.
   ix. This 8-nucleated and 7-celled structure is called female gametophyte or embryo sac of angiosperms.
   x. Both the polar nuclei are present in central cell but just before fertilization cthey unite and fuse together in center to form secondary nucleus.
7. Embryo sac:
   i. Organization of mature embryo sac.
   ii. Mature embryo sac contains 7 cells and 8 nuclei arranged in the following manner-
   a. Egg apparatus (3)
      - synergid cells
      - egg cell
   b. Central cell (1)
   c. Antipodal cells (3)
   iii. *Polygonum* type:
   a. Most common type, found in 70% angiosperms.
   b. First reported by Strasburger in 1879 in *Polygonum.*
   c. Develops from single chalazal megaspore of megaspores tetrad.
   d. Mature embryo has 8 nuclei and 7 cells.

POLLINATION: TYPES AND AGENCIES

The transfer of pollen from anther to stigma of the same or different flowers (of same or different plant) of the same species is known as pollination.

Process occurs only in gymnosperms and angiosperms.

I. Self pollination/Autogamy:

1. When pollen grains are transferrred from anther to stigma of the same flower, or different flowers of the same plant.

   E.g. Mustard, Wheat, Pea and Rice.

2. Geitonogamy- when pollination occurs between two flowers of the same plant. From genetic point of view self pollination as it forms genetically identical plants. But ecologically its considered as cross pollination.

II. Cross pollination/Allogamy:

1. When the pollen is transfered from anther to stigma of different flowers.

2. Xenogamy-When pollination occurs betweeen two different flowers of two different plants of same species. This is real or true cross pollination, genetically as well as ecologically.

III. Adaptation for cross pollination:

1. Unisexually/dicliny- unisexually confirms cross pollination, unisexual flowers are either staminate or pistillate.

2. When flowers are unisexual, the two conditions of plants are:

   i. Monoecious plants: Having both staminate and pistillate flowers.

      E.g. Maize, Castor, Coconut, Banana

   ii. Dioecious plants: When two types of unisexual flowers are present on two different plants. Male plant bears staminate flowers and female plant bears pistillate flowers.

      E.g. Papaya, Hemp, *Asparagus*, Date palm, Spinach

3. Dichogamy: This is condition of bisexual flowers where male and female parts mature at different time.

   i. Protogyny-bajra, *Aristolochia.*

   ii. Protoandry- cotton, marigold, *Impatiens.*

4. Heterostyly: There is difference in betwen the length of the filament of stamen and length of style in flowers of some plants. This causes cross pollination.

   E.g. *Linum, Primula*

5. Self sterility/self incompatibility: In this condition the pollen grain of the flower can't germinate on the stigma of the same flower.

   E.g. *Petunia,* Apple, *Vitis, Passiflora,* Radish

IV. Methods/Agencies of cross pollination

Cross polination is favoured by nature as it leads to hybrid/superior progeny.

1. Anemophily:

Pollination by wind is called anemophily and such plants are called anemophilous plants.

   i. Pollen present in large number which are small dry and light in weight.

   ii. Feathery/brushy stigma too receive the pollen.

      E.g. Grasses and Palms, all Gymnosperms

   iii. Anemophilous flowers are neither attractive i.e. non essential whorls llike calyx, corolla, bracts are not showy, nor with fragrance They don't have nectar glands. Anemophilous flowers are generally unisexual.

      E.g. Sugarcane, Bamboo, Coconut, *Cannabis,* Grasses, Date palms, *Typha*

2. Hydrophily:

Pollination by water.

   i. Inconspicuous and small flowers.

   ii. Odour, nectar and colour absent in flowers.

   iii. Flower whorls, if present , then coated by wax.

   iv Pollen grains small, light weighted , non-sticky and coated by wax.

   v. Stigma un-wettable but sticky.

vi. Hydrophilous plants may be pollinated inside the water (hypohydrophily) as in Zostera and Ceratophyllum or at the surface of water (epihydrophily) e.g. *Vallisneria* (Tape grass, Ribbon weed).

vii. *Vallisneria* is a dioecious rooted submerged aquatic plant in which male flowers are small and light weight.

viii. Female flowers have very long coiled pedicels whcih uncoil when they become mature.

ix. Male flowers float at the surface of water.

x. As soon as the male flowers touch the female flowers, anther lobes burst, stigma receives the pollen grains and pedicels coil again.

3. Entomophily:

Pollination with the help of insects.

i. Nectar produced by nectariferous plants which attracts the pollinators.

ii. Edible pollen producing.

E.g. Rose, *Papaver, Clematis*

iii. Fragrant and scent emitting flowers.

E.g. Jasmine, *Cestrum*

iv. Special adaptations for insect pollination: Turn pipe/lever mechanism.

E.g. *Salvia*

5. Ornithophily:

Pollination by birds.

i. Large flowers with bell shaped corolla.

ii. Flowers are brightly coloured but odourless and produce plenty of nectar and large quantity of pollens.

E.g. *Bombax* (red silk cotton), *Callistemon* (bottle brush), *Sterlitzia, Erythrina* (coral tree) etc.

ii. Honey bird, humming bird and sun bird are common pollinators.

6. Chiropterophily:

Pollination by bats.

i. Plants show large and stout flowers which open at night (nocturnal).

ii. Bats pollinate the flowers of tropical regions. E.g. *Anthocephallus* (Kadamb), Cactus

DOUBLE FERTILIZATION: PROCESS AND SIGNIFICANCE

i. Fertilization (also known as conceptiion, fecundation and syngamy) is the fusion of gametes to produce a new organism.

ii. Fertilization was first reported by Strasburger in 1884 in *Monotropa.*

iii. In angiosperms, the male gametes are carried to the egg by a pollen tube. This process is called siphonogamy.

I. Germination and growth of pollen on stigma:

i. Pollen absorbs secretion of stigma (sugar , gum, resins) and swell up.

ii. After mutual recognition, pollen germinates

II. Pollen tube:

i. Pollen absorbs secretion of stigma, exine ruptures and intine comes out in the form of pollen tube.

III. Path taken by pollen tube:

i. After entry into sigma pollen tube grows through the stylar tissue and finally reaches the ovule.

IV. Entry of pollen tube into the ovule:

i. Through micropyle - Porogamy: most common in angiosperms.

E.g. Lily

ii. Through chalaza - Chalazogamy: less common in angiosperms.

E.g. *Betula, Casuarnia, Juglans*

iii. Through integuments or funiculus - Mesogamy

E.g. *Cucurbita, Pistacia*

V. Entry of pollen tube into embryo sac or female gametophyte:

i. Whatever be the entry of the pollen tube into the ovule, the pollen tube always enters the embryo sac at micropylar end.

ii. One synergid is always degenerated by pollen tube.

iii. The tip of the pollen tube is degenerated by hydrolytic substances secreted by the degenerating synergid.

iv. The contents of the pollen tube are discharged in the degenerating synergid and the pollen tube does not grow beyond it in the embryo sac.

vi Now the pollen tube is in embryo sac and the 2 male gametes are discharged through a sub terminal pore.

VI. Fusion of gametes:

i. One of the male gametes called the first male gamete moves towards the egg and fuses with it.

ii. This event is called syngamy or true fertilization; results in the formation of a diploid structure called zygote (2n), which is the first cell of the next generation i.e. sporophyte.

iii. The second male gamete fuses with the secendory nucleus or two polar nuclei to form triploid primary endosperm nucleus (PEN).

iv. This is called triple fusion. The result of triple fusion i.e. primary endosperm nucleus (3n) ultimately developes into a nutritive tissue for developing embryo celled endosperm.

VII. Double fertilization:

i. The syngamy and triple fusion occcurs simultaneously in angiosperms and this is called double fertilization.

ii. Double fertilization was first reported by S.G. Nawaschin (1898) in *Lilium* and *Fritillaria.*

iii. Double fertilization is unique and universal to angiosperms.

iv. Total number of nuclei involved in double fertilization are 5 (2 + 3) i.e. two in syngamy and three in triple fusion.

POST FERTILIZATION CHANGES

Soon after the act of double fertilization the flower begins to loose its shine, the petals, stamen and style fall and wither away. The calyx however may persist as in tomato and brinjal.

I. Major events are:

1. Development of endosperm from triploid primary endosperm nucleus in the central cell of embryo sac.
2. Development of embryo from diploid zygote.
3. Development of seed from ovule.
4. Development of fruit from ovary.

II. Fate of various parts:

Part before fertilization	Part after fertilization
Flower	Simple or aggregate fruit
Calyx	Fall off or remain attached
Corolla	Fall off
Stamens	Fall off
Ovary wall	Pericarp of fruit
Ovary	Simple fruit
Ovule	Seed
Outer integument	Testa (rough)
Inner integument	Tegmen (delicate)
Nucellus	Perisperm
Endosperm nucleus	Endosperm
Egg cell	Embryo
Funiculus	Stalk
Antipodals	Degenerate
Synergids	Degenerate

III. Endosperm:

As a result of triple fusion, a triploid structure called primary endospore nucleus (PEN) is formed. It divides mitotically and forms a mass of nutritive cells called the endosperm.

1. Types of endosperm:

On the basis of mode of development.

i. Nuclear endosperm:

a. It is most common type of endosperm development, found in 56% of angiosperms.

b. Here PEN divides by free nuclear division which are not followed by cell wall formation. Thus free nuclei remain in the cytoplasm of embryo sac.

c. A big central vacuole pushes all nuclei to the peripheral cytoplasm.

d. Later, these nuclei are arrange around the periphery of embryo sac.

e. Now cell wall formation takes place from periphery to center (centripetal).

ii. Cellular endosperm:

a. Found in 25 % of Angiosperm families particularly dicotyledonous families in which embryo develops slowly.

b. Here first and further nuclear division of PEN is followed by cytokinesis or wall formation and thus endosperm tissue is completely cellular.

iii. Helobial endosperm:

a. It is an intermediate type of endosperm found exclusively in Helobiae series of monocots.

2. Functions of endosperm:

i. Forms sufficient food for developing embryo. In majority of angiosperms division of zygote takes place only after endosperm has formed.

3. Endospermic and non-endospermic seeds:

i. Non endospermic/exalbuminous seeds- here no endosperm is left at maturity. Cotyledons of seeds are thick here due to storage of food.

E.g. Gram, Pea, Beans, *Tamarindus*, Orchids

iii. Endospermic/albuminous seeds- here the endosperm is not fully utillilzed and some amount is left in the seeds. Cotyledons are thin.

E.g. Wheat, Rice, Barley, Castor, Poppy, Palms

IV. Embryogenesis:

i. The first step in the development of the plant zygote is pre-determined mode of development: embryogensis.

ii. It gives rise to organized mass of cells called the embryo, that has the potential to form the complete plant.

1. Embryo:

i In majority of the angiosperms, the zygote (fertilized egg) divides by asymmetric mitotic division and generates two cells with two different fates.

ii. When endosperm is formed, development of zygote starts. In the beginning it absorbs food from endosperm and increase in size then a layer is formed by itself. Now its called oospore.

iii. First division of oospore is transverse and as a result two cells are formed. The one that lies towards micropyle is called basal cell or suspensor cell. The basal cell does not take part in subsequent development of embryo proper.

iv. The other cell is formed towards the chalaza is called apical cell or terminal/embryonal cell.

2. Basal and terminal cell:

i. Basal cells divide transversely and apical cells divide vertically resulting in two suspensor cells and two apical cells.

ii. This stage is made of four cells which are arranged in "T" shaped structure.

iii. Apical cells divide vertically to form 4 apical cells. This is the quadrant stage of embryo.

iv. The two basal suspensor cells divide transversely forming a 6 - 10 celled long filament like structure i.e. suspensor.

v. Suspensor; mainly functions to push developing embryo into food laden endosperm to provide nutrition.

3. Quadrant to octant stage:

i. Quadrant is made up of 4 apical cells. The four celled quadrant embryo further divides transversely to form 8 celled octant stage of embryo.

4. Globular embryo

i. All the cells of the embryo divide by periclinal division, so that a 16 celled globular embryo is formed (pro- embryo).

ii. Due to fast division of the cells of globular embryo and differential growth in the cotyledonary region that the plumule, a heart shaped embryo is formed.

iii. Due to fast growth in two lobes of the heart shaped embryo they develop into cotyledons, thath are curved due to curved position of body of ovule.

iv. Plumule is formed below the joining position of two cotyledons. Behind it epicotyl is formed.

v. The tissues present opposite to the plumule near the hypophysis give rise to radicle.

vi. The apex root (root cap) is formed by hypophysis.

vii This curved position of embryo is called horse-shoe stage.

viii. An axis present between plumule and radicle is called embryonal axis. Its called tigellum (main embryonal axis).

ix. Both the cotyledons are present at lateral position of embryonal axis and plumule is formed in terminal position in dicotyledon embryo.

x. Ovule is modified into seed in which testa is formed by outer integument and tegmen is formed by inner integument.

V. Parthenocarpy:

1. Formation of fruits without fertilization.
2. Results in seedless fruits.
3. Can also be induced using gibberellins.

E.g. Banana, Grapes

VI. Polyembryony:

1. Many embryos are formed inside the sinlgle seed.
2. Observed by Leeuwenhoek in Citrus (Orange) seeds.

CLASS WORK

Multiple Choice Questions

8.1 Modes of Reproduction (Asexual):

(1) Plants identical to mother plants can be had from

(a) Its seeds (b) Stem cuttings

(c) Its fruits (d) Hybridisation

(2) Which of the following is not a method of vegetative propagation

(a) Sowing (b) Cutting

(c) Layering (d) Grafting

(3) A clone is a group of individuals obtained through

(a) Self pollination

(b) Vegetative propagation

(c) Hybridisation

(d) Cross pollination

(4) Micropropagation is

(a) Microtomy of propagating organ

(b) Plant production from microspores

(c) Propagation of microbes

(d) Technique of obtaining new plants by cultivating cells or tissue in culture medium

(5) Micropropagation is carried out by

(a) Hybridisation

(b) Genetic recombination

(c) Parasexual mechanism

(d) Tissue culture

(6) *Begonia* reproduces vegetatively by

(a) Vegetative buds

(b) Adventitious buds

(c) Floral bud

(d) Bulbils

(7) Vegetative reproduction through offset is common in

(a) *Antigonon* (b) *Eichhornia*

(c) *Elodea* (d) *Amorphophallus*

(8) In *Amorphophallus*, vegetative reproduction is carried out through

(a) Bulbs (b) Offset

(c) Corm (d) Rhizome

(9) Scion is a term in relation to

(a) Grafting (b) Palaeobotany

(c) Embryology (d) Emasculation

(10) On the margins of leaves of a plant called *Bryophyllum*, tiny plants grow complete with roots. These tiny plants fall off and continue to grow. This is a form of

(a) Sexual reproduction

(b) Reproduction by fission

(c) Vegetative reproduction

(d) Hermaphroditism

(11) Vegetative growth (propagation) of potato is by

(a) Rhizome (b) Tuber

(c) Sucker (d) Bulb

(12) Grafting is not possible in monocots because they

(a) Have scattered vascular bundles

(b) Have parallel venation in leaves

(c) Lack cambium

(d) Are herbaceous

(13) The 'eyes' of the potato tuber are

(a) flower buds (b) shoot buds

(c) axillary buds (d) root buds

(14) Grafting is successful in dicots but not in monocots because the dicots have

(a) vascular bundle arranged in a ring

(b) cambium for secondary growth

(c) vessels with element arranged end to end

(d) cork cambium

(15) In which one pair, both the plants can be vegetatively propagated by leaf pieces ?

(a) Bryophyllum and Kalanchoe

(b) Chrysanthemum and Agave

(c) Agave and Kalanchoe

(d) Asparagus and Bryophyllum

8.2 Sexual Reproduction:

(16) In monoecious plants

(a) Male and female parts are borne by the same flower.

(b) Male and female parts are borne by different plants.

(c) Male and female parts are borne by the same plant but not by the same flower.

(d) Male, female and neuter flowers are borne by the same plant.

(17) A flower is a modified

(a) Fruit (b) Root

(c) Shoot (d) All (a) (b) (c)

(18) Which is the most logical sequence with reference to life cycle of angiosperms ?

(a) Germination, endosperm formation, seed dispersal, double fertilization

(b) Cleavage, fertilization, grafting, fruit formation

(c) Pollination, fertilization, seed formation, germination

(d) Maturation, mitosis, differentiation, fertilization

(19) Anther is generally composed of

(a) Two sporangia

(b) Three sporangia

(c) Four sporangia

(d) Only one sporangium

(20) When a microspore mother cell with 40 chromosomes undergoes meiosis, each of the four resulting cells has

(a) 80 chromosomes (b) 40 chromosomes

(c) 20 chromosomes (d) 10 chromosomes

(21) How many pollen grains can be formed after meiotic division in 10 microspore mother cells ?

(a) 80 (b) 40 (c) 20 (d) 10

(22) The number of meiotic divisions necessary to produce 1000 pollen grains

(a) 200 (b) 250 (c) 500 (d) 1000

(23) The tapetal nuclei in anthers of many angiosperm flowers are

(a) Mostly aneuploid

(b) Mostly polyploidy

(c) Mostly haploid

(d) Not having complete haploid genome

(24) Which of the following statements is correct for the pollen tube ?

(a) It shows chemotactic movement

(b) It shows only tip growth

(c) It is composed of three non-cellular zones

(d) It shows radial cytoplasmic streaming

(25) Which part of the reproductive structure produces both enzymes and hormones ?

(a) Archesporium (b) Middle layer

(c) Tapetum (d) Endothecium

(26) Even after killing the generative cell with a laser beam, the pollen grain of a flowering plant germinates and produces normal pollen tube because

(a) Laser beam stimulates pollen germination and pollen tube growth

(b) The vegetative cell has not been damaged

(c) The contents of killed generative cell permit germination and pollen tube growth

(d) The laser beam does not damage the region from which pollen tube emerges

(27) Germ pore is the region where the exine is

(a) Thin (b) Uniform

(c) Thick and uniform (d) Absent

(28) Pollen grain in angiosperms is released at which stage

(a) 1-celled (b) 2-celled

(c) 3-celled (d) 2 or 3-celled

(29) Male gametophyte of Angiosperms is reduced to

(a) one cell (b) two cells

(c) three cells (d) four cells

(30) Male gamete in angiosperm is produced by

(a) generative cell (b) microspore cell

(c) vegetative cell (d) tube cell

(31) Larger nucleus in a pollen grain is

(a) tube nucleus

(b) sperm nucleus

(c) generative nucleus

(d) none of these

(32) Tapetum is

(a) protective (b) reproductive

(c) nutritive (d) respiratory

(33) The nutritive layer of microsporangia of *Cypsella.*

(a) endothecium

(b) exothecium

(c) sporogenous tissue

(d) tapetum

(34) Which one of the following is most resistant to enzyme action ?

(a) Cork (b) Wood fibre

(c) Pollen exine (d) Leaf cuticle

(35) In angiosperms, an ovule represents

(a) Megasporophyll

(b) Megasporangium

(c) A megaspore

(d) A megaspore mother cell

(36) Part of the gynoecium which receives the pollen is called

(a) Style (b) Stigma (c) Ovule (d) Ovary

(37) The ovule is attached to the placenta by

(a) Hilum (b) Funicle (c) Petiole (d) Pedicel

(38) The tissue which attaches the ovules with the ovary is

(a) Placenta (b) Chalaza

(c) Funicle (d) Hilum

(39) An orthotropous ovule is one in which micropyle and chalaza are

(a) Oblique to funiculus

(b) At right angles to funiculus

(c) Parallel to funiculus

(d) In straight line of funiculus

(40) Stalk of ovule is called

(a) Funicle (b) Caruncle

(c) Nucellus (d) Pedicle

(41) The point where funicle joins with ovule is known as

(a) Chalaza (b) Hilum

(c) Integument (d) Micropyle

(42) Generally the number of integuments in the ovule of Angiosperms and Gymnosperms is

(a) One and two (b) One and one

(c) Two and one (d) Two and two

(43) When the hilum, chalaza and micropyle of the ovule lie in the same longitudinal axis, it is known as

(a) Anatropous ovule

(b) Amphitropous ovule

(c) Campylotropous ovule

(d) Orthotropous ovule

(44) Meiotic division in an ovule takes place in

(a) Megaspore

(b) Archesporium

(c) Nucellus

(d) Megaspore mother cell

(45) The sequence of development of embryo sac is

(a) Archesporium → Megaspore → Megaspo-rophyte → Embryo sac

(b) Archesporium → Megaspore → Megaspore mother cell → Embryo sac

(c) Archesporium → Megaspore mother cell → Megaspore → Embryo sac

(d) None of the above

(46) Which one is female gametophyte ?

(a) Embryo (b) Embryo sac

(c) Endosperm (d) Synergid

(47) Embryo sac is found in

(a) Endosperm (b) Embryo

(c) Ovule (d) Seed

(48) In an embryo sac of a typical Angiosperm there are

(a) Egg, synergids and antipodals

(b) Egg, synergids, polar nuclei and antipodals

(c) Egg, synergids, central cell and polar nuclei

(d) Egg, synergids and secondary cell

(49) A typical angiospermic embryo sac is usually

(a) One-celled (b) Two-celled

(c) Four-celled (d) Seven-celled

(50) The female gametophyte of a typical dicot at the time of fertilization is

(a) 8-celled (b) 7-celled

(c) 6-celled (d) 4-celled

(51) Embryo sac is called monosporic when it develops from -

(a) All the four megaspores

(b) Only from two functional megaspores

(c) Three megaspores

(d) One of the megaspores out of the four megaspores which are derived from division of megaspore mother cell

(52) A polygonum type of embryo sac is

(a) 7-celled and 8-nucleate

(b) 8-celled and 7-nucleate

(c) 7-celled and 7-nucleate

(d) 8-celled and 8-nucleate

(53) Monosporic 8-nucleate female gametophyte is found in

(a) *Fritillaria* (b) *Polygonum*

(c) *Adoxa* (d) *Allium*

(54) Monosporic 8-nucleate embryo sac is

(a) *Oenothera* type (b) *Allium* type

(c) *Polygonum* type (d) *Pepromia* type

(55) In Angiosperms, the functional megaspore of a linear tetrad is the

(a) First nearest to the micropyle

(b) Second from micropyle

(c) Third from micropyle

(d) Fourth from micropyle

(56) The microscopic structure in flower that contains polar nuclei is

(a) Only gametophyte

(b) Pollen tube

(c) Embryo sac

(d) None of the above

(57) During the formation of embryo sac, the functional megaspore undergoes

(a) two mitotic divisions

(b) two meiotic divisions

(c) three meiotic divisions

(d) three mitotic divisions

(58) Raphe is

(a) part of flower

(b) funicle attached to ovule

(c) ridge formed by funiculus

(d) parts of nucellus

(59) Embryo sac is also known as

(a) micro-gametophyte

(b) mega-gametophyte

(c) micro-sporangium

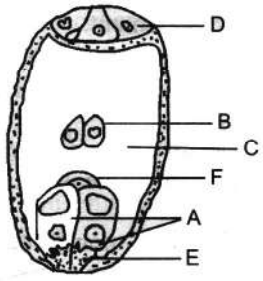
(d) mega-sporangium

(60) Filiform apparatus is a characteristic feature of

(a) egg (b) synergid

(c) zygote (d) suspensor

(61)



In the given diagram, parts labelled as A, B, C, D, E and F are respectively identified as

(a) synergids, polar nuclei, central cell, antipodals, filiform apparatus and egg

(b) polar nuclei, egg, antipodals, central cell filiform apparatus and synergids

(c) egg, synergids, central cell, filiform apparatus, antipodals and polar nuclei

(d) central cell, polar nuclei, filiform apparatus, antipodals, synergids and egg

(62) Which one of the following pairs of plant structures has haploid number of chromosomes ?

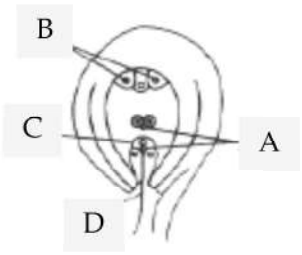
(a) Megaspore mother cell and antipodal cells

(b) Egg cell and antipodal cells

(c) Nucellus and antipodal cells

(d) Egg nucleus and secondary nucleus

(63) Which of the following indicates correct names of A,B, C and D regions of the given diagram?



(a) A – Male gamete B – Antipodals
C – Egg cell D – Pollen tube

(b) A – Synergids B – Secondary nucleus
C – Egg apparatus D – Integuments

(c) A – Antipodals B – Male gametes
C – Zygote D – Micropyle

(d) A – Secondary nucleus B – Synergids
C – Egg cell D – Integuments

(64) The arrangement of the nuclei in a normal embryo sac in the dicot plants, is

(a) 2 + 4 + 2 (b) 3 + 2 + 3
(c) 2 + 3 + 3 (d) 3 + 3 + 2

(65) Which of the following statement is/are true?

I. Endothecium lies below epidermis
II. Fusion of egg with male gamete is called apogamy
III. Synergids are haploid
IV. The point at which funicle touches the ovule is raphe.

(a) II and IV only (b) I and II only
(c) I and IV only (d) I and III only

8.3 Pollination: Types and Agencies:

(66) Pollination is best defined as

(a) Germination of pollen grains
(b) Visiting of flowers by insects
(c) Transfer of pollen from anther to stigma
(d) Growth of pollen tube in ovule

(67) Pollination is characteristic of

(a) Bryophytes (b) Fungi
(c) Angiosperms (d) Pteridophytes

(68) Pollination characteristically occurs in

(a) Angiosperms and Fungi
(b) Angiosperms and Gymnosperms
(c) Pteridophytes and Angiosperms
(d) Bryophytes and Angiosperms

(69) Self pollination means

(a) Transfer of pollen from anthers to stigma in the same flower
(b) Transfer of pollen from one flower to another on the same plant
(c) Occurrence of male and female sex organs in the same flower
(d) Germination of pollen within the anther

(70) Which prevents self-pollination ?

(a) Unisexuality (b) Dichogamy
(c) Self sterility (d) All the above

(71) If a pollen of a flower falls on the stigma of another flower belonging to the same plant it is

(a) Ecologically cross-pollination
(b) Genetically and ecologically cross-pollination
(c) Genetically self-pollination and ecologically cross-pollination
(d) None of these

(72) When pollen of a flower is transferred to the stigma of another flower of the same plant, the pollination is referred to as

(a) xenogamy (b) geitonogamy

(c) autogamy (d) allogamy

(73) Entomophily is pollination by

(a) Animals (b) Insects

(c) Air (d) Water

(74) Lever mechanism or turnpipe mechanism for pollination is a characteristic feature of-

(a) Antirrhinum *(b) Ocimum*

(c) Salvia *(d) Ficus*

(75) Unisexuality of flowers prevents

(a) autogamy, but not geitonogamy

(b) geitonogamy and xenogamy

(c) geitonogamy, but not xenogamy

(d) autogamy and geitonogamy

(76) Pollination by birds is

(a) entomophily (b) chiropterophily

(c) anemophily (d) ornithophily

(77) Wind pollination is common in

(a) lilies (b) grasses

(c) orchids (d) legumes

(78) Transfer of pollen grains from the anther to the stigma of another flower of the different plant is called

(a) xenogamy (b) geitonogamy

(c) karyogamy (d) autogamy

(79) Wind pollinated flowers are

(a) small, brightly coloured, producing large number of pollen grains

(b) small, producing large number of dry pollen grains

(c) large producing abundant nectar and pollen

(d) small, producing nectar and dry pollen

(80) In some plants, anthers and stigmas grow and mature at same time. This phenomenon is called

(a) homogamy (b) syngamy

(c) allogamy (d) fusion

(81) Pollination by bats is called

(a) anemophily (b) hydrophily

(c) ornithophily (d) chiropterophily

(82) Bright colouration of flowers is an adaptation for

(a) anemophily (b) hydrophily

(c) malacophily (d) entomophily

(83) Which type of pollen grains are found in insect pollinated flowers?

(a) Hygroscopic

(b) Light and sticky

(c) Light and smooth

(d) Heavy and coloured

(84) Which one of the following is a reference to hybridization ?

(a) Ripening of androecium earlier to gynoecium

(b) Pollen grains of one flower, reaching the stigma of another flower present on the same plant

(c) Pollen grains of one flower, reaching the stigma of another flower present on a different plant of the different variety

(d) The inability of pollen tube to germinate on the stigma of the same flower

8.4 Double Fertilization: Process and Significance:

(85) Fusion of one male gamete with the egg cell and fusion of another male gamete with secondary nucleus is called

(a) Fertilization (b) Double fertilization

(c) Triple fertilization (d) Karyogamy

(86) In angiosperms, triple fusion is required for the formation of

(a) seed coat (b) fruit wall

(c) embryo (d) endosperm

(87) Double fertilization is characteristic of

(a) Angiosperms (b) Algae

(c) Gymnospenns (d) Bryophytes

(88) Double fertilization was discovered (or first observed) by

(a) Karl Schnarf (b) P. Maheshwari

(c) S.G. Nawaschin (d) B.G.L. Swamy

(89) In double fertilisation, the male gamete and secondary nucleus give rise to

(a) Embryo (b) Endosperm

(c) Gametes (d) Egg

(90) If the endosperm mother cell of an angiosperm plant has 24 chromosomes, the same in the MMC will be

(a) 12 (b) 48 (c) 16 (d) 24

(91) When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is?

(a) Diploid (b) Triploid

(c) Tetraploid (d) Pentaploid

(92) Triple fusion in angiosperm is the fusion of second sperm with

(a) antipodal cell and one synergid cell

(b) two antipodal cells

(c) two synergid cells

(d) two polar nuclei

(93) The endosperm in angiosperms develops from

(a) zygote

(b) primary endosperm nucleus

(c) chalazal polar nucleus

(d) micropylar polar nucleus

(94) The fertilization in which male gametes are carried through pollen tube, is known as

(a) syngamy (b) porogamy

(c) siphonogamy (d) chalazogamy

(95) Vegetative fertilization is also called

(a) triple fusion

(b) true fertilization

(c) syngamy

(d) generative fertilization

(96) Micropyle is useful for the entry of

(a) pollen grain (b) pollen tube

(c) water (c) male gamete

(97) The fusion of male and female pronuclei of the gametes is called

(a) apomixis (b) conjugation

(c) amphimixis (d) panmixis

(98) The movement of pollen tube is called

(a) chemotropism (b) thermotaxis

(c) thermonastic (d) hydrotropism

(99) If root of flowering plant has 24 chromosomes then its gamete has how many chromosomes?

(a) 24 (b) 12 (c) 4 (d) 8

(100) Mesogamy is

(a) fusion of male and female gametes

(b) fusion fo physiologically similar and morphologically different gametes

(c) entry of pollen tube through integuments

(d) none of the above

(101) Double fertilization involves

(a) syngamy and triple fusion

(b) double fertilization

(c) development of antipodal cell

(d) none of the above

(102) Fertilization of egg takes place inside

(a) anther (b) stigma

(c) pollen tube (d) embryo sac

(103) What would be the number of chromosomes of the aleurone cells of a plant with 42 chromosomes in its root tip cells?

(a) 63 (b) 84 (c) 21 (d) 42

(104) What does the filiform apparatus do at the entrance into ovule ?

(a) It helps in the entry of pollen tube into a synergid

(b) It prevents entry of more than one pollen tube into the embryo sac

(c) It brings about opening of the pollen tube

(d) It guides pollen tube from a synergid to egg

(105) Through which cell of the embryo sac, does the pollen tube enter the embryo sac?

(a) Egg cell

(b) Central cell

(c) Persistant synergid

(d) Degenerated synergid

(106) Double fertilization involves

(a) fertilization of the egg by two male gametes

(b) fertilization of two eggs in the same embryo sac by two sperms brought by one pollen tube

(c) fertilization of the egg and the central cell by two sperms brought by different pollen tubes

(d) fertilization of the egg and the central cell by two sperms brought by the same pollen tube

8.5 Post-fertilization changes:

(107) In angiosperms, endosperm is formed by

(a) free nuclear divisions of megaspore

(b) division of fused polar nuclei

(c) union of fused polar nuclei and male gamete

(d) union of fused synergids and male gamete

(108) An example of naturally occurring parthenocarpic fruit is

(a) Guava (b) Mango

(c) Banana (d) Apple

(109) Apomixis in plant means development of a plant

(a) From stem cuttings

(b) From root cuttings

(c) Without fusion of gametes

(d) From fusion of gametes

(110) The best example of polyembryony is

(a) *Cycas* (b) *Cocus*

(c) *Citrus* (d) *Capsicum*

(111) Fruits are not found in gymnospermous plants because -

(a) They are seedless plants

(b) They are not pollinated

(c) They have no ovary

(d) The process of fertilization does not take place in them

(112) A true fruit develops from

(a) Ovary (b) Thalamus

(c) Petals (d) Receptacle

(113) Which of the following floral parts forms pericarp after fertilization?

(a) Nucellus (b) Outer integument

(c) Ovary wall (d) Inner integument

(114) The plant part which consists of two generations one within the other, is

(a) germinated pollen grain

(b) embryo

(c) unfertilized ovule

(d) seed

(115) Integuments forms which of the following parts of seed ?

(a) Seed coat (b) Perisperm

(c) Hilum (d) Raphe

(116) The ovary after fertilization is converted into

(a) embryo (b) endosperm

(c) fruit (d) seed

(117) Triploid tissue in angiosperms, is

(a) nucellus (b) endosperm

(c) endothelium (d) tapetum

(118) Nucellar polyembryony is reported in species of

(a) *Gossypium* (b) *Triticum*

(c) *Brassica* (d) *Citrus*

(119) Dicot embryo consists of

(a) radicle and plumule

(b) radicle, plumule, cotyledons and sometimes endosperm

(c) radicle, plumule, cotyledons and tegmen

(d) radicle, plumule, cotyledons, tegmen and testa

(120) After fertilization, the outer integument forms

(a) testa (b) tegmen

(c) perisperm (d) pericarp

HOME WORK

Multiple Choice Questions

8.1 Modes of Reproduction (Asexual):

(1) Reproduction helps in.

(a) perpetuation of species

(b) growth of species

(c) mutation of species

(d) evolution of species

(2) _____ method of reproduction doesn't produce gametes.

(a) Asexual (b) Vegetative

(c) Both (a) and (b) (d) Sexual

(3) Sexual Reproduction is.

(a) Uniparental (b) Biparental

(c) Both (a) and (b) (d) No parental

(4) In asexual reproduction the vegetative unit is called as.

(a) Propagule (b) Explant

(c) Propagation (d) Protist

(5) In an angiosperm plant the only non-vegetative part is.

(a) Leaf (c) Stem (c) Root (d) Flower

(6) Root tuber is found in.

(a) Sweet potato (b) Onion

(c) Potato (d) Ginger

(7) Best way to propagate *Begonia* is.

(a) Root cutting (b) Stem cutting

(c) Leaf buds (d) Seeds

(8) In grafting the plant which recieves a scion is called as.

(a) Scion (b) Expant (c) Stock (d) Parent

(9) Leaf is _____ part on the plant.

(a) Vegetative (b) Reproductive

(c) Embryonic (d) Gamete producing

(10) Vegetative part show _____ type of cell division.

(a) Mitosis (b) Meiosis

(c) Amitosis (d) Both (a) and (b)

(11) Vegetative reproducing part should posses.

(a) Sufficient food (b) Growing point

(c) Roots (d) Both (a) and (b)

(12) Shisham (*Dalbergia*) is propagated vegetatively by.

(a) Stem (b) Roots (c) Leaves (d) Flower

(13) Grass *Cynodon* vegetatively reproduces with the help of.

(a) Roots (b) Stolon (c) Runner (d) Leaves

(14) In Ginger _____ is the vegetative organ for its vegetative reproduction.

(a) Underground stem

(b) Aerial stem

(c) Subaerial stem

(d) Both (b) and (c)

(15) 'Eyes' of potato are.

(a) Terminal buds

(b) Axillary buds

(c) Under developed flowers

(d) Domant buds

(16) In _____ adventitious buds are produced by the leaves.

(a) *Bryophylum* (b) *Kalanchoe*

(c) Both (a) and (b) (d) Potato

(17) Find the odd man out.

(a) Cutting (b) Grafting

(c) Budding (d) Stolon

(18) Stock and scion are terms used in

(a) Cutting (b) Grafting

(c) Binary fission (d) Both (b) and (c)

(19) The succcess of grafting mainly depends on _____ of stock and scion.

(a) Union of cambium (b) Union of epidermis

(c) Union of xylem (d) Union of phloem

(20) Progagules are produced by _____ method in micropropagation

(a) Cutting (b) Layering

(c) Tissue Culture (d) Grafting

(21) When identical plants to be produced in large amount with minimum time the best method of propagation is

(a) Stem cutting (b) Micropropagation

(c) Leaf cutting (d) Root cutting

(22) Genetically large number of plants with similar characters to be produced, which method you would suggest ?

(a) Micropropagation (b) Cutting

(c) Grafting (d) Pollination

8.2 Sexual Reproduction:

(23) Flower is a

(a) modified spike

(b) modified cone

(c) modified reproductive shoot

(d) modified branch system

(24) Specialized, condensed shoot meant for sexual reproduction is

(a) Inflorescence (b) Ovule

(c) Flower (d) Pollen grain

(25) A characteristic of Angiosperms is

(a) Flower (b) Root

(c) Seed (d) Both (b) and (c)

(26) Male gametophyte in angiosperms, is represented by

(a) microspore (b) megaspore

(c) nucellus (d) microsporangium

(27) In angiosperms, the meiosis occurs when

(a) seeds germinate

(b) flowers are formed

(c) ovules are formed

(d) pollen grains are formed

(28) 256 microspores are formed as a result of reduction division in

(a) 16 microspore mother cells

(b) 32 microspore mother cells

(c) 64 microspore mother cells

(d) 128 microspore mother cells

(29) The most resistant biological material is

(a) lignin (b) cellulose

(c) sporopollenin (d) lignocellulose

(30) Generally a typical anther contains

(a) four microsporangia

(b) three microsporangia

(c) two microsporangia

(d) one microsporangium

(31) The intine of a pollen grain is made up of

(a) lignin and cutin (b) lipid and pectin

(c) pectin and lignin (d) cellulose and pectin

(32) Meiosis in anther occurs in

(a) pollens (b) tapetal cells

(c) endothecium cells (d) spore mother cells

(33) In angiosperms, a mature male gemetophyte is formed from a pollen mother cell through

(a) Two meiotic divisions

(b) Three mitoic divisions

(c) One meiotic and two mitotic divisions

(d) A single meiotic division

(34) Germ pore is the area where exine is

(a) Thick (b) Thick and uniform

(c) Uniform (d) Absent

(35) Nuclei present in mature male gametophyte of angiosperms is

(a) One (b) Two (c) Three (d) Four

(36) Which cell of the pollen grain give rise to male gametes ?

(a) Tube cell (b) Generative cell

(c) Pollenin (d) Exine

(37) A bithecous anther has _____ number of sporangia.

(a) 2 (b) 4 (c) 8 (d) 16

(38) A layer of pyramidal cells lining the microspore mother cells in anther is

(a) Wall layer (b) Endothecium

(c) Tapetum (d) Pollen wall

(39) Sporoderm of pollen grain is made up of

(a) Exine (b) Intine

(c) Both (a) and (b) (d) Cytoplasm

(40) One microscope mother cells produce

(a) 4 diploid cells (b) 4 haploid cells

(c) 2 diploid cells (d) 2 haploid cells

(41) Pollen should reach on _____ for further development.

(a) Carpel (b) Gynoecium

(c) Stigma (d) Pistil

(42) The ovule is attached to the placenta by

(a) petiole (b) hilum

(c) pedicel (d) funiculus

(43) The tissue which attaches the ovules with the ovary is

(a) funicle (b) hilum

(c) chalaza (d) placenta

(44) Carpel of Angiospermic flower is an evolved

(a) microsporophyll (b) megasporophyll

(c) microsporangium (d) megaspotangium

(45) Female gametophyte in Angiosperms is

(a) embryo sac

(b) ovule

(c) nucellus

(d) megaspore mother cells

(46) Which of the following is the most common type of ovule in Angiosperms?

(a) orthothropous (b) anatropous

(c) amphitropous (d) campylotropous

(47) Embryo sac is monosporic , when it develops from

(a) two functional megaspores of archegonium

(b) three megaspores of a megaspore tetrad

(c) one of the four megaspores of a megaspore mother cell

(d) the megaspore mother cell where cytokinesis does not take place

(48) The female gametophyte of a typical dicot (*Polygonum*) at the time of fertilization is

(a) 8 nucleated and 7 celled

(b) 7 nucleated and 8 celled

(c) 4 nucleated and 4 celled

(d) 8 nucleated and 8 celled

(49) Primary endosperm nucleus is

(a) tetraploid (b) diploid

(c) triploid (d) pentaploid

(50) How many meiotic divisions would be require to produce 101 female gemetophytes in an angiosperms ?

(a) 26 (b) 101 (c) 127 (d) 126

(51) Part of the gynoecium which recives the pollen grain is called

(a) ovary (b) Stigma (c) style (d) ovule

(52) Microspore mother cells in anther produce microspores through

(a) mitosis (b) endomitosis

(c) meiosis (d) amitosis

(53) How many free nuclear mitotic divisions are required for the development of a typical Polygonum type of embryo sac?

(a) one (b) three

(c) five (d) seven

(54) The point where funicle is attached to the body of an ovule is called

(a) micropyle (b) nucellus

(c) pedicel (d) hilum

(55) When hilum , chalaza and micropyle of ovule lie in same long axis, it is known as

(a) campylotropous (b) anatropous

(c) amphitropous (d) orthotropous

(56) Endothecium helps in

(a) formation of intine

(b) despersal of seeds

(c) formation of exine

(d) dehiscence of anther

(57) In a pollen grain large nucleus is

(a) vegetaive nucleus

(b) tube nucleus

(c) generative nucleus

(d) Polar nuclei

(58) In ovule the meiosis occurs in

(a) megaspore mother cell

(b) archesporium

(c) microspore

(d) nucellus

(59) Megasporogenesis produces _____ number of megaspores.

(a) 2 (b) 4 (c) 6 (d) 8

(60) Megaspore mother cell is

(a) Haploid (b) Diploid

(c) Triploid (d) Tetraploid

(61) Angiospermic *Polygonum* type of embryo sac nuclear arrangement is

(a) 3 + 3 + 3 (b) 3 + 2 + 3

(c) 2 + 2 + 2 (d) 3 + 3 +2

(62) Filiform apparatus helps in

(a) attraction of male gametes

(b) attraction fo female gametes

(c) attraction of pollen tube

(d) attraction of tube nucleus

(63) In *Polygonum* type of embryo-sac the number of haploid cells are

(a) 3 (b) 4 (c) 6 (d) 8

(64) Select the correct sequence of ploidy level.

	MMC	Nucellus	Functional Megaspore	Secondary Nucleus
(a)	2n	1n	2n	1n
(b)	2n	2n	2n	2n
(c)	2n	2n	1n	2n
(d)	1n	2n	1n	2n

(65) For using incompatible pollen grains plants breeeders has to study

(a) Pollen-ovule interaction

(b) Pollen-egg interaction

(c) Pollen-pistil interaction

(d) Pollen-secondary nucleus interaction

(66) _____ number of megaspores are involved in the development of embryo sac in an angiosperm.

(a) One (b) Two (c) Three (d) Five

(67) Female gametophyte in an angiosperm originate from

(a) Integument cell (b) Chalazal cell

(c) Nucellar cell (d) Hilum cells

(68) Egg apparatus of embryo sac consist of _____ cells in an angiosperm.

(a) One (b) Two (c) Three (d) five

(69) _____ of egg apparatus attracts pollen tube during fertilization in an angiosperm.

(a) Polar nuclei (b) Filiform apparatus

(c) Hilum apparatus (d) Synergids

(70) Secondary nucleus is actually made up of _____in Angiosperm embryo sac.

(a) One polar nucleus

(b) Two polar nuclei

(c) One polar nuclei and another synergid

(d) Two synergid cells

(71) A typical Angiosperm embryo sac/female gametophyte is

(a) 7 celled, 8 nucleated

(b) 8 celled, 7 nucleated

(c) 7 celled, 7 nucleated

(d) 8 celled, 8 nucleated

(72) How many meiosis in involved in the formation of an angiosperm embryo sac/female gametophyte?

(a) One (b) Two (c) Three (d) Four

(73) In an Angiosperm's unfertilized ovule, _____ parts are haploid ?

(a) Egg aparatus

(b) Antipodal cells

(c) Secondary nucleus

(d) Both (a) and (b)

8.3 Pollination: Types and Agencies:

(74) In Angiosperm the first step towards sexual reproduction is

(a) Pollination (b) Fertilization

(c) Fruit formation (d) Seed formation

(75) In geitonogamy the flowers are

(a) Two flowers

(b) Two unisexual flowers in the same plant

(c) Two flowers of different plants

(d) Two bisexual flowers in the same plant

(76) Aquatic plant Lotus shows _____.

(a) Hydrophily (b) Zoophily

(c) Entomophily (d) Anemophily

(77) Bat pollination in referred as

(a) Entomophily (b) Zoophily

(c) Ornithophily (d) Chiropterophily

(78) In *Salvia* _____ lobe of anther produces pollen grains.

(a) Upper (b) Lower (c) Middle (d) Basal

(79) When a male and female flowers are seen in separate plants, it is termed as

(a) autoecious (b) heteroecious

(c) dioecious (d) monoecious

(80) The agent in Anemophily is

(a) Animal (b) Wind

(c) Water (d) Insect

(81) Transfer of pollen to the stigma of another flower of the same plant is

(a) Autogamy (b) Allogamy

(c) Xenogamy (d) Geitonogamy

(82) Fruits fomed without fertilization are known as

(a) Epicarpic (b) Mesocarpic

(c) Endocarpic (d) Parthenocarpic

(83) Entomophily is brought about by

(a) insects (b) wind

(c) water (d) air

(84) Unwettable floral parts and pollen grains are found in _____ flowers.

(a) Anemophilous (b) Entamophilous

(c) Hydrophilous (d) Zoophilous

(85) In *Bougainvillea* _____ is colourful parts to perform entamophily.

(a) Corolla (b) Calyx (c) Leaf (d) Bracts

(86) Flowers are large, non-fragrant but brightly coloured with copious nectar, suggest it shows _____ type of pollination.

(a) Anemophilous (b) Entamophilous

(c) Orinithophilous (d) Chiropterophilous

(87) *Kigella pinnata* and *Anthocephallus* shows _____ type of pollination.

(a) Anemophilous (b) Entamophilous

(c) Chiropterophilous (d) Hydrophilous

(88) One of them is not water pollinated

(a) *Cannabis* (b) *Vallisneria*

(c) *Zostera* (d) *Hydrilla*

(89) _____ is the most common agent for insect pollination.

(a) Bees (b) Flies (c) Wasps (d) Ants

(90) Epihydrophylly is

(a) Pollination is submerged plants

(b) Water pollination in submerged plants

(c) Water pollination in plants above the water surface

(d) Water pollination in lotus

(91) In *Ceratophyllum* the pollen grains are

(a) Spiny (b) Waxy

(c) Exineless (d) smooth

(92) Self- fertilization is known as

(a) Autogamy (b) Allogamy

(c) Cleistogamy (d) Chiasmogamy

(93) Incompatibility favour

(a) Self pollination (b) Cross pollintation

(c) Self fertilization (d) Both (a) and (b)

(94) Incompatibility is _____ method to prevent self pollination

(a) Physical (b) Physiological

(c) Genetical (d) Chemical

(95) Papaya is

(a) Bisexual (b) Monoecious

(c) Dioecious (d) Both (b) and (c)

(96) Autogamy and geitonogamy can be prevented when the plants are

(a) Monoecious (b) Dioecious

(c) Unisexual (d) Both (b) and (c)

(97) Incompatible pollens on a stigma of pistil

(a) cannot germinate (b) germinate slowly

(c) germinate fast (d) medium growth

(98) Pollen pistil interaction refers to

(a) pollen deposition and pollen tube developement

(b) pollen deposition and pollen rejection

(c) pollen deposition and entry of pollen tube in the ovule

(d) pollen deposition and pollen recognition

(99) Out-breeding devices prevents

(a) Cross pollination (b) Self pollination

(c) Fruit pollination (d) Seed pollination

(100) Dichogamy takes place only in

(a) Unisexual flowers (b) Sterile flowers

(c) Bisexual flowers (d) Asexual flowers

(101) When stamens and carples mature at different times it is called as

(a) Dichogamy (b) Homogamy

(c) Syngamy (d) Heterogamy

(102) Sunflower shows _____ type of dichogamy.

(a) Protandry (b) Protogyny

(c) Bigany (d) Polygamy

(103) Protogyny refers to

(a) Early maturation of gynoecium

(b) Late maturation of gynoecium

(c) Pollination of gynoecium

(d) Fertilization of gynoecium

(104) Preventing the germination of its own pollen grains on the stigma is called

(a) Self incompatibility

(b) Self sterility

(c) Both (a) and (b)

(d) Compatibility

(105) Dioeceous plants always show _____

(a) Self pollination

(b) Cross pollination

(c) Self or cross pollination

(d) Wind pollination

8.4 Double fertilization: Process and Significance:

(106) True siphonogamy is

(a) fusion of gametes in a tube

(b) pollen tube with two motile gametes

(c) pollen tube with two non motile gametes

(d) entry of pollen tube through micropyle

(107) Most striking feature of Angiosperms is

(a) double fertilization

(b) large size

(c) long lifespan

(d) flowers

(108) The role of double fertilization in Angiosperms is to produce

(a) endosperm (b) zygote

(c) cotyledons (d) both (a) and (b)

(109) Double fertilization is a characterstic feature of

(a) Bryophytes (b) Pteridophytes

(c) Gymnosperms (d) Angiosperms

(110) Fertilization in which pollen tube enters through chalaza is known as

(a) syngamy (b) porogamy

(c) siphonogamy (d) chalazogamy

(111) Endosperm nucleus of Angiosperms is generally

(a) Haploid (b) Diploid

(c) Triploid (d) Tetraploid

(112) The process of fusion between male nucleus and egg nucleus is called

(a) triple fusion (b) double fertilization

(c) conjugation (d) syngamy

(113) The nature of secondary nucleus after fertilizatioin in an Angiosperm is

(a) n (b) 2n (c) 3n (d) 4n

(114) Micropyle in seed helps the entry of

(a) minerals (b) water

(c) male gamete (d) pollen tube

(115) The fusion product of polar nuclei and male gamete is

(a) zygote

(b) triple fusion

(c) secondary nucleus

(d) primary endosperm nucleus

(116) Syngamy refers to fusion of

(a) one of the sperms with the egg

(b) one of the sperms with the egg and other with the secondary nucleus

(c) one of the sperms with synergid

(d) one of the sperms with secondary nucleus

(117) In fertilization of Angiosperm PEN stands for

(a) Primary Endounucleus

(b) Protease Endonuclease

(c) Primary Endosperm Nucleus

(d) Primary Endronucleus

(118) In fertilization of Angiosperms , the role of pollen tube is

(a) To deliver gametes

(b) To deliver male gametes

(c) To stimulate ovule

(d) To stimulate ovary

(119) The nuclei involved in Triple fusion are

(a) Two male gametes and secondary nucleus

(b) Two male gametes and polar nuclei

(c) A male gamete and a secondary nuclei

(d) Two polar nuclei and a male gamete

(120) In a recently fertilized ovule, the haploid, diploid and triploid conditions are respectively seen in

(a) endosperm; nucellus; egg

(b) egg; nucellus; endosperm

(c) antipodals; oospore; PEN

(d) polar nuclei; secondary nucleus; endosperm

(121) How many diploid nuclei are there in a fertilized embryo-sac ?

(a) One (b) Two (c) Three (d) Four

8.5 Post fertilization changes:

(122) Integuments of ovule is _____ in seed.

(a) Seed coat (b) Ovulatory memrane

(c) Testa (d) Tegmen

(123) Nutritive tissue in the seed is

(a) Perisperm (b) Monosperm

(c) Endosperm (d) Nucellus

(124) Thin and papery cotyledons are the characterstics of _____ seeds.

(a) Endospermous (b) Non-endospermous

(c) Albuminous (d) Both (a) and (c)

(125) Fruit is _____ ovary.

(a) Immature (b) Mature

(c) Ripened (d) Shrivelled

(126) Pericarp is

(a) Ovary wall (b) Ovule wall

(c) Fruit wall (d) Seed wall

(127) The fate of basal cell is

(a) To produce embryo

(b) To produce suspensor

(c) To produce radicle

(d) To produce plumule

(128) Endosperm of angiosperm shows _____

(a) Haploidy (b) Diploidy

(c) Triploidy (d) Tetraploidy

(129) Cotyledons of endospermic seeds are

(a) Fleshy (b) Papery

(c) Succulant (d) Hard

(130) When cotyledons are fleshy in an embryo the seed is

(a) Non endospermous

(b) Ex-albuminous

(c) Both (a) and (b)

(d) Endospermous

(131) In _____ type of endosperm formation cytokinesis doesn't occur.

(a) Free nuclear (b) Cellular

(c) Helobial (d) Acellular

(132) In _____ type of endosperm a septa develops towards its base.

(a) Cellular (b) Helobial

(c) Free-nuclear (d) Acellular

(133) In Angiosperms the sexual reproduction products are

(a) Seed (b) Fruits

(c) Both (a) and (b) (d) Flower

(134) Seed and fruit in Angiosperm is a _____ product.

(a) Pollination (b) Fertilization

(c) Pre-fertilization (d) Post- fertilization

(135) A true fruit develops from

(a) ovary (b) receptacle

(c) petals (d) sepals

(136) After fertilization, the seed coats of seeds develop from

(a) chalaza (b) ovule

(c) nucellus (d) integuments

(137) Seeds develop from

(a) embryo (b) embryo sac

(c) ovary (d) ovule

(138) Parthenocarpy is the production of

(a) only seeds and no fruit

(b) both seeds and fruits

(c) seeds without fertilization

(d) fruit without fertilization

(139) Seed is the combination of _____ tissue.

(a) Haploid (b) Diploid

(c) Triploid (d) Both (b) and (c)

(140) Seed encloses

(a) Embryo (b) Endosperm

(c) Both (a) and (b) (d) Fruit

(141) Seed is a metamorphosed

(a) Ovary (b) Embryo

(c) Ensosperm (d) Ovule

(142) Suspended growth of embryo in a seed is called as its

(a) Dormancy (b) Viability

(c) Non-viablity (d) Potentiality

(143) Polyembryony is found in

(a) Citrus (b) Rose

(c) Mango (d) Rice

(144) _____ is important process in hybrid seed industry.

(a) Aposporv (b) Apogamy

(c) Apomixis (d) Hypogymy

CLASS WORK - ANSWER KEY

1 **b**	2 **a**	3 **b**	4 **d**	5 **d**	6 **b**	7 **b**	8 **c**	9 **a**	10 **c**
11 **b**	12 **c**	13 **c**	14 **b**	15 **a**	16 **c**	17 **c**	18 **c**	19 **c**	20 **c**
21 **b**	22 **b**	23 **b**	24 **b**	25 **c**	26 **b**	27 **d**	28 **d**	29 **c**	30 **a**
31 **c**	32 **c**	33 **d**	34 **c**	35 **b**	36 **b**	37 **b**	38 **a**	39 **d**	40 **a**
41 **b**	42 **c**	43 **d**	44 **d**	45 **c**	46 **b**	47 **b**	48 **b**	49 **d**	50 **b**
51 **d**	52 **a**	53 **b**	54 **c**	55 **d**	56 **c**	57 **d**	58 **c**	59 **b**	60 **b**
61 **a**	62 **b**	63 **a**	64 **b**	65 **d**	66 **c**	67 **c**	68 **b**	69 **a**	70 **d**
71 **c**	72 **b**	73 **b**	74 **c**	75 **a**	76 **d**	77 **b**	78 **a**	79 **b**	80 **a**
81 **d**	82 **d**	83 **b**	84 **c**	85 **b**	86 **d**	87 **a**	88 **c**	89 **b**	90 **c**
91 **c**	92 **d**	93 **b**	94 **c**	95 **a**	96 **b**	97 **c**	98 **a**	99 **b**	100 **c**
101 **a**	102 **d**	103 **a**	104 **d**	105 **d**	106 **d**	107 **c**	108 **c**	109 **c**	110 **c**
111 **c**	112 **a**	113 **c**	114 **c**	115 **a**	116 **c**	117 **b**	118 **d**	119 **b**	120 **a**

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HOME WORK - ANSWER KEY

1 **a**	2 **c**	3 **b**	4 **a**	5 **d**	6 **a**	7 **c**	8 **c**	9 **a**	10 **a**
11 **d**	12 **b**	13 **c**	14 **a**	15 **b**	16 **c**	17 **d**	18 **b**	19 **a**	20 **c**
21 **b**	22 **a**	23 **c**	24 **c**	25 **a**	26 **a**	27 **d**	28 **c**	29 **c**	30 **a**
31 **d**	32 **d**	33 **c**	34 **d**	35 **c**	36 **b**	37 **b**	38 **c**	39 **c**	40 **b**
41 **c**	42 **d**	43 **d**	44 **b**	45 **a**	46 **b**	47 **c**	48 **a**	49 **c**	50 **b**
51 **b**	52 **c**	53 **b**	54 **d**	55 **d**	56 **d**	57 **b**	58 **a**	59 **b**	60 **b**
61 **b**	62 **c**	63 **c**	64 **c**	65 **c**	66 **a**	67 **c**	68 **c**	69 **b**	70 **b**
71 **a**	72 **a**	73 **d**	74 **a**	75 **b**	76 **c**	77 **d**	78 **a**	79 **c**	80 **b**
81 **d**	82 **d**	83 **a**	84 **c**	85 **d**	86 **c**	87 **c**	88 **a**	89 **a**	90 **c**
91 **c**	92 **a**	93 **b**	94 **c**	95 **c**	96 **d**	97 **a**	98 **c**	99 **b**	100 **c**
101 **a**	102 **a**	103 **a**	104 **b**	105 **b**	106 **c**	107 **a**	108 **d**	109 **d**	110 **d**
111 **c**	112 **d**	113 **c**	114 **b**	115 **d**	116 **a**	117 **d**	118 **b**	119 **c**	120 **c**
121 **a**	122 **a**	123 **c**	124 **d**	125 **c**	126 **c**	127 **b**	128 **c**	129 **b**	130 **c**
131 **a**	132 **b**	133 **c**	134 **d**	135 **a**	136 **d**	137 **d**	138 **d**	139 **d**	140 **c**
141 **d**	142 **a**	143 **a**	144 **c**						

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