



UNIT 20

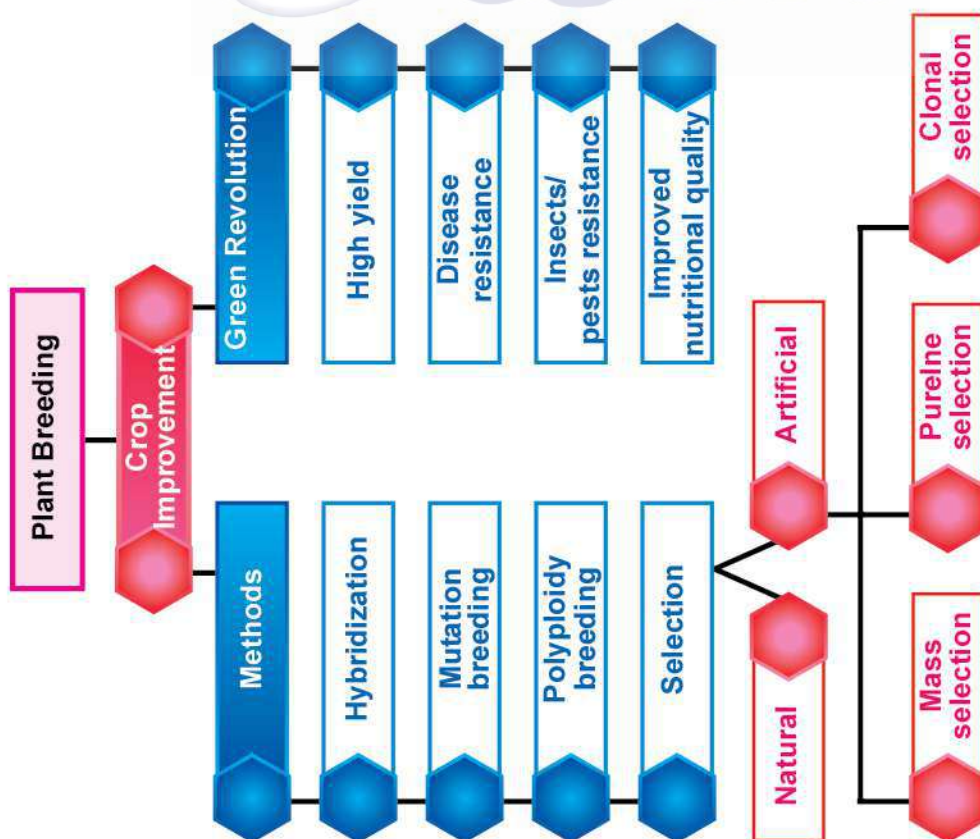
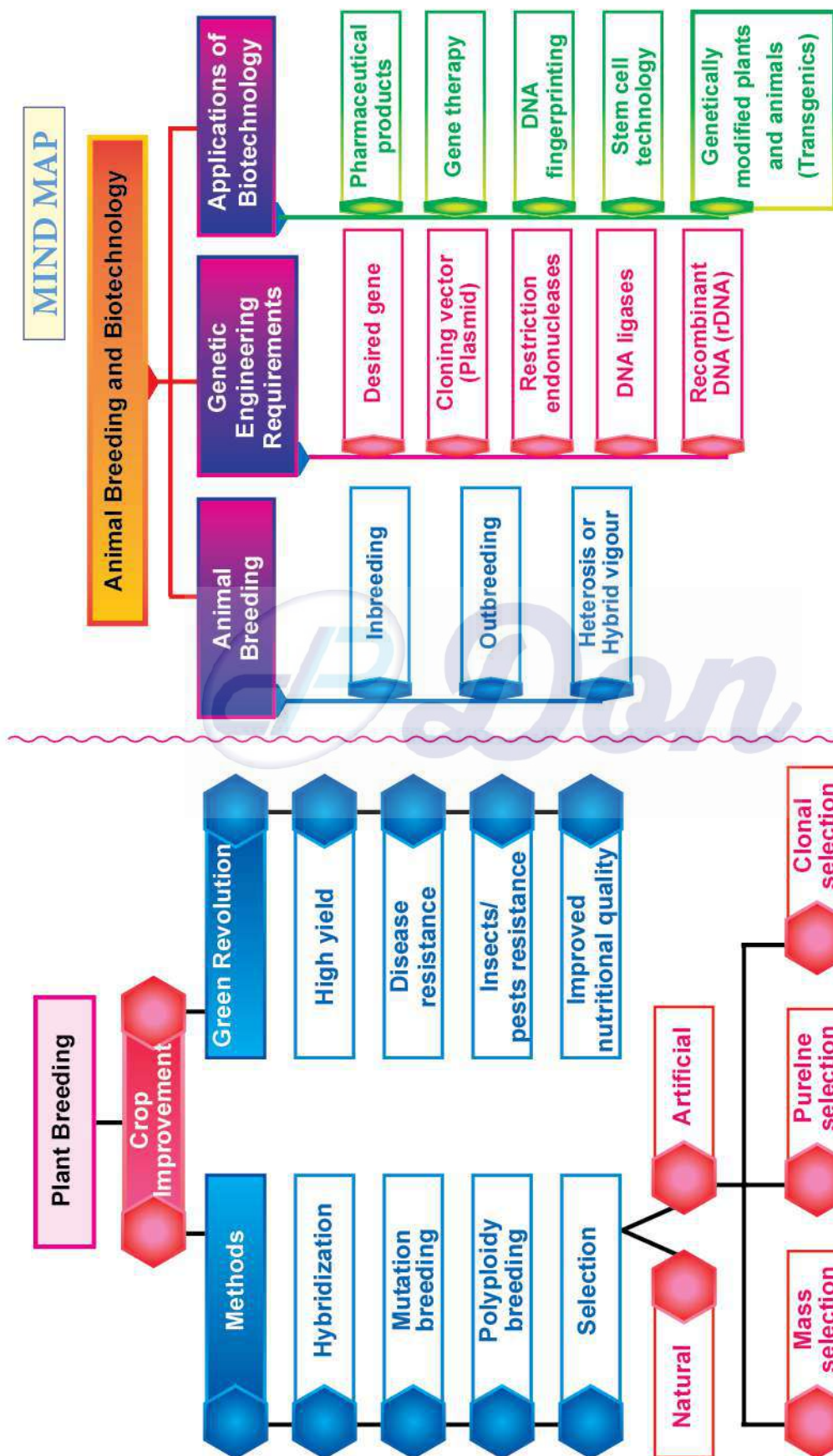
Breeding and Bio Technology

POINTS TO REMEMBER

Plant breeding	: It is the art of developing economically important plant with superior quality.
Exotic species	: Plant / animal species introduced from other countries.
Polyloid	: An organism having more than two sets of chromosomes is called polyloid.
Mutagen	: Factors which induce mutation.
Triticale	: First man made cereal hybrid by crossing rye and wheat.
Hybridization	: Hybridization may be defined as the process of crossing two or more types of plants for bringing their desired characters together into one progeny called hybrid.
Inbreeding	: Inbreeding refers to the mating of closely related animals within the same breed for about 4-6 generations.
Outbreeding	: Breeding of unrelated animals.
Heterosis/hybrid vigour	: The superiority of the hybrid obtained by cross breeding is called as heterosis or hybrid vigour.
rDNA	: Recombinant DNA got by combining DNA from two different sources by genetic engineering.
Restriction enzyme	: Enzymes which cut or break DNA at specific sites.
DNA ligase	: Enzymes which help to join the broken DNA fragments.

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MIND MAP



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Gene therapy	: Gene therapy refers to the replacement of defective gene by the direct transfer of functional genes into humans to treat genetic disease or disorder.
Stem cells	: They are undifferentiated or unspecialised cells and have the ability to give rise to specialised cells.
DNA fingerprinting	: A technique to compare genetic differences among two individuals by analysing unique DNA sequences of an individual.
Genetically modified organisms	: Genetic modification refers to the alteration or manipulation of genes in the organisms using rDNA techniques in order to produce the desired characteristics.
Transgenic organisms	: Plants or animals expressing a modified endogenous gene or a foreign gene are also known as transgenic organisms.
Bio fortification	: Crops to increase their nutritional value by conventional selective breeding
Mass selection	: Desired characters - collected mixed population
Pureline selection	: Self breeding
Mutation	: Sudden heritable change

Scientists and Inventions:

Dr. Norman E. Borlaug	- Father of the Green Revolution
Dr. M.S. Swaminathan	- Green Revolution. (Father of Indian Green Revolution)
Dr. Ian Wilmut - Dolly	- First cloned female sheep.
Eli Lilly and company	- Human insulin
Alec. Jeffrey	- DNA fingerprinting

Textbook Evaluation

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

- Which method of crop improvement can be practised by a farmer if he is inexperienced?
 a) Clonal selection b) Mass selection c) Pureline selection d) Hybridisation

II. Fill in the blanks

1. Economically important crop plants with superior quality are raised by _____.
2. A protein rich wheat variety is _____. ★ ★
3. _____ is the chemical used for doubling the chromosomes. ★
4. The scientific process which produces crop plants enriched with desirable nutrients is called _____.
5. Rice normally grows well in alluvial soil, but _____ is a rice variety produced by mutation breeding that grows well in saline soil. ★ ★
6. _____ technique made it possible to genetically engineer living organism.
7. Restriction endonucleases cut the DNA molecule at specific positions known as _____.
8. Similar DNA fingerprinting is obtained for _____.
9. _____ cells are undifferentiated mass of cells.
10. In gene cloning the DNA of interest is integrated in a _____.

Ans:

1. Plant breeding	2. Atlas 66
3. Colchicine	4. Bio fortification
5. Atomita-2	6. Recombinant DNA
7. Molecule scissors	8. Identical twins
9. Stem	10. Suitable vector (Plasmid)

III State whether true or false. If false, write the correct statement

1. **Raphano brassica is a man-made tetraploid produced by colchicine treatment.**
Raphano brassica is an allotetraploid by colchicine treatment. **False**
2. **The process of producing an organism with more than two sets of chromosome is called mutation.** ★ ★
An organism having more than two sets of chromosome is called Polyploid. **False**
3. **A group of plants produced from a single plant through vegetative or asexual reproduction are called a pureline.** **False**
A group of plants produced from a single plant through vegetative or asexual reproduction are called clones.
4. **Iron fortified rice variety determines the protein quality of the cultivated plant** **True**
5. **Golden rice is a hybrid.** ★ ★ **True**
6. **Bt gene from bacteria can kill insects.** **True**
7. **Invitro fertilisation means the fertilisation done inside the body.** **False**
Invitro fertilisation means the fertilisation done outside the body.
8. **DNA fingerprinting technique was developed by Alec Jeffrey.** **True**
9. **Molecular scissors refers to DNA ligases.** **False**
Molecular scissors refers to restriction endonucleus.

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IV. Match the following

1) Column A

1. Sonalika
2. IR 8
3. *Saccharum*
4. Mung No. 1
5. TMV – 2
6. Insulin
7. Bt toxin
8. Golden rice

Column B

- a) *Phaseolus mungo*
- b) Sugarcane
- c) Semi-dwarf wheat
- d) Ground nut
- e) Semi-dwarf Rice
- f) *Bacillus thuringiensis*
- g) Beta carotene
- h) First hormone produced using rDNA technique

(c)
(e)
(b)
(a)
(d)
(h)
(f)
(g)

V. Understand the assertion statement, justify the reason given and choose the correct choice

- a) Assertion is correct and reason is wrong
- b) Reason is correct and the assertion is wrong
- c) Both assertion and reason is correct
- d) Both assertion and reason is wrong.

1. **Assertion:** Hybrid is superior than either of its parents.

Reason: Hybrid vigour is lost upon inbreeding.

Ans: a) Assertion is correct and reason is wrong

2. **Assertion:** Colchicine reduces the chromosome number.

Reason: It promotes the movement of sister chromatids to the opposite poles.

Ans: d) Both assertion and reason is wrong.

3. **Assertion:** rDNA is superior over hybridisation techniques

Reason: Desired genes are inserted without introducing the undesirable genes in target organisms.

Ans: c) Both assertion and reason is correct

VI. Answer in a sentence

1. Give the name of wheat variety having higher dietary fibre and protein. ★ ★

Bulgar-wheat variety having higher dietary fibre Atlas-66, a protein rich wheat variety.

2. Semi-dwarf varieties were introduced in rice. This was made possible by the presence of dwarfing gene in rice. Name this dwarfing gene.

Dee-geo-woo-gen

3. Define genetic engineering. ★ ★ ★

Genetic engineering is the manipulation and transfer of genes from one organism to another organism to create a new DNA.

4. Name the types of stem cells.

Embryonic stem cells, Adult stem cell or somatic stem cell.

5. What are transgenic organisms? ★ ★

Plants or animals expressing a modified endogenous gene or a foreign gene is also known as transgenic organism.

6. State the importance of biofertiliser.

Bio-fertiliser increase soil fertility without causing any damage to the soil.

7. Give an example for mass selection.

Groundnut varieties TMV – 2 and AK – 10

8. How the factors that induce mutations are known as?

The factors which induce mutations are known as mutagens or mutagenic agents.

9. What is called r DNA?

As a result of Genetic engineering a new DNA called as recombinant DNA or r DNA is formed.

VII. Short answers questions

1. Discuss the method of breeding for disease resistance.

- Introduction of new varieties of plants.
- Selection
- Polyploidy breeding
- Mutation breeding
- Hybridization

2. Name three improved characteristics of wheat that helped India to achieve high productivity.

Semi dwarf nature high yield, disease resistance, early maturity

3. Name two maize hybrids rich in amino acid lysine. ★ ★ ★

Protina, shakti and Rathna are lysine rich maize hybrids.

4. Distinguish between ★ ★

a. somatic gene therapy and germ line gene therapy

Somatic gene therapy	Germ line gene therapy
It is the replacement of defective gene in somatic cells .	It is replacement of defective gene in germ cell .

b. undifferentiated cells and differentiated cells

Undifferentiated cells	differentiated cells
Undifferentiated cells continuously proliferate throughout the life time of the organism. E.g: Umbilical cord	Differentiated cells some are unable to proliferate . E.g: Pancreatic cells to secrete insulin.

5. State the applications of DNA fingerprinting technique. ★ ★

- DNA fingerprinting technique is used in **forensic applications** like crime investigation.
- It is also used for **paternity testing** in case of disputes.
- It also helps in the study of genetic diversity of population, evolution and speciation.

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6. How are stem cells useful in regenerative process?

- Sometimes cells, tissues and organs in the body may be permanently **damaged** or **lost** due to genetic to disease or injury.
- In such situations stem cells are used for the **treatment of disease** which is called stem-cell therapy.

7. Differentiate between outbreeding and inbreeding. ★ ★

Outbreeding	Inbreeding
Cross between two different species (unrelated) with desirable features of economic value are mated.	Mating of closely related animals within the same breed for about 4 - 6 generations.
The hybrids are stronger and vigorous than their parents. E.g: Mule	It helps in the accumulation of superior genes and elimination of genes which are undesirable . E.g: Hissardale

VIII. Long answers questions

1. What are the effects of hybrid vigour in animals?

- Increased production of **milk** by cattle.
- Increased production of egg by poultry.
- High quality of meat is produced.
- Increased growth rate in domesticated animals.

2. Describe mutation breeding with an example. ★ ★

Mutation:

- Mutation is defined as the sudden **heritable change** in the nucleotide sequence of DNA in an organism.
- It is a process by which **genetic variations** are created which in turn brings about changes in the organism.
- The organism which undergoes mutation is called a **mutant**.
- The factors which induce mutations are known as mutagens or mutagenic agents.
- Mutagens are two types namely physical mutagens and chemical mutagens.

i. Physical mutagens:

- **Radiations** like X - rays, α, β and γ - rays, UV rays, temperature etc., which induce mutations are called physical mutagens.

ii. Chemical mutagens:

- **Chemical substances** that induce mutations are called chemical mutagens.
E.g: Mustard gas and nitrous acid.
- The utilisation of induced mutation in crop improvement is called mutation breeding.

Achievements of mutation breeding:

- **Sharbati Sonora** wheat produced from Sonora - 64 by using gamma rays.
- Atomita 2 rice with saline tolerance and pest resistance.
- Groundnuts with thick shells.

3. Biofortification may help in removing hidden hunger. How?

- Biofortification is the scientific process of developing crop plants enriched with **high levels** of **desirable** nutrients like vitamins, proteins and minerals.
- Production of Bio fortification crops help in removing hidden hunger.

Examples:

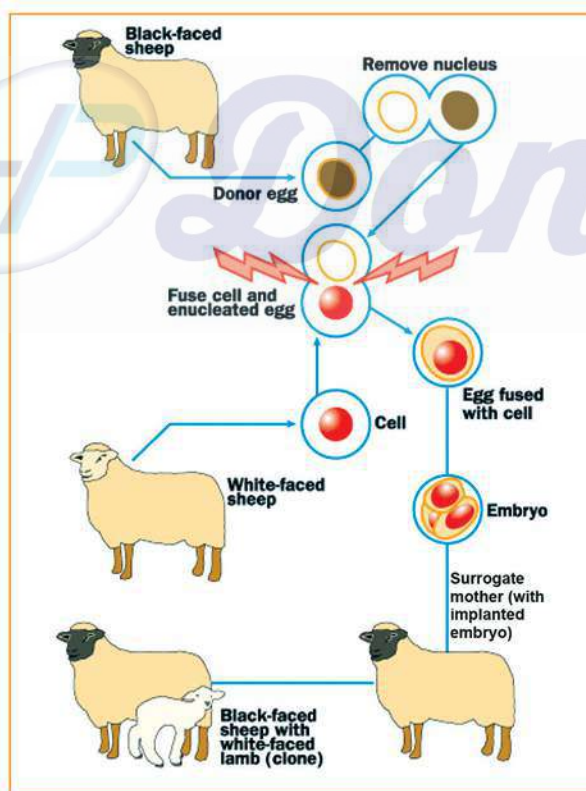
- Protina, shakti and Rathna are **lysine** rich maize hybrids (developed in India)
- Atlas 66, a **protein** rich wheat variety.
- **Iron** rich fortified rice variety.
- **Vitamin A** enriched carrots, pumpkin and spinach.

So in this way, Biofortification may help in removing hidden hunger.

4. With a neat labelled diagram explain the techniques involved in gene cloning.

Gene cloning: ★ ★ ★

- The carbon copy of an individual is often called a clone. However, more appropriately, a clone means to make a genetically exact copy of an organism.
- In gene cloning, a gene or a piece of DNA fragment is inserted into a bacterial cell where DNA will be multiplied (copied) as the cell divides.



Development of Dolly

Techniques involved in gene cloning:

- To produce cloned sheep Dr. Ian Wilmut took the udder cell which is a somatic cell with diploid number of chromosomes.
- An egg cell was also removed from a donar sheep.
- The egg cell cannot grow into a new sheep on its own because it has only half a set of chromosomes (n).

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- The body cell cannot grow into a new sheep on its own because it is not a reproductive cell an udder cell nucleus ($2n$) was removed.
- Similarly the egg cell nucleus (n) was also removed.
- The nucleus of the somatic cell was injected into the enucleated egg.
- The egg after the nuclear transplantation comes to possess full set of chromosomes the $2n$ diploid.
- The egg was then transplanted back into the uterus of the sheep from which it was removed.
- The egg also can be transplanted to a new surrogate mother for development.
- The egg cell grew and developed into a sheep (Dolly)

5. Discuss the importance of biotechnology in the field of medicine. ★★

- Insulin used in the treatment of **diabetes**.
- Human growth hormone used for treating children with **growth deficiencies**.
- Blood clotting factors are developed to treat **haemophilia**.
- Tissue plasminogen activator is used to dissolve **blood clots** and prevent **heart attack**.
- Development of **vaccines** against various disease like Hepatitis B and rabies.

IX. Higher Order Thinking Skills (HOTS)

1. A breeder wishes to incorporate desirable characters into the crop plants. Prepare a list of characters he will incorporate.

A breeder will incorporate the following characters:

- Tallness and profuse branching are desirable characters for fodder crops.
- Dwarfness is desirable in cereals, so that less nutrients are consumed by these crops.

2. Organic farming is better than Green Revolution. Give reasons

Reason:

- No chemicals fertilisers are used on the soil.
- No pesticides are sprayed on the plants.
- The seeds used to produce plants have not been genetically altered.

3. Polyploids are characterised by gigantism. Justify your answer.

Polyploidys are characterised by gigantism

An organism having more than two sets of chromosomes is called polyploid. It causes increase in size. Polys = Many + aploos = One fold + eidos = Form

(E.g) Watermelon

4. 'P' is a gene required for the synthesis of vitamin A it is integrated with genome of 'Q' to produce genetically modified plant. 'R'

i. What is P, Q and R?

- P - Beta Carotene gene .
- Q - improved variety of rice with best nutritional value .
- R - prevent vitamin A deficiency synthesis of Beta carotene.

ii. State the importance of 'R' in India.

- R - The transgenic plants are much stable with improved nutritional value.

Additional Questions

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. In Cow pea, Pusa Komal - Resistance to disease is a
 - a) Hill bunt
 - b) Black rot
 - c) Bacterial blight
 - d) Leaf and stipe rust
2. Dee-geo-woo, gen is a dwarf variety from ★
 - a) India
 - b) Japan
 - c) Indonesia
 - d) China
3. Atlas 66 is a _____ rich wheat variety.
 - a) protein
 - b) fat
 - c) carbohydrate
 - d) vitamin
4. The tool, which is not involved in Genetic engineering
 - a) Restriction enzymes
 - b) DNA ligases
 - c) Lysosome
 - d) Plasmid
5. _____ wheat is produced from Sonora – 64 using gamma rays.
 - a) Triticale
 - b) Sharbati Sonora
 - c) Atomitta
 - d) AK-10

Ans:

1) c) Bacterial blight	2) d) China
3) a) protein	4) c) Lysosome
5) b) Sharbati Sonora	

II. Fill in the blanks

1. _____ was a Tamil agricultural scientist.
2. _____ is a protein rich wheat variety. ★
3. _____ saline tolerance and pest resistance.
4. _____ are the enzymes which help in joining the broken DNA fragments.
5. Stem cells are _____ mass of cells.
6. _____ is a concept in which the atomic energy is used for the crop improvement
7. _____ is the first man made cereal hybrid. ★
8. _____ is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Australian Marino rams.
9. _____ is developed by crossing a male donkey and female Horse.
10. The superiority of the hybrid obtained by cross breeding is called as _____.
11. _____ is making of genetically exact copy of an organism.
12. The first cloned female sheep was developed by _____.

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Ans:

1. Dr. G.Nammalvar	2. Atlas 66
3. Atomita 2 rice	4. DNA ligase
5. Undifferentiated	6. Gamma Garden or Atomic garden
7. Triticale	8. Hissardale
9. Mule	10. Heterosis or hybrid vigour
11. Cloning	12. Dr. Ian Wilmut

III State whether true or false. If false, write the correct statement

1. Progeny from pureline selection, Progeny is dissimilar both genotypically and phenotypically. **False**

Progeny from pureline selection, Progeny is similar both genotypically and phenotypically.

2. Triticale is a hybrid of wheat and rice which has higher dietary fibre and protein **True**

3. The cross between different breeds is called inbreeding. **False**

The cross between same breeds is called inbreeding.

IV. Match the following1) **Column A**

1. Father of the Green Revolution
2. Father of Indian Green Revolution
3. Pusa shubhra
4. Pusa Komal

Column B

- a) Bacterial blight
- b) Black rot
- c) Dr, M.S.Swaminathan
- d) Dr.Norman E.Bork

(d)
(c)
(b)
(a)

2) **Column A**

1. Mass selection
2. Pureline selection
3. TV-29

Column B

- a) Drought tolerance
- b) TMV-2
- c) Self breeding

(c)
(a)
(b)

3) **Column A**

1. Physical mutagen
2. Tritical
3. Chemical mutagen

Column B

- a) Nitrous acid
- b) UV-rays
- c) Man-made cereal

(b)
(c)
(a)

V. Understand the assertion statement, justify the reason given and choose the correct choice

- a) Assertion is correct and reason is wrong
- b) Reason is correct and the assertion is wrong
- c) Both assertion and reason is correct
- d) Both assertion and reason is wrong.

1. **Assertion:** Introducing high yielding varieties of plants from one place to another called exotic speceis.

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Reason: (E.g) *Phaseolus mungo* was introduced in China

Ans: c) Both assertion and reason is correct

2. **Assertion:** We want to compare the genetic difference among the two individuals is called DNA fingerprinting

Reason: It helps in the study of genetic diversity of population, evolution and speciation.

Ans: c) Both assertion and reason is correct

VI. Short answers questions

1. Define Green Revolution?

Green Revolution is the process of **increasing food production** through high yielding crop varieties and modern agricultural technique in under developed and developing nations.

2. What are pathogens?

Plant disease are caused by pathogens like Viruses, Bacteria and Fungi.

3. What is Biofortification? ★

Biofortification is the scientific process of **developing crop plants** enriched with high levels of desirable nutrients.

4. What is Polyploid?

An organism having **more than two sets of chromosomes** is called Polyploid.

5. What is mutation breeding? ★

The utilisation of **induced mutation** in crop improvements is called mutation breeding.

6. Define Heterosis.

The **superiority** of the **hybrid** obtained by cross breeding is called heterosis.

7. What is meant by Gene therapy?

Gene therapy is the **replacement of defective gene** by the direct transfer of functional genes into humans to treat genetic disease or disorder.

8. Name two disease that are treated by stem cell therapy.

Parkinson's disease and Alzheimer's disease.

9. What is transgenic organisms?

Plants or animals expressing a **modified endogenous gene** or a foreign gene are also known as transgenic organisms.

10. What is Golden rice?

Genetically modified rice can produce beta carotene, that can prevent Vitamin A deficiency.

11. Give the importance of stem cell therapy.

Stem - cell therapy:

- Sometimes cells, tissues and organs in the body may be permanently damaged or lost due to genetic condition or disease or injury.

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- In such situations stem cells are used for the treatment of diseases which is called stem-cell therapy.
- In treating neurodegenerative disorders like Parkinson's disease and Alzheimer's disease neuronal stem cells can be used to replace the damaged or lost neurons.

12. DNA finger printing technique is used to identify a person. Justify . ★

- 1% DNA sequence differs from one individual to another.
- This is known as satellite DNA.
- The number of copies of the repeat sequence also called as VNTRs differs from one individual to another and results in variation in the size of DNA segment.

VII. Long answers questions

1. Write about methods of selection.

There are three methods of selection. They are

- Mass selection
- Pureline selection
- Clonal selection

Mass selection:

- Seeds of best plants showing desired characters are collected from a mixed populations.
- The collected seeds are allowed to rise the second generation.

Pureline selection:

- Pureline is the progeny of a single individual obtained by self breeding.
- This is also called an individual plant selection.

Clonal selection:

- Selection of desirable clones from the mixed population of vegetatively propagation crop is called clonal selection.

2. Write basic steps involved in gene cloning.

- **Isolation** of **desired DNA** fragment by using restriction enzymes.
- **Insertion** of the **DNA** fragment into a suitable vector (Plasmid) to make rDNA.
- **Transfer** of **rDNA** into bacterial host cell.
- **Selection** and **multiplication of recombinant host cell** to get a clone.
- **Expression** of **cloned gene** in host cell

3. Write an account on genetically modified animals

- Transgenic sheep (genetically modified animals) when inserted the genes for synthesis of amino acid, Cysteine, then produce improved wool quality and production.
- Transgenic fish (genetically modified animals) when inserted with growth hormone gene then produce increased growth in fishes which is of commercial value.

VIII. Higher Order Thinking Skills (HOTS)

1. What are the main effects of heterosis?

Heterosis leads to increase in yield, reproductive ability, adaptability, general vigour, quality, etc.

2. How does somatic gene therapy differ from Germline gene therapy?

Gene therapy conducted till date has targeted only somatic (non-reproductive) cells. Correction of genetic defects in somatic cells may be beneficial to the patient but the corrected gene may not be carried to the next generation.

3. How does DNA base, sequence differs in human beings?

- In human beings 99% of the DNA base sequences are the same and this is called as bulk genomic DNA.
- The remaining 1% DNA sequence differs from one individual to another. This 1% DNA sequence is present as small stretch of repeated sequence and is called satellite DNA.
- The number of copies of the repeat sequence also called as VNTRs differs from one individual to another and results in variation in the size of the DNA segment.



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Unit Test - 20

Breeding and Bio Technology

Time : 1 hr

Marks : 30

I. Choose the most suitable answer and write the code with the corresponding answer.

5 × 1 = 5

- Himgiri developed by hybridisation and selection for disease resistance against rust pathogens is a variety of _____.
a) Chilli b) Maize c) Sugarcane d) Wheat
- The miracle rice which saved millions of lives and celebrated its 50th birthday is
a) IR 8 b) IR 24 c) Atomita 2 d) Ponni
- We can cut the DNA with the help of
a) scissors b) restriction endonucleases
c) knife d) RNAase
- DNA fingerprinting is based on the principle of identifying _____ sequences of DNA
a) Single stranded b) Mutated c) Polymorphic d) Repetitive
- In Cow pea, Pusa Komal - Resistance to disease is a
a) Hill bunt b) Black rot c) Bacterial blight d) Leaf and stipe rust

II. Answer the following questions in one or two lines.

5 × 2 = 10

- Discuss the method of breeding for disease resistance.
- Differentiate between outbreeding and inbreeding.
- What are pathogens?
- What is mutation breeding?
- What is meant by Gene therapy?

III. Answer the following questions in brief.

2 × 4 = 8

- Write an account on genetically modified animals
- Write basic steps involved in gene cloning.

IV. Answer the following questions in detail.

1 × 7 = 7

- i) Discuss the importance of biotechnology in the field of medicine.
ii) Write the achievements of polyploidy breeding.

