UNIT 20

BREEDING AND BIOTECHNOLOGY

Points to Remember

- Crop improvement is the development of improved crop varieties possesing higher yield, better quality, resistance to diseases and shorter duration.
- When breeding takes place between animals of the same breed, it is called inbreeding.The cross between different breeds is called outbreeding.
- The superiority of the hybrid obtained by cross breeding is called as heterosis or hybrid vigour.
- Genetic engineering is the manipulation and transfer of genes from one organism to another organism.
- Stem cells are undifferentiated or unspecialised mass of cells and can be used for the treatment known as stem cell therapy.

TEXT BOOK EVALUATION

I. Book Exercise – Choose the best answer

1. 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

Ans : (b) Mass selection

2. Pusa Komal is a disease resistant variety of _____.
a) sugarcane b) rice c) cow pea d) maize

Ans : (c) Cow pea

3. Himgiri developed by hybridisation and selection for disease resistance against rust pathogens is a variety of _____.
a) chilli b) maize c) sugarcane d) wheat

Ans : (d) Wheat

4. 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

Ans : (a) IR 8

5. Which of the following is used to produce products useful to humans by biotechnology techniques?
a) enzyme from organism b) live organism
c) vitamins d) both (a) and (b)

Ans : (d) both (a) and (b)

6. We can cut the DNA with the help of
a) scissors b) restriction endonucleases
c) knife d) RNAase

Ans : (b) Restriction endonucleases

7. rDNA is a
a) vector DNA b) circular DNA
c) recombinant of vector DNA and desired DNA d) satellite DNA

Ans : (c) Recombinant of vector DNA and desired DNA

8. DNA fingerprinting is based on the principle of identifying _____ sequences of DNA
a) single stranded b) mutated c) polymorphic d) repititive

Ans : (d) Repititive

9. Organisms with modified endogenous gene or a foregin gene are also known as
a) transgenic organsims b) genetically modified c) mutated d) both a and b

Ans : (d) Both a and b

10. In a hexaploid wheat (2n = 6 x = 42) the haploid (n) and the basic(x) number of chromosomes are
a) n = 7 and x = 21 b) n = 21 and x = 21 c) n = 7 and x = 7 d) n = 21 and x = 7

Ans : (d) n = 21 and x = 7

II. Book Exercise – Fill in the blanks

1. Economically important crop plants with superior quality are raised by_____. **Ans :** Plant breding
2. A protein rich wheat variety is _____. **Ans :** Atlas 66
3. _____is the chemical used for doubling the chromosomes. **Ans :** Colchicine
4. The scientific process which produces crop plants enriched with desirable nutrients are called _____.
Ans : Biofortification
5. Rice normally grows well in alluvial soil, but _____ is a rice variety produced by mutation breeding that grows well in saline soil. **Ans :** Atomita 2
6. _____ technique made it possible to genetically engineer living organism. **Ans :** Genetic Engineering
7. Restriction endonucleases cut the DNA molecule at specific positions known as _____.
Ans : Restriction sites
8. Similar DNA fingerprinting is obtained for _____. **Ans :** Paternity testing
9. _____ cells are undifferentiated mass of cells. **Ans :** Stem
10. In gene cloning the DNA of interest is integrated in a _____. **Ans :** Vector DNA

III. Book Exercise – True or false (If false give the correct statement)

1. Raphanobrassica is a tetraploid man–made genus produced by colchicine treatment.
Ans.: True.

2. The process of producing an organism with more than two sets of chromosome is called mutation.
Ans.: False**.** The process of producing an organism with more than two sets of chromosome is called Polyploidy breeding.

3. A group of plants produced from a single plant through vegetative or asexual reproduction are called a pureline.
Ans.: 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.
Ans.: False**. Amino acid** fortified rice variety determines the protein quality of the cultivated plant.

5. Golden rice is a hybrid.
Ans.: False. Golden rice is a **Genetically modified crop**.

6. Bt gene from bacteria can kill insects.
Ans.: True.

7. In vitro fertilisation means the fertilisation done inside the body.
Ans.: False. In vitro fertilisation means the fertilisation done **outside** the body.

8. DNA fingerprinting technique was developed by Alec Jeffrey.
Ans.: True.

9. Molecular scissors refers to DNA ligases.
Ans.: False. Molecular scissors refers to **Restriction Endonucleases**.

IV. Book Exercise – Match the following

1. Match Column A with B

	Column A		Column B
1.	**Sonalika**	**(a)**	**Phaseolus mungo**
2.	**IR 8**	**(b)**	**Surgarcane**
3.	**Saccharum**	**(c)**	**Semi–dwarf wheat**
4.	**Mung No. 1**	**(d)**	**Ground nut**
5.	**TMU – 2**	**(e)**	**Semi–dwarf Rice**
6.	**Insulin**	**(f)**	**Bacillus thuringienesis**
7.	**Bt toxin**	**(g)**	**Beta carotene**
8.	**Golden rice**	**(h)**	**First hormone produced using rDNA technique**

Ans :

S.No.	Column A		Column B
1	Sonalika	c	Semi–dwarf wheat
2	IR 8	e	Semi–dwarf rice
3	Saccharum	b	Sugarcane
4	Mung No. 1	a	Phaseolus mungo
5	TMU – 2	d	Ground nut
6	Insulin	h	First hormone produced using rDNA technique
7	Bt toxin	f	Bacillus thuringienesis
8	Golden rice	g	Beta carotene

V. Book Exercise – Assertion and Reason

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 : (c) Both assertion and reason is correct

2. **Assertion :** Colchicine reduces the chromosome number.
   Reason : It promotes the movement of sister chromatids to the opposite poles.
   Ans : (b) Reason is correct and the assertion is wrong

3. **Assertion :** rDNA is superior over hybridisation techniques.
   Reason : Desired genes are inserted without introducing the undesriable genes in target organisms.
   Ans : (c) Both assertion and reason is correct

V. Book Exercise – Answer in a sentence (1 mark)

1. Give the name of wheat variety having higher dietary fibre and protein.
Atlas 66 is the wheat variety having higher dietary fibre and protein.

2. Semi-dwarf varieties were introduced in rice. This was made possible by the presence of dwarfing gene in rice. Name this dwarfing gene.
Name of the dwarfing gene is sd1.

3. Define genetic engineering.
Genetic engineering is the manipulation and transfer of genes from one organism to another organisms to create a new DNA called as recombinant DNA (rDNA). Genetic engineering is also called as recombinant DNA technology.

4. Name the types of stem cells.

- **Embryonic stem cells:** They can be extracted and cultured from the early embryos.
- **Adult stem cells or somatic stem cells:** They are found in the neonatal (new born) and adults.

5. What are transgenic organisms?

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

6. State the importance of Biofortification .

Biofortification is used to develop the crop plants enriched with high levels of desirable nutrients like vitamins, proteins and minerals.

VI. Book Exercise – Short answer question (2 mark)

1. Discuss the method of breeding for disease resistance.

Plant diseases are caused by pathogens like viruses, bacteria and fungi. This affects crop yield. Hence, it is important to develop disease resistant varieties of crops, that would increase the yield and reduce the use of fungicides and bactericides.

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

- Higher yield with better quality. eg: Protein Rich Atlas 66
- Resistance to diseases. eg: Himgiri
- Shorter duration / Semidwarf. eg: Sonalika and Kalyan Sona

3. Name two maize hybrids rich in amino acid lysine

Lysine (Amino acid) rich maize hybrids are;

- Protina,
- Shakti and
- Rathna

4. Distinguish between

a. Somatic gene therapy and germ line gene therapy

b. Undifferentiated cells and differentiated cells

a) Differences between Somatic gene therapy and Germ line gene therapy.

S.No.	Somatic Gene Therapy	Germline Gene Therapy
1	It is the replacement of defective gene in somatic cell.	It is the replacement of defective gene in germ cell (sperm and egg).
2	Correction of genetic defects is beneficial to patient. It may not be carried to next generation.	It may not be carried to next generation and will be beneficial to next generation.

b) Differences between Undifferentiated cells and Differentiated cells.

S.No.	Undifferentiated cells	Differentiated cells
1	They are unspecialized mass of cells. So these cells could still become any kind of cell that the body needs.	They become specialized cells for doing certain jobs.
2	Example: Cells in early embryos are undifferentiated. The cells are multiplying, but they haven't started become specific types of cells.	Example: These cells become a liver cell, a blood cell, or a neuron, muscle cells, skin cells, etc.

5. State the applications of DNA fingerprinting technique.

Applications of DNA Fingerprinting

- DNA fingerprinting technique is widely used in forensic applications like crime investigation such as identifying the culprit. 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.

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

condition or disease or injury.

- ❖ 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.

7. Differentiate between outbreeding and inbreeding.

S.No.	Outbreeding	Inbreeding
1	It is the breeding of unrelated animals.	It refers to the mating of closely related animals with the same breed.
2	The hybrids are stronger and vigorous than their parents.	It helps in the accumulation of superior genes and elimination of genes which are undesirable.
3	Cross between two different species with desirable features of economic value are mated. Male donkey + Female Horse = Mule.	Superior males and superior females of the same breed and identified and mated in pairs. Bikaneri (Magra) ewes + Australian Marino rams sheep = Hissardale Sheep.

VII. Book Exercise – Long answer question (5 mark)

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

The superiority of the hybrid obtained by cross breeding is called as heterosis or hybrid vigour.

Effects of hybrid vigour in animal breeding

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

Example 1: Cross breed of fowls:

White Leghorn X Plymouth Rock

↓

Hybrid fowl - yield more eggs

Example 2: Cross breed of cows:

Developed by mating the bulls of exotic breeds and cows of indigenous breeds.

Brown Swiss X Sahiwal

↓

Karan Swiss - yield 2-3 times more milk than indigenous cows.

2. Describe mutation breeding with an example.

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 of 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 : Some achievements of mutation breeding are

- ❖ 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?

Hidden hunger (Micronutrient deficiencies) may occur when one or more vitamins and minerals important for human health are consistently inadequate in a person's diet. Diets based mostly on staple crops, such as maize, wheat and rice, which provide large amounts of energy but relatively low amounts of essential bioavailable vitamins and minerals, frequently result in hidden hunger.

Biofortification may help in removing hidden hunger.

i) Biofortification is the scientific process of developing crop plants enriched with high levels of desirable nutrients like vitamins, proteins and minerals.

ii) Biofortification is a complementary intervention to supplementation and fortification.

iii) Biofortified staple foods can help close the intake gap of targeted micronutrient deficiencies in most other cases and increase the daily intake of micronutrients throughout a person's life cycle.

iv) Some examples of crop varieties developed as a result of biofortifi cation are given below :

a) Protina, Shakti and Rathna are lysine rich maize hybrids (developed in India).

b) Atlas 66, a protein rich wheat variety.

c) Iron rich fortifi ed rice variety.

d) Vitamin A enriched carrots, pumpkin and spinach.

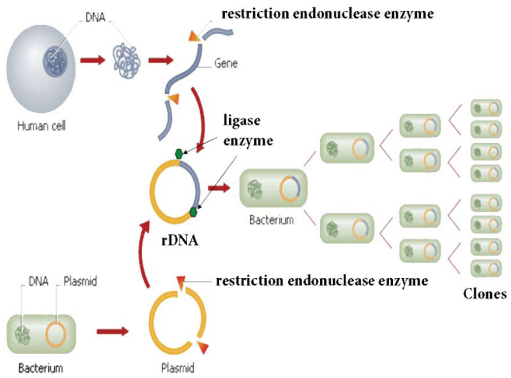
4. With a neat labelled diagram explain the techniques involved in gene cloning.

The carbon copy of an individual is oft en 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.

A brief outline of the basic steps involved in gene cloning are :

- 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 (Transformation)
- Selection and multiplication of recombinant host cell to get a clone v. Expression of cloned gene in host cell.



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

Using genetic engineering techniques medicinally important valuable proteins or polypeptides that form the potential pharmaceutical products for treatment of various diseases have been developed on a commercial scale.

Pharmaceutical products developed by rDNA technique :

- 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 diseases like Hepatitis B and rabies.

VIII. Book Exercise – 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.

The desirable characters into the crop plants :

i) Higher yield.
ii) Resistance to diseases.
iii) Insects/Pests Resistance.
iv) Drought resistant.
v) Shorter duration.
vi) Frtilizer responsive.
vii) The nutritional quality with respect to its
- ❖ Protein content and quality of protein,
- ❖ Oil content and
- ❖ Mineral content**.**

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

i) When we hear about organic farming we think of clean, unadulterated food, while when people hear about the green revolution labs with genetically mutated seeds and plants come to mind.
ii) The basic idea of the green revolution is to improve the yield of crops by using:
- ❖ Chemical fertilizers,
- ❖ Pesticides and
- ❖ Genetically altered seeds/plants.

iii) Pesticides are not only bad for plants, but also for humans. If we spray too many pesticides on our plants they too, like the chemical fertilizers, get washed into the local water sources and can be consumed if the spraying happened close to the harvest of the crops.
iv) Because of tremendous benefits on environmental, social and health front, organic agriculture seems to be emerging as an alternative to 'green revolution technology'.

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

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

Quantitative changes in the mass of chromosomes and genes must have played a very important part in the development of plants towards greater variability including the size of the organisms and with it more appropriate adaptations to the demands of their environment. Mostly gigantism is usual consequence in plants. It seems as though doubling the number of chromosomes will increase the size of the organism also.

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

i) P = Beta Carotene Gene
Q = Plasmid of vector
R = Transgenic Organism

ii) **The importance of 'R' (Transgenic Organism) in India :** The transgenic plants are much stable, with improved nutritional quality, resistant to diseases and tolerant to various environment conditions. Similarly transgenic animals are used to produce proteins of medicinal importance at low cost and improve livestock quality. In India, transgenic organism provide an opportunity to increase food and feed production efficiently by generating plants with higher yields and greater nutritional benefits in reasonably short times.

Additional – Choose the best answer

1. For his contributions to the world food supply, Dr. Norman E. Borlaug was awarded the Nobel Peace Prize in the year _____.

a) 1960 b) 1970 c) 1972 d) 1975

Ans : (b) 1970

2. Sonalika, Kalyan Sona are semi-dwarf varieties of _____.

a) Paddy b) Maize c) Groundnut d) Wheat

Ans : (d) Wheat

3. The wheat variety which has resistance against the diseases leaf and stipe rust, hill bunt is _____.

a) Himgiri b) Pusa Shubhra c) Pusa Komal d) Pusa Snowball

Ans : (a) Himgiri

4. Pusa Shubhra and Pusa Snowball are the varieties of _____ having resistance against black rot disease.

a) Rice b) Cauliflower c) Wheat d) Cow pea

Ans : (b) Cauliflower

5. The cowpea variety which has resistance against the disease bacterial blight is _____.

a) Himgiri b) Pusa Shubhra c) Pusa Komal d) Pusa Snowball

Ans : (c) Pusa Komal

6. Indian scientist known for his leading role in India's Green Revolution.

a) Dr. G. Nammalvar b) Dr. M. S. Swaminathan

c) Dr. Norman E. Borlaug d) Dr. Ian Wilmut

Ans : (b) Dr. M. S. Swaminathan

7. Pusa Sem 2 and Pusa Sem 3 are the varieties of _____.

a) Brassica b) Cauliflower c) Flat Bean d) Lady's finger

Ans : (c) Flat Bean

8. Pusa Sawani and Pusa A4 are the varieties of _____.

a) Brassica b) Cauliflower c) Flat Bean d) Lady's finger

Ans : (d) Lady's finger

9. Pusa Gaurav is the variety of _____.

a) Brassica b) Cauliflower c) Flat Bean d) Lady's finger

Ans : (a) Brassica

10. The nutritional quality of crops may be improved with respect to its

a) Protein content b) Oil content c) Mineral content d) All the above

Ans : (d) All the above

11. Protina, Shakti and Rathna are lysine rich _____ hybrids developed in India.

a) Maize b) Wheat c) Rice d) Lady's finger

Ans : (a) Maize

12. Atlas 66 is a protein rich _____ variety.

a) Maize b) Wheat c) Rice d) Lady's finger

Ans : (b) Wheat

13. Phaseolus mungo (Black Gram) is an exotic species introduced from _____.

a) China b) Mexico c) Philippines d) Japan

Ans : (a) China

14. The plant breeding method in which progeny of a single individual obtained by self breeding is known as _____.

a) Pureline selection b) Clonal selection c) Polyploidy Breeding d) Mass selection

Ans : (a) Pureline selection

15. Selection of desirable clones from the mixed population of vegetatively propagated crop is called _____.

a) Pureline selection b) Clonal selection c) Polyploidy Breeding d) Mass selection

Ans : (b) clonal selection

16. Sexually reproducing organisms have two complete set of chromosomes in their somatic cells. This is called _____.

a) Haploid (n) b) Diploid (2n) c) Triploid (3n) d) Ploypoid

Ans : (b) Diploid (2n)

17. The gametic cells have only one set of chromosome. This is called _____.

a) Haploid (n) b) Diploid (2n) c) Triploid (3n) d) Ploypoid

Ans : (a) Haploid (n)

18. An organism having more than two sets of chromosomes is called _____.

a) Haploid (n) b) Diploid (2n) c) Triploid (3n) d) Ploypoid

Ans : (d) Polyploid

19. The hybrid of wheat and rye is _____.

a) Phaseolus mungo b) Raphano brassica c) Triticale d) TMV–2

Ans : (c) Triticale

20. _____ is an allotetraploid poruduced by colchicine treatment.

a) Phaseolus mungo b) Raphano brassica c) Triticale d) TMV–2

Ans : (b) Raphano brassica

21. Mustard gas and nitrous acid are examples for _____.

a) Physical mutagens b) Chemical mutagens c) Biological mutagens d) None of the above

Ans : (b) Chemical mutagens

22. The utilisation of induced mutation in crop improvement is called _____.

a) Hybridization b) Mutation breeding c) Polyploidy breeding d) Mass selection

Ans : (b) Mutation breeding

23. Some achievements of mutation breeding are _____ is wheat variety produced by using gamma rays.

a) Sharbati Sonora b) Atomita 2 c) Triticale d) Raphano brassica

Ans : (a) Sharbati Sonora

24. _____ is a rice variety with saline tolerance and pest resistance produced by mutation breeding.

a) Sharbati Sonora b) Atomita 2 c) Triticale d) Raphano brassica

Ans : (b) Atomita 2

25. Triticale is obtained by crossing

a) Wheat and rice b) Rice and black gram c) Rice and Rye d) Wheat and Rye

Ans : (d) Wheat and Rye

26. The diploid number (2n) of chromosome in wheat (Triticum durum) is _____.

a) 14 b) 21 c) 28 d) 42

Ans : (c) 28

27. The diploid number (2n) of chromosome in rye (Secale cereal) is _____.

a) 14 b) 21 c) 28 d) 42

Ans : (a) 14

28. The diploid number (2n) of chromosom in Triticale is _____.

a) 14 b) 21 c) 28 d) 42

Ans : (d) 42

29. When breeding takes place between animals of the same breed, it is called _____.

a) Outbreeding b) Inbreeding c) Cross breeding d) Test breeding

Ans : (b) Inbreeding

30. The cross between different breeds is called _____.

a) Outbreeding b) Inbreeding c) Cross breeding d) Test breeding

Ans : (a) Outbreeding

31. The enzymes which can cleave or split the phosphodiester bond within DNA is _____.

a) Restriction Enzymes b) DNA Ligases c) Polymerase d) None of the above

Ans : (a) Restriction Enzymes

32. The enzymes which help in ligating (joining) the broken DNA fragments are _____.

a) Restriction Enzymes b) DNA Ligases c) Polymerase d) None of the above

Ans : (b) DNA Ligases

33. Find out correct sequence of the basic steps involved in gene cloning

i. Selection and multiplication of recombinant host cell to get a clone

ii. Transfer of rDNA into bacterial host cell (Transformation)

iii. Insertion of the DNA fragment into a suitable vector (Plasmid) to make rDNA

iv. Expression of cloned gene in host cell.

v. Isolation of desired DNA fragment by using restriction enzymes

a) i – ii – iii – iv – v b) ii – iii – v – i – iv c) v – iii – ii – i – iv d) v – iv – ii – iii – i

Ans : (c) v – iii – ii – i – iv

35. Dolly was born to her surrogate mother on

a) 5th July 1996 b) 5th June 1996 c) 5th July 2006 d) 5th July 1966

Ans : (a) 5th July 1996

36. Dr. Ian Wilmut and his colleagues developed Dolly at the Roslin Institute situated in _____.

a) Italy b) Russia c) Scotland d) Germany

Ans : (c) Scotland

37. Dolly was created by somatic cell _____ technique.

a) Hybridization b) Nuclear transfer c) Polyploidy Breeding d) Selection

Ans : (b) Nuclear transfer

38. Dolly lived for 6.5 years and died in _____ because of lung disease.

a) 2000 b) 2003 c) 2006 d) 2012

Ans : (b) 2003

39. First commercial production of human insulin by using rDNA technology was started in 1979 by the pharmaceutical company _____.

a) Pfizer Inc b) Eli Lilly c) Johnson & Johnson d) Roche

Ans : (b) Eli Lilly

40. Correction of genetic defects in _____ is not inheritable.

a) Germ cells b) Egg c) Sperm d) Somatic cells

Ans : (d) Somatic cells

41. Correction of genetic defects in _____ is inheritable.

a) Germ cells b) Body cells c) Brain cells d) Somatic cells

Ans : (a) Germ cells

43. In humans, _____ carotene is required for the synthesis of Vitamin A.

a) Alpha b) Beta c) Gamma d) None of the above

Ans : (b) Beta

Additional – Fill in the blanks

1. Improving the genotypes of animals to make them more useful to the welfare of mankind is the main aim of _____. **Ans :** Animal husbandry
2. Developing improved crop varieties possessing higher yield, better quality, resistance to diseases and shorter duration is the main aim of _____. **Ans :** Crop improvement
3. The process of increasing food production through high yielding crop varieties and modern agricultural techniques in underdeveloped and developing nations is known as _____. **Ans :** Green Revolution
4. _____ is called as the "Father of the Green Revolution". **Ans :** Dr. Norman E. Borlaug
5. The miracle rice, _____ is a high-yielding semi-dwarf rice variety developed by International Rice Research Institute (IRRI),Philippines. **Ans :** IR-8
6. Nammalvar Ecological Foundation for Farm Research and Global Food Security Trust (NEFFFRGFST-Vanagam) was founded by _____ to create public awareness about the benefits of organic farming. **Ans :** Dr. G. Nammalvar
7. _____ is called as Father of Indian Green Revolution. **Ans :** Dr. M. S. Swaminathan
8. In India Dr. M. S. Swaminathan joined with Dr.Borlaug in bringing Green Revolution by introducing _____ wheat varieties. **Ans :** Mexican
9. The scientific process of developing crop plants enriched with high levels of desirable nutrients like vitamins, proteins and minerals is known as _____. **Ans :** Biofortification
10. A group of plants produced from a single plant through vegetative or asexual reproduction are called _____. **Ans :** Clones
11. Polyploidy can be induced by chemical agents like _____. **Ans :** Colchicine
12. The sudden heritable change in the nucleotide sequence of DNA in an organism is known as _____. **Ans :** Mutation
13. The organism which undergoes mutation is called a _____. **Ans :** Mutant
14. The factors which induce mutations are known as _____. **Ans :** Mutagens or mutagenic agents
15. _____ is a concept popularised after World War II for the peaceful use of atomic energy for crop improvement. **Ans :** Gamma garden or Atomic garden
16. _____ is a type of induced mutation breeding where radioactive sources particularly gamma rays from Cobalt-60 or Caesium-137 are used to induce desirable mutations in crop plants. **Ans :** Gamma garden or Atomic garden
17. Radiations like X-rays, α, β and γ-rays, UV rays, temperature etc. which induce mutations are called _____. **Ans :** Physical mutagens
18. Chemical substances that induce mutations are called _____. **Ans :** Chemical mutagens
19. Sharbati Sonora is wheat variety produced from _____ by using gamma rays. **Ans :** Sonora-64
20. The process of crossing two or more types of plants for bringing their desired characters together into one progeny is called _____. **Ans :** Hybridization
21. _____ is a progeny of plant or animal that has been produced from two different types of plant or animal, especially to get desired characters. **Ans :** Hybrid
22. _____ is the first man- made cereal hybrid. **Ans :** Triticale
23. A new hybrid obtained by crossing Triticum durum and Secale cereal is _____. **Ans :** Triticale
24. The condition of having 6 copies of each chromosome is known as _____. **Ans :** Hexaploid
25. The chromosome number of Triticale is doubled by using _____. **Ans :** Colchicines

26. Two main aspects of hybridization are to combine the characters of two plants in one plant and to utilize _____. **Ans :** Hybrid vigour
27. A _____ is a group of animals that has certain distinguishing characters that are not found in other members of the same species like general appearance and others striking features. **Ans :** Breed
28. The process which involves mating parents of different varieties each having some desired trait which are passed onto the offspring is known as _____. **Ans :** Breeding
29. Mating or breeding of closely related animals within the same is called _____. **Ans :** Inbreeding
30. The cross between different breeds is called _____. **Ans :** Outbreeding
31. _____ is a new breed of sheep developed by crossing Bikaneri (Magra) ewes and Australian Marino rams. **Ans :** Hissardale
32. _____ is a hybrid produced as the result of cross between male donkey and female horse. **Ans :** Mule
33. Hybrid fowl produced as the result of cross between White Leghorn and Plymouth Rock yield more _____. **Ans :** Eggs
34. _____ is a cross breed of cow developed by mating the bulls of exotic breed Brown Swiss and indigenous cow Sahiwal. **Ans :** Karan Swiss
35. Brown Swiss X Sahiwal = _____. **Ans :** Karan Swiss
36. The superiority of the hybrid obtained by cross breeding is called as _____. **Ans :** Heterosis or hybrid vigour.
37. The manipulation and transfer of genes from one organism to another organisms to create a new DNA is called _____. **Ans :** Genetic Engineering or Recombinant DNA technology.
38. The new DNA produced as the result of Genetic Engineering is known as _____. **Ans :** Recombinant DNA or rDNA
39. The small circular double stranded DNA molecule found in the cytoplasm of bacterial cell is known as _____. **Ans :** Plasmid
40. _____ is called as molecular scissors. **Ans :** Restriction Enzyme
41. The enzyme used to cut or break DNA at specific sites is _____. **Ans :** Restriction enzymes
42. _____ is the first cloned sheep. **Ans :** Dolly
43. The genetically exact copy of an organism or carbon copy of an individual is called a _____. **Ans :** Clone
44. The first cloned female sheep Dolly, was developed by _____. **Ans :** Dr. Ian Wilmut
45. Blood clotting factors can be developed by rDNA technique to treat _____. **Ans :** Haemophilia
46. Tissue plasminogen activator is used to dissolve _____ and prevent heart attack. **Ans :** Blood clots
47. First commercial production of human insulin by using rDNA technology was started in the year _____. **Ans :** 1979
48. The replacement of defective gene by the direct transfer of functional genes into humans to treat genetic disease or disorder is known as _____. **Ans :** Gene therapy
49. _____ gene therapy is the replacement of defective gene in body cells. **Ans :** Somatic
50. The replacement of defective gene in germ cell (egg and sperm) is known as _____ gene therapy. **Ans :** Germ line
51. Undifferentiated or unspecialised mass of cells are known as _____. **Ans :** Stem
52. The unspecialised mass of cells with ability to give rise to specialised cells with specific functions by the process of differentiation are known as _____. **Ans :** Stem cells
53. Embryonic stem cells can be extracted and cultured from the inner cell mass of _____ of early embryo. **Ans :** Blastocyst
54. Amniotic fluid, umbilical cord and bone marrow are the sources for _____ stem cells. **Ans :** Adult or somatic

55. Treating the permanently damaged or lost cells, tissues and organs of the body with stem cells is called _____. **Ans :** Stem-cell therapy
56. In treating neurodegenerative disorders like Parkinson's disease and Alzheimer's disease _____ stem cells can be used to replace the damaged or lost neurons. **Ans :** Neuronal
57. DNA fingerprinting technique was developed by _____. **Ans :** Alec Jeffrey
58. The human _____ has 3 billion base pairs. **Ans :** Genome
59. Each person's DNA sequence is unique due to the small difference in the _____ pairs. **Ans :** Base
60. The _____ technique analyses each individual's unique DNA sequences and provides distinctive characteristics of individual which helps in identification. **Ans :** DNA fingerprinting
61. _____ serve as molecular markers for identification.
Ans : Variable number of tandem repeat sequences (VNTRs)
62. In human beings, 99 % of the DNA base sequences are the same and this is called as _____.
Ans : Bulk genomic DNA
63. The 1 % of the DNA base sequence is present as small stretch of repeated sequences which is known as _____. **Ans :** Satellite DNA
64. DNA fingerprinting technique is widely used in _____ applications. **Ans :** Forensic
65. _____ technique is used for paternity testing in case of disputes. **Ans :** DNA fingerprinting
66. The organism produced by the alteration or manipulation of genes in the organisms using rDNA techniques in order to produce the desired characteristics is known as _____.
Ans : Genetically Modified Organisms (GMOs)
67. The DNA fragment inserted in the organism by using rDNA techniques is called _____.
Ans : Transgene
68. Plants or animals expressing a modified endogenous gene or a foregin gene are also known as _____. **Ans :** Transgenic organisms
69. Genetically modified rice which can produce beta carotene and can prevent Vitamin A deficiency is _____. **Ans :** Golden Rice
70. The plants with _____ genes of bacteria Bacillus thuringiensis can produce the toxin protein that kills the insects which attack them. **Ans :** Bt
71. Salmon or Rainbow trout or Tilapia are examples for _____ fish. **Ans :** Transgenic
72. Transgenic sheep contain genes responsible for synthesis of _____ amino acid. **Ans :** Cysteine

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Additional – True or false (If false give the correct statement)

1. **Raphano brassica or Rabbage is a cross between the radish (Raphanus) and cabbage (Brassica).**
Ans.: True.
2. **Hybrid is superior in one or more characters to both parents.**
Ans.: True.
3. **Breeding of related animals is known as Outbreeding.**
Ans.: False. Breeding of **unrelated** animals is known as Outbreeding.
4. **The hybrids produced by breeding are stronger and vigorous than their parents.**
Ans.: True.
5. **The hybrid mule is a sterile.**
Ans.: True.
6. **Mule is a hybrid produced as the result of cross between male giraffe and female horse.**
Ans.: False. Mule is a hybrid produced as the result of cross between male **donkey** and female horse.
7. **DNA Ligases are cut enzymes and Restriction Enzymes are paste enzymes.**
Ans.: False. **Restriction Enzymes** are cut enzymes and **DNA Ligases** are paste enzymes.
8. **Dolly sheep is the first mammal to be cloned from an adult cell.**
Ans.: True.

9. The DNA pattern of two individuals cannot be same except for identical twins.
Ans.: True.

10. Rainbow trout and Tilapia are transgenic sheep.
Ans.: False. Rainbow trout and Tilapia are transgenic **fish**.

Additional – Match the following

1. Section – I :

1.	**Kalyan Sona**	**(a)**	**Protein rich wheat**
2.	**IR–8**	**(b)**	**Phaseolus mungo**
3.	**Rice variety peta**	**(c)**	**Miracle rice**
4.	**Dee–geo–woo–gen**	**(d)**	**Semi–dwart wheat**
5.	**Dr. G. Nammalvar**	**(e)**	**Pusa Gaurav**
6.	**Brassica**	**(f)**	**Indonesia**
7.	**Lady's finger**	**(g)**	**Dwart rice variety**
8.	**Flat Bean**	**(h)**	**Pusa A4**
9.	**Atlas 66**	**(i)**	**Pusa Sem 2 & 3**
10.	**Exotic species**	**(j)**	**Organic farming**

Ans :

1	Kalyan Sona	d	Semi–dwart wheat
2	IR – 8	c	Miracle rice
3	Rice variety Peta	f	Indonesia
4	Dee–geo–woo–gen	g	Dwart rice variety
5	Dr. G. Nammalvar	j	Organic farming
6	Brassica	e	Pusa Gaurav
7	Lady's finger	h	Pusa A4
8	Flat Bean	i	Pusa Sem 2 & 3
9	Atlas 66	a	Protein rich wheat
10	Exotic species	b	Phaseolus mungo

2. Section – II :

1.	**Groundnut**	**(a)**	**Sahiwal**
2.	**Triploid variety of tea**	**(b)**	**Secale cereale**
3.	**Allotetraploid**	**(c)**	**Restriction enzymes**
4.	**Chemical mutagens**	**(d)**	**TV–29**
5.	**Triticale**	**(e)**	**Mustard gas and nitrous acid**
6.	**Wheat**	**(f)**	**First man–made cereal**
7.	**Rye**	**(g)**	**Raphano brassica**
8.	**Exotic bull**	**(h)**	**Triticum durum**
9.	**Indigenous cow**	**(i)**	**Brown Swiss**
10.	**Molecular scissors**	**(j)**	**TMV–2 and AK–10**

Ans :

1	Groundnut	j	TMV–2 and AK–10
2	Triploid variety of tea	d	TV–29
3	Allotetraploid	g	Raphano brassica
4	Chemical mutagens	e	Mustard gas and Nitrous acid
5	Triticale	f	First man–made cereal
6	Wheat	h	Triticum durum

7	Rye	b	Secale cereale
8	Exotic bull	i	Brown Swiss
9	Indigenous cow	a	Sahiwal
10	Molecular scissors	c	Restriction enzymes

Additional – Assertion and Reason (2 Marks)

Direction: In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements given below, mark the correct answer as

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 :** Genetic Engineering can overcome the drawbacks of traditional hybridization.
   Reason : Genetic Engineering can create desired DNA sequences to meet the specific requirements.
   Ans : (c) Both assertion and reason is correct

2. **Assertion :** Plasmids are extra chromosomal DNA.
   Reason : Plasmids are found in bacteria and are useful in genetic engineering.
   Ans : (c) Both assertion and reason is correct

3. **Assertion :** Genetic variations due to mutation will not bring about changes in the organism.
   Reason : Mutation is the sudden heritable change in the nucleotide sequence of DNA in an organism.
   Ans : (b) Reason is correct and the assertion is wrong

4. **Assertion :** Inbreeding helps in the accumulation of superior genes and elimination of genes which are undesirable.
   Reason : Inbreeding refers to the mating of unrelated animals.
   Ans : (a) Assertion is correct and reason is wrong

5. **Assertion :** Somatic gene therapy is the replacement of defective gene in gametes.
   Reason : Correction of genetic defects in germ cells may not be carried to the next generation.
   Ans : (d) Both assertion and reason is wrong

Additional – Answer in a sentence (1 mark)

1. Define plant breeding.

Plant breeding is the art of developing economically important plants with superior quality.

2. What is the aim of crop improvement?

The aim of crop improvement is to develop improved crop varieties possessing higher yield, better quality, resistance to diseases and shorter duration.

3. What is Green Revolution?

Green Revolution is the process of increasing food production through high yielding crop varieties and modern agricultural techniques in underdeveloped and developing nations.

4. Who is known as Father of the Green Revolution"?

Dr. Norman E. Borlaug, an American agronomist is known as the "Father of the Green Revolution".

5. What is Biofortification ?

Biofortification is the scientific process of developing crop plants enriched with high levels of desirable nutrients like vitamins, proteins and minerals.

6. Give examples for Physical mutagens.

Radiations like X-rays, α, β and γ-rays, UV rays, temperature etc. are examples for physical mutagens.

7. What are chemical mutagens? Give examples.

Chemical substances that induce mutations are called chemical mutagens.

Examples : 1. Mustard gas and
2. Nitrous acid.

8. Give an example for cross breed of fowls.

White Leghorn X Plymouth Rock = Hybrid fowl (Yield more eggs).

9. Give an example for cross breed of cows.

Developed by mating the bulls of exotic breeds and cows of indigenous breeds. Brown Swiss X Sahiwal = Karan Swiss (Yield 2-3 times more milk than indigenous cows).

10. What is Heterosis ?

The superiority of the hybrid obtained by cross breeding is called as heterosis or hybrid vigour.

11. What is plasmid?

Plasmid is the small circular double stranded DNA molecule found in the cytoplasm of bacterial cell and separated from chromosomal DNA. It can replicate independently.

12. Define clone.

The carbon copy of an individual or genetically exact copy of an organism is often called a clone.

13. Name the US company which produced insulin first by rDNA Technology.

Eli Lilly and Company, United States, in 1979 first started commercial production of human insulin by using rDNA technology.

14. Name the diseases that can be treated by gene therapy.

Neuronal stem cells can be used to replace the damaged or lost neurons while treating neurodegenerative disorders like Parkinson's disease and Alzheimer's diseases.

Additional – Short answer questions (2 mark)

1. What is animal husbandry?

Animal husbandry is the branch of agriculture concerned with animals that are raised for meat, fibre, milk, eggs, or other products. It includes day-to-day care, selective breeding and the raising of livestock. It aims at improving the genotypes of animals to make them more useful to the welfare of mankind.

2. What are the modern Agricultural Practices?

Modern agricultural practices are activities carried out to improve cultivation of plants. It includes

- ✦ Preparation of soil,
- ✦ Sowing,
- ✦ Application of manures and fertilizers,
- ✦ Proper irrigation,
- ✦ Protection from weeds and pests,
- ✦ Harvesting and threshing and
- ✦ Storage.

3. Name Semi-Dwarf varieties in Wheat and Rice.

i) Semi-dwarf varieties of wheat
   - ✦ Sonalika
   - ✦ Kalyan Sona

ii) Semi-dwarf varieties of rice
   - ✦ IR - 8

4. What are the nutritional quality of the feed crops?

The nutritional quality of crops depends on

- ✦ Protein content and quality of protein
- ✦ Oil content and
- ✦ Mineral content

5. Name crop varieties developed as a result of biofortification.

Some examples of crop varieties developed as a result of biofortification are given below:

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

6. What is Gamma Garden?

Gamma garden or Atomic garden is a concept popularised after World War II for the peaceful use of atomic energy for crop improvement. This is a type of induced mutation breeding where radioactive sources particularly gamma rays from Cobalt-60 or Caesium-137 are used to induce desirable mutations in crop plants.

7. Define 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. Hybrid is superior in one or more characters to both parents. Hybridization is the common method of creating genetic variation to get improved varieties.

8. Define Polyploidy Breeding. Give examples for crop plants produced by polyploidy.

An organism having more than two sets of chromosomes is called polyploid. Such condition is called Polyploidy. It can be induced by physical agents such as heat or cold treatment, X-rays and chemical agents like colchicine.

Examples :

- ✦ Seedless watermelons (3n) and bananas (3n).
- ✦ TV-29 (triploid variety of tea) with larger shoots and drought tolerance
- ✦ Triticale (6n) is a hybrid of wheat and rye. It has higher dietary fibre and protein.
- ✦ Raphanobrassica is an allotetraploid by colchicine treatment.

9. What is Mutation Breeding? What are the achievements of mutation breeding in crop improvement?

Mutation is defined as the sudden heritable change in the nucleotide sequence of DNA in an organism. The utilisation of induced mutation in crop improvement is called mutation breeding. Some achievements of mutation breeding are

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

10. Which is the first man-made cereal by hybridization method? How is it obtained?

Triticale is the first man- made cereal hybrid. It is obtained by crossing wheat (Triticum durum, 2n = 28) and rye (Secale cereal, 2n = 14). The F1 hybrid is sterile (2n = 21). Then the chromosome number is doubled using colchicine and it becomes a hexaploid Triticale (2n = 42).

11. What is Breed?

A breed is a group of animals of common origin within a species that has certain distinguishing characters that are not found in other members of the same species like general appearance and others striking features such as increased yield of milk, egg and meat.

12. What are the objectives of Animal Breeding?

Objectives of Animal Breeding includes

- ✦ To improve the genotypes of domesticated animals to increase their yield
- ✦ To improve the desirable qualities to produce milk, egg and meat.

13. What is inbreeding? Give an example.

Inbreeding refers to the mating of closely related animals within the same breed.

Example : Hissardale is a new breed of sheep developed in Punjab by crossing Bikaneri (Magra) ewes and Australian Marino rams.

14. What is outbreeding? Give an example.

The cross between different breeds is called outbreeding. It is the breeding of unrelated animals.

Example : The animal produced by crossing a male donkey and a female horse is called a mule.
Male Donkey X Female Horse = Mule.
Mule is superior to horse in strength, intelligence, ability to work and resistance to diseases but they are sterile.

15. Define Genetic Engineering or Recombinant DNA technology.

Genetic engineering is the manipulation and transfer of genes from one organism to another organisms to create a new DNA called as recombinant DNA(rDNA). The term recombinant is used because DNA from two different sources can be joined together. Hence, genetic engineering is also called as recombinant DNA technology.

16. What are the basic requirements for techniques of Genetic Engineering?

Important discoveries that led to the stepping stone of rDNA technology were

- ✦ Presence of plasmid in bacteria that can undergo replication independently along with chromosomal DNA.
- ✦ Restriction enzymes cuts or break DNA at specific sites and are also called as molecular scissors.
- ✦ DNA ligases are the enzymes which help in ligating (joining) the broken DNA fragments.

17. Write a note on Dolly.

- ✦ Dolly was the first cloned female sheep, developed by Dr. Ian Wilmut and his colleagues at the Roslin Institute, Scotland in July 1996.
- ✦ She was created by somatic cell nuclear transfer technique.
- ✦ She lived for 6.5 years and died in 2003 because of lung disease.

18. Define Gene Therapy. What are the two types of 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 .

Two types of Gene therapy are;

- ✦ Somatic gene therapy : It is the replacement of defective gene in somatic cells. It is not inheritable.
- ✦ Germ line gene therapy: Germ line gene therapy replacement of defective gene in germ cell (egg and sperm). It is inheritable.

19. What are Stem Cells? What are the properties of stem cells?

Stem cells are undifferentiated or unspecialised mass of cells.

The two important properties of stem cells that are:

- ✦ They have ability to divide and give rise to more stem cells by self-renewal
- ✦ They have ability to give rise to specialised cells with specific functions by the process of differentiation.

20. What is 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. In such situations stem cells are used for the treatment of diseases which is called stem-cell therapy.

21. What are Genetically Modified Organisms (GMOs) or Transgenic organisms?

Genetic modification refers to the alteration or manipulation of genes in the organisms using rDNA techniques in order to produce the desired characteristics. The DNA fragment inserted is called transgene. Plants or animals expressing a modified endogenous gene or a foreign gene are also known as transgenic organisms.

22. What are the improved characteristic features of Genetically Modified Organisms (GMOs) or Transgenic organisms?

Transgenic plants : They are much stable, with improved nutritional quality, resistant to diseases and tolerant to various environment conditions.

Transgenic animals : They are used to produce proteins of medicinal importance at low cost and improve livestock quality.

Additional – Long answer questions

1. Name different methods of Plant Breeding for Crop Improvement.

Methods of plant breeding to develop high yielding varieties are;

i) Introduction of new varieties of plants.
ii) Selection.
iii) Polyploidy breeding.
iv) Mutation breeding.
v) Hybridization.

Different methods of Plant Breeding for Crop Improvement

i) **Introduction of New Varieties of Plants :** It is a process of introducing high yielding varieties of plants from one place to another. Such plants are called as exotic species. Example: Phaseolus mungo was introduced from China.

ii) **Selection :** Individual plants or groups of plants are sorted out from a mixed population based on the morphological characters. There are three methods of selection. They are

- ✦ Mass selection : Seeds of best plants showing desired characters are collected from a mixed population. Th e collected seeds are allowed to raise the second generation. Examples for mass selection are groundnut varieties like TMV–2 and AK–10.
- ✦ Pureline selection : Pureline is "the progeny of a single individual obtained by self breeding". This is also called as individual plant selection.
- ✦ Clonal selection A group of plants produced from a single plant through vegetative or asexual reproduction are called clones. Selection of desirable clones from the mixed population of vegetatively propagated crop is called clonal selection.

iii) **Polyploidy Breeding :** An organism having more than two sets of chromosomes is called polyploid. Such condition is called Polyploidy. It can be induced by physical agents such as heat or cold treatment, X-rays and chemical agents like colchicine.

Examples :
- ✦ Seedless watermelons (3n) and bananas (3n).
- ✦ TV-29 (triploid variety of tea) with larger shoots and drought tolerance
- ✦ Triticale (6n) is a hybrid of wheat and rye. It has higher dietary fibre and protein.
- ✦ Raphanobrassica is an allotetraploid by colchicine treatment.

iv) **Mutation Breeding :** 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 utilisation of induced mutation in crop improvement is called mutation breeding. Some achievements of mutation breeding are

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

v) **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. Hybrid is superior in one or more characters to both parents.

Important Abbreviations to Remember

IRRI	International Rice Research Institute
NEFFFRGFST	Nammalvar Ecological Foundation for Farm Research and Global Food Security Trust
DGWG	Dee–geo–woo–gen
DNA	Deoxyribonucleic Acid
rDNA	Recombinant DNA
VNTRs	Variable Number of Tandem Repeat Sequences
GMO	Genetically Modified Organisms

Important Scientists to remember

1	Dr. Norman E. Borlaug	Father of Green Revolution / Received Nobel Prize in 1970
2	Dr. M.S.Swaminathan	Father of Indian Green Revolution
3	Dr. G.Nammalvar	Founder of Nammalvar Ecological Foundation for Farm Reserch and Global Food Security Trust (NEFFRGFST)
4	Dr. Ian Wilmut	Development of Dolly - 5th July 1996
5	Alec Jeffrey	Developed DNA fingerprinting Technique

UNIT TEST - 20

Time : 1.15 Hrs. Marks : 50

I. Choose the best answer

(5 × 1 = 5)

1. **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
2. **The miracle rice which saved millions of lives and celebrated its 50th birthday is _____.**
   a) IR 8 b) IR 24 c) Atomita d) Ponni
3. **We can cut the DNA with the help of**
   a) scissors b) restriction endonucleases
   c) knife d) RNAase
4. **For his contributions to the world food supply, Dr. Norman E. Borlaug was awarded the Nobel Peace Prize in the year _____.**
   a) 1960 b) 1970 c) 1972 d) 1975
5. **Protina, Shakti and Rathna are lysine rich _____ hybrids developed in India.**
   a) Maize b) Wheat c) Rice d) Lady's finger

II. Fill in the blanks

(5 × 1 = 5)

6. Economically important crop plants with superior quality are raised by _____.
7. The scientific process which produces crop plants enriched with desirable nutrients are called _____.
8. _____ cells are undifferentiated mass of cells.
9. _____ is called as the "Father of the Green Revolution".
10. Polyploidy can be induced by chemical agents like _____.

III. State whether the statements are true or false. Correct the false statement

(5 × 1 = 5)

11. Raphanobrassica is a tetraploid man-made genus produced by colchicine treatment.
12. The process of producing an organism with more than two sets of chromosome is called mutation.
13. Golden rice is a hybrid.
14. DNA fingerprinting technique was developed by Alec Jeffrey.
15. Breeding of related animals is known as Outbreeding.

IV. Match the following

(5 × 1 = 5)

16.	Sonalika	(a)	Ground nut
17.	Saccharum	(b)	Semi–dwarf wheat
18.	Mung No.1	(c)	Beta carotene
19.	TMU – 2	(d)	Sugarcane
20.	Golden rice	(e)	Phaseolus mungo

V. Assertin and Reasoning

(5 × 1 = 5)

Direction: In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements given below, mark the correct answer as

a. If both A and R are true and R is the correct explanation of A.
b. If both A and R are true but R is not the correct explanation of A.
c. If A is true but R is false.
d. If both A and R are false.

21. **Assertion:** Hybrid is superior than either of its parents.
    Reason: Hybrid vigour is lost upon inbreeding.
22. **Assertion:** rDNA is superior over hybridisation techniques.
    Reason: Desired genes are inserted without introducing the undesriable genes in target organisms.
23. **Assertion:** Colchicine reduces the chromosome number.
    Reason: It promotes the movement of sister chromatids to the opposite poles.
24. **Assertion:** Genetic Engineering can overcome the drawbacks of traditional hybridization.
    Reason: Genetic Engineering can create desired DNA sequences to meet the specific requirements.
25. **Assertion:** Plasmids are extra chromosomal DNA.
    Reason: Plasmids are found in bacteria and are useful in genetic engineering.

VI. Write the answer for the following questions in word or sentence

(5 × 1 = 5)

26. State the importance of Biofortification.
27. Name the types of stem cells.
28. What are transgenic organisms?
29. What is Heterosis?
30. What is plasmid?

VII. Write the short answer for ANY 5 of the following questions

(5 × 2 = 10)

31. Name three improved characteristics of wheat that helped India to achieve high productivity.
32. Distinguish between somatic gene therapy and germ line gene therapy.
33. Differentiate between outbreeding and inbreeding.
34. State the applications of DNA fingerprinting technique.
35. What is Gamma Garden?
36. Name crop varieties developed as a result of biofortification.
37. What is inbreeding? Give an example.

VIII. Write long answer for the following questions

(2 × 5 = 10)

38. Discuss the importance of biotechnology in the field of medicine.

or

39 With a neat labelled diagram explain the techniques involved in gene cloning.
40 Name different methods of Plant Breeding for Crop Improvement.

or

41 Biofortication may help in removing hidden hunger. How?