

# Chapter 31

## Strategies for Enhancement in Food Production

- Artificial selection to obtain cows yielding higher milk output represents
  - directional as it pushes the mean of the character in one direction
  - disruptive as it splits the population into two, one yielding higher output and the other lower output
  - stabilising followed by disruptive as it stabilises the population to produce higher yielding cows
  - stabilising selection as it stabilises this character in the population.

(NEET 2017)
- Homozygous purelines in cattle can be obtained by
  - mating of unrelated individuals of same breed
  - mating of individuals of different breed
  - mating of individuals of different species
  - mating of related individuals of same breed.

(NEET 2017)
- A true breeding plant is
  - one that is able to breed on its own
  - produced due to cross-pollination among unrelated plants
  - near homozygous and produces offspring of its own kind
  - always homozygous recessive in its genetic constitution.

(NEET-II 2016)
- Interspecific hybridisation is the mating of
  - animals within same breed without having common ancestors
  - two different related species
  - superior males and females of different breeds
  - more closely related individuals within same breed for 4-6 generations.

(NEET-II 2016)
- Among the following edible fishes, which one is a marine fish having rich source of omega-3 fatty acids?
  - Mystus*
  - Mangur
  - Mrigala
  - Mackerel

(NEET-II 2016)
- A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called
  - strip farming
  - shifting agriculture
  - ley farming
  - contour farming.

(NEET-I 2016)
- A protoplast is a cell
  - undergoing division
  - without cell wall
  - without plasma membrane
  - without nucleus.

(2015)
- Outbreeding is an important strategy of animal husbandry because it
  - is useful in overcoming inbreeding depression
  - exposes harmful recessive genes that are eliminated by selection
  - helps in accumulation of superior genes
  - is useful in producing purelines of animals.

(2015)
- A technique of micropropagation is
  - protoplast fusion
  - embryo rescue
  - somatic hybridisation
  - somatic embryogenesis.

(2015 Cancelled)
- Which of the following enhances or induces fusion of protoplasts?
  - IAA and kinetin
  - IAA and gibberellins
  - Sodium chloride and potassium chloride
  - Polyethylene glycol and sodium nitrate

(2015 Cancelled)
- In vitro* clonal propagation in plants is characterized by
  - PCR and RAPD
  - northern blotting
  - electrophoresis and HPLC
  - microscopy.

(2014)

12. To obtain virus - free healthy plants from a diseased one by tissue culture technique, which part/parts of the diseased plant will be taken?  
 (a) Apical meristem only  
 (b) Palisade parenchyma  
 (c) Both apical and axillary meristems  
 (d) Epidermis only (2014)
13. In plant breeding programmes, the entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called  
 (a) evaluation and selection of parents  
 (b) germplasm collection  
 (c) selection of superior recombinants  
 (d) cross-hybridisation among the selected parents. (NEET 2013)
14. Tissue culture technique can produce infinite number of new plants from a small parental tissue. The economic importance of the technique is in raising  
 (a) genetically uniform population identical to the original parent  
 (b) homozygous diploid plants  
 (c) new species  
 (d) variants through picking up somaclonal variations. (Karnataka NEET 2013)
15. The viability of seeds is tested by  
 (a) 2, 6 dichlorophenol indophenols  
 (b) 2, 3, 5 triphenyl tetrazolium chloride  
 (c) DMSO  
 (d) Safranin. (Karnataka NEET 2013)
16. Which of the following statements is not true about somatic embryogenesis?  
 (a) The pattern of development of a somatic embryo is comparable to that of a zygotic embryo.  
 (b) Somatic embryos can develop from microspores.  
 (c) Somatic embryo is induced usually by an auxin such as 2, 4-D.  
 (d) A somatic embryo develops from a somatic cell. (Karnataka NEET 2013)
17. Which one of the following is a case of wrong matching?  
 (a) Somatic - Fusion of two diverse hybridization cells  
 (b) Vector DNA - Site for tRNA synthesis  
 (c) Micropropagation - *in vitro* production of plants in large numbers  
 (d) Callus - Unorganised mass of cells produced in tissue culture. (2012)
18. Which part would be most suitable for raising virus-free plants for micropropagation ?  
 (a) Bark (b) Vascular tissue  
 (c) Meristem (d) Node (2012)
19. Green revolution in India occurred during  
 (a) 1960's (b) 1970's  
 (c) 1980's (d) 1950's. (Mains 2012)
20. A collection of plants and seed having diverse alleles of all the genes of a crop is called  
 (a) herbarium (b) germplasm  
 (c) gene library (d) genome. (2011)
21. "Jaya" and "Ratna" developed for green revolution in India are the varieties of  
 (a) maize (b) rice  
 (c) wheat (d) bajra. (2011)
22. 'Himgiri' developed by hybridisation and selection for disease resistance against rust pathogens is a variety of  
 (a) chilli (b) maize  
 (c) sugarcane (d) wheat. (2011)
23. Breeding of crops with high levels of minerals, vitamins and proteins is called  
 (a) somatic hybridisation  
 (b) biofortification  
 (c) biomagnification  
 (d) micropropagation. (2010)
24. Polyethylene glycol method is used for  
 (a) biodiesel production  
 (b) seedless fruit production  
 (c) energy production from sewage  
 (d) gene transfer without a vector. (2009)
25. Somaclones are obtained by  
 (a) plant breeding  
 (b) irradiation  
 (c) genetic engineering  
 (d) tissue culture. (2009)
26. Haploids are more suitable for mutation studies than the diploids. This is because  
 (a) haploids are more abundant in nature than diploids  
 (b) all mutations, whether dominant or recessive are expressed in haploids  
 (c) haploids are reproductively more stable than diploids  
 (d) mutagens penetrate in haploids more effectively than in diploids. (2008)

27. Which one of the following is linked to the discovery of Bordeaux mixture as a popular fungicide?  
 (a) Loose smut of wheat  
 (b) Black rust of wheat  
 (c) Bacterial leaf blight of rice  
 (d) Downy mildew of grapes (2008)
28. Consider the following four measures (1-4) that could be taken to successfully grow chickpea in an area where bacterial blight disease is common.  
 (1) Spray with Bordeaux mixture  
 (2) Control of the insect vector of the disease pathogen  
 (3) Use of only disease-free seeds  
 (4) Use of varieties resistant to the disease  
 Which two of the above measures can control the disease?  
 (a) 3 and 4 (b) 1 and 4  
 (c) 2 and 3 (d) 1 and 2 (2008)
29. Compared to a bull a bullock is docile because of  
 (a) higher levels of cortisone  
 (b) lower levels of blood testosterone  
 (c) lower levels of adrenaline/noradrenaline in its blood  
 (d) higher levels of thyroxine. (2007)
30. In cloning of cattle a fertilized egg is taken out of the mother's womb and  
 (a) in the eight cell stage, cells are separated and cultured until small embryos are formed which are implanted into the womb of other cows  
 (b) in the eight cell stage the individual cells are separated under electrical field for further development in culture media  
 (c) from this upto eight identical twins can be produced  
 (d) the egg is divided into 4 pairs of cells which are implanted into the womb of other cows. (2007)
31. Which one of the following is a viral disease of poultry?  
 (a) Coryza (b) New castle disease  
 (c) Pasteurellosis (d) Salmonellosis (2007)
32. In maize, hybrid vigour is exploited by  
 (a) crossing of two inbred parental lines  
 (b) harvesting seeds from the most productive plants  
 (c) inducing mutations  
 (d) bombarding the seeds with DNA. (2007)
33. Crop plants grown in monoculture are  
 (a) highly prone to pests  
 (b) low in yield  
 (c) free from intraspecific competition  
 (d) characterised by poor root system. (2006)
34. In maize, hybrid vigour is exploited by  
 (a) inducing mutations  
 (b) bombarding the protoplast with DNA  
 (c) crossing of two inbred parental lines  
 (d) harvesting seeds from the most productive plants. (2006)
35. In order to obtain virus-free plants through tissue culture the best method is  
 (a) meristem culture (b) protoplast culture  
 (c) embryo rescue (d) anther culture. (2006)
36. *Triticale*, the first man-made cereal crop, has been obtained by crossing wheat with  
 (a) barley (b) rye  
 (c) pearl millet (d) sugarcane. (2006)
37. Three crops that contribute maximum to global food grain production are  
 (a) wheat, rice and maize  
 (b) wheat, rice and barley  
 (c) wheat, maize and sorghum  
 (d) rice, maize and sorghum. (2005)
38. Which of the following is generally used for induced mutagenesis in crop plants?  
 (a) X-rays  
 (b) UV (260 nm)  
 (c) Gamma rays (from cobalt-60)  
 (d) Alpha particles (2005)
39. The name of Norman Borlaug is associated with  
 (a) white revolution (b) green revolution  
 (c) yellow revolution (d) blue revolution. (2005)
40. The world's highly prized wool yielding 'Pashmina' breed is  
 (a) goat  
 (b) sheep  
 (c) goat-sheep cross  
 (d) Kashmir sheep - Afghan sheep cross. (2005)
41. The technique of obtaining large number of plantlets by tissue culture method is called  
 (a) plantlet culture (b) organ culture  
 (c) micropropagation  
 (d) macropropagation. (2004)
42. India's wheat yield revolution in the 1960s was possible primarily due to  
 (a) hybrid seeds

- (b) increased chlorophyll content  
(c) mutations resulting in plant height reduction  
(d) quantitative trait mutations. (2004)
43. Which one of the following plants are used as green manure in crop fields and in sandy soils ?  
(a) *Crotalaria juncea* and *Alhagi camelorum*  
(b) *Calotropis procera* and *Phyllanthus niruri*  
(c) *Saccharum munja* and *Lantana camara*  
(d) *Dichanthium annulatum* and *Azolla nilotica* (2003)
44. Maximum application of animal cell culture technology today is in the production of  
(a) insulin (b) interferons  
(c) vaccines (d) edible proteins. (2003)
45. If a diploid cell is treated with colchicine then it becomes  
(a) triploid (b) tetraploid  
(c) diploid (d) monoploid. (2002)
46. In tissue culture medium, the embryoids formed from pollen grains is due to  
(a) cellular totipotency  
(b) organogenesis  
(c) double fertilization  
(d) test tube culture. (2002)
47. Which of the following crops have been brought to India from New world?  
(a) Cashewnut, potato, rubber  
(b) Mango, tea  
(c) Tea, rubber, mango  
(d) Coffee (2002)
48. Before the European invader which vegetable was absent in India?  
(a) Potato and tomato  
(b) Shimla mirch and brinjal  
(c) Maize and chichinda  
(d) Bitter gourd (2001)
49. *Triticale* is obtained by crossing wheat with  
(a) oat (b) barley  
(c) maize (d) rye. (2001)
50. Which fish selectively feed on larva of mosquito?  
(a) *Gambusia* (b) *Rohu*  
(c) *Clarias* (d) *Exocoetus* (2001)
51. Coconut milk is used in tissue culture in which present  
(a) cytokinin (b) auxin  
(c) gibberellin (d) ethylene. (2000)
52. Which statement is correct?  
(a) *A. indica* is largest wild honey bee.  
(b) Wax is waste material of honey bee.  
(c) Workers are the smallest of the three castes.  
(d) Drone of honey bee is diploid. (2000)
53. The new varieties of plants are produced by  
(a) introduction and mutation  
(b) selection and introduction  
(c) selection and hybridization  
(d) mutation and selection. (1999)
54. Due to which of the following organism, yield of rice is increased?  
(a) *Sesbania* (b) *Bacillus popilliae*  
(c) *Anabaena* (d) *Bacillus subtilis* (1999)
55. The term aquaculture means  
(a) inland fisheries (b) aspergillosis  
(c) marine fisheries (d) both (a) and (c). (1999)
56. Fish, which eradicate the mosquito larva, is  
(a) *Gambusia* (b) cutter fish  
(c) *Anabus* (d) rohu. (1999)
57. Life span of a worker bee is  
(a) 6 weeks (b) 10 weeks  
(c) 10 days (d) 15 days. (1999)
58. Hybridoma cells are  
(a) only cells having oncogenes  
(b) product of spore formation in bacteria  
(c) nervous cells of frog  
(d) hybrid cells resulting from myeloma cells. (1999)
59. The reason for vegetatively reproducing crop plants to suit for maintaining hybrid vigour is that  
(a) they are more resistant to diseases  
(b) once a desired hybrid produced, no chances of losing it  
(c) they can be easily propagated  
(d) they have a longer life span. (1998)
60. High milk yielding varieties of cows are obtained by  
(a) use of surrogate mothers  
(b) superovulation  
(c) artificial insemination  
(d) all of these. (1997)
61. Honey is  
(a) alkaline  
(b) basic after some days  
(c) acidic  
(d) neutral. (1997)

62. Pebrine is a disease of  
(a) silk worm (b) lac insect  
(c) honey bee (d) fish (1997)
63. Which one of the following constitutes natural silk?  
(a) Nitrogen (b) Magnesium  
(c) Potassium (d) Phosphorus (1996)
64. Which one of the following fish is introduced into India by foreigners?  
(a) *Mystus singhala* (b) *Clarius batrachus*  
(c) *Labeo rohita* (d) *Pomphret* (1996)
65. When scientists make an animal superior by view of genotype, introducing some foreign genes in it, is called  
(a) immunization (b) genetic engineering  
(c) tissue culture (d) biotechnology. (1996)
66. Improvement of human race by controlled selective breeding between individual with desirable characteristics is called  
(a) inbreeding (b) eugenics  
(c) eugenics (d) none of these. (1996)
67. Which of the following is the New World spice, that has become an essential part of Indian cuisine?  
(a) Red pepper (b) Black pepper  
(c) Ginger (d) Cardamom (1995)
68. The silkworm silk is the product of  
(a) salivary gland of the larva  
(b) salivary gland of the adult  
(c) cuticle of the larva  
(d) cuticle of the adult. (1995)
69. Haploid plants can be obtained by culturing  
(a) pollen grains (b) root tips  
(c) young leaves (d) endosperm. (1994)
70. Silk is produced by  
(a) adult moth (b) cocoon  
(c) larva (d) both (a) and (c). (1994)
71. Which among the following is the real product of the honey bee?  
(a) Honey (b) Propolis  
(c) Pollen (d) Bee wax (1994)
72. Haploid plants are preferred over diploids for mutation study because in haploids  
(a) recessive mutation express immediately  
(b) induction of mutations is easier  
(c) culturing is easier  
(d) dominant mutation express immediately. (1993)
73. Which crop variety is not due to induced mutations?  
(a) Reimei of rice  
(b) Prabhat of arhar  
(c) Sharbati sonora of wheat  
(d) Aruna of castor (1993)
74. Cellular totipotency was demonstrated by  
(a) Theodore Schwann  
(b) A.V. Leeuwenhoek  
(c) F.C. Steward  
(d) Robert Hooke. (1991)
75. Which ones produce androgenic haploids in anther cultures?  
(a) Anther wall  
(b) Tapetal layer of anther wall  
(c) Connective tissue  
(d) Young pollen grains (1990)
76. In crop movement programme, haploids are important because they  
(a) require one half of nutrients  
(b) are helpful in study of meiosis  
(c) grow better under adverse conditions  
(d) form perfect homozygous. (1989)

**Answer Key**

1. (a) 2. (d) 3. (c) 4. (b) 5. (d) 6. (c) 7. (b) 8. (a) 9. (d) 10. (d)  
11. (a) 12. (c) 13. (b) 14. (a) 15. (b) 16. (b) 17. (b) 18. (c) 19. (a) 20. (b)  
21. (b) 22. (d) 23. (b) 24. (d) 25. (d) 26. (b) 27. (d) 28. (b) 29. (b) 30. (a)  
31. (b) 32. (a) 33. (a) 34. (c) 35. (a) 36. (b) 37. (a) 38. (c) 39. (b) 40. (a)  
41. (c) 42. (d) 43. (a) 44. (c) 45. (b) 46. (a) 47. (a) 48. (a) 49. (d) 50. (a)  
51. (a) 52. (c) 53. (c) 54. (c) 55. (d) 56. (a) 57. (a) 58. (d) 59. (b) 60. (d)  
61. (c) 62. (a) 63. (a) 64. (d) 65. (b) 66. (c) 67. (a) 68. (a) 69. (a) 70. (c)  
71. (d) 72. (a) 73. (d) 74. (c) 75. (d) 76. (d)



## EXPLANATIONS

1. (a)
2. (d) : When breeding is between animals of the same breed for 4-6 generation, it is called inbreeding. Inbreeding, as a rule, increases homozygosity. Thus, inbreeding is necessary if we want to obtain a pureline in any animal.
3. (c)
4. (b) : In interspecific hybridisation, a species is mated with a different related species of the same genus. Interspecific hybrids are generally difficult to produce, but they are important in plant breeding, particularly in breeding for disease resistance. This is also called intrageneric hybridisation.
5. (d) : Mackerel is a marine fish, rich in omega-3-fatty acids. *Mystus*, Mangur and Mrigala are freshwater fishes.
6. (c) : Ley farming is an agricultural system where the field is alternately seeded for grain and left fallow for growing hay or used for pasture. During the fallow/pasture period the soil is filled with roots of grasses and other plants. New ploughing mixes them in the soil and also increases the amount of nitrogen in the soil especially when legume forage are used. It also protects soil from erosion by maintaining constant soil coverage.
7. (b) : A protoplast is a cell which has its cell wall removed by mechanical or enzymatic means.
8. (a) : Outbreeding is the breeding of unrelated animals, which may be between individuals of the same breed (but having no common ancestors), or between different breeds (cross breeding) or different species (inter specific hybridisation). Outbreeding is an important strategy of animal husbandry as it helps to overcome inbreeding depression.
9. (d) : Micropropagation is the latest method of obtaining a large number of plantlets from plant tissue culture. It is called micropropagation because of the minute size of the propagules. It involves repeated subculture of the explant by changing the medium so as to form a large number of plantlets from that single explant. Somatic embryogenesis *i.e.*, developing embryos from somatic cells is one of the techniques of micropropagation.
10. (d) : When a hybrid is produced by fusion of somatic cells of two varieties or species, it is known as somatic hybrid. The process of producing somatic hybrids is called somatic hybridization. First, the cell wall of the plant cells are removed then the protoplasts of the two cells are brought in contact and made to fuse by means of electrofusion or chemicals like polyethylene glycol (PEG) and sodium nitrate. The fused protoplasts soon develop their own walls and are called somatic hybrids.
11. (a) : Clonal propagation can be characterized by PCR and RAPD. The polymerase chain reaction (PCR) technique, generates microgram ( $\mu\text{g}$ ) quantities of DNA copies (upto billion copies) of the desired DNA (or RNA) segment, present even as a single copy in the initial preparation, in a matter of few hours. RAPD stands for Random Amplification of Polymorphic DNA. It is a type of PCR, but the segments of DNA that are amplified are random. No knowledge of the DNA sequence for the targeted gene is required, as the primers will bind somewhere in the sequence, but it is not certain exactly where. Its resolving power is much lower than targeted, species specific DNA comparison methods, such as short tandem repeats.
12. (c) : Meristem is a localized group of cells, which are actively dividing and undifferentiated but ultimately giving rise to permanent tissue. Although the plant is infected with a virus, yet the meristem is free of virus. Therefore, meristem can be removed and grown *in vitro* to obtain virus free plants. Cultivation of axillary or apical shoot meristems is called meristem culture. The apical or axillary meristems are generally free from virus.
13. (b) : Germplasm of any crop species consists of (i) cultivated improved varieties, (ii) improved varieties that are no more in cultivation, (iii) old local or '*desi*' varieties, (iv) pure lines and (v) wild species related to the crop species.
14. (a) : Plant tissue culture, also called micro-propagation, is the growth of plant cells outside the plant body in a suitable culture medium which contains mixture of nutrients in solid or liquid form, under controlled environmental condition. Tissue culture technique is based on totipotent nature of plant cell or phenomenon of totipotency *i.e.*, each and every plant cell has inherent capacity to develop into complete plant. The entirely vegetatively produced descendents of somatic cells are collectively called clone. They are genetically identical to parents.
15. (b) : Viability of seeds can be known by two methods: (i) ability to germinate, (ii) testing their ability to respire. All viable seeds respire. This can be tested by immersing a section of seed containing the embryo in 0.1% solution of triphenyl tetrazolium chloride. The viable embryo will turn pink due to conversion of colourless triphenyl tetrazolium chloride into insoluble

coloured dye called triphenyl formazone due to reduction.

**16. (b) :** Somatic embryos develop from somatic cells. Their development is comparable to that of a zygotic embryo. They are just like a normal embryo except that their development is induced from a diploid somatic cell. Somatic embryo culture is induced by a high concentration of an auxin. Microspores are haploid cells which do not give rise to somatic embryo.

**17. (b) :** Vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. They are used in recombinant DNA technology.

**18. (c) :** Refer to answer 12.

**19. (a) :** The development and usage of several high yield varieties of wheat and rice, better irrigation facilities, fertilizer application, weed, pest and pathogen control and better agricultural management in 1960s, increased the yields per unit area. This phase is often called green revolution. In India, it was witnessed during mid 1960s. Norman E. Borlaug is known as Father of Green Revolution as he developed the semi-dwarf varieties of wheat. In 1963, many lines like Sonalika and Kalyan Sona were selected from these and introduced all over India. Semi-dwarf varieties of rice were developed from IR-8 at International Rice Research Institute (IRRI), Philippines and Taichung Native -1 from Taiwan which were introduced in 1966, in India. Dr. M.S. Swaminathan, pioneer mutation breeder has produced Sharbati Sonora, a variety of wheat by mutation, which is responsible for green revolution in India. Dr. Swaminathan is called Father of Green Revolution in India.

**20. (b) :** The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasm collection.

**21. (b) :** Green Revolution was one of the major task for agricultural scientists in India to produce sufficient food for increasing population. Better yielding semi-dwarf varieties of rice, "Jaya" and "Ratna" were developed for green revolution.

**22. (d) :** 'Himgiri' is a variety of wheat. HS-375 and HS375 are the two common varieties of Himgiri. HS-375 is produced on irrigated/rain-fed area. It is medium fertility and late sown hybrid of Himgiri, while HS375 is produced on very high altitude *i.e.*, in the Northern Himalayan and Garhwal region. 'Himgiri' is resistance to leaf and stripe rust and hill bunt diseases.

**23. (b) :** Breeding of crops with higher levels of vitamins and minerals or higher protein and healthier fats is called biofortification. This is the most practical aspect to improve the health of the people.

**24. (d) :** Direct gene transfer is the transfer of naked DNA into plant cells, but the presence of rigid plant cell wall acts as a barrier to uptake. Therefore, protoplasts are the favoured target for direct gene transfer. Polyethylene glycol mediated DNA uptake is a direct gene transfer method that utilizes the interaction between PEG, naked DNA, salts and the protoplast membrane to effect transport of the DNA into the cytoplasm.

**25. (d) :** Genetic variation present among plant cells during tissue culture is called somaclonal variation. The term somaclonal variation is also used for the genetic variation present in plants regenerated from a single culture. This variation has been used to develop several useful varieties.

**26. (b) :** Haploid plants, are always pure because they possess only one set of chromosomes. So, the mutations are expressed very easily in haploid plants as compared to diploid plants.

**27. (d) :** First inorganic fungicide was developed by R.M.A. Millardet (1882) against downy mildew (*Plasmopara viticola*) of grape-vine at the University of Bordeaux and commonly known as Bordeaux mixture. It consists of copper sulphate, lime and water.

**28. (b) :** Bacterial blight of chickpea is caused by bacterium *Xanthomonas campestris*. The stems and the leaves of infected plant give blighted or burnt up appearance. Control measures includes rogueing, 3-year crop rotation, disease free seeds, spray of copper fungicides (Bordeaux mixture) and antibiotics besides sowing disease resistant varieties.

**29. (b) :** A bullock is a castrated bull. Bulls have castrated to make them more meek and docile. Castration is any action, surgical, chemical, or otherwise, by which a male loses the functions of the testes or a female loses the functions of the ovaries. Castration is the removal or destruction of one or both testicles and results in sterility, decreased sexual desire, and inhibition of secondary sex characteristics. It is performed for the purpose of improving the quality of meat and decreasing the aggressiveness of farm animals; in pet animals it prevents unwanted mating behaviour, reproduction, and wandering.

**30. (a)**

**31. (b) :** New castle disease is a highly contagious zoonotic bird disease affecting many domestic and wild avian species. The causal agent, New castle disease virus (NDV), is a negative-sense single-stranded RNA virus. Transmission occurs by exposure to faecal and other excretions from infected birds, and through contact with contaminated feed, water, equipment and clothing. Signs of infection with NDV vary greatly depending on factors such as the strain of virus and the health, age and species of the host. They can include respiratory signs (gasping, coughing), nervous signs (depression, inappetence, drooping wings, paralysis), swelling of the eyes and neck, diarrhoea, rough or thin-shelled eggs and reduced egg production.

**32. (a) :** Hybridisation or heterosis or hybrid vigour is defined as superiority of hybrid over parents. It has been commercially exploited in different commercial crops like maize, sorghum, bajra, etc. The main steps include: selection of parents, selfing of parents, emasculation, bagging, crossing of desired and selected parents and finally seed setting and harvesting.

**33. (a) :** Monoculture describes systems that have very low diversity. Monoculture is the destruction of a diverse ecosystem and replacement with a single species or crop. It depletes the soil, fruits and vegetables become more susceptible to pests and diseases than those grown in a diverse crop environment, thus requiring larger amount of chemical spray.

**34. (c) :** Refer to answer 32.

**35. (a) :** Refer to answer 12.

**36. (b) :** *Triticale* is the first man made cereal or crop, which has been produced by intergeneric hybridization between common wheat (*Triticum aestivum*) and European rye (*Secale cereale*) with a view to combine characters of these two parent plants. *Triticale* is hexaploid, i.e.,  $2n = 6x = 62$  (when tetraploid wheat is used) or octaploid, i.e.,  $2n = 8x = 56$  (when hexaploid wheat is used). *Triticale* or *Triticosecale* is not suitable for purpose of bread making due to low gluten content, but it is a good forage crop.

**37. (a) :** Most important source of food in the world are cereals. They are a rich source of carbohydrates, present in endosperms which is the edible portion in cereals. Wheat, corn and rice contribute to about two thirds of the total world's food. Rice alone is the staple food of 60% of world population and more than 50% Indians. Wheat is world's most widely cultivated crop. Maize is an important kharif crop of India and also contributes to food production.

**38. (c) :** Gamma rays are produced when an unstable atomic nucleus like cobalt-60 releases energy to gain

stability. Sharbati Sonora and Pusa Lerma are the two important varieties of wheat that are responsible for green revolution in India. These are produced by gamma rays treatment of Sonora-64 and Lerma Rojo-64 which are Mexican dwarf wheat varieties.

**39. (b) :** Refer to answer 19.

**40. (a) :** Pashmina refers to a type of cashmere wool and textiles made from it. This wool comes from a special breed of goat indigenous to high altitudes of the Himalayan mountains. The Himalayan mountain goat, *Capra hircus*, sheds its winter coat every spring and the fleece is caught on thorn bushes. One goat sheds approximately 3-8 ounces of the fibre.

**41. (c) :** Refer to answer 9.

**42. (d)**

**43. (a) :** Green manures are fast growing herbaceous crops which are ploughed down and mixed with the soil while still green for enrichment of soil. These provide both organic matter and nitrogen to the soil, in which Indian soils are generally poor. The green manure checks soil erosion by forming protective soil cover and also prevents leaching. Increase in yield by 30-50% has been observed by use of green manures. Some important green manure crops, which are mostly members of Family Leguminosae are *Alhagi* and *Crotolaria juncea*.

**44. (c) :** Maximum application of animal cell culture technology is in the production of vaccines. Vaccines are chemical substances prepared from the proteins of other animals which confer immunity to a particular virus. Some of the vaccines synthesized biologically through genetic engineering are vaccines for hepatitis B virus, vaccines for rabies virus, vaccines for poliovirus and vaccines for small pox virus, etc.

**45. (b) :** Colchicine is an alkaloid extracted from seed and corm of *Colchicum autumnale*. It has the property of arresting and breaking the spindle so that a cell division without cell wall formation may be affected leading to doubling of chromosome number. So a diploid cell will become tetraploid by chromosome doubling.

**46. (a) :** Totipotency refers to the capacity of each living cell of a multicellular organism being capable of independent development when provided with suitable conditions. Guha and Maheshwari (1966) cultured anthers of *Datura*. The haploid pollen grain inside the anther divides to form a multicellular mass of cells called callus. Using varying quantities of auxins and cytokinins in the culture medium, this callus is differentiated into embryoids which later germinates to form the entire plant.



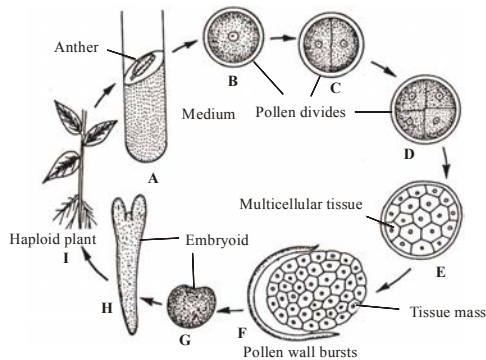


Fig.: Differentiation of embryoids from pollen grains in culture.

47. (a) : New world crops are those which have their center of origin as America. Cashewnut and rubber have their center of origin in Brazil and potato has Peru as its center of origin. All of them have been brought to India from New world.

48. (a) : Potato and tomato are new world crops. Their center of origin is Peru, so they are new world crops. They were brought to India by the European invaders.

49. (d) : Refer to answer 36.

50. (a) : *Gambusia affinis* is regarded as a larvicidal fish as it selectively feeds on mosquito larvae. It forms an effective tool for biological control of mosquitoes.

51. (a) : Coconut milk or liquid endosperm of coconut could initiate as well as sustain the proliferation of tissues in a culture. Eventually coconut milk was shown to contain the cytokinin zeatin, but this finding was not obtained until several years after the discovery of cytokinins. The first cytokinin to be discovered was the synthetic analog kinetin.

52. (c) : A highly organised division of labour is found in the colony of honey bees. A good and well developed colony of bees had 40 to 50 thousand individuals consisting of 3 castes viz., queen, drone and worker. Although the workers are the smallest of the three castes but they function as the main spring of the complicated machinery like honey bee colony. It takes 21 days in the development from the egg to the adult and the total life span of a worker is about 6 weeks. The workers are atrophid female which sacrifice themselves for the well-being of the colony. The total indoor and outdoor duties of the colony are performed by the workers only. *Apis dorsata* is the largest honey bee and *A. indica* is slightly smaller than it. Bees wax is a by product of honey bee and drone of honey bee is haploid in nature.

53. (c) : The new plant varieties are produced by selection and hybridization. Selection is a non-random process which leads to individuals of different genotypes being represented unequally in their

progeny in later generations of a population of self propagating units. It can be natural or artificial. Hybridization is the crossing of two varieties, species or genera having desired genes by bringing together the useful characters of these into one progeny. Both these processes produce new plant varieties.

54. (c) : *Azolla* plays a very important role in rice production. *Azolla* and its nitrogen-fixing partner, *Anabaena*, has been used as green manure to fertilize rice paddies and increase production. With the help of *Azolla*, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary.

55. (d) : Aquaculture involves production of useful aquatic plants and animals such as fishes, prawns, shrimps, lobsters, crabs, molluscs by proper utilization of small and large bodies of water. The production of fishes is called pisciculture. Inland fishery deals with the fishery aspects of waters other than marine water. Marine fishery deals with the fishery aspects of the sea water or ocean.

56. (a) : Refer to answer 50.

57. (a) : Refer to answer 52.

58. (d) : Hybridoma is hybrid cell resulting from the artificial fusion of an antibody-producing lymphocyte and a myeloma cell from a lymphoid tumour. Such cells can produce a clone that may be maintained in tissue culture and used for the continuing production of monoclonal antibody.

59. (b) : Hybrid vigour or heterosis is defined as the superiority of the hybrid over its parents. It is lost on inbreeding. It is lost in the  $F_2$  generation in self pollinated plants and declines slowly in cross pollinated plants. So it is more profitable in vegetatively propagated plants as they do not involve sexual reproduction and so hybrid vigour is not lost in subsequent crops, e.g., sweet potato, sugarcane, strawberry and grapes, etc.

60. (d) : High milk yielding varieties of cows are obtained by use of surrogate mothers, super ovulation, artificial insemination. To get an increased yield of milk surrogate mothers are used in dairy. Superovulation is the hormonal stimulation of multiple ovarian follicles resulting in release from the ovary of a larger number of oocytes (ova) than normal. So, implantation into surrogate mothers increases the number of offspring, usually from highly selected cows. Artificial insemination is a reasonably straight forward process to remove semen from a chosen male animal, and transfer it into a female, at the appropriate stage of the oestrous cycle. This process is well developed in case of dairy cattle breeding for more milk production.

**61. (c) :** Honey is very acidic. Its pH is between 3 and 4 about the same as orange juice or a can of coke.

**62. (a) :** Pebrine is a disease of silkworm caused by a small parasite *Nosema* which has a devastating effect on silk industry.

**63. (a) :** Silk is a pasty secretion of the silkworm produced by the salivary gland of the larva. As this pasty secretion comes in contact with air, it becomes hard and forms strong and pliable silk strands. This secretion forms two cores of fibroin: (i) a tough elastic insoluble protein consisting of 75% of the fibre's weight and cemented together with sericin from the middle region of the silk gland at the time of secretion, and (ii) a gelatinous protein which is easily soluble in warm water. As proteins consist of nitrogen component so, it is a main constituent of natural silk.

**64. (d) :** *Pomphret* fish is the one, which was introduced in India by foreigners. It is consumed as an edible fish.

**65. (b) :** Genetic engineering is experimental manipulation of genetic material, especially for industrial or medical uses. It encompasses the techniques of gene cloning, the modification DNA by changes in sequence arrangement or deletion, and the introduction of novel genes into cells and organisms. It may prove possible to advantageously modify the genes of farmed animals, to correct genetic deficiencies of the human by inserting novel genes. This can be done by breakage of a DNA molecule at two desired places into another DNA molecule of the desired animal.

**66. (c) :** Euthenics is the suitable environment for human well being, health and intellect.

Inbreeding involves production of progenies by mating between relatives.

**67. (a) :** New world crops are those which have their centre of origin in America. Red peppers are the dried ripe fruits of *Capsicum* sp., indigenous to the American tropics and subtropics and the West Indies. It is a new world crop.

**68. (a) :** Refer to answer 63.

**69. (a) :** Haploid plants are those plants which have single set of chromosomes. Pollen grains are haploid as they are produced after meiosis so they are used for haploid production. It was first made in *Datura innoxia* by Guha and Maheshwari in 1964.

Haploids are important in plant breeding as mutation can be easily detected in them and they are also used

to produce homozygous diploids.

**70. (c) :** Refer answer 63.

**71. (d) :** Bee wax is a very useful by-product of bee keeping industry. It is yellowish to greyish brown in colour and insoluble in water but completely soluble in ether. Bee wax is a natural secretion of the worker bees and is poured out in thin delicate scales or flakes. It is secreted by pair of wax glands placed ventrally on the abdomen. Bee wax is used in the manufacture of cosmetics, for Catholic churches, face cream, paints, ointments, insulators, plastic works, polishes, carbon paper, lubricant etc. Honey is not the real product of honey bees. It is a mixture of nectar, pollen, cane-sugar and saliva of honey-bees.

**72. (a) :** Haploids are preferred over diploids for mutation study because in haploids recessive mutation is easier. Most of the induced mutations are recessive and these have to be in double to be expressed phenotypically. Mutations are not seen in heterozygous conditions. So, in haploid plants, recessive mutation express immediately.

**73. (d) :** Aruna of castor is a crop variety which is not due to induced mutations. Aruna variety has been developed by mutation, where maturity period has been reduced from normal 270 days to 102 days.

**74. (c) :** Cellular totipotency is the technique of regeneration or development of complete plant from explant or cell or tissue of the plant. This technique was established by F. C. Steward and developed the new carrot plant from carrot root culture

**75. (d) :** Haploid production through a culture has been referred to as androgenesis. The androgenic method of haploid production is from the male gametophyte of an angiosperm plant *i.e.*, microspore (immature pollen). Young pollen grains produced androgenic haploids in anther cultures while anther wall, tapetal layer of anther wall and connective tissue are the parts of anther. Tapetal layer is the nutritive tissue.

**76. (d) :** In crop movement programme, haploids are important because they form perfect homozygous lines. Homozygous are the pure line selection plants resulting from self pollination. In this way, considerable homozygosity is obtained. Haploids are those plants which possess a gametophytic number of chromosomes. Haploids are used in plant breeding, especially for the production of homozygous plants and in their studies in the detection of mutation.

