UNIT - IV
PLANTS AND HUMAN WELFARE

4.1. CROP IMPROVEMENT

SYNOPSIS

- The process of bringing wild species under human management is referred to as domestication.
- Plant breeding began when man first chose certain plants for cultivation.
- Plant breeding developed as a science only after the rediscovery of Mendel's laws of heredity.
- Application of knowledge acquired in the fields of molecular genetics & cytogenetics helped breeders to achieve wonderful results in a short time.

Aims and Objectives

- Incorporation of as many desirable qualities as possible into a single variety, so as to make it superior to the existing varieities is the main objective of plant breeding.
  1. To increase the yield of grains, fodder, fibre, oil and other plant products.
  2. To improve the quality of crops with regard to size, colour, shape, taste, nutritional value, storage ability of grains, vegetables, fruits etc. and many special qualities like high sugar content in sugar crops, high protein content in pulses, long and fine fibres in fibre crops, large size fruits in fruit crops etc.
  3. To develop varieties that are resistant to diseases, insects, drought, frost, floods, alkaline and saline conditions.
  4. To produce early maturing varieties for crop rotation purposes.
  5. To change the growth habits and agronomic characteristics of plants and to produce dwarf varieties, plants with profuse branching or more tillering, tolerance to moisture stress and salts.
  6. Suitability for easy harvesting, adaptability to wide regions are some of the other objectives.
- **Methods of Plant breeding**

  The methods of plant breeding are dependent on the type of reproduction and pollination mechanisms in plants. Different methods of plant breeding are

  A) Plant introduction B) Selection
  C) Hybridization D) Mutation breeding
  E) Polyploidy breeding

- **Plant Introduction**

  Plant introduction is a process of introducing plants into a new locality with different climate from their natural growing places.
  1. It is the simplest & easiest method. No scientific knowledge is necessary and only some amount of skill is required.
  2. Introduced varieties can be directly used in agriculture & horticulture.
  3. They serve as germplasm banks for crop improvement.

     The sum total of genes in a plant species is referred to as germ plasm.

     The germ plasm is stored in the form of seeds, pollen etc.
- **Achievements**

  Ex: Sonora 63,64, varieties of wheat from Mexico.
  I R 8 variety of rice from philippines.

Selection

Selection is the basis for crop improvement

- **Mass selection**

  This is the oldest known method of selection and is useful in cross pollinated crops.

  Mass selection is utilised to improve the yield and quality of the crop.

  Best results are obtained based on the heterozygosity within the crop varieties.

  About 8 years time is taken for production of a variety by this method.
- **Advantages**
  1. It is the easiest method of selection. No scientific knowledge is required except some amount of skill. It is, therefore, said that the mass selection is more of an art than a science.
  2. This is the only method of selection in wild or local crop varieties of cross pollinated plants.
- **Achievements**

  Many of the existing crops are products of mass selection only. They are

  a) Cotton : Many of the Indian commercial varieties like Dharwar American, Dodahatti-local, Cambodias etc.

  b) Bajra : Pusa Moti.
- **Pure-line selection**

  The progeny of a single, self-pollinated, homozygous plant is known as 'pure line. The method of production of a variety from the pure line is known as "**Pure line selection"**.

  W.L Johannsen, a Denmark scientist proposed pure line selection method for crop improvement.

  He conducted selection experiments on 'princess variety' of bean (*Phaseolus vulgaris*)

This method is employed only for **self-pollinated crops**.

By this process for about **10 years,** a new variety is produced.

- **Advantages**
  1. It is the only method to improve the local varieties of self-pollinated crops.
  2. Pure line selection increases homozygosity and consequently all the progeny developed by this method are phenotypically and genotypically uniform
- **Achievements :** Some examples of crop plants developed through pure line selection are
  a) Groundnut : TMV - 3 and RSB - 17
  b) Rice : CO 4, 6, 10, 14 varieties
- **Clonal selection**
  A group of plants obtained vegetatively from a single plant is known as 'clone' and the method of developing varieties from the clones is known as 'clonal selection'.
  All the plants in a clone are phenotypically and genotypically similar. Like pure line selection, their characters remain constant.
  However, in the vegetatively propagated plant, the characters are in heterozygous state, and they remain the same throughout the breeding.
  Many vegetative parts such as setts (sugarcane), cuttings (roses), tubers (Potato), bulbs (onion), suckers (banana) etc. are the units of clonal selection.
  Selection is effective when it is **between clones but not within a clone,** because all the individuals within a clone have the same genotype.
  Selection within a clone seems to be effective only when a mutation intervenes.
  Generally, it takes **nine years** to produce superior variety.
- **Advantages**
  The progeny of clonal selection remain stable for any number of generations. If they possess hybrid vigour, the character can be exploited for many generations.
- **Achievement**
  Many crop plants have been developed through clonal selection. Some examples are
  a) Potato : Kufri red and kufri safed varieties.
  b) Mango : Mundapa pedda neelam.
- **Hybridization**
  Hybridization is the **most important method** of plant breeding. Either in introduction or in selection there is no scope of incorporating new desired characters, but it is possible through hybridization.
  Hybridization can be defined as the method of producing new crop varieties by crossing two genetically different parents.

The plant breeder always aims to incorporate as many desirable qualities from various varieties into a single variety.

In nature, cross pollination occurs in many plants leading to hybridization.

In hybridization genetic recombination occurs.

Hence great amount of genetic variability results in the offspring, which are utilized for crop improvement.

- **Hybridization procedure**

  Crossing two plants of different genotypes involves the following procedure.
- **Selection of parents :** The foremost aspect of hybridization is to select homozygous plants with desirable characters as parents.

  Heterozygous plants can be converted into homozygous plants by repeated selfing (inbreeding).
- **Emasculation : Removal of anthers from bisexual flowers of female parents, when the flowers are still in bud condition is called 'emasculation'.**

  It prevents self pollination.

  In case of large flower buds, emasculation is easily performed by opening the flower buds by means of sterilized forceps and fine needle and then removing anthers without causing injury to other floral parts.

  In case of small flowers, which are crowded in dense inflorescences as in bajra, jowar etc. the whole inflorescence is dipped in hot water at $45-50^0C$ or different periods of 1-10 minutes.

  The gynoecium can withstand higher temperatures but anthers get killed.

  Some plants are male sterile, i.e., in them although bisexual flowers have stamens, they do not possess active and fertile pollen.

  Male sterile plants can be used directly as female parents without emasculation.
- **Bagging :** After emasculation is done, the female flower is enclosed in a polythene bag to prevent any other pollen grains falling on the stigmatic surface.

  Thus bagging prevents the undesired cross pollination.
- **Artificial cross pollination :** Pollen grains are collected from the male parent with the help of a brush or blotting paper and these are transferred carefully to the surface of the stigma and thus cross pollination is affected artificially.

The flowers are immediately enclosed in polythene bags.

Seeds and fruits are formed after fertilization.

Self pollination occurs in F_1 plants and plants of F_2 generation develop.

The plants possessing desirable characters are selected and developed by different methods. Seeds are multiplied and finally released to farmers for cultivation.

- **Advantages :** New genetic recombinations can be created by hybridization. Many hybrids exhibit hybrid vigour. A large number of desirable characters can be incorporated into a single variety.
- **Hybrid vigour or Heterosis**

The F_1 hybrids, as a rule in majority of the cases are more vigorous (taller, sturdier and more productive) than the parents.

> The superiority of the hybrids over the parents in terms of size and vigour is known as hybrid vigour or **heterosis**

Although **Koelreuter** identified hybrid vigour, he could not understand the reasons. **G.H. Shull** an American Scientist introduced the term 'Heterosis'.

He found that in maize, constant self pollination (inbreeding) produced a considerable loss of vigour (inbreeding depression) and when the weak progenies were crossed, the resulting hybrids exhibited the hybrid vigour.

Hybrid vigour is caused due to the presence of **more number of dominant genes** in a hybrid than its parents or due to its **heterozygosity** unlike its parents.

- **Mutation breeding**

Mutations are sudden heritable changes in the genotype of an organism.

Hugo de Vries for the first time used the term 'mutation' for the appearance of new types in the evening primrose plant (Oenothera).

Induction of desirable mutations in plants and their utilization for the production of new superior varieties is called 'Mutation breeding'.

It is an efficient method of plant breeding. The ingenious experiments of **Muller** and **Stadler** laid the foundation for Mutation breeding. According to their origin, mutations are classified into two types.

i. Spontaneous Mutations ii. Induced Mutations

- **Spontaneous mutations**

These mutations arise automatically in nature.

Their frequency is extremely low.

They are caused due to the action of naturally occurring aspects like electric currents, atomic rays and particles, temperature variations etc. *Oenothera gigas* (large sized plants) and *O. nanella* (dwarf plants) are few examples of spontaneous mutations.

- **Induced mutations**

H.J. Muller induced mutations in *Drosophila* for the first time using X-rays, while **L.J. Stadler** induced mutations in barley in 1928.

Genetic variations required for crop improvement are induced in large numbers in relatively short period. Substances which induce mutations are called **'mutagens'** .

These are of two types.

1. Physical mutagens and
2. Chemical mutagens

All ionizing radiations (X-rays, α -rays, β -rays, γ -rays) and non-ionizing radiations like ultraviolet rays are powerful physical mutagens.

The seeds, seedlings, buds and flowers are subjected to irradiation leading to the production of large number of mutations.

Chemical mutagens are colchicine, formaldehyde, ethyl methane sulphonate (EMS),malic hydrazide etc. Mostly they cause gene mutations.

Mutation breeding is a quick method to induce genetic variability in many crops.

- **Achievements**

a) By mutation breeding, disease resistance is incorporated into IR-8 rice

b) The sweedish variety of barley with hardiness

c) Aruna variety of castor

- **Polyploidy breeding**

In nature, sexually reproducing organisms are in diploid condition. In them two sets of chromosomes are present.

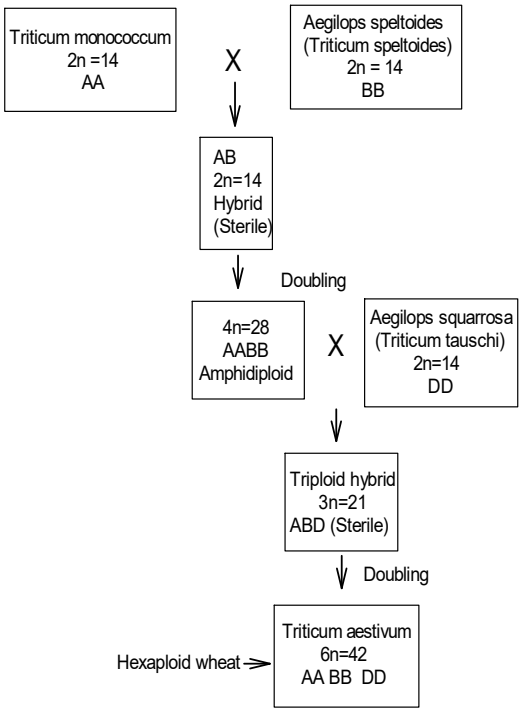
However, many plants, especially grasses are either triploids (3x), tetraploids (4x), hexaploids (6x) or octaploids (8x).

Such plants having more than two sets of chromosomes are termed as **polyploids.**

The utilization of polyploidy for the improvement of crops is called '**polyploidy breeding**'.

- **Hexaploids**

The commercial bread wheat (*Triticum aestivum)* is a classic example for an allohexaploid.The origin of bread wheat is schematically described in following figure.



- **Polyploidy production methods**
  a) Cold treatment of zygote when it is in a dividing stage
  b) Application of chemicals like acenapthene, colchicine, coumarin.etc to floral buds and vegetative buds
  c) Treating the floral & vegetative buds with x-rays

LEVEL - I

1. Cross pollinating crops can be improved by
   1) Pureline selection 2) Mass selection
   3) Clonal selection 4) Pedigree selection
2. Pureline selection in crop improvement was proposed by
   1) G.H.Shull 2) W.L.Johannsen
   3) Gregor Mendel 4) Hugo de Vries
3. An example produced by clonal selection in india
   1) Kufri red variety of potato
   2) Pusa ruby variety of tomato
   3) Pusa moti variety of bajra
   4) Jaya variety of rice
4. Hybrid vigour was first identified by
   1) Gregor Mendel 2) Koelreuter
   3) Cotton Mather 4) Kaerpechenko
5. The term heterosis was introduced by
   1) Gregor Mendel 2) Mather
   3) G.H.Shull 4) Kolreuter
6. Colchicine induces doubling of chromosome number by
   1) Promoting DNA replication
   2) Promoting spindle formation
   3) Splitting the chromosome into chromatids
   4) Suppressing the spindle formation
7. The first induced mutation in plants was obtained by
   1) L.J.Stadler 2) H.J.Muller
   3) Hugo de Vries 4) Karpechenko
8. One of the following is a non-ionizing mutagenic radiation
   1) Alfa-rays 2) UV-rays 3)X-rays 4)Gama-rays
9. The rice variety, which was improved by mutation breeding technique is
   1) Aruna 2) Sharbati sonora
   3) Disease resistant IR-8 4) Padma
10. A process which is essential in a female parent before performing hybridization
    1) Removal of carpels 2) Removal of stamens
    3) Removal of petals 4) Removal of sepals
11. Hybridization results in
    1) Increase of homozygosity
    2) Increase of heterozygosity
    3) Doubling of chromosome number
    4) Decrease of vigour
12. Chemical mutagens cause
    1) Gene mutations
    2) Destruction of cell metabolism
    3) Destruction of cell wall
    4) No change in the genetic material
13. A progeny of plants obtained from the vegetative parts is
    1) Pureline 2) Hybrid 3) Mutant 4) Clone
14. In pure lines the degree of variability of characters is less because of
    1) Compatibility 2) Incompatability
    3) Heterozygosity 4) Homozygosity
15. Which one of the following methods generates large amount of genetic variability in plants
    1) Vegetative propagation 2) Self pollination
    3) Induced mutations 4) Pureline selection
16. The chief cause of variations in plants
    1) Mass selection 2) Pureline selection
    3) Clonal selection 4) Natural hybridization
17. In potato new varieties can be developed by
    1) Pureline selection 2) Mass selection
    3)Natural selection 4) Clonal selection
18. Colchicine is
    1) An enzyme 2) a glucoside
    3) an alkaloid 4) a protein
19. The term mutation was coined by
    1) Muller 2) De vries 3) Stadler 4) Mendel
20. Which of the following cannot induce mutation
    1) Malic hydrazide 2) Ethylemethane sulphonate
    3) Indole acetic Acid 4) Mustard gas
21. Oldest method of breeding useful in crop improvement is
    1) Protoplast fusion 2) Transgenesis
    3) Gene slicing 4) Mass selection

22. Which of the followiong is genetically pure & produced by self pollination?
1) Clone 2) Hybrid 3) Pureline 4) Mutant

23. The plant used by Johannsen for proposing the concept of pureline was
1) Taichung native 1 variety of rice
2) Swedish variety of barley
3) TV-29 variety of tea
4) Princess variety of Phaselous vulgaris

24. Bagging prevents undesired
1) Self pollination 2) Autogamy
3) Cleastogamy 4) Allogamy

25. The part of the flowers that can with stand higher temperatures is
1) Anther 2) Gynoecium
3) Microsporophyll 4) Calyx

26. Groundnut variety produced by pure line selection is
1) CO-4 2) IR-8 3) RSB-17 4) Aruna

27. In Bajra & Jowar emasculation is done
1) with the help of forceps
2) by Hot water treatment
3) By chemical treatment
4) By harmonal treatment

28. The external observable characteristics of an organism is known as
1) Phenotype 2) Karyotype
3) Hetrosis 4) Genotype

29. Which of the following character is induced by mutations in swedish barely
1) Disease resistance 2) Flood resistance
3) Hardiness 4) High yield

30. Classical example for an allohexa ploid is
1) Barely 2) CO-h
2) Combodias 4) Bread wheat

31. F_2 generation developed in hybridization technique is as a result of
1) Cross pollination 2) Self pollination
3) Vegetative reproduction
4) Asexual reproduction

32. The process of bringing wild species under human management is called
1) Domestication 2) Taming
3) Socialization 4) Naturalization

33. Plant breeding is
1) An applied branch of botany 2) A pure science
3) An applied branch of Biology
4) An art than science

34. The new variety can directly be used in agriculture or horticulture in this method of crop improvement
1) Plant introduction 2) Selection
3) Polyploidy breeding 4) Mutation breeding

35. The methods of plant breeding are largely dependent on
1) Rate of growth of the plant
2) No. of fruits produced on each season
3) Method of germination of the seeds
4) Methods of reproduction

36. Theory of natural selection was proposed by
1) G.J. Mendel 2) Charles Darwin
3) Linnaeus 4) Johanssen

37. Better results in selection is possible due to greater
1) Genetic variability 2) Homozygosity
3) Phenotype 4) Genotype

38. Adaptability of the variety developed by pureline selection is poor due to
1) Heterozygosity 2) Homozygosity
3) Superiority 4) High specificity

39. The advantage of hybridization over introduction and selection types of crop improvement is
1) Improving homozygosity
2) Improving heterozygosity
3) Making plants disease resistant
4) Incorporation of new characters

40. Large number of desirable characters can be incorporated into a single variety by
1) Mutation breeding 2) Clonal selection
3) Hybridization 4) Pure line selection

41. In the process of hybridization, bagging of the flowers on the female plant should be done
1) Only before carrying out artificial pollination
2) Only before the anthesis of flowers
3) Only after carrying out artificial pollination
4) Before and after carrying out artificial pollination

42. Labels carrying the details of the parents, date of crossing etc., are tagged to the
1) Male flowers of male parent
2) Female flowers of male parents
3) Emasculated flowers after crossing
4) Plants of pure line

43. A hybrid is generally more vigorous than either of the parents. This is due to
1) Homozygosity 2) Heterozygosity
3) Fusion of cytoplasm of male an female gametes
4) Superior genes in the hybrid

44. Inbreeding depression is due to
1) Mutation
2) Vegetative propagation
3) Cross pollination 4) Self pollination

45. It is a spontaneous mutant variety
1) Oenothera nanella 2) Sharbati Sonora
3) O-gigas 4) Both 1 & 3

46. Mutagenic effect of X-rays was discovered by
1) T.H. Morgan 2) H.J. Muller
3) Beadle 4) Hugode Vries

47. L.J. Stadler induced mutations for the first time in this plant
1) Wheat 2) Rice 3) Mango 4) Barley

48. Who among the following laid foundation to mutation breeding ?
1) Hugo de Vries 2) Karpenchenko
3) Muller and Stadler 4) M.S. Swaminathan

49. The original I.R-8 of paddy is susceptible to
1) Leaf spot 2) Blast
3) Blight 4) All of them

50. Most common method of inducing polyploidy
1) Cold treatment 2) Using X-rays
3) Colchicine treatment
4) Acenaphthene treatment

51. EMS is used as
1) Pesticide 2) Fungicide
3) Chemical mutagen 4) Chemical fertilizer

52. The first to observe hybrid vigour was
1) Knight 2) G.H. Shull
3) Koelreuter 4) Thomas Fair child

LEVEL - II

53. Identify the correct statement
1)Mass selection is based on genotypic characters
2) Mass selection is used to improve self pollinating crops
3) Mass selection increases heterozygosity
4) Mass selection increases homozygosity

54. Which of the following methods is not useful in inducing polyploidy
1) Giving cold treatment to zygote
2) Treating floral buds with Acenapthene
3) Treating the vegetative buds with X-rays
4) Treating the seeds with IAA

55. Which statement is not related to pureline selection
1) New characters cannot be incorporated in the population
2) It is for self pollinated crops
3) Multilocational adaptability is poor
4) Desirable characters are not stable

56. A common feature between a clone and a pureline is
1) Both can be obtained by repeated selfing
2) Both show high degree of heterozygosity
3) Both are phenotypically and genotypically uniform
4) Both are hybrids.

57. Application of knowledge acquired in which of the following fields help breeders to achieve wonderful results in a short time
I) Molecular genetics II) Cytology
III) Cytogenetics IV) Taxonomy
1) I, II 2) II, IV 3) I, III 4) All

Note: For all Assertion (A) and Reason (R) Questions, identify the correct answer from the choices given below.

1. A and R are correct and R is the correct explanation of A
2. A and R are correct but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

58. Assertion (A) : Cultivated crop plants are the result of domestication
Reason (R) : The process of bringing wild species into cultivation is referred to as domestication

59. Assertion (A) : With the beginning of civilization man started domesticating plants
Reason (R) : Domestication refers to identification of plants found growing in wild places

60. Assertion (A) : Man is mostly dependent on plants for his necessities.
Reason (R) : Plants are major sources of man's needs like food, fuel, medicines

61. Assertion (A) : Early maturing varieties are produced through plant breeding
Reason (R) : Early maturing variety is not useful in crop rotation

62. Assertion (A) : Some total of genes in a plant species is referred to as germplasm.
Reason (R) : The germ plasm is stored in the form of seeds, pollen etc

63. Assertion (A) : Introduction is the simplest and easiest method of plant breeding
Reason (R) : No scientific knowledge is necessary for introducing plants

64. Assertion (A) : All rice varieties cultivated in our country were introduced from Philippines.
Reason (R) : I.R-8 variety of rice was introduced into India from Philippines.

65. Read the following statements and find out the incorrect ones
I) Selection is oldest breeding method
II) Mass selection is oldest selection method
III) Pure line selection is one of an art more than science
IV) In nature cross pollination occurs in many plants leading to hybridization
1) I & II 2) II & III 3) IV only 4) III only

66. Which of the following statements is true ?
1) Dodahatti local of cotton is a product of selection
2) Androecium withstands high temperature
3) Self pollination increases heterozygosity
4) Inbreeding depression is due to allogamy

67. The development of improved varieties of economically important plants is mainly due to
1) Judicious combination of selection, introduction and hybridization of different varieties
2) Introduction of varieties of crops under different conditions
3) The scientific improvement of cultivated plants
4) Selection of seeds from healthier plants.

68. Assertion (A) : Dwarf Mexican wheat cultivar Sonara-64 was introduced in India.
Reason (R) : Dwarfness increases disease susceptibility

69. Identify the odd crop variety from the following in relation to the method of production
1) Sonora 64 2) IR-8
3) Dodahatti local 4) Sonora -63

70. Choose the correct statement
1) Homozygosity is the basis for mass selection
2) Mass selection is the easiest and fastest method of crop improvement
3) Varieties obtained by pureline selection show high adaptability to wide areas
4) Hybrid vigour can be exploited for many years by pure line selection

71. If a plant breeder has to evolve a disease resistant strain, then the first step that he has to take is
1) to start with hybridization
2) to select the parents
3) to go to the field to find out such plants
4) to go to the library in search of book on the subject

72. Assertion (A): Selection is the oldest breeding method
Reason (R): Many of the existing crops are obtained by selection

73. Assertion (A): Selection is the basis for crop improvement
Reason (R) : The greater the genetic variability in a population, better are the results of selection

74. Which one of the following is wrong statement regarding the aims of plant breeding ?
1) To produce early maturing variety
2) Suitability for easy harvesting
3) Adaptability to a particular region
4) Increase yield of crop plants

75. The type of selection best applicable to a crop having mixed populations and uncontrolled pollination is
1) Mass selection 2) Pure line selection
3) Clonal selection 4) Mutation breeding

76. The plant breeding method which involves only isolation and multiplication of best genotypes already present in the population
1) Introduction 2) Mutation breeding
3) Polyploidy breeding 4) Selection

77. All the statements except one of the following are true for mass selection . Which one is that ?
1) The plants with desirable characters are chosen on the basis of phenotype
2) This method is practiced for homozygous plants which are self pollinated
3) This method is more suitable in case of cross pollinated crops
4) In this method, selection of plants with desirable characters is continued upto six generations successively

78. Assertion (A) : Mass selection is oldest method of selection.
Reason (R) : Mass selection is useful in cross pollinated crops.

79. Assertion (A) : Mass selection is more of an art than science.
Reason (R) : No scientific knowledge is required except some amount of skill

80. Which one of the following is the result of pure line selection?
I. Loss of adaptability of the crop
II. Loss of heterozygosity
III. Uniformity in the crop in both phenotype and genotype
1) I only 2) I & II 3) III only 4) I, II & III

81. The method of mass selection is based on.
1) Phenotype of the parental plants
2) Phenotypes of the female parent only
3) Genotype of the male parent only
4) Genotype and phenotype of the female parent

82. A plant breeding method that may cause loss of vigour if continued for longer periods is
1) Heterosis 2) Hybridization
3) Mass selection 4) Pure line selection

83. The plant on which Johanssen conducted experiments belongs to
1) Asteraceae 2) Fabaceae
3) Solanaceae 4) Apiceae

84. Assertion (A) : Progeny developed by pureline selection are phenotypically and genotypically uniform
Reason (R) : Pure line selection is applicable for cross pollinated crops

85. Assertion (A) : All the progeny developed by pure line selection are genotypically uniform.
Reason (R): Pureline selection increases homozygosity.

86. Assertion (A): Pure line selection is the only method to improve the local varieties of self pollinated crops
Reason (R) : It takes 10 years to produce a new variety through pure line selection

87. Assertion (A) : Pure line selection method for crop improvement was proposed by W.L. Johannsen.
Reason (R): W.L. Johannsen conducted experiments on evening primrose

88. The propogule in kufrired is
1) Bulb 2) Cutting 3) Stem tuber 4) Ear

89. Taking it for granted that mutation has not intervened, then during clonal selection, it is always advisable to do selection between the individuals of different clones, but not within a clone. The logical explanation is
1) Individuals of the same clone do not have good adaptive value
2) Individuals of the same clone have the same genotypical constitution
3) In individuals of the same clone yield is less
4)In individuals of the same clone hybrid vigour is less

90. Assertion (A) : The progeny obtained by clonal selection is both phenotypically and genotypically similar.
Reason (R) : They are obtained through vegetative propagation.

91. Assertion (A) : Clonal selection is a method of breeding in sugar cane
Reason(R): Sugarcane is propagated through stolons

92. Assertion (A): Pusa Moti is a variety obtained through clonal selection.
Reason (R): A group of plants obtained by vegetative propagation from a single plant is called clone

93. Assertion (A) : The progeny of clonal selection remain stable for any number of generations.
Reason (R) : All the individuals within a clone show same genotype.

94. Assertion (A): Emasculation is removal of male parts.
Reason (R):Bagging is not required for emasculated flowers.

95. Arrange the following steps of hybridization procedure in a sequence
I. Artificial cross pollination II. Selection of parents
III. Bagging IV. Emasculation
1) III, I, II, IV 2) II, IV, III, I
3) IV, II, I, III 4) II, I, IV, III

96. Assertion (A) : Great amount of genetic variability results in the off spring obtained through hybridization
Reason (R) : Recombinants are formed in hybridization leading to variability

97. Assertion (A) : Emasculation of bisexual flowers of female parent is a pre-requisite for artificial crossing.
Reason (R) : There is a possibility of self pollination in bisexual flowers, which must be avoided by the removing of stamens.

98. Assertion (A) : Dense inflorescence of bajra, is dipped in hot water to kill the anthers, before carrying out crossing, instead of using forceps
Reason (R) : Emasculation by forceps is difficult in bajra as the flowers are minute

99. Assertion (A) : Flowers of Bajra and Jowar are dipped in hot water at 45 -50^{o}C for emasculation
Reason (R) : Gynoecium can withstand higher temperature than androecium

100. Emasculation is not needed for
A) Bisexual Flowers B) Unisexual flowers
C) Male sterile plants
1) A & B 2) B & C 3) A & C 4) C alone

101. Assertion (A) : Emasculation is not required in male sterile plants.
Reason (R) : Self pollination is not possible due to the absence of fertile pollen

102. Assertion (A) : G.H. Shull introduced the term heterosis
Reason (R) : He found that inbreeding in maize resulted in loss of vigour

103. Assertion (A) : A hybrid can exhibit superiority over its parents in terms of size and vigour
Reason (R) : The total number of favourable dominant genes are more in the hybrid plant than its parents.

104. Assertion (A) : The mutations that arise automatically in nature are described as spontaneous.
Reason (R) : Oenothera gigas is an example of spontaneous mutation.

105. Identify wrong statement
1) Muller and Stadler laid foundation for mutation breeding
2) Hugo deVries for the 1 st time used the term mutation for the appearance of new types in princess variety of beans
3) Oenothera nanella is an example for spontaneous mutation
4) Stadler induced mutation in Barley

106. Assertion(A): Malic hydrazide is a chemical mutagen.
Reason (R) : Malic hydrazide is a chemical that brings sudden heritable change in the genotype of an organism.

107. Identify the correct statement :
1) Sweedish variety of Barley with disease resistance was developed by mutation breeding
2) Muller for the 1 st time used the term mutation
3) Aruna variety of wheat was developed by mutation breeding
4) Ethyl methane sulphonate is chemical mutagen

108. Number of chromosomes belonging to the genus-Aegilops in fertile commercial bread wheat is
1) 7 2) 14 3) 28 4) 42

109. One of the following is not a parent of Triticum aestivum
1) Triticum monococcum 2) Aegilops speltoides
3) Aegilops squarrosa 4) Secale cereal

110. The number of genomes of Aegilops speltoides present in the egg cell of Triticum aestivum
1) Seven 2) Fourteen 3) Two 4) One

111. Identify wrong statement
1) Aegilops squarrosa is also called Triticum tauschi
2) Triticum speltiodes is also called Aegilops speltoides
3) Aegilops squarrosa is an amphidiploid
4) In Triticum speltoides 2n = 14

112. A chemical substance that can induce mutations as well as polyploidy is
1) Formaldehyde 2) Malic hydrazide
3) Colchicine 4) Nitrogen mustard gas

LEVEL - III

113. Match the following with respect to plant breeding

List-I	**List-II**
I. Simplest& easiest	A) Selection method
II. Oldest method	B) Hybridization
III.Quick method to induce genetic variability	C) Introduction
IV. Most important method to create genetic recombinations	D) Mutation breeding

	I	II	III	IV
1)	C	A	D	B
2)	B	D	A	C
3)	A	D	B	C
4)	B	C	D	A

114. Desired characters of different plants are introduced into a plant by following breeding methods.
1) Hybridization 2) Selection
3) Introduction 4) Mutation breeding

115. Match the following

List - I	**List - II**
A) Dodahatti local	I) Pure line selection
B) Mundapapedda neelum	II) Introduction
C) TMV - 3	III) Mass selection
D) Sonora - 63	IV) Clonal selection

	A	B	C	D
1)	II	III	I	IV
2)	III	IV	I	II
3)	II	I	IV	III
4)	I	II	III	IV

116. Match the following

List - I	**List -II**
A) Sugarcane	I) Bulb
B) Roses	II) Sucker
C) Banana	III) Setts
D) Onion	IV) Tubers
E) Potato	V) Stem cuttings

	A	B	C	D	E
1)	III	V	II	I	IV
2)	IV	I	II	V	III
3)	III	IV	II	I	V
4)	II	I	IV	V	III

117. Find out incorrect statement :
1) TMV-3 is ground nut variety
2) Cambodias is cotton variety
3) Selection is the basis for crop improvement
4) Introduced variety cannot be directly used in agriculture

118. Identify mismatch among the following:
1) Emasculation -Prevents self pollination
2) Shull -Heterosis
3) Colchicine -Chemical mutagen
4) Non ionizing -Beta rays

119. Identify the incorrect statement
1) Darwin emphasized that nature selects plants
2) For introducing a new variety scientific knowledge is required
3) Pure line selection is employed only in self pollinated crops
4) Aruna variety of castor is an achievement of mutation breeding

120. Select the wrong pair
1) Aruna- Castor 2) I.R.8 -Rice
3) Princess vareity -Maize 4) Sonora - Wheat

121. Find out the miss match :
1) Triticum- Aegilops 2) Muller -Drosophila
3) Shull -Heterosis
4) Charles Darwin - Artificial selection

122. Find out wrong combination :
1) CO-14 -Rice variety
2) TMV-3 -Ground nut
3) Kufri red -Bajra
4) Doda hatti local - Cotton

123. Read the following statements : Choose the true statement
1) Hybridization is easiest method of plant breeding
2) New genotypes arise during clonal selection
3) Mass selection is a science
4) Pure line selection method is more laborious than mass selection method

124. Assertion (A) : In pure lines, characters remain stable for several generations.
Reason (R) : Pure lines are obtained from homozygous parents by self fertilization

125. Assertion (A) : Pure line selection is more of science than an art.
Reason (R) : Knowledge of pollination and techniques of field designs are required for testing the progeny in pureline selection .

126. Assertion (A) : There is no scope of incorporating new characters in introduction, clonal selection and pure line selection
Reason (R) : New characters are incorporated through hybridization

127. The similarity between a clone and pureline is that both
1) are hybrids
2) Can be obtained by repeated crossing
3) Exhibit high degree of heterozygosity
4) Are phenotypically and genotypically uniform

128. Identify incorrect statement
1) Introduced new varieties can be directly used in agriculture and horticulture
2) Pure line selection increases homozygosity
3) Kufrired is a variety in potato
4) Many of the existing crops are the products of pure line selection

129. Assertion (A) : The majority of crop plants have unisexual flowers.
Reason (R) : For making crosses in normally self pollinated crops emasculation is a prerequisite

130. Assertion (A): Many hybrids exhibit hybrid vigour.
Reason (R) : Hybridization increase heterozygosity.

131. Identify true statement among the following :
1) The Australian variety of barley with hardiness was produced through mutation breeding
2) Muller and Standler laid the foundation of mutation breeding
3) Constant self pollination generally leads to increase in vigour in many crop plant
4) Hybrid vigour is caused due to less number dominant genes

132. Identify wrong statement :
1) Colchicine is an alkaloid obtained from flower of colchicum
2) Inbreeding refers to breeding between genetically related individuals of species by self pollination
3) Progeny of single plant obtained by vegetative propagation is called clone
4) Polyploids can be produced artificially through cold treatment of zygote.

133. Find out the incorrect statement
1) Triticum aestivum is popularly known as commercial bread wheat
2) Plants having more than two sets of chromosomes are called polyploids
3) Oenothera nanella is dwarf variety
4) Stadler induced mutation in Drosophila

134. Greater genetic variability can be created in the plants through
1) Mass selection and clonal selection
2) Pure line selection and clonal selection
3) Pure line selection and mass selection
4) Hybridization and mutation breeding

135. Identify the incorrect combination :
1) Charles Darwin - Natural selection
2) Hugo de Vries - Polyploidy breeding
3) Triticum monococcum - 2n =14
4) Ionizing radiation - Gamma rays

136. Identify the wrong statement
1) Clonal selection is employed only for self pollination crops
2) In sugarcane setts or stem cuttings are the units of clonal selections
3) The progeny obtained by pure line selection method are phenotypically and genotypically uniform
4) Johannsen conducted experiment on Phaseolus vulgaris.

137. Which of the following is not applicable to bread wheat?
1) It is an allohexaploid
2) Its botanical name is Triticum aestivum
3)Two crosses and two doublings of chromosomes are involved in its formation
4) Its male gamete consists of 21 chromosomes all contributed by Aegilops only

138. Match the following :

List – I	List – II
A) Muller	I) Mutation
B) deVries	II) Hybrid vigour
C) Shull	III) Mutation breeding
D) Johannsen	IV) Artificial hybrid
	V) Pureline

1) A-III, B-I, C-II, D-V
2) A-I, B-II, C-III, D-IV
3) A-V, B-III, C-II, D-I
4) A-II, B-III, C-IV, D-V

139. Study the following table and identify the correct combinations :

List - I

A) Plant introduction
B) Clonal selection
C) Mass selection
D) Pure line selection

List - II

I) TMV -3 variety of ground nut
II) Pusa moti variety of Bajra
III) IR-8 variety of rice
IV) Kufri safed variety of potato
V) Bread wheat

1) A-III, B-IV, C-II, D-I 2) A-III, B-IV, C-V, D-I
3) A-III, B-V, C-II, D-I 4)A-III, B-II, C-IV, D-V

140. Study the following table and identify the correct combinations :

Crop	Variety	Mode of production
I) Rice	Sonora 64	Introduced from Mexico to India
II) Ground nut	Cambodias	Mass selection
III) Mango	Mundapa pedda neelam	Clonal selection
IV) Barley	Sweedish	Mutation breeding

1)I & III 2)II & IV 3)II & III 4)III & IV

141. Study the following lists and identify the correct combinations

List - I

A) Clonal selection
B) Hybridization
C) Mutation breeding
D) Heterosis

List - II

I) Increases homozygosity
II) Progeny remain stable for any number of generations
III) More number of dominant genes
IV) Incorporation of new characters
V) Creation of new characters

1) A-I, B-IV, C-II, D-III
2) A-II, B-IV, C-V, D-III
3) A-II, B-IV, C-III, D-V
4) A-III, B-II, C-IV, D-V

142. Find the true match

List - I

A) Colchicine
B) Bread wheat
C) Barley
D) Cambodias

List - II

I) Polyploidy breeding
II) Mutation breeding
III) Mass selection
IV) Production of artificial polyploids
V) Seed germination inhibitor

1) A-IV,B-I, C-II, D-III 2) A-I, B-II, C-III, D-IV
3) A-IV, B-V, C-II, D-III 4) A-I, B-V, C-IV, D-II

143. Study the following table and identify the correct combinations:

Scientist	Experimetnal organism	Contribution
I) G.H.Shull	Maize	Heterosis
II) Stadler	Barley	Induced mutations
III) Hugo deVries	Tobacco	Polyploidy
IV) Muller	Drosophila	Discovery of mutations

1)I & II 2)II and III 3)III and IV 4)II and IV

144. Study the following lists :

List - I

A) Mutation breeding

B) Selection

C) Hybridization

D) Introduction

List - II

I) Laborious and expensive process to obtain variations

II) Hybrid vigour can be maintained for several generations

III) Simplest and easiest method of plant improvement

IV) Oldest breeding method

V) Quick method to obtain gene variations

The correct combination is

1)A-V, B-IV, C-I, D-II 2)A-V, B-IV, C-I, D-III

3)A-IV, B-II, C-III, D-I 4)A-I, B-II, C-IV, D-V

145. Study the following table and find the correct combination

Crop	Selection method	Variety developed
I) Ground nut	Pureline Selection	RSB – 17
II) Cotton	Mass selection	Pusa moti
III) Potato	Mass selection	Kufri safed
IV) Rice	Purline selection	CO – 4, 6

1)I & II 2) II & III 3) I & IV 4) III & IV

146. Study the following table and identify the correct combinations

Breeding method	Type of crops can be improved	Improved variety
I) Mass selection	Cross pollinated crops	CO variety of rice
II) Pureline selection	Self pollinated crops	TMV – 3 variety of ground nut
III) Clonal selection	Vegetatively pro – pagated crops	Kufrired variety of potato
IV) Hybridizatoin	Self pollinated crops only	Cambodias variety of cotton

1) I & II 2) II & III 3) I & IV 4) III & IV

147. Study the following :

Plant	Variety	Crop improvement method
I) Ground nut	TMV-3	Clonal selection
II) Cotton	Cambodias	Mass selection
III) Bajra	Pusa rubi	Mass selection
IV) Rice	CO – 4	Pure line selection

The correct combinations are

1) I & II 2) II & IV 3) I & III 4) II & IV

148. Match the following :

List – I	List – II
A) Sonora	I) Potato
B) Cambodias	II) Tomato
C) Kufri safed	III) Bean
D) Princess	IV) Cotton
	V) Wheat

1) A-II, B-I, C-III, D-IV 2) A-V, B-IV, C-I, D-III

3) A-I, B-IV, C-II, D-III 4) A-V, B-IV, C-III, D-I

149. Choose the correct statement

1) Homozygosity is the basis for mass selection

2) Mass selection is the easiest and fastest method of crop improvement

3) Varieties obtained by pureline selection show high heterozygosity

4) Hybrid vigour can be exploited for many years by pure line selection

150. Emasculat ion is concerned with (EAMCET - 1994)

1) Hybridization 2) Double cross

3) Pureline selection 4) Mass selection

151. Hybrid vigour can be induced by (EAMCET - 1994)

1) Crossing single point 2) Crossing two plants

3) Clonal selection 4) None of the above

152. IR-8 is a variety of (EAMCET - 1994)

1) Rice 2) Sorghum 3) Pearl millet 4) maize

153. Hybrid vigour is mostly due to (EAM - 1998)

1) Homzygosity of pure characters

2) Heterozygosity

3) Mixing up of cytoplasm of the male with that of female exclusively 4) None

154. The scientist who first carried out experiments on hybrid vigour in maize is (EAMCET - 1999)

1) Mendel 2) Shull 3) Johannsen 4)Koelreuter

155. Emasculation means (EAMCET - 1996)

1) Removal of sepals 2) Removal of petals

3) Removal of stamens 4) Removal of carpels

156. Who introduced the term 'Heterosis' (EAMCET - 2001)

1) Koelreuter 2) Shull 3)Johannsen 4)Borlaug