

MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION

B.Sc. (Hons.) Horticulture

Semester	: II (New)	Academic Year	: 2017-18
Course No.	: H/BOT-123	Title	: Principles of Plant Breeding
Credits	: 3(2+1)		
Day & Date	:	Time	: 3 hrs
		Total Marks	: 80

Note :

1. Solve ANY EIGHT questions from SECTION 'A'
2. All questions from SECTION 'B' are compulsory
3. All question carry equal marks
4. Draw neat diagrams wherever necessary

Q1 Define Plant Breeding. Give its aims and explain objectives of plant breeding.

Ans Plant Breeding: Plant breeding is a science as well as art of improving the genetic make up of plants in relation to their economic use. 1

Aims:

- 1) Plant breeding aims to improve the characteristics of plants so that they become more desirable agronomic ally and economically.
- 2) The specific objectives may vary greatly depending on the crop under consideration. 1

Objectives of Plant Breeding: Explain each point briefly

- | | | |
|-----------------------------------|-----------------------------------|----------------------------------|
| 1) Higher yield | 2) Improved quality | 3) Biotic and abiotic resistance |
| 4) Earliness | 5) Photo and thermo insensitivity | 6) Synchronous maturity |
| 7) Removal of toxic compounds | 8) Wider adaptability | 6 |
| 9) Non shattering characteristics | 10) Varieties for new seasons | |

Q2. Define pollination. Explain various mechanisms that promote self and crosspollination.

Ans. Pollination: The transfer of pollen grains from the anther of one flower the stigma of another flower of the same or different plants is called pollination. Pollination is of two types Self pollination and cross pollination 1

Mechanism promotes self pollination (Short explanation of each)

- | | | |
|----------------|------------------------|----------------|
| 1) Bisexuality | 2) Homogamy | 3) Cleistogamy |
| 4) Chasmogamy | 5) Position of Anthers | |

Mechanism promotes Cross pollination (Short explanation of each) 4

- | | | |
|--------------|-------------------------|-------------------|
| 1. Dicliny | 2) Dichogamy | 3) Heterostyly |
| 4. Herkogamy | 5) Self incompatibility | 6) Male sterility |

Q3. Define self incompatibility. Give different types of self incompatibility along with the main features of self incompatibility.

Ans. Self incompatibility: It is the inability of a plant producing functional female and male gametes to self seed when self pollinated.

Main features of Self incompatibility:

- 1) It is an important out breeding mechanism which prevents autogamy.
- 2) Self incompatible species do not produce seed on self pollination but led to normal seed set on cross pollination
- 3) It maintains high heterozygosity in species
- 4) Self incompatibility reaction can operate at any stage between pollination and fertilization.
- 5) It is reported in 70 families of angiosperm plants.

Self incompatibility is classified on the basis of

- | | | |
|-----------------------|----------------|------------------|
| 1) Flower morphology | | |
| a) Heteromorphic | i) Distyly | ii) tristyly |
| b) Homomorphic | i) saprophytic | ii) gametophytic |
| 2) Genes involved | | |
| a) Monoallelic | b) Diallelic | c) Polyallelic |
| 3) Site of expression | | |
| a) stigmatic | b) stylar | c) Ovarian |
| 4) Pollen cytology | | |
| a) Binucleate | b) trinucleate | |

Q4. Enlist different breeding methods of cross pollinated plants. Give the procedure for the development of synthetic variety.

Breeding methods that are used for genetic improvement of cross pollinated plants

- Ans.** 1) Plant Introduction 2) Mass and progeny selection 3) Back cross method
 4) Heterosis breeding 5) Synthetic breeding 6) Composite breeding
 7) Polyploidy breeding 8) Distant hybridization 9) Transgenic breeding

Synthetic varieties : A variety which is developed by intermating in all possible combinations a number of inbred lines with good general combining ability and mixing the seed of F_1 crosses in equal quantity is referred to as synthetic variety.

Procedure of development of synthetic variety

1. Isolation of inbreds 5
2. Evaluation of inbreds for GCA
3. Intermating of good general combining inbreds
4. Mixing of F_1 seeds

Q5. What is hybridization? Explain various steps involved in hybridization.

Ans. Hybridization: The mating of two plants or lines of dissimilar genotype is known as hybridization. 1

Step involved in hybridization (Short explanation of each)

- 1) Choice of parents 7
- 2) Evaluation of parents
- 3) Emasculation
- 4) Bagging
- 5) Tagging
- 6) Pollination
- 7) Harvesting and storing of F_1 seeds.

Q6. What is heterosis? Enlist the different theories of heterosis and explain dominance hypothesis of heterosis.

Ans. Heterosis: Superiority of F_1 hybrids in one or more characters over its parents 1
Estimation of heterosis:

- 1) Average heterosis: When heterosis is estimated over the mid parent.
- 2) Heterobeltiosis: When heterosis is estimated over the superior or better parent. 2
- 3) Useful heterosis: When heterosis is estimated over the standard commercial check

Theories of Heterosis:

- 1) Dominance Hypothesis 2) Over Dominance Hypothesis 3) Epistasis Hypothesis 5

Dominance Hypothesis: This theory was proposed by Davenport (1980). This is the most widely accepted explanation of heterosis. According to this hypothesis

heterosis is the result of the superiority of dominant alleles when recessive alleles are deleterious. Here the deleterious recessive genes of one parent are hidden by the dominant genes of another parent and the hybrid exhibits heterosis. A hybrid between two parent AABbCcdd and aabbCCDD having four dominant genes AaBbCcDd and exhibit superiority.

Q7. Define mutation breeding. Give the advantages and limitations of mutation breeding

Ans. Mutation Breeding :The genetic improvement of crop plants for various economic characters through the use of induced mutations is referred to as mutation breeding.

Advantages:

- 1) Induced mutagenesis is used for induction of cytoplasmic male sterility.
- 2) It is cheap and rapid method of developing new varieties
- 3) It is more effective in improvement of oligogenic characters.
- 4) It is best method to introduced a new characters.

Limitations:

- 1) Most of the mutations are deleterious and undesirable.
- 2) Identification of micro mutations is usually very difficult.
- 3) A large population has to be screened to identify mutants as frequency is very low (0.1%)
- 4) Have limited scope for improvement of quantitative or polygenic character.

Q8. Define male sterility. Enlist the different types of male sterility found in crop plants. Explain genetic male sterility.

Ans. Male Sterility: Male sterility is characterized by nonfunctional pollen grains while female gametes function normally.

Types of sterility found in plants

- 1) Genetic male sterility
- 2) Cytoplasmic male sterility
- 3) Cytoplasmic genetic male sterility

Genetic male sterility:

The pollen sterility which is caused by nuclear genes is termed as genetic male sterility. Main features and maintenance of genetic male sterility:

1. Male sterility genes are usually recessive and rarely dominant. 3
2. In majority of cases sterility is caused by single gene.
3. Consists of two types of lines i.e. A line and B line.
4. A line is sterile line and B line is heterozygous fertile line.

Maintenance of GMS:

2

GMS line is maintained by crossing recessive male sterile plants with heterozygous male fertile plants. Such cross will yield 50% sterile plants and 50% fertile plants. The male sterile plants are used as female parents in the development of hybrids. The fertile plants are roughed out.

Q9 Write short notes on (Any two) 8

a) Inbreeding depression: it is mating between individuals related by descent or ancestry. When the individuals are closely related i.e. sib mating the degree of inbreeding is high. The highest degree inbreeding is achieved by selfing. Selfing reduces heterozygosity by a factor of $\frac{1}{2}$ in each generation. The degree of inbreeding increases in the same proportion. Inbreeding effects are appearance of lethal and sublethals, reduction in vigour, reproductive ability, separation of the population into distinct lines, reduction in yield. Inbreeding depression may be defined as the reduction or loss in vigour and fertility as a result of inbreeding. It is clear that inbreeding has harmful effects in cross pollinated and asexually propagated species.

b) Heritability: In crop improvement only the genetic component of variation is important since only this component is transmitted to the next generation.

The ratio of genetic variance to the total variance i.e. phenotypic variance is known as heritability. Thus heritability denotes the proportion of phenotypic variance that is due to genotype.

c) Complex cross: More than two parents are crossed to produce the hybrid which is then used to produce F₂ or is used in a backcross. Such a cross is also known as convergent cross because this crossing programme aims at converging genes from

several parents into a single hybrid. In breeding of highly improved self pollinated crops like wheat and rice complex crosses are commonly used.

Q10 Differentiate between (Any two)

a.

Pure line selection

1. The new variety is pureline
2. The new variety is highly uniform
3. The selected plant are subjected to progeny test
4. Generally 7-8 years are required to develop a new variety
5. Pureline selection is used in self pollinated and often cross-pollinated crops

mass selection

1. The new variety is a mixture of pureline
2. The variety has genetic variation for quantitative characters
3. Progeny test is generally not carried out.
4. Generally, 6-7 years are required to develop a new variety
5. Mass selection is used in both self and cross pollinated crops

b.

Qualitative traits

1. Qualitative characters are controlled by one or few genes
2. Such characters exhibit discontinuous or discrete variation
3. Effect of individual gene is large and easily detectable
4. Characters are very little influenced by environmental changes
5. Statistical analysis of such traits is based on ratios and frequencies

quantitative traits

1. Quantative characters are governed by several genes
2. Such characters exhibit continuous variation
3. Effect of individual gene is small and undetectable
4. Characters are highly sensitive to environmental changes.
5. Statistical analysis of these characters is based on means, variances and covariances

c.

Asexual reproduction

- 1 New individuals are formed from a single parent
- 2 Quick method of reproduction
- 3 New individual are genetically similar to parent
- 4 Variability is not created
- 5 Not evolutionary important

Sexual reproduction

- 1 formed from one or two parents.
- 2 Relatively slower
- 3 New individual are genetically different parent
- 4 Introduce variability
- 5 Has evolutionary importance

SECTION 'B'

b.11

1) Give the contribution of following scientist in one sentence.

- 1) Thomas Fairchild: Developed first interspecific hybrid between sweet William and carnation species of *Dianthus*.
- 2) Stadler L.J.: First used X rays for induction of mutations in crop plants.
- 3) Johannsen W. L.: developed the concept of pureline. Coined the term genotype and phenotype
- 4) Shull G. H. First used the term heterosis for hybrid vigour.

b) Fill in the blanks.

1. **Hybridisation** is the crossing between genetically dissimilar plants.
2. Reselection generation after generation with intermating of selected plants is called **recurrent selection**.
3. **Introduction** is the quickest method of plant breeding.
4. The gene which restores male fertility in the male sterile line is known as **restorer gene**.

Q.12 Define the following terms

- 1) **Germplasm:** The sum total of genes in a species is called germplasm.
- 2) **Mutation:** The sudden heritable change in the genotype of an organism.
- 3) **Clone:** Progeny of a single plant obtained by asexual reproduction.
- 4) **Simple cross:** The cross in which two parents are crossed to produce the F₁.
- 5) **Allogamy:** Development of seed by cross-pollination.
- 6) **Domestication:** The process of bringing wild species under human management.
- 7) **Pedigree:** Record of the ancestry of an individual selected plant for its various generation.
- 8) **Apomixis:** Development of seed without sexual fusion i.e. fertilization.

Signature of Course Instructor
Name: S. A. Bhuyar
Mob.No. 9657725822

Signature of University Head of the Department
Name: Dr. R.S. Nandanwar
Mob.No. : 9011097478