MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE

Semester End Theory Examination

B.Sc. (Horti.)

Semester	: II (New)	Academic year	: 2014-15
Title	: Principles of Plant Breeding	Credits	: 2 (1+1)
Course No.	: H/BOT-122	Total marks	: 40
Day & date	:	Time	: 2 hrs.

MODEL ANSWER SHEET

SECTION "A"

Q.1. Describe in detail Autogamy.

Ans. : (4 marks)

When pollen grains are transferred from the anther to the stigma of same flower, it is known as Autogamy or self pollination. Autogamy is the closest form of inbreeding. Autogamy leads to homozygosity. Such species develop homozygous balance and do not exhibit significant inbreeding depression. There are several mechanisms which promote Autogamy.

a. Bi sexuality.
b. Homogamy
c. Cleistogamy
d. Chasmogamy
e. Position of anthers

Q.2. Describe mass selection method in crop improvement.

Ans. : (4 marks)

Mass selection is one of the oldest methods of crop improvement. In this method, individual plants are selection on the basis of phenotype from a mixed population, their seeds are bulked and used to grow the next generation. Mass selection is applicable to both self and cross pollinated species. However, it is more commonly used in the improvement of cross pollinated crops than in self pollinated species. This method is rarely used in vegetatively propagated crops.

Main features of mass selection :

1. Genetic constitution.
2. Adaptation
3. Variation
4. Selection
5. Quality
6. Resistance

Q.3. Explain in brief about sexual reproduction.

Ans. : (4 marks)

Multiplication of plants though embryos which have developed by fusion of male and female gametes is known as sexual as sexual reproduction. All the seed propagating species belong to this group. The new plants arise from the embryos which have developed form the fusion of male and female gametes. The main features of sexual reproduction are given below:

1. The embryo develops through the fusion of male and female gametes.
2. The male and female gametes are formed in the flower. First microspores and megaspores are formed in anthers and ovules respectively by meiotic cell division. This process is known as sprogenesis. Then sperms and egg cells are formed in microspores and megasproes . This process is called gametogensis.
3. The union of male and female gametes lead to fertilization and zygote formation. The zygote develops into diploid embryo which is used for sexual reproduction.

Sexual reproduction plays an important role in creating and maintaining vast genetic variability in crop plants.

Q.4. Describe in detail about estimation of heterosis.

Ans. : (4 marks)

Heterosis refers to the superiority of F1 hybrids in one or more characters over its parents. The term hybrid vigour is used as synonym for heterosis.

Heterosis is estimated in three different ways, viz. (1) over mid parent, (2) over better parent, and (3) over commercial cultivar/Hybrid. Thus on the basis of estimation, heterosis is of three as given below.

1. Average heterosis : When the heterosis is estimated over the mid parent, i.e. mean value or average of the parents, it is known as average heterosis, which is estimated as follows:

   Average heterosis = [(F1 – MP)/ MP] x 100

Where, F1 is the mean value of F1 and MP is the mean value of two parents involved in the cross.

2. Heterobeltiosis : When the heterosis is estimated over the superior or better parent, it is referred to as heterobeltiosis. It is worked out as follows:

   Heterobeltiosis = [(F1 – MP)/ BP] x 100

Where, BP is the mean value (over replications) of the better parent of the particular cross.

3. Useful heterosis : The term useful heterosis was used by Meredith and Bridge (1972). It refers to the superiority of F1 over the standard commercial check variety.

It is also called as economic heterosis. This type of heterosis is of direct practical value in plant breeding. It is estimated as follows.

Useful heterosis = [(F1 – CC)/ CC] x 100

Q.5. Explain in brief about classical plant breeding.

Ans. : Classical Plant breeding started after the rediscovery of Mendel's results in 1900 independently by three scientists. Classical plant breeding uses deliberate interbreeding (crossing) of closely or distantly related individuals to produce new crop varieties or lines with desirable properties. **(1 mark)**

(3 marks)

1. Discoveries / concepts developed

   The important concepts include principles of inheritance, progeny selection, individual plant selection, pureline selection, dominance hypothesis, overdominance hypothesis, recurrent selection, backcross, bulk, pedigree methods and single seed descent etc.

2. Breeding techniques used

   Classical breeding relies largely on homologous recombination between chromosomes to generate genetic diversity. In the beginning, mainly plant introduction, mass selection and progeny selection techniques were used.

3. Products developed

   In the beginning, the main products developed included landraces, mass selected varieties, and exotic varieties, later on semi dwarf varieties in wheat and rice and hybrids in maize, Pearlmillet.

Q.6. Describe utilization of male sterility in crop improvement.

(4 marks)

Ans. :

All the three types of male sterility are used in crop improvement programmes. Genetics male sterility can be used for the development of commercial hybrids in both seed propagated and vegetative propagated crop plants. GMS lines have been used for the development of commercial hybrids in watermelon, cotton, wheat and rice. The cytoplasmic male sterility has limited applications in plant breeding. CMS is useful for the development of hybrids in vegetatively in plant. CGMS can be successfully utilized for the development of commercial hybrids in both seed propagated and vegetative propagated crop plants. CGMS has been effectively used for the commercial production of hybrids in maize, sorghum, onion, sugar beet and Pearlmillet and some other crops.

Q.7. Describe the causes of non fruitfulness self incompatibility.

Ans. : **(4 marks)**

Incompatibility refers to the failure of pollen to fertilize the same flowers on the same plant.

Non fruitfulness in incompatibility may be due to :

1. Pollen grains fail to germinate on the stigma.
2. Pollen grains germinate but pollen tube fails to enter the stigma and style.
3. Pollen tube enters the style but growth is very slow to effect fertilization.
4. Pollen tube enters the ovule but there is no fertilization due to degeneration of the egg cell.

Q.8. What is hybridization? Describe the types of hybridization.

Ans. : Hybridization is used when there is limited genetic variability in a species and improvement is not possible by pureline selection and mass selection. Hybridization is defined as artificially crossing between genetically dissimilar plants. Hybridization may involve genotypes of the same species, different species and different genera of the same family. (2marks)

Types of hybridization : (2marks)

1. Intra specific hybridization.: it involves crossing of two different genotype of same species
2. Interspecific hybridization : it involves crossing of two different species belonging to same genus
3. Intergeneric hybridization. : it involves crossing of two species belonging to different genus of a family

Q.9. Elaborate the procedure for mutation breeding.

Ans. :

Procedure of mutation breeding in seed propagated species : **(4 marks)**

Year	Breeding activities
1	1. Seed treatment with selected mutagen [X-rays, gamma rays, UV rays or chemical utagen] mutagen using recommended dose and duration of treatment. 2. Raising M1 generation using wider spacing. 3. Recording observations on morphological variants and fertility 4. Selfing of all M1 plants to avoid contamination. 5. Harvesting of each M1 plant separately
2	1. Raising M2 generation from self seeds obtained from M1 using wider speacing. 2. Identification and selection of disease resistant mutants

	2. Harvesting seed of such mutants separately.
3	1. Raising M3 generation separately for each M2 selected plants. 2. Evaluation of homozygosity for disease resistance. 3. Bulking of homozygous disease resistant M3 progeny.
4.	Planting of M4 disease resistant progeny in replicated trial using local check for comparison.
5-9	1. Multi-location evaluation in coordinated trials for disease resistance. 2. The disease resistant line is released as a variety.

Q.10. Write short notes on (any two)

1 Apomixis (2 marks)

Ans. : Apomixis refers to the development of seed without sexual fusion (fertilization). In apomixis embryo develops without fertilization. Thus apomixis is an asexual means of reproduction. Apomixis is found in many crop species. Reproduction in some species occurs only by apomixis. This apomixis is termed as obligate apomixis. Such apomixis is known a facultative apomixis.

Classification of Apomixis :

1. Parthenogenesis
2. Apogamy,
3. Apospory
4. Adventives embryony.

Role of apomixis in plant breeding :

2 Recurrent selection. (2 marks)

Ans. : Hull defined recurrent selection as reselection generation after generation with interbreeding of selects to provide for genetic recombination. Thus it is a cyclic selection that is used to improve the frequency of desirable alleles for a character in a breeding population. In other words, it is an important method of population improvement.

Types of recurrent selection :

(1) Simple recurrent selection, (2) recurrent selection for general combining ability (3) recurrent selection for specific combining ability, and (4) reciprocal recurrent selection.

3 Cross pollination (2 marks)

Ans. : Transfer of pollen grains from the anther of one plant to the stigma of another plant is called Allogamy or cross pollination. This is the common form of outbreeding. Allogamy leads to heterozygosity. Such species develop heterozygous balance and exhibit significant inbreeding depression on selling. There are various mechanisms which promote Allogamy. These are briefly discussed below.

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

SECTION "B"

Q.11. Define following terms

1 A line : The male sterile line.

2 Back cross : Crossing of F_1 with either of parent.

3 Pedigree : Record of the ancestry of an individual selected plant for its various generations.

4 Isogenic Lines : Genotypes having single locus difference only.

Q.12. Give the contribution of following scientist.

1 C. A. Barber : Barber was an eminent sugarcane breeder. Developed several improved varieties of sugarcane.

2 Pushkarnath : He was famous potato breeder developed several high yielding varieties of potato.

3 D. S. Athawal : He was an eminent pearl millet breeder developed several high yielding varieties of pearl millet.

4 M.S. Swaminathan : introduced semi dwarf varieties of wheat from Mexico to India which resulted in green revaluation

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