MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION
B.Sc. (Hort.)

emester	: II (Old)	Academic year :2017-18	
Course No.	: H/BOT-122	Course Title:-Principles of Plant Breeding	
Credits	: 2 (1+1)		
Day & Date	:	Time:	Total Marks: 40

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

SECTION 'A'

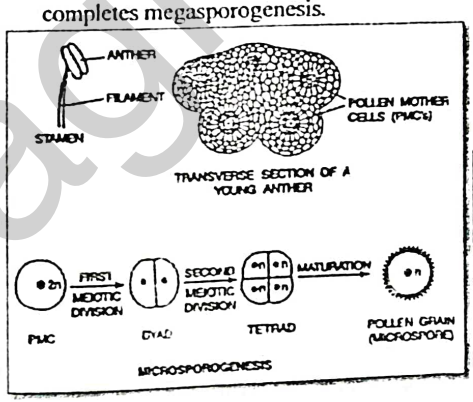
.1 **Define sporogenesis. Explain the process of Micro and magasporogenesis with neat labeled diagrams.**

ns: **Definition:** Productions of microspores and megaspores is known as **sporogenesis.** 1
Microspores are produced in anthers (microsporogenesis), while megaspores are produced in ovules. (megasporogenesis).

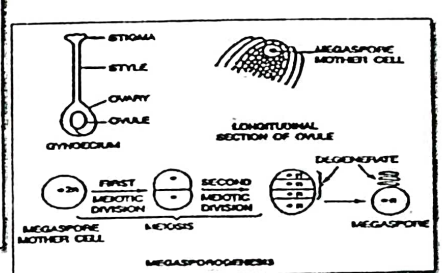
Microsporogenesis: Each anther has four pollensacs, which contains numerous pollen 1
mother cells (PMCs). Each PMC undergoes meiosis to produce four haploid cells or microspores. This process is known as microsporogenesis.

Megasporogenesis: Megasporogenesis occurs in ovules, which are present inside the ovary. A single cell in each ovule differentiates into a megaspore mother cell. The megaspore mother cell undergoes meiosis to produce four haploid megaspores. Three of them megaspores degenerate leaving one functional megaspore per ovule. This completes megasporogenesis.

2



Microsporogenesis



Megasporogenesis

Q.2 **Define polyploidy. Give the classification of polyploidy. Describe the role polyploidy in crop improvement.**

Ans: **Definition:**An individual with more than two identical or distinct genomes is called polyploidy.

Types of polyploidy- 1.) Autopolyploids – Genome identical with each other i. e.

Autotriploid- Three copies of one genome 3X

Autotetraploid – Four copies of one genome 4X

Autopentaplid – Five copies of one genome 5X

Autohexaplid – six copies of one genome 6X

2.) Allopolyploid- Two or more distinct genomes. i.e. $2x + 2X_2$

Allotetraploid – Two distinct genomes ($2X_1 + 2X_2$)

Allohexaplid- Three distinct genomes($2X_1 + 2X_2 + 2X_3$)

Role of polyploidy in Crop Improvement:

Application of Autopolyploidy in Crop improvement:

Triploids: They are generally highly sterile, except in a few cases. This feature is useful in the production of seedless watermelons.

Tetraploids: The advantages of tetraploid over its diploid counterpart are large kernel size, superior ability to emerge under adverse condition and higher protein content tetraploid varieties have been released for cultivation.

Application of Allopolyploid in crop improvement:

1. Utilization as a Bridging species:
2. Creation of new crop species:
3. Widening the genetic base of existing Allopolyploids
4. In Interspecific gene transfer
5. In tracing the origin of natural aliopolyploids

Q. 3 **Distinguish between. (Minimum four points)**

Ans:

	Pedigree Method	**Pure line selection**
1.	Used in both cross and self-pollinated species	Used in self-pollinated species
2.	Mixture of several pureline in self-pollinated species In cross pollinated species, mixture of several open pollinated genotypes	It is a progeny of a single homozygote
3.	Genetic variation is present	Genetic variation is absent

4.	Variety has wide adaptation	Pure line variety has narrow adaptation
5.	Mass selected variety has broad genetic base	Pure line variety has narrow genetic base
6.	Developed variety has less uniform	Developed variety highly uniform
7.	Release of new variety takes 14-15 years	Release of new variety takes 9-10 years
8.	Minimum two genetically different genotypes are required.	One genotype or variety is sufficient.
9.	Crossing is involved.	Crossing is not involved.
1	Pedigree records have to be maintained which is often time consuming and laborious	No pedigree records are maintained hence save time and labour.

Q. 4 Define recurrent selection. Give it's types and explain simple recurrent selection.

Ans: Reselection generation after generation with inbreeding of selects to provide for genetic recombination. 1

1. Simple Recurrent Selection 1
2. Recurrent Selection for GCA
3. Recurrent Selection for SCA
4. Reciprocal Recurrent Selection

1st Year: Several phenotypically superior plants are selected from a population 'A' and 'B'. The pollen of some selected plants of 'A' population is used to cross large number of randomly selected plants of population of 'B'. Similarly, pollen of some selected plants of 'B' population is used to cross large number of plants of population of 'A'. All the plants of population of 'A' and 'B' used as a pollen parents in the crosses are selfed. 2

2nd Year: The progeny of a test crosses made with pollen parents of 'A' and 'B' populations are evaluated in separate replicated trials. The superior progenies are identified.

3rd Year: The selfed seeds of those 'A' and 'B' plants whose progenies were found superior in replicated trials are grown in separate block. All possible crosses are made among the progenies of 'A 'and 'B' plants The crossed of 'A' block are composited in equal quantity to raise A_1 generation. Similarly, crossed seeds of 'B' block are bulked to raise B_1 generation. This complete original cycle of selection

4th Year: The A1 and B1 populations are grown from the composite crossed seeds of respective population obtained in third year. Then operations of first year are completed.

5th Year: The operations of second year are repeated.

6th Year: The operations of third year are repeated.

The last three years constitutes first cycle of reciprocal recurrent selection. Such selection cycles may be continued till the desired improved is achieved.

(Diagrammatic representation.)

Q. 5 Define wide hybridization. Enlist its types and explain role of wide hybridization crop improvement.

Ans: Definition: Crossing between different specie of the same genus or different genera the same family is known as wide or distant hybridization.

Types: 1.) Interspecific hybridization

2.) Intraspecific hybridization

Role of Wide Hybridization in Crop Improvement:

1.) Diseases and insect resistance
2.) Improvement in quality
3.) Improvement in adaptation
4.) Improvement in yield
5.) Mode of reproduction
6.) Other characters

(Explanation of above points is expected)

Q. 6 Write short note ~~on~~ (Any two).

Ans: 1) 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 crosses in equal quantity is referred to as synthetic variety. The use of synthetic varieties for commercial cultivation was first suggested in maize (Hayes and Garber, 1919). After release, synthetic varieties are maintained by open pollination

Synthetic varieties differ from mass selected varieties and lines breeding in the way of selection of component genotypes. The constituent genotypes are selected on the basis of general combining ability for a synthetic variety, whereas combining ability is not tested in mass selected varieties and line breeding. In mass selected varieties the component genotypes are selected on the basis of phenotypic performance and in the line breeding on the basis of progeny performance. Moreover, the synthetic variety is developed by crossing selected genotypes in all possible combinations and mixing the seeds of all F_1 crosses in equal quantity. Such crosses are not made to develop mass selected or line

breeding varieties.

Steps in development of synthetic variety

Isolation of inbreds

Evaluation of inbreds for GCA

Intermating of good general combining inbreds

Mixing of F_1 seeds

b) **2) Self-incompatibility:** In self-incompatibility plants, the flowers will produce functional or viable pollen grainswhich fail to fertilize the same flower or any other flower of the same plant. 4

- Self- incompatible pollen grain may fail to germinate on the stigmatic surface.
- Some may germinate but fails to penetrate the stigmatic surface.
- Some pollen grains may produce pollen tube, which enters through stigmatic surface, but its growth will be too slow. By the time the pollen tube enters the ovule the flower will drop.
- Some time fertilization is effected but embryo degenerates early.

Reason: Self-incompatibility is appeared to be due to biochemical reaction, but precise nature ofthese is not clearly understood.

Classification of self- incompatibility:

According to Lewis (1954) the self-incompatibility is classified as follows:

1. Heteromorphic system – a) Distyly b) Tristyly
2. Homomorphic system – a) Gametophytic system b) Sporophytic system

(Brief explanation of each system)

c) **3) Clonal selection:-**

Clonal crops are generally improved by crossing two or more desirable clones, followed by selection in the F_1, progeny and in the subsequent clonal generation. Once the F_1 has been produced, the breeding procedure is essentially the same as clonal selection. 4

The improvement through hybridization involves the following three steps:

1) Selection of parents, 2) Production of F1 progeny, and 3) Selection of superior clones.

Merits of clonal selection.

2) It is the only method of selection applicable to clonal crops. It avoids inbreeding depression, and preserves the gene combinations present in the clones.

3) Clonal selection, without any substantial modification, can be combined with hybridization to generate the variability necessary for selection.

4) The selection scheme is useful in maintaining the purity of clones.

Demerits of clonal selection:

1) This selection method utilizes the natural variability already present in the population, it has not been devised to generate variability.
2) Sexual reproduction is a prerequisite for the creation of variability through hybridization.

Q.7 Define mutation breeding. Explain the procedure of mutation breeding.

Ans: When mutations are induced for crop improvement, the entire operation ofthe induction and isolation, etc. of mutants is termed as mutation breeding

Procedure of Mutation breeding:

1. Objectives of the Programme
2. Selection of the Variety for Mutagen Treatment
3. Part of the Plant to be Treated
4. Dose of the Mutagen
5. Giving Mutagen Treatment
6. Handling of the Mutagen-Treated Population

(Brief explanation of above points)

Q.8 Define heterosis. Enlist theories & explain Over-dominance hypothesis of heterosis.

Ans: Heterosis- Superiority of an F_1 hybrid over both of its parents in terms of yield or some other character.

Theories of heterosis

1) Dominance hypothesis
2) Over-dominance hypothesis

Over-dominance hypothesis:

Theory was independently proposed by Shull and East (1908) and supported by East (1936) and Hull (1945).This theory is called by various names such as stimulation of heterozygosis, emulative action of divergent alleles, single gene heterosis, super dominance.Though this theory was proposed by Shull and East (1908), the term over dominance was coined by Hull in 1945. According to this hypothesis, heterosis is the result of superiority over its both homozygous parents.

i.e Aa > AA or aa

This theory assumes a special effect for the heterozygous condition over the homozygous condition.Thus heterosis is directly proportional to the heterozygosis. The superiority of

heterozygote may arise either due to if,

1) Production of superior hybrid substance in heterozygote which is completely different from either of the homozygous products or due to
2) Greater buffering capacity in the heterozygote resulting from cumulative action of divergent alleles or stimulation of divergent alleles.

$P_1 x P_2$

AAbbCCxaaBBcc

F_1AaBbCc

AaBbCc> AABBCC or aabbcc

Q. 9 Define plant Breeding. Give its aim and explain objectives of plant breeding.

Definition: Plant breeding can be defined as an art, a science, and technology of improving the genetic makeup of plants in relation to their economic use for the mankind. 1

or

Plant breeding is the art and science of improving the heredity of plants for the benefit of mankind.

or

Plant breeding deals with the genetic improvement of crop plants also known as science of crop improvement.

or

Science of changing and improving the heredity of plants

Aim: Plant breeding aims to improve the characteristics of plants so that they become more desirable agronomically and econonically. The specific objectives may vary greatly depending on the crop under consideration. 3

Objectives of plant breeding. (Explain any Six)

1 Higher yields
2 Improved quality
3 Abiotic resistance
4 Biotic resistance
5 Change in maturity duration/earliness
6 Determinate Growth
7 Dormancy
8 Desirable Agronomic characteristics
9 Elimination of Toxic substances
10 Non-shattering characteristics
11 Photo and thermo insensitivity
12 Synchronous maturity
13 Wider adaptability

Q. 10 Define pollination. Give its types and explain various mechanisms that pron cross pollination

Ans. Definition: The process by which pollen grains are transferred from anthers to stigma is referred as pollination.

Types: 1) Autogamy or self- pollination and 2) Allogamy or cross pollination.

Mechanisms that promotes cross pollination:

1. **Dicliny** or unisexuality is a condition in which the flowers are either staminate or pistillate.
    a) **Monoecy:** Staminate and pistillate flowers occur on the same plant, either in the same inflorescence, *e.g., Castor*, mango and coconut, or in separate inflorescences, chestnut, strawberries, rubber, grapes and cassava.
    b) **Dioecy:** The male and female flowers are present on different plants, i.e. the Plants in such species are either male or female, *e.g.,* papaya, date, hemp, asparagus and spinach.
2. **Dichogamy:** It refers to maturation of anthers and stigma of the same flowers at different times.

Dichogamy is of two types: viz. i) Protogyny and ii) Protandry. When pistil matures before anthers, it is called **protogyny**such as in pearl millet. When anthers mature before pistil, it is known as **protandry**. It is found in maize, sugar beet and several other species.

3. **Heterostyly:** When styles and filaments in a flower are of different lengths, it is called heterostyly. It promotes cross pollination, such as linseed.
4. **Herkogamy:** Hindrance to self-pollination due to some physical barriers such a presence of hyaline membrane around the anther is known as herkogamy. Such membrane does not allow the dehiscence of pollen and prevents self-pollination such as in alfalfa.
5. **Self- incompatibility:** The inability of fertile pollens to fertilize the same flower is referred to as self-incompatibility. It prevents self-pollination and promotes cross pollination. It is found in several crop species like *Brassica, Radish, Nicotiana*and many grass species.
6. **Male sterility:** In some species, the pollen grains are non-functional. Such condition is known as malesterility. It prevents self-pollination and promotes cross pollination.

SECTION 'B'

Q.11 **Define :** the following terms :

1. **Back cross:** A cross between hybrid and one of its parents
2. **Luxuriance:** Superiority of F1 over its parents in terms vegetative growth, but not in yield and adaptaion.
3. **Apomixis:-** Embryo is directly developed from egg cell without fertilization
4. **Cross incompatibility:** Inability of functional pollen of one specie or genera to effect fertilization of the female of another species or genera.

Q. 12 **Contribution of following Scientist**

Ans:

1. **Vilmorin:-** Progeny Test
2. **Thomas Fairchild :-**1st artificial hybrid between sweet Williams &Carnation
3. **Hugo de vries:-** Coined the term mutation
4. **Hayes & Garber:-**Gave initial idea about recurrent selection.

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