MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE

Semester End Theory Examination

B.Sc. (Horti.)

Semester	:	II (New)	Academic year	:	2013-14
Title	:	Principles of Plant Breeding	Credits	:	2 (1+1)
Course No.	:	H/BOT-122	Total marks	:	40
Day & date	:		Time	:	2 hrs.

Note
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 diagram wherever necessary.

MODEL ANSWER SHEET

SECTION "A"

Q.1. What is mutation? Elaborate the procedure for mutation breeding..

Ans. : Mutation refers to sudden heritable change in an individual, in the molecular term, mutation is defined as the permanent and relatively rare change in the number or sequence of nucleotides. (1marks)

Procedure of mutation breeding in seed propagated species : (3marks)

Year	Breeding activities
1	1. Seed treatment with selected mutagen [X-rays, gamma rays, UV rays or chemical mutagen using recommended dose and duration of treatment. 2. Raising M_1 generation using wider spacing. 3. Recording observations on morphological variants and fertility 4. Selfing of all M_1 plants to avoid contamination. 5. Harvesting of each M_1 plant separately
2	1. Raising M_2 generation from self seeds obtained from M_1 using wider speacing. 2. Identification and selection of disease resistant mutants 3. Harvesting seed of such mutants separately.
3	1. Raising M_3 generation separately for each M_2 selected plants. 2. Evaluation of homozygosity for disease resistance. 3. Bulking of homozygous disease resistant M_3 progeny.
4.	Planting of M_4 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.2. What is apomixis? Enlist the types of apomixis and describe the role of apomixis in plant breeding.

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 facultative apomixis. (1marks)

Classification of Apomixis : (1marks)

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

Role of apomixis in plant breeding : (2marks)

1. *Rapid production of pure lines.* Apomixis is an effective means for rapid production of purelines. Haploid parthenogenesis gives rise to haploid plants which upon colchicines treatment will produce diploid pure lines that can be used in plant breeding programmes.
2. Maintenance of superior genotypes. A superior plant type which produces seed by apomictic means will usually bread true for the characteristics of mother plant. Thus apomixis is useful in maintaining the characteristics of mother plant from generation to generation
3. Conservation of heterosis. In some cases, hybrid vigour may be conserved for many generations by using recurrent apomixis.

Q.3. Explain in brief sexual reproduction. (4marks)

Ans. : 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 estimation of heterosis. (4marks)

Ans. : 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 replicatins) 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 the mechanisms which promote self pollination?

Ans. : Mechanisms which promote is self pollinated : (4marks)

1. Bisexuality: presence of male and female organ in the same flower
2. Homogamy :maturation of anthers and stigma at the same time
3. Cleistogamy :pollination and fertilization occour in unopen flower
4. Chasmogamy :opening of flower only after completion of pollination
5. Position of anthers :in some of species stigma are surrounded by anthers and in some legumes the staimns and stigma are enclosed by the petals

Q.6. Enlist types of male sterility. Explain cytoplasmic genetic male sterility.

Ans. : Types of male sterility : (1marks)

1. Genetic male sterility 2. Cytoplasmic male sterility 3. Cytoplasmic genetic male sterility

. Cytoplasmic genetic male sterility (3marks)

In this sterility is due to interaction between nuclear gens and cytoplasm gene. Neither the cytoplasm nor the genetic factors alone cause male sterility.

This type of male sterility was first discover by joans and davis in 1994in onion .this system includes A, B And R lines this type of male sterility is used for hybrid development in vegetative and seed propagated crop. this type of male sterility is highly reliable and stable and not affected by temperature.

Q.7. What is self incompatibility? Enlist the causes and classification of self incompatibility.

Ans. : Genetically controlled, physiological hinderance to self fruitfulness.

Incompatibility is the failure of the pollen tube to penetrate the full length of the style and effect fertilization.

Incompatibility refers to the failure of pollen to fertilize the same flowers on the same plant. (1marks)

Non fruitfulness in incompatibility may be due to : (1marks)

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.

Lewis (1954) has suggested various classification of self incompatibility. (2marks)

However, the two main types found in plants are type :

1. Heteromorphic incompatibility
2. Homomorphic incompatibility

Heteromorphic incompatibility : In this system flowers of different incompatibility groups

differs in their morphology. This system depends on relative lengths of stamens and style. There are two types of plants on the basis of styler length i.e.

a. Distyly b. Tristyly

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. Describe in brief Johannes's pureline selection. (4marks)

Ans. : The concept of pureline theory (selection) was developed by Johannsen, a Danish biologist in 1903. Pureline refers to the homogeneous progeny of a self pollinated homozygous plant development of new variety through identification and isolation of single best plant progeny is known as pureline selection or individual plant selection. This method is commonly used in self pollinated species. The main features of purelines are briefly presented below:

1. Purelines are homozygous and homogeneous.
2. The variation within a pureline is entirely due to environmental factors. Thus the variation is non hereditable in the purelines.
3. A variety developed by pureline selection is highly uniform in quality due to absence of genetic variation.
4. Selection is ineffective in pureline due to lack of heritable variation selection is effective when heritable variation is present
5. Generally, pureline varieties have narrow adaption and poor adaptability than heterogeneous population. The poor adaptability is due to narrow genetic base.

Johannsen (1903, 1926) a Danish biologist developed the concept of pureline theory working with princess variety of common bean (*Phaseolus vulgaris*) he concluded that :

1. Continuous inbreeding (selfing) leads to homozygosity.
2. Variation with a pureline results from environmental factors only.
3. Selection within a pure line is not effective because all the plants in a pureline have exactly the same genotype.
4. Selection in the original population is effective because the plants have genetic variation.

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

1. Mass selection (2marks)

Ans. : 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

2. Recurrent selection (2marks)

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 (2marks)

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) Plant breeding : A science as well as an art which deals with genetic improvement of crop plant in relation to their economic use for mankind, also called as crop improvement.

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

3) A Line : The male sterile line.

4) Rline : lines that restores fertility when crossed with CGMS line

Q.12. Give the contribution of following scientist.

1. C. T. Patel : Father of Hybrid cotton

2. Athwal D. S. : Pioneers of Bajara breeder.:

3. NGP RAO : Eminent sorghum breeder .

4. M.S. Swaminathan : introduced semi dwarf varieties of wheat from maxico to india which resulted in green revoluvation

S. V. Kalyankar
Signature of Course Instructor
Name : Prof. S. V. Kalyankar
Mobile No.: 9730899377

Borade
Signature of Head,
Name: Dr. B.D.Borade
Mobile No: 9011343061