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## SEMESTER END THEORY EXAMINATION

## B.Sc. Agriculture (Hons.)

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|---|---|---|---|---|---|---|---|
| **Semester** | **:** | **III** | **Term** | **:** | I | **Academic Year** | **:** 2020-21 |
| **Course No.** | **:** | GPB-232 | **Title** | **:** | Fundamentals of Plant Breeding | | |
| **Credits** | **:** | (1+1) | | | | | |
| **Day & Date** | **:** | **20.11.2021** | **Time** | **:** | 1.00 Hr | **Total Marks** | **:** 40 |

**Note : 1) Solve ANY FOUR questions from SECTION-A**
**2) Solve ANY SIX questions from SECTION-B**
**3) ALL questions from SECTION-C are compulsory**
**4) Send the PDF file of answer sheet to the email id of respective course teacher**

**MODEL ANSWER**

**SECTION-A**

**(Write the answers in 4-5 sentences only. Each question carries 4 marks)**

**Q. 1 What is male sterility? Give its types and explain in brief cytoplasmic genetic male sterility.**

**Male sterility:** In some species, the pollen grains are non functional. Such condition is known as male sterility.

**It is of three types:** viz. genetic, cytoplasmic and cytoplasmic genetic.

Cytoplasmic Geneic Male Sterility: This is a case of cytoplasmic male sterility where dominant nuclear gene restorers fertility. This system is utilized for the production of hybrids in bajra, jowar, maize, rice, wheat and many other crops.

Genetic structure : A line or ms line: This tem represents a male sterile line belonging to anyone of the above categories. The A line is always used as a female parent in hybrid seed production. B line or maintainer line: This line is used to maintain the sterility of A line. The B line is isogenic line which is identical for all traits except for fertility status. R line and restoration of fertility: It is other wise known as Restorer line which restores fertility in the A line. The crossing between A x R lines results in F 1 fertile hybrid seeds which is of commercial value.

Maintenance: The A line which is male sterile is maintained by crossing it with isogenic B line which is also known as maintainer line. The B line is similar to that of A line in all characters (isogenic) except fertile cytoplasm.

**Q. 2 Define plant breeding and explain in brief four general objectives of plant breeding.**

**Plant breeding** is an art and science, which tells us ways and means to change the genetic architecture of plants so as to attain a particular objective.

The objectives may be

1. Increased yield
2. Improving the quality
3. Elimination of toxic substance
4. Resistance against biotic and abiotic stresses
5. Change in maturity duration
6. Improved agronomic characters
7. Reducing the plant height to prevent lodging
8. Photoinsensitivity
9. Non-shattering nature
10. Synchronized maturity
11. Determinate Growth habit –determinate growth
12. Elimination or introduction of dormancy

**(Explain in brief)**

**Q. 3 Define Mutation Breeding and explain in brief types of mutation**

**Ans. Defination ;** The genetic improvement of crop plants for various economic characters through induced mutation is referred to as mutation breeding.

**Types of mutation:-** Mutations are of two types

1) **Spontaneous mutations :-** Mutations occur in natural populations without any treatment by man, at low rates.
2) **Induced mutations:-** Artificial induction of mutations by a treatment with certain physical or chemical agents are termed as induced mutations are of two types.

a. **Macromutations:-** Mutations with distinct morphological changes in the phenotype are referred to as macro-mutations. Such mutations are found for qualitative characters and, therefore, are also called oligogenic mutations. Identification of such mutations is easy.

b. **Micromutations:-** Mutations with invisible phenotypic changes are called micro-mutations. Such mutations are observed in quantitative characters and, hence are also referred to as polygenic mutations. Identification of such mutations is very difficult. Micro mutations are of economic value in plant breeding.

Depending upon the effect on the survival of an individual, induced mutations are of four types namely:-

a. **Lethal mutations:-** Lethal mutations kill each and every individual that carries them in appropriate genotype.

b. **Sublethal and subvital:-** Sublethal and subvital mutations reduce the viability but do not kill the individuals carrying them. Sublethals kill more than 50% of the individuals, while subvitals kill much less than 50%.

c. **Vital:-** They do not reduce the viability of individuals carrying them and hence can be used in crop improvement programme. Vital mutations occur in much lower frequency.

**Q. 4 What is pedigree method? Explain in brief pedigree breeding method and its two features**

**Pedigree method:** In this method, individual plants are selected from F2 and subsequent generations and their progenies are tested. During this process details about the plants selected in each generation is recorded in Pedigree Record.

**Pedigree Method Procedure:** F1 Generation The F1 seeds are space planted so that full expression of F1 can be had. It is advisable to raise the parents involved in the cross to raise as border rows so that dominance and other characters can be studied. The F1s are harvested as single plants. F2 generation In F2, 2000 to 10,000 plants per cross are planted. About 100 - 500 plants are selected and harvested on single plant basis. The selection in F 2 depends upon the skill of the breeder. The selection intensity may be 5 to 10%. F3 generation Individual plant progenies are space planted. Again desirable plants are selected. From F3 onwards the term family is introduced. The line selected from each cross is termed as family. F4 generation Similar to F3. F5 generation Many families would have attained homozygosity and may be harvested as row bulk. F6 generation The row bulk may be assessed in multi row trial. The families exhibiting segregation may be isolated and studied separately. F7 generation RRYT F8 generation PYT

**Main features of pedigree breeding method:-**

1. **Application:-** This method is widely used for the improvement of self-pollinated species. It is generally used when both the parents that are used in the hybridization have good agronomic characters or are well adapted. Moreover, it is more commonly used for the improvement of polygenic traits.
2. **Maintenance of pedigree records:-** In this method proper record of the ancestry of each selected plant or plant progeny is maintained for all generations of selection. Important characters of each selected plant and progeny are recorded.
3. **Selection:-** In this method only human selection or artificial selection is used.
4. **Time taken:-** Development of new crop cultivar by the method generally takes 14-15years.
5. **Genetic constitution:-** The variety developed by this method is homozygous and homogeneous, because it is a progeny of single homozygote

Q. 5 **What is wide hybridization? Enlist types of wide hybridization.**

**Ans. Defination :** Hybridization involving individuals from different species belonging to the same genus or to different genera, is termed as distant hybridization or wide hybridization.

**Interspecific hybridization**

Interspecific hybridization gives rise to three types of crosses, viz. fully fertile, partially fertile and

fully sterile in different crop species.

**Fully fertile crosses:-** Interspecific crosses are fully fertile between those species that have complete chromosomal homology. **Partially fertile crosses:** Interspecific crosses are partially fertile between those species which differ in chromosome number but have some chromosome in common. In such situations, the $F_1$ plants are partially fertile.

**Fully sterile crosses:** Interspecific crosses are fully sterile between those species which do not have chromosomal homology. In such species, chromosome number may (or) may not be similar. The lack of chromosomal homology does not permit pairing between the chromosomes of two species during meiosis. Such hybrids can be made self fertile by doubling of chromosomes through colchicine treatment.

**Intergeneric hybridization**

## SECTION-B

**(Write the answers in one sentence only. Each question carries 2 marks)**

Q. 6 (Answer in one sentence/Do as directed/Define )

**a) Enlist the breeding methods for cross pollinated crops**

I. Population improvement A. Selection a) Mass selection b) Modified mass selection Detasseling Panmixis Stratified or grid or unit selection Contiguous control. B. Progeny testing and selection a) Half sib family selection i) Ear to row ii) Modified ear to row. b) Full sib family selection. c) Inbred or selfed family selection. i) Sl self family selection ii) S2 self family selection. C. Recurrent selection a) Simple recurrent selection b) Reciprocal recurrent selection for GCA c) Reciprocal recurrent selection SCA d) Reciprocal recurrent selection D. Hybrids E. Synthetics and Composites

**b) Write any two differences between qualitative and quantitative characters.**

| | Qualitative characters | | Quantitative characters |
|---|---|---|---|
| 1 | It deals with the inheritance of traits of kind, viz. form, structure, colour etc. | 1 | It deals with the inheritance of traits of degree, viz, heights of length, weight, number etc. |
| 2 | Discrete phenotypic classes occurs which display discontinuous variations. | 2 | A spectrum of phenotypic classes occurs which contain continuous variation |
| 3 | Each qualitative traits is governed by two or many alleles of a single gene. | 3 | Each quantitative traits is governed by many non-allelic genes or polygenes. |
| | It concerns with individual mating and their progeny. | 4 | It concerns with a population of organisms consisting of all possible kinds of matting |

**c) Give the characteristics of pure line.**

1. All plants within a pure line have the same genotype.
2. The variation with in a pureline is environmental and nonheritable.
3. Pure lines become genetically variable with time due to natural hybridization, mutation and mechanical mixtures.

**d) Define Backcross method and write its disadvantages.**

**In backcross method** of breeding, the hybrid and the progenies in subsequent generations are repeatedly backcrossed to one of the parents. As a result, the genotype of the backcross progeny becomes increasingly similar to that of the recurrent parent.

**Disadvantages of Backcross Method**

1. The new variety generally cannot be superior to the recurrent parent, except for the character that is transferred.
2. Undesirable genes closely linked with the gene being transferred may also be transmitted to the new variety.
3. Hybridization has to be done for each backcross. This is often difficult, time taking and costly.
4. By the time the backcross is over, the recurrent parent may have been replaced by other varieties superior in yielding ability and other characteristics.

**e) Give classification of self-incompatibility on the basis of flower morphology**

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

Self-incompatibility 1) Heteromorphic system - a) Distyly b) Tristylty

2)Homomorphic system- Gametophytic system b) Sporophytic system

**f) Enlist the various types of recurrent selection**

**a**) Simple recurrent selection b) Reciprocal recurrent selection for GCA c) Reciprocal recurrent selection SCA d) Reciprocal recurrent selection.

**g) Differentiate between synthetics and composites (Any Two)**

| S,N. | Synthetics | Composites |
|---|---|---|
| **1** | Parental components are generally inbreds | It is not so in composite. |
| **2** | Tested for their GCA | The lines are not tested for their GCA. |
| **3** | No of parental lines are limited to 4 - 6 inbred | No such limit |
| **4** | Synthetic produced with inbreds can be reconstituted | It is not possible |
| **5** | Yield performance can be predicted. | Yield performance cannot be predicted |

## SECTION-C

**(Choose the correct option. Each question carry 1 mark)**

Q. 7

**1)** Central Institute for Cotton Research located at ----- ---------

a) Simla b) **Nagpur**

c) Cuttack d) None of the above

**2)** Chromosome number of bajara is ----------

a) **14** b) 20

c) 22 d) 36

**3)** Presence of male and female organs in the same flower is known as ----------

a) Homogamy b) Cleistogamy

c) Chasmogamy d) **Bisexuality**

**4)** CIP is important International Institute for conserving germplasm of ----------

a) **Potatoes** b) Maize

c) Groundnut d) Rice

**5) Botanical name of Soybean is----------**

a) *Vigna unguiculata* b) *Vigna radiate*

c) *Vigna mungo* d) ***Glycine max***

**6)** Cotton crop is -------- pollinated crop.

a) Self b) **Offencross**

c) Cross d) All of above

**7)** Male sterility is characterized by ---------- pollen grains**.**

a) Functional b) **Non-functional**

c) Pollen tube d) Dominance

**8)** ----------is mating between individuals related by descent or having common ancestry.

a) **Inbreeding** b) Heterosis

c) Heterobeltiosis d) hybrid vigour

**9)** Ability of a strain to produce superior progeny when crossed with other strains is called as---------

a) Composite b) Poly Cross Test

c) Synthetic d) **Combining ability**

**10)** A ---------- is group of plants produced from a single through asexual reproduction.

a) **Clone** b) Inbreeding

c) Immortality d) Genotypic variation

**PTO**

**11)** The ratio of phenotypic variance to genotypic variance is ----------

a) Hybridization
b) Variation
c) **Heritability**
d) Heterosis

**12)** Crop in which detasseling is done----------

a) Cotton
b) **Maize**
c) Groundnut
d) Sunflower

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