MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE

MODEL ANSWERS OF SEMESTER END EXAMINATION

B.Sc. (Hons.) Agriculture

Semester	:	IV (New)			Academic Year		:	2022-23
Course No.	:	ELE GPB-244	Title	:	Commercial Plant Breeding			
Credits	:	3 (1+2)						
Day & Date	:		Time	:		Total Marks	:	40
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 diagrams wherever necessary.							

SECTION "A"

Q.1. Define male sterility. Enlist the types of male sterility. Give the advantages and disadvantages of CGMS male sterility. [1 mark for each : define, type, advantage and disadvantage]

Answer : **Male sterility** is defined as an absence or non-function of pollen grain in plant or incapability of plants to produce or release functional pollen grains.

Types of Male sterility / Classification:

(1) Genetic (GMS)
(2) Cytoplasmic,
(3) Cytoplasmic-genetic
(4) Chemically – induced Male Sterility

Advantages of CGMS male sterility.

1. In CGMS system, CMS is highly stable and is not affected by environmental factors.
2. In CGMS system, CMS 'A' line gives only male sterile plants.
3. Conversion of a genotype in CGMS system 'A' line is quicker and direct.
4. CMS requires less area for maintenance.
5. Quantity of seed produced is more.
6. There is no chance of admixture.

Disdvantages of CGMS male sterility.

1. In CGMS, only limited number of crosses can be made due to availability of limited number of restorers.
2. In CGMS, both male and female parents of the hybrid need to be converted.
3. CMS is solely controlled by cytoplasmic genes and hence it may have some adverse effect on other characters.
4. It is not possible to breed a variety from CMS line.

Q.2. Explain the agronomical classification of crop plants. [4 marks … any eight points]

Answer :

1. **Grain crops:** The grains are used for consumption. It may be cereals as millets cereals are the cultivated grasses grown for their edible starchy grains. The larger grain used as staple food is cereals. Eg. Rice, Jowar, Wheat, Maize, Barley and millets are the small grained cereals which are of minor importance as food. Eg. Bajra, Finger millet.
2. **Pulse/legume crops:** Seeds of leguminous crops plant used as food. Also used for production of dal which is rich in protein. Eg. Green gram, Black gram, Soybean, Pea, Cowpea etc.
3. **Oil seeds crops:** The crop seeds are rich in fatty acids and are used to extract vegetable oil to meet various requirements. Eg. Groundnut, Mustard, Sunflower, Sesamum, Linseed etc.
4. **Forage Crop:** The vegetative matter fresh as preserved utilized as food for animals. Crop cultivated and used for fickler, hay, silage preparation. Eg. Sorghum, Elephant grass, Guinea grass, Berseem and other pulse, Bajara etc.
5. **Fiber crops:** The crops grown for fiber yield. Fiber may be obtained from seed. Eg. Cotton, Jute, Mesta, Sunhemp, flax etc.
6. **Roots crops:** Roots are the economic produce in root crop. Eg. sweet, potato, sugar beet, carrot, turnip etc.
7. **Tuber crop:** The crop whose edible portion is not a root but a short thickened underground stem. Eg. Potato, Sweet potato.
8. **Sugar crops:** The two important crops are sugarcane and sugar beet cultivated for production for sugar.
9. **Starch crops:** The crops grown for the production of starch. E.g. Tapioca, Potato, Sweet potato.
10. **Drug crop:** Thee crops used for preparation for medicines. Eg. Tobacco, Mint, pyrethrum.
11. **Spices and condiments/spices crops:** The crop plants as their products are used to flavor taste and sometime color the fresh preserved food. Eg. Ginger, Garlic, Chili, Onion, Coriander, Cardamom, Pepper, Turmeric etc.
12. **Vegetables crops:** may be leafy as fruity vegetables. E.g. Palak, mentha, Brinjal, tomato.
13. **Green manure crop:** The crops grown and incorporated into soil to increase fertility of soil. Eg. Sunhemp.
14. **Medicinal and aromatic crops:** Medicinal plants includes cinchona, isabgol, opium poppy, senna, belladonna, rauwolfra, iycorice and aromatic plants such as lemon grass, citronella grass, palmorsa, Japanese mint, peppermint, rose geranicem, jasmine, henna etc.

Q.3. Write short notes on the following [2 mark to each]

a) Different methods of developing hybrid seed production of rice. (any two method)

Hybrid rice can be produced by three different methods as below ..

- **Three line system :** Hybrid rice is produced by utilizing cytoplasmic genetic male sterile system. The source of male sterile cytoplasm used is wild abortive. In this method there are three different lines *i.e.* A-line or male sterile line, B-line or maintainer line and restorer line or R-line. For maintaining A-line it has to be crossed with B-line and for producing hybrid seed A-line has to be crossed with R-line.

- **Two line system :** This method of hybrid rice seed production involves the use of photoperiod sensitive genetic male sterile system or temperature sensitive genetic male sterile system. In this method any normal line can be used as pollen parent (male parental line).
- **By Using chemical emasculants :** The chemicals which kills or sterilize the male gamete with little or no effect on the normal functioning of the female gamete can be used to emasculate female parental line in hybrid seed production. In China chemical emasculants are commonly used in hybrid seed of rice. In India they are not used commercially for hybrid seed production, but they are used in academic studies. The chemical which can be used as potent gametocides are etheral, maleic hydrazide, etc.

b) **Benefits of IPR**

1. It encourages and safeguards intellectual and artistic creations.
2. It enables the dissemination of new idea and technologies quickly and widely; this is achieved by the requirement of disclosure for the grant of patents etc.
3. It encourages investment in R&D efforts.
4. It provides consumer with the result for creations and inventions.
5. It provides increased opportunities for the distribution of the above effects across countries in a manner proportionate to the national levels of individual and economic development.

Q.4. Complete the following table for foundation hybrid seed production. [1 mark for each point]

Sr. No.	Crop	Use of Male sterility	Isolation distance (mt.)	Planting ratio (A & R line)	Seed rate (A & R line)
1.	Hybrid Bajra	CGMS	1000	4 : 2	A line: 6 kg/ha R line: 2 kg/ha

Q.5. Write the objectives of PPV&FRA act? Explain in brief criteria for protection of plant varieties.

Answer : Objectives of PPV&FRA act [2 mark]

1. Registration of plant varieties.
2. Characterization and documentation of registered varieties.
3. Documentation, indexing and cataloguing of farmer's varieties.
4. Providing compulsory cataloguing facility for all plant varieties.
5. Ensuring that seeds of all registered varieties are made available to farmers.
6. Collection of comprehensive statistics on plant varieties.
7. Maintenance of National Register of Plant variety.
8. To encourage scientists, farmers, communities for the development of new plant varieties having quality and production potential.
9. Registration of varieties for legal protection.
10. Establishing Gene Funds for rewards and compensation.

Criteria for protection of plant varieties. [2 mark]

1. **Novelty:** The variety shall be new from existing varieties.
2. **Distinctiveness:** The variety shall be distinct in 1 or 2 characters from any other variety.
3. **Uniformity:** The variety shall be uniform.
4. **Stability:** The variety shall be stable for its relevant characteristics remain unchanged after repeated propagation .

Q.6. Define hybrid. How to maintain nucleus seed of pre - released or newly released varieties? [1 mark define, 3 mark for nucleus seed]

- **Hybrid :** Hybrids are the first generation (F_1) from a cross between two pure lines, inbred lines, open pollinated varieties or clones that are genetically dissimilar. or Cross between two genetically dissimilar lines.

Maintaince of nucleus seed of pre - released or newly released varieties :

Harrington 1952 has outlined the procedure for multiplication of nucleus seed as below;

1. Selection of variety
2. Examination of variety
3. Selection of field
4. Inspection of nucleus seed plot and removal of off types
5. Harvesting and threshing

1. Sampling of a variety :

- Already released or newly released varieties are selected for nucleus seed production. These varieties are used as base material for nucleus seed production. In any crop not more than 15 new varieties should be selected for nucleus seed production.

2. Examination of varieties /samples:

- Select approximately 200 single plants from one of the yield trials, which are true to type, harvest and threshed separately. Discard poor diseased and inferior plants.
- The selected plants should be harvested 4 to 5 days before harvest to avoid shattering.
- All the 200 plants should be tied individually and wrapped in a cloth bag and stored till the yield results are obtained. The bundles are threshed separately and the seed should be examined in piles on the purity work board. Piles with undesirable characters (diseased, off types etc.) should be discarded. Remained true to type seed of variety is used for sowing as a nucleus in plant to row progeny

3. Selection of field or Location of nucleus seed:

- Select clean, fertile soil in which same crop was not grown in previous year. The land should be free from volunteer plants and properly isolated. The 200 progenies sown in double rows in four plots of 50 progenies each plot.
- Sufficient spacing between and within the rows to facilitate examination of each row during the crop growth.

4. Inspection of nucleus seed plots and removal of off types :

- The double row nucleus seed plot critically examined from the seedling stage until maturity. If any plot differ distinctly from that of the nucleus seed variety it should be removed before flowering stage.
- After flowering and during maturity plots examined critically for characters like flower colour, ear head shape, seed colour etc. and the off types should be removed before harvest.

- When a plant is removed after flowering all the plants or plots within 3 meters should be removed as they may contaminate the surrounding plants .

5. Harvesting and threshing:

- The nucleus seed crop can be harvested soon after it attains physiological maturity. It is better to harvest are to row lines separately. The remaining plots (between 180-200) should be harvested individually and tied into a bundle.
- The individual plots are threshed cleaned and dried separately. The seed of each plot should be placed on the purity work board in piles and examined for uniformity of seed characters.
- Off type or diseased piles should be discarded
- All the remaining plot seed should be mixed together into one lot. Then treated with fungicide and insecticide bagged, labeled and stored as breeder stock seed for next year.

Q.7. Write in detail major steps involved in variety testing, release and notification. [4 mark]

Answer : Major steps involved in variety testing, release and notification as below.

1. Identification of the best cultures / Evaluation
2. Station trial
3. Multilocation trial
4. Adaptive research trial (At farmers field)
5. Disease and insect tests
6. Quality test
7. Preparation of variety release proposal
8. Variety release committee
9. Notification of the variety

1. Identification of the best cultures / Evaluation

- After identification of the best cultures from the segregating generation or any other source it has to undergo the following trials.

2.Station trial

2a. Row yield trial

- For every 10^{th} row there will be a check entry when the trial will be non replicated.

2b. Replicated row yield trails

- From the row yield trial, the best cultures will be tested in RRYT along with appropriate check. The best entries from RRYT will be carried forward to preliminary yield trial.

3. Multilocation trial

3a. Preliminary yield trial / Initial Evaluation trial

- Replicated trial conducted with appropriate checks. PYT will be conducted normally for two seasons. While conducting, PYT, the best entries will be nominated to All India coordinated trials also.
- Screening for biotic and abiotic stresses will be done during PYT stage. The best entry will be carried to comparative yield trial. The entries entered into All India trial will be given project number. For eg. sorghum entry will be given SPV (Sorghum Project Variety). Rice - IET (Initial Evaluation Trial), etc.

3b. Comparative Yield trial / Uniform Regional trial

- CYT is replicated one conducted with more than one check. The trial will be repeated for 3 seasons. The entry proved to be superior in all the 3 seasons will be proposed for multilocation trial. (MLT). The MLT will be conducted at Research Stations of university spread over the State.

3c. Coordinated trial /National trial

- The best entries from MLT trial will be sent for ICAR coordinated trial at national level. Each station will propose its own entry. Based on merits and demerits of each culture, the entries will be nominated to IVT/IHT.

3d. Agronomic trial

- The best entries found in MLT and coordinated trial will be proposed for Adaptive Research Trial (ART). The best entry identified from average of above trials is consider for agronomic trial. It is tested with check variety for spacing and fertilizer doses.

4. Adaptive Research Trial (At farmers field)

- ART will be conducted at farmers field. Minimum 20 ART is to be conducted. The entries for ART will be decided during Research Review Committee (RRC) meeting at university level and Joint Agresco Meeting at state level which will be held once in a year. In Joint Agresco scientists of four university and Agri. Dept. Staff will participate. The entries performing well in ART will be proposed for release as a variety.

5. Disease and Insect Tests

- During the University and National ICAR coordinated trials all recommended entries are tested for major pest and diseases. Resistant / tolerant genotypes are identified and recommended for release.

6. Quality Test

- During the University and National ICAR coordinated trials all recommended entries are tested for quality parameters. Better quality genotypes are identified and recommended for release.

7. Preparation of Variety Release Proposal

- The scientist incharge of the center will propose the culture for release as a variety.
- There are two proposal: a. Pre- release proposal
  b. Final Release Proposal
- There is a proforma for variety release proposal. This proforma will contain all the information about the culture *viz.*, Name of the developers, parentage, parents morphology, cultures morphology, key characters of the culture for identification, agronomic practices, pest and disease resistance, quality characters yield trial results and DNA finger printing data .
- The variety release proposal will be discussed in RRC meeting of university where Vice chancellor, All the Director, Head of the sections and scientist are present. After approval the proposal will be presented in RFRC (Research Finding Release Committee) and then in Joint Agesco. Once it is approved in Joint Agresco it is submitted to State Variety Release Committee.

8. Variety release committee

8a. State Variety Release Committee
8b. Central Variety Release Committee

- SVRC will be headed by Commissioner and Secretary, Agril. Dept. members will be Director of Agriculture, Joint Directors of Agriculture and four University scientists. Besides these, two leading farmers of the state will also be the members. After discussion, based on merit the SVRC it will submitted to CVRC at New Delhi. Once CVRC will approve it for release. Then the culture will be released for general cultivation.

9. Notification of the variety

- For certified seed production, the variety is to be notified by the central variety release committee, Delhi. After release of the variety for notification purpose the information will be furnished in the prescribed proforma. After notification only, a variety can be multiplied under certified seed production.

Q.8. Explain in brief various factors responsible for loss of genetic purity during quality seed production. [4 marks]

Answer :

Factors responsible for loss of genetic purity during quality seed production.

The several factors that are responsible for loss of genetic purity during seed production as listed by Kadam (1942) are as below :

1. Developmental Variation
2. Mechanical Mixtures
3. Mutations
4. Natural Crossing
5. Minor Genetic Variation
6. Selective influence of Diseases
7. Techniques of the Breeder
8. Breakdown of male sterility
9. Improper / defective seed certification System

1. **Developmental variation :** The genetic purity of a variety or trueness to its type deteriorates due to several factors during the production cycles.
2. **Mechanical mixtures :** To avoid this sort of mechanical contamination it would be necessary to rogue the seed fields at different stages of crop growth and to take ulmost during seed production, harvesting, threshing, processing etc.

3. Mutations : If any visible mutations are observed they should be removed by roguing from seed plots to purify the seeds. In case of vegetative propagated crops, periodic increase of true to type stock would eliminate the mutants.

4. Natural crossing : The extent of contamination depends upon the amount of natural cross-fertilization. On the other hand natural crossing is main source of contamination in cross-fertilized or often cross-fertilized crops.

5. Minor genetic variation : some minor genetic changes may occur during production cycles due to difference in environment. Due to these changes the yields may be affected.

6. Selective influence of diseases : New crop varieties often become susceptible to new races of diseases often caused by obligate parasites. Vegetatively propagated stocks deteriorate fast if infected by viral, fungal and bacterial diseases.

7. Techniques of the breeder : Instability may occur in a variety due to genetic irregularities if it is not properly assessed at the time of release. Premature release of a variety, which has been breed for particular disease, leads to the production of resistant and susceptible plants which is still segregating may be an important cause of deterioration.

8. Breakdown of male sterility : Generally in hybrid seed production if there is any breakdown of male sterility it may lead to a mixture of F_1 hybrids and selfed seed .

9. Improper / defective seed certification System : It is not a factor that deteriorates the crops varieties, but is there is any lacuna in any of the above factors and if it has not been checked it may lead to deterioration of crop varieties.

Q.9. a) Write in brief the principles of quality seed production of vegetable crops under protected environment. [2 marks]

Answer :

a) **Principles of quality seed production of vegetable crops under protected environment.**

- Soil system
- Cultivation practices
- Temperature maintenance
- Climate control system
- Irrigation / Water management
- Pest and disease control
- Higher yield under poly houses and shade net houses
-

Q.9. b) Write in short uses of haploids [2 marks].

Answer :

- Production of homozygous varieties in self pollinated crops.
- In cross-pollinated crops, the derivation from heterozygous material of pure lines for use as parents of the intended single cross or double cross hybrids.
- The obvious advantage of haploids is that they display mutations with successive effects in single dose.
- Effective fixation by chromosome doubling on transformation.
- Double haploid plants are also used in mutagenesis, biochemical, and physiological studies.
- Development of pure lines and disease resistant lines for mildew and yellow mosaic-barley
- Parthenogenetic haploids in maize
- Recovery of sexual inter specific hybrids between wild and domestic species - tomato
- Development of pure lines and 100% male plants in asparagus
- Complex hybrids for disease resistance in coffee

Q.10. Explain in detail the safeguards for maintenance of genetic purity? [4 marks]

Answer :

- The important safe guards for maintaining genetic purity during seed production are;
  1. Control of seed source (Appropriate class)
  2. Preceding crop requirement (Due to volunteer plants)
  3. Isolation
  4. Rouging of seed fields
  5. Seed certification
  6. Grow out test

1. Control of seed source (Appropriate class) : The seed used should be of appropriate class from the approved source for raising a seed crop. There are four classes of seed nucleus, breeder, foundation and certified seed.

2. Preceding crop requirement (Due to volunteer plants) : This has been fixed to avoid contamination through volunteer plants and also the soil borne diseases.

3. Isolation : It is required to avoid natural crossing with other undesirable types, off types in the field and mechanical mixtures at the time of sowing, threshing, processing and contamination due to seed borne diseases from nearby fields. Protection from these sources of contamination is necessary for maintaining genetic purity and good quality seed.

4. Rouging of seed fields : The existence of off types plants is another source of genetic contamination. Off types plants differing in their characteristics from that of the seed crop are called as offtypes. Removal of offtypes is referred as rouging. Offtype should be roughed frm the plot before they shed pollen and pollination occurs. To accomplish this regular supervision of trained person is required.

5. Seed certification : Genetic purity in seed production maintained through a system of seed certification. The main objective of seed certification is to make available seeds of good quality to farmers. To shieve this qualified and traind person from SCA carry out field inspections at appropriate stages of crop growth. They also make seed inspection by drawing samples from seed lots after processing. The SCA verifies for both filed and seed standards and the seed lot must uniform to get approval as certified seed.

6. Grow out test : Varieties that are grown for seed production should be periodically tested for genetic purity by conducting GOT to make sure that they are being maintained in true form. GOT test is compulsory for hybrids produced by manual emasculation and pollination and for testing the purity of parental lines used in hybrid seed production.

Q.11 Define the following term ..... [1 mark for each]

1. **Genetic purity :** It refers trueness to type, or the degree of contamination of seeds caused by undesired genetic varieties or species called as genetic purity.
2. **Pure line :** It is the progeny of single self-fertilized homozygous plant.
3. **Rouging :** Removal of offtypes is called as rouging
4. **Nucleus seed :** is the handful of original seed obtained from selected individual plants of a particular variety for maintenance and purification by the originating breeder.

Q.12 Fill in the blanks ... [1 mark for each]

1. In sorghum, the source of male sterile cytoplasm used is **kafir**.
2. ***Allium cepa*** is the botanical name of onion.
3. **Cytoplasmic male sterility (CMS)** male sterility may be utilized for producing hybrid seed in certain ornamental species, or in species where a vegetative part is of economic value.
4. In Maize, removal of tassel from the female parent before shedding pollen is called as **detasseling**.

Dr. Suhil R. Karad
Professor of Agril. Botany (CAS)
RCSM College of Agriculture, Kolhapur
0231 2605851
9420330036

Dr. A. G. Bhoite
Professor of Agril. Botany
RCSM College of Agriculture, Kolhapur
0231 2605851
7588064909
Prof.of Agril.Botany
RCSM College of Agriculture,
Kolhapur