Model Answer Paper

MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END THEORY EXAMINATION

B.Sc. (Hons.) Agriculture

Semester	: V (New)	Term	: I	Academic Year	: 2022-23
Course No.	: GPB 355	Title	: Crop Improvement-I (*Kharif* Crops)		
Credits	: 2(1+1)				
Day & Date	:	Time (hrs.)	: 2 hrs.	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'

Marking scheme

Q.1 **Describe hybrid seed production technology in rice.** 4M

Ans: **Choice of location:**

Paddy field with fertile soil, a desired irrigation and drainage system, sufficient sunshine, and no serious disease and insect problems are essentially needed.

Isolation distance:

Space isolation: A space isolation of 50 – 100 m

Time isolation: a time of over 20 days is practiced

Barrier isolators: Topographic features like wood lot, tall crops to a distance of 30m/artificial obstacles of (plastic sheet) above 2m height.

Seeding of parental lines in the seedbed

Seed rate: A line: 15 kg/ha, R line: 5 kg/ha

Transplanting:

Transplanting seedlings of A and R lines as and when they attain the age of 21-25 days.

Planting ratio:

A: R - 2:8; 2:12; 3:10

Seed production plot should be perpendicular to the prevailing wind direction expected at flowering time of the parents.

Spacings:

Between 'R' line rows: 30 cm Between 'A' line rows : 15 cm Between 'R' & 'A' line blocks : 20 – 30 cm Between hills ('A' & 'R' lines) : 15 cm

Roguing:

Off-type rogues can be removed whenever they are identified – earlier the better. The most important stages for roguing are at maximum tillering, flowering and just before harvesting

Flag leaf clipping:

The clipping of flag leaf helps in free movement and wide dispersal of pollen grains to give higher seed production.

Application of gibberellin:

GA_3 affects exertion of panicle completely out of flag leaf sheath. In India recommended dose of GA_3 is 50g/ha using knapsack sprayer

Supplementary pollination:

Supplementary pollination can be done either by rope pulling or by shaking the pollen parent with the help of two bamboo sticks. It has to be done for 7-10 days during the flowering period.

Harvesting: First harvest R line then A line.

Storage: For short term storage use gunny bag or cloth bag 8% moisture content

Yield: 800-1200 kg ha-1

Q.2 **Describe the different mechanisms of disease resistant in crop plants.** 4M

Ans:

1. **Disease escape:**
   The ability of susceptible host plants to avoid attack of disease due to environmental conditions factors, early varieties, change in the date of plating, change in the site of planting; balanced application of NPK etc. e.g. Early varieties s of groundnut and potato may escape 'Tikka' and 'Late blight' diseases respectively since they mature before the disease epidemic occurs.
2. **Disease endurance or tolerance:**
   The ability of the plants to tolerate the attack of the pathogen without showing much damage. This endurance is brought about by the influence of external characters.. e.g. Wheat varieties when fertilized with potash and phosphorus are more tolerant to the rust and mildew infection.
3. **Disease Resistance:**
   The ability of plants to withstand, oppose or overcome the attack of pathogens. Resistance is a relative term and it generally refers to any retardation in the development of the attacking pathogen. It may be controlled by single dominant gene e.g. in wheat all rusts NP 809
4. **Immunity:**
   When the host does not show the symptoms of disease it is known as immune reaction. In immune reaction the rate of reproduction is zero i.e. r = 0
5. **Hypersensitivity:**
   Immediately after the infection several host cells surrounding the point of infection are so sensitive that they will die. This leads to the death of the pathogen because the rust mycelium cannot grow through the dead cells.
6. **Nutritional factors:**
   Reduction in growth and in spore production is generally supposed to be due to unfavourable physiological conditions within the host.

Q.3 **Define plant genetic recourses. Explain in brief kinds of Germplasm.**

Ans: **Plant Genetic Resources:** 1M

The sum total of genes in a crop species is referred to as genetic resources.

Kinds of Germplasm 3M

1. **Land races**
   These are nothing but primitive cultivars which were selected and cultivated by the farmers for many generations without systematic plant breeding efforts.
2. **Obsolete Cultivars**
   These are the varieties developed by systematic breeding effort which were popular earlier and now have been replaced by new varieties.
3. **Modern cultivars**
   The currently cultivated high yielding varieties are referred to as modern cultivars. They are also known as improved cultivars or advanced cultivars.
4. **Advanced breeding lines**
   These are pre -released plants which have been developed by plant breeders in modern scientific breeding programmes.
5. **Wild forms of cultivated species**
   Wild forms of cultivated species are available in many crop plants. Such plants have generally high degree of resistance to biotic and abiotic stresses and are utilized in breeding programmes.
6. **Wild Relatives**
   Those naturally occurring plant species which have common ancestry with crops and can cross with crop species are referred to as wild relatives or wild species. Wild relatives include all other species, which are related to the crop species by descent during their evolution.
7. **Mutants**
   Mutation breeding is used when the desired character is not found in the genetic stocks of cultivated species and their wild relatives. The extra variability which is created through induced mutations constitutes important components of genepool.

Q.4 **Define back cross. Explain the procedure of back cross method of breeding for transfer of dominant trait.**

Ans: **Back cross:** F_1 hybrid crossed with either of its parent. 1M

Procedure for transfer of dominant gene: 3M

Let us suppose that a high yielding and widely adopted variety 'A' is susceptible to stem rust (rr) and another variety 'B' is poor yielding but resistant to stem rust (RR) i.e. dominant to susceptibility. In this back-cross programme rust resistance trait is transfer from donor parent into a recurrent parent.

1) Hybridization:

Variety 'A' is crossed with variety 'B' in which variety 'A' is used as female parent which is recurrent and variety 'B' is used as donor parent.

2) F_1 Generation:

During the second year F1 plants are backcrossed to variety 'A' since all the F1 plants will be heterozygous for rust resistance. Selection for rust resistance is not necessary.

3) First back cross generation:

In the third-year half of the plant would be resistant and remaining half would be susceptible to stem rust, rust resistant plants are selected and backcross to variety 'A'.

4) BC_2 –BC_6 generation:

In each backcross generation, segregation would occur for rust resistance. Rust resistant plant are selected and backcrossed to the variety 'A' selection for plant type of variety 'A' may be practised particularly in BC2 and BC3 generation.

5) BC_6 generation:

On an average the plant will have 98.50 genes from variety A rust resistant plants are selected and selfed, their seeds are harvested separately.

6) BC_6 F2 generation:

Individual plant progenies are grown from the selected plants. Rust resistance once plant, which are similar to variety 'A' are selected and selected plants are harvested separately.

7) BC_5 F3 generation:

Individual plant progenies are grown homozygous progenies resistant to rust and similar to plant type of variety 'A' harvested in bulk. Several similar progenies are mixed to constitute the new variety.

8) Yield Test:

The new variety is tested in RYT i.e. replicated yield trials along with the variety 'A' as a check. Plant type, dates of flowering, date of maturity, quality, etc are critically evaluated. The new variety would be identical to variety 'A' in performance. Therefore, detail yield test is not required, and the variety may be directly released for cultivation.

Q.5 **Describe the different morphological characters associated with drought resistance.**

Ans: **Morphological characters:** 4M

1. Earliness:

Earliness is a desirable character which leads to drought escape in many crops. For example, in wheat, sorghum, maize, and rice yield of early maturing varieties is less affected by severe drought than late maturing varieties.

2. Stomatal features:

Sunken, small size and a smaller number of stomata are associated with drought resistance. Control of stomatal aperture is important in drought resistance. The rapid closing of stomata during development of drought helps in maintaining higher water potential in the tissues by reducing transpiration rate and thus resulting in drought avoidance. The stomatal aperture is measured with the help of porometers. Drought resistant genotypes have rapid closing habit of stomata. Leaves with closed stomata will exhibit higher temperature than those with open stomata. Leaves with open stomata have cooling effect due to water loss through transpiration.

3. Leaf characters:
Cuticular thickness and Waxiness of leaf surface, Leaf rolling, Leaf hairiness, Glossiness

4. Rooting patterns:
Length, width and branching of root systems leads to decrease in plant water stress.

5. Growth habit:
In upland cotton, indeterminate genotypes yielded more than determinate genotypes in a semiarid environment. Indeterminate plants produce flowers throughout the growing seasons whenever sufficient moisture is availability.

6. Awns:
In wheat and barley, presence of awns appears to be associated with high yield under drought conditions. The increase in yield from awns results due to increase in seed size. Awns play important role in growth and development of seeds through increase in photosynthetic surface of spike.

Q.6 **Give botanical name and centre of origin of the following crops.**
2. Rice 2. Pigeonpea 3. Soybean 4. Sunflower 1M each

Ans:

Crop	Botanical name	Centre of origin
Rice	*Oryza Sativa*	South East Asia
Red gram (P.p.)	*Cajanus cajan*	Africa and India
Soybean	*Glycine max*	China
Sunflower	*Helianthus annuus*	North America

Q.7 **Write breeding objectives of maize. Describe the development of synthetic variety.**

Ans: **Breeding objective of maize:** 2M

Yield improvement: The various yield components contributing to yield in maize include number of ears, number of kernel rows, number of kernels per row, test weight and shelling percentage.

Adaptability and stability: Development of varieties or hybrids with wide adaptability and stability is to ensure higher and stable returns to the farmers.

Breeding for disease and pest resistance: leaf blight post-flowering stalk rot complex downy mildew and common rust.

Insect pests like stem borers, army worms, aphids, cutworm, jassids, thrips, root worm, leaf miner etc.

Breeding for quality

Development of synthetic variety 2M

1. Evaluation of inbred lines for GCA:
   Three methods of evaluation: 1. Poly cross 2. Top cross 3. Single cross
2. Production of synthetic variety:
   Two methods: 1. Equal amount of seed from the parental lines are mixed and planted in isolation.Open pollination is allowed and produce crosses in all combinations. Seed harvested in bulk. Population raised from this seed is the Syn 1 generation.
3. All possible crosses among selected lines are made in isolation. Equal amount of seed from each cross is composite to produce synthetic variety.
4. Multiplication of synthetic variety: After a synthetic variety has synthesized. It is multiplied in isolation for one or more generation.

Q.8 **Define emasculation. Describe the different methods of emasculation.**

Ans: **Emasculation:** Removal of stamens or anthers or killing the pollen of a flower without the female reproductive organ is known as emasculation. 1M

1. Hand Emasculation 3M

In species with large flowers, removal of anthers is possible with the help of forceps. It is done before anther dehiscence. It is generally done between 4 and 6 PM one day before anthers dehisce.

2. Suction Method

It is useful in species with small flowers. Emasculation is done in the morning immediately after the flowers open. A thin rubber or a glass tube attached to a suction hose is used to suck the anthers from the flowers. However self-pollination

cannot be eliminated in this method.

3. Hot Water Treatment

In case of hot water emasculation, the temperature of water and duration of treatment vary from crop to crop. It is determined for every species. For sorghum 42-48OC for 10 minutes is found to be suitable. In the case of rice, 10 minutes Treatments with 40-44OC is adequate.

4. Alcohol Treatment

It is not commonly used. The method consists of immersing the inflorescence in alcohol of suitable concentration for a brief period followed by rinsing with water. In Lucerne the inflorescence immersed in 57% alcohol for10 second was highly effective. It is better method of emasculation than suction method.

5. Cold Treatment

Cold treatment like hot water treatment kills the pollen grains without damaging gynoecium. In the case of rice, treatment with cold water 0.6OC kills the pollen grains

6. Genetic Emasculation

Genetic/ cytoplasmic male sterility may be used to eliminate the process of emasculation. This is useful in the commercial production of hybrids in maize, sorghum pearl millet, onion, cotton, and rice, etc.

7. Use of Gametocide

Also known as chemical hybridizing agents (CHA) chemicals which selectively kills the male gamete without affecting the female gamete. e.g. Ethrel, Sodium methyl arsenate, Zinc methyl arsenate in rice, Maleic hydrazide for cotton and wheat.

Q.9 **Give important features of ideotype for sorghum and cotton.**

Ans: Ideotype for sorghum 2M

Dr. Swaminathan 1972 proposed ideal plant type of Sorghum.
High grain yield.
Harvest index greater than 30.
High ear head exertion.
Panicle dry matter of total dry matter: >50%
Higher relative water content. 2M

Ideotype for cotton

Short stature (90-120 cm)
Compact and sympodial plant habit making pyramidal shape
Determinate in fruiting habit with unimodal distribution of bolling
Short duration (150-165 days)
Responsive to high fertilizer dose
High degree of inter plant competitive ability
High degree of resistance to insect pests and diseases, and
High physiological efficiency.
Earliness (150-165 days)
Fewer small and thick leaves
Compact and short stature, indeterminate habit
Sparse hairiness,
Medium to big boll size
Synchronous bolling

Q.10 **Differentiate between (ANY TWO)** 2M each

Ans:

1. Qualitative Trait	**Quantitative Traits**
1) Characters of kind.	1) Characters of degree.
2) Discontinuous variation; distinct phenotypic classes.	2) Continuous variations; phenotypic measurements from a spectrum.
3) Single gene effect.	3) Polygenic control; effects of single genes too slight to be detected.

4) Concerned with individual matings & their progeny.	4) Concerned with population of organisms consisting of all possible kinds of matings.
5) Analysed by making counts and ratios.	5) Statistical analyses.
6) Ex. Form (round/wrinkled seeds of pea), Structure (horned /hornless conditions in cattle's)	6) Ex. In plants (Seed colour in Wheat, Ear size in Maize, Corolla length in tobacco etc.)
2. Pure line selection	**Mass selection**
1. New variety is pure line	1. New variety is mixture of pure lines
2. New variety is highly uniform	2. Less uniform as compared to pureline
3. Progeny test is done	3. Progeny test is not performed
4. Pure line variety is expected to have narrow adaptation	4. Usually variety has wider adaptation
5. Pure line variety has lower stability	5. Mass selected variety has greater stability
6. Variation within a pure line variety is purely environmental	6. The variety has genetic variation of quantitative traits
3. Vertical resistance	**Horizontal resistance**
1. Specific resistance of a host to the particular race of a pathogen	1. The resistance of a host to all the races of a pathogen
2. Provides protection only from one race of a pathogen.	2. Host plant provides protection from all the prevailing races of a pathogen
3. Controlled by oligogenes/one or few genes	3.Controlled by a number of genes/ polygenes
4. Displays discontinuous variation among genotypes.	4.Displays continuous variation among genotypes.
5.Vertical resistance applies to host pathogen gene for gene relationships	5.Not applicable to gene for gene relationships.
6. Host controls only one race therefore also known as non-uniform resistance.	6. Resistance is similar to all the races of a pathogen, hence also referred as uniform resistance.
7. Transfer of vertical resistance from one host genotype to another is simple.	7.Transfer horizontal resistance from one genotype to another is difficult
8. Identification of resistant types is easy due to major effect of oligogenes	8.Identification of resistant types is difficult due to small effect of polygenes.
9. Also known as specific resistance/ non uniform resistance/ oligogenic resistance / major gene resistance	9. Also known as general resistance/ non-specific resistance/ polygenic resistance/ minor gene resistance

SECTION 'B'

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

Ans: 1M each

1. **Expressivity :** The degree of phenotypic expression of a penetrant gene is called expressivity **OR**

   Ability of a gene to produce identical phenotypes in all the individuals carrying it in the appropriate genotype

2. **Acclimatization** : The process that leads to the adoption of a variety to a new environment is known as acclimatization.
3. **Hybrid:** F_1 offspring obtained by crossing genetically dissimilar parents.
4. **Obsolete cultivar** :Cultivar developed by systematic breeding efforts, which were popular earlier and now have been replaced by new varieties. OR

   Improved varieties of recent past.

Q.12 **Fill in the blanks**

Ans:
1. **Gossypol**
2. **Pure lines**
3. **A and R**
4. **Monoecy and Protandry**

1 M each

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