Model Answer Paper

MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END THEORY EXAMINATION
B. Sc. (Hons.) Agriculture

Semester : **VI (New)** **Term II** Academic Year: **2023-24**
Course No. : GPB 366
Credits: 2 (1+1) Title : Crop Improvement- II (Rabi Crops)
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 a neat diagrams wherever necessary.

SECTION 'A'

Marking scheme

Que 1. **Write major breeding objectives in Guava and Field Pea.** **4**

Ans:

Breeding objectives of guava : 2 marks (Minimum 5-6 objectives)

1. High yield with good keeping quality
2. Good fruit quality and uniform ripening.
3. Development of seedless varieties'
4. Longer shelf life with improved texture.
5. Other quality parameters viz.
   a. Appearance (size,shape,colour,and skin finish)
   b. Eating quality (Flavour, flesh colour,seedlessness and ttexture)
   c. Processing quality (High Vit C,or pectin content)
6. High fruit : shoot ratio
7. Resistant to fruit fly, mealy bug, scale insects, leaf eating caterpillar.
8. Tolerance to salt, saline and alkaline soils

Breeding objectives of Field Pea : 2 marks

1. Early maturity 2. Pod characteristics 3.Bold seed size
4. Shelling percentage 5. High pod yield

Que 2. **Give breeding objectives in Chickpea and Safflower.** **4**

Breeding objectives of chickpea. 2 marks (Minimum 5-6 objectives)

1. Breeding for higher yield
2. Breeding for increased biomass , tall ,erect and compact cultivars.
3. Resistance to diseases (blight, wilt, root rot grey mould)
4. Resistance to insect pest (pod borer, hairy caterpillar)
5. Tolerance to stress environment (cold, heat, drought, saline)
6. Mechanical harvesting.

Breeding objectives of safflower. 2 marks

1. High seed yield of oil contents with better quality
2. Wide adaptability
3. Development of early and non-spiny varieties
4. Tolerance / Resistance to Diseases & Pest

5.Tolerance to abiotic stresses:
6. Development of appraisal type genotypes (to accommodate more plant population)
7. Development of stable GMS lines

Que 3. Define stability. Enlist different models of stability and explain Eberrhart and Russell model. 4

Ans : **Stability :** Consistency in performance of variety over varying environment.

(1 marks)

Models of stability: (Minimum 4 models) **(1 marks)**

1.Finlay and Wilkinson [1963] 2.Eberhart and Russell [1966]

3.Perkins and Jinks [1968] 4.Freeman and Perkins [1971]

5.Model of Tai [1971] 6.Model of Wrick and Webeber [1980]

Eberrhart and Russell model: **(2 marks)**

It is the most popular and useful model.

In 1966 both made further improvement in stability analysis by partitioning the G.E interaction of each variety into 2 parts. one is slope of the regression line , second is deviation from regression line.

In this model total variance is first divided into 2 components: genotypes & environment plus interaction (E+G*E)

The second component is further divided in to 3 components.

I. Environment linear ii. G.E linear iii. Pooled deviations

Sum of squares due to pooled deviations are further divided into sum of squares due to individual genotype.

MAIN FEATURES OF THIS MODEL

ü This model consists of three parameters

a) mean yield over locations b. regression coefficient =bi c. Deviation from regression =s^2di

Analysis of stability parameters is simple as compared to other models of stability analysis.

i. The degree of freedom for environment is 1.

ii. It requires less area hence less expensive when compared to other models.

iii. It does not provide independent estimation for mean performance and environmental index

Que 4. Write about Mango crop on following points. 4

a) i)Origin b) ii) Breeding objectives c) iii) Wild relatives

d) iv) Constrains in hybridization

Ans : **(1 marks each point)**

i. Origin : Hindustan (Indo Burma)

ii. Wild species : *Mangifera sylvatica, Mangifera cassia, Mangifera odorata, Mangifera foetida*

iii. Breeding objectives:

1.To induce regular bearing habit in alternate bearing habit varieties
2.Good fruit quality (High pulp : stone ratio, Fibreless flesh)
3. Dwarf tree
4. Attractive colour after ripening
5. Medium size (5 in a kg)

6. High keeping quality
7. Introduction to polyembryony.
8. Lessening of premature fruit drop
9. Varieties suitable for export market

iv. Constraints in hybridization:

1. High fruit drop: In early stages many young fruit drop after pollination & fertilization.
2. Only one seedling can be obtained from one fruit (Monoembryonic)
3. The heterozygous nature and cross fertilization makes it difficult to predict qualities of the hybrid.
4. Complex nature of panicle and flower and excessive fruit drop.
5. Large area of land is required for hybrid seedling
6. Long juvenile phase : Mango hybrids usually take 4-5 years to come to bearing and stability in yield could be assessed only after 10-15 years.

Que 5. **Define ideotype. Describe the features of Wheat ideotype** 4

Ideotype : It is a biological model ,which is expected to perform or behave in a predictable manner within a defined environment **(1 marks)**

Feature of wheat ideotype: (3 marks)

1. **Short strong stem :** It imparts lodging resistance and reduces the losses due to lodging
2. **Erect leaves:** Which provides better arrangement for proper light distribution resulting in high photosynthesis or CO_2 fixation.
3. **Few small leaves:** Leaves are the important site of photosynthesis ,respiration and transpiration. Few and small leaves reduces water loss due to transpiration.
4. **Larger ear:** It will produce more grains per ear.
5. **An erect ear :** It will get light from all sides resulting in proper grain development
6. **Presence of awns:** Awns contribute towards photosynthesis
7. **A single culm :** In tillering genotypes ,at least some of the tillers do not produce ears and this represents the waste of resources and additional useless competition. this problem will not be encountered in uniculm genotypes.

Que 6. **Describe the hybrid seed production technology of rabi sorghum by using CGMS on following points** 4

i) Sowing time ii) Planting ratio iii) Isolation distance iv) Field inspection

Ans: 1. **(1 marks for each point)**

1.	Sowing time and seed rate kg/ha	:	15 September to 30 October Female (A line) 8 kg/ha , Male (R line) 4 kg/ha
2.	Planting ratio	:	4 rows of female : 2 rows of male With 4 border rows of male parent around seed plot
3.	Isolation distance	:	Certified 200 m (400 m from Johnson grass and forage sorghum)
4	Field inspection	:	Four (1 – before flowering, 2- During

flowering and 1- during harvesting

Que 7. Give the botanical name and centre of origin following crops 4

a) i) Maize b) ii) Barley c) iii) Pearl millet d) iv) Potato

(1 marks for each crop)

Crop	Botanical name	Centre of origin
Maize	*Zea mays*	Mexico / Central America
Barley	*Hordeum vulgare*	Egypt
Pearl millet	*Pennisetum glaucum*	India/ W. Africa
Potato	*Solanum tuberosum*	Central America

Que 8. Define gene pool. Describe the classification of gene pool. 4

Gene pool.: Gene pool consists of all the genes and their alleles present in all such individuals, which can hybridize with each other. **(1 mark)**

Classification of gene pool of crop: (3 marks)
The gene pool is classified into following three groups-

1. **Primary gene pool (GP1):** It includes strains and species which hybridize easily with each other and gives fertile hybrids. It includes plants of the same species or of closely related species which produce completely fertile offspring on intermating. In such gene pool, genes can be exchanged between lines simply by making normal crosses. This is the material of prime breeding importance. Members of GP1 are most commonly used in breeding programs.

2. **Secondary gene pool (GP2):** The genetic material that leads to partial fertility on crossing with GP1 is referred to as secondary gene pool. It includes plants that belong to related species. Members of GP2 hybridize with members of GP1 with considerable difficulty and produced partially fertile hybrids. Members of GP2 are often used in breeding programs. Transfer of gene from such material to primary gene pool is possible but difficult.

3. **Tertiary gene pool (GP3):** The genetic material which leads to production of sterile hybrids on crossing with primary gene pool is termed as tertiary gene pool. Members of GP3 cross with members of GP1 with great difficulty and produced hybrids are invariably sterile. GP3 is occasionally used in breeding programs. Transfer of genes from such material to primary gene pool is possible with the help of special techniques.

Que 9. Write information of Sugarcane on following points **4**

a) अ Breeding objectives b) ii) Floral biology

Breeding objectives of sugarcane: (2 Marks)

1. High cane yield/height of stem, thickness, tillering capacity and weight of individual cane.
2. Moderate high sucrose content
3. Early to full season maturity.
4. Resistance to diseases (Red rot, Smut, Wilt, Mosaic), Ratoon – Stunting diseases ,Grassy shoot
5. Resistance /tolerance to insect pest(Stem borer, Cane borer, Pyrilla, Mealy bugs, Whitefly, Termites ,white grub.)
6. Tolerance to abiotic stress (Drought, Salinity, Flooding, High temp)
7. Wider adaptability.

Floral Biology : (2 Marks)

- Photoperiod is an important factor for flowering sugarcane. It flowers all the year round at equator, where day length is constant for 12 hours. Warm nights, humid conditions and high rainfall favours flowering, while cool weather and high altitude where the day length varies affecting the flowering.
- The inflorescence is a panicle called arrow, contains many flowers (about 10,000 to 50,000 individual spikelets)
- The flowers are in pair, one sessile (without petiole) and one pedicellate (with petiole). The sessile spikelet flowers before the pedicellate spikelet.
- The stamens are three and stigma is feathery and bifurcated.
- The flowers open in the morning between 5 and 6 a.m. About 7 to 14 days are required for an arrow to complete the flowering
- The flowers show a wide range of fertility, ranging from male sterility to high pollen fertility. Generally, the flowers are protogyny in nature.
- Flower opening will be from top to downwards.
- The seeds produced are extremely small in size, often poorly developed and invisible.

Que 10. Write short notes on (Any Two)

(i) Evolution of hexaploid wheat
(ii) Genetically Modified (GM) Mustard hybrid in India
(iii) Floral biology of Sunflower

Ans: (i) Evolution of hexaploid wheat :

Unknown spp. (♀) (n=7, BB) X *Triticum Monococum var. Urartu* (♂) (n=7, AA)

↓

F_1 Hybrid — AB

Spontaneous chromosome doubling ↓

AABB (♀) (n=14) Tetraploid wheat X *AE. Tauschii* (n=7, DD) (♂)

↓

F_1 Hybrid — ABD (Triploid, 2n=3x=21, sterile)

↓ Spontaneous chromosome doubling

AABBDD (n=21) Hexaploid bread wheat (*Triticum aestivum*) (2n=6x=42, Fertile) — Amphidiploid

ii. Genetically Modified (GM) Mustard hybrid in India:

- The Genetic Engineering Appraisal Committee (GEAC) of Government of India has approved the environmental release of Genetically Modified (GM) Mustard hybrid DMH-11 and its parental lines on 18th October, 2022 for its seed production and testing as per existing ICAR guidelines and conditions imposed by the GEAC.
- **Dhara Mustard Hybrid-11**, otherwise known as DMH-11, is a genetically modified hybrid variety of the mustard species *Brassica juncea*.
- It was developed by **Professor Deepak Pental** from the University of Delhi, with the aim of reducing India's demand for edible oil imports.
- DMH-11 was created through transgenic technology, primarily involving

the **Bar, Barnase and Barstar gene system**. It is a genetically modified variant of Herbicide Tolerant (HT) mustard.

- DMH-11 is a result of a cross between Indian mustard variety **'Varuna'** and East European **'Early Heera-2'** mustard.
- It contains two alien genes (**'barnase'** and **'barstar'**) isolated from a soil bacterium called *Bacillus amyloliquefaciens* that enable breeding of high-yielding commercial mustard hybrids.
- **Barnase** in **Varuna** induces a temporary **sterility** because of which it can't naturally self-pollinate. **Barstar** in **Heera** blocks the effect of barnase allowing seeds to be produced.
- DMH-11 has shown approximately 28% more yield than the national check and 37 % more than the zonal checks and its use has been claimed and approved by the GEAC.
- **"Bar gene"** maintains the genetic purity of hybrid seed. The insertion of the third gene Bar, enables DMH - 11 to produce phosphinothricin-N-acetyl-transferase, the enzyme responsible for **Glufosinate resistance**.

iii. Floral biology of sunflower :

B.N. : *Helianthus annus*

Family : Composite

Flower: Heterogamous head or Capitulum, Peripheral ray florets are ligulate and central disc florets are tubular. Involucre of bracts are also present.

Ray floret : Br. sessile, incomplete, zygomorphic, Unisexual, pistilate, epigynous, cyclic

Calyx : Sepals 2, reduced to pappus Corolla: : Petal 5, gamopetalous

Androecium: Absent

Gynoecium : Bicarpellary, Syncarpous, Overy inferior, basal placentation, short style , stigma bifid.

Disc floret : Br. sessile, complete, Actinomorphic, Bisexual, epigynous, cyclic

Calyx : Sepals 2, reduced to pappus

Corolla: : Petal 5, gamopetalous, tubular

Androecium: stamen 5, epipetalous,Syngenesious, Anthers fused to form a tube around the style.

Gynoecium : Bicarpellary, Syncarpous, Overy inferior, basal placentation, short style , stigma bifid.

SECTION (B)

Que. 11 **Do as directed.** 4

i. Define Multiline variety.

Multiline is a mixture of pure lines which are phenotypically similar but genotypically dissimilar.

ii. Spell out NBPGR.- National Bureau of Plant Genetic Resource

iii. Give the name and location of National Research Institute of Maize.-

ICAR-Indian Institute of Maize Research, Ludhiana

iv. Give term for arrangement of stamens in field pea .- Diadelphous.

Que. 12 **Fill in the blanks** 4

i. **Tropical America** is the origin of guava.

ii. Chromosome number of Oat is **2n=42**

iii. Botanical name of Berseem is ***Trifolium alexandrium*** .

iv. In Maize Modified Ear to Row method was proposed by **Lonquist.**

Signature:
Name of Course Instructor- Dr. J. M. Patil
Designation: Assistant Professor of Botany,
College of Agriculture, Dhule
Mob: 94033 74707
E-mail:jmpatilmpkv@gmail.com

Signature:
Name of Head/In-charge:- Dr. V.S. Girase
Designation: *I/c* Professor of Botany,
College of Agriculture, Dhule
Mob: 97676 50817
E-mail: vikramgirase@gmail.com