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

Semester:	VI (New)	Term: II	Academic Year: 2021-22
Course No.	GPB-366	Title:	Crop Improvement-II (Rabi Crops)
Credit:	2 (1+1)		
Day & Date		Time	Total marks: 40

Note:
Solve **ANY EIGHT** questions from **SECTION 'A'**
All questions from **SECTION 'B'** are compulsory.
All questions carry equal marks.
Draw a neat diagram whenever necessary.

SECTION "A"

Q.1. **Define ideotype breeding and describe in short the important features of ideotype for wheat and maize crop.**

Ans. (Definition 1 mark, Description 3 mark: Wheat 1.5 and Maize 1.5)

Ideotype breeding can be defined as a method of crop improvement which is used to enhance genetic yield potential through genetic manipulation of individual plant character.

Wheat:

1. Short strong stem: It imparts lodging resistance and reduces the losses due to lodging.
2. Erect leaves: which provide better arrangement for proper light distributionresulting in high photosynthesis or CO2 fixation.
3. Few small leaves: Leaves are the important sites of photosynthesis, respiration and transpiration. Few and small leaves reduce 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

Maize:

1. Stiff-vertically-oriented leaves above the ear.
2. Maximum photosynthetic efficiency.
3. Efficient translocation of photysynthates into grain.
4. Short interval between pollen shed and silk emergence.
5. Small tassel size.
6. Photoperiod insensitivity
7. Cold tolerance
8. Long grain -filling period

Q.2 **Define germplasm. Describe in short different kinds of germplasm**

Ans. (Definition 1 mark, Kinds of germplasm 3 mark)

Definition: Germplasm may be defined as the sum total of hereditary material i.e., all the alleles ofvarious genes present in a crop species and its wild relatives.

Kinds of Germplasm:

The germplasm consists of various plant materials of a crop such as land races, advanced (homozygous lines), breeding materials, obsolete cultivars, wild forms ofcultivated species , modern cultivars, wild relatives and mutants.

The details of germplasm is as below :

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. Land races were not deliberately bred like modern cultivars. They evolved under subsistence agriculture. Land races have high level of genetic diversity which provides them high degree of resistance to biotic and abiotic stresses. Land races have broad genetic base which again provides them wider adoptability. The main drawbacks of land races are that they are less uniform and low yielders. Land races were first collected and studied by N.I. Vavilor in rice.

2. Obsolete Cultivars:

These are the varieties developed by systematic breeding effort which were popular earlier and now have been replaced by new varieties. Improved varieties of recent past are known as obsolete cultivars. Obsolete varieties have several desirable characters they constitute an important part of gene pool. Example : Wheat varieties K65, K68, pb 591 were most popular traditional tall varieties before introduction of high yielding dwarf Mexican wheat varieties. Now these varieties are no more cultivated. They are good genetic resources and have been widely used in wheat breeding programmes for improvement of grain quality. Now such old varieties are found in the genepool only.

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. These varieties have high yield potential and uniformity as compared to obsolete varieties land races.They constitute a major part of working collections and are extensively used as parents in the breeding programmes. As these are good sources of genes for yield and quality, can be introduced in a new area and directly released. However, these have narrow genetic base and low adoptability as compared to land races

4. Advanced breeding lines:

These are pre -released plants which have been developed by plant breeders in modern scientific breeding programmes. These are known as advanced lines, cultures and stocks.This group includes, nearly homozygous lines, lines derived from biotechnology programmes i.e. transgenic plants and mutant lines etc. These lines which are not yet ready for release to farmers. They often contain valuable gene combinations.

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. They can easily cross with cultivated species. Wild forms of many crop species are extinct.

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. Both these groups are sources of valuable genes for biotic and abiotic stress and for quality traits and yield.

7. Mutants:

Mutation breeding is used when the desired character is not found in the genetic stocks of cultivated species and their wild relatives. Mutations do occur in nature as well as can be induced through the use of physical and chemical mutagens. The extra variability which is created through induced mutations constitutes important components of genepool. Mutant for various characters sometimes

may not be released as a variety, but they are added in the genepool. The germplasm includes those carrying gene mutations, chromosomal aberrations and marker genes etc. are considered special genetic stocks. They are useful in breeding programmes.

Q.3 **Write short notes on the following**
a) Adaptability
b) Breeding objectives of sugarcane

Ans. **(Adaptability : 2 Marks, Breeding objectives of sugarcane:2 marks)**

a) Adaptability.

Definition: Ability to genotype to exhibit relatively stable performance in different environment or capacity of a genotype or population for genetic change in adaptation

Types:

1. **Specific genotype adaptation:** It is the close adaptation of genotype to a limited environment.
2. **General genotypic adaptation:** It is refers to the capacity of a genotype to produce a wide range of phenotypes compatible with a wide range of environmental conditions.
3. **Specific Population adaptation:** It refers to the capacity of heterogeneous population toadapt to specific environment.
4. **General population adaptation :** It is the capacity of heterogeneous population to adapt the variety of environment.

Factor affecting adaptability:

1. **Heterogeneity:** The heterogeneous population have broad genetic base, such population have greater capacity to stabilize production over a wide range of changing environment.
2. **Heterozygosity:** It has been observed that heterozygous individuals such as F_1 hybrids are more stable than their homozygous parents to environmental variation.
3. **Genetic polymorphism:** The regular occurrence of several phenotypes in a genetic population is known as genetic polymorphism..
4. **Mode of Pollination:** The cross pollination species have better buffering capacity that self pollination species because of more heterozygosity.

b) Breeding objectives of sugarcane (Short description on following point)

1. High cane yield.
2. Moderate high sucrose content
3. Early to full season maturity
4. Resistance to diseases.
5. Resistance / tolerance to insect pests
6. Tolerance to Abiotic stresses
7. Wider adaptability.

Q.4 **Mention centre of origin and wild relatives of wheat and barley. Enlist breeding methods and breeding objectives for both crops.**

(Marks: Wheat 2 and Barley 2 for four each point)

Ans. **Wheat:**

Centre of origin: South Asia

Wild species: *T. timopheevii T. dicoccoides Aegilops speltoides, A. squarrosa.*

Breeding methods:

i. Introduction
ii. Multiline and pureline selection
iii. Pedigree, backcross and bulk selection
iv. Hybridization
v. Mutation breeding

vi. Single seed decent method

Breeding objectives:

i) High grain yield.
ii) Early maturity with short duration.
iii) Photo and thermo-insensitive varieties.
iv) Resistant to diseases like rust, loose smut, leaf blight etc. and pests like aphids, armyworms and gujia weevil etc.
v) Responsive to high doses of fertilizers.
vi) Semi-dwarf varieties having synchronies productive tillers.
vii) Resistant to water logging and shattering.
viii) Good milling and baking quality i.e. suitable for chapatti and bread making.
ix) Amber grain colour and grain with high protein and lysine content.
x) Salt and drought tolerant varieties.

Barley:

Centre of origin: Fertile Crescent : Egypt

Wild species: *Hordeum spontaneum, Hordeum depressum , Hordeum intercedens, Hordeum bulbosum.*

Breeding methods:

i. Introduction
ii. Pureline selection
iii. Pedigree and bulk selection
iv. Hybridization
v. Double haploid breeding
vi. Recurrent selection
vii. Single seed decent method

Breeding objectives:

i) Yield improvement.
ii) Increased adaptability.
iii) Resistance to diseases and pests.
iv) Improvement in nutritional quality.
v) Improvement in attributes related to malt industries.
vi) Breeding for drough resistance, wider adaptability, shattering and lodging resistance,

Q.5 **Write information on gram crop on following points**

a) Wild species b) Floral biology

c) Breeding objectives d) Breeding methods used

Ans. **(1 mark for each point)**

a) Wild species

The wild species of *Cicer* closely related to chickpea are :

i) C. bijugum
ii) C. echinospermum
iii) C. ecticulatum

b) Floral biology

1. The flowers are papilionaceous.
2. They are solitary in axillary racemes.
3. Double flowers are rare, but are very much sought after by the breeders as possible sources of yield increase.
4. The calyx has five deep lancelolate teeth. Peduncle and calyx are hairy.
5. The vexillum is obovate, 8-11 mm long and 7-10 mm wide.

6. Wings are obovate, 8-9 mm long. The keel is 6-8 mm long.
7. Number of pods/plant is highly variable, generally between 30 and 150 depending on the year, location, sowing time and other factors.

Breeding objectives

c) (i) Increased seed yield.
(ii) Increased biomass, tall, erect and compact cultivars
(iii) Resistance to diseases: *Ascochyta* blight. *Fusarium* wilt, Root rot, Botrytis grey mould
(iv) Resistance to insect pests: Pod borer
(v) Tolerance to stress environments: cold, drought and heat
(vi) Genotypes suitable for Mechanical harvesting.

d) **Breeding methods**
i. Selection
ii. Mutation breeding
iii. Pureline selection
iv. Hybridization

Q.6 **Write about Sunflower crop on following points.**
a) Wild species **b) Floral biology**
c) Breeding objectives **d) Breeding methods**

Ans **(1mark for each point)**

a) **Wild species :**
Helianthus hirsutus, Helianthus rigidus
The genus *Helianthus* comprises of 67 species. Two species *H. annus* and H. *tuberosus* are cultivated as food plants genus has basic chromosome number of 17 and diploid, tetraploid and hexaploid species are found.

b) **Floral biology:**
- The inflorescence is a capitulum or head, characteristic of composite family.
- The number of flowers in oilseed cultivars may vary from 700 to 3000.
- The flower of the outer whorl of the head are called as ray florets.
- They have five elongated petals which are united to form strap like structures.
- They have vestigeal styles and stigmas and no anthers.
- The other flowers arranged in concentric rings over the remainder of the head are called as disc flowers.
- Five anthers are united to form a tube with separate filament attached to the base of thecorolla tube.
- Inside the anther tube, there is the style, terminating in a stigma which is divided.
- The receptive surfaces of stigma remain in close contact in bud stage.
- The achene or the fruit of the sunflower consists of a seed often called the kernel.
- The adhering pericarp is usually called the hull.
- The seed consists of seed coat, endosperm and embryo.
- Major part of embryo is in the form of cotyledons.

c) **Breeding objectives**
i) High seed yield
ii) Early maturity
iii) Lodging resistant dwarf plant type
iv) Uniformity of plant type
v) High oil percentage

vi) Tolerance to stress conditions
vii) Resistance to bird damage
viii) Resistance to diseases

d) **Breeding Methods**

1. Mass selection:
Ec 68414 from Russia. Co1 mass selection from Morden. Useful for characters which are highly heritable. E.g. Plant height, disease resistance.
2. Hybridization and selection
a) Intervarietal
3. Mutation
Co_3 (Mutant from Co_2 thro' gamma rays)
4. Head to row and remnant seed method
Developed by Pustovoit in Russia.
5. Population improvement
By mass selection, recurrent selection and use of male sterile lines population can be improved and utilized for breeding.
6. Heterosis breeding

Q.7 **Write about Mango crop on following points.**
a) Origin b) wild species c) Breeding objectives
c) Constraints in hybridization.

Ans. **(1 mark for each point)**

a) **Origin** - IndoBurma

b) **Wild relatives –**
M. laurina, M. gedebe, M. grifith, M. pentandra, M.minor, M.odorata, M.foetida,M.zeylanica, M.pajang

c) **Breeding objectives:**
- Dwarfness
- Profuse and regular bearing
- Attractive, good sized and quality fruits
- Absence of physiological disorders
- Disease and pest resistance and improved shelf life
- High productivity

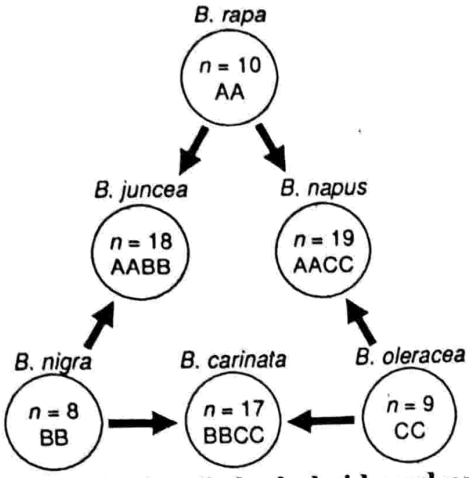
d) **The constraints encountered in mango hybridization are:**
1. High fruit drop: In early stages, many young fruits drop after pollination and fertilization.
2. Only one seedling can be obtained from one fruit (since the varieties are monoembryonic).
3. The heterozygous nature and cross fertilization makes it difficult to predict the qualities of the hybrids.
4. Complex nature of panicle and flower and excessive fruit drop.
5. Large area of land is required for hybrid seedlings
6. Polyembryony - Difficulty in accurately identifying the zygotic seedling: polyembryonic varieties in Israel show that weight of zygotic seedling is higher than the nucellar seedling. Use of polymorphic enzyme systems (isozyme) has been used to identify zygotic seedling since the nucellar seedlings have the same isozyme alleles as in the maternal parent.

Q.8 **Describe evolution of different species of Brassica.**

Ans. **(4 marks for dicription alongwith U triangle diagram or table)**

There are three basic species of *Brassica* from which three different tetraploid

species have originated . The tetraploid species have originated through interspecific hybridization between diploid species and chromosome doubling of the F_1 in nature . Brassica Juncea is natural amphidiploid between *B. campestris* and *B. Nigra*. *B. napus* is amphidiploid between *B. oleracea and B. Campestris* and *B. carinata* is amphidiploid between *B. nigra* and *B. oleracea*. The origin of different tetraploid species from three diploid basic species can be represented by triangle of U.



Q.9 **Write in detail the hybrid seed production technology of castor on following points.**

Ans. **(1 marks to each point)**

a.	**Isolation distance**	Foundation seed: 600 m and Certified seed: 300 m
b.	**Seed rate**	10 kg / ha (varieties) 2 kg / ha male and 5 kg/ ha female for hybrids.
c.	**Spacing**	Varieties : 90 x 20 to 90 x 60 cm Hybrids : 90 x 40 to 90 x 60 cm
d.	**Stages of inspection**	10 days prior to flowering -Stem colour, inter-node length. During flowering - Number of nodes upto primary raceme Before 1st picking (Spike and capsule character, reversion to monoecious in second order raceme)) After 1st picking - Reversion to monoecious or flower initiation in third order raceme.

Q.10 **Write major breeding objectives in Guava and field pea.**

Ans. **(2 marks to each crop objectives with description)**

Breeding objectives of Guava

1. Development of seedless variety
2. Less pectin content for edible purpose
3. More pectin content for processing
4. Uniform ripening
5. High keeping quality
6. Resistance to tea mosquito bug and wilt.

Breeding objective of Field pea

1. Early maturity
2. Pod characteristics
3. Seed size
4. Shelling percentage
5. Pod yields

6. Suitability for processing
7. Resistance to disease
8. Resistance to insect
9. Resistance to abiotic stress

SECTION "B"

Q.11 **Do as directed**

1. Write chromosome number of safflower **(2n=24)**
2. Write scientific name of Aonla ***(Phyllanthus emblica)***
3. Write centre of origin of Maize **(Maxico)**
4. Write family of Rapeseed **(Brassicacea)**

Q.12 **Fill in the blanks**

1. ***Hordeum spontaneum*** wild species is considered as progenitor of **Hordeum vulgare.**
2. ***Linum usitatissimum*** -is only cultivated species in family Linaceae
3. Oat spikelet contain **3** number of anthers
4. **Berseem** crop is known as King of fodder

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