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The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	: Botany
Level	: Level 5
Name of the Examination	: Final Examination
Course Title and - Code	: Plant Breeding (BYU5306/BYE5306)
Academic Year	: 2024/2025
Date	: 29.05.2025
Time	: 1.30 – 3.30 pm
Duration	: 02 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **06** questions in **04** pages.
3. Answer any **04** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary
6. Involvement in any activity that is considered as an exam offense will lead to punishment.
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script.

1.

(A) Gene frequency, also known as allele frequency, refers to the proportion of a specific allele at a particular gene locus in a population.

i) What are the factors which affect the change in gene frequencies? Explain briefly.

ii) The following data refers to the frequency of *a* allele, controlling bacterial resistance in tea clones.

Frequency of allele *a* in Low-country tea clones in Sri Lanka – 0.60
Frequency of allele *a* in Mid-country tea clones in Sri Lanka – 0.43
Frequency of allele *a* in Up-country tea clones in Sri Lanka – 0.01

Calculate the total proportion (*m*) alleles that have entered the Mid-country tea clone population in Sri Lanka.

(B) Mutations are the original source of genetic variation.

i) There are two types of mutations. What are they? Briefly explain.

ii) At a particular locus which controls the Pod length, there are two alleles, *L* and *l*. The mutation rate of *L* to *l* is 3.2×10^{-5}, whereas the mutation rate of *l* to *L* is 6.4×10^{-7}. Allele frequency (*p*) of *L* is 0.6.

Assumption: No other factor is operating in the population to disturb the equilibrium.

What is the equilibrium frequency of *l* allele?

2. A breeding program is set up to improve certain characteristics in a crop.

a) There are certain strategic perspectives to be considered when planning a breeding programme. What are they?

b) There are five major factors affecting the selection methods in a breeding programme. What are they? Briefly Explain.

c) What is Hybrid Vigour? Briefly explain.

d) Explain briefly how Hybrid Vigour is utilized in a breeding programme.

3. Average effect (α), Breeding value (A) and Dominance deviation (D) are important components of population genetics.

a) Briefly explain, the Average effect (α), Breeding value (A) and Dominance deviation (D).

b) The wing length (*l*) in *Drosophila* is a quantitative trait.
The wing length of three genotypes in *Drosophila* at 4 weeks of age are as follows:

	Genotypes		
	++	+*l*	*ll*
Wing length in mm	12	10	7

Find out the average effects of the genes. (Assume allele frequency (q) of *l* is 0.4).

c) Gene frequencies of three genotypes in three sample populations, x, y and z are as follows.
What are the Breeding Values (A) of these genotypes in the population?
(**Hint**: take the average)
(Gene frequency of allele A (p) is 0.4).

Genotype	**Frequencies**		
	Population x	**Population y**	**Population z**
AA	0.02	0.17	0.50
AB	0.22	0.44	0.23
BB	0.43	0.10	0.07

4.

a) Several factors determine the reproductive behavior of plants.

i) What are the factors that determine whether a plant is predominantly self-pollinated or predominantly cross-pollinated?

ii) Give a brief account of each factor.

b) Differentiate between inbreeding and outbreeding, explaining the consequences of each.

c) What is self-incompatibility?

d) Briefly explain the terms 'Gametophytic self-incompatibility' and 'Sporophytic self-incompatibility'.

5. The choice of breeding methods for a crop depends on its mode of reproduction and flower morphology, as these are critical factors.

a) Based on these characteristics, plant breeders categorize crops into four fundamental population types. What are they? Briefly explain.

b) Selection and Hybridization are the two main approaches of breeding self-pollinated crops.

i) Briefly explain the Selection procedure used for self-pollinated crops.
ii) Give a comparison between Mass Selection and Pure Line Selection procedure.
iii) Briefly explain the Hybridization procedure practiced in self-pollinated crops.
iv) Several methods are used in Hybridization of self-pollinated crops. What are they?

c) Selection and Hybridization are also used in breeding cross-pollinated crops.

i) Give an account of the genetic structure of cross-pollinated crops.
ii) Several types of Selection methods are practiced for cross pollinated crops. What are they?
iii) Hybridization in cross-pollinated crops aims to identify heterotic crosses, typically involving the crossing of two or more inbreds. There are four main types of crosses. What are they?

6.

(A)

a) What are the uses of tissue culture techniques in plant breeding?

b) Embryo rescue is one of the applications of tissue culture in plant breeding. Explain what embryo rescue is, and describe its use/s.

c) Somoclonal variations are often found among plants which have been propagated through tissue culture.

i) What is somoclonal variation?
ii) Explain how somaclonal variation can be utilized for crop improvement.

(B)

a) Explain briefly what is understood by Genetic Engineering of plants.

b) Describe how herbicide resistant plants are developed using biotechnology.