



# MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF AGRICULTURE, ENVIRONMENT AND HEALTH SCIENCES

DEPARTMENT OF AGRICULTURAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (AGRICULTURAL EDUCATION AND EXTENSION)

**AGR 305: PLANT BREEDING**

**DATE:**

**TIME:**

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**INSTRUCTION:** Answer Question One (Compulsory) and Any Other Two Questions.

**QUESTION ONE (COMPULSORY)(30 MARKS)**

- a) Explain two shortcomings that may result when improving the adaptability of pigeon peas variety for drought tolerance (2 marks)
- b) Distinguish between the following terms used in plant breeding (6 marks)
- i) Orthodox and recalcitrant seeds
  - ii) General combining ability (GCA) and specific combining ability (SCA)
  - iii) B line and R line
- c) With the aid of an illustration in each case, explain the implication of the following Mendel's principles in plant breeding programmes.
- i) Principle of segregation (3 marks)
  - ii) Principle of independent assortment (3 marks)
- d) Explain three factors that determine genetic gain in breeding for abiotic stresses in beans (3 marks)
- e) i) With the aid of an equation, describe role of each component of phenotypic variation in rice breeding (4 marks)

- ii) Explain two reasons why heritability is crucial in breeding green grams for disease resistance (2 marks)
- f) Explain two implications of plant breeder's protection rights in developing high-yielding maize varieties for low-land areas (2 marks)
- g) Explain three classical methods used in breeding groundnuts for tolerance to saline conditions (3 marks)
- h) Explain two reasons why breeders are discouraged from utilizing apomixis in developing high-yielding sorghum varieties (2 marks)

**QUESTION TWO (20 MARKS)**

- a) With an example of a disease infection on a specific crop in each case, describe three plant response mechanisms in the prevention of infection (6 marks)
- b) Using a diagram, describe an appropriate method used to develop stem rust resistance in oats controlled by recessive genes. (14 marks)

**QUESTION THREE (20 MARKS)**

- a) Explain four techniques of breeding yam varieties for heat tolerance (12 marks)
- b) With the aid of diagrams, describe two ways of breeding superior lines in maize utilizing self-incompatibility (8 marks)

**QUESTION FOUR (20 MARKS)**

- a) With the aid of a diagram in each case, describe two applications of modern breeding methods that can be employed in breeding superior lines for drought tolerance and high-yielding varieties in beans. (12 marks)
- b) During the development of the varieties in (a) above, explain four ways of developing transgressive segregants (8 marks)

**QUESTION FIVE (20 MARKS)**

- a) Describe the step-by-step process employed by a breeder in developing new sunflower varieties for drought adaptation (8 marks)
- b) Assume you have been employed by CIMMYT, Kenya as a plant breeder, and you are tasked with the improvement of maize production for high yield using cytoplasmic male sterility (CMS). Using an illustration, describe how you would deploy the method.

(16 marks)