

**UNIVERSITY OF KWAZULU-NATAL**  
**SCHOOL OF AGRICULTURAL, EARTH & ENVIRONMENTAL SCIENCES**  
**DISCIPLINE OF PLANT BREEDING**  
**EXAMINATION: JUNE/JULY 2014**  
**AGPS311: BIOTECHNOLOGY IN CROP IMPROVEMENT**

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**DURATION: 3 HOURS**

**TOTAL MARKS: 100**

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**Moderator: Dr J. Sibiya**  
**Internal Examiner: Prof J. Derera**

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**NOTE: THIS PAPER CONSISTS OF THREE PAGES; PLEASE SEE THAT YOU HAVE THEM ALL.**

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*Answer all questions and you can use examples to illustrate your answers.*

**QUESTION 1: CASE STUDY:** Read the newspaper story below and answer questions that follow.

**Zim Imports GMO Maize.**

**HARARE** - Zimbabwe is importing Genetically Modified Organism (GMO) maize from South Africa after its newly- resettled farmers failed to provide enough food to feed its 12 million citizens. Presenting a State of the Economy Report yesterday, Finance minister Tendai Biti said government has allowed imports of GMOs from the neighbouring country despite earlier declarations by President Robert Mugabe that Zimbabweans will not consume GMOs.

Mugabe and Agricultural minister Joseph Made are both on record vowing that Zimbabweans will not be subjected to any genetically modified foodstuffs as this has a long-term consequence on health. But Biti said there was not enough maize for the nation and government has been forced to import GMOs. Biti said this is not the first time that government is allowing GMO foodstuff in the country as it once imported prior to the formation of the inclusive government in 2009.

“The country urgently needs 150 metric tonnes to August 2013 and private millers themselves have the financial capacity to import 150 metric tonnes,” Biti said. “I need to tell Zimbabwe that part of the grain that they are importing is actually GMO grain.” The minister said these GMOs will be milled under tight security conditions under heavy police guard to ensure that the imported maize is not planted for agricultural purposes. “When the grain is imported, it is milled under very secured environment, the police will have to be there to ensure that nobody takes the grain and goes and plant it in a little field in Dotito or Chendambuya. They are already doing so and they are already importing,” Biti said.

(Adapted from Xolisani Ncube, Daily News, 16 April 2013.  
<http://www.dailynews.co.zw/articles/2013/04/16/zim-imports-gmo-maize.>)

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Using the case study above and application of your own knowledge of the subject matter, answer the following questions (total 50 marks).

- 1.1 Do you think the Agriculture Minister and President Mugabe's fear of genetically modified (GMOs) food is valid? Give reasons for your answer. (10)
- 1.2 Do you think it was necessary for the Finance Minister to inform Zimbabweans that the maize they were importing from South Africa was actually GMO? Give reasons for your answer. (2)
- 1.3 Why is Zimbabwe importing maize grain from South Africa? (2)
- 1.4 What precautions has the Finance Minister put in place to allay the fears of GMOs by the Zimbabwean public? Do you think the strategy works? (2)
- 1.5 The writer rather "forgot" to cover the potential benefits that Zimbabwe can realise by growing transgenic crops. As an expert on agricultural biotechnology, what advice can you give to President Mugabe and the Agriculture Minister regarding the benefits of growing genetically engineered crops? (12)
- 1.6 Transgenic crops are widely grown in South Africa and the USA and there are no problems that have been reported. Discuss different strategies that are being used to manage transgenic crops in South Africa and other countries (10).
- 1.7 Describe the two broad classes of selectable markers used for plant transformation (4).
- 1.8 Identify and list any four selectable markers that are used during transformation of crop varieties (4).
- 1.9 Explain the issues which are associated with use of selectable markers in genetic engineering (4).

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**QUESTION 2** (total 20 marks)

Write short notes on each of the following:

- 2.1 Pedigree selection (2)
- 2.2 Recombinant inbred lines (5)
- 2.3 Doubled haploid technology (5)
- 2.4 Marker assisted backcross breeding (5)
- 2.5 The Central Dogma (3)

**QUESTION 3 (Total marks 10)**

- 3.1 Identify three major plant breeding strategies (3).
- 3.2 Discuss the merits and de-merits of marker assisted selection (MAS) over the other two approaches (7)

**QUESTION 4 (Total 20 marks)**

- 4.1 What criteria are used to select suitable DNA markers? (5)
- 4.2 Give an outline of the main features of DNA markers (5)
- 4.3 Discuss why the SNPs and SSRs have become the markers of choice in plant breeding (10)

**END OF EXAM PAPER**

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