UNIVERSITE CHEIKH ANTA DIOP DE DAKAR
□□◆□□
OFFICE DU BACCALAUREAT
Email : office@ucad.edu.sn
Site web : officedubac.sn

1/4

2025TF641NA0128
Durée : 02 heures
Série : F6 – Coef. 02

Épreuve du 1ᵉʳ groupe

A N G L A I S

AI and Genetics to Help Optimize Fertilizer Use

3 The United States is the world's leading producer of corn. This major cash crop requires large amounts of nitrogen to grow, but much of the fertilizer fed to corn is not taken up or used. Corn's low nitrogen use efficiency presents a financial challenge for farmers, given the increasing costs of fertilizer—the majority of which is imported—and also risks harming the soil, water, air, and climate. To address this challenge in corn and other crops, NYU researchers have

6 developed a novel process to improve nitrogen use efficiency that integrates plant genetics with machine learning, a type of artificial intelligence that detects patterns in data—in this case, to associate genes with a trait: nitrogen use efficiency.

9 Using a model-to-crop approach, NYU researchers tracked the evolutionary history of corn genes that are shared with Arabidopsis, a small flowering weed often used as a model organism in plant biology due to the ease of studying it in the lab using the power of molecular genetic approaches.

12 In a previous study, Coruzzi's team identified genes whose responsiveness to nitrogen was conserved between corn and Arabidopsis and validated **their** role in plants. "Traits like nitrogen use efficiency or photosynthesis are never controlled by one single gene. The beauty of the

15 machine learning process is it learns sets of genes that are collectively responsible for a trait, and can also identify the transcription factor or factors that control these sets of genes," said Coruzzi.

The researchers first used RNA sequencing to measure how genes in corn and Arabidopsis

18 respond to nitrogen treatment. Using **these data**, they trained machine-learning models to identify nitrogen-responsive genes conserved across corn and Arabidopsis varieties, as well as the transcription factors that regulate the genes-of-importance to nitrogen use efficiency. For each

21 "NUE Regulon"—the transcription factor and corresponding set of regulated NUE genes—the researchers calculated a collective machine learning score and then ranked the top performers based on how well the combined expression levels could accurately predict how efficiently nitrogen

24 is used in field-grown varieties of corn. This will not only result in a cost savings for farmers, but also reduce the harmful effects of nitrogen pollution of ground waters and nitrous oxide greenhouse gas emissions.

Adapted from https://www.sciencedaily.com/releases/2025/05/250514164325.htm

I. **TEXT COMPREHENSION** *(10 marks)*

A) Read Paragraph 1 and fill in the table with the phrases in the box below. *(02 marks)*

> Corn has low nitrogen use efficiency ✿ The majority of fertilizers is imported ✿ A novel process has been developed ✿ NYU researchers want to improve nitrogen use efficiency ✿ Plant genetics is integrated with machine learning

Science's response to the problem	Objective of the researchers	Method used to solve the problem	Biggest problem with using fertilizers
1.	2.	3.	4.

A N G L A I S   2/4   2025TF641NA0128
Série : F6 – Coef. 02
Épreuve du 1ᵉʳ groupe

B) Arabidopsis is a small plant from the mustard family. Take a look at comments 5-6-7-8-9 about the plant. Then select (✓) the three (3) comments that are confirmed in Paragraph 2.   *(03 marks)*

5. Science has demonstrated that Arabidopsis and corn have genetic similarities. ☐

6. Arabidopsis has become one of the world's most useful weeds for biologists. ☐

7. Biologists frequently use Arabidopsis in genetic experiments to test hypotheses. ☐

8. Arabidopsis is a plant that can be grown easily and doesn't take much lab space. ☐

9. Coruzzi found the same Arabidopsis gene reaction to nitrogen in other plants. ☐

C) Read paragraph 3 and choose (✓) option a), b), or c) to answer questions 10-11-12.   *(03 marks)*

10. Identifying nitrogen-responsive genes conserved across corn and Arabidopsis was done by…
   ☐**a)** the researchers;
   ☐**b)** the transcription factors;
   ☐**c)** machine-learning models.

11. An NUE Regulon (Line 21) is…
   ☐**a)** the transcription factor and corresponding set of regulated NUE genes;
   ☐**b)** a collective machine learning score;
   ☐**c)** the top performing genes.

12. Accurate prediction of how efficiently nitrogen is used in field-grown varieties results in…
   ☐**a)** cost savings for farmers;
   ☐**b)** reduction of the harmful effects of nitrogen pollution;
   ☐**c)** cost savings for farmers and reduction of the harmful effects of nitrogen pollution.

D) Specify WHAT the phrases 'their' and 'these data' refer to in the passages indicated.   *(02 marks)*

13. "their" (Line 13): ☞ _____

14. "these data" (Line 18): ☞ _____

II. <u>LINGUISTIC and COMMUNICATIVE COMPETENCE</u> *(06 marks)*

E) The segments on the paper are all from the same paragraph. Write a letter (a, b, c, d, or e) next to each number (15-16-17-18-19) to indicate the normal order of the segments in the paragraph.   *(02 marks)*

[a]…place in the zygote to develop into a seed. Flowers play a significant role in the fertilization process, as they… ❀ [b]Fertilization can be defined as the fusion of the male gametes (pollen) with the female gametes (ovum) to form a diploid zygote. It is a physicochemical ❀ [c] …fertilization in plants occurs when gametes in haploid conditions fuse to produce a diploid zygote. ❀ [d]…are the reproductive structures of angiosperm (flowering plants). The method of… ❀ [e]…process, which occurs after the pollination of the carpel. The complete series of this process takes…

Adapted from https://www.byjus.com/biology/fertilization-in-plants/

Answer Box				
15.	**16.**	**17.**	**18.**	**19.**

F) Use the phrases in bold in the description to complete labels 19-20-21-22 in the legend. *(02 marks)*
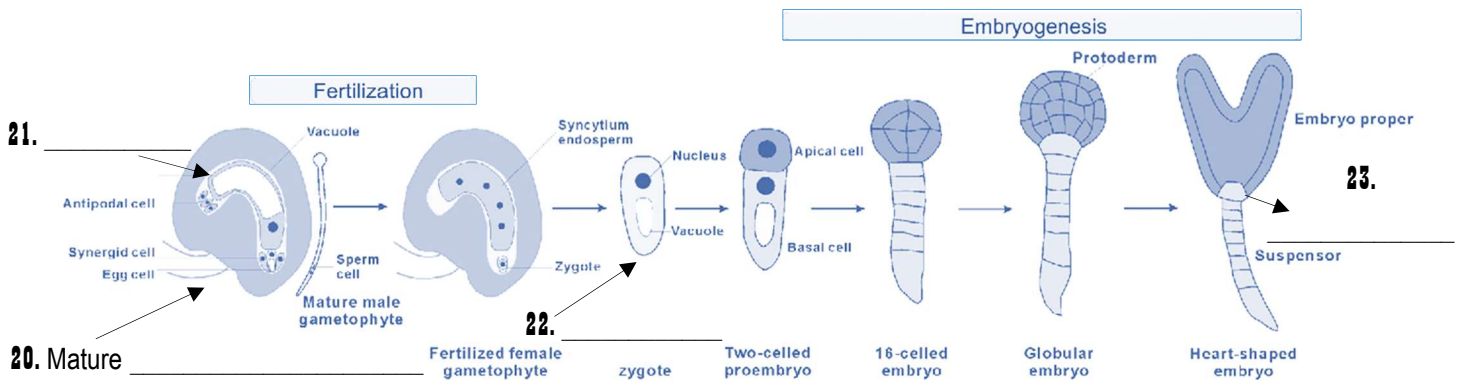
In angiosperms, the early **male gametophyte** germinates and produces a pollen tube that grows through the pistil to deliver a pair of sperm cells to the **female gametophyte**. The female gametophyte usually consists of seven cells: three **antipodal cells**, two **synergid cells**, one **egg cell**, and one **central cell**. During fertilization, one of the sperm cells fuses with the egg cell to produce a diploid zygote, which develops into an embryo, and the other sperm cell fuses with the central cell to produce a triploid primary endosperm cell. During embryogenesis, the **elongated zygote** divides asymmetrically, giving rise to a larger **basal cell** and a smaller **apical cell** with distinct developmental fates. The small apical cell develops into the main body of the **embryo proper**, whereas the larger basal cell continues to expand longitudinally and divides transversely to form a **suspensor**. The uppermost suspensor cell, termed the **hypophysis**, eventually becomes part of the primary root meristem.

Adapted from https://www.researchgate.net/figure/The-process-of-fertilization-and-embryogenesis-in-higher-plants-In-angiosperms-the_fig1_280627457

G) Use appropriate forms of the words in parentheses to complete this paragraph. *(02 marks)*

Nitrogen fertilizers are nitrogen-rich substances, either solid or liquid, widely used in agriculture to stimulate plant growth and favor higher yields. They have become an indispensable tool in the modern farmer's (**24**) _____ *(equipped)*, but their use is not without challenges. While they enable farmers to maximize harvests, their improper usage can lead to environmental hazards like groundwater contamination and greenhouse gas emissions. Indeed, nitrogen fertilizer abuse not only wastes resources but also poses agricultural and (**25**) _____ *(ecology)* risks. Therefore, applying the right balance is fundamental. Nitrogen is a common component of fertilizers because it is essential for all plants to produce energy in their cells. However, there is not enough nitrogen in our soils to fully supply crop demands, particularly when you consider how much food the globe needs to (**26**) _____ *(food)* everyone. In order to supplement that deficit, farmers all around the world rely on nitrogen in fertilizers. There are two types of nitrogen fertilizers: a) organic fertilizers such as manure, compost, blood and feather meal, etc., which are created naturally through fermentation or composting, and b) synthetic or chemical fertilizers that are produced by (**27**) _____ *(transformation)* nitrogen gas into nitrogen-based products such as nitrates or ammonia.

Adapted from https://eos.com/blog/nitrogen-fertilizers/

…/… 4

III. <u>WRITING</u> *(04 marks)*

Choose <u>ONE</u> topic and write between 100 and 150 words about it.

<u>Topic 1</u>: Advocates of science and technology argue that artificial intelligence and genetic research are making agriculture more lucrative and environmentally friendly. On the other side, supporters of traditional and biological farming believe that genetically modified food is dangerous for humans, animals, and the environments. What is your preference? Give examples to support your view.

<u>Topic 2</u>: The CEO of an agribusiness company recently announced in the media that the government has given them permission to occupy 5,000m² in the only land left for people in your village or district to practice sport and organize public events. Today, you are leading a delegation that has decided to meet the local governor and protest against the government's decision. Write your speech to the governor.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____