

一、 選擇題(每題 2.5 分) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

(複選題)Multiple choice answers: pick the correct answers, more than one answer is possible.

1. Which form of phosphorus is taken up by plants?
a. Organic; b. Inorganic; c. Phosphate ions; d. Polyphosphate
2. Which answers best describe phosphorus behavior in soil?
a. Immobile; b. Mobile c. Highly bioavailable; d. Tends to precipitate
3. Which important biomolecules contain phosphate?
a. Proteins; b. Nucleic acids; c. Starch; d. Membrane lipids
4. What are the effects of phosphate deficiency in plants?
a. Accumulation of anthocyanin (plants turn purple); b. Shorter primary root and increased root branching
c. Longer roots; d. Chlorosis (plants turn yellow)
5. Under standard conditions, how is the cytosolic calcium concentration?
a. Low; b. High; c. Higher than in the apoplast; d. Lower than in the apoplast
6. Which of the following amino acids contain sulfur?
a. Tyrosine; b. Methionine; c. Leucine; d. Cysteine
7. Why is Arsenic accumulation a problem for rice?
a. Rice possess Si transporters that can also transport As(III)
b. Rice grows in paddy fields, under anaerobic conditions that enhance As bioavailability
c. Arsenic is toxic, and can enter the food chain through rice
d. Rice is very sensitive to As, and low concentration of As can impair the yield
8. Which of the following metals are essential?
a. Cadmium, Aluminum, Nickel; b. Copper, Zinc, Iron
c. Indium, Gallium, Uranium d. Molybdenum, Manganese, Boron

(單選題)Pick the single correct answer. Only one answer possible.

9. What is the main form of sulfur taken up by plants through their roots?
a. Sulfur dioxide; b. Sulfite; c. Sulfate; d. Glutathione
10. In which organic molecule is sulfur first assimilated?
a. Sulfite; b. Sulfate; c. Adenosine 5'phosphosulfate; d. Cysteine
11. Which strategy is employed by grass plants to take up iron from soil?
a. Transport of free ferrous ions (Fe^{2+} , reduced form)
b. Transport of free ferric ions (Fe^{3+} , oxidized form)
c. Secretion of chelators, called phytosiderophores, and uptake of ferric chelates
d. Secretion of chelators, called phytosiderophores, and uptake of ferrous chelates

見背面

12. What is the main cause of magnesium deficiency in plants?
- Not enough magnesium in the soil
 - High soil pH causing precipitation
 - Competition with other ions, and protons at acidic pH
 - Low bioavailability
13. What is the main cause of iron deficiency?
- Not enough iron in the soil;
 - High soil pH causing precipitation;
 - Too much iron;
 - Anaerobic edaphic conditions
14. A plant that can survive with very high concentration of metals in its tissues is called:
- A halophyte;
 - An hyperaccumulator;
 - A chelator;
 - A calcicole plant
15. What is the main visual symptom of iron deficiency in plants?
- Anemia;
 - Interveinal chlorosis;
 - Accumulation of anthocyanin;
 - Increased plant size

二、閱讀測驗 Reading test: (單選題，每題 2.5 分) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

Phosphorus is an important nutrient for crop productivity. More than 60% of the total phosphorus in cereal crops is finally allocated into the grains and is therefore removed at harvest. This removal accounts for 85% of the phosphorus fertilizers applied to the field each year. However, because humans and non-ruminants such as poultry, swine and fish cannot digest phytate, the major form of phosphorus in the grains, the excreted phosphorus causes eutrophication of waterways. A reduction in phosphorus accumulation in the grain would contribute to sustainable and environmentally friendly agriculture. Here we describe a rice transporter, SULTR-like phosphorus distribution transporter (SPDT), that controls the allocation of phosphorus to the grain. SPDT is expressed in the xylem region of both enlarged- and diffuse-vascular bundles of the nodes, and encodes a plasma- membrane-localized transporter for phosphorus. Knockout of this gene in rice (*Oryza sativa*) altered the distribution of phosphorus, with decreased phosphorus in the grains but increased levels in the leaves. Total phosphorus and phytate in the brown de-husked rice were 20–30% lower in the knockout lines, whereas yield, seed germination and seedling vigour were not affected. These results indicate that SPDT functions in the rice node as a switch to allocate phosphorus preferentially to the grains. This finding provides a potential strategy to reduce the removal of phosphorus from the field and lower the risk of eutrophication of waterways.

From Yamaji et al., 2017, *Nature*, 541:92-95.

16. What happens to the major portion of phosphate fertilizers applied to rice crops?
- Phosphate precipitates and becomes unavailable.
 - Rain provokes the leaching of phosphate into underground water, causing eutrophication.
 - Rice plants take up and store phosphate it in their grains. It is then removed from the field when the grains are harvested.
 - 85% of the phosphate is not taken up by plants and stays trapped in phytates in the soil.
17. What are the properties of the SPDT transporter characterized in this article?
- SPDT is expressed in the roots and it mediates phosphate uptake from the soil.
 - SPDT is expressed in the seeds and controls phosphate storage in the husk.
 - SPDT is expressed in the nodes and control phosphate the whole-plant phosphate distribution.
 - SPDT transports phosphate into leaves, thereby decreasing transport to the seeds.

18. How does SPDT protein performs its function?
- It is a vacuolar transporter that store the phosphorus inside cells.
 - It is a plasma-membrane transporter that load phosphorus into the xylem.
 - It is a plasma membrane transporter that transport the phosphorus out of the xylem.
 - It is a plasma membrane transporter that mediates phosphorus uptake into leaf cells.
19. Phosphorus is an important nutrient. Why is it not better to have more in the rice grains?
- Too much phosphorus will become toxic for animals and humans who eat the grains.
 - Phosphorus is stored as phytate in rice grains, and phytate is not bioavailable to humans and animals.
 - Animals do not need phosphorus, only plants do.
 - More phosphorus in the grains means that less fertilizers are used.
20. Which application of SPDT do the authors suggest?
- Silencing SPDT would lead to an improvement of phosphate utilization efficiency, thereby decreasing the use of fertilizers.
 - Overexpressing SPDT would lead to an improvement of phosphate utilization efficiency, thereby decreasing the use of fertilizers.
 - Silencing SPDT would decrease the production of phytate which is harmful to humans, poultry and swine.
 - Silencing SPDT would increase the production of phytate which is beneficial to humans, poultry and swine.

三、問答題

21. Explain cotransport system (secondary active transport) in plants. (10 分)
22. What are driving forces for long distance transport in xylem and phloem? (10 分)
23. What are the substrates, enzymes, primary products during carbon assimilation in C3 and C4 plants? (10 分)
24. Explain the differences of EC, ESP, pH of Saline soil and Alkaline soils. (10 分)
25. What are potassium deficiency symptoms in plants? Why potassium is important for plants? (10 分)

試題隨卷繳回