

1. 請寫出下列酵素在植物體內參與的反應(包含基質與產物)。(10分)
  - A. Glutamine oxoglutarate aminotransferase
  - B. Nitrite reductase
  - C. Aminocyclopropane-1-carboxylic acid synthase
  - D. Phytase
  - E. Invertase
2. 近期由於食安問題所引起討論之植物殘留藥劑 Agent Orange (橙劑，也稱落葉劑)，請說明 Agent Orange 主要的成分與其在雙子葉植物葉片中作用機制為何?(10分)
3. 請設計實驗及預期結果說明如何區別作物需要的大量及微量必須元素? 如何判斷元素之移動性?請以 Co、Cu、Fe、K、Mg 為例。(10分)
4. 小麥穀粒中主要儲存營養成分包括澱粉、蛋白質與脂質，請問這些成分主要儲存於種子之何種組織?此外在發芽過程中如何轉換為能量?(10分)
5. 種子發育過程中的主要三個時期為何? Auxin, cytokinin, gibberellin 及 abscisic acid 含量變化及生理作用為何?(10分)
6. (a) 請將下列短文翻譯成中文(10分)

Sustainably feeding the world's growing population in future is a great challenge and can be achieved only by increasing yield per unit land surface. Efficiency of light interception and biomass partitioning into harvestable parts (harvest index) has been improved substantially via plant breeding in modern crops. The conversion efficiency of intercepted light into biomass still holds promise for yield increase. This conversion efficiency is to a great extent constrained by the metabolic capacity of photosynthesis, defined by the characteristics of its components. Genetic manipulations are increasingly applied to lift these constraints, by improving CO<sub>2</sub> or substrate availability for the photosynthetic carbon reduction cycle. Although these manipulations can lead to improved potential growth rates, this increase might be offset by a decrease in performance under stress conditions. Thus, it is important to assess possible positive or negative effects of the introduction of a CO<sub>2</sub>-concentrating mechanism (CCM) in C3 crop species on crop potential productivity and yield robustness.
- (b) 若你想將 C4 作物之 CO<sub>2</sub>-concentrating mechanism (CCM) 導入 C3 型之水稻，你會選擇什麼基因(至少一個)，基於什麼理由?(5分)
- (c) 為何 C3 作物會因 photorespiration，導致碳同化物之減少而損失產量，而 C4 作物則可避免。(5分)
7. 作物於鹽份逆境下之反應，最先是滲透壓之改變；再者即是鈉離子引起之毒性；最後則是鈉離子過量累積引起之氧化逆境。作物有何機制就(a) osmotic stress (b) ion homeostasis 及(c) oxidative stress 進行調控以提昇對鹽份逆境之耐受性。(15分)
8. (a) 如何定義 Yield Potential 及 Potential Yield? 並請說明兩者之差別?(5分)
- (b) 何謂 Ideotype? 以水稻為例，高產水稻(high yield rice variety) 之 Ideotype 需具備什麼樣之農藝特性，為什麼?(10分)