一、試述水分如何進入根部與運輸至植株地上部?如何利用植物生理參數提供精準合理的灌溉? (15 分)

二、試述植物不能開花與不能授粉受精的生理原因。(20 分)

三、試述高溫對植物的傷害為何?如何提高植物的耐熱性? (15 分)

四、請閱讀下文並依其所述回答以下問題。(25 分，每小題 5 分)

Bitter pit is a physiological disorder of pome fruit associated with calcium deficiency that renders fruit unsalable for fresh consumption. Unlike other macronutrients, calcium is exclusively mobile in xylem; however, within the fruit of apple, xylem becomes progressively more dysfunctional with maturity, effectively limiting calcium delivery to fruit tissues. Auxins promote the differentiation of xylem, and abscisic acid (ABA) is linked with calcium mobility. Therefore, we hypothesized that early-season applications of auxins (native and synthetic) or ABA would impart greater longevity and functionality to xylem tissue and/or improve the transport of calcium and mitigate bitter pit incidence. Exogenous indole-acetic acid, naphthaleneacetic acid (NAA), and ABA were applied individually at 30, 45, and 60 days after full bloom in 2021 and 2022 to crop load-adjusted trees. The primary vascular bundle function was three-fold higher for NAA and ABA compared with the control and negatively correlated with bitter pit (−0.87) at harvest in 2021. Treatment differences in the number of vascular bundles were not observed in 2022, when bundle function was higher and fruit size was smaller than those in 2021. Peel calcium was unaffected by any treatments in either year; however, the most efficacious rates of auxins and ABA markedly and significantly reduced the bitter pit incidence of control fruit by 60% to 71% at harvest and by 54% to 65% after postharvest in 2021, and by 32% to 44% at harvest and by 36% to 45% after postharvest in 2022. More research is warranted to elucidate the mechanisms by which these plant growth regulators mitigate the incidence of bitter pit.

4.1. 為何缺鈣容易發生於果實?

4.2. 為何本文研究人員認為 Auxin 及 ABA 可能減少果實缺鈣現象?

4.3. 兩年的試驗結果並不一致，作者如何解釋?

4.4. 兩年的試驗結果顯示果皮的鈣含量並未受到處理所影響，請進一步說明此結果與本試驗主題之關連。

4.5. 就你所學，除了本文之試驗處理，還有那些方法可以減少果實缺鈣現象?

五、請閱讀下文並依其所述回答以下問題 (25 分，每小題 5 分)

Drum-priming is an attractive technique for improving seed germination and can be performed on a bulk scale owing to its simplicity. This study investigated the cause of germination inhibition at high temperature and identified the optimal drum-priming conditions of lettuce seeds for uniform seedling growth in high temperature conditions. Using seeds of 'Hwahong,' the most thermosensitive lettuce cultivar, we demonstrated that endosperm acts as a mechanical barrier to inhibit germination at high temperature (30 °C). Furthermore, we provided evidence for the beneficial effect of the combination of plant growth regulators (PGRs) in the drum-priming solution on seed germination. Treatment of seeds with the PGRs gibberellic acid (GA3) and benzylaminopurine (BA) enhanced the germination of the lettuce seeds with longitudinal cut, which reached the maximum at 30 °C, and the combination of GA3 (1 $mg \cdot L^{-1}$), BA (1 $mg \cdot L^{-1}$), and ethylene (390 $mg \cdot L^{-1}$) at 8 °C for 3 days was the optimal condition for drum-priming. We also explored the effect of drum-priming in the presence of a combination of PGRs on endo-β-mannanase (EBM) production and on the structure of the lettuce seeds at high temperature and showed that in contrast to non-primed seeds, drum-priming with a combination of PGRs promoted EBM production even before germination and increased the EBM activity in primed seeds. The results indicated that drum-priming with a combination of PGRs resulted in condensation of the cytoplasm of the endosperm cells

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and weakening of the structure of the micropylar endosperm. In conclusion, drum-priming with a combination of PGRs led to high and rapid germination of lettuce seeds under high-temperature conditions by increasing metabolic enzyme production and decreasing mechanical resistance.

5.1. 本研究所用植物材料為何?

5.2. 該植物材料的那個部份是其受高溫抑制的主要原因?

5.3. 本文所稱之 Priming 意義與目的為何?

5.4. 本研究提出那些證據支持其處理可以提高代謝活力及降低物理阻抗之結論?

5.5. 就你所學，除了本研究所採用的方式，還有那些常用的 priming 技術?

試題隨卷繳回