生物策略格式

KJC, 2019/10/21

類別	生物策略 (Strategy)
生物策略 STRATEGY	表皮細胞儲存水 (Surface cells store water)
生物系統 LIVING SYSTEM	冰花 *Mesembryanthemum crystallinum* (Ice plant)
功能類別 FUNCTIONS	#儲存液體 #Store liquids
作用機制標題	冰花的葉子以類似囊狀的細胞將水儲存在表面 (The leaves of ice plants store water in surface bladder-like cells.)
生物系統/作用機制示意圖	

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

冰花 (又叫水晶冰菜、冰菜、非洲冰菜，冰葉日中花)，原生於非洲南部及東部，其名字來自於覆蓋在葉子上的透明小囊泡 (bladder)，使它看起來像被結凍的露水覆蓋一般。這些小囊泡叫做表皮囊狀細胞 (epidermal bladder cell)，是覆蓋於許多植物表面的髮絲狀結構的特化形式。表皮囊泡狀細胞的作用如許多的水分儲存庫，在乾旱及高鹽度期間起很大的作用。它們可以保留水分並隔離多餘的鹽分，使其遠離對高鹽度更敏感的組織。

該策略由 EcoRise Youth Innovations 共同提供。

The ice plant, which is native to southern and eastern Africa, is named for the small, transparent bladders that cover its leaves and make the plant look like it’s covered with frozen dew. These bladders are called epidermal bladder cells; they are modified versions of hair-like structures that cover the surfaces of many plants. Epidermal bladder cells act as numerous small reservoirs that are especially helpful during times of drought and high salinity. They retain water and also sequester excess salt to keep it away from tissues that are more sensitive to high salinity.

This strategy was co-contributed by EcoRise Youth Innovations.

文獻引用 (REFERENCES)

「非洲南部是龐大而多樣的冰花植物 (Mesembryanthemums) 分佈中心…一個物種能在每個葉片表面膨脹的微小氣囊中保留液體，在陽光下閃閃發光而得名「冰花」，儘管在陽光普照的土地上是難以置信的。」(Attenborough 1995: 278)

「普通或結晶狀的冰花 (*Mesembryanthemum crystallinum* L.) （一種鹽生、兼性的景天酸代謝物種），其表面覆蓋著被稱作表皮囊狀細胞 (epidermal bladder cell, EBC) 的特化茸毛 (trichome) 細胞。EBC 被認為是次要的水分和/或鹽分的儲存器官以增進在高鹽份及缺水逆境下的存活率。然而，ESC 對於冰花耐鹽性的確切貢獻所知甚少。在一植物群體中，通過快中子射線誘變分離出沒有 ESC 的突變株。光學及電子顯微鏡顯示出突變植物在葉和莖的表面都缺乏 EBC…和野生型植物相比，沒有 ESC 的突變株葉片多汁性及葉、莖含水量均降低。培養在 400 mM NaCl 兩週後，野生型植物的空氣組織 (aerial tissue) 比突變株的 Na^+和 Cl^-含量高約 1.5 倍。野生型植物將 Na^+和 Cl^-區隔在 EBC 中，使得光合活性葉的組織中這些離子的濃度低於無 EBC 突變的葉子，特別是處於高鹽度逆境下。透過果實、種子數和種子的平均重量評估 EBC 突變的植株，結果顯示高鹽份逆境下植物顯著受損。這些結果清楚的表明冰花的 EBCs 透過作為水分的儲存容器而有具有多肉性 (succulence) 和藉由離子螯合和光合作用活性組織內的體內平衡 (homeostasis) 維持而使有耐鹽性。」 (Agarie et al. 2007: 1957）

"Southern Africa is the headquarters of a vast and varied family, the mesembryanthemums…One species retains liquid in tiny bladders on the surface of each bloated leaf that glisten in the sunshine and so give it the name, apt though improbable in these sun-baked lands, of 'ice plant'." (Attenborough 1995: 278)

"The aerial surfaces of the common or crystalline ice plant *Mesembryanthemum crystallinum* L., a halophytic, facultative crassulacean acid metabolism species, are covered with specialized trichome cells called epidermal bladder cells (EBCs). EBCs are thought to serve as a peripheral salinity and/or water storage organ to improve survival under high salinity or water deficit stress conditions. However, the exact contribution of EBCs to salt tolerance in the ice plant remains poorly understood. An *M. crystallinum* mutant lacking EBCs was isolated from plant collections mutagenized by fast neutron irradiation. Light and electron microscopy revealed that mutant plants lacked EBCs on all surfaces of leaves and stems…The EBC mutant also showed reduced leaf succulence and leaf and stem water contents compared with wild-type plants. Aerial tissues of wild-type plants had approximately 1.5-fold higher Na^+ and Cl^- content than the mutant grown under 400 mM NaCl for 2 weeks. Na^+ and Cl^- partitioning into EBCs of wild-type plants resulted in lower concentrations of these ions in photosynthetically active leaf tissues than in leaves of the EBC-less mutant, particularly under conditions of high salt stress…The EBC mutant showed significant impairment in plant productivity under salt stress as evaluated by seed pod and seed number and average seed weight. These results clearly show that EBCs contribute to succulence by serving as a water storage reservoir and to salt tolerance by maintaining ion sequestration and homeostasis within photosynthetically active tissues of *M.*

crystallinum." (Agarie et al. 2007: 1957)

參考文獻清單與連結 (REFERENCE LIST)

Agarie, S., T. Shimoda, Y. Shimizu, K. Baumann, H. Sunagawa, A. Kondo, O. Ueno, T. Nakahara, A. Nose, and J. C. Cushman. (2007). Salt tolerance, salt accumulation, and ionic homeostasis in an epidermal bladder-cell-less mutant of the common ice plant *Mesembryanthemum crystallinum*. *Journal of Experimental Botany* 58: 1957-1967. (https://dx.doi.org/10.1093/jxb/erm057)

延伸閱讀:

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

https://en.wikipedia.org/wiki/Mesembryanthemum_crystallinum

文章貢獻/編修者與日期:

洪舜德翻譯 (2019/04/28)；朱天愛編修 (2019/12/28)；吳晧編修 (2020/01/04)；譚國鎏編修 (2020/05/26)；許秋容編修 (2020/11/26)；紀凱容編修 (2020/11/26)

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