生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	仙人掌躲避陽光 (Cactus hides from the sun)
生物系統 LIVING SYSTEM	烏羽玉 *Lophophora williamsii*、岩牡丹 *Ariocarpus fissuratus* (Mescal buttons, living rock cactus)
功能類別 FUNCTIONS	#改變位置 #保護免受液體流失危害 #Modify position #Protect from loss of liquids
作用機制標題	烏羽玉透過失水引起的收縮潛入沙漠地面，在降雨後吸水誘導膨脹而重新冒出，以適應季節性水分供應變化 (The shoot of the mescal cactus adapts to seasonal water availability via dehydration-induced shrinking below the desert floor, and hydration-induced swelling to reemerge after rainfall.)
生物系統/作用機制示意圖	

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

文獻引用 (REFERENCES)

「他提到烏羽玉 (*Lophophora williamsii*) 給人深刻印象的適應能力，這種仙人掌在乾旱季節開始時，利用失水引起的收縮現象 (dehydration-induced shrinking) 縮短枝葉長度，潛入沙漠的地底下。在一場季節性的降雨之後，枝葉吸收水分，藉著將能進行光合作用的頂端推出土壤表層，重新露出地面，接受外界的陽光及空氣。」(Bar-Cohen 2006: 489)

這裡則是另一物種：

「我們探討了「活石」仙人掌，岩牡丹 (*Ariocarpus fissuratus*)，是如何像其它低矮的

沙漠植物一樣，能夠忍受地表上可能致死的高溫。具體地說，我們檢視了在土壤石塊的存在或缺乏的情況下，透過根系收縮的枝葉下沉，如何影響枝葉的溫度及蒸散作用…儘管岩石無法調節溫度變低，但種在岩質土壤中的植株能在極端炎熱的逆境中存活，這和種在砂土中的植物不同。根部收縮的發生與季節或土壤濕度無關。木質部導管（xylem conduits，或寬帶管胞 wide-band tracheids）形成可壓縮的晶格 (compressible lattice)，隨著射髓讓根的基部沿徑向擴展時縮短根的長度。植株在土壤中的位置並不會影響蒸散作用…可收縮的根部以 [每年] 6-30 mm 的速率將岩牡丹拉進土壤之中。讓枝葉維持在土壤表面，能使植株的溫度維持在致死的高溫以下，而且能在表面有岩石遮蔭的土壤之中增加存活率。(Garrett et al. 2010: 1951)

"He refers to the impressive adaptation of the mescal cactus *Lophophora williamsii*, which converts the dehydration-induced shrinking during the beginning of the dry season to reduce the shoot length and submerge below the desert floor. After just one seasonal rainfall the hydrating shoot reemerges by pushing the photosynthesizing apex out of its soil cover into the light and open air." (Bar-Cohen 2006: 489)

Here's another species:

"We investigated how the 'living rock' cactus *Ariocarpus fissuratus*, like other low-growing desert plants, can endure potentially lethal high temperatures at the soil surface. Specifically, we examined how shoot descent by root contraction in the presence or absence of soil rocks influences shoot temperatures and transpiration…Plants embedded in rocky soil survived an extreme heat episode, unlike plants in sandy soil, though rocks did not moderate low temperatures. Root contraction occurred regardless of season and soil moisture. Xylem conduits (wide-band tracheids) formed a compressible lattice that decreased root length as rays enlarged the root base radially. Plant position in the soil did not affect transpiration…Contractile roots pulled plants of *A. fissuratus* into the soil at rates of 6 – 30 mm [per year]. Maintaining shoots level with the soil surface kept plant temperatures below the high lethal temperature and improved survivorship in soil shaded by surface rocks." (Garrett et al. 2010: 1951)

參考文獻清單與連結 (REFERENCE LIST)

Bar-Cohen, Y. (2006). Biomimetics: biologically inspired technologies. *CRC Press*.

Garrett, T. Y., C. V. Huynh, and G. B. North. (2010). Root contraction helps protect the "living rock" cactus *Ariocarpus fissuratus* from lethal high temperatures when growing in rocky soil. *American Journal of Botany* 97: 1951-1960. (https://doi.org/10.3732/ajb.1000286)

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/lophophora_williamsii https://www.onezoom.org/life/@lophophora_williamsii https://eol.org/pages/486998
撰寫/翻譯/編修者與日期
譚國鎏翻譯 (2021/03/22)；洪麗分編修 (2021/04/10)
AskNature 原文連結
https://asknature.org/strategy/cactus-hides-from-the-sun/