


## 生物策略表

類別	生物策略 (Strategy)	
生物策略 STRATEGY	聚焦光線的葉片 (Leaves focus light)	
生物系統 LIVING SYSTEM	四季秋海棠 <i>Begonia cucullata</i> (Clubed begonia)	
功能類別 FUNCTIONS	#獲得、吸收、或過濾能量 #Capture, absorb, or filter energy	
作用機制標題	秋海棠的葉片透過清晰的表皮細胞聚焦光線，使在低光環境下的光合作用率最大化 (The leaves of begonias maximize photosynthesis in low-light conditions by using clear surface cells to focus light.)	
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)		
<p>「同樣生長在這些亞洲森林底層中的秋海棠，有額外的把戲。在葉片上表面的一部分細胞是透明的，能充當小型的鏡片，收集微弱的光線並聚焦到含有葉綠素的顆粒之中。」 (Attenborough 1995: 48)</p> <p>「很多森林底層的植物依靠漫射光 (diffuse light) 來進行光合作用，因為直射陽光通常會在照射到森林底層之前就被上層樹冠層所分散掉。在關於直射或漫射光與葉片互相作用的文獻中有著很大的差距。有些森林底層的植物有發育完全的鏡片狀表皮細胞 (lens-shaped epidermal cells)，長久以來被認為是用作增加散射光的吸收。為了評估表皮細胞形狀在獲取直射及散射光中起的作用，我們以一個整合的球形系統，使用扁平表皮細胞（紅葉秋海棠 <i>Begonia erythrophylla</i>、寬皮柑 <i>Citrus reticulata</i> 及垂榕 <i>Ficus benjamina</i>）及鏡片狀表皮細胞（虎斑秋海棠 <i>B. bowerae</i>、芋頭 <i>Colocasia esculenta</i> 及龍州鳳仙花 <i>Impatiens morsei</i> ‘Velvetea’）的葉片來測量葉片反射率及透射率 (transmittance)。在檢測過的物種當中，照射直射光的葉片比照射漫射光的吸收到更多光線。當葉片以漫射光照射時，兩類型葉片皆有較多的光線透射及反射，導致漫射光的吸收值較直射光低約 2-3%。從這些數據推測鏡片狀表皮細胞並不會幫助獲取漫射光。柵狀及海綿狀葉肉細胞的解剖構造及葉片厚度似乎在獲取及吸收光線上比表皮細胞形狀有較多影響…鏡片細胞可能在聚</p>		

焦直射光線上更為重要 (Vogelmann et al., 1996)，或是為了其它原因例如貯存水分及增加葉片表面的疏水性。這些森林底層植物鏡片狀細胞的發育，可能主要與直射光有機會以光斑 (sun flecks) 形式穿透到森林地層有關。另外，有著鏡片狀細胞的植物通常都有極疏水 (hydrophobic) 的表面，而凸面形狀的細胞會增加防水效果 (Wagner et al., 2003; Bhushan and Jung, 2006)。」 (Brodersen and Vogelmann 2007: 1061, 1065)

“Begonias, which also grow on the floor of these Asiatic forests, have an additional trick. Some cells in the upper surface of their leaves are transparent and act as tiny lenses, gathering the feeble light and focusing it on to the grains of chlorophyll within.” (Attenborough 1995: 48)

“Many understory plants rely on diffuse light for photosynthesis because direct light is usually scattered by upper canopy layers before it strikes the forest floor. There is a considerable gap in the literature concerning the interaction of direct and diffuse light with leaves. Some understory plants have well-developed lens-shaped epidermal cells, which have long been thought to increase the absorption of diffuse light. To assess the role of epidermal cell shape in capturing direct vs. diffuse light, we measured leaf reflectance and transmittance with an integrating sphere system using leaves with flat (*Begonia erythrophylla*, *Citrus reticulata*, and *Ficus benjamina*) and lens-shaped epidermal cells (*B. bowerae*, *Colocasia esculenta*, and *Impatiens morsei* ‘Velvetea’). In all species examined, more light was absorbed when leaves were irradiated with direct as opposed to diffuse light. When leaves were irradiated with diffuse light, more light was transmitted and more was reflected in both leaf types, resulting in absorptance values 2–3% lower than in leaves irradiated with direct light. These data suggest that lens-shaped epidermal cells do not aid the capture of diffuse light. Palisade and mesophyll cell anatomy and leaf thickness appear to have more influence in the capture and absorption of light than does epidermal cell shape...Lens cells may then be more important for the focusing of direct light (Vogelmann et al., 1996) or for other reasons such as storing water and improving the hydrophobicity of the leaf surface. The development of these lens-shaped cells in understory tropical species may be primarily related to chance opportunities to exposure to direct light when sun flecks penetrate to the ground level of the forest. In addition, plants with these types of cells typically have an extremely hydrophobic surface, and convexly shaped cells increase water repellency (Wagner et al., 2003; Bhushan and Jung, 2006).” (Brodersen and Vogelmann 2007: 1061, 1065)

#### 參考文獻清單與連結 (REFERENCE LIST)

Attenborough, D. (1995). *The private life of plants*. Princeton University Press.

Brodersen, C. R., and T. C. Vogelmann. (2007). Do epidermal lens cells facilitate the absorptance of diffuse light? *American Journal of Botany* 94: 1061-1066.  
(<https://doi.org/10.3732/ajb.94.7.1061>)

#### 延伸閱讀

AskNature Team. (1 October, 2016). Hornet electricity. *AskNature*. Retrieved from:  
<https://asknature.org/idea/hornet-electricity/>

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

<https://en.wikipedia.org/wiki/begonia>  
<https://www.onezoom.org/life/@begonia>  
<https://eol.org/pages/585688>

**撰寫/翻譯/編修者與日期**

譚國銓翻譯 (2020/08/25)；許秋容編修 (2021/03/16)

**AskNature 原文連結**

<https://asknature.org/strategy/leaves-focus-light/>