How the leaves of the giant Amazonian waterlily create remarkable mechanical rigidity at an economical material cost

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Abstract

The giant Amazonian waterlily (genus Victoria) produces the largest floating leaves of all plants. Famously, this plant can support a large amount of weight, even that of a human child. In this talk, we explore how the structural form of the vasculature system enables this remarkable mechanical rigidity, and speculate how the vasculature underpins gigantism in these extraordinary leaves. Specifically, by means of mechanical testing and mathematical modelling of the leaf-vasculature structure, we found that the bending resistance of the Amazonian waterlily is considerably higher than that of an elastic floating sheet of the same amount of material. Our analysis suggests that the unique pattern of branching veins on the underside of the Victoria leaf provides structural support at an economical material cost and, as such, enables gigantism. We infer that this multi-purpose system may have evolved to maximise photosynthesis and enable rapid growth in fast-drying pools, thereby conferring a selective advantage in an unstable environment. Box, F., Erlich, A., Guan, J.H. and Thorogood, C., 2022. Gigantic floating leaves occupy a large surface area at an economical material cost. Science Advances, 8(6), p.eabg3790.

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