Researchers reveal how an insect-eating plant uses rain energy to power its traps

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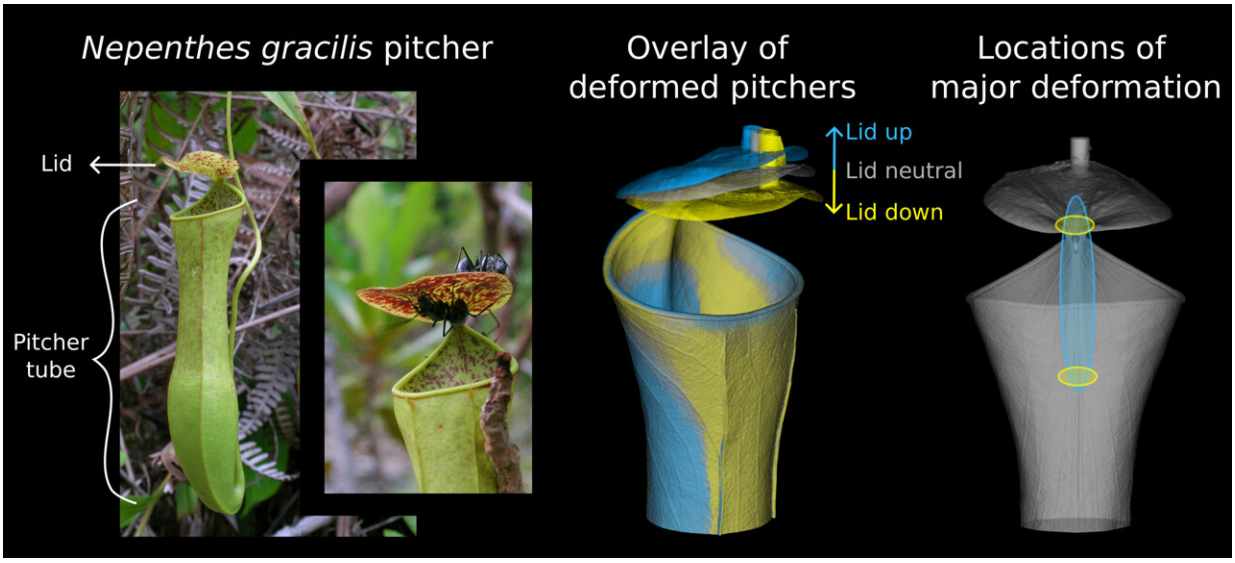

Graphic showing mechanisms of Nepenthes gracilis. Credit: Anne-Kristin Lenz

Scientists at the University of Bristol have uncovered the deadly workings of a carnivorous plant.

In the steaming jungles of Borneo, plants have evolved innumerable tricks to help them survive and outcompete their neighbors. The Slender Pitcher Plant, Nepenthes gracilis, is amongst the most ingenious: Its elaborate cup-shaped leaves are equipped with a canopy-like hanging lid that turns into a deadly springboard for ants when it is hit by a falling

rain drop.

The findings, published today in *Biology Letters*, reveal for the first time how the lethal spring works.

The team were surprised to find that rather than bending in the lid itself or in the narrow constriction between pitcher cup and lid, the spring is located far down in the back of the tubular pitcher wall. The off-center location at the rear of the tube has two effects.

First, it makes the spring direction-dependent, and as a result, the lid moves easily down, but not up. When a rain drop hits, the lid is accelerated quickly downwards, flicking any insects sitting on its underside into the fluid-filled trap below. On the way up though, the increased resistance of the spring slows the lid down, so that it stops moving sooner and the trap is quickly ready to capture again.

Second, the off-center spring prevents the lid from twisting or wobbling, thereby maximizing the transmission of impact energy into downward movement.

The Slender Pitcher Plant known as Nepenthes gracilis. Credit: Dr Ulrike Bauer

Lead author Anne-Kristin Lenz of Bristol's School of Biological Sciences explained, "If you look at the pitcher shape you would assume that the deformation happens at the smallest cross section, which is the transition point from lid to pitcher tube, but in fact it also deforms further down at the back of the pitcher tube.

"Pitcher plant traps are lightweight, but sturdy. Nepenthes gracilis uses small changes in the trap shape to transmit impact energy with astounding efficiency. We can learn from these plants how to optimize structures geometrically, which could help to save material and weight, while still having a functional spring. The springboard trapping mechanism might even provide inspiration for designing new mechanical devices for harvesting energy from rain or hail."

The Slender Pitcher Plant known as Nepenthes gracilis. Credit: Dr Ulrike Bauer

This clever use of geometry makes Nepenthes gracilis the only known plant to exploit an external energy source to achieve extremely fast movement—entirely free of metabolic costs.

More information: Pitcher geometry facilitates extrinsically powered 'springboard trapping' in carnivorous Nepenthes gracilis pitcher plants, *Biology Letters* (2022). royalsocietypublishing.org/doi …/rsbl.2022.0106

Provided by University of Bristol