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Plant Biology

The plant with the spider-like poison – Australia's giant stinging tree

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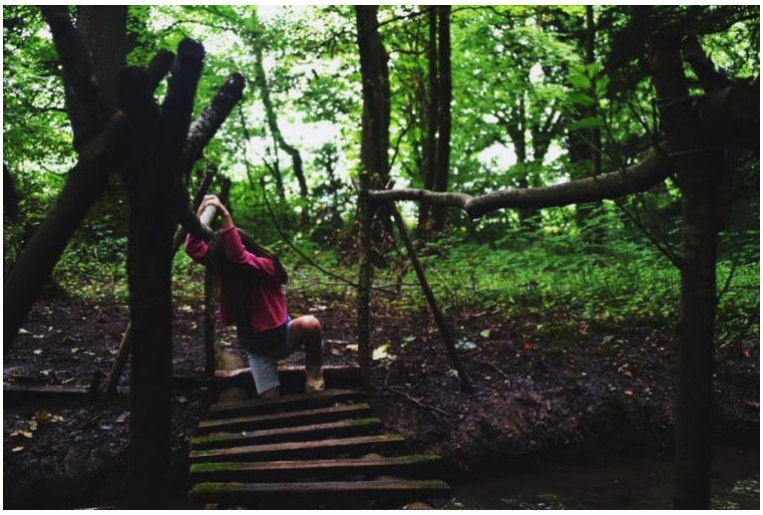
Stings from Australia's Dendrocnide species of plants cause pain lasting for months. In a new study, Gilding and colleagues have now found out how – these plants secrete neurotoxins that resemble spider venom, interrupting your body's signals and making sure you never want to touch one ever again.



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Deep in the rainforests of eastern Australia, all along New South Wales up to south-eastern Queensland, one can find *Dendrocnide excelsa*, the giant stinging tree. Key to its name, the stinging tree possesses thin, felt-like hairs on its leaves that, in reality, act as densely packed needles. When an unfortunate victim touches such a leaf, they may find themselves in excruciating pain for days, weeks, or even months.

Being in pain for months after touching a tree is definitely quite unusual, but it's made even stranger with some understanding of the pain response. The cells that signal pain are called nociceptors, and they come in a few different types. Some nociceptors respond to intense mechanical stimuli, like stubbing your toe, while others respond to intense heat. A particular type of nociceptors, known as polymodal nociceptors, respond to more complex stimuli, including chemicals like histamine. These chemicals are released by the body when cells are damaged, and pain can thus act as an important warning sign that something is wrong.

The existence of polymodal nociceptors means that some plants and animals can use histamine, or chemicals like it, as a type of self-defense. Even if a plant can't hit you hard enough to signal your mechanical nociceptors, and isn't hot or cold enough to signal your thermal nociceptors, it can use otherwise harmless chemicals to stimulate your polymodal nociceptors and get you to feel pain even if nothing is actually wrong. While it is a fascinating way to deter predators, you might not be such a fan of it if you decide to take a bushwalk through an Australian rainforest.

The particularly strange thing about the stinging tree, though, is the excessive degree and extended duration of the pain it causes. Whenever any nociceptor responds to a stimulus, it sends signals to the brain through channels in their structure, which is then interpreted as pain. Normally, when the stimulus is gone, the signaling stops and so the pain disappears – as long as you don't break anything, your stubbed toe should stop hurting after a few hours, after all. This makes the extended pain caused by the stinging tree particularly strange – why would the nociceptors continually signal for so long?

In the past, the pain caused by the stinging tree has been attributed to chemicals like histamine that do directly stimulate the nociceptors, or acids that can cause actual damage, but these shouldn't cause such intense, extended pain as the stinging tree normally does. This mystery has led a group of Brisbane-based scientists to believe there to be a new, unidentified family of toxins created and secreted by the giant stinging tree.

To investigate how the stinging tree could cause this pain, the researchers collected extracts of the stinging tree's leafy hairs, and then separated these extracts into its various components. One of these components seemed to be a new group of large organic molecules, which they elected to name "gympietides", from the Gubbi Gubbi language of the local First Nation people. The researchers found that injection of these gympietides would cause levels of pain comparable to whole extracts from the stinging tree.

The researchers then determined the nature of the pain caused by the gympietides. They found that gympietides activate some nociceptors in a similar way to how molecules like histamine would. In addition, though, the gympietides irreversibly affect channels in the nociceptors. Since these channels are actually transmitting the pain signal to the brain, damage to these channels could affect how the pain is felt. In this case, the damage would make sure the channels are continually transmitting the pain response, leading to the characteristic, extended pain.

What was most surprising, however, was that the gympietides shared both their structure and their function with some animal venoms. This was the first time such structures were observed in plants, and this could therefore help scientists better determine the activity of this type of venoms.

The scientists also spend some time describing their own experiences with the stinging tree. Perhaps they bear a grudge. This author cannot blame them.

By studying the stinging tree, these scientists have identified and studied a brand new family of plant toxins, and found that they caused such significant and prolonged pain by both directly activating the pain cells – the nociceptors – while also disabling their channels to ensure they keep signaling. Hopefully this brings us ever so closer to an antitoxin!