Plant deafness

There has been much discussion of late concerning 'plant blindness', the general relegation of the plant world into little more than scenery. Along with not seeing plants, are we also failing to hear them?

There is no question that plants sense their environment and change their activities in response to it. They have highly developed systems for detecting light and temperature. They sense gravity and touch, and have a diverse suite of receptors for all kinds of molecules, both volatile and otherwise. Some of these are used as environmental cues produced either by other organisms, be they threats or potential partners, while others they produce themselves. The intricacy of this network of signalling molecules has led some researchers to describe plants as communicating in a language of chemicals. If plants are making use of all these senses, it seems unlikely that they would be ignoring sound.

We have all heard that talking to plants encourages them to grow more luxuriously. It is a fun high school science project to try to prove that effect. In fact, in 2018 the Swedish furniture giant Ikea ran an advertising campaign involving pot plants being verbally abused rather than encouraged and growing less well (an experiment reminiscent of the fictional demon Crowley in Neil Gaiman and Terry Pratchett's book Good Omens, although Crowley's plants grew very well as a result of his bullying making them terrified of him). Sadly, the Ikea experiment has not been formally published or peer reviewed as far as I know, and seemed to have been poorly controlled at best.

A better example of plants responding to sound, or at least vibrations, is 'buzz pollination'. A large number of insect-pollinated plants across a range of genera display this behaviour, releasing their pollen only when their anthers are vibrated at specific frequencies corresponding to the wing beats of their preferred pollinators, such as bumble bees. This helps the plant avoid self-pollination and, by restricting the insect species capable of obtaining pollen, reduces its loss to less selective pollenivorous creatures. The effect is a result of the specific tubular shape of these plants' anthers, and generally the bees will be holding onto the flower while shaking the pollen out, but audio recordings alone have been shown effective at releasing the pollen[1]. There is also a report that the beach evening primrose (*Oenothera drummondii*) responds to the sound of a flying pollinator by increasing the sugar content of its nectar within a matter of minutes[2], presumably conserving resources when pollinators are absent.

Another indication that plants may detect the audio environmental are experiments that suggest that plant roots grow towards the sound of water[3]. These involve pea plants (*Pisum sativum*) grown in pots with a bifurcated base, which acts as a Y-maze choice test. In the bottom of the arms there could be either nothing, water, water running through a sealed pipe or a small speaker broadcasting sounds such as running water, white noise or no sound. The pea roots grew more into an arm containing water or water in a pipe than an arm containing no stimulus. However, they generally chose to avoid arms containing speakers, no matter what they were playing. But they did show a clear preference for an arm containing a speaker playing water sounds over an arm with a speaker playing no sound.

While these studies point towards plant responses to airborne vibrations, they do not imply that the plants themselves are making any sounds. When stressed or under attack by herbivores, plants release a cocktail of volatile chemicals that can serve a number of purposes, including triggering neighbouring plants to 'prepare' for a coming assault and attracting insectivores to prey upon the unwanted infestation: 'the enemy of my enemy is my friend'. This chemical 'cry' could be thought equivalent to the deafening scream purported to be emitted by the mythological mandrake root when pulled from the ground (more recently to be found in the Harry Potter stories by J.K. Rowling), but like Edvard Munch's painting it is a silent scream.

It is possible, however, that we are just not listening at the right frequency. A study, as yet only presented on the bioRxiv preprint server, reports that plants routinely produce sounds in the 20–100 kHz range. These ultrasound emissions occured more frequently when plants are were stressed[4]. Furthermore, the spectrum of these sounds could be used to determine whether the plants were suffering the effects of drought or had been cut. The source of these 'phytoacoustic' events is not known, although a good guess would be that they are the result of explosive cavitation in xylem when the water tension in these vessels can no longer be sustained, and could explain their increased occurrence during water scarcity. There is also no indication that these noises have any effect on surrounding plants or other organisms, although the authors of the study suggest that they could form the basis of a remote monitoring system for the condition of crops.

The timescales upon which plants operate are so different to ours that people are easily seduced into seeing them as passive and unresponsive components of the landscape. But maybe they are living in a rich audio world that we have not yet learnt to hear. ❐

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