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INSIDE JEB

How buzzing helps bees to pollinate plants

A bumblebee buzz pollinating a *Solanum citrullifolium* flower. Photo credit: Christian Ziegler.

Some flowers do not give away their pollen easily. Stored securely in specialised pore-studded anthers, pollen from these tight-fisted plants can only be released when the flower is given a good hard shake; which is exactly how bumblebees extract the precious grains. 'A bumblebee usually grabs a flower with its mandibles and curls its body around the anthers, then the bee starts vibrating its powerful flight muscles … causing pollen grains to be shaken out', says Mario Vallejo-Marín from the University of Stirling, UK. Explaining that this process is known as 'buzz pollination', Vallejo-Marín adds that more than 20,000 plants have to be shaken like a pepper pot to distribute their pollen, while half of all bees tremble flowers to extract the nutritious grains. 'Yet we don't know how the transmission of vibrations during buzz pollination depends on the shape and structure of the flower', says Vallejo-Marín. Intrigued by the enigmatic pollination mechanism, Vallejo-Marín and a pair of dedicated undergraduate researchers, Ceit Beattie and Blanca Arroyo-Correa, began sizing up the vibrations produced by bumblebee species from the UK to east Asia.

Tending four different bumblebee species (*Bombus terrestris* and *B. audax* from northern Europe, *B. canariensis* from the Canary Islands and *B. ignites* from Japan), Beattie trained insects from individual colonies to be at ease in a flight arena by encouraging them to fly to a well-stocked pollen and nectar feeder, herb buffalo bur flowers and watermelon nightshade flowers. Once the bees had got the hang of buzzing around the enclosure, Arroyo-Correa attached a minute accelerometer to the base of a flower and gave individual insects 15 min to get up close and personal with the tiny bloom. 'We had a particularly hard time getting some bee species to vibrate the experimental flowers', says Vallejo-Marín, recalling that the Japanese bees were the most reluctant. After recording the vibrations of 230 flowers, Arroyo-Correa then calculated how hard they were being shaken by the bees and how the vibrations had travelled from the bee down through the flower to the accelerometer at its base.

Surprisingly, when Arroyo-Correa compared the bees' trembling techniques, they were remarkably different, with the smallest bees, *B. audax*, giving the herb buffalo bur flowers the fastest and hardest shake, while the Japanese bees (*B. ignitus*) and *B. audax* produced the widest vibrations. And when Arroyo-Correa compared how the vibrations were carried through the two different flowers, the blooms didn't seem to alter the frequency of the vibrations travelling through, but they did alter how hard the bees were effectively shaking the flower, even though the flowers were closely related. Ultimately, even though the bees seem to have different shaking strategies, they all seem to give flowers equally vigorous shakes, while the different shape of the blooms alters how bee's buzzes travel through the bloom.

Vallejo-Marín says, 'Buzz pollination probably represents the escalation of a battle between bees and flowers to control access to pollen'; the flowers try to restrict the amount of pollen that greedy bees plunder to feed their larvae, in order to ensure that there is sufficient for their own pollination. And he concludes that the variation in buzzes among bee species may be important 'as it hints at the need to conserve different types of bees that are able to produce different types of buzzes, as different types of plants may need different types of buzzes to maximise seed production'.

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