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How cacti become 'rock busters'

Matt Walker
Editor, Earth News**Few plants can grow without soil and even fewer are capable of growing on nothing but bare rock.**

Yet some species of desert cactus manage this extraordinary feat, and now scientists have worked out how.

The plants have evolved a symbiotic relationship with rock-dissolving bacteria, which they allow to grow in their roots, say the scientists.

The cacti even incorporate these rock-busting bugs into their seeds, passing them on to future generations.

"We were working in the desert, when we observed that many individual cacti grew in sheer rocks," says Dr Yoav Bashan, a biologist at the Northwestern Center for Biological Research in La Paz, Mexico.

"They looked good and green in habitats where usually plants do not grow."

The enigma, says Dr Bashan, is that plants need minerals and nitrogen to survive.

But neither are available from rock, which binds in minerals and contains no accessible nitrogen.

"The only explanation that we could think of is involvement of microorganisms assisting the plant to grow, fixing nitrogen and dissolving mineral."

"We looked for them and found them."

Dr Bashan and US-based colleagues Dr Esther Puente and Dr Ching Li have discovered that cardon catus (*Pachycereus pringlei*) growing in the volcanic region of the Baja California Sur mountain range harbour bacteria that are capable of dissolving rock.

These bacteria not only live on the surface of the plant's roots, but also within cells that make up the root itself, the scientists report in the journal *Environmental and Experimental Botany*.

Further tests revealed the endophytic bacteria also grow in the cactus fruit and from there are transferred into seeds, and that these bacteria can weather rock, dissolving particles into smaller sizes.

"We believe that we have found a new symbiosis between bacteria and plants," says Dr Bashan.

"The cactus is the carbon provider for the bacteria and the bacteria indirectly provide the minerals and nitrogen for the plant."



Home is where a rock is

We believe that we have found a new symbiosis between bacteria and plants

Dr Yoav Bashan

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The bacteria and plant work in concert. The bacteria dissolve the rock, allowing the cactus seed to take purchase. The roots then drill into the weathered rock, fracturing it further.

A cross section reveals the roots of a cardon cactus seedling taking hold

"Consequently, below the plant is a small cave where the rocks were consumed and washed as soil and the roots are literally in the air," Dr Bashan explains.

Further tests revealed that without the bacteria, cacti couldn't survive.

The relationship is especially fruitful because the cacti are able to pass the bacteria onto the next generation.



"When a seed falls in bats and bird droppings onto barren rock, it contains all the bacteria it needs to pioneer colonisation of that rock," says Dr Bashan.

"The seed is the lucky one, as there is no other competition from other plants that do not have these bacteria."

With a little help, even cracks aren't inhospitable

The bacteria and cactus likely evolved together, with their ancient ancestors developing their symbiotic relationship.

The cactus also then helps produce soil from the rock, which other plants can use to colonise what was once an extreme habitat.

"They are the pioneering plants," says Dr Bashan.

"They formed soil in accelerated speed that otherwise will take millions of years to form."

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