Plants and fungi share fair-trade underground market

19:00 11 August 2011 by **Ferris Jabr**
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Beneath your feet, plants and fungi are exchanging nutrients in a marketplace where generosity is rewarded and cheating punished. The two kingdoms were known to exchange nutrients at root level – now, researchers have shown that they have evolved ways to enforce fair trading.

In almost every habitat on land, fungi intertwine with the roots of plants in mutually beneficial relationships known as mycorrhizal associations. Fungi provide plants with phosphorus they can't get from the soil on their own; plants provide fungi with carbohydrates. Many different plant and fungal species will often be linked in a single mycorrhizal association; and within such an association, several different fungi often colonise the roots of a single plant.

Such promiscuous communities might seem present plenty of opportunity for cheating. A fungus could attach itself to many different plants to sponge up as many carbohydrates as possible, but only supply phosphorus to some of those plants. Alternatively, a tree could hook up with lots of fungi, but give a steady stream of carbohydrates to only a few fortunate shrooms.

To find out how plants and fungi regulate their subterranean bartering, Stuart West of the University of Oxford and his colleagues studied associations of *Medicago truncatula*, a small clover-like plant, and three different mycorrhizal fungi. Two of the three fungi are known to provide less phosphorus than the third, more generous species.

To determine how *M. truncatula* responded to generous versus miserly fungal species, he traced the flow of carbon isotopes from plant roots to fungi. He found that the more phosphorus a plant received, the more carbon it dished out, rewarding the generous fungus.

Rich get richer

Next, West allowed two fungi of the same species to colonise a single plant root and controlled the amount of phosphorus available to them – and therefore how much they could pass on to the plant. One fungus was given much more than the other. West found that the plant rewarded this phosphorus-rich fungus with more carbon than its poverty-stricken rival.

When West allowed one fungus no phosphorus at all and the other only a tiny bit, the plant root still supplied 10 times as much carbon to the fungus with something to offer as to the empty-handed one.

West repeated the experiments in reverse, allowing two different plant roots to associate with a single fungus and providing one root with more carbon than another. Just as the plant rewarded generous fungi, the fungus gave more phosphorus to the root offering more carbohydrates.

"It's a two-way interaction," says West. "They are both sensing and rewarding what the other does."

"A plant can identify the function of an individual fungus and reward it accordingly, and a fungus can identify the function of a host and reward it accordingly – they know who the good and bad guys are," says Roger Koide of Pennsylvania State University in University Park. "Many of us have hypothesised this must be true, but until now we didn't have much evidence for it."

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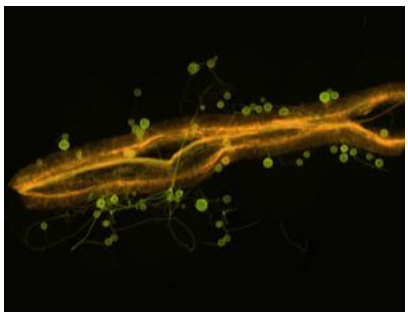

A *Medicago truncatula* root is colonised by fungi, in green (Image: Science/AAAS)

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