

Hungry microbes share out the carbon in the roots of plants

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Sugars made by plants are rapidly used by microbes living in their roots, according to new research at the University of York, creating a short cut in the carbon cycle that is vital to life on earth.

The green leaves of plants use the energy of sunlight to make sugar by combining water with carbon dioxide from the atmosphere. This sugar fuels the plant's growth, but scientists in the University's Department of Biology discovered that some of it goes straight to the roots to feed a surprising variety of microbes.

A study led by Professor Peter Young, of the Department of Biology at York and Dr Philippe Vandenkoornhuyse of the University of Rennes in France is published in the latest issue of the *Proceedings of the National Academy of Sciences*.

In the carbon cycle, plants remove carbon dioxide (a greenhouse gas) from the atmosphere. Eventually, the carbon compounds that plants make are "eaten" by microbes and animals, which release carbon dioxide back into the atmosphere. The rapid cycling demonstrated by the new research is an important link in this process.

Professor Young said: "Our research identifies microbes in roots that create a short cut in the carbon cycle. This is an important development given current interest in reducing outputs of carbon dioxide and the 'carbon trading' that is intended to help this."

The researchers traced the path of the carbon by replacing the normal carbon dioxide in the air around the plants with a version made with C-13, a natural, non-radioactive form of carbon that is slightly heavier than the usual kind. Within hours, microbes in the roots were feeding on sugars laden with C-13 and using it to build their own cells.

The newly-made molecules of DNA and RNA produced by the microbes could be separated from pre-existing ones because the C13 made them heavier. DNA and RNA are large molecules that carry genetic information about the organisms that made them, so it was possible to identify the microbes that made those heavy molecules. These were the “greedy” ones that were consuming the largest share of the sugars provided by the plant.

Professor Young said: “There are rich communities of microbes growing in or around the roots of all plants growing in normal soil. Most do no harm to the plant, and some are very beneficial to it. We looked at two sorts of microbe: bacteria and mycorrhizal fungi.”

The researchers found a high diversity of both types of microbe inside the roots of grass or clover plants growing in a pasture, but the “heavy” label revealed that some of these were growing much more actively than others.

Professor Young added: “It is these active organisms that are important because they are turning sugar back into carbon dioxide, which is released into the atmosphere. We were astonished at the wide variety of active bacteria that we discovered. Many of them had not been seen in plant roots before, and we have no idea how they may affect plant growth.”

The role of mycorrhizal fungi is better known. They are particularly important in carbon cycling, because they pump the carbon compounds

out of the root into a massive network of fine fungal filaments in the soil, where it becomes available to other microbes and also to larger soil organisms like worms, mites and insects. In return, the fungus gathers phosphorus from the soil and delivers it to the plant, helping the plant to grow better. The research confirmed that there were many different fungi in the roots of each plant, but revealed, for the first time, which of these fungi were most active.

Source: University of York

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