Plant perfumes woo beneficial bugs

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Scientists funded by the Biotechnology and Biological Sciences Research Council (BBSRC) have discovered that maize crops emit chemical signals which attract growth-promoting microbes to live amongst their roots. This is the first chemical signal that has been shown to attract beneficial bacteria to the maize root environment.

The study was led by Dr Andy Neal of Rothamsted Research in Hertfordshire and Dr Jurriaan Ton of the University of Sheffield's Department of Animal and Plant Sciences. By deepening our understanding of how cereals interact with microorganisms in the soil their research aims to contribute to ongoing efforts to increase cereal yields sustainably to feed a growing world population.

This research could be particularly useful in the fight against soil-borne pests and diseases. By breeding plants that are better at recruiting disease suppressing and growth promoting bacteria scientists hope to reduce agricultural reliance on fertilisers and pesticides.

The research is published today (24 April 2012) in the open-access journal PLoS One.

Dr Andrew Neal, who co-led the research, said "We have known for a while that certain plants exude chemicals from their roots that attract other organisms to the area. In fact, the environment around a plant's roots teems with microorganisms and populations of bacterial cells can be up to 100 times denser around roots than elsewhere. Simple compounds such as sugars and organic acids are attractive to these

microorganisms as they are a good source of energy; however other more complex chemicals were not known to serve as attractants because they were typically thought of as toxic.

"Now we have evidence that certain bacteria – we studied a common soil bacterium called Pseudomonas putida – use these chemical toxins to locate a plant's roots. The plant benefits from the presence of these bacteria because they make important nutrients like iron and phosphorous more available and help by competing against harmful bacteria around the root system."

The soil around a plant is awash with chemicals exuded by its roots. This makes it rich in nutrients but also potentially more toxic for microorganisms. The roots of young maize plants exude large quantities of chemicals called benzoxazinoids or 'BXs' which are known to play a role in helping the plant defend itself against pests above the ground in its stem and leaves. Dr Neal and Dr Ton found that a number of bacterial genes that are associated with movement responded to one of these BX chemicals, encouraging Psudomonas putida to migrate towards the plant. They also found that the presence of Psudomonas putida accelerated the breakdown of BX molecules suggesting that the bacteria have evolved the ability to detoxify the root environment, perhaps even using BX molecules as an energy source.

Dr Jurriaan Ton from the University of Sheffield co-led the research. He added "Our study has opened up exciting new opportunities for follow-up research. One interesting lead came from our analysis of the bacterial genes that were switched on in the presence of root –produced BX chemicals. This analysis suggested that the BX chemicals not only recruit the bacteria to the root surface, but they also activate processes in these bacteria that can help to suppress soil-borne diseases. This is really exciting as it would mean that the plant is not only recruiting beneficial microbes but also regulating how they behave."

He added "The next important step is to obtain a molecular blueprint of the microbial communities that are shaped by these root chemicals, and to investigate what beneficial impacts these microbes have on plant growth, plant health and soil quality."

Professor Douglas Kell, BBSRC Chief Executive, said "Sustainability must be at the heart of our efforts to help provide the world with enough nutritious food. Only by broadening our focus beyond individual plants and animals, and striving to understand the complex relationships between species, can we ensure that our food supply will be able to weather the challenges of pests and environmental change in the long term. By using advances in computing to study entire biological and ecological systems we can help develop robust solutions to ensure food security."

More information: dx.plos.org/10.1371/journal.pone.0035498

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