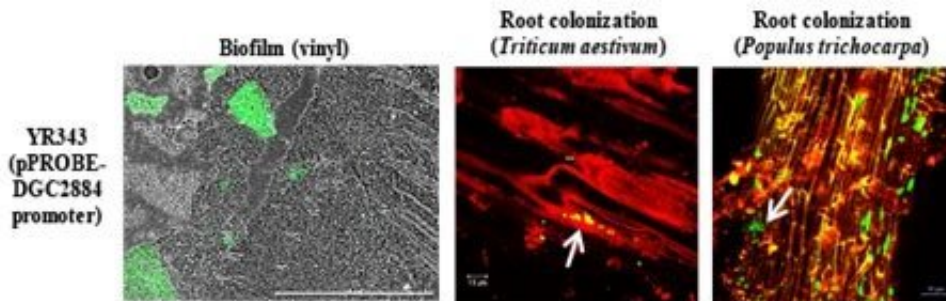


# Scientists identify genes key to microbial colonization of plant roots

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Expression of the enzyme diguanylate cyclase (DGC2884, in green) by a bacteria called *Pantoea* sp. YR343 on tree roots when forming biofilms and colonizing those roots. Arrows indicate locations of bacterial colonization. Credit: Oak Ridge National Laboratory

Some microbes can form thin films called biofilms. These biofilms give them an advantage over other microbes by protecting them from stresses such as a lack of nutrients or the presence of harmful substances in the environment. Researchers often focus on the biofilms that pathogens use to resist antibiotics. However, some biofilms can be helpful to plants and other host organisms. In previous work, researchers found that *Pantoea* sp. YR343, a bacterium that promotes plant growth, forms robust biofilms along the root surface of *Populus*, the genus which includes willow and cottonwood trees. Scientists know relatively little about the mechanisms behind the formation of biofilms on plant roots, particularly at the genetic level. However, research has found that enzymes called

diguanylate cyclases are key to biofilm formation. This new research has identified a diguanylate cyclase, DGC2884, that is expressed specifically in the presence of plants when bacteria colonize roots and form biofilms.

Diguanylate cyclases are found in many species of bacteria. These enzymes control multiple behaviors, including how bacteria form biofilms, cause disease, and move. This research shows that a particular diguanylate cyclase, DGC2884, operates specifically during biofilm formation and when bacteria are near a plant. This research also identified genes that could be involved in [root](#) colonization, suggesting that root colonization may be controlled at the [genetic level](#). This will help microbiologists and other researchers better understand how bacteria colonize root surfaces and how [gene expression](#) may play a part. The results may also help scientists study similar behaviors in microbes important to medicine and agriculture.

This study used promoter-reporter constructs to identify a diguanylate cyclase, DGC2884, that is expressed in the presence of a plant. The researchers characterized this enzyme further and determined that when overexpressed, it affected exopolysaccharide production, biofilm formation, motility, and pellicle formation. They also demonstrated that the N-terminal transmembrane domain, as well as a functional GGDEF active site, are required for the activity of DGC2884. Based on phenotypes associated with overexpression of DGC2884 in *Pantoea* sp. YR343, the scientists performed transposon mutagenesis to identify genes that no longer exhibited the unique phenotypes observed when DGC2884 was overexpressed. They identified 58 different genes with this screen and selected a subset of transposon mutants for further characterization. Interestingly, mutations affecting Type VI secretion, as well as a nucleoside-diphosphate kinase and ABC transporter, exhibited increases in colonization, while mutations affecting exopolysaccharide production resulted in decreases in colonization when compared to the wild type control. Further, they found that some mutants exhibited

differences primarily in the patterns of root colonization, more than the amount of colonization, suggesting that certain patterns of root colonization may be modulated on a genetic level.

The research was published in *PLOS ONE*.

**More information:** Amber N. Bible et al, Identification of a diguanylate cyclase expressed in the presence of plants and its application for discovering candidate gene products involved in plant colonization by *Pantoea* sp. YR343, *PLOS ONE* (2021). [DOI: 10.1371/journal.pone.0248607](https://doi.org/10.1371/journal.pone.0248607)

Provided by Oak Ridge National Laboratory

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