

War on weeds takes toll on beneficial bacteria in the soil

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As farmers battle in their above-ground war on weeds, they may inadvertently create underground casualties – unintentionally attacking the beneficial bacteria that help crops guard against enemy fungus, according to Cornell University research.

Specifically, Cornell researchers found negative consequences of the weed-killing herbicide glyphosate on *Pseudomonas*, a [soil](#)-friendly bacteria.

"Beneficial *Pseudomonas* in the soil can help crops thrive. They can produce plant-stimulating hormones to promote plant growth and antifungals to defeat problematic fungi – such as *Pythium* and *Fusarium* – found in agricultural soil, but previous studies reported that the abundance of [beneficial bacteria](#) decreased when the herbicide glyphosate seeps underground," said Ludmilla Aristilde, assistant professor of biological and environmental engineering. "Our study seeks to understand why this happens."

Soil bacteria require their proteins – composed of [amino acids](#) – and their metabolism to support cellular growth and the production of important metabolites to sustain their underground fight. But glyphosate applied to crops can drain into the soil and disrupt the molecular factories in the bacterial cells in some species, interfering with their metabolic and amino acid machinery.

The new findings show that glyphosate does not target the amino acid

production and metabolic gadgetry equally among the *Pseudomonas* species. For example, when *Pseudomonas protegens*, a bacteria used as a biocontrol agent for cereal crops, and *Pseudomonas fluorescens*, used as a fungus biocontrol for fruit trees, were exposed to varying glyphosate concentrations, the researchers noted no ill effects. However, in two species of *Pseudomonas putida*, used in soil fungus control for corn and other [crops](#), the bacteria had notably stunted growth, said Aristilde, who is a faculty fellow at Cornell's Atkinson Center for a Sustainable Future.

"Thus, if a farmer is using *Pseudomonas fluorescens* as a biocontrol, then it is probably okay to use glyphosate," Aristilde said. "But if the farmer uses *Pseudomonas putida* to control the fungus in the soil, then glyphosate is more likely to prevent the [bacteria](#) from doing its job."

The study offers molecular details for why [glyphosate](#) adverse effects on *Pseudomonas* are species-specific. "That's actually good news because – as a society – we will likely not stop using herbicide completely," said Aristilde. "If that is the case, farmers need to know which beneficial soil biocontrol they're using can be susceptible. If they're using a strain that is susceptible and conflicting with their herbicide application, then it is a problem. That's the bottom line."

"Glyphosate-Induced Specific and Widespread Perturbations in the Metabolome of Soil *Pseudomonas* Species" was published in *Frontiers of Environmental Science* in June 2017.

More information: Ludmilla Aristilde et al. Glyphosate-Induced Specific and Widespread Perturbations in the Metabolome of Soil *Pseudomonas* Species, *Frontiers in Environmental Science* (2017). [DOI: 10.3389/fenvs.2017.00034](https://doi.org/10.3389/fenvs.2017.00034)

Provided by Cornell University

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