

Honey bees, already at risk, face a new threat from a common herbicide

By [Sue Nicolson](#)

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Glyphosate is the world's most widely used herbicide. Because it's considered safe for animals, it's extensively used not only in agriculture, but also for weed control in urban areas and home gardens.



PollyDot via [Pixabay](#)

It's the active ingredient in the controversial weedkiller Roundup, which has been [in the news](#) after a recent lawsuit in the US. A jury found that it had caused terminal cancer in a former school groundskeeper who was heavily exposed to the herbicide. The manufacturer, Monsanto, was ordered to pay damages amounting to \$289m. The legal battles are continuing.

Glyphosate has been labelled a [perfect herbicide](#). It's non-selective, killing all plants. And it's easily translocated in plants and is slow-acting and stable.

From a toxicology point of view, it targets a metabolic pathway involved in manufacturing certain amino acids, the building blocks of proteins. Glyphosate binds to a particular enzyme and inactivates it. This metabolic pathway, called the shikimate pathway, is present in plants but not in animals, so glyphosate is assumed to be harmless to animals. Animals, lacking this enzyme, obtain the amino acids from food.

Until the development of transgenic crops, glyphosate was used to get rid of weeds before planting. Now crops are genetically engineered to be resistant to glyphosate. "Roundup-ready" transgenic crops can be directly sprayed with glyphosate, which kills the weeds without damaging the crop. The crops are tolerant to the herbicide but the weeds are not. Naturally, the use of glyphosate increased dramatically around the world after the development of Roundup-ready crops.

It seems that glyphosate may not be so innocuous after all. Studies are beginning to reveal deleterious effects of glyphosate on non-target species - animals. One of these species, whose pollinating activities are hugely important to biodiversity and to human food security, is the honey bee. This insect is the main pollinator in the agricultural environments in which glyphosate is so heavily used.

Foraging bees are exposed to a cocktail of toxic chemicals in the environment. There has been much recent attention given to the adverse effects of insecticides such as neonicotinoids on honey bees and other pollinators. These may have interacting effects with bee diseases and [poor nutrition](#). Glyphosate may be one more factor contributing to the recent declines in bee populations.

How glyphosate may affect bees

Exposure to glyphosate can affect bees in various ways. Firstly, glyphosate kills weeds which are an important source of nectar and pollen for pollinators. Unlike crops grown as monocultures, weeds provide variety in the [diet of bees](#). For this reason, farmers have long been urged to retain areas of natural vegetation on the edges of crops.

Secondly, glyphosate has been shown to affect honey bee behaviour. Researchers using field-realistic doses, similar to those bees might encounter in the environment, have found effects on navigation, with treated bees being less successful at returning to the hive.

Others have shown that glyphosate makes bees less sensitive to sugar and affects their learning ability. Experiments with free-flying bees, offered a choice between pure sugar water and sugar water containing glyphosate, have even shown a slight preference for the glyphosate solution. It's not surprising that glyphosate residues have been detected in honey samples and in pollen stored in the hive.

Now, a new study shows another mechanism whereby glyphosate affects bee health. It causes changes in the honeybee [gut microbiome](#). As in other animals, the health of bees depends on the bacterial community in their guts. A team of researchers at the University of Texas fed bees sugar syrup containing glyphosate at levels similar to those they might encounter during foraging. Three days later, they found that some types of dominant gut bacteria were reduced in numbers. This is because some (but not all) bacteria resemble plants in having the shikimate pathway and being susceptible to glyphosate.

The researchers also found that glyphosate exposure increased the mortality of honeybees that were exposed to a pathogen. This suggests that disruption of the microbial community makes the bees more vulnerable to infection.

Bees are a vital link given their central role as pollinators. Glyphosate adds an additional risk to an increasing number of threats facing this key species.

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ABOUT THE AUTHOR

Sue Nicolson is a professor of Zoology at the University of Pretoria.

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