

Fipronil and imidacloprid reduce honeybee mitochondrial activity

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Honeybee. Credit: Adam Siegel

New research published in *Environmental Toxicology and Chemistry* addresses the effects of two broad-spectrum systemic insecticides, fipronil and imidacloprid, on honeybees. These insecticides are widely used in agriculture, and the authors conclude that fipronil and imidacloprid are inhibitors of mitochondrial bioenergetics, resulting in depleted cell energy. This action can explain the toxicity of these compounds for honeybees.

Scientists are urgently trying to determine the causes of [colony collapse disorder](#) and the alarming population declines of honeybees. The cross-pollination services they provide are required by approximately 80

percent of all flowering plants, and 1/3 of all agricultural food production directly depends on bee pollination. As a result, there has been a flurry of research on honeybee parasitic mite infestations, viral diseases, and the direct and indirect impacts of pesticides.

The effects of pyrazoles (e.g., fipronil) and neonicotinoids (e.g., imidacloprid) on the [nervous system](#) are fairly well documented. Daniel Nicodemo, professor of ecology and beekeeping at the Universidade Estadual Paulista in Dracena, Brazil, and lead author of the study states, "These insecticides affect the nervous system of pest and beneficial insects, often killing them. Sublethal effects related to insect behavior have been described in other studies; even a few nanograms of active ingredient disturbed the sense of taste, olfactory learning and motor activity of the bees." A key characteristic of colony collapse disorder is the incapacity of the honeybees to return to their hives, and these disruptions have a direct impact on that ability.

In this study, Nicodemo et al. looked at the effects of fipronil and imidacloprid on the bioenergetics functioning of mitochondria isolated from the heads and thoraces of Africanized honeybees. Mitochondria are the power plants of a cell, generating most of a cell's supply of adenosine triphosphate (ATP), used as a source of chemical energy.

Honeybee flight muscles are strongly dependent on high levels of oxygen consumption and energy metabolism. Mitochondrial oxidative phosphorylation drives ATP synthesis, which is required to contract the muscles during flight. "If something goes wrong, the energy production is impaired," explains Nicodemo. "Similar to a plane, honeybees require clean fuel in order to fly." Both fipronil and imidacloprid negatively affected the mitochondrial bioenergetics of the head and thorax of the [honeybees](#). While at sublethal levels, insecticide damage may not be evident, even such low level exposure clearly contributes to the inability of a honeybee to forage and return to the hive, which could result in

declining bee populations.

More information: *Environmental Toxicology and Chemistry*,
[onlinelibrary.wiley.com/doi/10...02/etc.2655/abstract](https://onlinelibrary.wiley.com/doi/10.1002/etc.2655/abstract)

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