Food safety lies in the wings and memory of bees

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Photos Milagro Castro

Pollinators are in charge of more than one third of the food that fills the world's plates. If their numbers disappear or fall, humanity will be in deep trouble, a threat driving research at the Universidad del Rosario into their learning methods and memory, as well as the especially important topic of how pesticides affect bees.

An estimated 10 million beehives have been lost since 2006. It is a number that tends to go unnoticed, at least until you understand that a third of the food humans eat requires pollination, and that local diet can mean this figure in some regions being as high as 80 percent. In other words, their disappearance is a serious threat to food safety, as well as the cause of grave environmental damage.

There is a complex equation of reasons behind diminishing bee populations that includes loss of habitat, the establishment of monocultures, plagues affecting bees, and the use of pesticides. It was the lethal and sublethal effects of the latter that led Andre Josafat Riveros, professor of the Faculty of Natural Sciences and Mathematics at the Universidad del Rosario, to study the cognition of these particular pollinators.

According to this biologist, who has spent almost 20 years studying what he calls "his bees", the sublethal effects of pesticides include loss of ability to learn, memory, decision making, navigation, and sensory evaluation of resources. They also affect bees' immune systems, meaning parasites attacking them have greater impact. "My main interest is to know how they take decisions and how they use information to make their decisions. In honey bees this is a key issue since those who leave the hive have special jobs assigned to them. Some look for water, others pollen or nectar, and each individual decision has a lesser or greater effect on the colony. Imagine what happens when they do not know how to return or cannot remember which flower has the best nectar," explains Riveros who, irony of ironies, is allergic to bee stings!

THE WORLD KNOWS WHAT MIGHT HAPPEN

In the aftermath of the 1970s food crisis, new pesticides began to be produced to effectively control crop diseases, the aim being to avoid new shortages. Thus, the use of organophosphorus compounds became widespread until plague pathogens started to generate resistance and the chemicals affected human health. Research then brought the use of neonicotinoids and, in the 80s, products appeared on the market such as imidacloprid, a pesticide that is still the most used of all worldwide While human health was safeguarded, several years passed until bees began to disappear, first in the USA, later in Europe. Ignorance of what might be going on even led to conspiracy theories about alien beings. Nevertheless, *Colony Collapse Disorder*, as it was labelled, was

THERE ARE AN ESTIMATED 20,000 SPECIES OF BEE IN THE WORLD, AND WHILE THERE IS NO PRECISE FIGURE FOR COLOMBIA, IT IS BELIEVED IT COULD REACH ONE THOUSAND.

being caused by something that was here on earth, not in outer space, something in human hands: pesticides. When not lethal, they had grave effects on pollinator populations. "The problem of neonicotinoids is that they also attack the brains of the insects that benefit from them, overstimulating them until they no longer function," explains Riveros.

Since then, the scientific community got on with the job of testing the lethal or sublethal affects of these pesticides on bees. After a period of push and pull with the pharmaceutical industry, in 2013 science achieved its first solid step forward through the European Commission's temporary ban on neonicotinoids, a prohibition expected to be made total this year following confirmation by the European Food Safety Authority (EFSA) of the risk these substances represent for wild pollinators and honey bees.

SEARCHING FOR A HALFWAY POINT

Professor Riveros' interest in this topic began in 1998. He relates how he had already searched for bumblebees close to the town of La Calera, so when he studied for his PhD in the University of Arizona, he had no hesitation in exploring *Bombus impatiens*, a species of bumblebee credited with being the second most important group in industrial pollination in the USA after the honeybee.

← Andre Riveros, professor of the Faculty of Natural Sciences and Mathematics at the Universidad del Rosario, says the effect of pesticides on "his bees" makes them lose their abilility for learning, memory, and making decisions.

WORLD FOOD SAFETY

One third of human food requires bee pollination, as much as 80% in some areas.

By 2050, global production of food must rise 70-100% to meet the world's needs.

24%

In 2008 neonicotinoid sales topped 1,500m euros, 24% of the insecticide market.

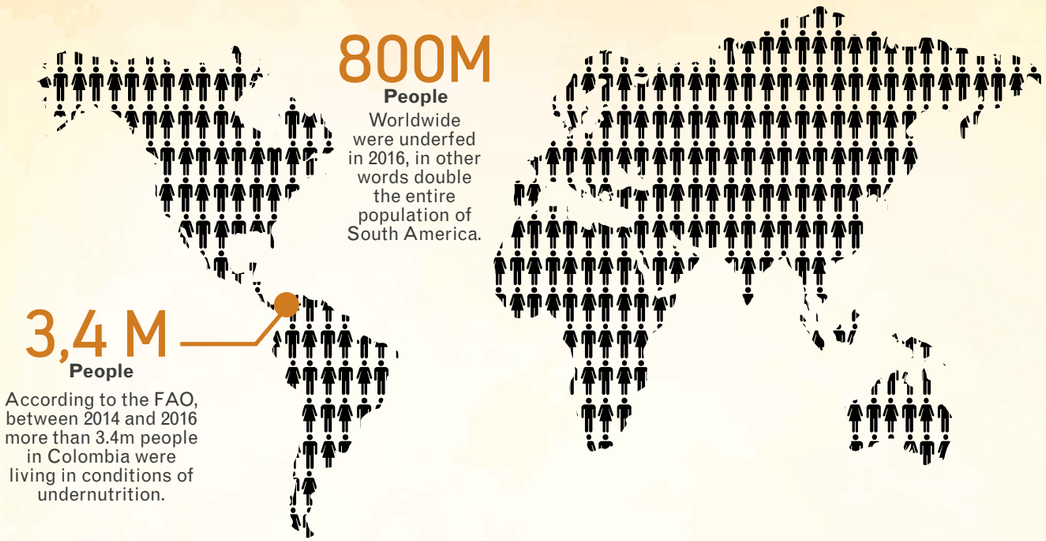
"I began to study what is known as the conditioning protocol from a learned response, which is when one teaches an animal. It is what is done with dogs when a bell is sounded and the animal begins to salivate because it knows there is a reward coming. Exactly the same happens in bees."

The experiment Riveros is currently carrying out in Bogotá works in this way, its aim being to discover the learning, memory, and information handling processes of bees. "We use the sound of a metronome, a click-like sound that lets us know exactly how much time must pass before we give the bee nectar. In addition, we provide a color or olfactory stimulus for the bee to associate with the driblet of sugar that comes when its antennae are moved. This is the same behavior that they show when they come to a flower; they walk and, when they feel nectar on their antennae, they stick our their tongue," he explains.

The researchers note down the time and number of times it takes the bee to learn this behavior. The same methodology is repeated, but with a supply of neonicotinoids. So far, the result is that the bees ingesting the latter need many more repetitions or simply do not learn.

This is how the research found another avenue, one in search of the halfway point that allows for control of diseases but without damaging the pollinators. "It is important to find the way to protect bees against neonicotinoids because the total ban on these would also threaten food safety. We must research to find a solution that significantly stops the effects. Through science we are now creating information so that we can understand the problem, so what remains is to work on strategies for putting it into practice," concludes the expert.

In Colombia, plants economically important for exportation need to be pollinated, and these include coffee, cacao, avocado pears, oranges, and gulupa.



800M

People

Worldwide were underfed in 2016, in other words double the entire population of South America.

3,4 M

People

According to the FAO, between 2014 and 2016 more than 3.4m people in Colombia were living in conditions of undernutrition.

80%

Almost 80% of wild flowering plants depend on pollinating insects.

50%

There are now 50% fewer beehives in the USA than halfway through the last century.