



Bees are presented with cotton buds covered in saliva specimens with and without Covid. After the specimens with Covid they are offered sugar water. They stick out their tongues for the sugar water. And within a few minutes they start sticking out their tongues as soon as they smell Covid, with or without a reward.

Trained bees sniff

A startup called InsectSense has developed a surprisingly quick, non-invasive and easy coronavirus test. You hold a throat swab on a cotton bud in front of a trained bee. If the bee sticks its tongue out, you are infected. ‘We train honeybees within minutes, after which they work accurately and at top speed.’

TEXT MARION DE BOO PHOTOGRAPHY ERIC SCHOLTEN

Bees have a legendary sense of smell: they can smell a flower from kilometres away. ‘A bee’s detection capacity is one particle per billion, comparable to detecting a single odour molecule in 20 Olympic swimming pools. The sense of smell of insects beats our best technology, and there’s enormous potential in that,’ says Aria Samimi from Iran, founder of the start-up InsectSense. In Croatia, Samimi tapped into this potential by getting honeybees to detect landmines from a remote-controlled car he had built. Now his team is focussing on diagnosing diseases. Samimi: ‘Saliva from coronavirus

patients acquires a particular odour due to subtle changes in the metabolism. Bees can learn to recognize that mix of volatile metabolites. They don’t smell the virus itself, but the odours that are released from the saliva of an infected person.’

LITTLE WHITE HARNESESSES

Founded last year, the company InsectSense is located in the StartHub, an incubator for startups and scale-ups at Wageningen University & Research. Here, Samimi and his business partner Leon Schipper built BeeSense, a piece of apparatus in which trained bees are

confined in little white harnesses. You can use it to train several bees at once to recognize new odours.

Samimi: ‘First you give the bees various cotton bud samples to smell, some infected with coronavirus and some healthy. With all the samples with the virus on them, they get sugar water immediately afterwards and they stick out their tongues for that. Within a few minutes they are conditioned to stick out their tongues as soon as they smell Covid, even without a reward. A Pavlov reaction.’

The prototype of BeeSense is an apparent chaos of Lego bricks and cables. Three



‘Training bees
takes a matter
of minutes’

out Covid

bees are lined up for a demonstration. Carefully, Samimi holds a cotton bud in front of them – for safety reasons, this one is not a Covid sample but is just soaked in sugar water. The bee promptly sticks out its long, pinkish-red proboscis. Later, when the job is done, the researcher releases his troops from their harnesses. In the doorway, the bees sit on his hand, a little dazed, before flying off to a nearby patch of chamomile.

PLATFORM

In Iran, Samimi studied mining engineering and geology and worked in the marble quarries of the family business. He came to Wageningen University & Research in 2018 as a guest researcher. His research topic was generating electricity from plants. In 2020, he founded his own startup, InsectSense. The young company works closely together with the WUR Laboratory of Entomology and with Wageningen Bioveterinary Research (WBVR) in Lelystad. Testing Covid samples, for example, was done in a highly secure biosafety laboratory at WBVR, in collaboration with Professor Wim van

der Poel’s viral zoonoses group. A study was also conducted on the best method of training the bees. For how many seconds do you need to offer them the odour volatiles? Should the reward follow instantly or after a short interval? The Covid samples that were used came mostly from infected minks and later from people with Covid-19.

DRUG DOGS

Samimi: ‘We know that dogs have a very good sense of smell too. There are drug dogs, bomb dogs and dogs that sniff out bank notes. But training a dog takes three to nine months, while training bees takes a matter of minutes. Besides, you always use just one dog. The charm of our method is that it is easy to scale up to do multiple testing. Our BeeSense set-up with 10 bees detects Covid with a sensitivity of 92 percent. What is more, bees are much cheaper to keep than dogs, and they definitely don’t get infected with the coronavirus themselves.’ Samimi expects BeeSense to be an option for developing countries with poorer infrastructure and less access to laboratory testing. Honeybees are available all over the

world, and you could test more than 100 patients an hour using a hand-held tool. The company wants to automatize the process more fully by capturing images on camera of the bees that stick out their tongues and converting them to digital signals. Samimi: ‘As well as Covid, you could also teach bees to detect diseases such as avian flu or various plant diseases at an early stage.’

In December last year, Samimi’s group was awarded a Take-off grant by the Dutch Research Council (NWO) to study the feasibility of using a biochip, LumiNose, with synthetic insect genes to detect volatile compounds. This follow-up study is being done in collaboration with the Bioscience researchers at Wageningen Plant Research. Virologist Van de Poel thinks it is very promising. ‘We could make a synthetic sensor based on bee cells that can automatically detect odour compounds, probably including other viral diseases in plants, animals and humans. We still have to figure out how specific it is.’ ■

www.wur.eu/training-bees