Do **neonicotinoids** have a sting in their tail?

Wayne Coles, Media Relations Officer at the NERC Centre for Ecology & Hydrology, explores recent research into neonicotinoid pesticides and bees.

Bees are big business and have been creating a buzz amongst the scientific community – not to mention international regulators, farmers and conservationists – since neonicotinoid pesticides were first used across Europe and elsewhere in the 1990s and the debate about their risks to bees began to take flight in 2009.

Bees are believed to contribute £651m to the British economy each year, and there is much public feeling for our bees. In 2015 more than 364,000 people signed a petition calling on the then Environment Minister Liz Truss to veto farmers' requests to sidestep the current ban on neonicotinoids across the EU.

The debate on neonicotinoids and their effects on bees is likely to rumble on until the European Food Safety Authority (EFSA) meets in the autumn to decide on their future.

There have been hundreds of scientific papers looking at different aspects of neonicotinoid use and their effects on a variety of bee species.

One recent study, led by Dr Gemma Baron of Royal Holloway University of London, for example, investigated the impact of a type of neonicotinoid called thiamethoxam on four species of bumblebee queen collected from the wild. The findings suggest that it reduces egg development in queen bees of some species.

Scientists at the NERC Centre for Ecology & Hydrology (CEH) have also been researching the impacts of neonicotinoid treated oilseed rape crops on bees. An England-wide study, led by Dr Ben Woodcock, analysed tens of thousands of records collected by the Bees, Wasps and Ants Recording Scheme and found neonicotinoids were linked to large-scale and long-term declines in the areas where wild bee species live and in the overall number of wild bees.

Aerial view of the UK field site for the pan-European neonicotinoid pesticide study.

Now Ben and his colleagues from CEH, including Professor Richard Pywell who conceived the project, have conducted a pan-European field experiment in an attempt to assess the impact of neonicotinoids on bees across three countries. Currently this is the largest study of its kind.

The study, carried out in collaboration with researchers from Landerinstitut fur Bienenkunde, Germany and Szent Istvan University in Hungary, looked at the impact of neonicotinoid-treated oilseed rape at 33 sites in the UK, Germany and Hungary on both honeybees and wild bees.

Ben said: "The temporary ban on neonicotinoids has been controversial because although lab-based studies suggested these pesticides are harmful for bees it's hard to know whether the same thing would happen in the real world where bees can also feed on flowers and crops not treated with neonicotinoids.

"Previous research into the effects of neonicotinoids on honeybees and wild bees has been inconclusive. The scale and scope of our latest study means that it represents, as far as possible, what happens when bees are exposed to these pesticides in the real world.

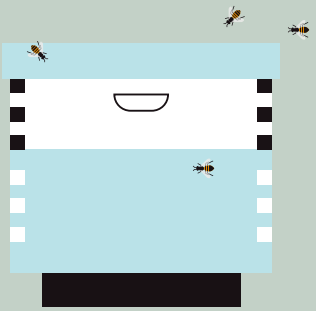
A summary of the experimental design

Countries
UK, Germany, Hungary

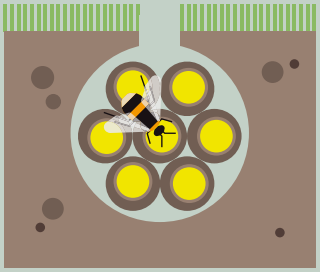
Farms

Crop treatments
Clothianidin, Thiamethoxam and control (no treatment)

1,650
Solitary bee cocoons



198
Honeybee hives



396
Buff-tailed bumble bee colonies

Robust: randomised block design and statistics

"In this way we hope to explain why some of the results of past research have been inconsistent because we can consider other factors such us how much of the pesticide the bees were exposed to, what other food resources they had and if the bees had other health issues such as disease."

The independent research was conducted on 3,000 football pitches worth of arable land across 33 farms in three countries managed by commercial farmers using otherwise typical farming methods. Each field was surrounded by crops that were not attractive to bees. Treated and untreated fields were separated by at least 3km to prevent cross-contamination to ensure, as far as possible, a 'real world' exposure of bees to neonicotinoids.

Ben said: "Many previous field studies have been criticised for being poorly replicated and small scale, while laboratory studies have been questioned for not representing real world exposure.

"Using this knowledge we designed our field experiment to measure the impact of neonicotinoid pesticides on honeybee and wild bee populations over multiple countries. We particularly looked at how well populations continued from one year to the next, how healthy they were and their mortality rates."

Ben led this large CEH field study with funding from Bayer Crop Science and Syngenta as well as the Natural Environment Research Council (NERC) which funded the analysis of the impact on wild bees.

Lab assessment of the bumblebee hives.

There's no easy solution. We need to use pesticides to produce enough food for the growing population. However, pesticides need to be used responsibly to minimise the risk of harming the environment.

Lucy Hulmes

CEH were further supported in this endeavour by an independent scientific advisory panel chaired by Professor Bill Sutherland of Cambridge University.

Professor Richard Pywell said: "We have been completely open about the study design and methodology, and all datasets created as part of the experiment will be publically available when the paper is published following peer-review.

"At the start of the study qualified CEH statisticians undertook a rigorous statistical power analysis to ensure that the experiment had a sufficient number of replicates – elements that can be repeated by other scientists – to give confidence in the outcomes."

Richard said this latest study – building on previous research – is a good opportunity to reconsider how we can best manage farmland in a sustainable and responsible way to keep producing food.

He added: "There's no easy solution. We need to use pesticides to produce enough food for the growing population. However, pesticides need to be used responsibly to minimise the risk of harming the environment.

"More work is needed to develop so-called integrated pest management strategies that seek to maximise natural pest control provided by beneficial insects in the fields, like ladybirds, and use the minimum pesticide to best effect.

"Changes in land use have meant bees have lost a lot of these habitats and climate change and disease have also squeezed the area they can colonise.

"So another positive action would be to manage small areas of farmland sympathetically to provide alternative food resources and nest sites for wild bees so they are less likely to feed on treated crops."

Findings of the pan-European field study

The researchers found that exposure to neonicotinoid-treated crops made honeybee colonies less able to survive from year to year in two of the three countries. In Hungary, the number of bees in a colony fell by 24% in the following spring. In the UK, all of the bees in the study died over the winter. In Germany, no harmful effects on overwintering honeybees were found.

In all three countries they found a link between lower reproductive success – shown by the number of queens and egg production – and increasing levels of neonicotinoid residues in the nests of wild bee species the buff-tailed bumblebee and the red mason bee.

According to the CEH lead author, Dr Ben Woodcock: "The neonicotinoids investigated caused a reduced capacity for all three bee species to establish new populations in the following year, at least in the UK and Hungary."

He suggests the differing impacts on honeybees between countries may be associated with interacting factors including the availability of alternative flowering resources for bees to feed on in the farmed landscape as well as general colony health, with Hungarian and UK honeybees tending to be more diseased. In contrast, the hives in Germany happened to be larger, showed little evidence of disease and had access to a wider range of wild flowers to feed on. Dr Woodcock suggests that this may explain why Germany was the only country where there was no evidence of a negative effect of neonicotinoids on honeybees.

Richard explains more about the latest CEH research on the 'impacts of neonicotinoids on honeybees' page on the CEH website where the results from Ben's study will also be published.

www.ceh.ac.uk