EUROPEAN FOOD SAFETY AUTHORITY (EFSA) – NEONICOTINOIDS AND BEES REPORT DELAYED UNTIL 2017

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Background history

On 18 June 2014 a review paper was published on the effects of neonicotinoids and other systemic pesticides on vertebrate wildlife (David Gibbons, Christy Morrissey & Pierre Mineau. 2014. A review of the direct and indirect effects of neonicotinoids and fipronil on vertebrate wildlife *Environ Sci Pollut Res* DOI 10.1007/s11356-014-3180-5). This paper focused on imidacloprid and clothianidin and fipronil, which itself is not a neonicotinoid but does have a similar mode of action. The authors concluded, using the US Environmental Protection Agency's ecotoxicity classification system, all three insecticides showed direct toxicity to vertebrates. All three insecticides exert sub-lethal effects on vertebrates, including genotoxic and cytotoxic effects, impaired immune functions, reduced growth and reduced reproductive success. These effects occurred at concentrations of the insecticides well below those associated with mortality. Imidacloprid showed moderate to high toxicity to birds. Clothianidin was moderately to nearly no toxicity to rats, mice and birds and was practically non-toxic to fish. Fipronil was highly toxic to game birds and fish.

In June 2014, the Task Force on Systemic Pesticides (www.tfsp.info*)* published the largest global study into the effects and risks of systemic pesticides, including neonicotinoids.

Having studied over 1,000 peer reviewed papers, the Task Force concluded that: Neonicotinoids impact all species that chew a plant, sip its sap, drink its nectar, eat its pollen or fruit and these impacts cascade through an ecosystem, weakening its stability. The combination of persistence (over months or years) and solubility in water has led to large scale contamination of, and the potential for accumulation in, soils and sediments, ground and surface water and treated and non-treated vegetation. In addition to contaminating non-target species through direct exposure (e.g. insects consuming nectar from treated plants), the chemicals are also found in varying concentrations outside treated areas. They run off into surrounding soil and aquatic habitats easily. This polluted water, along with the dust created during the drilling of treated seeds, can contaminate wild plants growing in agricultural field margins and hedgerows providing the potential for major impacts on a broad range of non-target herbivorous invertebrates living in or near farmland. This provides multiple routes for chronic and acute exposure of non-target species. Organisms inhabiting farmland are being chronically exposed and so are aquatic organisms living downstream of farmland, including inhabitants of riparian zones, estuarine and coastal marine systems. The large scale bioavailability of these insecticides in the global environment at levels that are known to cause lethal and sub-lethal effects on a wide range of terrestrial, aquatic and soil beneficial microorganisms, invertebrates and vertebrates, poses risks to ecosystem functioning and services provided by terrestrial and aquatic ecosystems including soil and freshwater functions such as litter break down and nutrient cycling, food production, biological pest control, and pollination services.

On 17 December 2014, The European Food Safety Agency (EFSA) recommended that the EU Commission reduce the acceptable human exposure limits to two neonicotinoids. (www.efsa.europa.eu/en/press/news/). The report stated that two neonicotinoids – acetamiprid and imidacloprid – may affect the developing human nervous system, and in light of this, the acceptable exposure levels of these pesticides should be lowered to prevent detrimental effects. The recommendation came as a result of research into the effects of neonicotinoid neurotoxicity, including a recent 2012 paper by a team of Japanese scientists on acetamiprid and imidacloprid. That paper recommended further study on neonicotinoid's toxicity, but found that both neonicotinoids studied had similar effects on the mammalian brains of neonatals to nicotine, causing prolonged excitation and damage to neurons. The authors pointed out that this may disrupt brain development in humans as well as in the rats studied. The European Food Safety Authority (EFSA) began a review that would examine the need to initiate an EU-wide ban on three neonicotinoid insecticides which some suggested had severe deleterious effects on European bee populations.

On 24 March 2015, Professor Dave Goulson (University of Sussex) re-analysed data from a 2013 study by the UK Food and Environment Research Agency (FERA) (Goulson D. (2015) Neonicotinoids impact bumblebee colony fitness in the field; a reanalysis of the UK's Food & Environment Research Agency 2012 experiment *PeerJ*., 3: e854). The FERA study had come to the conclusion that there was no significant link between pesticide exposure and colony performance. However, attempts to improve the realism of the experiment by conducting it in the field (rather than the lab) led to problems, and neonicotinoids were recorded in control colonies that should have been neonicotinoid-free. Re-analysis of the data showed that colonies of free-flying bumblebees exposed to neonicotinoids used as part of normal farming practice suffered significant impacts in terms of reduced colony growth and queen production. Exposure frequently occurred even on the control farm, where no neonicotinoids were used within 1 km of the bee colonies – perhaps, it was speculated, because neonicotinoid residues persist and can accumulate in soil from usage in previous years, or because the bees travelled further afield than 1 km to forage.

On 22 April 2015 - two studies were published in the journal *Nature*. Kessler, SC, Tiedeken EJ, Simcock KL, Derveau J, Softley S, Stout, JC & Wright GA. (2015). Bees prefer foods containing neonicotinoid pesticides. *Nature*. **521**, (7550), 74–76. This research was led by Geraldine Wright,

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an insect neuroethologist at Newcastle University, and looked into whether bees could 'taste' neonicotinoids and therefore choose to avoid them. Honeybees (*Apis mellifera*) and buff-tailed bumblebees (*Bombus terrestris*) were confined to boxes and given a choice between plain nectar and nectar laced with three of the most common neonicotinoids, imidacloprid (IMD), thiamethoxam (TMX) or clothianidin. The bees showed no preference for the plain nectar, but bees of both species 'preferred' to eat more of the nectar laced with IMD or TMX than the plain nectar. It was concluded that bees cannot taste neonicotinoids and are not repelled by them and, therefore, treating flowering crops with IMD and TMX presents a sizeable hazard to foraging bees.

The second paper (Maj Rundlöf, Georg K. S. Andersson, Riccardo Bommarco, Ingemar Fries, Veronica Hederström, Lina Herbertsson, Ove Jonsson, Björn K. Klatt, Thorsten R. Pedersen, Johanna Yourstone & Henrik G. Smith. (2015). Seed coating with a neonicotinoid insecticide negatively affects wild bees. ***Nature:* 521**, 77–80) examined honeybees and wild bees in the field. Researchers in Sweden analysed eight fields of oilseed rape sown with seeds treated with the neonicotinoid clothianidin, and eight fields sown with untreated seeds. Wild bee density in treated fields was around half that in untreated fields and nests of solitary bees, and bumblebee-colony growth were also reduced in treated fields. Honeybees, however, did not show a difference between treated and untreated fields - perhaps because they have larger colony sizes, which could sustain higher losses of foraging bees before showing overall health effects. Dr Maj Rundlöf, lead author of the study, surprisingly concluded that as honeybees are the model organism that is used in toxicity testing for pesticides and if they are not representative of bees in general, it could explain why more studies have not detected negative effects.

On 8 April 2015, the European Academies Science Advisory Council (EASAC) (www.easac.eu/fileadmin/Reports/Easac_15_ES_web_complete_01.pdf), in the wake of the Commission's 2013 regulation restricting some uses of neonicotinoids to protect bees, assembled 13 leading experts to review the science. (EASAC is the European Academies Science Advisory Council, a network of the national science academies of the EU Member States, Norway and Switzerland.) Their report came to four key conclusions: There is an increasing body of evidence that the widespread prophylactic use of neonicotinoids has severe negative effects on non-target organisms that provide ecosystem services including pollination and natural pest control. There is clear scientific evidence for sub-lethal effects of very low levels of neonicotinoids over extended periods on non-target organisms, which should be addressed in EU approval procedures. Current practice of prophylactic usage of neonicotinoids is inconsistent with the basic principles of integrated pest management, as expressed in the EU's Sustainable Pesticides Directive. Widespread use of neonicotinoids (as well as other pesticides) constrains the potential for restoring biodiversity in farmland.

On 6 January 2016, the US Environmental Protection Agency (EPA) released a report for Risk Assessment on imidacloprid and its impact on bees (yosemite.epa.gov/opa/). The report focused on the most widely used neonicotinoid, imidacloprid, and confirmed that it can pose significant risks to honeybee populations. The study found that pollinators going back to the hive with concentrations of imadacloprid greater than 25 ppb showed decreased populations and produced less honey. The EPA confirmed it will be conducting reviews on clothianidin, thiamethoxam and dinotefuran, which will be completed by December 2016. However, it is important to note that this review has been highly criticised by many, principally because it only looked at the effect of imidacloprid on honeybees, and not native bees (4,000 species) or other insect pollinators.

On 7 January 2016, the European Food Safety Authority began a review into extending the ban on three neonicotinoids: imidacloprid, clothianidin and thiamethoxam (www.environmentalhealthnews.org/t/4315400396389439688). It was stated that the risk evaluation should be finished by January 2017 and the restrictions on the use of neonicotinoids remained in place while this review was carried out. Evidence from the EFSA study could be used to support an extension and tightening of the existing ban on neonicotinoids, following an EFSA ruling in 2012 that they posed an unacceptable danger to bees.

These new evaluations, requested by the European Commission, will be finalised by January 2017, not 2016 as previously communicated. EFSA is to update its assessments of the risks to bees posed by three neonicotinoid pesticides. The new evaluations of clothianidin, thiamethoxam and imidacloprid were requested by the European Commission, which placed restrictions on the use of the substances in 2013 following assessments carried out by EFSA. The updated assessments, which will look at the use of the substances as seed treatments and granules, will be completed by January 2017. They will take into account any new data from studies, research and monitoring that has come to light since the previous assessments were carried out, in particular information submitted to EFSA following a call for data in 2015. In 2016, EFSA confirmed that clothianidin, thiamethoxam and imidacloprid were a risk to bees when used as foliar sprays.

Pressure from 'environmentalists'

The Wildlife Trusts are calling for an outright ban on the use of all neonicotinoid insecticides. They claims that there is a growing body of evidence to show that neonicotinoids have a detrimental effect at sub-lethal doses on insect pollinators; pose a serious risk of harm to a wide range of beneficial invertebrate species in soil, vegetation, aquatic and marine habitats; have a harmful effect on a variety of vertebrate species; pose a severe risk to the wider environment and delivery of essential ecosystem services; and may adversely impact human health. For these reasons, The Wildlife Trusts believe that the continued use of neonicotinoids in the UK represents an unacceptable risk to insect pollinator populations and ecosystem health. It urges the Government to retract its opposition to the EU ban, recognise the scale of the risks posed by the continued use of neonicotinoids and place a permanent moratorium on the use of all neonicotinoid insecticides. It says it is deeply concerned that the Government has granted the use of neonicotinoid pesticides on 30,000 hectares of oil seed rape this autumn (around 5% of the total crop). The decision was made following a second application by the NFU for an 'emergency derogation' to allow the use of banned pesticides in areas deemed particularly at risk from Cabbage Stem Flea Beetle (*Psylliodes*

chrysocephala) - Suffolk, Cambridgeshire, Bedfordshire and Hertfordshire. Minutes of the meetings at which the application was discussed and approved were initially suppressed by Defra in order to avoid "provoking representations from different interest groups." The NFU application and criteria upon which the decision was made have still not been made available. Barry Gardiner, Labour's shadow Defra minister, has written to environment secretary Liz Truss challenging her to release whatever scientific evidence she considers could possibly justify this decision. Public confidence cannot be maintained if she refuses. By lifting the ban the government is giving in to short term commercial pressures at the expense of the future of British of farming. Friends of the Earth prepared a legal challenge which was refused.

The statement that some neonicotinoids are at least 5,000 to 10,000 times more toxic to bees than DDT is a typical anxiety raising statement issued by organisations such as the Wildlife Trusts comparing new, highly active insecticides to banned, significantly less active older compounds. But people know (or think they know) about DDT.

They also argue that neonicotinoids contaminate the crop's pollen and nectar sources, so all insects feeding on nectar, including pollinators such as honey bees, bumblebees, hoverflies and butterflies, are exposed to a small dose of the toxin when the crop is in flower.

They claim that the effects of exposure to neonicotinoids range from instant and lethal, to chronic; even long term exposure at low (non-lethal) levels can be harmful. There is a growing body of evidence, using field-realistic dosages of insecticide, to show that 'sub-lethal' doses affect the survival of honey bees and bumblebees by interfering with foraging behaviour and foraging efficiency.

A point that no one has made is that bees are one of the insects that pollinate tobacco plants. Tobacco plants produce nicotine, but over many decades there has not been any evidence for a decline in bees in tobacco growing regions such as North Carolina and Virginia in the USA or in Turkey.

Colony collapse disorder

A major factor in the global decline of bee populations is a phenomenon known as colony collapse disorder (CCD). This occurs when the majority of worker bees within a colony disappear and leave behind a queen, plenty of food and few nurse bees to care for immature bees and the queen. It is currently unclear as to what causes CCD, however, scientific research over the last decade indicates that the increased use of neonicotinoid pesticides may be accelerating instances of CCD.

The agro-chemical companies that produce neonicotinoids claim that the major factor causing colony collapse disorder is the infestation of hives with the *Varroa destructor* mite. The Varroa mite is an aggressive parasite of honeybees, largely due to their ability to transmit diseases and viruses including deformed wing virus. However, the claim that they are the main cause of bee decline is inconsistent with observations of CCD in bumblebees and Japanese honeybees. Both these species have high resistance to the Varroa mite and, therefore, suffer few negative effects from infestation, yet CCD has been recorded in both. The claim is, however, supported by the fact that Varroa does not exist in Australia and neonicotinoids are still used there and there have been no incidences of CCD. Similarly, it would have been expected that banning the use of neonicotinoids in Europe would have reversed this loss of bees. This is not the case.

Wider environmental impacts

Recently the EPA has suggested that neonicotinoids could harm honeybees and a preliminary assessment will help form the scientific basis for US government policy as it considers whether to control the use of the pesticides

Neonicotinoids are thought to affect parts of the bee's brain where sensory information related to orientation is stored. Some scientists fear that exposure to even low doses of the substances could confuse bees, making it harder for them to find good sources of nutrition or safely return home to their hives.

Greenpeace said it was optimistic that the new EFSA review would confirm its earlier assessment, partly because the authority would be using the latest risk assessment standards. These studies require more testing and distinguish between different types of bees, like honeybees and bumblebees.

Pesticide manufacturers such as Syngenta have argued that the EFSA guidance document, which is not used by all the EU's member states, obliges a statistically untenable demonstration of safety because it requires the ability to detect a 7% effect on honeybee colonies, which is below the natural variability you would see normally.

Europe's pollinators are estimated to be worth €22 billion (£16 billion) a year, but one in six pollinators died off between 1985 and 2005 – with greatest declines recorded in the UK, Germany and Sweden. It must be remembered, however, that early spring weather encourages early flowering of many plants and encourages bee foraging. If this early warm snap is followed by cold, wet weather, bees that were active remain in their hives which could well lead to premature death.

Conclusion

So we wait for the decision of EFSA and do not envy them their task. Early poorly applied seed treatments in Europe led to the release of neonicotinoids as a dust and such exposure has been shown to kill pollinators (see David Nuyttens & Pieter Verboven. 2015. Dust Emission from Pesticide Treated Seeds During Seed Drilling. *Outlooks on Pest Management*. **26(5),** 215-219). Correct applications have removed this risk. The pesticide industry is certain of the safety of their products as one would expect. The green groups are certain of their toxicity again as you would expect. There has been a huge amount of experimentation, much of it sound and much of it less so, and it is not uncommon for the two opposing groups to conclude different answers from the same data. I have heard whispered that some academic research groups who are seeking funding apply for money to support studies that show neonicotinoids kill pollinators as it is a 'hot' topic and money for research is so hard to find these days. But can I really believe that these individuals will run studies that are designed to show toxicity rather than to examine the real effects of field equivalent application rates on bee activity? I hope not.