Pesticide Action Network UK

Bee Declines and the Link with Pesticides

Summary of the science and PAN UK calls for action

There is growing consensus that certain harmful pesticides, especially neonicotinoid insecticides, play a key part in the complex puzzle of the dramatic declines in honey bees and other pollinators worldwide. Yet the role of these pesticides is largely dismissed by the agrochemical industry and the UK Government, while information in the media is often misleading or inaccurate. PAN UK has prepared a series of factsheets, based on the latest scientific evidence, to cut through the confusion and provide an up-to date and balanced explanation of the role of pesticides in pollinator declines. This leaflet summarises the key points and our 12 point call for action on bee-toxic pesticides.

Credit: Graham White

Pollinators in peril

For the past few years reports of massive numbers of bees dying unusual deaths have been heard across the globe. Most reports are related to the deaths of honey bees, including the phenomenon that has come to be known as Colony Collapse Disorder (CCD) in the US. In Europe, beekeepers have averaged sudden, unexplained losses of 25-30% of their hives and witnessed abnormal behaviour in worker bees, loss of queens and increased symptoms of ill health. In the UK, hive losses over winter have been around 20-40% in the last few years.

It is not just honey bees that are in decline. Many wild pollinators, such as

bumblebees and butterflies, are suffering severe population losses too. These wild species are just as important as honeybees as pollinators for food and medicinal crops we grow and for native plants we want to conserve. Pollination services increase the edible yield of 46 of the world's leading 115 food crop species - including apples, citrus, tomatoes, sunflowers, rapeseed and soya.

Several factors are thought to be behind these pollinator declines including: changes in farming practices which affect bees' food sources; increased susceptibility to bee parasites and diseases; and contamination by pesticides and other pollutants. These factors are complex and poorly understood and so far it has been impossible to single out the 'smoking gun'.

Neonicotinoids – new insecticides with a nasty reputation

There is no doubt that pesticides that are harmful to bees and other pollinators are being used in ever increasing amounts. Even the companies that make such pesticides do not deny their direct toxicity to bees, if sprayed or released into fields when bees are foraging or if high levels contaminate hive food sources.

What is less clear but more controversial is the role of repeated bee exposure to very low doses of pesticides, especially the neonicotinoid family of insecticides, now routinely used to treat the seeds of many crops before sowing. Neonicotinoids are a relatively new type of insecticide, increasingly used since the 1990s to control a variety of pests, such as aphids (greenfly), leaf-feeding beetles and root-feeding grubs. Products containing neonicotinoids can be applied at the

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root (as seed coating or soil drench) or sprayed onto crop foliage. Unlike contact pesticides, which remain on the surface of the treated foliage, neonicotinoids are taken up by the plant and transported to the leaves, flowers, roots and stems, where the toxin remains active for many weeks, protecting the crop throughout the growing season. It is not just farmers that use these insecticides- more than 25 products containing neonicotinoids are available to the public as treatments for lawns, houseplants and greenhouse fruit and vegetables (for a list see PAN UK's webpages via *http://www.pan-uk.org/home-garden/list-of-home-and-garden-pesticides-containing-neonicotinoids*).

Neonicotinoids pose different and poorly understood risks to bees and other non-target insects due to their:

- unintended presence in pollen and nectar
- persistence in the soil, contaminating other plants
- potency at extremely low concentrations
- widespread use in many cropping systems

Graham White

- These factors build up a worrying picture of low level but continued exposure for pollinators, which our governmental risk assessment for pesticides has failed to take into account.

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"The amount of clothianidin on a single maize seed treated at the dose of 0.5mg per kernel contains enough active ingredient to kill over 80,000 honey bees"

Christian Krupke and colleagues, Purdue University & Connecticut Agricultural Experiment Station, USA

How neonicotinoids affect pollinating insects

Acutely toxic by direct contact:

Like many other insecticides, neonicotinoids are acutely toxic to bees and other pollinator species by direct contact or by mouth. Furthermore, they are many hundreds of times more toxic than most other insecticides, meaning that small amounts in the wrong place can have devastating consequences. Mass bee kills have occurred in several countries at maize sowing time, due to high concentrations of neonicotinoids in the particles of treated seed coating and dust released by the seed drilling equipment. Droplets of water 'sweated' by crop seedling leaves can contain very high levels too and may pose a risk to bees collecting these for drinking water.

Sub-lethal effects in contaminated pollen & nectar:

Given the scale of neonicotinoid use in a range of crops, pollinators now face widespread and repeated exposure to low doses of residues in their food and water sources. While these very low doses generally won't kill them outright, they can lead to serious, adverse ('sub-lethal') effects in the medium to longer term.

Residues in the pollen and nectar bees collected, either from treated crops or contaminated wild plants, may reach the levels known from lab studies to impair social insect health, including disruption to foraging behaviour, navigation, communication, reproduction and larval development. Neonicotinoid toxins can persist in soil and water and can even be taken up by untreated crop plants and nearby flowering weeds for up to two years after the original application. Some of their breakdown products can be more toxic than the original compounds, posing a risk to hive bees and larvae consuming contaminated stored food.

Exposure of worker bees during foraging also affects their nest mates and brood by bringing contamination into the colony. Low level poisoning effects on individual bees can build up to colony-level harm, especially if exposure continues for several weeks. Functioning as a 'super-organism' made up of the different bee castes, the hive can only survive and prosper if all its members can perform their various tasks effectively. Recent studies show that exposure to these insecticides at very low doses can negatively affect the

immune system of bees, making them more susceptible to the impact of parasite and disease infections. Keeping the hive as a whole clean and free of foreign bodies is also thought to be disrupted by pesticide exposure. Interactions within the hive between the 'cocktail' of different pesticides bees encounter in their environment can make sub-lethal damage even worse.

Uncertain science and vested interests lead to bad decision making

The pesticide industry has responded to emerging evidence from the science by questioning the results and claiming that adverse effects reported in the lab are from 'worst case' scenarios that just don't happen in the real, field situation. One of the problems is that very few of the handfull of honeybee field studies published to date are adequately designed or conducted for long enough to properly understand the risks to honeybees from low dose neonicotinoid exposure, or large enough to 'prove' statistically any adverse effects observed. Even less is known about impacts on other pollinators. Two recent and robust field studies, however, have now demonstrated for the first time that:

- repeated exposure to the very low doses of imidacloprid contaminating pollen and nectar at levels found in oilseed rape flowers can stunt the growth of bumblebee colonies and dramatically reduce the production of new queens (conducted by Stirling University)
- a third of honeybees exposed to sub-lethal levels of the neonicotinoid thiamethoxam in food failed to return to the hive - doubling the natural loss rate of foraging workers. This level of additional loss could trigger a marked decline from which the colonies struggle to recover (conducted by French Agricultural Research Institute).

"Bee colonies in agroecosystems will be exposed to 2-4 week pulses of exposure to neonicotinoids during the flowering period of crops"

Penelope Whitehorn & colleagues, Universities of Stirling and Lancaster, UK

A more fundamental issue is that the toxicity tests on bees currently required of pesticide manufacturers when seeking approval for their products and the way governments then assess the toxicity data are totally inadequate to assess the risks that neonicotinoids pose to pollinators. The tests focus on short term, acute toxicity to adult worker bees and mainly ignore chronic toxicity and sub-lethal effects on bee behaviour, on larvae and on hive overwintering.

Pollinator exposure routes via contaminated nectar and pollen or seed drilling dust are not properly considered in the risk assessment process, which looks mainly at acute, direct contact toxicity. Neither the 'cocktail effect' between different pesticides contaminating hive materials and stored food nor the interactions between neonicotinoid exposure and bee immune defences against infection by diseases and parasites feature at all in the assessment by government regulators of whether these products should be approved or not.

To make things worse, the European Commission has delegated revision of the bee testing protocols to outside agencies and expert committees, on which a large number of pesticide company employees or associates sit, constituting a clear conflict of interest with commercial gain.

Reflecting the uncertainties in the science on bee impacts and the differences in expert opinion across Europe, four EU countries have imposed partial restrictions on certain neonicotinoid and other systemic insecticides in recent years. Sometimes misleadingly referred to as complete bans, the regulatory actions in France, Germany, Italy and Slovenia are temporary suspension of approval and use of specific chemicals on seed treatments for maize, and sometimes for oilseed rape and sunflower. Despite calls for similar action from 77 British MPs and a coalition of 14 environmental organisations, including PAN UK, the British government and regulatory officials continue to state that neonicotinoids pose no unacceptable risks to bees if used properly. Professor Bob Watson, Chief Scientific Advisor to the Department for Environment, Food & Rural Affairs (Defra), has now urged the government to look again at its position, in the light of the latest research findings

Can restrictions on systemic insecticides help restore bee health?

This is a valid question raised by farmers and others in the food supply chain. The pesticide industry claims that the restrictions imposed in France from 1999 onwards did not stop losses of honeybee hives and therefore losses must be due to other factors. However, bee declines have multiple causes so it is hard to judge the impact of neonicotinoid restrictions alone on bee health. In addition, bees continue to be exposed to neonicotinoids via unrestricted applications on other crops, while bee monitoring data is often unsuitable for drawing useful conclusions.

There are some indications that French bee losses fell following the original restrictions, but clearer, convincing evidence has now come from Italy, which first banned neonicotinoids as seed treatment for maize in 2008. Collecting data via a special national bee health network set up precisely to measure whether the bans have been effective, Italian researchers have documented that mass bee kills at spring sowing have now stopped and winter hive losses have declined following suspension of neonicotinoid maize seed treatments. Just as importantly, they found no evidence that the restrictions are causing economic problems for farmers. Italian maize farmers have not seen serious pest attacks on untreated seed and have maintained yields, showing that seed treatment is largely unnecessary in their national context.

Both sides of the economic coin must be considered in relation to bee losses and pesticide use – the costs to farmers and the whole food supply chain of impaired crop pollination can be very high, while farmers may well risk future pest control problems and escalating costs if pests develop resistance to neonicotinoids if current use trends continue. Like other pesticides, these chemicals may also end up harming other beneficial insects, including natural predators of insect pests, which provide free pest control services to farmers.

"…the best way to reduce colony collapse disorder is adopting integrated pest management and safe production by implementing suitable agronornic methods such as crop rotation …and using pesticides (including in treated seeds) only in case of real need"

Prof. Stefano Maini, University of Bologna, Italy.

What could farmers do to rely less on neonicotinoids?

Routine seed treatment with neonicotinoids without field monitoring of actual pest levels, have become common in Europe and the US, driven by market signals and industry propaganda. This kind of 'insurance policy' pest control runs counter to the basic principles of Integrated Pest Management, where decision making should be based on demonstrated need or accurate forecasting of pest attack and in which biological control and other methods are prioritised over chemical treatments.

Practical experience in arable crops in France and UK research shows that at least 30% reduction in pesticide inputs in general is technically feasible – without negative effects on farm income or yields – given proper advice and other support to farmers. In oilseed rape – the largest acreage of neonicotinoid-treated seed in a bee-favoured crop in British farming – the question should be whether farmers really need to control pests in all seasons and in every field using these bee-toxic products?

Improved field monitoring of pest numbers and better decision support could help reduce the perceived need for neonicotinoid use. Building an ecologically-based Integrated Pest Management (IPM) strategy, based on diversifying crop rotations, using crop varieties more tolerant of pests and encouraging natural predators of pests, can help farmers move away from reliance on neonicotinoids. More support for organic farming and more research into alternatives and investment in farmer training is needed from the government and the farming and food sectors, while agricultural suppliers could help by offering a wider range of untreated seed varieties.

"Bees are reaching their tipping point because they are expected to perform in an increasingly inhospitable world"

Marla Spivak, University of Minnesota, & colleagues, USA

Improving and expanding pollinator habitats

Halting the decline of our managed and wild pollinators means addressing the 'bigger picture' beyond neonicotinoid impacts. Farmers can reduce direct and indirect harm to pollinators by avoiding the use of bee-toxic pesticides and cut back on herbicide spraying which eliminates flowering plants in field margins (an important foraging source). More options for farmers under agri-environment payment schemes to manage their pest, weed and disease problems using biological control and other non-chemical methods would help too.

Expanding crop rotations, especially with bee favoured legumes, leaving more uncultivated areas on the farm, sowing special floral field borders for bees and joining up fragments of hedges, woodland and grassland, all contribute to improving and expanding farmland habitat for a range of pollinators and other wildlife.

It is not just farming practices that affect pollinators. Avoiding use of pesticides in private gardens should be encouraged and there is plenty of advice and products available for organic gardening. Planting bee-favourite plants in gardens, parks and open spaces can expand pollinator foraging in urban and rural landscapes.

Action needed on bee-toxic pesticides

EU experts now admit that the risk assessment for neonicotinoids to date has been totally inadequate – but will this prompt regulators to take these bee-toxic pesticides off the market any time soon?

PAN UK is a leading member of the UK NGO coalition working on bee-toxic pesticides We support Friends of the Earth's Bee-Cause campaign and their call for a National Action Plan for Bees. PAN UK is now calling for the following specific actions from the government and other sectors on bee-toxic pesticides:

PAN UK 12 point call for action on bee-toxic pesticides

UK government:

1. Immediate and urgent independent review of the latest science and recent conclusions about the flawed EU risk assessment of neonicotinoids currently on the market.
2. Moratorium on UK approvals and use of neonicotinoids in agricultural, ornamental and amateur garden sectors until proven not to be causing harm to pollinators.
3. Commit to and support Friends of the Earth's call for a National Bee Action Plan.
4. Build more options into entry-level agri-environment schemes to encourage farmers to adopt more Integrated Pest Management (IPM) methods, especially biological control, which will reduce dependency on pesticides – especially as an 'insurance' treatment.

Food and farming sector:

5. Food retailers to put neonicotinoids onto 'restricted' lists within their own company standards and plan how to phase in safer, IPM and organic strategies while ending the use of neonicotinoids across their global supply chains.
6. Practical research with farmers on IPM and organic strategies for replacing neonicotinoids, with a focus on oilseed rape, fruit and vegetable uses.
7. Training and advice for farmers and crop consultants on effective IPM strategies based on agroecology and smarter cropping system design
8. Collaboration between farming, retail, research and advisory, government agencies, beekeeping and civil society organisations to reduce reliance on pesticides and phase in ecologically-based Integrated Production approaches.

Ornamentals and amenity sector:

9. Ornamentals and garden supply sector to end the use of neonicotinoid treatments on pot plants.
10. Parks, local authorities and other amenity users of neonicotinoids to end their use and replace them with ecologically-based IPM strategies.

Amateur gardening sector

11. Immediate suspension of sales to the public of garden products that contain neonicotinoids.
12. Offer gardeners alternative, organic products and advice for managing insect pests.

In Spring 2012 PAN UK coordinated a letter to the Defra Minister from 14 organisations, demanding an immediate, independent review of the science and a moratorium on UK neonicotinoid approvals and use.

There are growing numbers of voices among parliamentarians and academics calling for action to address the issues of pesticides and more countries starting to re-think their pesticide approvals. France has increased its restrictions further, withdrawing use of thiamethoxam on oilseed rape seed in June 2012. The European Ombudsman opened an investigation in April 2012 into whether the European Commission has taken the appropriate measures to combat bee declines across Europe, following complaints from Austria.

NGO and beekeeper campaigns and legal challenges are taking place across Europe and in the US, calling for precautionary suspensions of neonicotinoid approvals, while the first signs of concern in the food retail sector are now emerging. The Co-operative supermarket in the UK first flagged up the issue of neonicotinoid harm to bees in 2009 and other retailers could follow suit, if consumer and public pressure rises.

NB the references for the information in this summary leaflet can be found in the relevant fact sheets.

Join us and support actions to reduce bee-toxic pesticide use in farms, parks and gardens!!

Visit **http:\bees.pan-uk.org** to find out more

If you would like to find out more about the relationship between pesticides and pollinator declines, our set of fact sheets and other information are available at: http://bees.pan-uk.org/

Bee Declines and the Link with Pesticides. Summary leaflet.

Fact sheets:

1. Different routes of pesticide exposure
2. Sub-lethal and chronic effects of neonicotinoids on bees and other pollinators
3. Serious shortcomings in assessing risks to pollinators
4. Different regulatory positions on neonicotinoids across Europe
5. Can restrictions on systemic insecticides help restore bee health?
6. What could farmers do to rely less on neonicotinoids?
7. Opportunities for improving and expanding pollinator habitats
8. Action on neonicotinoid and other bee-toxic pesticides

PAN UK's vital work in the UK and in developing countries

Pesticide Action Network UK is a registered charity dedicated to:-

- Eliminating the most hazardous pesticides,
- Reducing dependence on chemical pesticides,
- Promoting sustainable and equitable food systems and increasing the use of alternatives to chemical pest control in agriculture, urban areas, public health and homes and gardens

In the UK, we campaign for tighter regulatory controls on pesticides and encourage retailers to tackle pesticide problems in their supply chains. We provide advice on alternative ways to control pests and work with local communities to reduce public exposure to pesticides. In the developing world, we raise awareness about pesticide hazards and train farmers in organic and low input agricultural techniques to help them to make a decent living without putting their own health, their families or their environment at risk.

Populations of bees and other insect pollinators have fallen dramatically in recent years. The reasons for these declines are complex and wide ranging, but there is little doubt that pesticides are playing a key part. PAN UK has prepared these fact sheets to cut through the confusion and provide an up-to date and balanced explanation of the role of pesticides in pollinator declines. To find out more and what you can do, please visit http:\\bees.pan-uk.org

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PAN UK, Development House, 56-64 Leonard Street, London, EC2A 4LT

Tel: 44 (0)20 7065 0905, admin@pan-uk.org, www.pan-uk.org