Scottish Wildlife Trust Briefing

Neonicotinoids - research update

Neonicotinoid insecticides are harmful to pollinators and should be permanently banned for use on all outdoor crops in Scotland.

This briefing builds on previous updates from the Trust on the effects of neonicotinoids on wildlife. The latest research adds to the overwhelming evidence which shows neonicotinoids damage pollinator health and this negatively impacts on bee populations and bee biodiversity.

Background

The EU-imposed moratorium restricting the use of three types of neonicotinoid insecticides, came into effect in December 2013 due to the "high acute risks" to bees.[1]

Neonicotinoids that had restrictions on their use from 2013 were: clothianidin, imidacloprid and thiamethoxam. They have mainly been used in Scotland as seed treatments for oilseed rape (OSR) and cereal crops. They are also applied as foliar sprays and have been used in soft fruit, legumes and potato production.[2] Bees are exposed to risks from neonicotinoids through[3]: contaminated pollen and nectar; foliar sprays; dust from drilling neonicotinoid coated seeds, neonicotinoid granules applied to the soil and guttation[4] .

Since the EU-imposed temporary ban came into effect in 2013 there has been a considerable amount of research published which has justified the EU's decision. Recently, the European Commission recommended that the three neonicotinoids restricted under the moratorium are completely banned from use for all crops grown in Member States (with the only exception being for plants entirely grown in greenhouses).

Evidence

Summary of four significant pieces of recently published research investigating the impacts of neonicotinoids[5]:

Country-specific effects of neonicotinoid pesticides on honey bees and wild bees[6]

This research by Woodcock et al used large scale field experiments to assess the effects of neonicotinoid-treated crops on three bee species across three countries. For honey bees, there was negative effects during crop flowering in two out of three countries. In one of the countries, the negative effects on honey bees persisted over winter and resulted in smaller colonies in the spring. In wild bees, reproduction was negatively associated with neonicotinoids. The researchers concluded that: "the findings point to neonicotinoids causing a reduced capacity of bee species to establish new populations in the year following exposure."

Neonicotinoids linked to bee biodiversity decline in the UK[7]

A study by Woodcock et al looked at the relationship between the distributions of wild bees in the UK (data for 62 species, collected over 18 years) and the amount of neonicotinoid used in oilseed rape. Evidence was found which suggested that neonicotinoid use is linked to large-scale and long-term decline in wild bee species distributions and communities. They found that bees foraging on oilseed rape (OSR) treated with neonicotinoids were three times more negatively affected than those bees not foraging on OSR treated crops. This led them to conclude that "*neonicotinoids were a contributing factor leading to reduced population persistence*."

Chronic exposure to neonicotinoids reduces honey bee health near corn crops in Canada[8]

This research assessed for how long and by how much honeybee colonies where exposed to neonicotinoids in Canada's corn-growing regions and used the results (i.e. field-realistic doses) to design experiments to examine the effect of these insecticides on honey bees. The results showed neonicotinoids increased honeybee worker death and were associated with lower queen production. They also found that the acute toxicity of neonicotinoids to honey bees doubled in the presence of a commonly encountered fungicide. Their work demonstrated that field-realistic exposure to neonicotinoids can reduce honey bee health in corn-growing regions. The research also found that neonicotinoids persisted in non-target plants.

Bees are exposed to neonicotinoids in their food throughout the world[9]

Mitchel et al (2017) assessed the global exposure of pollinators to neonicotinoids by analysing nearly 200 honey samples from across the world. They found at least one of five neonicotinoids (acetamiprid, clothianidin, imidacloprid, thiacloprid, and thiamethoxam) in 75% of all honey samples tested, 45% of samples contained two or more of these compounds, and 10% contained four or five. They concluded that: "*a substantial proportion of world pollinators are probably affected by several neonicotinoids*" and they went on to say that: "*The fact that 45% of our samples showed multiple contaminations is worrying and indicates that bee populations throughout the world are exposed to a cocktail of neonicotinoids*."

Research findings up to end of 2015:

Neonicotinoids have been found to harm bees by: damaging bee brains;[10] reducing bumblebee queen production;[11] reducing wild bee density;[12] decreasing solitary bee nesting[13] and bumblebee colony growth and reproduction.[14] Being tasteless to bees in pollen and nectar - bees can't avoid contaminated pollen or nectar.[15] Neonicotinoids may also negatively affect wild bees even more than honeybees[16] (because honeybees are better at detoxifying after neonicotinoid exposure and have a greater buffering capacity because of colony size compared to bumblebees).[17]

Neonicotinoids are known to persist in the agricultural landscape,[18] reduce bumblebee capacity to provide a pollination service,[19] contaminate and remain in soils,[20] potentially impact upon soil invertebrates,[21,22] contaminate wildflowers at arable margins;[23] leach into the aquatic environment,[24] and may lead to a decline in insectivorous birds and butterflies in farmed systems[25,26] and impact on terrestrial and aquatic ecosystems.[27,28]

The opinion of the UK Expert Committee on Pesticides[29]

The UK's expert advisors on pesticides were asked by Defra to give their opinion on the risks posed by neonicotinoids (specifically: imidacloprid, clothianidin and thiamethoxam) based on all of the research now available. In September 2017 the Committee stated that:

- Exposure to these neonicotinoid pesticides under field conditions can have an unacceptable effect on honey bee health.
- Such unacceptable effects are occurring at a landscape level and between seasons.
- These neonicotinoid pesticides are relatively persistent in the environment and can occur in non-target plants foraged by bees.
- Wild bees (bumblebees and solitary bees) are negatively affected by exposure to neonicotinoid residues from across the landscape.
- The unacceptable effects of these pesticides are not always apparent. They appear to be subtle and driven by environmental factors such as the availability of feeding sources and bee health stressors.

For further information please contact:

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See also previous Trust briefings and reports:

- Nature in Brief: Integrated Pest Management http://scottishwildlifetrust.org.uk/docs/002_293__intergratedpestmanagament_scottishwildlifetrust_natureinbrief_december2013_1387469755.pdf
- Pollinators Briefing http://scottishwildlifetrust.org.uk/docs/002_057__briefingonpollinators_aug2014_1407495997.pdf
- Neonicotinoids http://scottishwildlifetrust.org.uk/docs/002__057__publications__policies__Briefing_on_Neonicotinoids___Oct_2012__1350310904.pdf
- Neonicotinoids - supplementary briefing for MSPs http://scottishwildlifetrust.org.uk/docs/002_057__briefingonneonicotinoids_jan2013_1359042800.pdf
- Neonicotinoids post EU vote http://scottishwildlifetrust.org.uk/docs/002_057__briefingonneonicotinoids_march2013_1370013511.pdf
- Neonicotinoids campaign 2015 https://scottishwildlifetrust.org.uk/wp-content/uploads/2016/09/002_167__campaignbriefingnov2015_1448892582.pdf

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[1] Commission implementing regulation (EU) No 485/2013
[2] See: http://www.sasa.gov.uk/pesticides/pesticide-usage/pesticide-usage-survey-reports
[3] http://www.efsa.europa.eu/en/press/news/130116
[4] Guttation is the process by which some plants exude sap in droplets that resemble dew
[5] Mainly clothianidin, imidacloprid and thiamethoxam
[6] Woodcock et al (2017) Country-specific effects of neonicotinoid pesticides on honey bees and wild bees. Science 356, 1393–1395 (2017)
[7] Woodcock et al (2016) Impacts of neonicotinoid use on long-term population changes in wild bees in England . Nature Communications 7:12459 | DOI: 10.1038/ncomms12459 |www.nature.com/naturecommunications
[8] Tsvetkov, et al (2017) Chronic exposure to neonicotinoids reduces honey bee health near corn crops Science 356 (6345), 1395-1397.
[9] Mitchel et al (2017) A worldwide survey of neonicotinoids in honey. Science 358, 109–111
[10] Moffat et al.2015 Chronic exposure to neonicotinoids increases neuronal vulnerability to mitochondrial dysfunction in the bumblebee (*Bombus terrestris*). *FASEB J*. doi:10.1096/fj.14-267179
[11] Whitehorn et al 2012 Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production Science 336 (351-352)
[12] Rundlof et al 2015 Seed coating with a neonicotinoid insecticide negatively affects wild bees. Nature Doi:10.1038/nature14420
[13] Rundlof et al 2015 Seed coating with a neonicotinoid insecticide negatively affects wild bees. Nature Doi:10.1038/nature14420
[14] Whitehorn et al 2012 Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production Science 336 (351-352)
[15] Kessler et al. 2015 Bees prefer foods containing neonicotinoids. Nature 521 (74–76)
[16] Rundlof et al 2015 Seed coating with a neonicotinoid insecticide negatively affects wild bees. Nature Doi:10.1038/nature14420
[17] Henry et al 2015 Reconciling laboratory and field assessments of neonicotinoid toxicity to honeybees. Proc. R. Soc. B 282: 20152110.
[18] Goulson 2013. An overview of the environmental risks posed by neonicotinoid insecticides. Journal of Applied Ecology 11/1365-2664.12111
[19] Stanley et al 2015. Neonicotinoid pesticide exposure impairs crop pollination services provided by bumblebees Nature doi:10.1038/nature16167
[20] US Environmental Protection Agency, Office of Pesticide Programs. Factsheet Clothianidin (2003) EPA Publication 7501C; www.epa.gov/opp00001/chem_search/reg_actions/registration/fs_PC-044309_30-May-03.pdf.
[21] Goulson 2013. An overview of the environmental risks posed by neonicotinoid insecticides. Journal of Applied Ecology 11/1365-2664.12111
[22] Hopwood, J., S. H. Black, M. Vaughan, and E. Lee-Mäder. 2013. Beyond the Birds and the Bees. Effects of Neonicotinoid Insecticides on Agriculturally Important Beneficial Invertebrates: The Xerces Society for Invertebrate Conservation
[23] Krupke et al 2012 Multiple Routes of Pesticide Exposure for Honey Bees Living Near Agricultural Fields. PLoS ONE 7, e29268
[24] Goulson 2013. An overview of the environmental risks posed by neonicotinoid insecticides. Journal of Applied Ecology 11/1365-2664.12111
[25] Hallmann et al 2014 Declines in insectivorous birds are associated with high neonicotinoid concentrations. Nature 511 (341-343)
[26] Gilburn et al. 2015 Are neonicotinoid insecticides driving declines of widespread butterflies? Peer J 3:e1402 DOI 0.7717/peerj.1402
[27]Van Dijk et al 2013 Macro-invertebrate decline in surface water polluted with imidacloprid. PLoS ONE 8, e62374
[28] Roessink et al 2013 The neonicotinoid imidacloprid shows high chronic toxicity to mayfly nymphs. Environ. Toxicol. Chem. 32, 1096–1100
[29] For information on committee see https://www.gov.uk/government/groups/expert-committee-on-pesticides - Report quoted in this briefing was published September 2017