Department for Environment, Food and Rural Affairs

The UK Expert Committee on Pesticides (ECP)

Advice to Departments

Risks arising from the use of neonicotinoid pesticides

Introduction

Defra has requested that the UK Expert Committee on Pesticides (ECP) provide its current assessment of the risks to pollinators posed by the neonicotinoid pesticides thiamethoxam, clothianidin and imidacloprid.

In 2013 the EU agreed to restrict the use of these neonicotinoid pesticides on a range of mostly flowering crops. Earlier this year the Commission proposed further restricting the use of these pesticides (so that they could only be used on plants that spend their entire life cycle in permanent greenhouses).

Background

Since the Committee's predecessor last formally wrote to Ministers on the overall assessment of risks to pollinators from neonicotinoids in 2013, it has kept a close watch on emerging evidence about neonicotinoids and pollinator health. New scientific reports are regularly reviewed by the ECP, which weighs their scientific rigour, contribution to the evidence base, consistency with previous findings and coherence with general knowledge about the hazard. Periodically, the ECP reviews the current balance of evidence and tests it against previous advice to Ministers.

At its July 2017 meeting the ECP considered a major study entitled "Country-specific effects of neonicotinoid pesticides on honey bees and wild bees", a link to which can be found at: http://science.sciencemag.org/content/356/6345/1393.full. At the same meeting the ECP also considered several potentially important recently published scientific reports, including the work of Tsvetkov *et al*, "Chronic exposure to neonicotinoids reduces honey bee health near corn crops" which can be found at http://science.sciencemag.org/content/356/6345/1395.full and other papers. The Committee's views on these studies and the current balance of evidence are given below.

The study by Woodcock *et al.*, Science, June 2017

The study by Woodcock and colleagues assessed the effect of exposures to the neonicotinoid pesticides clothianidin and thiamethoxam on honey bees and wild bees.

It was conducted at sites in Germany, Hungary and the UK. Effects were reported against two of the three EFSA primary assessment end-points: over-wintering success (whether there is a significant difference between the control and treatment colonies in colony strength following the over-wintering period (i.e. in the next spring following the exposure period)) and colony strength (the number of individual bees a colony contains). Forage mortality was not studied.

For **honey bees** the results differed between countries or, more precisely, the situations that prevailed at the test sites.

Over-wintering success: In Germany, following exposures to the two pesticides no overall effects on over-wintering success were detected. In Hungary, no statistically significant effects were detected for thiamethoxam, but exposure to clothianidin was associated with a lower number of bees, a finding that was significant statistically. In the UK, over-winter survival of the population was too low to complete a robust analysis, although findings tended towards those in Hungary.

Colony strength: Colony strength – as judged by worker numbers and number of storage cells – was not significantly related to exposure to thiamethoxam. Exposure to clothianidin was associated with a statistically significant reduction in both these measures in the UK, but not in Germany or in Hungary. Effects on egg cell production (which is a secondary end-point for colony strength) varied, being lower in Hungary, higher in Germany, and mixed in the UK; clothianidin exposure was associated with the statistically significant elevation in Germany, but thiamethoxam was linked with the statistically significant reduction in Hungary.

For **wild bees**, no overall effects on queen or egg cell production were detected. The study highlighted, however, that exposures could arise from historical use of the neonicotinoid pesticide imidacloprid, still present in the environment. When an estimate was made of total concentrations of all neonicotinoids in bumble bee and solitary bee nests, including those due to environmental contamination, a significant relationship was found between higher pesticide levels and reduced reproductive success, specifically reduced bumble bee queen production and solitary bee egg cell production.

The findings as a whole, therefore, present a complex picture. Some evidence exists that exposure to neonicotinoids can affect the over-wintering success and colony strength of honey bees, and that neonicotinoids can affect the reproductive health of wild bees. On the other hand, findings varied by setting and by pesticide.

Certain unavoidable limitations in the investigation may account for some of this variation. It was noted, for example, that crops grown from the treated seed in Germany tended to flower later than those elsewhere and, as a result, might have contained fewer pesticide residues in pollen and nectar; or, that later flowering might have allowed bees at the German site to forage on a wider range of pollen and nectar

sources; it was further noted that in Germany, oilseed rape grown from treated seed constituted a smaller proportion of the bee's diet than in Hungary or the UK; and that varroa and nosema were less often present in honeybee hives in Germany than in Hungary or the UK. Findings between countries may also have differed simply by chance, as the study's size did not allow it to establish statistically significant effects as small as those proposed in EFSA guidance. Another possibility is that pollinator health is dependent on a wide range of other environmental factors, differences in which may have existed between the sites despite the care taken over the experimental design; some of these may have existed at the landscape level.

Overall, the study is taken by the ECP to represent further evidence that neonicotinoids may harm pollinators under field conditions.

Such a conclusion would be compatible with the only other large-scale field experiment on pollinator health, conducted in Sweden in 2015 (Seed coating with a neonicotinoid insecticide negatively affects wild bees (*Rundlöf et al.)*). This study focussed on spring-sown rather than winter-sown oilseed rape and detected effects in bumble bees and not in honey bees.

The differences by setting, by agent and between studies underscore the major challenges posed to robust risk assessment: subtle but important differences in risk may exist according to the landscape and circumstances in which neonicotinoid pesticides are applied.

Of concern to the Committee was the evidence on environmental contamination by imidacloprid. This pesticide is known to persist in the environment, and the study by Woodcock *et al* adds to a growing body of evidence which implies continued risks beyond the season of application and in non-target plants foraged by bees.

The study by Tsvetkov *et al.*, Science June 2017

This study established that honey bees near corn crops in Canada were naturally exposed to neonicotinoids for up to 4 months and it quantified their exposures. Honey bees were then fed an experimental diet containing clothianidin at field-realistic levels for 12 weeks and found to have higher mortality and queenlessness over time.

The acute toxicity was doubled in the presence of a commonly encountered fungicide. This is the first substantive evidence of this kind from the field and is an observation that lies outwith the regulatory framework.

The study adds to a growing literature implying adverse effects on honey bee health at exposure levels compatible with those measured in the environment; persistence of neonicotinoid pesticides in non-target plants was evident in the data presented.

Other recent studies

The ECP also considered an experiment by Baron *et al.* (2017) which reported an adverse effect of thiamethoxam on the ovary development and feeding of wild bumble bee queens; and an experiment by Tosie *et al.* (2017) which reported an adverse effect of thiamethoxam on honey bee flight ability.

Increasingly, the Committee has noted that a range of adverse effects have been reported that lie outwith the established regulatory end-points. Such studies add to the range of plausible biological mechanisms that may explain observed effects in the laboratory and in semi-field and field studies.

A list of the studies considered by the Committee since March 2015 is listed in the Annex to this advice note.

ECP conclusions

The ECP considered that the study by Woodcock *et al* significantly adds to the evidence base, being compatible with, and adding considerable weight to, concerns identified in previous research. Other recent reports have also been informative.

The Committee considers that the body of evidence now currently available indicates that:

- Exposure to these neonicotinoid pesticides under field conditions can have an unacceptable effect on honeybee 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.
- Precise risk assessment is not possible at current levels of uncertainty, posing a major challenge to risk management.

ECP Advice

The Committee advises that the currently available evidence indicates that the risk posed to pollinators from the use of three neonicotinoids (imidacloprid, clothianidin

and thiamethoxam) in flowering crops is greater than the position set out in the ACP's advice of 2013.

This revised advice is based on the continued emergence of evidence of adverse effects in pollinators as determined from laboratory studies, evidence of interactions with other (chemical and non-chemical) stressors, and evidence of landscape scale effects on honey bees and other bee species. There are also new data/information that demonstrate the environmental persistence of the neonicotinoid pesticides (particularly that of imidacloprid as revealed by detection in areas where there had been no recent known use); such persistence is likely to increase the exposure and risk to pollinators. These recent studies, when considered altogether, make it difficult to provide certainty that there is an acceptable risk to pollinators from the use of these three neonicotinoids on flowering crops. Therefore, ECP supports the current restrictions.

The advance in knowledge described above and, in addition, important new evidence of occurrence of residues in plants in non-cropped areas, also raises ECP concerns about the use of these three neonicotinoids on non-flowering crops (other than those grown in completely enclosed systems). ECP notes a paucity of published, peer-reviewed studies comparable with those that show environmental persistence in oilseed rape fields and hence direct evidence of an impact on pollinators from use of these compounds on non-flowering crops. This inhibits the development of fully evidence-based advice on this issue. However, there remains the potential for effects, which could occur if:

- in-field soil residues resulting from the planting of a treated, non-flowering crop persist into following years when they could be taken up by a mass-flowering crop; and

- sowing a treated non-flowering crop results in contamination of non-cropped areas, leading to subsequent uptake and expression of compound by off-field wild flowers.

The Committee has identified a number of data gaps/opportunities for further study to better understand these risks. In no particular order of priority, these are: the impact of neonicotinoid use on ecosystem services, pollinators other than bees and the aquatic environment; persistence of these chemicals in soils following different cropping regimes, particularly those including non-flowering crops; the mechanism for contamination of plants in non-cropped farm areas; the potential for uptake of neonicotinoid residues in soil by subsequent flowering crop and non-crop plants; whether exposure to these compounds may be dampened/amplified when other bee health stressors are present; whether mitigation measures can be used to reduce exposures.

The lack of direct evidence to substantiate potential impacts from use of these three compounds on non-flowering crops is an issue of concern for the Committee. Such evidence is needed. Nevertheless, on the basis of the limited number of studies to date, the Committee considers that extension of the current restrictions could be justified.

UK Expert Committee on Pesticides
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Addendum

Subsequent to the September 2017 meeting of the ECP, a study conducted by Mitchell et al. 'A worldwide survey of neonicotinoids in honey' has been published. This paper reports that 75% of honey samples collected from across the world contain detectable neonicotinoid residues reflecting regional differences in the use of different products. The Committee considers that this does not pose a direct danger for human health since the concentrations are lower than currently accepted threshold levels; nor are the average reported concentrations likely to have an acute effect on pollinators, though the authors argue that chronic effects may arise at these levels. The Committee feels that this additional evidence of widespread neonicotinoid occurrence in biological systems across agricultural landscapes further substantiates its advice that the current restrictions on use could be extended.

Annex

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