‘Gold standard’ assessing neonicotinoids: Field bee hive studies find pesticides not major source of health issues

Are bee populations around the world in decline?

Are pesticides–particularly the class known as neonicotinoids–a major contributor to health problems in honey bees, bumble bees, and wild bees?

How can we best make sense of the dozens of sometimes confusing and conflicting studies on the global bee population?

Most entomologists and other bee experts believe that the gold standard for assessing bee health issues is the field hive study. Field studies of honey bees and bumble bees foraging in neonic pesticide-treated crops, supplemented by other available forage, give the most realistic insight into the possible effects of these pesticides on the hive**.** Hive level effects are the most relevant because individual bees, whose life span is measured in a few weeks to a few months (queens alone can live a few years), are the short-lived members of a super-organism – the hive, which is ongoing. The hive’s tens of thousands of individual insects, each carrying out a specialized role according to its life-cycle stage, create a whole – a food-gathering, food-storing, self-cleansing and detoxifying, reproductive colossus — that is greater than the sum of its parts.

10 years of bee health field studies vs laboratory research

There is a tendency in the science media to report on studies, no matter how weak, that suggest problems rather than ones that reaffirm current practices as safe. This has been true in the debate over neonicotinoids: while the media continues to produce stories suggesting a pesticide-fueled bee-apocalypse is unfolding, the world’s top entomologists and regulators are going in a different direction–they believe that while bee health issues are real, the challenge from pesticides in general and neonicotinoids in particular–the boogymen of anti-pesticide activists–represent only the tiniest fraction of the cause. Field study after field study has indicated that there is little to no observable adverse effect on honey bees at the hive level from field-realistic exposures to properly-applied pesticides.

More than 18 field studies have been completed and published in the last 10 years that have been focused on honey bees, bumble bees and, in one case, a solitary bee species (red mason bees) foraging in neonic-treated crops. Involving great expense, methodological complexity (to ensure against contaminated results), and usually a year or more of effort, these studies provide field-realistic exposures of neonics for bees in actual crop settings. These studies – compiled and summarized below – have not gotten the media attention of one-off laboratory studies, many of which are poorly constructed, and some of which have been overseen by scientists whose ideological views on pesticides and ‘intensive agriculture’ are well known. [Read GLP article on biologist David Goulson]

Why such a discrepancy between field and lab studies? Field studies offer a reality check to lab studies – most commonly ‘caged bee’ studies – which depend on setting up a rigid experimental protocol that is in

direct conflict with the dynamic nature of a bee hive. On close examination, it also turns out that lab studies almost always overdose the bees, for several reasons.

- First, in the field, bees have access to a wider variety of forage than neonic-treated crops – whereas lab studies commonly feed the bees only neonic-spiked food.
- Second, in the field, bees' exposure period to neonic-treated crops is limited by the short duration of crop flowering – while most lab studies expose bees to continuous diets spiked with neonic pesticides for many weeks.
- Third, lab studies are unable to capture the unique self-detoxification capacities of the super-organism that the bee hive represents.
- Finally, many lab studies simply feed bees doses of neonic pesticides at levels far above field-realistic exposures. Such lab studies prove little more than that you can definitely kill honey bees (or bumble bees) if you feed them enough of a pesticide.

What follows is an annotated compilation of available field studies of neonics' effects on honey bees, bumble bees and red mason (solitary) bees, accompanied by a compilation of available review studies:

Field Studies – Honey Bees

–"**Sublethal Effects of Imidacloprid on Honey Bee Colony Growth and Activity at Three Sites in the U.S." by W.G. Meikle, J.J. Adamczyk, M. Weiss, A. Gregorc, D.r. Johnson, S.D. Stewart, J. Zawislak, M.J. Carroll, G.M. Lorenz. PLOS One, December 28, 2016.**
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0168603

In six separate hybrid forced-exposure field studies – two each, in consecutive years (2013-14 and 2014-15), at three separate sites (in Arizona, Arkansas and Mississippi, each representing distinctly different agricultural and non-agricultural foraging environments for honey bees) — researchers found no discernible differences – in brood success, foraging success, or ability to regulate the hive's internal temperature — between honey bee colonies exposed to field-realistic imidacloprid doses (5 ppb) and 'control' colonies unexposed to imidacloprid. There were, in short, no observable adverse effects at the colony level from field-realistic exposures to this neonic pesticide. In fact, evidence from one site suggested that such low-level neonic exposure may actually stimulate heightened foraging activity by bee colonies, improving overall colony performance. The experiment demonstrated that high doses of imidacloprid (100 ppb – many times higher than would normally be encountered in field-realistic settings — significantly reduced honey bee colonies brood rearing, foraging, food storage, and hive temperature stabilization capabilities – but these high levels of exposure were not as lethal to the honey bees as EPA's established lethality levels would have predicted. Study results also demonstrated that both caged honey bees and honey bee colonies being fed sugar syrup highly spiked with 100 ppb of imdacloprid avoided – consumed less – the high pesticide concentration.

–"Large-scale Monitoring of Effects of Clohianidin-dressed Oilseed Rape Seeds on Pollinating Insects in Northern Germany: Effects on Honey Bees (*Apis mellifera*) by D. Rolke, S. Fuchs, B Grunewald, Z. Gao, . Blenau. Ecotoxicology, September 19, 2016.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5093180/

This large-scale field study, conducted in 2014, found that 'honey bee colonies foraging in clothianidin seed-treated oilseed rape did not show any detrimental symptoms as compared to colonies foraging in clothianidin-free oilseed rape. Development of colony strength, brood success as well as honey yield and pathogen infection were not significantly affected by clothianidin treatment during this study.'

Funding: Expenses supported by Bayer CropScience AG (Monheim, Germany).

–"Reconciling Laboratory and Field Assessments of Neonicotinoid Toxicity to Honeybees" by M. Henry. N. Cerrutti, P. Aupinel, M. Gayrard, J-F Odoux, A. Pissard, C. Ruger, V. Bretagnole. Proceedings of the Royal Society B, November 18, 2015.
http://rspb.royalsocietypublishing.org/content/282/1819/20152110.

This study, seeking to reconcile the deleterious effects of neonicotinoids on individual honey bees in laboratory studies and field studies' consistent results showing no observable deleterious effects at the hive level from field realistic exposure, paradoxically confirmed previous field studies observations. While the authors claimed to demonstrate that foraging bees did have shorter lives when exposed to neonics in field-realistic settings, these effects were 'buffered by the colonies demographic regulation response' so that, again, no adverse effects were observable at the colony level.

Funding: Equipment and fieldwork were provided by Terres Inovia, the French Ministry of Agriculture and the European Community programme (797/2004) for French beekeeping, coordinated by the French Ministry of Agriculture (RISQAPI project). ACTA and INRA SPE Division provided funds for field assistance.

–"Thiamethoxam: Assessing Flight Activity of Honeybees Foraging on Treated Oil Seed Rape Using RFID Technology" by H. Thompson, M. Coulson, N. Ruddle, S. Wilkins, S. Harkin. gov, February, 2016. https://www.ncbi.nlm.nih.gov/pubmed/26222207

This study used radio-frequency identification technology to track honey bees exposed and not exposed to field-realistic doses of Thiamethoxam in seed-treated OSR. It concluded that exposure to this neonic pesticide had no effect on the bees' foraging lifespan, bees' total number of foraging flights and their duration, or their ability to successfully navigate back to the hive.

–"Inventering av risken for forgiftning av bin med vaxskyddsmedel av typen neonikotinoider under svenska forhallanden" by M. Rundlof, R. Bommarco, I. Fries, H.G. Smith, T.R. Pedersen. Jordbruks verket Slutrapport
https://www.jordbruksverket.se/download/18.1cc979d215215dfe04bb8650/1452158845294/Rapportbinochne

This repetition of the following Runlof et al. study confirmed that there was no observable effect on honey

bee colonies exposed to clothianidin seed-treated OSR. Its results regarding bumble bees, solitary bees and wild bees differed with the previous study, as the bumble bee experiments failed (producing too little data on which to based conclusions) and no solitary bee or wild bee results have yet been published.

–"Seed Coating with a Neonicotinoid Insecticide Negatively Affects Wild Bees" by M. Rundlof, G.K.S. Andersson, R. Bommarco, I. Fries, V. Henderstrom, L. Herbertsson, O. Jonsson, B. Klatt, T.R. Pederson, J. Yourstone, & H.G. Smith. Nature, April 22, 2015.
http://www.nature.com/nature/journal/v521/n7550/full/nature14420.html

This large field study of honey bees, bumble bees solitary bees and wild bees foraging in clothianidin-treated Oil seed rape (OSR) found no effect of seed-treated OSR on honey bee colonies. The study did find some negative impacts on bumble bees, solitary bees and wild bees, but the results were equivocal given the very small bee populations used in the study and the fact that control fields and test fields were sprayed with different pesticides. As seen above, an attempt to recreate these findings failed.

–"Assessment of Chronic Sublethal Effects of Iidacloprid on Honey Bee Colony Health" by G. Dively, M. Embrey, A. Kamel, D. Hawthore, J. Pettis. PLOS One, March 18, 2015.
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118748

This forced exposure field study showed that chronic exposure to the most likely field-realistic doses (5 ppb) of neonic exposures in seed-treated crops had negligible effects on overall honey bee colony health and were not likely a cause of colony declines – even though exposure at the highest dose ranges found in pollen of certain treated crops could adversely affect overall colony health and over-wintering success.

–"A Large-Scale Field Study Examining Effects of Exposure to Clothianidin-treated Canola on Honey Bee Colony Health, Development and Over-wintering Success" by G.C. Cutler, C. Scott-Dupree, M. Sultan, A. McFarlane, L. Brewer. PeerJ, October 20, 2014.
https://peerj.com/articles/652.pdf

This large-scale field study conducted in southern Ontario, Canada, found that honey bee colonies 'were vigorous before and after the exposure period, and we found no effects of exposure to clothianidin seed-treated canola on any endpoint measures.' 'Over-wintering success did not differ significantly between treatment and control hives and was similar to overwintering colony loss rates reported for the winter of 2012-2013 for beekeepers in Ontario and Canada.' The study concluded that 'canola grown from seed-treated with clothianidin poses low risk to honey bees.'

Funding: All expenses for this study was through Bayer CropScience. Bayer CropScience personnel had no role in collecting or interpreting field and honey bee colony data or in writing the manuscript.

–"A Four-year Program Investigating Long-Term Effects of Repeated Exposure of Honey Bee Colonies to Flowering Crops Treated with Thiamethoxam" by E. Pilling, P. Campbell, Mike Coulson, Natalie Ruddle, Ingo Tornier. PLOS One, October 23, 2013.
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0077193

This field study, the first to specifically test the ability of honey bee hives to successfully over-winter

repeatedly while foraging repeatedly on neonic-treated corn and oil seed rape crops, showed that there were no significant differences between unexposed and neonic-exposed bee hives on any of the study's figures of merit – mortality, foraging behavior, colony strength, colony weight, brood development or food storage. It also found that neonic residues detected in nectar and pollen collected by bees from the treated crops were negligible – usually at or below the point of detection – and concluded that Honey bee exposure to Thiamethoxam at field-realistic levels posed a low risk to bees.

Funding: Authors report no external support or funding.

–"RFID Tracking of Sublethal Effects of Two Neonicotinoid Insecticides on the Foraging Behavior of *Apis mellifera*" by C.W. Schneider, J. Tautz, B. Grunewald, S. Fuchs. PLOS One, January 11, 2012. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0030023.

While not a full field study, the authors used radio-frequency tracking devices (RFID) to study changes in the foraging behavior of honey bees exposed to differing levels of neonic pesticides – imidacloprid and clothianidin – under 'field-like circumstances'. They concluded that, 'At field-relevant doses for nectar and pollen no adverse effects were noted for either substance.' (However, significant reduction of foraging ability was noted at higher dosages — above .5 ng/bee for clothianidin and above 1.5 ng/bee for imidacloprid — within the first three hours after dosing.)

Funding: European Union and the State of Hesse (Project No: 37150400). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

–"The German Bee Monitoring Project: A Long-Term Study to Understand Periodically High Winter Losses of Honey Bee Colonies" by E. Genersch, W. von der Ohe, H. Kaatz, A. Schroeder, C. Otten, R. Buchler, S. Berg, W. Ritter, W. Muhlen, S. Gisder, M. Meixner, G. Liebig, P. Rozenkranz. Apidologie, April 7, 2010.
http://www.apidologie.org/articles/apido/full_html/2010/03/m09161/m09161.html.

In this four-year study monitoring 1200 bee colonies from 120 apiaries via twice-yearly sampling for parasitic and pathogenic effects, the authors identified four factors significantly related to observed overwinter losses in the observed bee colonies (high varroa infestation levels; deformed wing virus (DWV) and acute bee paralysis virus (ABPV) infections in autumn; queen age; and colony weakness in autumn). 'No effects could be observed for *Nosema* spec. or pesticides.'

Funding: Project financially supported by the German IVA (Industrieverband Agrar) and the German Beekeepers' Association (DIB) and non-financially supported by the State Ministry of Nutrition, Agriculture and Consumer Protection (BMELV). E.G. was supported by grants from the Ministries for Agriculture from Brandenburg and Sachsen-Anhalt, Germany. In addition, we are indebted to all the beekeepers who cooperated within this monitoring project and to all those who contributed to the success of the project by fruitful discussions and by assisting with the field and lab work. We thank Dr. Martens (LUFA, Speyer, Germany) for performing the residue analysis in pollen.

–"Does Imidacloprid Seed-Treated Maize Have an Impact on Honey Bee Mortality?" by B.K. Nguyen, C. Saegerman, C. Pirard, J. Widart, B. Thirionet, F.J. Verheggen, D. Berkvens, E. De Pauw, E. Haubruge. Journal of Economic Entomology, April 1, 2009.

http://jee.oxfordjournals.org/content/102/2/616

This Belgian study examined 16 honey bee apiaries and mapped all the maize fields treated or untreated with the neonic imidacloprid within 3000 meters of their locations. The study found honey bee mortality to be positively correlated with the size of the apiary and inversely correlated with the area of treated and untreated maize fields surrounding the apiaries, 'suggesting that this pesticide does not interact with bees fitness.' The results 'support the hypothesis that imidacloprid seed-treated maize has no negative impact on honey bees.'

–"Exposure to Clothianidin Seed-Treated Canola Has No Long-term Impact on Honey Bees" by G.C. Cutler and C. Scott-Dupree. Journal of Economic Entomology, 100, 2007, 765-772.
http://jee.oxfordjournals.org/content/100/3/765

This long-term field study of honey bee colonies exposed to clothianidin seed-treated oilseed rape fields found 'no differences in bee mortality, worker longevity or brood development occurred between control and treatment groups throughout the study' and that 'weight gains of and honey yields from colonies in treated fields were not significantly different from those in control fields'. Tests of clothianidin residues in honey, nectar and pollen in the treatment group colonies were found to be between 8- and 22-fold below the no observable adverse effects levels. Over-wintered colonies assessed in the spring revealed no differences between those exposed to treated and untreated canola. In short, there were no observable adverse effects on honey bee colonies from field-realistic exposure to clothianidin seed-treated canola crops.

Field Studies – Bumblebees

–"Large-scale Monitoring of Effects of Clothianidin-dressed OSR Seeds on Pollinating Insects in Northern Germany: Effects on Large Earth Bumble Bees (*Bombus terrestris)* by G. Sterk, B. Peters, Z. Gao, U. Zumkier. Ecotoxicology, September 27, 2016.
http://link.springer.com/article/10.1007/s10646-016-1730-y

This long-term, large-scale field study involving a total of 60 bumble bee hives at 10 different locations in the study area, found that 'Colony development in terms of hive weight and the number of workers showed a typical course with no statistically significant differences between [treated and untreated] sites. Reproductive output was comparatively high and not negatively affected by the exposure to treated OSR. In summary, [clothianidin]-dressed OSR did not cause any detrimental effects on the development or reproduction of bumble bee colonies."

Funding: All expenses for this study was through Bayer CropScience.

–"Investigating the Impacts of Field-Realistic Exposure to a Neonicotinoid Pesticide on Bumblebee Foraging, Homing Ability and Colony Growth" by D. Stanley, A. Russel, S. Morrison, C. Rogers, N. Raine. Journal of Applied Ecology, May 30, 2016.
http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12689/abstract

Using RFID tracking technology (similar to the C. W. Schneider et al. and H. Thompson et al. honey bee studies above), this forced exposure field study found that bumblebees exposed to field- realistic doses (2-4 ppb.) of a neonic pesticide (thiamethoxam) carried out longer foraging flights and brought back less pollen than un-exposed bumble bees. But the exposed bumblebees actually performed better than the unexposed bees in returning to their hives when released from a 1 km distance. Neonic exposure had no effect on bumblebees' ability to navigate back to their hives when released from a 2 km distance. And neonic exposure had no effect on overall colony size.

Funding: (via: react-text: 5956 http://onlinelibrary.wiley.com/…/1365-2664.12689/full… /react-text)

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- Biotechnology and Biological Sciences Research Council (BBSRC)
- Wellcome Trust
- Scottish Government
- Department for Environment, Food and Rural Affairs (DEFRA)
- Natural Environment Research Council (NERC)
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–"Monitoring the Effects of Thiamethoxam Applied as a Seed Treatment to Winter Oilseed Rape on the Development of Bumblebee (*Bombus terrestris)* Colonies" by H. Thompson, M. Coulson, N. Ruddle, S. Wilkins, P. Harrington, S.Harkin. Pest *Management Science, 2016.*
http://onlinelibrary.wiley.com/wol1/doi/10.1002/ps.4202/full

This field study, involving the placement of bumblebee colonies adjacent to flowering neonic-treated and untreated fields of oilseed rape, found that bumblebee colonies exposed to neonic (thiamethoxam) seed-treated oilseed rape developed comparably to colonies not exposed to neonics.

Funding: Syngenta

–"A Field Study Examining the Effects of Exposure to Neonicotinoid Seed-Treated Corn on Commercial Bumblebee Colonies" by G. C. Cutler, C. Scott-Dupree. Ecotoxicology, November, 2014. http://link.springer.com/article/10.1007/s10646-014-1340-5.

This field study placed commercial bumblebee colonies adjacent to conventional (neonic-treated) and organic (no neonic treated) cornfields at the time of corn pollen shed to test the effect of neonic-treated corn pollen on bumblebees. It found, first and predictably, that very little corn pollen, containing minute neonic traces, was collected by the bees. It further found that both neonic-exposed and un-exposed bumblebee colonies developed normally and healthily and that neonic seed-treatments had no effect on any hive endpoints measured except the number of worker bees, which was approximately 1/3 greater in hives placed next to organic cornfields than for hives placed next to conventional (neonic-treated) fields. Conclusion: exposure to neonic-treated corn pollen shed poses low risk to commercial bumblebees.

–"Effects of Neonicotinoid Seed Treatments on Bumble Bee Colonies Under Field Conditions" by H. Thompson. UK Food and Environmental Research Agency, March, 2013.

http://fera.co.uk/news/resources/documents/chem-defraBumbleBeeReportPS2371V4a.pdf

This short-term study, performed to test a previous year's study conclusion that neonic-treated crop exposure caused bumble bee colonies to produce fewer than normal numbers of queens, this field experiment, which placed 20 bumble bee colonies among untreated, imidacloprid-treated and clothianidin-treated oilseed rape crops. It assessed the colonies' health and collected residue samples. It determined that there was no discernable difference among the colonies in terms of the numbers of new queens produced. It found significant differences in the neonic residues detected in nectar and pollen collected from the colonies at the three different sites but concluded, 'Using the observed variation in neonicotinoid residues across colonies within and between sites, possible correlations with colony mass and the number of new queens produced were explored. No clear consistent relationships were observed.'

Funding: The Food and Environment Research Agency, Sand Hutton, Yorkshire, England

Field Studies – Solitary Bees

–"Large-scale Monitoring of Effects of Colthianidin-dressed Oilseed Rape Seeds on Pollinating Insects in Northern Germany: Effects on Red Mason Bees (*Osmia bicornis*) by B. Peters, Z. Gao, U. Zumkier. Ecotoxicology, October 5, 2016. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5093198/

This large-scale, long-term study – part of a four-part evaluation of possible effects of clothinidin seed-treatments on three different bee species and of its residues in nectar and pollen – concluded that 'High reproductive output and low parasitization rates indicated the [clothianidin]-dressed oilseed rape did not cause any detrimental effects on the development or reproduction of mason bees.'

Funding: All expenses for this study was through Bayer CropScience AG.

Review Articles

–"Climate Change Impacts on Bumblebees Converge Across Continents" by J.T. Kerr, A. Pindar, P. Galpern, L. Packer, S.G. Potts, S.M. Roberts, P. Rasmont, O. Schweiger, S.R. Colla, L.L. Richardson, D.L. Wagner, L.F. Gall, D.S. Sikes, A. Pantoja. Science, July 10, 2015.
http://science.sciencemag.org/content/349/6244/177.

Observed shifts in bumblebee ranges in response to climate warming – northward extension for species in northern and southern hemisphere temperate zones temperate zones and toward higher elevations in southern regions while remaining stable in the tropical/equatorial region – were determined to be *independent of changing land uses and of total pesticide or neonicotinoid applications.*

–"Interactive Effects of Pesticide Exposure and Pathogen Infection on Bee Health – A Critical Analysis" by E. Collinson, H. Hird, J. Cresswell, C. Tyler. Biological Reviews, July 6, 2015.
http://onlinelibrary.wiley.com/doi/10.1111/brv.12206/abstract.

This review study, assessing available studies of the effects of pesticide exposures on bee pathogen

infections and bee immune response, concludes that, at field-realistic exposure levels, pesticide exposure and pathogen infection do not interact. It is unclear whether there is any interaction between pesticide exposure and *Nosema* infections, viral loads and honey bee immune response at the colony level, as these interactions have only been observed in the laboratory.

–"The Dose Makes the Poison: Have 'Field Realistic' Rates of Exposure of Bees to Neonicotinoid Pesticides Been Overestimated in Laboratory Experiments?" by N. Carreck & F.L.W. Ratnieks. Journal of Apicultural Research, November 28, 2014.
http://www.tandfonline.com/doi/pdf/10.3896/IBRA.1.53.5.08

From the fact that various sublethal effects of neonicotinoids on honey bees and bumblebees observed in laboratory experiments have not been confirmed in any field studies to date, the authors conclude, from examining three key dosage factors relevant to field conditions (concentration, duration and choice), that laboratory studies have ended up overdosing the bees to produce the observed results.

–"A Causal Analysis of Observed Declines in Managed Honey Bees (*Apis mellierfa*)" by J.P. Staveley, S.A. Law, A. Fairbrother, A. Menzie. Human and Ecological Risk Assessment: An International Journal, 2014.

In this report of a Bayer-sponsored 2012 expert workshop, techniques of formal causal analysis were applied to known risk factors for honey bees, yielding the conclusions that "Varroa mites plus viruses were judged to be a 'probable cause' of the reduced survival [of honey bee colonies] while nutrient deficiency was judged to be a 'possible cause.' Neonicotinoid pesticides were judged to be 'unlikely' as the sole cause of this reduced survival, although they could possibly be a 'contributing factor.'

–"Risks of Neonicotinoid Insecticides to Honeybees" by A. Fairbrother, J. Purdy, T. Andrson, R. Fell. Environmental Toxicology and Chemistry, April 1, 2014.
http://onlinelibrary.wiley.com/doi/10.1002/etc.2527/abstract

This review of a large body of literature concluded that, while various negative effects of neonicotinoids had been demonstrated under laboratory conditions, typically exposing the bees to unrealistically high doses, under field conditions and exposed to field-realistic doses, similar negative effects on honey bee colonies has not been demonstrated. It is, consequently, not reasonable to conclude that crop applied neonicotinoids are a major risk factor for honey bee colonies within current uses and beekeeping practices.

–"**Neonicotinoids: Trying to Make Some Sense of the Science" by R. Oliver. com (Originally published in The American Bee Journal, August, 2012.** http://scientificbeekeeping.com/neonicotinoids-trying-to-make-sense-of-the-science/

In this wide-ranging, 'on-the-one-hand, on-the-other' analysis of evidence from a wide range of sources, Oliver gives seven logically hierarchical considerations, as well as real-world, practical evidence, for why neonic pesticides at field-realistic exposures are probably not responsible for colony declines or losses (apart from planter dust drift episodes).

Funding: None. This is an independent blog, authored by an entomologist: “This site is more or less a record of my learning process as I apply my formal training as a biologist to the practice of running a commercial beekeeping operation.“

–“Dietary Traces of Neonicotinoid Pesticides s a Cause of Declines inn Honeybees: An Evaluation of Hill’s Epidemiological Criteria” by J.E. Cresswell, N. Desneaux, E. van Engelsdorp. Pest Management Science, April 4, 2012. http://onlinelibrary.wiley.com/doi/10.1002/ps.3290/abstract.

Using Hill’s epidemiological criteria ‘as a structured process for making an expert judgment about the proposition that trace dietary neonicotinoids in nectar and pollen cause population declines in honey bees,’ the authors conclude that ‘dietary neonicotinoids cannot be implicated in honey bee declines’ (though they considered this conclusion provisional in light of important remaining gaps in current knowledge.

–“Neonicotinoids in Bees: A Review on Concentrations, Side-effects and Risk Assessments” by T. Blacquiere, G. Smagghe, C.A.M. van Gestel, V. Mommaerts. Ecotoxicology, February 18, 2012. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3338325/.

Claiming to be the first-ever review of 15 years of research on the effects of neonics on bees – particularly honey bees, bumble bees and solitary bees – the authors found that ‘environmental residue levels of neonicotinoids were found to be lower than acute chronic toxicity levels’ (though more research in this area was needed because of data limitations). Moreover, ‘many laboratory studies described lethal and sublethal effects of neonicotinoids on the foraging behavior, and learning and memory abilities of bees, while no effects were observed in field studies at field-realistic dosages.’ The authors also confirmed that a proposed risk-assessment scheme was applicable to neonics as it would consider their side-effects at both different stages of a bee’s life and at different levels of ‘biological organization (organism versus colony)’.

–“A Meta-analysis of Experiments Testing the Effects of a Neonicotinoid Insecticide (Imidicloprid) on Honey Bees” by J.E. Cresswell. Ecotoxicology, January, 2011. http://link.springer.com/article/10.1007/s10646-010-0566-0.

This meta-analysis of 14 different studies of the effects of the neonic imidacloprid on honey bees found that there would be little expected bee mortality from exposure to field-realistic doses – though Cresswell predicted that dietary exposure to the neonic in oilseed rape and sunflower pollen would impair honey bees’ navigation to varying degrees.

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