Neonicotinoid Insecticides Causing Bee Losses

A Synopsis of Recent Literature, with special reference to the situation in Germany

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Introduction

Bees face many threats to their survival, including: loss of habitat and wildflowers, industrial monoculture of crops; Varroa parasites; viral, fungal and bacterial diseases; climate change, etc. However, the weight of evidence from recent research, strongly confirms that systemic insecticides, notably the neonicotinoids (NNs), are the primary factor in the death of millions of bee colonies globally. The current 'state of the science' was recently confirmed in various comprehensive reviews (1 - 3). In response to this massive body of scientific evidence, in December 2013, the European Union imposed a moratorium on the use of three neonicotinoid insecticides, as seed-coatings on crops which attract bees; this suspension will last for two years (4).

A similar moratorium was also imposed on Fipronil, a phenyl-pyrazole insecticide, whose mode of action is similar to NNs. This ban will be reviewed in December 2015.

Mode of action of neonicotinoids (NN)

Neonicotinoids (NN)- were launched upon the market in 1992, by the inventor BAYER, for use *'against biting and sucking insects'*. Neonicotinoids kill insects by blocking nerve impulses and paralysing muscles. Since neonicotinoids were first licensed, there has been an exponential rise in the death of bee-colonies across Europe and America.

Neonicotinoids poison bees in a way that is similar to the action of nicotine on human brains; they bind chemically to post-synaptic acetylcholine receptors in the bee's brain. But, nicotine only stimulates the human brain for a short time, hence the nicotine-addict's need for constant re-supply. In marked contrast, NN have an irreversible, permanent effect on bees. They hyper-stimulate synapses in the bees' brain, overload sensory systems and impair muscular co-ordination.

It is easy to see this neural hyper-stimulation in bees, when they fall quivering from the flowers, as a direct result of acute intoxication by neonicotinoid poisons.

The toxicity of NNs to bees, ranges from 5,000 to almost 10,800 times more poisonous than DDT (5).

The seeds of most common crops, such as wheat, oilseed rape, maize and soybeans, are all coated with neonicotinoids. These insecticides are water soluble and persist in soil and water, with a half-life in some soils of up to 18 years (6); moreover they degrade into chemicals, which are just as toxic to bees, as the neonics themselves. Since soil and water remain contaminated for many years, it is unlikely that the EU's two year ban on neonics will show any positive results.

These neurotoxins are termed 'systemic', because they are absorbed into the entire tissues of a plant, from: roots to leaves and flowers to fruit. Crucially, the insecticide also renders the pollen and

nectar of the poisonous to bees . The whole plant becomes poisonous to insects; this happens to every plant, in every treated field, including non-target plants like wildflowers.

However, the real danger from these insecticides is subtle and hidden; it is unusual for bees to fall dead from the flowers, acutely poisoned by NN; but the infinitesimal amounts of these neurotoxins, which bees gather in pollen and nectar, engender a slow, sub-lethal poisoning. This chronic poisoning damages the bees' entire nervous system. This explains why forager bees become disoriented and fail to navigate their way back to the hive (7,8) This is the simple explanation for 'CCD' (Colony Collapse disorder), (mainly seen in the USA), in which forager/worker bees disappear en-masse, from apparently healthy colonies. All one finds in the hive are: the queen, a few young bees and a hive full of honey. Hardly any dead bees are found in the hive or nearby; almost the entire working population of bees vanishes without trace, dying somewhere in the field. Such colonies are doomed.

A Harvard research group carried out a 'semi-field' investigation by feeding bees sub-lethal doses of imidacloprid (brand name "Gaucho"); remarkably, while all colonies survived initially, for 12 weeks, 96% of colonies died after 23 weeks (9). Sub-lethal toxic effects also damage processes which are vital to the survival of honeybee colonies like: task differentiation in the hive, caring for the larvae, mutual grooming (esp. removal of parasites), thermo-regulation in the hive. We also observe severe abnormalities among the bees; they cannot retract their tongues; they tremble on the comb; they cannot perform the normal 'waggle dance' (which communicates the precise angle and distance of a food source); they fail to recognise related bees, etc. (10). Furthermore, sub-lethal doses of imidacloprid cause the hypo-pharyngeal glands to shrink in young honeybees; reducing their ability to produce royal-jelly for the queen and brood (11).

Recent weight of publications demonstrates the impact of NN

In marked contrast to the impressive number of high quality investigations, which confirm the toxic effect on bees of chronic, sublethal poisoning by NN, just two papers absolved NNs from responsibility for bee deaths. Both papers came from authors associated with the pesticide industry.

The first claimed, that all existing laboratory and semi-field investigations, used doses of NNs, which were too high and too toxic; the claim was that these doses did not reflect 'real world' concentrations of NN in pollen and nectar which bees gather from the fields.

Such was the phrase in a 'publication in preparation' from Helen Thompson; who was then head of the pesticide department at the British Ministry of Environment and Food DEFRA (12). On April 29th 2013 the UK government used Thompson's data in the attempt to block the EU's moratorium on NN (4); they failed.

Shortly afterwards, in September 2013, Helen Thompson resigned her UK government post and moved to a new job with the NN producer SYNGENTA in Basel / Switzerland. Recently it has been proved that the data provided by Thompson, and used by the UK government, was false (13).

Then, in April 2015, a research group from several Swedish universities published the results of a very ambitious study in 'Nature'; this used 16 paired and matched landscapes (14). Control areas (planted with untreated seeds)were compared with treated areas, in which oilseed rape seeds had been coated with clothianidin. However, bees in the study also had access to certain areas of field margin plants and an area with wild flowers. After estimating the proportion of oilseed rape pollen collected, the concentrations of clothianidin in pollen and nectar collected by bees, were measured. It turned out that, both honeybees and bumble bees, had collected higher amounts of Clothianidin in

comparison to earlier studies. This finding refuted Thompson's claim, that previous researchers had over-estimated NN concentrations in earlier experiments (15).

Secondly, any studies that reported adverse effects of NN to bees were criticised and undermined by claiming that *'unrealistically high dosages of NN'* had been used in the experiments; this implied that the studies were 'invalid'. They claimed that, under 'real' field conditions, bees could detect chemical residues of NN in treated crops and so avoided foraging on them (16). Yet again, this spurious claim was shown to be wrong, as recently published in ***Nature*** (same issue as ref. 14) (15,18).

Once again, one can see a strong association with the pesticide industry among these critics, as the likely main author T. Blaquière, belongs to an institute (loosely connected to the University Wageningen / NL), which is funded by both BAYER and SYNGENTA. Strangely, among his fellow authors Blaquière is rather unknown for bee-research. In addition he has a bad reputation in the Netherlands, due to peddling his fake expertise, with false assertions about Neonicotinoids (17).

Blaquière's false claim, that bees could detect the taste of neonicotinoids and thus avoid them by feeding preferentially on untreated flowers, was demolished by research groups from English and Irish universities. They used a dual-choice-feeding test, in which honeybees and one bumblebee species, were offered: either a pure sucrose solution or a neonic-laced solution. The experiment confirmed that, neither honeybees nor bumblebees, avoid three of the most commonly used NN, imidacloprid ("Gaucho"), Thiamethoxam ("Cruiser"). and clothianidin ("Poncho") in food, when offered field relevant concentrations of NNs found in nectar.

Moreover bees of both species preferred to ingest more of the imidacloprid and thiamethoxam-laced sucrose solutions than the uncontaminated sucrose.

This research strongly suggests that bees cannot taste neonicotinoids in solution and thus are not repelled by contaminated nectar.

Rather, the bees learned to prefer a solution which contained two different NN's -presumably because they were 'stimulated' by the NNs. The authors assume that the bees experience a 'pleasurable' stimulation in their brains, similar to that enjoyed by smokers who are addicted to nicotine.

If foragers preferentially choose to collect nectar laced with neonicotinoids, it follows that they will bring more NN laced food back to the colony. This suggests that colonies could be exposed to even higher levels of these neoicotinoids than experiments with field concentrations had earlier predicted.

The validity of measuring chronic (sub-lethal) toxicity, rather than acute (LD50) toxicity

The overwhelming weight of scientific research confirms that neonicotinoids are sub-lethally toxic, to honeybees and other pollinators. Faced with these facts the industry simply ignores the current state of scientific knowledge, and clings to the outdated LD50 test (the measurement of acute toxicity used in toxicology, chemistry, and medicine since the 1940s). The industry does this, despite recent recommendations by EFSA that the EU should adopt better methods to measure lethal chronic toxicity in regard to neonicotinoids (19).

Acute-lethal toxicity (LD50) is established in the laboratory by feeding subjects a range of concentrations of the test substance, from low to high doses. The dose which is seen to kill 50% of the test-animals within 24 - 48 hours, is then defined as the LD50 (lethal dosage 50%). It was discovered that the dose needed to produce death by **chronic toxicity** was dramatically less: 29 to 172 times lower than the acute LD50 dose. If bees are assumed to have a wintering-time of 150 days, it is estimated that a chronic, sub-lethal pesticide exposure of just 0.25 ppb (ppb = 1 part per billion, or 1 ng/g imidacloprid) This means that a dose of just 250pg (picogrammes) of neonicotinoids per bee, would kill an entire colony of honeybees (20).

NN cause direct suppression of the bees' immune system

One of the most significant, if not THE most important publications in recent years, concerning NN stems from Di Prisco et al. (21): Biological processes are regarded as 'proven', if they can be demonstrated at the molecular-biological (genetic) level. Scientists from three Italian universities found definite evidence at the molecular level, that clothianidin and imidacloprid negatively affect the transcription factor in honeybees, which controls the immune response; thus exposure to NN reduces a bee colony's immune defences. In order to demonstrate the impact of these molecular events in practice, using freshly emerged honeybees, the authors demonstrated increased replication of the Deformed Wing Virus genome (DWV).

Indeed, the number of DWV genome copies increased up to 1000-fold after field-realistic sub-lethal amounts of NN were given. The increase in virus replication was dose-dependent and the rate at which honeybees died was also dose-dependent.

In order to prove this direct lethal effect of NN, the authors chose the DWV virus because it is a hidden infection, endemic in virtually all bee colonies worldwide. But on its own, Deformed Wing Virus does not cause the death of bee-colonies; it is always present, but usually has no effect.

However, when one adds neonicotinoids to the equation, DWV kills bee colonies (22, 23). Thus DWV becomes the deadly partner of the Varroa mite, by infecting and killing immune-deficient honeybees (24). According to Di Prisco et al. (21) such immune suppression by NNs also exists in regard to bacterial gut infections or with Nosema. There is great concern over the triggering of immune system suppression by NNs. Moreover, while the entire pesticides-lobby continues to deny the dangers which NNs pose to bees, there is strong agreement among scientists, that the discoveries of the Di Prisco group, are a major breakthrough for understanding the impact of neonicotinoidw on honeybees and for the threat that NNS pose to biodiversity in general.

On the 8th of April 2015 the threats which NNs pose to ecosystem services were asserted, by EASAC (the European Academies Science Advisory Council) (25). This broad and detailed meta-analysis of the worldwide literature on NN (with 331 references) also confirmed the impacts which NNs have on bees' immune response.

Referring to the results of Di Prisco et al. it was concluded "***that neonicotinoids cannot be considered as the only 'cause' of Colony losses, but they can aggravate the impact of viral pathogens, stably associated with honeybee colonies all over the world"*.**

Such a statement from EASAC (a council of 29 National Science Boards from the EU and Switzerland) may be considered as almost a ***'definitive confirmation'*** of the causal connection between neonicotinoids and immune-system deficiency in bees, as discussed above.

Effects of neonicotinoids clarify previously obscure aspects of bee deaths.

Some questions cannot be answered, if we limit the discussion of the threats to bees, and loss of colonies, to a purely biological basis; if we **only** look at parasites and biological pathogens, we simply cannot account for the massive scale of bee colony losses. However, if we take into account current knowledge about the effects of systemic insecticides, namely the NN, those phenomena can be explained, or can at least be investigated. The agro-chemical industry lobby tries to cover up any uncertainties in their unconvincing (pesticide-free) explanations. However, the bee expert H.J.Flügel, famed for his meticulous and honest presentations and articles, recently gave an excellent review (23); his examples proved ideal for discussing the impact of Neonicotinoids. For simplicity, these citations from H.J.Flügel (23) will be indicated in << italics >> below.

Varroa mites

Most of our current knowledge, that neonicotinoids are the primary cause of accelerating bee-losses worldwide, along with the accompanying threat to biodiversity as a whole, has emerged from other European countries, rather than from Germany. In contrast to the scientific concensus, the agro-chemical lobby maintains that systemic pesticides pose little threat to bees (except for mistakes in applying them); the industry preaches that the primary danger to bees comes from the varroa mite (26).

In Germany, the pesticide industry's **Varroa Cover Story** is preached and parroted by the so-called 'Bee Institutes', and even by some university bee research departments. They usually publish this pesticide-defence propaganda in non-academic journals, to hoodwink the public and the politicians (27, 28). Such authors also created the notorious German Bee Monitoring Project (DEBIMO), initiated and co-funded by the pesticide industry. Predictably, the conclusion of this industry sponsored project, was that the Varroa mite is the main cause of bee losses; neonicotinoids are innocent!

However, the DEBIMO Report was false, biased and incompetent. It contained falsified graphs, and it did not even admit that the most-found pesticide - thiacloprid - is itself a neonicotinoid (23, 29). EFSA did not even consider such a biased and incompetent publication worthy of mention (4).

Since Varroa mites only parasitise honeybees, the claim that the Varroa mite is the primary cause of honeybee colony losses, seems absurd, because the even more dramatic decline of bumble bees (30) and wild bees (31) cannot be explained by the Varroa mite. A major study in "Nature" by Swedish universities dealt with meticulous research into the neonicotinoid clothianidin ("Poncho") in 16 replicated and matched landscapes; this was already mentioned above (14). Under the toxic impact of clothianidin, wild bees disappeared completely, while survival of bumblebees was greatly reduced; this confirmed the findings of earlier semi-field trials with NN (14, 15). This is why the agro-chemical lobby usually avoids all mention of the decline of wild bees and other pollinators. The pesticide lobby is equally anxious to bury the paper by Di Prisco et al., which proves that sub-lethal doses of NN suppress the bees' immune response (21).

The Varroa mite's original host is the Eastern Honeybee, *Apis cerana,* in East-Asia; Varroa was first described in 1852 on the Russian Pacific coast. But Apis *cerana* suffers only minor damage from *Varroa destructor*, since they have co-evolved over millennia; moreover only the male drones are affected by the parasite; female worker bees are unaffected. During the late 1970s ***Varroa destructor*** was imported to Germany hidden inside Asian honeybee colonies. Since the western honeybee *Apis mellifera* did not co-evolve with varroa, it enjoys none of the natural defences which Apis cerana has developed: in grooming, biting and physically removing mites. Sadly, in the case of

our Western honeybees, this alien blood-sucking parasite attacks every bee: male drones, female workers, developing larvae and queens. It seems certain, however, that Varroa by itself does not directly kill honeybee colonies; but the mite does weaken colonies by acting as a carrier of infectious diseases (24).

<< In 1993 populations of the western Apis mellifera had been detected in the "Primorski-Region" (the Russian pacific coast between Wladiwostok and the Chinese border) which were living in coexistence with Varroa mites. The bees had been brought to the Primorski-Region more than 100 years ago by Ukrainian settlers. Great hope arose that these Varroa-resistant honeybee populations could solve the Varroa problem. The results from tests in the USA and in Europe in the late 1990s were unsatisfactory, however >>(23).

In Germany, the five leading Bee-Institutes worked on the so-called ‘co-operation project Primorski’ from 2002 to 2003. When this ended, the result was *"so unsatisfactory that further experiments cannot be recommended to beekeepers"* (32).

Actually, the Varroa mites had increased less in the exotic Primorski colonies than in they did in the native honeybee hives (*Apis carnica)*, but "all requisite tests for honeybee colonies had been clearly below average”. The yield of honey from the Primorski colonies did not reach 65% of that of the carnica bees, even though the native bees had more varroa mites. In fact, in order to offer the best possible conditions to the Russian Primorski hives, these had been placed in the middle of canola fields, treated intensively with NNs. It is amazing that no hypothesis was framed to explain such changes for the worse due to the toxic influence of NN. After all, as early as 1999, the French Minister for Agriculture had already banned the NN imidacloprid from use on sunflower crops, because of the toxic damage it caused to honeybees (33). Later, this French NN ban was extended to other crops like maize, without any reduction of crop yields (34). Consequently, any denial of the dangers posed for honeybees by NNs is simply not credible, even if one accepts that internet access was less developed in those years. The French situation was well known.

<< Another unexplained item is: why damages of bee colonies due to Varroa destructor infestations are expressed differently in different parts of the world; and this in spite of the proof that Varroa destructor, outside Asia, all belong to one single clone. >>(23).

It is obvious that the synergistic effects of NN with Varroa were not taken into account. The pesticide -loading with NN in different regions should have been considered. However, even when analyses of NN in honeybee hives might have been too costly, the adoption of so-called ‘spray book records’ of surrounding areas would have been best. The highest NN loadings are found in: North-America (100% NN in crops of maize and 95% for soya beans in the US); in certain European countries, and for China (in some southern parts of which apple trees have to be hand pollinated due to the absence of bees). A further toxic penalty, from long-term poisoning of plants with systemic insecticides, is that NN persist in the soil with a half life of up to18 years (6).

<< As a matter of fact genetically identical Varroa mites increase faster in temperate climate zones than in warmer tropical climate. Thus honeybee colonies in Africa survive infestation by this mite for significantly longer times than honeybees in temperate latitudes of the world - even without any treatment against Varroa -. >>(23).

Again it seems reasonable to consider additional impacts by NN. For, the crops most heavily treated with NN like: maize, canola and sunflowers, are grown over huge areas in temperate zones. We also know that untreated fields are nevertheless contaminated by wind-borne NN, when poison-coated seeds are sown in adjacent fields (35). In landscapes where industrial-scale farming prevails, it may be impossible to find <u>any</u> areas which remain uncontaminated by neonicotinoids. This was confirmed by a Government investigation in the U.K. (13).

Since radically different growing conditions apply to crops in tropical countries, fewer neonicotinoids are used there; sometimes none at all. Moreover, healthy honeybees with a good immune response are able to cope with Varroa mites. Also, we have a much better situation in the sun drenched tropics, since NNs decompose under the impact of strong UV-light.

<< In regard to the Varroa mite another phenomenon exists: when during the 1980s about 2000 dead mites in a honeybee hive had been counted after treatment for varroa, this was not alarming at all. Nowadays a honeybee colony will be lost, when 500 or less dead mites are found. The question is whether Varroa mites have become more aggressive, or whether they adapted to the western honeybee by moderate reproduction in order to prevent extinction of their sole host in a short period of time. On the other hand, it is assumed that honeybee colonies are threatened by viral infections, transmitted through the bites of these blood-sucking mites.>>(23).

Such considerations are not likely to be logical. It is not plausible that Varroa mites, being genetically identical in the whole western world (36), should have developed, at different locations, identical genetic changes, which lead to diminished replication. Moreover, this would run contrary to the normal evolutionary path, which generally leads to increased reproduction.

On the contrary, the increasing lethality of Varroa mites, which we observe, suggests that it is suppression of the bees immune response by NN (see below), which has made these mites more deadly to the honeybees.

It would be interesting to know how the German Varroa lobby will explain these biological phenomena. It is probable, however, that they will continue to hide and ignore these inconvenient facts.

Nosema

Several research groups found that sublethal dosages of NN (even minute amounts corresponding to the lowest borderline ranges of field concentrations) increased infection of the bees' gut by Nosema ssp., leading to death (37, 38, 39, 40). Presumably, suppression of the immune response as described above (Di Prisco et al., 21) cripples the bees immune defence against such gut pathogens.

<< In contrast to Varroa mites honeybees can pass Nosema cerana via flowers to bumble bees, and it was found that for, all 7 bumble bee species being investigated, Nosema cerana was significantly more dangerous to bumble bees than to honeybees. >>(23).

The toxicity of NN to honeybees corresponds, in principle, to their toxicity for other bee species (41). However, the honeybee is the worst model for assessing NN toxicity to other bee species, because the sheer size and resilience of a honeybee colony serves as a buffer, against the loss of thousands of foragers and workers (15, 25). By contrast, bumblebee colonies are very small; they may only have 10 to 100 workers and thus are far more sensitive to the loss of worker-bees. Solitary bees are even more vulnerable than bumblebees; in solitary bees a single female-mother has the sole responsibility for feeding her larvae. This 'single mother' enjoys no buffering capacity like the huge colonies of social bees . Moreover, in honeybee colonies, new queens will be reared, if NN shorten the lifespan of a queen (31); bumble bees cannot make 'emergency queens' in this way(42). Taken together, the result of these very different biological and ecological systems, is that bumblebees are more vulnerable to NN and solitary bees are even more vulnerable than bumblebees. Thus *Nosema cerana* constitutes a much greater danger to NN-compromised bumble bees.

Viruses

<< In the middle of the 20th century it became possible to give evidence of viruses with disease potency for honeybees. But it was not until the mid 1990s that the tool of "Reverse Transcription PCR" enabled rapid identification of viruses in honeybees. Worldwide, about 20 virus species are now known, which can induce disease in honeybees. >>(23).
It is true that Reverse Transctiption PCR makes it far easier to detect viruses in honeybees. It is notable, however, that the rising number of virus species identified has kept step with the rising use of NN since the mid 1990s. This may suggest that the rising number of viruses found in bees were actually the result of direct immune suppression by NN (21); this is even more likely, as bee losses were also increasing during that time.

<< In particular DWV (Deforming Wing Virus) is regarded as dangerous for honeybees. If DWV is injected by parasiticVarroa mites, these viruses are allegedly much more dangerous than the existing DWV. Severe changes of this virus species must have occurred, if it had been spread all over the world since long times, because before 2003, it was not known that bumble bees could be infected, too; thereby developing the disease of crippled wings as known from honeybees >>(22).

As explained above, for the similar process involving *Nosema cerana,* such a change in other species, may indicate that suppression of the bees' immune response following the application of NN, is the underlying cause; this is even more so in the case of bumblebees. Varroa mites do not affect bumblebees and so could not be responsible for increased losses due to varroa-transmitted viruses. DWV is found at all stages of bee development: in the eggs and larvae, as well as in drone sperm (22). The reason why DWV has such exceptionally harmful effects on honeybees has been explained by Di Prisco et al. (21), when neonicotinoids suppress the bees' immune response, we see enhanced replication of Deformed Wing Virus., which tips the balance towards colony death.

Compilation of neonicotinoid effects

Recent research has clarified certain biological phenomena, which previously we could not explain. Generally, it is the sub-lethal effects of systemic pesticides, mainly NNs, which damage or destroy the bees' immune response. As far as the Varroa mite is concerned; there is no scientific proof that Varroa causes the collapse of honeybee colonies, as claimed by the agro-chemical lobby and many official institutions in Germany. Varroa mites clearly live as parasites in honeybee hives, where they may weaken bee larvae, but they do not kill colonies. They may contribute to bee deaths indirectly, by infecting bees with viruses and bacteria via their bites. However, such endemic infections may already exist within the colony, as was proven for the potentially deadly DWV, since both the eggs and drone sperm can already be infected with the virus. Such endemic infections in the past could also explain why DWV is to be found in almost every beehive worldwide. DWV exists chronically and covertly within healthy bee colonies, but DWV only becomes virulent and deadly when direct immune suppression is triggered by NN (Di Prisco et al. (21):

The ***"Worldwide Integrated Assessment of the Impact of Systemic Pesticides on Biodiversity and Ecosystems"*** of the Task Force on Systemic Pesticides (TFSP), examined 1120 peer-reviewed scientific papers on bee deaths and pesticides. These confirmed that not only honeybees and other pollinators are damaged by NN, but that biodiversity in general is being endangered and, is already damaged (3). This was confirmed by the Policy Report of the European Academies Science Advisory Council (EASAC) to the EU (25). The general threat which NNs pose to global

biodiversity and human food security was highlighted. In particular EASAC condemned the widespread prophylactic use of NN and recommended that they should be removed from the natural environment. Alternative systems of Integrated Pest Management (IPM) should be implemented; a return to traditional crop rotation would be a major step. EASAC is supported by the 29 National Science Academies of the EU and Switzerland, which underlines the gravity of its judgement, of the ecological threats posed by NN. The General Assembly of the 29 National Science Academies meets twice a year in a European capital (25).

Political background

USA

The US EPA (Environmental Protection Agency) continues to betray its alliance and partnership with the pesticide industry. In 2003 for instance, the EPA licensed BAYER's clothianidin ("Poncho"); it did this against the written, formal advice of its own Scientific Division and then ignored several petitions for retraction of that license, from environmental NGOs.

After the European Union's ban on neonicotinoids in 2013, the official response by the EPA was that: ***'there is no reliable evidence of damage to bees being caused by NN';*** furthermore, the EPA only agreed to 'reassess' NNs by 2019. To reaffirm its loyalty to the pesticide industry, the EPA then issued an unlimited licence for Sulfoxaflor, a fourth generation neonicotinoid which is equally deadly to bees. Sulfoxaflor was released to the market by DOW CHEMICAL in early 2014 without any independent risk-assessment or testing; only the manufacturer's test data was used. However, on Sept., 12th, 2015 , a US court ordered the EPA to revoke its biased and scientifically unjustifiable licence for Sulfoxaflor (43)

Europe

The European Food Safety Authority, EFSA, serves as the expert scientific board of the 27 countries of the EU. In late 2012 a crucial majority at EFSA demanded a ban on the three NNs most dangerous to bees: Imidacloprid, Thiamethoxam and Clothianidin. Following this expert advice, in April 2013, the European Commission imposed a two year moratorium on the use of these three NN (plus Fipronil) on crops which attract bees. The ban commenced as of December 2013 (4).

A court case against the European Commission's moratorium on Neonics was lodged by BAYER and SYNGENTA, and remains pending at the European Court in Luxembourg. In view of the large number of scientific papers, which confirm the toxic effects of NNs on bees, it is likely that the neonics ban will be extended, both in time and scope.

However, the pesticide industry's relentless lobbying of the European Commission is intensive and sustained; the industry's success is confirmed by the fact that Sulfoxaflor from DOW CHEMICAL,was granted a license by the EU in July 2015; this was done against the clear advice of EFSA (44). This biased and irrational decision may explain, why a request for 20,000 Euros, by scientists of the Task Force on Systemic Pesticides (TFSP), to conduct risk assessments on Sulfoxaflor, was earlier refused by EU authorities.

Germany

A strange situation exists in Germany, where the agro-chemical lobby has entered into an unholy alliance with the Bee Institutes of various federal states; together they continue to falsely claim that the Varroa mite is: “bee killer number one”. While making this false claim they steadfastly ignore the overwhelming consensus of international research which points to the real cause of global bee deaths: the systemic insecticides (neonicotinoids).

This perverse lobby continues to promote the ‘truth’ of their German Bee Monitoring Study (DEBIMO), on winter-loss of bee colonies. This study was launched in 2003, largely funded by BAYER and SYNGENTA. This pathetically flawed study ground to a halt, after ten years, in 2013. The results of that overtly false and biased study were exactly as predicted: *"There is no doubt, that the varroa is the main cause of bee colony losses",* followed by diseases. This hopelessly deficient and biased study could not even meet basic scientific standards (23, 39). Pointedly, it was ignored by the international literature and dismissed out of hand by EFSA.

In order to salvage something from the disastrous DEBIMO study, a new project, "SMARTBEES" seeks to generate more propaganda for the pesticide-lobby. The project, led by the Hohenneuendorf Bee Institute, in the state of Brandenburg, is repeatedly featured in the tabloid press; the pesticide lobby was granted 6 Million Euros by the European Union to fund this fake ‘research’. The project now employs experts from the fields of: bee-genetics, parasitology, virology, molecular biology, immunology, beekeeping, and public-relations specialists; what are conspicuously absent are any toxicologists. A key SMARTBEES research topic relates to the ‘dangerous triangle’ of: bees + mites + viruses. This spurious research purports to discover how Varroa mites magically transform existing harmless viruses, into bee-killing viruses. Such absurd hypotheses are revealed as false, when the confirmed results from Di Prisco et al. (21) are taken into account.

De Prisco’s team proved, at the molecular level, that NN depress the bees’ immune response in a dose-dependent manner. Moreover, NNs stimulate replication of Deformed Wing Virus (21). These synergistic interactions, between Neonicotinoids and bee-virus pathogens were also noted by the expert scientists of the European Science Academies (25).

But a genuinely real and dangerous German triangle, which does need investigation, is the three way conspiracy of: the Agro-Chemical-Lobby; the German Bee Institutes (paid from the public purse) and the German Pesticide Regulators".

Two examples will suffice:

Federal Institute for Pesticide Risk Evaluation (**BFR -** Bundesinstitut für Risikobewertung)

On March 30th 2015, German conservationists saw disturbing news about the BFR in the French journal ***Le Monde***. The BFR was already under suspicion over its peculiar risk evaluations; for example it declared glyphosate to be ‘harmless’ despite massive evidence to the contrary. ***Le Monde*** revealed that a third of the Members of the ***BFR Commission on Pesticides and Residues*** were direct employees of the chemical industry; others came from what the author regards as ‘dubious’ Bee Institutes.

The satirical comment from ***Le Monde*** was, that in Germany: **"people from the pesticide industry give expert safety advice on their own products"** (45).

Federal authority for Consumer Protection and Food Safety: BVL (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit)

During a presentation in 2015, in Berlin, at the world´s largest agricultural products fair, '*Die Grüne Woche*', the Director of the Department for the Admission of Plant Protection (Pesticide Regulation Authority), Dr. Karsten Hogardt, stated, that the BVL sees itself as: ***'a service for its clients, the plant protection industry'***. In this role it is 'advised' by an expert group of 'risk-managers' including many from the pesticide industry. Astonishingly, no independent scientists are involved in the regulation, or licensing, of pesticides in Germany (46).

However, a ray of hope suddenly appeared, when the Federal Minister for Agricultural Affairs, Christian Schmidt, released an urgent order on 22nd July, 2015. Based on the EU Moratorium, this order banned the Neonicotinoids: imidacloprid, clothianidin, thiamethoxan for use in seed-coating of winter-cereals (47).

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