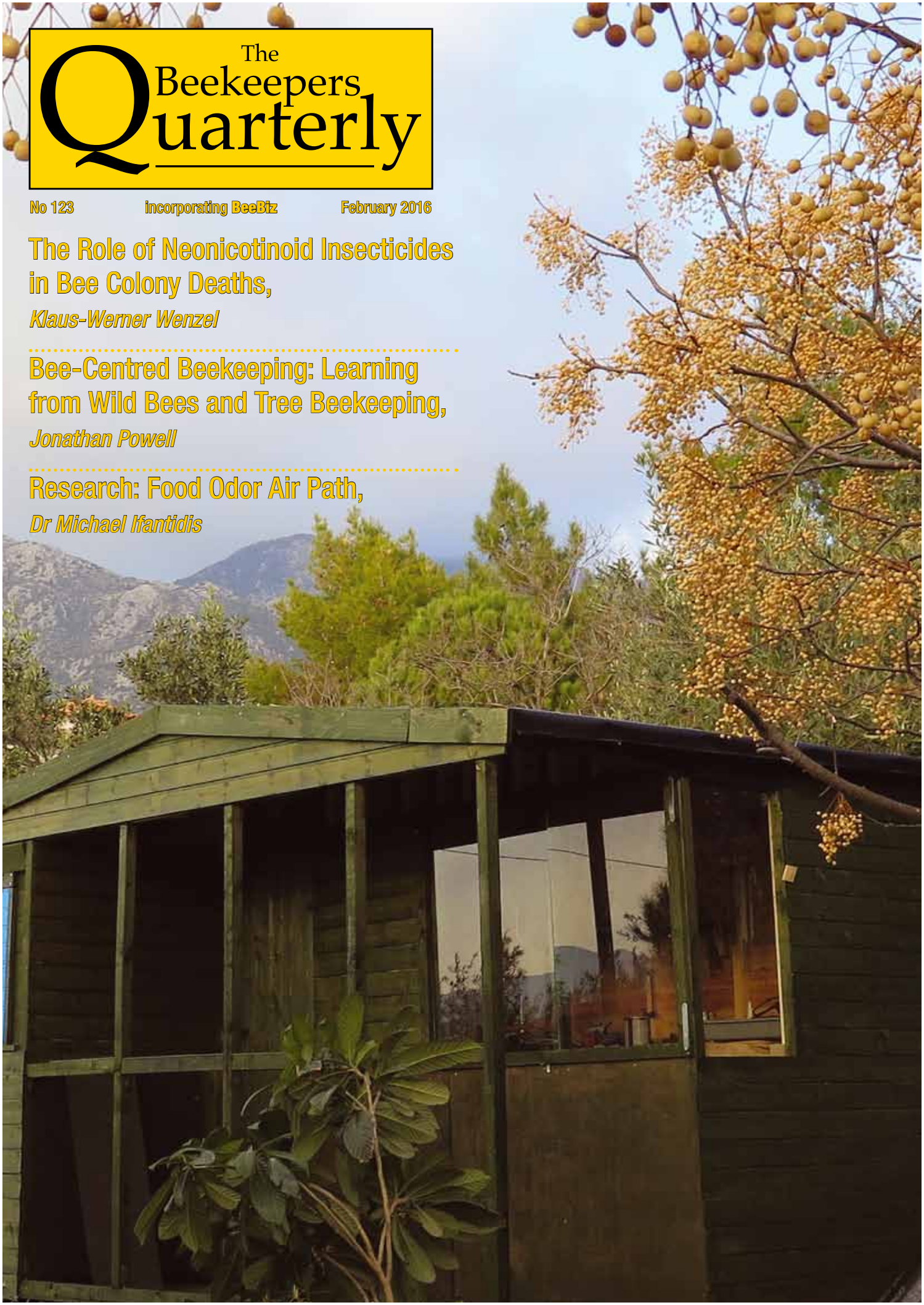

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AGRICULTURAL PESTICIDES AND HONEYBEES

The Role of Neonicotinoid Insecticides in Bee Colony Deaths:

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

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INTRODUCTION

BEES today face many threats, including: loss of habitat and wildflowers, industrial monoculture crops; Varroa parasites; viral, fungal and bacterial diseases; climate change, etc. However, the weight of recent research confirms neonicotinoid insecticides as the primary killers of millions of bee colonies.

This 'state of the science' has been recently confirmed in various reviews (1 - 3). In December 2013, responding to this mountain of scientific evidence, the European Union imposed a moratorium banning the use of three neonicotinoid insecticides, as seed-coatings on crops which attract bees; this suspension has been in force for two years (4).

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

MODE OF ACTION OF NEONICOTINOIDS (NN)

Neonicotinoids (NN) were released onto the market in 1992, by BAYER (the inventor), for use *'against biting and sucking insects'*. They kill insects by blocking nerve impulses and paralysing muscles. Ever since they were licensed, we have seen an exponential rise in bee colony deaths, in Europe and America.

The effect of neonicotinoids on bee-brains, is similar to the effect of nicotine on human brains; they chemically bind to acetylcholine receptors on the brain synapses. While nicotine only stimulates the human brain for a short time, (hence the smoker's need for constant re-supply), neonics cause permanent damage to bees' brains; they hyper-stimulate synapses, overload sensory systems and wreck muscular co-ordination.

We can see this neural hyper-stimulation in bees, when they fall quivering from the flowers, intoxicated by neonicotinoids.

Neonicotinoids are far more poisonous to bees than DDT: from 5,000 to 10,800 times more toxic (5).

The seeds of wheat, oilseed rape, maize and soybeans, are almost universally coated with neonicotinoids. These insecticides are water soluble and persistent 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 as the neonics themselves. Moreover, since soil and water remain contaminated for years, it is unlikely that the EU's two year ban on neonics will yield positive results.

Neonicotinoids are termed 'systemic', because they invade the entire tissues of a plant, from roots and leaves to flowers and fruit. Crucially, they also appear in the pollen and nectar of the flowers, rendering them poisonous to bees. The entire plant becomes poisonous to insects; every plant, in every treated field is toxic to bees, along with marginal plants like wildflowers.

However, the real danger from these insecticides is subtle and hidden; we don't often see bees falling dead from the flowers, poisoned by neonics; but the minute amounts of these toxins, gathered by the bees with the pollen and nectar, induce a slow, sub-lethal poisoning. Neonicotinoids damage the bees' entire nervous system; foragers become disoriented and cannot find their way back to the hive (7,8). This is the simple explanation for so-called 'CCD' (Colony Collapse disorder), mainly seen in the USA, in which almost all the foragers disappear from apparently healthy colonies. All that remain in the hive are the queen, a few young bees and combs full of honey. Very few dead bees are found, in or around the hive. The entire working population of bees simply vanishes without trace, dying somewhere out there in the fields. 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 the colonies survived for the first 12 weeks, 96% of them were dead by the 23rd week (9). This reveals the 'time dependent' nature of chronic, sub lethal poisoning by neonics.

The sub-lethal toxic effects of neonics damage processes vital to the survival of the colony like:

task differentiation in the colony,
feeding and caring for the larvae,
mutual grooming (esp. removal of parasites),
thermo-regulation in the hive.

We also observe grossly abnormal behaviour among the bees; they cannot retract their tongues; they tremble uncontrollably on the comb; they cannot perform the 'waggle dance'; they fail to recognise related bees, etc. (10). Sub-lethal doses of imidacloprid also cause the hypo-pharyngeal glands to atrophy, damaging young nurse bees' ability to produce royal-jelly for the queen and brood (11).

WEIGHT OF RECENT PUBLICATIONS CONFIRMS THE IMPACT OF NN

In contrast to hundreds of high quality studies, which confirm that bees **are** killed by chronic, sub-lethal neonicotinoid poisons; just **two** papers claimed that NNs are **not** responsible for bee deaths. Both papers came from authors who are linked to the pesticide industry.

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

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Such was the phrase in a 'publication in preparation' from Helen Thompson, 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 an attempt to block the EU's moratorium on neonics (4); they failed.

Shortly afterwards, in September 2013, Helen Thompson resigned her UK government post and moved to a new job with the neonicotinoids 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 neonic- treated areas, in which oilseed rape seeds were 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 discovery 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 taste the chemical residues of NN in treated crops, and so would avoid foraging on them (16). Yet again, this claim was also disproved, as recently published in ***Nature*** (same issue as ref. 14) (15,18).

We note a strong association between these critics and the pesticide industry; a key 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 barely known for bee-research. Moreover, 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 avoid them, by choosing to feed 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 sugar solution, or a neonic-laced solution. The experiment proved that, when offered field-relevant doses of neonicotinoids found in nectar, neither honeybees nor bumblebees avoid imidacloprid ("Gaucho"), Thiamethoxam ("Cruiser"), or clothianidin ("Poncho") in food. Moreover, bees of both species preferred to ingest more of the imidacloprid and thiamethoxam-laced sucrose solutions than the uncontaminated sucrose.

This strongly suggests that bees cannot taste neonicotinoids in solution and 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 nicotine-addicted smokers.

If bees prefer 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 neonicotinoids than experiments with field concentrations had earlier predicted.

THE VALIDITY OF MEASURING CHRONIC (SUB-LETHAL) TOXICITY, RATHER THAN ACUTE (LD50) TOXICITY

The mass of scientific research confirms that neonicotinoids are sub-lethally toxic to honeybees and other pollinators. Faced with this, 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 more sensitive modern 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 kills 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) will kill them. This means that a cumulative 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 publication 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 fed to bees. 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. On its own, Deformed Wing Virus does not cause the death of bee-colonies; it is always present in colonies, but usually has no effect.

However, when one adds neonicotinoids to the equation, DWV becomes lethal to bee colonies (22, 23). Thus DWV forms a deadly partnership with the Varroa mite, by infecting and killing colonies which have been rendered immune-deficient by neonicotinoids (24). According to Di Prisco et al. (21) such immune suppression by NNs also exists in regard to bacterial gut infections such as Nosema. Thus, there is great concern over the triggering of immune system suppression by NNs since they open a Pandora's Box of lethal pathogens. Moreover, while the pesticides-lobby continues to deny the dangers which NNs pose for bees, there is strong agreement among scientists that the discoveries of the Di Prisco group are a major breakthrough for understanding the impact of neonicotinoids on honeybees, and for the threat that they pose to other pollinators, moths, butterflies and to biodiversity.

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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 which represents the 29 National Science Boards of the European Union 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.

If we limit the discussion of the threats to bees, and loss of colonies, to biological factors alone, some questions just can't be answered; if we **only** look at parasites and diseases, we simple cannot account for the vast scale of colony losses. However, if we take into account current knowledge on the effects of systemic neonicotinoids, then these phenomena **can** be explained, or can at least be investigated. The agro-chemical industry lobby tries to hide 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, has emerged from other European countries, rather than 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 by the so-called 'Bee Institutes', and even some university bee research departments. They usually publish this pesticide-defence story 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, 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 bees' immune response (21).

The Varroa mite's original host is the Eastern Honeybee, *Apis cerana*, of East-Asia; Varroa was first described on the Russian Pacific coast in 1852. But *Apis cerana* suffers little damage from *Varroa destructor*, since they have co-evolved over millennia. Only the male drones are affected by the varroa parasite; female worker bees are entirely unaffected. During the late 1970's ***Varroa destructor*** invaded Germany, hidden within 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* employs: in grooming, biting and physically removing mites. Sadly, in the case of our Western honeybees, this exotic blood-sucking parasite attacks every bee: male drones, female workers, developing larvae and queens. It seems certain, however, that Varroa by itself does not kill honeybee colonies; but the mite weakens colonies by acting as a vector for 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 happily coexisting 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 collaborated on the so-called '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 increased less in the Russian Primorski colonies than they did in the German honeybee hives (*Apis carnica*), but "all requisite tests for honeybee colonies had been clearly below average".

The yield of honey from the Russian colonies was 35% less than that of the carnica bees, even though the native German bees had more varroa mites. In fact, to provide the Russian colonies with the best possible foraging conditions, these were placed right in the middle of canola fields, treated intensively with NNs. It is amazing that no-one considered if the failure of the Russian colonies was due to the toxic influence of neonicotinoids. After all, as early as 1999, the French had already banned the NN imidacloprid from use on sunflower crops, because of its poisonous effect on honeybees (33). Later, the French NN ban was extended to other crops like maize, without any fall in 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 in regard to neonicotinoids and bee deaths was widely known.

<< *Another unexplained item is: why damage caused to bee colonies by Varroa destructor infestations is 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 way neonicotinoids act in synergy with Varroa was 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

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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 3 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 still contaminated by wind-borne NN when treated seeds are sown in adjacent fields (35). In landscapes where industrial monocultures prevail, it may be impossible to find any area which remains uncontaminated by neonicotinoids. This was actually confirmed by a Government investigation in the UK. (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 strong immune systems, are well able to cope with Varroa mites. Also, we have a further advantage in the sun-drenched tropics, since NN's decompose under the impact of strong UV light.

<< In regard to the Varroa mite another phenomenon exists: when during the 1980's 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 unlikely. 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 sp., leading to death (37, 38, 39, 40). Presumably, suppression of the immune response, as described above (Di Prisco et al., 21) weakens the bees' immune defence against such 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 is similar, 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 huge 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 mother has sole responsibility for feeding her larvae. This 'single mother' enjoys no such 'buffering capacity', unlike the huge colonies of social bees .

Moreover, in honeybee colonies, if neonics shorten the lifespan of a queen the colony will simply rear new queens (31); bumble bees cannot make 'emergency queens' in this way (42). Because of their very different biology and ecology, bumblebees are far more vulnerable to neonicotinoids; 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 1990's 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).*

Reverse Transcription PCR makes it far easier to detect viruses in honeybees. It is notable, however, that the rising number of virus species identified has kept pace with the rising use of NN since the mid 1990's. This may suggest that the increasing number of viruses discovered 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 parasitic Varroa 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 possibly 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, previously unexplained, biological phenomena. 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 is claimed by the agro-chemical lobby and many official institutions in Germany. Varroa mites clearly live as

parasites in honeybee hives; they may weaken bee larvae, but they do not kill entire 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. Chronic latent infections of DWV remain hidden within apparently healthy bee colonies; but this virus becomes virulent and deadly when the bees' immune systems are damaged 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 not only confirmed that honeybees and other pollinators are damaged by NN, but that biodiversity in general is threatened and 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 NN's pose to global biodiversity and human food security was highlighted. In particular, EASAC condemned the widespread prophylactic use of NNs 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 reveal the extent of its close alliance and partnership with the pesticide industry. In 2003 for instance, the EPA licensed BAYER's clothianidin ("Poncho"); it did so against the formal, written judgement of its own Scientific Division and then ignored several petitions from environmental NGOs for retraction of that license.

After the European Union banned neonicotinoids in 2013, the EPA's official response was that: ***'there is no reliable evidence of damage to bees being caused by neonicotnoids'***; furthermore, the EPA only agreed to 'reassess' NNs by 2019. As if to flaunt its servitude to the pesticide industry, the EPA then granted an unlimited licence for Sulfoxaflor, a fourth generation neonicotinoid, equally deadly to bees. Sulfoxaflor was released to the market by DOW CHEMICAL in early 2014, without any independent risk-assessment or testing; only Dow'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 for 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 then launched by BAYER and SYNGENTA; it 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 continues to lobby the European Commission intensively; its success is confirmed by the fact that Sulfoxaflor from DOW CHEMICAL,was granted a license by the EU in July 2015, 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 marriage with the Bee Institutes of various federal states; together they falsely assert that the Varroa mite is: ***"bee killer number one"***. With their hands over their eyes, they ignore the overwhelming consensus of international research, which points to the real cause of global bee deaths being neonicotinoid insecticides.

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 incompetent and biased study failed to meet even the most 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 wreck of the DEBIMO study, a new project, "SMARTBEES" seeks to generate even more propaganda for the pesticide-lobby. The project, led by the Hohenneuendorf Bee Institute, in the state of Brandenburg, is often touted in the tabloid press; the pesticide lobby was granted 6 Million Euros by the European Union to fund this fake 'research'. The project employs many experts from the fields of: bee-genetics, parasitology, virology, molecular biology, immunology, beekeeping, and public-relations specialists; but toxicologists are conspicuously absent! SMARTBEES research focuses on the 'dangerous triangle' of: bees + mites + viruses. This spurious research purports to discover how Varroa mites magically transform harmless endemic viruses into lethal 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 enhance replication of Deformed Wing Virus (21). These synergies, between Neonicotinoids and bee-virus pathogens were also noted by the expert scientists of the European Science Academies (25).

But the really dangerous 'German Triangle', which should be investigated, 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 read 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.

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Le Monde revealed that one third of the Members of the ***BFR Commission on Pesticides and Residues*** are directly employed by the chemical industry; others came from the '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. It is shocking and disgraceful, that no independent scientists are allowed in the regulation, or licensing, of pesticides in Germany (46).

However, a ray of light 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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